

**INFLUENCE CURRENT AND WIND CONCERNING *BEST ESCAPE HEADING*
WHEN WILL OPERATE THE DP VESSEL FROM MANUAL SYSTEM TO
DP MODE SYSTEM**



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INFLUENCE CURRENT AND WIND CONCERNING *BEST ESCAPE HEADING*
WHEN WILL OPERATE THE DP VESSEL FROM MANUAL SYSTEM TO
DP MODE SYSTEM

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FOREWARD

First of all I want to give thanks to Allah SWT, who has given grace and guidance as well as safety advice during my research assignment on a DP (Dynamic Positioning) ship, and I feel a situation that fluctuates in trying to overcome life's problems on board, Understandably, I have left the sea world for several years so I always try to ward off with enthusiasm and it is truly extraordinary to my wife and children who always support and give me the spirit of life, the spirit to fight.

And other things related to my research on the ship, I have tried as much as possible to do research by taking the data that I need to make this research report. And I also thank my leader Director of PIP (Merchant Marine Polytechnic Semarang) who has given permission for my research assignments on the ship and I also thank my fellow lecturers, younger slings and cadets who are as coatings the purpose to share knowledge about what I have done research on the ship.

Alhamdulillah, I did research on **"INFLUENCE CURRENT AND WIND CONCERNING *BEST ESCAPE HEADING* WHEN WILL OPERATE THE DP VESSEL FROM MANUAL SYSTEM TO DP MODE SYSTEM"**. On this occasion, I am grateful that there are a number of experiences I have received, and hopefully what I have poured in the research report can be useful for the world of our shared voyages.

So I can say, with the limited knowledge and experience I have, hopefully the results of this research will not reduce the intellectual value of the teachers who should always develop by doing useful research. Amen, hopefully all of us are always given youth and smooth amen.

Semarang, September 2019

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Table of Contents

Title Page	i
Approval Page.....	ii
Foreword.....	iii
Table of Contents	iv
CHAPTER I. PRELIMINARY	
A. Background.....	6
B. Formulation of The Problem.....	9
C. Research Purposes.....	10
D. Benefit of Research.....	10
E. The Scope of Research	11
F. Writing System.....	11
CHAPTER II. THEORETICAL BASIS	
A. Literature Review.....	13
B. Framework for Thinking.....	76
C. Operational Definition....	78
CHAPTER III. RESEARCH METHODS	
A. Time and Location of Research.....	86
B. Type of Research Method.....	86
C. Required Data.....	87

D. Method of Collecting Data.....	89
E. Technic of Data Analyse.....	89

CHAPTER IV. ANALYZE THE RESULT OF RESEARCH AND DISCUSSION

A. Overview of Research Objects.....	91
B. Analysis of Research Result.....	221
C. Research of Problem.....	251

CHAPTER V. CLOSING

A. Conclusion.....	307
B. Suggestion.....	308

References

Attachment

CHAPTER I

PRELIMINARY

A. Background

The environment of the Oil and Gas mining industry especially the offshore drilling exploration sector in operation requires a great number of Support and Supply Vessels in the form of ships capable of working and operating dynamically in terms of moving and doing work- special jobs, for example: Supplying, Diving Operations, Pipe / Cable Laying Operations, Remotely Over Vehicle (ROV) Operations, Platform Maintenance Operations even to serve and support Drilling and Jack-up Rig work or for Supporting Surveys also need ships like this, which lately we know as the DP (Dynamic Positioning Vessel).

The understanding of the DP ship is a ship which in its control to maintain and change its position and direction (act as motion) in such a way that as desired is equipped with a computerized equipment system that works automatically with the help of the ship's propeller, front and rear propeller (thruster), Position reference system (PRS), Wind sensor, Vertical Reference Sensor (VRS) and Gyro Compass which are used for working to provide information directly to the computer receiving data about the position of the ship, the magnitude and direction of external weather pressures (wind, currents and waves) that cause an influence on the position of the ship, then the data received by the computer is processed in such a way including correction- The correction then results in giving an order to the ship's engine how big the load is the engine will work to respond to the pressure requested by the computer to maintain the position and direction of the ship or change in such a way as desired so that this ship has more value when compared with non DP ships or other conventional vessels.

On the occasion of the research I carried out was on the DP2 SMS ship. SUPPORTER, this ship is a type of AHTS DP2 which is chartered by PHE (Pertamina Hulu Energi) which is a consortium between PT.Wintermar, GTI (Guna Tesuma International) and AOS (Advance Offshore Services). The operation of the ship is about the maintenance, inspection and repair of underwater pipes which are Pertamina's assets that must be maintained considering the age of the pipes is quite old, which is almost 45 years. Therefore SMS.SUPPORTER gets the trust to accommodate and facilitate these activities which are known as "The 2018 Air Dive Campaign"

PHE ONWJ (Offshore Northwest Java Contract Area) is a block offshore drilling area north of the island of Java which is a large area consisting of the West Area namely BIMA FIELD, East Area namely ARDJUNA FIELD and ARIMBI FIELD.

And therefore the trust given by PT. Pertamina against PT. Wintermar is a prestige job trust which is the first Air Diving project of PT. Wintermar Offshore Tbk. 2018 is a milestone year for the start of an extraordinary achievement. In the consortium with PT. Advanced Offshore Services and PT.Guna Tesuma Internasional, PT. Wintermar has won one of the largest projects of its kind in Indonesia, its first water diving project by SMS. Supporter. The 3-year contract to provide offshore inspection, repair and maintenance services to the PHE ONWJ Subsea Team was won by the consortium and has been started since February 2018. The DP2 SMS Ship. Supporters are Indonesian-flagged AHTS vessels and DP2 type ships which have 4 (four) reference systems and have been specifically modified with a 10-ton capacity crane and accommodation for more than 60 people to support 2 water diving systems, 2 ROV inspection classes , and other equipment, with a team consisting of expert members of the consortium.

From carrying out my duties as a DPO (Dynamic Positioning Operator), what I do is carrying ships safely and well using the DP or DP mode system. The implementation of this guard duty plays a very important role in serving movements that are suitable for each daily work that has been scheduled by the client, in this case the PHE Team as a full authority on the implementation of the Air Dive Campaign.

When performing a guard duty which in this case I get a schedule of 18:00 to 06:00 or a 12-hour duty (Scheduled Guard duty attached) must pay attention to what is called a "Master Standing Order", there is clear and detailed what must be done by a DPO when carrying ships with DP Mode, they must really pay attention to the movement of ships in DP Mode conditions. The things that I should pay attention when carrying out guard duty as a DPO, it must be really full of concentration and focus because of remembering risks or things that are not desirable, and when I relate to the title of the research that I want me to carry out is true that the most dominant influence is "Effect of Current and Wind" on all movements, i.e. when going in and out of the DP Mode system. This means that when in a manual condition going to DP mode also must pay attention to the influence of the current and wind and vice versa when typing from the DP mode to manual mode. Significance that I should note that in the DP Console includes about DP Current means that this is a calculation of the DP system to calculate the direction and strength of the current, but if seen clearly there are differences. And for the DP Wind, this is also the result of the calculation of the DP system to calculate the direction and strength of the wind, but if you see it and compare it with looking at the Wind Sensor, there are differences. From all of these things about DP Wind and DP Current I should note because it is a calculation produced by the DP system to maintain the ship according to the expected position.

In the presence of a very dominant environment or influence on ship movement by using a DP system, the internal power of the engine, thruster, and steering as power output or output power, then a DPO should be able to control the ship by minimizing the power of the thruster, and this is what I always observe and I value it because the feedback thruster does not trip or stop because it is very dangerous when the ship is in a position or fixed position near the platform (the attached Platform Area and the sample ship are in position).

Because of the things mentioned above that I have explained about the effect of currents and winds on what I am trying to carry out in the research and which also describes in a research proposal, I am very interested in deciding matters that are very influential on the ability of DP ships to pay attention to the best course in order to be able to survive at the same time for strategies in the case of an emergency or emergency where the ship must exit or pull put. By saying Bismillahirrohmanirrohim, the title that I want to do in this study is **""INFLUENCE CURRENT AND WIND CONCERNING *BEST ESCAPE HEADING* WHEN WILL OPERATE THE DP VESSEL FROM MANUAL SYSTEM TO DP MODE SYSTEM "**.

B. Formulation Of The Problem

Based on the background described above and to formulate the problem, compiled in the form of questions, discussions that require answers and solutions to solve them. Problems regarding the effect of current and wind on Best Escape Heading when going to operate a DP ship from a manual system to a DP Mode system can be formulated when I carry out research on a DP ship can be put into several ways as follows, namely

1. How is the DP's ability to process the ship's motion when going to change the manual system to DP mode system to achieve Best Escape Heading due to the influence of currents and wind?
2. What is the result of a good Capability Plot so that changes in direction due to the influence of currents and wind can be shown to maintain the Best Escape Heading?

C. Research Purposes

The Research Purposes that I undertook when carrying out my research assignments on board were:

There are two (2) types of research objectives:

1. To find out the extent of the DP mode system's ability to influence currents and wind to maintain the bow with the status of Best Escape Heading.
2. Attempting to analyze the changes in Capability Plot that are very dominant affecting Best Escape Heading

D. Benefit of Research

There are two (2) benefits for this research, namely:

1. Theoretical uses, namely analyzing and applying in order to contribute critical thinking and can develop science and technology, especially in the rapidly growing shipping industry.
2. Practical Uses, which are expected to provide alternative solutions to problems for DP Operators in harmonizing and maximizing the use of DP systems on DP vessels.

E. The Scope Of Research

The scope of research that researchers will do is limited to the influence of currents and wind and Capability Plots on best escape headings on DP ships means that researchers will conduct research on DP ships by taking into account all systems that have been integrated with the DP Control Unit namely input that will affect the DP system so that the output expected from the DP system that is driven by the engine, steering and thruster can maintain the position of the DP ship with the best escape heading conditions so the researchers hope that observation and analysis can be carried out continuously and directed.

F. Writing System

CHAPTER I. PRELIMINARY

- A. Background
- B. Formulation Of The Problem
- C. Research Purposes
- D. Benefit Of Research
 - 1. Theoretically
 - 2. Practically
- E. The Scope Of Research
- F. Writing System

CHAPTER II. THEORETICAL BASIS

- A. Literature Review
- B. Framework for Thinking
- C. Operational Definitions

CHAPTER III. RESEARCH METHODS

- A. Time and Location of Research
- B. Type of Research Method

- C. Required Data
- D. Method of Collecting Data
- E. Data Analysis Technique

CHAPTER IV. ANALYZE THE RESULT OF RESEARCH AND DISCUSSION

- A. Overview Of Research Objects
- B. Analysis Of Research Result
- C. Discussion Of Research Result

CHAPTER V. CLOSING

- A. Conclusion
- B. Suggestion

CHAPTER II

BASIC THEORY

A. Literature Review

On this chapter will explain the literature review which this research about **“INFLUENCE CURRENT AND WIND CONCERNING *BEST ESCAPE HEADING* WHEN WILL OPERATE THE DP VESSEL FROM MANUAL SYSTEM TO DP MODE SYSTEM”**. More detail on this basic theory will explain on below:

1. Dynamic Positioning

Dynamic Positioning can be described as an integration of a number of shipboard systems to obtain the ability of accurate manoeuvrability. DP can be defined as a computer controlled system to automatically maintain a vessel's position and heading by using its own propellers and thrusters. Position reference sensors, combined with wind sensors, motion sensors and gyro compasses, provide information to the computer pertaining to the vessel's position and the magnitude and direction of environmental forces affecting its position. Examples of vessel types that employ DP include, but are not limited to, ships and semi-submersible Mobile Offshore Drilling Units (MODU) and Oceanographic Research Vessels. The computer program contains a mathematical model of the vessel that includes information pertaining to the wind and current drag of the vessel and the location of the thrusters. This knowledge, combined with the sensor information, allows the computer to calculate the required steering angle and thruster output for each thruster. This allows operations at sea where mooring or anchoring is not feasible due to deep water, congestion on the sea bottom (pipelines, templates) or other problems.

Dynamic positioning may either be absolute in that the position is locked to a fixed point over the bottom, or relative to a moving object like another ship or an underwater vehicle. One may also position the ship at a favourable angle towards wind, waves and current, called weather warning.

2. DP PHILOSOPHY

The principal elements in DP operations are illustrated in the DP system outline in Figures 1 and 2 below :

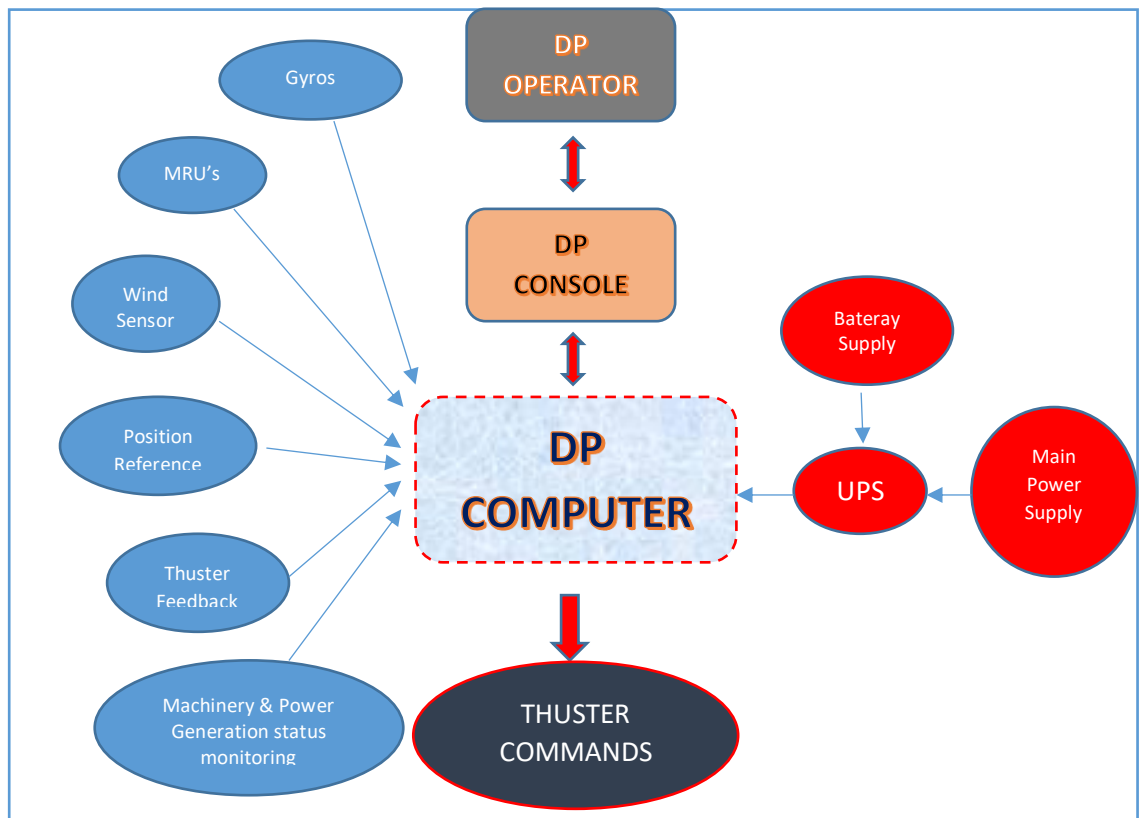


Figure 1. DP Control System – Basic Outline

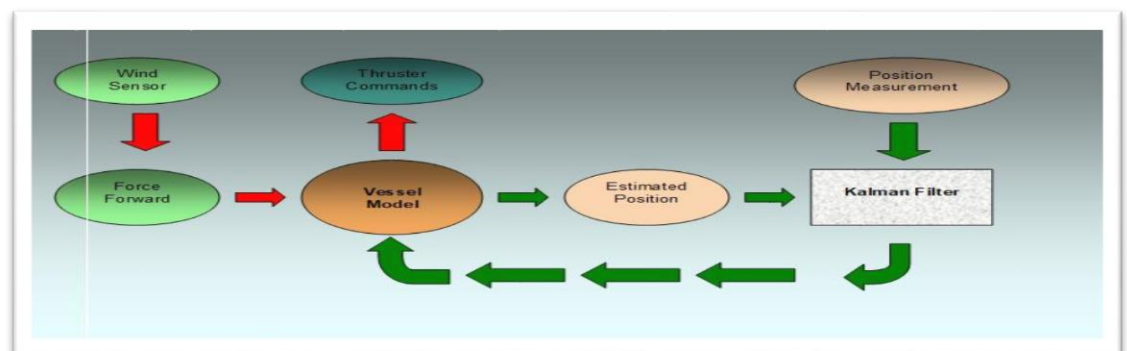


Figure 2. DP Operational Principles

The DP system control computer programme, contains a model of the dynamics of the vessel, which simulates the vessel's responses to various forces. Deviations from the required position and heading of the vessel are detected by the DP system's position reference systems and gyro compasses. The calculated position and heading is compared to the measured position and heading and the model is continuously updated with the difference information. This information is then processed by the model to produce commands to the vessel's propulsion system to counteract the deviations from the required position and heading. An error compensation force is calculated over a period of time, which is added to the modelled forces to produce the total external force. This is to counteract forces that cannot be measured directly, such as current and wave action. This additional force is displayed on the console as current, it generally being the largest component. A sudden change in the wind speed or direction can be measured as it happens. To avoid the vessel moving out of position and a correction applied by the model, the calculated wind force is fed forward and applied to the total external force.

The load on the switchboard buses is monitored and power is reduced to the connected thrusters, by reducing the pitch or speed, if the load exceeds a nominal limit.

3. DP SYSTEM ELEMENTS

The layout of any DP system will divide into six separate groups or elements. The DP system is dependent upon many shipboard services (such as power management) and these be considered to be integrated to the DP system. Another vital part of the 'system' is the human element, the DP operators, or watch- keeping officers on the bridge, the engineers and electronics operators who are required to provide running, maintenance and repair functions. These personnel must all be fully competent and

qualified to carry out their respective tasks. The six elements are Control, Position Reference Systems, Heading Reference Systems, Environment Reference Systems, Power Supply elements and the Manoeuvring elements.

a. Control Elements

Central to the DP system configuration is the Control element. This consists of the computers or processors, the bridge control console, and the DP Operator. The computer installation will be configured according to the level of reliability required for the DP function.

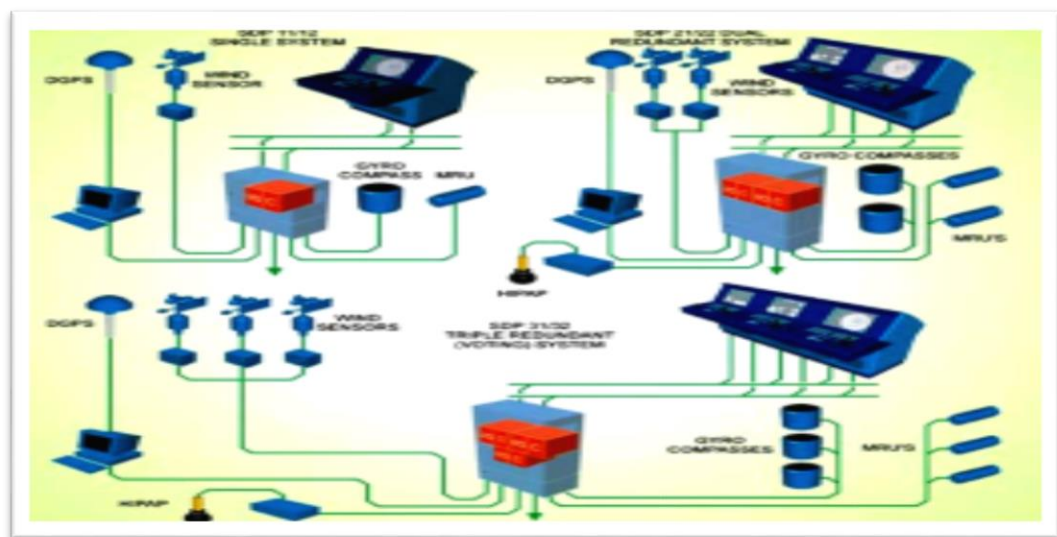


Figure 3. Redundant DP Installation

The consideration here is one of redundancy. For ship types and operational modes where DP failure would cause serious risk to life, major risk of pollution or severe economic penalty it is necessary that the whole system be protected from catastrophic failure. It is obvious that for Diving Support Vessels, Drill-ships and Multi-Role Support Vessels, a fully redundant installation is required. For other vessel types, e.g. ROV support, stone dumping, or dredging then redundancy is desirable but not essential and since the provision of redundancy as a whole is very expensive it is often uneconomic to provide full redundancy in these vessels.

In any DP system, the basic processor principles are the same, and the system requirements regarding ship positioning are the same also. Input data is fed into the system from sensors such as position reference sensors, gyrocompass, wind sensors, vertical reference sensors together with feedback data from the power plant, thrusters etc.

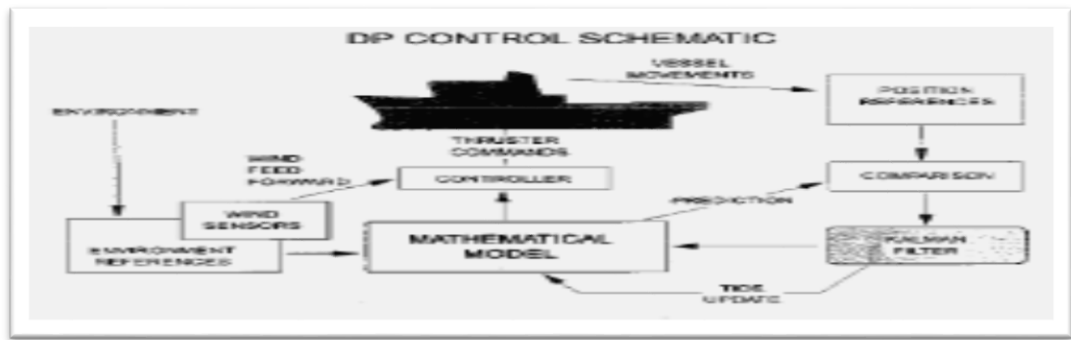


Figure 4. DP Control Schematic

A number of program subroutines continually check the validity of the data against pre-set limits and values predicted from mathematical modelling multiple sensor inputs are compared, yielding data regarding accuracy for each sensor input. Modern DP processors utilise mathematical modelling to provide predictions upon the vessels dynamic behaviour. Sensor measurements update the vessel estimator, the output from which is an estimate of vessel position. From this controller can determine thrust allocation required maintaining or restoring maintaining or restoring set point position and heading.

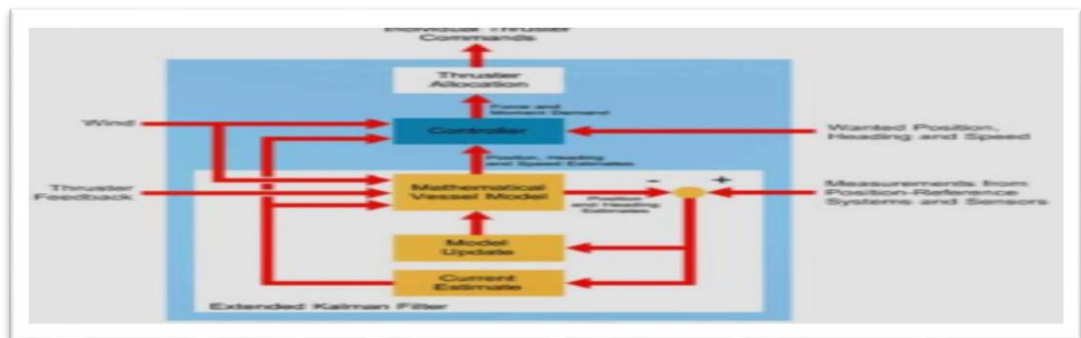


Figure 5. DP Model Diagram

The processor's programme routines are initially determined at the vessel design stage, usually being the programme from previous similar vessel installations. After completion the vessel will undergo extensive DP trials, FMEA, in a variety of weather conditions during which the systems can be tuned to provide optimum DP performance, not only for position keeping characteristics but also regarding power requirements hence fuel consumption. This is known as DP tuning and will be performed by technicians from the DP maker.

The physical control of the vessel is in the hands of the DP operator at the Bridge Control Console. This is the point from which the operator/system/ship communication is provided. When in DP mode the operator has no need to leave this console and all manoeuvring functions are carried out from here. The system provides comprehensive feedback data upon one or more VDU screens, together with all control, function, display and alarm facilities. The location of this console will depend upon the vessel function. Usually on the bridge, affording the DPO an adequate view of the operation from the console position, the console is often placed (in DSV installations) in an aft- facing configuration in the after wheelhouse.



Figure 6. SMS.SERENITY KPOS 21 KONGSBERG DP2

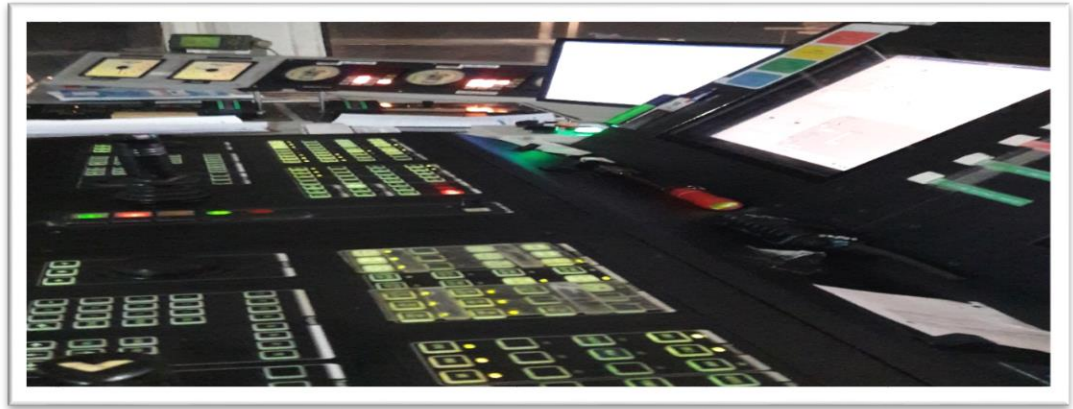


Figure 7. SMS.SUPPORTER SDP 21 KONGSBERG DP2



Figure 8. WM.MAKASSAR CONVERTEAM DP2

b. Position Reference System

Position Reference is an essential input to any DP system. Ideally the position accuracy of systems used should be 0.1 - 1.0 metre. A variety of position reference systems are in use, with varying levels of effectiveness. Each system employed will have its own characteristics of range, accuracy and operational limitations; the operator must take these into account when establishing position reference for DP. Although there have been in the past around forty different position reference systems used in conjunction with DP, there are four types predominating. These are the Taut Wire system, the Hydro- Acoustic Position Reference (HPR) and HiPAP, the Differential GPS system, DARPS, Differential Absolute and Relative Position System and the Surface Microwave

position reference (Artemis). Other PRS in common use include the SYLEDIS hyperbolic radio survey system, "Fanbeam", which is a laser radar system. There are still new position reference systems being developed. Lately 2 new systems has been developed and tested by the Kongsberg-Maritime group in Norway. These are the ARAP, Absolute and Relative Acoustic Position reference system. The system is based on LBL transponders placed in an array on the seabed around an FPSO. The other new system is called RADius. This system is based on the Radar principles. It involves an Interrogator (antenna) and one or more reflectors targets.

Some DP operations require better than 3m relative accuracy. A DP control system requires data at a rate of once per second to achieve high accuracy. Reliability is, of course, of vital importance, to operations where life and property may be put at extreme risk through incorrect position data. All DP vessels have position reference systems (PRS), (sometimes referred to as position monitoring equipment or PME), independent of the vessel's normal navigation suite. Five types of PRS are in common use in DP vessels; Hydroacoustic Position Reference (HPR), Taut Wire, DGPS, Laser-based systems (Fanbeam and CyScan) and Artemis. A brief description will be given of each. DP control systems 'pool', or combine, position reference data from two or more position reference systems. If only one position reference system is enabled into the DP then it is simply checked, filtered and used. If two or more are available, then the system needs to use both equally or according to their individual performance. In all modern DP systems the weighted average option can be selected, whereby individual position references are weighted in inverse proportion to the variance or 'spread' of position data; the higher the weighting for an individual position reference system, the greater the influence

of that system in the position calculation. Early DP control systems did not have the capability to learn from the past performance other than by the integral terms of the controller. Modern systems are able to improve station keeping performance by using a Karman filter, which provides a model of recent performance to improve present performance. For any operations requiring DP redundancy (equipment Class 2 or 3 operations) it is necessary to utilise three position references. Two PRSs are not adequate, because if one has failed, contradictory reference data provides an impass, whereas three systems provide two-out-of-three voting to identify a rogue sensor. Where three PRSs are required, the DPO should choose systems that are different. This reduces the probability of common-mode failure, where one event may result in a loss of position. A brief description will be given of the five commonly used position reference systems.

The Taut wire PRS

In this system a weight is placed upon the seabed, connected to the ship by a thin wire rope. This wire passes over a sheave at the head of a short gantry projecting over the side of the vessel. The wire spools onto the drum of a constant tension winch. The weight is about half a tonne, with approx. a quarter-tonne of tension on the wire. The length of wire paid out, together with the wire angle to the vertical in both the longitudinal and transverse planes, will define the position of the vessel with respect to the position of the weight. Sensors on the head sheave and another on the drum provide feedback information to the DP system for the calculation. A taut wire is a useful position reference, particularly when the vessel may spend long periods in a static location and the

water depth is limited. The commonest consists of a crane assembly on deck, usually mounted at the side of the vessel and a depressor weight on a wire lowered by a constant-tension winch. At the end of the crane boom angle sensors detect the angle of the wire. The weight is lowered to the seabed and the winch switched to constant tension, or 'mooring' mode. From then on, the winch operates to maintain a constant tension on the wire and hence to detect the movements of the vessel. The length of wire deployed, together with the angle of the wire, defines the position of the sensor head with reference to the depressor weight once the vertical distance from the sheave of the crane boom to the seabed is known. This is measured on deployment.

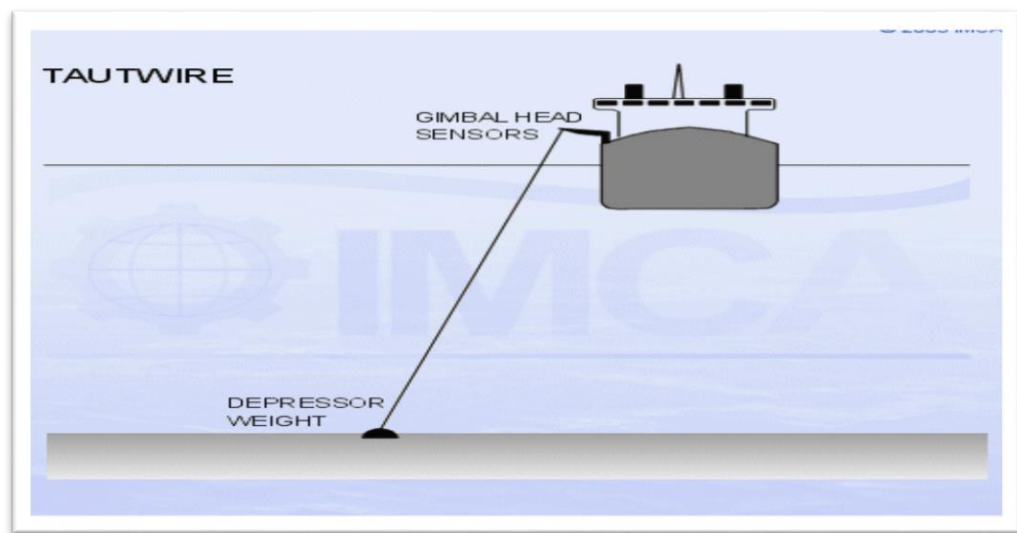


Figure 9.Taut Wire Principles

The Artemis PRS

In this system a microwave (X-band, 3 cm) radio link is established between two transceivers, one Mobile station mounted on board ship, and a fixed station, usually mounted upon a nearby platform. Each unit contains an antenna similar to a radar scanner, but non-rotating in the continuous sense. Once the microwave link is established the two (fixed and mobile) antennae

face each other with radio interrogation signals passing between. By this means accurate range and bearing information is passed to the DP system, defining the ship position. Its range is up to about 10 km but greater ranges are possible at a reduced accuracy.

An Artemis and a DARPS system (Differential, Absolute and Relative Positioning System) are configured to handle this problem. For the measurement of relative position by GPS, differential corrections are not needed, as the errors induced are the same for the shuttle tanker as they are for the FPSO. A DARPS transmitter on the FPSO sends the received GPS data to the UHF receiver aboard the shuttle tanker. A computer aboard the shuttle tanker then calculates a range/bearing from the FPSO's stern, which is put in to the DP control system as position reference in the same way as Artemis.

The Hydro Acoustic PRS (HPR/HIPAP)

This system utilises transducers on the bottom of the ship communicating with transponders placed upon the seabed. Once a transponder is deployed upon the seabed, the vessel transmits acoustic signals to it. These signals are received and immediately re-transmitted back. The transducer on the bottom of the ship detects the returning signals and is able to determine range and direction to the transponder. This defines the vessel position with reference to the seabed transponder, and this feedback information is fed to the DP.

Underwater acoustics have many applications, one of which is the provision of position reference for DP purposes. Acoustic positioning is also used for tracking of underwater vehicles or equipment, the marking of underwater features or hardware and the control of subsea equipment by means of acoustic

telemetry. There are three types of acoustic position reference systems in common use - ultra- or super-short baseline systems (USBL or SSBL), short baseline systems (SBL) and long baseline systems (LBL). Each has advantages and disadvantages which determine when and how each is used.

Ultra – or Super – Short Baseline Acoustic System

The principle of position measurement involves communication at hydroacoustic frequencies between a hull-mounted transducer and one or more seabed-located transponders. The ultra- or super-short base line (SSBL) principle means that the measurement of the solid angle at the transducer is over a very short baseline (the transducer head).

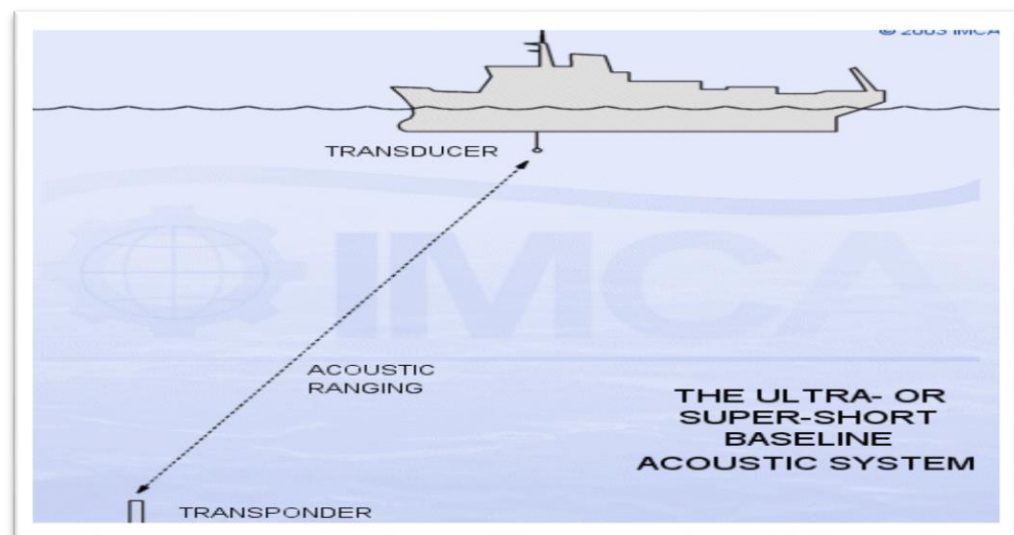


Figure 10. SSBL Principles

An interrogating pulse is transmitted from the transducer. This pulse is received by the transponder on the seabed, which is triggered to reply. The transmitted reply is received at the transducer. The transmit/receive time delay is proportional to the slant and range. So range and direction are determined. The angles and range define the position of the ship relative to that of the

transponder. The measured angles must be compensated for values of roll and pitch.

The vessel must deploy at least one battery-powered transponder. They can be deployed by downline from the vessel, by an ROV or simply dropped overboard. The performance of an acoustic system is often limited by acoustic conditions in the water. Noise from vessel thrusters and other sources, aeration and turbulence will all be detrimental to efficient acoustic positioning. Thus the limits of the system are ill-defined. In addition, layering can cause errors, especially when the horizontal displacement from the vessel is large. Acoustic systems are supplied by a number of manufacturers, notably Kongsberg Simrad, Sonardyne and Nautronix. All use frequencies in the 20-30 kHz band. Some transponders are compatible with more than one supplier's equipment.

Long Baseline System

In deep water locations, where the accuracy of the other types degrades, the long baseline (LBL) becomes more appropriate. LBL systems are in extensive use in drilling operations in deep water areas (>1,000m).

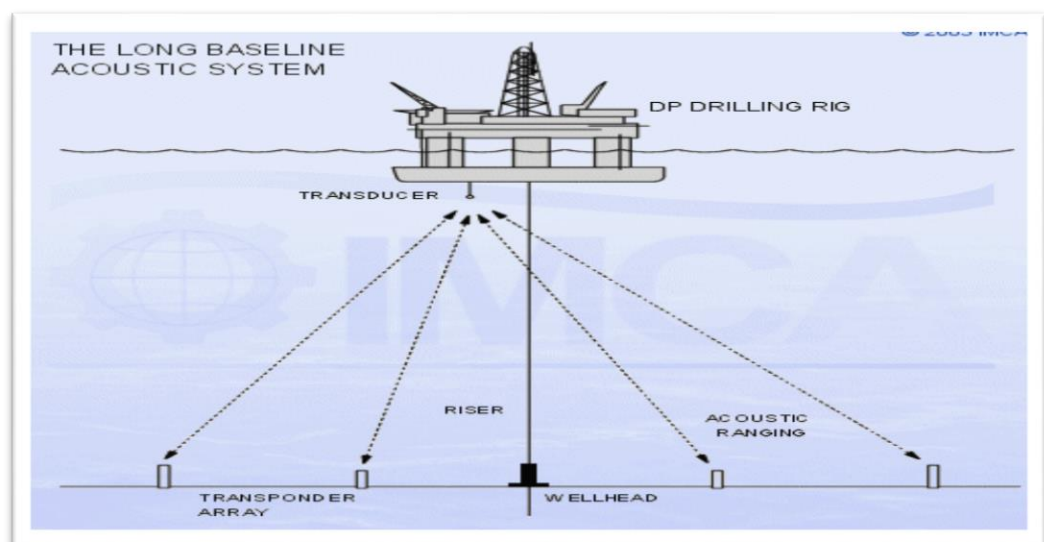


Figure 11. LBL Principles

The long baseline system uses an array of three or more transponders laid on the seabed in the vicinity of the worksite. Typically the array will form a pentagon (5 transponders) on the seabed, with the drillship at the centre above. One transducer upon the vessel interrogates the transponder array, but instead of measuring range and angular information, ranges only are measured, because the baseline distances have already been calibrated (distances between transponders). Position reference is obtained from range-range geometry from the transponder locations. Calibration is done by allowing each transponder to interrogate all the others in the array, in turn. If, at the same time, the vessel has a DGPS or other geographically-referenced system, then the transponder array may also be geographically calibrated. Accuracy is of the order of a few metres, but the update rate can be slow in deep water because the speed of sound in sea water is about 1,500 m/sec.

Short Base Line

A short baseline is like a long baseline system, except that there is an array of transducers (hydrophones), spread along the underside of the DP vessel and the baseline(s) are the distances between them. Thus the accuracy can be better than the ultra- or super-short baseline type of system and work with one transponder or beacon, but it still relies on vessel motion corrections. Some vessels have as many as eight hull penetrations for tubes or poles on which the hydrophones are deployed.

The HIPAP 500 (High Precision Acoustic Positioning)

The Kongsberg Maritime's HiPAP, as the name suggests, offers better accuracy than their other HPR systems. This is achieved due to the development of the

HiPAP transducer, which have more sending and receiving elements than standard transducers have. The HiPAP transducer is an acoustic transmitter and receiver (acoustic antenna) with 241 elements, and the same elements are used for transmitting and receiving. As the transducer is ball shaped, thus covering the whole sphere under the vessels bottom, almost to the horizontal level.

The system will dynamically control the beam so it is always pointing towards the transponder. The transponder may be moving, and roll, pitch and yaw affect the vessel itself. Data from roll/pitch sensors are used to roll and pitch compensate the position.

The HiPAP 500 system operates with the transducer mounted on a hull unit to allow the transducer to be lowered some meters below the hull of the vessel. A Transceiver Unit containing transmitter, preamplifiers and beam forming electronics is mounted close to the hull unit. The system can be configured with one or two hull-mounted transducers. With the use of two transducers, accuracy and redundancy will be improved.

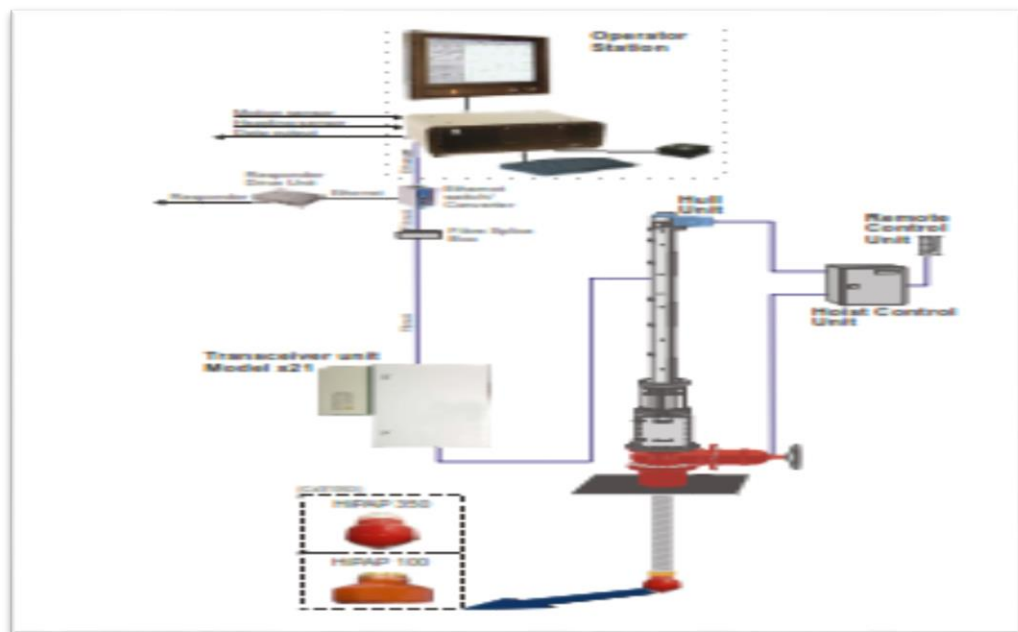


Figure 11.HIPAP 500

Differential GPS (DGPS)

DGPS has become the most commonly-used position reference for DP operations. The US Department of Defense (DoD) Global Positioning System (GPS) is in widespread general use, with typical accuracies available from the GPS Standard Positioning Service (SPS - civilian access) of 20m (68% RMS or 1 sigma). Prior to May 2000 the DoD applied a further downgrading known as 'selective availability' (SA), which reduced SPS accuracy to values around 100m. SA has been switched off, but the DoD reserves the right to re-apply it. Even without SA, GPS accuracy is not adequate for DP purposes. In order to improve GPS accuracy to levels useful for DP, differential corrections are applied to GPS data.

This is done by establishing reference stations at known points on the WGS 84 spheroid (the working spheroid of the GPS system). The pseudo ranges derived by the receiver are compared with those computed from the known locations of the satellites and reference station, and a Pseudo-Range Correction (PRC) derived for each satellite. These corrections are then included in a telemetry message sent to the ship's receiver by a data link. The receiver then applies the PRCs to the observed pseudo ranges to compute a differentially corrected position. Differential GPS systems are provided on-board by a service provider. The provider maintains and operates a network of reference stations worldwide and will install receiving equipment on-board to access the services. The basis of the DGPS system is the Global Positioning System which consists of a number of satellites orbiting the earth at a range of 20,000 km and transmitting signals to earth. The satellites act as reference points, their positions being monitored by ground stations and known at all times. Measurement of the travel times (pseudo ranges) from at least 3 satellites

provides enough information for a two dimensional global position to be calculated, four satellites will give a three dimensional fix. Up until recently the accuracy of GPS by itself was not good enough for DP, there being a number of known errors in the system, such as SA (selective availability, a deliberate variable error which can be introduced by the US Department of Defence at will), satellite clock, orbit errors or inaccurate modelling. However, the SA error has for some years now been discontinued, resulting in a significant improvement in position keeping by raw GPS signals.

The differential correction was introduced to counteract the sum of all system and environmental errors. The raw signals are received at a fixed station where the precise location is known. The differential error is there for the difference between the received signal and the accurately known position of the fixed station. The errors are transmitted to the vessel either by radio link or via various commercial communication satellite systems where they can be applied to the raw GPS data, making the positioning information more accurate and stable for DP and survey purposes. Care must be taken when using DGPS in the proximity of offshore structures due to the possibility that the line of sight of the GPS antenna and / or the differential antenna may be interrupted or masked resulting in loss of signal and subsequent reference drop out. Multi-path interference can also be expected, particularly when receiving MF differential signals, if working closer than 150m from a structure.

The use of dual DGPS as two independent reference systems is dependent upon the number and geographical spread of available GPS satellites, the quality and redundancy of the differential signals, physical separation of the various antennae and redundancy of power supplies to each component of the system.

IMCA M 141 (Guidelines on the Use of DGPS as a Position Reference in DP Control Systems) gives useful advice and information on the capabilities and limitations of DGPS systems.



Figure 12. DGPS

Network DGPS

Most DGPS services accept multiple differential inputs obtained from an array of reference stations widely separated. Generally, network DGPS systems provide greater stability and accuracy, and remove more of the ionospheric error than obtainable from a single reference station. Network systems are more comprehensively monitored at the Hub, or control stations, where user information or warning data may be generated and sent out.

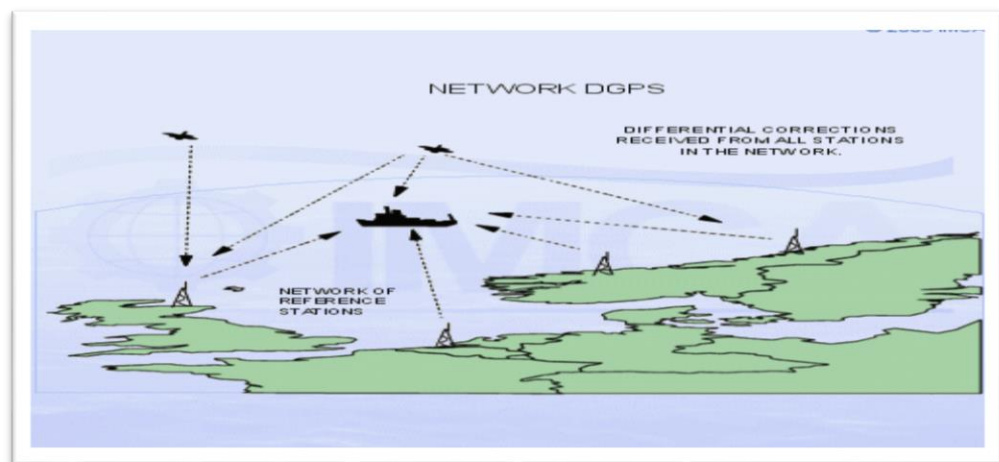


Figure 13. NETWORK DGPS

The choice of which link to hire or purchase must be made based on the vessel's expected work areas. If a vessel is expected to be working near fixed platforms, a local HF connection can be best. For floating production, storage and offloading (FPSO) vessels, a local UHF link and relative GPS solution can be the best arrangement.

The accuracy obtainable from DGPS systems is in the area of 1-3m dependent upon the distances to the reference stations, ionospheric conditions, and the constellation of satellites available. DGPS tends to be less reliable in close proximity to large structures (ie. platforms) due to interference to satellite and differential signals. DGPS performance near the magnetic equator has suffered due to scintillation (sun spot activity causing ionospheric disturbances). This reached a peak in 2001 with the maximum of the 11-year sunspot cycle.

CYSCAN ACCOUSTICS (Hydro-acoustic Position Reference)

This is a high precision acoustic positioning system. It has a hull mounted transducer that is lowered below the level of thruster and propeller interference. There is a transceiver unit mounted close to the hull transducer unit. The transceiver unit contains the transmitter, preamplifiers and beam forming electronics. The transceiver communicates with the operator unit on the bridge. The operator unit contains a display and a keyboard.

The CYSCAN system uses heading information from gyro compass and pitch/roll data from the vessel's MRU 3. The system can operate with one or more subsea transponders or responders. Transponders are placed on the seabed, on subsea structures or on ROVs and are interrogated by a signal from the transducer, while a responder is interrogated via a signal sent through a

cable connecting it to the HPR system (e.g. through an ROVs umbilical).

Care should be taken when selecting a location for subsea transponders to ensure that they are clear of the worksite and any seabed obstructions while still remaining within the operational range of the HPR system.

Care should be taken when any water jetting or especially air-lift operations are in progress as acoustic noise may interfere substantially with Sonardyne transceiver performance. Operators should be aware that acoustic reflections from structures on the seabed may sometimes produce a coherent pattern of echoes which could cause the acoustics system to miscalculate the vessels position.

Reference should be made to the system operating manual with regard to range limits of the system when planning DP operations. Effective range reduces proportional to water depth.

Transceiver poles should only be lowered for DP operations or system testing. **They must never be lowered in port without the Master's permission** and a careful check on under keel clearance. Poles should be fully retracted before getting under way after completion of DP operations. A lowered pole may be damaged at transit speeds.

Great care must be exercised to ensure that transceiver poles are not lowered onto closed gate valves. The transceiver head is easily damaged in this situation, entailing costly and lengthy repairs or replacement. The transceiver pole can raised and lowered either locally or more usually, remotely from the bridge. Interlocks on the gate valve prevent accidental operation of the pole when the gate valve is shut.

Care should be taken when selecting transponders or responders fixed to ROVs. Such beacons must normally be designated as "mobile".



Figure 14. CYSCAN

RADIUS 100

The implementation is fully solid state and based on measurement of reflected radar signals from a number of passive transponders in the nearby area. Each reflected signal is mixed with a unique ID to separate different targets from each other. Advanced signal processing allows simultaneous and continuous measurements to any practical number of transponders. RADIUS is designed for multiple users leveraging the same transponders simultaneously.

Multiple sensor heads

RADIUS can be deployed as an omni directional system utilising four sensor heads, which can be placed on suitable locations on the vessel dependent on the construction and operation. This provides full 360° signal acquisition as well as avoidance of blind angles as there will be a sensor head at a receiving angle to transponders at all times, regardless of the vessels relative position to the RADIUS transponder.

Signal processing will effectively remove possible interference with other transmitting devices in the same frequency band. Accurate Doppler

measurements allow for rapid and reliable determination of relative velocities between the manoeuvring vessel and transponders.

Application software makes configuration and monitoring of the RADius operation easy and effective, and interfaces to remote systems like Dynamic Position may either be serial lines or Ethernet based.

RADius is designed to fill the need specified by IMO for DP Class 2 vessels.

Operational features

RADius is capable of detecting and measuring accurate range and bearing to any transponder within the range of up to 550 metres. (Dependant on the targets transponder) The direction from the interrogator to each transponder is accurately determined by the use of interferometry methods. Due to use of open standards, deployment of the operator interface is very flexible.

Wide opening angles

RADius has a vertical and horizontal opening angle of 90°. These secure stable operations in close by operations where the difference in mounted transponder and interrogator can be considerable. Due to this there is not necessary to tilt the sensor head in any direction to obtain signal.



Figure 15. RADius 100

Heading Reference

Heading reference is provided from one or more gyrocompasses. The gyrocompasses used are normally identical units to those provided in conventional vessels; indeed, one of the gyros provided for DP purposes also doubles as the "master" gyro for navigational purposes, driving repeaters for such functions as autopilot, radar stabilisation, and azimuth repeaters. The number of gyros required for DP Class II and III operations is usually three.



Figure 16. Gyro Compasses C Plath Navigate X MK1 Mod 10

Environmental Reference

Wind sensors are provided to give the system a continuously updated value for wind direction and strength. Short-term variations in both must be compensated for if precise positioning is to be achieved. Wind sensors or transmitting anemometers are fitted, usually in duplicate, to provide feed-forward signals directly to the thrusters to compensate for wind-induced movement of the vessel from its set point position and heading. Problems arise, associated with wind sensors due to wind shadow of the sensor element by ship's structure or from adjacent platform structure. This will be particularly pronounced if the vessel is downwind of a structure. It may happen that the wind sensor at masthead height is wind shadowed by the platform topside, while the bulk of the vessel hull and superstructure is less wind shadowed by the lattice structure of the platform jacket. Other wind sensor problems arise due to helicopter disturbance, particularly if the wind sensor installation is close to the helideck. Helicopter downdraft can induce false momentary wind sensor inputs, which are not representative of the wind forces acting upon the ship as a whole. Since wind sensor input has an immediate feed forward effect, the result may be a rapid drive-off as the DP attempts to compensate for apparent gusts.

Often, two wind sensors are fitted; allowing the operator to select which input is likely to be the most representative.

The two sensors may be fitted at different heights on the mast, or at opposite ends of a transverse yard. In the latter case the operator would probably select the windward sensor in order to avoid as much as possible disturbance caused by ship's structure. One suggested remedy to the problem of wind shadow from adjacent upwind platform structure is to deselect the wind sensors from the DP altogether, however, caution must be exercised here since there will be no wind feed forward available. Problems will arise when changes in wind speed and/or direction occur,

resulting in deterioration in positioning of the vessel. It must also be remembered that while all wind sensors are deselected the processor will continue to use the model values for the wind, i.e. the values last recorded. If, when a wind sensor is reselected into the system, there are different wind values obtaining (which is likely) then a temporary loss of position control may be expected. In vessels where the helideck is adjacent to the wind sensor location, or where helicopter wind sensor disturbance has been observed, it is common to deselect wind sensor input during helicopter movements. In some cases this will necessitate temporary suspension of the operation in progress. A vector is shown on the Pos Plot display pages indicating the set and rate of the current or tide. It is important to realise that this is not a measured value; there is no tide sensor deployed. This is a derived vector determined from a summation of differences between predicted positions and measured positions. This displayed vector will not necessarily be accurate, as it will contain elements of residual errors within the system. It is necessary to provide an input to the processor regarding vessel attitude, i.e. angles of roll and pitch, on a continuous basis. Several of the Position Reference systems function by measuring angles relative to the shipboard sensor element. Roll and pitch of the vessel will introduce errors into these angle inputs, which will translate into position errors. By providing the system with constant roll and pitch angle data, the position reference input data may be corrected to the true vertical. Roll and Pitch information is provided from a Vertical Reference Unit or Sensor (VRU, VRS or MRU). There are three types of VRS: those use a vertical gyro, those using a pendulous mass and those using accelerometers for angle measurement. The latter type is commonly used in current DP installations. From one manufacturer, two types of vertical reference sensor are available. The simplest type yields angular information regarding roll and pitch. A more complex type

utilises more accelerometers to yield values for vessel Heave (vertical bodily movement) also. Although a consideration of heave is not essential to the DP function, this output can be utilised elsewhere, in heave compensation for diving bells or crane hook, or in fire monitor stabilisation.

The wind sensors measure wind speed and relative direction, which is used to determine the resultant effect on the vessel. The DP Operator should be aware of the effects that may occur if the wind sensor is in the lee of an obstruction such as a platform and especially if the wind sensor is suddenly moved into or out of such a lee. Similarly, care should be exercised during helicopter operations (either on the vessel or nearby installations) as the down draught from an aircraft may cause the vessel to increase thrust temporarily to counteract a perceived increase in wind velocity. This effect, sometimes known as "gust thrust compensation", can be countered by temporarily disabling the wind sensors from the DP system during helicopter operations.

Care must be exercised when disabling the wind sensors in this way, especially in high wind conditions, since the temporary loss of the wind sensor signal may result in deterioration of position keeping.

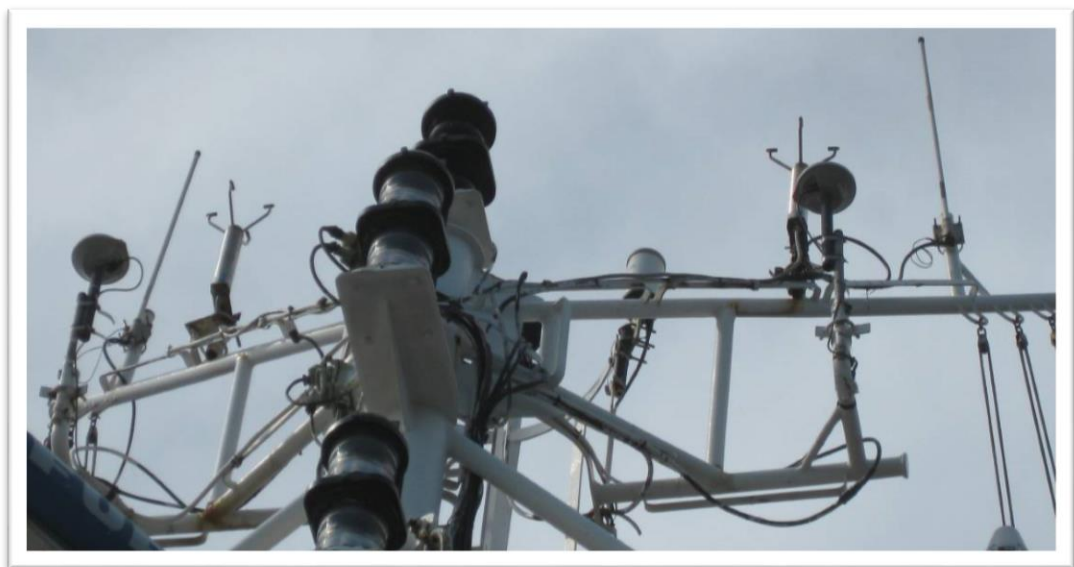


Figure 17. GILL Wind Observers II

MRU (Motion Reference Unit)

The motion reference units are used to measure instantaneous pitch, roll and some also measure heave of the vessel. Pitch and roll values are used in the position reference system calculations to allow for motion of GPS antenna.



Figure 22. MRU's Located Forward in the Cement Compartment

Power Generation and Distribution

Central to the operation of any DP vessel is the power generation supply and distribution system. Power needs to be supplied to the thrusters and other manoeuvring systems fitted, and also to the DP control elements and reference systems. A more detailed consideration of power supply and distribution is given in a later section; a brief overview is given here. The thrusters will generally absorb more power than any other consumer on board. Dynamic Positioning requires more power than other ship functions so it is often found that DP vessels have a very high level of installed power. The DP function often requires large unpredictable changes of power load such as occurs when a vessel is on DP headed into the wind, and the wind rapidly freshens and changes direction. The result may be the vessel maintaining station beam-on to a gale force wind, requiring much more power than

hitherto. It can be seen that the power generation system needs to be flexible in order to avoid unnecessary fuel consumption. Many DP vessels are fitted with a diesel-electric power plant with all thrusters and consumers electrically powered. Power is generated by a number of diesel alternators. Another configuration consists of part diesel direct-drive and part diesel electric. A vessel may have twin screws as main propulsion driven direct from diesel engines. Bow and stern thrusters are electrically driven taking power from shaft alternators coupled to the main diesels or from separate diesel alternators. There are many alternatives. The DP system is protected against power failure by the inclusion of an Uninterruptible Power Supply (UPS.). This system provides a stabilised power supply not affected by short-term interruptions or fluctuations of the ship a/c. power supply. Power is supplied to the computers, consoles, displays, alarms, position and environment reference systems. In the event of an interruption to the main a/c. ships supply, a bank of batteries will supply power to all these systems for a minimum of 30 minutes. It should be noted that this emergency back up applies only to the DP system electronics, not the thrusters. Also, the battery supply does not provide power to the taut-wires.

In general, power requirements in DP vessels are much higher than in conventional ships. The commonest type of power installation is diesel-electric, with all-thruster power and services supplied from electric motors. Direct-drive diesel is not suitable due to the uncertainties in starting and stopping. It is, however, possible to apply direct-drive diesel to a controllable pitch thruster, with all thrust control obtained from blade pitch angle. A few DP vessels are equipped with individual direct-drive diesels coupled to each thruster, the propeller in each case being CPP.

Thruster motors are usually constant RPM, AC motor driving CPP propellers, with all thrust control provided by the variable pitch. A recent development is the variable-speed a.c. motor drive, in which a synchro-converter, or cyclo-converter, or

Pulse Width Modulator system provides a variable frequency voltage supply to the AC motor type of drive is suitable for DP installations with fixed-pitch propellers. This type of installation is finding great favour in larger vessels, where high-power CPP propellers would be very expensive.

In a diesel-electric installation, a number of generators provide power to a switchboard like on a "power station" basis. Typically the voltage generated in a diesel-electric installation is high-tension, e.g. 6 kV or 6.6kV. Main and auxiliary switchboards run at 440V or 240V with power fed from the H.T. switchboard via transformers. The generators are driven by diesel engines, each of which should be provided with independent services such as fuel, cooling and lubrication. The provision of a number of generators lends itself to the principle of redundancy. Failure of one generator will leave a number of others on-line, and normal margins of working should ensure that

loss of one generator does not result in an emergency status arising. The number of generators running can be changed to match the power requirements. In favourable conditions, shutting down generators, keeping them ready for instant start-up upon deteriorating conditions can conserve fuel.

The switchboard is arranged to provide redundant capability. Initially, redundancy is obtained by ensuring that loss of one thruster, or one generator does not result in a loss of DP, but further to this, the switchboard will be split into two or more bus bars. Bus bars are supplied from different generators, and in turn supply different thrusters. They are arranged so that position-keeping ability is maintained (in a reduced state) using the thrusters from remaining bus bars, even when one is not available. In normal operation the bus bars will be switched together but may be

isolated subsequent to failure, or during operation deemed to have a high level of risk associated.

Many vessels utilise combined diesel direct drive and electric drive. Arrangements vary, but often there will be twin screws, controllable pitch in a conventional arrangement, together with a variety of thrusters. The screws will be driven at constant RPM by one or more diesels, also driving shaft alternators providing electrical power onto the switchboard. Diesel alternators provide additional electrical power. Thrusters are electrically powered, or driven by their own independent diesels.

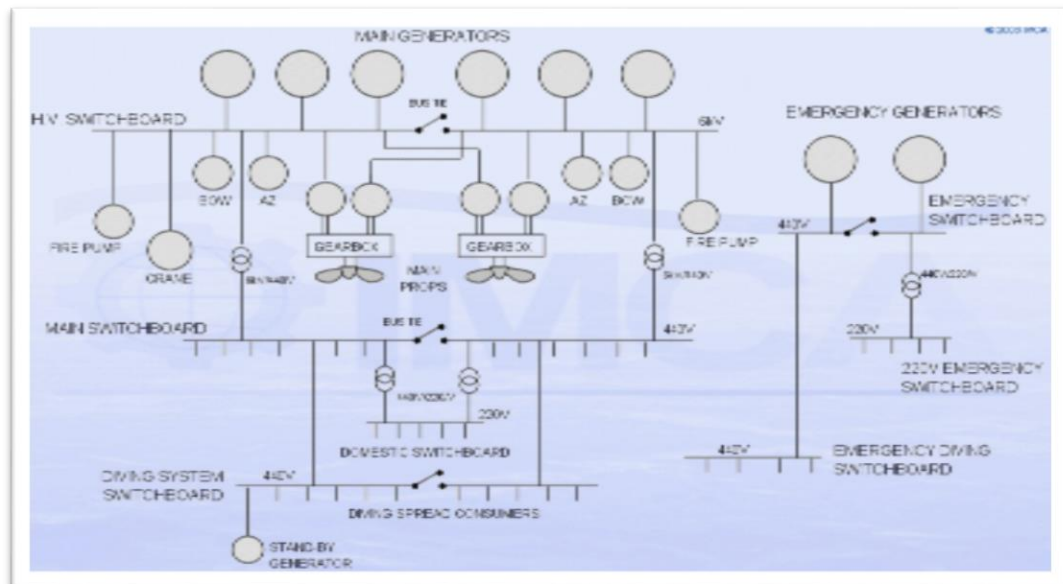


Figure 18. Power Distribution on a Typical OSV

Thrusters, Propellers and Manoeuvring Systems

The thrusters provide the manoeuvring capability of the vessel. In general, three main types of thruster are fitted in DP vessels, main propellers, tunnel thrusters and azimuth thrusters. Main propellers, either single or twin screw is provided in a similar fashion to conventional vessels. In DP vessels where such main propulsion

forms part of the DP function propellers are often controllable pitch (CPP) running at constant rpm. This facilitates the use of shaft driven alternators, as these could not be used if the shaft drive is not at constant rpm. A more recent development is the installation of synch converter systems allowing variable speed a/c. motors to be used in conjunction with fixed-pitch propellers. Conventional rudders and steering gear usually accompany main propellers. Generally (though not exclusively) the DP system does not include rudder control; the autopilot being disconnected and the rudder set amidships when in DP mode. In addition to main propellers, any DP vessel will employ a variety of thrusters for manoeuvrability. Typically a DP vessel will use six thrusters, three at the bow and three aft. Forward thrusters tend to be tunnel mounted, operating transverse. Here a CPP propeller (or impeller) is mounted in a tunnel and runs at constant RPM. Drive is from above using a bevel gearing, from an electric motor or diesel engine. Pitching the blades port or starboard produces thrust. Usually two or three tunnel thrusters are fitted in the bow, with control applied identically to all. The resultant turning moment applied to the vessel is most marked if the vessel does not have appreciable headway - or sternway. Once the vessel is making way the effect of tunnel thrusters drops off radically. Tunnel thrusters may be used at the stern also; alternatively she may employ Azimuth Thrusters. These units consist of a CPP propeller mounted in a short tunnel. The unit projects beneath the bottom of the vessel and can be rotated to provide thrust in any direction. Propeller drive is by bevel gearing from above. The whole unit may in some cases be retracted into the hull. Azimuth thrusters have the advantage that they can provide thrust in any direction (compared with tunnel thrusters) and are often used as main propulsion. However, they are more troublesome to locate satisfactorily. If fitted below the bottom of the hull they increase the draught considerably and need to be

retractable, and to state the obvious, if they are retracted in shallow water, their power is not available. A wide range of azimuth thrusters is available from a number of manufacturers, ranging from 600kW to 7000kW (800 HP to 10,000 HP) with propeller diameters ranging from around 2.0 m to over 4.0 m.

The resultant turning moment applied to the vessel is most marked if the vessel does not have appreciable headway - or sternway. Once the vessel is making way the effect of tunnel thrusters drops off radically.

Tunnel thrusters may be used at the stern also; alternatively she may employ Azimuth Thrusters. These units consist of a CPP propeller mounted in a short tunnel.

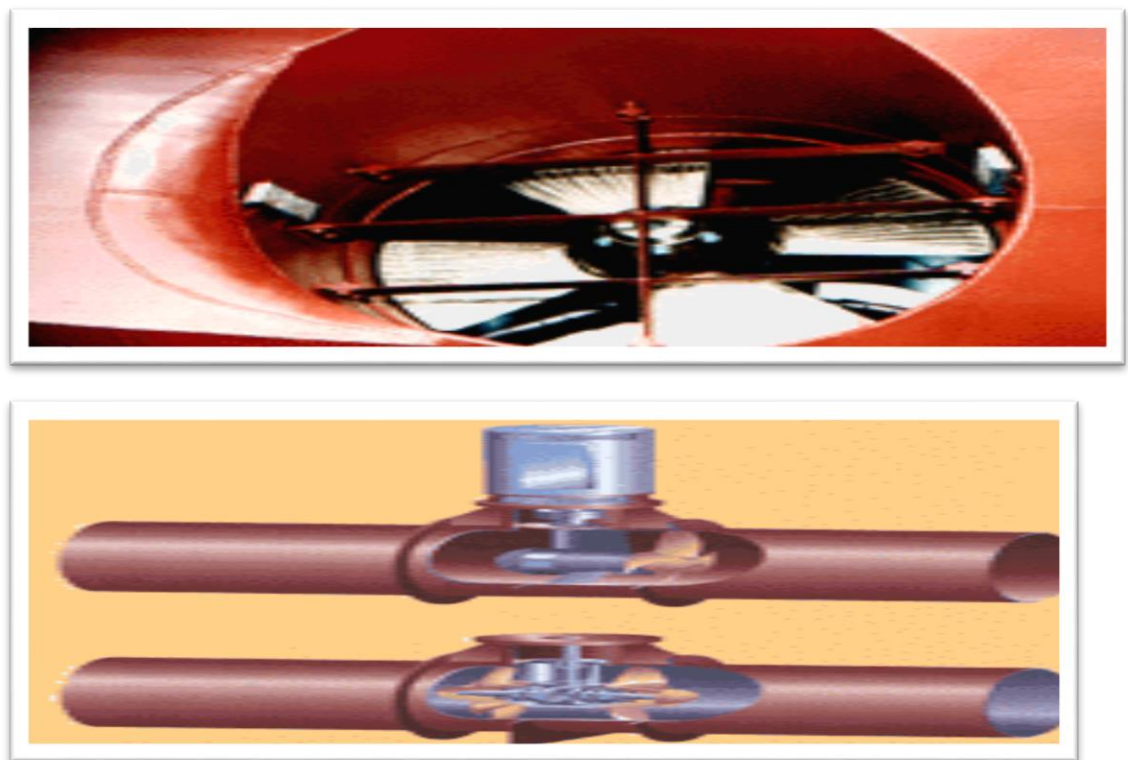


Figure 19. Tunnel Thrusters

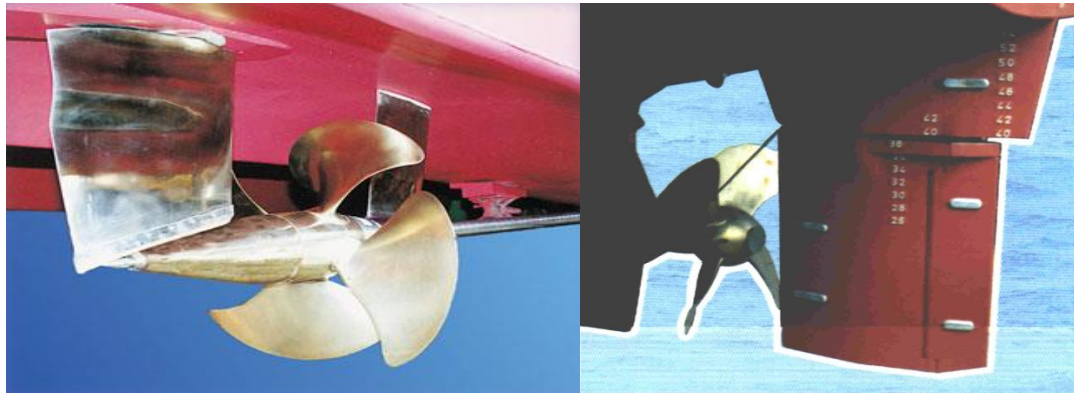


Figure 20. Main Propulsion Pitch & Rudder (S)

4. DP CONTROL SYSTEM

The DP system is an example of closed- loop control using mathematical modelling. A separate model is built for the dynamics of the vessel's hull, her underwater surface area, or drag value, her above water surface area or windage and its distribution, the thrusters, each position reference system, also the various other sensors used. The mathematical model takes time to build up to an optimum level, acquiring data upon all of the variables. Since most of these variables change their characteristics only slowly if at all then the model can be based upon a number of minutes sampling of values.

A system model is only an approximation, which characterises the behaviour of that physical system. The accuracy of the model will vary; the more complex it is, the more costly it is to produce. The ultimate function of the control system is to compute thruster commands that will maintain the vessel on station or return her to the desired position and heading. This task must be carried out in the face of a variety of external forces such as wind and tide, also other ship-induced forces such as thrust from fire fighting monitors, or the drag induced when Pipe laying due to the maintained pipe tension. One of the most important forces that must be compensated for is that resulting from the wind. Since the wind speed and

direction are subject to very rapid changes, and since wind forces rapidly influence the vessel, it is necessary to provide direct thruster compensation for measured wind variations. This is referred to as Feed forward and requires an accurate wind sensor input in order to function. Without wind feed forward changes in wind speed and direction would not be fully compensated for until the model was fully updated.

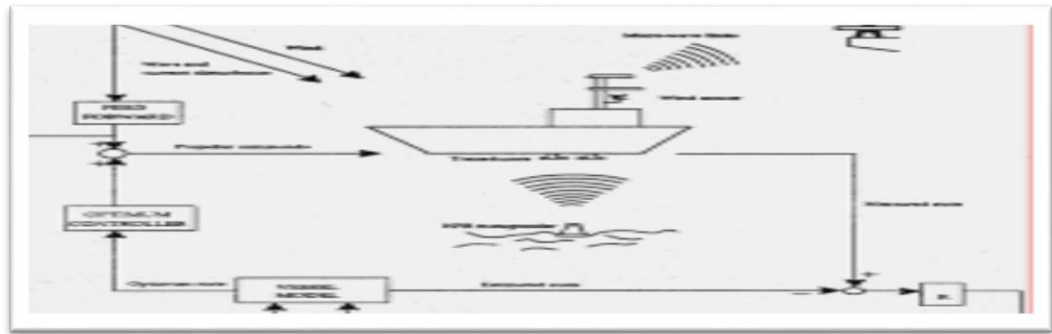


Figure 21. Wind Feed Forward

Benefits of the mathematical modelling

The use of a sophisticated mathematical modelling technique allows a number of advantages to be realised. An effective "dead reckoning" mode is available such that DP control is not lost if all position reference and/or heading reference input are lost. The system continues to position the vessel using the information in the model. The model will deteriorate in time, and accuracy will degrade but meanwhile she can be kept in automatic DP mode with often better results than by switching to manual control. The use of modelling techniques also allows for combination of several position reference systems in a pooling arrangement; observed position spreads allow a weighting to be allocated to each system so that the optimum value for the ships position is continuously calculated.

Mathematical modelling is inexact science and its limitations must be recognised. One problem, which results from the modelling technique, concerns the determination of the tide vector. Although treated as tide, with the characteristics as such, it must be realised that inherent errors will be also treated as "Tide".

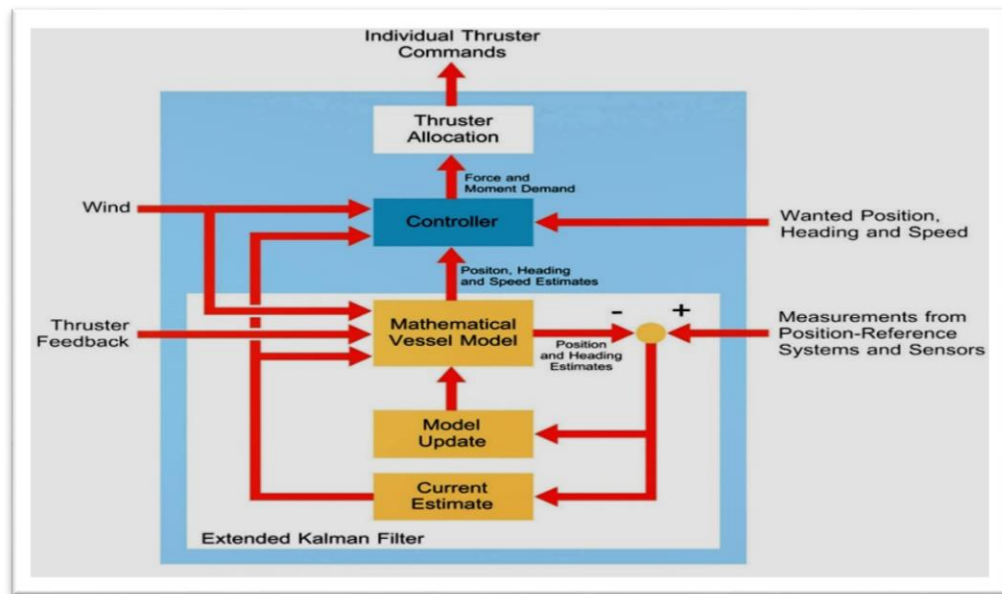


Figure 22. The DP Control System

The DP system is an example of closed – loop control using mathematical modelling. The Model contains data of:

- Vessels hull dynamics
- Wet surface area, drag value or water resistance
- Surface, wind area, distribution
- Thrusters
- Sensors
- Position Reference Systems

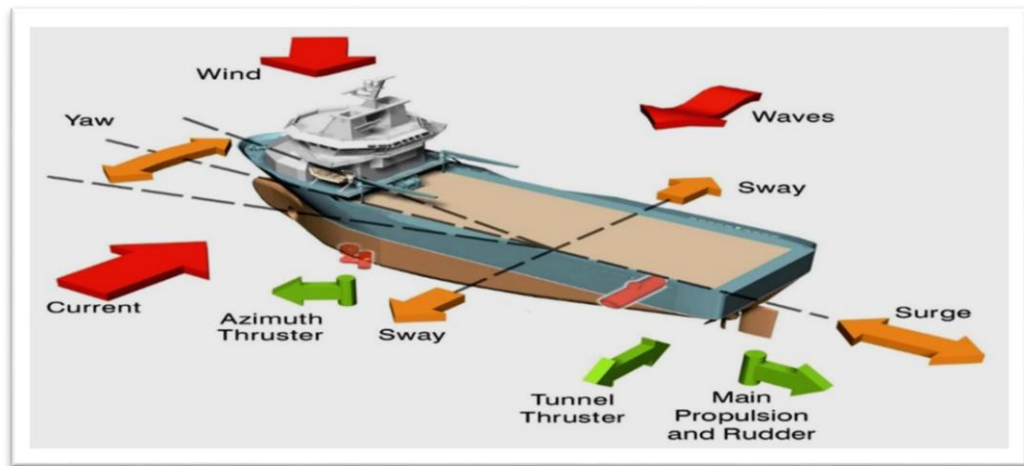


Figure 23. The DP Control System

The mathematical model takes time to build up to an optimum level. Acquiring data upon all of the variables. Most of these variables change their characteristics slowly, if at all, then the model can be based upon a number of minutes sampling of values.

