

MULTIPURPOSE DIVING SUPPORT & CONSTRUCTION VESSEL

TECHNICAL SPECIFICATIONS

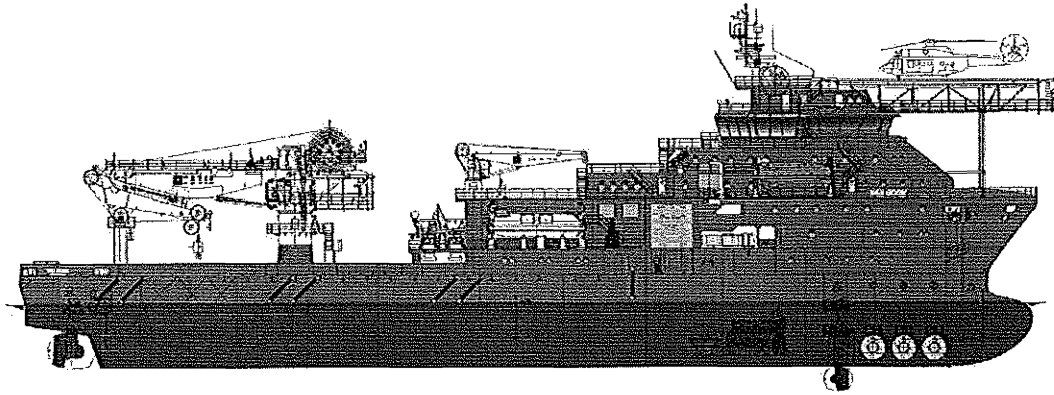


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MAIN GROUP 0 GENERAL

DEFINITIONS

AC	=	Air condition
AVS	=	Abandon Vessel Shutdown
BUICS	=	Backup Underwater Integrated Control System
C&E	=	Cause & Effect
C.S.	=	Classification Society.
CAP	=	Critical Action Panel
CCTV	=	Closed circuit television
CAA	=	Civil Aviation Authorities
DB	=	Double bottom
DDU	=	Delivered Duty Unpaid
DIN	=	German Industrial Standardization Organization
DN	=	Diameter nominal
DP	=	Dynamic positioning
E.R.	=	Engine Room
ECDIS	=	Electronic chart display information system
EMC	=	Electromagnetic compatibility
EPR	=	Ethylene, propylene, rubber
ERRV	=	Emergency Response Rescue Vessel
ESD	=	Emergency Shut Down System
F&G	=	Fire & Gas Detection and Protection.
FCU	=	Fan coil unit
FMEA	=	Failure Mode Effects Analysis
FPDS	=	Fire Protection Data Sheets
GA-plan	=	General Arrangement Plan.
GRP	=	Glass Reinforced product
HPU	=	Hydraulic power unit
HW	=	Hard Ware

IAS		Integrated automation system
IMO	=	International Maritime Organization
ISO		International Organization of Standardization.
IWO	=	In way of
KHI		Kinetic Hydrate Inhibitor
M.C.R.		Maximum Continuous Rating
MAS	=	Monitoring and alarm system
MCB	=	Moulded case breaker
MCCB	=	Moulded case circuit breaker
MLC	=	Meter Liquid Column
MP		Moon Pool
NMD	=	The Norwegian Maritime Directorate/Sjøfartsdirektoratet
NS	=	Norwegian Standard
OCS	=	Operations control station
OFI	=	Owner Free Issued
PA	=	Public Address
PABX	=	Private automatic branch exchange
PAPA	=	Platform Abandon Platform Alarm
PCA	=	Process control system
PCC	=	Pipe control console
PGA	=	Platform General Alarm
PMS	=	Power management system
PS	=	Portside
PTP	=	Production Test Procedure
PTW	=	Permit to Work
RA	=	Risk Assessment
S.A.	=	Statutory Authorities
S.I.	=	Système International.

SB		
SCSSV	=	Surface Controlled Sub-surface Safety Valve
SDA		Subsea Distribution Assembly
SDC		Submersible Decompression Chamber (diving bell)
SMPEP		
SOLAS		International Convention for Safety of Life at Sea The Special Purpose Ship Code.
STCW	=	International Convention on Standards of Training, Certification and Watchkeeping for seafarers.
Sub-	=	All parties contracted by the Builder to perform services Contractor and/or deliveries for the construction of the ship.
SVC	=	Vessel control system
SW	=	Soft Ware
TC	=	Thruster control
THD	=	Total Harmonic Distortion
TUP	=	Transfer Under Pressure
UPS	=	Uninterruptible Power Supply
VDR	=	Voyage data recorder
VO	=	Variation order
VSD	=	Variation speed drive
WAS	=	One Atmosphere Suit
DIFFS	=	Deck Integrated Fire Fighting System
SDC	=	Submersible Diving Chamber

GENERAL DESCRIPTION

A. GENERAL

The vessel to be built according to general arrangement drawing no. 2367-101-100 and this Rev.B specification, from, Industrivegen 21, 6080 Gurskoy - Norway.

The specification below presents a diesel electric driven (frequency controlled propellers, pumps, fans) MULTIPURPOSE SUBSEA OPERATION & DIVE SUPPORT CONSTRUCTION VESSEL, which is designed to meet the general market, in addition to be specially designed for oil field support duties, with saturation diving for safe and economic Worldwide service (acc. to class notation), except in the Arctic and Antarctic Regions.

The construction and fitting out of the vessel shall be carried out in accordance with the best practice at high standard shipyards, with safe operation and simple maintenance as important guidelines.

In the following, the Buyer, his staff and those who work for him in connection with this vessel, will be mentioned as the Owners.

The Builders with staff and contractors are mentioned as the Yard. Det Norske Veritas (DNVGL) will be mentioned as the Class, and its acting regional office will be mentioned as the Authorities, or other relevant authorities, acting on behalf of the relevant flag state (Bahamas).

The vessel to be delivered to the owners ready for taking on board provisions, stores and crew completely seaworthy.

Possible extra charges must be approved by the Buyer, in writing.

Where the expression "or equal" has been used behind equipment or component type, this means that possible replacements will have the same standard and quality, choice of such alternative shall be approved by Buyer.

The expression "approved" refer to the Class, Authorities' and Buyer's approval if not otherwise specified. The Builder shall prepare offer for detailed spare parts for one (1) years operation, based on manufacturers standard and class requirements.

All equipment and piping systems covered by the Class are to be designed to operate under the following environmental conditions if not otherwise specified in the detail requirements for the respective equipment or piping system:

- Ambient air temperature in the machinery space between 0°C and 45°C,
- Relative humidity of air in the machinery space up to 60%
- Barometric pressure 1000 mbar.
- Sea water temperature up to -2 - 34°C
- Outside air temperature -10°C towards 45°C
- List, rolling, trim and pitch according to rules.

B. ARRANGEMENT, DESCRIPTION

The vessel to be arranged as shown on GA-plan. The hull to be dimensioned for a maximum draft of 7,15 m.

Two fixed pitch azimuth main propellers, one Azimuth thruster and three tunnel thrusters to be installed.

Main deck from stern to fr.74 to be arranged for deck cargo with deck load of 10 t/m². Main deck between fr. 74 and 113 to be arranged for deck cargo with deck load of 5 t/m².

One of 150 ton @ 10,5m offshore rated knuckle boom crane, heave compensated, to be installed.

One of 10 ton crane at a radius of 12,5m to be arranged SB side Boat deck.

Two of 2 ton @ 15m offshore foldable crane, pedestal mounted on Capt. deck to be installed.

Helicopter deck for Sikorsky S92 diameter 22m to be installed.

The vessel to be dimensioned for one integrated dive moon pool (longitudinal strength).

The vessel to be arranged with accommodation for 120 persons.

The vessel to be arranged with a 18 men (singel) bell dive saturation System.

C. MAIN PARTICULARS

Length overall	111,58 m
Length between p.p.	103,70 m
Breadth moulded	23,00 m
Dept. main deck midship	10,00 m
Max. draft midship (SWL)	7,00 m
Depth shelter deck	12,80 m

D. CAPACITIES

Fresh water	approx.	1200 m ³
Fuel Oil	approx.	1350 m ³
Water Ballast	approx.	6000 m ³ (incl. anti heeling tanks)
Potable Water	approx.	300 m ³
Anti-Heeling	approx.	1050 m ³
Lubricating oil	approx.	50 m ³
Bilge water storage tk.	approx.	60 m ³
Miscellaneous tanks	approx.	190 m ³
Dead-weight	approx.	5500 T at SWL (incl. Dive, ROV equip. & solid ballast)
Gross tonnage	approx.	9200
Net tonnage	approx.	2760

Cargo deck area aft of dive hangar approx.: 1000 m²

1 x Moon pool 3,9m x 3,9m

Max speed approx. 12,5 knots at dm = 5 meter. Based upon 2x3000kW US305 FP Thrusters. (The vessel's speed to be confirmed by model testing in basin or other qualified calculations).

E. CLASS, TONNAGE REGULATIONS, CERTIFICATES

The vessel to be built of steel with full strength to main deck, and to Class, preferably;

DNVGL +1A1 - SPS - SF - E0 - Dynpos AUTR - DK(+) - HELDK-SH
COMF-V(3) – CLEAN DESIGN – DSV-SAT– DSV SURFACE – CRANE – ICE C – NAUT OSV(A) – BWM-T
– RECYCLABLE.

The vessel shall comply with the SPS Code, MSC.266(84), adopted 13th May 2008).

The vessel to be Deck Strengthened for heavy cargo.

All tanks for fuel oil, lubricating oil, hydraulic oil and waste oil including overflow tanks, irrespective of the size, shall be protected and located above the moulded line of the bottom shell plating nowhere less than the distance h as specified below: $h=B/20$ or $h=2.0m$, whichever is lesser. The minimum value of $h=0,76m$. According to CLEAN DESIGN Rules pt.6 ch.12 sec.3 D100 gravity based drain tank may be considered specially.

The fuel oil tanks shall be located inboard of the moulded line of the side shell plating, nowhere less than distance w which, as shown in figure 2, is measured at any cross-section at right angles to the side shell, as specified below: $w=0.4 + 2.4C / 20000$ m (Where C is the vessels total volume of fuel oil, in m^3 , at 98% tank filling). The minimum value of $w=1.0$ m, however for individual tanks with an oil fuel capacity of less than 500 m^3 the minimum value is 0.76 m.

According to the "International Convention for the Safe and Environmentally Sound Recycling of Ships," the Builder shall provide an "Inventory of Hazardous Materials" for hazardous materials contained in the ships structure and equipment, ref. DNVGL RECYCLABLE notation.

A complete PC based spare parts and maintenance system of type NS5, TM Master, Premaster or similar to be installed. The system to be installed on board before delivery of the vessel, and the system to be supplied by the owner.

The maintenance system shall be connected to rotating equipment's (motors, thrusters gear etc) above 10 kw, in order to count running hours.

In additional it shall also be room for 10 off counters to be installed in the future.

All electric motors above 50 kw to be equipped with SPM measuring points.

All Generators and electric motors for thrusters and propulsion regarding SPM to be according to requirements in Class.

Vibration analyser type FAG bearing to be delivered by owner.

Vibration measurement to be taken by yard during sea trials, thruster load acc.to class requirement.

The ship to comply with the rules and regulations of the Class and Authorities in (Marshall Island?) and IMO guidelines for design and construction of Offshore vessels. The Builders with staff and contractors are mentioned as the Yard. Det Norske Veritas (DNVGL) will be mentioned as the Class, and its acting regional office will be mentioned as the Authorities, or other relevant authorities, acting on behalf of the relevant flag state.

Load Line approval shall be according the international Load Line Convention.

Other statutory surveys can be carried out by Class on behalf of the flag state.

The ship to be classified for World-wide trade, except arctic and Antarctic regions, (according to class notation).

ERN calculations to be done. (Min. ERN 99,99,99,93)

The ship shall also satisfy the rules covering construction and equipment in SOLAS, International Convention for Safety of Life at Sea consolidated 2001 and amendments as applicable to present day (hereafter called the Safety Convention).

The Ship also to satisfy the International Load line Convention of 1966 and subsequent amendments, rules concerning tonnage measurements (1969 tonnage measurements rules) of the ship, MARPOL requirements and International and National rules for worldwide operations, Marpol 73/78 Annex VI to be included.

As a base for the contract price of the vessel, the rules valid on the date when the contract is signed shall be applied for the Classification Society.

For the National Authorities and Safety Convention rules, keel laying date is applied.

The vessel shall be delivered with all relevant certificates from the Class and Authorities without any remarks.

All certificates shall be delivered with the ship, placed in plastic pockets in a ring binder. A set of Photostat copies to be delivered to the Owners.

Registration letters, Load line and other official marks to be fitted according to the rules.

Owner's representative shall during the building period have access to the Builders Yard and workshops for control and inspection. Builder to assist the Owner's representative so he can inspect and supervise at the Yard's subcontractors.

Special attention shall be paid to noise level in accommodation.

F. DRAWINGS, INSTRUCTION MANUALS AND CERTIFICATES ETC.

Marin Teknisk AS, Norway, will prepare the main drawings and carry out necessary calculations for the vessel according to a separate agreement with the yard.

Marin Teknisk AS shall, on behalf of the Yard, submit all drawings required by the rules to the Class and the Authorities, in accordance with MT scope of delivery drawing list.

Arrangement and Class drawings to be submitted to the Owners for approval. The Owners shall within two weeks after receipt return the drawings with their comments/approval. If this is not done, the Yard may start the production, if no other time limit has been specially agreed. Drawings to be according to Technical Specification & contract.

A drawing schedule shall be submitted.

3 folders each containing following copies of drawings and manuals corrected as fitted to be delivered.

1. General Arrangement
2. Hydrostatic tables, PN(KY) tables, MaxVCG limit curves
3. Trim and stability information (with inclining report)
4. Sounding tables
5. Capacity and tank plan
6. Deck arrangement
7. Midship section
8. Longitudinal bulkhead and deck plans
9. Watertight bulkheads
10. Shell expansion
11. Aft ship and azimuth thrusters
12. Fore ship
13. Docking plan
14. Engine room arrangement
15. Azimuth thrusters arrangement
16. Air and Sounding pipes
17. Bilge & Ballast pipes
18. All piping systems
19. Electric plant schematic

20. Accommodation drawing
21. Ventilation arrangement
22. Fire & Safety plan
23. SOPEP manual
24. Cargo Securing manual
25. Clean Design documentation
26. FMEA documentation
27. Security Plan as per Owners Instructions

Further the yard shall deliver a complete list of all the drawings, except detailed production drawings such as NC production data, ISO pipe spool's and minor equipment foundations, which exists for this ship used during construction, so that the Owners can obtain the drawings from the Yard. CD's with all "as built" drawings copies in electronic .pdf file format to be delivered to Owner and Marin Teknisk.

Piping system drawings to include pipe & and valve Specification.

Cable drawings shall state that the specified cables are to be class approved and of good marine type.

Buyer shall furnish relevant operational information for the preparation of SMPEP Manual and builder shall get it approved from the class.

DRAWINGS TO BE FRAMED AND MOUNTED ON BOARD:

The following drawings to be framed/inserted in transparent plastic and mounted on board:

- Safety plan
- Danger plan
- Capacity plan
- Docking plan
- White board for noting tank loading and rescue operations
- Fuel oil bunkering plan One (1) copy posted in ECR
- Tank plan, One (1) copy on bridge and one (1) copy in ECR
- Bilge arrangement plan, One (1) copy on bridge and one (1) copy in ECR
- Firefighting plan, One (1) copy on bridge and one (1) copy in ECR

Two (2) sets of plastic laminated drawings A2 format shall be delivered of:

- Vent.-, filling and sounding pipes
- Bilge and ballast system
- El. supply system
- Firefighting plan

All system diagram drawings.

The Yard to deliver 3 copies of all relevant drawing "as is" and Instruction Manuals for all machinery and larger equipment components in English, the as built drawings to be delivered in Pdf. Format.

Yard also to work out an Equipment specification with a brief description of all equipment and with a statement of Make, Type, Production No., Supplier with address, telephone no., telefax, and other relevant information for effective maintenance of the ship.

CERTIFICATES:

Generally all certificates acc. To IACS, class, authorities and equipment to be delivered in 1 original + 2 copies.

CERTIFICATES ISSUED BY THE CLASS:

1. International Load line certificate
 2. Certificates for Hull and Machinery
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3. Certificates for anchor
4. Certificates for anchor chain
5. Certificates for water mist system
6. Certificates for windlass
7. EIAPP Certificate (NOx)

CERTIFICATES ISSUED BY THE NATIONAL AUTHORITIES:

Safety Certificates for equipment
Safety Certificate for radio telephone
Certificates for Lifeboats, MOB boat and Life rafts
Certificate for Compass
Certificate for signal lights
Tonnage Certificate
Special Purpose Ship Safety Certificate (Res. MSC.266(84), Issued by Class).

MISCELLANEOUS CERTIFICATES & REPORTS:

1. DE ratification Certificate.
2. Builder's Certificate.
3. National Certificate to be provided by the Owners.
4. International tonnage certificate 1969 convention.
5. Suez Canal tonnage certificate.
6. Panama Canal tonnage certificate.
7. Document of Compliance for carriage of dangerous goods on deck.
8. Test certificates of lifting appliances.
9. Crane certificates equipment.
10. Noise and Vibration report.
11. Certificate for helicopter deck, in accordance with IMO regulations and UK Aviation Authorities UK 437 regulation.
12. ISM Code. (**International Safety Management Code** - A set of rules adopted by IMO to provide an international standard for the safe management and operation of ships and for pollution prevention). Owner to provide if necessary.
13. The International Ship and Port Facilities Security Code.
14. International Convention for Prevention of Collision at Sea.
15. International Convention for Prevention of Pollution from ships, (protocol and amendments to MARPOL).
16. International Convention on Standards of Training, Certification and watch-keeping for Seafarers.
19. International Tele-Communications Union (ITU) Radio Regulations.
20. Panama Canal regulations.
21. USCG Rules regarding Oil Pollution, Sanitation and Navigation Safety.

In connection with the above, those certificates required by Classification Society and National Authorities to be delivered. If any of the above mentioned certificates and or documents are not required by the Class or Authorities, these certificates / documents shall not be delivered.

G. MATERIALS

Only steel / aluminium materials used to build this ship to be of first class with certificate for the Classification Society. All other materials shall be of Good Ship Building / Marine quality. But owner/Yard reserves their right to inspect the materials/consumable at their discretion.

H. BUILDING METHOD AND WORKMANSHIP

Hull with equipment and accessories in all concerns to be suitable and solid acc to IACS / ISO Standard. All workmanship to be carried out according to approved drawings and good yard practice. Steel work to be carried out according to IACS Shipbuilding Standard.

Piping standards requirements and workmanship see gr 7, and shall apply for all systems.

Piping outside on weather decks below DN 40 used for oil, air and water shall be in stainless steel. Connections and valves for same in a non-corrosive material.

Areas where electronic instruments or switch boards are located shall not be used as temporary work shop during outfitting after introduction of the above mentioned equipment has commenced. This applies but not limited to bridge, instrument room and switch board room(s) and other compartment where there is located such equipment vulnerable to dust.

Upon delivery, the Vessel shall be completed in all respects and in a seaworthy condition, as per contract, and fully in accordance with the specification. All the paint, greasing and cleaning work shall be completed to Buyer's satisfaction.

All tanks, cargo areas, bilge wells, engine room, accommodation, stores room and other areas shall be thoroughly cleaned before delivery.

All machinery shall function perfectly under world-wide conditions (moderate, arctic, tropical areas) under specified temperature and conditions.

SUB-CONTRACTOR'S REQUIREMENTS

Sub-contractors requirements and indications will be acted upon, in order to secure faultless function of equipment and maintenance of the warranty. This concerns system design, installation, surroundings, connected systems etc.

I. TRIM & STABILITY

Minimum metacentre heights GM, for fully equipped and loaded ship to satisfy the National Authorities' requirements.

The same to apply for the ship's GZ-curves for characteristic loading conditions.

When the ship is as near fulfilment as possible, an inclination experiment to be carried out and stability calculations to be submitted to the National Authorities for approval. The stability calculations also to be submitted to the Owners for approval.

The Trim and Stability calculations for the vessel to meet the relevant IMO rules and Regulations.

J. SURVEYOR

See contract.

K. OWNER DELIVERIES

Following to be delivered by the Owner:

Galley and Mess utensils

- Blankets and linen
- Books, charts
- Electronic charts.
- Consumable
- Spare parts and other equipment above Class requirements
- Loose burning and cutting equipment for steel with hoses and gas bottles

-
- Mooring ropes
 - Hand tools Personal protection equipment
 - Personal Computers incl. software.
 - Medicines and Drugs required for the vessel.
 - Other items as mentioned in this specification.

Yard to bring the equipment on board and secure Owner's delivery. Yard to supply necessary storage place and crane assistance for Owner's deliveries.

L. ROUTINE BY ALTERATIONS

Owner shall before and during the construction period have the permission to make alterations in the specification and on drawings. Any alteration shall always be agreed upon in writing before the work starts. A variation order (V.O) system included.

Price consequences and eventually delays in delivery time shall also always be agreed upon in writing before any such alterations are effected.

M. CONSTRUCTION SCHEDULE

Builder to work out a construction schedule for the whole construction period. Any possible deviation from the schedule has to be reported immediately to Purchaser and stating the reasons for it and the consequences. Progress report to be forwarded each month.

All milestones shall be clearly stated. Critical lines shall be defined.

In the contract period the Builder shall each two (2) weeks (two days before building meeting), present a progress report where actual physical progress is reported against planned progress.

The reported progress shall be shown according to standard milestones. The Buyer shall be presented detail plan on request. Any revision to the plans shall be done as a baseline revision.

N. QUALITY INSURANCE

The Builder shall have a system to maintain quality control of engineering, procurement and production. Buyer has the right to verify the Builder's procedures for maintaining such control.

Before any production or system or part of system is presented to buyer for approval, the builder shall have checked that the presented items are ready for inspection and or approval.

O. PROTECTION/PRESERVATION OF EQUIPMENT

All equipment delivered to the vessel shall be taken properly care of. This applies to stored equipment before taken on board, and after installation on board.

They shall be properly stored to protect for water, dust, paint and mechanical damage.

The yard shall have a system in place that monitor protection of yard supply, subcontractor supply and buyer's supply regularly.

Equipment installed on board shall be preserved to hinder exposure from dust, water paint and mechanical damage. Covered equipment shall be inspected regularly to verify the integrity of the protection.

Equipment found not properly taken care of under yards responsibility and found polluted by water and or dust and mechanical damage, shall if rejection is not possible or impractical be subjected to increased warranty period.

If a warranty claim is rejected by equipment supplier based on consequence from contamination of dust, this claim shall be paid by the builder.

Minor damage to panels on switch boards or other cabinets and consoles may be repaired if this can be made "invisible". Major damages panels mentioned above where re-painting is not "invisible" shall not be repaired, but be replaced by new.

P. DATA BOOK AND OPERATION MANUAL

All equipment installed on board or delivered to the vessel shall be registered in a data book. The data book shall list information about:

Purpose, Type, serial number, capacities, Maker, Makers contact info

For equipment that consist of several sub components e.g. HPU; the number of pumps with relevant data and electric motors filters, coolers etc. shall be included.

For electric motors:

Purpose, Size, Type, V, kW, A, RPM, IP, Bearing DE, Bearing NDE, Duty, Insulation, Mounting.

The vessel shall be supplied with an operation manual that describes the daily use of all major equipment. (The manuals to be supplied from the different vendors). The yard is suggested to contact equipment supplier to get relevant info for input to the manual. The manuals shall cover the normal use of equipment and start-up operation and stopping of equipment or systems.

The intent of this manual is to have a short description of operation with reference to more detailed description in operator's manual. Yard and Owner to find a smooth way to organize and arrange this.

This includes:

Main and auxiliary engines normal starting and stopping procedures

Propulsion starting and stopping procedures

Dead ship start up

Black out recovery

Emergency steering

Emergency manoeuvring

Emergency Shut Down

Emergency operation of cargo systems

Command transfer between ECR and bridge and between the various manoeuvring positions on the bridge.

Fire systems operation

Bilge system operation (with ref. to MARPOL req)

Cargo system operation

Breathing air compressor operation

Mooring systems

Ventilation system operation including AC equipment

IAS normal daily and emergency operation

Special equipment like radars and other navigation equipment and DP operation is excluded.

The same are lathe, drilling machines and other special tools.

Copy of the manual in electronic version shall be delivered to the vessel and head office for later amendments or changes of procedures.

MAIN GROUP 1 GENERAL

10 SPECIFICATION, MODEL TEST, DRAWINGS

101 CONTRACT - AND SPECIFICATION WORK PROJECT & DRAWING IN GENERAL - MODEL TEST

Before the work starts, the arrangement and accommodation drawings to be supplied with as many details as possible and submitted to the Owners for approval.

MAKER'S LIST.

Maker's list as attached to the specification shall be regarded as an approved list of manufactures/subcontractors of major machinery and equipment to be purchased.

Other suppliers may be chosen after agreement between the owners and shipyard.

The shipyard has the right to choose the most favourable supplier from the list, with regard to price, delivery, etc., insofar this equipment is in accordance with the specification. However, all main components shall be approved by the owner whose approval shall not be unreasonably withheld.

Before final decision about suppliers, the owners shall be informed about the shipyard's proposal. The owners may approve this, or, against price adjustment, choose another supplier of higher standard.

