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| C0 | 31/10/08 | Emissione per approvazione | | | | DV | DL | YE |
| REVISIONE | | DESCRIZIONE | | | | EL. | CON. | APP. |

MINISTERO DELLE INFRASTRUTTURE E DEI TRASPORTI
MAGISTRATO ALLE ACQUE

NUOVI INTERVENTI PER LA SALVAGUARDIA
DI VENEZIA

LEGGE N.798 DEL 29-11-1984

CONVENZIONE REP. 7191 DEL 04-10-1991

ATTO ATTUATIVO REP. 8249 DEL 28-12-2007 (PROGETTAZIONE)

INTERVENTI ALLE BOCCHE LAGUNARI PER LA
REGOLAZIONE DEI FLUSSI DI MAREA

CUP: D51B02000050001

PROGETTO ESECUTIVO

WBS:LN.L1.50

BOCCA DI LIDO: SAN NICOLO' - TREPORTI

IMPIANTI

MEZZI PER LA RIMOZIONE DEI SEDIMENTI

SPECIFICA TECNICA - IMPIANTO DI GENERAZIONE,
DISTRIBUZIONE E UTILIZZO ENERGIA ELETTRICA,
AUTOMAZIONE E POSIZIONAMENTO DINAMICO -
APPENDICE B - PROPOSTA SISTEMA POSIZIONAMENTO
DINAMICO

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| ELABORATO D. Varisco | CONTROLLATO D. Lesina | APPROVATO Y. Eprim |
| N. ELABORATO MV146P-PE-GES-2003-C0 | CODICE FILE MV146P-PE-GES-2003-C0.doc | DATA 31 Ottobre 2008 |

CONSORZIO "VENEZIA NUOVA"

COORDINAMENTO PROGETTAZIONE

VERIFICATO:

S. Pastore

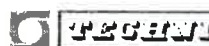
CONTROLLATO:

M.T. Brotto



CONSORZIO VENEZIA NUOVA


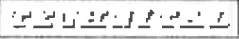
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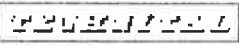
PROGETTAZIONE
SPECIALISTICA



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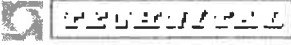
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1. SCOPO DEL DOCUMENTO

La presente Appendice riporta informazioni tecniche relative a una proposta di sistema di posizionamento dinamico, con caratteristiche simili a quelle riportate nel documento MV146P-PE-GES-2001.

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2. PROPOSTA KONGSBERG SISTEMA DP

Kongsberg Maritime

Dynamic Positioning System

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Kongsberg Maritime AS

Klirkegårdsvælen 45, Carpus
P.O.Box 483
N-3601 Kongsberg,
Norway

Telephone: +47 32 28 50 00
Telefax: +47 32 28 50 13
www.kongsberg.com
E-mail: km.sales@kongsberg.com



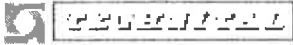
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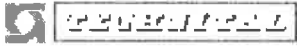
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Dynamic Positioning System

1 COMMENTS TO QUOTATION

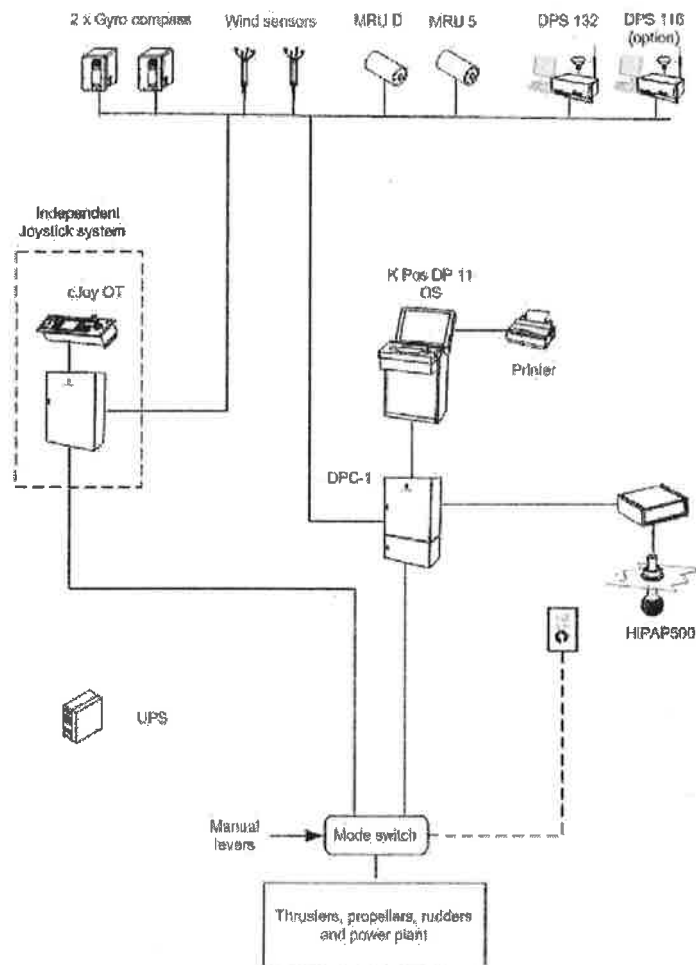
1. Our quotation is based upon the inquiry received from Spline Srl for a support vessel with RINA Classification Society in DYNAPOS AM - DP 1 requirements.
2. The c-Joy independent joystick system is quoted in order to comply with the DP Class 1 requirements.
3. The DYNAPOS AM class requires at least two position reference systems. Therefore our proposal is considering the use of one (1) HIPAP 500 system and one (1) DGPS DPS 132 system. We have quoted as option a second DGPS (one (1) DPS 116), as offered in the ADV jack-up barge scope of supply.
4. We have also quoted the K-Pos DP 21 upgrade scope of supply, as option.