The advantages of the mathematical modelling technique:

- Dead reckoning mode if all reference are lost
- Continues to position the vessel using the information in the model
- No need to take manual control. DP will position better
- DP model will, over time, deteriorate.

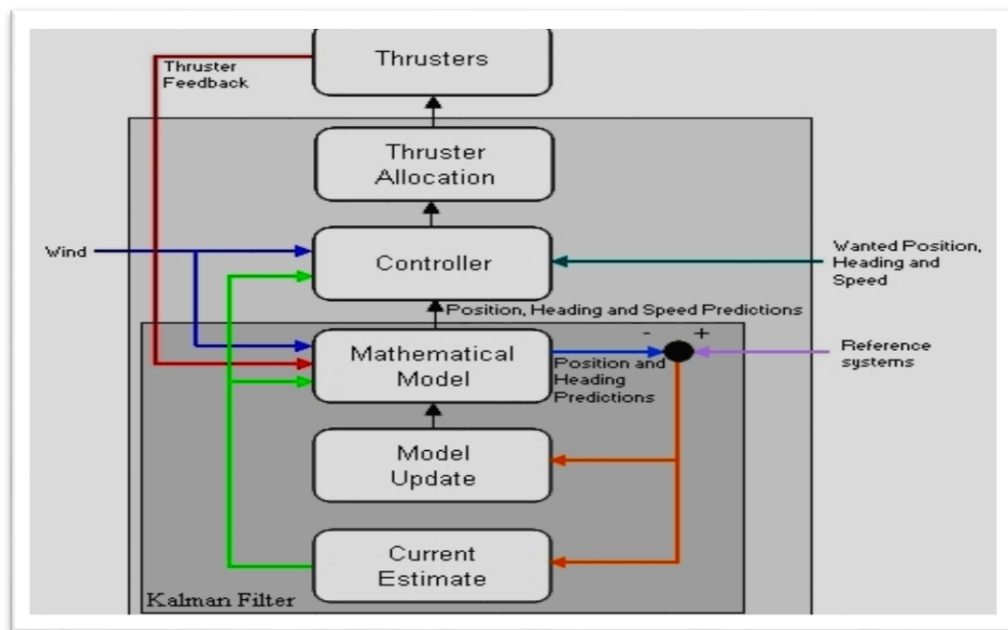


Figure 24. Kalman Filter

5. DP FUNCTIONS AND APPLICATIONS

a. Anchor or mooring assist

In this mode a vessel may be moored to an anchor spread but still employ active thrust to reduce the forces acting in the anchor cables. With this function the DP acts so as to control the vessel to maintain her natural position and heading within the anchor spread. The Anchor Assist function (Damping Surge, Sway and Yaw) applies an ultra-low Gain level to the Auto-DP function, thus allowing a shared position control between DP and anchors. The function also allows minor adjustments to both position and heading to be made within the constraints of the mooring pattern.



Figure 25. FPSO

It is important to realise that if this button is operated when the vessel is not partly controlled by an anchor spread, i.e. in normal DP operations, then the low gain applied may be insufficient to position the vessel. The position footprint will expand and she may suffer drift-off. However, a vessel that is moored to an anchor spread, or connected to a turret, is not considered to be a DP operated unit. It is defined as a thruster assisted moored vessel, thus it does not qualify for DP time according to NMD and NI.

b. Follow submersible

Many DP vessels have a requirement to track and follow a submersible vehicle, either an unmanned or manned submarine or else a seabed crawler tractor

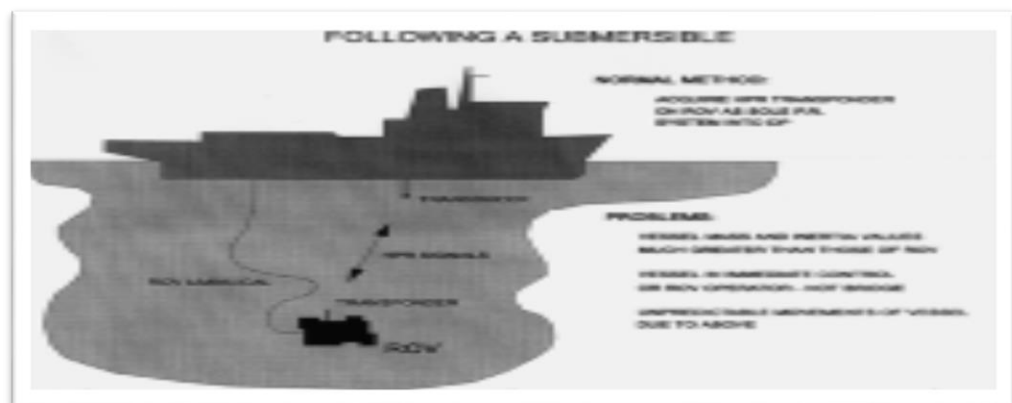


Figure 26. Following a Submersible

The common method of carrying out this operation is to place a transponder or responder on the vehicle, and acquire that on the DP as the sole position reference. The Tp or responder is selected into the HPR and DP as a fixed reference (not Mobile), thus the vessel will position with reference to the (moving) vehicle. This is sometimes referred to as the “dog on a lead” method. This method cannot be fully approved of, since the DP system is configured to treat PRS elements as fixed in location. When following a submersible this is not the case, thus there will be inertia-related problems; the vehicle will be more manoeuvrable than the vessel, which will have difficulty in following precisely. It must also be realised that the movements of the vessel are not

under the immediate control of the DPO, but of the ROV operator. Good communications and planning involving the two parties are essential.

c. Follow sub or Follow Target

In this mode of operation the vessel is required to attend an ROV, or an unmanned submersible. This vehicle may be undertaking a linear survey of a pipeline, for example, and the vessel needs to follow it. The HPR system is used, with a transponder placed upon the submersible. The vessel thus positions itself with reference to the submersible. Allowance has to be made for the fact that the submersible is lighter and far more manoeuvrable than the ship, so that the ship does not try to follow the precise movements of the sub. For this reason a “dead band” (or “react Radius”) is set at perhaps 30 metres around the submersible, and the vessel will only manoeuvre to follow when the sub breaks the perimeter of this zone. Position reference must be obtained from some other PRS, e.g. Artemis or DGPS.

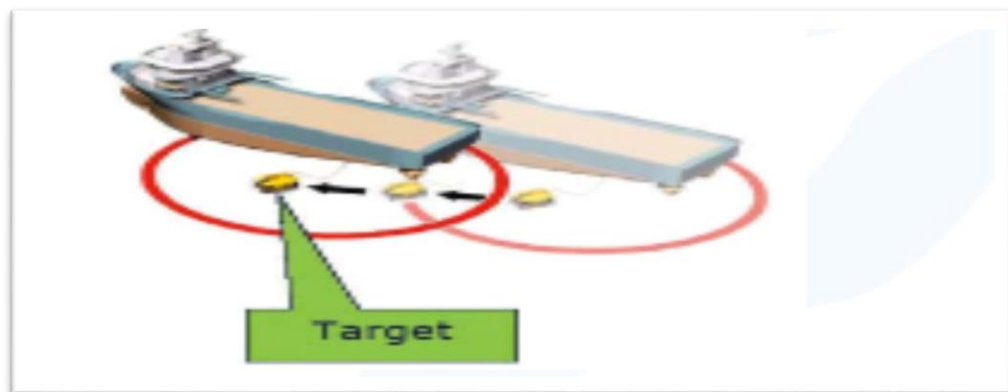


Figure 27. Follow Target

d. Auto Track

Using this function, a series of turn-points (TP) positions can be entered and a vessel speed required, and once initiated the vessel will follow the predetermined track from turn point to turn point. The vessels heading may be

kept constant, or may be changed at will. If “Auto select” heading is pressed then the vessel will take up the heading of the direction to the next turn point. Upon reaching the last turn point defined, the vessel will stop at that position, reverting back to “Auto DP

A typical Auto track function allows the operator to define up to 100 turn points.

when a track is defined, the operator selects the order of visiting the turn points and may also select the speed and heading separately for each leg. In some vessels, particularly rock-dumping types, the Auto track function allows for “Track Compensation” whereby the operator can offset the whole track (or selected legs) by a number of metres to port or starboard of the pre-defined track. Track compensation may be applied while the Auto track is underway.

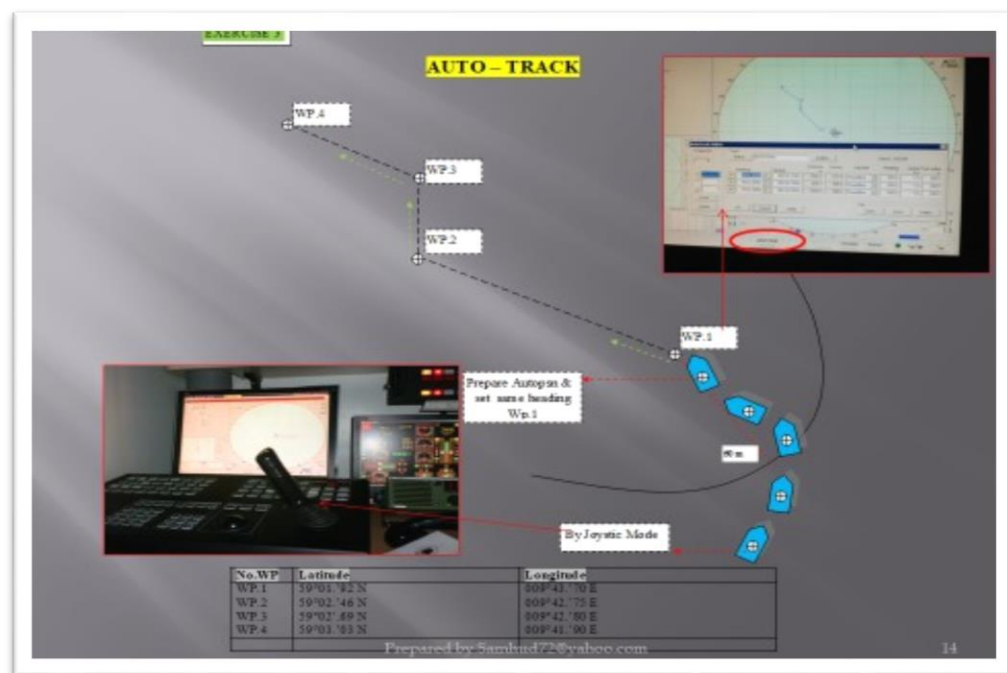


Figure 28. Auto Track

e. Dive Support Operations

A whole generation of DP-capable Dive Support Vessels (DSV's) is in operation, and DP is a well-established technique for this particular function. Early dive support vessels operated by means of anchoring the bow of the vessel, and mooring the stern to the platform. This is frequently not possible due to the amount of hardware on the seabed precluding the use of mooring lines. DP is thus the preferred method in many areas. Also, the versatility and manoeuvrability of DP vessels ensures that their work capability is much greater.



Figure 29a. Dive Support Operation

There are three modes of underwater operation. Up to a depth of 50m the technique is “air diving”, i.e. the diver’s breathing gas is compressed air. The diver may be deployed from a basket over the side of the vessel, or from a wet-bell, or from a mini-bell. The latter two methods represent increased safety to the diver in the most hazardous diving zone. One requirement of the diving set – up, from a DP vessel is that amount of umbilical the diver may be given,

measured from the tending point (basket or bell) must be no more than 5 meters less than the distance to the nearest thrusters. This is to ensure that the diver cannot be drawn into thrusters.

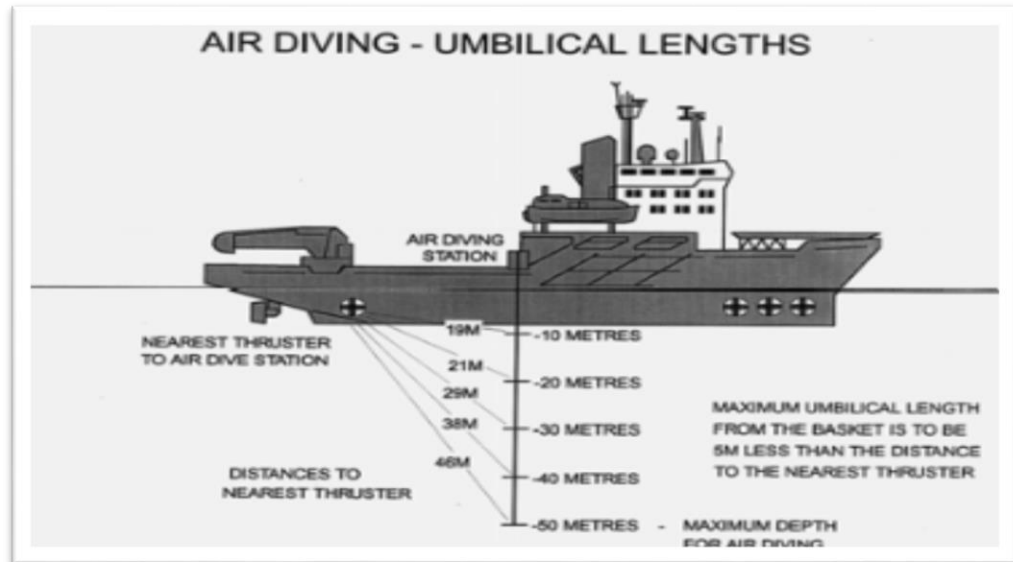


Figure 29b. Air Diving – Umbilical Lengths

Below 50m the diver must be deployed from a diving bell and his breathing gas will be a helium/oxygen mix (Heliox). The diving bell maintains the diver at the pressure of the working depth, and mates with a hyperbaric complex on board the vessel.

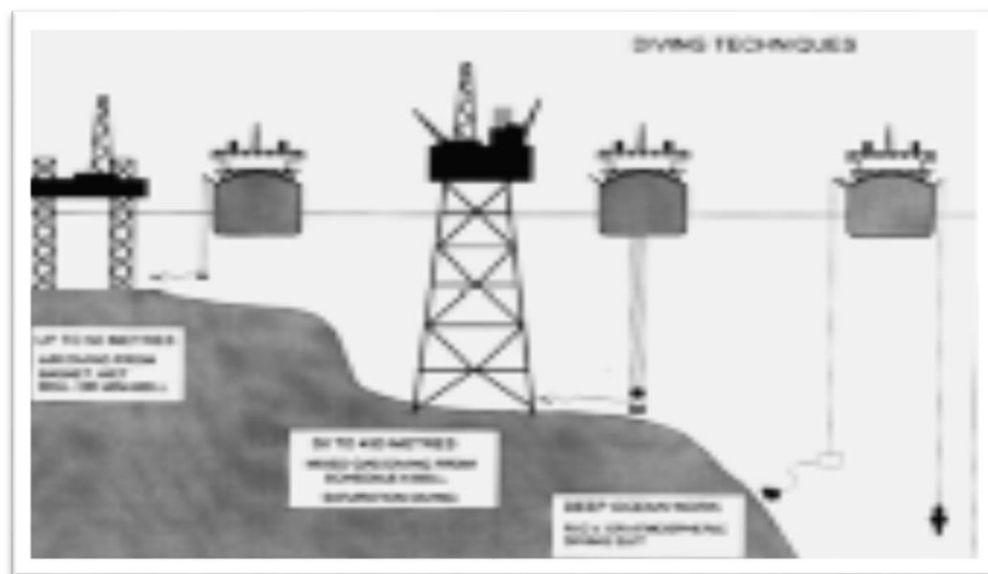


Figure 30. Diving Techniques

The divers live in this hyperbaric chamber, also maintained at the pressure of the working depth, for up to 28 days, travelling “to work” in the diving bell. This technique is known as “saturation diving”. The bell is usually deployed through the moon pool, an open well in the centre of the vessel, or over the side.

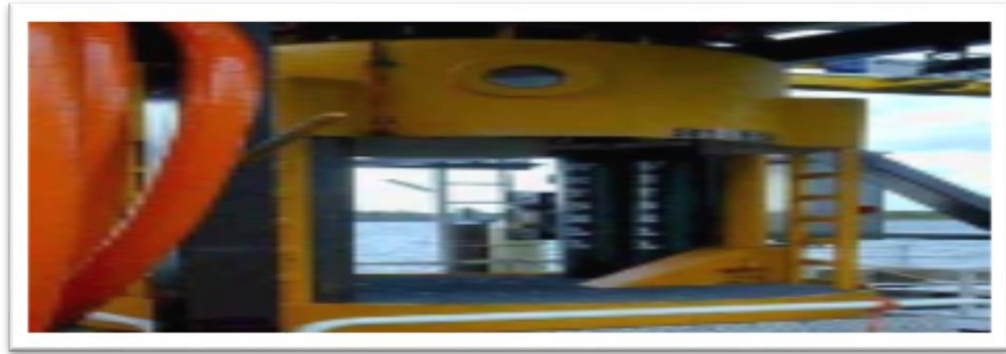


Figure 31. Diving Bell

A typical “bell-run” would consist of three divers (two swimmers and a bellman) operating for an eight hour shift. The swimmers are provided with all gas, hot water for heating, and communications through the umbilical connected to the bell and ultimately to the vessel. Emergency supplies of breathing gas are carried on the bell, and each diver has a bale-out bottle on his back - for dire emergencies only. The bellman remains in the bell to tend to the swimmer’s umbilical and to assist in an emergency.

At present the practical limit for bell diving is about 400 - 450m. At greater depths than this ROV or a diver in an atmospheric Diving Suit (ADS) must do the work.

ROV (Remotely Operated Vehicles or unmanned submersibles) may be very sophisticated units able to operate a wide variety of tooling, sensors and other instrumentation. They are taking the place of divers in many localities, and modern

oil field developments are designed to be ROV-friendly, allowing the elimination of diver intervention



Figure 32. ROV

Atmospheric Diving Suits are used to place a diver in very deep water. The suit is a pressure vessel, with air at atmospheric pressure inside. The diver is able to operate claws, manipulators, tooling etc., to carry out a wide variety of operations. He is not subjected to the pressure of the working depth so has no breathing gas and decompression problems. Several different types of ADS are in use; some, like the “New Suit” has legs so the diver can walk other are fitted with thrusters allowing the diver to “fly”

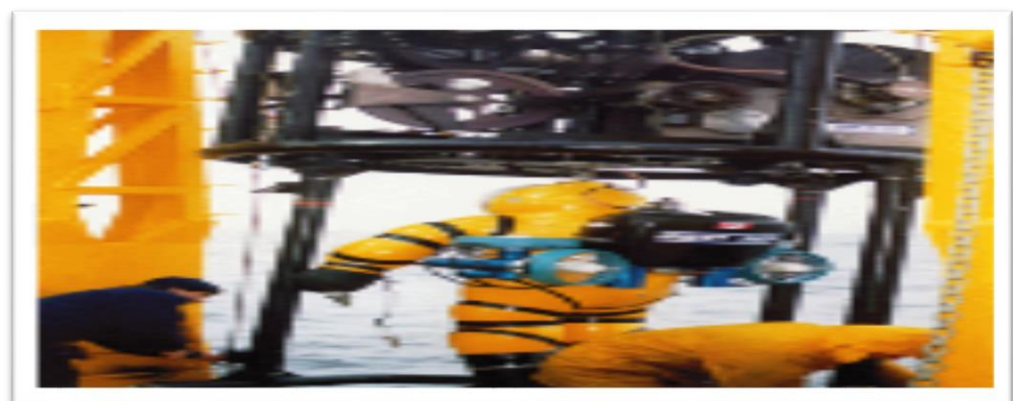


Figure 33. Diver Suit

Many DSV'S operations entail positioning the vessel close to a platform structure, enabling the divers to access the structure, wellheads etc., for inspection and maintenance. In some vessels it is possible to operate two, three or even four separate diving “spreads” simultaneously. Each diving operation is under control of a dive supervisor, operating from the dive control cabin. The dive supervisor has all the communications and bell control to his fingertips, and he is able to start or stop the dive at any time. The safety of the divers is his responsibility. If more than one dive is underway than there will be a dive control station in charge of a supervisor for each dive station. The dive supervisors for each shift are under the overall control of the Dive Superintendent. There will be a dive status/alert system in force, with green, flashing amber and flashing red status and alarms. Green status is ‘normal’; dive able to proceed. Flashing Amber alarm indicates a degraded status, divers to return to the bell and obtain a seal. Flashing Red alarm indicates a dive emergency status resulting from a vessel loss of position, divers to return to the bell and be recovered to the surface.



Figure 34. Amber Alarm

Before engaging in diving operations from a DP DSV'S the DPO must ensure that all his systems are functioning correctly with full redundancy available in all areas. The vessel must be stabilised on her location, and must have had at least 30 minutes to settle and build the mathematical model into the system. All pre- DP and pre-dive checklists must be complete and the status on board marked up. Warnings should be promulgated in the vessel and on the platform to inform that diving operation will need to comply with the permit-to-work system. The bridge team needs to apprise themselves of the number of divers in the water, their location, depth and work situation, particularly whether they are working on an open seabed or in a tightly constricted site. The number of the emergency transponders on the bell as well as on the ROV must be noted. All diving operations are hazardous, but some more so than others. Shallow water air diving from DP vessels is particularly difficult; the proximity of the thrusters, the amount of noise from thrusters and the strength of tide all providing problems which must be overcome. Sometimes diving operations may only take place at slack water, when the tidal rate is less than about 0,9 knots. Under these circumstances the in-water time is precious and the DP vessel must be fully prepared for each dive window

Diving is particularly hazardous in the vicinity of underwater mooring lines and anchor chains. Sometimes an anchored pipe lay barge is moving slowly ahead under the control of its anchor wires. Because these wires are moving it is not possible for a DSV'S to set up within the catenaries due to the hazard of fouling the bell cables on the mooring lines. It is necessary for the barge to stop before divers can be deployed on the stinger. Another particularly hazardous technique is Habitat diving. A Habitat is a compartment placed over a seabed operation, like an inverted shoebox. Gas is pumped into the habitat until the interior is

dewatered and dry. The divers enter the habitat, either by locking the bell directly onto it, or from the water, accessing from underneath. The habitat may be located on a joint in a pipeline needing welding. The divers once in the habitat can remove their diving suits and helmets and work in a dry environment. However, the operation is totally dependent upon the presence of the support vessel above. If this is a DP DSV'S, and she has a run-off then the habitat may be dragged with consequent major survivability problems for the divers.

f. Survey and ROV Operations

Sophisticated ROV's, not needing divers can carry out many underwater operations. The support vessels engaged in this work do not need to be so sophisticated since there is not usually human life at risk. Many of these vessels are of equipment class 1, often being conversions from other vessel types. Some are ex- freezer trawlers. Vessels of this type may perform a multitude of tasks from hydrographic survey, wreck investigation, underwater recovery, site survey pre-lay (pipe or cable), installation inspection and maintenance. Although the task itself may indicate a relatively non-hazardous job, it must be remembered that the location itself may imply considerable hazard. A location up-tide of a fixed installation or in the "blow-on" position may be highly dangerous for a non-redundant vessel.



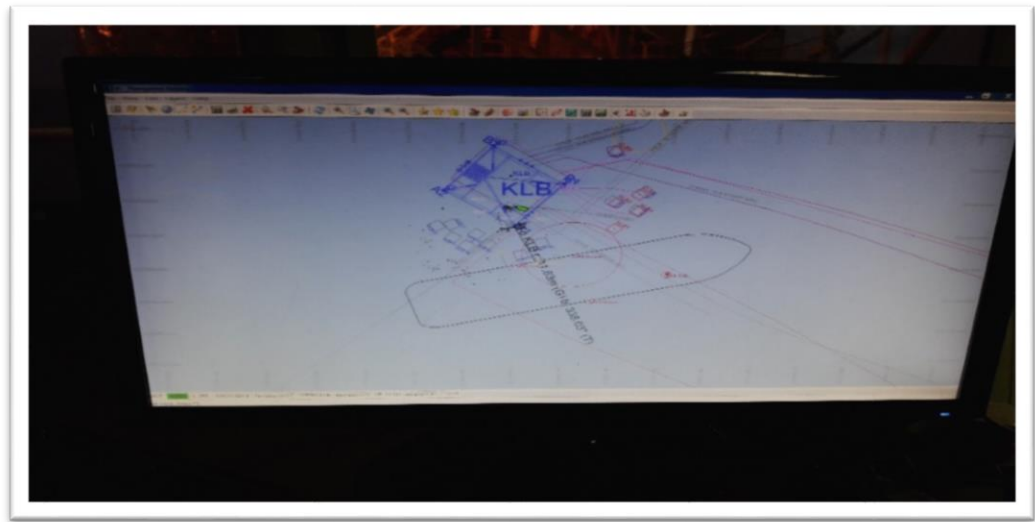


Figure 35. ROV Operations

g. Offshore Loading Operations

At many offshore oilfields, export crude oil is transhipped into shuttle tankers through bow loading manifolds from buoy mooring structures. In severe weather conditions the final approach to the buoy can be difficult, with a large tanker in ballast proving somewhat unmanageable. Also, once connections are made, heavy swell can put huge stresses in the mooring hawsers, necessitating break-off and waiting-on-weather. Utilising DP techniques modified to suit the offshore loading function may alleviate these problems. In a typical 2nd generation shuttle tanker has a small control room located at the bow, containing the DP system, position reference systems, together with engine controls, bow mooring control and monitoring systems, and bow loading control and instrumentation. Newer shuttle tankers do not have any bow control room, but everything is operated from the vessels bridge. Cameras are used to monitor hose and hawser at the bow. The DP system is often a non-redundant type such as the Albatross ADP 100 or ADP 701, but the latest built shuttle tankers are equipped with a redundant system such as the Kongsberg-Simrad ADP 702,

SDP 11/21 or Alstom ADP (former Cegelec). Many of the shuttle tanker built since the late 1990's are built as DP Class II equipped vessels. The Norwegian Petroleum Directorate requires tandem loadings from FPSO's/FSU's to be carried out by Class II shuttle tankers.

h. Single Point Mooring (SPM)

On approaching an SPM buoy, the vessel picks up the light messenger, then the main messenger in the normal way. DP can be engaged at any time once a position reference is available. Keeping the vessel head into wind, she is manoeuvred up to the buoy using thrusters and messenger. At a predetermined mooring distance from the buoy the hawser is secured and the DP put into mooring or weathervane mode, and the heading is set as the minimum power heading (optimum heading). The vessel then maintains a constant distance from the buoy with the hawser slack if required, maintaining a constantly calculated weathervane heading. Because the hawser can remain slack, the vessel can work too much more severe weather limits, increasing her annual productivity. As an alternative to a slack hawser, a propeller bias may be entered to maintain a pre-set hawser tension.

Position reference is usually obtained from an Artemis system, with the fixed station replaced by an Artemis beacon (since the buoy is not directionally stable), but the Relative GPS is also used for this type of operations



Figure 36. SPM Buoy

i. Offshore Loading System (OLS)

Offshore Loading Systems (OLS) involving shuttle tanker off take utilises a hawser less configuration. As the name implies, there is no hawser, the only connection between the vessel and the OLS being the loading hose. This simplifies both connection and breakaway procedures, and removes the need for the DP system to apply hawser tension compensation. No off take may take place on these systems unless the DP system and all connected equipment are fully functional.

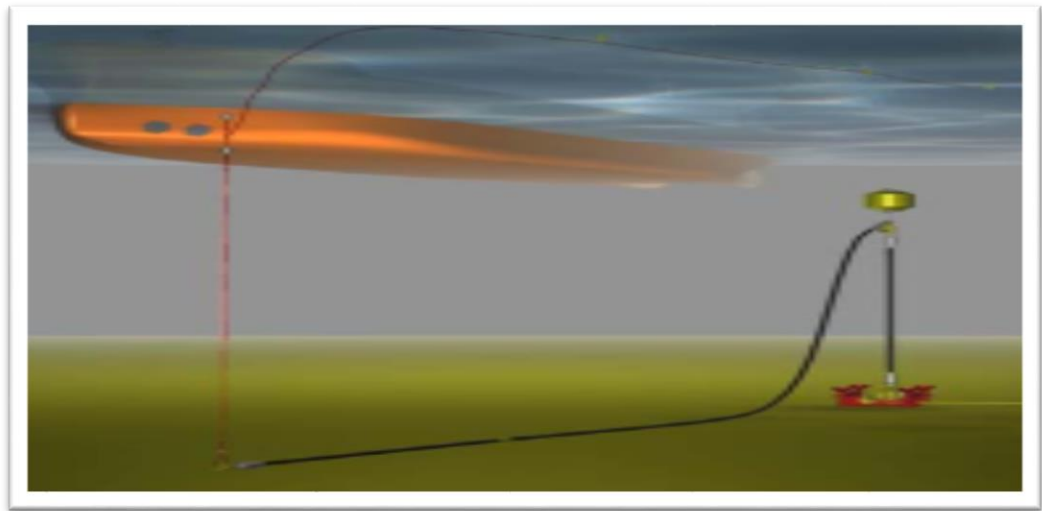


Figure 37. OLS

j. Offshore Loading Terminals (OLT's)

Many Offshore Loading Terminals (OLT's) are unmanned, with a number of control functions carried out by telemetry from the vessel. Among these functions will be turntable rotation, turntable locking, and valve and pump activation. The normal loading configuration has the OLT's turntable facing the vessel, with the vessel heading lined up to the OLT's, and at the correct predetermined distance. As the vessel weathervanes the OLT's turntable may be adjusted to remain facing the vessel. Any hose/turntable/vessel misalignment exceeding 20 degrees will initiate an alarm, as will the distance-off breaking pre-set limits. Emergency Shutdown and Disconnection (ESD) may be initiated by the DPO in two stages.

ESD 1 is an automatic shutdown of pumps followed by a closing of the valves. This may be initiated if the vessel reaches position and/or heading limits. ESD 2 involves disconnection of the hose and disconnection of the hawser.

k. Submerged Turret Loading

A new development in this area is the STL or Submerged Turret Loading configuration, in which a submerged buoy is connected to the seabed by an anchor spread. The buoy terminates the loading pipeline from the production platforms, and is fitted with HPR transponders for location. The shuttle tanker is fitted with arrangements for recovery and mating to the buoy under the fore body of the vessel, including underwater TV cameras for location. There are STL installations at the Heidrun and Harding fields today.

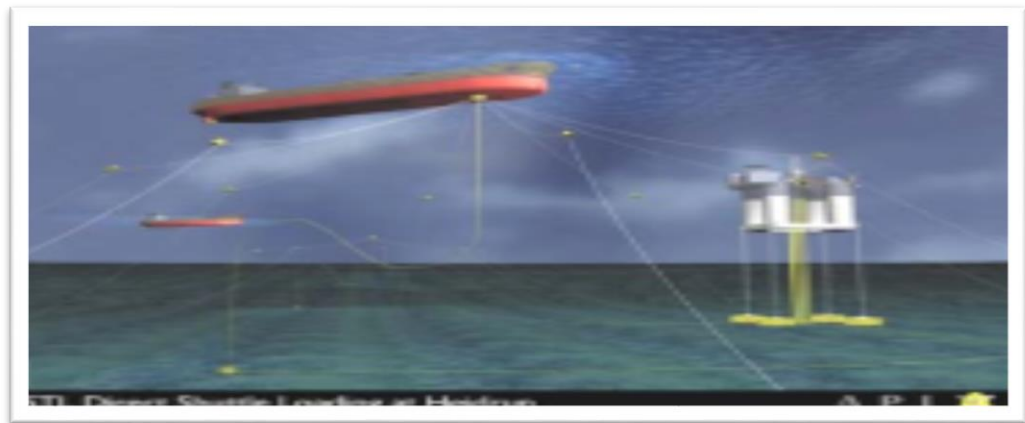


Figure 38. STL

Once connected, the vessel remains on location and can freely weathervane around the STL buoy. If the weather deteriorates the thrusters can be engaged and the DP activated to dampen the motion set up by the weather in all three axes. There will be a sheared positioning between the anchor spread and the DP system.

Examples of purpose built vessels for STL operations are "Navion Norvegia" and "Navion Europa" intended for use on the Heidrun field.

l. Floating Productions and Offtake Vessels (FPSO's)

The demand for oil has led to the need to produce from reservoirs hitherto deemed uneconomic due to the limited quantities of recoverable oil available. The demand for oil has led to the need to produce from reservoirs hitherto deemed uneconomic due to the limited quantities of recoverable oil available. The demand for oil has led to the need to produce from reservoirs hitherto deemed uneconomic due to the limited quantities of recoverable oil available. If it is not economic to build an expensive group of fixed production platforms and associated facilities, then the production facility may be conveniently built into a vessel, which may then be located on the site of the reservoir. The FPSO (Floating Production and off take Vessel) may be a mono hull or semi submersible, and positioned by means of an anchor spread, turret mooring or by using pure DP. Export of oil may be via pipeline to an OLT (Offshore Loading Terminal) where a shuttle tanker.



Figure 39. SPM Buoy

m. Pipe Laying

Pipe lay vessels are increasingly using DP techniques for positioning and tracking. Three methods are in use, S-lay, J-lay and Reel-lay. With S-lay the pipe

is constructed from 12m or 24m sections in a linear factory area at upper deck level, termed the “firing line”. A number of process stations each carry out one operation on the pipe fabrication, and the vessel moves forward in 12 m or 24 m steps. The pipe is supported over the stern on a heavy sloping gantry known as the “stinger”; it is vital that the pipe remains in tension. If tension is lost, then buckling will occur, either at the touchdown point on the seabed or at the point where the pipe curves onto the “stinger” from the “firing line”.

The DP system needs to be fully redundant, and equipped to provide pipe tension compensation. Sensors installed in the stinger measure the tension and feed this value back to the DP, which is able to apply immediate compensation. Position reference is usually provided by taut-wire and DGPS although Artemis, HPR and often SYLEDIS are fitted. In J-lay the pipe is raised to a near-vertical position before being welded onto the previous length. This vertical attitude is necessary when carrying out pipe lay operations in deep water. In Reel-lay the pipe is prefabricated ashore, and then coiled onto a large diameter vertical carousel, with a stringer used for laying.

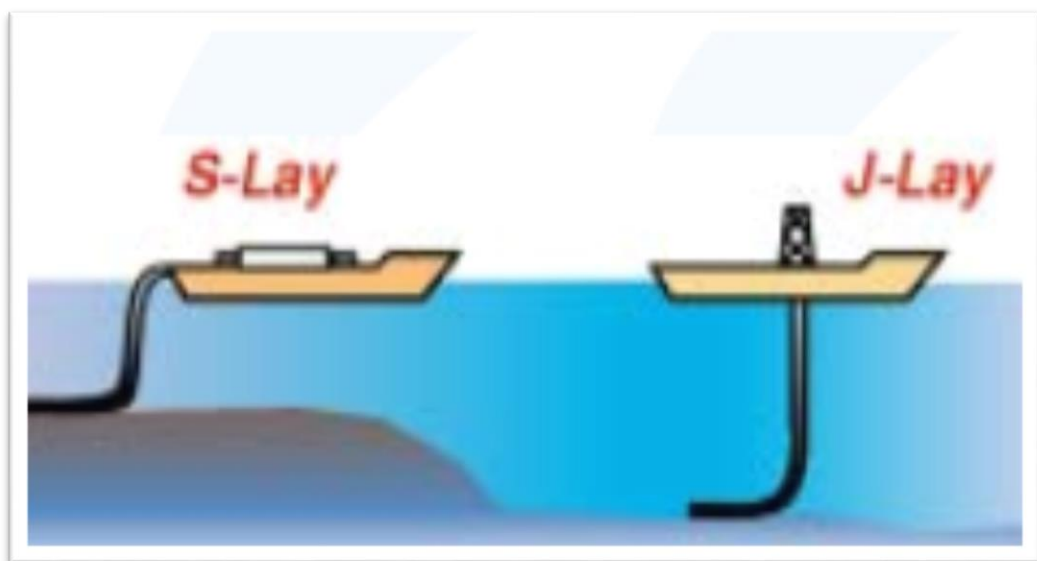




Figure 40. Pipe Lay

n. Trenching and Burying Operations

Vessels equipped to trench and bury the pipeline often accompany pipe lay vessels, such as "Lorelay". A seabed tracked Vehicle equipped with digging arms and water jetting carries out this operation. This tracked vehicle straddles the pipeline and moves slowly along excavating a trench under the pipe. Under the control of the trencher operators the trencher maintains a precise track over the top of the pipeline. As the trencher proceeds, the pipeline settles into the trench, ready to be covered at a later time. The vessel deploying the trencher is equipped with an A-frame or gantry at the stern. The vessel is positioned adjacent to the pipeline and the trencher is deployed. With the trencher held approx. 5m above the seabed, sonar units on the trencher assist in accurately locating and orientating the trencher onto the pipeline. The vessel will be on DP during this time, using DGPS, taut wire or HPR as position reference. The preferred heading during deployment is 90 degrees to the direction of the pipeline, with the stern of the vessel closest to the pipeline. Trencher deployment is then made simpler by adjusting the gantry/trolley extension; also, any yaw or

heading error does not cause trencher/pipeline misalignment. The heading of the vessel may be dictated by environmental circumstances; deployment headings other than the 90 degrees attitude described above needing greater care in positioning.

Once located onto the seabed, the trencher gets underway with the vessel maintaining station on it. The vessel may parallel the pipeline, or maintain a heading favourable to the environmental conditions. Position reference is now obtained from the trencher itself using HPR transponders or responders located on the trencher, and by “trim-cube”. The position of the trencher is maintained directly beneath the stern gantry, with the handling wire vertical. The trencher handling system is compensated for heave. Inclometers are fitted to the wires, which then give an output similar to the taut wire. This output is fed directly into the DP as a position reference such that the set point has the wires in the vertical position. Thus the DP is working with slowly moving rather than fixed position reference elements.

Having trenched a length of pipeline (a few kilometres) the trencher is recovered for inspection and servicing, and the vessel will track back to carry out a ROV survey of the trenching. The trencher is then configured for covering, tracking over the same ground, but now burying the pipeline using ploughshare devices. Pipelines may also need to be covered by mattress protection. This is laid using a handling frame specially designed for the purpose, deployed from the stern gantry. The frame contains lights and sonar transponders such that the pipeline may be accurately located. The frame can be rotated and translated using its own thrusters, allowing the mattress to be installed accurately. The above description applies to the Allseas vessel “Trenchsetter”, although other vessels carry out similar operations.

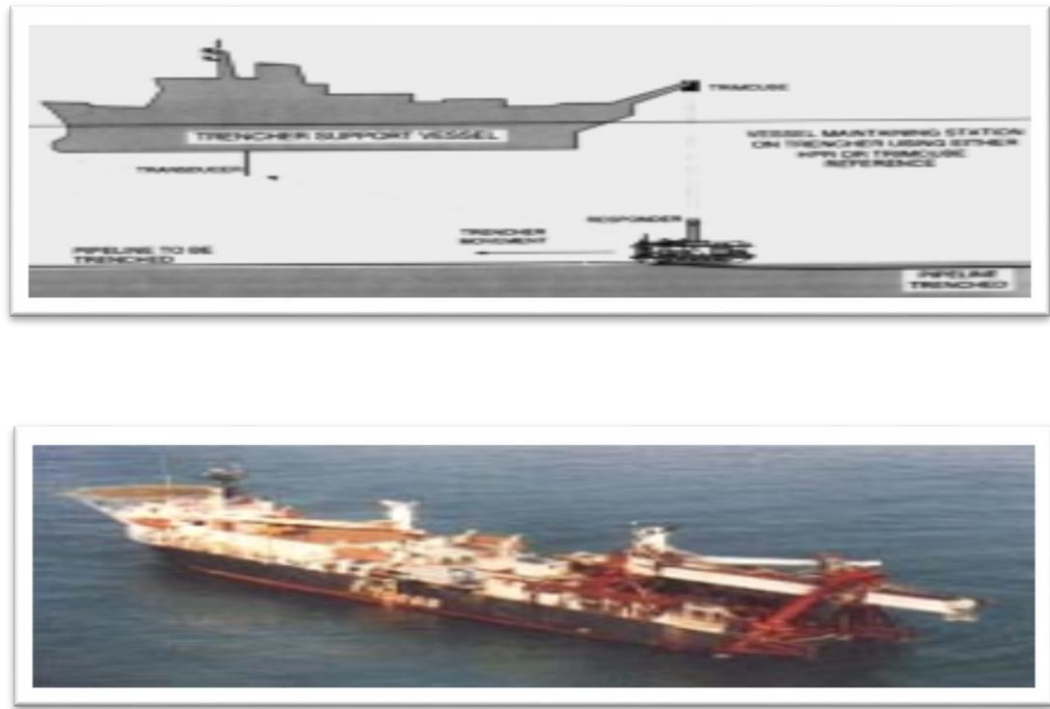


Figure 41. Trenching and Burying Operations

o. Cable and Repair Operations

All modern cable-lay vessels are DP- capable. Cable may be laid by plough or crawler vehicle. In the case of the former the vessel tows the plough by hawser and the plough trenches, lays and covers the cable all in one operation. Plough hawser tension is fed back to the DP system for direct compensation. The vessel may use Follow-Sub or Auto track techniques as appropriate. If the cable to be laid is a short one; (i.e. between two offshore platforms), then the cable may be handled by a seabed crawler vehicle, with no need to “tow” as with the plough technique.

Cable repair operations may involve lengthily search patterns being conducted, then a period on DP in deep water away from the land while the cable is being repaired. The use of DGPS as a position reference is valuable. DP also serves to position the vessel when carrying out a shore-end connection. Since this is often

done in shallow water there may be a problem obtaining position reference. Again, DGPS serves as a valuable PRS here.

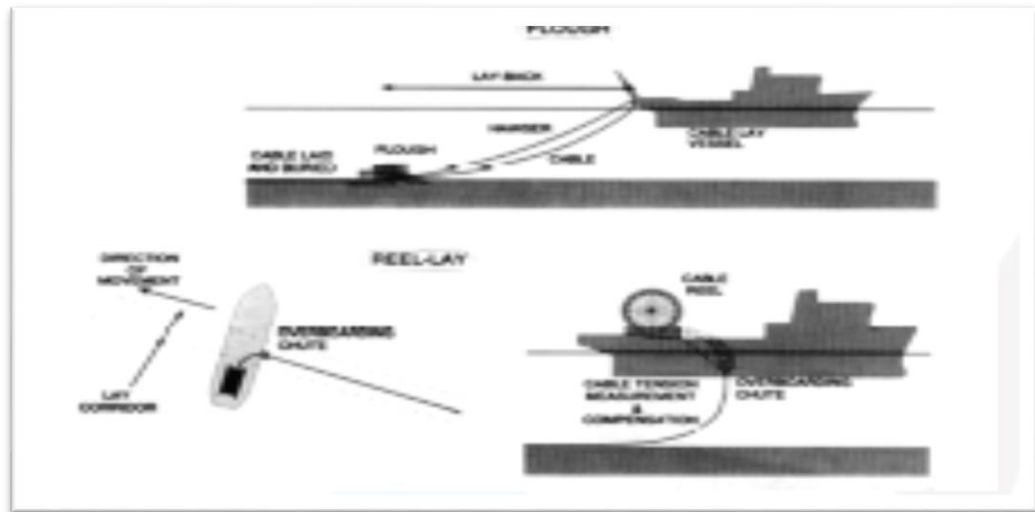


Figure 42. Cable and Rapair Operation

p. Dredging Operations

Dredging, both for the purposes of aggregate recovery or channel and harbour maintenance are a function utilising DP techniques. Dredging often requires precision manoeuvring and station keeping, and DP is being increasingly used for this. A trailing suction dredger may employ one or two drag heads, and these may be provided with sensors to measure drag head force and azimuth. These values are fed back to the DP such that full position compensation is provided. Dredgers are normally operated using an Auto track facility.

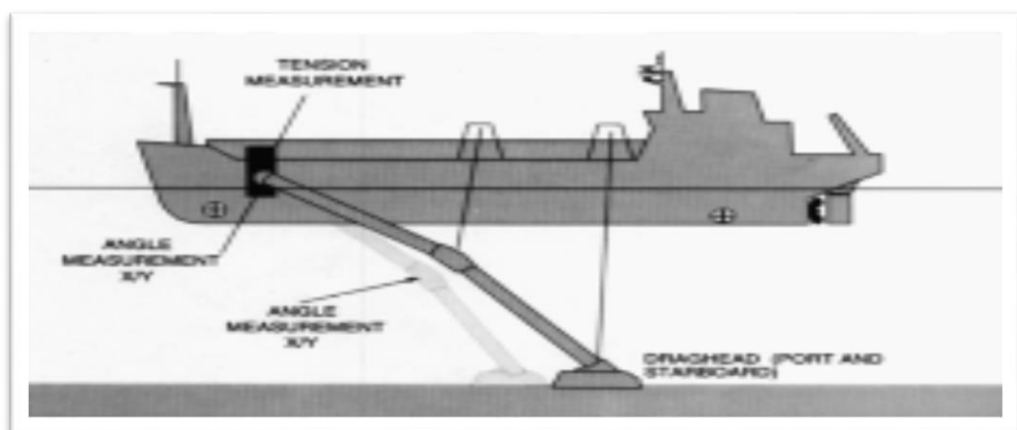


Figure 43. Dredging Operations

q. Rock Dumping Operations

A small group of specialist vessels are equipped to carry out rock dumping operations in order to bury pipelines to protect them from trawl and anchor damage. These vessels are usually small bulk carriers equipped with self-unloading facilities. A flexible, chain lattice fall pipe is deployed from the vessel, hanging vertically below the ship. The bottom of the fall pipe is equipped with an ROV with thrusters for precise location of the rock discharge. The rock falls through the centre of the ROV. Vessels of this type use DP in the normal manner, maintaining track using an Auto track facility, with position reference often from DGPS. A track compensation facility is sometimes provided, such that the whole track may be laterally translated a number of metres, input by the operator, to allow for errors in the initial track location. In areas of strong tidal flow, problems of erosion may adversely affect fixed structures. If not rectified, scouring of seabed material from around the legs of a jacket may cause the platform to become unstable. Some small vessels are employed to dump stone accurately around the legs of platforms. These vessels carry the load on hydraulic platforms on deck, which are tipped to discharge the stone (similar to a tipper lorry). To be effective the vessel must be located within only a few metres of the leg, requiring precision DP, and ideal environmental conditions. Rock Dumping vessels always work in a “low – off location (downwind of the tructure), as they are all non – redundant vessels.



Figure 44. Rock Dumping Operations

r. **Crane Barge**

A small number of ultra heavy- lift crane barges are equipped with DP. Examples are Saipem 7000 and McDermott's Derrick Barge 101 (DB101). The former is equipped with two 7000 tonne capacity cranes which can be coupled in tandem to lift 14000 tons, while the latter has one 2700 tonne crane. Vessels of this type are used for installation of large modules offshore. Of semi submersible construction, the vessels are very large when ballasted down to their operational draught, and DP plays a large part in their operational capability. Fully redundant to equipment class 3, a barge of this type can set up on DP very quickly, carry out the lifts required, and vacate the worksite all inside a few hours. Eliminating the lengthy time required to lay and recover anchors means that vessels of this type can carry out a major operation during the winter months. Usually, anchors are deployed away from the structure, on slack wires, such that if the DP gives a problem, then the mooring wires can be rapidly tensioned up, preventing the crane barge from running into the platform. Often the crane barge dwarfs the platform it is working on. Vessels of this type may be fitted with a draught compensation facility, whereby draught sensors input data to the DP system enabling an updated vessel mass to be computed and used. This form of compensation may also be found in shuttle tankers, floating production vessels and other types where the draught may be subject to rapid changes.



Figure 45. Crane Barge

s. Offshore Drilling Operations

Deepwater drilling is a well-established application involving DP techniques. A great number of drilling ships both mono hull and semi-submersible use DP for station keeping over the wellhead, although in shallower waters they have the ability to position using a spread mooring.

A DP drill ship may use any position reference system, and will often use multiple position references for redundancy purposes. Often HPR is the prime PR system, or taut wire. A series of Russian mono hull drill ships built in Finland utilise HPR and a moon pool taut wire. Being located in a moon pool the taut wire is not subject to interference from surface ice.

Some drill ship DP systems utilise a “Riser Angle Mode” facility. The drill ship is connected to the seabed wellhead by means of a marine riser, containing the drill string. It is essential that the lower end of the riser remains vertical at the wellhead ball joint, with a maximum ball joint angle of around three degrees. This means that the vessel must remain within a circular area the radius of which will depend upon the water depth. The DP console will display the set point, around which is shown a “watch circle” of radius percentage of water depth, equivalent to the 3 degrees ball joint angle limit. In deep water however, compensation arises due to tidal forces. The riser will bow down tide resulting in a ball joint angle. The drill ship must be shifted up tide until the angle again is zero. Riser angle is sensed by Inclinator Transponders attached to the riser transmitting acoustic signals for position reference and ball joint angle. Inclination sensors transmitting angular data may also sense Angle electrically by hard line along the riser. Riser angle data is used by the DP to compute a new

set point position for the ship in order to reduce riser angle to zero. Additional position reference transponders may be deployed on the seabed. Alternatively, position reference may be obtained from DGPS.



Figure 46. Offshore Drilling Operations

t. Offshore Supply Operations

Until a few years ago, the operation of offshore supply vessels alongside platforms were mainly performed by using a joystick with possibilities to lock the heading. Today, most of the supply vessels utilize the DP technology to the full extent. Some oil companies require DP Class II for their chartered supply vessels. One peculiar situation occurred as offshore supply vessels converted to DP operations. The number of collisions with platform legs rose to an alarming number, to great concern for the oil companies. The reasons for this rise may be multiple, however, lack of training and experience springs to mind as one of the reasons.



Figure 47. Offshore Supply Operations

B. Framework for Thinking

For these description about The Current and Wind effect when making on good Escape Heading, so I need for among focus with special data – data from own implementation when practised on board during the vessel on operation. It's mean own vessel was on DP Class 2 and many operation as like as ROV operation, Diving Operation and Supply vessel and also for standby vessel, and for the next step I would like to take the conclusion.

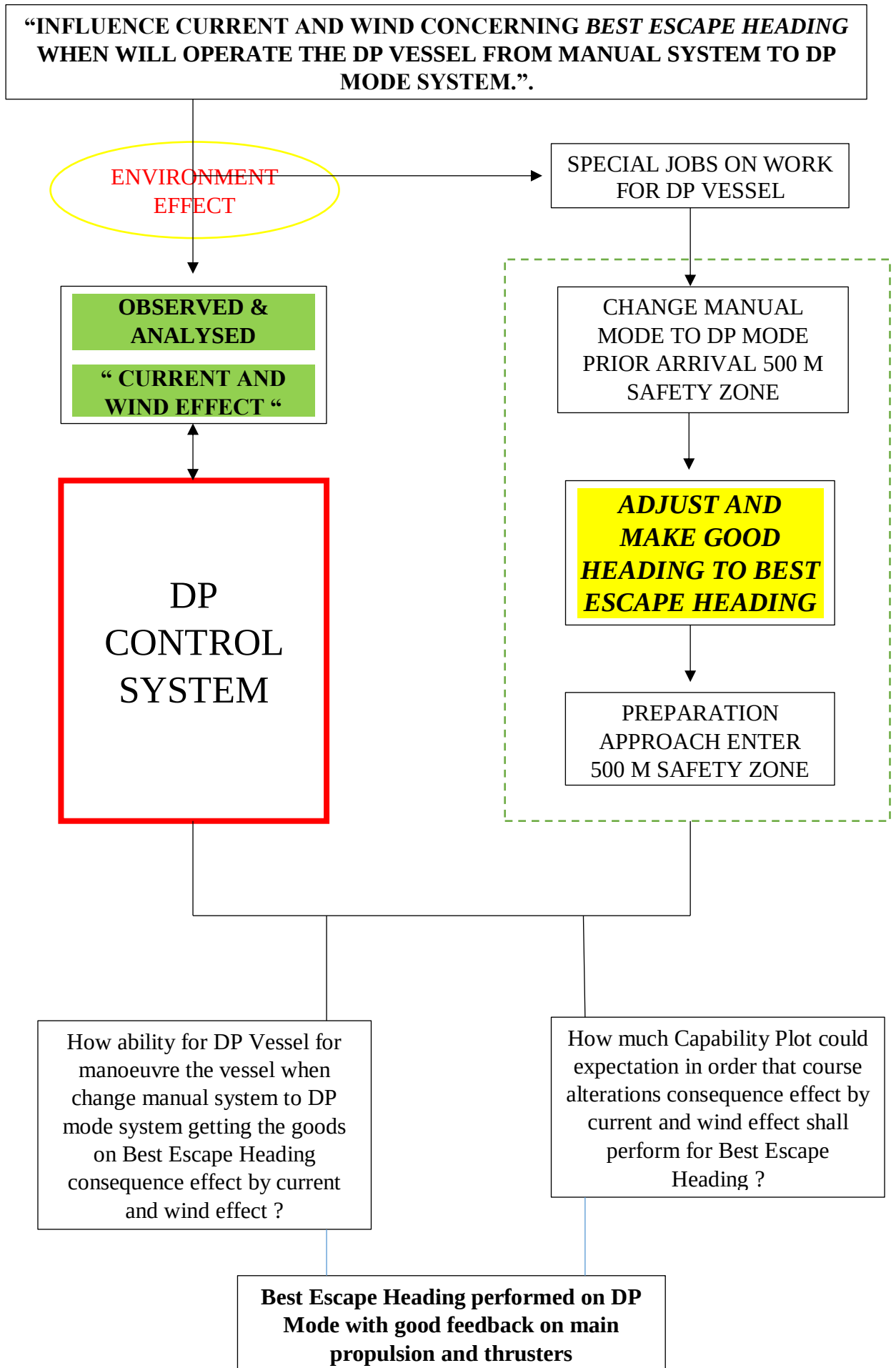
Based on the theory was explained on current and wind effect as a reason that could impact change of heading to make a good heading and become best

heading when making Good Escape Heading, and to be attention for every DPO when adjusting the DP vessel prior entering 500 metre safety zone.

To improve the safety aspect, so calculation, observation and analyse of effect the current and wind factor should be make clearly when approaching the 500 metre safety zone and also how to make the DP vessel could be bring on safety operation because it's recommended every DP vessel. On an appraisal to be attention the DP vessel as like as own DP vessel on class 2 DP Vessel, should follow the step by step from the manual mode to auto mode on DP mode.

Regarding that matter, on my own experienced on SMS. Supporter and SMS. Serenity on DP Vessel Class 2 and WM.Makassar , I was observed that preparation should be taken on proper and follow the procedure, also for the DP Check list should be in good arrangement and preparation to counter any failure step or phase.

On scheme investigation own this researched, writer can show on this underneath diagram:



C. Operational Definition

DP	Dynamic positioning: automatic control of vessel's position and heading by the use of thrusters with respect to one or more position references. May also be used to mean dynamically positioned.
DP System	All equipment that supports automatic position keeping control.
DP Control Location	Permanently manned location(s) on board a DP vessel or unit where the DPO is able to monitor the performance of the DP system and where the DPO is able to interface with the DP system, intervening as necessary.
DP Control System	The part of the DP system that calculates position and provides thruster commands.
DP Vessel	Dynamically positioned vessel
DPO	Operator of the DP control system
Abandon dive	On a DSV an equivalent to red alert instructing dive control to recall the divers to the bell immediately and to bring the bell to the surface.
Advisory	DP operational status; failure of redundant equipment. This is mainly used aboard drilling vessels.
Artemis	Radio system used to measure vessel's position. System operates using a microwave frequency and measures the range and bearing of the vessel from a fixed station that is usually installed on a platform.

Back up DP	A DP control system, physically separate from the main DP control system that will be available in the event of a total failure of the main system.
Beacon	Acoustic pulse generating device on the seabed or structure whose signals are repeated at a regular interval and used by HPR to establish the vessel's position.
Blackout	Loss of all main electrical power to thrusters or DP control system. Loss of electrical power that prevents the DP control system operating is known as DP Blackout.
BOP	Blow-out preventer: Blackout prevention.
Capability plot	A theoretical polar plot of the vessel's capability for particular conditions of wind, waves and current from different directions. These can be determined for different thruster combinations and should be produced in accordance with IMCA M 140 – <i>Specification for DP capability plots</i> .
CCTV Closed	circuit television.
Common failure mode	A failure which affects two or more similar items of equipment which are essential for redundancy.
Controlled disconnection	Release in a planned and controlled manner of all physical connections linking the vessels/units involved in two-vessel operations and their physical separation.

DGPS	GPS plus a differential correction supplied by one or more receivers at a known fixed location, to increase the accuracy of the position fix.
DP	Dynamic positioning: automatic control of vessel's position and heading by the use of thrusters with respect to one or more position references. May also be used to mean dynamically positioned.
DP control location	Permanently manned location(s) on board a DP vessel or unit where the DPO is able to monitor the performance of the DP system and where the DPO is able to interface with the DP system, intervening as necessary.
DP hazard observation	Set of circumstances identified which have had the potential to escalate to 'near-miss' status or more serious.
DP class notation	Notation used by classification societies, such as Det Norske Veritas (DNV), for DP vessels based upon IMO equipment class principles.
DP control system	The part of the DP system that calculates position and provides thruster commands.
DP downtime	Position keeping instability, loss of redundancy which would not warrant either a red or yellow alert, however loss of confidence has resulted in a stand down from operational status for investigation, rectifications, trials etc.

DP incident	Loss of automatic control, loss of position or any incident which has resulted in or should have resulted in a red alert.
DP near-miss	Occurrence which has had a detrimental effect on DP performance, reliability or redundancy but has not escalated into ‘DP incident’, ‘undesired event’ or ‘downtime’.
DP system	All equipment that supports automatic position keeping control.
DP undesired event	Loss of position or other event which is unexpected/uncontrolled and has resulted in or should have resulted in a yellow alert.
DP vessel	Dynamically positioned vessel.
DPO	Operator of the DP control system.
DSV	Diving support vessel: a vessel from which divers are deployed.
Duplex DP	DP control system with full redundancy including smooth automatic changeover between the two DP control systems.
EDS	Emergency Disconnect Sequence.
Emergency disconnection	Unscheduled rapid shutdown and release of all physical connections to enable separation of vessels/units.
Equipment class	Classification outlined in IMO MSC Circ.645 for the equipment capability of DP vessels defined by their worst case failure modes.

FMEA	Failure mode and effects analysis.
Footprint	A graphic illustration of a set of real observations of a vessel's DP station keeping ability in particular environmental conditions.
GPS	Global positioning system using satellites to establish a vessel's position, e.g. Navstar or GLONASS.
GPS relative	Differential and relative position system (note DGPS is used generally in this document but the same principles apply both for dual DGPS as dual DARPS or dual GPS).
Green status	Normal operational status; adequate DP equipment is on line to meet the required performance within the declared safe working limits.
HPR	Any hydro acoustic position reference system.
I/O	Input/output.
Independent joystick	A joystick that is independent of the DP control system.
Joystick	Positioning facility that uses a single lever for surge, sway and yaw control
Laser-based system	Positioning and tracking system, such as Fanbeam and Cyscan, measuring distance and angle using reflected pulsed laser light Limit alarms Selectable values for position and heading excursions at which points an alarm will activate.
Loss of position	Movement(s) of vessel and/or unit from the intended or target position.

Manual control	Use of individual thruster controls or joystick with or without automatic heading control.
Operator	Any member of the vessel's complement involved with DP equipment for example DPO, master, duty engineer, chief engineer, electrician, taut wire operator, radio operator. This can also mean the organisation which operates vessels on behalf of the owners.
Permit to work	Authority to carry out certain operations under a system whereby these permits are approved and issued for a specific period of time and work during which the work would normally be completed.
Platform	Any structure that is fixed relative to the DP vessel.
Plough	Towed unit generally used to bury cables.
Pseudo	Prefix used when a position measurement system is interfaced to a DP control system as another position reference.
Radar-based system	Position reference system based on the measurement of radar signals reflected from passive transponders e.g. Radascan, RADius.
Radio position reference	Any position reference that transmits radio waves through the air for example Microfix, Syledis.
Red alert	DP emergency status: Position and/or heading loss have happened or are inevitable.
Redundancy	The ability of a component or system to maintain or restore its function, when a single failure has

occurred.

Redundancy can be achieved, for instance, by installation of multiple components, systems or alternate means of performing a function.

Responder

A transponder in which the interrogation is by an electronic pulse sent down a cable. This is generally fitted to an ROV and interrogated down the ROV's umbilical.

ROV

Remotely operated vehicle that operates subsea.

Safe working limits

The environmental limits that a vessel or company sets for safely working on DP taking into account specified equipment failures and limitations imposed by the current worksite.

Shallow water

A depth of water in which, depending upon the work Being undertaken by the DP vessel, further considerations may be necessary.

SIMOPS

Simultaneous operations.

Simplex DP

DP control system with no redundancy.

Taut wire

Position reference using a tensioned wire vertically to a seabed weight or horizontally to an external fixed object nearby.

Thruster

Any propulsion device used by the DP control system.

Transponder

Device on the seabed that responds to acoustic interrogation from the HPR on the vessel and gives vessel relative position.

Trencher

Subsea vehicle used for pipe or control line burial.

Triplex DP	Triple DP control system that is able to vote and reject one of the three systems if it is faulty.
Umbilical	Connection carrying life support and communication systems between a support vessel and a diving bell, an ROV or similar device (also diver's umbilical between diver and bell).
UPS	Uninterruptible power supply – unit to provide electricity continuously to DP control system in the event of a blackout of the vessel's main power.
Worst case failure	The worst case failure of a DP system is the failure that has been the basis of the design and proved by the FMEA. This usually relates to a number of thrusters and generators that can simultaneously fail and that are used in consequence analysis.
WSOG	Well specific operating guidelines.
Yellow alert	Degraded DP status for which the DP vessel has a pre-planned response to prepare for the risks associated with a DP red alert.

CHAPTER III

RESEARCH METHODS

A. Time and Location of Research

Research executed by writer on board that were on SMS.SUPPORTER, SMS.SERENITY and WM.MAKASSAR. That vessel is 2 AHTS DP Vessel class 2, and PSV DP Vessel class 2 and writer conducted of this research about **“INFLUENCE CURRENT AND WIND CONCERNING *BEST ESCAPE HEADING WHEN WILL OPERATE THE DP VESSEL FROM MANUAL SYSTEM TO DP MODE SYSTEM*”**.

I was started research on board since 20th August 2018 until 25th September 2019, and I was taken experience with various situation and condition as per frame work of the vessel. The 1st Vessel , I was on board with SMS. Supporter and job work ROV and Diving Operation on PHE – ONWJ Java Sea Area. The 2nd Vessel , I was joint on board with SMS. Serenity and job work running cargo operation on Bintuni Bay, Sorong Papua. The 3rd Vessel , I was joint with WM. Makassar and job work for drilling on PHM Balikpapan area. The 4th Vessel , I was back again with SMS. Supporter and job work ROV and Diving Operation on PHE – ONWJ Java Sea area. And the last Vessel on WM.Makassar for fulfilment requirement for SDPO and job working for running cargo on a few days, and area operation on PHE – ONWJ Java Sea Area.

B. Type of Research Method

Research methode used by writer in submitting problem is descriptive qualitative to depict and eloborate the accurate object. As for such by descrptif according to Moleong (2002:6) here word collected by the form of words, draw and non number - number. Research report will contain the citations data to give the picture of report presentation, the data possible come from copy interview, field note, photo, personal document, note or memo, and other formal document. Become the descriptive method is containing article presentation, breakdown of and clarification about an object as it is periodically and do not take the conclusion

going into effect in general. Therefore in solution wait the out for writer of explained of the result from all obtained research and study, that goodness directly from writer experience as well as research from book literature.

Beside that writer perform the research with the approach of problem of observational, where conducted by observation of concerning research title which writer compile. As for matter which in perceiving is : *How ability for DP Vessel for maneuver the vessel when change manual system to DP mode system getting the goods on Best Escape Heading consequence effect by current and wind effect and How much Rate of Turn (ROT) could expectation in order that course alterations consequence effect by current and wind effect shall perform for Best Escape Heading.*

C. Required Data

In shipping and ship operations when using the DP console to serve charters and ensure all operational operations run well and smoothly, of course, here the data must be written down and recorded either manually or direct print. The operation of ships using special vessels such as DP class II ships experienced by researchers on ships owned by Wintermar Indonesia, of course, a lot of data - data used to support the smooth operation and operation of ships that have been chartered by charters. Official data or non-official data has been updated and used for its operation. General data such as other non-DP vessels such as log books, but for DP vessels there are some significant and different data on other vessels, such as DP Foot Print, DP Consequence Analysis, or data daily print from the DP Console. And other data sources to support the smooth operation of ships such as weather news via email sent by the client or charters. The supporting data is a source of reference for researchers to facilitate problem solving. The supporting data from researchers will be collected and analyzed.

. Previously, researchers will review the understanding of data summarized from various sources. This section will cite the understanding of data from different points of view.

1. According to various English-Indonesian dictionaries, data is translated as a term derived from the word "datum" which means facts or information material.
2. Data is everything that is presented in textual form or in the form of a description of words, in the form of graphics in the form of pictures or paintings, or in the form of tables in the form of a grouped arrangement.

From this understanding in writing the researcher collects data, facts and other information that explains the events experienced by the author while on the ship.

In this study provides a variety of qualitative data sourced from respondents, both verbally and in writing relating to the object that the author studied. Various kinds of data sources that the authors use when preparing a thesis are as follows:

1. Primary Data

Primary data is data obtained directly from the source, through data collection procedures and techniques, both individuals and groups :

- a). Data direct print out DP Console
- b). Data FMEA
- c). Data e-mail pencharter
- d). Data CAMO –ASOG
- e). Data Abstract DP log Book
- f). Data Log Book
- g). Nautical Publication
- h). Nautical Chart
- i). IMCA Publication

2. Secondary Data

Secondary data is data obtained indirectly. In order to obtain a complete, complete and comprehensive picture, in addition to the primary data, additional data are needed, namely secondary data. So secondary data is supporting and completing primary data. These archives or data are obtained from books on the ship that are related to the object under study.

D. Method of Collecting Data

To take data which I need, I just collect from the direct data when actual DP mode, as like as take picture, scanned data, copied data and copied from soft data from DP maker (Kongsberg and Converteam).

E. Technic of Data Analyse

Data Analysis Technique is a method or way to process a data into information so that the characteristics of the data become easy to understand and also useful for finding solutions to problems, which are mainly problems that are about a study. Or data analysis can also be interpreted as activities undertaken to change the data from the results of a study into information that can later be used to draw a conclusion.

In conducting qualitative research data analysis techniques obtained from various sources and using various data collection techniques (triangulation), and also carried out continuously,

According to Sugiyono the qualitative research method is a research method based on the philosophy of positivism, which is used to examine the natural conditions of objects, (as opposed to experiments) in which the researcher is a key instrument, from the sampling of data sources conducted by purposive and snowbaal, triangulation collection techniques, data analysis that is inductive or qualitative,

and the results of qualitative research more emphasis on the meaning of generalization.

CHAPTER IV

ANALYZE THE RESULT OF RESEARCH AND DISCUSSION

A. Overview of Research Objects

With this chapter that is hitting problem solution studying about analysis of data and data processing from research result which writer compile, pursuant to existing fact is field, this matter concerning about this research writing title. Writer will explain to the research pickings from existing fact, at the time of writer conducted the research on board about **“INFLUENCE CURRENT AND WIND CONCERNING *BEST ESCAPE HEADING* WHEN WILL OPERATE THE DP VESSEL FROM MANUAL SYSTEM TO DP MODE SYSTEM”**.

From perception and writer research on board the problem faced, especially about problem of research writing which writer compile. As for problems from this research is Best Escape Heading performed on DP Mode with good feedback on main propulsion and thrusters and also for impact the DPO could be carefully bring the DP vessel which in good performance.

1. General Description of My Experience on board with DP Class 2 Vessel, among other things could explained the Ship's Particular of The DP Class 2 Vessel SMS. SUPPORTER, SMS.SERENITY and WM.MAKASSAR.

a. SMS. SUPPORTER

AHTS DP2 VESSEL

Multi role construction support vessel

DP Class 2 multi role vessel for cable repair and maintenance, subsea recovery and installation, geophysical survey works & ROV constructions & IMR activities.



SMS SUPPORTER

AHTS DP 2 VESSEL

MULTI-ROLE CONSTRUCTION SUPPORT VESSEL

DP2 – Multi Role Vessel for cable repair and maintenance, subsea recovery and installation, Geophysical survey works & ROV construction support and IMR activities

GENERAL :

Vessel Type	Multi-Role Construction Support Vessel
Flag	Indonesia
Port of Registry	Jakarta
Year Built	2005
IMO / Call Sign	9336555
Class	ABS A1 (E), Towing Vessel, FIFI 1, +AMS, DPS-2
Maximum Speed	14.0 knots
Cruising Speed	12.0 knots
Economical Speed	10.0 knots

PRINCIPLE DIMENSIONS :

Length Overall	70.05 m
Length B.P.	63.00 m
Beam	14.95 m
Depth	6.10 m
Draft Max	4.95 m
Gross Tonnage	1951 Tons
Deadweight	800 tons (Approx)

PROPULSION :

Engine	5500 BHP 2 x 2750 BHP Wartsilla with Controllable Pitch Propellers
Bow Thrusters	2 x 515 kW
Stern Thrusters	1 x 515 kW
Shaft Generator	2 x 1228 kW, 440, 60 Hz
Auxiliary	2 x 370 kW, 440, 60 Hz
Emergency Genset	60 kW, 440, 60 Hz

CAPACITY :

Clear deck area	38.0 m x 12.51 m = 475 m ²
Ballast	460 m ³
Liquid mud	610 m ³
Lube Oil	11.8 m ³
Dry Bulk	4 x 50 m ³
Hydraulic Oil	6 m ³
Oily Bilge	6 m ³
Dirty Oil	6 m ³
Foam	13.2 m ³
Dispersant	13.2 m ³
Gas Oil	800 t (Approx)
Fresh Water	430 t (Approx)
Freezer	18.60 m ³ at -18 °C
Chill Room	15.43 m ³ at + 4 °C

DISCHARGE RATES :

Drill Water	100 m ³ / hr
Fresh Water	100 m ³ / hr
Fuel Oil	100 m ³ / hr
Liquid mud	100 m ³ / hr
Dry Bulk (free air)	20.2 m ³ / min

ACCOMMODATION :

4 Single bed cabins	4 Beds
3 Two bed cabins	6 Beds
8 Four bed cabins	32 Beds
1 Single bed hospital	1 Beds
	Total 42 Beds



SMS SUPPORTER

AHTS DP 2 VESSEL

MULTI-ROLE CONSTRUCTION SUPPORT VESSEL

DP2 – Multi Role Vessel for cable repair and maintenance, subsea recovery and installation, Geophysical survey works & ROV construction support and IMR activities

DP SYSTEM :

Main engine and all thrusters are remote controlled via Kongsberg SDP-21 DP system. HiPap 500, Radius 1000, 2 x VERIPOS ULTRA DGPS Ref.

NAVIGATION AND COMMUNICATION EQUIPMENT:

2 X radars, 3 x gyros (C-Plath Navigation Mk1), Echo-sounder, autopilot, SSB and VHF marine radio, Satellite Sat-Com C (Telex)

TOWING AND ANCHOR HANDLING:

Winch Model	Rolls Royce Brattvaag Elec/Hyd
Winch BL First Layer	225 mt
Type Line Pull	2 Drum Waterfall 150 mt
Winch Wire Capacity	52mm x 1200m each drum
Bollard Pull	72.2 mt continuous
Shark Jaw	1 X Karmfork
Stern Roller	250 mt; 1.6m dia x 3.5m wide
Storage Reel	Elec/Hyd 5 mt, 52mm x 1200m
Towing Pins	0-20m/pm
	2 x karmoy hyd.w/locking flaps, 300mt
Tugger Winches	2 x 10 mt elec/hyd; 0-19m/pm
Capstans	2 x 5.2 mt elec/hyd; 400mm; 0-19m/pm
Anchor	2 x 1590 kg bow anchors with 440m of 38 mm chain each
Anchor Windlass	Rolls Royce 17.3MT @8.5m/min 3.4 T @ 30 m/min

SPECIAL EQUIPMENT:

External FiFi	ABS FiFi-1, 2 x SKUM Monitors, one w/foam
FiFi Pump	2 x 1500 m3/hr x 135 m head
Discharge Meters	Fresh Water and Fuel; with printer
Container / Deck Power	1x63Ax440Vx3PHx60Hz, 2x32Ax440Vx3PHx60Hz, 1x32Ax220Vx1PHx60 Hz
Desalination Plant	10m3 / day
Sewage Treatment Plant	Available
Survival Craft	6 x 25 person inflatable life rafts
Rescue Boat	DSB 3.9SR, semi rigid; 6 person; 40 HP w/davit

CONSUMPTION:

Maximum Speed	20.9 t/day
Economical Speed	9.5 t/day
DP mode	8 t/day
Standby Mode	1 t/day

b. SMS. SERENITY

SMS SERENITY



6,000 BHP / DP2 / AHTS Call Sign: PLMB

Principal Particulars:

Flag : Indonesia
Year Built : 2015
Place Built : Yuxin Engineering, China
Length Overall : 65.0 m
Length B.P. : 58.50 m
Beam Moulded : 16.00 m
Depth Moulded : 6.20 m
Design Draft : 5.00 m
Scantling Draft : 5.20 m
IMO No. / GT - NRT : 9693862 / 2237 – 671 T
Official No. : 2015 Pst No. 8910/L

Classification:

ABS +A1(E) OFFSHORE SUPPORT VESSEL, (SUPPLY-HNLS, AH, TOW, FFV 1) SPS + AMS + DPS-2

Capacities:

Gross Tonnage : 2237 tons
Net Tonnage : 672 tons
Deadweight : 1500 tons
Fuel Tank : 572.4 m³ @ 100%
Potable Water : 361.4 m³ @ 100%
Ballast/Drill Water : 717.9 m³ @ 100%
Mud/Brine Tank : 386.1 m³ @ 100%
Dry Bulk : 170.0 m³ in 4 tanks
Deck Cargo Area : 435 m²
Deck Cargo : 600 tons
Cargo Deck Load : 7 T/ m²
Reefer Points : 4 (2x440v, 2x220v)

Fuel:

Quality of Fuel : MDO

Discharging Rates:

Drill Water/Pump : 100 m³ / hrs @ 70 m
Fresh Water/Pump : 100 m³ / hrs @ 70 m
Fuel/Pump : 150 m³ / hrs @ 70 m
Brine/Pump : 70 m³ / hrs @ 70 m
Liquid mud/Pump : 70 m³ / hrs @ 70 m
Flow Meter Printer : FO,FW, & BO

Bulk Plant:

170.0 m³ in 4 tanks
Working pressure 6 bar; Refrigeration Air Dryer units

Accommodation:

Officer/Crew : 16
Berth Total : 50
Cabins Total : 21
Hospital : 1
Air conditional throughout

Machinery & Equipment:

Main Engines : 2 x NIGATA/ 6MG-28AHX, 2206 Kw (2958HP) 800 Rpm
Generators : 3 x CATERPILLAR/ C18ACERT, 660 BHP (492 BkW) 1500 Rpm
Emergency Gen. : 1 x VOLVO/ D7AT, 99 Kw/ 1500 Rpm
Propellers : 2 x CPP/ KH-680, dia 2650 mm 4 Blade
Bow Thruster : 2 x KAWASAKI/ KT-72B3, 515 Kw/ 475 Rpm
Stern Thruster : 1 x KAWASAKI/ KT-72B3, 515 Kw/ 475 Rpm
Deck Crane : 2 T Knuckle Boom @ 15m radius (mounted on stbd side aft of accom)

Tow/Anchor-handling Equipment:

Tow/AH Winch : 1 x MACGREGOR/ MG-AHTW-1525U10056-7676, 150T x 0-6 m/min (1st speed) dia 56 mm x 1000 m, Brake Holding 250 T (static 1st Layer).
Hyd. Storage Reel : 1 x 5 T @ 0-20 m/min 1000 m x 56 mm
Tugger Winch : 2 x 10T each @ 15 m/min
Shark Jaw : 1 x MACGREGOR/ MG-STA-250-S, SWL 200 tons
Tow Pin : SWL 200 tons
Capstans : 2 x 10T @ 15 m/min
Stern Roller : dia 1800 mm x L 5000 mm
Grapnel Hook : 1 x 110 MT
Buoy Catcher : 7.48 MT
J Hook : 1 x 110 tons
Anchor Chain : 2 x dia 38 mm (467.5 m), Port = 220 m, Stbd = 247.5 m

Towing / AH Wires:

Main Tow Wire : 1000m x 56mm dia
AH Wire : 500m x 56mm dia
Spare tow Wire : 1000m x 56mm dia

Mooring Equipment:

Windlass : 10T x 0 – 9 m/min
Anchors : 2 x D-14 HHP, 1880 kg
Bollard Pull : 80 T

DP/Joystick Control:

Kongsberg/ K-POS DP-21 and cJoy

FiFi 1 System/Oil Pollution Control:

FiFi 1, Dispersant

Navigation & Communication Equipment:

VHF fixed : 2 x FURUNO FM 8900S
Inmarsat C : FURUNO FELCOM-18
Navtex : FURUNO NX-700A
Autopilot : SIMRAD AP70
Radar : FURUNO FAR 2117 / FAR 2137S
GPS Antenna : FURUNO GPA-017S
Gyro Compass : SIMRAD GC 80
Gyro Repeater : SIMRAD AR 81
Echo Sounder : FURUNO FE 700
AIS Transponder : FURUNO FA 150
Speed Log : FURUNO DS 80
GMDSS Portable VHF : 3 Pcs, MC MURDO R5 TT 1709A

c. WM.MAKASSAR



WM MAKASSAR

PLATFORM SUPPLY VESSEL
3600 DWT

Transportation of liquid products and deck cargo to drilling rigs, production platforms, pipe laying barges, and drillship. Perform Safety Standby Service function. She is DP Class 2, Fire Fighting Class 1.