Where the specification mentions the name of a supplier or type of equipment, this is only an indication of the standard intended for the equipment.

Model Test

A model test to be done inclusive;

- Calm water performance test
- Ship resistance for two (2) WL.
- Propulsion test
- Sinkage & trim test
- Streamline paint test
- Sea keeping test
- Roll Decay test

- (Wake measurements – Not needed when using Azimuth thrusters).

109 INSTRUCTION MATERIAL

Instruction Manuals in three copies for all machinery and equipment to be delivered. Manuals to be in English.

Three (3) sets of instruction book for all equipment and systems on board the Vessel shall be delivered before Vessel's delivery (two (2) for the Vessel and one (1) for the Buyer head office). The booklets shall have parts lists, addresses and information of the equipment.

The instruction books shall also be delivered on CD Rom (Deviations to this shall be accepted in each case).

One (1) set of instruction books shall be made available for the Buyer's representative as soon as possible during the construction.

Maker's installation instructions shall also be delivered to buyer prior to installation.

Yard shall also ensure that the ship's crew have the necessary instructions on board for using the equipment fitted.

Maintenance system including hook up of counters to software system.
PC with printer to be delivered by the Owners.

DATA NETWORK

The LAN shall have connection points on the following locations:

Top of wheelhouse:

- 1 off LAN in Reception
- 1 off LAN in Lounge

Bridge:

- 4 off LAN in office/radio
- 3 off LAN in operation control
- 2 off LAN in bridge consoles.

Captain deck:

- 1 off LAN in Captain cabin
- 1 off LAN in Chief Eng. cabin
- 2 off LAN in ship office.
- 1 off LAN in Lounge/Conference
- 1 off LAN in all cabins
- 1 off LAN in Client cabin.
- 1 off LAN in instrument room

Boat deck :

- 1 off LAN in all cabins
- 2 off LAN in Hospital
- 1 off LAN in Gymnasium
- 1 off LAN in instrument room

Forecastle deck :

- 1 off LAN in instrument room
- 1 off LAN in all cabins

Shelter deck:

- 2 off LAN in Mess Room
- 2 off LAN in each Dayroom
- 6 off LAN in ROV control room (Offline)
- 2 off LAN in reception
- 1 off LAN in Galley

Main deck:

- 2 off LAN in Engine Control Room
- 4 off LAN in Client office
- 6 off LAN in project office
- 3 off LAN in Techs. Office
- 2 off LAN in Techs. Workshop
- 4 off LAN in Dive Control Room
- 2 off LAN in Air Dive control room

Tween deck:

- 2 off LAN in Switchboard Room.
- 1 off LAN in each workshop incl dive workshop
- 4 off LAN in Sat control room
- 1 off LAN in each Dive system switchboard room
- 2 off LAN in Lower Dive area (tank top)
- 1 off LAN in engine room

PC hardware/software is client supply. Client server to be located in new offline room Cabling to be CAT. 7 type.

POWER SUPPLY (UPS)

The computer connected to the network shall be supplied from a common UPS, with power outlets side by side with the network connections. These outlets shall be in a different colour than the ordinary. (yellow) and marked "Computer Only".

Power to the satellite television system ref. item 546, shall also be supplied from UPS.

The local network shall consist of the following outlets for:

6 off personal computers.

1 off server

3 off colour printers

1 off scanner

GENERAL UPS:

Rectification to battery, invert to 230V.

Appropriate arrangement for bypassing UPS shall be provided.

PERSONAL COMPUTERS (PC)

The PC shall as a minimum be according to the following min. specification:

Owner supply

SOFTWARE

Software according to maker's standard, Windows XP, Microsoft Office XP Professional and Maintenance system

11 INSURANCE, FEES & CERTIFICATES

111 INSURANCE

See Contract

112 CLASS FEES

All Class fees to Classification Society and National Authorities to be paid by Builder, except fees for the diving system, supplied by Owner.

127 MODELS

2 piece off ship models 1:75 to be delivered by Yard.

15 MEASUREMENTS, TRIALS & TESTS

151 TEST OF MACHINERY

Before trial test of the main engine at the factory, the Owner shall be called upon in due course. Torsional vibration calculations to be carried out by the manufacturer and submitted to the Owner and the Class for approval.

Before the trial trip the main machinery to be tested at dock until the engine and propeller suppliers are satisfied with the preliminary adjustments. Instruments and alarm plant shall be tested. The machinery to be tested at dock before the trial trip to the extent necessary to obtain temporary service permission for the trial trip from Classification and National Authorities. All machinery to be tested to the Owner's, Class and sub-contractor's eventual satisfaction. All DG sets shall be tested with the ship's equipment load, available at that time.

152 TANK CAPACITY, INCLINATION EXPERIMENT

All tank capacities to be calculated and sounding tables to be made.
One condition with trim forward, one for even keel condition and three for condition with trim aft.

The inclination experiment is described under general data - Item I, previously.

153 FUEL AND LUB OIL FOR DOCK AND TRIAL TEST

Make of lub oil to be decided by the Owners in due course before delivery.
Yard to deliver fuel oil with certificate, lub oil and grease for trial trip and tests.
Left over stock in storage tanks and unopened containers from the trial trip to be taken over by the Owners for net price.

154 TRIAL TRIP

Technical trial trip to be carried out according to Classification and National Authorities requirements.

A special program for technical trial trip to be submitted to the Owners at least 2 weeks before the trip.

Tests to be carried out:

1. Anchor test according to Classification requirement.
2. Steering test according to Classification requirements.
3. Manoeuvring test according to Classification requirements.
4. Test which includes 4 hours continuous service with unmanned engine room. All alarms and service data for the main engine to be noted on a special form. The form to be enclosed with technical documentation at delivery.
5. Full speed tests to be carried out with double runs at a waterline of 4.5 meters (dm). 100% output on main propulsion el. motors.
6. Noise measurements to be carried out according to Class requirements
7. Compass to be corrected to the National Authorities' requirements.
8. Side thrusters to be tested and adjusted. Time for 360 degrees turn starboard and port to be measured with various combinations of thrusters.
9. Electric log to be adjusted during speed trial and radars to be adjusted and demonstrated.
10. The joystick system to be adjusted and demonstrated.
11. DP to be FMEA tested in all modes, incl. full function and calibration test of reference system. (FMEA test according to classification guidelines).

After the trial trip a report to be worked out for all tests carried out during the trial and this to be submitted to the Owners.

Generally all equipment to be tested according to supplier specification and Class Approval. A final list of complaints, recommendations, and alterations to be handed over to the Yard within 24 hours from the end of the trial trip.

All paper filters to be changed after trial trip. Other filters to be cleaned before delivery.

156 TESTING OF ELECTRIC PLANT

The electrical plants to be tested in all parts with regards to functioning and insulation conditions before delivery.

The Owner's inspector and class to be informed in due time before the test.

Test to be carried out as follows:

- a) The generators with switchboard equipment to be tested according to the Class requirement.
- b) Consumers in General:
Equipment and components, including motors, to be tested under normal service conditions, to prove that they are suitable and satisfactory for its purpose. Load current and temperatures to be observed when normal steady service conditions are obtained.
- c) Lighting equipment etc.
Test must be carried out for all switches to prove that they are working as assumed and that the light distribution is satisfactory. Test must be carried out to ensure that the plug sockets are in order.
- d) Alarm Plant.
All warning and alarm devices for fire, light controls, steering gear, main engine, auxiliary engine etc. to be tested to ensure satisfactory operation.
Yard to deliver a complete EO-list.
- e) The electrical network to be measured for all THD all operational modes, incl. documentation of the results.
- f) Thermal photographing of electrical plant and hotspots on engines.

156 TESTING OF DIVING SYSTEM

Nominated Subcontractor's responsibility.

162 GUARANTEE

Guarantee work to be carried out according to the Contract.

MAIN GROUP 2 HULL

20 MATERIALS, CONSTRUCTIONS, WORKMANSHIP, UNITS & STANDARDS

201

All materials, equipment, fittings and finish are to be of Good Ship Building standard, suitable for marine use and shall be new and free from defects and imperfections.

All materials used shall be to the C.S. requirements where applicable or to equivalent standards, taking into account their use in the marine environment and specified ambient conditions.

All plates, bars and sections shall be well and cleanly rolled to the full sections and be free from cracks and surface flaws, laminations, roughness and other defects. They shall be straight within appropriate limits and have a smooth surface.

The steel to be used is to be of shipbuilding quality with a minimum tensile strength of 400 N/mm² and yield point not less than 235 N/mm² in general. The steel to be tested and approved by class of which test certificates have to be delivered.

Profiles below main deck in generally to be of HP-profile.

Stainless steel in general is to be of the quality ASTM 316 and ASTM 316 L on exposed area (outside), unless specified differently.

All galvanising to be done with best virgin spelter containing not less than 98% of pure zinc, after all welding, adjustments etc.

All galvanising to be carried out by the hot process where possible and weighing not less than 350 g/m².

All galvanised materials of pipelines shall be taken out and re-galvanised after proper re-treatment in all cases where the materials or pipelines have been subjected to heat by welding for making "last minute connections" etc. Where impractical to carry out hot galvanising, cold galvanising will be applied.

All equipment to be stored properly indoors, before fitting in the hull.
After the equipment is stored on-board the shipyard have to cover it properly to avoid damages because of dust, paint, water etc.

202 CONSTRUCTION AND WORKMANSHIP

All workmanship entering into the construction of the hull, shall be according to Good Shipbuilding Standard subject to the approval of Class.

The workmanship shall be such as to assure fair lines and smooth surfaces.

The hull to be all welded with double shell in machinery rooms obtained by arranging fuel and ballast tank at sides.

Transverse framing with frame distance 600 mm and 650 mm. ref. GA.

Watertight transverse bulkheads according to the rules and GA drawing to be built in, and double bottom to be fitted.

Decks to have no camber and no sheer.

Main deck from stern to fr.74 to be arranged for deck cargo with deck load of 10 t/m². Main deck between frame 74 and frame 113 to be arranged for deck cargo with deck load of 5 t/m².
The upper mezzanine (hangar roof / Boat deck) to have a cargo deck load of 1 t/m².

The main deck, from stern to fr.74, in work deck area, to have extra thickness, min. 18mm, in steel deck plate, and should be of Z-grade quality.

The deck to be supported by strong girders and pillars, placed to suit the approved machinery arrangement.

UNITS AND STANDARDS

All drawings and documents are to show dimensions in metric units, scales, engine outputs and pressures to be in S.I. units.

Temperatures are to be stated in degrees Celsius (°C).

The following most common units are applicable:

1 ton	=	1000 kg
1 Pa	=	1 N/m ²
1 W	=	1 Nm/s
1 kW	=	1,36 HP
density sea water	=	1025 kg/m ³

DIN -standards are to be used throughout, unless specified differently.
ISO-standards may be used, if they correspond to DIN-standards. DIN-standards are to be applied for dimensions of pipe flanges and face to face dimensions of valves which are to be connected to imported equipment and also those required in view of their special nature etc.

203 CLEANING

Prior to applying each coat of paint, all surfaces to be thoroughly cleaned and free from scale, grease, moisture or any foreign matter.
Before delivery of the hull, a complete cleaning of all compartments tanks etc. to be carefully effected.

204 TESTING OF TANKS, BULKHEADS ETC.

All tanks to be water or air tested according to Classification requirements.

No tank or compartment boundary connection to be coated or painted until testing has been completed and passed by Classification Surveyor, unless the primer is accepted by Class.

All decks, flats, shell, bulkheads, to be hose tested as required by Classification rules.
All decks, bulkheads shell etc. to be checked according to straightness according to IACS.

205 X-RAY AND ULTRASONIC TESTING OF HULL PARTS

X-ray or ultrasonic tests of welding connections are to be carried out at positions mutually agreed upon by the Classification Surveyor, the Shipbuilder and the Owners representative.
Tests to show good welding technique compliant with Classification requirements.

207 WELDING STEEL CONSTRUCTION

Builder to carefully follow the welding table as approved by C.S. (Classification).

21 AFT BODY

211 SHELL PLATING

All welding under main deck to be double continuous.
However, in room where there are no linings, only continuous welding to be used.

Steel structure in way of main azimuth propellers to be reinforced to propeller manufacturers and class's satisfaction. PL. of 18 mm. to be applied as shell plating around the azimuth propeller.

FRAMES

The ship to have transversal and longitudinal frames dimensioned according to max. draft midship.

Frame spacing: 600 mm aft of # 14. 650mm between #14 and #138. 600 mm from #138 and forward.

Double bottom aft of engine room to be built with whole floors on every 4th. frame , or according to strength requirement, or as per approved drawings.

212 EYE PLATES

Eye plates are to be arranged under the stern to facilitate the fitting and removal of main azimuth thrusters.

Where eye plates are welded directly to shell plating, local stiffeners have to be welded on the inside.
The stiffeners to be in line with the eye plates.

213 STERN SECTIONS

A main azimuth thruster room is to be located below main deck.

The hull is to have aft peak tanks extending to Main deck at SB and P-side of the stern.

Access to azimuth thruster room to be arranged by one staircase with ladder from main deck and one corridor from Upper Cargo Room through Roll reduction- and WB. tanks.

Access to stores room for main deck to have a sill height of 600 mm and to have weather tight door.

214 SKEG

A tapered box constructed skeg is to be arranged at the centreline aft.

Box coolers for propellers, el.motors etc to be located in the skeg, according to drawings.

22 ENGINE AND MIDSHIP AREA

222 BOTTOM CONSTRUCTION AND KEEL

Double bottom

Double bottom to be arranged acc. to GA. Double bottom to be entirely closed from PS to SB, according to the rules, refer to class notation.

Plate floors are to be arranged at every transverse frame. All floors (excluding tank bulkheads) are to have lightening and access holes.

Floors to be double continuously welded to shell plates, tank top and girders.

All open floor plates and non-watertight girders are to have drainage holes at upper and lower edge with area at least 25% in excess of pipe suction area.

All burned edges inside coated to be rounded by grinding. Bilge wells, drain tanks, sludge tanks, cofferdams etc. are to be arranged in double bottom as required.

Gutter to be arranged aft in Engine Room between P&S bilge well.

Each double bottom tank (excluding sludge tank, cofferdams, oil sludge tank, bilge water tank and F.O. drain tank) to be provided with two access manholes with bolted plate covers. All other tanks and cofferdam(s) to have one access manhole each.

Below manholes, tanks to be provided with ladders to give easy access to the tank. (as per DNV GL requirement).

223 INNER BOTTOM AND FOUNDATIONS

INNER BOTTOM

Inner bottom plates to be longitudinal stiffened and forming the tank top of double bottom tanks, to be strengthened according to C.S.

MAIN GENERATOR SETS FOUNDATIONS

Reinforcement for each main generator sets to be arranged.

VALVE FOR DYNPOS EQUIPMENT

Valve for ND 500 in DB to be installed at frame 54-58 PS & SB.

HPR TRUNK

Trunk for ND 500 mm to be arranged at frame 54-58PS & SB with overboard valve.

There shall be a local status indicator on each valve and an adjacent telephone to the bridge.

There shall be a bilge suction below each valve (double bottom plate in trunk to be min. 15mm).

DIVE MOON POOL.

Moon pool to be arranged between frame 75 and 82. Radius in the Moon pool corners on the shell plating to be acc. to class requirement. Moon pool size (free opening): 3,9m x 3,9m.

Damping zone preferably to be arranged around the diving moon pool, according to arr. drawings.

A cursor system for diving bell to be arranged in the moon pool according to dive supplier requirement.

DIVE AREA / MOON POOL

Area on tank top between frame 75 – frame 103, to be arranged with diving Kelly bottles and various diving equipment, acc. to arrangement drawings.

Area, tween deck between frame 75 – frame 103, to be arranged with diving equipment and 3 of chambers.

224 UPPER DECK

MAIN DECK

The main deck, from stern to fr.74, in work deck area, to have extra thickness, min. 18mm, in steel deck plate, and should be of Z-grade quality.

Main deck from stern to fr.74 to be arranged for deck cargo with deck load of 10 t/m^2 . Main deck to have no sheer or no camber. Flush hatches on exposed cargo deck area to be dimensioned for 5 t/m^2 .

Stiffening of main deck to be longitudinal in cargo area, with transverse girders supporting the longitudinal beams. In forward part of Maindeck (foreship), the deck beams to be transverse and in line with the hulls framing system.

Foundation / pedestal for 150 tonnes crane at a radius of 10,5 m (offshore rated) to be arranged starboard side at approx frame 41 – fr. 47.

Foundation and pedestal for one 10 ton crane at a radius of 12,5m to be arranged SB side Boat deck at Fr. 74. Crane to have 300m wire.

Foundation and pedestal for two 2 ton foldable cranes at a radius of 15m to be arranged SB- & P side Capt. deck at Fr. 109.

Dive control room and Air dive room to be arranged in Dive Hangar on SB- side on Main deck between frame 74 – frame 88. Air dive baskets landing area to be arranged on SB main deck with 2 off Air Dive A-frame above on Shelter deck, according to GA. FRC with Davit (boarding) to be arranged on PS on Shelter deck, according to GA. Dive Store workshop to be arranged on Main deck in Dive Hangar, acc. to GA.

A Dive System Switchboard Room, Diver Suit Wash room, Dive Sat Control room, Pantry Store, and Dive Pantry to be arranged on Tween deck between fr.75 and fr. 103, acc. to GA.

Sufficient foundations for the Dive equipment to be arranged acc. to GA.

Engine control room, wardrobe, laundry and offices to be arranged on main deck according to GA.

Foundations and reinforcements for deck equipment to be arranged. Sufficient drainage to be arranged.

Details regarding this equipment to be arranged in accordance with suppliers and Owner.

Railing at the sides where openings to be arranged as removable railing. Splitted in 3 sections each side.

DIVING HANGAR

Dive hangar to be arranged from main deck to boat deck between frame 74 and fr. 103, according to GA. The hangar to be built in steel, but as light construction as possible. Adequate stiffening/strength to be maintained to prevent unsightly steel constructions of hanger panels. Deck and stiffening in hangar roof to be arranged in accordance with the dive supplier's recommendation.

Main deck in hangar area to be locally strengthened for diving equipment where needed according to suppliers requirements and 5 t/m^2 in general.

The shelter deck in hangar area between fr. 75 to fr.103 to be dimensioned for 2 t/m^2 . The deck to be built and arranged according to GA & detail arr. drawings

Deck load on shelter deck outside hangar area to be built with 2 tons/m², and locally strengthened for the various equipment where needed.

The Dive Hangar to be arranged with door on PS and SB sides, according to GA.

A trunk with lift for provision/food for the diving chambers to be arranged from shelter deck area to tween deck area.

Dive control room (steel / insulated) to be arranged in dive hangar area acc. to GA.

elter deck outside of hangar on both according to GA.

ROV HANGAR

ROV hangar to be arranged between main deck and boat deck between frame 103 and fr. 112, according to GA. The hangar to be built in steel, but as light construction as possible. Adequate stiffening/strength to be maintained to prevent unsightly steel constructions of hanger panels. Deck and stiffening in top of hangar to be arranged in accordance with the dive supplier's recommendation.

Deck load on main deck in hangar area to be built with 5 tons/m², and locally strengthened for the various equipment (ROV LARS & umbilical winch system) where needed.

Hangar to be arranged with door/side port on PS and SB sides, according to GA. The hangar to be arranged according to GA.

226 DECK, FLOORS, PLATFORMS, BULKHEADS AND HULL TANKS BELOW SHELTER DECK.

ENGINE FLOOR

In engine room ladders stairs etc. are to be provided.

Arrangement to be agreed upon and approved in details by Owners representative.

TWEEN DECK

Tween deck to go throughout the hull without sheer or camber. Where tween deck forms tank top/tank bottom, plate thickness and stiffeners to be increased according to Classification requirements.

BULKHEADS

The hull to be divided into compartments as indicated on the GA-plan by means of transverse and longitudinal bulkheads of oil/watertight construction.

Bulkheads to be of plain construction, welded directly to shell, deck and tank top, and provided with stiffeners of bulb or angle profiles.

Minor steel bulkheads inside accommodation may be of corrugated type or stiffened by flatbars.

TRANSVERSE WATERTIGHT BULKHEADS

Transverse watertight bulkheads to be arranged according to Classification requirements and according to GA-plan.

GENERAL TANKS

In all tanks cut outs in floors and beams for drainage and air escape to have an area of at least 25% above suction pipe.

For specification of bilge and ballast, air pipes and sounding systems see main gr. 8.

All cargo tanks, FW and Ballast tanks except double bottom tanks and peak tanks to have suction well recessed in tank bottom.

Note! The suctions/filling and tank ventilation pipes to cargo tanks and room / compartments shall be arranged such that the watertight integrity is not compromised.

CARGO TANKS

FUEL OIL

Arrangement to be made for sample taking from each tank. Ref 701.

FRESH WATER

To be arranged with possibility for sample taking from each tank.

Arrangement to be made for possibility to add sodium chlorite to each tank.

STABILISING TANKS/ROLL REDUCTION TANK

One -1- off passive stabilising/Roll Reduction tanks to be arranged below main deck between fr.29 - fr.34.

The tank to be arranged with 3 longitudinal rows of water flow restrictors. These restrictors or grids to be built by vertical angle bars of sufficient strength, or as bulkheads with openings as per drawings.

The roll reduction tank to have ventilation pipe and suction pipe from both sides of the tank. Ventilation pipes to be arranged with water traps.

227 MANHOLES AND LADDERS IN TANKS

Manholes of NS standard no 6261/ Yard Standard Nominal size 600 x 400 type B12 in general to be used and fitted in all tanks.

For double bottom see also part 222.

Where necessary, ladders or steps to be fitted below manholes to give easy access to all tanks. Handgrips to be fitted outside and inside above manholes where vertical lids. Internal ladders in ballast water tanks to be galvanized and bolted.

242 FORECASTL

Forecastle-deck extends from fr. 112 to stem with transverse stiffening and longitudinal girders supporting the beams. Below cranes, winches and davit, deck to be reinforced with inserted plate of increased thickness. Beams and girders to be increased according to Classification requirements.

243 BOAT DECK

Boat deck to be built closed above forecastle deck. Five -5- of mooring openings, two -2- on each ship side, and one -1- in bow, between forecastle deck and boat deck, to be arranged/built in near location above the fairleads. Sizes according to GA and detail steel drawings. The five mooring hatches, between forecastle deck and boat deck, to be hydraulic operated.

Railing of solid design to be arranged on boat deck, all the way round.

Chain lockers for anchor chain to be arranged. Manholes and steps for access to chain locker to be arranged. Near bottom of chain locker a grating of perforated galvanised plates to be arranged approx. 300 mm above bottom level. The chain locker to be self-stowing and arranged with suction.

Attachment for securing 'bitter end' to be provided.

251

A three-tier superstructure according to GA-plan built in steel to be constructed on forecastle deck.

Boat deck to be built closed above forecastle deck.

Railing of solid design to be arranged on boat deck, all the way round.

Outline and areas of superstructure are indicated on GA-plan.

All decks to have no sheer and no camber.

Deck height between main deck and shelter deck, to be 2800mm.

Deck height between shelter deck and forecastle deck, to be 2750mm.

Deck heights in the three uppermost tier's, to be 2700mm between deck plates (from steel deck to steel deck).

Outer bulkheads to be well stiffened with angle profiles on the inside.

The whole structure to be of welded construction with direct welded connections to deck plating. Pillars below girders within deckhouses to be adapted to accommodation partition bulkheads.

Exterior doors preferable to be made of Steel/GRP with sill heights in accordance to the "International Load Line convention" requirements. In deckhouses all outer bulkheads to have gutters. The exterior doors provided shall meet ISPS code.

Flat steel bars forming gutters to be welded to bulkhead stiffeners and brackets, and to be continuously welded to deck plate on the wet side. On the dry side welding may be of intermittent type.

252 CASING AND FUNNEL

Casing and funnel to be arranged as shown on GA-plan.

Casing to extend from main deck to above wheelhouse top and with adequate strength to carry the funnels uptake structures.

Access to casing and funnel to be arranged. Vertical ladder inside casing to be arranged.

Expansion tanks for main engines cooling system to be located in casing.

Open gratings to be arranged within casing and funnel at deck levels. In the upper section of funnel fixed ventilation louvers with weathertight closing possibilities are to be fitted.

Easy access for inspection.

254 BRIDGE DECK AND WHEELHOUSE

BRIDGE DECK

Bridge deck to be arranged as shown on general arrangement drawing. The deck to be arranged with outside stairs for access to boat deck on starboard and port side.

Bridge deck to be well stiffened with beams and girder system adapted to wheelhouse bulkheads.

WHEELHOUSE

Wheelhouse to be arranged as shown on general arrangement drawing.

The wheelhouse to be built in steel and of welded construction. Deck height in wheelhouse to be minimum 3800 mm from steel deck to steel deck.

To give space for cables and pipes etc. an angle steel structure for carrying a fire and water resistant floor to be fitted approx. 1100 mm above bridge deck level.

Doors in wheelhouse to be of GRP with window.

Bulkheads to be arranged for windows according to GA-plan.

Flat bars forming gutters to be welded on inside of the stiffeners all around the wheelhouse` perimeter.

Reinforcements for installation of a helicopter deck designed for a helicopter of type Sikorsky S92, with a diameter of 22 m to be arranged.

STORE / SKY-LOBBY ON TOP OF WHEELHOUSE

One store and sky lobby to be arranged on top of wheelhouse according to GA plan.