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Dynamic Positioning System

2 TOPOLOGY



Quotation no.: 82040 Rev 1 / 20 October 2008

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3 SCOPE OF SUPPLY K-POS DP-11

The KONGSBERG K-Pos DP-11 is a single dynamic positioning system designed for all DP applications with the full range of functionality. Its modularity and use of common building blocks allows for high flexibility and various upgrades. The system is designed to satisfy class notations equivalent to Dynamic Positioning Class 1.


It consists of a controller unit (K-Pos DPC-1) and an operator station (K-Pos OS). The controller unit contains a powerful control computer and I/O units to provide an interface to position-reference systems, sensors and various types of propellers, thrusters and rudders. The operator station contains a high-performance computer running Windows XP. A high-resolution colour flat-screen, approved for maritime operations, provides the main graphic display for presentation of data.


3.1 System hardware

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|---------|---|---|
| One (1) |  | K-Pos OS Operator Station <ul style="list-style-type: none"> • Joystick (3-axis) control • Heading wheel • Trackball • Buttons and status lamps • Colour display (23" TFT flat screen) • Windows XP marine computer • Dual LAN interface • cWing Terminal interface (CAN) |
| One (1) |  | K-Pos DPC-1 Controller Unit <ul style="list-style-type: none"> • Single real time processor • General purpose analogue inputs and outputs w/ field termination • General purpose digital inputs and outputs w/ field termination • Isolated analogue inputs for thruster feedback w/ field termination • Isolated analogue outputs for thruster commands w/ field termination • Isolated serial inputs • Single LAN interface • Power supply |



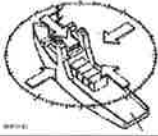
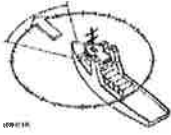
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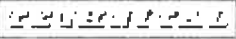
3.2 Basic principles

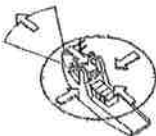

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|  | <p>The Extended Kalman Filter</p> <p>The Extended Kalman filter uses a mathematical model of the vessel. The Extended Kalman filter provides the following advantages:</p> <ul style="list-style-type: none"> • Optimum self-adaptive noise filtering of heading and position measurements according to noise level and measurement- update rate. • Optimum combination of data from the different position-reference systems. • In the absence of position measurements, the model provides a “dead-reckoning” mode. <p>The Controller</p> <p>In station-keeping operations the K-Pos Controller can be working in several of the following modes, all with special characteristics:</p> <p>High Precision Control</p> <ul style="list-style-type: none"> • Excursion Feedback • Wind Feed-Forward • Current Feedback <p>Relaxed Control</p> <ul style="list-style-type: none"> • Excursion Feedback • Wind Feed-Forward • Current Feedback <p>GreenDP® Control</p> <ul style="list-style-type: none"> - Environment Compensator - Model Predictive Controller - Position Predictor |
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3.3 Operational modes

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|  | <p>Joystick Mode</p> <p>Manual positioning using the three-axis joystick (integrated joystick and rotate controller)</p> <ul style="list-style-type: none"> • Joystick Thrust Selection (Reduced, Full) • Joystick Precision Selection (General, High-Speed, Low-Speed) • Environmental Force Compensation • Avoid Current Update • Rotation Center for Joystick Manoeuvring |
|  | <p>Mixed Joystick / Auto Mode</p> <p>Enabling the operator to select any of the three degrees of vessel movements (Surge, Sway and Yaw), as manual and/or auto control.</p> |
|  | <p>This means that the operator can select automatic control of Sway and Yaw and manual control of Surge, or any other combination.</p> |
|  | <p>Auto Heading Mode</p> <p>Accurate control of selected vessel heading.</p> <ul style="list-style-type: none"> • Present Heading • Change Heading (Marked Heading, Change Heading Absolute, Previous Heading, Change Heading Incremental, Heading Wheel with Buttons Dec Set and Inc) • Minimum Power Heading • Set ROT • Set ROT Acceleration • Predefined Controller Gain Selection • Heading Warning and Alarm |

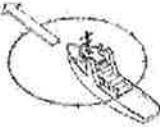
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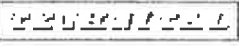
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|  | <p>Auto Position Mode</p> <p>Station keeping with control of selected vessel heading and position. The functions available for heading control are described under the Auto Heading Mode.</p> <ul style="list-style-type: none"> • Present Position • Change Position (Marked Position, Change Position Absolute, Previous Position, Change Position Incremental, Change Position Range / Bearing) • Set Speed • Set Acceleration • Position Warning and Alarm • Predefined Controller Gain Selection • Rotation Center |
|  | <p>Follow Target Mode</p> <p>Automatic following a moving target, keeping the vessel within a "position window".</p> <ul style="list-style-type: none"> • Present Heading • Change Heading • Minimum Power Heading • Change Reaction Circle • Change Distance to Target • Predefined Controller Gain Selection • Rotation Center |