PRINCIPAL PARTICULARS:

Year Built	2010
Classification	NKK
Flag / Registry	Indonesia / Jakarta
Call Sign / IMO No.	PNMC / 9491551
Construction	Steel
Length Overall	78.00 m
Breadth	17.00 m
Depth	8.00 m
Loaded Draft	6.25 m
GRT / NRT	3245 / 974 Tons
Deadweight Tonnage	3683 Tons
Dynamic Positioning	DP-2 Converteam DPS-21 Duplex

MACHINERY AND PROPULSION:

Main Engines	2 x 3111 HP MAK 8M25C Total 6222 BHP @ 720 RPM
Gearbox	2 x Reintjes LAF 2346 K41 (3.033:1)
Shaft Generator	2 x 2144 HP AEM SE-500-S4 @ 1800 RPM
Aux. Engines	2 x 650 HP Cummins KTA19-D @ 1800 RPM
Emergency Generator	1 x 150 HP Cummins 6BT5.9-D @ 1800 RPM
Propulsion	CPP with Kort Nozzles
Bow Thruster	2 x 15 tons Kawasaki KT-157BS
Stern Thruster	2 x 7 tons Kawasaki KT-55B3

CARGO CAPACITIES:

Clear Deck Space	754 m ² (52.0 m x 14.5 m)
Fuel Oil	1305 m ³
Fresh Water	761 m ³
Drill Water	913 m ³
Dry Bulk/Cement	308 m ³ (4 tanks)
Liquid Mud	988 m ³ (10 tanks)
Brine	790 m ³ (6 tanks)
Base Oil	397 m ³ (4 tanks)
Methanol	141 m ³ (2 tanks)

DISCHARGE PUMPS:

Fuel Oil	100 m ³ /hr @ 90 m head
Fresh water	100 m ³ /hr @ 90 m head
Drill Water/ Ballast	100 m ³ /hr @ 90 m head
Dry Bulk/Cement	25 m ³ /min @ 56 m head
Liquid Mud	75 m ³ /hr @ 18 bar
Brine	75 m ³ /hr @ 18 bar
Base Oil	50 m ³ /hr @ 90 m head
Methanol	75 m ³ /hr @ 90 m head

DECK MACHINERY AND MOORING:

Tugger Winches	: 2 x 10 Tons @ 15m/min Norcrane
Capstans	: 1 x 8 Tons @ 15m/min Norcrane
Deck Crane	: 1 x 3.8 Tons @ 16 m Palfinger
Anchor Windlass	: 2 x 7.8 Tons @ 10m/min Norcrane

COMMUNICATION AND NAVIGATION:

SSB	JRC JSB-196 GM
GPS	JRC JLR-7700 MKII
VHF	JRC JHS-770S
Radar	JRC JMS-5312-6 (X Band) JRC JMA-5332-12 (S Band)
Echo Sounder	JRC JFE-680
Navtex	JRC NCR-333
AIS	JRC JHS-182
Inmarsat	JRC JUE-85
Satellite Phone	Sailor FB-250
GMDS	Type A1+A2+A3

OTHERS:

Accommodation	: 50 Persons
Life Saving and Fire Fighting Equipment	: As per SOLAS requirements
External Fire Fighting	: Fire Fighting Class 1
- Fire pump	: 2 x 1700 m ³ /hr @ 120 m head
- Fire monitor	: 2 x 1200 m ³ /hr

30.07.18 – Rev.0

Note : The information shown is given in good faith without any warranties or conditions, express or implied, statutory or otherwise.

2. General Description of DP (Dynamic Positioning) Console KPOS 21 KONGSBERG

a. The KPOS DP System

Kongsberg K-Pos DP system is a computerised system for automatic position and heading control of a vessel and .To control the vessel's heading, the K-Pos DP system uses data from one or more gyrocompasses, while at least one position-reference system (for example, DGPS or hydroacoustics) enables the K-Pos DP system to position the vessel. Setpoints for heading and position are specified by the operator and are then processed by the K-Pos DP system to provide thrust control signals to the vessel's thruster and main propeller systems. The K-Pos DP system always allocates optimum thrust to whichever propulsion units are in use Deviations from the desired heading or position are automatically detected and appropriate adjustments are made by the system. The K-Pos DP system also provides a manual joystick control which may be used for manual control alone or for combined manual/auto control.

Without a position-reference system, the K-Pos DP system can provide automatic stabilization and control of the vessel heading using the gyrocompass as the heading reference.

The DP system includes control strategies that will reduce fuel consumption and greenhouse gases.

b. Basic forces and motions

A seagoing vessel is subjected to forces from wind, waves and current, as well as from forces and moments generated by the vessel's propulsion system.

The term “forces” in the following sections includes both forces and yawing moments, unless otherwise stated. The vessel's responses to these forces, i.e.

its changes in position, heading and speed, are measured by position-reference systems, gyrocompasses and vertical reference sensors. Reference system readings are corrected for roll and pitch using readings from the vertical reference sensors. Wind speed and direction are measured by the wind sensors.

The system calculates the forces that the thrusters must produce in order to control the vessel's motion in three degrees of freedom - surge, sway and yaw - in the horizontal plane.

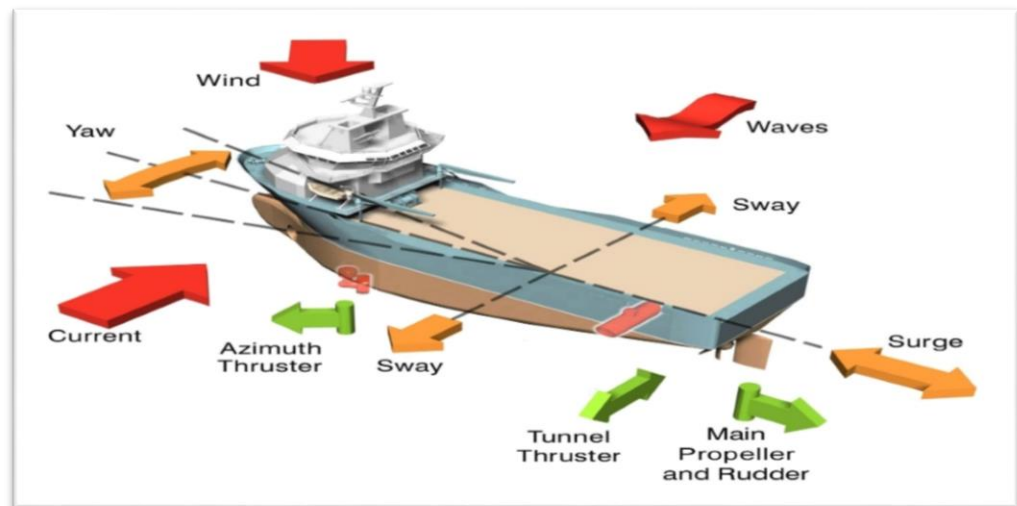


Figure 48. Forces and motions

The vessel also moves in three vertical degrees of freedom: pitch, roll and heave.

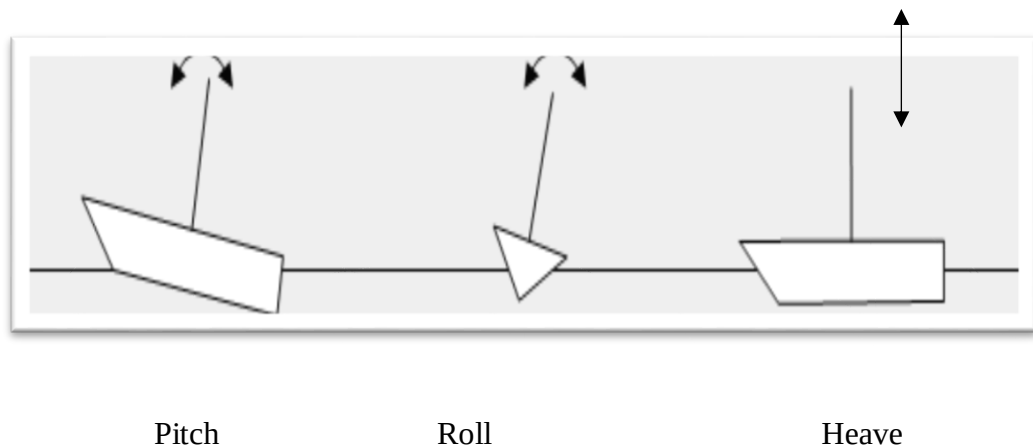


Figure 49. Pitch, roll and heave

The pitch and roll motions are not controlled by The K-Pos DP system. However, in order to allow the positions – reference system to correct for these motions, the system must have information about them. This information is received from vertical reference sensors.

The K-Pos DP system does not control or require information about the heave motion, but the motion can be measured and displayed.

c. K-Pos DP system principles

A simplified block diagram of the K-Pos DP system is shown in system principles

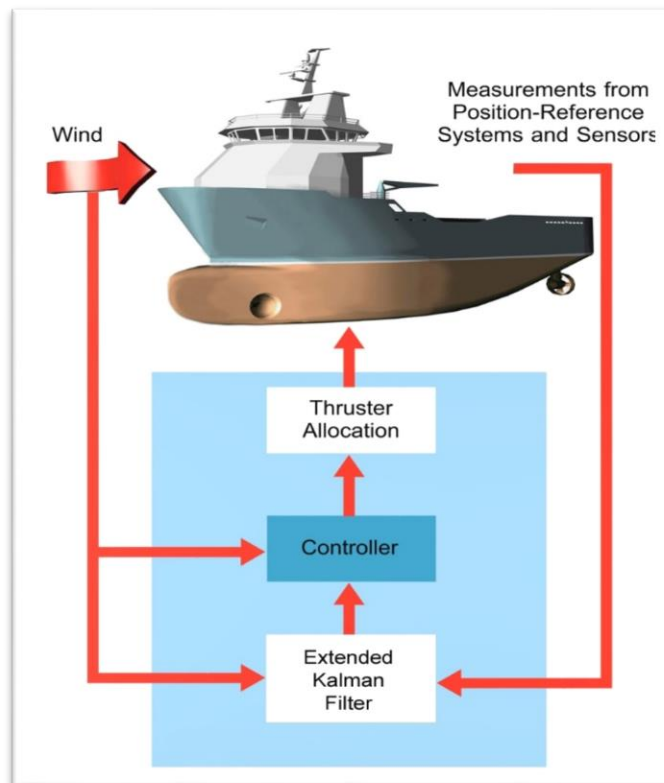


Figure 50. K.Pos DP system principles

The K-Pos DP system relies on a mathematical vessel model which includes hydrodynamic characteristics such as current drag coefficients and virtual mass data. This model, called the Mathematical Vessel Model, describes how the vessel responds to an applied force, e.g. from wind or thrusters.

d. K-Pos DP system principles

The Extended Kalman Filter estimates the vessel's heading, position and velocity in each of the three degrees of freedom - surge, sway and yaw. It also incorporates algorithms for estimating the effect of sea current and waves. The Extended Kalman Filter uses a mathematical model of the vessel. A mathematical model itself is never a 100% accurate representation of the real vessel. However, by using the Extended Kalman Filtering technique, the model is continuously corrected.

The vessel's heading and position are measured using the gyrocompasses and position-reference systems, and are used as input data to the K-Pos DP system. These measurements are compared with the predicted or estimated data produced by the mathematical model, and the differences are then used to update the model.

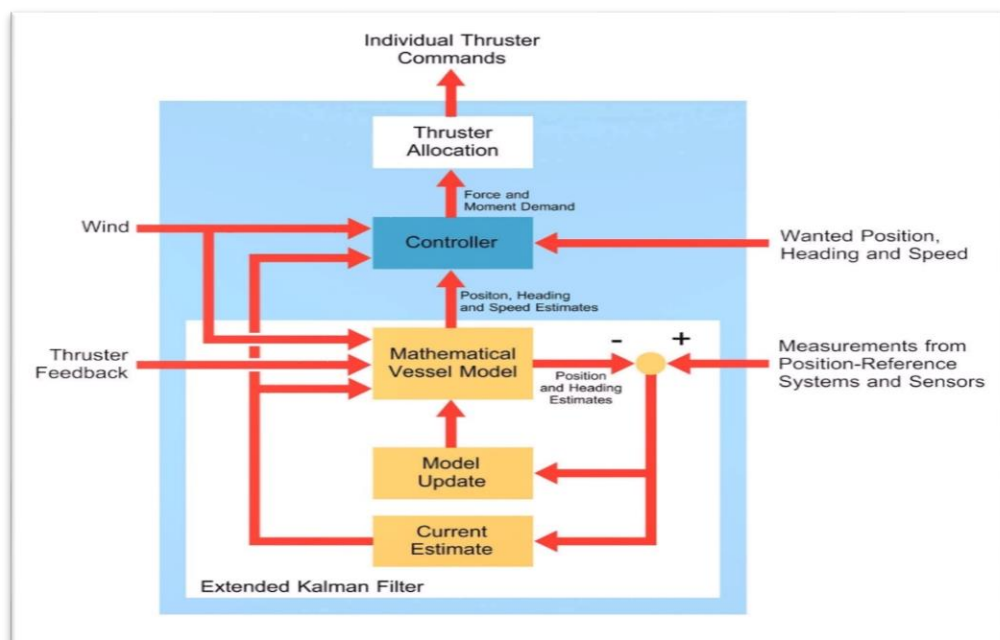


Figure 51. Simplified block diagram showing the extended Kalman Filter

The Extended Kalman Filter provides the following advantages:

Optimum self-adaptive noise filtering of heading and position measurements according to noise level and measurement-update rate.

Optimum combination of data from the different position-reference systems. The system calculates a variance for each position-reference system in use, and places different weighting on their measurements according to each system's individual quality.

In the absence of position measurements, the model provides a “dead-reckoning” mode. This means that the system is able to perform positioning for some time without position measurement updates from any position-reference systems.

In the Extended Kalman Filter, The mathematical Vessel Model's reliability and the noise level of the position measurements are the basis for deciding how much to trust each measurement. As time the model uncertainty will decrease by learning from measured vessel response.

The process is adaptive. If, for example, only one position-reference system is active and it has a low update rate, the model uncertainty will increase in the periods between measurements, and the vessel model will therefore be heavily updated with each measurement.

Offshore trials have verified that the K-Pos DP system principles give:

Improved suppression of noise in position measurement with a better station-keeping performance.

Reduced power consumption and wear and tear on the thrusters due to the improved suppression.

A robust handling of combined high and low update rate position sensors, such as DGPS and traditional Long Base-Line hydroacoustic positioning.

The Extended Kalman Filter is also used for the heading information based on measurement from the actual gyrocompass in use.

Additional advantages can be obtained by use of:

Speed measurements

Speed measurements can be used as an addition to position measurements to improve the vessel speed control, and to make calibration of position measurements faster when sailing at high speed.

A combination of speed measurement and a position-reference system will be better able to handle drop out of position measurements during sailing.

The speed measurement interface can be DGPS or Doppler Log.

ROT measurements

ROT (Rate Of Turn) measurements from ROT sensors can be used to improve the heading control of the vessel. This is useful when very accurate heading control is required during high-speed sailing, or when the vessel has a hull shape that makes it difficult to control the heading.

e. The Controller

The controller calculates the resulting force to be exerted by the thrusters/propellers in order for the vessel to remain on station.

f. DP Control Strategy

In station-keeping operations, the K-Pos DP controller can be working in several of the following modes, all with special characteristics:

- **High Precision control**
- **Relaxed control**
- **Green control**

High Precision control provides high accuracy station-keeping in any weather condition at the expense of power consumption and exposure to wear and tear of machinery and thrusters.

Relaxed control uses the thrusters more smoothly, at the expense of station-keeping accuracy. However, this type of control cannot guarantee that the vessel will stay within its operational area, and is mainly applicable for calm weather conditions.

Green control uses a different control technology called non-linear Model Predictive Control, which is optimised for precise area keeping with minimum power consumption. Green control is applicable in all weather conditions.

The transition between K-Pos DP controller modes is bumpless.

High Precision and Relaxed control

The controller consists of the following parts:

- **Excursion Feedback**

The deviation between the operator-specified position/heading setpoints and the actual position/heading data, and similar deviations with respect to the vessel's velocity/heading rate, drive the excursion feedback. The differences are multiplied by gain factors giving a force demand (restoring demand and damping demand) required to bring the vessel back to its setpoint values while also slowing down its movements.

The main difference between **High Precision control** and **Relaxed control** is the restoring characteristics of the two controller types:

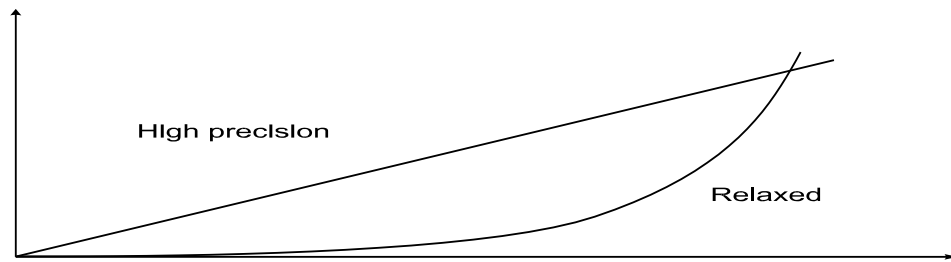


Figure 51. High Precision and Relaxed control

Wind Feed-Forward

In order to counteract the wind forces as quickly as possible, the feed-forward concept is used. This means that the K-Pos DP system will not allow the vessel to drift away from the required position, but counteracts the wind-induced forces as soon as they are detected.

- **Current Feedback**

The excursion feedback and wind feed forward are not sufficient to bring the vessel back to the desired setpoints due to unmeasured external forces (such as waves and current). The system estimates these forces overtime, and calculates the forces demand required to counteract them.

Green control

In the *Green control* mode, the system maintains the vessel within an allowed area with minimum use of power.

The controller design consists of two main parts, each giving its contribution to the control:

The Environment Compensator is designed to compensate for the averaged environmental forces, which will maintain the required position under averaged conditions.

The Model Predictive Controller (MPC) uses a prediction (Position Predictor) of the vessel movement as input for the control. When the operational boundaries are predicted to be exceeded, the controller reacts to ensure that the vessel stays within the operational area

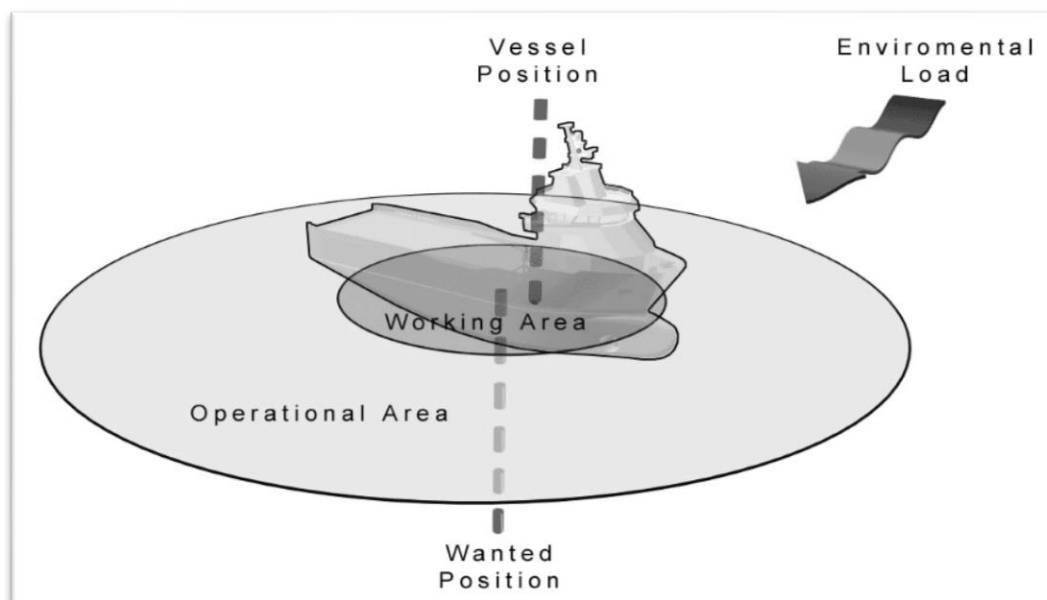


Figure 52. Vessel under Green control in the operational area

The very smooth control actions reduce wear and tear on mechanical parts of the power and thruster system and reduce fuel consumption and greenhouse gases.

A simplified block diagram of the MPC Green control

Due to its nature, the MPC will not instantaneously react to sudden changes in external forces, such as wind gusts, unless the Position Predictor detects that actions must be taken immediately. Unnecessary sudden use of thrust is therefore avoided.

The non-linear Model Predictive Controller is an online optimisation function, finding the best compromise between using thrust and predicted overstepping of operational boundaries.

Figure 53. Green control structure

The controller of the K-Pos DP system continuously calculates the actual force requirements in the alongships and athwartships directions (the force demand), and the required rotational moment (the turning moment demand).

The Thruster Allocation distributes these demands as pitch/rpm/force/load and azimuth control signals to each thruster/propeller, thus obtaining the force and moment required for the position and heading control.

If it is not possible to maintain both the turning moment and the force demand due to insufficient available thrust, priority is normally set to obtain the turning moment demand (heading).

If a thruster/propeller is out of service or deselected, the “lost” thrust is automatically redistributed to the remaining thrusters/propellers.

The magnitude of thrust allocated is reduced if the available power is too low to meet the thrust demand. The allocated thrust will however still be correct with respect to the direction of thrust. Heading (or position) priority is also kept in such a situation.

Power optional allocation is the primary barrier for preventing blackouts and requires the same information as that required for Power Load Monitoring and Blackout Preventions.

2. User Interface

a. Operator station



Figure 54. Kongbergs DP K-Pos 21

The K-Pos DP operator station includes a high resolution colour flat screen for monitoring and operation of the system, and an operator panel with push buttons, lamps and joystick controls. The power switch and adjustment controls for screen are placed on the right hand side of the screen. The use of the power switch and adjustment controls is described in the hardware module description for the screen. Some systems are delivered with a secondary screen which includes the same display layout and information, but the operator is allowed to select panes also on the dashboard.

b. Operation panel

The operator panel provides:

Dedicated buttons (most of these have status lamps)

Keypads

Trackball

3 – axis joystick

Heading wheel and buttons

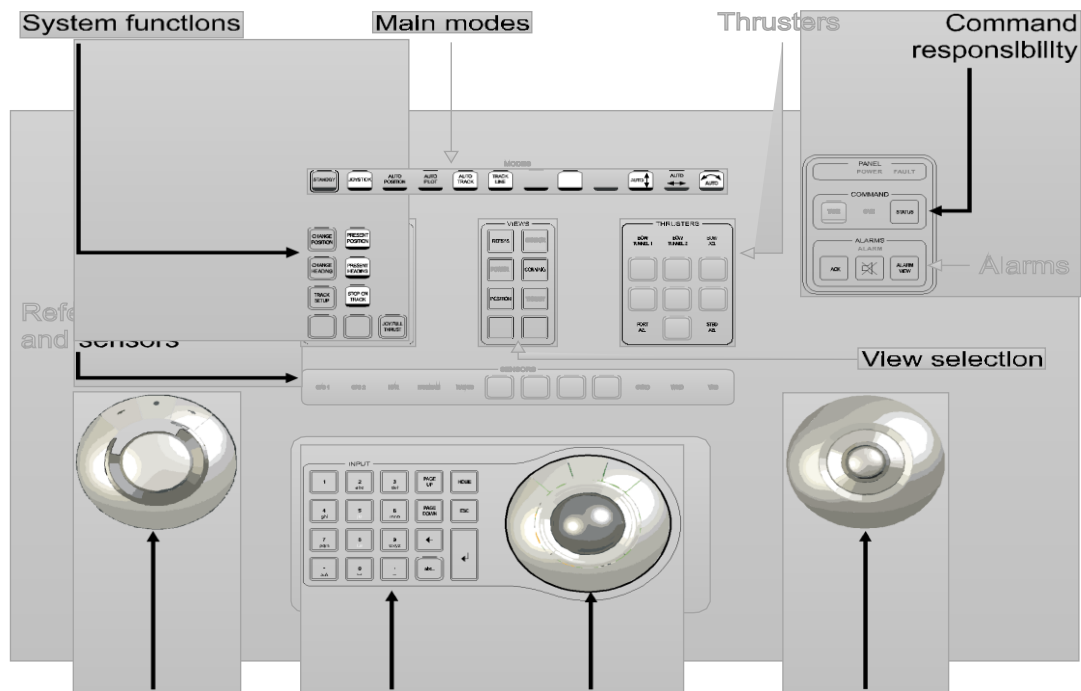


Figure 55. K-Pos 21 Operation panel

Push buttons

Push buttons with status lamps are provided on the operator panel for activation of main modes, position-reference systems, thrusters and functions. The accompanying status lamps indicate activation of a particular function, mode or system.

Other frequently-used functions, such as selection of display views and dialog boxes, may also have dedicated push buttons on the operator panel.

The buttons are grouped according to their main function. For safety reasons, some of buttons must be pressed twice within four seconds to invoke action. These buttons are indicated by a white line along the lower edge.

c. Display layout

The display interface uses standard Microsoft Windows operating features such as menus and dialog boxes.

The display is divided into a number of predefined areas as shown in the the following figure. In addition to these, dialog boxes are displayed whenever operator interaction is required.

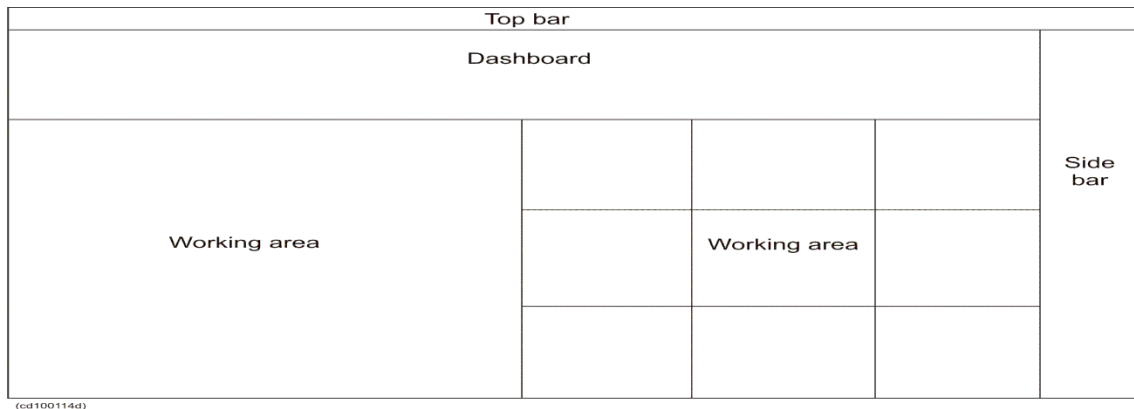


Figure 56. Display lay out

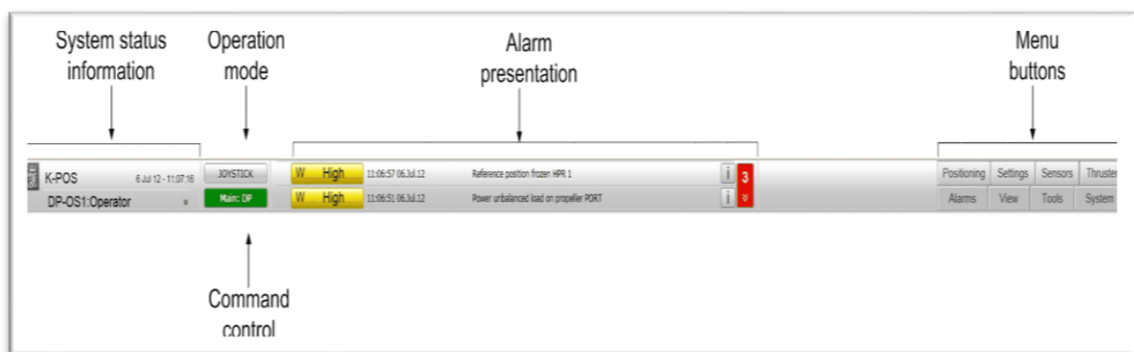
In some deliveries other display sizes are used. The principles for dividing the display into top bar, dashboard and working areas, as well as the principles of operation are the same as for display with aspect ratio 16:9



Figure 57. Display lay out for Kongsberg DP Class 3



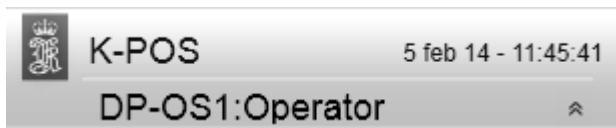
Figure 58. K-Pos 21 Display layout on OS1



The information on the top bar, presented by controls and indicators, is grouped in different parts showing the following:

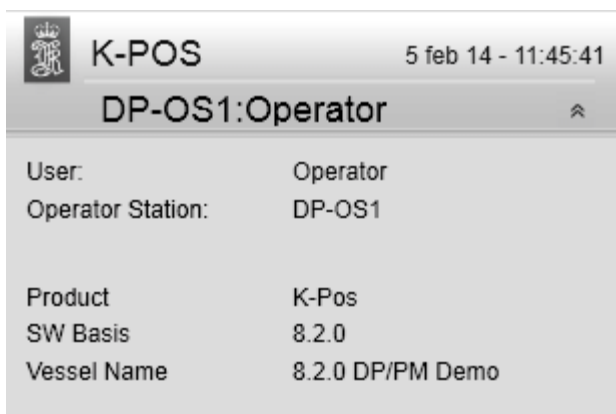
1. Product name
2. Date and time
3. Operator station and user name
4. Drop down menu for detailed system information
5. Operation mode
6. Controller PS group
7. Information about unacknowledged alarms
8. Menu buttons for accessing dialog boxes

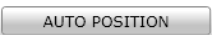
The system status provides information about the Operator station and the user, in addition to the product name and current date and time



When the built-in simulator is in use the text **SIMULATING** replaces the name of the user: **DP-OS1:SIMULATING**. The text changes also when the remote diagnostics are running.

Clicking the extension button  provides detailed system information such as delivery name, system software version, etc.



You can close the information box by clicking the collapse button . 

The indicator shows current operation mode.



When the Operator station is in command the command group button, e.g. 'Main: DP' is green. Pressing this button activates the **Command Control** dialog box. If the thrusters are not ready but the operator station is in command, the background colour of the button is yellow



W High	11:15:18 17-02-11	Power limits reached on conn_swbd 1	i	3
A Normal	11:10:22 17-02-11	CmdCtrl DP not under command	i	⌵

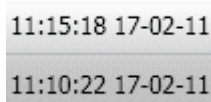
The alarm area shows the most recent emergency, alarm or warning message that has not yet been acknowledged.



The icon shows the priority of the alarm:

- red — highest priority Alarm and Emergency
- yellow — second priority Warning

Clicking the icon acknowledges the alarm and it disappears from the top bar but can still be seen in the Event list view.



Represents the time and date when the alarm was generated.



Represents the tag name of the OS alarm.



The icon is a short-cut to more information about the alarm. Clicking the icon activates the online help for system events. (See *Message explanations — online help* on page 89.)



The extension button shows the number of unacknowledged alarms. Clicking the icon expands the list of alarms because only two alarms are visible on the top bar at any time.

W	High	11:18:37 17-02-11	Heading out of limits	i	5
W	High	11:18:15 17-02-11	Diesel shaft PORT overload	i	5
W	High	11:15:18 17-02-11	Power limits reached on conn_swbd 1	i	
A	Normal	11:10:22 17-02-11	CmdCtrl DP not under command	i	
A	High	11:10:04 17-02-11	Equipment Alarm Printer: Station have halted	i	

The colour of the extension button is the colour of the unacknowledged alarm with highest priority, e.g.:

W	High	06:41:44 24-02-11	Reference position frozen HPR 1	i	3
A	Normal	06:39:59 24-02-11	CmdCtrl DP not under command	i	

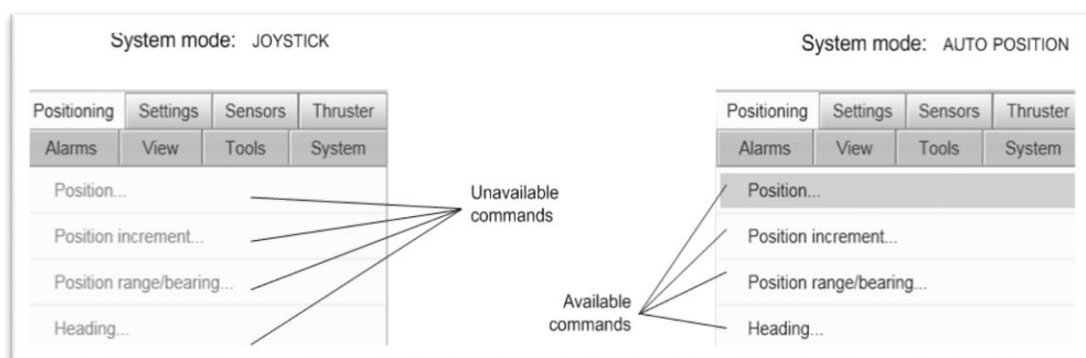
or:

W	High	06:41:44 24-02-11	Reference position frozen HPR 1	i	1

The menu buttons provide command menus allowing access to the respective dialog boxes. Which menus are available depends on the configuration of the delivered system.

Positioning	Settings	Sensors	Thruster
Alarms	View	Tools	System

Because some commands are relevant to specific modes, these are not available until the relevant mode is selected:



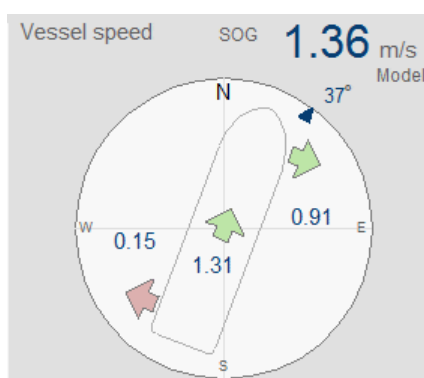
d. Dashboard layout

The dashboard area shows important performance information to allow immediate assessment of the situation. On the operator station in command, the content of this area cannot be altered by the operator, but changes automatically according to the selected main mode. On the operator station not in command, you can change the panes that are shown, but as soon as the operator station takes command, the layout of the dashboard goes back to default.

Several parts of the dashboard area are click-sensitive. At the same time as the cursor image changes when it is moved over a click-sensitive object, a tooltip is displayed for a few seconds. This text explains the use of the click-sensitive object.



1. Vessel speed pane



SOG 1.36

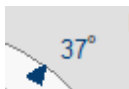
The vessel's speed is given in the top right-hand corner of the pane.

SOG/STW: The indicator next to the reading for speed tells you whether speed over ground (SOG) or speed through water (STW) is shown.

The name of the sensor measuring the speed is usually shown. If the vessel speed is input manually this is indicated by the text Manual on pink background, or if it is calculated by the system it is indicated by the text Model on pink background.

This area is click-sensitive. The ordinary cursor changes to a pointing hand when positioned over this area. Clicking the left trackball button shows

the setpoint values in orange colour.



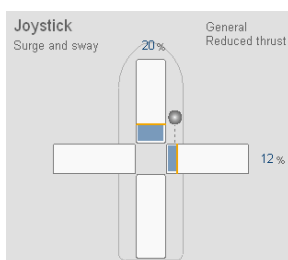
The blue arrowhead indicates the course over ground together with the value in degrees.



Forward/reverse speed: The value of the speed forwards or reverse is shown in the centre of the fixed ship symbol, where it appears beneath the arrow indicating forwards (green) or reverse (pink).

This area is click-sensitive. The ordinary cursor changes to a pointing hand when positioned over this area. Clicking the left trackball button opens the **Speed Setpoint** dialog box.

2. Joystick pane

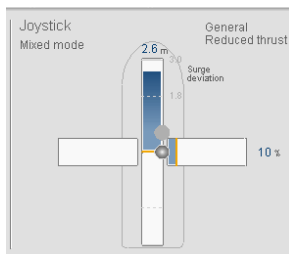


The pane displays joystick-related information during *Joystick* mode.

The joystick setpoint is indicated by the orange line and is shown as two percentage values (ahead or astern for surge and port or starboard for sway). The obtained response (feedback) is indicated by the blue bar.

The tilt of the joystick is indicated by the filled grey circle and dashed coordinate lines that are positioned relative to the centre of the cross formation (zero tilt).

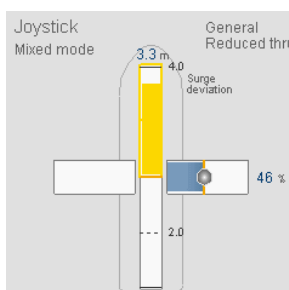
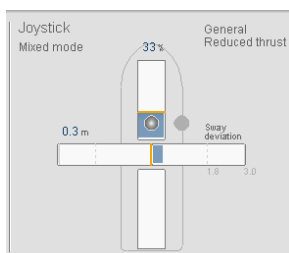
This area is click-sensitive. The ordinary cursor changes to a pointing hand when positioned over this area. Clicking the left trackball button opens the **Joystick** view in the right-hand working area.



In *Mixed Joystick/Auto* modes, the bars for the surge or sway axis in automatic control are replaced by a position deviation bar graph.

The joystick setpoint and response for the axis in joystick control is indicated as described for the *Joystick* mode.

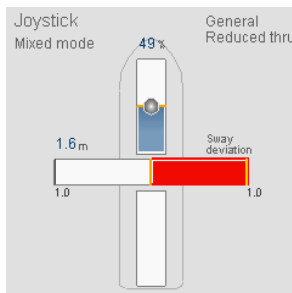
The direction of the joystick tilt in the axis under joystick control is indicated by the position of the filled grey circle.



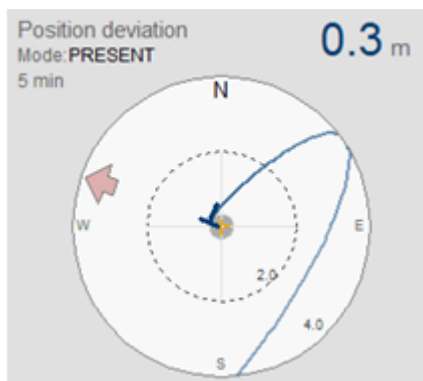
Position deviation in the axis under automatic control is indicated by a single bidirectional bar which represents the

deviation from the position setpoint. The colour of the bar changes in relation to the position warning and alarm limits:

- **Yellow** — Warning limit exceeded
- **Red** — Alarm limit exceeded



3. Position deviation pane



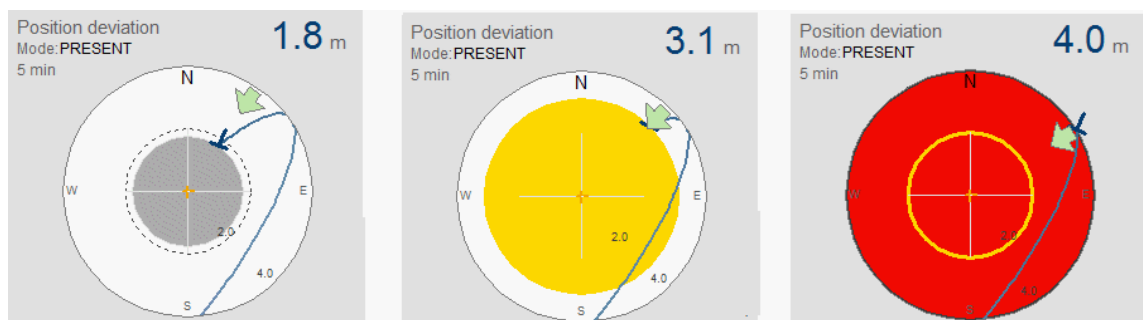
In *Auto Position* mode:

The position deviation is shown both graphically and numerically. An arrow symbol shows whether the estimated position is moving towards (green colour, decreasing deviation) or away from (pink colour, increasing deviation) the position setpoint.

This area is click-sensitive. The ordinary cursor changes to a pointing hand when positioned over this area. Clicking the left trackball button opens the Alarm Limits dialog box.

The position deviation is indicated by a filled circle whose radius represents the deviation from the position setpoint. The colour of the circle changes in relation to the position warning and alarm limits (if active):

- Grey — within the limits
- Yellow — Warning limit exceeded
- Red — Alarm limit exceeded



4. Heading pane



This shows numerical and graphical information relevant for manual and automatic heading control functions. The information changes automatically according to the selected main mode.

Heading
Mode: PRESENT

The title area also indicates the mode in which the heading is controlled.

Auto control axis: 
Auto damping axis: 

Auto control axis and **Auto damping axis**

These are graphic indications of the axes that are under automatic control or damping control.

The descriptions of the surge and sway axes apply to a system with the vessel diagram displayed “bow up” (see *Orientation of the OS and effect on display views* on page 49).



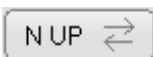
The surge axis is under automatic or damping control.



The sway axis is under automatic or damping control.



The yaw axis is under automatic or damping control.

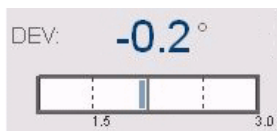


This is a toggle button changing the views between **N UP** and **H REL**.

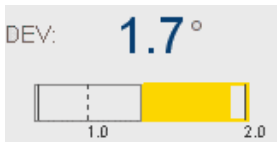
(north-up), while the heading of the vessel symbol is shown as relative.



H REL is Heading RELative. All views in the working area that show the vessel’s heading will be displayed relative to the vessel heading, while the heading of the vessel symbol is fixed.

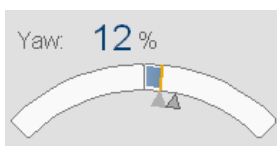
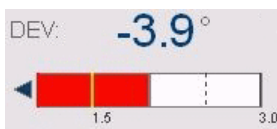


When automatic heading control is selected, the heading deviation is displayed.



Heading deviation is indicated by a bidirectional bar that represents the deviation from the heading setpoint. The colour of the bar changes in relation to the heading warning and alarm limits:

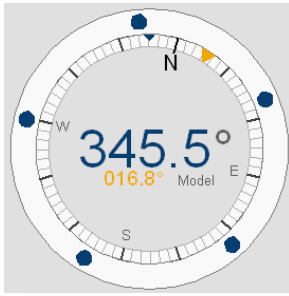
- **Yellow** — Warning limit exceeded
- **Red** — Alarm limit exceeded



When the system is under joystick heading control in *Joystick* mode, the turning force setpoint and the resulting vessel response are shown by a bar and a numeric value.

The rotation of the joystick is indicated by a dark-grey triangle. The turning force setpoint is indicated by the orange line and a light-grey triangle.

The obtained turning moment is indicated by numeric value (in percent port or starboard). With full thrust selected, the range is 100% port to 100% starboard whereas with reduced thrust selected, the range is typically, 50% port to 50% starboard.



The vessel heading (either as estimated by the Vessel Model, or from the gyrocompass in use) is shown graphically against a rotating compass rose and as a numeric value.

The heading setpoint is shown graphically on the compass rose as an orange triangle. The current heading is a blue triangle.

When the system is in *Joystick* mode (with or without automatic heading control selected) or *Auto Position* mode, the displayed vessel heading is as estimated by the Vessel Model. This is indicated by the text **Model** being shown under the numeric value.

This area is click-sensitive. The ordinary cursor changes to a pointing hand when positioned over this area. Clicking the left trackball button shows the setpoint values in orange colour.

Controller Mode: High Precision
Gain level: Medium

Shows the selected control strategy for station-keeping operations, and the gain level (applicable for **High Precision** and **Relaxed** modes).

This area is click-sensitive. The ordinary cursor changes to a pointing hand when positioned over this area. Clicking the left trackball button opens the **Gain** dialog box

ROT: 16.2 °/min
8.0 °/min

The vessel's Rate Of Turn (**ROT**) is shown numerically in degrees per minute (as in this example) to port or starboard.

This area is click-sensitive. The ordinary cursor changes to a pointing hand when positioned over this area. Clicking the left trackball button shows the setpoint values in orange colour.

Gyro: 1 2 3 4 5

Shows the status of the gyro compasses: enabled and in use (in this example gyro 1), enabled, but not in use (in this example gyro 2 and 3) and not enabled (in this example gyro 4 and 5).

5. Rotation center position pane

Rotation center position
60 00.0751 N
005 00.0962 E
Reference origin sensor GPS-1
Position setpoint:
60 00.0753 N
005 00.0957 E
DP class None

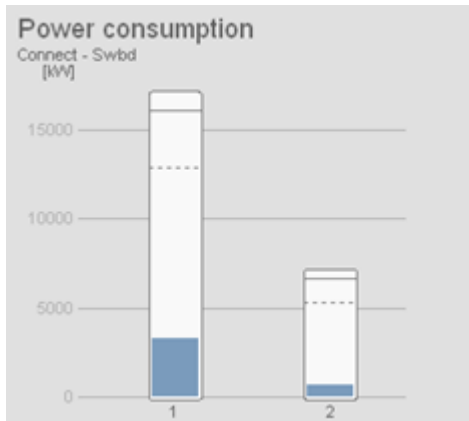
The different areas are click-sensitive:

- clicking on the coordinates shows the position setpoint in orange text,
- clicking on the vessel symbol opens the **Rotation Center** dialog box,
- clicking on the name of the reference origin opens the **Reference System Settings** dialog box,
- clicking on the area indicating the DP class opens the **DP Class** dialog box.

60 00.4388 N
005 00.2452 E
Midships
-- No reference system --

During position drop-out the background changes to pink to indicate the error Situation

6. Power consumption pane



There is a separate bar graph displayed for each connect-switchboard (1, 2, 3, etc.). This means that the number of displayed bar graphs will be automatically adjusted to reflect the vessel's connect-switchboard configuration whenever it is changed due to bus-tie breakers being opened and closed. The height of each bar graph is scaled to represent the generator capacity of the corresponding connect – switchboard. In the example, connect – switchboard 1 has a larger generator capacity than connect switchboard 2. Each bar graph has a blue bar and two predefined power consumption limits (one for warning and one for alarm) that are shown as dashed horizontal lines. A yellow frame around the bar graph indicates that the lower (warning) limit (typically) 60 %) is exceeded. A red frame around the bar graph indicates that the upper (alarm) limit (typically 80 %) is exceeded. This area is click-sensitive. The ordinary cursor changes to a pointing hand when positioned over this area. Clicking the left trackball button displays the Power view in the right-hand side working area.

Side Bar



The side bar contains buttons for quick access to functions concerning the display:

- changing the light and colours on the display (palettes)
- selecting special display views
- defining and selecting combinations of display views and panes in the two working areas

A check mark on the palette button shows which option is selected.

Working areas

The working areas show operator-selectable display views.

The area on the left-hand side displays detailed views. The operator can select which main views will be displayed

The area on the right-hand side is divided into panes which display different information. The operator can select what information will

be displayed. In addition detailed views can be displayed replacing the nine panes with one view.

A predefined combination of display views and panes can be stored and selected by one button click

7. Dialog boxes

You can enter data into the system using dialog boxes. These are displayed using panel buttons, selecting menu commands or by clicking on graphical symbols in the views or icons on the top bar.

Dialog boxes appear in the working area and you can move them as required.

To locate information about individual dialog boxes, use the *Index* at the end of this manual.

When data has been modified on a dialog box, the message **(Changed)** is added to the title bar text.

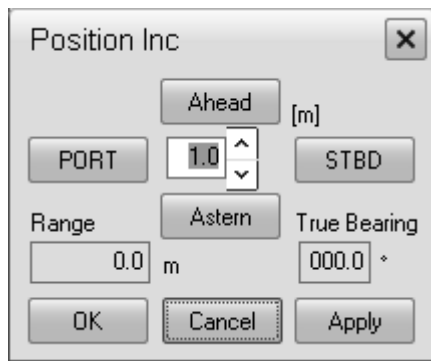
Data entered on a dialog box is not used by the system until you confirm the input by clicking the **Apply** or **OK** button:

- If click the **OK** button, the changes that you have made are applied and the dialog box is removed from the display. If any data errors are found, no changes are made and the dialog box remains open.

If you click the **Cancel** button, no changes are made and the dialog box is removed from the display.

- If you click the **Apply** button, the changes that you have made are applied and the dialog box remains open.

When you are not allowed to make changes to the data on a dialog box, both the **OK** and **Apply** buttons will be unavailable (dimmed). This can occur, for example, when the Operator Station is not in command or the system is not in an appropriate mode.



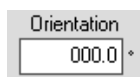
Some dialog boxes have several pages which you access by clicking on the page tab. For this type of dialog box, both the **Apply** and **OK** buttons apply the changes that you have made on all pages of the dialog box.

Click the **Cancel** button to close the dialog box without action. If a dialog box can be accessed by pressing a panel button, pressing this panel button while the dialog box is displayed closes the dialog box without action.

Entering numeric values

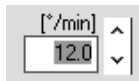
Numeric values can be entered into text boxes in dialog boxes, you can achieve this in several different ways, depending on the types of numeric input field used and the functionality available on the Operator Station.

There are two types of input fields used for entering numeric values:



Text box

This is a rectangular box in which you can type a numeric value. If the box already contains a numerical value, you can select the value to be used or delete it and type in a new value.



Spin box

This is a text box equipped with two additional up and down arrows (on the right-hand side) that can be clicked to increase or decrease the numerical value by a fixed increment. A numerical value can also be typed directly in the box.

On an operator panel equipped with a numeric keypad, this keypad represents the easiest way to enter numeric values.

However, the **Enter a New Numeric Value** dialog box may be used. This will be displayed on the screen when enabled, and is especially suited to Operator Stations having:

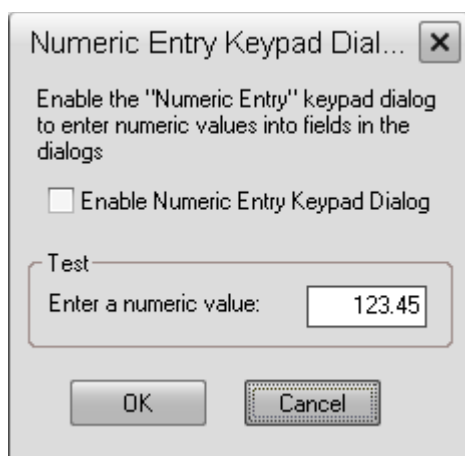
No numeric keypad on the operator panel

Enabling the Enter a New Numeric Value dialog box

The **Enter a New Numeric Value** dialog box must be enabled before use. To enable the **Enter a New Numeric Value** dialog box:

1. Select **Tools**→**Numeric Entry Dialog**.

- The **Numeric Entry Keypad Dialog Use** dialog box is displayed.

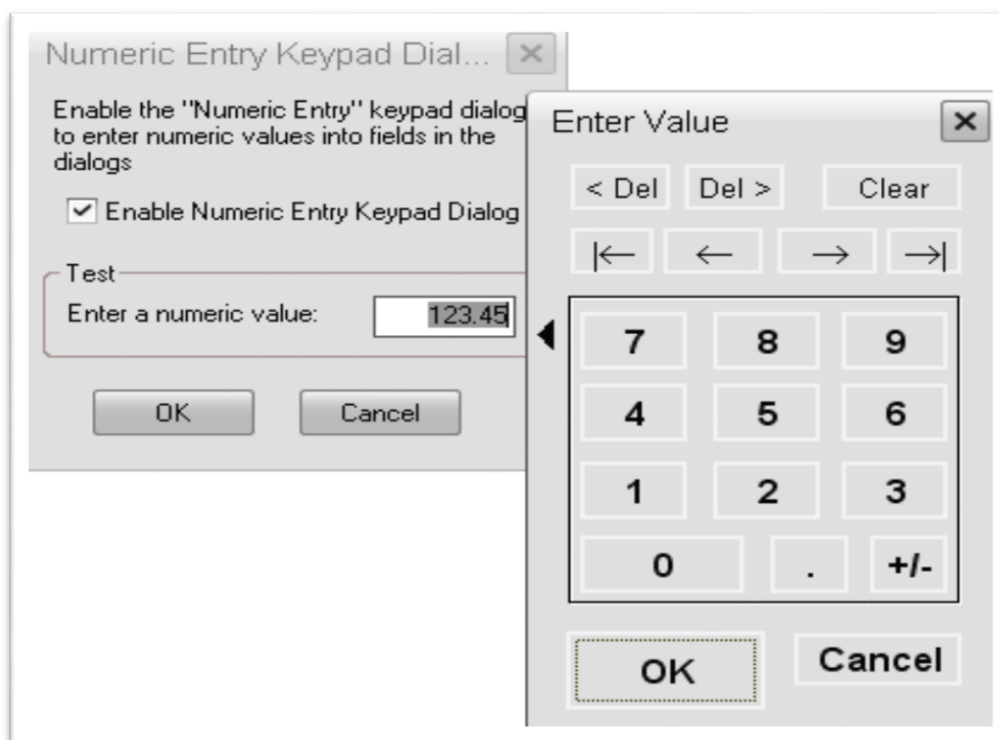


2. Select the **Enable Numeric Entry Keypad Dialog** check box and click the **OK** button.

The **Enter a New Numeric Value** dialog box is enabled. To test the **Enter a New Numeric Value** dialog box:

1. In the **Numeric Entry Keypad Dialog Use** dialog box, ensure that **Enable Numeric Entry Keypad Dialog** is selected.
2. Place the cursor in the **Enter a numeric value** text box and click the left trackball button.

The Enter a New Numeric Value dialog box is displayed



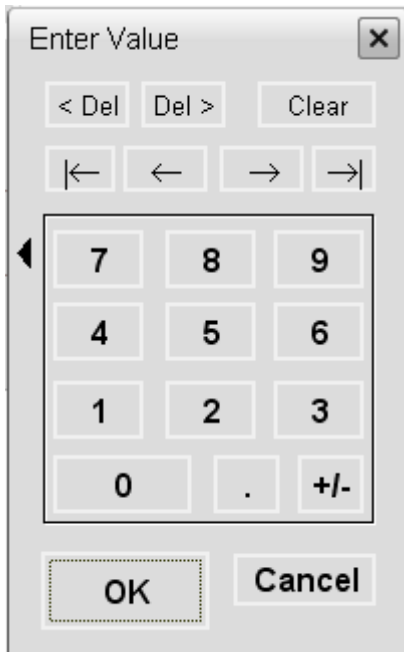
3. Enter a new numeric value in the **Enter a numeric value:** text box using the numeric keys on the **Enter a New Numeric Value** dialog box and then click the **OK** button (on the **Enter a New Numeric Value** dialog box).

4 Click the **OK** button on the **Numeric Entry Keypad Dialog Use** dialog

box.

- The **Enter a New Numeric Value** dialog box is tested and ready for use.

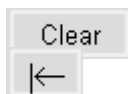
In the **Numeric Entry Keypad Dialog Use** dialog box, select the **Enable Numeric Entry Keypad Dialog** check box and click the **OK** button. Click in the **Enter a numeric value** text box



Deletes the digit to the left of the cursor.



Deletes the digit to the right of the
cursor.



Deletes the entire
number.

Moves the cursor to the far left on the text box.



Moves the cursor one digit to the left.



Moves the cursor to the far right on the text box.



Moves the cursor one digit to the right.

When you enter a numerical value, it is validated by the system. The value must be within the selected display format limits for this data type (for example, a heading value must be between 0 and 360 degrees). If you enter an illegal value, and then click the **OK** or **Apply** button, an **Illegal value** dialog box is displayed.



Click the **OK** button on this dialog box. The illegal value will remain highlighted in the text box until it is corrected.

If the dialog box has more than one page, and you enter an illegal value on one of the pages, the validation will be performed when you click the **OK** or **Apply** button, even though another page is displayed. The dialog box is automatically displayed with the page containing the illegal value on top.

If more than one validation error occurs, all errors are listed in one message box. In the dialog box, however, only the first error will be highlighted.

3. Display Views

Display views present the operator with information about the operation.

a. Orientation of the OS and effect on display views

Several of the display views show information relative to a diagram of the vessel; for example, thrusters are shown on the Thrusters view in their relative positions on the vessel diagram. The orientation of the vessel diagram is configured to suit the orientation of the Operator Station, so that it is easier to interpret what is seen on the screen. There are four possible orientations which are generally used in the following situations:

- i. The operator is facing forward in the vessel when looking at the display screen.
The vessel diagram is displayed “bow up” on the display.
- ii. The operator is facing to starboard in the vessel when looking at the display screen.
- iii. The vessel diagram is displayed “bow left” on the display.
- iv. The operator is facing aft in the vessel when looking at the display screen. The vessel diagram is displayed “bow down” on the display.
- v. The operator is facing to port in the vessel when looking at the display screen.
The vessel diagram is displayed “bow right” on the display.

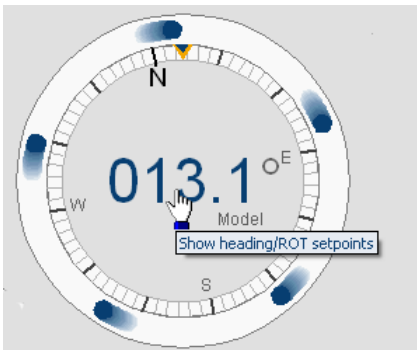
In this manual, the example display views show the vessel diagram “bow up”.

For other orientations, the displayed information in each view is the same, but it may be arranged differently.

b. Tooltip/hotspot cursor and change of cursor image

In many of the display views, the ordinary cursor changes to a pointing hand (the hotspot cursor) when it is moved over an area defined as click-sensitive. Typical examples of such click-sensitive areas are:

- i. Push buttons for zooming in and out.
- ii. Numerical fields showing other related numerical values when clicked.
- iii. Graphical fields showing a specific dialog box when clicked.
- iv. Change of position set point.
- v. Opening another view related to the specific component
- vi. Opening the control dialog box for a specific plot



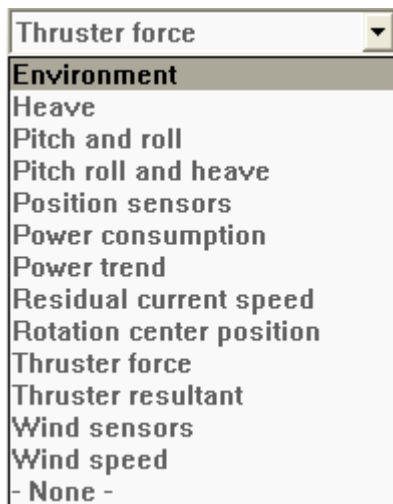
At the same time as the cursor image changes when it is moved over a click-sensitive object, a hotspot cursor text in a tooltip is displayed for a few seconds. This text explains the use of the click – sensitive object

c. Selecting display views and panes

Panes can be displayed only on the right – hand side working area

To select a pane to be displayed

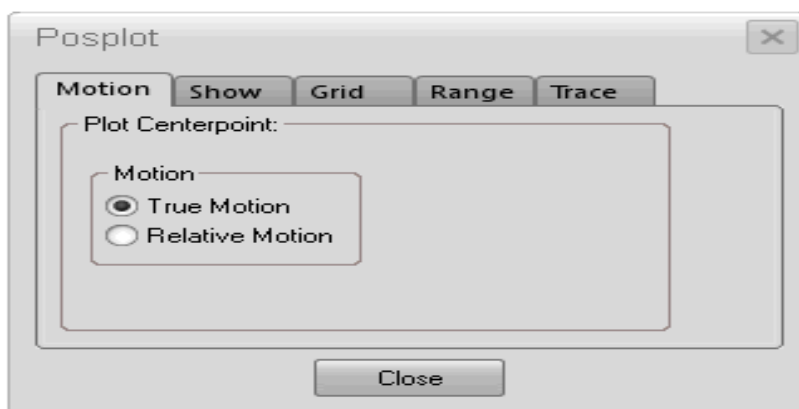
- i. Place the cursor on the upper left corner of any of panes. A drop down menu a list of available panes is displayed



- ii. Click on a name to select the pane

d. View control dialog boxes

Many of the views have control dialog boxes for selecting the displayed information and controlling features of the view. These dialog boxes are accessed via the shortcut menu of the view.



e. Alarm limit dialog box

Position page on the dialog box select **Alarms** → **Position and Heading**.

The screenshot shows a software window titled "Alarm Limits" with a close button (X) in the top right corner. Inside, there are two tabs: "Position" and "VRS". The "VRS" tab is currently selected. Below the tabs, there are two main sections: "Position" and "Heading". Each section has three columns: "Active", "Warning", and "Alarm". For "Position", the "Warning" limit is set to 1.8 m and the "Alarm" limit is set to 3.0 m. For "Heading", the "Warning" limit is set to 1.00 ° and the "Alarm" limit is set to 3.00 °. Each limit value is in a text box with up and down arrow buttons. At the bottom of the window are three buttons: "OK", "Cancel", and "Apply".

Position

Warning and alarm limits can be set for position deviation. When the vessel's actual position differs from the position setpoint by more than the warning limit, a warning message is displayed. When the vessel's actual position differs from the position setpoint by more than the alarm limit, an audible signal sounds and an alarm message is displayed.

When active, the position limits are displayed as black circles — solid for alarm and dashed for warning, in the **Position Deviation** pane. When inactive, the position limits are shown as gray circles.

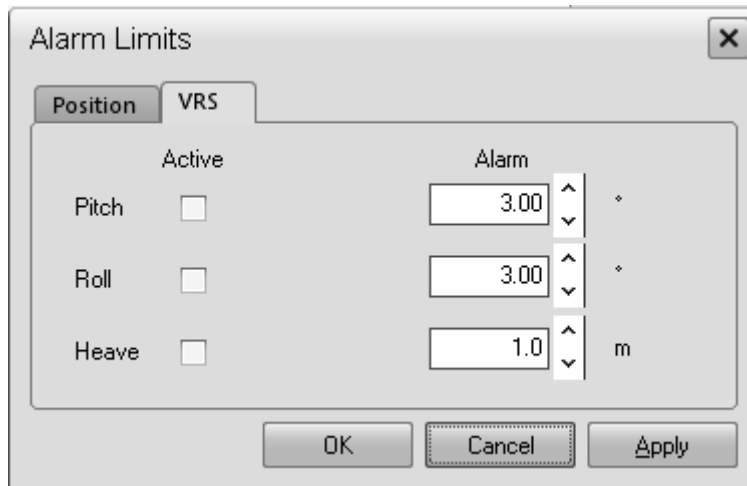
Heading

Warning and alarm limits can be set for heading deviation. When the vessel's actual heading differs from the heading setpoint by more than the warning limit, a warning message is displayed. When the vessel's actual heading differs from the heading setpoint by more than the alarm limit, an audible signal sounds and an alarm message is displayed.

The limits are active only when the yaw axis is under automatic control.

When active, the heading limits are shown as black lines — solid for alarm and dashed for warning, on the Posplot view. When inactive, the heading limits are shown as gray lines.

VRS pane



The image shows a software dialog box titled "Alarm Limits" with a close button (X) in the top right corner. It has two tabs: "Position" and "VRS", with "VRS" currently selected. The dialog contains a table with three rows: "Pitch", "Roll", and "Heave". Each row has an "Active" checkbox, an "Alarm" value field, and a unit indicator. For "Pitch" and "Roll", the "Active" checkboxes are unchecked, the "Alarm" value is "3.00", and the unit is degrees (°). For "Heave", the "Active" checkbox is unchecked, the "Alarm" value is "1.0", and the unit is meters (m). Each "Alarm" field has up and down arrow buttons for adjustment. At the bottom of the dialog are three buttons: "OK", "Cancel", and "Apply".

	Active	Alarm	Unit
Pitch	☐	3.00	°
Roll	☐	3.00	°
Heave	☐	1.0	m

Pitch, Roll, Heave

The system monitors the pitch and roll motions of the vessel as measured by the Vertical Reference Sensors (VRS). If heave measurements are also available from the VRS, the system also monitors this motion. You can specify maximum alarm limits for each motion. If an alarm limit is exceeded, an audible signal sounds and an alarm message is displayed.

To change the limits, either enter new values directly in the text boxes, or use the up and down arrow buttons to increase or decrease the current values.

To activate the limits, select the **Active** check boxes.

f. Gain dialog box

To display the dialog box, select **Settings→(Control) Gain**.

Alternatively, press the **CONTROL SETUP** button.

The content of this dialog box will vary according to system configuration. The dialog box in the system installed on your vessel may display only some of the items shown in this example.

Gain

Controller Mode — In Use — Outer Radius [m] — Inner Radius [m]

☒ High Precision ☐ In Use [m] [m]

☐ Relaxed ☐ In Use

☐ Green ☐ In Use [m]

Gain Level (High Precision/Relaxed)

☐ High (10.0)

☒ Medium (0.0)

☐ Low (-10.0)

☐ Customised

Customisation

Surge Sway Yaw

0.0 0.0 0.0

Speed Constraints (Green)

☐ Surge ☐ Sway

OK Cancel Apply

Controller Mode

The option buttons allow you to select from **High Precision**, **Relaxed** and **Green** controller modes.

The **In Use** check boxes indicate which controller mode is currently in use by the system.

High Precision

This is the default controller mode. It is also the controller mode setting if controller mode selection is not available in the K-Pos DP system installed on

your vessel. Gain level and customised gain settings (if available) apply for this controller mode.

Relaxed

This controller mode is available in *Auto Position* and *Mixed Joystick* system modes.

Select the radius by clicking the arrows or typing in a value in the **Outer Radius** text box. Gain level and customised gain settings (if available) apply for this controller mode. If it is not possible to use **Relaxed** controller mode when it is selected, the **High Precision** controller mode will be used.

With **Relaxed** controller mode, the position gains are modified to vary within the Relaxed control circle. This means that the force setpoint used to bring the vessel back to the position setpoint is very low when close to the center of the control circle. It then increases up to the normal values when close to the border of the area defined by the radius.

Green

This controller mode is available in *Auto Position* system mode.

Select the **Outer Radius** and **Inner Radius** by clicking the arrows or typing a value in the text box.

If it is not possible to use **Green** when it is selected, the **High Precision** controller mode will be used.

The **Inner Radius** and **Outer Radius** define the working area and the operational area, respectively. When the inner radius is predicted to be exceeded, additional thrust is added in a smoother way than if the outer radius is predicted to be exceeded.

Gain Level (High Precision/Relaxed)

Gain Level is applicable for **High Precision** and **Relaxed** controller modes.

High/Medium/Low

Select the required controller gain level using the **High/Medium/Low** option buttons. If available, the gain factors in use for each of the three gain levels are shown in parentheses. The values in parentheses may vary depending on vessel configuration.

Customised

This setting is optional. Select this option button when you want to perform customised settings of the gain level. Selecting **Customised** will make the **High/Medium/Low** option buttons unavailable (they will appear dimmed).

After you have selected **Customised** you can input the **Customisation** setting for gain factors in the **Surge**, **Sway** and **Yaw** axes by clicking the arrows or typing a new gain factor in the corresponding text box. The currently selected gain factors in the **Surge**, **Sway** and **Yaw** axes are shown graphically above the numerical values.

Speed Constraints (Green)

Speed Constraints are used in **Green** controller mode to limit the vessel speed. You can select **Speed Constraints** for the **Surge** and/or **Sway** axes. Speed constraints should be used while operating within a large area.

Gain Level for High Precision and Relaxed controller mode

There are three predefined controller gain levels available; high, medium and low. The selected gain level applies to any of the surge, sway and yaw axes when they are under automatic control and High Precision or Relaxed controller mode is used.

If configured, customised setting of the controller gain level can be performed, with individual gain factor settings for the surge, sway and yaw axes.

Different gain factors for each of the three standard gain levels are defined to suit the characteristics of the vessel. The deviations in position, speed, heading and rotation rate are multiplied by the selected gain factor to obtain the required force setpoint.

The most suitable gain level depends on the vessel characteristics, the weather conditions and the required positioning accuracy. Operational experience plays a large part in determining the optimum gain level, but the following general points should also be noted:

- High gain provides the quickest vessel response, the most accurate manoeuvring,

and the smallest positioning window.
- Medium gain provides a slower vessel response than high gain.

- Low gain provides the slowest vessel response and the largest positioning window.

For all three predefined controller gain levels, and also for the customised gain levels, the gain factors are reduced when the position deviation is close to zero. Under ideal conditions (optimum Vessel Model and constant environmental forces), there will be little difference between the effect of the various gain levels since the position deviation will be minimal.

Under less than ideal conditions there can be some variation in the vessel position, and you should set the gain level to control the speed and extent of the variation according to the general comments given above.

h. Rotation center dialog box

During *Joystick* mode, the **Rotation Center** dialog box allows you to specify the required manual rotation centre.

For automatic control, the dialog box allows you, in addition, to define the rotation centre to be used when the vessel heading and position are under automatic control.

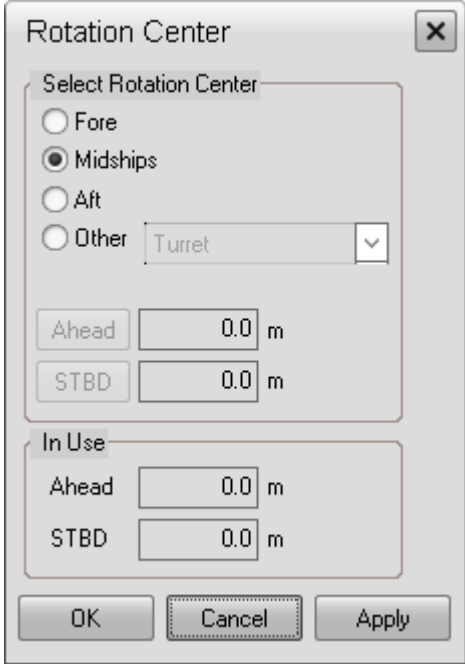
The rotation center is used when both the vessel heading and position are under automatic control. Up to 20 rotation centres can be predefined for the vessel in fixed positions relative to the midships position on the vessel. The coordinates of the required rotation centre can also be entered manually. The rotation centre can be located anywhere, even outside the vessel itself.

A suitable configuration of thrusters must be enabled. For example, if you want the vessel to rotate about the aft part of the vessel, there must be at least one thruster enabled forward of the vessel center.

If thrusters are disabled so that the selected rotation centre no longer can be applied, the rotation centre in use will automatically be changed.

When automatic position control is active, the rotation centre can only be changed when the position and heading modes are **PRESENT**.

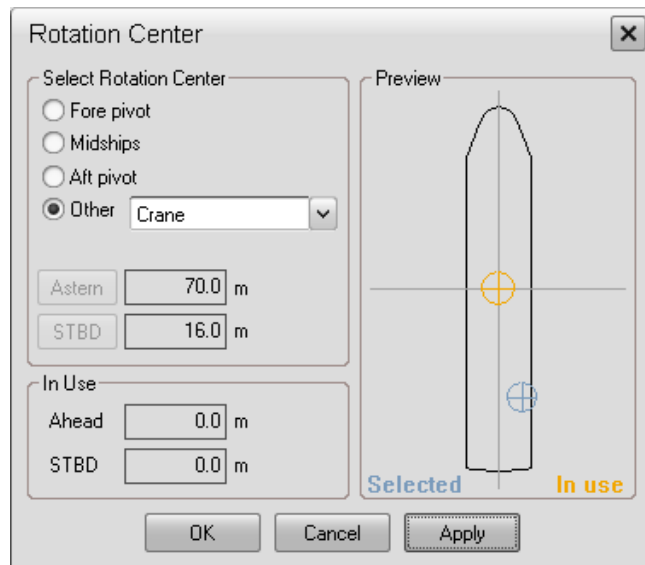
To display the dialog box, select **Settings→(Control) Rotation Center**.

The image shows a software dialog box titled "Rotation Center" with a close button (X) in the top right corner. The dialog is divided into two main sections. The top section, labeled "Select Rotation Center", contains four radio button options: "Fore", "Midships" (which is selected), "Aft", and "Other". Next to the "Other" option is a dropdown menu currently showing "Turret". Below these options are two input fields: "Ahead" with a value of "0.0 m" and "STBD" with a value of "0.0 m". The bottom section, labeled "In Use", also contains two input fields: "Ahead" with a value of "0.0 m" and "STBD" with a value of "0.0 m". At the bottom of the dialog are three buttons: "OK", "Cancel" (which is highlighted with a dashed border), and "Apply".

Select Rotation Center

The available rotation centres are displayed in the Select Rotation Center field. Select a rotation centre by clicking the appropriate option button. When a predefined rotation centre is selected, its coordinates are displayed in the **Ahead** and **STBD** boxes.

If **Other** is selected, the drop-down list box, from which you can select among predefined rotation centres, becomes available, and the dialog box is enlarged to show a **Preview** display. The intersection of the horizontal and vertical lines on the **Preview** on the **Rotation Center** dialog box marks the midships position on the vessel.



When a rotation centre is selected in the drop-down list box, its coordinates are displayed in the **Ahead/Astern** and **STBD/PORT** boxes and in the **Preview** display. All coordinates are measured relative to the midships position.

If **User Defined** is selected in the drop-down list box, the coordinates of the required rotation centre can be entered directly in the **Ahead/Astern** and **STBD/PORT** boxes.

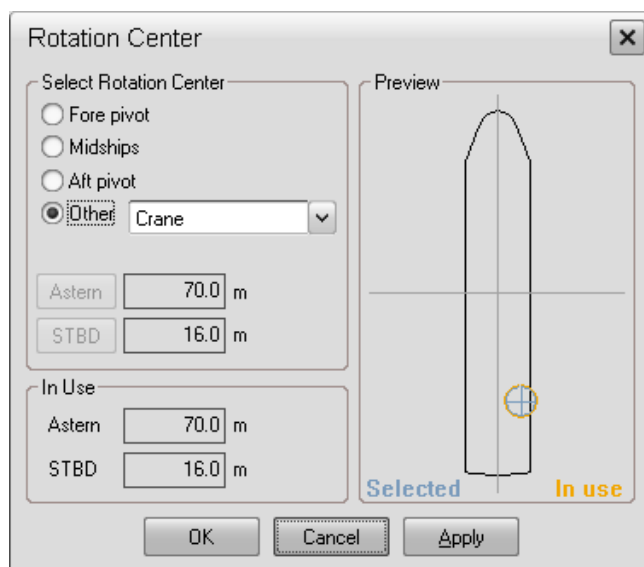
In Use

The **In Use** boxes show the coordinates of the currently-active rotation centre in the

Ahead/Astern and **STBD/PORT** axes.

Preview

An orange circle on the **Preview** display shows the position of the currently-active rotation centre (**In Use**). A blue circle shows the position of the proposed rotation centre (**Selectd**). When the selected rotation centre becomes in use (the **Apply** button is clicked), the two circles have the same position:

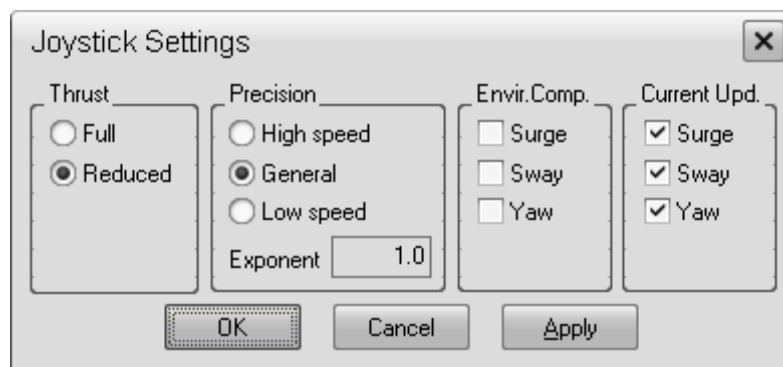


i. Joystick Setting dialog box

The **Joystick Settings** dialog box allows you to adjust the following settings:

- Joystick thrust
- Joystick precision
- Environmental compensation
- Current update

To display the dialog box, select **Settings→(Modes) Joystick** or press the **JOYSTICK SETUP** button.



j. Thrust

These option buttons allow you to select either **Full** or **Reduced** thrust.

Full

The maximum force available from all thrusters can be used. This increases the vessel's response to movement of the joystick compared to the **Reduced** option.

Reduced

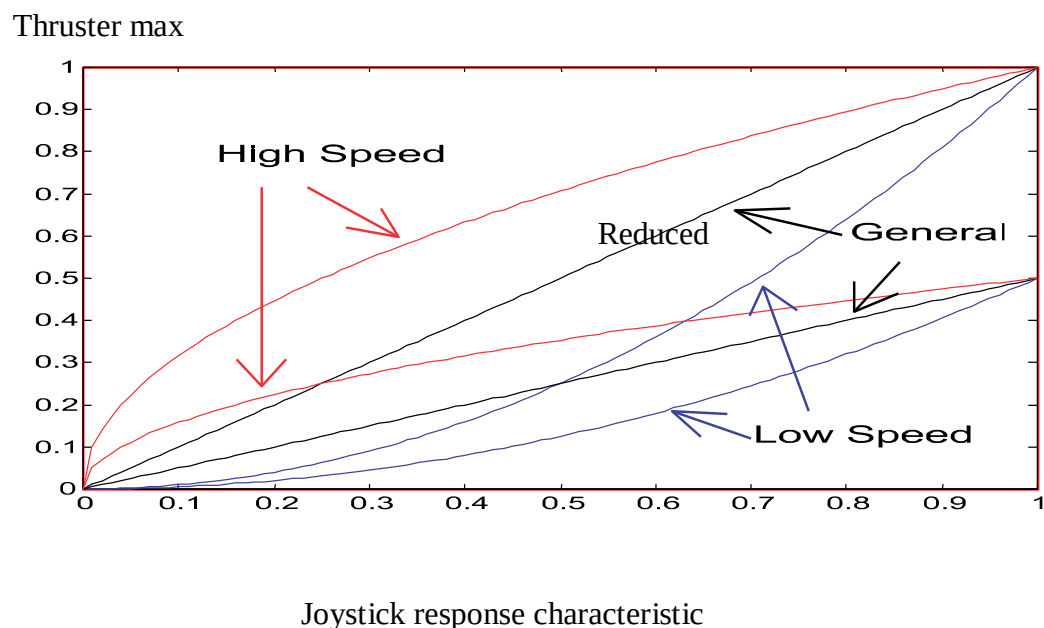
The maximum applied thruster force for axes that are under joystick control is limited to about 50% of the available force from all thrusters.