Sky lobby to be arranged with sufficient entrance with weather tights doors and stairs down to bridge deck.

26 HULL OUTFITTING

261 MARKS ON HULL

VESSELS NAME

Name of vessel to be in raised steel plate letters 500 mm high welded to ship's side forward. Name and port of registry in raised steel plate letters 400 mm and 300 mm high respectively to be welded to Port and Starboard quarter.

"MT 6023" to be welded on each side of hull below boat deck level.

Owners fleet emblems in steel to be fitted according to GA.

Shipyards logo on both sides, to be fitted.

IMO Number to be on both sides.

DRAFT MARKS

Metric draft marks of steel plate to be welded on ship's side forward, midship and aft and at centreline of the transom.

Size of figures and letters 100 mm.

FUNNEL MARKS

Owners fleet emblems to be cut out of aluminium plate/stainless steel and to be mounted on distance pieces on both side of funnel, with lightning.

Option: Charterer's logo, where convenient, on both sides. Option end.

WARNING MARKS

Standard warning sign for bulbous bow, retractable azimuth, bow thruster units and echo-sounder/log to be welded on each side of hull above loaded waterline. Signs to be of steel plate.

FREEBOARD/TONNAGE MARKS

Freeboard and load line markings to be welded on port and starboard side and midship according to load line certificate and Classification Surveyor's satisfaction.

TANK BORDER LINES

Corners and borderlines between tanks to be marked by welding marks.

Tank identification and content to be marked beside each tank bottom plug.

PAINT MARKING LINES

Border line between antifouling and hull paint to be marked with interrupted welding marks.

262 BOTTOM PLUGS, SEA CHESTS AND BILGE WELLS

BOTTOM PLUGS

All double bottom and peak tanks and cofferdams to have one 42 mm drain plug of stainless steel - NS 2573 M42 x 2/ Yard equivalent shall be used.

The plugs to be of externally flush type with min. 25 mm thick flanges intersected in shell plates.

All bottom plugs to be marked with tank number.

The following sea chests to be arranged:

One sea chest to be arranged in engine room.

Separate sea chest for fresh water generator plant to be arranged.

Two sea chests for diving heaters to be arranged outer diving area.

One sea chest to be arranged in lower aft pump room, to serve ballast system and third fire pump.

General for sea chest mentioned above: Removable galvanised steel grids or gratings to be fitted flush with the shell plating in the sea chests openings. Sea chest to be arranged with air-blowing and antifouling device. Air ventilation from sea chest to be arranged to open deck.

Sea chests for box coolers to be arranged according to GA.

BILGE WELLS

Bilge wells of sufficient size to be arranged according to Classification requirements. Care to be taken in order to ensure access to wells for cleaning. Strainers of galvanised perforated steel plates to be fitted as covers for each bilge well.

263 FOUNDATIONS AND REINFORCEMENTS

Reinforcements to be arranged underneath foundations for:

Anchor/Mooring winches

Mooring winches

Tugger winches

Cranes

Davits

Reinforcement for offshore Cranes to be arranged amidships, below main deck. Reinforcement dependent of capacity of cranes, ref. GA.

Reinforcement for Helideck (Sikorsky S92).

Diving main equipment (chambers) and auxiliaries.

ROV LARS equipment

Below winches, cranes masts etc. extra girders to be fitted if needed.

All foundations on open deck to be made fully enclosed, or with good access for maintenance.

264 FENDERS AND BILGE KEELS ETC.

FENDERS

Steel fenders to be arranged as a sheer strake plate with increased thickness as shown on general arrangement. Plate thickness and extension to be approx.

20-25 mm and a height of approx. 1000 mm. between fr. 1 and 101 each side.

7 off rubber D 300 mm fenders on each side of the ship.

BILGE KEEL

Bilge keel to be made of 370 x 13 mm bulb profiles in general and reduced to 280 x 12 bulb profiles at the ends. Bilge keel to be supplied on each side.

Double continuous welding has to be applied, and the bilge keels to be welded on doubling plate against the shell plating.

266 ANCHOR POCKETS AND HAWSE PIPES

ANCHOR POCKETS

Anchor pockets suitable for anchors of Spek type (short shank) to be arranged on starboard and port side as indicated on G.A. drawing.

From anchor pockets to shelter deck a hawse pipe of sufficient size and wall thickness to be fitted on each side, with covers on top.

At shelter deck level hawse pipes to be adapted to ensure a good lead in to chain stoppers and anchor windlass.

Hawse Pipe to be fitted with water wash for anchor chain.

267 GUTTERS, BULWARK, RAILINGS AND CARGO DECK

GUTTERS

In all accommodation areas and in wheelhouse, gutters to be arranged on the inside of outer bulkhead stiffeners. Drain system on gutters to be arranged.

Gutters are also to be fitted on main deck on the inside of frame brackets in the accommodation and provision room area.

Welding of gutters to be carried out as specified in section 251.

BULWARKS

On shelter deck, forecastle deck and bridge deck bulwarks are to be arranged according to GA-plan.

Freeing ports in bulwark plate and shipside on main deck sb. and port side to be carried out in accordance to the International Load Line Convention. Freeing ports on main deck to have hinged covers. Liners in hinges of bronze.

Freeing ports arrangements to be approved separately.

Freeing ports shall be designed so that blocking by ice is avoided as far as possible and so that they are easily accessible for removal of ice should blocking occur. (ICE C)

When locating the bollards and fairleads, supports to be taken into consideration.

The bulwark is to be vertical and have a height of approx. 1100 mm.

On top of bulwark, a pipe, dia. approx. 139 x 8 mm or bulb profile to be double continuously welded to bulwark plate and supports.

On forecastle deck the bulwark to have flanged supports on every second frame and a vertical flat bar stiffener in between.

Forward on forecastle deck the bulwark to have a height according to GA-plan.

The bulwark to be faired outwards as per GA plan, and a bulb profile is welded on top.

Bulwark supports forward to have depth of min. 300 mm at deck or as per drawings.

Removable bulwark sections to be arranged on main deck according to GA-plan.

RAILING

Railing on open deck to be arranged according to GA-plan.

Railing to have a height of ab. 1050 mm with flat bar stanchions on every second frame. Top pipe on Shelter deck approx. $\varnothing 60$ mm and elsewhere according to NS. Railing in front of cargo deck, see separate drawing. Railing pipes and stanchions to be galvanised and have sufficient strength. Spacing between pipes to be in accordance with the "International Load Line Convention".

SECURING OF DECK CARGO

On main/cargo deck a total of 10 off "D" - rings with a min. breaking load of 5 tons to be fitted - 5 on each side of the deck.

12 off "D" - rings with a min. breaking load of 30 tons to be fitted - 3 rows, one in centreline and on each side of the cargo deck.

Location of steel eye plates, guiding rollers and "D" - rings to be shown on Deck arrangement drawings.

268

Funnel to be built on wheelhouse top according to GA-plan and separate drawings
The funnel to be well stiffened, supported and of welded construction.
See also section 252.

Drain pipes from the aft end of funnel to be lead down and overboard at main deck level.

27 INITIAL SURFACE PREPARATION

All steel plates and profiles, before these are welded in the construction, to be dry abrasive shot-blasted to ISO standards SA 2½ and shop-primed in automatic plants.

Mill scale, rust or other kinds of impurities to be carefully removed. Possible remnants must only appear as faint shadows on the uniform, metallic grey surface. Any damage incurred during storage, transport and working of steel plates is to be made good by mechanical cleaning and primer re-coat to paint manufacturer approval.

Two - component zinc - epoxy shop-primer in compliance with the paint system to be used. The film thickness of the shop-primer to be 15 - 20 microns but shall not exceed 20 microns, otherwise adhesion problems with the paint system might occur.

PREPARATION BEFORE MAIN PAINTING

Prior to the application of the first coat of the main paint system, all welding slag and spatter, rust, salt, grease and other contamination to be removed from weld areas and plate surface.

All welds, burned spots/areas, damaged or rusted shop-primer areas etc. to outer hull, weather exposed areas, tanks and wet compartments to be blast-cleaned to SA 2½ and touched up with zinc-rich epoxy primer or primer for following coat.

All welds, burned spots/areas and damaged or rusted shop-primer to remaining areas to be thoroughly cleaned by mechanically wire brushing, rotating grinding discs or if necessary blast cleaning to SA 2½ .

All sharp edges to be rounded radius minimum 2 mm.

PAINTING

A stripe coat to be applied in way of all welding, sharp edges, notches, scallops, brackets etc., before and in between each full spraying coat.

Intervals between coats shall be strictly in accordance with the paint manufacturer's instructions.

Primers and coatings to be applied within the temperature and humidity ranges as required by the paint manufacturer.

The vessels paint maintenance system to be followed regarding touch up of damage during conversion. Yard to apply well known painting system. (i.e. Jotun or International)

The Yard to organize paint representative to Yard account.

Polisiloxane for top sides and Elastomeric Foul Release Coat for under water areas; IMO specification for Ballast tank coatings with coating technical file.

All paint application to be carried out in the presence of the paint manufacturer.

271 BOTTOM SIDES UP TO LOADED WATER LINE, SEA CHESTS:

The vessel shall be painted in accordance with following specifications which has been provided for guidance.

All thickness in DFT.

FLATBOTTOM

1 coat of Intershield 300	1x 125 my
1 coat of Intershield 300	1x 125 my
1 coat of Intersleek 737	1x 100 my
1 coat of Intersleek 970	1x 150 my

Antifouling thickness for five year dry docking intervals. For worldwide sailing with average operations of 5000nm per month.

Seachest, Thrusters, Cross over tanks, Thruster –tunnels

A low surface energy foul release coating scheme with self clean characteristics

1 coat of Intershield 300	1x 125 my
1 coat of Intershield 300	1x 125 my
1 coat of Intersleek 737	1x 100 my
1 coat of Intersleek 970	1x 150 my

Anti-fouling thickness for five year dry-docking intervals. For worldwide sailing with average vessel speed 14 knots in 70% of dry-docking interval.

272 TOP SIDES WITH BULWARKS (OUTSIDE)

2 coat of Intershield 300	2 x150 my
1 coat of Interfine 979	1 x125 my
Final coat Yew Green	

273 WEATHER DECK SURFACE INCL. BULWARK (INSIDE) AND CARGO RAILS

1 coat of Intergard 269	1 x 50 my
1 coat of Intershield 300	1 x 150 my
1 coat of Interfine 979	1 x 125 my

DECK BENEATH WOOD SHEATING

2 coats Intershield 300	2 x150 my
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274 EXTERNAL GALVANIZED RAILING AND STAIRS

1 coat of Integuard 269	1 x 60 my
1 coat of Interfine 979	1 x 125 my

275 DECK EQUIPMENT, CRANES, DAVITS, HATCHES ETC.

1 coat of Intershield 300	1 x 150 my
1 coat of Interfine979	1 x 125 my

276 SUPERSTRUCTURE, DECK HOUSE, CASING, FUNNEL, MASTS ETC.

1 coat of Intershield 300	1 x 150 my
1 coat of Interfine 979	1 x 125 my

All painting stated above shall be applied after application of necessary primer coating as recommended by the paint manufacturer.

277 EQUIPMENT SUBJECT TO GALVANIZING

- a. External stairs.
- b. Pipes and flat bars in external railing.
- c. Strainer plates in main and aux. engine sea chests.
- d. Strainer plates in bilge wells.

278 CATHODIC PROTECTION - EXTERNAL

The hull to have cathodic protection against corrosion by impressed current.

28 MATERIAL PROTECTION INTERIOR

281 ACCOMMODATION, DECKHOUSES, STORES ROOMS

STEEL BEHIND INSULATION IN ACCOMMODATION

1 coat of Interguard 276 1 x 50 my

DECKHOUSES, STORE ROOMS, LAUNDRY, TOILET ROOMS AND OTHER ROOMS WHERE NO LINING

1 coat of Interguard 276 1 x 50 my
1 coat of Interlac 665 1 x 70 my

282 ENGINE ROOM, CASING, FUNNEL, THRUSTER ROOMS, CARGO ROOMS

Steel behind insulation in engine room, control room, bowthruster room etc.

1 coat of Interguard 276 1 x 50 my
1 Coat of Interlac 665 1 x 70 my

TANKTOP BELOW INNER FLOOR, MAIN ENGINES AND MAIN GEARS, BILGE WELLS, FOUNDATIONS ETC.

1 coat Intershield 300 1 x 150 my
1 coat Interfine 979 1 x 50 my

INTERNAL DECK

1 coat Integuard 276 1 x 50 my
1 coat Interprime 538 1 x 50 my
1x coat of Interlac 665 1 x 40 my

285 CHAIN LOCKERS, BALLAST-, BILGE WATER- & ANTI ROLLING TANKS

2 coat Intershield 300 2x 125 my
1 coat of Intershield 300 1x 125 my

Stripe coating before each coat. Coating to meet IMO requirements for ballast tanks. Technical file for coating to be provided.

COFFERDAMS, AIR DUCTS & DRYTANKS.

1 coat Intershield 300 1 x 200 my

Stripe coating before each coat

SEWAGE-, BILGE WATER-, SLUDGE SETTLING TANK.

2 coats Interline 704 2 x 125 my

1 x coat of Interline 704 1 x 125 my

Stripe coating before each coat.

286 FRESH WATER TANKS

1 coat Interline 925 1 x 125 my

1 coat of Interline 925 1 x 250 my

Stripe coating before each coat.

Pot water tanks shall be coated with paint, which is recommended for potable water. Note: Cleaning, disinfect and maintenance of pot water tanks, used for transportation of fresh water to offshore installation as well as for domestic use, shall be in accordance with regulations from United Kingdom.

287 FUEL OIL AND LUB. OIL TANKS

Fuel oil tanks Oiled

Lub.oil storage tanks Oiled

Hydraulic oil tanks Oiled

289 MISCELLANEOUS

INSULATION

Insulation is not to be painted where this might have influence on the insulating quality. This applies for both acoustic and thermal insulation.

PIPES & CHANNELS

To be treated as bulkheads and superstructure with coats as for surroundings.

CEMENTING

On inaccessible places or where necessary for drainage to be filled with light-weight concrete.

MAIN GROUP 3 EQUIPMENT FOR CARGO

30 HATCHES AND PORTS

306 SMALLER HATCHES AND MANHOLES

EMERGENCY AND STORES HATCHES

Hatches with a size of 600 x 800 mm to be fitted as emergency exits, access hatches and stores hatches as indicated on GA-plan. 800 x 800 if required.

Hatches from open deck to be of watertight type with steel coamings and central closed aluminium covers. Height of coamings to be in accordance with the "International Load Line Convention". See also section 216.

Arrangement for closing of Emergency hatches to be arranged on inside of hatches according to ISPS. Blocked from outside, easy to open from inside.

For security purposes hatches to be capable of being locked from the inside whilst retaining emergency access where required.

HYDRAULIC OPERATED STORES HATCH FOR ENGINE ROOM.

1 off hydraulic operated flush hatch with size approx. 2000 x 2500 mm to be fitted at main deck above engine room according to GA. (Note! Pay attention to whether it can be fully opened).

The hatch to have steel covers dimensioned for a load of 1 tons/m². 50 mm stainless steel ball valve with drainpipe arranged for drainage around coming of hatch.

HYDRAULIC OPERATED HATCHES FOR CARGO HOLD ROOM

2 off flush hatches above cargo room to be arranged acc. to GA.

The hatch to be hydraulic operated and to have steel cover dimensioned for a load of 10 tons/m², and the covers to be flushed without the wooden sheathing. 50 mm stainless steel ball valve with drain pipe arranged for drainage around coaming of hatch.

2 off hydraulic operated flush hatch in tween deck.

HYDRAULIC OPERATED HATCH FOR DIVING BELL ON TOP OF DIVE HANGAR / BOAT DECK

1 off flush hatches, one above dive bell on top of dive hangar to be arranged acc. to GA.

The hatch to be hydraulic operated and to have steel cover dimensioned for a load of 0,5 tons/m², and the covers to be flushed. 50 mm stainless steel ball valve with drain pipe arranged for drainage around coaming of hatch.

MANHOLES

Manholes marked with cc and tank no. be in accordance with NS standard with a light opening of 400 x 600 mm / 600 x 800 mm. The manholes to be of non-recessed type. Handholds to be fitted inside and outside where vertical lids.

For location of manholes see also section 222 and 227.

Stainless bolts and black steel nuts.

MOORING HATCHES

5 off hydraulic operated mooring hatches to installed on forecastle deck.

307 SIDE PORTS

Hinged side ports of steel construction as indicated on GA-plan to be arranged. Hinges to have liners of bronze or similar. Bolts and securing clamps to be of stainless steel.

31 EQUIPMENT FOR CARGO AND HOLDS ON DECK

The WROV system will be Owner supplied. It may be installed pre or post vessel delivery. If it is installed pre-delivery, Builder shall undertake its installation and hook up with advice and assistance of Owner. Owner will supply builder with relative specification of services required.

311 POWER SUPPLIES TO WORKING DECK

A common ROV Distribution Switchboard to be arranged. The following power distribution is required, and to be looked upon as preliminary capacities. Deviations may happen acc to final capacity equip. requirements:

ROV POWER FOR 1 X WORKING ROV 440 VAC 60HZ

- 1 x 1042A (650kVA) power outlets inside a common connection box located at shelter deck level, in the ROV hangar area. A separate connection box to be arranged, including 4 times 230V power outlets for power supply to lights, sockets etc.

ROV POWER FOR 1 X OBS ROV 440 VAC 60HZ

- 1 x 240A (150kVA) power outlets inside a common connection box located on shelter deck level in ROV dive hangar area, aft. The connection box also to include 4 times 230V power outlets for power supply to lights, sockets etc.

ROV/ AVAILABLE PROJECT POWER ON WORKING DECK 440 VAC 60HZ

- 1 x 630A (385kW) power outlet inside a connection box located on the port crane pedestal. A separate connection box to be arranged including 4 times 230V power outlets for power supply to lights, sockets etc.
- 2 x 630A (385kW) power outlets inside a common connection box located on the starboard crane pedestal. A separate connection box to be arranged including 4 times 230V power outlets for power supply to lights, sockets etc.

ROV/ PROJECT POWER IN UPPER CARGO HOLD 440 VAC 60HZ

- 1 x 630A (385kW) power outlets inside a connection box located in aft cargo room tween deck.
A separate connection box to be arranged including 4 times 230V power outlets for power supply to lights, sockets etc.

Close to each of the above mentioned connection boxes a separate junction box must be installed to provide signal connections to the ROVs, data link to include CCTV, communication system, twisted pair, LAN etc. Detailed list to be informed to builder during detail engineering phase.

314 EXTERNAL DECK COVER

T-bars for securing of deck planking (75 mm thickness) to be mounted on Main deck.

T-bars to have strength for container fastening.

Longitudinal & transversal t-bars for welding to be arranged on main deck according to GA.

316 PROTECTION BUMPERS FOR EXPOSED EQUIPMENT & CANVAS COVERS

Sufficient arrangement with bumper bars and plates to be arranged for protection of exposed equipment on work/cargo deck area. Especially considerations to be made in areas where cargo are stored and handled.

Covers to be delivered for compass. The covers to be of Herquillite or similar quality.

All Covers to be equipped with brass eyelets and lashings.

32 SPECIAL EQUIPMENT FOR CARGO HANDLING

331 DECK CRANES

1 off 150T @ 10,5m working radius subsea lift AHC crane. (approx. 50T @ 30m working radius) with wire capacity down to 3000m water depth, arranged with personal lifting and remote access.

Aux. winch

10t @ all radius – Internal/Sub-sea/Sea Lift. Wire capacity 500m.

1.5t @ all radius – Personnel lift (DAF=2,0)

Working radius main winch: max 30m, min 6,0m

Working radius aux. winch: max 30m

Yard to fully prepare vessel for mounting of the offshore cranes.

Installations to include hull reinforcements, foundations, and also pedestal. Further yard to provide power supplies and signal cabling to crane.

Main power cabling to be arranged from switchboard to crane starter cabinet, and also cabling from starter cabinet to main power slip rings. Crane to be powered by both sides of the switchboard (in the case of loss of one side of the switchboard the crane can continue to work).

Crane signal cabling shall include connection to vessel PA and telephone system.

Crane to be installed according to general arrangement.

Crane cradle incl. boom rest and bucket for hook to be arranged at suitable location by the yard.

Suitable ladders /staircases for access to all cranes and cradles to be arranged.

Hydraulic pipes and couplings to be of stainless steel.

Yard responsibility to weld flange to pedestal according to approved welding procedure.

Important: Flatness of flange shall be according to acceptance criteria provided by crane supplier. Yard is to ensure that pedestal flange is checked and machined as necessary to comply with acceptance criteria /data provided by crane manufacturer.

Yard to completely install and commission the cranes, including foundation, reinforcements and power supply. (Eventual couplings of chrome heated steel, to be covered with Denzo tape).

Offshore cranes to be arranged with minimum 0,75T personal lifting feature.

Sufficient ducts for pipes and cables to be arranged in the tank structure / Cofferdams underneath the Crane foundation / column, for easy appropriate access and arrangements.

DECK CRANES:

One 12 10 ton crane at a radius of 12,5m to be arranged SB side Boat deck at Fr. 82, ref. GA-Plan. Crane to have 300m wire.

Two -2- of 2 tonnes at 15 m radius offshore rated foldable cranes to be arranged on aft part of Capt. deck SB & PS side, acc. to GA.

Note:

Yard to completely install and commission the cranes, including foundation, reinforcements and power supply. Hydraulic pipes to be of stainless steel. Couplings to be of chrome heated steel, covered with Denzo tape.

Note! All cranes to have Oil purifier for Crane Hydraulics.

332 CARGO SECURING WINCHES

4 off Air tuggers (type Ingersoll Rand or equivalent), rated for. 5 tons hoisting capacity / 7.5 tons brake, to be delivered and mounted according to GA.

Air supply generated out from air compressor (ref 731- general service compressor)

Air supply to open deck area to be installed by Builder under the form of 2" rigid piping tending with ball valve and Chicago coupling.

35 LOADING / DISCHARGING FOR LIQUID CARGO

351 CARGO/DISCHARGE PUMPS

Loading and discharging stations for all liquid shall be arranged on both sides midship (if not other specified under each product below). Safe and easy access to connections shall be arranged.

Fuel oil	4 inch Avery Hardoll, male connection
Fresh water	4 inch Weco, female connection
Ballast water	4 inch Weco, male connection

Shoreside discharge facilities to be included for Sanitary-/Food waste-/Sludge/Bilge Settling tanks.

Tanks to be arranged so that they are accessible from open deck, even with cargo on deck. The hatches/manholes to be built flush with deck.

All tanks to have suction wells where possible.

All cargo pumps to be el. driven with frequency control.

INSTRUMENT.

All manometers for cargo system to be filled with liquid.

BALLAST WATER PUMP SYSTEM

2 off, two-spindle, self-priming pumps, frequency controlled, capacity 0-100 m³/h at 90 MLC each, with local and remote suction- and pressure indication, Class certificate.

All necessary valves for discharge and filling of tanks to be remote controlled, with feed back for remote indication open/shut to be arranged according to schematic pipe diagram approved by owner and class.

Pipes to be hot dip galvanized after completed welded and treatment.

FRESH WATER CARGO

2 off, two-spindle, self-priming pumps, frequency controlled, capacity 0-100 m³/h at 90 MLC each, with local and remote suction- and pressure indication. Class certificate. Possibility for sampling and chlorinating of each tank.

All necessary valves for discharge and filling of tanks to be remote controlled, with feedback for remote indication open / shut to be arranged according to schematic pipe diagram approved by owner and class.

Fresh water piping system to be arranged with valve manifolds.

FUEL OIL CARGO

2 off, two-spindle, self-priming pumps, frequency controlled, capacity 0-100 m³/hr at 90 MLC each, with local and remote suction- and pressure indication. Class certificate.

All necessary valves for discharge and filling of tanks to be remote controlled with feedback for remote indication open/shut, to be arranged according to schematic pipe diagram approved by owner and Class. Sampling lines and device for each tank and on filling pipe.

Fuel oil piping system to be arranged with valve manifolds.

A fuel meter with ticket printer shall be installed on the fuel discharge line. The fuel oil flowmeter to read both filling and discharging of the system. Pipes to be hot dip galvanized on open deck.

38 AUXILIARY SYSTEMS FOR CARGO

381 TANK SOUNDING SYSTEM

A tank sounding system to be connected to automation system type for all cargo, ballast- and fuel tanks to be installed in compliance with relevant regulations. In addition the bilge water tanks to be connected. The sounding system to be interfaced to Vessel Management system, sensor to be IPH or equal, to be approved by owner. 95% alarm where required.

387 SPECIAL STRUCTURES FOR LOADING/DISCHARGING OVER SIDE

Installation of Taut Wire. Reinforcements and foundation for this equipment to be fitted.

401/402/403 STEERING SYSTEM, REF.S.GR.635.

Two off rotatable thrusters will be fitted in the aft of the ship, with rudder/steering gear function through the azimuth control steerable thrusters with fixed pitch propeller. The propellers shall be 3000 kW, electric driven and frequency controlled. Minimum 12 pulse drive, water cooled. Type RRM 2x3000kW US305 FP Thrusters, (or similar) Supplier: See makers list.

Separate alarm on each steering gear.

404 SIDE THRUSTERS AND AZIMUTH THRUSTER FORWARD

The ship to be equipped with three-3 off CP tunnel thrusters.