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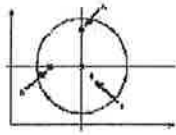
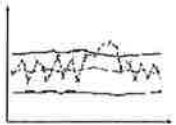
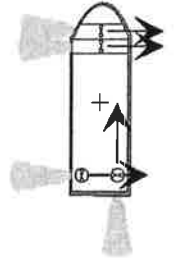
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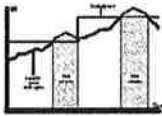
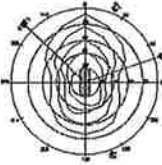
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|  | <p>Autopilot Mode</p> <p>Automatic heading control for cruising.</p> <ul style="list-style-type: none"> • Present Heading • Change Heading • Manual Heading Control • Speed control from joystick • Set ROT • Set ROT Acceleration • Off-Course Alarm / Warning • Gyro Difference Alarm • Rudder / Azimuth Limit • Autopilot Gain Selection • Wind Compensation <p>Option</p> <ul style="list-style-type: none"> • Speed control from external levers |
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3.4 System functions


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|  | <p>Sensor System Data Processing</p> <p>When a sensor group consist of at least three sensors (enabled), voting will be performed, otherwise (i.e. two sensors) a difference test will be performed.</p> |
|  | <p>Position-Reference System Data Processing</p> <ul style="list-style-type: none"> • Freeze Test – “live” assessment • Variance Test – long-term assessment • Prediction Test – short-term assessment • Slow Drift Tests – assembly assessment <p>Divergence Test</p> <p>Median Test</p> |
| | <p>Position-Reference System Functions</p> <ul style="list-style-type: none"> • Reference System Location • Reference System Monitoring • Reference System Fixed Origin |
|  | <p>Thruster Allocation / Control</p> <p>Low-speed and Station-Keeping Operations</p> <ul style="list-style-type: none"> • Fixed Thruster Azimuth modes • Variable Thruster Azimuth mode • Rudder / Nozzle Control |


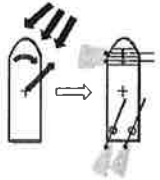
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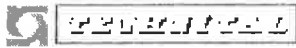
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|  | <p>Power Load Monitoring and Blackout Prevention</p> <p>Barrier for dynamic reduction of DP thruster/propeller commands to overload power system.</p> <p>Require interface to:</p> <ul style="list-style-type: none"> • Generator power and breaker status • Bus-tie breaker status • Thruster breaker status (if more than one for each thruster) |
|  | <p>DP Capability Analysis</p> <p>Predicting the maximum weather conditions in which the vessel is able to continue its DP operations.</p> <ul style="list-style-type: none"> • Online analyses (using sensor data) • Offline analyses (operator specified data) <p>The following situations are always evaluated:</p> <ul style="list-style-type: none"> • Present condition with regards to thrusters and generators • Worst single failure (according to IMO DP class) <p>In addition, the operator can also include in the analysis:</p> <ul style="list-style-type: none"> • Loss of one or more thruster units • Loss of one or more power generators • Loss of one or more switchboards <p>The most loaded thruster's force requirement in the present environmental condition is also calculated.</p> |

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|  | <p>Human-Machine Interface (HMI)</p> <p>The HMI consists of the Operator Panel and the Colour Display.</p> <p>Operator Panel</p> <p>Dedicated push buttons for activation of main modes, position-reference systems, sensors, thrusters and functions important to the operation assessment.</p> <p>A Trackball, a 3-axis joystick and a heading wheel as well as numeric input buttons and alarm indicators are incorporated.</p> <p>Colour Display</p> <p>A Windows XP™ based display interface provides a high degree of flexibility in the presentation of information. The display is divided into a number of predefined areas that are shown simultaneously on the screen:</p> <ol style="list-style-type: none"> a) Message line (part of Alarm System) b) Performance area c) Working areas <p>These areas display information about:</p> <p>Position & Heading, Thrusters & Propellers, Power Generation, DP Conning Display, Reference Systems, Sensors, Trends and Alarms.</p> <p>In addition to familiar Windows features such as Menu bar and Dialog boxes, Title bar, Status line and Status bar are also incorporated.</p> <p>Display Presentation</p> <ul style="list-style-type: none"> • Selection of Display Presentation for Position <ul style="list-style-type: none"> - US State Plane - Geographic (latitude/longitude) - UTM - Local N/E • Selection of Display Units |
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|  | <p>Alarm System</p> <ul style="list-style-type: none"> • System Diagnostics • Operational Checks • Audible and Visual Indications • Four Categories of Messages (Priority) • Alarm Display (Message Line and Alarm view) <ul style="list-style-type: none"> - Dynamic Alarm Page - Historic Event Page - Dynamic Event Page • Alarm Advisory Function • Message Printout • Operator Advice Messages |
| | <p>Status Page Printout</p> <p>Contains information about:</p> <ul style="list-style-type: none"> • Environmental conditions • Thruster forces • Vessel position and heading |
|  | <p>Built-in Trainer</p> <p>Facilities for operator training and analyses of vessel behaviour for use when DP is not in control</p> <ul style="list-style-type: none"> • Position Change • Heading Change • Simulated Vessel Mode • Thruster Operation • Environmental Conditions |



Rev. C0

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Rev.