The joystick thrust setting can also be changed by pressing the **JOY. FULL THRUST** button. The status for the joystick thrust setting will be dynamically updated on the **Joystick Settings** dialog box to reflect this change.

Precision

The applied thruster force for axes that are under joystick control can be scaled in various ways. This scaling gives a different response to movement of the joystick, depending on the configuration and operational requirements of the vessel. Figure 12 displays thrust as a function of joystick deflection in the cases of **Full** and

Reduced thrust, with **High speed**, **General** or **Low speed** precision.



The option buttons allow you to select from **High speed**, **General** or **Low speed**

precision.

High speed

For precise high-speed manoeuvring. At small movements of the joystick the change in thruster force is large, but decreases with increasing movements.

General

Linear relationship between movement of the joystick and force exerted by the thrusters. The **Precision** is automatically changed from **High speed** to **General** when changing from high speed to low speed manoeuvring (for example from *Autopilot* mode to *Joystick* mode).

Low speed

For precise low – speed manoeuvring. Progressive relationship between movement of the joystick and force exerted by the thruster. At small movement of the joystick the change in thruster force is low, but increase with increasing movements.

Exponent

This shows the exponent used in the calculation of thrust for the currently selected

Precision option. This is for information only.

Environment Comp.

The check boxes allow you to combine joystick control with environmental compensation separately for each of the **Surge**, **Sway** and **Yaw** axes. The system then automatically compensates for the wind forces acting on the vessel by providing the thrusters with the necessary extra thrust in the appropriate direction.

When position-reference system measurements are available, the system will calculate the unknown forces, including sea current and wave forces, which are

acting on the vessel (collectively referred to as “current”) and perform automatic compensation for these forces.

Environmental compensation is always performed when selected, but the compensation due to “current” forces is zero if no position-reference system has been accepted or if **Current Upd.** is not selected.

Current Upd.

Current Update is enabled by default. You must clear the required **Surge/Sway/Yaw** check boxes if you do not want the system to compensate for the calculated residual forces for axes under joystick control.

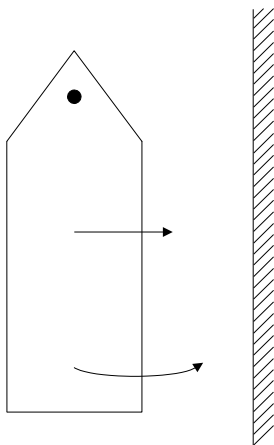
Compensating for residual forces when under joystick control normally increases the system performance when entering automatic control. However, there can be situations where the calculated residual forces are no longer valid for the new operational condition. A typical example would be when entering automatic control after a period using thrusters to hold the vessel against a quay.

k. Rotation centre for joystick manoeuvring

When the vessel is in *Joystick* or *Mixed Joystick/Auto* mode, it is possible to specify that the vessel should rotate about the fore or aft part of the vessel instead of Midships

which is the default. This feature can be useful when leaving or approaching another

vessel or a fixed structure such as a quay.



For example, when manoeuvring alongside a quay which lies to starboard, you may want to move the stern of the vessel in towards the quay without the bow moving out, while at the same time applying a small thrust to starboard. This would be difficult when using Midships as the rotation centre. By selecting the fore part of the vessel as the rotation centre, you can easily use the joystick both to rotate the vessel counter-clockwise about the bow and to move the vessel to starboard as illustrated here.

Only rotation centres that are intended for use during joystick manoeuvring can be activated in *Joystick* mode.

(01/17/20)

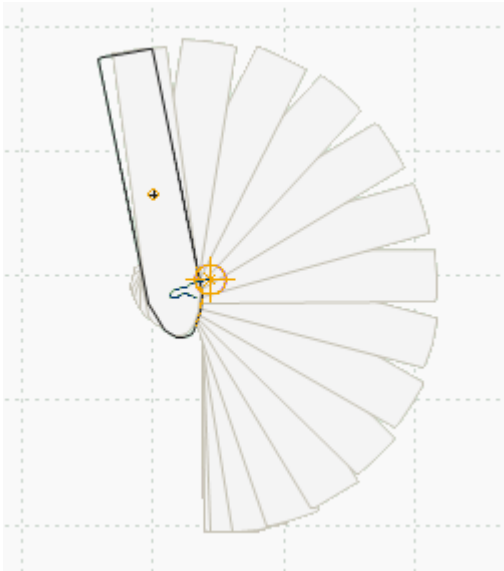
A suitable configuration of thrusters must be enabled. For example, if you want the vessel to rotate about the aft part of the

vessel, there must be at least one thruster enabled forward of the vessel centre.

In *Joystick* mode you can specify a rotation centre for use in automatic mode, but the selection will not be effective until an automatic mode is selected.

If thrusters are disabled so that the selected rotation centre no longer can be applied, the rotation centre in use will automatically be changed.

In mixed *Joystick* mode the system will, if possible, use the Fore, Midships or Aft rotation centre, but the position setpoint will be at the operator-specified rotation centre. The position controller may then force the vessel to rotate around the operator-specified rotation centre. We will clarify this with an example.



Assume that the vessel is in *Auto Position* mode with an operator-specified rotation centre different from Fore, Midships or Aft. The operator then disables automatic yaw control and uses the joystick to command the vessel to rotate counter-clockwise. The joystick control in yaw will try to rotate

the vessel around Midships, but the position control will work in such a way as to keep the vessel at its position setpoint. The vessel may then be forced to rotate around the position setpoint as shown in this figure.

I. Message System

Message priority

There are four categories of messages, depending on their severity:

- Emergency (audible signal and flashing light)
- Alarms (audible signal and flashing light)
- Warnings (flashing light)
- Information

Emergency, alarm and warning messages must be acknowledged by the operator.

• Emergency messages

Emergency messages are generated in response to critical system faults such as over-temperature or power supply failure.

All emergency messages must be critically examined to determine their cause and effect.

Alarm messages

Alarm messages are generated when conditions are detected that critically affect the capability or performance of the system (such as a system fault or a defined alarm limit exceeded).

All Alarm messages must be critically examined to determine their cause and effect.

- **Warning messages**

Warning messages inform you of the occurrence of conditions in the system that, if ignored, could result in unwanted system response or eventual failure (such as incorrect operator actions, intermittent position-reference data or a defined warning limit exceeded).

- **Information messages**

Information messages inform you of conditions that are noteworthy, but that have no serious effect on the performance of the system.

Emergency and Alarm messages are accompanied by an audible signal which continues until you acknowledge the message. There are no audible signals associated with Warning or Information messages.

m. Presentation of messages

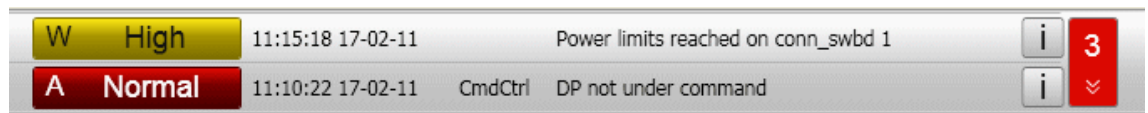
System messages are colour coded in the following ways:

- Emergency messages are displayed on red background.
- Alarm messages are displayed on red background.
- Warning messages are displayed on yellow background.
- Information messages are displayed on grey background.

The messages are presented in two different displays: on the top bar and on the Event List view. The presentation of events is subjected to filtering. Only those events that match all attributes specified in the filter are included in the presentation.

System-defined filters are provided which cannot be changed by the operator.

- The alarm presentation on the top bar always shows the most recent Emergency, Alarm or Warning message that has not yet been acknowledged.



Alarm presentation on the top bar

- The event list view contains a list of all the current system message. By pressing the ALARM VIEW buttons, can display the Event List view.

Time	Origin	Member	Tag	Priority	State	Text	Additional Info
12:13:19 05 Feb 14	DP-OST		CmdCtrl	Alarm	Warning	DP not under command	
12:43:17 05 Feb 14	DpMain	A B C		Warning	High	Internal system logging not running	DP-OST
12:42:57 05 Feb 14	DP-OST		Equipment Server	Alarm	High	Alarm Printer Station have halted	
12:42:46 05 Feb 14	DpMain	A B C		Alarm	High	Disk limit exceeded	DP-OST

Example event list view

(First column)

If you have not yet acknowledged a message, an asterisk (*) is displayed and the background colour is displayed flashing .

A vertical bar (|) is displayed in the place of the asterisk for an unacknowledged message that is in a command group over which the operator station does not have control.

Time

Time and date when the message was first reported.

Origin of the message:

- **DP-OS#** – Operator station
- **DpMain** – Controller PS group
- **Equipment** – Equipment monitoring system

Member

Members of the originator of the message (not relevant when the originator is an

Operator Station or a controller PS group with only one member).

If the message is from a controller PS group with more than one process station, this column identifies the members of the group. It may contain up to three characters, depending on the redundancy level. For example, for a triple-redundant system:

A B C	The message was reported by all three process stations and is still active.
C	The message was reported only by process station C and is still active.
- B	The message was reported by process stations A and B. The message from process station A is now inactive.
- - -	The message was reported by all three process stations and is now inactive (but is not yet acknowledged).

Tag

Identifies the source of process events and system events.

Priority

Message priority: Emergency, Alarm, Warning or Info (Information).

- **High** — Indicates that the alarm condition is present.
- **Normal** — Indicates that the alarm condition is no longer present

Additional information

Up to three blocks of additional data may be included in the message. The meaning of this additional data varies for each message. See *Message explanations — online help* on page 89.

(Event pages)

You can choose among the following Event pages:

Dynamic Alarm Page

The Dynamic Alarm Page shows a list of the most recent messages. The Dynamic Alarm Page has a limited length; as the list is filled up, the oldest messages are pushed out while the most recent ones are added to the top of the list. Messages where the underlying condition is no longer present are displayed with the state Normal.

Messages can be acknowledged on the Dynamic Alarm Page. Acknowledged messages where the underlying condition is no longer present are removed from the Dynamic Alarm Page.

Use the Dynamic Alarm Page to get a survey of the current alarm situation.

Historic Event Page

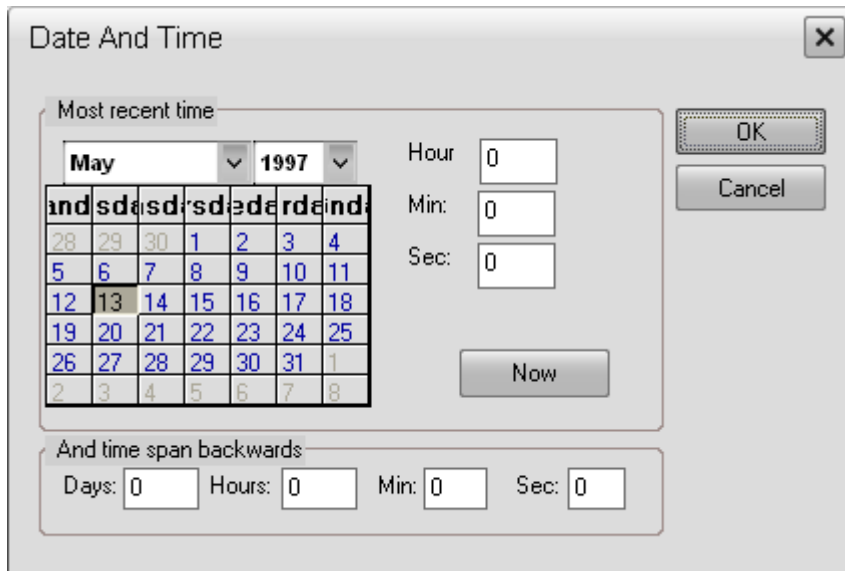
The Historic Event Page provides a log of all messages that occur. Within the limits of the event database, you can define the time span to be covered by the Historic Event Page. While a message can appear only once on the Dynamic Alarm page, it appears as many times on the historic page as there are changes in its state.

Use the Historic Event Page whenever you need to analyse the evolution of events.

If the list extends beyond the window area of the display, you can use the up/down arrows in the tool bar.

n. Dynamic Event Page

The Dynamic Event Page shows a list of the most recent messages. The Dynamic Event Page has a limited length; as the list is filled up, the oldest messages are pushed out while the most recent ones are added to the top of the list. While a message can appear only once on the Dynamic Alarm page, it appears as many times on the Dynamic Event Page as there are changes in its state. Acknowledged messages where the underlying condition is no longer present remain displayed with the state Void.



The dialog box titled "Date And Time" contains the following elements:

- Most recent time:** A group box containing:
 - Month and year dropdowns: "May" and "1997".
 - A calendar grid showing days of the month. The 13th is highlighted.
 - Time input fields: "Hour: 0", "Min: 0", "Sec: 0".
 - A "Now" button.
- And time span backwards:** A group box containing four text boxes: "Days: 0", "Hours: 0", "Min: 0", "Sec: 0".
- Buttons: "OK" and "Cancel" on the right side.

Most recent time

The time span is defined relative to a specified date and time. The “most recent time” is the reference. This group box contains controls for setting the most recent time.

And time span backwards

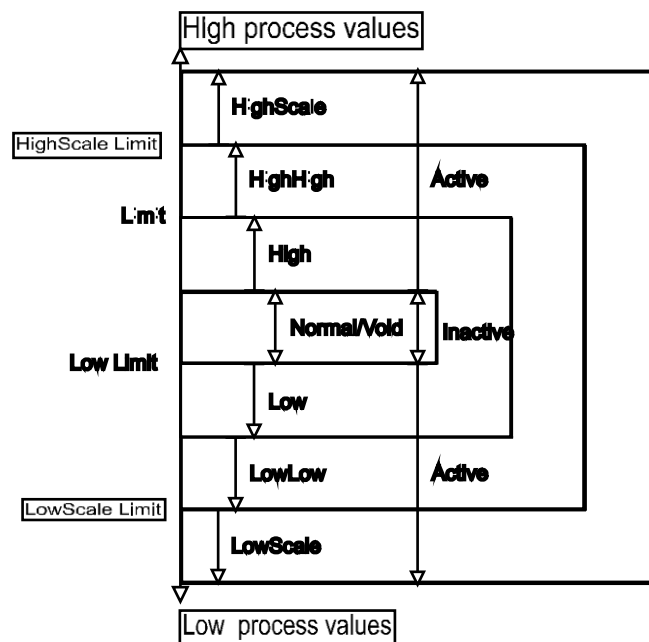
The time span is defined in days, hours, minutes and seconds backwards in time. Type in the required values in the **Days:**, **Hours:**, **Min:** and **Sec:** text boxes.

o. Alarm States

Digital alarms are either “Active” (the underlying condition is present) or “Inactive” (the underlying condition is no longer present).

Inactive digital alarms are presented with the status “Normal” on all three pages of the Event List view. Inactive, acknowledged digital alarms are presented with the status “Void” on the Dynamic Event Page and the Historic Event Page. Active digital alarms are presented with the status High on all three pages of the Event List view.

For alarms on analog terminals, however, the Active state is further refined by means of alarm limits. Figure 15 shows the relation between the alarm limits and the validity of alarms states.



An analog alarm is in the Normal/Void state when the terminal value is within the High and Low alarm limits. This means that the alarm is Inactive.

The alarm becomes Active when the terminal value exceeds the High/Low limits. Any change in the alarm state is indicated in the Status cell for that message in the Event List view.

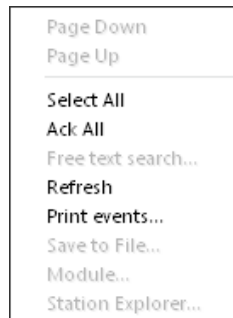
p. Acknowledging Messages

When a message has been acknowledged, and the message is reported as inactive by all the controller process stations, it is removed from the message list. If this results in “gaps” in the list displayed in the **Event List** view, you can remove these “gaps” by selecting **Refresh** on the **Event List** shortcut menu, by clicking the refresh button on the toolbar, or by closing and reopening the **Event List** view.

You can acknowledge messages in the following ways:

- Press the **ACK** button.
- Click on the alarm icon on the top bar.

- Click the  button in the tool bar of the **Event List** view.
- Place the cursor in the **Event List** view, click the right trackball button to display the following shortcut menu, and then select **Ack All**.



To acknowledge all visible current messages in the **Event List** view:

- 1 Press the **ALARM VIEW** panel button.
 - The **Dynamic Alarm Page** of the **Event List** view is displayed.
 - 2 Click the right trackball button to display the shortcut menu, and then click **Select All**.
 - The font of the message texts changes to bold.
 - 3 Press the **ACK** button or click **Ack** on the shortcut menu.
 - All visible messages are acknowledged. To acknowledge a selection of messages:
- 1 Press the **ALARM VIEW** button.
 - The **Event List** view is displayed.
 - 2 Select a group of consecutive messages by dragging the cursor over the asterisks in the left column.
 - The font of the message texts changes to bold.
 - 3 Press the **ACK** button or select **Ack** on the shortcut menu as described above.

q. System start – up / shut down and OS stop / restart

The K-Pos DP controller cabinet and Operator Stations are usually left with the power on and with the system in *Standby* mode.

Placement and naming of switches used in system start-up and shut-down procedures will vary depending on the hardware installed.

If the system has been shut down, use the procedure in the System Maintenance

Information document for your vessel to restart the system.

Stop/Restart dialog box

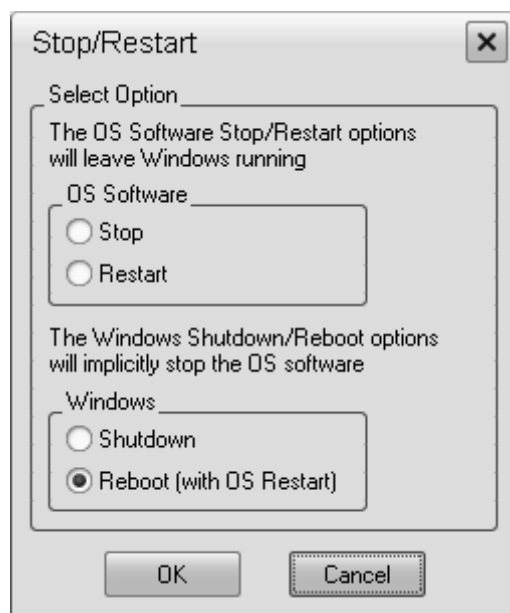
With the **Stop/Restart** dialog box, you can perform the following tasks at your Operator

Station:

- Stop the OS software and leave the Windows session running.
- Restart the OS software with the Windows session running.
- Shutdown the Windows session (and thus also stop the OS software).
- Reboot the Windows session (and thus also stop and restart the OS software). Reboot the Operator Station if the system is not performing as required, for example:
- Display views are not updated (i.e. numerical values, heading and position do not change).
- The Operator Station does not respond to operator input.

Any of these options should be performed on one Operator Station at a time to facilitate operation and monitoring of the K-Pos DP system from other Operator Stations.

To display the dialog box, select **System**→**Stop/Restart**.



OS Software

Stop

Stop the OS software and leave the Windows session running.

Restart

Restart the OS software with the Windows session running.

Windows

Shutdown

Stop the OS software, shut down the Windows session and turn off the computer.

Reboot (with OS Restart)

Stop the OS software, reboot the Windows session and restart the OS software.

The K-Pos DP controller cabinet and Operator Stations are usually left with the power on and with the system in *Standby* mode.

r. Command control dialog box

The **Command Control** dialog box shows the current command control status and allows you take or give control of the K-Pos DP system.

This dialog box has three pages, one page with the name of the Operator Station (in this example **DP-OS1**), **Overview**, and **Give**. The **DP-OS1** page is referred to as “the **DP-OS** page” and some elements are present on all three pages.

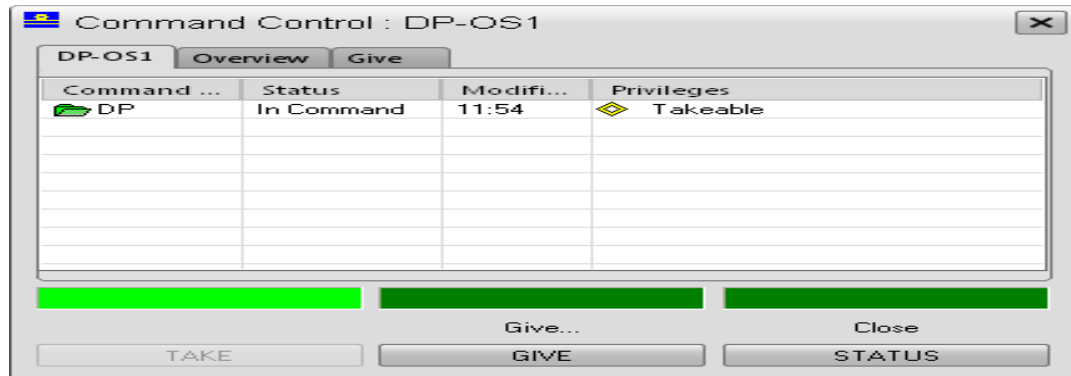
The information available from the **Command Control** dialog box is mainly intended for operation of systems with several Operator Stations.

The **Command Control** dialog box provides some opportunities not available from panel buttons

The **Command Control** dialog box is designed to correspond to the equivalent dialog box in the K-Chief system where it is more frequently used. This has been done to improve the user interface, especially on vessels with integrated automation systems on board.

To display this dialog box, press the **STATUS** button on the panel or the command group button, e.g. Main: DP, on the top bar.

s. **DP – OS page**



Command Group

All command groups are listed in this column. Only **DP** and **DP(Sim)** are of interest for the K-Pos DP system.

Status

Using the text **In Command**, this column displays the command groups over which this Operator Station has control.

Modified

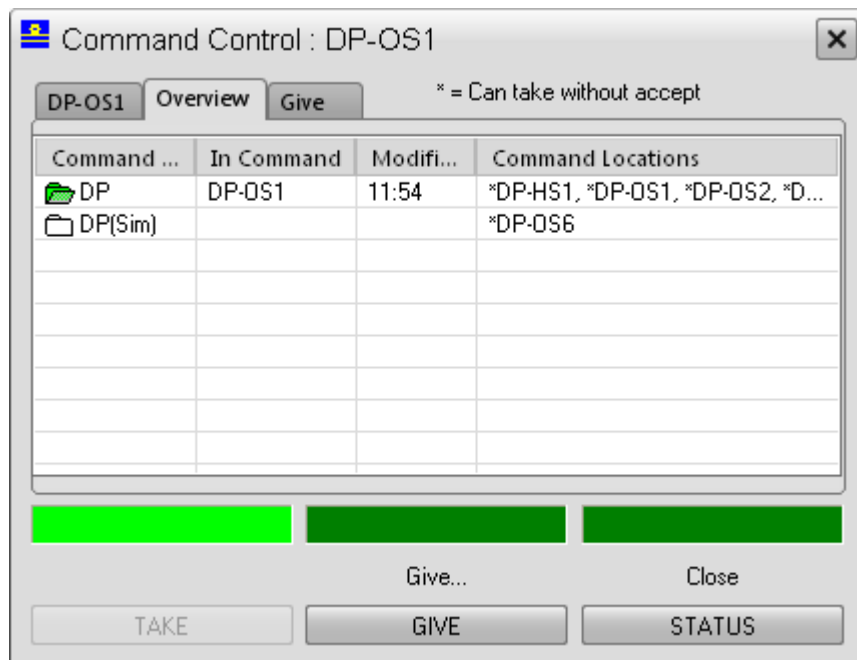
Displays the time the command control state of the command groups was last changed by this Operator Station.

Privileges

Displays the Operator Station's privileges for each command group. **Takeable** is the only one of interest for the K-Pos DP system. “Takeable” means that an Operator Station can take command of the command group in question without acceptance from the Operator Station that was originally in command.

Overview page

To display the **Overview** page, click the **Overview** page tab



Command Group

All Command groups are listed in this column.

In Command

Displays the Operator Station that is in command.

Modified

Displays the time when the command control state was last changed by any Operator Station. This may be different from the time displayed for the same command group on the **DP-OS** page as it shows the time the command control state was last changed by the Operator Station that you are at.

Command Locations

Displays the Operator Stations that can take command of each command group. The asterisks (*) means that the Operator Station can take command without acceptance. This is usually the case for Operator Stations in K-Pos DP systems.

To OS Group:

Displays the Operator Station(s) to which command can be transferred.

Give Command of:

Clicking a DP-OS in the **To OS Group** list, causes a list of all the command groups over which the Operator Station you are at (here DP-OS1) currently has command, to be displayed in this field.

Command Groups

In IAS systems, the functionality is divided into Command groups that reflect the way in which the system will be operated. Each of these Command groups will usually represent a specific process area, for example, Ballast, Power, Propulsion, Propulsion Simulation, etc.

All the available information about the command groups is available at all the connected

Operator Stations, but, for each Command group, only one Operator Station can be in command at any time.

For K-Pos DP purposes, **DP** and **DP(Sim)** are the relevant Command groups, and “Take Command”, “Request Command” and “Give Command” are the relevant command transfer actions.

DP

The Operator Station that controls this Command group, controls the vessel's Propulsion system. All operator stations can take command of DP

DP(Sim)

A simulation session can be performed on the Operator Station that controls this Command group.

A training or simulation session can be performed on the Operator Station that controls this Command group

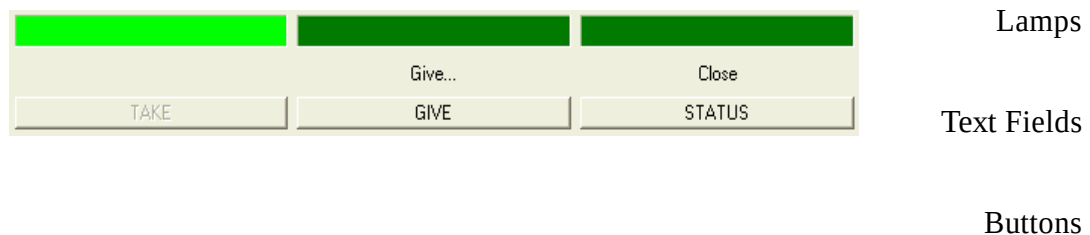
For K-Pos DP operations only the **DP** and **DP(Sim)** command groups are of interest. You select a command group by clicking its identifier in the **Command Group** list.

There is a folder icon for each command group. The folder icons are colour coded and have their presentation changed to indicate the current status of each command group.

- **Red, closed folder** — Uncontrolled, critical command group.
- **White, closed folder** — Uncontrolled command group.
- **Grey, closed folder** — Another Operator Station is in control of the command group.
- **Green, open folder** — This Operator Station (here DP-OS1) is in control of the command group.

t. Controls and indicators

The command transfer controls are divided in three groups, **TAKE**, **GIVE** and **STATUS**. Each group contains a lamp, a text field and a button.



For K-Pos DP systems, when the dialog box is open, pressing **STATUS** on the operator panel closes the dialog box.

The following descriptions of controls and indicators uses DP-OS1 as an example.

Lamps

TAKE

- Lit on **DP-OS1** when **DP-OS1** is in command.
- Not lit on **DP-OS1** when another OS is in command.
- Flashes until **DP-OS1** accepts when **DP-OS1** is offered command, or during the timeout period of one minute.
- Flashes while **DP-OS1** is giving command to another Operator Station, until the other Operator Station accepts, or during the timeout period of one minute.

GIVE

- Flashes while **DP-OS1** is giving command to another Operator Station, until the other Operator Station accepts, or during the timeout period of one minute.

Text fields and buttons

The text fields display the command transfer action that will be performed when the related button is clicked.

TAKE button and text field

The **TAKE** button is unavailable when DP-OS1 is in command or when no command group is selected for command transfer.

The messages that may appear in the text field are as follows:

- **Take...**

Default on the **Give** page. Clicking the **TAKE** button displays the **DP-OS1** or **Overview** page, depending on which was last used.

- **Take**

Appears above the **TAKE** button on the **DP-OS** page when an uncontrolled command group or a command group currently under command of another Operator Station is selected. Clicking the **TAKE** button transfers the command to DP-OS1.

- **Cancel Give...**

Appears above the **TAKE** button when a **Give** request is initiated. Clicking the **TAKE** button cancels the **Give** request.

Accept Give...

Appears above the **TAKE** button when a **Give** request is received. Clicking the **TAKE** button accepts a **Give** request and transfers command to DP-OS1.

GIVE button and text field

The messages that may appear in the text field are as follows:

Give...

Default on the **DP-OS** and **Overview** pages. Clicking the **GIVE** button displays the **Give** page.

- **Give selected...**

Appears above the **GIVE** button on the **DP-OS** and **Overview** pages when “Giveable” command groups are selected. Clicking the **GIVE** button displays the **Give** page.

- **Start Give Transfer**

Appears above the **GIVE** button on the **Give** page when “Giveable” command groups are selected. By clicking the **GIVE** button you start a **Give** transfer of the selected command groups.

- **Reject Give**

Appears above the **GIVE** button when a **Give** request is received. Clicking the **GIVE** button rejects the **Give** request.

STATUS button and text field

For K-Pos DP systems, the message that may appear in the text field is:

Close

Default above the **STATUS** button on all three pages. Clicking the **STATUS** Button closes the dialog box.

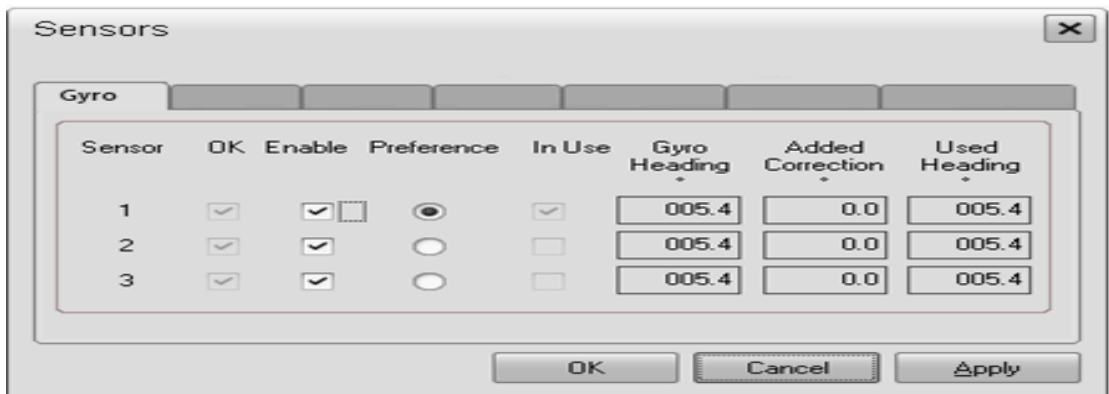
4. Controller Process Stations

i) Gyrocompasses

At least one gyrocompass must be enabled at all times to provide heading information to the system for automatic control of heading.

Gyrocompasses are enabled and controlled using the **Sensors** dialog box - **Gyro** page.

You can examine the measured values from the gyrocompasses in more detail on the Sensor view.



OK

The OK status for each gyrocompass is shown in the matching **OK** check box. The status for all channels from the gyrocompass must be OK for the check box to be selected. This check box is for information only.

Enable

Each gyrocompass has an associated **Enable** check box. Selecting this check box enables the signals from the gyrocompass. The system will automatically disable a gyrocompass if it is not OK, i.e. clear the **Enable** check box, and also make the check box unavailable.

Preference

These option buttons allows you to specify which gyrocompass is preferred for use by the system.

In Use

The gyrocompass that is currently used by the system to calculate the vessel's heading is indicated in the **In Use** check box. If the gyrocompass is not OK or a failure is detected, the check mark is cleared from the **In Use** check box, and the system will automatically switch to another gyrocompass enabled for use.

Gyro Heading

The measured heading from the gyrocompass.

Added Correction

This text box allows you to specify a gyrocompass correction to compensate for a possible offset of the ships gyrocompass for example compared with a surveyor's gyrocompass.

Faulty gyrocompasses

If measurements from a gyrocompass are not accepted by the system, a message is given with information about the failure. The message may define the faulty gyro directly; for example: **Gyro 1 not ready**. Alternatively, it may indicate only that there is a difference between the measurements from the available gyrocompasses. In the latter case, you must try to find the faulty compass by comparing the received measurements with an alternative source of heading information.

In the following examples it is assumed that two gyrocompasses are available, that both gyrocompasses are enabled and that Gyro 1 is in use:

- If there is a failure on Gyro 2 (the gyrocompass that is not in use), disable the signals from Gyro 2 and rectify the fault.
- If a fault is detected on Gyro 1 (the gyrocompass that is in use), the system will switch to Gyro 2 automatically if Gyro 2 is enabled. Disable the signals from Gyro 1 and rectify the fault.
- If there is a failure on a gyrocompass and the system cannot detect which compass is faulty; for example:

Compass difference

Do the following:

- 1 Check the values from the gyrocompasses on the Sensors view and use an alternative compass to find which gyrocompass is faulty.
- 2 Disable the faulty gyrocompass and rectify the fault.

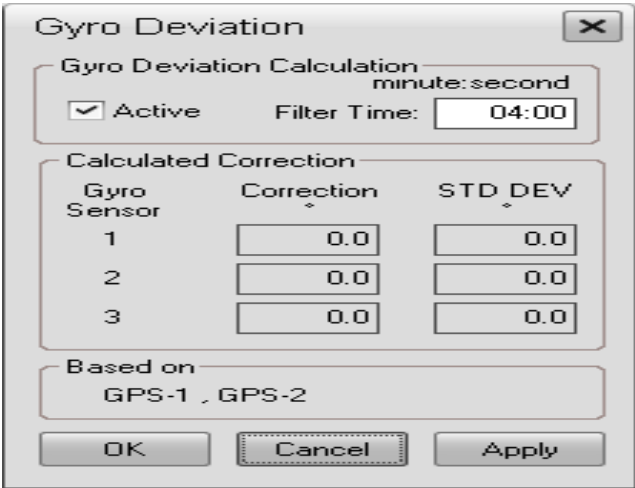
When a faulty gyrocompass is repaired, you should enable it again.

Gyro Deviation dialog box

The data from each gyro can be monitored and evaluated using Gyro Deviation Calculation. This function is based on the fact that the vessel heading can be derived from the relative positions between two GPS antennas. The error for each gyro is estimated from the filtered difference between the GPS derived heading and the gyro data. Recommended minimum antenna separation is 10 m, and the accuracy of the computed heading increases with distance between the antennas.

When sailing at high speed, the used heading may deviate from the computed heading due to lack of speed/latitude compensation. After the vessel has stopped, the **Correction** value may still be incorrect for some minutes.

To display the dialog box, select **Sensors→Gyro Deviation**.



The dialog box titled "Gyro Deviation" contains the following elements:

- Gyro Deviation Calculation** section:
 - A checkbox labeled "Active" which is checked.
 - A "Filter Time" field with a unit selector set to "minute:second" and a value of "04:00".
- Calculated Correction** table:

Gyro Sensor	Correction	STD DEV
1	0.0	0.0
2	0.0	0.0
3	0.0	0.0
- Based on** section:
 - A text field containing "GPS-1 , GPS-2".
- Buttons at the bottom: "OK", "Cancel", and "Apply".

ii) Wind sensors

At least one wind sensor should be enabled at all times to provide the system with wind speed and direction information.

Normally, input from all the available wind sensors will be enabled. The system then receives and compares the signals from all the sensors, but uses only one of them to calculate the wind force acting on the vessel.

Sensors dialog box — Wind page

Wind sensors are enabled and controlled using the **Sensors** dialog box - **Wind** page. You can specify which wind sensor is preferred for use by the system. If no errors are detected in the wind sensor measurements, the system will always use the operator-preferred sensor.

The raw measurements of wind speed and direction are filtered internally (using a Kalman filter with both low and high frequency parts), to estimate the most reasonable speed and direction values to be used by the K-Pos DP system.

To display the dialog box, select **Sensors**→**Wind**, or press the **WIND** button.

Sensor	OK	Enable	Preference	In Use	Relative Speed m/s	Relative Dir.
1	☒	☒	☒	☒	9.2	302
2	☒	☐	☐	☐	9.3	302
3	☒	☐	☐	☐	9.3	302
Manual				☐	True Speed 8.1	True Dir. 312

Spectrum Type: Harris

OK Cancel Apply

OK

The OK status for each wind sensor is shown in the corresponding **OK** check box. The status for all channels from the wind sensor must be OK for the check box to be selected. This check box is for information only.

Enable

Each wind sensor has an associated **Enable** check box. Selecting this check box enables the signals from the wind sensor.

Preference

Use these option buttons to select the operator-preferred wind sensor to be used by the system.

In Use

Indicates the wind sensor currently used to calculate the wind force acting on the vessel. If no errors are detected in the Wind sensor measurements, the system will always use the operator-preferred sensor (see **Preference** above).

Relative Speed

The displayed wind speed is the measured wind speed relative to the vessel, not corrected for vessel motion.

Relative Dir.

The displayed wind direction is the measured direction relative to the vessel heading, not corrected for vessel motion.

Manual

You can manually enter the values for wind speed and wind direction which the system should use to calculate the wind force acting on the vessel. To enter values, disable all sensors and click the **Apply** button. The **In Use** check box for **Manual** input will be selected, the **True Speed** and **True Dir** fields will appear white, and you may enter values using the keyboard or the **Numeric Entry Keypad** dialog box.

True Speed, True Dir

Display the true wind speed and direction. The present mode and whether or not one or more sensor is enabled, determine which values are displayed in these fields:

- In *Standby* mode with one or more wind sensor enabled, the **True Speed** and **True Dir** fields display the same values as **Relative Speed** and **Relative Dir**.
 - In any mode other than *Standby* with one or more wind sensor enabled, the **True Speed** and **True Dir** fields display the true wind speed and direction values (filtered values).
- In any mode with no wind sensors enabled, the **True Speed** and **True Dir** fields contain the manually-entered values for the [Wind status lamp](#)

The **WIND** button has a status lamp which shows the status of the wind sensors:

- **On** — At least one wind sensor is enabled and accepted by the system.
 - **Flashing** — The measurements from one of the enabled wind sensors are not accepted by the system or an error situation exists in at least one of the wind sensor channels if only a single wind sensor has been enabled.
- **Off** — No wind sensors are enabled.

Faulty wind sensors

If measurements from a wind sensor are not accepted by the system, a message is given with information about the failure. The message may define the faulty sensor directly; for example:

Wind 1 not ready

Alternatively, it may indicate only that there is a difference between the measurements from the available sensors. The difference may be due to a faulty wind sensor. In the latter situation, you must try to find the faulty sensor by comparing the received measurements with an alternative source of wind information.

In any case you should use an alternative source of wind information to determine which wind sensor that provides the wind measurements that is most representative for the wind forces acting on the vessel.

In the following examples it is assumed that two wind sensors are available, both sensors are enabled and Wind 1 is in use:

- If there is a failure on Wind 2 (the sensor that is not in use), disable the signals from Wind 2 and rectify the fault.

If a fault is detected on Wind 1 (the sensor that is in use), the system will switch to Wind 2 automatically. Disable the signals from Wind 1 and rectify the fault.

- If there is a failure on a wind sensor and the system cannot detect which sensor is faulty; for example:

Wind speed difference

Do the following:

- 1 Check the values from the wind sensors on the Sensors view and use an alternative source of wind information to find which sensor is faulty.
- 2 Disable the faulty sensor and rectify the fault.

When a faulty wind sensor is repaired, you should enable it again.

Operating without wind sensor input

There can be situations where you want to temporarily stop using the input from the wind sensors, such as during helicopter operations or when operating close to another large structure where there may be sudden disturbances of the measured wind. If you disable all the wind sensors, the system continues to use the wind speed and direction values that were measured just before the most recent wind sensor was disabled.

iii)VRS (Vertical Reference Sensors)

At least one vertical reference sensor must be available to provide the system with roll and pitch information. This information is used to adjust the measurements received from the position-reference systems for the vessel's roll and pitch motions. If the VRS is equipped with a heave sensor, the heave information is used for monitoring purposes only.

If VRS information is lost, the system will be unable to compensate the received position measurements for vessel motion. The positioning capability of the system can then be severely degraded.

Vertical reference sensors are enabled and controlled using the **Sensors** dialog box **VRS** page.

Normally, all the available VRSs will be enabled for use. The system then receives and compares the signals from all the VRSs, but uses only one of them. You can specify which VRS is preferred for use by the system. If no errors are detected in the VRS measurements, the system will always use the operator-preferred sensor (for which **Preference** is selected on the **Sensors** dialog box - **VRS** page).

Sensors dialog box — VRS page

Vertical reference sensors are enabled and controlled using the **Sensors** dialog box - **VRS** page.

To display the dialog box, select **Sensors**→**VRS**, or press the **VRS** button.

Sensor	OK	Enable	Preference	In Use	Pitch	Roll	Heave
1	☒	☒	☒	☒	° 0.00	° 0.00	m
2	☒	☒	☐	☐	° 0.00	° 0.00	
3	☒	☒	☐	☐	° 0.00	° 0.00	0.0

OK

The OK status for each VRS is shown in the corresponding **OK** check box. The status for all channels from the VRS must be OK for the check box to be selected. This check box is for information only.

Enable

Each VRS has an associated **Enable** check box. Selecting this check box enables the signals from the VRS.

Preference

These option buttons allow you to specify which VRS is preferred for use by the system.

In Use

The VRS that is currently used by the system is indicated in the **In Use** check box.

Pitch

The measured pitch from the VRS

Roll

The measured roll from the VRS

Heave

The measured heave from the VRS

VRS status lamp

The **VRS** button has a status lamp which shows the status of the VRS:

- **On** — At least one VRS is enabled and accepted by the system.
- **Flashing** — The measurements from one of the enabled VRSs are not accepted by the system or an error situation exists in at least one of the VRS channels if only a single VRS has been enabled.
- **Off** — No VRSs are enabled.

Displayed VRS information

You can examine the measured values from the VRS in more detail on the Sensors views.

Faulty VRS

If measurements from a VRS are not accepted by the system, or if at least one of the channels for a VRS is faulty, a message is given with information about the failure.

The message may define the faulty VRS directly; for example: **VRS not ready**. Alternatively, it may only indicate that there is a difference between the measurements from the available VRSs. In the latter situation, you must try to find the faulty sensor by comparing the received measurements with an alternative source of VRS information.

In the following examples it is assumed that two VRSs are available, that both are enabled, and that VRS 1 is in use:

- If there is a failure on VRS 2 (the VRS that is not in use), disable the signals from VRS 2 and rectify the fault.
- If a fault is detected on VRS 1 (the VRS that is in use), the system will switch to VRS 2 automatically. Disable the signals from VRS 1 and rectify the fault.
- If there is a failure on a VRS and the system cannot detect which VRS is faulty; for example,

VRS pitch difference

Do the following:

- 1 Check the values from the VRSs on the Sensors view and use alternative VRS information to find which VRS is faulty.
- 2 Disable the faulty VRS and rectify the fault.

When a faulty VRS is repaired, you should enable it again.

5. Sensors

- a. Speed measurements can be used as an addition to position measurements to improve the vessel speed control. The speed information is received from two sources, the Doppler Log sensors and the GPS speed sensors. You can enable available speed sensors or enter a manual alongships vessel speed value using the **Sensors** dialog box.

The screenshot shows the 'Sensors' dialog box with the 'Speed' tab selected. It contains three sections: 'Doppler Log', 'GPS Speed', and 'Manual Speed'.

Doppler Log			Along m/s	Athwart m/s	
Sensor	Enable	In Use			
1	☒	☐	-0.03	0.02	SOG
2	☒	☐	-0.02	0.02	SOG

GPS Speed			Speed m/s	Course °
Sensor	Enable	In Use		
1	☒	☐	0.00	358.2
2	☒	☐	0.00	358.2

Manual Speed			Along m/s	Athwart m/s
	Enable	In Use		
Manual	☐	☐	0.00	
Used speed			0.00	-0.00

Buttons: OK, Cancel, Apply

Doppler Log

Enable

Select this check box to enable the Doppler Log speed sensor. You will not be able to select this check box if the Doppler Log is not OK (the check box is dimmed).

In Use

The sensors that are currently used by the system is indicated in the **In Use** check box. If a sensor fails, it will no longer be in use, and this check box is cleared.

Along

Shows the measured alongships vessel speed.

Athwart

Shows the measured athwartships vessel speed.

The Doppler Log speed is marked with SOG or STW depending on the type of speed output:

- **SOG** — Speed over ground
- **STW** — Speed through water

GPS Speed

Enable

Select this check box to enable the GPS speed sensor. You will not be able to select this check box if the measured GPS speed is not OK (the check box is dimmed).

In Use

The sensor that is currently used by the system is indicated in the **In Use** check box. If a sensor fails, it will no longer be in use, and this check box is cleared.

Speed

Shows the measured vessel speed.

Course

Shows the measured vessel course.

Manual Speed

Enable

Select this check box to enable **Manual** speed. In high speed operations it is recommended to enable **Manual** when using speed sensors to have an initial Manual value that reflects the real situation.

In Use

If the manual value is currently used by the system, it is indicated in the **In Use** check box. This check box is for information only.

Along

When no speed sensors are enabled, you can enter a value in this field. This field is not available when one or more sensors are enabled.

If you try to enter a value that is too high, a message informing you about the legal range is displayed. You will have to change the input value to continue.

Used Speed

Shows the vessel speed used by the system. This is an average, filtered value of the combined measurements from the **In Use** speed sensors or manual input.

Along

Shows the used alongships vessel speed.

Athwart

Shows the used athwartships vessel speed. This will be zero when no speed sensors are enabled.

Sensors dialog box — Rate Of Turn page

Rate Of Turn (ROT) measurements can be used to improve the heading control of the vessel. This is useful when a very accurate heading control is required during high-speed sailing, or when a vessel has a hull shape that makes it difficult to control the heading. Measurements of the vessel's Rate Of Turn are received from the gyrocompasses, or a dedicated ROT sensor. The ROT sensors should be enabled to allow this information to be used by the K-Pos DP system.

ROT sensors are enabled and controlled using the **Sensors** dialog box - **Rate Of Turn** page. To display the dialog box, select **Sensors**→**Rate Of Turn**.

Sensor	OK	Enable	In Use	Rate Of Turn */min
1	☒	☒	☐	0.0
2	☒	☒	☐	0.0

OK

The OK status for each sensor is shown in the matching **OK** check box. This check box is for information only.

Enable

Each sensor has an associated **Enable** check box. You enable the sensor by selecting this box. The system will automatically disable a sensor that is not OK. The **Enable** check box will be cleared and will appear dimmed.

In Use

The sensor that is currently used by the system is indicated in the **In Use** check box. If no errors are detected in the ROT sensor measurements, the system will use all the OK and enabled sensors.

Rate Of Turn

Shows the measured Rate Of Turn.

6. Position Information

- a. Two dialog boxes are used to set up the required conditions for handling and conversion of position information from the position-reference systems and to and from the display :
 - The **Position Presentation** dialog box can be used to select the datum and coordinate system for display of position information. See *Position Presentation dialog box*
 - The **Reference System Properties** dialog box can be used to provide information about the input position data from each reference system. See *Reference System Properties dialog box* on page 143. The following characteristics can be specified:
 - Input datum.
 - Offset of antenna or sensor head from the vessel's Midships position.
 - Update period and accuracy.

Certain position-reference systems provide a UTM position without the required format information which must then be entered by the operator.

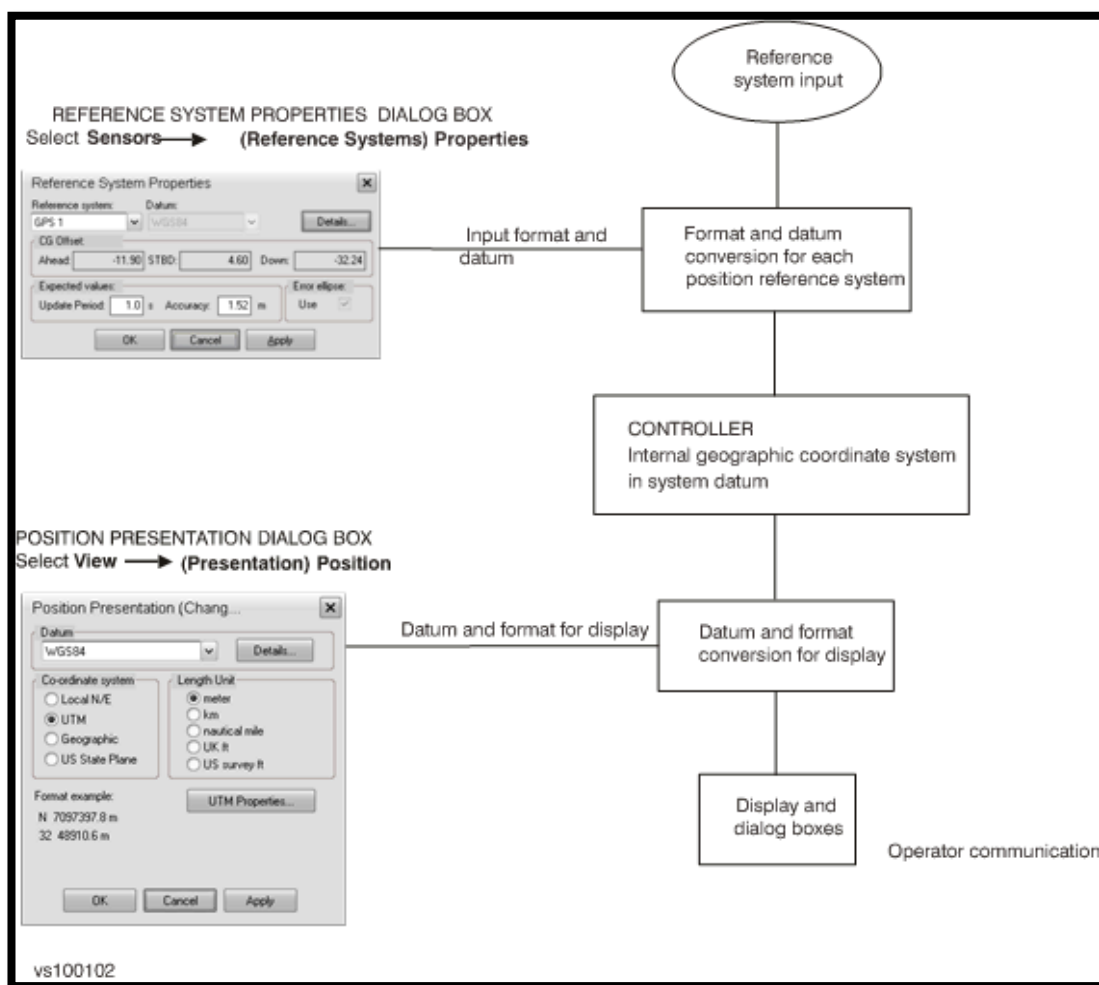


Figure 59. Dialog boxes for handling position information

b. Position presentation dialog box

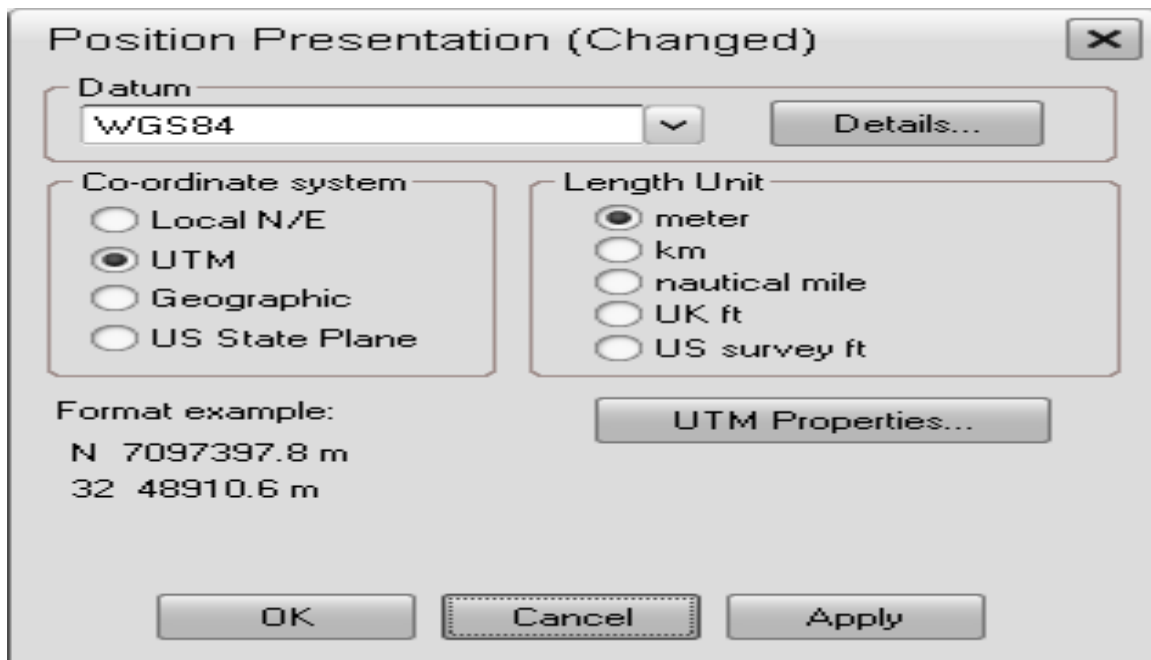
The **Position Presentation** dialog box allows you to select the display format for positions. The most appropriate display presentation for position information depends on the operational situation. For example, if you are using only a local position-reference

system such as HPR, then you will normally use a **Local N/E** presentation.

If **UTM**, **Geographic** or **US State Plane** presentation is selected for position coordinates, a presentation datum for the displayed positions must be selected because a global position must be related to a specific datum if it is to be unambiguous.

Position-presentation in global coordinates may be inaccurate when a local position-reference system is providing the reference origin.

To display this dialog box, select **View**→**(Presentation) Position**.



This dialog box changes appearance according to the selected **Co-ordinate system**.

Datum

The available datums can be selected from the drop-down list.

If **Local-datum** is selected, the **Details** button must be clicked to define all the required transformation parameters.

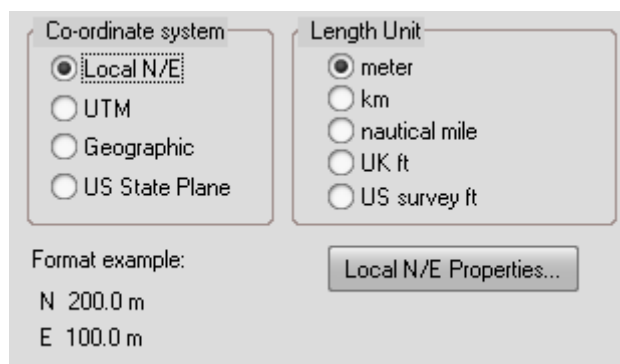
Details

Click this button to call up a dialog box which deals with definition of datum transformation parameters. See *Datum Details dialog box* on page 133.

Co-ordinate system

Select the coordinate system to be used for displaying position information.

Local N/E

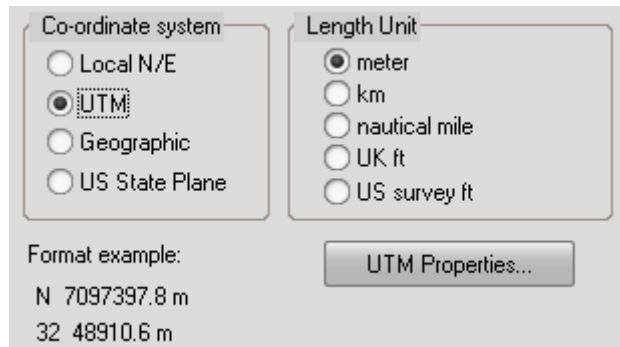


Displays positions in a local north/east coordinate system. The positions are presented as North/East coordinates relative to the local origin point. If you select

this option you can (if configured) select between a system selected or operator specified of origin.

The length unit to be used is specified by the **Length Unit** option.

UTM

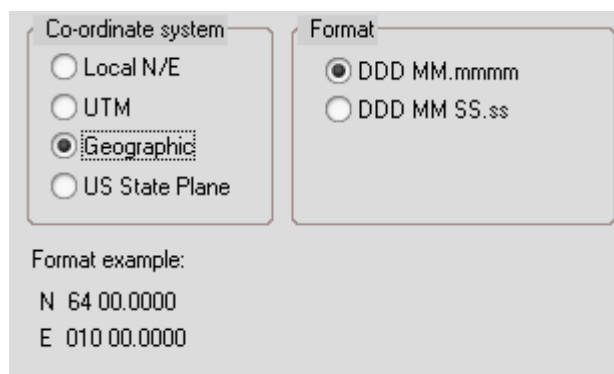


The screenshot shows a dialog box for the UTM coordinate system. It has two main sections: 'Co-ordinate system' and 'Length Unit'. In the 'Co-ordinate system' section, there are four radio buttons: 'Local N/E', 'UTM' (which is selected and highlighted with a dashed border), 'Geographic', and 'US State Plane'. In the 'Length Unit' section, there are five radio buttons: 'meter' (selected), 'km', 'nautical mile', 'UK ft', and 'US survey ft'. Below these sections, there is a 'Format example:' label followed by the text 'N 7097397.8 m' and '32 48910.6 m'. To the right of the examples is a button labeled 'UTM Properties...'.

Displays positions in the Universal Transverse Mercator projection. Positions are represented by north and east distance and UTM Zone (with compensation for false northing and false easting if appropriate; see *UTM Properties dialog box* on page 135). If you select this option, you must also select the datum that is to be used for the conversion from the internal coordinate system to these coordinates.

The length unit to be used is specified by the **Length Unit** option.

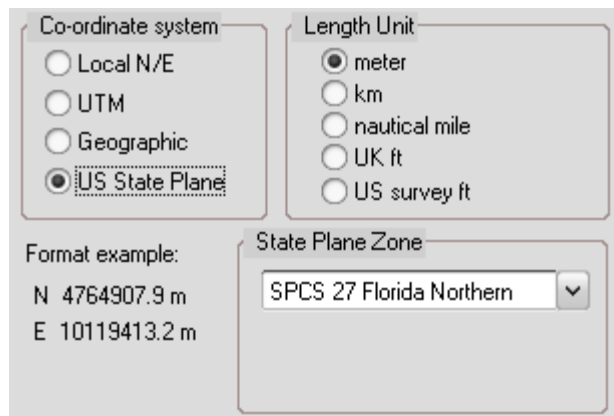
Geographic



The screenshot shows a dialog box for the Geographic coordinate system. It has two main sections: 'Co-ordinate system' and 'Format'. In the 'Co-ordinate system' section, there are four radio buttons: 'Local N/E', 'UTM', 'Geographic' (which is selected and highlighted with a dashed border), and 'US State Plane'. In the 'Format' section, there are two radio buttons: 'DDD MM.mmmm' (selected) and 'DDD MM SS.ss'. Below these sections, there is a 'Format example:' label followed by the text 'N 64 00.0000' and 'E 010 00.0000'.

Displays positions in a global geographic coordinate system. Positions are presented as latitude and longitude in the format specified by the **Format** option. If you select this option, you must also select the datum that is to be used for the conversion from the internal coordinate representation to these coordinates.

US State Plane



Co-ordinate system

☐ Local N/E

☐ UTM

☐ Geographic

☒ US State Plane

Length Unit

☒ meter

☐ km

☐ nautical mile

☐ UK ft

☐ US survey ft

Format example:

N 4764907.9 m

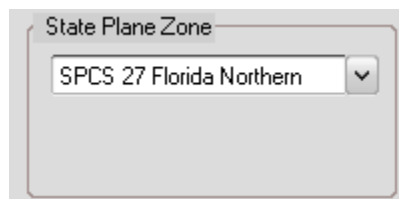
E 10119413.2 m

State Plane Zone

SPCS 27 Florida Northern

Displays positions in the US State Plane coordinate system. Positions are represented by north and east distance to the origin of the State Plane Zone. If you select this option you must also select the datum that is to be used for the conversion from the internal coordinate system to these coordinates.

If **US State Plane** is selected, the **State Plane Zone** drop-down list allows you to select the relevant state plane zone to be used.



State Plane Zone

SPCS 27 Florida Northern

SPCS 27 and SPCS 83 are defined for NAD 27 and NAD 83 respectively. The proper datum should therefore also be set, i.e. select NAD 27 as datum when using SPCS 27 and select NAD 83 when using SPCS 83.

Length Unit

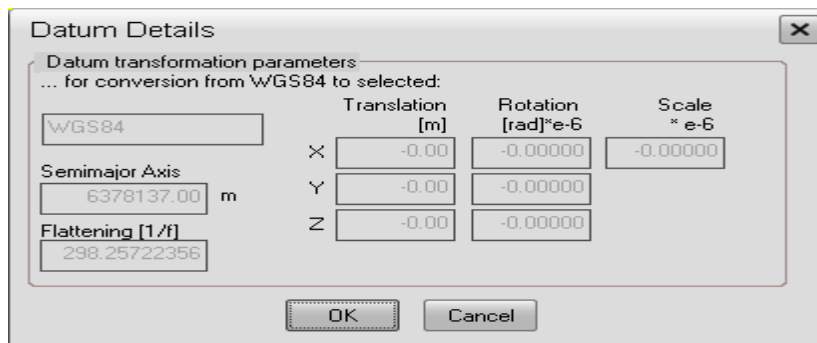
The length unit to be used is specified by the **Length Unit** option.

The **Length Unit** part of the dialog box changes according to the coordinate system selected. For **Local N/E**, **UTM** and **US State Plane** presentations, the system allows you to select the length unit to be used. For **Geographic** presentation, the system allows you to select the display format for latitude and longitude.

c. Datum details dialog box

A datum describes the earth as an ellipsoid using two parameters: **Semimajor Axis** and **Flattening**.

The **Datum Details** dialog box contains the **Semimajor Axis** and **Flattening** values and datum transformation parameters for conversion from WGS84 to the selected datum. To display the dialog box, select Details button on the Position Presentation dialog box.



The **Datum Details** dialog box is used for datum transformation parameters. It includes a dropdown for the source datum (WGS84), input fields for Semimajor Axis (6378137.00 m) and Flattening (1/f) (298.25722356), and a table for transformation parameters.

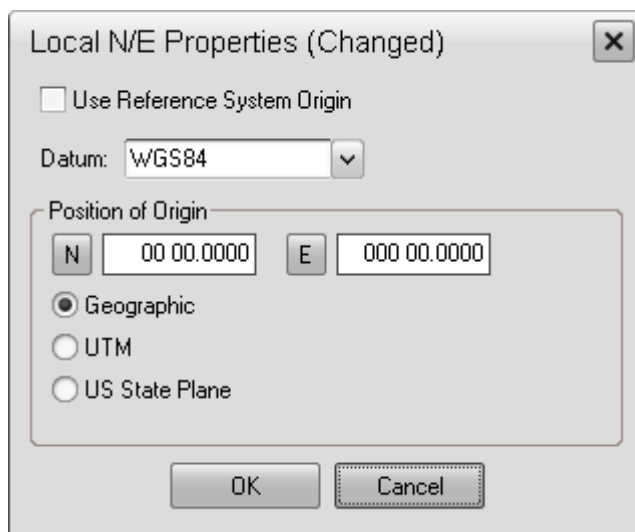
	Translation [m]	Rotation [rad]*e-6	Scale * e-6
X	-0.00	-0.000000	-0.000000
Y	-0.00	-0.000000	-0.000000
Z	-0.00	-0.000000	-0.000000

Buttons: OK, Cancel

d. Local N/E Properties dialog box

The **Co-ordinate system - Local N/E** option button on the **Position Presentation** dialog box must be selected.

To display the dialog box, click the **Local N/E Properties** button.



The **Local N/E Properties (Changed)** dialog box allows configuration of the local coordinate system. It includes a checkbox for 'Use Reference System Origin', a 'Datum' dropdown (WGS84), and a 'Position of Origin' section with N and E input fields (both 00 00.0000). It also has radio buttons for Geographic (selected), UTM, and US State Plane.

Buttons: OK, Cancel

Use Reference System Origin

Allows you to select between a system selected or operator-specified position of origin.

When this check box is selected, the position data of the reference origin is subtracted from the position information received by the system.

An operator-specified position of origin cannot differ from the actual position by more than 20000m. If you try to enter a position of origin that is too far from the actual position, a message box is displayed informing you about the error.

Datum and **Position of Origin** are unavailable when the check box is selected.

Leave the check box cleared if you want to use an operator-specified position of origin.

Datum

Select the required datum for position of origin (on this dialog box only).

Position of Origin

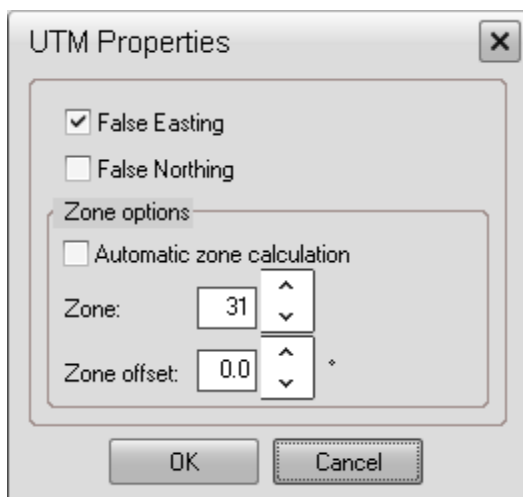
Enter coordinates of the position of origin.

Select the format of the position of origin (in this dialog box only), **Geographic**, **UTM** or **US State Plane**.

e. UTM Properties dialog box

The **Co-ordinate system - UTM** option button on the **Position Presentation** dialog box must be selected.

To display the dialog box, select the **UTM Properties** button.



False Easting

When **UTM** presentation is selected, to avoid the presentation of negative coordinates, you can specify that a fixed offset of 500 000 m is to be added to the east/west component of a UTM position before it is displayed.

False Northing

When UTM presentation is selected, you can specify that a fixed offset of 10 000 000 m is to be added to the north/south component of a UTM position before it is displayed (10 000 000 m is the approximate distance from the Equator to the North Pole in a UTM grid). This avoids the display of negative coordinates for positions in the southern hemisphere. False Northing is normally only applicable on the southern hemisphere.

Zone options

Automatic zone calculation

Select this box to have the UTM zone calculated automatically from the geodetic position measurements.

Zone

The required system UTM zone (not available if the UTM zone is calculated automatically).

Zone offset

Allows you to apply a fixed offset to the received longitude degrees when calculating the UTM zone of a position. You can offset the system UTM zone up to $\pm 3^\circ$.

Methods for enabling position – reference systems

The K-Pos DP system provides the following methods for enabling and disabling position-reference systems:

- Panel buttons
- One of the following, depending on system configuration:

- **Reference System Settings** dialog box
- **Reference System** dialog box

For information about all the options available from these dialog boxes.

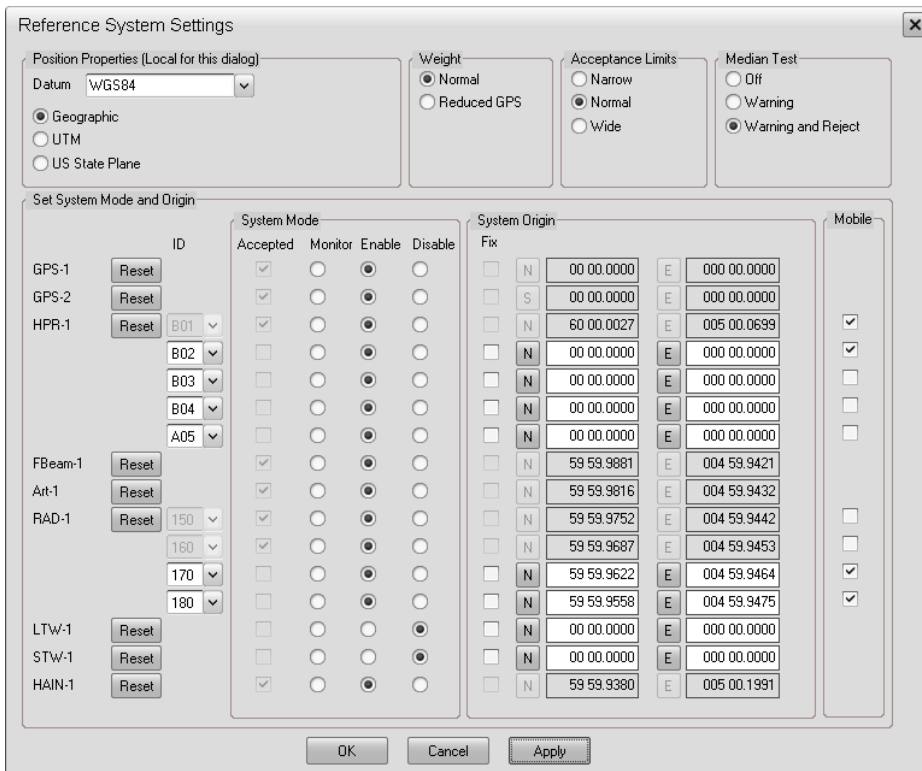
Panel buttons

The **SENSORS** button group contains buttons which enable or disable each of the available position-reference systems. Each button has a status lamp which shows the status of the reference system:

- **Off** — disabled
- **Flashing** — enabled and calibrating, enabled and calibrated but rejected by the DP, or not providing data
- **On** — enabled and accepted (acceptable position measurements are being received)

Reference System Settings dialog box

To display the dialog box, select **Sensors→(Reference Systems) Settings**.



The screenshot shows the 'Reference System Settings' dialog box. It is divided into several sections:

- Position Properties (Local for this dialog):** Includes a 'Datum' dropdown set to 'WGS84' and three radio buttons: 'Geographic' (selected), 'UTM', and 'US State Plane'.
- Weight:** Includes two radio buttons: 'Normal' (selected) and 'Reduced GPS'.
- Acceptance Limits:** Includes three radio buttons: 'Narrow', 'Normal' (selected), and 'Wide'.
- Median Test:** Includes three radio buttons: 'Off', 'Warning', and 'Warning and Reject' (selected).
- Set System Mode and Origin:** This section contains a table with columns for 'ID', 'System Mode' (Accepted, Monitor, Enable, Disable), 'System Origin' (Fix), and 'Mobile'.

ID	System Mode	System Origin	Mobile			
	Accepted	Monitor	Enable	Disable	Fix	
GPS-1	☒	☐	☒	☐	☐	N 00 00.0000 E 000 00.0000
GPS-2	☒	☐	☒	☐	☐	S 00 00.0000 E 000 00.0000
HPR-1	☒	☐	☒	☐	☐	N 60 00.0027 E 005 00.0699
	☐	☐	☒	☐	☐	N 00 00.0000 E 000 00.0000
	☐	☐	☒	☐	☐	N 00 00.0000 E 000 00.0000
	☐	☐	☒	☐	☐	N 00 00.0000 E 000 00.0000
FBeam-1	☒	☐	☒	☐	☐	N 59 59.9881 E 004 59.9421
Art-1	☒	☐	☒	☐	☐	N 59 59.9816 E 004 59.9432
RAD-1	☒	☐	☒	☐	☐	N 59 59.9752 E 004 59.9442
	☒	☐	☒	☐	☐	N 59 59.9687 E 004 59.9453
	☐	☐	☒	☐	☐	N 59 59.9622 E 004 59.9464
	☐	☐	☒	☐	☐	N 59 59.9558 E 004 59.9475
LTw-1	☐	☐	☐	☒	☐	N 00 00.0000 E 000 00.0000
STW-1	☐	☐	☐	☒	☐	N 00 00.0000 E 000 00.0000
HAIN-1	☒	☐	☒	☐	☐	N 59 59.9380 E 005 00.1991

At the bottom of the dialog box are buttons for 'OK', 'Cancel', and 'Apply'.

Position Properties

Select the required **Datum** for position presentation to be used on this dialog box. Select the format of the position of origin, either **Geographic**, **UTM** or **US State**

Plane.

Weight

You can change the position-reference system's relative weight.

Normal

Provides standard relative weight between the enabled position-reference systems, i.e. all systems with equal estimated variance have equal weights.

Reduced GPS

Reduces the influence from the measured GPS positions relative to measurements from other position-reference systems.

Reduced GPS weight is especially important if you have an oscillating GPS system, as often will be the case in equatorial waters due to ionospheric degradation of GPS. In this way a position-reference system with slow update rate, such as an LBL system, will have greater influence on the model than a GPS system with faster update rate.

Example showing typical relative weights when using 2 GPSs and 1 LBL with similar accuracy levels:

	GPS-1	GPS-2	HPR
Normal	0.33	0.33	0.33
Reduced GPS	0.10	0.10	0.80

The relative weights used are shown on the Reference system main view.

Acceptance Limits

The acceptance limit for the Prediction Test and indirectly also the Median Test can be changed.

Narrow

Narrow limit. Corresponds to a Minimum Prediction Error circle with a small radius. The radius may still increase due to increased noise in the position-reference system. **Narrow** is recommended when operating in calm weather and with requirements for accurate station-keeping. If all available (or the dominating) position reference exhibit an erroneous drift in position, the system(s) will also

be rejected at an early stage before the vessel is significantly affected by the wrong measurements.

Normal

Medium limit. The same Minimum Prediction Error limit as for **Narrow** is used. There is an additional feedback mechanism where the actual deviation from the model is used to increase the Prediction Error limit up to a maximum of 2 to 3 times the smallest radius. **Normal** should be applied in situations where there is a chance that the DP model does not follow the actual movement of the vessel. This is especially relevant when operating in rough sea. It is also applicable for a vessel operating with another vessel alongside. A negative side-effect of this setting is that the system will, to a larger extent than with the **Narrow** setting, tend to follow drifting position-reference systems.

Wide

Wide limit. A Minimum Prediction Error circle with an increased radius compared to the other two settings is used. The same feedback mechanism as for **Normal** is used, and the maximum value of the Prediction Error is also increased. **Wide** is suitable, for example, for sailing in *Mixed/Joystick* mode at high speed.

Median Test

The settings of the Median Test (see *Median test* on page 151) can be changed.

Off

Turns off the median testing. This is indicated with the text **OFF** in the **Median Test** field on the Refsys view, and by removal of the median test limit circle from the plot on the Refsys view.

Warning

Turns on the median testing. When selected, a deviation warning is given if the difference between the position data from a specific position-reference system and the median of all online reference systems exceeds a preset warning limit.

Warning can be preferable compared to **Warning and Reject** (below) in some instances. For example, when operating with two GPSs and one or two HPR systems, and the GPSs have similar failures, **Warning and Reject** could lead to rejection of the HPR by the median test.

Warning and Reject

Turns on the median testing. When selected, a reject warning is given if the difference between the position data from a specific position-reference system and the median of all online reference systems exceeds a preset combined warning and reject limit. The position-reference system is rejected.

The median test limit circle is shown on the plot on the Refsys view, together with the limit value in the Median Test field.

Set System Mode and Origin

Reset

Click this button to reset the System Origin and to deselect all position sources of the corresponding position-reference system.

ID

Select the position sources to use for the required position-reference systems from the drop-down lists.

System Mode

The **Accepted** check boxes show which position-reference systems and/or individual position sources are currently enabled and accepted. The **Monitor**, **Enable** and **Disable** option buttons are used for selecting position-reference systems and individual position sources to monitor, enable and disable, respectively.

A reference system enabled for monitoring will not influence the DP model (zero weight), and it will not be included as an active reference system for the median test. Apart from this all other reference system checking is active.

System Origin

The operator may choose to fix the reference origin of one or more reference systems. A reference system with a fixed reference origin will not be calibrated towards the model. Fixed reference origins can be specified by typing the coordinates and selecting **Fix**. This is useful when the reference origin is known, for example the position of an HPR or LBL transponder relative to a BOP or an Artemis Fix antenna.

Mobile

Position sources can be specified to be mobile by selecting the corresponding check boxes. This is important for operations such as following a mobile target.

f. Reference System Properties Dialog Box

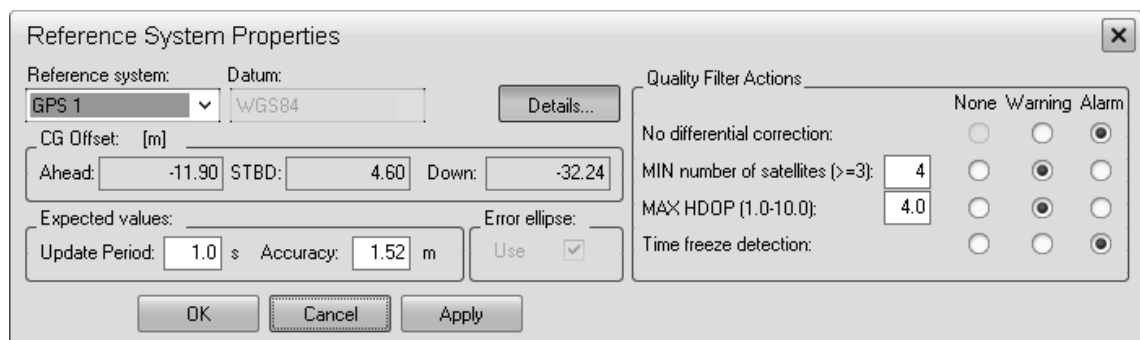
The **Reference System Properties** dialog box allows you to change the characteristics, update period and accuracy of a position-reference system.

However, the characteristics of the position-reference system can only be defined when it is not enabled for use or monitoring, whereas the update period and accuracy can be specified while in operation.