Effect/rpm. approx	: 1800 kW / approx. 880 RPM input, water cooled el.motor, 12 pulse
Prop.dia.approx.	: 2650 mm
Prop. rpm.	: TBA
Tunnel length	: TBA
Max tip speed on propeller	: 29 m/sec.
Drive motor voltage/frequency:	: 690/0-60 V/Hz
Type.	: See Makers List

THE DELIVERY SHALL CONSIST OF, BUT NOT LIMITED TO:

Thruster unit with 4-blades fixed pitch propeller.
 Tunnel with foundation for El.motor.
 Flexible coupling between El.motor and thruster.
 Hydraulic system for lubricating, incl. header tank.
 Electronic remote control from two bridge positions to be taken care of by thruster controls and DP on bridge.

The shape of the shell plating in way of tunnel thrusters tunnel to be carefully considered in co-operation with the ship model tank, in order to reduce noise.
 The servo pump aggregates for the fore thrusters to be resiliently mounted.

GENERAL FOR ALL THRUSTERS:

Connection nipple for SPM measuring device to be installed for all thrusters' motor bearing fore and main propellers (thrusters aft) aft.

Temperature from all thrusters to be transmitted to Automation System.

For emergency operation, the same handle as in manual operation to be used.

RETRACTABLE AZIMUTH THRUSTER

One -1- azimuth thruster, make: see makers list, including:

Power	1200 kW, water cooled, 12 pulse
Motor speed el.motor	0-1200 rpm
Prop. dia	2000 - 2100 mm in a nozzle.
Stem length	TBA (to be confirmed)
Type:	See Makers List
Propeller Speed	TBA

- standard horizontal drive, retractable type thruster for «bolt-in» type mounting,.
- built-in, hydraulically operated clutch
- four-bladed, fixed pitch type NiAl-bronze propeller of dia. 2300 mm running in the patented PV-nozzle (the inner surface of the nozzle made of stainless steel)
- «bolt-in» type bottom well cover with retracting cylinder and guides, fastening elements and O-ring seal
- Steering machinery with electric motors, a planetary gear and a large slewing ring
all components of the electric motor system are ready fixed on the thruster for easy and time-saving installation on-board
- detachable shafting and locking equipment for retracting
- retracting equipment with electric motor driven hydraulic lifting pump.
- gravity tank for maintaining the static pressure of propeller shaft seals
- alarm transducers, to be incorporated to ship's monitoring and alarm system.
- Electronic remote control from two bridge position to be taken care of by thruster controls and DP on bridge.
- Frequency converter to be water-cooled.
- Automatic lock in upper position.

GENERAL FOR ALL THRUSTERS:

Connection nipple for SPM measuring device to be installed for all thrusters' motor bearing fore and main propellers (thrusters aft) aft.

Temperature from all thrusters to be transmitted to automation system.

For emergency operation, the same handle as in manual operation to be used.

Two (2) of offline oil purifiers for removing of water from oil to be installed for the thrusters fore, and main propellers (thrusters) aft.

One purifier in aft and one in fore ship.

Note! Shipyard to receive clarification from designer upon size of equipment before purchasing.

405 PASSIVE ROLL REDUCTION TANKS AND ANTI HEELING SYSTEM

ROLL REDUCTION SYSTEM

A passive roll reduction system to be installed according to GA plan, 1 off roll reduction tank.

ANTI HEELING SYSTEM

The ship is to be provided with an anti-heel system for manual and automatic control of ships list during loading/unloading condition or any crane operation.

The system to be based on reversible propeller pumps system, and to include propeller pumps with capacity approx. 2 x 1200m³/h – 10 MLC, and soft-starter for el. Motor.

Cross-over pipes to be installed with separate pressure/suction pipes in anti-heel tanks, all valves/actuators to be remote operated butterfly valves. The system to include filter sensors, and control system. Local control supplied by AH-supplier, and remote control from IAS.

Anti-heel system to be completely installed and tested by yard.
The system to be installed in accordance with Class requirement and supplier recommendation.

There will be discharge/filling line for anti-heel tanks via ballast water system.
Sufficient tank venting to be arranged.

Submergible butterfly valves between anti-heel tanks to be installed according to GA (In blkhds at Frame 46, 58 & 75, PS & SB, at bottom and top.)

408 DYNAMIC POSITIONING, THRUSTER CONTROL, INDEPENDENT JOYSTICK SYSTEM

GENERAL

Ship to be equipped with dynamic positioning system according to DNV GL class DYNPOS AUTR. Preferably to be part of the Kongsberg K-Master integrated operator chair. The K-master system is also able to be integrated with the ships IAS system. Make: see makers list.

The dynamic positioning system, remote thruster control system, independent joystick and vessel automation system to be controlled via uniform touch screen panels. Preferably integrated in the Kongsberg K-Master operator chair. Manual levers to be located in both captain chairs and one (1) set in forward bridge.

The DP to be delivered completely tested to the Class and the owner satisfaction.
The system shall as a minimum consist the following:

HARDWARE

- Redundant DP operator station on aft bridge - preferably to be an integrated part of the K-Master work station using multi-functional displays.
- One (1) redundant DP control unit.
- One (1) Joystick control unit.
- Independent joystick system utilizing the same joystick as for the DP system. In addition one (1) portable unit with three (3) connections points.
- Manual leavers forward and aft on bridge, direct hardwired to units. Aft bridge levers to be an integrated part of the K-Master work station.
A mode selector switch to be located at each manual lever position.
- Remote diagnostic.

SENSORS, REFERENCE SYSTEMS AND PERIPHERAL EQUIPMENT

- Two (2) UPS for DP installation in instrument room with filter/noise transformer.
- One (1) printer for installation in wheelhouse
- One (1) colour printer for hard copy printing of VDU MIMIC
- Three (3) Gyro compasses
- Two (2) MRU-2 and one (1) MRU-5
- Two (2) Wind sensor c/w remote display one aft and one fore bridge.

- One (1) DGPS 700 system (Includes 1 of DPS 232 & 1 of DPS 132)
- Interface for 2 No. C-Nav 2050 G Series DGPS (Kongsberg)
- 2 No. C-Nav 2050 G Series DGPS with suitable interface (not Kongsberg)
- One (1) Radius 1000D
- Two (2) Taut Wire Mk 15\500 - 500m operation (arr. acc. to GA-Plan).
- Two (2) Fanbeam
- OPTION. Replace MRU-2 by MRU-5.
- Two (2) Taut Wire Mk 15 (latest model) with 500m line (electrically remote launch & recovery from bridge). To be P&S on dedicated platforms located at Shelter Deck level at Fr.96 – fr.99, Ref. GA-Plan.

INTERFACE

The DP systems shall interface to all necessary Reference Systems and Reference sensors In addition the system must interface to other relevant components (Main Switchboard, Propeller controls etc.)

The DP system shall control the following thruster units:

- Two (2) Rotatable thrusters (360 degrees) aft.
- Three (3) Tunnel thrusters forward.
- One (1) Retractable Azimuth thruster forward.
- In addition hardware capacity for future interfaces for HPR, Seapath, Artemes, Tautwire to be supplied.

The DP system supplier is responsible for interface to all systems involved.

SOFTWARE

The system shall control the vessel's thrusters In most optimum way, utilising mathematical modelling of vessel behaviour, Kalman Filtering techniques and Optimal Controllers in order to provide the required positioning accuracy and reliability for the various modes of operation

Dead reckoning mode to maintain vessel on station in event of position reference drop out shall be provided.

The DP system shall have at least the following functions:

- Manual-/Joystick Mode
 - Environmental force compensation
 - Joystick Thrust selection. Reduced and full.
 - *Reduced
 - *Full
 - *Non-linear
- Auto Mode (Station keeping)
 - Auto heading
 - Present heading
 - Operator selected heading

Optimum heading
Set Rotate Speed
Heading Alarm
Present Position
Marked Position
Set Position
Previous Position
Set Vessel Speed
Position Alarm
Follow Target

- Thruster Allocation
- Power Load Monitoring and Blackout Prevention
- Controller Gain Selection
- Alternative Rotation Point
- Alarm System
- Built-in Trainer

On-line diagnostics.

Message reporting.

Online consequences analysis. (Ref. To IMO Class).

Online DP capability analysis for Diving/construction vessels.

Message printout.

Extra printer for print screen (colour) with own button on console – Option.

All hardware, software and configuration to be of at least one (1) year warranty.

JOYSTICK SYSTEM

An Independent Joystick system to be installed according to owner and class requirements. The system to consist of the following equipment:

- Independent Joystick controller.

- Main operating unit preferably integrated in the K-Master work station, utilizing the same joystick device as the DP system.

- One (1) remote operator terminal with three (3) connection points:

- One (1) Receptacle located forward bridge
- One (1) Receptacle located port bridge wing
- One (1) Receptacle located stb bridge wing

The joystick system to include at least the following functionality:

Manual joystick control (Surge, Sway and Yaw)

Auto Heading mode

Wind compensation

The built-in trainer and operation simulator shall be implemented as a tool for simulating vessel motion for operator training purposes, and for simulations of operational conditions.

41 NAVIGATION AND SEARCH EQUIPMENT

410

The vessel to be equipped with a radar monitoring system according to rules and regulations from class and authorities. (ref.

The vessel to be equipped with a comprehensive range of the latest equipment available and in accordance to requirement. This equipment should as a minimum include the following item:

- Two independent ARPA radar sets.

Navigation & Communication equipment to be interfaced to Voyage Data Recorder (VDR).

1 off FURUNO FAR-2137S 10cm/S band incl. ARPA and Performance Monitor, or equal make.

IMO ARPA 20 Target Automatic
 20 Target Manuel
Display: 23,1" LCD Full colour
Range: 0,125 to 96nm
Transmitter: 30 kW
Antenna: 12ft
Power supply: 230 vac. one and three-phase
Complete with 30m composite cable

1 off FURUNO FCR - 2117 3cm/X band chart radar incl. ARPA and Performance Monitor or equal make.

Comprising:
Display: 23" LCD Full colour
Range: 0,125 to 96nm
Transmitter: 12 kW
Antenna: 6,5ft
Power supply: 230 vac. one phase
30m Composite cable
To be equipped with IMO ARPA

1 off Inter Switch between radars.

1 off Furuno Radar Slave aft console.
Track ball RCU-016, or similar.
Connected to X-band radar, which is Inters witched to S-band and X-band radar.
Power supply: 230V, 60Hz.

Navigation and communication equipment to be interfaced to voyage data recorder (VDR).

412 NAVIGATION/DIRECTION FINDER

2 off Furuno GP 150, 12 Ch D-GPS with antenna or equal. At least one with DGPS capacity.

1 off NMEA distribution unit.

1 off AIS type Furuno Universal AIS FA-150.

ECDIS – NAUT OSV

2 off Conning display, JH-23" T04 MMD-A1, 23" TFT or acc. to NAUT OSV.

Two ECDIS type Telchart TECDIS with JH-23" T04 MMD-A1, 23"TFT, to be installed for automatic voyage control, with interface to radars, DGPS, Echo Sounder, AIS system, gyro compass. The following parameters for voyage control may be set individually:

Ship speed

ETA

Destination

Voyage control

1 off 19" slave-display for aft bridge

413 GYRO PLANT, AUTOPILOT, COMPASS

- 3 off Gyro compass (One no. for ship's navigation system, and two nos. as part of DP system) type ANSCHUTZ Standard 22 or similar with speed correction. including change-over unit gyro 1 - 2 , universal signal-unit type Nauto-alarm with ready signal from each gyro to the DP-system and NMEA distribution.
- 2 off Digital gyro repeaters for steering-gear rooms
- 1 off Analogue repeater for front bridge
- 1 off Digital repeater for aft bridge
- 2 off Bearing compasses with brackets and 1 bearing sight
- 1 off Magnetic compass with digital repeater and reserve-compass
The night hose to have 2 lights
- 1 off Autopilot, type ANCHUTZ Pilotstar D or similar.
- 1 off Spare compass to be delivered in a box.413

414 ECHO SOUNDER AND SPEED-LOG

- 1 off Echo sounder type Furuno FE 800 (colour), transducer and DNV GL approved steel tank.
- 1 off Digital remote display:
- 1 off Electromagnetic Speed Log (Doppler-log), Furuno DS-80 with transducer in steel tank or similar. (preferably to be arranged in a void tank or a cofferdam).
- 1 off 200ppm log-pulse extension-box:

415 CLINOMETERS, LOADING COMPUTERS

- 1 off Clinometer to be mounted in wheelhouse.
- 1 off Clinometer to be mounted in engine control room.
- 1 off Loading computer for offshore support vessel, preferably of type MT/BIG Chief Shipload to be mounted in the wheelhouse. The loading computer to be linked to ships sounding system and draft sensors, fore, aft and midship. Can be integrated in IAS system on vessel.

417 MISCELLANEOUS NAUTICAL EQUIPMENT

The following equipment to be delivered according to regulation in force:

- 1 off Barometer
- 2 off Thermometers
- 2 off Binoculars 7x50 with binocular boxes
- 1 off Low light binocular
- 2 off Compass
- 1 off Radio clock
- 6 off Chromed battery clocks 6"
- 1 off Parallel ruler
- 1 off Black signal beacon

-
- 2 off Anchor signal balls
 - 2 off Torches with spare battery and bulb
 - 1 off Voyage data record (VDR) type Furuno VR-3000.

Certificates to be delivered.

418 RADAR, SIGNAL OBSERVATION AND ANTENNA MASTS

MAIN MAST

A main mast to be located on wheelhouse top as shown on GA. The mast foundation and the mast itself to be of solid design to minimise vibrations in the mast. The mast to be equipped with foundations for radar antennas, satcom antenna etc., flag staff etc., and also with brackets for light and lanterns, air whistle, misc. antennas etc. (Double mast).

Sufficient space to be considered for extra antennas for the charterers need.

All cables to be inside mast as far as practical.

Antenna and mast arrangement on top of wheelhouse to be rearranged according to installation of helideck and the safety sector requirements for the helideck.

STERN MAST

A short pole mast to be arranged at stern for anchor lights. (Removable)

FORE MAST

A foremast to be located as required by National Authorities.

42 COMMUNICATION EQUIPMENT

Radio installation according to GMDSS Sea area A3 to be provided.
Helicopter Monitoring System, Helicom and Helibeacon according to CAP 437/UKCAA.

Spare parts and tools according to National Authorities.

421 GMDSS A3 RADIO STATION

- 1 off MF/HF 150 W simplex radio station with DSC-unit, make Sailor or equal.
- 2 off Inmarsat C, type Sailor or equal with telex and EGC receiver.
- 2 off Sailor GMDSS alarm panel or similar acc. to Naut OSV.
- 1 off Navtex receiver type Furuno NX-700B.
- 1 off Battery charger 24 V 25 A.
- 1 off Battery-container.
- 2 off Radio-batteries (based on 230 V backup from emergency gen.set).
- 2 off Fuse-boxes.
- 1 off Ship security alert system, (to be included in Inmarsat C).
- 1 off LRIT (long range identification and tracking system) to be included in Inmarsat C.

Antennas for MF/HF and VHF communications:

422 LIFE BOAT TRANSMITTERS, EMERGENCY EQUIPMENT

- 3 off Portable VHF radios.
- 2 off Radar transponders for life raft /boat (9 GHz).
- 1 off VHF free-float with bracket mounting arrangement (EPIRB).

423 SATELLITE COMMUNICATION SYSTEM

- 1 off Satellite V-system to be provided by owner and installed by yard.
- 1 off Inmarsat Fleet broadband 500 with interface to PABX (telephone central) and ships computer network.

424 VHF AND UHF RADIO TELEPHONES

Four off separate VHF radio sets, stationary mounted, with all channels and dual watch. Two sets to be positioned at the aft end console on bridge. Three off separate UHF radio sets, stationary mounted, with all channels used in service for international operation. Channels/frequencies for international operation installation will be given access to by Charterer.

All stationary VHF stations to be delivered with all international channels.

- 2 off Simplex/ Semi Duplex VHF stations with DSC and multi watch. Type Sailor RT 6222 or similar. 1 with slave handset in Hospital.
- 2 off Simplex VHF stations with dual watch Type Sailor RT 6210 or similar. Slave handset in ECR.
- 4 off UHF type Motorola GP 380, with easy select of channels.
- 2 off Smoke divers outfit. In helmet, for GP-series.
- 3 off UHF radios, stationary model, type GM 360 with mic and antenna, 230 v/ac power supply, two for installation in WH and one in ECR.
- 1 off GSM radio with line interface and antenna.

All portable VHF & UHF to be equipped with loose microphone, and one (1) spare battery each.

External antenna system for connected to portable mobile telephones to be mounted on bridge, capacity to connect at least 2 mobile telephone at the same time.

Communication systems, UHF-, VHF- and telephone system shall be arranged in a such way that both navigating officers shall be able to communicate independently with other communicators. UHF-, VHF-radio shall be mounted stationary and connected to external antennas.

Note: Use of UHF/VHF handset on bridge is prohibited. All radio set (mobile telephones incl.) used on bridge shall be connected to an external antenna.

DIGITAL COMMUNICATION

V-sat with internet. High speed data transfer and desktop terminal with 17" flat screen monitor at the following locations:

- Ship office
- Project office
- Master's day cabin
- Chief engineer's day cabin

ETO OFFICE

- Client offices
- Offshore manager's office
- Field engineer's office
- Diving superintendent's office
- Sat control
- Dive control
- 3 sat chambers
- WROV control

Internet access via V-sat system with Wi-Fi (LAN connection). Antenna for each accommodation level for laptop connection and private email access.

NAVIGATION/VIDEO SCREEN.

Digital video network sharing with 10 multiple audio/video channels:

- Vessel position / route mapping
- 4 Sat divers (2 x Diver video 1 + 2 (SDC 1) and 2 x Diver video 3 + 4 (SDC 2))
- 2 off air diver
- 2 x ROV video
- 1 not allocated

19" flat screen video monitors with screen partition capability at the following locations:

- Bridge
- Survey room
- Project office
- Client offices
- Dive control
- WROV control
- Master's day cabin
- Offshore manager's cabin
- Diving superintendent's cabin

425 INTERCOMMUNICATION SYSTEM

INTERCOM/TELEPHONE/PA –SYSTEM

- 1 off GSM modem with interface to PABX.
- 1 off GSM modem with interface to ships computer network.
- 1 off Satellite communication station F(ref. 421), with telephone and telefax.
- V-sat to be connected to telephone central.

1 off Mobile telephone system GSM, to be used for e-mail only.

The central to be equipped with voice and "debiting" system, minimum 8 line in. The logging system to have enough capacities to handle all telephones on-board the vessel.

It shall be possible to receive incoming telephone as well as doing outgoing telephone call from all telephones locations.

3 off Portable telephone in engine room, all with suitable headset and adapters and carrier bag: Chief Engineer - 1 st engineer – Electrician.

The portable telephones system to have enough antenna signal strength, which makes it possible to have contact within accommodation, machinery spaces and on working deck.

Portable telephone in engine room to be connected to alarm system (AUTOMATION SYSTEM)

- 1 off 1 hour UPS /From EM source.
- 1 telephone station in bridge console with central function.
- 1 telephone station in bridge aft.
- 1 telephone station in bridge operation central.
- 1 telephone station in bridge survey area.

- 1 telephone station in sky lobby.
- 1 telephone station in each cabin.
- 1 telephone station in sleeping chambers (Captain and Chief engineers cabins)
- 1 telephone station in office & Conf. room on capt. deck.
- 1 telephone station in each Instrument room (2 off) on Forecastle deck.
- 1 telephone station in dayroom.
- 1 telephone station in mess room.

- 1 telephone station in galley.
- 1 telephone station in office & lounge on shelter deck.
- 1 telephone station in hospital.
- 1 telephone station in coffee shop
- 1 telephone station in deck workshop

- 2 telephone station in ECR, switchboard room, one portable type Doro 1500 or similar.
- 1 telephone station in wardrobe main deck (ex and water proof IP 66) to be fitted in a plastic cabinet.

- 1 telephone station in deck workshop, main deck port aft.
- 1 telephone station in engine workshop.

- 1 telephone station in el. workshop.
- 1 telephone station in switchboard room.

- 1 telephone in lower pump room.
- 1 telephone station in bow thrusters room.
- 1 telephone station in main azimuth thrusters room.

- 1 telephone station in emergency generator room.
- 2 telephone stations in ROV control room
- 1 telephone station in helicopter reception
- 1 telephone station in offshore crane
- 1 telephone stations in dive control room on main deck
- 1 telephone stations in SAT control room on tween deck

- 2 telephone stations in offline room
- 2 telephone stations in conference room
- 2 telephone stations in offices on main deck

The communication system shall be sufficient for the vessel's complement of 91

PA also to cover the total external deck area during operations.

Telephone stations in bow thrusters room, main azimuth thrusters room, lower pump room and emergency generator room, shall be equipped with acoustic and optical signal. For these stations ear phones with microphone and enough cable to cover the entire room.

The telephone system shall have the following features:

Min. 4 simultaneous calls.

Priority for essential stations.

Override for essential stations.

Loudspeakers for PA function to be mounted according to class requirements.

SOUND POWERED TELEPHONE SYSTEM.

- 1 telephone station in bridge console fwd.
- 1 telephone station in bridge console aft.
- 1 telephone station in engine control room.
- 1 telephone station in main azimuth thrusters room.
- 1 telephone station in Captain's cabin.
- 1 telephone station in Chief Engineer's cabin.
- 1 telephone station in Dive Control Center port side (provisional).

Telephones and Sound Powered telephone in engine control room shall have common acoustic and optical signals in engine room, lower pump room. Acoustic signals also to be common with E0/ACCU alarm.

LOUDHAILER SYSTEM

- 1 off 150W loudspeaker to be mounted on wheelhouse top.
- 1 separate line amplifier with microphone on goose neck in aft bridge console centre.

CCTV-SYSTEM

A CCTV system consisting of 9 cameras to be installed as to allow captain to monitor vessel on main deck from bridge. Main station/control to be located on bridge.

Location of cameras to be agreed with Owner, however to include:

- Working deck deck area, 2 off camera aft of new accommodation
- Gangway PS and STB, 1 off camera on each side.
- Helicopter deck, 1 off camera.

Main monitors 20 " with selector switch shall be located in aft bridge (2 monitors), one monitor in crane cabin, one monitor ROV control room and one slave monitor in ships reception.

CLEARCOM SYSTEM

Clearcom system to be installed for communication in offshore crane cabin, ROV control room, and client offices. Main clearcom station on bridge. Cables to be installed. System to be Owners delivery.

427 SIGNAL LIGHTS

MAIN NAVIGATION LIGHT CONTROL PANEL:

The panel is equipped with a changeover main switch for two separate 230 V supplies. One directly from 230V main switchboard and one from em. distr. Board 230V, wheel-house.

MORSE AND MANOEUVRE LIGHT IF REQUIRED:

These lanterns shall be controlled from the forward bridge console.

All lanterns to be approved and to be delivered with certificate stated by manufacturer.

Day light signalling lamp to be delivered by Yard, complete with battery and charger.

All navigations lanterns to be duplicated, and to be approved and to be delivered with certificate.

Helicopter lighting as required by DGCA guidelines.

TYPHONE (WHISTLE):

Typhon type Kockum or similar with automatic controller to be fitted in Radar Mast and arranged according to Authorities requirements. The typhoon to have built in heating and push button in fore and aft bridge console supplied by 24V DC system. Automatic fog signal.

Air pipe of Ermeto steel pipe with normal coupling from air system, to be laid easy accessible and at least possible exposed to frost, and so that water pockets are avoided. Insulated where necessary.

BELL

One 12" bell (chromed brass) to be mounted.

FLAGS

Signal flags etc. and lockers in wheelhouse to be delivered by the shipyard.

43 ANCHORING, MOORING AND TOWING EQUIPMENT

431 ANCHOR WITH CHAIN AND EQUIPMENT.

The vessel shall be equipped with two -2- off anchors (Spek type, short shank), according to class. Anchors to be fitted in pockets forward.

Anchor, chain and windlass to each chain locker to be in accordance with Class requirements.

Rope store below forecastle deck, with two rope hatches in deck to store below forecastle deck.

The first half piece of the stud-link chain cable connected to the anchors to be hot dip galvanized.

432 ANCHOR WINDLASS AND CHAIN STOPPERS

Anchor / Mooring windlass

Two -2- off electric driven combined anchor/mooring winches to be provided local command shift, with de-clutchable combined drum and capstan to be provided acc. to GA-plan. Minimum 10 T.

Remote start / stop with light from fwd bridge.

433 MOORING CAPSTANS/WINCHES AFT

Two -2- off 10 tons hydraulic mooring Capstans/winches to be fitted as indicated on GA plan, aft on shelter deck. With local start/stop, and command shift, and remote start/stop with light from aft bridge.

435 FIXED MOORING EQUIPMENT

The shipyard shall include in its price mooring equipment according to owner requirements/drawing.

CHOCKS AND ROLLER FAIRLEADS FOR BULWARK:

Chocks to be arranged according to drawings. In general ordinary type of Chock (NS 2587) to be used. The foremost Chocks on forecastle deck to be of type Panama approved, type NS 2589.

On Forecastle deck roller fairleads to be arranged (2 double and 2 single) and aft on Main deck, 4 single and 2 double roller fairleads, acc.to GA.