Data:

SPECIFICA TECNICA - IMPIANTO DI GENERAZIONE,
DISTRIBUZIONE E UTILIZZO ENERGIA ELETTRICA,
AUTOMAZIONE E POSIZIONAMENTO DINAMICO -
APPENDICE B - PROPOSTA SISTEMA
POSIZIONAMENTO DINAMICO

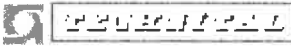
Pag. n. 17

Kongsberg Maritime



Dynamic Positioning System


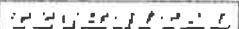
3.5 System interfaces

| | |
|---------|--|
| Two (2) | Gyro Compass Serial line (NMEA-0183) |
| Two (2) | MRU Analogue Input / Serial line (Kongsberg Maritime Standard) |
| Two (2) | Wind Serial line (NMEA-0183) |
| One (1) | DGPS Serial line (NMEA-0183) |
| One (1) | HiPAP Serial line (Kongsberg Maritime Standard) |
| Set | Thruster Interfaces Ready Signals - Digital Input Command Signals – Analogue Output Feedback Signals – Analogue Input |
| Set | Power system interfaces Bus-tie breaker signals – Digital Input Generator ready signals – Digital Input Generator power signals – Analogue Input Thruster breaker signals - Digital Input |

| | | | | |
|---|---------|----------------|---|------------|
|  | Rev. C0 | Data: 31/10/08 | EI. MV146P-PE-GES-2003-C0 | Pag. n. 18 |
| | Rev. | Data: | * SPECIFICA TECNICA - IMPIANTO DI GENERAZIONE, DISTRIBUZIONE E UTILIZZO ENERGIA ELETTRICA, AUTOMAZIONE E POSIZIONAMENTO DINAMICO - APPENDICE B - PROPOSTA SISTEMA POSIZIONAMENTO DINAMICO | |


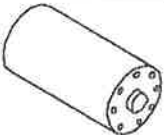
3.6 Sensors

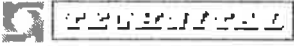
| | | |
|---------|---|---|
| Two (2) |  | <p>Master Gyro Compass C. Plath Navigat X Mk 1, Mod 10 (option)</p> <ul style="list-style-type: none"> • Microprocessor Controlled Digital Gyrocompass System complete with automatic north-speed correction • One single unit • Insensitive to horizontal accelerations • Self synchronising repeaters • 20 serial line outputs (14 NMEA-0183 and 6 RS422) • Position and speed input (NMEA-0183) • Speed input (200 pulses/nm) • Magnetic compass input • Rate of turn output • Status and alarm signals <p>The compass is fully compliant with IMO resolution A424 (XI), A821 (19).</p> |
| Two (2) |  | <p>Gill Ultrasonic Wind Sensor</p> <ul style="list-style-type: none"> • Stainless steel • Wind Speed and Direction Sensor • Wind Speed and Direction Indicator • Junction box with 2m cable • Serial line output |

| | | | | |
|---|---------|----------------|---|------------|
|   | Rev. C0 | Data: 31/10/08 | EI. MV146P-PE-GES-2003-C0 | Pag. n. 19 |
| | Rev. | Data: | SPECIFICA TECNICA - IMPIANTO DI GENERAZIONE, DISTRIBUZIONE E UTILIZZO ENERGIA ELETTRICA, AUTOMAZIONE E POSIZIONAMENTO DINAMICO - APPENDICE B - PROPOSTA SISTEMA POSIZIONAMENTO DINAMICO | |

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Dynamic Positioning System

| | | |
|---------|---|---|
| One (1) |  | KONGSBERG MRU-D Motion Reference Unit <ul style="list-style-type: none"> • Pitch and Roll sensor • Mounting Bracket • Serial and Analogue output • Junction Box incl. Cable |
| One (1) |  | KONGSBERG MRU-5 Motion Reference Unit <ul style="list-style-type: none"> • Pitch, Roll and Heave sensor • Mounting Bracket • Serial and Analogue output • Junction Box incl. Cable |

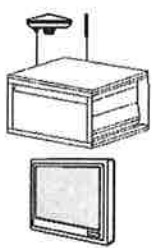
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|  | Rev. C0 | Data: 31/10/08 | EI. MV146P-PE-GES-2003-C0 | Pag. n. 20 |
| | Rev. | Data: | SPECIFICA TECNICA - IMPIANTO DI GENERAZIONE, DISTRIBUZIONE E UTILIZZO ENERGIA ELETTRICA, AUTOMAZIONE E POSIZIONAMENTO DINAMICO - APPENDICE B - PROPOSTA SISTEMA POSIZIONAMENTO DINAMICO | |


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Dynamic Positioning System

3.7 Position – reference systems

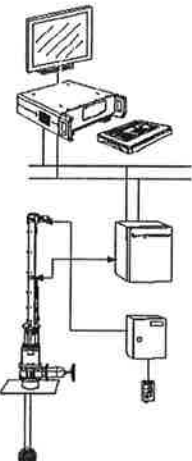
ù


| | | |
|---------|---|---|
| One (1) |  | <p>KONGSBERG DPS 132 - Differential Position System, with cabinet</p> <ul style="list-style-type: none"> • DPS 132 module • Target monitoring software • On line monitoring and display of quality control data • Lever arm compensation • Satellite prediction software • 16 serial ports • Data logging • 26 channel L1/L2 GPS receiver • Gyro interface (NMEA/RS232) • Ionospheric error compensation module • GPS L1/L2 /SBAS antenna • IALA beacon receiver and IALA beacon antenna • Keyboard with track-ball • Colour display (17" TFT flat screen) with bracket • Connector kit • 30 m antenna cable <p>Note: Differential correctional signal service is not included</p> |
| One (1) | | <p>Spotbeam</p> <ul style="list-style-type: none"> • Spotbeam receiver and demodulator • Antenna |