The **Reference System Properties** dialog box can be used to define the input conversion that is required for each position-reference system:

- For global reference systems, you must specify the datum that is used by that system so that the position information can be converted to the selected system datum.
- For all reference systems, you can specify the offset from the antenna or sensor head on the vessel to the vessel's Midships position, so that the position information can be adjusted for this offset.

To display the dialog box, select **Sensors→(Reference Systems) Properties**.



The dialog box is titled "Reference System Properties" and contains several sections. On the left, there is a "Reference system:" dropdown menu with "GPS 1" selected, and a "Datum:" dropdown menu with "WGS84" selected. Below these are three input fields for "CG Offset: [m]" with values "Ahead: -11.90", "STBD: 4.60", and "Down: -32.24". There is also a "Details..." button. On the right, there is a "Quality Filter Actions" section with three columns of radio buttons labeled "None", "Warning", and "Alarm". The first row is "No differential correction:" with "None" selected. The second row is "MIN number of satellites (>=3):" with a value of "4" and "Warning" selected. The third row is "MAX HDOP (1.0-10.0):" with a value of "4.0" and "Warning" selected. The fourth row is "Time freeze detection:" with "Alarm" selected. At the bottom, there is an "Expected values:" section with "Update Period: 1.0 s" and "Accuracy: 1.52 m", and an "Error ellipse:" section with a "Use" checkbox checked. At the very bottom are "OK", "Cancel", and "Apply" buttons.

Reference system

Select the name of the reference system from the list box. If you have changed the properties of a reference system, and then selected another system from the list, a dialog box is displayed prompting you want to save the changes.

Datum

For a global reference system, the datum in which the position measurements are received. If this datum is different from the selected system datum (WGS84), conversion to the system datum will be performed.

If position information from a global reference system is based on a predefined datum other than those present in the **Datum** drop-down list, you can select

Local-datum from this drop-down list. You must then use the **Position Presentation**

dialog box and **Datum Details** dialog box (see *Position Presentation dialog box* on page 130 and *Datum Details dialog box* on page 133, respectively) to define the required transformation parameters.

CG Offset

Allows you to specify the offset (**Ahead**, **STBD** and **Down**) from the antenna or sensor head on the vessel to the vessel's centre of gravity (Midships). The received position information is then adjusted for this offset.

Expected values

Allows you to specify an **Update Period** and an **Accuracy** for the selected

position-reference system. The **Update Period** is mostly used for HPR systems. To avoid unnecessary timeout warnings, you can extend the **Update Period** and thus the time before a warning is issued. The **Accuracy** value is used for calibration purposes and when testing the accuracy of the position-reference system. If calibration fails, increase the value to ease calibration of a position-reference system. Note that the higher the value entered in the **Accuracy** text box, the wider the limits for the tests on position-reference systems.

Error ellipse

The system calculates a variance of the measurements for each position-reference system. Based on these calculations, the system places different weighting on their measurements according to each system's individual quality and gives

more emphasis on the position-reference systems that are providing the best measurements. The higher the system's variance, the lower its weighting factor.

In addition, an error ellipse may be used while calculating the accuracy of the measurements — check box selected.

For some reference systems this error ellipse can be too large and pessimistic, resulting in lower weighting of the reference system than necessary. De-select the check box to switch off the function for including the error ellipse in the calculations.

To change the selection of the function, the reference system should be de-selected (the respective button on the panel unlit).

Depending on the type of position-reference system and its internal settings, this function can be permanently set to on or off and not available for the operator to select it.

Details

Clicking this button opens an extension of the **Reference System Properties** dialog box. This expansion allows you to set up a quality filter, defined as a general satellite navigation system filter for both GPS, GLONASS and GNSS reference systems.

The **Details** button is only present in the **Reference System Properties** dialog box when one of the above satellite navigation reference systems has been selected in the list box.

7. Main Modes and Operating Procedures

a. Joystick Mode

In Joystick mode, the operator controls the movement of the vessel using the three-axis joystick.

The following applies if the operator is facing forwards or aft when looking at the display screen:

- Moving the joystick forward/back controls the vessel in the surge axis.
- Moving the joystick left/right controls the vessel in the sway axis.
- Rotating the joystick rotates the vessel (the yaw axis).

The following applies if the operator is facing to port or starboard when looking at the display screen:

- Moving the joystick forward/back controls the vessel in the sway axis.
- Moving the joystick left/right controls the vessel in the surge axis.
- Rotating the joystick rotates the vessel (the yaw axis).

From standby mode to joystick mode

To take the system from *Standby* mode to *Joystick* mode:

- 1** Ensure that the joystick is in the zero position in all three axes, and that it is functioning correctly.

- 2 Ensure that the required gyrocompasses are enabled.
- 3 Ensure that the required wind sensors are enabled.
- 4 Ensure that the required VRSs are enabled.
- 5 Ensure that the required draught sensors are enabled
- 6 Ensure that the required thrusters, propellers and rudders are enabled
- 7 If the vessel has a switch or button to select between manual and K-Pos DP thruster control (usually located on the main thruster control panel), set this switch/button to K-Pos DP.
- 8 Press the **JOYSTICK** button twice.
 - The **JOYSTICK** button status lamp starts to flash and then becomes steadily lit when the mode is entered.
- 9 Enable the required position-reference systems.

Joystick control of position and heading

To move the vessel along the surge and sway axes (alongships and athwartships directions), tilt the joystick. The direction in which the joystick is tilted determines the direction of applied thruster force, and the angle of tilt determines the amount of applied thruster force.

To turn the vessel (the yaw axis), rotate the joystick. The direction in which the joystick is rotated determines the direction of the turning force demand, and the angle through which the joystick is rotated determines the amount of applied turning moment.

Mixed joystick/ auto modes

While remaining in *Joystick* mode, and provided the required gyrocompasses and/or position-reference systems are enabled, you can select either one or two of the surge, sway and yaw axes for automatic control:

- Press the **YAW** button for automatic heading control with joystick control of the surge and sway axes
- Press the **SURGE** and **SWAY** buttons for automatic position control with joystick heading control

- Press the **YAW** and **SURGE** buttons for automatic heading control, automatic stabilisation in the surge axis, and joystick control of the sway axis
- Press the **YAW** and **SWAY** buttons for automatic heading control, automatic stabilisation in the sway axis, and joystick control of the surge axis

If you select all three axes for automatic control, the system automatically enters the *Auto Position* mode.

Joystick mode with automatic heading control

In *Joystick* mode with a gyrocompass enabled, you can select automatic heading control. When automatic heading control is selected, the system automatically provides the thruster control necessary to maintain this heading.

Selecting automatic heading control

To select automatic heading control while in *Joystick* mode:

- 1 Check that none of the status lamps for the **SURGE**, **SWAY** or **YAW** buttons are lit.
- 2 Ensure that the required gyrocompasses.
- 3 Press the **YAW** button twice within four seconds.
 - The **YAW** button status lamp starts to flash.
 - The vessel rotation (Rate Of Turn) starts to slow down in a controlled manner at a rate that depends on the selected controller gain.
 - When the Rate Of Turn is reduced to less than a predefined limit, automatic heading control is enabled and the **YAW** and **PRESENT HEADING** button status lamps become steadily lit. The current vessel heading becomes the heading setpoint, and the system automatically keeps the vessel on this heading.
 - The deviation between the estimated heading and the heading setpoint is shown on the Heading pane.

b. Auto Position Mode

In *Auto Position* mode, the system automatically maintains the heading and position of the vessel. This mode requires at least one active gyrocompass and at least one active position-reference system. The actual number of active sensors required depends on the DP Class requirements for the operation to be performed.

From Joystick mode to Auto Position mode

To take the system from *Joystick* mode to *Auto Position* mode:

1. Ensure that none of the status lamps above the **YAW**, **SURGE** and **SWAY** buttons are lit.
2. Ensure that at least one gyrocompass is active and enabled
3. Ensure that at least one position-reference system is active and enabled
4. Ensure that either **High Precision** or **Relaxed** (if configured) is set as the selected

Controller Mode in the **Gain** dialog box.

5. Hold the vessel as stationary as possible using the joystick.
6. Press the **AUTO POSITION** button twice within four seconds.
 - The **AUTO POSITION** button status indicator starts to flash and then becomes steadily lit when the mode is entered.
 - The **YAW**, **SURGE** and **SWAY** button status lamps start to flash.
 - The vessel rotation (Rate Of Turn) starts to slow down in a controlled manner at a rate that depends on the selected controller gain.
 - The deviation between the estimated heading and the heading setpoint is shown in the Heading area of the display.

The vessel starts to slow down (loose speed) in the surge and sway axes in a controlled manner at a rate that depends on the selected controller gain.

- When the vessel speed (in both the surge and sway axes) is reduced to less than predefined limits, automatic position control is enabled and the **SURGE**, **SWAY** and **PRESENT POSITION** button status lamps become steadily lit. The current vessel position becomes the position setpoint, and the system automatically keeps the vessel at this position.
- The deviation between the estimated position and the position setpoint is shown on the Position area on the display.

If *Green* controller mode is desired, continue as follows:

7. Allow the vessel to stabilise in *Auto Position* mode for about 15 minutes to attain optimal performance in the *Green* controller mode.
8. Select *Green* controller mode with the required area set in the **Gain** dialog box.
 - The defined area is displayed on the Posplot view. The inner and outer areas are indicated with dashed circles with green shading on the inner area.

c. Changing the position setpoint

Stopping the movement during change of position

You can stop the movement of the vessel during change of position either by changing the setpoint to the present position or, in some modes, by taking a pause (without changing the setpoint).

Stopping by use of the Present Position button

To set the vessel's present position as the position setpoint, press the **PRESENT POSITION** button twice within four seconds.

The **PRESENT POSITION** button status indicator starts to flash and then becomes continuously lit when the vessel's present position is set as the position setpoint.

Stopping by use of the STOP button

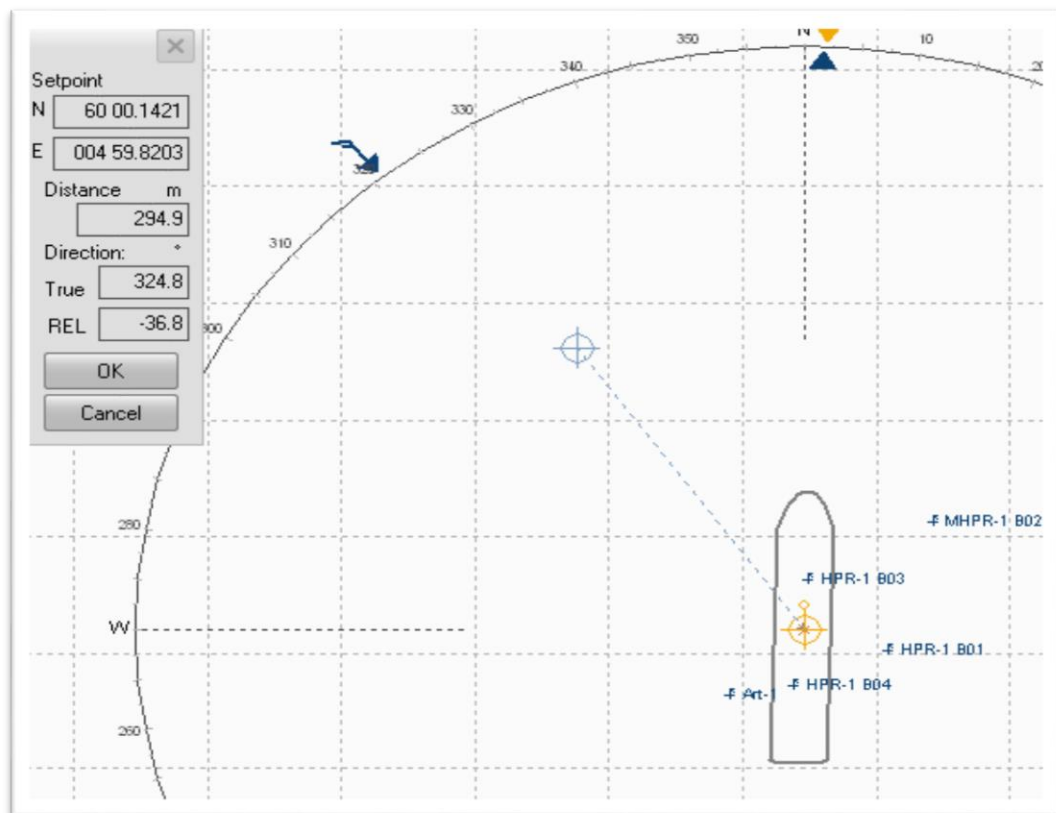
To take a pause in the movement while changing the position:

1. Press the **STOP** button twice within four seconds. The vessel starts to slow down in a controlled manner at a rate that depends on the selected controller gain.
2. The **SURGE** and **SWAY** button status lamps are flashing and the text 'SLOWDOWN' is shown in the heading pane on the dashboard.
3. When the vessel comes to a stop the **SURGE** and **SWAY** button status lamps become steadily lit and the text 'STOPPED' is shown in the heading pane on the dashboard.
4. Deselect the **STOP** button and the vessel will continue the movement to the defined position setpoint.

Marking a new position setpoint on the Posplot view

With the Posplot view displayed, you can change the position setpoint using the trackball.

1. Click on the position setpoint symbol  in the Posplot view.
 - The **Position** dialog box is displayed.



2. Move the setpoint symbol with the trackball.
 - The setpoint symbol moves on the display and the position coordinates are updated dynamically on the **Position** dialog box.
3. Click again to fix the setpoint symbol at the required position.
 - A temporary position setpoint symbol is displayed at the new position and the coordinates, distance and both true and relative direction from the present position setpoint are displayed on the **Position** dialog box.
4. Either click the **OK** button to accept the new position setpoint, or click the **Cancel** button to continue using the existing setpoint.

d. **Position dialog box**

The **Position** dialog box contains four tabbed pages (**Inc**, **R/B**, **Absolute** and **Speed**) that allow you to specifying the required position setpoint in the following ways:

- **Inc** (Incremental) for defining the setpoint relative to the existing setpoint
- **R/B** for defining the setpoint using range and bearing

- **Absolute** for defining the setpoint using absolute coordinates
- **Speed** for specifying the speed at which the vessel should try to move during a change of position

To display the dialog box, select **Positioning→Position** or press the **CHANGE POSITION**

button.

Inc page

The **Inc** (Incremental) page allows you to define the position setpoint relative to the existing setpoint.

You can select either **Relative** or **True** increments. An increment can be entered by typing a value into the increment spin box. The size of the increment can be adjusted by clicking on the up or down arrows next to the increment spin box.

To add the selected increment in a particular direction to the **New Setpoint** coordinates, click **Ahead/Astern/Port/Starboard** or **North/South/East/West** as appropriate. Each time you click one of these, the **New Setpoint** coordinates are adjusted and the temporary setpoint symbol on the Posplot view is moved accordingly.

The screenshot shows the 'Position' dialog box with the 'Inc' tab selected. The 'New Setpoint' section shows coordinates N 60 00.0001 and E 005 00.0000. Below this are buttons for 'Relative' and 'True' (selected), and directional buttons: 'Ahead', 'PORT', '1.0' (spin box), 'STBD', and 'Astern'. The 'From Present Setpoint to New Setpoint' section shows 'Range' 0.0 m and 'True Bearing' 000.0°. At the bottom are 'OK', 'Cancel', and 'Apply' buttons.

New Setpoint

Shows the coordinates that will be used for the new position setpoint when you click the **OK** or **Apply** button.

A temporary setpoint symbol is displayed on the Posplot view showing the position of the **New Setpoint** relative to the **Present Setpoint**.

Relative

This applies increments **Ahead/Astern/Port/Starboard**.

True

This applies increments **North/South/East/West**.

From Present Setpoint to New Setpoint

Shows the **Range** and **True Bearing** from the **Present Setpoint** position to the **New Setpoint** position.

R/B page

The **R/B** page allows you to define the position setpoint using range and bearing.

The image shows a 'Position' dialog box with a close button (X) in the top right corner. It contains several tabs: 'Inc', 'R/B', 'Abs', and 'Speed'. The 'R/B' tab is selected. Inside the dialog, there is a section for 'New Setpoint:' with input fields for 'N' (60 00.0001) and 'E' (005 00.0000). Below these are 'Range' (0.0 m) and 'Bearing' (000.0 °) fields. Another section, 'Start position', has two radio buttons: 'Present Setpoint' (selected) and 'Present Position'. To the right, a 'Bearing' section has two radio buttons: 'True' (selected) and 'Relative'. A third section, 'From Present Setpoint to New Setpoint:', contains 'Range' (0.0 m) and 'True Bearing' (000.0 °) fields. At the bottom are 'OK', 'Cancel', and 'Apply' buttons.

New Setpoint

Shows the coordinates that will be used for the new position setpoint when you click the **OK** or **Apply** button.

A temporary setpoint symbol is displayed on the Posplot view showing the position of the **New Setpoint** relative to the **Present Setpoint**.

To define a new position setpoint, enter the range and bearing in the **Range** and **Bearing** text boxes.

Start position

Choose whether the new position setpoint is to be calculated relative to the **Present Setpoint** or the **Present Position** by clicking the matching option button.

Bearing

Select either **True** or **Relative** bearing by clicking the matching option button.

From Present Setpoint to New Setpoint

Shows the **Range** and **True Bearing** from the **Present Setpoint** position to the **New Setpoint** position.

Abs page

The **Abs** page allows you to define the position setpoint using absolute coordinates.

The image shows a 'Position' dialog box with a close button (X) in the top right corner. It has four tabs: 'Inc', 'R/B', 'Abs' (which is selected), and 'Speed'. The 'New Setpoint' section contains a latitude input (N 60 00.0001) and a longitude input (E 005 00.0000). The 'Previous Setpoint' section has a 'Use' button followed by the same latitude and longitude values. The 'From Present Setpoint to New Setpoint' section includes a 'Range' input (0.0 m) and a 'True Bearing' input (000.0 °). At the bottom are 'OK', 'Cancel', and 'Apply' buttons.

New Setpoint

Shows the coordinates that will be used for the new position setpoint when you click the **OK** or **Apply** button. You can enter **New Setpoint** coordinates by typing the required coordinates directly into the **New Setpoint** boxes.

A temporary setpoint symbol is displayed on the Posplot view showing the position of the **New Setpoint** relative to the **Present Setpoint**.

Previous Setpoint

Shows the coordinates of the previous position setpoint. Clicking the **Use** button writes these coordinates into the **New Setpoint** boxes. This feature can be used to return the vessel to a previous position.

From Present Setpoint to New Setpoint

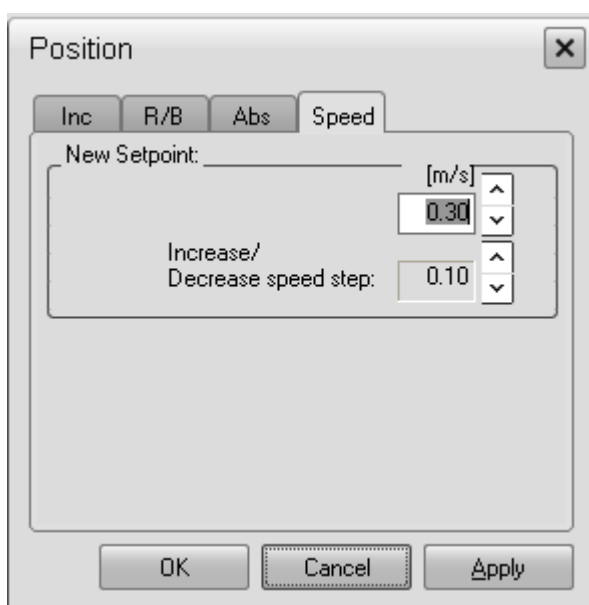
Shows the **Range** and **True Bearing** from the **Present Setpoint** position to the **New Setpoint** position.

Speed page

The **Speed** page allows you to specify the speed at which the vessel should try to move during a change of position.

The speed setpoint applies only when the surge and sway axes are under automatic control.

As the vessel approaches the position setpoint, the speed setpoint is reduced to zero.



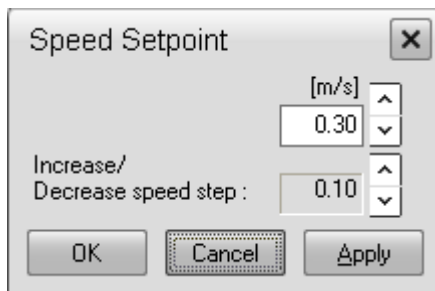
New Setpoint

Either enter the required value in the **New Setpoint** spin box, or use the up and down arrows to adjust the setpoint by the selected increment or decrement defined in the **Increase/Decrease speed step** spin box.

Speed Setpoint dialog box

The **Speed Setpoint** dialog box is useful in operations that require frequent changes of speed setpoint as it allows you to specify the speed at which the vessel should try to move during a change of position.

As the vessel approaches the position setpoint, the speed setpoint is reduced to zero. This speed applies only when the surge and sway axes are under automatic control. To display this dialog box, select **Settings→(Control) Speed**.



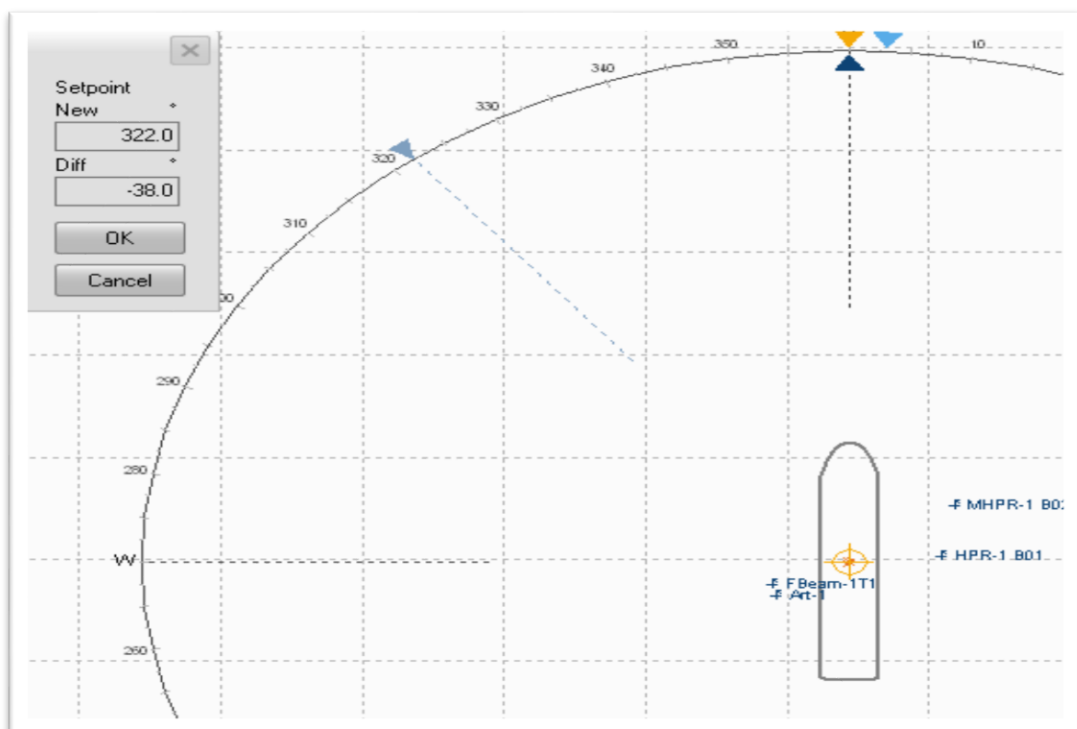
Either enter the required value in the **Speed Setpoint** spin box, or use the up and down arrows to adjust the setpoint by the selected increment or decrement defined in the **Increase/Decrease speed step** spin box.

a. Changing the heading setpoint

Marking a new heading setpoint on the Posplot view

With the Posplot view displayed, you can change the heading setpoint using the trackball.

- 1 Click on the heading setpoint symbol  in the Posplot view.
 - The **Heading** dialog box is displayed.



- 2 Move the setpoint symbol with the trackball.

- The setpoint symbol moves along the edge of the Posplot view and the heading is updated dynamically on the **Heading** dialog box.
- 3 Click again to fix the setpoint symbol at the required heading.
- A temporary heading setpoint symbol is displayed.
 - The **New** setpoint and the difference (**Diff**) from the **Present Setpoint** are displayed on the **Heading** dialog box.
- 4 Either click the **OK** button to accept the new heading setpoint, or click the **Cancel** button to continue with the existing setpoint.

Heading Wheel and its associated buttons



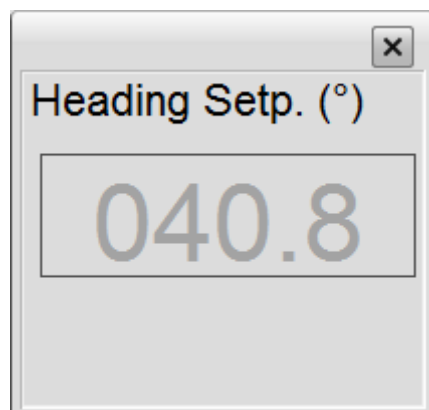
You can change the heading setpoint using the Heading Wheel and its **HEADING** buttons (from left to right),

DECREASE, **ACTIVATE** and to activate the Heading Wheel, one of these three associated buttons must be pressed.

To change the heading setpoint:

Press the **DECREASE**, **ACTIVATE** or **INCREASE** button once.

- The **Heading Setpoint** dialog box is displayed.



With the **Heading Setpoint** dialog box displayed, rotate the Heading Wheel clockwise or counter-clockwise to increase (to starboard) or decrease (to port) the heading setpoint, or use the **INCREASE** and **DECREASE** buttons (typically 0.1 degree for each press).

Heading dialog box

The **Heading** dialog box contains two tabbed pages (**Heading** and **Rate Of Turn**) which allow you to change the heading setpoint and specify the Rate Of Turn.

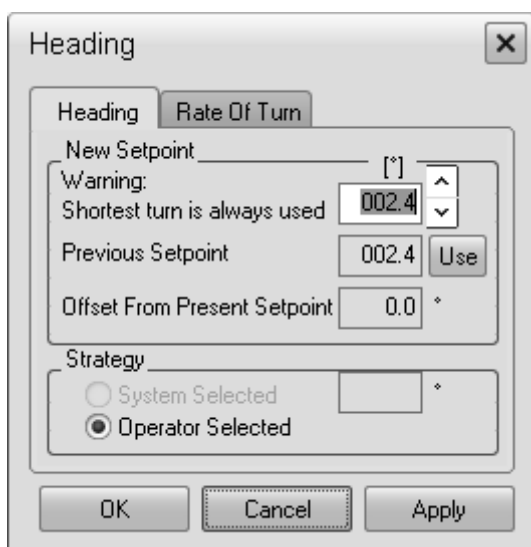
To display the dialog box, select **Positioning** → **Heading**, or press the **CHANGE HEADING**

button.

Heading page

The **Heading** page of **Heading** dialog box allows you to define the heading setpoint. While entering data on the **Heading** page, before you click the **OK** or **Apply** button, a temporary heading setpoint symbol is displayed on the Posplot view showing the proposed heading setpoint.

When **System Selected** is chosen as **Strategy**, the heading chosen by the system depends on the current operational mode. For example, in *Auto Position* mode the system will select the heading that requires the minimum power to be maintained in the current environmental conditions. This heading will change continuously according to the prevailing environmental forces on the vessel.



New Setpoint

Shows the heading that will be used as the new heading setpoint when you click the **OK** or **Apply** button. When **Operator Selected** is chosen under **Strategy**, you can enter the **Heading Setpoint** by typing the required heading or by increasing or decreasing the value by clicking the arrows next to the **New Setpoint** spin box.

A temporary heading setpoint symbol is displayed on the Posplot view showing the proposed heading setpoint.

Previous Setpoint

Shows the previous heading setpoint. Clicking the **Use** button writes this heading into the **New Setpoint** box. You can therefore use this feature to return the vessel to a previous heading.

Offset From Present Setpoint

Shows the difference in heading between the **New Setpoint** and the **Present Setpoint**. This value is updated dynamically when you enter the new heading setpoint.

Strategy

System Selected

If you choose **System Selected**, the displayed system-selected heading is written into the **New Setpoint** box. When you click the **OK** or **Apply** button, the system will continue to determine what the heading setpoint should be.

This function is available when the environmental conditions are above a certain limit. When system heading is selected, the alarm limits are turned off.

Heading (Changed) [X]

Heading [Rate Of Turn]

New Setpoint [°]
Warning: Shortest turn is always used 011.8 [↑][↓]

Previous Setpoint 007.7 [Use]

Offset From Present Setpoint 0.1 *

Strategy
☒ System Selected 011.8 *
☐ Operator Selected

Note: Heading alarm limits will be turned off

[OK] [Cancel] [Apply]

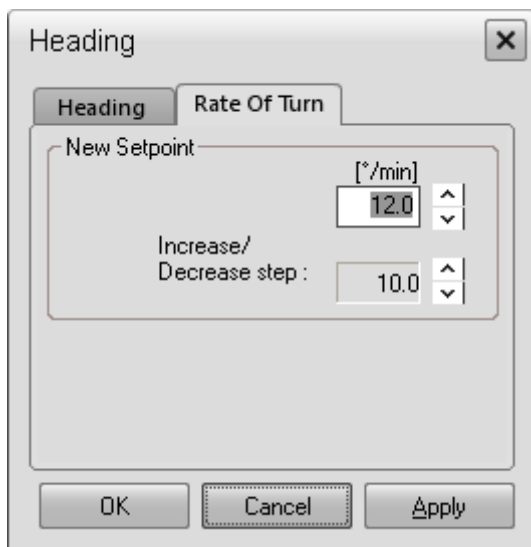
If you choose **Operator Selected**, you can enter the **Heading Setpoint** using any of the other methods described here.

Rate Of Turn page

The **Rate Of Turn** page allows you to define the speed at which the vessel should try to rotate during a change of heading (the vessel's Rate Of Turn).

This Rate Of Turn applies only when the yaw axis is under automatic control.

As the vessel approaches the heading setpoint, the Rate Of Turn is reduced to zero. When the vessel rotation centre is at a position other than the vessel's Midships position, the actual Rate Of Turn may be less than the speed specified. This is because the speed of movement of the Midships position is limited in proportion to the required vessel speed and the distance of the rotation centre from the Midships position.



New Setpoint

Either enter the required value in the **New Setpoint** box, or use the up and down arrows to adjust the setpoint by the selected increment or decrement (**Increase/Decrease step**).

8. Thrusters

a. Enabling Thruster

When a thruster can be enabled for K-Pos DP control, the thruster is shown as **Ready** on the Thruster main view (see *Thruster main view* on page 309) and on the **Thruster Enable** dialog box.

There are generally two criteria for a thruster **Ready** status:

- The individual thruster must be running.
- The individual thruster must be available for K-Pos DP control.

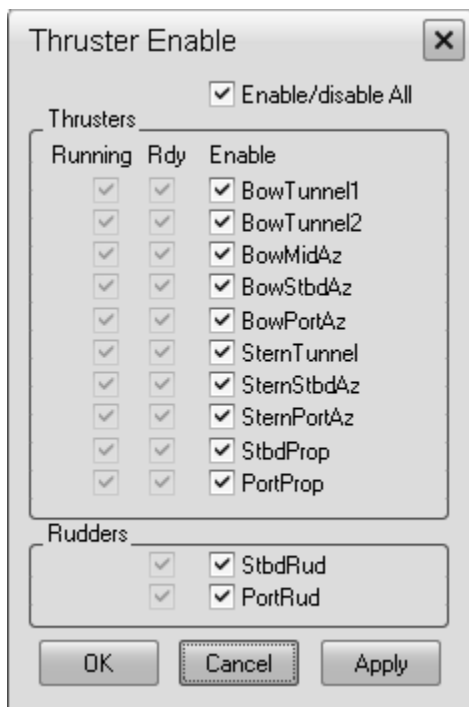
The K-Pos DP system uses only those thrusters that are enabled for use by the system. The thrusters can be enabled and disabled using the **Thruster Enable** dialog box. You can also monitor if the thrusters are running and ready.

The **THRUSTERS** button group contains buttons used to enable or disable each of the available thruster units for K-Pos DP control. Each thruster button has a status lamp which is lit when the thruster is enabled.

Before a thruster can be enabled, it must be **Ready**. If a thruster is enabled and it subsequently loses its **Ready** status, it is automatically disabled.

Thruster Enable dialog box

To display the dialog box, select **Thrusters→Enable**.



Thrusters / Rudders

Enable/disable All

Selecting or clearing this check box allows you to enable or disable all thrusters and rudders for K-Pos DP control simultaneously.

Running

These check boxes show whether the thrusters are running or not. When a thruster status is set as running, the K-Pos DP system reads the feedback signal from the thruster and calculates the resulting thruster force.

Under certain conditions, the operator can switch the thruster Running signals on/off. The running status can be changed in this way only if all of the following conditions are satisfied:

- The running status is not interfaced directly from the thruster to the K-Pos DP system.
- The thruster is not **Ready**.
- The system configuration allows manual setting of thruster running status.

Ready

These check boxes show whether the thrusters are **Ready** for K-Pos DP control.

Enable

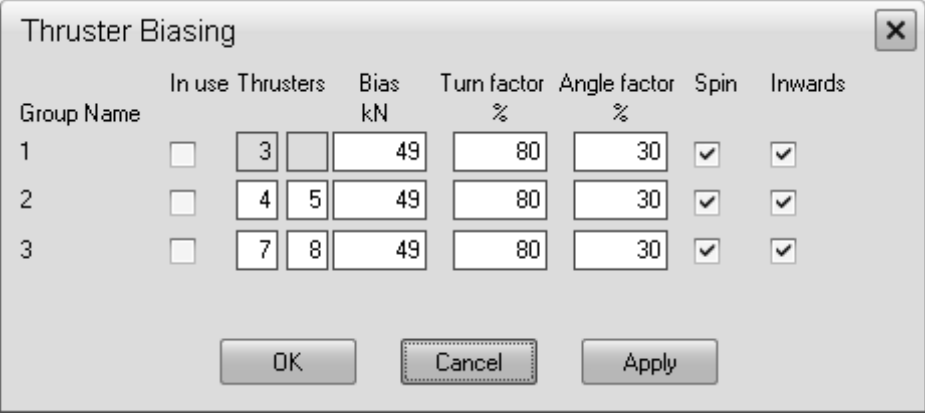
These check boxes allow you to enable or disable each of the thrusters for K-Pos DP control. The system will automatically disable a thruster if it is not **Ready**, i.e. clear the **Enable** check box, and also make the check box unavailable, thus indicating that before a thruster can be enabled, it must be **Ready**.

Thruster Biasing dialog box

The content of the **Thruster Biasing** dialog box will vary according to system configuration. The dialog box in the system installed on your vessel may display only some of the items shown in the following examples, *Manual selection of thruster biasing* and *Automatically changing biasing available*.

To display this dialog box, select **Thrusters**→**Biasing**.

Manual selection of thruster biasing



The screenshot shows a dialog box titled "Thruster Biasing" with a close button (X) in the top right corner. The dialog contains a table with the following columns: "Group Name", "In use Thrusters", "Bias kN", "Turn factor %", "Angle factor %", "Spin", and "Inwards". There are three rows of data, numbered 1, 2, and 3. Each row has a checkbox under "In use Thrusters". The "Bias kN" column has two input fields for each row, and the "Turn factor" and "Angle factor" columns have percentage input fields. The "Spin" and "Inwards" columns have checkboxes.

Group Name	In use Thrusters	Bias kN	Turn factor %	Angle factor %	Spin	Inwards
1	☐	3 49	80	30	☒	☒
2	☐	4 5 49	80	30	☒	☒
3	☐	7 8 49	80	30	☒	☒

At the bottom of the dialog are three buttons: "OK", "Cancel", and "Apply".

Group Name

The predefined name of the thruster group. The thruster groups are shown colour-coded on the small thruster force model on the Thruster main view (see *Thruster main view* on page 309).

In use

Select this check box to turn on the Thruster Biasing function for this thruster group.

Thrusters

Shows the thruster numbers to counteract each other in each group. A special situation is when there is only one thruster in a group. The text boxes for this group then appear dimmed, with the thruster number shown only in the first text box. With two or more thrusters in a group, you can define the thrusters to interact.

An error checking routine informs if:

- The same thruster number is specified twice in the same group.
- The same thruster number is specified in two different groups.
- An illegal thruster number is entered.
- An illegal thruster type is entered.

These checks only apply for thruster groups that have the **In use** check box selected.

The minimum force to be used for each thruster when running the thrusters to counteract each other.

Turn factor

The thrusters will work towards each other (when the **Inwards** check box selected until this force level is reached. When this level is reached, one thruster will turn, and they will both work in the same direction

Angle factor

Determines the relative priority of angle against force to satisfy the force demand

Spin

If one thruster in this group is disabled and the other is not, and the demand to the enabled thruster is less than the **Bias** force, you can choose to spin the enabled thruster.

Inwards

When two thrusters are counteracting each other, you can choose between running them towards each other (**Inwards** check box selected), or away from each other (**Inwards** check box not selected).

Automatically changing bias available

Group Name	In use Thrusters	Joined	Bias kN	Turn factor %	Angle factor %	Spin	Inwards
1	☐		49	80	30	☒	☒
2	☒ 4 5 3		49	80	30	☒	☒
3	☒ 7 8		49	80	30	☒	☒

Thruster Select Used
☐ Automatic
☐ By Operator
☒ No Bias

Total Bias
☒ Use
 Request: 196
 Applied: 0
 Turn factor %: 100.0
 Angle factor %: 80.0

Bias Type
☐ PORT
☐ STBD
☒ Both

OK
Cancel
Apply

Thrusters

Shows the thruster numbers to counteract each other in each group. With two or more thrusters in a group, you can define the thrusters to interact when **By Operator** is selected (see **Thruster Select** below).

Bias

The minimum force to be used for each thruster when running the thrusters to counteract each other. You can enter a required **Bias** value when **By Operator** is selected (see **Thruster Select** below).

Thruster Select

Allows you to set the system to change bias pairs automatically as a function of demand direction. In the **Thruster Select** group box, you can choose between **Automatic**, **By Operator** or **No Bias**.

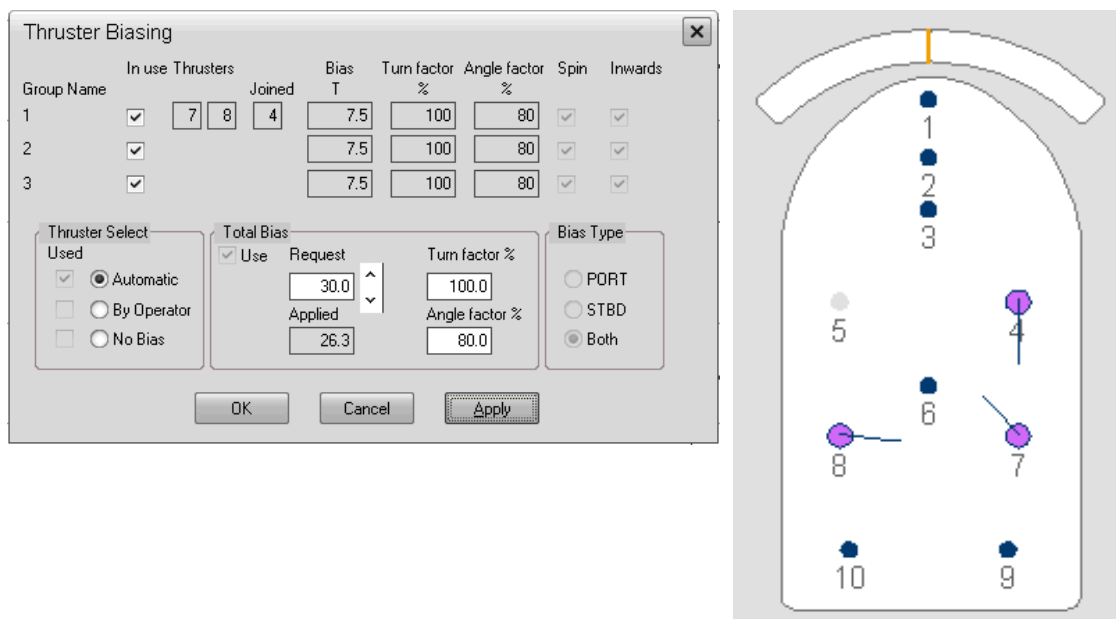
Used

A check mark in this column indicates the option (**Automatic**, **By Operator** or **No Bias**) used by the system.

Automatic

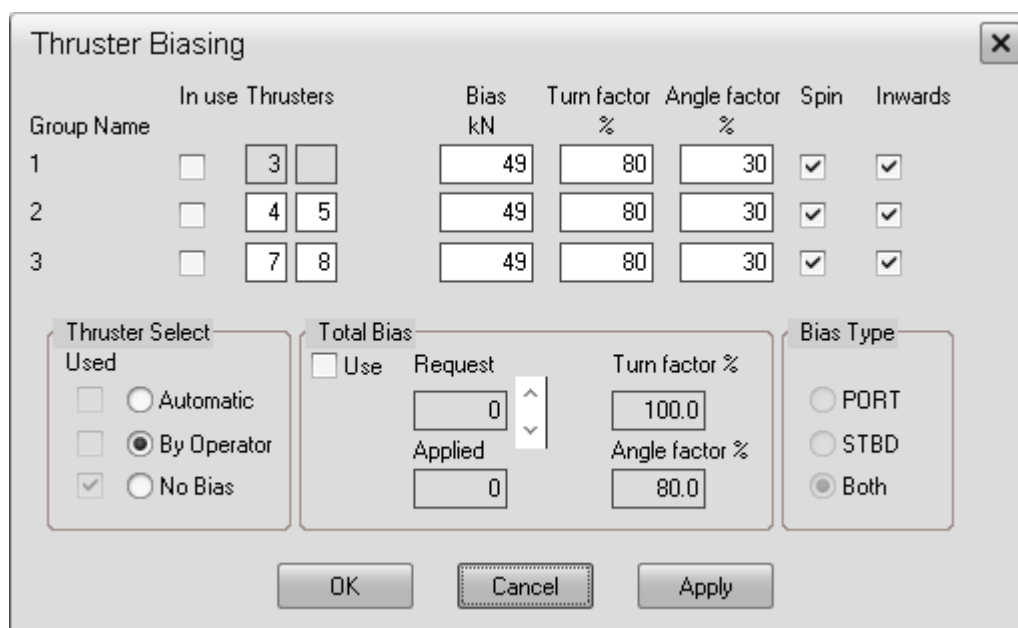
When selected (see Figure 25), the **Thrusters** and **Bias** columns become dimmed, i.e. unavailable for editing by the operator. The system selects thruster bias groups automatically based on a predefined setting. The demand direction decides which group setup is selected.

If a thruster becomes the only enabled thruster in a group, this thruster can (based on certain criteria) join another group. The thrusters will then counteract each other so that the resulting thrust is zero for this “new” group. When a thruster joins a group, the thruster number is shown below the text **Joined** on the **Thruster Biasing** dialog box, adjacent to the numbers of the other thrusters in the group.



By Operator

With **Thruster Select** set to **By Operator**, the operator can select the thrusters in each group by typing the required thruster numbers, and enter **Bias** values or select **Total Bias**.



No Bias

With **Thruster Select** set to **No Bias**, the system is still in thruster bias main thruster allocation mode, but no bias is applied.

Total Bias

Use

When **Use** is selected, a total common bias can be entered. You can also monitor the total applied bias on the dialog box.

Request

When the total bias is entered in this spin box, this bias value is distributed to all of the bias groups. If the bias was initially equal for each group, the total bias is distributed equally. If, however, the bias was initially unequal for each group, the total will be distributed in the same proportion as the initial proportions.

Applied

This text box shows the difference of the thrust before and after total bias was applied.

Bias Type

The **Bias Type** group box only becomes available when running in **FIX** thruster allocation mode. The frame appears dimmed in all other thruster allocation modes. You can select between **PORT**, **STBD** or **Both** in this frame. By default the **Bias Type** is set to **Both**.

When running in **FIX** thruster allocation mode the K-Pos DP system automatically selects a fixed angle for each azimuth thruster, i.e. the azimuth thrusters cannot turn.

You can use the **Bias Type** settings in the Thruster Biasing function to work around this restriction. Depending on the direction of applied thruster setpoint, removal of the thruster biasing on specific thrusters in a group can be allowed. In this situation,

the thruster will run below its bias value, including negative values (e.g. pitch/rpm). The thruster will not turn, but the thruster force will be in the opposite direction.

In the following examples we have set (by operator) thrusters 7 and 8 to be in the group 3 (and thus to counteract each other). The vessel is run in *Joystick* mode using the joystick to control the thruster setpoint. The effects of the configured Bias Types **Both**, **PORT** and **STBD** on thruster behaviour are described.

When **Bias Type** is set to **Both** and thruster setpoint to starboard, a bias is applied on both thruster 7 and 8. Thruster 7 cannot turn because it is in **FIX** thruster allocation mode (see Figure 26). The same will happen when you set the thruster setpoint to port. Thruster 8 will not turn. None of the thrusters will go below the **Bias** value you have set for the group 3.

Thruster Allocation

Mode

☐ VARIABLE

☒ FIX

☐ ENVIRON FIX

☐ DIVING

☐ STEERING

☐ HEAVE RED

☐ MANUAL FIX

Control

☐ Increased Power

☐ Position Priority

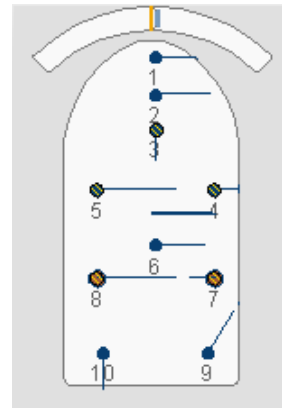
Free Run

☐ Off

☐ On

☒ Automatic

OK Cancel Apply



Thruster Biasing

Group Name	In use	Thrusters	Bias kN	Turn factor %	Angle factor %	Spin	Inwards
1	☐	3	49	80	30	☒	☒
2	☐	4 5	49	80	30	☒	☒
3	☒	7 8	49	80	30	☒	☒

Thruster Select Used

☐ Automatic

☒ By Operator

☐ No Bias

Total Bias

☐ Use Request 98 Applied 551

Turn factor % 100.0

Angle factor % 80.0

Bias Type

☒ PORT

☐ STBD

☐ Both

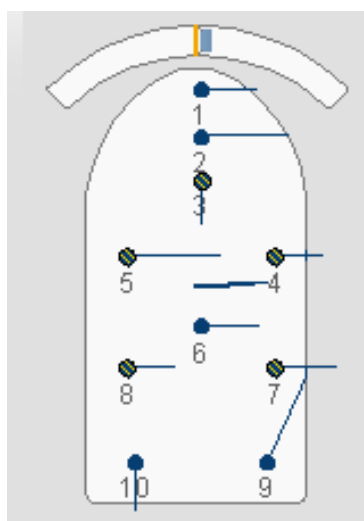
OK Cancel Apply

Bias Type

☒ PORT

☐ STBD

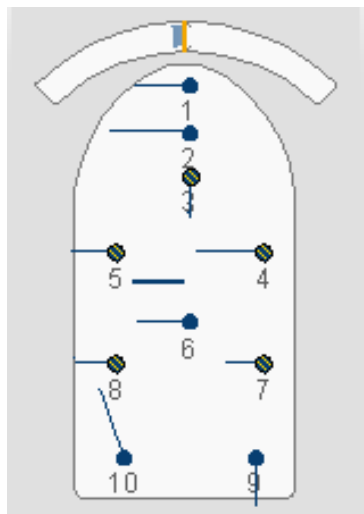
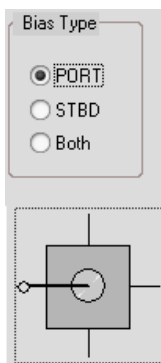
☐ Both



Bias Type set to PORT.

Thruster setpoint to **Starboard** (illustrated by the joystick symbol).

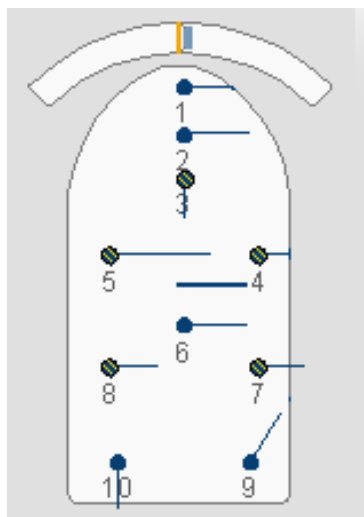
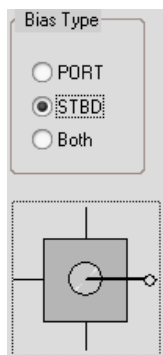
Starboard thruster (7) is allowed to go negative (i.e. no bias on this thruster). It will only go negative if the force setpoint is not fulfilled by the PORT thruster (8).



Bias Type set to **PORT**.

Thruster setpoint to **PORT** (illustrated by the joystick symbol).

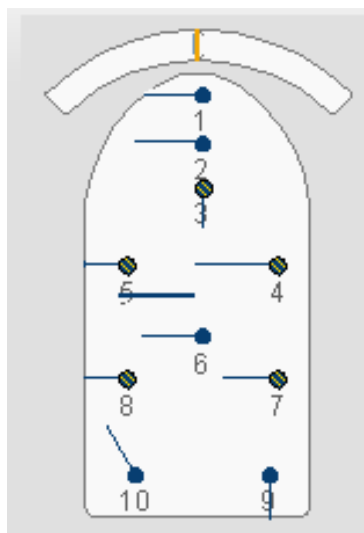
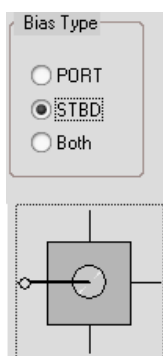
Port thruster (8) stops at its bias value and is not allowed to go negative.



Bias Type set to **STBD**.

Thruster setpoint to **Starboard** (illustrated by the joystick symbol).

Starboard thruster (7) stops at its bias value and is not allowed to go negative.



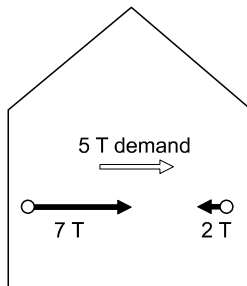
Bias Type set to **STBD**.

Thruster setpoint to **PORT** (illustrated by the joystick symbol).

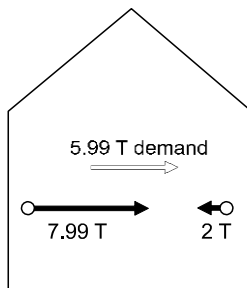
PORT thruster (8) is allowed to go negative (i.e. no bias on this thruster). It will only go negative if the force setpoint is not fulfilled by the starboard thruster (7).

b. Turn factor

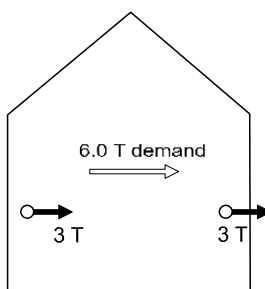
The **Turn factor** determines when to turn a thruster within a group, instead of continuing to counteract the other thruster. In the examples below, the maximum force for each thruster is 10 tonnes and the idle or bias force is 2 tonnes.



Starboard thruster counteracting port thruster.



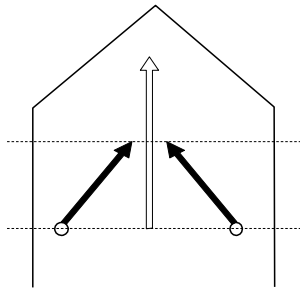
Port thruster about to reach 80%.
Starboard thruster will start turning.



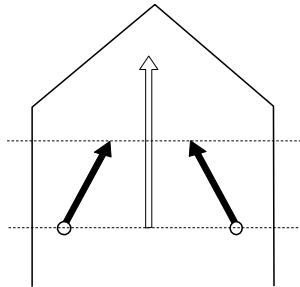
Port thruster reached 80%, so
starboard thruster turned.
(Increasing turn factor to 90% would
turn starboard thruster back again.)

c. Angle factor

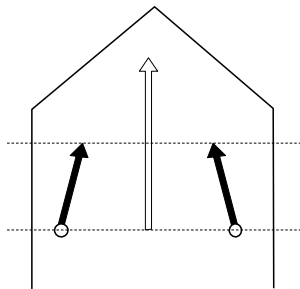
The **Angle factor** determines the relative priority of angle against force to satisfy the force setpoint. In the examples below, the same 10 tonnes demand ahead is achieved, but more thrust is used in example 1 (with a higher angle factor), than in example 3 (with a lower angle factor).



Force demand = 10T ahead
Angle factor = 80%



Force demand = 10T ahead
Angle factor = 80%

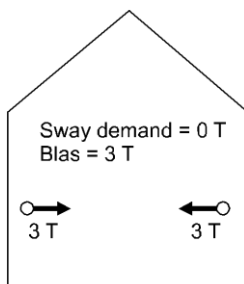


Force demand = 10T ahead
Angle factor = 40%

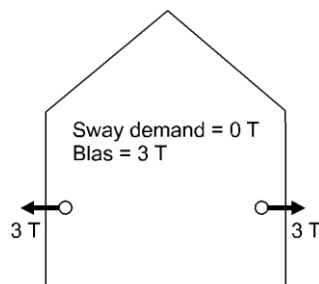
Inwards

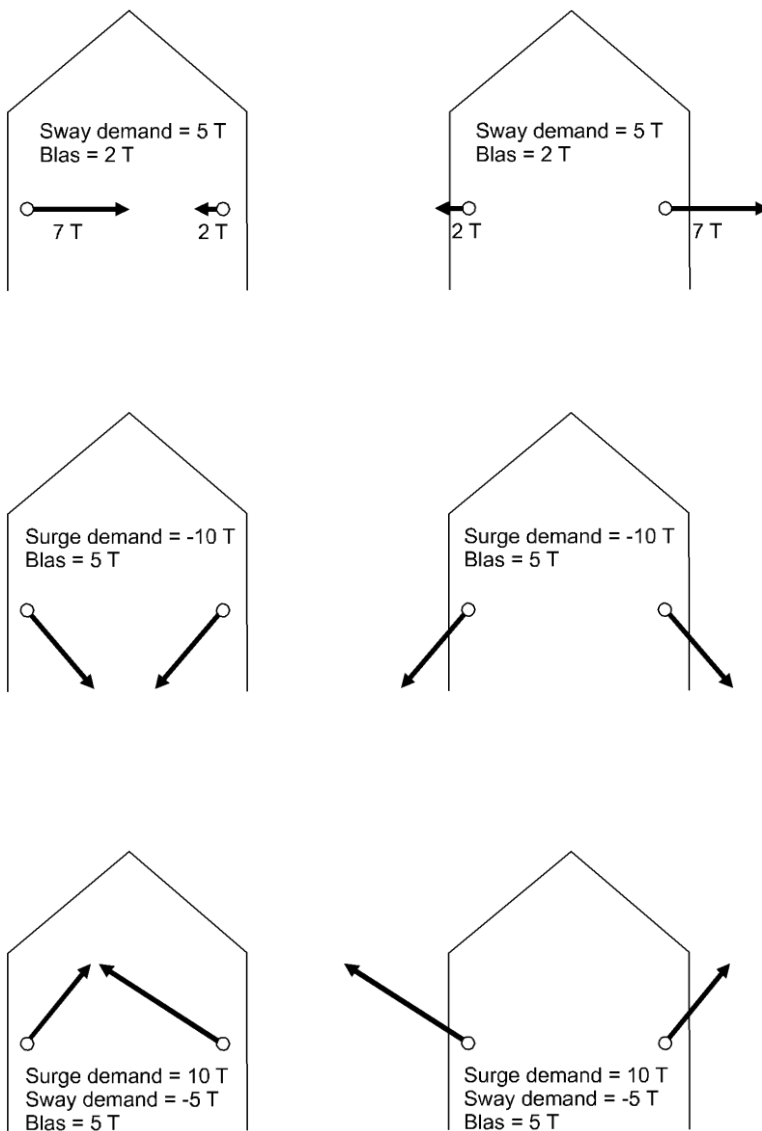
When two thrusters are counteracting each other, the **Inwards** check box determines whether they should be run towards each other or away from each other. The examples below show various situations with Inwards both selected and not selected. The specified setpoint is the force setpoint for this group.

Inwards selected



Inwards not selected





9. Power System

a. Power monitoring

The K-Pos DP system has no direct control over the vessel's electrical power system. This is administered by a separate Power Management System (PMS).

Normally the K-Pos DP system receives information about:

- The power produced by each main generator.
- Which switchboard each generator is connected to.
- How the switchboards are connected.
- How the thrusters are connected to the switchboards

b. Power load monitoring and blackout prevention

The Power Load Monitoring function monitors the total load on the connected switchboards and checks for unbalanced load. It will also act upon input failures from equipment connected to the power distribution network, e.g. generators. Single failures

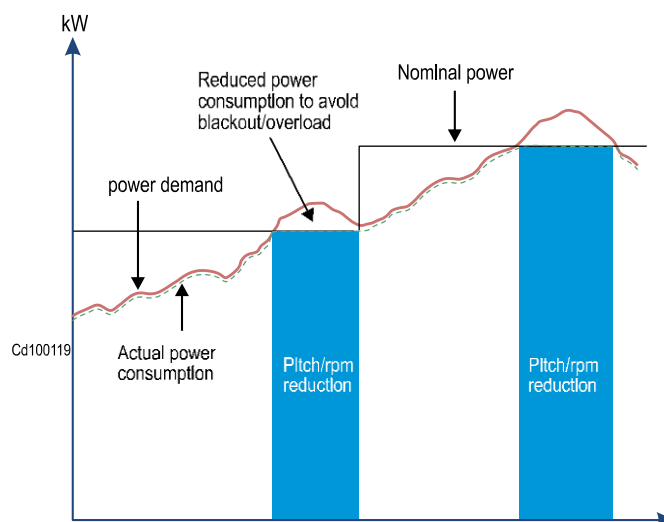
will be handled in such way that the Power Optimal Allocation and the Blackout Prevention will still work. The Blackout Prevention function is the last barrier in the K-Pos DP system to prevent overload on the connected switchboards. Some functions in the K-Pos DP system can add thrust to the resulting thrust from the Power Optimal Allocation, which might lead to an overload situation if not handled by the Blackout Prevention function. The Blackout Prevention function will reduce the thrust demand if the estimated load exceeds the nominal limit. The reduction is done as percentage wise distribution of phase back power according to the rated power for each thruster.

The Blackout Prevention function will only limit thruster commands to avoid a stable power plant becoming overloaded. The function cannot prevent a potential blackout caused by generator tripping.

The Power Load Monitoring and Blackout Prevention functions cover the following standard power plant configurations:

- diesel generators supplying thruster/propeller drives
- shaft generators supplying thruster drives
- a combination of diesel generators and shaft generators

This function supplements the vessel's Power Management System (PMS). The thruster/propeller setpoint reduction criteria during DP control are set at lower overload levels than the load reduction initiated by the vessel's own PMS. The Power Load Monitoring and Blackout Prevention functions are active in all operational modes and are illustrated at below.



The K-Pos DP system requires the following information in time to perform blackout prevention:

- Generator power and breaker status
- Bus-tie breaker status

- Thruster breaker status (if more than one for each thruster) The following functions are

also available:

- **Generator Load Limitation**

Performs load limitation of the most loaded generator if a skew-load situation occurs on the connect-switchboard. The overload protection is achieved by automatically reducing the pitch/rpm/force/load on the thrusters/propellers connected to the connect-switchboard until the most loaded generator operates within its nominal capacity.

- **Diesel Engine Load Limitation**

Monitors the load on each diesel engine (fuel-rack monitoring) which drives both a generator and a controllable-pitch propeller on the same shaft. Power load is reduced by reducing the pitch setpoint on the connected propeller when the nominal engine load is exceeded. Note that this function requires an interface to the diesel engine fuel-rack reading.

- **Diesel Engine Load Monitoring**

Monitors the load on each diesel engine (fuel-rack monitoring) which drives a controllable-pitch propeller. This function requires an interface to the diesel engine fuel-rack reading. This function is for presentation purposes only, and does not perform any load limitation.

- **Thruster Load Monitoring (Current/Power)**

Monitors the current/power load on each individual thruster/propeller motor. Note that this function requires an interface for the motor current/power reading.

10. DP On Line Consequence Analysis

a. DP on line consequence analysis

The DP Online Consequence Analysis function performs analyses to determine the vessel's ability to maintain its position and heading after predefined worst-case single equipment failures. The analyses are called “online” because they consider the present environmental conditions, thruster status and power consumption.

This function satisfies the requirements of IMO Equipment Class 2 and Equipment Class 3.

The analysis checks whether the thrusters remaining in operation after a worst-case single failure are able to generate the same resultant thruster force and moment as required before the failure, and whether the remaining generators are able to produce a sufficient amount of power. An alarm message is issued if failure would result in lack of thrust or power, and subsequently drift-off.

The worst-case single failures that are simulated are predefined according to the power and thruster configuration of the vessel. Typically, these failures will be the loss of one complete switchboard, one engine room, or a group of thrusters that can be affected by a single equipment failure.

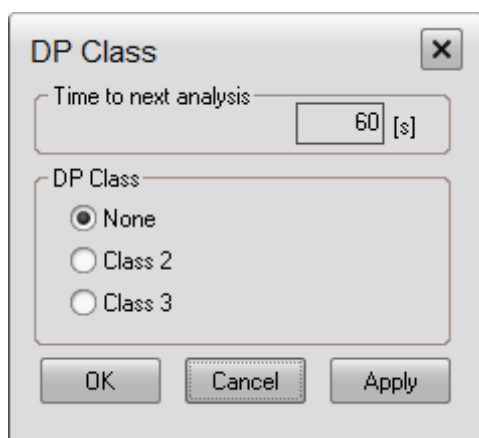
Consequence analyses are performed cyclically, every minute, whenever the following criteria are satisfied:

- The vessel is in *Auto Position* mode (consequence analysis can also be performed in other modes, if configured).
- The position setpoint status displayed on the Dashboard is **PRESENT** (for *Auto Position* mode).
- The heading setpoint status on the Dashboard is **PRESENT** (for *Auto Position* mode).
- DP Class 2 or 3 is selected.

b. Selecting DP Class

DP Class 2 or 3 must be selected on the **Dp Class** dialog box to activate the DP Consequence Analysis.

To display this dialog box, select **Settings (General)→Dp Class**.



If configured, the currently selected DP Class is indicated on the dashboard.

When the consequence analysis is running, the time to the next sample is counting down and shown in the box **Time to next analysis**.

Consequence analysis status messages

When the DP Online Consequence Analysis function is activated, an information message is displayed:

Consequence analysis running class 2 or Consequence analysis running class 3

When the system mode is changed from automatic control, or if you explicitly turn off the function using the **DP Class** dialog box, the following information message is displayed:

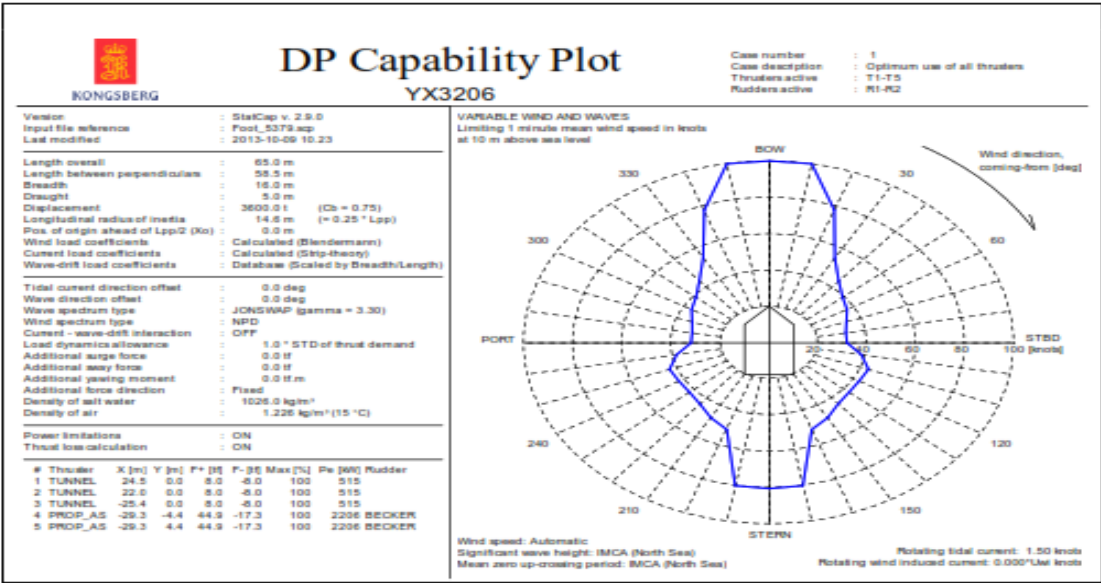


Figure 60. DP Capability Plot

B. Analyse of the problem

Analyse was research result as the core of this research. On this chapter will explain about result of research when researcher got experience on board DP vessels about influence current and wind concerning *best escape heading* when will operate the DP vessel from manual system to DP mode system. Otherwise researcher will explain some matter about influence current and wind concerning get impact to best escape heading when operation on DP mode. This Explanation will briefly as ensuing below:

1. Observation on board during DP Operation

Observation should be conducted by officer on watch as well as also for DPO & SDPO or Master. Observation has function to make sure that area was clear and safe to enter and fairway from any dangerous navigation. And also for DP capability that the effect of current and wind is very strong, and DP could not measure very well. Please look on this figure:

- a. Area of PHE ONWJ consist of:
Ardjuna Field and Bima Field

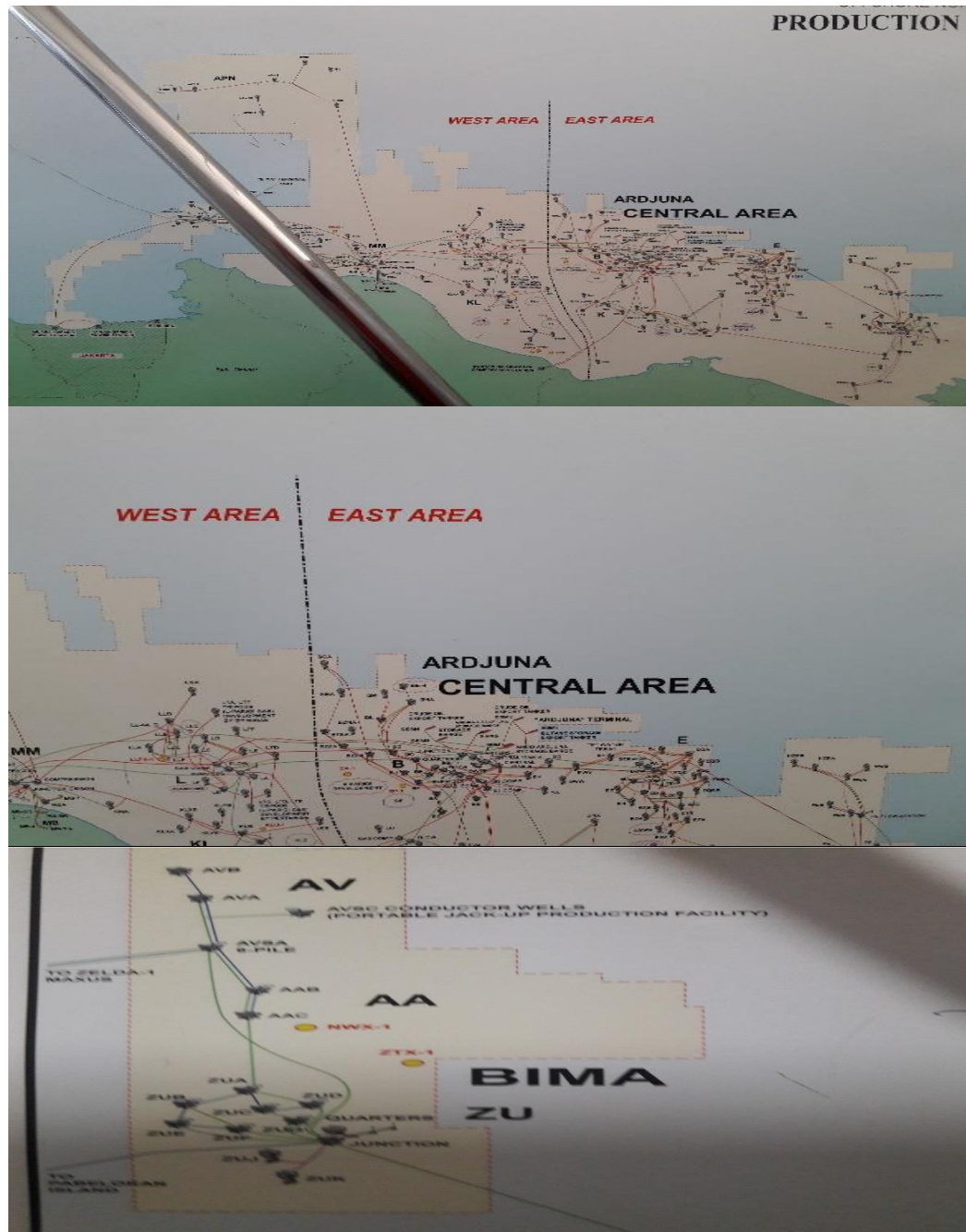


Figure 61. Area of PHE – ONWJ JAVA SEA

- b. Area of BP Berau, only on Tangguh Bintuni Bay

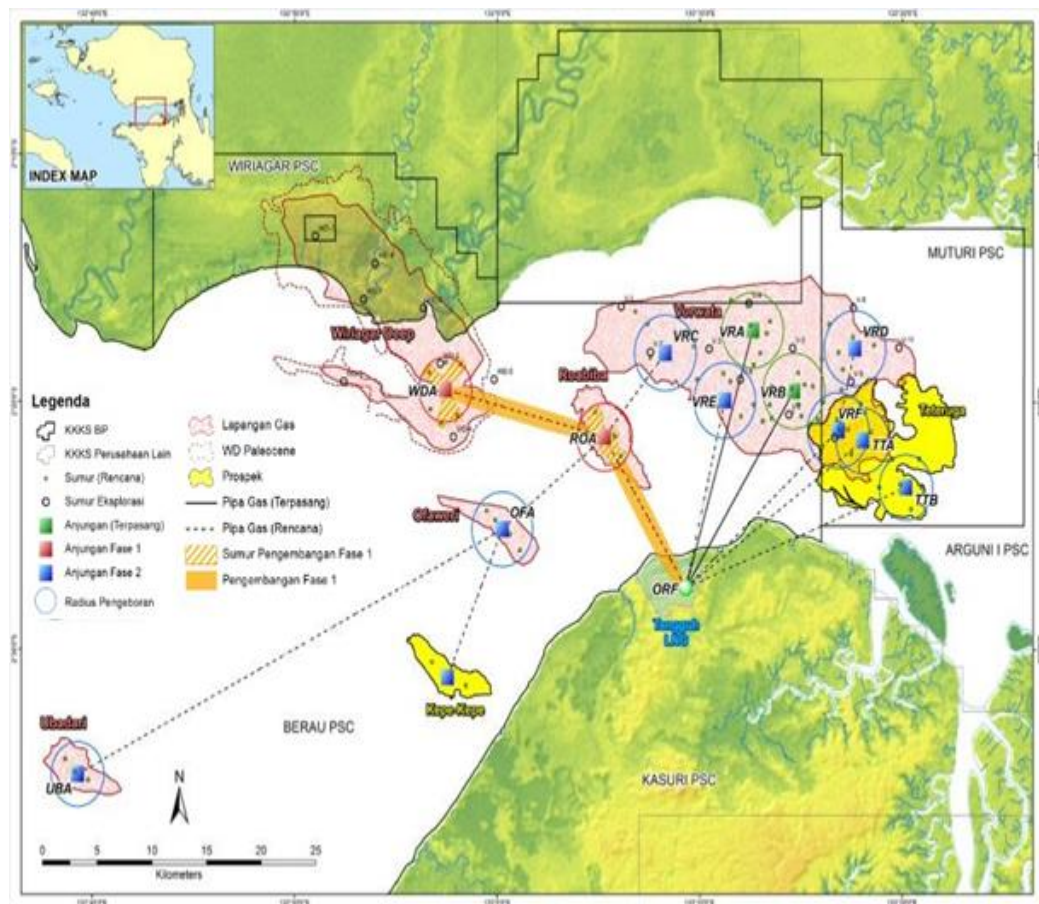


Figure 62. Area of BP – BINTUNI BAY SORONG PAPUA

- c. Area of PHM Balikpapan consist of :
South Mahakam Field (Bekapai, Peciko)

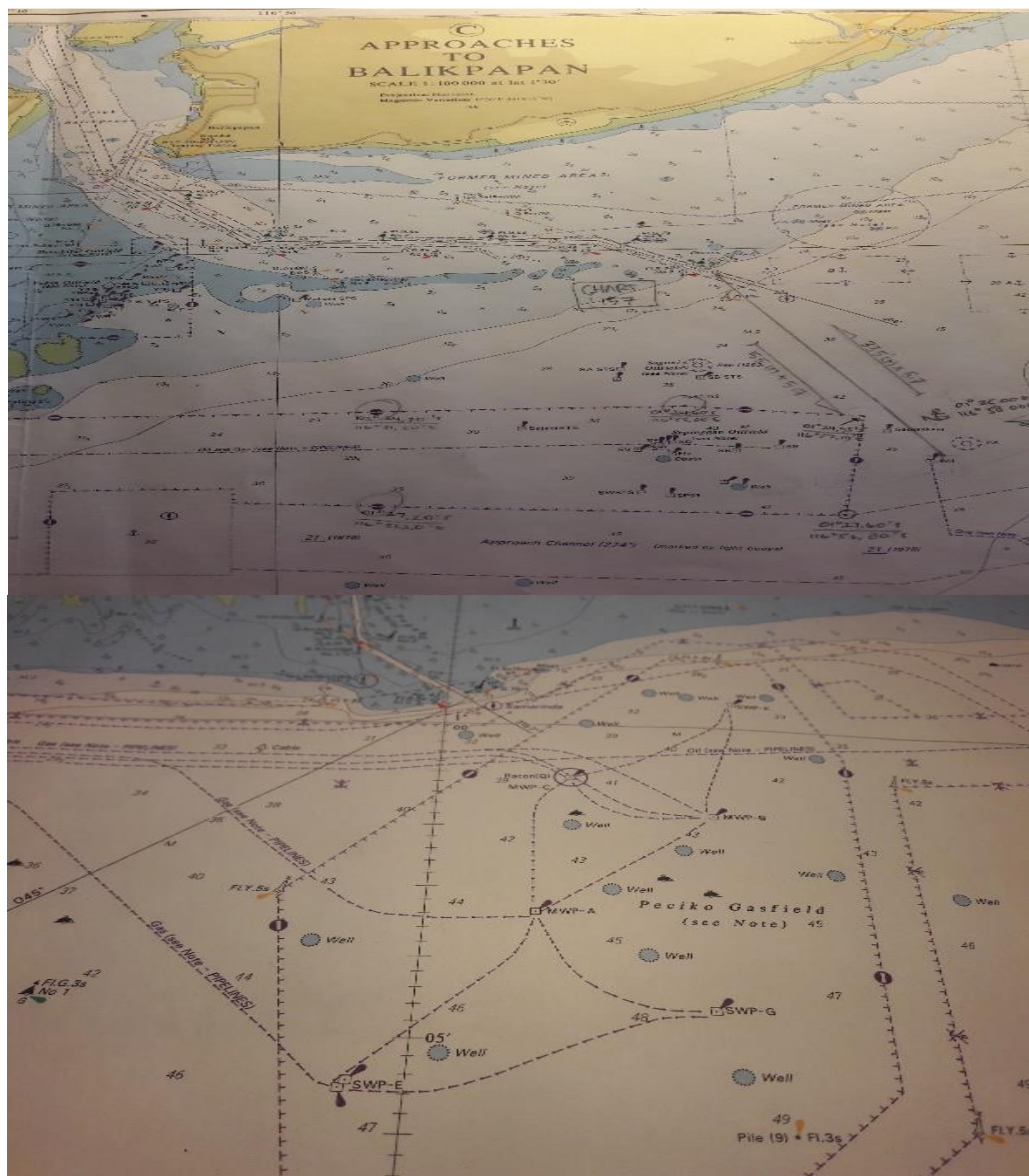


Figure 63. Area of PHM – MAKASSAR STRAIT BALIKPAPAN

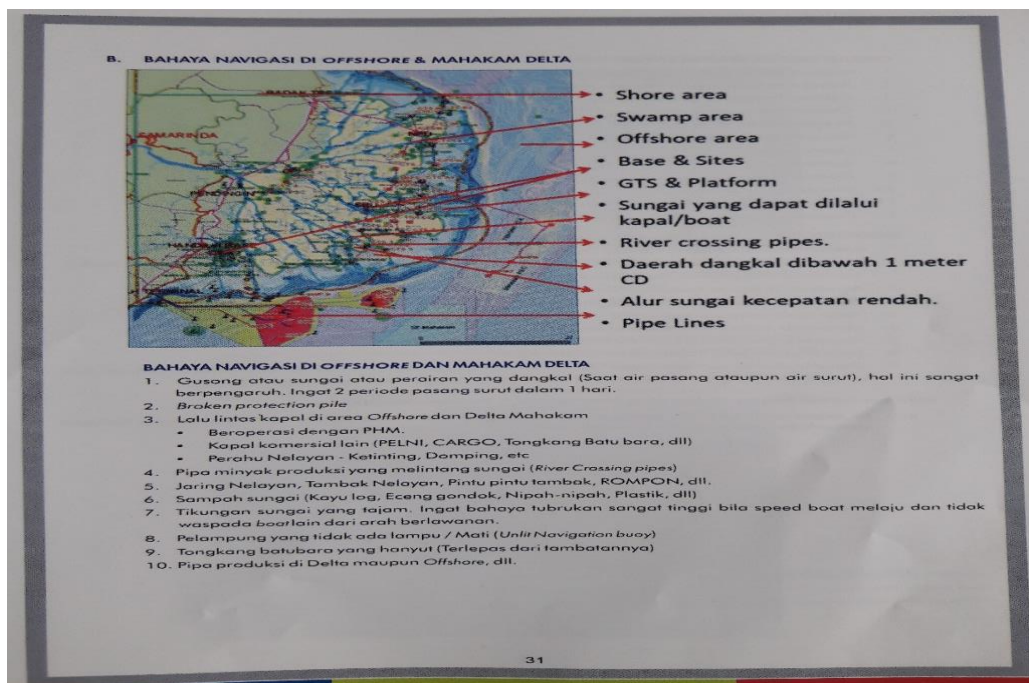
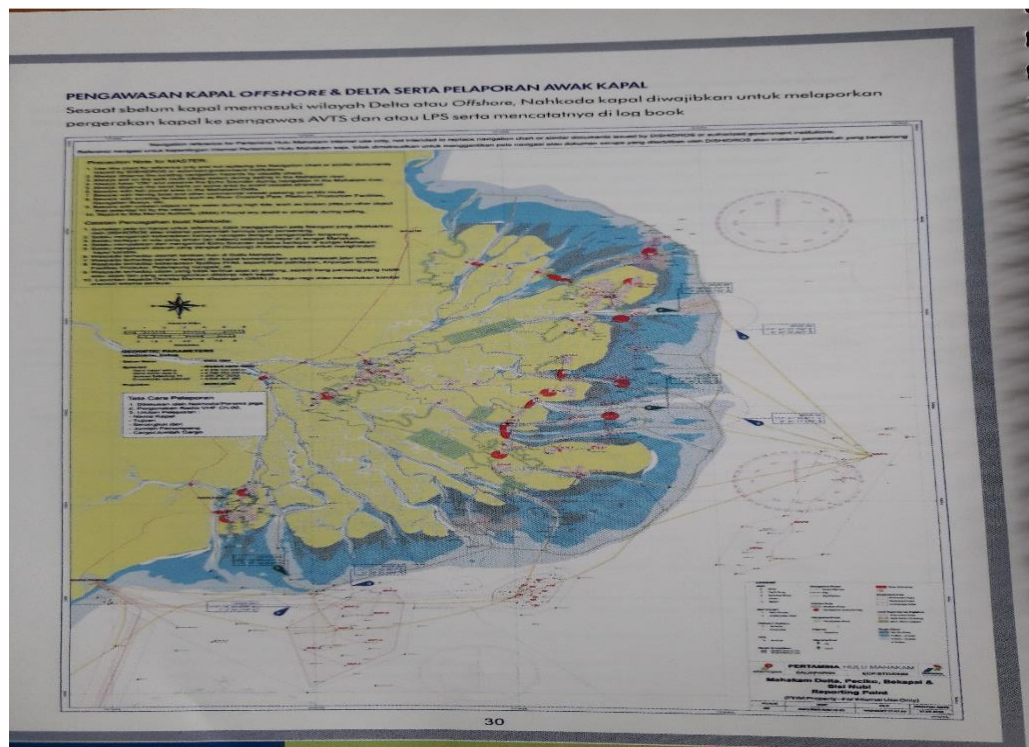


Figure 64. Area of PHM BLOK MAHAKAM

2. Discussion with other DPO

a. Main Power and Thruster Distribution

When running DP mode, every vessel have main power distribution figure depend of the type of the vessel. If we want to know please look on ship particular's. On my experience site, i was experience with DP Vessel Class 2

with redundancy, so if any broken on DP Workstation , the other DP Workstation could change and replace become back up. On Propulsion System Figure, many information overthere, and very important information for the figure of capability the engine. Every vessel when i was on board , have any experience regarding the main power distribution. The first vessel , the problem was AE (Auxiliary Engine) and Shaft Generator. And output thruster could not in good figure, because on Stern Thruster was stopped, and this impact the DP mode not in fully good figure but vessel can hold position.