436 LOOSE MOORING EQUIPMENT

Owner delivery

44 REPAIR, MAINTENANCE AND CLEANING EQUIPMENT

THE FOLLOWING TOOL MACHINES, ETC. TO BE INSTALLED IN THE ENGINE WORKSHOP:

- 2 off Lockable lockers.
 - 1 off Wash basin of stainless steel with hot and cold water.
 - 1 off Lathe complete with all equipment: 1000 mm length and 250 mm centre high.
 - 1 off Drilling machine make Stand, type SB 25 w/pivoted vice. The drilling machine to be equipped with 1 off drilling chuck and 1 off drilling bushing.
 - 1 off Wheel grinder PSDs model 2 or similar.
 - 1 off 6" engineers vice.
 - 1 off Welding trafo on workshop. Secondary welding outlet in deck workshop and in aft workshop /storeroom aft main deck..
 - 1 off Unitor UWR 150 welding machine, with Tig welding equipment (complete).
 - 1 off Connection to centralised Ac/Ox central.
 - 1 off Steel work bench with drawers and lockers underneath of builder's standard.
 - 1 off Bin for dirty and oily waste.
 - 1 off Pressure tester
 - 1 off Multimeter
 - 1 off Calibrating instrument for temperature sensors
 - 1 off Megger
- Above work bench tool board to be arranged

WORKBENCH IN ENGINE ROOM TANK TOP:

- 1 off Steel work bench
 - 1 off 6 " engineers vice.
- Above workbench a tool board to be arranged.

IN AFT WORKSHOP/STOREROOM:

- 1 off Steel work bench with drawers and lockers underneath of builder's standard
 - 1 off 6 " engineers vice.
 - 1 off Secondary welding outlet.
 - 1 off Air supply.
 - 1 off Bin for dirty and oily waste.
- Appropriate number and size of shelves.
Above work bench tool board to be arranged

DECK WORKSHOP FORWARD CARGO DECK:

- 1 off Steel work bench with drawers and lockers underneath of builder's standard
 - 1 off 6 " engineers vice.
 - 3 off Lockable lockers.
 - 1 off Drilling machine make Stand, type SB 25 w/pivoted vice. The drilling machine to be equipped with 1 off drilling chuck and 1 off drilling bushing.
 - 1 off Wash basin of stainless steel with hot and cold water.
 - 1 off Wheel grinder PSDs model 2 or similar.
 - 1 off Air supply.
- 1 off Bin for dirty and oily waste.
1 off Unitor UWR 200 welding machine.
1 off Secondary welding outlet, with 2 x 40 mtr welding cable.
Connection to AC/Ox central with 2 x 40 mtr cable.

Appropriate number and size of shelves.
Above work bench tool board to be arranged

EL. WORKSHOP:

Ref.gr 8

1 off work bench with drawers and lockers underneath of builder's standard
1 off 5 " engineers vice.
2 off Lockable lockers.
1 off Clip-on Ammeter (1000A / 1000V).
1 off SPM measure instrument. (ref: General Description E)
1 off Drilling machine make Stand, type SB 25 w/pivoted vice. The drilling machine to be equipped with 1 off drilling chuck and 1 off drilling bushing.
1 off Air supply.
1 off work lamp with magnifying glass.
1 off Adjustable high, work chair.
Above work bench tool board to be arranged

Loose tools to be supplied by owners.

444 CLEANING EQUIPMENT

1 off HP washing machine, two pumps 160 bar, with stainless steel piping and quick couplings. The HP washing machine to be able to handle 2 users at the same time. Local and remote start / stop. Remote start / stop from deck workshop fwd main deck.

Connection to locate from: Steering gear room and upper passage way.
2 in engine room, 2 on main deck. forecastle deck, aft superstructure, bridge deck. Total of 10 connections.
Pipes to be of stainless steel. Hot water supply.
4 x 20 mtr + 2 x 10 mtr hose. 2 "long" and 2 "tank" "gun" to be supplied.

445 INCINERATOR

1 off Incinerator type, see makers list, with gate, for burning dirty MGO, sludge oil and waste oil to be installed. The incinerator to be complete with control panel, el.pilot fuel heater, flue gas fan and flue gas damper. The incinerator to be according to IMO resolution MEPC.76(40).
Sludge/miring/heating tank to be arranged.
The incinerator also to mounted with Racon fuel oil filter, type Racon 460 w/element R60T.

The fuel oil tank for incinerator to be of hull integrated type.

The incinerator room also to be arranged with bins for garbage storage, with drainage from bottom.

446 STORE ROOMS AND WORKSHOP

STORE ROOMS

Store rooms to be arranged according to general arrangement plan.
In store rooms shelves to be provided according to agreement between building yard and Owner.
See group 441.

447 CLAMPS AND FOUNDATIONS FOR SPARE PARTS

10 pc. Lockers and shelves for smaller spare parts to be delivered and fitted by building Yard.
Heavier spare parts to be stored in special clamps or foundations at suitable places in engine room or store room.
Clamps and foundations to be fitted by building Yard.

448 SIGNBOARDS AND MARKING ON MACHINERY, PIPES ETC.:

All pipes to be marked with colour code and flow direction.
All valves, pumps etc. to be marked with brass / stainless steel signs, to be fastened with stainless steel screws or nails.

45 LIFTING AND TRANSPORT EQUIPMENT FOR MACHINERY COMPONENTS

452 LIFTING BEAMS

Above main gen. sets, beams for lifting and removal of cylinder heads and pistons to be arranged.

Each of the lifting beams to be dimensioned for a lifting capacity of 2 tons. All lifting equipment to be marked with SWL c/w certificates. The beams to be led to hatches.

Above heavy engine equipment, lifting eyes with necessary reinforcement to be fitted.

Yard to supply double runner and chain tackle for each lifting beams.

All lifting beams, runners and chain tackle to be approved by class.

Lifting beams with trolley to be arranged above existing engine room hatch on main deck, beams to extend from frame no. 105 to frame no 116, for transportation of machinery parts through hangar area on each side.

Lifting beams to be dimensioned for SWL 2 t, yard to arrange load testing/certificate.

A lifting plan for generators in engine room to be provided.

MAIN GROUP 5 EQUIPMENT FOR CREW

GENERAL

Accommodation and Safety equipment shall be based on a total number of 120 persons on-board. All safety equipment to be of general good standard for this type of vessel, with English text.

50 LIFESAVING EQUIPMENT

501 LIFEBOATS WITH DAVIT.

Lifeboats to be arranged on both sides of the vessel. Capacity 2 x 60 persons, according to rules. (On GA-plan, 2 x 70 persons lifeboats from Harding are shown Type: KISS 800. or equal arrangement).

1 off MOB boat, diesel driven water jet, with one A-frame davit to be arranged. The MOB and its arrangement to be according to Solas.

According to rules. 1 off the lifeboats to be certified as a rescue boat.

502 LIFERAFTS WITH EQUIPMENT

Life rafts to be arranged on both sides of the vessel, capacity acc. to Flag state/Authority rules.

503 LIFESAVING, SAFETY EQUIPMENT

According to Flag state/Authorities rules and SOLAS for 120 crew and passengers. Survival suites for a total number of 120 persons, to be delivered and to be arranged on muster stations in heated lockers. All safety equipment to be of general good standard for this type of ship, with English text.

504 HOSPITAL, MEDICINES AND MEDICAL EQUIPMENT

According to rules.

The ship shall have a medical facility capable of providing basic medical care, acc. to Flag rules. Medical and first aid supplies to be delivered by Owner and installed by the Yard in suitable medical refrigerated lockers with locks for the master key system.

Medical Cabinets with integrated lockable drug compartment and medial refrigerator, with sufficient shelving to arrange drugs and equipment in an orderly and logical manner, are to be provided. Consideration should be given to ensure that the cabinet can be accessed in inclement weather; doors can be held open and drawers to be lockable in two positions.

Three sectional treatment bench, hydraulic adjustable and with side frames, ship legs and paperroll-holder.

The floor in the hospital shall be arranged as "wet floor" with drains.

Yard to prepare for installation of:

Software/system to verify the maintenance and control of supplies, logistics and use of medicines and medical equipment should be considered to ensure an easy, secure and safe operation of the hospital. Software is Owner supply.

Software/system including ECG belt and web camera, for safe transfer of text, picture and sound connected to emergency centre/doctor ashore.

Owner to deliver software, equipment and medicines for installation by yard. Yard to deliver and install medical furniture's according to drawings delivered from MT.

505 LOOSE FIRE FIGHTING EQUIPMENT

According to rules.

An appointed number of fire extinguishers (powder and water) to be provided for machinery spaces and accommodation. GRP boxes with fire hoses and jet nozzles to be mounted in suitable places.

SMOKE DIVING EQUIPMENT

Complete fireman's outfit to be supplied and stowed according to requirements and owners approved type

Each set to be equipped with UHF communication sets (Headset type).

One (1) off Breathing air compressor, 300 bar to be supplied for filling of air bottles. Arrangement to be made for safe filling of air bottles.

The compressor to be el. supplied also via emergency generator.

Emergency breathing apparatus according to IMO requirement.

All safety equipment's supplied shall also meet flag state requirements.

51 INSULATION, PANELS, PARTITION BULKHEADS, DOORS, SIDE SCUTTLES AND WINDOWS

510 GENERAL

It is the intention of this specification to obtain a safe, modern and comfortable accommodation of good design, pleasing appearance and normal Norwegian standard. The interior shall be built for easy maintenance and seaworthiness in every detail.

Max Noise and Vibration levels to satisfy COMF-V(3) requirements.

All materials used for walls, ceilings and floors in accommodation shall be certified as non-combustible and shall not produce toxic gases during a fire. Colours of panel, ceilings and doors to be approved by owner.

The accommodation to be arranged for 120 persons acc. to GA :

TWEEN DECK:

1 off toilet with wash basin. Hot and cold water. The room to be arranged in the forward part of the Engine room.

Engine workshop.

El. workshop

Workshops to be sound insulated. Insulation to be lined with galvanised steel plate, thickness approx. 1 mm.

Switchboard room.

Saturation control room.

2 of store room (PS / SB).

Diver suit wash room.

Diver suit dry room.

Pantry store.

Dive pantry.

2 of dive system switchboard rooms.

MAIN DECK:

Deck workshop.

Rigging store.

2 of Air dive chambers

Dive control room.

Dive store/workshop

ROV Workshop

Incinerator

Wardrobe./Locker room

Laundry work clothes.

6 off toilet's.

Engine control room.

3 off Stores.

Linen store

Laundry.

Client office

Project office.

Techs Library

Technical Office.

Technical Workshop.

Dive Technical store.

DIVING HANGAR

Insulation in Diving hangar (on Main deck) outer bulkhead to be provided and to be covered with painted galv. thin plates. Type of insulation according to insulation plan.

SHELTER DECK:

Reception.
ROV control room.
Two (2) of WC.
Broom closet.
Provision rooms with cool & freeze sections.
Dry provision, in three compartments.
Galley.
Bakery.
Scullery.
Mess room.
Dayroom none smoker.
Dayroom smokers.
Waste trunk.

FORECASTLE DECK:

34 of Twin-berth cabins.
1 off Instrument room.
1 of Laundry
Linen
One WC/shower pr. cabin, -acc. to GA-plan.

BOAT DECK:

Electrician cabin
Store keeper cabin
Safety officer cabin
Hydraulic engineer cabin
ETO cabin
1 of Officer cabin.
9 of Single-berth cabins.
12 of Twin-berth cabins.
One WC/shower pr. cabin, acc. to GA-plan.
1 of Instrument room (w/1 of Gyro).
Broom closet.
One (1) of WC
Store.
Hospital
Gymnasium

CAPTAIN DECK:

Captain's cabin.
Chief engineer's cabin.
2 of Chief officer cabin's.
2 of 1st engineer cabin's.
2 of 2nd engineer cabin's.
2 of 2nd officer cabin's.
1 Client cabins.
2 of 1 officer cabin's.
Laundry

Linen
One WC/shower pr. cabin, -acc. to GA-plan.
Ship Office.
Conference / Lounge room.
Instrument Room (w/1 of Gyro).
AC Room.

BRIDGE DECK:

Wheelhouse with work and manoeuvring stations according to GA plan.
Navigation workstation fwd
Ship operation workstation aft
Survey area SB wing (lowered in floor)
Operational Control Office area SB (lowered in floor)
Radio station SB side fore
Toilet.
Pantry

TOP OF WHEELHOUSE:

Sky lobby lounge / reception.
Heli suit store
Toilet
Em. Gen
AC room

511 INSULATION, PARTITION BULKHEADS AND PANELLING

INSULATION

All insulation shall be certified as non-combustible according to SOLAS Ch II/2 Reg. 5.3.1.

All surfaces shall be covered with aluminium or fibreglass to prevent dust from the insulation. The insulation shall be fixed to the bulkhead or deck by using pre-welded pins according to suppliers guidance. Lining to be fitted minimum 10 mm from insulation. Accommodation panels to be fitted minimum 20 mm from insulation.

Fire-resistant constructions shall have EC-Type Examination Certificate (MED-certificate).

Sound-reducing structures shall as a minimum meet the requirements indicated in the insulation plan, and the solution to be documented by laboratory tests.

Against the hull the insulation shall end 50 mm above the deck to make sure that any condensation is drained, and it shall be used vapour sealing against the interior such as aluminium foil with taped seams. Comfort insulation shall have an U-value of at least 0,24 W/m²K (0,75 above stiffeners) based on a thermal conductivity at 10°C (λ_{10}) (example: Glava Marine Mat 16 100 mm + 50 mm)

Insulation in technical areas such as engine room, workshops and similar compartments which are not covered by panels shall be covered by a 0,9 mm galv. sheet metal lining with tightly lapped joints. Alternatively a certified pre-covered insulation may be mounted instead. The cover shall be of fire resistant material, delivered pre-covered by the manufacturer.

Floating floors are described in 521

PARTITION BULKHEADS

Walls in the accommodation areas shall be made of certified modular systems such as Contech/Norac or similar good quality. The products' characteristics in terms of noise reduction shall be emphasized. To prevent structural noise from propagate through the inner panel, it shall be used rubber suspensions between panel

and structure. There shall be a minimum gap of 20 mm between panel and structure/insulation. Panels to be fitted with lockable service-hatches as shown on GA.

Noise reduction (Rw) requirements: according to COMF-V(3) requirements

Walls between dayroom, corridor and mess room to be fitted with windows according to GA.

CEILINGS

Ceilings in the accommodation areas shall be made of certified modular systems such as Contech/Norac or similar good quality. The products' characteristics in terms of noise reduction shall be emphasized. To prevent structural noise from propagate through the ceiling, it shall be used rubber suspensions between ceiling and structure. There shall be a minimum gap of 20 mm between ceiling system and structure/insulation.

Noise reduction (Rw) requirements: according to COMF-V(3) requirements

WET ROOM UNITS

Wet room units to be of prefabricated type such as Contech/Norac or similar good quality, and shall be delivered fully ready for use with all the necessary equipment installed.

To ensure the longevity of the product, drains and drain-pipes shall be made of stainless steel. It shall further be used membrane between the tiles and concrete/coaming to ensure a tight layer. Membrane to be glued to the drain.

All pipes shall be continuous with no hidden seams. All joints and connections shall be accessible from inside or through service hatches. Equipment to be installed from inside so that it can easily be replaced.

Bathrooms to be supplied with heated floor with a thermostat.

If there is a barrier against the shower area, there shall be fitted 2 drains.

512 INTERNAL DOORS

A-class doors to be made of steel with steel frames and fitted with door closer. A-class doors that is normally open shall in addition be fitted with magnetic holder which is connected to the fire-alarm central and can be released from bridge. Doors that leads to machinery spaces shall be fitted with sound gaskets to reduce noise.

B-class and C-class doors to be fitted with ventilation louver except where there is a closed ventilation system. Considering Comfort Class notation, the cabin doors shall meet a noise reduction of at least Rw 37 dB.

All doors between cabins and corridors to be equipped with self closers according to rules. All other B-, and C-class doors to be fitted with doors stoppers and hooks to keep them in open position.

Doors from dry provision room to cooling and freezing areas to be galvanized and insulated.

Clear opening (width):

General:	750 mm
Escape routes: Min.	900 mm (To be calculated according to FSS-code)
Cabins:	650 mm
Toilets	600 mm
Hospital:	900 mm

General clear height above deck 2000 mm.

Doors leading to Mess room, Dayroom and lounge to have window with owners logo.

Hydraulic watertight sliding doors to be fitted according to GA-plan. Doors to be monitored and remote controlled from bridge. In addition it shall be possible to monitor and close the doors manually from a safe position above Main deck.

Minimum clear opening 700 mm, but shall be as wide as possible in terms of transportation of equipment through them.

Doors from open deck to accommodation and wheelhouse to be made of GRP and fitted with window if possible. Doors that are frequently used shall be of Quick-closing type.

All external doors to be equipped with non-corrosive material in movable parts.

For sill heights above 300 mm a step shall be mounted on each side.

Clear opening (width):

General: 800 mm

Escape routes: minimum 900 (to be calculated according to FSS-code)

Leading to hospital: 900 mm

General clear height above deck 2000 mm.

515 SIDE SCUTTLES AND WINDOWS WITH EQUIPMENT

Windows and scuttles shall be delivered in accordance with the relevant ISO standards. and to be installed as indicated on GA. Final size/type to be according to approved arrangements. All Side Scuttles and Windows to have framing welded to the shell/bulkhead.

Window glass to be made of safety laminated glass with required thickness, fixed within sealed brass or stainless steel retaining frames. Glass retaining frames to be polished to visible side. Closing handles, hinges, bolts etc. to be of brass or stainless steel. Hooks for hinged windows and deadlights to be provided. Spare glass etc. as prescribed by Rules.

PORTHOLES

Insulated window boxes of fire resistant laminated/veneered plywood to be installed, well connected to the selected wall system and to steel/aluminium structure. Soft/flexible rubber sealing's to be provided within the boxes to keep tightness and to avoid rattling. Drainage rim to be installed with drain hose to gutter way. Backsides to be sprayed with an approved noise absorbing compound.

Inner windows to be installed in noise exposed positions on Main deck, Shelter deck and Forecastle deck to improve noise levels in accommodation

WHEELHOUSE WINDOWS

All windows in wheelhouse *within the required field of vision*, shall be equipped with window wipers of straight line vertical blade type and variable speed. Heated windows to be installed according to NAUT OSV(A) requirements for vessels navigation in ice.

All wheelhouse windows to be equipped with external fresh water spray (with compressed air purging) and defroster nozzles and transparent sun curtains inside.

Window wiper-, heated windows-, and fresh water flushing-systems to be segregated into multiple zones according to agreement with owner.

518 MASTER KEY SYSTEM

A complete master key system shall cover:

- all accommodation doors (master key system)
- Cabins (touch/key card system)
- all external doors (master key system)
- wardrobe locker doors (master key system)
- Inside cabins, drawers and lockers (master key system)
- in addition 10 padlocks

52 INTERNAL DECK COVERING - STAIRS, LADDERS, RAILINGS ETC.

521 DECK BASE COVERING, INTERNAL

In order to maintain the requirements for fire integrity, noise and vibration, it shall be installed floating floor on main, shelter and forecastle deck in accordance with the following specification:

MAIN DECK

3 mm Visco-elastic with pieces of steel
30+50 mm insulation (Rockwool Marine Slab 140 or similar)
3 mm steel plate
1 mm Visco-elastic
2 mm Steel plate
1 mm Visco-elastic
2 mm Steel plate
15 mm Self levelling compound (30 mm in wet rooms)

2 mm Visco-elastic with pieces of steel
50 mm insulation (Rockwool Marine Slab 140 or similar)
3 mm steel plate
1 mm Visco-elastic
2 mm steel plate
15 mm Self levelling compound (30 mm in wet rooms)

FORECASTLE DECK

2 mm Visco-elastic with pieces of steel
30 mm insulation (Rockwool Marine Slab 140 or similar)
3 mm steel plate
1 mm Visco-elastic
2 mm steel plate
15 mm Self levelling compound (30 mm in wet rooms)

The floating floor shall be separated from the rest of the structure along the boundary by using an insulation layer.

On the remaining decks there shall be used 10-20 mm of self-levelling compound as a base for top covering.

NOTE!

Solution as mentioned above is to be considered as a general MT-solution, and is not specified for this particular vessel. Any recommendations as a result of a sound- and vibration analysis must be met.

522 DECK TOP COVERING INTERNAL

Top layers to be of 2 mm thick oil and seawater resistant PVC-cover (vinyl), glued on top of the aforementioned underlay with a suitable adhesive, recommended by respective makers. Covers to be suitably fabricated for high working stress and to be of anti-slip type.

Compass rose to be arranged in deck cover in wheelhouse and dayroom.

Treads and risers to have vinyl cover of the same thickness and quality as the rest of the floors. All stairs to be provided with an anti-slip list.

In wet rooms membrane and anti-skid tiles to be applied on top of cement compound. Coamings also to be fitted with membrane and tiles.

Rooms without covering to be painted with anti-slip type paint as directed in the paint schedule.

In Switchboard room floor to be covered with rubber tiles of approved type.

524 STAIRS, FLOOR PLATES, PLATFORMS, LADDERS, RAILINGS, ETC. IN ACCOMMODATION

All internal stairs to be built of steel in permanent steel trunks with lining and insulation according to drawings. Stairs to have 45 degree rising.

In wheelhouse angle bar frame support for a raised floor approx. 1100 mm above steel deck to be arranged. Flooring shall be made of certified non-combustible plywood.

Internal railings to be of aluminium or hardwood and to be fitted in corridors and on both sides of stairs.

525 FLOOR PLATES, LOOSE, LADDERS, PLATFORMS, RAILINGS, ETC. IN ENGINE ROOMS, PUMP ROOMS ETC.

Loose floors in engine room to be of chequered steel plate (in all escape routes). Aluminium plates where allowed by class. Floor to be laid in frames of aluminium support, above all piping/installations on tank top. Around foundations, machinery, valve boxes, piping etc. the floor to be laid with openings for handies. The plates to be divided in handy sections and fixed by countersunk galvanised screws.

(Use of where to arrange loose aluminium floors in engine room to be clarified with class at an early construction stage).

Stairs in engine rooms, cargo/ stores room, etc., to be made of pre-fabricated anti-skid galvanised steps. Railings of non corrosive metal.

Ladders to be mounted in all tanks with tank height more than 1000 mm.

Vertical ladder, especially in tanks, the steps to be made of two 20 x 20 mm steel bars. The bars to be welded to 50 x 8 mm flat bar members. Ladders also to be arranged in casings/funnels.

53 EXTERNAL DECK COVER - STAIRS AND LADDERS ETC.

533 EXTERNAL HANDRAILS, AND RAILINGS

Railings to be arranged around the deck perimeter and on outside of superstructure as shown on the GA-plan and/or as per separate drawing(s).

The railing to be made of galvanised steel pipe with stanchions of galvanised flat bars. Top rail not to be less than 48 mm outer diameter.

534 EXTERNAL LADDERS, STAIRS, PLATFORMS, GRATINGS ETC.

Stairs and Ladders on external deck to be galvanised.

Vertical ladders to have flat steel strings and steps of square iron bars.

Grating outside to be of anti-slip and fire resistant fibreglass type.

Stairs serving as escape routes shall be according to rules and regulations.

54 FURNITURE, INVENTORY AND ENTERTAINMENT EQUIPMENT.

540 GENERAL

Arrangement of furniture shall be according to GA-plan. All furniture's and equipment shall be of solid construction and shall be easy to clean and maintain.

Wooden furniture shall be of good design and quality, and be made of plywood, covered with veneer or plastic laminate with hardwood- or PVC-edges. Tables to be fitted with wobble-edges. All corners on furniture's to be rounded.

Sofas to be provided with seats, arm and back-rests, well stuffed with foamed synthetic resin and covered with leather.

Furniture, textiles and equipment to be reviewed and approved by owner before ordering.

541 FURNITURE FOR CREW AND PASSENGERS

2-MEN CABIN /TWIN CABINS

- Bunk bed 2000x800 mm (measured inside) fitted with 2 lockable drawers with a volume of at least 0,06 m³ each, fixed ladder and curtains. Bedside shelf to be fitted if possible.
- 1 of table acc. to GA-plan.
- 2 of wardrobe size 500x600 mm (floor to ceiling) fitted with lock, 2 shelves and clothes-bar.
- Minimum 2 of seats which at least 1 to be a chair.
- 1 of book shelve (can be combined with other furniture's i.e top of wardrobe)
- 1 of TV with adjustable wall bracket. Size min.24".
- 1 of stereo or entertainment system

1-MAN CABIN

- Single bed 2000x800 mm (measured inside) fitted with 2 lockable drawers with a volume of at least 0,06 m³ each. Bedside shelf to be fitted if possible.
- 1 of table acc. to GA-plan.
- 1 (or 2 if possible) wardrobe size 500x600 fitted with lock, 2 shelves and clothes-bar.
- Minimum 2 of seats which at least 1 to be a chair.
- 1 of book shelf. (can be combined with other furniture's i.e top of wardrobe)
- 1 of TV with adjustable wall bracket. Size min.24".
- 1 of stereo or entertainment system

OFFICER /CLIENT CABINS

- Single bed 2000x800 mm (measured inside) fitted with 2 lockable drawers with a volume of at least 0,06 m³ each.
- 1 of bed table
- 1 of table acc. to GA-plan.
- 2 of wardrobe size 500x600 fitted with lock, 2 shelves and clothes-bar.