| | | | | |
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|  | Rev. C0 | Data: 31/10/08 | El. MV146P-PE-GES-2003-C0 | Pag. n. 21 |
| | Rev.: | Data: | SPECIFICA TECNICA - IMPIANTO DI GENERAZIONE, DISTRIBUZIONE E UTILIZZO ENERGIA ELETTRICA, AUTOMAZIONE E POSIZIONAMENTO DINAMICO - APPENDICE B - PROPOSTA SISTEMA POSIZIONAMENTO DINAMICO | |

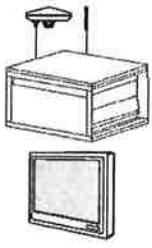
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Dynamic Positioning System

| | | |
|----------------|--|---|
| <p>One (1)</p> |  | <p>KONGSBERG HiPAP® 500 system</p> <ul style="list-style-type: none"> • Colour display (19" TFT flat screen) • APC 10 Desktop Acoustic Positioning Computer with keyboard and tracker ball • APOS, Acoustic Position Operator Station. Base for running all applications • HiPAP 500 SSBL / LBL function • HiPAP 500 Transceiver in cabinet • HiPAP 500 Hull Unit with Sphere Transducer (3,2m) • Hoist Control and Remote Control Unit, for raising and lowering the Hull Unit • Gate Valve, light-opening $\varnothing=500$ mm, DNV certified • Mounting Flange, $\varnothing=500$ mm, DNV certified • Interface to Gyro and MRU |
|----------------|--|---|

| | | | | |
|---|---------|----------------|---|------------|
|  | Rev. C0 | Data: 31/10/08 | El. MV146P-PE-GES-2003-C0 | Pag. n. 22 |
| | Rev. | Data: | SPECIFICA TECNICA - IMPIANTO DI GENERAZIONE, DISTRIBUZIONE E UTILIZZO ENERGIA ELETTRICA, AUTOMAZIONE E POSIZIONAMENTO DINAMICO - APPENDICE B - PROPOSTA SISTEMA POSIZIONAMENTO DINAMICO | |

3.8 Position reference systems (options)




| | | |
|----------------|---|--|
| One (1) option |  | <p>KONGSBERG DPS 116 - Differential Position System, with cabinet</p> <ul style="list-style-type: none"> • DPS 116 module • Target monitoring software • On line monitoring and display of quality control data • Lever arm compensation • Satellite prediction software • Data logging • 16 serial ports • 14 channel L1 GPS receiver • Gyro interface (NMEA/RS232) • GPS/SBAS antenna • IALA beacon receiver and IALA beacon antenna • Keyboard with track-ball • Colour display (17" TFT flat screen) with bracket • Connector kit • 30 m antenna cable <p>Note: Differential correctional signal service is not included</p> |
| One (1) option | | <p>Inmarsat</p> <ul style="list-style-type: none"> • Inmarsat B / Fleet 77 demodulator • Narda coupler (when applicable) |


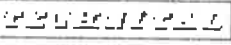
| | | | | |
|---|---------|----------------|---|------------|
|  | Rev. C0 | Data: 31/10/08 | EI. MV146P-PE-GES-2003-C0 | Pag. n. 23 |
| | Rev. | Data: | SPECIFICA TECNICA - IMPIANTO DI GENERAZIONE, DISTRIBUZIONE E UTILIZZO ENERGIA ELETTRICA, AUTOMAZIONE E POSIZIONAMENTO DINAMICO - APPENDICE B - PROPOSTA SISTEMA POSIZIONAMENTO DINAMICO | |

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Dynamic Positioning System

3.9 Peripheral equipment

| | | |
|---------|---|--|
| One (1) |  | <p>HP LaserJet Printer, P2015n A4 B/W laser printer for alarm and event printing. Network connection.</p> |
| One (1) |  | <p>UPS 3kVA Mk4</p> <ul style="list-style-type: none"> • UPS: Powerware 9120 • Enclosure: IP 22 • Input: 1 x 230Vac, 50/60 Hz • Output: 1 x 230 Vac, 50 Hz, 2100W/3000VA • Online UPS • Manuel bypass switch • LCD information display • Failure output to alarm system • Earth Fault Monitoring |
| One (1) |  | <p>Mode Selector Switch (3 positions) for command signal switching between</p> <ul style="list-style-type: none"> • Manual levers • Independent joystick • DP |

| | | | | |
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|   | Rev. C0 | Data: 31/10/08 | El. MV146P-PE-GES-2003-C0 | Pag. n. 24 |
| | Rev. | Data: | SPECIFICA TECNICA - IMPIANTO DI GENERAZIONE, DISTRIBUZIONE E UTILIZZO ENERGIA ELETTRICA, AUTOMAZIONE E POSIZIONAMENTO DINAMICO - APPENDICE B - PROPOSTA SISTEMA POSIZIONAMENTO DINAMICO | |

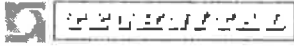
4 SCOPE OF SUPPLY K-POS DP-21 UPGRADE OPTION

The KONGSBERG K-Pos DP-21 is a dual redundant dynamic positioning system designed for all DP applications with the full range of functionality. Its modularity and use of common building blocks allows for high flexibility and various upgrades. The system is designed to satisfy class notations equivalent to Dynamic Positioning Class 2.