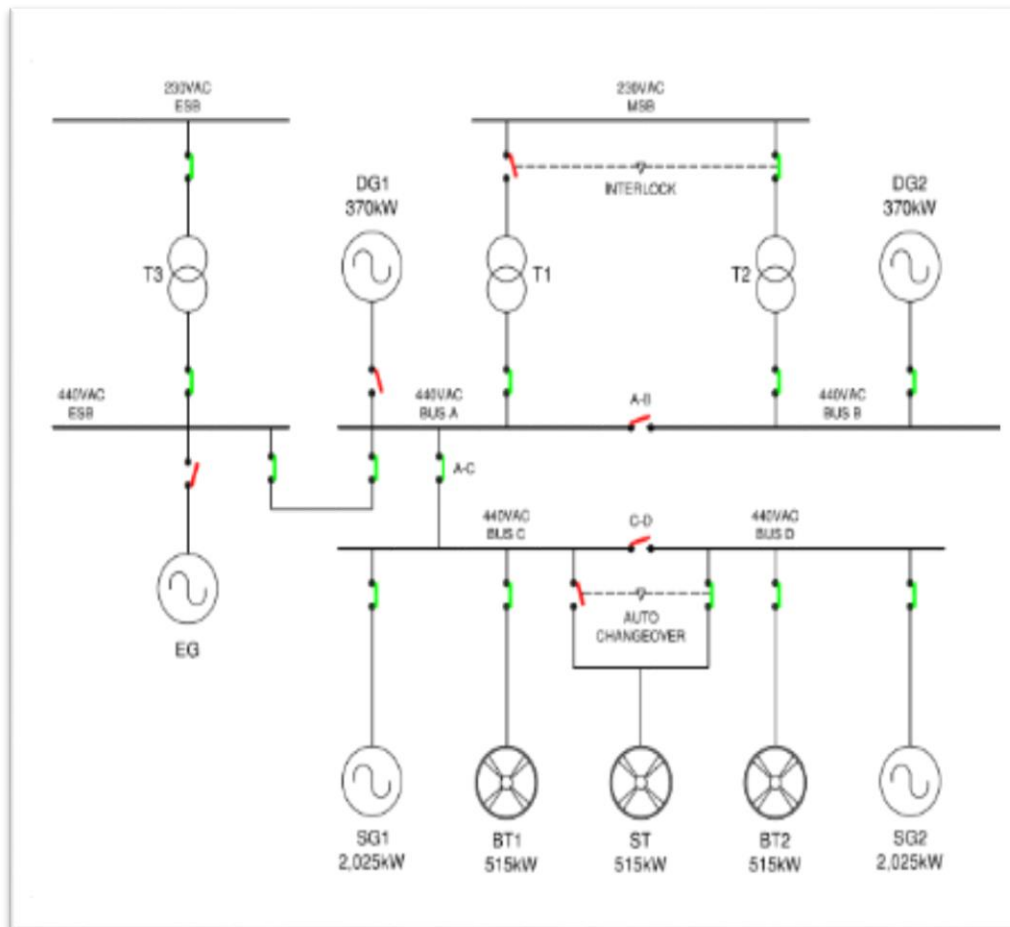


Figure 65 : Bus System SMS. Supporter

- 5.2.1 Main propulsion is provided by two 'Wartsila 6L26A' marine diesel engines, each developing up to 5506 bhp (2015 kW) of power at a speed of 1000 rpm. The main engines directly drive the main propulsion CPP Propellers via a reduction gearbox.
- 5.2.2 Steering is provided by two independent 'Scandia Shipping PI-40-2HEL-1' rudders and located in the aftermost compartment of the vessel.
- 5.2.3 Three four bladed 515 kW 'Kawasaki KT72B3' tunnel thrusters with controllable pitch propellers are installed. Two located in the forward watertight compartment of the vessel and the third located in the aft.
- 5.2.4 Main electrical power is provided by the two 'Caterpillar 3408' diesel generators, each generating 3 phase 440V AC and capable of delivering 370 kW each at a lagging power factor of 0.8.
- 5.2.5 There are two 'Leroy Somer LSA M50' shaft generators providing power for the tunnel thrusts each generating 3 phase 440V AC capable of delivering 1210 KW each at a lagging power factor of 0.8.
- 5.2.6 There is also a 60 kW diesel generator set which connects to the emergency switchboard.

Figure 66 : Display Information on SMS. Serenity

And second vessel on SMS. Serenity, the most important when I was discussed is the power configuration can displayed on below:

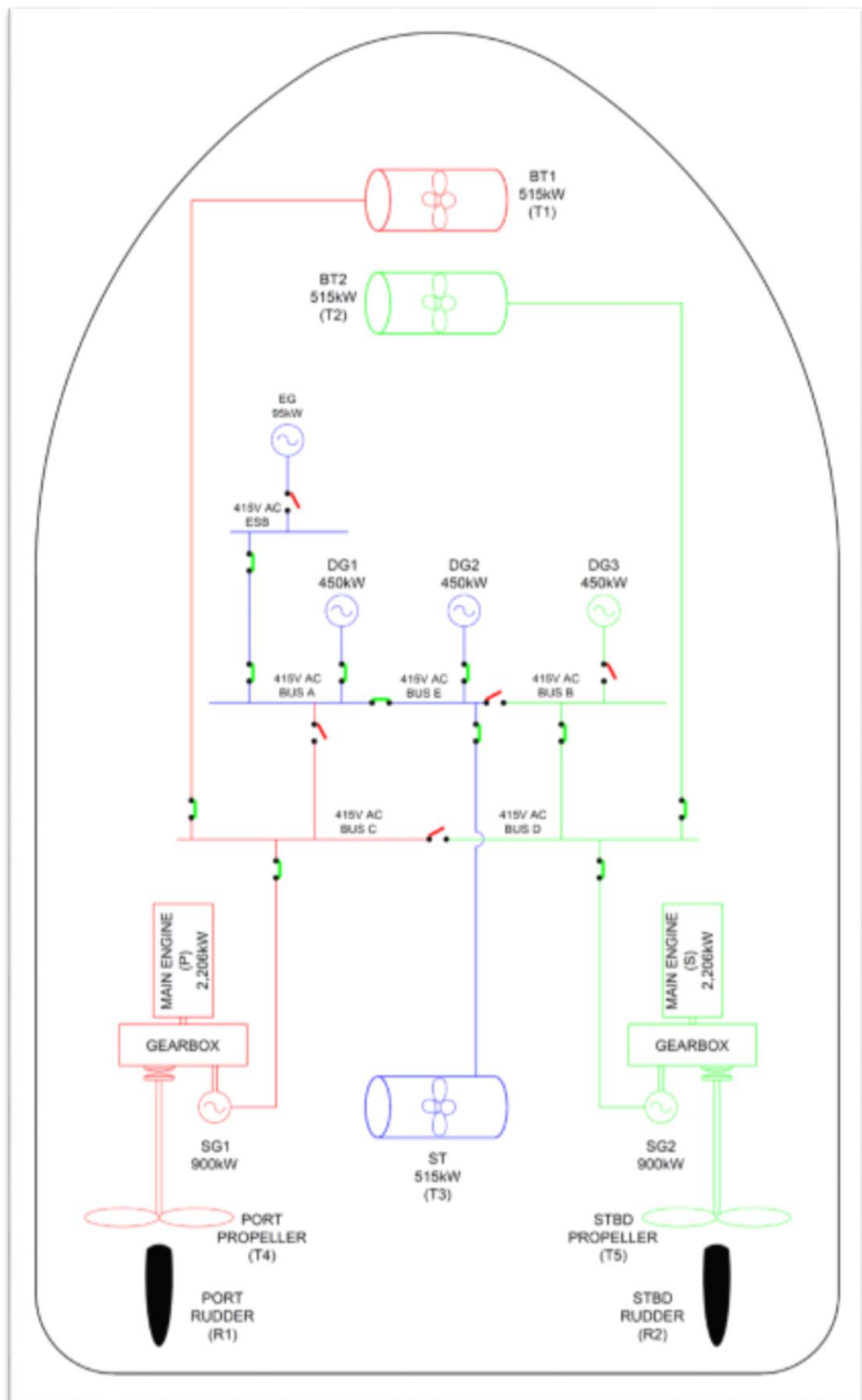


Figure 66 : Bus System SMS. Serenity

6.3.2 The thruster and propulsion units consist of:

- Two 'Kawasaki KT-72B3' bow tunnel thrusters, designated Bow Tunnel Thruster No.1 (T1) and Bow Tunnel Thruster No.2 (T2).
- One 'Kawasaki KT-72B3' Stern Tunnel Thruster (T3)
- Two 'Berg BCP 760' main propellers (propulsion thrusters), (T4) and (T5)
- Two spade type rudders, (R1) and (R2)

6.3.3 The DP control system thruster 'T' designations are shown in Figure 6.3.

6.3.4 Shaft Generator No.1 supplies power to 415V AC Bus 'C' of the main switchboard, which supplies power to the Bow Thruster No.1.

6.3.5 Shaft Generator No.2 supplies power to 415V AC Bus 'D' of the main switchboard, which supplies power to the Bow Thruster No.2.

6.3.6 Diesel Generators No.1 and No.2 supply power to 415V AC Bus 'A' and Bus 'E' of the main switchboard, which supplies power to the Stern Thruster.

6.3.7 The main propellers provide propulsion during transit by the two independent 'Niigata 6MG28AHX' main diesel engines via a reduction gearbox and clutch arrangement, steering being provided by two separate high lift rudders.

6.3.8 When the DP system is controlling the manoeuvring and positioning of the vessel, both rudders can be held in the static amidships position or selected independently to assist in generating a greater turning moment.

6.3.9 There are two main propulsion and steering controls at the Bridge, one at the forward console and one at the aft console.

6.3.10 There are two manual thruster control stations at the Bridge, one at the forward console and one at the aft console. Each control station has control panels for each bow and stern thruster.

6.3.11 Emergency stops for each tunnel thruster are located on the control consoles, located at the Bridge. When the emergency stops are activated, the thruster motor stops.

6.3.12 An emergency de-clutch provides the emergency stop facility for each main propulsion thruster. Main engine emergency stops are also located at the main propulsion control consoles.

Figure 67 : Display Information on SMS. Serenity

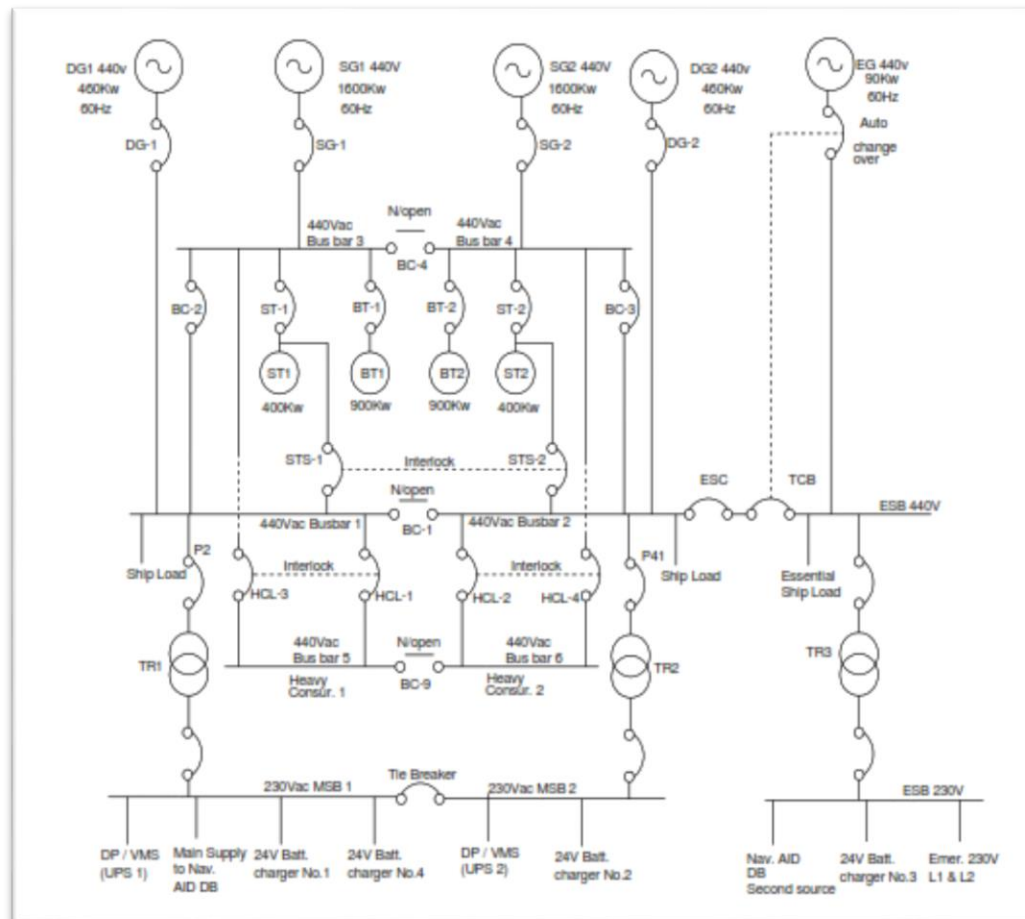
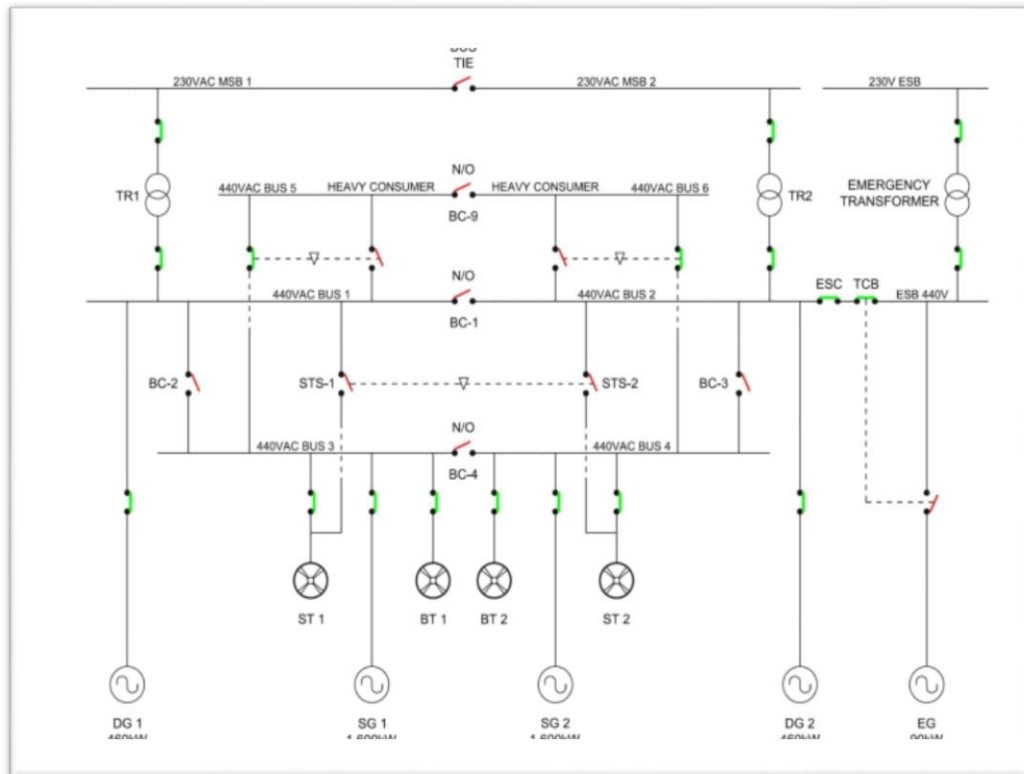


Figure 68 : Bus System WM.Makassar

- 6.4.1 Two 900 kW, variable pitch propeller, 'Kawasaki KT-157B5' bow tunnel thrusters are installed and located in the forward watertight compartment of the vessel.
- 6.4.2 Two 400 kW, variable pitch propeller, 'Kawasaki KT-55B3' stern tunnel thruster are installed and located in the aftermost watertight compartment of the vessel.
- 6.4.3 The bow and stern tunnel thrusters units are driven by fixed speed electrical motors. Each thruster is an independent, self-contained unit with its own lubricating oil, hydraulic servo oil and control system.
- 6.4.4 The electrical drive motor for Bow Thruster No.1 and Stern Thruster No.1, designated DP Thrusters 'T1' and 'T3', are supplied with power from the port shaft generator (Bus Bar 3).
- 6.4.5 The electrical drive motor for Bow Thruster No.2 and Stern Thruster No.2, designated DP Thrusters 'T2' and 'T4', are supplied with power from the starboard shaft generator (Bus Bar 4).
- 6.4.6 Steering is provided by two spade type rudders, operated independently by "Jastram Twin S2X1X" hydraulic steering gears and located in the aftermost compartment of the vessel.
- 6.4.7 The actuators are both located in the steering compartment, at the aft end of the vessel, situated port and starboard. They are independent units, each consisting of two hydraulic pump units, a hydraulic oil reservoir and a control system. Only one pump on each unit is required to be operation at any one time although for DP operations, both pumps should be in operation.

Figure 69 : Display Information on WM.Maksasar



- 631 The main switchboard is located in the Engine Control Room. It is divided into six 440V AC sections and two 230V AC sections.
- 632 Switchboard arrangements are designed to be 'split', port and starboard, with the consumers being supplied from the respective shaft generator and diesel generator.
- 633 Shaft Generator No.1 directly supplies power to 440V AC Bus Bar 3 which supplies Bow Thruster No.1 and Stern Thruster No.1.
- 634 Shaft Generator No.2 directly supplies power to 440V AC Bus Bar 4 which supplies Bow Thruster No.2 and Stern Thruster No.2.
- 635 Diesel Generator No.1 supplies power to 440V AC Bus Bar 1 and Diesel Generator No.2 supplies power to 440V AC Bus Bar 2.
- 636 The 440V AC heavy consumer bus sections, Bus Bar 5 and Bus Bar 6, can be supplied from the shaft generators or the diesel generators via their respective bus bars.
- 637 The 230V AC main switchboard is divided into two sections by an interconnecting bus-tie breaker. These switchboard sections are supplied independently from 440V AC Bus Bar 1 and Bus Bar 2 via two 130 KVA transformers, TR1 and TR2.
- 638 The emergency switchboard is located in the emergency generator room. It is divided in two sections, one 440V AC section and one 230V AC section. The 440V AC section is supplied with power from 440V AC Bus Bar 2, and can also be supplied from the emergency generator, and the 230V AC section is supplied with power from the 440V AC section via one 40 KVA emergency transformer.
- 639 The principal arrangement of the main switchboard and power distribution system, in the operational configuration, is shown under Figure 6 on the following page.

Figure 70 : Display Information on WM.Maksasar

b. General

All seagoing vessels are subject to environment weather forces; wind, current and waves. These forces will cause an unmoored vessel to drift away from its position.

A dynamically positioned vessel (DP Vessel) is a vessel which automatically, its position (fixed location or predetermined track) by means of thruster force. To achieve this, dynamic positioning counteracts the environmental forces by controlling the direction and force of thrust from the vessel's thruster and propulsion units.

A dynamic positioning system (DP System) means the complete installation necessary for the dynamic of a vessel and comprises the following subsystems:

- Power Systems
- Thruster Systems
- DP Control Systems

The power system is all of the components and systems necessary to supply the DP systems with power and includes prime movers, generators, switchboards, power distribution system and all associated auxiliary systems/ arrangements including piping, cables and routing etc.

The DP control systems is all the components, systems, hardware and software necessary to control the vessel in the dynamic positioning mode, operator control panels, position reference systems and environmental sensors. It will have the following functions as a minimum

- A method of measuring external forces
- A method of measuring vessel position
- A method of calculating required counter forces
- A method of providing man / machine interface

c. DP Control

Details of the systems fitted to this vessel are given each vessel depend of the type of DP Control. The main DP control system is located in the wheelhouse and consist of two controller computers and two separate operator stations. The two controllers are in principal, functionally separate and independent of each other but share the I/O. Two operator stations are located on the Bridge, Simrad Kongsberg, KPos-21 Kongsberg and Converteam DPS21 duplex 'C' series DP

system and The system also includes an operator terminals (Joystick). There is also an independent joystick control system consisting of a single controller unit and operator terminal with interfaces to a gyrocompass for heading reference.

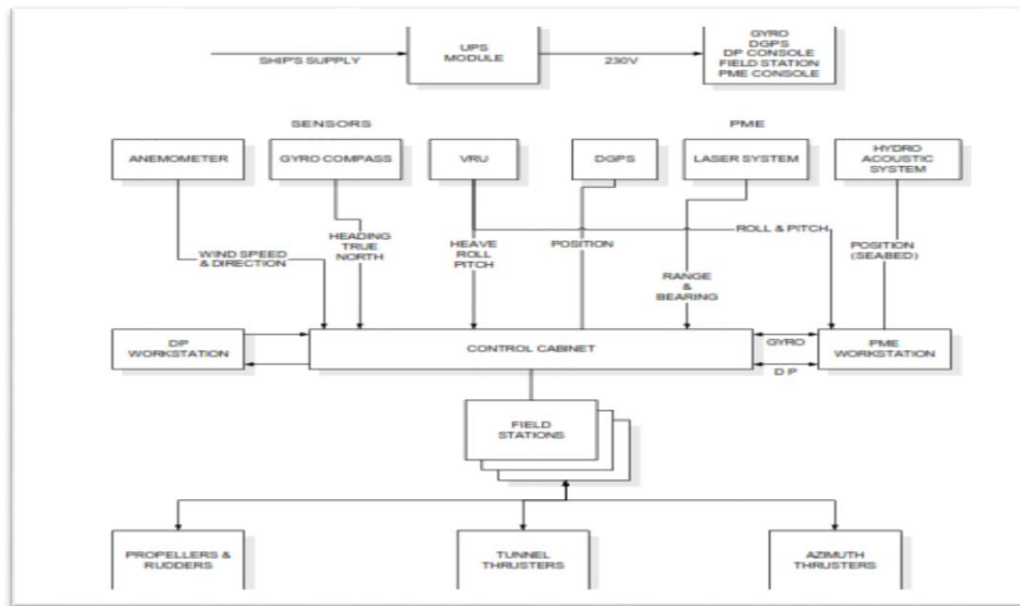


Figure 71 : Display Information on WM.Makassar

d. Environmental References

Wind provides a force which will act on the sail area of the vessel (hull/superstructure) if it is not counteracted. Anemometer are fitted to measure wind speed and direction. In order to compensate for wind forces prior to the vessel being blown off station, the DP control system has a method of calculating the effects of monitored wind speed and direction, and applies the necessary compensating thrust before the wind has this effect. This is continuous process. Wave and current forces are not measured but are derived by calculating the differences between the known wind speed and direction, and the applied thruster forces. In order to minimize error in the position reference systems, the pitch and roll of the vessel has to be measured and compensated. This is achieved by Vertical Reference Units (VRU's) which continuously measured the vessel's motion. The VRU's measure the angular difference between the vessel's plane and the true plane. The measured data is used by the DP control system to determine accurate position information by correcting the measured from the position reference sensors. In order for the DP control system to have a heading reference, gyro compasses are used which provide the healing with respect to the North; hence the actual vessel heading can be calculated.

e. Position Reference Systems

There are a number of methods for measuring the vessel's position and the systems used are referred to as Position Reference Systems or Position Measuring Equipment. This vessel is fitted with three position reference systems:

- Two DGPS position reference system with IALA, spotbeam and GPS L1/L2 differential corrections
- One Cyscan Position Reference Systems

3. Procedure preparation manual system to DP mode system

Most important for DP operator on watch, when preparation from manual to DP mode be carefully for the main propulsion and thruster. Make sure in good order and already tested well. And prior on arrival 500 m safety zone, usually DPO should be care the situation and condition. If any bad weather do not in DP mode, try to manual mode first and analyse the environment condition. If the thruster on high feedback due to the current and wind effect, don't entrance area 500 m safety zone in DP mode.

4. Procedure preparation enter 500 metre safety zone

When vessel prior on arrival outside 500 metre safety zone, the master and chief engineer and also DPO duty must be ensure all equipment and engine in good condition with connected process inspection which prerequisite on check list entering 500 metre safety zone. The master should be ensure the weather in good condition and have suppose data at present condition and also for next few days and also still on minimum tolerance or save limit for hold the ship position and could work when close approach with platform. After check list completed entry 500 metre safety zone and already fill up, master must be report the result test to radio room operator.

5. DP Watch – keeping

The Senior DPO shall continually monitor the operational status of the DP system, power and propulsion systems and also keep abreast of project operations throughout the period of the watch.

To identify and discuss all aspects of general marine operations is considered both

unrealistic and too restrictive, however as a guideline, the following considerations to good DP practice shall be made throughout the period of a DP watch:-

- The DPO shall see to it that no operation is started until permission from the Master and the Client has been granted, and that the appropriate permits, both in field and onboard, are in place. The Duty Senior DPO shall keep the Master informed of any changes in the original project plan.
- The Duty Senior DPO shall keep himself properly informed about weather conditions by consulting weather charts and weather forecasts. If increasing environmental conditions are being reported, the Master, and Offshore Project Manager shall be kept informed. The Master shall be called well in advance of the weather deteriorating, so that the decision to terminate DP operations can be made in a timely manner.
- During DP subsea operations, the DPO shall keep close contact with the relevant Supervisor on duty and keep himself informed as to the status of all subsea operations being performed. He shall at any time know the location of any subsea equipment in relation to the vessel.
- No other vessels are allowed to come alongside or within the vicinity of the vessel, or the platform, unless the Duty Shift Supervisor is informed and permission is granted.
- All information between bridge and project supervisor(s) is to be documented in writing in the DP log. The Duty DPO shall also ensure that any movement of the vessel on DP is properly documented in the DP log.
- Ensuring sufficient electrical power available to the thrusters and the propulsion units.
- Make sure that at all times, the required number of position reference systems are on line.
- Making sure that position movements are carried out with the approval of the Senior DPO and the project Supervisor.
- Checking that all vessel movements are done within the limits of the position reference systems and that all movements will clear obstructions.

6. DP Check List

The following page check list that are recommended for all DP vessel. These check list should be replicated into company and vessel specific check lists and logged in

the form of controlled documentation. They should be updated periodically as required as deemed necessary within the company's management system. Kind's of check list on DP vessels ; Mobilisation Trial Check List, Field Arrival Trial Check List, Pre-DP operation and 6 Hourly DP Check List, 500 m Zone Check List and Engine Room Pre-DP Operation and 6 Hourly Check List.

7. Weather observation

On progress for DP operation, master or DPO should be take observation the weather, the most important think when on DP mode, be carefully when on bad weather or the famous condition is on overcast. Overcast condition is like the wind suddenly coming high until 45 knots. It's very dangerous when on DP mode. And other factor should be measured by master or DPO is Air Temperature; Air Pressure and Air Humidity and Wind and Cloud.

8. Communication & Reporting

All personal on board the vessel must report to the DPO any observation or accurrence that may affect the safe and efficient operational status of the vessel. This includes, but is not limited to the following:

- The intention to perform maintenance on any equipment, including inspection or measurements
- The intention to start or stop any machinery/equipment, or change the defined system operational configuration of a system
- The intention to start or stop any pumping operations
- The intentions to handle equipment which may change the trim or list of the vessel

As general rule, maintenance of any DP related equipment or auxiliary equipment should be covered a formal work permit and risk assessment. All communications systems that may be required to be used should be regulary tested prior to and during DP operations, including any VHF and / or UHF systems.

The DPO will have communications directly with engine control room. Communications will also be arranged based on specific operations. This will include but not be limited to:

- Hard wired and redundant communications between the DP control stations and any subsea control station

- Communication between the DP control station and the working deck/cranes
- Communications between the DP control stations and the appropriated superintendent
- Communications between the DP control station and the offshore installation
- Communication between the DP control station and other vessels in the vicinity
- Communication between the DP control stations and any field control stations

The DPO should always communicate with all concerned parties when the vessel has entered or departed the 500 m safety zone of an offshore installation or other vessel. Any equipment, machinery or electrical faults, or potential faults, should always be reported between the DP control station and engine control room.

Communications should be clear and in English Language only, unless otherwise specified in the vessel operator safety management system. Communication channels should be allocated and only designated for a specific purpose/operation.

Example of specific information that should be communicated between the DPO and the engine control room are as follows:

- Request for additional power/diesel generator
- Vessel on location
- Green light given to commence operations
- Warning of moves, or squalls, that may require additional power
- Increasing/decreasing weather conditions
- Ballasting requirements
- Major deck operations , lifting or landing of equipment/cargo

Examples of specific information that should be communicated between the DPO and any offshore installation or other vessel are as follows:

- Change in status of the operations
- Change in status of DP system
- Intention to perform any task involving the operation of any hazardous tools or equipment
- Intended vessel movements , closer the installation, or to new work location
- Vessel alarm status
- Any other information requested by the units offshore installation manager

Examples of specific information that should be communicated between any offshore installation or the DPO are as follows:

- Movements of other vessels and helicopters

- Crane lift or over side platform work which could interfere with the project operations or positions reference systems
- Scaffolding operations
- Intention to start and stop pumps that discharge
- Requirements for the vessels to observe radio silence
- Hazardous operation, well test
- Other operational or abandoned HPR transponders which may be in the vicinity
- Platform alarm status

9. The Core of All problem above

a. Assessments of *Environment Effect* at every area before entering 500 metre safety zone when DP vessel will close side of The Rig

The purpose assessment of environment effect is analyse and observe the impact of environment to capability the vessel on DP mode. Some of problem for officer duty or DPO should be care about the environment effect. Some of place sometime was not in good condition, and some time in good condition. It's mean the environment should be to be observe before enter point at 500 metre zone. The environment effect could be measured and noted with data available on the bridge. When DP vessel would like to approach the point to the rig. The parameter data must be fill up to data as per check list standard which one already commonly used on the bridge. It is given some example data should be entering and fill up by officer duty or DPO when prior on duty. It's become controlled data and sometime should be report to the Rig Radio Room:

Table 4.1 Weather Observation

Date	Time	Air Temp'	Cloud Condt'	Current		Wind		Swell		Wave	
				Dir.	Spd.	Dir.	Spd.	Dir.	High	Dir.	High.

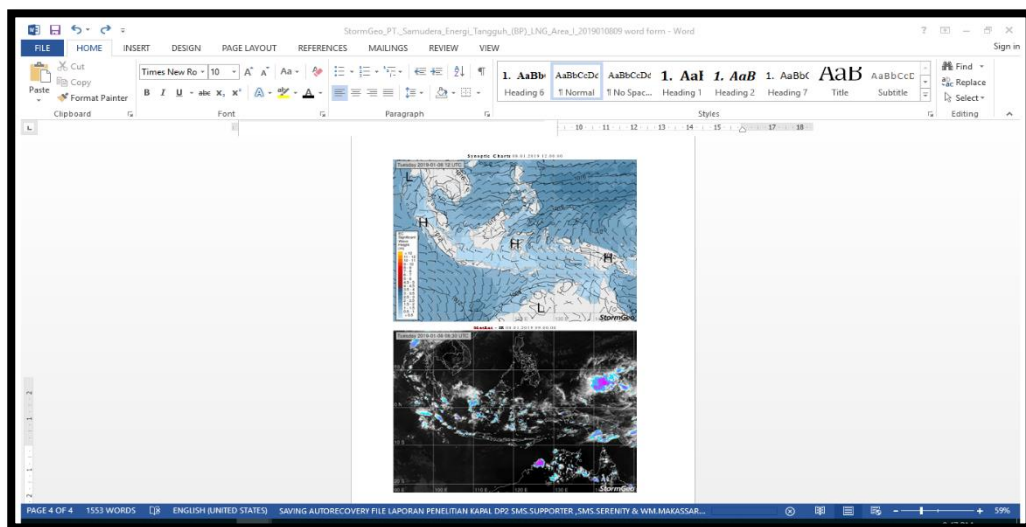
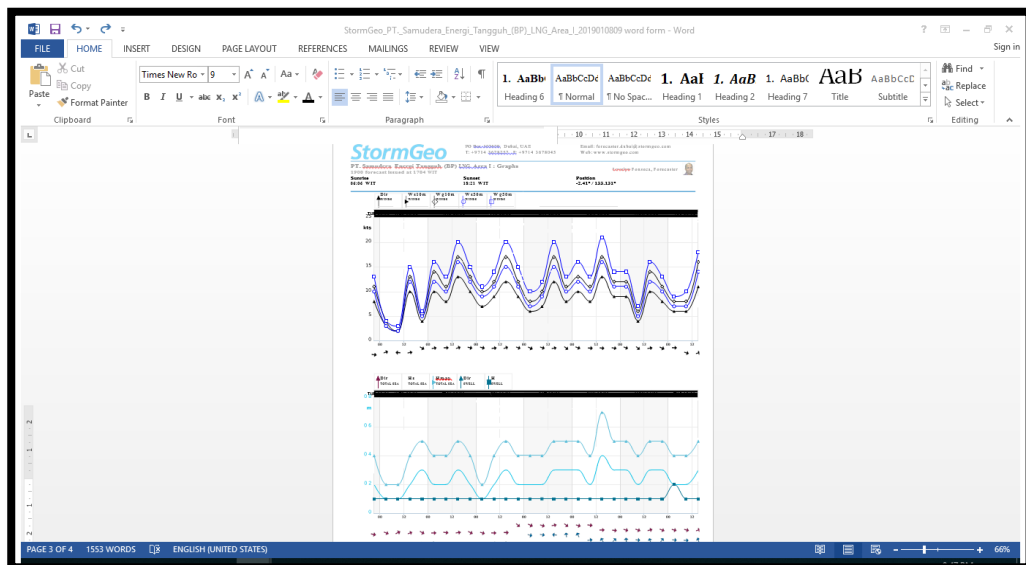
Example1. Observer could take observation by the environment effect weather forecast when present at location area which vessel standby for operation.

StormGeo_PT_Samudera_Energi_Tanggulh_(BP)_LNG_Area_I_2019010809 word form - Word

Date Time	Conf	Dir	W10m	W10m	W10m	W10m	Hs	Hmax	Za	Zp	Dir	H	T	Dir	H	T	T1m	V1
08/01/18	●	W	8	11	10	13	0.3	0.5	1.6	2.2	W	0.3	2.0	SE	0.1	4.2	28	10.0
08/01/19	●	W	8	11	10	13	0.3	0.5	1.6	2.3	W	0.3	2.0	SSE	0.1	4.1	28	10.0
08/01/20	●	W	8	11	10	13	0.2	0.4	1.6	2.4	W	0.2	2.0	SSW	0.1	4.1	27	10.0
08/01/21	●	W	8	11	10	13	0.2	0.4	1.6	2.5	W	0.2	2.0	SW	0.1	4.0	27	10.0
08/01/22	●	W	8	11	10	13	0.2	0.4	1.6	2.5	WNW	0.1	1.8	WSW	0.1	3.4	27	10.0
08/01/23	●	W	7	10	9	11	0.1	0.2	1.5	2.5	WNW	0.1	1.6	WSW	0.1	2.8	26	9.0
09/01/00	●	W	6	8	7	10	0.1	0.2	1.5	2.5	N	0.1	1.4	W	0.1	2.2	26	9.0
09/01/01	●	W	5	7	6	8	0.1	0.2	1.5	2.5	WNW	0.1	1.4	W	0.1	2.2	26	9.0
09/01/02	●	WSW	4	5	5	6	0.1	0.2	1.5	2.4	WNW	0.1	1.5	W	0.1	2.2	25	8.0
09/01/03	●	WSW	3	4	3	4	0.1	0.2	1.5	2.4	W	0.1	1.5	W	0.1	2.2	25	8.0
09/01/04	●	SW	2	3	3	4	0.1	0.2	1.5	2.8	SE	0.1	1.9	W	0.1	2.2	25	8.0
09/01/05	●	SW	3	4	3	4	0.1	0.2	1.5	3.2	S	0.1	1.6	W	0.1	2.2	24	6.0
09/01/06	●	SSW	3	4	4	5	0.1	0.2	1.5	3.3	SW	0.1	1.3	W	0.1	2.3	24	6.0
09/01/07	●	SSW	3	4	4	5	0.1	0.2	1.5	3.3	SW	0.1	1.2	W	0.1	2.3	25	6.0
09/01/08	●	SSW	3	4	4	5	0.1	0.2	1.5	3.4	SSW	0.1	1.2	W	0.1	2.3	26	7.0
09/01/09	●	SSW	3	4	4	5	0.1	0.2	1.5	3.4	SSW	0.1	1.1	W	0.1	2.3	27	7.0
09/01/10	●	SW	4	6	5	7	0.1	0.2	1.4	2.8	SW	0.1	1.3	W	0.1	2.2	28	8.0
09/01/11	●	SW	6	8	7	9	0.1	0.2	1.4	2.1	WSW	0.1	1.4	WSW	0.1	2.2	28	8.0
09/01/12	●	SW	7	10	9	11	0.1	0.2	1.3	1.5	WSW	0.1	1.6	WSW	0.1	2.1	28	10.0
09/01/13	●	WSW	8	11	10	13	0.1	0.2	1.4	1.7	WSW	0.1	1.7	WSW	0.1	2.5	29	10.0
09/01/14	●	WSW	9	12	11	15	0.2	0.4	1.4	1.8	WSW	0.2	1.8	S	0.1	2.9	29	10.0
09/01/15	●	W	10	13	12	15	0.2	0.4	1.5	2.0	WSW	0.2	1.9	SE	0.1	3.3	30	10.0
09/01/16	●	W	10	13	12	16	0.2	0.4	1.5	1.9	W	0.2	1.8	SE	0.1	2.6	29	10.0

StormGeo_PT_Samudera_Energi_Tanggulh_(BP)_LNG_Area_I_2019010809 word form - Word

Date Time	Conf	Dir	W10m	W10m	W10m	W10m	Hs	Hmax	Za	Zp	Dir	H	T	Dir	H	T	T1m	V1
11/01/03	●	WNW	7	10	9	11	0.1	0.2	1.4	1.8	WNW	0.1	1.7	W	0.1	2.0	25	9.0
11/01/06	●	W	8	11	10	13	0.2	0.4	1.5	1.9	WNW	0.2	1.8	WSW	0.1	2.2	26	10.0
11/01/09	●	W	9	12	11	14	0.2	0.4	1.5	1.9	W	0.2	1.9	NNE	0.1	2.3	27	10.0
11/01/12	●	W	10	13	12	16	0.1	0.2	1.4	1.8	W	0.1	1.8	W	0.1	5.0	29	10.0
11/01/15	●	WSW	12	17	15	20	0.3	0.5	1.6	2.2	WSW	0.3	2.0	N	0.1	3.8	30	10.0
11/01/18	●	W	11	15	13	17	0.3	0.5	1.7	2.3	W	0.3	2.2	SSE	0.1	2.9	29	10.0
11/01/21	●	WNW	9	12	11	15	0.2	0.4	1.6	2.6	WNW	0.2	2.0	SW	0.1	2.8	27	10.0
12/01/03	●	WNW	6	8	7	10	0.2	0.4	1.6	2.3	WNW	0.2	2.0	WNW	0.1	1.9	25	7.0
12/01/09	●	WNW	7	10	9	12	0.2	0.4	1.6	2.1	WNW	0.2	2.1	W	0.1	2.9	27	10.0
12/01/15	●	W	12	17	15	20	0.3	0.5	1.8	2.6	W	0.3	2.3	E	0.1	1.6	29	10.0
12/01/21	●	WNW	8	11	10	13	0.3	0.5	1.7	2.5	WNW	0.3	2.1	S	0.1	1.8	27	10.0
13/01/03	●	WNW	10	13	12	16	0.3	0.5	1.7	2.6	WNW	0.3	2.1	SSE	0.1	1.9	25	8.0
13/01/09	●	W	8	11	10	13	0.2	0.4	1.7	2.7	W	0.2	2.1	W	0.1	3.0	27	10.0
13/01/15	●	W	13	17	16	21	0.4	0.7	2.0	3.1	W	0.4	2.5	SSE	0.1	1.6	29	10.0
13/01/21	●	W	9	12	11	14	0.3	0.5	1.9	3.0	W	0.3	2.4	SW	0.1	3.3	26	10.0
14/01/03	●	WNW	9	12	11	14	0.3	0.5	1.8	2.9	WNW	0.3	2.3	S	0.1	1.9	25	9.0
14/01/09	●	WNW	4	6	5	7	0.2	0.4	1.7	2.9	WNW	0.1	1.7	W	0.1	2.6	28	10.0
14/01/15	●	W	10	14	12	16	0.3	0.5	1.8	2.3	WSW	0.3	2.3	SSE	0.1	2.0	29	10.0
14/01/21	●	WNW	8	11	10	13	0.3	0.5	1.8	2.8	WNW	0.3	2.3	SW	0.1	1.7	25	9.0
15/01/03	●	W	6	8	7	9	0.2	0.4	1.8	2.9	WNW	0.1	1.7	W	0.2	2.6	24	7.0
15/01/09	●	WNW	6	8	7	10	0.2	0.4	1.8	3.5	WNW	0.2	2.4	W	0.1	3.5	27	10.0
15/01/18	●	WSW	11	16	14	18	0.3	0.5	1.8	3.6	WSW	0.3	2.4	SSE	0.1	2.9	30	10.0



Weather Precaution:

DPOs shall pay close attention to any weather forecast changes, especially sudden wind shifts or gusting, or both of these. This is to make sure they take prompt action to reduce the possibility of losing position. Before starting operations, every effort shall be made by the vessel Master to assess any known anomalies, for example, unusual currents that changing environmental conditions may cause.

The vessel Master shall make sure that suitably qualified crew members:

☐ get regular and frequent weather forecasts for the area of operations

☐

seek information by radio from other vessels in the vicinity about prevailing weather conditions in the area

☐ use experience to assess the prevailing conditions and likely trends

assess environmental information measured by the DP system and any trends in conditions that it can provide

☐ use on board meteorological instruments

5																									
TERMINAL TANGGUH LNG																									
02° 26' 14.7" S - 133° 06' 59.7" E																									
NOPEMBER 2018																									
HEIGHT IN METRE Time Zone : G.M.T. + 09.00																									
D H	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	D H
1	341	298	247	199	163	148	157	186	228	268	293	293	269	227	178	133	100	88	101	140	197	260	312	343	1
2	347	327	289	243	199	165	150	158	182	220	257	281	285	268	235	194	154	123	109	118	150	198	253	299	2
3	328	334	317	284	241	198	163	145	148	171	207	245	273	284	277	252	217	178	145	126	128	152	193	242	3
4	287	316	325	313	281	239	193	155	133	133	158	194	237	273	294	295	276	242	201	163	137	131	148	185	4
5	232	278	310	322	310	278	232	182	140	115	116	141	185	237	282	312	318	301	285	219	173	140	129	143	5
6	179	227	275	310	322	308	271	219	164	119	95	99	131	185	248	301	335	343	323	281	228	176	138	125	6
7	139	177	229	279	312	321	301	257	199	140	95	75	87	130	194	265	324	359	363	336	287	228	172	134	7
8	122	140	183	237	286	315	316	287	235	173	114	73	62	85	139	213	289	349	379	375	340	284	221	165	8
9	130	124	148	195	249	294	315	304	266	208	145	90	58	58	93	158	239	315	369	390	376	333	273	210	9
10	159	131	132	163	211	263	299	308	286	239	179	119	72	52	65	112	185	266	337	381	390	366	317	257	10
11	199	155	136	146	181	229	273	296	294	262	211	152	99	64	57	83	139	214	291	352	382	379	347	297	11
12	240	190	157	147	184	201	245	279	290	275	236	184	132	89	67	73	108	169	242	310	356	373	360	323	12
13	275	226	185	162	161	183	218	255	277	277	253	212	165	121	90	81	96	138	198	263	319	351	356	335	13
14	299	255	214	184	170	175	198	230	258	270	262	234	195	155	121	102	101	123	166	221	277	319	338	334	14
15	311	276	239	207	184	177	186	208	235	256	261	248	221	188	156	131	120	125	149	189	237	281	311	321	15
16	312	289	258	227	200	183	180	191	212	235	250	252	240	218	191	166	148	141	148	170	205	245	279	300	16
17	305	293	271	243	216	193	178	177	189	209	231	246	249	241	224	204	183	168	161	166	184	213	246	274	17
18	290	291	280	258	231	204	181	168	168	181	203	227	246	255	252	240	222	202	185	175	176	190	215	243	18
19	268	283	284	271	248	218	189	164	151	153	170	197	228	254	270	272	262	243	219	197	182	179	190	213	19
20	242	267	281	281	265	237	203	168	142	130	136	159	196	237	271	293	297	285	260	229	201	181	176	187	20
21	212	243	270	285	282	260	225	183	143	115	106	119	154	202	253	296	321	323	304	271	232	197	174	169	21
22	184	214	250	279	292	283	253	208	158	114	88	65	108	155	217	278	325	349	344	316	273	226	186	163	22
23	162	184	220	261	291	300	283	242	187	130	86	63	69	105	166	239	307	355	372	358	319	266	213	172	23
24	152	158	187	231	275	304	305	277	226	163	103	60	45	62	112	185	266	336	380	388	362	312	252	197	24
25	158	144	158	196	245	290	314	306	267	207	139	80	42	36	65	127	209	294	362	396	393	356	298	235	25
26	180	146	139	162	207	260	302	318	301	254	188	119	64	34	38	78	148	235	319	379	403	388	342	280	26
27	216	165	138	139	169	218	271	308	317	292	239	172	107	58	37	50	98	173	259	336	386	399	374	323	27
28	260	199	154	133	141	176	227	277	309	311	281	227	164	105	64	50	70	121	195	278	344	383	386	356	28
29	303	242	186	146	131	144	181	231	277	304	302	271	221	164	113	79	71	93	144	213	286	343	372	368	29
30	336	285	228	176	141	130	145	182	230	272	296	294	267	224	174	130	101	95	116	162	224	287	334	356	30

TERMINAL TANGGUH LNG																									
02° 26' 14.7" S - 133° 06' 59.7" E																									
DECEMBER 2018																									
Height in Metre Time Zone : G.M.T. + 09.00																									
D H	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	D H
1	349	317	269	216	169	136	126	142	178	224	265	289	291	271	235	193	153	126	116	135	174	227	281	321	1
2	339	331	301	257	207	161	130	120	135	170	215	257	286	294	282	254	217	179	150	138	148	180	225	271	2
3	307	323	317	289	247	197	152	120	109	124	160	206	254	289	305	300	277	241	202	169	151	155	180	219	3
4	261	295	311	306	279	236	186	139	106	96	113	152	204	258	300	322	321	300	282	219	181	158	157	177	4
5	213	254	287	304	297	269	224	171	123	90	83	103	149	208	269	317	343	343	318	277	229	186	160	155	5
6	174	210	251	284	299	289	257	208	153	104	75	72	100	153	220	286	337	362	359	329	283	230	185	157	6
7	154	175	212	253	284	295	279	241	188	132	86	62	67	104	165	239	308	357	376	367	331	279	225	180	7
8	154	155	179	218	259	286	289	266	222	167	112	71	55	70	117	186	263	330	373	385	365	323	268	214	8
9	173	153	159	188	229	266	286	280	249	201	145	95	62	57	83	138	212	288	349	381	382	354	307	252	9
10	201	166	155	168	201	241	272	283	268	230	179	127	84	62	67	104	166	241	311	361	380	369	334	285	10
11	233	189	163	160	180	216	252	276	276	253	211	161	115	81	70	87	131	196	267	327	363	369	348	308	11
12	260	214	178	162	168	193	229	261	276	267	237	195	149	110	87	87	112	161	225	288	336	357	351	322	12
13	281	236	196	170	163	176	206	240	265	272	257	225	184	145	115	102	110	141	191	249	302	335	344	327	13
14	294	253	213	181	163	165	184	215	248	266	267	249	217	181	149	127	121	135	169	216	267	307	328	325	14
15	302	267	228	193	168	157	165	188	220	249	266	264	246	217	187	160	145	143	160	192	235	276	306	316	15
16	306	279	244	207	175	155	150	162	189	222	250	266	264	249	225	199	177	164	164	180	209	246	279	300	16
17	303	288	259	224	188	159	141	140	157	186	221	251	269	271	260	240	216	195	182	181	194	219	250	277	17
18	293	292	274	244	207	171	142	126	126	148	181	220	255	276	285	276	259	235	211	195	190	200	222	249	18
19	274	288	285	265	232	193	154	123	108	113	137	177	223	265	294	305	299	276	250	222	201	192	199	219	19
20	247	272	286	282	260	223	179	136	103	89	97	128	176	231	280	315	329	320	295	260	225	199	187	194	20
21	215	245	273	288	283	257	215	164	117	83	70	84	123	180	245	302	340	352	338	305	262	221	190	176	21
22	186	212	248	278	294	286	255	205	149	97	63	54	75	124	192	265	327	364	371	350	307	256	209	176	22
23	165	178	210	251	286	302	290	251	195	133	79	46	43	73	132	209	289	352	385	384	352	300	242	192	23
24	160	153	173	213	260	296	309	291	245	183	118	65	46	34	79	148	232	314	373	399	387	345	285	223	24
25	173	144	144	172	219	269	306	314	290	238	172	106	56	33	45	93	169	257	336	388	403	380	329	265	25
26	201	153	130	138	174	227	279	313	316	285	230	163	100	55	40	60	114	193	280	352	394	397	365	308	26
27	241	180	136	120	136	178	234	286	316	314	280	224	160	102	63	55	80	138	217	297	360	390	383	343	27
28	284	218	161	123	114	136	183	240	289	315	309	275	222	163	111	80	76	105	163	237	308	359	378	362	28
29	319	259	197	145	114	111	138	186	242	288	311	305	273	225	173	129	102	102	131	185	250	310	349	359	29
30	336	294	237	180	133	107	109	138	187	241	285	306	302	276	235	190	151	128	128	154	200	256	305	334	30
31	337	314	272	219	166	124	102	107	137	185	238	280	304	304	284	251	211	176	153	151	171	209	255	294	31

Example1. Observer could take observation by Current Data presented when on location to the Rig or platform:

BABO		CURRENT IN KNOTS																									
02° 32' 00" S - 133° 27' 30" E Dir.: Pos.350° Neg.170°		NOPEMBER 2018																									
Time Zone : G.M.T. + 09.00		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24		
D	H	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	D	
		1	-0.89	-0.68	-0.35	0.04	0.44	0.76	0.88	+ 0.71	0.29	-0.21	-0.62	-0.80	+ -0.75	-0.53	-0.21	0.16	0.56	0.90	1.07	+ 0.95	0.54	-0.05	-0.60	-0.94	1
		2	-1.01	+ -0.87	-0.59	-0.25	0.16	0.56	0.86	0.92	+ 0.66	0.18	-0.35	-0.72	-0.82	+ -0.69	-0.42	-0.09	0.27	0.65	0.95	1.05	+ 0.84	0.34	-0.27	-0.78	2
		3	-1.02	+ -0.98	-0.76	-0.45	-0.10	0.29	0.67	0.91	+ 0.89	0.54	0.01	-0.50	-0.77	+ -0.77	-0.55	-0.26	0.05	0.38	0.71	0.95	0.96	+ 0.65	0.10	-0.50	3
		4	-0.91	-1.02	+ -0.87	-0.59	-0.28	0.05	0.40	0.74	0.90	+ 0.78	0.36	-0.18	-0.61	-0.76	+ -0.64	-0.38	-0.09	0.17	0.44	0.72	0.88	+ 0.80	0.41	-0.17	4
		5	-0.69	-0.96	+ -0.92	-0.68	-0.38	-0.11	0.18	0.49	0.76	0.83	+ 0.62	0.16	-0.34	-0.65	-0.66	+ -0.46	-0.18	0.05	0.25	0.47	0.67	0.75	+ 0.58	0.14	5
		6	-0.40	-0.80	-0.91	+ -0.74	-0.46	-0.19	0.04	0.28	0.53	0.73	+ 0.71	0.42	-0.03	-0.44	-0.61	+ -0.51	-0.26	-0.02	0.15	0.29	0.44	0.58	+ 0.58	0.34	6
		7	-0.11	-0.56	-0.81	+ -0.77	-0.53	-0.25	-0.02	0.15	0.34	0.54	0.65	+ 0.56	0.24	-0.18	-0.47	-0.51	+ -0.34	-0.09	0.09	0.19	0.27	0.38	0.46	+ 0.39	7
		8	0.11	-0.29	-0.63	-0.74	+ -0.60	-0.32	-0.07	0.09	0.21	0.36	0.51	0.56	+ 0.42	0.09	-0.25	-0.43	+ -0.38	-0.18	0.02	0.13	0.17	0.21	0.29	0.33	8
		9	0.22	-0.06	-0.39	-0.62	+ -0.61	-0.42	-0.16	0.03	0.15	0.24	0.36	0.48	0.48	+ 0.31	0.01	-0.26	-0.36	+ -0.27	-0.09	0.05	0.10	0.11	0.14	0.21	9
		10	0.22	+ 0.10	-0.15	-0.41	-0.54	+ -0.48	-0.28	-0.07	0.08	0.16	0.25	0.36	0.45	+ 0.43	0.25	-0.01	-0.22	-0.29	+ -0.21	-0.08	0.00	0.03	0.04	0.09	10
		11	0.16	0.16	+ 0.05	-0.16	-0.37	-0.45	+ -0.38	-0.21	-0.05	0.07	0.16	0.26	0.38	0.46	+ 0.42	0.24	0.00	-0.19	-0.26	+ -0.23	-0.15	-0.09	-0.06	-0.01	11
		12	0.07	0.15	0.17	+ 0.07	-0.12	-0.30	-0.38	+ -0.34	-0.22	-0.08	0.05	0.17	0.30	0.43	0.50	+ 0.45	0.27	0.03	-0.19	-0.31	-0.33	+ -0.28	-0.21	-0.13	12
		13	-0.03	0.10	0.20	0.23	+ 0.14	-0.05	-0.24	-0.37	-0.38	+ -0.29	-0.14	0.03	0.20	0.37	0.52	0.58	+ 0.52	0.31	0.02	-0.26	-0.44	-0.49	+ -0.43	-0.30	13
		14	-0.15	0.01	0.18	0.31	0.35	+ 0.24	0.02	-0.24	-0.43	-0.48	+ -0.38	-0.19	0.04	0.27	0.47	0.63	0.69	+ 0.59	0.32	-0.05	-0.41	-0.63	-0.67	+ -0.56	14
		15	-0.35	-0.12	0.11	0.32	0.46	0.49	+ 0.33	0.03	-0.31	-0.56	-0.61	+ -0.47	-0.20	0.09	0.37	0.60	0.76	0.79	+ 0.64	0.28	-0.19	-0.61	-0.85	+ -0.84	15
		16	-0.63	-0.33	-0.03	0.25	0.48	0.63	+ 0.62	0.39	-0.01	-0.44	-0.71	-0.73	+ -0.51	-0.17	0.19	0.49	0.73	0.88	+ 0.87	0.63	0.17	-0.39	-0.85	+ -1.05	+ 16
		17	-0.94	-0.63	-0.25	0.10	0.41	0.66	0.79	+ 0.71	0.38	-0.13	-0.61	-0.86	+ -0.81	-0.50	-0.09	0.30	0.61	0.85	0.97	+ 0.90	0.56	-0.01	-0.63	-1.07	17
		18	-1.18	+ -0.97	-0.56	-0.13	0.26	0.58	0.82	0.91	+ 0.74	0.30	-0.28	-0.77	-0.97	+ -0.82	-0.43	0.02	0.40	0.71	0.93	1.02	+ 0.87	0.43	-0.22	-0.86	18
		19	-1.24	+ -1.23	-0.91	-0.44	0.02	0.40	0.72	0.95	0.98	+ 0.72	0.18	-0.44	-0.90	-1.00	+ -0.76	-0.33	0.12	0.48	0.76	0.96	1.00	+ 0.78	0.25	-0.44	19
		20	-1.04	-1.31	+ -1.19	-0.78	-0.29	0.15	0.52	0.83	1.03	+ 0.99	0.64	0.04	-0.58	-0.96	-0.96	+ -0.66	-0.22	0.19	0.51	0.77	0.94	+ 0.94	0.64	0.06	20
		21	-0.62	-1.14	-1.29	+ -1.06	-0.63	-0.16	0.25	0.60	0.89	1.05	+ 0.95	0.53	-0.09	-0.66	-0.94	+ -0.87	-0.54	-0.14	0.21	0.49	0.73	0.88	+ 0.83	0.49	21
		22	-0.11	-0.73	-1.14	-1.17	+ -0.90	-0.47	-0.06	0.30	0.63	0.91	1.03	+ 0.88	0.43	-0.17	-0.66	-0.86	+ -0.74	-0.44	-0.11	0.17	0.42	0.65	0.79	+ 0.71	22
		23	0.34	-0.22	-0.75	-1.05	+ -1.01	-0.73	-0.36	-0.01	0.31	0.63	0.90	0.99	+ 0.80	0.35	-0.20	-0.61	-0.74	+ -0.63	-0.39	-0.14	0.08	0.32	0.55	0.68	+ 23
		24	0.59	0.25	-0.25	-0.69	-0.90	+ -0.83	-0.59	-0.30	-0.01	0.29	0.60	0.86	0.94	+ 0.74	0.32	-0.16	-0.51	-0.63	+ -0.56	-0.40	-0.23	-0.03	0.20	0.45	24
		25	0.59	+ 0.52	0.21	-0.21	-0.57	-0.73	+ -0.68	-0.51	-0.29	-0.04	0.25	0.57	0.83	0.90	+ 0.71	0.33	-0.10	-0.42	-0.56	+ -0.55	-0.47	-0.34	-0.15	0.10	25
		26	0.37	0.53	+ 0.49	0.24	-0.12	-0.43	-0.59	-0.59	+ -0.48	-0.31	-0.08	0.21	0.54	0.80	0.88	+ 0.72	0.37	-0.03	-0.36	-0.55	-0.61	+ -0.58	-0.46	-0.25	26
		27	0.04	0.33	0.52	+ 0.52	0.31	0.00	-0.30	-0.50	-0.56	+ -0.50	-0.35	-0.12	0.20	0.53	0.80	0.89	+ 0.74	0.41	0.00	-0.36	-0.60	-0.71	+ -0.69	-0.55	27
		28	-0.31	0.02	0.34	0.56	0.58	+ 0.41	0.09	-0.23	-0.47	-0.57	+ -0.53	-0.38	-0.12	0.21	0.55	0.82	0.91	+ 0.76	0.42	-0.02	-0.43	-0.70	-0.81	+ -0.76	28
		29	-0.59	-0.30	0.05	0.39	0.63	0.67	+ 0.48	0.14	-0.23	-0.50	-0.60	+ -0.55	-0.36	-0.09	0.24	0.59	0.85	0.93	+ 0.76	0.37	-0.12	-0.56	-0.82	-0.89	+ 29
		30	-0.78	-0.56	-0.25	0.12	0.48	0.72	0.74	+ 0.51	0.12	-0.29	-0.56	-0.63	+ -0.53	-0.31	-0.02	0.30	0.63	0.87	0.92	+ 0.69	0.24	-0.28	-0.71	-0.92	+ 30

BABO		CURRENT IN KNOTS																									
02° 32' 00" S - 133° 27' 30" E Dir.: Pos.350° Neg.170°		DECEMBER 2018																									
Time Zone : G.M.T. + 09.00		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24		
D	H	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	D	
1		-0.90	-0.73	-0.47	-0.14	0.23	0.58	0.80	+ 0.77	0.47	0.03	-0.38	-0.61	-0.61	+ -0.45	-0.21	0.06	0.37	0.67	0.88	+ 0.86	0.56	0.06	-0.48	-0.84	1	
2		-0.95	+ -0.85	-0.62	-0.33	-0.01	0.35	0.68	0.84	+ 0.73	0.36	-0.11	-0.49	-0.63	+ -0.55	-0.34	-0.09	0.16	0.43	0.69	0.84	+ 0.75	0.37	-0.17	-0.67	2	
3		-0.93	-0.91	-0.72	-0.45	-0.17	0.14	0.47	0.75	0.84	+ 0.64	0.20	-0.27	-0.56	-0.60	+ -0.43	-0.20	0.02	0.24	0.47	0.68	0.76	+ 0.57	0.13	-0.41	3	
4		-0.81	-0.93	+ -0.80	-0.53	-0.26	-0.01	0.27	0.57	0.78	+ 0.77	0.48	0.02	-0.40	-0.59	+ -0.51	-0.29	-0.06	0.12	0.29	0.48	0.63	+ 0.62	0.35	-0.12	4	
5		-0.61	-0.88	+ -0.86	-0.62	-0.33	-0.08	0.14	0.38	0.63	0.76	+ 0.66	0.30	-0.16	-0.49	-0.55	+ -0.38	-0.14	0.06	0.19	0.31	0.45	0.55	+ 0.45	0.12	5	
6		-0.35	-0.74	-0.87	+ -0.72	-0.42	-0.13	0.08	0.26	0.47	0.66	0.70	+ 0.51	0.12	-0.30	-0.52	+ -0.47	-0.25	-0.02	0.13	0.21	0.30	0.41	0.43	+ 0.27	6	
7		-0.09	-0.52	-0.79	+ -0.78	-0.55	-0.23	0.03	0.20	0.35	0.52	0.65	+ 0.62	0.36	-0.04	-0.38	-0.50	+ -0.38	-0.14	0.05	0.15	0.20	0.27	0.34	+ 0.32	7	
8		0.11	-0.26	-0.61	-0.76	+ -0.66	-0.37	-0.07	0.14	0.28	0.42	0.56	0.63	+ 0.52	0.23	-0.14	-0.41	-0.45	+ -0.29	-0.08	0.07	0.13	0.17	0.23	0.28	+ 8	
9		0.21	-0.02	-0.35	-0.62	-0.68	+ -0.52	-0.24	0.02	0.20	0.33	0.46	0.57	0.60	+ 0.44	0.14	-0.20	-0.40	-0.41	+ -0.26	-0.09	0.02	0.08	0.13	0.20	9	
10		0.24	+ 0.15	-0.08	-0.37	-0.57	-0.58	+ -0.41	-0.16	0.07	0.23	0.36	0.49	0.59	+ 0.58	0.39	0.09	-0.22	-0.40	-0.40	+ -0.29	-0.15	-0.05	0.02	0.11	10	
11		0.20	0.23	+ 0.14	-0.08	-0.33	-0.50	-0.50	+ -0.36	-0.14	0.06	0.23	0.39	0.53	0.62	+ 0.58	0.38	0.07	-0.23	-0.41	-0.45	+ -0.38	-0.26	-0.14	-0.01	11	
12		0.11	0.23	0.27	+ 0.18	-0.02	-0.26	-0.44	-0.47	+ -0.37	-0.18	0.03	0.24	0.43	0.58	0.66	+ 0.61	0.40	0.07	-0.25	-0.48	-0.56	+ -0.51	-0.37	-0.20	12	
13		-0.02	0.16	0.30	0.36	+ 0.28	0.07	-0.20	-0.42	-0.50	+ -0.43	-0.24	0.01	0.25	0.47	0.65	0.72	+ 0.66	0.42	0.06	-0.32	-0.61	-0.72	+ -0.65	-0.47	13	
14		-0.23	0.02	0.24	0.42	0.49	+ 0.40	0.16	-0.17	-0.45	-0.58	-0.52	-0.30	0.00	0.29	0.54	0.72	0.80	+ 0.71	0.44	0.01	-0.45	-0.78	-0.89	-0.78	14	
15		-0.52	-0.20	0.10	0.36	0.56	0.64	+ 0.53	0.22	-0.19	-0.54	-0.69	+ -0.60	-0.33	0.01	0.34	0.61	0.80	0.87	+ 0.76	0.42	-0.10	-0.62	-0.97	-1.04	+ 15	
16		-0.85	-0.51	-0.14	0.21	0.51	0.73	0.79	+ 0.62	0.23	-0.27	-0.66	-0.81	-0.66	-0.33	0.06	0.40	0.68	0.88	0.94	+ 0.77	0.34	-0.25	-0.82	-1.15	+ 16	
17		-1.14	-0.86	-0.45	-0.03	0.34	0.66	0.89	0.91	+ 0.66	0.17	-0.39	-0.79	-0.89	+ -0.67	-0.29	0.11	0.46	0.74	0.93	+ 0.97	0.73	0.22	-0.44	-1.01	17	
18		-1.27	+ -1.16	-0.80	-0.34	0.09	0.48	0.81	1.02	+ 0.99	0.65	0.07	-0.53	-0.90	-0.92	+ -0.64	-0.23	0.16	0.50	0.77	0.96	+ 0.95	0.65	0.06	-0.63	18	
19		-1.15	-1.31	+ -1.11	-0.68	-0.22	0.21	0.60	0.93	1.11	+ 1.01	0.57	-0.06	-0.65	-0.95	+ -0.89	-0.57	-0.17	0.20	0.51	0.78	0.95	+ 0.89	0.51	-0.12	19	
20		-0.78	-1.22	-1.27	+ -0.98	-0.55	-0.10	0.31	0.70	1.01	1.15	+ 0.97	0.46	-0.19	-0.72	-0.94	-0.81	-0.49	-0.13	0.20	0.49	0.76	0.90	+ 0.79	0.36	20	
21		-0.29	-0.88	-1.20	+ -1.15	-0.83	-0.40	0.00	0.39	0.76	1.05	1.13	+ 0.88	0.34	-0.29	-0.74	-0.87	+ -0.71	-0.42	-0.11	0.16	0.44	0.70	0.82	+ 0.67	21	
22		0.22	-0.39	-0.89	-1.10	+ -0.98	-0.66	-0.29	0.07	0.43	0.78	1.05	1.07	+ 0.78	0.23	-0.34	-0.70	-0.78	+ -0.62	-0.38	-0.14	0.10	0.37	0.62	0.72	+ 22	
23		0.54	0.10	-0.43	-0.82	-0.94	+ -0.80	-0.52	-0.21	0.10	0.44	0.78	1.01	+ 0.99	0.67	0.16	-0.33	-0.63	-0.68	+ -0.56	-0.39	-0.20	0.02	0.29	0.54	23	
24		0.62	+ 0.44	0.05	-0.39	-0.70	-0.76	+ -0.63	-0.41	-0.17	0.11	0.43	0.74	0.94	+ 0.90	0.59	0.13	-0.29	-0.54	-0.60	+ -0.54	-0.43	-0.28	-0.06	0.21	24	
25		0.46	0.54	+ 0.38	0.05	-0.30	-0.54	-0.60	+ -0.51	-0.36	-0.16	0.09	0.40	0.70	0.87	+ 0.82	0.54	0.14	-0.24	-0.48	-0.58	+ -0.57	-0.50	-0.36	-0.13	25	
26		0.15	0.40	0.49	+ 0.38	0.11	-0.19	-0.40	-0.48	+ -0.45	-0.34	-0.17	0.07	0.37	0.65	0.82	0.77	0.52	0.15	-0.20	-0.46	-0.60	-0.63	+ -0.57	-0.42	26	
27		-0.17	0.12	0.38	0.50	+ 0.43	0.20	-0.08	-0.30	-0.42	-0.42	+ -0.34	-0.18	0.06	0.35	0.62	0.78	0.74	0.51	0.15	-0.22	-0.50	-0.66	-0.70	+ -0.62	27	
28		-0.44	-0.18	0.14	0.41	0.55	+ 0.50	0.28	-0.01	-0.26	-0.41	-0.43	+ -0.34	-0.17	0.06	0.34	0.60	0.76	0.73	0.49	0.11	-0.29	-0.59	-0.74	+ -0.74	+ 28	
29		-0.62	-0.42	-0.13	0.19	0.47	0.62	+ 0.57	0.32	0.00	-0.29	-0.44	+ -0.44	-0.32	-0.14	0.09	0.36	0.61	0.75	+ 0.70	0.43	0.01	-0.41	-0.70	+ -0.80	+ 29	
30		-0.74	-0.57	-0.34	-0.05	0.28	0.57	0.70	0.60	0.31	-0.06	-0.35	+ -0.47	-0.42	-0.28	-0.09	0.13	0.39	0.62	0.74	+ 0.64	0.31	-0.15	-0.56	-0.79	30	
31		-0.81	+ -0.68	-0.47	-0.22	0.08	0.40	0.67	0.75	+ 0.58	0.22	-0.18	-0.44	-0.49	+ -0.38	-0.20	-0.02	0.19	0.43	0.64	0.71	+ 0.53	0.13	-0.35	-0.72	+ 31	

PT. Samudera Energi Tangguh (BP) LNG Area I : Table 1900 forecast issued at 1749 WIT

Mani Sockan, Forecaster



Sunrise
05:45 WIT

Sunset
18:00 WIT

Position
-2.41° / 133.131°

SYNOPTIC SITUATION

Tropical Depression 55 is located about 180 NM east of Cebu City, Philippines. It is moving to the west-northwest at 15 kts. It is now forecast to move through the southern Philippines as a depression. It is then forecast to strike southern Vietnam on Saturday as a tropical storm with winds of 60 kts. Disturbance 58 is near 5N, 155.5E. It is moving to the west-northwest near 9 kts. This motion is expected to continue. In about 3 to 4 days, the system could pass close to Guam. There is now a 90 percent chance of tropical development. The weak low pressure area over Arafura Sea persists. Weak high pressure area covers eastern Papua and Papua New Guinea. Isolated rain/showers to continue.

Local Weather Tuesday 19:00 to Wednesday 07:00

Weather : Light rain
Visibility: 7 - 9 km
Lightning Risk: Low to High
Fog Risk: Low
Max Sustained Wind (Ws10): 9 kts
Max Significant Wave Height (Hs): 0.4 m
Max Temperature: 26 °C
Min Temperature: 24 °C

WIT	CONF	WINDS					TOTAL SEA				WIND WAVES			SWELL			WEATHER	
Date Time	Conf	Dir	Ws10m	Wg10m	Ws50m	Wg50m	Hs	Hmax	Tz	Tp	Dir	H	T	Dir	H	T	T2m	Vis
			(kts)	(kts)	(kts)	(kts)	(m)	(m)	(s)	(s)		(m)	(s)		(m)	(s)	(°C)	(km)
TUE																		
20/11 17	🟢	W	13	17	16	21	0.4	0.7	1.5	2.1	W	0.2	1.9	WSW	0.1	4.6	27	10.0
20/11 18	🟢	W	12	16	14	19	0.4	0.7	1.5	2.0	W	0.2	1.8	WNW	0.1	5.4	27	10.0
20/11 19	🟢	WNW	9	13	11	15	0.4	0.7	1.5	2.1	NW	0.1	2.2	W	0.1	4.3	26	9.0
20/11 20	🟢	NW	7	9	8	11	0.3	0.5	1.5	2.2	NNE	0.1	2.7	W	0.1	3.1	25	8.0
20/11 21	🟢	NNW	4	6	5	7	0.3	0.5	1.5	2.3	ENE	0.1	3.1	W	0.1	2.0	24	7.0
20/11 22	🟢	NW	5	6	6	8	0.3	0.5	1.5	2.3	ENE	0.1	3.1	W	0.1	2.0	24	7.0
20/11 23	🟢	WNW	5	6	6	8	0.3	0.5	1.5	2.2	ENE	0.1	3.1	W	0.1	2.0	24	7.0
WED	CONF	Dir	Ws10m	Wg10m	Ws50m	Wg50m	Hs	Hmax	Tz	Tp	Dir	H	T	Dir	H	T	T2m	Vis
21/11 00	🟢	W	5	7	6	8	0.3	0.5	1.5	2.2	ENE	0.1	3.1	W	0.1	2.0	24	7.0
21/11 01	🟢	WNW	5	7	6	8	0.3	0.5	1.5	2.2	NE	0.1	2.7	W	0.1	2.0	24	7.0
21/11 02	🟢	NW	6	8	7	9	0.3	0.5	1.4	2.1	NNE	0.1	2.3	W	0.1	2.1	24	7.0
21/11 03	🟢	N	6	8	8	10	0.3	0.5	1.4	2.1	NNE	0.1	1.9	W	0.1	2.1	24	7.0
21/11 04	🟢	NNE	6	8	7	10	0.3	0.5	1.4	2.2	NNE	0.1	1.9	W	0.1	2.1	24	7.0
21/11 05	🟢	NE	6	8	7	9	0.2	0.4	1.4	2.4	NE	0.1	1.8	W	0.1	2.0	24	7.0
21/11 06	🟢	ENE	5	7	6	8	0.2	0.4	1.4	2.5	NE	0.1	1.8	W	0.1	2.0	24	7.0
21/11 07	🟢	ENE	6	8	7	9	0.2	0.4	1.4	2.5	NE	0.1	1.6	W	0.1	2.0	25	8.0
21/11 08	🟢	NE	6	9	8	10	0.2	0.4	1.4	2.5	NE	0.1	1.3	W	0.1	2.0	26	9.0
21/11 09	🟢	NNE	7	9	8	11	0.2	0.4	1.4	2.5	NE	0.1	1.1	W	0.1	2.0	27	10.0
21/11 10	🟢	NNE	6	8	7	10	0.2	0.4	1.4	2.5	NE	0.1	1.3	W	0.1	2.0	28	10.0
21/11 11	🟢	NNE	5	7	7	9	0.2	0.4	1.4	2.5	ENE	0.1	1.6	W	0.1	2.0	29	10.0
21/11 12	🟢	NNE	5	6	6	8	0.2	0.4	1.4	2.5	E	0.1	1.8	W	0.1	2.0	30	10.0
21/11 13	🟢	NNW	6	8	7	9	0.2	0.4	1.4	2.5	NNE	0.1	1.7	W	0.1	2.1	30	10.0
21/11 14	🟢	NW	7	9	8	11	0.2	0.4	1.3	2.4	NNW	0.1	1.5	W	0.1	2.1	30	10.0
21/11 15	🟢	WNW	8	11	10	13	0.2	0.4	1.3	2.4	WNW	0.1	1.4	W	0.1	2.2	30	10.0
21/11 16	🟢	WNW	8	10	10	12	0.2	0.4	1.3	2.1	WNW	0.1	1.4	W	0.1	2.0	29	10.0
21/11 17	🟢	WNW	7	10	9	12	0.3	0.5	1.2	1.8	WNW	0.1	1.4	W	0.1	1.9	28	10.0
21/11 18	🟢	WNW	7	10	9	11	0.3	0.5	1.2	1.5	WNW	0.1	1.4	W	0.1	1.7	27	10.0
21/11 21	🟢	N	10	13	12	16	0.3	0.5	1.2	1.5	NNW	0.1	1.2	W	0.1	1.6	26	10.0
THU	CONF	Dir	Ws10m	Wg10m	Ws50m	Wg50m	Hs	Hmax	Tz	Tp	Dir	H	T	Dir	H	T	T2m	Vis
22/11 00	🟢	ENE	9	11	10	14	0.3	0.5	1.2	1.5	ENE	0.1	1.0	NW	0.1	1.6	25	8.0
22/11 03	🟢	NE	5	7	6	8	0.2	0.4	1.2	2.4	ENE	0.1	3.1	WNW	0.1	1.6	24	8.0
22/11 06	🟢	SSE	4	5	5	7	0.2	0.4	1.3	2.4	ENE	0.1	3.1	WNW	0.1	1.8	24	7.0
22/11 09	🟢	WNW	5	7	6	8	0.2	0.4	1.3	2.4	ENE	0.1	3.1	W	0.1	1.8	28	10.0
22/11 12	🟢	W	8	11	10	13	0.2	0.4	1.2	2.4	W	0.1	1.3	WNW	0.1	1.7	30	10.0
22/11 15	🟢	WSW	14	19	17	22	0.4	0.7	1.4	1.7	WSW	0.2	1.6	NW	0.1	1.8	30	10.0
22/11 18	🟡	WNW	12	16	14	19	0.4	0.7	1.5	2.2	W	0.2	1.8	SW	0.1	2.3	28	10.0
22/11 21	🟡	NW	10	14	12	16	0.3	0.5	1.4	1.8	NW	0.1	1.5	WSW	0.1	2.2	27	10.0
FRI	CONF	Dir	Ws10m	Wg10m	Ws50m	Wg50m	Hs	Hmax	Tz	Tp	Dir	H	T	Dir	H	T	T2m	Vis

- c. Observed and Analysed of *DP Control System* prior set up manual to *DP mode* conjunction with *DP Operational Procedure*.