- Minimum 3 of seat in sofa (alt. 1 easy chair)
- Bookshelves acc. to GA-plan
- 1 of writing desk with office-chair and 2+1 drawers
- 1 of TV-bench with 23 litre fridge
- 1 of TV with adjustable wall bracket. Size min.26".
- 1 of stereo or entertainment system

CAPTAIN'S CABIN & CHIEF ENGINEERS CABIN

- Single bed 2000x800 mm (measured inside) fitted with 2 lockable drawers with a volume of at least 0,06 m3 each.
- 1 of table size approx. 700x500 mm
- 2 of wardrobe size 500x600 fitted with lock, 2 shelves and clothes-bar.
- Minimum 3 of seat in sofa
- Bookshelves acc. to GA-plan
- 1 of writing desk with office-chair and 2+1 drawers
- 1 of TV-bench with 60 litre fridge
- 1 of TV with adjustable wall bracket. Size min.40".
- 1 of stereo or entertainment system

MESS ROOM

Furniture according to GA. Tables to be at least 1200 mm in diameter, and to have 600 mm space for each seat. Chairs to be either fixed "swing " type or to be of solid stacking chair type with means to secure the chair to the table when not in use. Fridge for cold drinks to be arranged.

DAY-ROOMS

Furniture according to GA. TV-bench to be delivered with space for DVD player & stereo, and to be fitted with drawers and cupboards.

HOSPITAL

See chapter 504 (Medical first aid equipment)

DUTY MESS

To be fitted with seats and tables according to GA, and a kitchen-unit with:

- 1 of sink with hot and cold water
- 1 of coffee-machine
- 1 of refrigerator (60 litre)
- 2 of wall cupboards

In addition a shelf with a Micro Stereo System shall be delivered.

WARDROBES

Wardrobe to be arranged as shown on GA-drawing. Wardrobe lockers to be fitted with ventilation gratings in top and bottom.

Sky lobby / reception

Sky lobby to be fitted with sofas and tables according to GA. It shall also be fitted with a TV-bench and upholstered chairs/benches (Eknes Transit Yacht 3000 or similar).

542 OFFICE EQUIPMENT AND SPECIAL FURNITURE IN WHEEL HOUSE, NAVIGATION ROOM, RADIOROOM, ETC.

OFFICES

Interior to be of same standard as mess and dayroom, and to be arranged according to GA. Conference table to be fitted with connections for power and LAN

WHEELHOUSE

Layout and equipment to be arranged according DNV GL regulations for Offshore Supply Vessel (OSV) and NAUT OSV(A) and provide maximum visibility and efficiency.

- Workstation for Navigation
- Workstation for Navigation support
- Workstation for Route planning
- Workstations for Docking operations (SB&PS)
- Workstation for Ship handling
- Workstation for Aft support
- Workstation for Communication
- Workstation for Safety monitoring and emergency operations

Some of the workstations may be combined according to rules

The sliding rail of pilot chairs to be flush with the floor. See item 791.

The following furniture's shall be installed:

- Office work stations for Survey aft with 2 chairs and 3 of 2+1 drawers.
- Office work stations for Operational control office with 4 chairs and 4 of 2+1 drawers
- Radio station desk with integrated radio equipment, and 2 office chairs
- 1 of kitchen unit with sink for hot & cold water, bench & wall cupboards, fridge and coffee machine
- 3 of high bookshelves 800x350x1800
- 8 of low bookshelves 800x350x900
- 4 of wall mounted bookshelves
- 1 of cupboard for signal flags
- 3 of cupboards for safety equipment etc.
- 1 of chart table with drawers.

All surfaces to be of non-reflex type.

Furniture and window-framing on bridge deck to be of oak or similar (approved by owner).

On wheel house top a project compass to be fitted.

Binocular box and flag rack to be delivered and fitted in a suitable place.

Fuse boards and lantern controllers to be fitted in a suitable place. The arrangement will be carried out as practical and survivable as possible and according to the shipyard's practice.

ENGINE CONTROL ROOM (E.C.R.)

An air conditioned and sound insulated control room to be located on main deck, according to GA-plan. In this room the following furniture shall be provided:

- 1 of console for automation equipment with 2 comfortable office chairs.
- 1 of office work station with 1 comfortable office chair and 2 of 2+1 drawers
- 3 of large bookshelves 800x350x1800 mm
- 1 of archive cabinet
- 1 of cupboard with fridge.
- Comfortable chairs and table according to GA

SWITCHBOARD ROOM.

The main switchboard to be arranged on tween deck in aft part of the engine room.

The floor to be pressurized with air conditioned air to insure proper ventilation of the room and switchboards.

In addition to the electrical equipment installed in the room one office workstation with chair shall be provided.

543 LINEN AND MATTRESSES

For all beds to be delivered mattresses, 2000 x 800 x 180, type Svane Ideal or similar, flame retardant. Linen to be delivered by the Owners.

544 CURTAINS WITH EQUIPMENT

All port holes and windows, except in galley, to be provided with curtains and curtain frills. Curtains also to be arranged for beds, according to the National Authorities' requirements. Curtains shall be flame retardant. In wheelhouse transparent sun shielding roller curtains to be installed.

546 HOBBY, SPORTS AND ENTERTAINING EQUIPMENT

1 off 1,5m Sat TV-RO antenna (type SeaTel or similar) to be installed with a digital tuner system. (Type; triax TDX system, or similar).

Connection for radio and T.V. in wheelhouse, mess rooms, engine control room, Galley (only radio), gymnasium (only radio), dayrooms, sky lobby, coffee shop, hospital, offices and all cabins. Connection for radio in engine workshop and el. workshop.

ENTERTAINMENT EQUIPMENT					
Room	Projector Beam	Projector screen	TV	Stereo/ Entertainment system	DVD player & Home theatre
Top of Wheelhouse					
Sky lobby		1 of 80"			1
Reception TV Room			1 of 36"	1	
Bridge Deck					
Wheelhouse			1 of 26"	1	
Office(3)					
Captains Deck					

Captain			1 of 36"		1
Chief engineer			1 of 36"		1
Chief officer			2 of 26"	2	
2.nd Officer			2 of 26"	2	
1.st Engineer			2 of 26"	2	
2 of Officer			2 of 26"	2	
2.nd Engineer			2 of 26"	2	
Client			1 of 26"	1	
Ships office/conference		1 of 80"		1	
Boat Deck					
Officer cabin			1 of 26"	1	
Store keeper			1 of 26"	1	
Safety officer			1 of 26"	1	
Hydraulic engineer			1 of 26"	1	
ETO			1 of 26"	1	
Electrician			1 of 26"	1	
1-man cabin			9 of 24"	9	
2-men cabin			12 of 24"	12	
Hospital/ward			1 of 26"	1	
Gymnasium			1 of 26"	1	
Forecastle Deck					
2-men cabin			34 of 24"	34	
Shelter Deck					
Galley with Scullery and Bakery				1	
Day room			1 of 50"	1	1
Day room smokers			1 of 42"	1	1
Reception			1 of 26"	1	
ROV control room (Offline)				1	
Main Deck					
Engine control room			1 of 24"	1	
Tech workshop				1	
Techs office				1	
Client office				1	
Project office				1	
Tween Deck					
Workshop				1	
Dirty El. Workshop				1	
Total		2	82	89	5

GYMNASIUM

Gymnasium to be arranged according to agreement with owner.

55 GALLEY, MESS AND PROVISION ROOM

551 GALLEY MACHINERY

Galley (including Bakery and Scullery) to be equipped with machinery of good quality to ensure longevity and easy maintenance and cleaning. The galley shall be equipped with the following machinery:

- 2 of Refrigerators 500 litre (METOS MBC-500 or similar)
- 2 of Freezers 500 litre (METOS MBF-500 or similar)
- 1 of Combidamper (METOS CM 101 or similar)
- 1 of Combidamper (METOS CM 61 or similar)
- 1 of Cooking range with 6 plates (METOS7602 CEPQ or similar)
- 1 of Frying/Bratt pan (METOS Superprince 20S or similar)
- 1 of Deep fat fryer (METOS Valentine V2200 or similar)
- 1 of Ventilation hood with removable filters (above the cooking area)
- 1 of Potato peeler (METOS MF-5 or similar)
- 1 of Food slicer (METOS Prima 250 or similar)
- 1 of Mixmaster (METOS Bear AR30 or similar)
- 1 of Dishwasher machine (METOS Master Hood 110 or similar)
- 2 of Waste disposers (IMC 525 or similar)
- 1 of Window shutter (A-15) (between Mess and Scullery), acc. to Class rules.

Plug sockets for galley machinery to be arranged. 230/440 V supplied el. equipment in galley, incl. galley fans, to have common main switch outside the room.

Disposal pipes shall be as straight as possible to the tank.

Above the galley range and deep fat fryer, a ventilation hood to be arranged with removable filter. Ventilation hood to be arranged with separate firefighting system.

552 GALLEY EQUIPMENT/INTERIOR

Galley (including Scullery, Bakery and Dry Provision) to be arranged with benches, drawers, cupboards and sinks according to GA.

Arrangement and equipment shall be suitable for serving 120 persons.

Galley interior shall be of good marine quality. Working benches and other furniture in galley with cupboards, drawers and top plates to be of stainless steel with no sharp edges. Above benches, lockers and shelves of stainless steel to be arranged. Cupboards and drawers to be fitted with locks or other means for preventing them from opening, shelves to have framing.

Dishwashing line to be arranged with deep sink with pre wash shower and basket line into and out of dishwashing machine. Storage shelves for baskets below benches. Stainless steel covers on wall, extending 800 mm above bench in full length.

Outside the galley (in mess room) a bench for dirty dishes and disposal racks shall be arranged. Bench to have integrated sink with hot and cold water supply.

Pots, pans, napery and mess gear - Owner's delivery through the galley.

Galley area to have continuous drain in floor along the walls.

All mixing tap in galley, pantry and public toilet to be of automatic photocell type.

One toilet for Galley personnel only to be arranged according to GA.

Pots, pans, napery and mess gear - Owner's delivery through the galley.

Arrangement and equipment shall be suitable for up to 120 persons.

553 PANTRY EQUIPMENT

Mess room to be arranged according to GA with the following equipment:

A self-serving bench with tray board containing:

- 1 of Hot Water Bath VRB 1400
- 1 of Hot Water Bath VRB 1100
- 1 of Cold Counter RBK1600
- 2 of K-Benches
- 3 of Tray Boards
- 2 of Plate Arrangements
- 1 of Cutlery Holder
- 2 of Rack of glass baskets (wall mounted)
- 1 of Microwave with grill.
- 1 of Toaster
- 1 of Coffee machine B5 HW (with water supply)
- 1 of Hot water boiler, capacity approx. 20 ltr. water inn/out.
- 1 of Juice dispenser, 2 x 10 ltr.
- 1 of Ice cube machine
- 1 of Water Cooler WLHC 3000 (for bench with water supply)

Benches according to practical arrangement.

Machinery/compressors for cold-counter to have max noise level below 60dB.

OTHER PANTRYS

Kitchen units (pantry) to be arranged on the following spaces:

- Saturation room
- Coffee Lounge/dirty mess
- Ships office (Capt. deck)
- Bridge
- Sky lobby

These kitchen units shall include:

- 1 of 60 litre fridge
- 1 of Coffee machine (some double with hot water acc. GA)
- 1 of Sink with hot and cold water supply
- 1 of water cooler

In Captain's cabin and Chief engineers cabin one 53 liter fridge to be installed. In officer and Client cabins one 23 litre fridge to be installed.

555 PROVISION ROOMS

Freezing room, refrigerated room and dry provision room to be arranged adjacent to the galley, and arranged according to GA-plan.

Temperature:	Freezing room :	- 20°C
	Refrigerated room:	+ 4°C

Dry prov. rooms: + 15°C

Air-cooling unit to be arranged in aft dry provision room on shelter deck.

Automatic defrosting to be arranged.

INSULATION PROVISION ROOM:

ROOM FOR -20 DEGREES C:

DC-system panels or equal.

Switch on door for stopping of the fan when the door is open.

ROOM FOR +4 DEGREES C:

DC-system panels or equal.

Dry provision room to be connected to air conditioning plant. Return air through galley.

The refrigerating plant for the freezing-/refrigerated rooms shall have freshwater cooled, condensing units and shall operate fully automatic.

Plant as dimensioned for an air temperature of 40 degrees C, and 22 degrees inside, and a seawater temperature of 34 degrees C and freshwater temperature of 38 degrees C.

Provision cool/freeze plant to be connected to separate cooling circuit on box cooler in bow thruster room.
Two FW cooling pumps to be arranged, one in back-up.

Cooling medium according to CLEAN DESIGN. Each compressor shall have capacity to maintain the specified temperatures 17 hours every 24 hours. The compressors are "stand-by" for each other. The cooling elements are equipped with electric de-icing with drip tray underneath. Remote temperature reading of the provision rooms to be arranged in galley. Provision rooms to be arranged with lining, shelves and bins that are suitable and easy to clean. Temperature in dry provision room to be approx. 15 deg. C

558 LAUNDRY

GENERAL

Laundry equipment shall include washing machines, drying tumbler, tables and baskets to wash, rotary ironers, iron and storing of washing powder, etc.

The capacity shall be sufficient to provide the above services for the expected number of crew on board the ship. Steel lockers and a stainless steel sink to be provided.

The washing machines and tumble dryers to be installed 100 mm above floor on vibration dampers.

In floor 1 off scupper in each corner with connection to sewage tank to be arranged in addition to separate drain from each washing machine.

Laundry's to be arranged according to GA.

LAUNDRY ON MAIN DECK

- 4 of Washing machine 10 kg capacity. Miele or similar good quality (industrial)
- 4 of Tumble dryer 10 kg capacity Miele or similar good quality (industrial)

- 1 of Rotary ironer
- 1 of Ironing table with iron
- 1 of wash basin of stainless steel with hot & cold water
- 2 of cupboards to store detergent etc.

LAUNDRY ON MAIN DECK (WORKING CLOTHES)

- 1 of Washing machine 10 kg capacity. Miele or similar good quality (industrial)
 - 1 of Tumble dryer 10 kg capacity Miele or similar good quality (industrial)
 - 1 of wash basin of stainless steel with hot & cold water
 - 2 of cupboards to store detergent etc.
-
- 2 of Washing machine 6 kg capacity. Electrolux or similar good quality
 - 2 of Tumble dryer 6 kg capacity. Electrolux or similar good quality.
 - 2 of cupboards for storing detergent etc.

LAUNDRY ON CAPT DECK

- 1 of Washing machine 10 kg capacity. Miele or similar good quality (industrial)
- 1 of Tumble dryer 10 kg capacity Miele or similar good quality (industrial)
- 1 of Ironing table with iron
- 1 of wash basin of stainless steel with hot & cold water
- 2 of cupboards for storing detergent etc.

56 LIFTING AND TRANSPORT EQUIPMENT

564 PILOT LADDER

5 off pilot ladders to be delivered and stored. Fastenings for ladders to be arranged on railing.

565 GANGWAY

Suitable approved telescopic gangway, length according to requirements, of aluminium with step of knuckled profiles and a removable bulwark ladder to be delivered.
Ports in bulwark on Shelter deck (PS & SB)

566 HELICOPTER DECK

Above top of bridge deck a helicopter deck of aluminium for helicopter Sikorsky S92 with a D=22 m according to rules to be arranged according to GA plan.

The truss work below helicopter deck to be of aluminium and internal truss work connections to be welded.

The helicopter deck to be arranged and fitted out to comply with the class HELIDK-SH, the IMO regulations and UK Aviation Authorities UK 437 regulation.

The Helideck has to have certificate for a fire integrity test according to class requirement. This test has to show that the platform will withstand and pass a 10 minute duration pool fire test, performed on a prototype for the aluminium deck.

Necessary arrangement and safety equipment to be delivered.

CAP 437: Offshore Helicopter Landing Areas – Guidance on Standards.

57 VENTILATION AND HEATING PLANT

571 VENTILATION PLANT IN ACCOMMODATION

VENTILATION.

An air conditioning plant to be provided for the entire accommodation. This is to be a one-string system with heating in ceiling (heating in floor where this is more practical). Thermostatic control for each room. Heat to be switched off if fan stops. Humidifier to be arranged.

Ventilation plant for accommodation to be served by air handling units:

AHU 1, located on Main deck.

AHU 2, located on Captain deck

AHU 3, located on Top of wheelhouse

The plant to be dimensioned for the condition as follow:

Winter: Outside: -20 °C

Summer: Outside: + 45 °C /45% rel. humidity

Inside accommodation: max + 25 °C /50% rel. humidity / min. + 20 °C.

Inside instrument rooms: max + 45 °C /50% rel. humidity

AC fans to be frequency controlled by air pressure or manually.

Sanitary rooms to have suction ventilation with capacity 20 air changes per hour, cabins and mess/day rooms 8 changes and wheelhouse 15 changes per hour.

Galley to have suction ventilation 40 air changes per hour, and supply ventilation 30 air changes per hour.

The accommodation ventilation to be of make, according to makers list.

Stores rooms to have natural ventilation.

Separate defroster unit with nozzles on windows in wheelhouse to be arranged.

The compressors for the "Chilled Water System for AC" to have 2 x 60% capacity of ISO standard heat calculation. Max. 50% return air. All louvers on mechanical ventilation inlets be of water separation type. All outlet louvers to be of galvanised type.

All air condition to be supplied from chilled water compressors.

Chilled water compressors to be FW cooled by plate coolers/air cooled type.

Alternatively sea chest to be used for sea water suction (DP requirements). Normally solved by using main sea chest in CL and one of the box cooler sea chest.

In addition to the accommodation, the following rooms are to be air conditioned:

- Engine workshop
- Forward and aft thruster room.
- Engine control rooms
- Switchboard rooms to be air conditioned by AC units.
- Instrument rooms
- El. workshop
- Galley
- Project office
- Superintendent office, Survey room, customer project office
- Diving chamber area
- Sat. control room
- Diving equipment area, Main deck
- Diving gas store
- Air dive control
- Dive control room
- Technical workshop, Main deck
- Deck workshop, Main deck

Air inlets to be arranged with filters and the inlets/outlets must be designed to reduce the noise level from fans.

Special consideration reg. heat reduction in wheelhouse. Additionally 2 off 2 TR split AC plants for Wheelhouse and 1 off 2 TR split AC plant for Sky lobby are to be provided.

574 VENTILATION IN ENGINE ROOM

2 separate steel ventilation ducts from ER to above Forecastle deck to be built according to drawings.

Two axial fan with support to be arranged inside each duct. One of the engine room ventilation fan shall be possible for reversible operation. The engine room fan capacity to be according ISO 8861:1998, and class requirement.

Fans to be frequency controlled, regulated by temperature and opressure in engine room.

Air intakes to be provided with water mist separate louver.

Special consideration reg. noise reduction; duct to be insulated, and insulation to be covered with perforated steel plate. Silencer unit to be install on top of the engine room fans.

Closing damper to be mounted below ER fans.

Return air from ER to be led through casing. Air outlets on funnel to be provided with hot galvanised ventilation louvers of approved type.

Thin plate ducting to be arranged in ER for air distribution. Regulating damper to be arranged on each air outlet for the internal air distribution arrangement in ER.

Engine room workshop to have separate exhaust ventilation for welding areas.

576 VENTILATION IN THRUSTER ROOMS, CARGO ROOM

AFT THRUSTER ROOM

Ventilation to be provided for aft thruster room. Steel ventilation pipes to be arranged on each side.

Inlets and outlets to be situated in opposite side of the room.

Air to be cooled by 2 off FCU's, connected to chilled water system.

CARGO ROOMS

Steel vent. ducts to be provided.

Two ventilation ducts to be arranged for cargo room.

Ventilation outlets to end at sides above main deck. Vent. closing arrangement to be supplied. Two 2-speed controlled fans to be provided.

DIVING GAS STORE

Mechanical ventilation to be arranged. Steel ventilation ducts to be arranged on each side (cross ducting).

Inlets and outlets to be situated in opposite end of the room.

Air to be cooled by 2 off FCU's, connected to chilled water system.

DIVING CHAMBER AREA

Mechanical ventilation to be arranged. Steel ventilation ducts to be arranged on each side (cross ducting).

Inlets and outlets to be situated in opposite end of the room.

Air to be cooled by 2 off FCU's, connected to chilled water system.

DIVING EQUIPMENT AREA

Mechanical ventilation to be arranged. Steel ventilation ducts to be arranged on each side (cross ducting). Inlets and outlets to be situated in opposite end of the room. Air to be cooled by 2 off FCU's, connected to chilled water system.

DIVING HANGAR

Mechanical ventilation to be arranged. Inlets and outlets to be situated in opposite end of the room. Diving hangar to be arranged with louvers to avoid pressure differences when water level in moon pool is moving. Louvers to be hot dip galvanized steel.

BOW THRUSTER ROOM

One steel ventilation pipe for inlet air and one for return air to be arranged from thruster-room through accommodation as indicated on GA-plan. Outlets in front of superstructure to be equipped with galvanised ventilation louver and closing covers. Air to be cooled by 2 off FCU's, connected to chilled water system.

579 VENTILATION OF VARIOUS COMPARTMENTS

GENERAL

Air ventilation ducting and piping to be routed with damage stability aspect taken into consideration.

AIR INLETS/OUTLETS.

All inlet louvers, in connection with mechanical ventilation, to be of mist eliminator type made from sea water resistant aluminium. All exhaust louvers to be hot dip galv steel.

DECK WORKSHOP

Ventilation to be provided by separate exhaust fan.

PAINT STORE & CHEMICAL STORE

Ventilation to be provided by separate EX-proof exhaust fan.

INCINERATOR ROOM

Ventilation to be provided with separate exhaust fan for mode when incinerator is not running. Flue gas fan to be included in incinerator installation. Supply louver and duct to dimensioned according to flue gas fan capacity.

EMERGENCY GENERATOR ROOM

Ventilation to be provided with separate exhaust fan for mode when generator is not running. Radiator eahuat fan to ventilate room when generator is running. Natural inlet to be arranged.

OTHER SPACES/COMPARTMENTS

According to class requirements.

58 SANITARY SYSTEM WITH DISCHARGE DRAINING FOR ACCOMMODATION

581 SANITARY SUPPLY AND HYDROPHORE SYSTEM

A fresh water plant of make Allweiler or equivalent to be provided. System to consist of 2 automatic hydrophore tank pumps with a capacity of 11000 l/h - 60 MLC each. One pump to be redundant. Hydrophore pumps to be of pressure controlled pumps.

Accumulator for hydrophore system tank to be arranged.

Hot water to be circulated by means of two smaller centrifugal pumps, with a capacity of approx. 2000 l/h - 3 MLC, or capacity according to supplier specification, each of make Grundfos or equal. (Not to be installed if integrated in Water Heater from supplier).

Fresh water hydrophore pipes to be of copper / stainless steel.

One (1) of UV- sterilizer of ample capacity to be arranged in FW system (Hot and cold water to accommodation).

One (1) off activated charcoal filter to be arranged in FW system.

One electrically heated hot water clarifier to be installed on foundation.

Capacity of clarifier for domestic heating(hot water to wash basins, showers, bath tubs and galley) approx. 750 litres.

El. heating elements: 6 x 9 kW. (If Pyro Oil Fired Water Heater is installed, this clarifier will not be required).

OUTSIDE ACCOMMODATION TAP OF COLD WATER:

1 off Bridge deck starboard side.

2 off Forecastle deck (aft & fwd).

1 off Main deck fwd (Hot & cold water).

1 off Main deck (in agreed position with owner)

Tap to be freezing resistance.

INSIDE ACCOMMODATION TAP FOR HOT & COLD WATER:

2 off Engine room (upper & lower)

2 off Fwd thrusters room

2 off Lower cargo room (fwd & aft)

2 off Upper cargo room (fwd & aft)

1 off Aft thruster room

All water connection on deck & engine room area to be equipped with stainless steel quick connection (male), and water tap.

Two off eye washers to be arranged, one of Main deck and one in engine room.

582 SANITARY DISCHARGE SYSTEM

Two off sanitary holding tanks to be built as integrated steel tank in bow thruster compartment. Sanitary holding tanks to be arranged with flushing nozzles with SW supply from fire line.

The tank to be discharged by means of a pump with capacity 15 m³/h - 30 MLC. Discharge pump to be arranged for circulation of sanitary holding tanks.

A ejector to be arranged parallel to the pump as back-up.

Discharge piping (grey water) from washstand and scuppers to be led to sanitary holding tanks by vacuum arrangement where necessary. Also discharge line directly overboard to be arranged for grey water system.

Grey water from hospital to be led to the sewage tank.

A separate sewage overboard pipe to be arranged below deepest load line in vicinity of the tank.

Air pipe DN80 to be arranged to top of casing, overflow branch to overboard to be connected above Main deck.

A sewage treatment plant acc. to USCG, MARPOL and class regulations to be provided. The sewage treatment plant to be of biological type, with capacity for 120 person accommodation.

Waste or sewage to be arranged on Main deck.

Vacuum-Toilet system or equal to be provided, according to MARPOL requirements.
Vacuum system to include vacuum pumps and necessary control equipment.

Sanitary discharge piping to be of Blucher type stainless steel part system where approved by classification. Elsewhere piping to be off galv. steel.

Separate holding tank (approx. 5 m³) for garbage mill in Galley discharge, to be arranged as an hull-integrated tank in Bow thruster room.

583 SHOWER AND TOILETS

WC/showers to be arranged as show on the GA plan.

Each showers to be equipped with towel rack, clothes hooks, soap dish, shower mat and plastic curtains, Plastic buckets, showers to be thermostatically controlled.