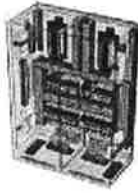
It consists of a dual redundant controller unit (K-Pos DPC-2) and two operator stations (K-Pos OS). The controller unit contains two powerful control computers and I/O units to provide an interface to position-reference systems, sensors and various types of propellers, thrusters and rudders. The operator stations each contain a high-performance computer running Windows XP. High-resolution colour flat-screens, approved for maritime operations, provide the main graphic displays for presentation of data.


Dual Redundancy

- No single-point failure
- Failure detection
- Fault isolation
- Switchover to hot standby
- Comparison of sensor data between computers

| | | | | |
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|  | Rev. C0 | Data: 31/10/08 | EI. MV146P-PE-GES-2003-C0 | Pag. n. 25 |
| | Rev. | Data: | SPECIFICA TECNICA - IMPIANTO DI GENERAZIONE, DISTRIBUZIONE E UTILIZZO ENERGIA ELETTRICA, AUTOMAZIONE E POSIZIONAMENTO DINAMICO - APPENDICE B - PROPOSTA SISTEMA POSIZIONAMENTO DINAMICO | |

4.1 System hardware

| | | |
|-----------------------|---|---|
| One (1) additional |  | K-Pos OS Operator Station <ul style="list-style-type: none"> • Joystick (3-axis) control • Heading wheel • Trackball • Buttons and status lamps • Colour display (23" TFT flat screen) • Windows XP marine computer • Dual LAN interface • cWing Terminal interface (CAN) |
| One (1) |  | K-Pos DPC-2 Dual Redundant Controller Unit <ul style="list-style-type: none"> • Dual real time processor • General purpose analogue inputs and outputs w/ field termination • General purpose digital inputs and outputs w/ field termination • Isolated analogue inputs for thruster feedback w/ field termination • Isolated analogue outputs for thruster commands w/ field termination • Isolated serial inputs • Dual LAN interface • Dual power supply |

| | | | | |
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|  | Rev. C0 | Data: 31/10/08 | El. MV146P-PE-GES-2003-C0 | Pag. n. 26 |
| | Rev. | Data: | SPECIFICA TECNICA - IMPIANTO DI GENERAZIONE, DISTRIBUZIONE E UTILIZZO ENERGIA ELETTRICA, AUTOMAZIONE E POSIZIONAMENTO DINAMICO - APPENDICE B - PROPOSTA SISTEMA POSIZIONAMENTO DINAMICO | |

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Dynamic Positioning System

4.2 Basic principles

As in previous K-Pos DP 11 scope of supply


4.3 Operational modes

As in previous K-Pos DP 11 scope of supply

4.4 System functions

As in previous K-Pos DP 11 scope of supply with addition to the following:

| | |
|--|---|
| | <p>DP Online Consequence Analysis</p> <p>Perform an analysis of the vessel's ability to maintain its position after a worst-case single failure.</p> <p>Typical worst-case single failures are:</p> <ul style="list-style-type: none"> • Failure in the most critical thruster • Failure in one thruster group (if any) • Failure in one power bus section <p>The failure situation analysed are in accordance with:</p> <ul style="list-style-type: none"> • IMO Class-II |
|--|---|

| | | | | |
|--|---------|----------------|---|------------|
|  ENERGIA | Rev. C0 | Data: 31/10/08 | El. MV146P-PE-GES-2003-C0 | Pag. n. 27 |
| | Rev. | Data: | SPECIFICA TECNICA - IMPIANTO DI GENERAZIONE, DISTRIBUZIONE E UTILIZZO ENERGIA ELETTRICA, AUTOMAZIONE E POSIZIONAMENTO DINAMICO - APPENDICE B - PROPOSTA SISTEMA POSIZIONAMENTO DINAMICO | |

Kongsberg Maritime


Dynamic Positioning System

4.5 System interfaces

Additional to the previous K-Pos DP 11 scope of supply


| | |
|--|--|
| One (1) additional Three (3)Total | Gyro Compass Serial line (NMEA-0183) |
| One (1) Additional Two (2) Total | DGPS Serial line (NMEA-0183) |


| | |
|------------|--|
| Set | Thruster Interfaces Ready Signals - Digital Input Command Signals – Analogue Output Feedback Signals – Analogue Input |
| Set | Power system interfaces Bus-tie breaker signals – Digital Input Generator ready signals – Digital Input Generator power signals – Analogue Input Thruster breaker signals - Digital Input |

| | | | | |
|--|---------|----------------|---|------------|
|  ENERGIE | Rev. C0 | Data: 31/10/08 | EI. MV146P-PE-GES-2003-C0 | Pag. n. 28 |
| | Rev. | Data: | SPECIFICA TECNICA - IMPIANTO DI GENERAZIONE, DISTRIBUZIONE E UTILIZZO ENERGIA ELETTRICA, AUTOMAZIONE E POSIZIONAMENTO DINAMICO - APPENDICE B - PROPOSTA SISTEMA POSIZIONAMENTO DINAMICO | |