In general the DP-control system should be arranged in a DP-control station where the operator has a good view of the vessel's exterior limits and the surrounding area. The DP-control station should display information from the power system, thruster system and DP-control system to ensure that these systems are functioning correctly. Information necessary to operate the DP-system safely should be visible at all times. Other information should be available upon operator request. Display systems and the DP-control station in particular should be based on sound ergonomic principles. The DP-control system should provide for easy selection of control mode, i.e. manual, joystick, or computer control of thrusters, and the active mode should be clearly displayed. For equipment classes 2 and 3, operator controls should be designed so that no single inadvertent act on the operator's panel can lead to a critical condition. Alarms and warnings for failures in systems interfaced to and/or controlled by the DP-control system are to be audible and visual. A permanent record of their occurrence and of status changes should be provided together with any necessary explanations. The DP-control system should prevent failures being transferred from one system to another. The redundant components should be so arranged that a failure of one component should be isolated, and the other component activated. It should be possible to control the thrusters manually, by individual joysticks and by a common joystick, in the event of failure of the DP-control system. The software should be produced in accordance with an appropriate international quality standard recognized by the Administration.

For equipment class 1, the DP-control system need not be redundant. For equipment class 2, the DP-control system should consist of at least two independent computer systems. Common facilities such as self-checking routines, data transfer arrangements, and plant interfaces should not be capable of causing the failure of both/all systems. For equipment class 3, the DP-control system should consist of at least two independent computer systems with self-checking and alignment facilities. Common facilities such as self-checking routines, data transfer arrangements and plant interfaces should not be capable of causing failure at both/all systems. In addition, one back-up DP control system should be arranged, see 3.4.2.6. An alarm should be initiated if any computer fails or is not ready to take control.

For equipment classes 2 and 3, the DP-control system should include a software function, normally known as 'consequence analysis', which continuously verifies that the vessel will remain in position even if the worst case failure occurs. This analysis should verify that the thrusters remaining in operation after the worst case failure can generate the same resultant thruster force and moment as required before the failure. The consequence analysis should provide an alarm if the occurrence of a worst case failure would lead to a loss of position due to insufficient thrust for the prevailing environmental conditions. For operations which will take a long time to safely terminate, the consequence analysis should include a function which simulates the thrust and power remaining after the worse case failure, based on manual input of weather trend. Redundant computer systems should be arranged with automatic transfer of control after a detected failure in one of the computer systems. The automatic transfer of control from one computer system to another should be smooth, and within the acceptable limitations of the operation. For equipment class 3, the back-up DP-control system should be in a room separated by A.60 class division from the main DP-control station. During DP-operation this back-up control system should be continuously updated by input from the sensors, position reference system, thruster feedback, etc., and be ready to take over control. The switch-over of control to the back-up system should be manual, situated on the back-up computer and should not be affected by failure of the main DP-control system. An uninterruptable power supply (UPS) should be provided for each DP computer system to ensure that any power failure will not affect more than one computer. UPS battery capacity should provide a minimum of 30 minutes operation following a mains supply failure.

Position reference systems should be selected with due consideration to operational requirements, both with regard to restrictions caused by the manner of deployment and expected performance in working situation. For equipment classes 2 and 3, at least three position reference systems should be installed and simultaneously available to the DP-control system during operation. When two or more position reference systems are required, they should not all be of the same type, but based on different principles and suitable for the operating conditions. The position reference systems should produce data with adequate accuracy for the intended DP-operation. The performance of position reference systems should be monitored and warnings provided when the signals from the

position reference systems are either incorrect or substantially degraded. For equipment class 3, at least one of the position reference systems should be connected directly to the back-up control system and separated by A.60 class division from the other position reference systems. Vessel sensors should at least measure vessel heading, vessel motions, and wind speed and direction. When an equipment class 2 or 3 DP-control system is fully dependent on correct signals from vessel sensors, then these signals should be based on three systems serving the same purpose (i.e. this will result in at least three gyro compasses being installed). Sensors for the same purpose, connected to redundant systems should be arranged independently so that failure of one will not affect the others. For equipment class 3, one of each type of sensors should be connected directly to the back-up control system and separated by A.60 class division from the other sensors.

The DP operational practices listed below are intended to further reduce the risk of loss of position. They are intended to be used by all DP OSVs in all normal operating circumstances

List of DP Operational Procedures:

Arrival Checks

Arrival checks should be carried out before the vessel comes within 500 metres of the installation. The purpose of the arrival checks is to ensure satisfactory operation of the DP system and should include full functional checks of the operation of the thrusters, power generation, auto DP and joystick/manual controls. The checks should also ensure that the DP system is set up correctly for the appropriate DP capability class, e.g. the bridge manning should be in accordance with DP capability class requirements. These checks should be documented and kept on board the vessel and are done once for each location/operation.

Communications

There should be an effective means of communication between the DP OSV and the offshore installation. In most cases this will be by VHF and will link the DP control console with appropriate personnel on the installation. These are likely to be the crane driver, deck foreman and radio room. Communications should be tested before arrival. There should also be effective communications between the DP console and the vessel crew on deck.

Approaching the Installation

The vessel should be manoeuvred at a safe speed when inside 500 metres of the installation. The vessel should not approach the installation unless authorised to do so. When making a final approach to the installation the vessel should not head directly towards it. Where a final approach is made to the installation

having conducted DP set up checks, this approach should be conducted on DP or in manual control using the DP joystick.

DP Location Setup Checks

Location setup checks should be carried out on every occasion and before the vessel moves into the final working location. The principal objectives of these checks are to assess the vessel's station keeping performance at the working location and to ensure that the position reference systems are properly set up. These checks should be carried out at a safe distance from the installation, in the region of 50 metres. They should also be carried out, wherever possible, at a location where, in the event of a loss of thrust, the vessel would drift clear of the installation. These checks should be documented and kept on board the vessel.

Close Proximity Time

Close proximity time at the working location should be kept to a minimum. The vessel should only remain in the working location when supply operations are being carried out. During periods of inactivity, e.g. when the installation crane is not available for cargo transfers, the vessel should move a safe distance away from the installation. Wherever possible, when undertaking hose transfers, sufficient hose length should be given to allow the vessel to increase the separation distance.

Separation Distance

The separation distance at set up between the vessel and the installation should be carefully selected. The distance should be agreed between the vessel and offshore installation before the start of operations. The separation distance should take account of the combined movements of the vessel and the installation, where the installation is not fixed in position (such as an FPSO, spar buoy, TLP, etc.). The separation distance should be as large as is attainable in the circumstances, without adversely affecting the safety of the supply operation. Wherever possible, such as when hose transfers alone are being carried out, consideration should be given to maximising the distance by extending hose length.

Selecting a Safe Working Location

A safe working location should be selected for every supply operation. It is safer to work on the lee side of the installation than on the weather side. Even where Table 6 shows that vessels may operate on the weather side, it is always preferable to set up on the lee side. Other elements to be considered in selecting a safe working location include the position and reach of the installation cranes, obstructions on the installation and interaction with installation thrusters.

Safe Working Heading

The most appropriate vessel heading should be selected on the basis that it may be necessary to make a rapid escape from the installation by driving ahead or astern. It can be an advantage to provide a good steadying vector by placing the vessel such that environmental forces are opposed by a steady state thrust output.

Escape Route

An escape route should be identified. The escape route should provide a clear path for the vessel to follow when making a routine or emergency departure from the installation. Other vessels should stay clear of the escape route. The escape route should, if possible, extend 500 metres from the installation.

Environment Forces Monitoring

Environmental forces are never constant. Wind, current and swell should be monitored continuously as should their effects on position keeping. Electronic monitoring methods, such as wind sensors and resultant force vectors provide the DP control system with inputs, but these methods should be supported by visual monitoring and forecasting. Great care should be taken where there is likely to be sudden wind and/or current changes. Preventative measures may require the vessel to cease operations during these periods and move off to a safe location.

Great care should also be taken in areas where lightning strikes are likely. Preventative measures may also require the vessel to cease operations during these periods and move off to a safe location.

Maintaining a Safe Working Location

A safe working location should be maintained at all times at the installation. In particular this will require constant vigilance in respect of a possible cumulation of a number of hazards. These could include, for example, those from environmental forces and other potential dangers, such as marine and airborne traffic, or cargo operations. It will also require the vessel to operate within its design parameters and within the range of the vessel's DP capability plots. Consideration should be given to unrestricted view of the work area from the DPO position. CCTV or an observer could be of assistance.

DP Watchkeeping Handovers

Wherever possible, watch handovers should take place when the vessel is in a steady state and where the vessel is settled in position. Using a checklist handover ensures that all relevant information is passed on to the oncoming watchkeeper. See Appendix 7 for an example of a checklist.

On board Engineering, Electrical and Electronics Support

An engineer should be available when the vessel is within 500 metres of the installation. On an UMS vessel it may not be necessary for the engineer to be in the engine room, subject to charterer's agreement. For a vessel without UMS the engineer would need to be in the engine room. Wherever possible, electricians and, where carried, electronics officers should be on call when the vessel is inside the 500 metre zone. Engineers, electricians and electronics officers should take account of the following when the vessel is inside the 500 metre zone: Do not start, stop or carry out maintenance on any machinery or equipment that could affect the DP system while the vessel is in DP, when in doubt a check should be made with the DP bridge watchkeeper. If problems or potential problems are detected with any DP or associated equipment during a DP operation then the DP bridge watchkeeper is to be informed immediately.

Critical and Allowable Vessel Excursions

Critical and allowable excursion limits should be set. The critical limit should not exceed half of separation distance between the vessel and the installation. The allowable limit should not exceed half of the critical limit.

Electronic Off Position Warning and Alarm Limits

The electronic warning limit should not exceed the allowable excursion limit above. The electronic alarm limit should not exceed the critical excursion limit above. For example, where the separation distance is 10 metres, the warning limit should not exceed 2.5 metres and the alarm limit should not exceed 5 metres. However, wherever possible, the warning and alarm limits should be less than the critical and allowable excursion limits.

Electronic Off Heading Warning and Alarm Limit

The electronic off-heading warning limit should be set at a value that does not result in movement of any part of the vessel greater than the allowable excursion limit. The electronic off-heading alarm limit should be set at a value that does not result in movement of any part of the vessel greater than the critical excursion limit. However, wherever possible, the off-heading warning and alarm limits should be set at lower values. In setting the off-heading limits consideration should be given to the alignment of the vessel and the installation and the vessel's point of rotation.

Position and Heading Changes

Changes in vessel position and heading are frequently necessary during supply operations when supply vessels are alongside fixed installations, typically because of wind and/or current changes, or for operational reasons. Such changes should be carried out in small increments. Operators should be aware of the potential dangers of a number of cumulative changes, e.g. that they may affect the line of sight for some position reference systems, such as Fanbeam.

Power Consumption and Thruster Output Limits

The power and thruster limits will depend on the nature of the vessel/installation interface. Vessels with DP class notations 2 and 3 can, if agreement is reached with the installation OIM and or charterer, if applicable, operate to DP class 1 standards on those occasions when a DP class 1 vessel would be permitted alongside. Refer to the vessel positioning matrix, Table 7. For vessels that are operating to DP class 2 or 3 standards, the limits should be set so that the vessel will be left with sufficient power and thrusters to maintain position after worst case failure. The Guidelines thus provide two possible limits. For DP OSV capability 2 and 3, the vessel operates to worst case failure in the given environmental conditions, typically half the propulsion. For DP OSV capability 1, the vessel operates to the intact capability in given environmental conditions. Methods of monitoring power consumption and thruster output limits include the use of the DP computer system's consequence analyser and effective DPO watchkeeping. After a failure the main objective would be to make the situation

safe. The route to getting back to work again is to carry out a risk assessment, taking account of all possibilities. The risk assessment should determine whether it is safe to do so. Regional and or charterer's guidelines may take precedence.

Consequence Analyser

Where classification societies require consequence analysers to be fitted, to IMO DP equipment class 2 and 3 Vessels and classification society equivalents (see MSC Circular 645 3.4.2.4), to remain in class it is a requirement for these vessels to operate with the consequence analyser switched on. The consequence analyser monitors power and thrust output and gives a warning to the operator when it is calculated that the vessel will lose position if the worse case failure occurs. Whenever the consequence analyser alarms, the vessel is in a degraded operational condition and appropriate action should then be taken to ensure the safety of the vessel. Appropriate action will include a degraded condition risk assessment, see 3.5.1.

Safe Operating Limits

Safe operating limits are not solely based on power consumption and thruster output levels. In setting safe operating limits consideration should be given to other relevant factors such as a mariner's awareness of the weather environment, the nature of the operation, the safety of the crew and the time needed to move clear. The safe operating limits should be governed by risk assessment.

Position Reference Systems

Wherever possible, if multiple position references are in use, they should be independent of each other and should be based on different principles. Relative position references should be used at installations that are not fixed in position, such as FPSOs, spar buoys, TLPs, etc. Relative systems include, for example, Fanbeam, CyScan and DARPS. The use of relative and absolute position reference systems can cause conflicts. A possible example of 'three position references' could be a dual laser system operating on independent targets on different lines of sight with one DGPS.

Changing of Operating Control Mode

There may be occasions during a normal supply operation when it is appropriate to change over from auto DP control to joystick/manual control. In this case the vessel will revert to conventional supply vessel mode and will be subject to appropriate controls. Where the vessel transfers control from DP to manual or conventional control, transfer back to DP control should be subject to a repeat of location set up checks. Another possible issue in relation to control, is that the preferred location for the DP control console would be the aft end of the bridge to allow unrestricted view for the DPO of the work deck and the installation. Where this is not possible some other means should be available to observe external conditions, e.g. CCTV at the DP control console or an observer on the bridge with unrestricted view.

Standby Time

There are frequently occasions when the vessel is stood down for a period of time. Standby time should be put to good use. Standby time is useful since it provides opportunities to practice skills, such as (a) ship handling, (b) DP operating experience and taking DP footprint plots away from the installation.

Vessel Thruster Efficiency of Different Draft and Trims

Changes in vessel draft/trim usually occur at an installation. A shallower draft can have an adverse effect on thruster efficiency, particularly for bow tunnel thrusters. This can result in a significant loss of thruster effect, resulting in poor station keeping as well as impacting on thruster redundancy. Wherever possible, measures should be taken to maintain an appropriate draft/trim at all times when at an installation. This may mean taking in water ballast.

Dp Alerts Status

The operational status of the vessel in DP control should be monitored continuously. Owners should consider a monitoring system already in use in the industry, to ensure a consistency of understanding with operators and charterers. The commonly understood system, used internationally in the offshore industry utilises a concept of red, yellow and green status levels. This system does not necessarily need a system of lights or alarms, although it is useful to have an appropriate method on board to alert the relevant crew to changes in status level as shown below.

Table 9 – Examples of status levels (For DP OSV capability refer to Table 5, Section 3.2.2)			
	NORMAL OPERATIONS (Green)	Complies with appropriate DP OSV capability conditions	• Position and heading excursions are within acceptable limits, and • Power and thrust outputs are within limits for capability of vessel, and • Environmental conditions are acceptable, and • Minimum risk of loss of position and/or collision, and – For DP capability 2 and 3 vessels – DP equipment redundancy is intact and DP system is operating within 'worst case failure' limits, or – For DP capability 1 vessel – DP equipment is intact and operating within acceptable limits.
	DEGRADED CONDITION (Yellow)	Not in compliance with appropriate DP OSV capability conditions	• Position or heading excursions out of acceptable limits for more than brief or isolated periods, or • Power and thrust outputs are greater than the limits for capability of vessel for more than brief or isolated periods, or • Environmental conditions or other conditions are considered unsuitable for continuing DP operations, or • Increased risk of loss of position or collision, or – For DP capability 2 and 3 vessels – failure in DP equipment that results in loss of redundancy and the vessel operating outside "worst case failure" limits, or – For DP capability 1 vessels – failure in DP equipment that does not result in a loss of position
	EMERGENCY CONDITION (Red)	Emergency	• For DP OSV capability 1, 2 and 3 vessels – Unable to maintain position, or – Imminent threat of collision, or – Any other emergency situation

- d. Observed and Analysed of *Thruster* when adjusting course to make escape heading
- e. Observed and Analysed of *Capability Plot* to make course in good heading for escape route

C. Research of the problem

1. How ability for DP Vessel for manoeuvre the vessel when change manual system to DP mode system getting the goods on Best Escape Heading consequence effect by current and wind effect?

As per requirement when DP vessel will approach to the platform or rig, the DP vessel should in good figure and performance. The fulfil of ability of DP Vessel depend on inner side and outer side. Inner side consist of that own DP vessel only, and already in good order before by FMEA test or commonly used on DP mode with good condition. Outer side consist of environment condition, the Master or SDPO should measure the environment condition by manual calculation using table or software program or directly by visually observation, and probably when operate on DP mode, the impact of environment could view on DP monitor.

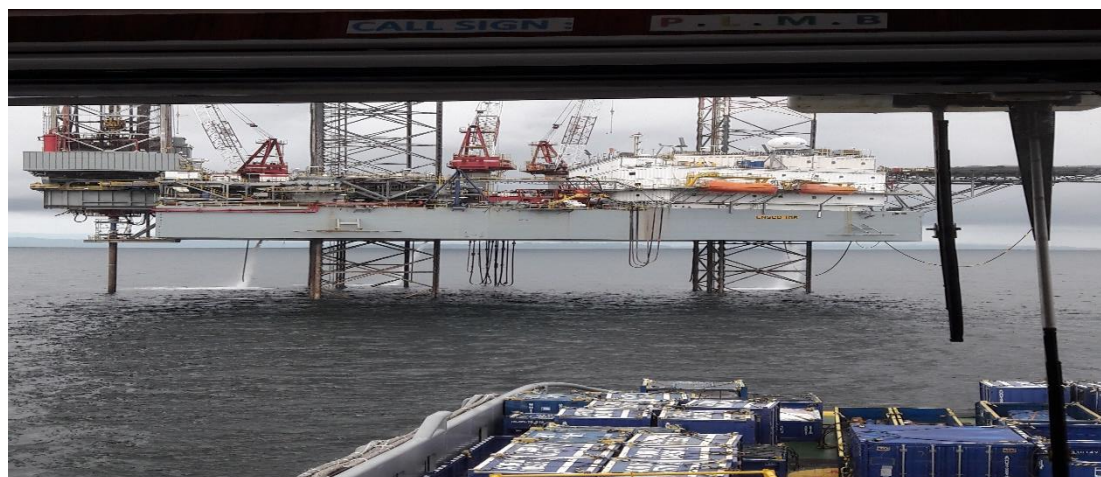
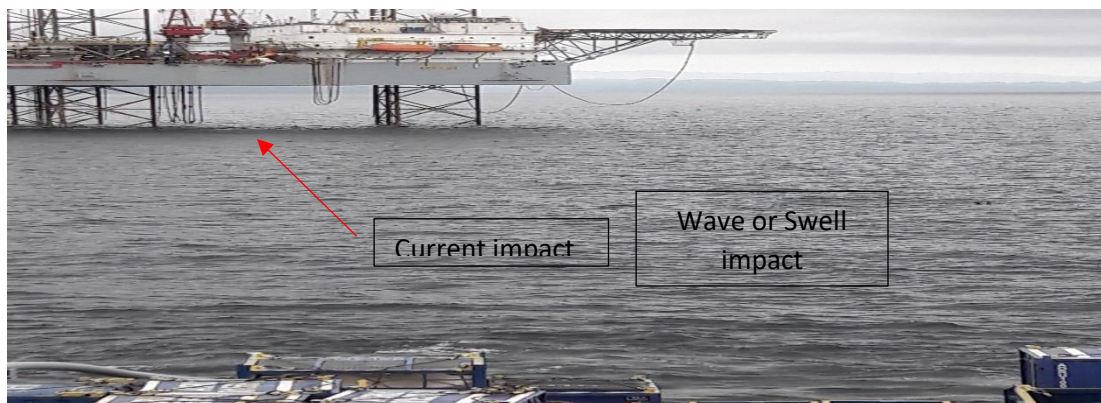


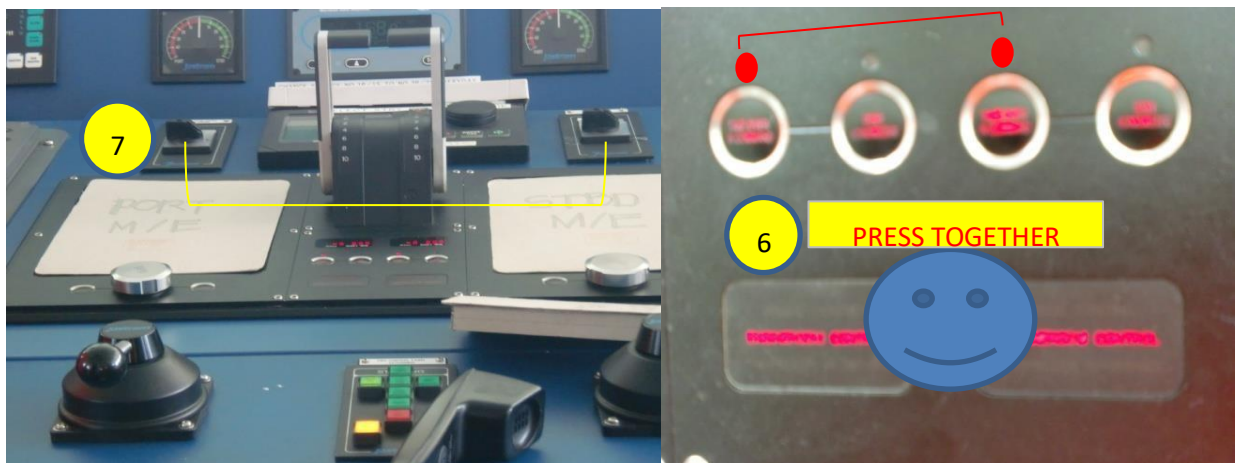
Figure 72 : Vessel prior approaching the Rig on Bintuni Bay

On that picture just for a sample view when DP vessel want to prepare enter the zona area rig or platform, on this note below , we could look the sample procedure when prior arrival on location and prepare from manual to DP mode.

a. Procedure reparation proceeding entering platform from manual to DP system

A. MANUAL CONTROL

1. Inform to Engine Room to Prepare Main Engine & Propulsion
2. [Prepare Check List " Start Up "](#)
3. Conform heading with Platform
4. Received information from Engine Room, and Engine Ready
5. Prepare RADAR/ARPA with True VRM 0,5 and Relative VRM 0,3
6. Push " Take Command " Port & Starboard Main Propulsion
7. Power Up Steering Generator 1 or 2 together Rudder Port & Starboard



8. Push & Select Steering system " Standby " and " Independent "



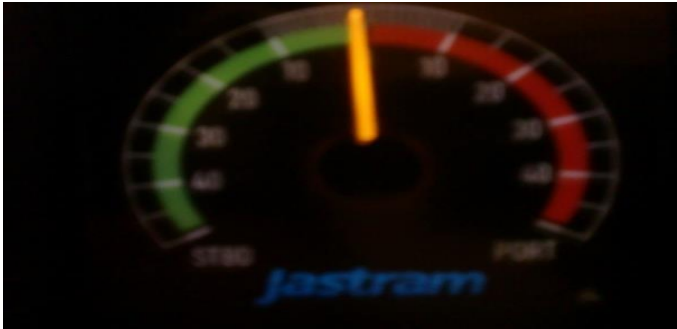
9. Power on " Servo " (to Prepare Thruster) BT-1,BT-2,ST-1,ST-2



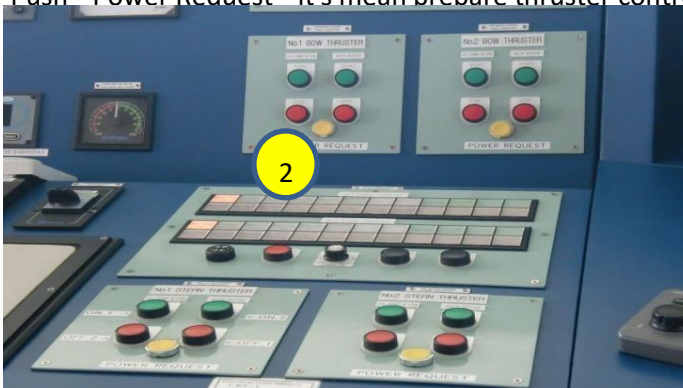
10. NOW, Please move the vessel proceed to platform using manual , and bring telegraph with Rpm 51-55 it's mean speed 8 knots
11. And adjust heading using independent or auto depend on situation
12. And look on the radar if nearly with ring 0,5 please adjust speed minimum until stop engine
13. Make sure the Own heading ship same with platform
14. If the own ship near with with platform around 0.6 ,adjust RPM minimum tiil stop engine, don't forget make sure the heading simliar with platform, Example Heading Platform is 335 °, and Adjust Own Ship Heading 335 ° also
15. Now, Please becarefull prepare to DP System on Aft Control

B. DP System

1. Make sure the Angle Indicator on Steering System P & S 000 or Fix in middle

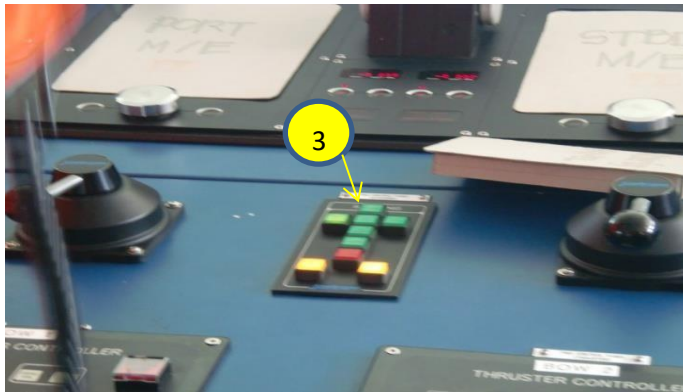


2. Push " Power Request " it's mean prepare thruster control on aft control station



3.

Push on Steering System



to " Transfer " it's mean Steering control change to Aft Control Station

4. And Now make sure all the Forward Control System on Zero like; Thruster Panel, Angle Indicator Stering Port & Starboard, and do't forget push request power and also change ring radar on 0,75
5. On Aft Control Station pust Steering Control on " Standby " and Push " Take Over Command " on Starboard main propulsion and Port Main Propulsion
6. Prepare Thruster Control BT-1;BT-2 & ST-1 ; ST-2
STEP BY STEP FROM NO 1,2,3

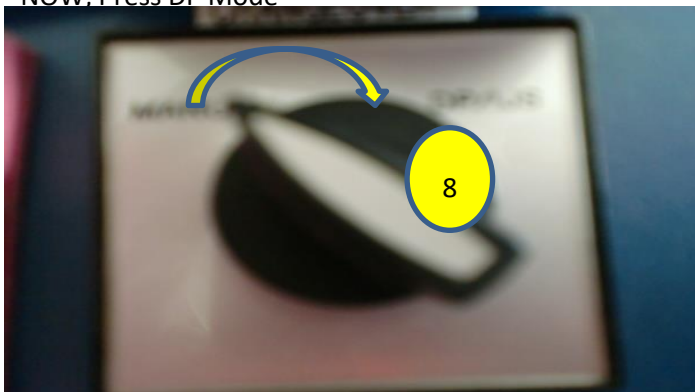


8.

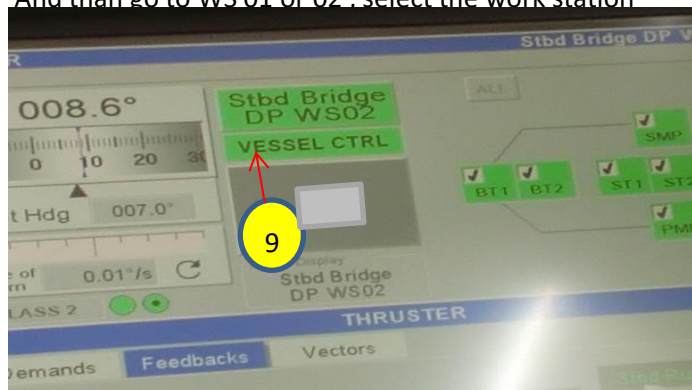
7. If Thuster BT-1,BT-2 & ST-1,ST-2 Running Well, and than press Steering Control on Aft Station with "Auto " and Press " Take Over Command " on Main Propulsion Port & Starboard



NOW, Press DP Mode



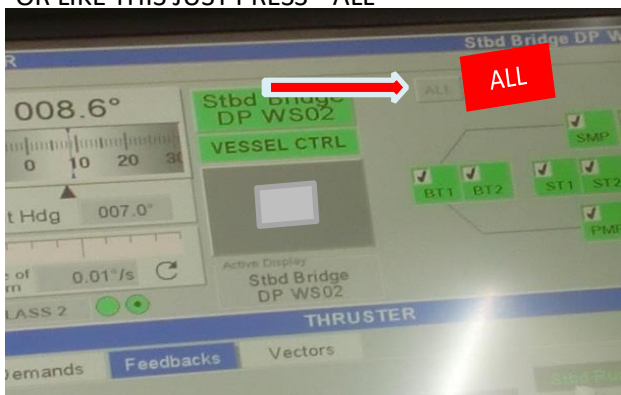
And than go to WS 01 or 02 . select the work station



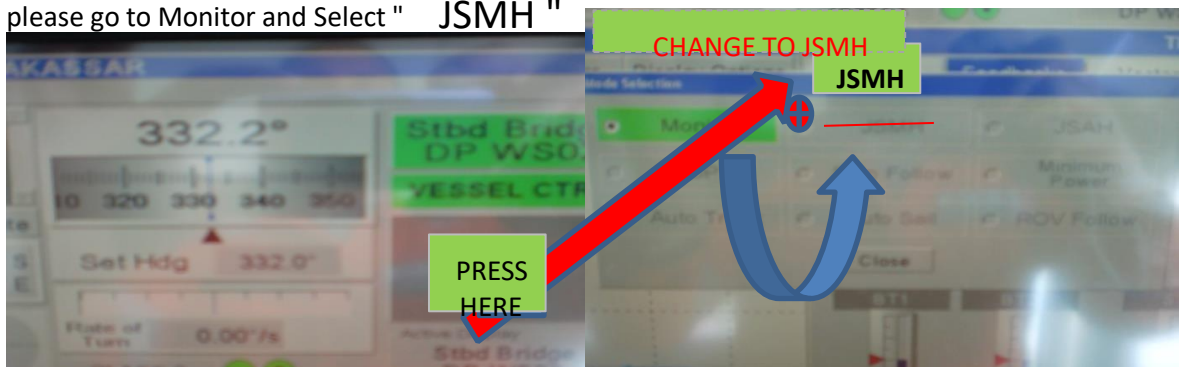
10. And Then Please Press button All Thruster or on the keypad



OR LIKE THIS JUST PRESS " ALL "

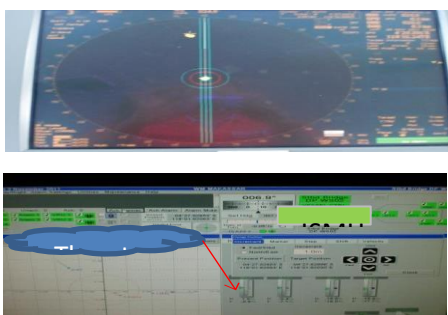


- 11 If Thruster was available, and please make sure again and recheck again please go to Monitor and Select " JSMH "



- 12 Now you can move the vessel in Manual Joystick. Move your vessel carefully and look also ROT and Heading, and also % all thruster

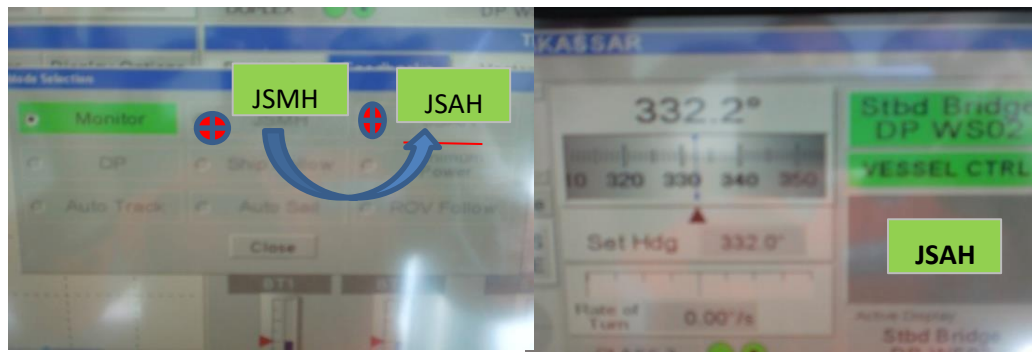
When using JSMH, pay attention to the ROT and the percentage of the heading changes should not be too large, if it is too large, if it is too large, the ROT will enlarge too, this will make it difficult to maintain the direction we want . The example besides this is the bow going into the 500 m zone.



When approaching the 500 m zone, try the same direction as the rig, and note that the "COP" is always considered on the Radar, so

that we are sure that the incoming movement is safe and controlled. And if our heading is good, and the ROT decreased to 0.02 degrees/ second then change it to JSAH.

Pay attention to the ship's speed and Vector, Vector = where the direction of the ship moves speed = Movement of the ship, use a max speed of 1.5 knots if clear and sure, could be change to JSAH. Example 332 °



Note that if you already use JSAH / auto heading, that the thruster is not too large, maybe up to 60%, this will result in OFF HEADING, this is always avoided, so use Joystic forwards / backwards, left / right to adjust speed and vector also pay attention percentage of thruster. If it is safe to keep the speed and vector, and if it is abeam with the platform / rig, then adjust the speed to a minimum, if I am alone 0.5 knots he..he ... try to be safe AND DON'T FORGET OFF RADAR

13. After Abeam Bow our ship with the stern of GSF Explorer as a Drill Ship, then adjust the speed of 0.5 knots, and always pay attention to the vector and thruster so that it does not off heading and the alarm moves slowly to where the position requested by GSF.Explorer, for example at Port Aft Crane
14. If our ship is approaching and declared parallel to the aft crane port, then place a neutral joystick on the surge, and still on the sway move to move to the right slowly

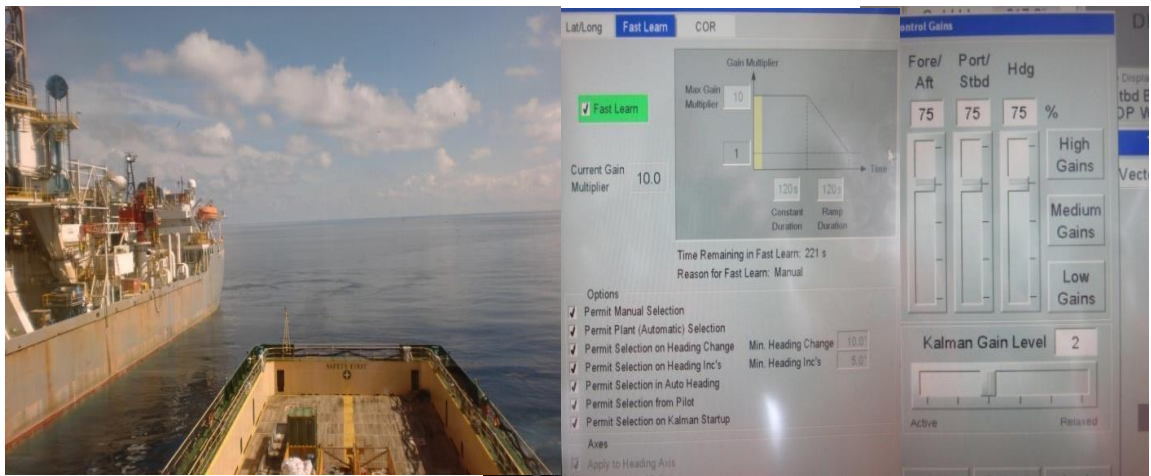


15. After docking with GSF.Explorer with a safe distance of 50 meters, then prepare for the setting to DP mode. Note the decrease in speed to 0.01 ° / s and the direction of the vector perpendicular to the object After that, wait 2 minutes for

the stabilization of BT-1, BT-2, ST-1, ST-2 thrusters, Then look at velocity and increment for moving closer



16. The MV.WM. Makassar has docked to GSF Drill Ship. Explorer Note the Radial error. And if the effect of current and wind is too large and the radial error increases, then use fast learn and control on the gain.



- b. From the good procedural, we could continue to prepare DP check list

Responsibility	Action
Master	Obtain status check of vessel systems, including the relevant DP checks. Advise Client Rep and Party Chief of the condition of the DP system.
Client Representative	Call up field operator. Advise that vessel is coming into field. Provide the Master with adequate field specific information for safe DP operations, e.g. site specific charts.
Chief Engineer	Ensure propulsion units and power distribution properly set up. Ensure that appropriate engine room checks are complete.
DP Operators	Ensure DP console control system is powered up.

	Ensure relevant worksite charts are in use. Carry out all appropriate tests and checks. <i>(Completion of Checklists)</i>
Offshore Project Manager	Ensure cable lay / ROV / trencher and all other sub sea equipment is operational. Ensure that a job plan is prepared and exact worksite is identified.

- c. Concern to make clear and good ability of DP Vessel when manoeuvre approach to rig or platform

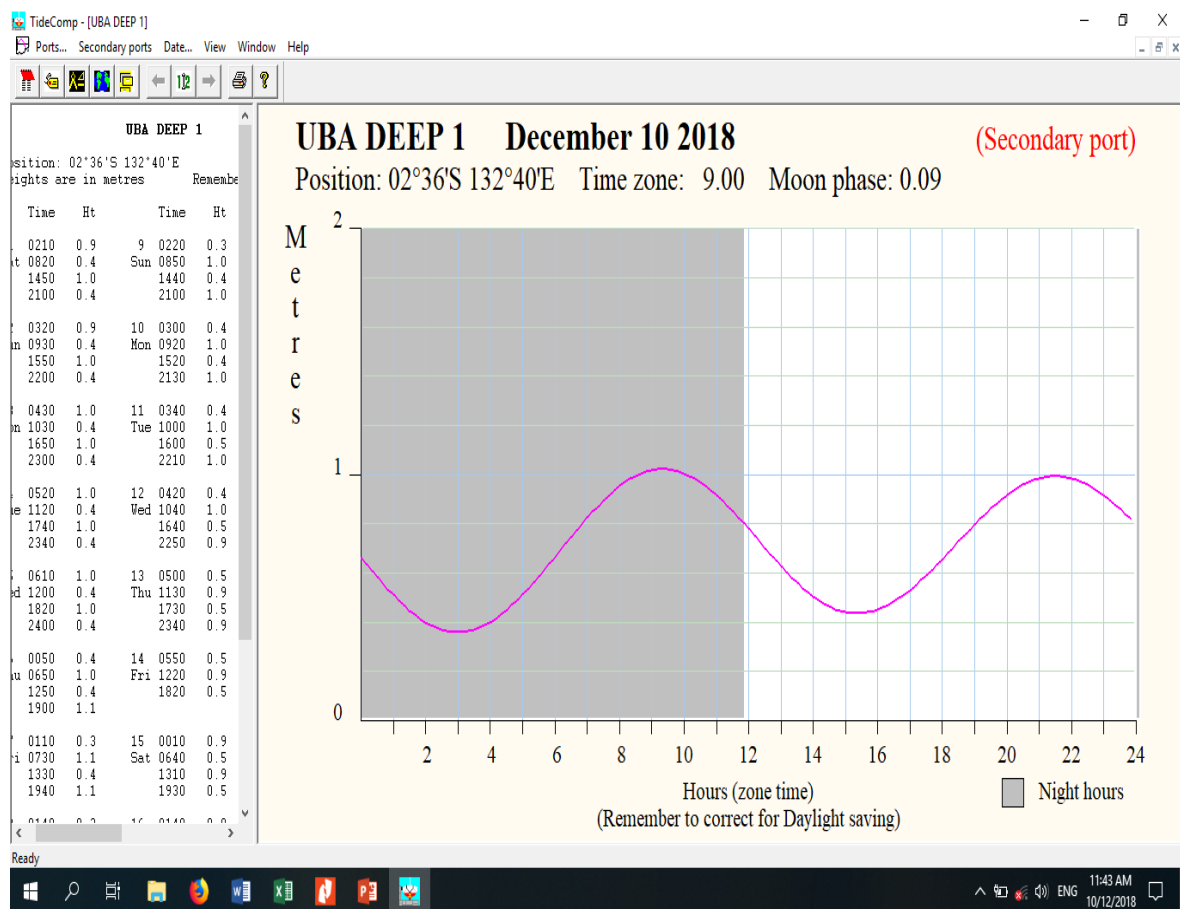
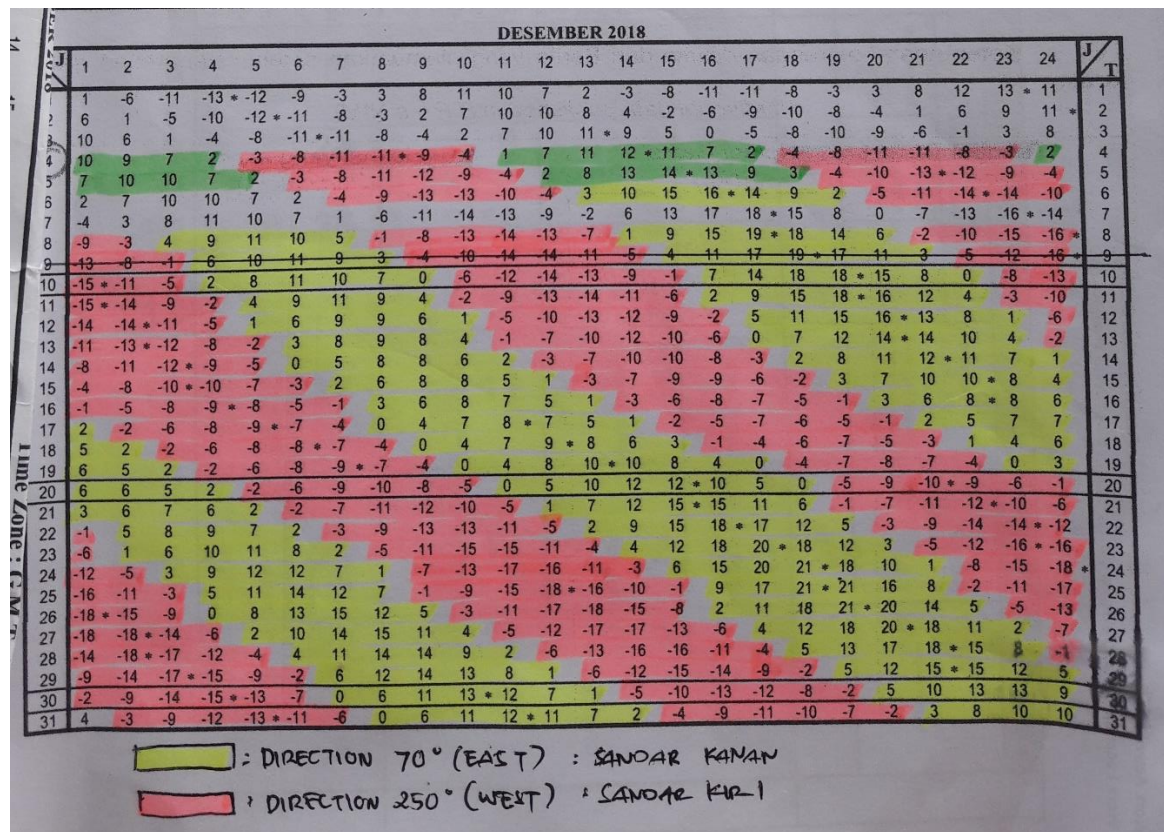
As per writer explained above, the DP vessel when approach to the rig or platform, should be carefully when manoeuvre to make good heading, and all information should collected with properly.

Set up on Radar/Arpa the ring with diatance 500 metre safety zone, to make easy for manoeuvre when approach to the rig or platform, and also easy for control movement the DP Vessel. On this picture , we can see 2 ring already setup and also we can see the target.

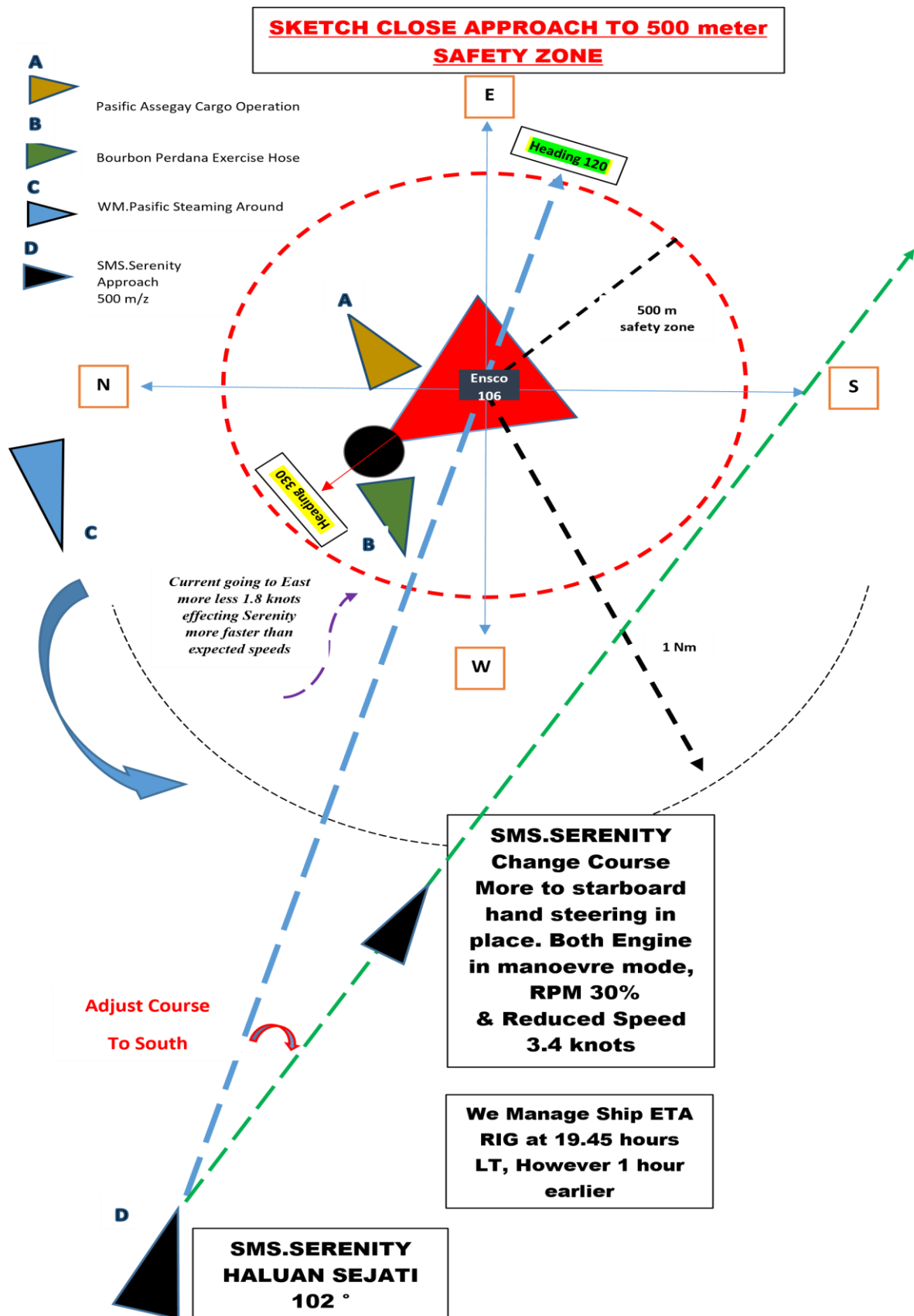


Figure 72 : Vessel prior approaching the Rig on Bintuni Bay

The observation of the tide, should be considered with the present condition, and we already take note from the tide table or software program to calculate the tide condition.



If we already understanding to read the environment condition, so we can easy to manoeuvre to approach which side should prepare port side or starboard side of the rig or platform.



And we should continue with the standard CAMO & ASOG as per requirement.

Activity Specific Operating Guidelines (ASOG) - SMS SERENITY					
This setup applies when the vessel is carrying out operations on DP for rig move, rig positioning and anchor handling activities for the Jackup Drilling Unit "ENSCO 106" at BP Tangguh Field located in Bintuni Bay, West Papua, Indonesia					
Pre-watch and pre-task meetings to cover IJS setup and use, precautions about inadvertent change of mode, need to setup and monitor position offsets independent of DP Control System.		Vessel to operate in Critical Activity Mode (CAMO). Inspection Repair Maintenance (IRM) while executing DP CAMO operations not permitted.		Default DP Mode: Auto Position Default Centre of Rotation (COR): Midships Default DP Gain Setting: Medium Expected weather / current events to trigger consideration of using High Gain. Use of Low Gain to trigger a Blue	
SG1, SG2, DG1, DG2 and DG3 running and connected online. Bus tie between 415VAC Bus Bar A and E closed, all other bus ties opened. 220VAC Bus Bar B1 supplied from 415VAC Bus Bar A and 220VAC Bus Bar B2 supplied from 415VAC Bus Bar B. Bus tie between 220VAC Bus Bar B1 and B2 opened.		Independence and segregation of auxiliary systems supporting station keeping equipment to be maintained in line with the redundancy concept. Integrity of isolating valves to be validated and verified. No cross connections in any auxiliary system.		Reinstating equipment post failures requires vessel to safely suspend operations, leave worksite / 500m Zone prior to attempting reinstatement (Example: low level auxiliaries, thruster, control voltages).	
When working within 500m Zone, default position reference systems for this activity are: At least three independent systems in use (two different principles, different I/O, different UPS)		Vessel to be setup and stabilised upon arrival at worksite. DP checks to be done with vessel at intended heading and thrust level to be verified to be within ASOG limits. Entry into 500m Zone is in DP Auto Position Mode. Default mode of exit from worksite until 200m off Surface Assets is on DP. This does not preclude Master from departing in manual or joystick in response to loss of station keeping event or necessitated by other emergencies.			
Critical Activity Mode (CAMO) Configuration - SMS SERENITY					
Condition		GREEN		ADVISORY	
Notify Master, Chief Engineer, Offshore Installation Manager,		NO		YES	
Action		CONTINUE NORMAL OPERATIONS		INFORM / CONSULT / RISK ASSESS (CONSIDER	
Main Engines & Generators & Power System	Main Switchboards	Bus tie between 415VAC Bus Bar A and E closed, all other bus ties opened. 220VAC Bus Bar B1 supplied from 415VAC Bus Bar A and 220VAC Bus Bar B2 supplied from 415VAC Bus Bar B. Bus tie between 220VAC Bus Bar B1 and B2 opened		Any other setup	
	Emergency Switchboard	Supplied from 415VAC Bus Bar A		Any other setup	
	Emergency Generator	Auto-start selected and available for use. Auto start/connect tested prior to arrival on field		Any other configuration or known deficiencies reducing redundancy	
	Blackout Drill	Blackout drill conducted for all DPOs and engineers. Procedures in place		Any DPOs or engineers not performed blackout drill within the last 6 months	
	Generators and Main Engines	DG1 and DG2 running and connected to 415VAC Bus Bar A and E respectively. DG3 running and connected to 415VAC Bus Bar B. Main Propellers clutched in to the respective Main Engine. SG1 and SG2 coupled to the respective gearbox and connected to 415VAC Bus Bar C and D respectively		Any other setup	
	All Generators and Main Engines	Tested to 100% upon field arrival or within the last 6 months		Any not tested to 100% upon field	

			arrival, or within the last 6 months, or problems found		
Thrusters & Steering	All Thrusters and Main Propellers	Available, selected to DP, tested to 100% on field arrival or within the last 6 months	Any not available, not selected to DP, or not tested to 100% on field arrival or within last 6 months, or problems found		
	Steering Hydraulic Pump	All pumps fully operational	Any known deficiencies or problem found		
	Main Propellers Hydraulic Pitch Pump	Fully operational and power supply to backup pitch pumps available. For CPP's watch keeping personnel, briefed on requirement for rapid intervention in the event of thruster pitch problems	Any known deficiencies, power supply to backup pitch pumps not available, watch keeping personnel not briefed or problem found		
	Tunnel Thrusters Hydraulic Pitch Pump	Fully operational. For CPP's watch keeping personnel, briefed on requirement for rapid intervention in the event of thruster pitch problems	Any known deficiencies, watch keeping personnel not briefed or problem found		
	Emergency Stops	Tested on field arrival or within the last six weeks	Not tested on field arrival, within the six weeks or problems found		

Manual Controls & IJS	Thruster and Main Propeller Manual Levers	Tested and fully operational and set at zero position verified at all locations on field arrival	Any known deficiencies or zero position not verified at all locations at field arrival		
	Independent Joystick	Tested, in standby mode, fully operational and set at zero position verified at all locations	Not in standby mode, any known deficiencies, or zero position not verified at all locations		
	All DP operators practice taking control from DP to manual and controlling the vessel on manual (individual levers) - intact and post WCF conditions	On field arrival, the Master and each DPO practise holding the vessel on position with manual controls for 10 minutes	Any operator not practiced		
	All DP operators practice taking control from DP to IJS and operating the vessel on IJS	On field arrival, the Master and each DPO practise operating the vessel on IJS for 10 minutes	Any operator not practiced		
Speed & Increment of Moves	Speed of Moves within 500m Zone	500m to 200m $\leq 0.15\text{m/s}$ (0.3 kn) 200m to worksite $\leq 0.05\text{m/s}$ (0.1 kn)	Any other setting		
	Increments of moves within 500m Zone	500m - 200m $< 50\text{m}$ 200m to worksite $< 10\text{m}$	Any other setting		
	Rate of Change of Heading (set in DP)	≤ 10 degrees/min	> 10 degrees/min		
	Increments of heading change within 500m Zone	≤ 10 degrees	> 10 degrees		
	Thrust Values when exiting 500m Zone on Joystick, Manual, or DP	0-200m $< 25\%$ (minimum to safely pull away) 200m - 500m $< 50\%$ (minimum to safely pull away out of 500m Zone)	Approaching 25% or 50% respectively		
DP Control System	DP Control System - Consequence Analysis	Consequence analysis enabled (Class 2 selected) and no associated alarms are active	Any other setup or associated alarms are active		
	DP Related Maintenance	Not permitted to be carried out on DP	If maintenance carried out through relevant Permit to Work arrangement		
	DP Position Reference System - Median Check	Median check setup and enabled, at least three independent position references (with two different principles) online	Less than three position references online, position reference deviation $> 3\text{m}$		

	DP Mode Selection	Protected from inadvertent operation	Any risk of inadvertent operation		
	DP Displays	Mimics correct	Any discrepancies evident between DP displays and other display / indicators		
	Position and Heading Alarms	Tested to be in fully operational condition. Heading Warning/Alarm set at 3 and 5 degrees. Position Warning/Alarm set at 3 and 5 metres	Any other setup or alarms not in operational condition		
	Centre of Rotation (COR)	COR set at vessel Midships	Any other setup		
	Thrust levels checked to within ASOG levels at operational heading before commencing operation	Within operating limits	Above operating limits		
Position Reference Systems	Position Reference Systems - Availability	Two (2) DGPS on power supplies separately provided from different DP UPS together with CyScan on power supply from DP UPS 2	Lack of redundancy in absolute or relative position reference systems or all on same UPS. Any known deficiencies		
	Position Reference Systems - Weighting	Auto (Normal) weighting enabled	Any other setup		
	DGPS - On Different Mask Elevations & Different Corrections/Configuration	Set at OEM default value for elevation mask and on different differential correction systems	Not set at OEM default value, not on different corrections, or alarms present		
	DGPS - Antenna Obstructions	No possibility of masking by cranes / structures	Possibility of masking by cranes / structures		
	CyScan (Laser Reference)	Able to operate in a satisfactory manner. Using prism as target with the rejection window threshold set to reject false signals	Any other setup or deficiencies found		
	2nd CyScan (Laser Reference)	Able to operate in a satisfactory manner. Using prism as target with the rejection window threshold set to reject false signals	Any other setup or deficiencies found		

Sensors	Wind Sensors	All three units need to be operational and selected on DP, no alarm	Any known deficiencies		
	Gyrocompasses	All three units need to be operational and selected on DP, no alarm, difference < 1 degree	Any other setup or known deficiencies		
	VRUs	All three units need to be operational and selected on DP, no alarm, difference < 1 degree	Any known deficiencies		
	Gyros - Latitude and Speed Setting	Manual input of speed and latitude	Auto input of speed and latitude		
	Weather / Environment Forecast	Reviewed and found to be within DP Capability and Verifying DP Footprint Plots	Any other conditions		
Cooling system	Fresh Water / Sea Water Cooling System	All systems, including standby arrangements, operational and completely segregated. Standby pumps tested on field arrival	Any other configuration or known deficiencies reducing redundancy		
Oil Systems	Fuel Systems	Redundancy concept maintained by complete segregation of crossover pipelines. Day tanks sludged every watch	Any other setup or level alarm for day tanks. Any sign of fuel contamination, blockage or supply failure		
	Main Engine LO Standby Pumps	Standby pumps set to Auto and tested on field arrival or within the last month	Any other setup or not tested on field arrival or within the last month, or problems found		
	Fuel Management Procedures	Effective procedures in place and adhered to	Effective procedures not		

			implemented or not adhered to		
PMS Control System	Power Management System - Load Dependent Stop	Load dependent auto stop disabled	Load dependent auto stop active		
	Power Management System - Power Limiting	Power limitation function checked at field arrival or within the last 6 months	Power limit function not checked at field arrival or within the last 6 months, or any problems found		
	Power Management System - Auto Mode	PMS operational and in Auto mode (or any specific mode for DP)	Any other setup or problems found		
Battery Power Supply	DP UPS's	Batteries tested for 30 minutes on load (at least 24 hours before field arrival or within last month and documented). Batteries fully charged before entering 500m Zone and operating in UPS mode	Batteries not tested for 30 minutes on load (at least 24 hours before field arrival or within the last month and documented) or problems found. Batteries partly discharged or operating in bypass mode		
	24V DC Battery Chargers	Batteries tested for 30 minutes on load (at least 24 hours before field arrival or within last month). Batteries fully charged before entering 500m Zone and operating on rectifier	Batteries not tested for 30 minutes on load (at least 24 hours before field arrival or within last month) or problems found. Batteries partly discharged		
Compressed Air System	Start Air System	Redundancy concept maintained by complete segregation and isolation valves closed. Both Starting Air Compressors fully functional with auto start function tested and corresponding air receivers full	Segregation compromised. A compressor or receiver not available		
	Control Air to Main Engines	Pressure reducing panels fully functional	Any known deficiencies		
HVAC System	Machinery Space Ventilation Fans	Supply / exhaust ventilation fans running in all machinery compartments	Any fan not running or unavailable		
	Air Conditioning	Operational and provide adequate cooling in all DP critical areas such as Bridge, Switchboard Room, ECR	Any known deficiencies		
Miscellaneous	Bridge Manning	Bridge manned by a minimum of one (1) SDPO and one (1) DPO, Chief engineer or 2nd engineer on the Bridge manning the tow winch and gear	Manning to a lesser standard		
	Engine Room Manning	ER manned by one engineering officer and one assistant	Manning to a lesser standard		
	Checklists	Completed satisfactorily	Any known deficiencies or problem found		
	Communications (Bridge/ECR/Deck/Platform)	Tested and fully operational	Any known deficiencies or problem found		
	Radar and Traffic	Both radar on and 100% operational, no traffic conflicting with planned operations	Any other conditions		
	Watertight Integrity	All watertight door and openings secured	Any not secured or controlled by PTW		
	Escape Route Established	Escape Route identified and agreed with field operations	Escape route compromised		
Activity Specific Operating Guidelines (ASOG) - SMS SERENITY					
Condition		GREEN	ADVISORY	YELLOW	RED
Notify Master, Chief Engineer, Offshore Installation Manager, Client Rep, Deck		NO	YES	YES	YES
Action		CONTINUE NORMAL OPERATIONS	INFORM / CONSULT / RISK ASSESS (CONSIDER ONGOING AND UPCOMING OPERATIONS) initiate actions to suspend	CEASE OPERATIONS Bring vessel to safe Head & position. And discuss with Lead Tow Vessel for Breaking the Tow	ABORT OPERATIONS Notify Lead

		activities		Tow Ves sel and Rig Ens co1 06 for eme rge ncy Dis con nec ted of Tow Wir e
Weather / Environment Forecast	Within operating limits	Approaching operating limits	Exceeding operational limits	
DRIVE OFF	No discrepancies observed in PRS's and thruster loading as expected	Discrepancies observed in PRS's and/or inexplicable ramp up of thrusters observed	Immediately when recognised by DPO	Unabl e to bring the vesse l under contro l
DRIFT OFF	No discrepancies observed in PRS's and thruster loading as expected	Discrepancies observed in PRS's and/or inexplicable loss of thrust from thrusters observed	Immediately when recognised by DPO	Unabl e to bring the vesse l under contro l
Vessel Footprint / Weather / Environment Related Excursion (From	No position alarms or warnings	Position excursions, frequent warning buzzer or exceed position limit (> 3 m)	Positioning excursion triggering alarm	
Heading Excursion	No heading alarms or warnings	Heading instability with frequent warning buzzer or heading deviation (> 3 degrees)	Heading deviation triggering alarm	
Heading and Position Control (Thrust Load/DP Feedback Limits)	Heading and position control achieved with <45%	Approaching 50%	More than 50%	
Tunnel Thrusters	Both operating without any alarms	Any other setup, alarms, poor performance, unexpected or unexplained event	Loss of any tunnel thruster	
Main Propellers	Both operating without any alarms	Any other setup, alarms, poor performance, unexpected or unexplained event	Loss of any main propeller	
Rudders	Both operating without any alarms	Any other setup, alarms, poor performance, unexpected or unexplained event	Loss of any rudder	
Thrusters and Main Propellers Loading (Thrust)	All < 45%	Any approaching 50%	Any > 50%	
Generators	SG1, SG2, DG1, DG2 and DG3 operating without any alarms	Any alarm, poor performance, unexpected or unexplained event	Loss of any generator	
Generators Loading	All < 45%	Any approaching 50%	Any > 50%	
24V DC Battery Chargers	Batteries fully charged and no alarms. Charger supply available	Batteries not fully charged, any	Any system on batteries	

		charger alarm or problems found		
DP UPS's	Batteries fully charged and no alarms. Not in bypass mode	Batteries not fully charged, any UPS alarm, in bypass mode or problems found	Any system on batteries	
DP Controllers and Power Supplies	Both controllers and power supplies available	Any alarm, poor performance, unexpected or unexplained event	Loss of one DP Controller or loss of power supply to a DP Controller	
DP Control System (Mimics)	All displays checked and up to date	Any incorrect information	Incorrect information that affects DP	
DP Operator Stations	All operating normally, no alarms	Any alarm, poor performance, unexpected or unexplained event	Loss of one DP Operator Station	
DP Network	Both networks available with no alarms	Any alarms or poor performance	Loss of one network	Complete loss of networks
DP Position Reference Systems	Two (2) DGPS and two (2) CyScan enabled on DP with power supplies adequately provided from two DP UPS units. Both DGPS to use different source of correction signals. No conflicts between relative and absolute reference systems	Any alarms, poor performance, unexpected or unexplained event	Loss of one position reference system and/or poor performance, unexpected or unexplained event	Failure to restore all position reference systems within an appropriate timeframe

Sensors	Heading Sensors (Gyro) into DP	All three Gyros enabled on DP	Any Gyro alarm	Loss of one Gyro and/or any Gyro alarm	Failure to restore all Gyros within an appropriate timeframe
	Motion Reference Sensors (MRU) into DP	Both MRUs enabled on DP	Any MRU alarm	Loss of one MRU and/or MRU alarm	Failure to restore all MRUs within an appropriate timeframe
	Wind Sensors into DP	All three Wind Sensors enabled on DP	Any Wind Sensor alarm	Loss of one Wind Sensor and/or Wind Sensor alarm	Failure to restore all Wind Sensors within an appropriate timeframe
PMS Control System	PMS Controllers and Power Supplies	Both controllers and power supplies fully functional	Any alarm, poor performance, unexpected or unexplained event		
	Thruster Phaseback or DP System Power Limiting	No alarms	Any alarm	Unexpected phasing back or limiting of thruster power	
Comms	Loss or Problem with any Essential Communications (Bridge/ECR/Offshore Installation Manager/Deck)	Redundant communications	Any problems experienced	One system remaining	
HVAC System	DP Critical Ventilation / Fans	All fans running in DP critical spaces	Any reduced ventilation	Any loss of ventilation affecting performance such as resulting in power reduction/equipment temperature alarms	
	Air Conditioning	Air conditioning / cooling in DP critical spaces	Any reduced air conditioning/cooling	Any loss of air conditioning affecting performance such as resulting in power reduction/equipment temperature alarms	
Compressed Air System	ME Starting / Control Air	Operating normally with no alarms	Any alarm present, loss of starting air when required to start main engines or loss of control air to any main engine		
Fire/Flood/ Collision	Fire - E/R or Elsewhere	No fire or any active fire alarms	Any fire alarm	Fire confirmed	Fire in DP critical compartments or spaces
	Flood	No bilge alarms active, no flooding	Multiple bilge alarms	Flood confirmed	Flooding in DP critical compartments or spaces
	Visibility	Daylight with good visibility	Any other condition		
	Collision (Errant Vessel)	No collision imminent / minimum approach > 500m	Minimum approach will be < 500m	If collision possible	Collision imminent
SIMOPS - Activity Specific Operating Guidelines - SMS SERENITY					
Condition		GREEN	ADVISORY	YELLOW	RED
Notify Master, Chief Engineer, Offshore Installation Manager, Client Rep, Deck		NO	YES	YES	YES
Action		CONTINUE NORMAL OPERATIONS	INFORM / CONSULT / RISK ASSESS (CONSIDER ONGOING AND UPCOMING OPERATIONS) Initiate actions to suspend activities	CEASE OPERATIONS Bring vessel to safe position. Prepare to exit 500m Zone (Depart Worksite to 200m on DP; 200m to 500m may exit on joystick or manual)	ABORT OPERATIONS Initiate contingency measures as appropriate. Prepare to or exit 500m Zone as appropriate to industrial mission
SIMOPS	Change from Green DP Status of any other vessel in the field	Green	Advisory	Advisory	Advisory
	Vessels Escape Routes	Escape route not compromised	Potential for escape route compromised	Escape route compromised	
	Comms/Interaction with Platform & Other Vessels	Vessels operating normally with no known problems. Redundant comms	Comms problem or possible heading/position conflict	No comms or definite heading/position conflict	

If done when preparation all, and also understanding the performance requirement as per charter needed and conform which area side, the Master or SDPO or officer in charge, should follow the guidance of company policy or company guidance as per check list which already distributed to all DP vessel.