All showers to have approved mixing valve, thermostatic type, with anti-scald protection.

Showers to be provided with scupper, and to be portioned off to prevent extensive wetting of the bathroom.

Showers and toilets to have ceramic non-slip tiles on floor.

The toilets are fitted according to shipyard standard with paper holder, ashtray, towel hook, and hand grip.

Toilet cabinets to have mirror and shaving socket, one sink with hot and cold water taps of normal type, chromium plated.

584 DRINKING WATER COOLER

4 off drinking water coolers type Water Logic 3000 or equal, to be fitted in the accommodation.

MAIN GROUP 6 MACHINERY MAIN COMPONENTS

GENERAL

Main engines, auxiliaries and other machinery, piping, electrical system, spares and all accessories to be built according to the regulation and requirements of Classification society, and to a good standard.

The components installed are to be designed for operation under conditions as follows:

Seawater temperature max. 34°C.

Air temperature for machinery compartments between 10°C and 50°C.

The yard to supply necessary cooled air to exposed components.

Foundations are to be designed in order to reduce vibrations and noise in the vessel.

The main generators, electrical switchboards and main electrical drives (equipment) components to be installed on solid foundations with vibration dampers.

All machinery to be delivered with spare parts and certificates according to the Class requirements and manufacturers recommendations where nothing else is stated.

For major machinery components such as propulsion machinery, shaft bearings and deck machinery, flexchocs / Vibracon to be used for chocking. For medium components such as compressors and major pumps, AC-units with anaconda hoses or equivalent, vibration dampers to be used for chocking.

601 GENERATOR PLANT

See item 651

625 ELECTRIC GENERATOR PLANT

The main diesel electric system consists of four – 4 - diesel engines / generators.

The AC generators to have the following specification:

Number of generator:	four, water cooled, slide bearings.
Generator output:	2 x 3380 ekW + 2 x 3840 ekW = Tot. 14440 ekW. (MAN)
Voltage / Frequency:	690V, 60 Hz
RPM:	720

Or,

Number of generator:	four, water cooled, slide bearings.
Generator output:	2 x 3165 ekW + 2 x 4220 ekW = Tot. 14770 ekW. (MAK)
Voltage / Frequency:	690V, 60 Hz
RPM:	720

Or,

Number of generator:	four, water cooled, slide bearings.
Generator output:	4 x 3683 ekW, (Gen efficiency: 0.96, $\cos\phi = 0.8$, 3840 kW on (MAK) engine flywheel) and
Voltage / Frequency:	690V, 60 Hz
RPM:	600
Tot. 14732 ekW.	

The diesel engine manufacturer shall be responsible for the base plate, in lining of diesel engine and generator, coupling and torsion analysis.

63 PROPELLERS, TRANSMISSIONS, FOILS

634 PROPELLER PLANT

Two (2) off Azimuth steerable routable (360 degree) thrusters or equal, stern mounted of weld-in design, el. Motor driven thrusters to be installed. Thrusters size abt. 3000 kW.

Propeller diameter: 3000 – 3200 mm units, fixed pitch propellers.

Propeller blades material: NiALBr

Shaft seal arrangement: IHC TS3 with additional dirt barrier

Remote control system to be provided in centre of wheelhouse fore and aft, and interfaced to the DYNPOS system and TC.

The electric main propulsion system consists of two main propulsion motors, located directly to the main azimuth thrusters. incl. manual locking devise. The el. motors are to have the following specification:

Number of el. motor:	Two, water cooled
Motor output Apr.:	2 x 3000 kW
Propeller diameter:	3.0 – 3.2 m
Voltage/frequency:	690V, 60 Hz
RPM El. motor:	~0 - 1200 rpm
RPM Propeller:	~0 – 208 rpm
Stem Length:	(min 4100mm, to be adjusted)
Type:	US305 FP Thrusters (or similar)

Each thruster installation is complete with:

Lube oil system

Hydraulic steering system

Remote control system comprising control cabinet, wheelhouse control Panel and interfaces for autopilot, DP system / joystick system.

Horizontal floating shaft.

Oil temperature to be transmitted to Automation System.

648 OIL FIRED WATER HEATER

One automatic Oil Fired Water Heater to be installed on foundation.

The hot water boiler to be connected to heat recovery system.

Capacity min.. 450.000 kcal/h

El. heating elements: 4 x 10 kW

Fuel: Gas oil without heating (ISO 8217-2010)

Circulation pump and expansion tank to be installed.

Alternatively electrical heating unit with same capacity as above to be arranged.

651

MAIN ENGINES:

The vessel shall be equipped with 4 off generating sets.

Four (4) off diesel engine with generator at 720 rpm, built on common frame. Generator output power:

2 x MAN 7L32/40 – each 3500 kW / 3380 ekW + 2 x MAN 8L32/40 – each 4000 kW / 3860 ekW

Or,

2 x MAK 6M32E – each 3300 kW / 3165 ekW + 2 x MAK 8M32E – each 4400 kW / 4220 ekW

Or,

Four (4) off diesel engine with generator at 600 rpm, built on common frame. Generator output power:

4 x MAK 8M 32 C, or equal) 3840 kW / 3683 ekW

Note! Shipyard to receive clarification from designer upon size of main gen. set equipment before purchasing. The system to be approved by the Classification Society and supplied with manufacturers standard spares and tools.

The following to be included (Diagnostic Tooling)

Customer Electronic Technician ET, single use licence, no subscription w/laptop and SIS. Cable from ET on each main engine to ECR with universal splitter (5 in, 1 out) and selector switch .

Valve adjustment kit.

Exhaust temperature from all engines (each cylinder) to be transmitted to Automation System.

The engines and generator to be resiliently mounted.

Electric governors for speed control and load sharing in isochronous mode.

The load control shall not be installed on the engines.

The governor shall receive 3 phase current and voltage signal.

Engines to be equipped with econometer.

FUEL: MGO

652 EMERGENCY GENERATOR DIVE

EMERGENCY GENERATOR DIVE

The generator consists of one radiator cooled diesel engine / air cooled generator, to cover both diving and vessel emergency electric power need.

Arrangement according to GA-Plan.

1 off generator, Type: Caterpillar 3512 of approx. 1360 ekW or similar.

The system to be approved by the Classification Society and supplied with manufacturers standard spares and tools.

The following to be included:

Customer Electronic Technician ET, single use licence, no subscription w/laptop and SIS. Cable from ET on engine to ECR with universal splitter (4 in, 1 out) and selector switch (splitter and selector switch).

Valve adjustment kit.

Exhaust temperature from engine (each cylinder) to be transmitted to automation system.
The engine and generator to be resiliently mounted.

Electric governors for speed control and load sharing in isochronous mode.
The load control shall not be installed on the engine.
The governor shall receive 3 phase current and voltage signal.

FUEL: Marine Gas oil.

Fuel Oil used for Main DG sets, Emergency DG set and Incinerator shall be Gas Oil as per ISO 8217-F-DMA.

The emergency generator to have a fuel oil day tank, with sufficient capacity to operate all components for 36 h, as required according to the rules.

Final electric load balance for emergency situations to be calculated. Final capacity for emergency generator to be decided after this calculation.

EMERGENCY GENERATOR SHIP:

The ship emergency / harbour generator consists of one radiator cooled diesel engine / air cooled generator, to cover vessel emergency electric power need.

Arrangement according to GA-Plan.

The generator set to have the following specification:

Generator:

Generator output approx.: 900 ekW

Voltage / Frequency: 690 / 60 Hz

RPM: 1800

Type: Caterpillar C32 of approx. 994 bkW or similar.

Engine:

Output approx.: Corresponding to generator effect.

RPM 1800

Fuel: Gas Oil as per ISO 8217-F-DMA

The emergency generator to have a fuel oil day tank, with sufficient capacity to operate all components for 36 h, as required according to the rules.

Final electric load balance for emergency situations to be calculated. Final capacity for emergency generator to be decided after this calculation.

MAIN GROUP 7 SYSTEM FOR ENGINE COMPONENTS

GENERAL

Grip couplings to be minimum used and only where allowed by the Classification Society, and owner. Otherwise to be used flanges for all connections with DN40 and above. For DN 32 and below welded sockets to be used with end connections to the equipment shall be threaded type.

For Copper and Cu-Ni pipes ductile iron valves to be used.
For Stainless steel pipes Stainless steel valves to be used.
Pipes to be coloured and direction marked.

All pipe lines to be according to system drawings approved by the Owners, Classification Society's and Sub-contractors involved.

National Authority's approvals to be obtained on systems where required.

Where necessary, the pipe lines to be equipped with expansion joints or to be laid with expansion bends.

Possibility to drain of pipelines exposed for freezing to be arranged.

Where fuel oil pipe and lub oil pipe are laid on hot areas, screens to be arranged.

Pipes above DN40 to be preferable flanged, use of flexible couplings to be agreed upon by Owners.

Electrical components for the main propulsion and side (tunnel) thrusters systems, such as distribution transformers, variable speed main propulsion drives (frequency converters), electric motors to be arranged with fresh water cooling system.

SEA WATER COOLING SYSTEM

Pipes to be of type CuNi (90/10). For copper and CuNi (90/10) pipes, flat steel clamps, with neoprene linings or similar to be applied. Corrosion piece of black steel to be arranged in sea water cooling circuits.
Valves general to be ductile iron with non-ferrous internal and spindles.

FRESH WATER COOLING SYSTEM

Pipes general to be seamless steel with mild steel flanges welded on, or coupling type
Piping below DN 40 to be fitted with socket welded couplings. Valves general to be cast iron with non-ferrous internal and spindles. Valves below DN 40 to be of forged steel. For DN50 and above Butterfly valves to be used to the greatest possible extent.

LUB. OIL SYSTEM

Pipes general to be seamless steel with mild steel flanges welded on. Pipes below DN 40 to be steel pipes with socket welded couplings. Valves general of ductile iron with internal and spindles of non-ferrous material. Valves below DN 40 to be of forged steel.

FUEL OIL SYSTEM

As specified for lub. oil system.

Hydr. pipes outside to be of stainless steel and Denso tape on couplings.

All pipes containing oils and other flammable fluids are to be routed away from hot surfaces.

WORKMANSHIP

For copper and CuNi (90/10) pipes, flat steel clamps, with neoprene linings or similar to be applied.
Pipes of CuNi (90/10) to be produced and fitted according to the Yard's standard.
Lub oil pipes, fuel oil pipes and pressure air pipes to be cleaned thoroughly.

Clamping of piping according to NS or equivalent Yard standard, and arranged to prevent vibration in piping systems.

PIPING SYSTEM MATERIALS

Piping materials according to schematic drawing approved by owner and Class:

Carbon steel Pipes : ASTM A106 GR B / ASTM A53-68H or equivalent.
Stainless steel Pipes : ASTM A312TP316L or equivalent.
Copper pipes : BS 2871 Part II C106 or equivalent.
90/10 Copper Nickel Pipes : BS 2871 Part II CN102 or equivalent.

Pipes(<40mm) on weather deck	: Stainless steel
Starting air	: Steel, seamless
Working air	: copper, / stainless steel
Bilge	: Hot dip galvanised steel.
Ballast and technical fresh water	: Hot dip galvanised steel
Fire main / Deck washing	: Hot dip galvanised steel
Fuel oil	: Steel, seamless
Control air piping	: Cu, brass, stainless steel
Air pipes for water tank	: Hot dip galvanised steel
Pneumatic controls	: Copper or stainless steel bundle type.
Sanitary supply (cold)	: Copper / stainless steel
Sanitary supply (hot)	: Insulated copper / stainless steel
Lub oil piping > 50 mm	: Steel with flanges.
Sanitary disch. Pipes in accomm.	: Type Blucher or equal.
Drains external	: Steel seamless galvanised hot dip.
Drains internal	: Steel seamless
SW Cooling	: Copper Nickel (90/10)
FW cooling	: Steel, seamless
Sounding pipes	: Steel, Hot dip galvanised in water tank.
Gas extinguishing	: Steel, seamless galvanised outside engine room, otherwise black pipes. (Hot dip)
Hydraulic piping	: Steel, seamless
Hydraulic piping for cranes	: Stainless steel
Potable water tanks	: Stainless steel

No Meson valves to be used. Strainers to be of cast Iron. For manual valves, Korean valves or equal good quality shall be used.

OVERBOARD PIPES

All overboard pipes to be hot dip galvanized.

MARKING

All valves, valve chest, pumps, tanks, machinery's, starters, armatures, etc to be marked with engraved metal signs in English.

All marking on open deck to be fastened by means of stainless steel screws.

Pipes to be direction marked with marking system. Type "Flow Code" or equivalent.

70 FUEL OIL SYSTEM

701 FUEL OIL DRAIN AND TRANSFER SYSTEM

FUEL OIL SYSTEM

The fuel oil system to be based on Gas Oil as per ISO 8217-F-DMA without any heating. Two off settling tank and four service tanks to be provided. Fuel oil supply system to be arranged as four segregated system for each engine, with normally closed connection between each system.

Alarm for high level, and switches for control signals (for filling pumps) to be arranged on settling tanks.

Overflow from service tanks to settling tank for round separating to be arranged. Overflow from settling tank to F.O. overflow tank to be arranged.

2 off f.o. transfer pump (screw type) to be provided, capacity $15\text{m}^3/\text{h}$ - 20 MLC. The transfer pump to be remote controlled.

1 off portable hand pump/device to be delivered and utilized for sample taking from each fuel oil tank (ref.226).

Fuel oil supply with separate pump to be led to Shelter deck for the HLBs PS/SB, and shelter deck for the FRC. Same pump to be able to transfer fuel oil from ER to incinerator room, emergency generators room and life boats at Boat deck PS/SB..

702 FUEL OIL SEPARATOR

Two off FO separators of suitable size to be provided. The separators to be provided with alarm for lost water trap.

The separators to have suction from storage, settling and service tanks and delivery to service and settling tanks. Fuel oil piping to be of ordinary steel pipes.

711 LUB. OIL SYSTEM - DRAIN AND TRANSFER SYSTEM

In engine room, lub. oil storage tanks to be arranged as integrated hull tanks according to GA. Separate filling lines to lub.oil tanks from deck. Tanks to be equipped with air pipes, sounding device, Level Alarm High, tapping cocks and waste tray. The waste trays to have possibility for drainage. 3 off smaller lub.oil storage tanks to be arranged in engine room.

A storage tank for Azimuth and tunnel thrusters to be arranged both in forward and the aft thruster room integrated hull tank as indicated on GA-plan.

Vent. and filling pipes from deck to be arranged.

In double bottom engine room, one off waste oil tank and one off sludge tank to be arranged with capacity according to Tank plan for drainage from separators to sludge tank and for drainage from waste tray and emptying of engines to waste oil tank.

The Lubricating oil system to fulfil engine supplier requirements.

2 x LO separator. Size according to engine suppliers recommendation, to be arranged in the engine room according to rules.

Two off LO purifier with heater as recommended by the engine manufacturer /Class, to suit the main engine installation.

Crankcase ventilation from each engine to be routed to top of Wheelhouse. Crankcase ventilation box/drip tray on top of wheelhouse to be segregated according to split of generator sets in switchboard.

72 COOLING SYSTEM

GENERAL:

All SW heat exchangers to have 1 ½" connection for flushing possibilities (ball valves and couplings).
Fresh water cooling temperature to be set to maximum 38 degree C.

721 SEA WATER COOLING

Sea water to be taken from sea chests in the various compartments. Anodes with impressed current, to be designed for minimum 5 year use.

The sea inlet filters to be off cast iron with strainer of galvanised steel.

S.W. cooling pumps to be of self-priming type.

All heat exchangers to have flange and strainer in sea water inlet section.

One suction line ND 200 to be installed in sea chest, for later installation of deck equipment cooling pump.

722 FRESH WATER COOLING SYSTEM

GENERAL

All cooling circuits related to box coolers to be temperature regulated by 3-way thermostatic valve.

All cooling water circuits to be arranged with expansion tanks. Expansion tanks to be fabricated of steel, with inspection holes/cover, pipe connections for filling, venting, low level alarm and drain.

MAIN GENERATOR SET

FW cooling system to be based on generator set engineering manual.

Separate FW cooling system including circulation pumps for each of main generator sets to be arranged.

Heat recovery system to be arranged for each main generator set.

Preheating of each generator set to be arranged.

Expansion tanks to be mounted according to main generator set supplier recommendation.

THRUSTER

Cooling systems for each thruster to be independent. Two off cooling pumps to cool thruster oil, thruster el. motors and converter in bow thruster room, one pump is working and other is stand-by to be arranged for each cooling circuit.

Separate FW system with box coolers on starboard and port side for cooling of equipment in thruster room aft.

Two off cooling pumps to cool thruster lub.oil, thruster el. motors and converter units fwd, one pump is working and other is stand-by to be arranged for each cooling circuit.

FORCED SEA WATER CIRCULATION SYSTEM

Forced circulation on sea chests for box coolers to be arranged. Separate sea water circulation pump, with DN80 branch to each sea chest to be arranged. Separate regulating valve to be arranged on each sea chest. Capacity for circulation pump to be 350 m³/h @ 30MLC.

Forced sea water circulation system to have back-up connection from ballast system.

Circulation system is not to be installed in sea chests for azimuth propellers / thruster units.

BOX COOLERS

Design criteria for box coolers:

Main generator sets	DP mode:	0-3 knot
Harbour generator	Harbour mode:	0 knot
Tunnel thrusters	Sailing mode:	> 3 knot
Azipull thrusters systems	Sailing mode:	> 3 knot

All box coolers to have integrated anti fouling system with capacity for a minimum of five (5) years.

Anti-fouling system for box coolers to be approved by box cooler supplier.

All box coolers to be bottom pulled type. Accessible void to be arranged above box cooler.

Glycol content in fresh water cooling water to be 10%.

Fouling factor for box cooler calculation to be minimum 10%.

73 AIR PRESSURE SYSTEM

731 STARTING AIR SYSTEM AND CONTROL AIR SYSTEM

2 off starting air compressors to be arranged in engine room. Capacity of starting air compressors and air receivers according to Class requirement.

Alarm on compressors for high temperature and lost lub.oil pressure.

Em. Conn. between work/start air.

WORKING AIR SYSTEM

2 off working air compr. 300 m³/h. – 7 bar, tank 2 x 1000l.

Sea chests without box cooler to have ice blowing from service air system via a reduction valve 7 - 1,5 bar.

Air piping generally to be of ordinary steel pipes.

Snatch couplings on service air supplies.

Backup connection from starting air system to be arranged.

SERVICE AIR SYSTEM

The service air compressor will provide air to the moon pool aeration system,

The service air compressor system includes:

2 off 1800 m³/h –12 bar air compressors. Electrically driven/auto start, tank 4000 l.

Air piping generally to be of ordinary steel pipes.

Quick couplings on service air supplies.

WORKING AIR SYSTEM IN ENGINE ROOM AREA.

3 off outlets for working air to be arranged in the engine room.

1 off outlets in engine workshop.

1 off outlets in el. workshop.

2 off outlets in Lower cargo room

2 off outlets in Upper cargo room

1 off outlets in steering room (propulsion room)

1 off outlets in fwd thrusters room.

WORKING AIR SYSTEM ON DECK.

1 off outlet on Top of wheelhouse.

1 off outlet on bridge deck.

2 off outlets on forecastle deck (fwd and aft)

1 off outlet on main deck fwd

1 off outlet in deck workshop fwd.

5 off outlets on main deck midship (according to Owner)

1 off outlet in deck workshop aft

1 off outlet in crane pedestal

All outlets on deck & engine room area to be equipped with stainless steel quick couplings (female) and ball valve.

All working air deck and engine to go through air dryers.

INSTRUMENT AIR

1 off 60 ltr instrument air buffer tank to be installed.

Air dryers to be arranged, refrigerant type dryer w/fog lubricator. The dryers to be arranged as back-up for each other. Instrument air to be provided with refrigerated air dryer.

74 EXHAUST SYSTEMS AND AIR INTAKES

744 EXHAUST SYSTEM FOR MAIN ENGINES

The ship to have one funnel.

Exhaust pipes to be made of rolled steel plates and to be equipped with compensators where necessary.

All exhaust pipes to be led to top of funnel, and penetrations in the top plate of the funnel to have a rainproof collar.

The pipe penetration in the top plate to be arranged with expansion sleeve and collar.

In exhaust pipes from main engines and auxiliary engine, combined silencers and spark arrester to be provided, the spark arrester to be of efficient type. Damping effect for silencers: 35 decibel. The silencers to be mounted on vibration dampers.

The exhaust pipes and silencers to be insulated with mats of mineral wool mattings.

The insulation thickness for main engines to be 50mm and for auxiliary engines, incinerator and boiler 40mm.

The insulation to be covered with galvanised plate.

For flanges and compensators, collars covered with galvanised plate to be fitted.

Top of the exposed exhaust pipes, outside top of funnel, to be of stainless steel. The pipes to be directed outward and aftward.

Exhaust gas ejectors to be arranged on top of each engine exhaust pipe.

Drain pot with manual drain valve from exhaust pipes to be arranged.

Pressure drop in exhaust gas piping to be below maximum limit defined by engine supplier.

OPTION

746 EXHAUST GAS CLEANING SYSTEM

Selective catalytic reduction converter system to be installed to clean the exhaust gas from the main engines.

Urea water to be used as reducing agent.

The system comprises:

- Reactor chambers for main engines
- Injector for urea/air
- Control/metering unit with control panel
- Service pump unit with filter
- Flow dresser
- Dust blower system including control function. (Option).
- Urea storage tank (hull tank approx. 40m³) with filling and vent line from open deck
- NOx analyser (Option).
- Dedicated compressor for air supply to SCR system

Bunkering station for urea to be arranged on main deck PS.

OPTION END

761 FRESH WATER MAKER

The ship to have two freshwater generators installed of reverse osmosis type. Capacity each: 20m³/24h at 20 C° sea water temperature°.

Electrical heater unit to be arranged in SW supply line, to heat SW temperature to min. 3 C°.

Each fresh water generator to have separate sea water inlet, with location widely separated from each other.

79 AUTOMATION SYSTEM FOR THE MACHINERY PLANT

791 CONTROL CONSOLES

CONSOLES – GENERAL

Consoles for manoeuvring, control and monitoring to be arranged to Owners and Class approval. Consoles to be made of steel and to have detachable covers. Equipment shall be mounted in top of consoles. Special considerations to be given to obtain best possible ergonomic lay-out and view, within the arrangement requirement in NAUT-OSV class notation.

All equipment acc. to industry standard and suitable for maritime use.

WHEELHOUSE CONSOLES

The following consoles to be arranged in the wheelhouse. The consoles to have at least the following equipment installed (guidance):

FORWARD CONSOLES with the following contents:

- Emergency stop for ventilation and FO/Lub Oil pumps.
- Thruster control (TC)
- Monitoring of the steering gear and diesel-electric propulsion plant
- Searchlight controller
- Window wiper controllers
- Morse lantern switch
- Sound powered telephone
- GMDSS Simplex VHF
- Echo sounder integrated in console
- S-band Radar display integrated in console
- Radar interswitch
- Miscellaneous light switches
- Two (2) Goose neck desk light with dimmer
- Status lamps for "emergency"/"harbour" aggregate mode
- Telephone station
- Telephone list
- Indication of AC Thruster parameters
- Indication of steering gear.
- One watch keeping system
- Gyro repeater
- Log repeater
- Autopilot
- X-band Radar display integrated in console
- Receptacle for DP Joystick
- Typhon push-button
- Display PMS control of engines.
- 1 indication panel "Total load / Power available"
- Rudder stick
- Panel for emergency operating of all thrusters (use same handles)
- Lantern and signal light controller.
- Main chart system with 23" LCD monitor, mouse and keyboard (ECDIS).
- AIS
- Window cleaning control.
- Dimmer for spot lights
- Control panel VDR.

AFT CONSOLES with min. the following contents:

- Remote control/emergency stop for cargo pumps and HPU's.
- Miscellaneous light switches

Window wiper controllers
Searchlight controller
EO Watch call panel.
Control panel main azimuth thrusters
Control panel tunnel thrusters fwd
Lantern and signal light controller
Sound powered telephone
Typhon push-button
Slave monitor electronic chart system + radar
Miscellaneous light switches
Receptacle for DP Joystick
Plug box Command/Intercom system
Gyro repeater
Fire alarm central
Two (2) Goose neck desk lights with dimmer
Reference system for DP
Automation system with 2 x 19" LCD monitors w/ mouse and keyboard,
Two (2) DP operator console aft
Overhead consoles aft consisting
Telephone station
Telephone list
Loudhailer microphone
GMDSS Simplex VHF
Simplex VHF
GMDSS alarm unit
Window cleaning control.
Dimmer for spot lights

BRIDGE WINGS (each console to have):

Slave searchlight controller.
Window cleaning control.
Typhon push-button.
Space for portable joystick
Plug box for portable joystick.
Dimmer for spot lights.

Above all consoles fwd, aft and wings spot lights with dimmer.

Final arrangement to be agreed upon during detail designing.

ENGINE CONTROL ROOM CONSOLE

An engine control room console (ECRC) to be arranged in engine control room. The console to have at least min. the following equipment installed:

Min. 2 x 19" LCD monitors with 1 off mouse and 1 off keyboard.
E0/ACCU Watch cal panels.
Steering gear indicators.
VHF/UHF.
Telephone station.
Monitor for all frequency converter units, with reset, adjusting and monitoring possibility.
Telephone list.
Sound powered telephone.
Fire alarm slave panel.
Necessary push-buttons/signal lights for start/stop of main engines.
Status signal lights "emergency/harbour aggregate".
PC, printer for Planned Maintenance Systems or according to Owners advice.