4.6 Sensors

Additional to the previous K-Pos DP 11 scope of supply

| | | |
|---|---|---|
| <p>One (1) additional</p> <p>Three (3)Total</p> |  | <p>Master Gyro Compass C. Plath Navigat X Mk 1, Mod 10</p> <ul style="list-style-type: none"> • Microprocessor Controlled Digital Gyrocompass System complete with automatic north-speed correction • One single unit • Insensitive to horizontal accelerations • Self synchronising repeaters • 20 serials line outputs (14 NMEA-0183 and 6 RS422) • Position and speed input (NMEA-0183) • Speed input (200 pulses/nm) • Magnetic compass input • Rate of turn output • Status and alarm signals <p>The compass is fully compliant with IMO resolution A424 (XI), A821 (19).</p> |
|---|---|---|

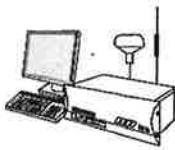
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|  | Rev. C0 | Data: 31/10/08 | El. MV146P-PE-GES-2003-C0 | Pag. n. 29 |
| | Rev. | Data: | SPECIFICA TECNICA - IMPIANTO DI GENERAZIONE, DISTRIBUZIONE E UTILIZZO ENERGIA ELETTRICA, AUTOMAZIONE E POSIZIONAMENTO DINAMICO - APPENDICE B - PROPOSTA SISTEMA POSIZIONAMENTO DINAMICO | |


Kongsberg Maritime

Dynamic Positioning System

4.7 Position – reference systems

Additional to the previous K-Pos DP 11 scope of supply

| | | |
|---------|---|--|
| One (1) |  | <p>KONGSBERG DPS 116 - Differential Position System, with cabinet</p> <ul style="list-style-type: none"> • DPS 116 module • Target monitoring software • On line monitoring and display of quality control data • Lever arm compensation • Satellite prediction software • Data logging • 16 serial ports • 14 channel L1 GPS receiver • Gyro interface (NMEA/RS232) • GPS/SBAS antenna • IALA beacon receiver and IALA beacon antenna • Keyboard with track-ball • Colour display (17" TFT flat screen) with bracket • Connector kit <p>Note: Differential correctional signal service is not included</p> <p>Option</p> <ul style="list-style-type: none"> • Antenna cable |
| One (1) | | <p>Inmarsat</p> <p>Inmarsat B / Fleet 77 demodulator</p> <ul style="list-style-type: none"> • Narda Coupler (When applicable) |


| | | | | |
|---|---------|----------------|---|------------|
|  | Rev. C0 | Data: 31/10/08 | El. MV146P-PE-GES-2003-C0 | Pag. n. 30 |
| | Rev. | Data: | SPECIFICA TECNICA - IMPIANTO DI GENERAZIONE, DISTRIBUZIONE E UTILIZZO ENERGIA ELETTRICA, AUTOMAZIONE E POSIZIONAMENTO DINAMICO - APPENDICE B - PROPOSTA SISTEMA POSIZIONAMENTO DINAMICO | |


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Dynamic Positioning System

4.8 Peripheral equipment

Additional to the previous K-Pos DP 11 scope of supply

| | | |
|---|---|---|
| <p>One (1) additional</p> <p>Two (2)</p> <p>Total</p> |  | <p>UPS 3kVA Mk4</p> <ul style="list-style-type: none"> • UPS: Powerware 9120 • Enclosure: IP 22 • Input: 1 x 230Vac, 50/60 Hz • Output: 1 x 230 Vac, 50 Hz, 2100W/3000VA • Online UPS • Manuel bypass switch • LCD information display • Failure output to alarm system • Earth Fault Monitoring <ul style="list-style-type: none"> • Battery type: Maintenance free, Valve Regulated Lead Acid (VRLA), AGM • Battery backup time: 30 minutes • 12 MCB's (6A) for power distribution • Remote disconnection of batteries (ESD) <ul style="list-style-type: none"> • Colour: RAL 7035 • Ambient temperature: 0 ... +40°C operating (+15 ... +25°C recommended) |
|---|---|---|

| | | | | |
|---|---------|----------------|---|------------|
|  | Rev. C0 | Data: 31/10/08 | EI. MV146P-PE-GES-2003-C0 | Pag. n. 31 |
| | Rev. | Data: | SPECIFICA TECNICA - IMPIANTO DI GENERAZIONE, DISTRIBUZIONE E UTILIZZO ENERGIA ELETTRICA, AUTOMAZIONE E POSIZIONAMENTO DINAMICO - APPENDICE B - PROPOSTA SISTEMA POSIZIONAMENTO DINAMICO | |

Kongsberg Maritime

Dynamic Positioning System

5 PROJECT SERVICES

Additional to the previous K-Pos DP 11 scope of supply

Project Support and Supervision estimated days

Installation supervision 1 man for 2 additional days
and commissioning

Sea trial: 2 men for additional 1 day

DP certification

According to :


RINA

- DYNAPOS AMR

Certification for the delivered DP Class 2 system and witnessing of Factory Acceptance Test by DNV representative is included. Kongsberg Maritime is responsible for obtaining DNV approval of necessary documents issued by Kongsberg Maritime. Onboard survey and any travel expenses are not included.