Well if the DP Vessel was ready to prepare everything, so we can to do for fill up the CL. In this performance, we can see the example of Check List :

	DYNAMIC POSITIONING KONGSBERG SYSTEM Pre-DP-Bridge Watchkeeping Checklist- K-Pos DP-21 (To be completed outside the 500m zone)		
	Date	Rev	Page
	Nov' 18	3	1 of 2

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Vessel Name	SMS. SEVERITY	UBA FIELD	709.00
Date	20 th NOV 2018	Latitude	02° 36.42' S
Time	08.30 L/T	Longitude	132° 39.116' E
		Charterer	BP
		Operation	Mobilization

Power and Propulsion		Location				Utm Zone			
		ME Port	ME Stbd	T2	T3	T4	T5		
Generators	Online	☒	☒	☒	☒	☒	☒	☒	
	Available	☒	☒	☒	☒	☒	☒	☒	
				T2	T3	T4	T5		
Thrusters	Online	ME Port ☒	ME Stbd ☒	SG1 ☒	SG2 ☒	DG1 ☒	DG2 ☒	DG3 ☒	
	Available	☒	☒	☒	☒	☒	☒	☒	
		R1				R2			
Rudders	Online	T1 ☒				☒			
	Available	☒				☒			

Reference Systems				
	DGPS 1	DGPS 2	CyScan 1	CyScan 2
Online	☒	☒	☐	☐
Available	☒	☒	☐	☐

K-Pos DP 21	
Manoeuvre ☒	Print Page ☒ Set hdg 090°
Gain : High ☐ Medium ☒ Low ☐	
Alarm Limits Pos'n : 7 m / Hdg : 5°	
Speed Set : 0.3 Kts	Rate of turn : 10°/m
Centre of rotation at :	MIDSHIP'S
Controller Online	(A) (B)
Operator Station Online	(1) (2)
Joystick setup:	
Thrust ☒ Precision ☒	
Full ☒ Reduced ☐ High Spd ☐ General ☒ Low Spd ☐	

Conditions	
Current Direction	065°
Current Speed	0.7 Kts
Sig. Wave	0.2 m
Max Wave	0.4 m

Communications			
	SPT	Radio	Open
ECR	☒	☐	☐
Deck	☐	☒	☐

Phone
☒

Sensors											
	Gyro			Wind				VRS			
	Heading	En.	Pref.	Speed	Dir.	En.	Pref.	Pitch	Roll	En.	Pref.
1	079.7	☒	☒	8.9	191	☒	☒	0.71	0.30	☒	☒
2	079.0	☒	☐	9.3	193	☒	☐	0.33	0.51	☒	☐
3	079.9	☒	☐	9.3	200	☒	☐	0.48	0.87	☒	☐

Radio Channels		
DEK VHF	Field 1	Field 2
06	69	

DP Control		
Mode	AUTOPOS	
Class 2	KPOS 2	

Independent Joystick (transfer control to cJoy Independent joystick if pre DP)			
Control in all three axis's If possible	☒	IJS available (power on)	☒

DPO Name :	Samuel Hest	DPO Signature :	



500m Exclusion Zone Entry Checklist
Vice President - Engineering

PR-CO-RAC-019

13-Jul-17

Page 1 of 1

Enesco Rig Heading and Meteorological Conditions			
Enesco Rig Name: ENSCO-106	Wind Speed / Dir. (from) 4 kts / 046°	Sea height / Dir (from) 0.3 m / NE	
Enesco Rig Heading: 330°	Current Speed / Dir. (to) 0.5 kts / 100°	Swell height / Dir (to) 0.3 m / SW	
Attending Vessel's Information			
Vessel Name: SMS SECURITY		Vessel Master's Name: YUSMOMO	
Declaration of Security on File: ☒ Yes ☐ No		Declaration of Security Exp Date: 25.12.18 Security Level: 1	
Attending Vessel Planned Operational Mode:		☐ DP Class 1 ☒ DP Class 2 ☐ DP Class 3 ☐ Joystick/Manual ☐ Moored	
Vessel Speed and Direction of Drift Test: 0.4 kts / NE			
Planned Operations			
Deck Cargo: ☒ Dry Bulk Hose ☐ Liquid Mud ☐ Base Oil ☐ Fuel ☐ SIMOPS ☐ Other ☐			
Working side: Port ☐ Stbd ☒ Fwd ☐ Aft ☐		VHF Working Channel(s): 69	
Vessel To Confirm Prior to Entering Exclusion Zone		Yes / No	Remarks
Present weather and forecasted weather suitable for planned operation		☒ ☐	
All main engines are available and operational		☒ ☐	
All propulsion equipment available and operational		☒ ☐	
Has maneuvering and steering equipment been tested		☒ ☐	
Radars are set to standby		☒ ☐	
Auto pilot is off		☒ ☐	
Vessel manned for 24 hr operations and with appropriately credentialed personnel		☒ ☐	
Attending vessel agrees that no preventive maintenance to occur while inside 500m zone		☒ ☐	
Attending vessel notified of restricted activities while alongside (Fishing, Hotwork, BBQ, Smoking)		☒ ☐	
Any propulsion, power generation or power distribution system equipment out of service		☐ ☒	
DP Vessels To Confirm Prior to Entering Exclusion Zone		Yes / No	Remarks
All position reference systems operational and available		☒ ☐	
Type of position reference systems to be used whilst inside the 500m zone (Minimum 1 relative reference system* in DP)			
Acoustics ☐ Fanbeam* ☐ Radiscan* ☐ CyScan* ☒ Tautwire ☐ DGPS ☒ Other ☒ CYSCAN NO. 2			
All motion reference units operational and available		☒ ☐	
All gyros operational and available		☒ ☐	
All wind sensors operational and available		☒ ☐	
All vessel specific DP checks have been completed		☒ ☐	
Permission		Yes / No	
500m zone checklists complete, Permission granted to enter 500m zone		☐ ☐	Date/Time: 02/12/18
Date / Time of 500m zone entry:			
Enesco designee granting permission:		Enesco designee Signature:	Date: 3-12-18 Time: 00.00

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**500M SAFETY ZONE ENTRY CHECK LIST FOR VESSEL
ARRIVAL AT AND DEPARTURE FROM OFFSHORE FACILITY**

Vessel name	SMS SERENITY	Date: 02/12/18	Local time: 23.24 LT
at Offshore Facility (name)	ENSCO - 106 / UFA-1	Offshore Installation Manager (OIM)	

No	Prior Arrival Check List	Y / NO / NA	Comments
1	Environmental conditions acceptable for a safe operation (including wind, sea, swell, visibility and current)	Y	
2	Limitations due to sea/weather condition	Y	Max wind 720 kt, sea 1.5m
3	Safe approach / exit routes identified; Stand-off location identified	Y	
4	Confirm whether any simultaneous operations anticipated whilst vessel is within 500M safety zone	Y	WM. PACIFIC AT STBD SIDE
5	Confirm whether any prohibited zones at facility	NA	
6	Bridge and Engine room manned in accordance with GOMO	Y	
7	Communication established; VHF Channel(s): 69 ; UHF Channel(s): -	Y	VHF 69
8	No hot work, smoking, mobile phone and portable electrical devices on deck within 500M safety zone	Y	
9	Auto Pilot off	Y	
10	All manoeuvring and steering gear systems tested including changeover between control positions and manoeuvring modes	Y	
11	Emergency manoeuvring system confirmed to be operational	Y	
12	Operating location confirmed with facility	Y	
13	Status of over-side discharges confirmed with facility	Y	
14	Vessel to be manoeuvred to set-up position before changing mode (1.5 ~ 2.5 ship's lengths depending on whether in drift on or drift off situation)	Y	
15	Vessel operational capability reviewed / confirmed (to include power, thrust, location, heading, etc.)	Y	
16	Risk assessment for alongside operations reviewed / confirmed (if working on weather side, complete additional risk assessment)	Y	
17	Facility to confirm readiness for vessel arrival and operation (including no overboard discharge)	Y	
18	Manoeuvring mode during the operation to be agreed (if DP mode vessel specific DP checklist to be completed)	Y	DP C/L Completed
19	On-going and / or planned activities within 500M safety zone confirmed between facility and any other vessels	Y	
20	Other need to be reviewed and confirmed with offshore facility:	-	

PERMISSION RECEIVED TO ENTER 500M SAFETY ZONE

DATE / LOCAL TIME	02-12-2018	FROM / FUNCTION	BY: ENSCO - 106 / ENTERING 500M SAFETY ZONE
NAME	KUTMONG	NAME	BEN BOONAN
SIGNATURE		SIGNATURE	
POSITION / RANK	onboard Master	POSITION / RANK	PP (PIC of Offshore Facility)

No	Prior Departure Check List	Y / NO / NA	Comments
1	Vessel to be manoeuvred well clear of Facility before changing mode (1.5 ~ 2.5 ship's lengths depending on whether in drift on or drift off situation)		
2	All controls set to neutral position before changing mode		
3	Where practical, vessel to depart down weather or down current from facility		
	Other need to be reviewed and confirmed with offshore facility:		

PERMISSION RECEIVED TO LEAVE 500M SAFETY ZONE

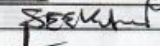
DATE / LOCAL TIME		FROM / FUNCTION	BY: / LEAVING 500M SAFETY ZONE
NAME		NAME	
SIGNATURE		SIGNATURE	
POSITION / RANK	onboard Master	POSITION / RANK	(PIC of Offshore Facility)

500M SAFETY ZONE ENTRY CHECK LIST FOR VESSEL**VESSEL ENGAGED IN LOGISTIC SUPPORT (ADDITIONAL CHECKLIST TO BE COMPLETED AND CONFIRMED)**

Vessel name	<u>SMS. FERGUSON</u>	Date: <u>02-12-2018</u> Local time: <u>23.24 LT</u>
at Offshore Facility (name)	<u>ENSCO -106 / URA-1 FIELD</u>	Offshore Installation Manager (OIM)

No	Prior Logistic Support Operation on 500M Safety Zone	Y / NO / NA	Comments
1	Proposed operations confirmed with facility. Discharge and Back-Load (Cargo, bulks, fluids, etc.)	Y	
2	Anticipated duration of operations confirmed	Y	
3	Confirm discharge / back-load sequence with facility 1. Can stow be broken safely? (adequate escape routes to safe havens, etc.) 2. Any priority lifts? (must not require "cherry picking" of stow) 3. Sufficient space for back-load except at last call? (see notes below)	Y	
4	Confirm any other activities may occur whilst vessel is alongside and connected to facility (particularly any operations involving crane driver / deck crew)	Y	
5	Confirm availability of facility personnel, equipment (particularly for any operations involving hoses)	Y	
6	Confirm whether any changes of working face will be required (if so, move from one to the next to be planned accordingly)	Y	
7	Confirm whether any unusual lifts will be involved 1. Any Main Block Lifts? 2. Any Vulnerable / Sensitive Lifts? 3. Any Lifts involving use of Tag Lines? 4. Any other Unusual Lifts? (including long objects, or not pre-slung lifts, etc.)	1. No 2. No 3. Y 4. No	
8	Confirm readiness to commence dry bulk transfer operations 1. Is Hose buoyancy adequate? 2. Has Valve configuration been correctly set?	Y	As Per Required
9	Confirm readiness to commence liquid transfer operations 1. Is Hose buoyancy adequate? 2. Has Valve configuration been correctly set? 3. If required, is illumination adequate? 4. If required, is additional monitoring in place?	Y	As Per Required
10	Confirm whether vessel will be required to receive any back-load bulk cargoes. (if so, confirm recent analysis report will be available prior to accepting cargo)	Y	As Per Required DATE / SIGNATURE
11	Other need to be reviewed and confirmed with offshore facility:	-	

notes: as a contingency, 10% of usable cargo deck of 1 clear bay is normally considered to be sufficient for back load cargoes

PERMISSION RECEIVED FOR LOGISTIC SUPPORT OPERATION WITHIN 500M SAFETY ZONE			
DATE / LOCAL TIME	<u>02-12-2018</u>	FROM / FUNCTION	<u>MY. ENSCO 106 / LOGISTIC SUPPORT OPS.</u>
NAME	<u>KUSHAL</u>	NAME	<u>BEN</u>
SIGNATURE		SIGNATURE	
POSITION / RANK	<u>onboard-Master</u>	POSITION / RANK	<u>TP</u> (PIC of Offshore Facility)



500m Exclusion Zone Entry Checklist
Vice President - Engineering

PR-CQ-RAC-019
13-Jul-17
Page 1 of 1

Enesco Rig Heading and Meteorological Conditions			
Enesco Rig Name: ENSCO-106	Wind Speed / Dir: (from) 7 Kts / 058°	Sea height / Dir (from) 0.3 / SW	
Enesco Rig Heading: 330°	Current Speed / Dir: (to) 0.3 Kts / 260°	Swell height / Dir (to) 0.2 / SW	
Attending Vessel's Information			
Vessel Name: SMS SERENITY		Vessel Master's Name: WIMOND	
Declaration of Security on File: ☒ Yes ☐ No		Declaration of Security Exp Date: 25.11.18 Security Level: 1	
Attending Vessel Planned Operational Mode:		☐ DP Class 1 ☒ DP Class 2 ☐ DP Class 3 ☐ Joystick/Manual ☐ Moored	
Vessel Speed and Direction of Drift Test: 0.3 Kts			
Planned Operation			
Deck Cargo ☒ Dry Bulk Hose ☐ Liquid Mud ☐ Base Oil ☐ Fuel ☐ SIMOPS ☐ Other ☐			
Working side: Port ☒ Stbd ☐ Fwd ☐ Aft ☐		VHF Working Channel(s): 69	
Vessel To Confirm Prior to Entering Exclusion Zone:		Yes / No	Remarks
Present weather and forecasted weather suitable for planned operation		☒ ☐	
All main engines are available and operational		☒ ☐	
All propulsion equipment available and operational		☒ ☐	
Has maneuvering and steering equipment been tested		☒ ☐	
Radars are set to standby		☒ ☐	
Auto pilot is off		☒ ☐	
Vessel manned for 24 hr operations and with appropriately credentialed personnel		☒ ☐	
Attending vessel agrees that no preventive maintenance to occur while inside 500m zone		☒ ☐	
Attending vessel notified of restricted activities while alongside (Fishing, Hotwork, BBQ, Smoking)		☒ ☐	
Any propulsion, power generation or power distribution system equipment out of service		☐ ☒	
DP Vessels To Confirm Prior to Entering Exclusion Zone:		Yes / No	Remarks
All position reference systems operational and available		☒ ☐	
Type of position reference systems to be used whilst inside the 500m zone (Minimum 1 relative reference system* in DP)			
Acoustics ☐ Fanbeam* ☐ Radiscan* ☐ CyScan* ☒ Tautwire ☐ DGPS ☒ Other ☒ CYSCAN NO. 2			
All motion reference units operational and available		☒ ☐	
All gyros operational and available		☒ ☐	
All wind sensors operational and available		☒ ☐	
All vessel specific DP checks have been completed		☒ ☐	
Permission		Yes / No	
500m zone checklists complete. Permission granted to enter 500m zone		☐ ☐	Date/Time: 02/12/18
Date / Time of 500m zone entry:			
Enesco designee granting permission:		Enesco designee Signature:	Date: Time:
WAYNE ROBERTSON / OIM			02/12/18 12.30

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	DYNAMIC POSITIONING KONGSBERG SYSTEM		
	500 M ZONE CHECK LIST		
	Date	Rev	Page
	Nov' 18	3	1 of 2
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SMS SERENITY 500 M ZONE CHECKLIST

Section 1 Initial Information			
Vessel	SMS SERENITY	Date	02-12-2018
Installation Name	ENSCO-106	Location (Field/Block)	UDA-1 FIELD
Installation Heading	330°		

Section 2 Communications										
Installation Bridge	☒ Y	☐ N	Ch	Field Radio 05/16	☒ Y	☐ N	Ch	Internal Telephone	☒ Y	☐ N
Installation Crane	☒ Y	☐ N	Ch	Deck Radio	☒ Y	☐ N	Ch	Sound Powered Telephone	☒ Y	☐ N
Installation Deck	☒ Y	☐ N	Ch	Engine Room Radio	☒ Y	☐ N	Ch	Any Other Comments	Y	☒ N

Section 3 Pre Arrival		
Notice given to Installation ETA, DG's, Cargo etc.	☒ Y	☐ N
Permit received from Installation (if applicable)	☒ Y	☐ N
Bridge and ECR Manning in accordance with requirements	☒ Y	☐ N
Notice given to Engine Room	☒ Y	☐ N

Section 4 Upon Arrival (Pre Entry)		
Assessment of Weather conditions for safe operation	☒ Y	☐ N
Approach towards installation assessed and offset course determined	☒ Y	☐ N
Run up necessary Engines, all thrusters and test as necessary	☒ Y	☐ N
Emergency maneuvering controls tested	☒ Y	☐ N
Change over between maneuvering stations tested	☒ Y	☐ N
DP Checklist completed (as applicable)	☒ Y	☐ N
Check all forms of communications (section 2)	☒ Y	☐ N
No hot work or smoking on deck within 500m zone	☒ Y	☐ N
Side of Installation / Crane to be confirmed	☒ Y	☐ N
Cargo Operations confirmed	☒ Y	☐ N
Stability Calculations considered for proposed operations	☒ Y	☐ N
Helicopter Operations confirmed	☒ Y	☒ N
Installation to confirm readiness and cease overboard discharges on working side	☒ Y	☐ N
Deck lighting operational including searchlights	☒ Y	☐ N
Offset course steered to installation in manual steering	☒ Y	☐ N
Navigation Lights set/ AIS set correctly/ Radars on Standby	☒ Y	☐ N

	DYNAMIC POSITIONING KONGSBERG SYSTEM		
	500 M ZONE CHECK LIST		
	Date	Rev	Page
Nov' 18	3	1 of 2	
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Section 5	Remarks

Section 6	Entry into 500m Zone			
Permission to enter 500m zone granted at	<table border="1"> <tr> <td></td> <td>Permission granted by</td> <td><i>AL</i></td> </tr> </table>		Permission granted by	<i>AL</i>
	Permission granted by	<i>AL</i>		

Completed by	EDWIN K. BAHAR	Signed		Date	02/12/18

500M SAFETY ZONE ENTRY CHECK LIST FOR VESSEL
VESSEL ENGAGED IN LOGISTIC SUPPORT (ADDITIONAL CHECKLIST TO BE COMPLETED AND CONFIRMED)

Vessel name	SMS. SERENITY	Date: 02-12-2018	Local time: 12.00 LT
at Offshore Facility (name)	ENSC6-106/URA-1 FIELD	Offshore Installation Manager (OIM)	

No	Prior Logistic Support Operation on 500M Safety Zone	Y / NO / NA	Comments
1	Proposed operations confirmed with facility. Discharge and Back-Load (Cargo, bulks, fluids, etc.)	Y	
2	Anticipated duration of operations confirmed	Y	
3	Confirm discharge / back-load sequence with facility 1. Can stow be broken safely? (adequate escape routes to safe havens, etc.) 2. Any priority lifts? (must not require "cherry picking" of stow) 3. Sufficient space for back-load except at last call? (see notes below)	Y	
4	Confirm any other activities may occur whilst vessel is alongside and connected to facility (particularly any operations involving crane driver / deck crew)	Y	
5	Confirm availability of facility personnel, equipment (particularly for any operations involving hoses)	Y	
6	Confirm whether any changes of working face will be required (if so, move from one to the next to be planned accordingly)	Y	
7	Confirm whether any unusual lifts will be involved 1. Any Main Block Lifts? 2. Any Vulnerable / Sensitive Lifts? 3. Any Lifts involving use of Tag Lines? 4. Any other Unusual Lifts? (including long objects, or not pre-slung lifts, etc.)	1. No 2. No 3. Y 4. No	
8	Confirm readiness to commence dry bulk transfer operations 1. Is Hose buoyancy adequate? 2. Has Valve configuration been correctly set?	Y	As Per Required
9	Confirm readiness to commence liquid transfer operations 1. Is Hose buoyancy adequate? 2. Has Valve configuration been correctly set? 3. If required, is illumination adequate? 4. If required, is additional monitoring in place?	Y	As Per Required
10	Confirm whether vessel will be required to receive any back-load bulk cargoes. (if so, confirm recent analysis report will be available prior to accepting cargo)	Y	As Per Required DART / BART
11	Other need to be reviewed and confirmed with offshore facility:	-	

notes: as a contingency, 10% of usable cargo deck of 1 clear bay is normally considered to be sufficient for back load cargoes

PERMISSION RECEIVED FOR LOGISTIC SUPPORT OPERATION WITHIN 500M SAFETY ZONE			
DATE / LOCAL TIME	02-12-2018	FROM / FUNCTION	MY ENSC 106 / LOGISTIC SUPPORT OPS.
NAME	KUSHAL	NAME	
SIGNATURE		SIGNATURE	
POSITION / RANK	onboard Master	POSITION / RANK	(PIC of Offshore Facility)

**500M SAFETY ZONE ENTRY CHECK LIST FOR VESSEL
ARRIVAL AT AND DEPARTURE FROM OFFSHORE FACILITY**

Vessel name	SMS SERENITY	Date: 02/12/18	Local time: 12.00 LT
at Offshore Facility (name)	ENSCO - 106/UBA-1	Offshore Installation Manager (OIM)	

No	Prior Arrival Check List	Y / NO / NA	Comments
1	Environmental conditions acceptable for a safe operation (including wind, sea, swell, visibility and current)	Y	
2	Limitations due to sea/weather condition	Y	Max wind 7 to 14, sea 1,5m
3	Safe approach / exit routes identified; Stand-off location identified	Y	
4	Confirm whether any simultaneous operations anticipated whilst vessel is within 500M safety zone	Y	WM. PACIFIC AT STBD SIDE
5	Confirm whether any prohibited zones at facility	NA	
6	Bridge and Engine room manned in accordance with GOMO	Y	
7	Communication established; VHF Channel(s): 69; UHF Channel(s): -	Y	VHF 69
8	No hot work, smoking, mobile phone and portable electrical devices on deck within 500M safety zone	Y	
9	Auto Pilot off	Y	
10	All manoeuvring and steering gear systems tested including changeover between control positions and manoeuvring modes	Y	
11	Emergency manoeuvring system confirmed to be operational	Y	
12	Operating location confirmed with facility	Y	
13	Status of over-side discharges confirmed with facility	Y	
14	Vessel to be manoeuvred to set-up position before changing mode (1.5 ~ 2.5 ship's lengths depending on whether in drift on or drift off situation)	Y	
15	Vessel operational capability reviewed / confirmed (to include power, thrust, location, heading, etc.)	Y	
16	Risk assessment for alongside operations reviewed / confirmed (If working on weather side, complete additional risk assessment)	Y	
17	Facility to confirm readiness for vessel arrival and operation (including no overboard discharge)	Y	
18	Manoeuvring mode during the operation to be agreed (If DP mode vessel specific DP checklist to be completed)	Y	DP 9/L Completed
19	On-going and / or planned activities within 500M safety zone confirmed between facility and any other vessels	Y	
20	Other need to be reviewed and confirmed with offshore facility:	-	

PERMISSION RECEIVED TO ENTER 500M SAFETY ZONE

DATE / LOCAL TIME	02-12-2018	FROM / FUNCTION	MV. ENSCO - 106 / ENTERING 500M SAFETY ZONE
NAME	KUMARU	NAME	
SIGNATURE		SIGNATURE	
POSITION / RANK	onboard Master	POSITION / RANK	(PIC of Offshore Facility)

No	Prior Departure Check List	Y / NO / NA	Comments
1	Vessel to be manoeuvred well clear of Facility before changing mode (1.5 ~ 2.5 ship's lengths depending on whether in drift on or drift off situation)		
2	All controls set to neutral position before changing mode		
3	Where practical, vessel to depart down weather or down current from facility		
	Other need to be reviewed and confirmed with offshore facility:		

PERMISSION RECEIVED TO LEAVE 500M SAFETY ZONE

DATE / LOCAL TIME		FROM / FUNCTION	MV. / LEAVING 500M SAFETY ZONE
NAME		NAME	
SIGNATURE		SIGNATURE	
POSITION / RANK	onboard Master	POSITION / RANK	(PIC of Offshore Facility)

When the CL done completed well, All function change position to aft control station. It's mean all operation fully in DP Mode.

We could see on the monitor of DP Console here:



The important thing that we should carefully when set heading from manual to auto heading on DP mode. Have three point on the Kongsberg DP Console, we can see on this picture below:



The DPO or Master should concern for this function, because we can bring the vessel in good order if the adjusting of three point could stabilized until locked to DP mode. If all point already lock, we can use with full in DP mode.



On that above picture, shown that the monitor of DP Console and Cyscan as 3rd position reference as becoming fulfil on DP mode, and depend the operator, to hold performance of DP, and perhaps any change situation and condition, the operator Master or SDPO should aware of the alarm when immediate come to the DP operation during vessel operation. And vessel ready enter 500 metre safety zone to the rig or platform.



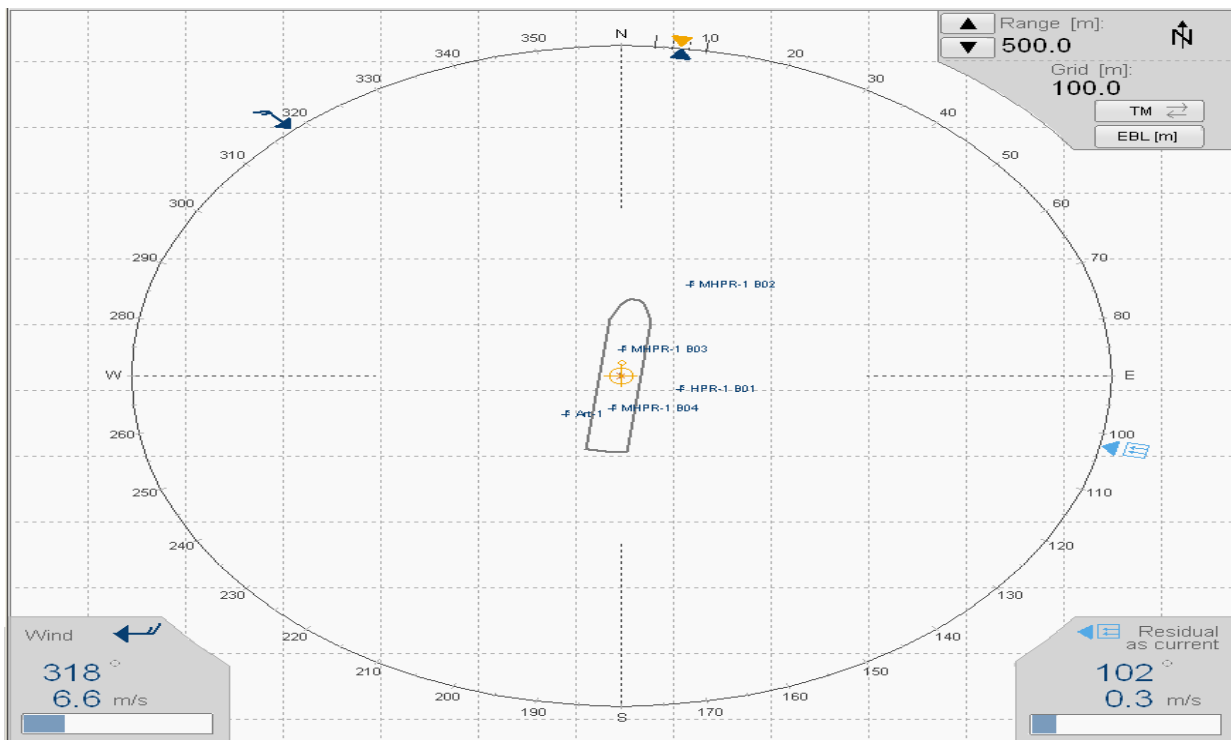
The DP Vessel when entering 500 M safety zone:



The Master or SDPO should be carefully when adjusting the heading and ready enter 500 M safety zone to the Rig or platform.



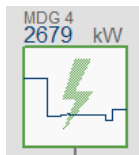
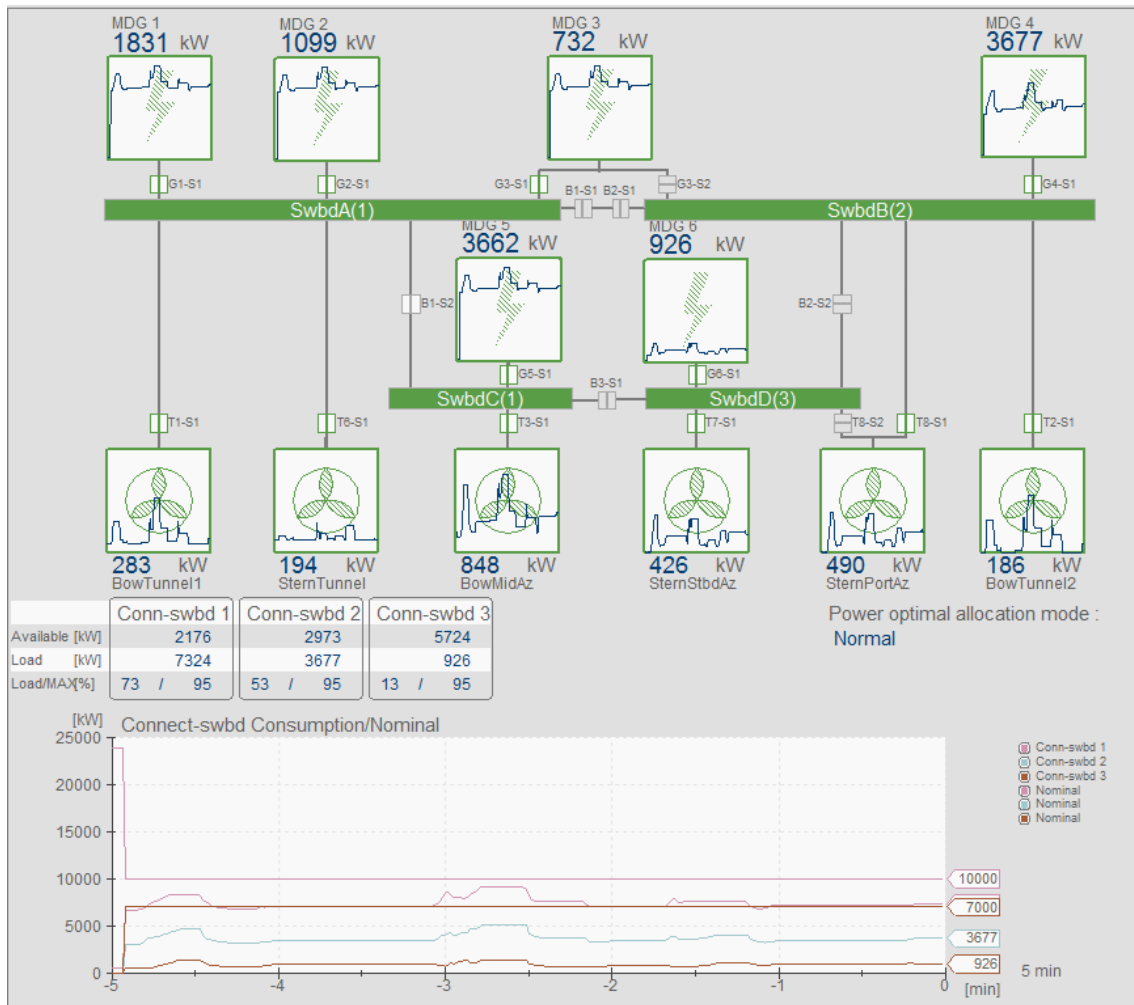
On the plot view, set increment and always monitor thruster forces to maintain on DP mode.



The Posplot view shows the vessel's position relative to the position and heading setpoints and to other displayed objects, such as the position of transponders. The prevailing wind and current are also displayed.

Using the **Posplot** view control dialog box, you can:

- Select either a true or a relative display, with either the position setpoint or the present vessel position at the centre of the display.
- Display or remove various features on the view.
- Show or hide a chart on the Posplot view.
- Show or hide the grid, and select grid type and grid spacing.



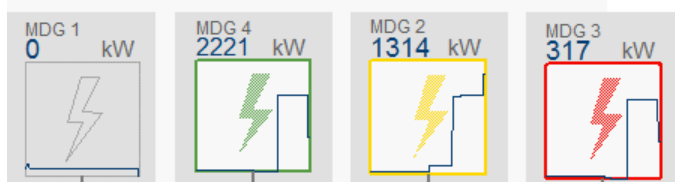
This is a generator symbol showing the produced power both as a numerical value (above the symbol) and graphically (the line in the symbol) as a percentage of the nominal power (where the vertical axis is 100%). The symbol is colour-coded:

Grey indicates that the generator is not running

Green indicates that generator is OK and running

Yellow indicates that the generator has a warning status

Red indicates that the generator has a signal error on the load signal

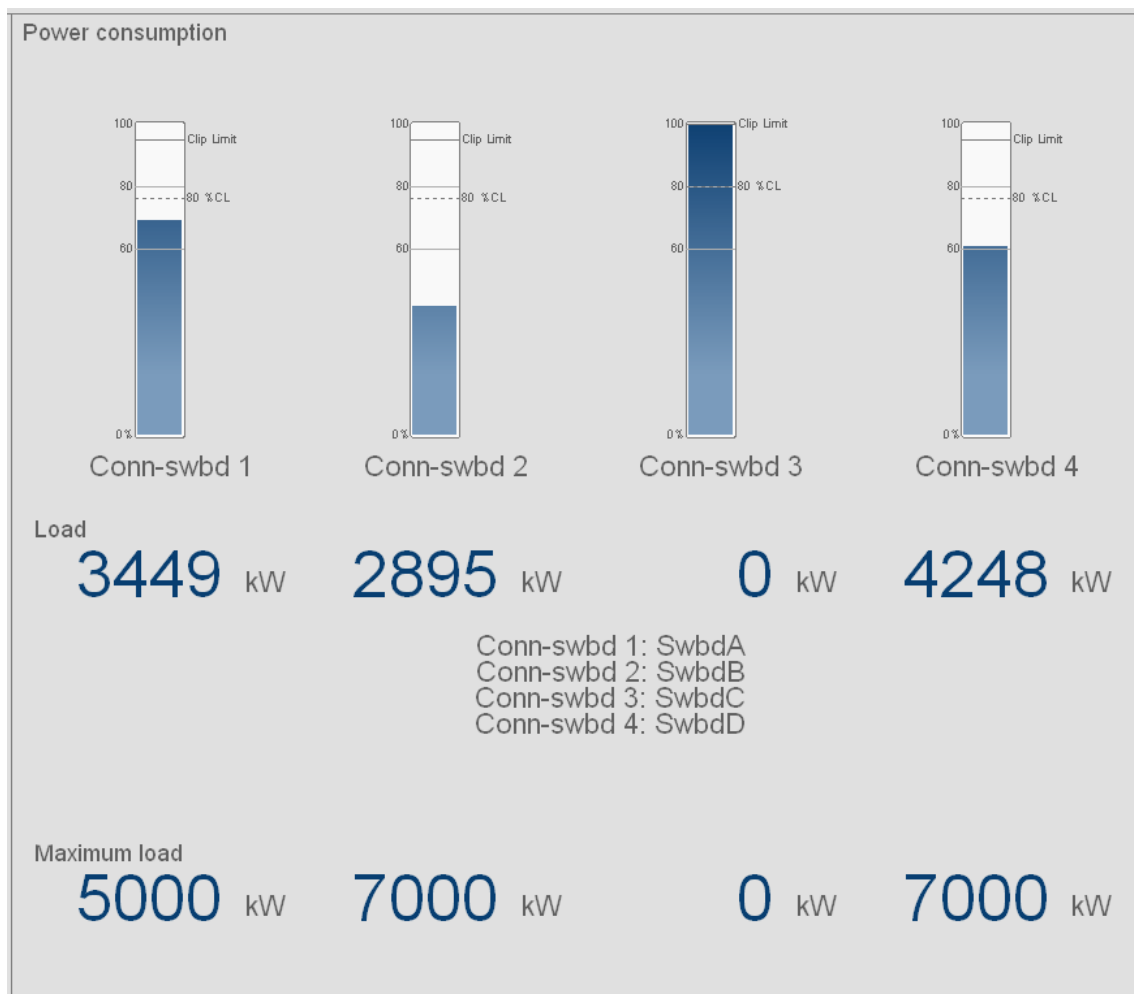


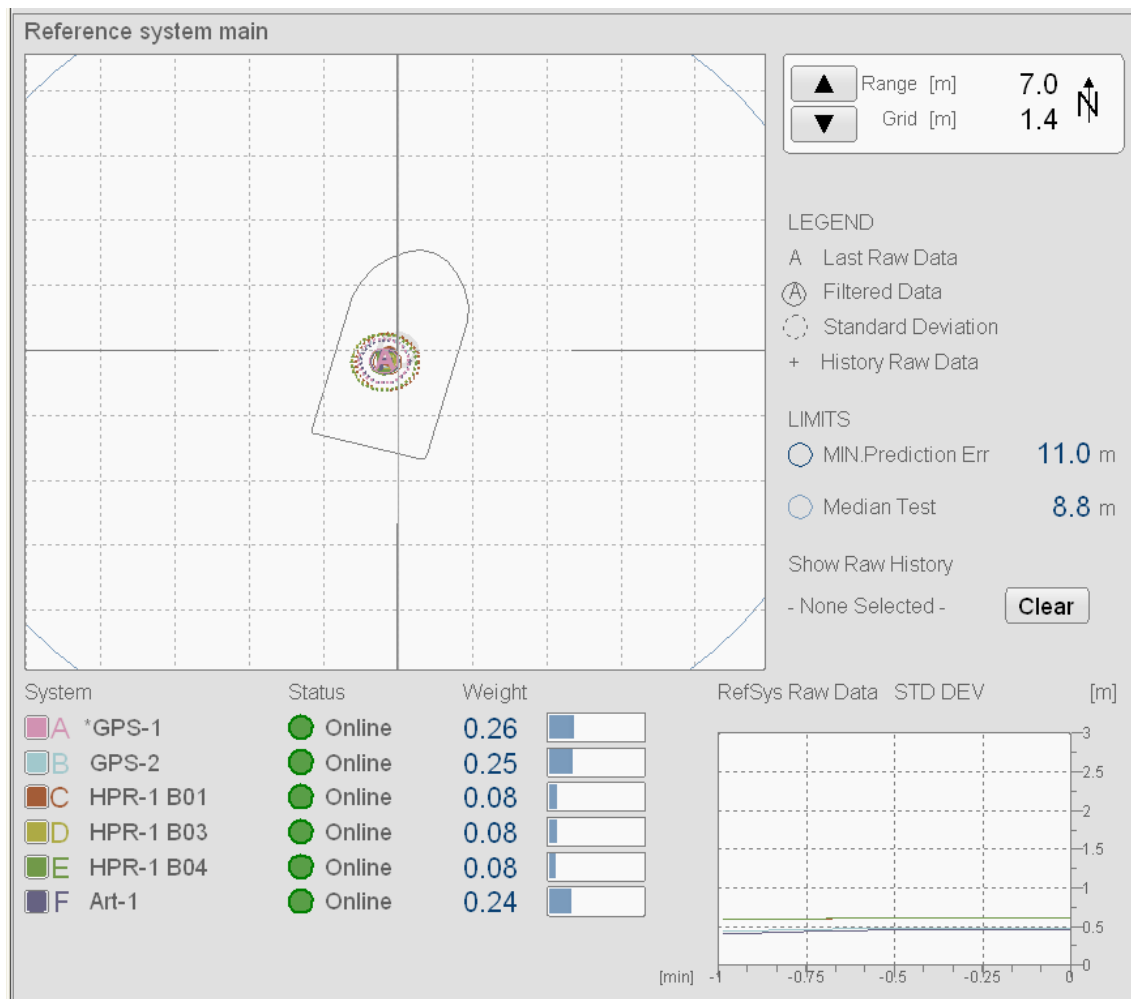
Power consumption view

The Power Consumption view shows:

- The consumed power for each connect-switchboard in numerical and graphical form as a percentage of available power.
- Which Switchboards are included in each connect-switchboard.
- The available power for each connect-switchboard in numerical form.

The view is dynamically updated to always show the current switchboard topology. To select the display view: place the cursor in the upper left corner of the working area so that the drop-down list becomes visible. Click on the arrow and select the view from the list.





These are the display range value, decrease/increase buttons and grid spacing value. The range is the distance from centre to edge of plot. The ▼ button decreases the display range. The ▲ button increases the display range.

The N symbol indicates the orientation of the heading as selected by the buttons on the heading pane — if **H REL** is selected the symbol is tilted in the respective direction.

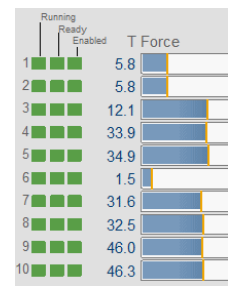
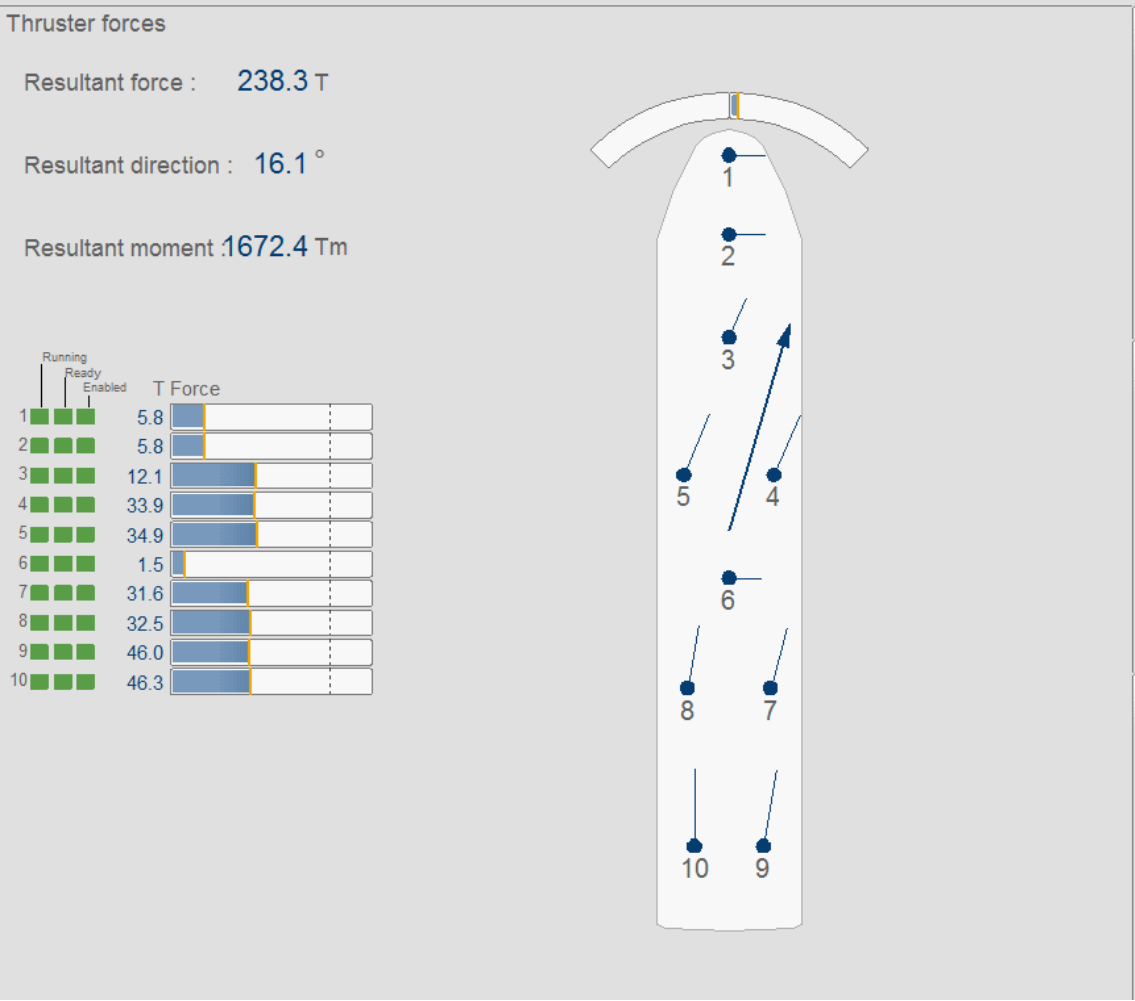
You can adjust the grid spacing using the view control,

Grid page. The grid spacing is automatically adjusted when decreasing/increasing the display range.

Thruster forces view

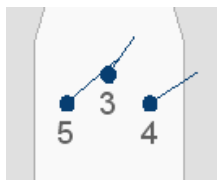
The Thruster forces view shows the resultant thruster forces and the “real” location of the thrusters.

To select the display view: place the cursor in the upper left corner of the working area so that the drop-down list becomes visible. Click on the arrow and select the view from the list.



These are numerical values and bar graphs showing the thruster force for each thruster unit. The bar graphs show the percentage of the maximum available thrust and are scaled individually. The numerical values are all based on feedback signals from the thrusters.

The Status boxes show the **Running**, **Ready** and **Enabled** status of each thruster unit.



Individual thrust vectors (thruster force feedback) for each thruster are shown. The vectors change colour according to the change of colour on the corresponding bar graphs (when passing limit values for percentage of available thrust).



The resultant thruster force vector (displayed from the vessel's Midships position) is displayed. A graphical indication of turning moment is also shown. The turning moment has a maximum sector range of $\pm 180^\circ$.

The colour of the bars, the background colour of the values and the force vectors change to yellow when the thrusters pass the limit for percentage of available thrust (typically 80%). This applies only in some modes (depending on your system configuration, but usually in auto-modes). The colour changes to red when there is a signal error from one of the thrusters. For example:

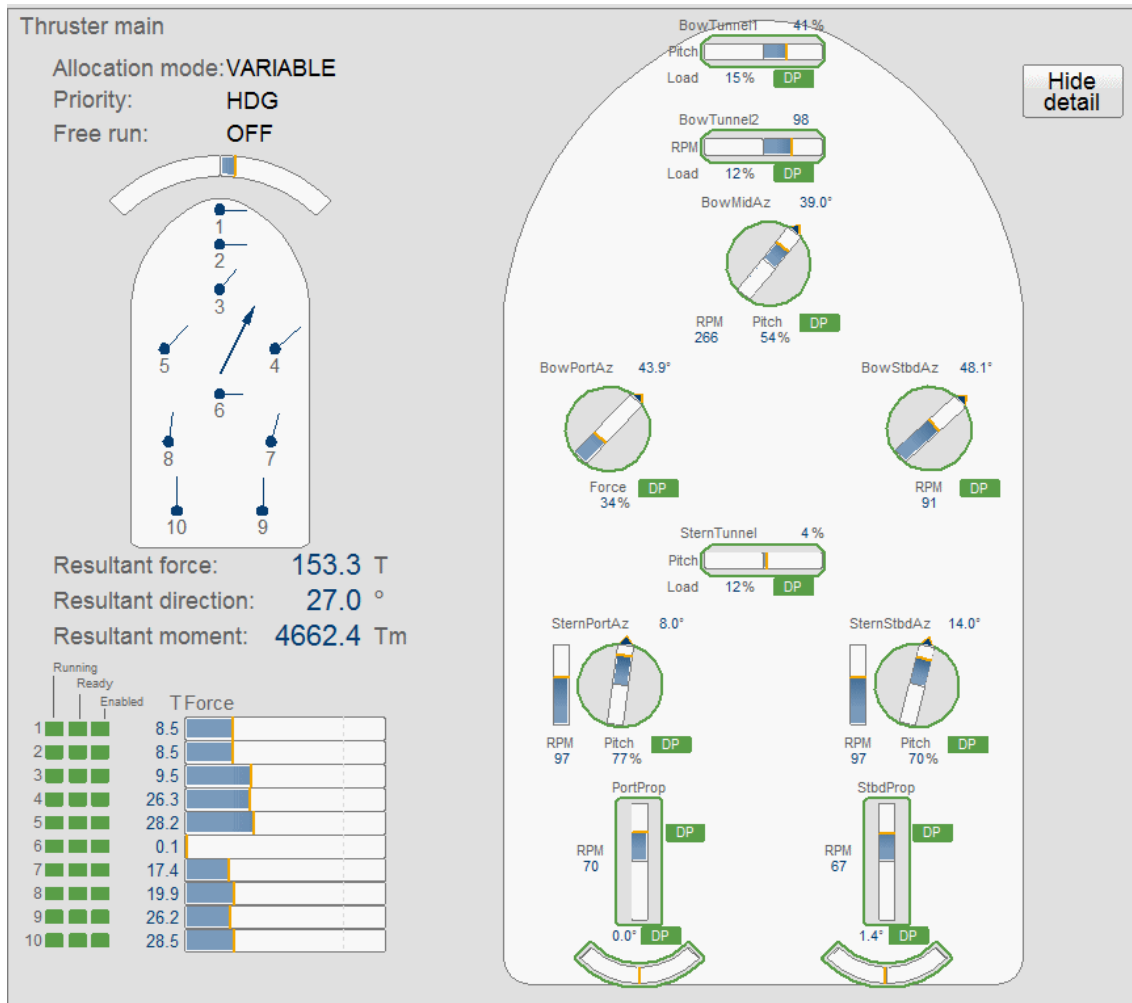
Thruster main view

The thruster main view shows the performance and status of all the thrusters.

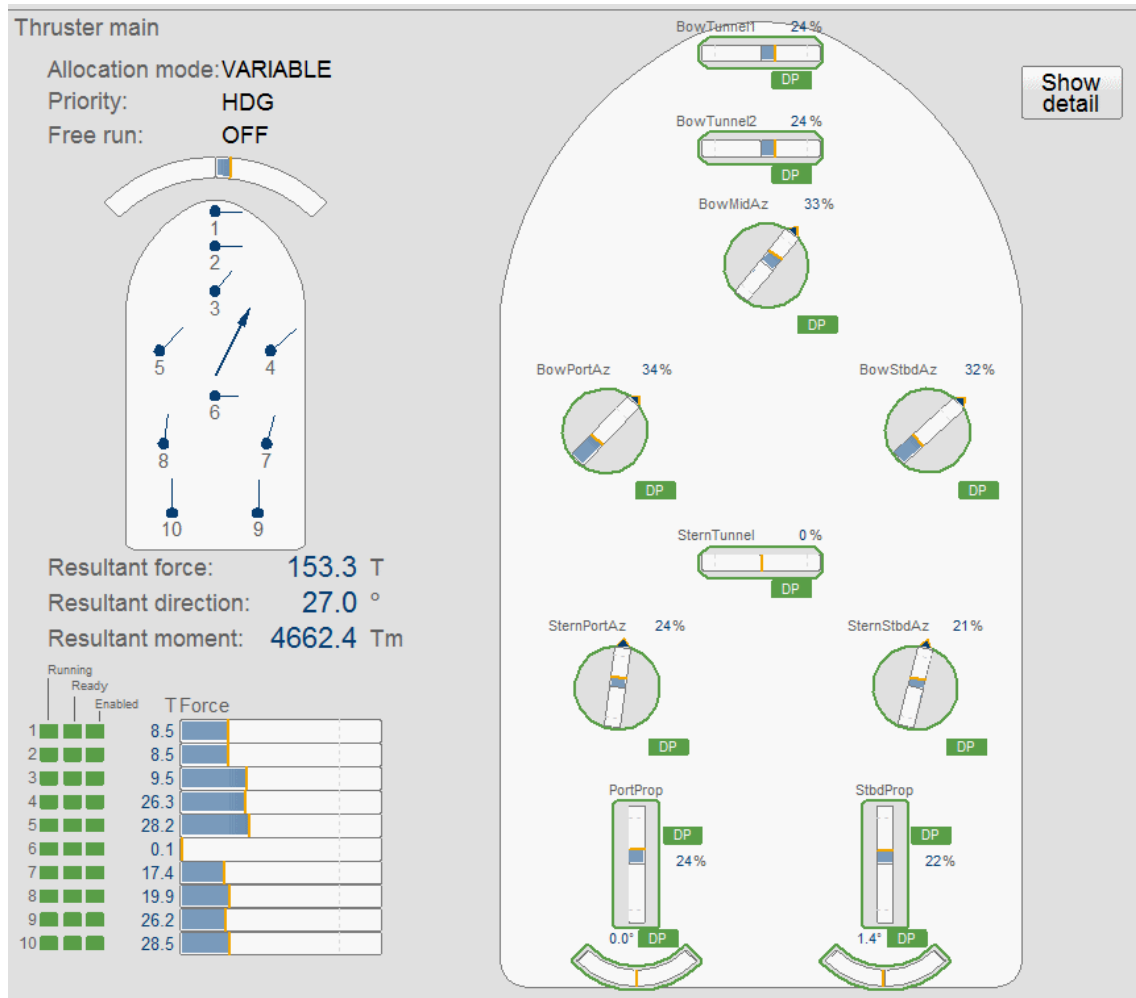
Bar graphs show the thruster force for each thruster unit. The thruster force for each thruster unit and their resultant thruster force are also represented by vectors.

To select the display view: place the cursor in the upper left corner of the working area so that the drop-down list becomes visible. Click on the arrow and select the view from the list.

You can also press the **THRUSTER** button



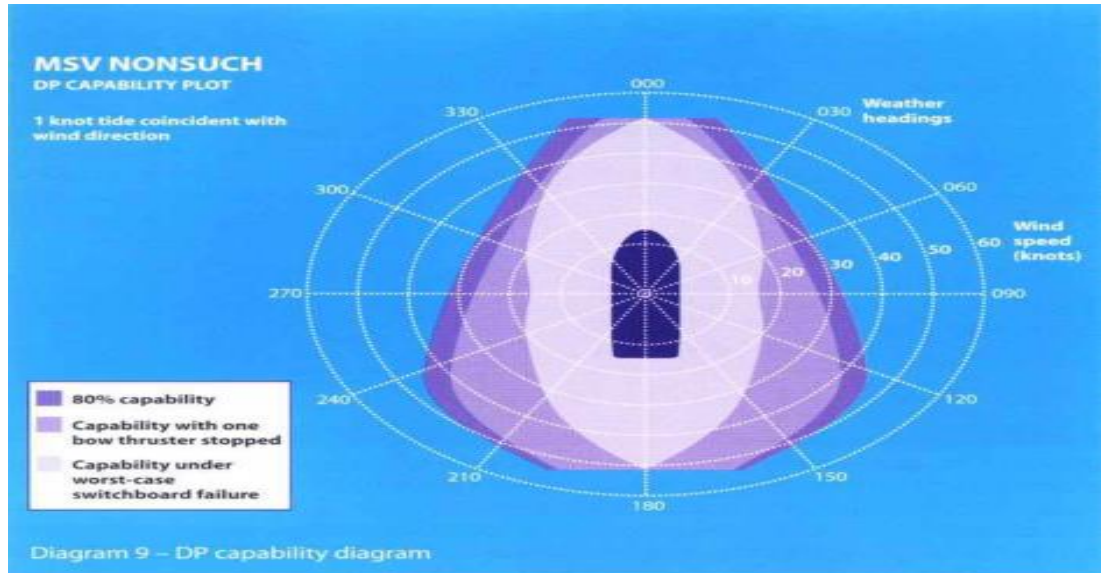
You can toggle the amount of information displayed on the view by clicking the **Show detail** / **Hide detail** button.



2. How much Capability Plot could expectation in order that course alterations consequence effect by current and wind effect shall perform for Best Escape Heading?

DP Capability diagrams which give an approximate indication of the capability of the vessel in a variety of weather conditions. The value of these diagrams is sometimes questionable, since the vessel and/or environmental conditions rarely match those tabulated in the diagrams. A better assessment of the capability is given by the online capability plot. This is a similar diagram calculated 'live' by the system on demand. Master or SDPOs must specify sea state and current values. They must also input a variety of degraded-status failure modes relating to power plant and propulsion. Once set up, the facility calculates and displays a capability plot for that set of conditions.

The operator must be aware of the limitations of this display, as it is still only a theoretical ,computer simulation of the vessel's capability, and not obtained from real observation.



The DP Capability and Motion prediction analysis function are used to analyse and predict operational margins on my own vessel experienced.

The Master and SDPO's when adjusting course and speed, should combine and observe with DP Capability and Motion prediction on DP menu console. Present environment conditions were specified on the DP Capability and Motion Prediction Setting on dialog Box.

The wave and current properties were calculated automatically from measured wind speed and direction and DP states to ensure that the correct present conditions are used. Refer this dialog shown in this figure.

DP Capability and Motion Prediction Settings

Present environmental condition

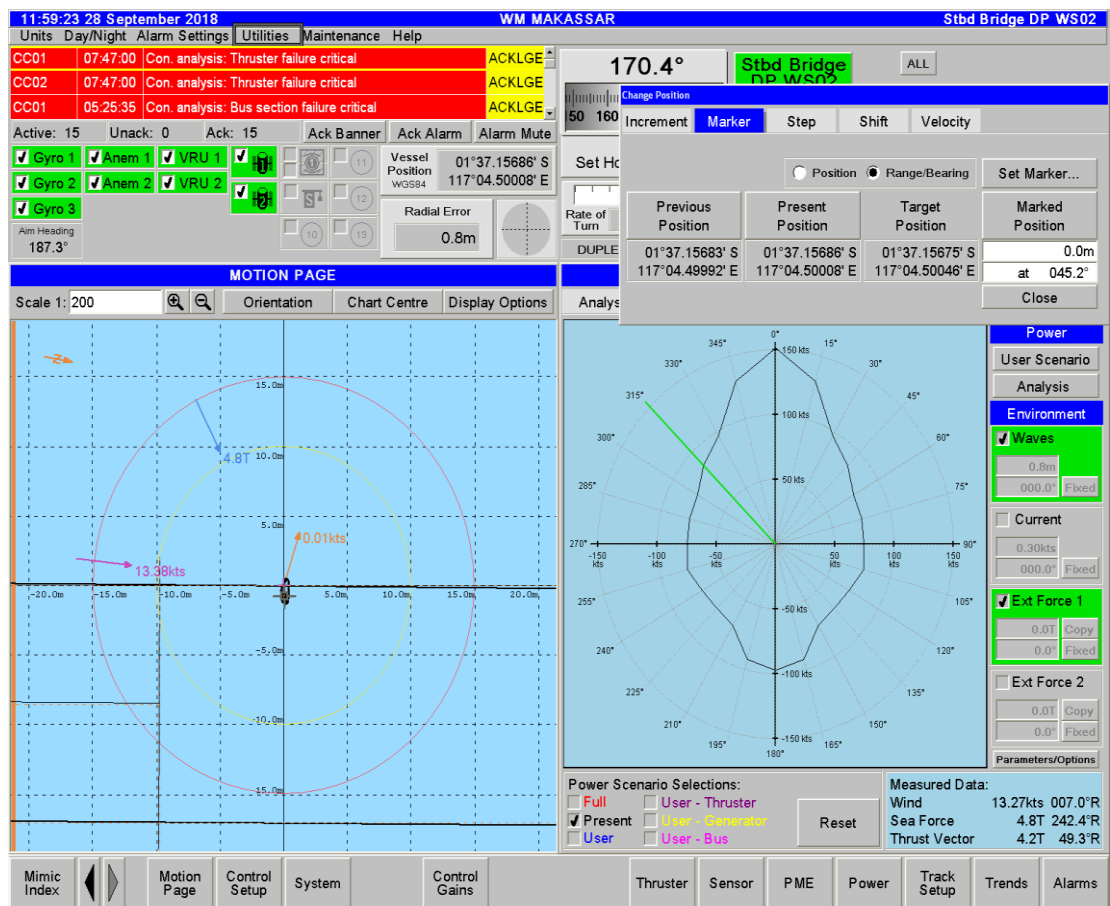
Waves		Average Wind	
Height	3.3 m	Speed	10.2 m/s
Period	6.6 s	Dir. (TRUE)	42 °
Dir. (TRUE)	42.3 °	Sea Current	
☒ Automatic calculation of wave and current properties		Speed	0.2 m/s
		Dir. (TRUE)	189 °

Average heading 276.3 °

Simulation possible: ☒

This is recommended procedure, however, the operator can also enter the PRESENT wave, wind and current properties manually, if configured.

To manually specify the present environmental condition, click main tab and deselect the check box for automatic calculation of wave and current properties.

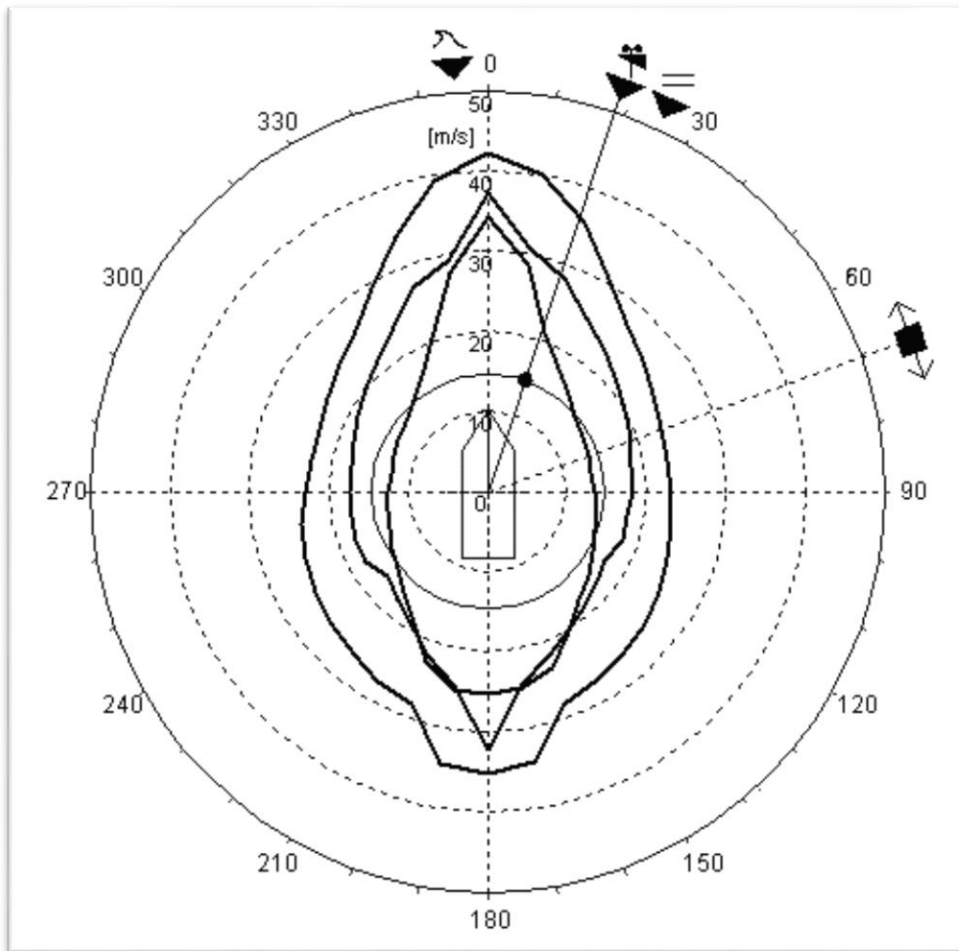


The Master or SDPO's should be measured the DP Capabilities.

The DP Capability Analysis function computes the maximum weather conditions in which the vessel was able to continue. DP operations and allows us to select the optimum heading for safe operation.

Analysis were performed cyclically (usually every 5 minutes)

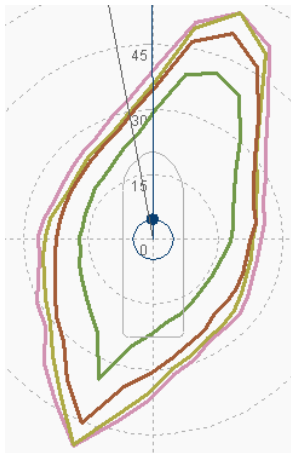
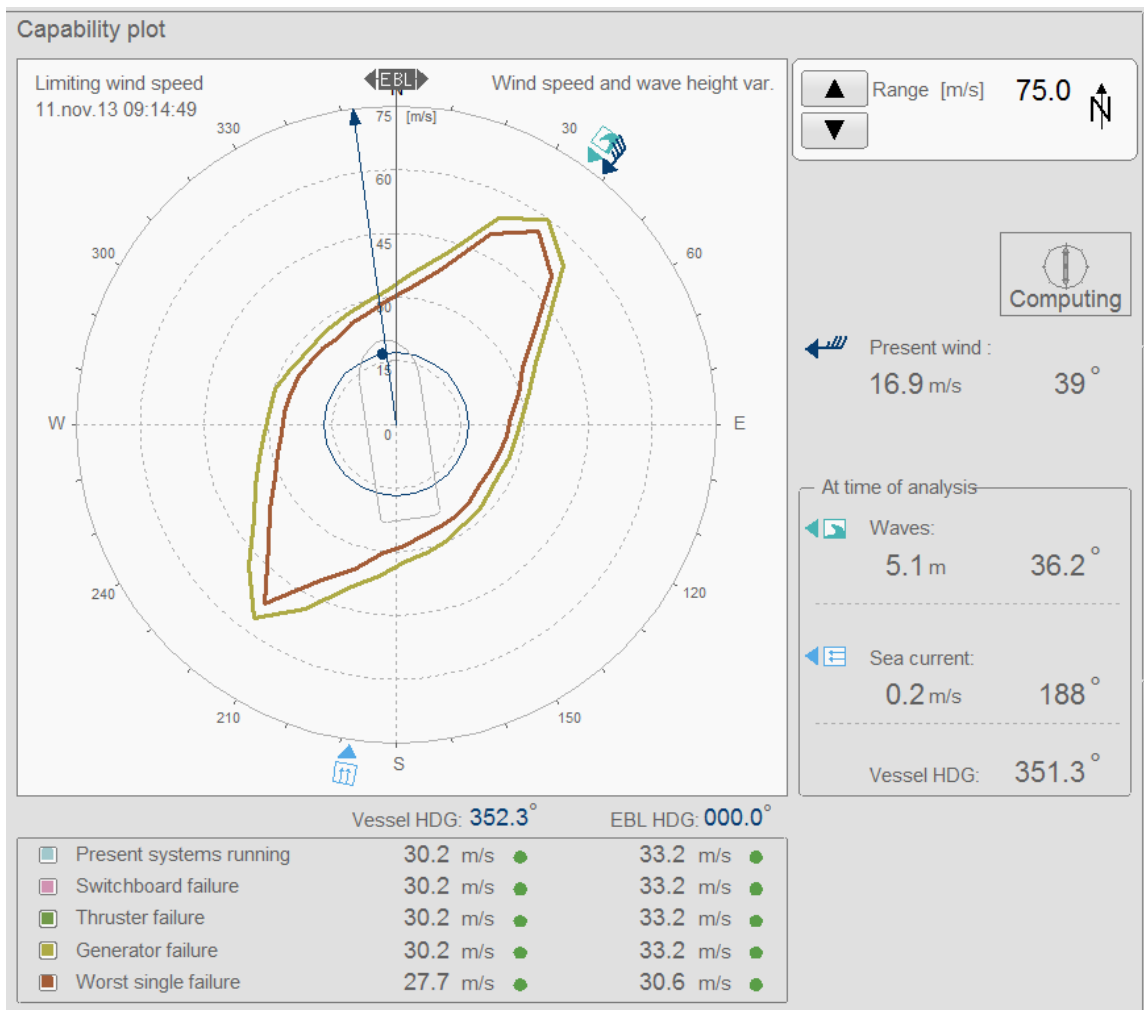
When the analysis are performed, a force corrections was taken into account.



In that example picture, the capability envelopes show the limiting one-minute mean wind speed. By examining this display, we could see the present operational margins with respect to the environment conditions, and the optimum heading (with respect to the weather conditions) to select for safe operation.

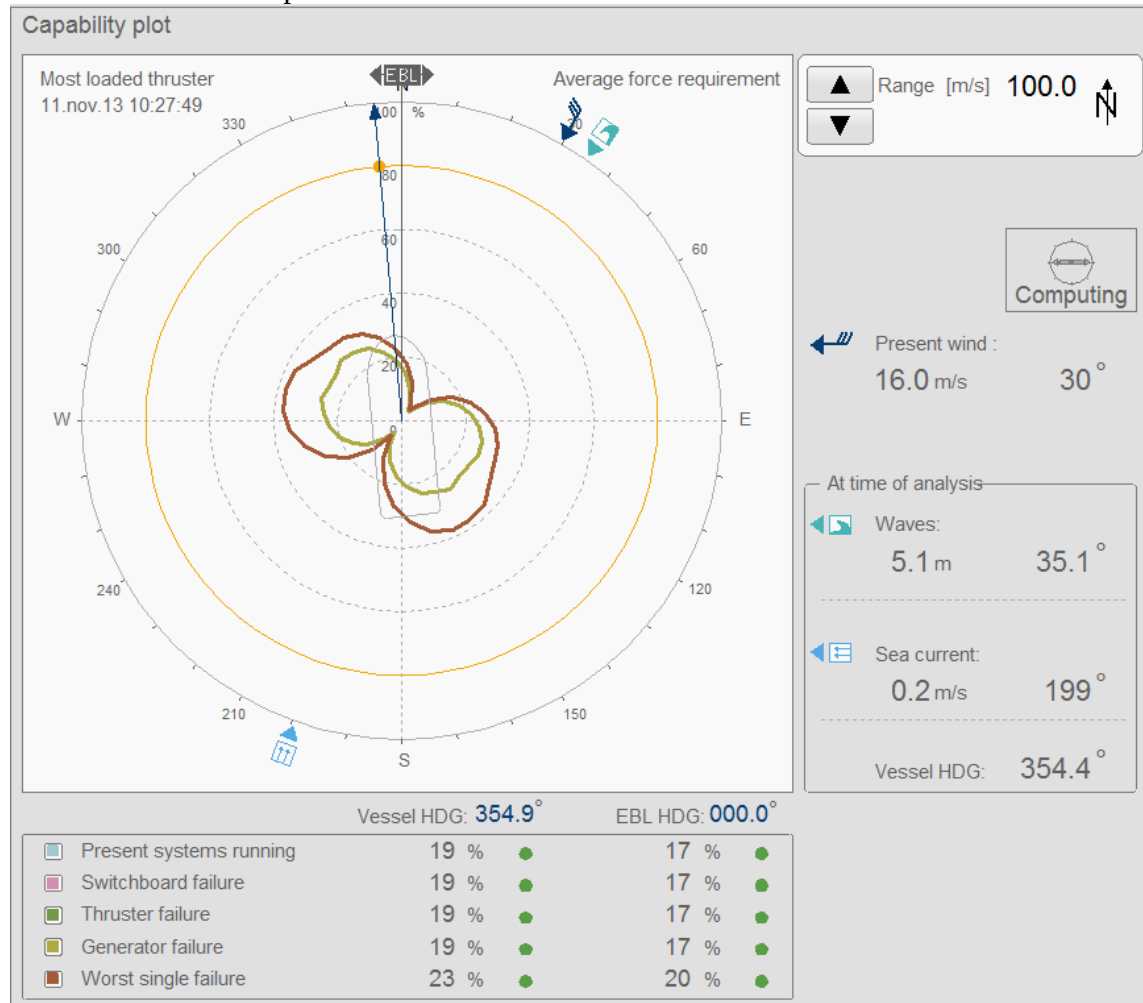
The capability plot view shows the result of the latest analysis performance by the DP Capability Analysis Function.

- Capability envelopes showing the various selected failures for limiting wind/current speed in engineering units
- Capability envelopes showing the force requirement for most loaded thruster in percent in the PRESENT environmental conditions as a function of vessel heading



Limiting wind/current speed plot showing capability envelopes for each of the analysed failure conditions, indicating the limiting wind (or sea current) speeds for any heading based on the present environment conditions

Most loaded thruster presentation



Examples demonstrating the use of DP Capability

The following example shows the DP Capability function used in a simulated environment, but the function and follow-up of results are the same as in “real life” applications.

To use the trainer:

- 1 Ensure that the vessel is controlled from the bridge or from another K-Pos OS. For systems with only one K-Pos OS, the system must be in *Standby* mode.
- 2 Select **System** → **Connect**.

- 3 Select **MainSim.** on the **Connect** dialog box.
- 4 Click the **OK** or **Apply** button.
 - The operator station is connected to the MainSimulator controller group.
- 5 Take command of MainSimulator at the K-Pos OS.
 - The **TAKE** status lamp on the operator panel is lit.

Then perform the following tasks:

- 1 Use the **Trainer Settings** dialog to specify a suitable combination of wind and sea current, preferably in a sector close to the bow.
- Refer to the *Built-in Trainer* chapter in the *K-Pos (OS) Operator Manual* for setting up and using the built-in trainer.

Note

Ensure that the selected weather condition is not so severe that it will cause the (simulated) vessel to drift off.

- 2 To enable all thrusters for DP operation, select **Thrusters→Enable**.
 - The **Thruster Enable** dialog box is displayed.
- 3 Select the **Enable/disable All** check box and click the **OK** button.
- 4 Ensure that the required sensors and position-reference systems are enabled.
- 5 Go to *Auto Position* mode by pressing the **AUTO POSITION** button on the operator panel twice.
- 6 Allow the vessel to settle.
- 7 Select **Settings→(General) DP capability analysis**.
 - The **DP Capability and Motion Prediction Settings** dialog box is displayed.
- 8 Watch the **Simulation possible** indicator on the dialog box, and wait for it to turn from yellow to green.
 - Green indicates that the DP Capability Analysis and Motion Prediction functions are available and that calculations can be performed.
- 9 If manual input is required, with the **Main** page still selected, deselect the check box and enter the **PRESENT** (NEVER anything else) weather conditions as accurately as possible (see Figure 8).

Figure 8 Example Main page of DP Capability and Motion Prediction Settings dialog box. Settings for present environmental conditions

DP Capability and Motion Prediction Settings

Main Run Control Thrusters Power Waves

Specify present environmental condition

Waves

Height (3.2) 5.3 m

Period (6.6) 10.0 s

Dir. (TRUE) 50.0 °

☐ Automatic calculation of wave and current properties

Average Wind

Speed 10.1 m/s

Dir. (TRUE) 42 °

Sea Current

Speed (0.2) 0.5 m/s

Dir. (TRUE) 189 °

Average heading 276.3 °

Simulation possible: ☒ OK Cancel Apply

To investigate the effect of taking one or more thrusters out of service:

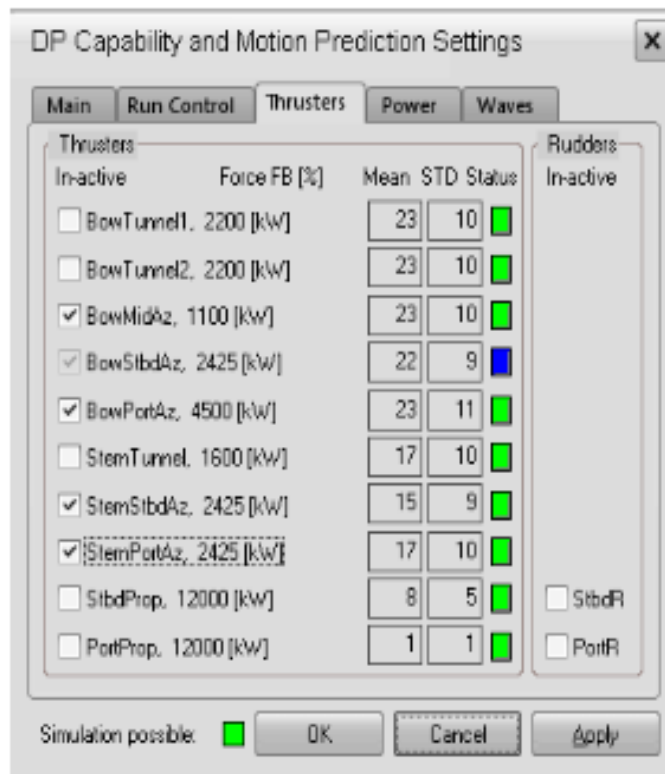
- 1 Select the **Run Control** page and then select the **Thruster failure** check box.
- 2 If you want to compare the conditions in the case of thruster failure with the present configuration regarding thrusters and power, select the **Present systems running** check box (see Figure 9).

Figure 9 Example Run Control page of DP Capability and Motion Prediction Settings dialog box. Selecting types of failures



- 3 Select the **Thrusters** page, and then select one or more thrusters as inactive by selecting the appropriate **Inactive** check boxes (see Figure 10).

Figure 10 Example Thrusters page of DP Capability and Motion Prediction Settings dialog box. Selecting thrusters to be inactive.



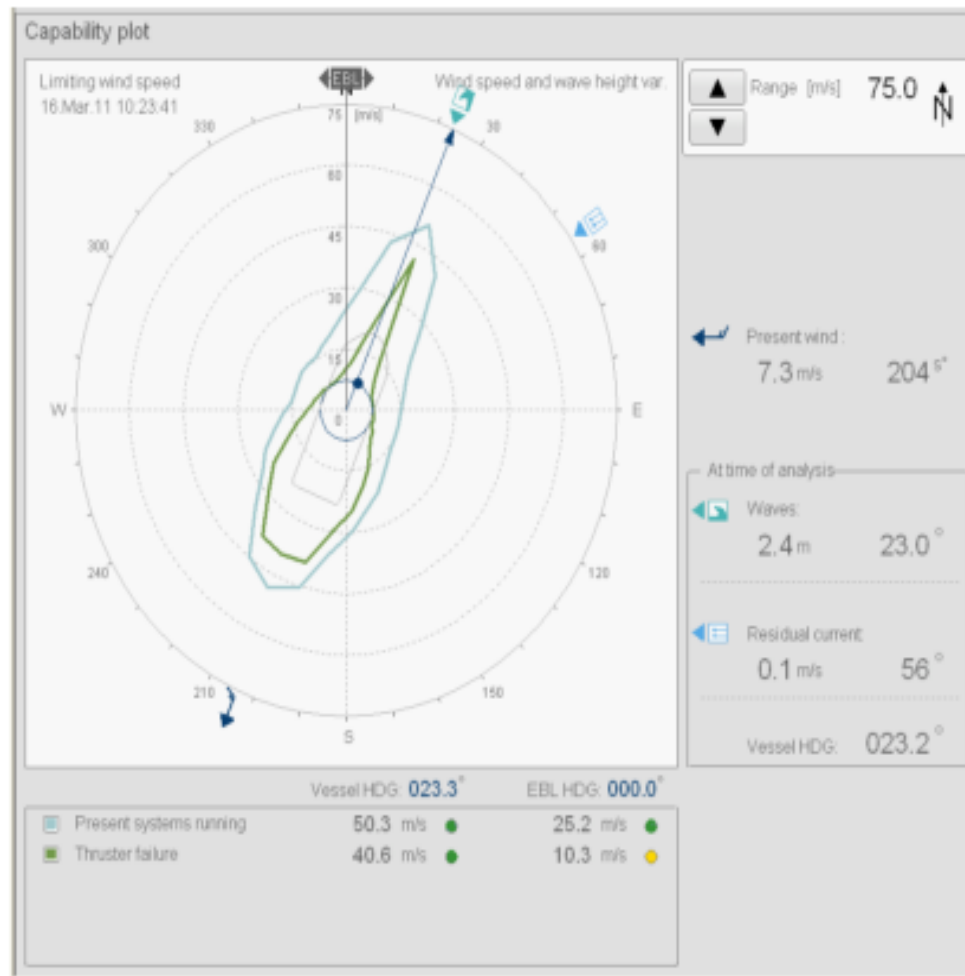
- 4 Click the **Apply** button to start the DP Capability Analysis.

Note

The box for Simulation possible must be green.

- 5 Select the **Capability plot** view.
- 6 Right-click in the working area to display the **Capability Plot** view control dialog box.
- 7 Ensure that **Limiting wind/current speed** is selected as presentation format.
- 8 Wait for the simulations to finish.
 - The DP Capability Analysis has low computational priority on the operator station, and the analysis may therefore take some time. The result may look like the view shown in Figure 11.

Figure 11 Example Capability plot view - Limiting wind/speed presentation: Effect of thruster failure compared to present systems running

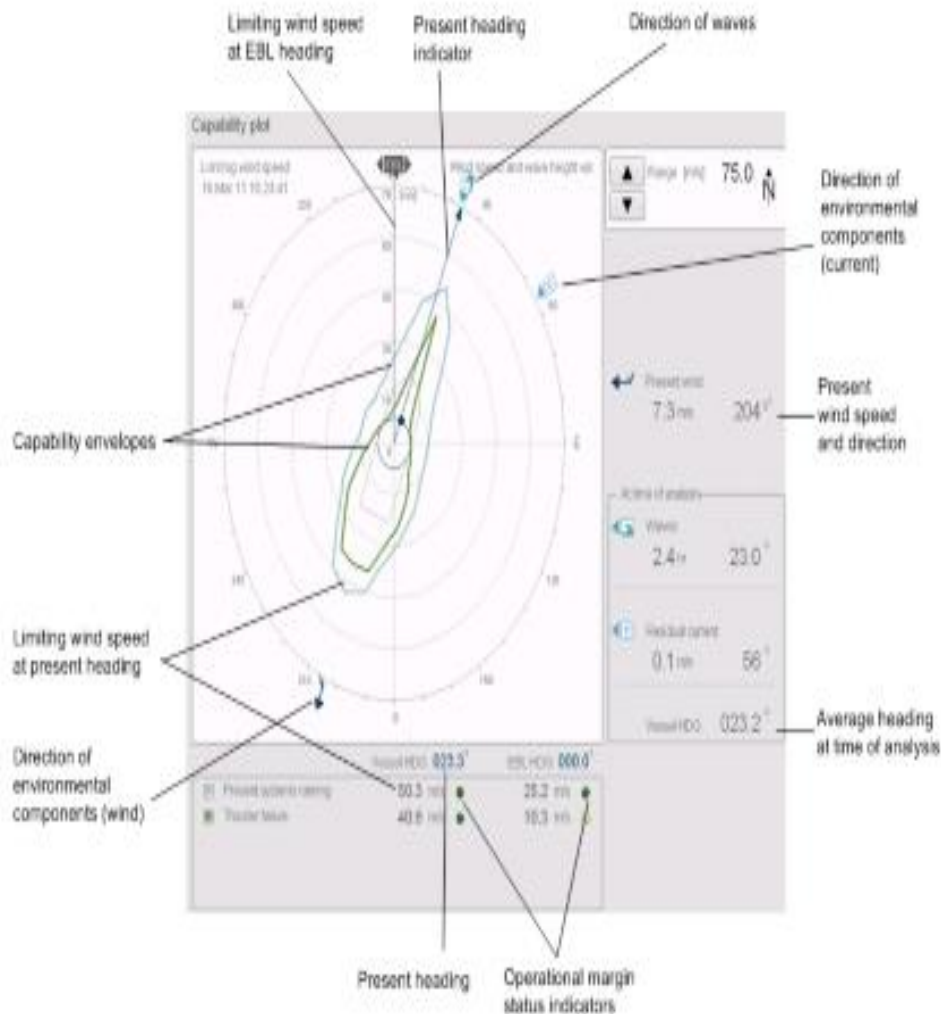


Interpreting the Capability plot view

The results of the DP Capability Analysis appear as two DP capability envelopes on the view, one for **Present systems running** and one for **Thruster failure** (see Figure 12).

The present wind speed is shown with a dark blue circle having a radius equal to the measured present wind speed. The intersection point between the present heading indicator arrow and the present wind speed circle is shown with a small, shaded, dark blue circle. It is important that you focus on this intersection point, because it is the position of the intersection relative to the limiting wind speed(s) that gives you the operational margins.

Figure 12 Capability plot view - Limiting wind speed presentation: Example showing the effect of thruster failure with identification of components in the view



You will get a good impression of the effect of removing four thrusters, as already specified, by simply looking at the capability envelopes and comparing them to the position of the wind speed indicator.

You can however investigate the effect more closely by looking at the field for numerical information presented below the capability plots. By examining the column for **Vessel HDG**, you will see the numerical values for limiting wind speed at the present heading for the two capability envelopes. By removing four thrusters as shown in Figure 10, the limiting wind speed is reduced from **50.3 m/s** to **40.6 m/s**. The present wind speed (for the present heading) is **7.3 m/s**. The operational margin is defined as the difference between the limiting wind speed and the present wind speed.

CHAPTER V

CLOSING

A. Conclusion

Based on the analysis and discussion of the problems in this study, the writer can draw related conclusions **INFLUENCE CURRENT AND WIND CONCERNING *BEST***

ESCAPE HEADING WHEN WILL OPERATE THE DP VESSEL FROM MANUAL SYSTEM TO DP MODE SYSTEM, the conclusions that can be drawn are as follows:

1. Before entering the 500m zone, the ship must carry out a drift test with the aim of ensuring the ship's ability to maintain its position against the forces of the wind and currents. Ships must reduce all speed and arrive at full stop before Drift Test. The captain must take about 5 minutes to drive a Drift Test outside the 500 m zone.(the success parameter is the ship is able to maintain its position with its main engine within 5 minutes which is determined where the drift speed is less than 0.5 knots and the turnaround is less than 20 degrees.
2. in motion while in the zone 500 meters from the installation, the ship must use a safe speed, and not move close to the installation if there are no orders or are not needed. When the ship moves to approach the installation, the ship's bow is not directed towards the installation. The process of approaching this platform must be carried out in stages using DP mode, namely change position and or change heading facilities.

DP set-Up location inspection must be done at every opportunity, especially before the ship moves to the work location. The main purpose of the inspection process is to analyze the performance of the ability to maintain a position while in the

location, and ensure that the systems and references used are prepared correctly. This check must be carried out at any time, anywhere, so that if the ship loses thrust, it can drift away from the installation.

B. Suggestion

I would like to give suggest according my riset when joint on board:

1. The basis for determining the direction of the ship's most appropriate direction is if necessary the ship can immediately move away from the installation by moving forward or backward. The advantage is that the ship is positioned so that the ship gets a fixed direction or magnitude, so that the direction and driving force needed to maintain the ship's position is also fixed.
2. The burden caused by the environment, such as wind, currents and the square must be monitored continuously in accordance with its influence on the ship's ability to maintain its position. more attention must be paid to the possibility of changes in wind or currents. The step to prevent collisions is to temporarily suspend work in progress and move immediately away to a safe location.

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Kongsberg K-Pos DP 21, Operator Manual

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International Maritime Organization. Guidelines for Vessel with Dynamic Positioning Systems. Maritime Safety Committee (MSC) Circular 645

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SOP for vessel with Dynamic Positioning System by Wintermar Offshore Marine Group, October 2018

Wheater Report by StormGeo

Weather Report by PHE – ONWJ Tanjung Priok Jakarta

Daftar Pasang Surut Indonesia Tahun 2018 & 2019

Tide Table Bintuni Area

Cyscan Operator Handbook