FMEA

FMEA for the quoted DP Scope of Supply is included. The complete FMEA for the entire vessel must be done by an independent consultant / company.

| | | | | |
|---|---------|----------------|---|------------|
|  | Rev. C0 | Data: 31/10/08 | EI. MV146P-PE-GES-2003-C0 | Pag. n. 32 |
| | Rev. | Data: | SPECIFICA TECNICA - IMPIANTO DI GENERAZIONE, DISTRIBUZIONE E UTILIZZO ENERGIA ELETTRICA, AUTOMAZIONE E POSIZIONAMENTO DINAMICO - APPENDICE B - PROPOSTA SISTEMA POSIZIONAMENTO DINAMICO | |


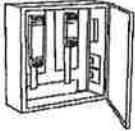
6 SCOPE OF SUPPLY cJoy Independent Joystick System

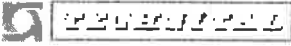
The KONGSBERG cJoy is a joystick control system. Its modularity and use of common building blocks allows for high flexibility.

It consists of a single controller unit (cJoy Controller) and an operator terminal (cJoy Operator Terminal). The controller unit contains a powerful control computer and the necessary I/O units to provide an interface to sensors and various types of propellers, thrusters and rudders. The operator terminal contains a built-in computer and a high-resolution colour flat-screen, approved for maritime operations.


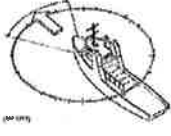
The solution may be extended with cWing wing terminals.


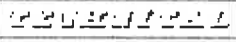
6.1 Basic system hardware

| | | |
|---------|---|--|
| One (1) |  | cJoy Operator Terminal <ul style="list-style-type: none"> • Operator panel consisting of: <ul style="list-style-type: none"> - Joystick (3-axis) control - Heading wheel - Buttons and status lamps - Built-in computer with colour display (6.5" TFT flat screen) • Connection box • Single net interface (LAN) • cWing wing terminal interface (CAN) |
| One (1) |  | cJoy Controller unit <ul style="list-style-type: none"> • Wall mount cabinet • Single Real Time Processor, RCU510 • Single net interface (LAN) • 7 ea Serial interfaces RS232/422 (galvanic isolated) • 32 ea multifunctional input/output embedded • Input power 115/230VAC from external UPS • Galvanic isolation Analogue Outputs |

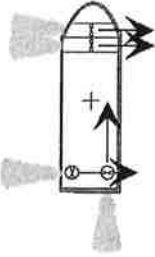


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|  | Rev. C0 | Data: 31/10/08 | EI. MV146P-PE-GES-2003-C0 | Pag. n. 33 |
| | Rev. | Data: | SPECIFICA TECNICA - IMPIANTO DI GENERAZIONE, DISTRIBUZIONE E UTILIZZO ENERGIA ELETTRICA, AUTOMAZIONE E POSIZIONAMENTO DINAMICO - APPENDICE B - PROPOSTA SISTEMA POSIZIONAMENTO DINAMICO | |

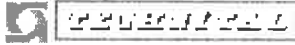
6.2 Basic operational modes

| | |
|---|--|
|  | <p>Joystick Mode</p> <p>Manual positioning using the three-axis joystick (combined joystick and rotate controller).</p> <ul style="list-style-type: none"> • Joystick Thrust Selection (Reduced, Full) • Wind Force Compensation • Rotation Point for Joystick Manoeuvring |
|  | <p>Auto Heading Mode</p> <p>Accurate control of selected vessel heading.</p> <ul style="list-style-type: none"> • Present Heading • Change Heading (Incremental, using Heading Wheel) • Set ROT • Predefined Controller Gain Selection • Heading Warning and Alarm |

| | | | | |
|---|---------|----------------|---|------------|
|   | Rev. C0 | Data: 31/10/08 | EI. MV146P-PE-GES-2003-C0 | Pag. n. 34 |
| | Rev. | Data: | SPECIFICA TECNICA - IMPIANTO DI GENERAZIONE, DISTRIBUZIONE E UTILIZZO ENERGIA ELETTRICA, AUTOMAZIONE E POSIZIONAMENTO DINAMICO - APPENDICE B - PROPOSTA SISTEMA POSIZIONAMENTO DINAMICO | |

6.3 Basic system functions

| | |
|---|--|
| | <p>Sensor System Data Processing</p> <p>When a sensor group consist of two sensors (enabled), a difference test will be performed.</p> |
|  | <p>Thruster Allocation / Control</p> <p>Joystick and Station-Keeping Operations</p> <ul style="list-style-type: none"> • Fixed Thruster Azimuth modes • Variable Thruster Azimuth mode • Rudder / Nozzle Control |
|  | <p>Human-Machine Interface (HMI)</p> <p>The HMI consists of the Operator Panel with built-in high resolution colour display.</p> <p>Dedicated push buttons with indicator lights for activation of main modes and functions important to the operation assessment.</p> <p>3-axis joystick, heading wheel as well as numeric input buttons and alarm indicators are incorporated. The operator panel has a built-in colour display for data input and overall status presentation.</p> |
|  | <p>Alarm System</p> <ul style="list-style-type: none"> • System Diagnostics • Operational Checks • Audible and Visual Indications • Four Categories of Messages (Priority) • Alarm Display (Message Line and Alarm view) |



| | | | |
|---------|----------------|---|------------|
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Kongsberg Maritime

Dynamic Positioning System

6.4 System interfaces

| | |
|---------|---|
| Two (2) | Gyro Compass (providing NMEA-0183 interface) Serial line |
| One (1) | Wind (providing NMEA-0183 interface) Serial line |
| Set | Thruster Interfaces Ready Signals - Digital Input Command Signals – Analogue Output Feedback Signals – Analogue Input |