AUTOMATION SYSTEM FOR MACHINERY – GENERAL

Automation system complying with DNV GL Class E0 to be installed. The automation system Automation system to include the following functions:

One operation station on bridge and two in ECR and one in switch board room.

The automation system may be one integrated system.

MONITORING AND ALARM SYSTEM (MAS)

The monitoring and alarm system shall be based on analogue sensors for continuous readings. Binary sensors may be accepted by the owner in special cases. The numbers of connection points in alarm central to be sufficient for connecting all alarm points and other sensors , a card of digital and a card of analog in each cabinet in spare.

Ten portable alarm watch cal system to be delivered.

All sensors and cables to be supervised by the system.

To be interfaced to load calculator.

Three portable watch call alarm devices (e.g. portable phones or pagers) to be delivered.

PROCESS CONTROL SYSTEM (PCS)

The process control system to be able to carry out all necessary process control for machinery systems and for other ship systems such as tank sounding, cargo systems, draft sounding etc.

POWER MANAGEMENT SYSTEM (PMS)

A fully automatic power management system to be installed according to Classification Society's requirements.

The PMS supplier is responsible of interface to all systems involved.

WATCH RESPONSIBILITY SYSTEM

A watch and responsibility system with LCD display to be installed according to Classification Society's requirements with control panel in ECR and in Wheelhouse.

Group panels to be installed according to the E0/ACCU requirements of the Authorities and the Classification Society. At least the following stations to be installed:

- Wheelhouse
- Conference room
- Office
- Mess/Day room
- Duty mess room
- Office
- Gymnasium
- Each engineer's Cabin
- Electrician cabin

DEAD MAN ALARM SYSTEM

A "Dead man alarm" system to be installed only if required by the Authorities. If required, at least six reset panels to be installed.

ACOUSTIC AND OPTICAL ALARM

Acoustic and optic alarm signal devices to be arranged according to requirements from Authorities and Class Society. At least the following compartments to have alarm devices installed, all places on board to be covered by acoustic alarm.

- Upper and lower engine room
- Main propeller room STD & PORT
- Bow thruster room
- Engine workshop
- Cargo room
- Lower pump room

793 REMOTE CONTROL OF PROPELLERS

- Manual emergency locally in thruster rooms.
 - Manual normal (with separate turn control propulsion) - TC
 - Emergency operation from wheelhouse aft and forward, on same levers as manual control.
 - Joystick - TC
 - DP
 - Autopilot
- Emergency Remote Control.
1 engine telegraph system to be installed for emergency manoeuvring.
One engine telegraph for each main propeller.

797 AUTOMATION EQUIPMENT FOR OTHER MACHINERY COMPONENTS

Before the delivery of the vessel, the crew shall be instructed in the design and handling of the automation plant.

An instruction book for the automation plant shall be worked out, containing detailed description of all systems and components, how they work and how to maintain them.

Spares for the automation plant to be stored in separate locker with drawers.

Emergency stop on bridge to be arranged for all cargo system.

The system should work in such a way that instructions should at fore-hand be given to the computer how the procedure is to be carried out and the computer may control necessary valves automatically when the pumps are manually started.

If any unexpected situation occurs, an alarm should be given and the system switched over to manual mode of operation.

BILGE SYSTEM

Three 3 pumps, DOL. Remote and local start/stop and suction/pressure indication

Valves (remote controlled) with feedback for remote indication open/shut. Bilge pumps and necessary valves to be remotely controlled from the keyboard in order to empty the bilge wells in a simple and proper way.

FUEL OIL CARGO/TRANSFER SYSTEM

2 pump, freq. start. Remote and local start/stop and suction/pressure indication.

The FO pumps are situated in a separate pump room.

Reading and display of fuel meter

Remotely operated butterfly valves with feedback for remote indication open/shut.

FRESHWATER CARGO/TRANSFER SYSTEM

2 pump, freq. start. Remote and local start/stop and suction/pressure indication.

Remotely operated butterfly valves with feedback for remote indication open/shut.

BALLAST SYSTEM

2 pump, freq. start. Remote and local start/stop and suction/pressure indication.
Remotely operated butterfly valves with feedback for remote indication open/shut.

ALARM, REMOTE CONTROL

2 engine telegraph to be installed for emergency manoeuvring.

MAIN GROUP 8 SHIP COMMON SYSTEMS

80 BALLAST AND BILGE SYSTEM - DRAIN SYSTEM OUTSIDE ACCOMMODATION

GENERAL

All overboard pipes to be hot galvanized.

All pipe lines to be according to system drawings approved by the Owners, Classification Society and if necessary the authorities.

Clamps normally to be welded, but screwed if this is more practical.

Where necessary the pipe lines shall be equipped with expansion joints or to be laid in expansion bends.

Possibilities for drain or airing to be arranged where this is necessary.

Sounding pipes with self-closing sounding valves to have 1 1/2" tread connection. Valves shall be as per 'General' clause of Main Group 7.

Overboard valves to be of ductile iron, with Class certificate.

Butterfly valves of LUG type to be used to the greatest possible extent.

WORKMANSHIP

For steel pipes galvanized steel clamps to be applied.

Galvanized pipe systems to be hot galvanized after completed welding and treatment.

Bolts and clamps inside tanks to be secured with double Nuts.

Marking - See Main Group 7 - General.

801 BALLAST SYSTEM

SOLID BALLAST

Solid ballast, approx. 350 Tonnes, lead or iron, to be installed PS in double bottom between fr.34 - fr.46,

BALLAST SYSTEM:

The ship's ballast tanks to be connected to a remote controlled ballast system, which enables transfer of ballast water between any of the ballast tanks, in addition to pumping to/from sea to deck.

Ballast piping system to be arranged with valve manifolds.

Ballast system to be arranged with forced circulation on box cooler sea chest in engine room.

Ballast control system must be controlled in the ECR and wheelhouse.

Air pipe closures shall be designed so that icing or freezing will not make them inoperable (ICE-C). DNV GL limit this requirement to Ballast System only.

Capacity: Ref. item 351.

A ballast water treatment system according to IMO "International convention for the control and management of ship's ballast water and sediments 2004" and class requirements to be installed. The capacity for ballast water treatment plant to be fitted to capacity/pressure rating of ballast water pumps in item 351.

803 BILGE SYSTEM

All bilge and ballast pipes to be of galvanized steel pipes.

The bilge and ballast systems to be kept separated.

In bilge system approved butterfly valves, to be applied.

The bilge lines in engine room and tank rooms to be equipped with necessary mud boxes, which is located for easy access for cleaning.

All bilge wells to be equipped with level alarm for E0/ACCU monitoring.

The bilge system in the fore ship to be connected with the bilge pumps in the engine room.

Necessary pumps and valves to be remote controlled from automation system.

The ship to be equipped with the following pumps:

3 off screw type bilge pumps, each having a capacity of min. 100m³/h – 15 MLC

Bilge system arrangement system to be according to SOLAS II-1, Pt. C, 35-1.

BILGE WATER SEPARATOR

1 off bilge water separator of approved type to be delivered and installed.

The installation shall fulfil IMO's and Authorities' requirements, at delivery of the vessel. One clean- and one untreated bilge water holding tank to be arranged

A bilge water settling tank to be arranged with electrical heating coil for settling of bilge water to be arranged.

Oil skimming bouy to be arranged inside bilge water settling tank.

1 off sludge pump, cap: 10 m³/h - 30 MLC to be installed.

804 DRAIN SYSTEM OUTSIDE THE ACCOMMODATION

Drain pipe lines to be of hot dip galvanized steel pipes.

By installation of pipes, the ship's possible trim shall be taken into consideration.

Sufficient number of pipes to be laid from the respective decks.

Drain pipes from outside deck to be laid where there are no outlets for the water through scuppers. Drain

pipes from superstructure to be fitted on outside where possible. Drain from funnel to be led overboard.

Scuppers and drain pipes to be of ordinary steel, plugs for scuppers to be of adjustable rubber type.

At least following drain pipes to be arranged from outside deck.

Drain pipes DN80 - 6 on each side of Shelter deck to be drained down to main deck. From Main deck 6 off drain pipes on each side DN100 to be laid down inside underlying tanks and through ship side about 400 mm below Main deck.

Including "palloc plugs" and possibilities to drain to bilge.

Aft. corners of Shelter deck to have one drainpipe on each side DN100 through shell plating at transom and one pipe each side at frame 3 through side plating. All drains about 500 mm below shelter deck.

Forecastle deck to have 7 drain pipes DN100.

Drain system for gutter inside accommodation to be arranged.

CLEAN DRAIN WATER SYSTEM

Clean drain water holding tank (5 m³) to be arranged in DB engine room. This tank to collect condensate water from AHU-units in accommodation and drain water from FCU-units.

Holding tank to have separate discharge-/circulation pump 10 m³/h @ 30MLC and to be arranged with connection for chlorinating.

Clean drain water discharge overboard via bilge water management system.

Separate intermediate tank with pump to be arranged in aft ship to serve FCU's in aft ship. Intermediate tank to discharge to clean drain water holding tank.

ROV DECK DRAIN WATER SYSTEM

Separate drain water tank with heating to be arranged on Tween deck in ER. Possibilities to transfer this tank to bilge water holding tank and sludge tank to be arranged with separate pump.

Oil skimming bouy to be arranged inside drain tank.

81 DECK WASHING SYSTEM

811 FIRE DETECTOR SYSTEM - FIRE & LIFEBOAT ALARM

The fire/lifeboat alarm plant shall be of approved type, and an digital addressable type.

Fire alarm to be connected to magnetic door holders.

The fire alarm central shall be mounted in the wheelhouse with slave in engine control room.

Detectors in cabins to be smoke detectors if approved by authorities.

Fire detectors will automatically lead to fire alarm when:

- The heat detector reach a preset maximum temperature limit or at a rapid increase of temperature.
- A combustion gas has reach the smoke detector
- A fire alarm push button (manual call point) is activated.

Alarm will be given by ringing bells, and in engine room by siren. The fire alarm will be intermittent.

Fire detectors to be easily accessible for testing.

The installation shall be according to requirements, and with:

Combined smoke/heat detectors in accommodation (stairways, corridors, etc.)

Smoke detector in cabins.

Combined smoke/heat detector in eng. room etc.

Heat detectors in eng. room etc.

Manual call point (push button) in accommodation (exits etc.)

Manual call point (push button) in engine room etc.

Alarm transmitters:

Alarm bell in accommodation.

Alarm bell eng. room.

Alarm siren in eng. room.

Optical alarm light in engine room.

A separate fire alarm system to be provided for diving chambers and hyperbaric life boat, with interface to ship's fire alarm system. (This separate fire alarm system is to be supplied by diving system supplier.)

Lifeboat alarm (General alarm) push button will be mounted in bridge console, and will make all alarm sounders to operate continuously when pressed.

The fire detection central panel shall have built-in monitoring circuits which are intended to control that the equipment at any time is in satisfactory order and indicate faults which could prevent fire alarm.

Faults in the system are indicated on the central panel by means of visual and audible signals.

The fire alarm plant shall be equipped with battery and charger.

Accommodation vent. fans to be stopped by emergency stop push button on bridge.

Engine room ventilation fans shall have emergency stop push button on bridge, and shall be stopped automatically when firefighting is released.

Fire detection system also to be installed on tank top Kelly tube area, acc. to rules.

813 FIRE/DECK WASHING SYSTEM

The pipes to be of galvanised steel pipes of suitable type. A necessary number of fire stations to be arranged in engine room, accommodation and on deck. Each station to consist of a glass fibre locker containing 15 m x 2" artificial fibre hose and one combined jet nozzle and fog nozzle.

The fire outlets with brass couplings to be located outside the lockers.

Fire pumps with cap. according to Class requirements to be installed:

3 off centrifugal type fire pumps, according to the SPS Code, as amended by Res. MSC.266(84). 2 off pressure holding pumps with buffer tanks to be installed to pre-set pressure in fire system.

Fire fighting in paint-/gas stores to Authorities requirements.

Fire system according to helicopter deck requirements; DIFFS according to class/authority requirements, driven by the fixed fire system, to be installed.

Sprinkler water from fire system provided for the following areas:

For above diving specific area the firefighting system should be in accordance with Class rules and shall include consequent drainage to the bilge system. Bilge wells on tween deck in diving chamber area to be arranged and connected to the bilge system.

Flushing of chain pipes and sewage tank to be supplied from fire water system.

815 FOAM NOZZLE SYSTEM

A DIFFS (Deck Integrated Fire Fighting System) system for protection of helicopter deck to be arranged.

817 FIXED FIRE FIGHTING SYSTEM WATERMIST

The following rooms will be connected to the total flooding water mist fire fighting system according to the authorities requirements

- Engine room/workshops
- Emergency generator room, dive system
- Emergency generator on Wheelhouse top
- Switchboard room
- Incinerator room
- Air Dive Station
- Air/Sat Dive Control Room
- Saturation Room
- Saturation Control Room

Spot fog system to be integrated into the water mist system

SPOT FOG SYSTEM

The Ship to be equipped with a spot fog system above/covering the main engines, hot water boiler, incinerator and auxiliary engine, according to rules. Spot fog system may be integrated into the water mist system.

818 FIRE FIGHTING SYSTEM WITH HAND EXTINGUISHERS

Hand extinguishers to be installed according to the authorities requirements. Number, location and colouring of the extinguishers to be approved by the authorities.

82 AIR AND SOUNDING SYSTEM

821 TANK VENTILATION- AND SOUNDING SYSTEM

SOUNDING SYSTEM

Remote tank sounding system to be provided for all ballast-, fresh water-, sanitary holding and fuel oil tanks with two sensors. In addition the bilge water-, sludge-, F.O. settling-, F.O. service- and waste oil tank to be connected with one sensor + one level switch. The sounding system to be interfaced to Vessel Management system, sensor to be according to Makers list, to be approved by owner. Separate 95% level alarm (level switch) on tanks where required.

Sounding pipes for water tanks to be of galvanised steel. Sounding pipes for oil tanks to be of ordinary steel.

Manual sounding pipes shall be arranged for tanks where necessary.

Four off trim/depth sensors to be installed: One in aft ship, one in aft ship, and two sensor midship PS/SB. Sensors to be connected to dedicated overboard pipe.

TANK VENTILATION SYSTEM

Tank ventilation head valves for tanks to be of class approved type.

Tank ventilation pipes for lubrication oil-, sludge-, bilge- and waste oil tanks to be of galvanised above main deck.

Water trap to be arranged to protect tank ventilation head valves on roll reduction tanks.

A combined tank ventilation- and overflow system to be arranged for fuel oil storage tanks. The tank ventilation- and overflow system for fuel oil tanks to be arranged to prevent progressive filling between

damaged and assumed intact tanks. LAH alarm inside flow box to be arranged on main pipe to overflow tank. Separate LAH to be arranged inside F.O. overflow tank.

Drip tray to be arranged below F.O: overflow main tank head ventilation valves on open deck.

// 120



GENERAL

The electrical plant to consist of:

- Main switchboard for 690/440/230 V 60 Hz
- Diving switchboard for 440/230 V 60 Hz
- ROV/ Deck switchboard for 440 V 60 Hz
- Emergency Dive switchboard 440V 60 Hz
- Emergency ship / harbour switchboard 440/230 V 60 Hz
- Electrical motors
- Transformers
- Starters
- Shore connection
- Control consoles in engine control room and wheelhouse
- El. distribution panels
- Electrical heaters
- Deck flood lights
- Search lights
- Fluorescent light and lamps
- Cables, plugs and fittings
- Dynamic positioning system, TC /Joystick system and Automation systems as described in 408 and 791 etc.

The electrical system to be 3-phase 60 Hz with insulated neutral.

All electrical systems to be according to requirements from Authorities and Class Society. THD Max according to class requirement on 690 V.

Special consideration shall be taken regarding Electromagnetic compatibility (EMC)/and THD. An EMC and THD-plan shall be presented.

THD to be measured in all operational modes during sea trials.

All 1-phase consumers to be distributed as equal as possible on the 3-phases.

VOLTAGE SYSTEM

The Voltage systems includes:

- 690 V, 60 Hz 3 phases for azimuth propeller motors, tunnel thrusters motors, ship service transformers, AHC offshore crane, ROV-transformers and Diving equipment transformers.
- 440 V, 60 Hz 3 phases for power supply to all other pump motors, main galley equipment, heating fans and for shore connection.
- 230 V, 60 Hz for power supply to light, emergency light, heating, minor galley equipment, nautical equipment, charging rectifiers for batteries etc.
- 24 V DC for instruments, automation equipment, converters, etc.
- Navigation lanterns to be 230 VAC alternatively 24V AC.

As far as practical all the el. power systems to be segregated in port/starboard systems.

DP / FMEA test / report to be made, based on open bus-tie breaker in center.

Equipment producing transient voltage, frequency and current variations is not to cause malfunction of other equipment on board, neither conduction, induction or radiation.

All electrical equipment shall be selected and installed so as to avoid EMC problems.

All electrical and electronically equipment connected to a high level THD distr. net or "dirty net" to be specially designed for the high THD conditions and to be informed to owner. In general to meet class requirements.

CABLES

All cables shall be of high quality Class approved type and approved by owner. All wires and cables inside switchboards, consoles and cabinets to have easy access. All cables to be properly marked for identification in both ends.

Cables for el. motors, cables to distribution panels and for other important use shall have no joints. Ethylene, propylene, rubber EPR insulated ship cables to be used from Main Generators to MSB, elsewhere XLPE cable are accepted.

In the accommodation, all cables shall be laid behind the linings. Where this is impossible, the cables shall be covered.

All cable trays in accommodation to be laid in the corridors behind removable ceiling covers for easy access.

CABLING

Steel cable trays to be used throughout the vessel. All cable trays to be hot dip galvanised. Indoor galvanised cable trays are not required to be painted.

Special care should be taken to avoid heat generation in high power cables. Space between cables according to rules for natural cooling.

Signal cables shall not be bunched together with, or run through the same pipe as power cables.

For power cables to and from frequency converters and power cables to frequency controlled motors 3-conductor screened cables must be used.

Care shall be taken to avoid EMC problems related to power cables and signal cables not having the right distance and crossing angle 90 degrees, class requirements to be followed.

The manufacturer of the EMC producing equipment, such as frequency drive etc. to arrange the equipment inside the switchgear in such manner that the EMC problems are taken care of.

Cables shall generally be laid in groups.

Special cable routing philosophy to be provided, ensuring proper cable routing.

Installation for EMC producing equipment, including cable.

The basic EMC rules.

All cable penetrations through watertight bulkheads etc. to be packed watertight.

Watertight penetration of type Roxtec or similar class approved sealing compound. Cable penetrations through non watertight bulkheads, holes etc. to be "packed" up with lead or similar. Cables on open deck to be laid in galvanised pipes. For vertical open deck penetrations, protection pipes to be approx. 300 mm above the deck, strongly welded and to be made watertight by suitable class approved sealing compound.

Fixing brackets for el. equipment outside to be of stainless steel.

Main and emergency power cables shall be separated, both vertically and horizontally, as widely as is practicable where these penetrate separations of main vertical fire zones.

MAIN SWITCHBOARD DESIGN:

- Auto, Semi auto and Manual operation
- 4 generators running in parallel with motor load + approx.800 kW AC3 spare capacity, as per 690 V Switchboard manufacturer's design. Number of generators running in parallel to be agreed upon between Owner, Yard and Switchboard supplier.
- 4 - split Busbar system.

Description philosophy of the vessel's main switchboard 4-four split system. All auxiliary system related to generator set's and thruster system to be arranged in 4 redundancy groups according to the 4- four split system, according to the main switchboard design.

Main switchboard to be installed in Switchboard room on tween deck aft of engine room.

The switchboard to be built up of zinc plated steel angle bars or equal and painted steel plates, and to be mounted on vibration dampers. The switchboard to be of "dead front" type. Hinged doors with stoppers and handrails in front. Backside to have large removable covers for easy access.

The switchboard shall consist of cubicles which will be separated by painted/zinc plated steel plates or equal to prevent spreading of arc and to minimise spreading of ionised gasses.

The main switchboard to have tripping equipment for unimportant load at overload on generators (-shunt trip). High voltage protection to be installed for automatic disconnecting generator breakers on each generator. All busbars, cables and wires to be fixed in such way that the systems can stand the strain and vibration or eventual short circuit without being damaged.

Cubicles for generators and important consumers in the switchboard to be well planned together with the owner and shipyard/switchboard manufacturer. All circuit breakers above 1000A to be of "draw-out" type.

Consumers above 10 kW to be supplied directly from the main switchboards as far as practical.

Fuses to be miniature circuit breakers (MCB) in main switchboard. Circuit breakers to be Moulded Case Circuit Breakers (MCCB).

The complete switchboards to be designed for ship worldwide operations.

All instrument, fuses, cables, switches, handles, etc. to be marked properly.

The shore connection circuit to have 2 contactors for selecting correct phase rotation on the main switchboard (440V). This switch to be interlocked over the circuit breakers for the generators in such a way that it cannot be switched on if at least one of the generators are connected and vice-versa. A signal lamp to be fitted on this circuit in the main switchboard for indication of power on. A separate A-meter, phase and automatic phase control and indicator also to be fitted.

The 230 V cell to be fitted with voltmeter and voltmeter switch.

All switchboards to be designed for equal no. of feeders on each side and total of 10 off spare feeders for 440V switchboards to be installed.

One off spare 500 kW breaker.

One -1- of Breaker for trafo, 500 kW / 600 kVA, 690V/440V – 60 Hz, to be arranged on each side of the bus tie breaker in main switch board, dedicated for future deck equipment.

One -1- of Breaker for trafo, 50 kW / 60 kVA, 690V/230V – 60 Hz, to be arranged on each side of the bus tie breaker in main switch board, dedicated for future deck equipment.

Note! Shipyard to receive clarification from designer upon main swb. size of equipment before purchasing.

GENERATOR CUBICLES IN MAIN SWITCHBOARD:

For each generator necessary equipment for monitoring and protection for the generator to be installed.

As a minimum each generator cubicle shall contain:

- 1 off ammeter with selector switch for each phase.
- kW-meter
- frequency meter
- Voltmeter and voltmeter switch
- Synchronising device and load sharing system
- Generator protection system
- PMS interface
- DP interface
- Over- voltage protection to be arranged in switchboard and/or generator.
- Differential protection to be provided.

The circuit for heating of the generators to be interlocked over the circuit breaker in such a way that the heating element is off when the respective generator is running.

Important signal lamps to be fitted.

EMERGENCY GENERATOR DIVE SWITCHBOARD:

An emergency switchboard to be installed close to the emergency dive aggregate.

The construction of and the equipment in the emergency switchboard to be similar to the main switchboard.

All emergency lights, (about 1/3 of all units), to be 230 VAC and to be supplied from emergency switchboard. A selection of lights in corridors, ECR, em.gen. room, emergency exits, embarkation area to have battery back up for 1 hour.

Socket outlets from ESB to be installed in ECR, 2 in SWB.room, 2 in engine room, 1 in lower aft pump room/ lower cargo hold, 1 in upper cargo hold, 1 in thruster room fwd. and 2 in thruster room aft. 1 in each instrument room.

TRANSFORMERS

Two (2) dry insulated transformers 690/440 V

Two (2) dry insulated transformers 690/230 V to be installed.

One (1) dry insulated transformer 440V/230 V emergency switchboard to be installed.

Two (2) dry insulated transformer 690/440 V 1600 kVA for Diving System

Transformers for diving system to be installed according to dive system suppliers requirements.

Two (2) dry insulated transformer 690/440 V 2500 kVA for ROV (Capacity to be agreed upon between Yard and suppliers).

Two (2) dry insulated transformers for ROV Outlets 440/110 V 50 kVA.

Two (2) dry insulated transformers for Cargo/ROV Outlets 690/230 V 40 kVA

One (1) dry insulated transformer for Galley equipments 440/230 V 100 kVA

One (1) dry insulated transformer for Galley equipments 440/440 V 200 kVA

STARTERS/MCC

The starters shall be installed as close as possible to the respective motors and fitted for remote and local operation if found appropriate.

Stand-by and priming pumps shall be remotely controlled from the ECR.

Motors which starting current is causing higher volt-drop. or peak, shall be equipped with starting current reduce device.

Starters to have a zero voltage release, if found appropriate, adjustable thermal motor protection for all phases and coloured buttons for start/stop. Red indication off, Green indication on.

All starters shall normally have a control voltage circuit not exceeding 230 V. This voltage to be delivered by the manoeuvring voltage transformers, which is built in the starters themselves.

All starters to be properly marked in clear text, showing which unit they belong to.

As far as possible, the starters to be of plate enclosed or cast enclosed type.

MCC to be arranged if appropriate.

EL MOTORS

Hour counters shall be fitted for all diesel engines and electrical motors above 10kW, to be integrated in the TM master maintenance system. All motors to be enclosure IP54, Class F or better. Stand still heating elements to be fitted in all motors above 15kW and in all el.motors exposed to weather decks and in wet or cold atmosphere.

EMERGENCY STOP

Emergency stop switches to be arranged for:

- Fuel oil pumps
- Oil separators
- Ventilation fans in accommodation
- Ventilation fans in engine rooms etc.

Quick closing release on all valves in connection to fuel oil tanks and feeding to main- and auxiliary engines to be arranged in groups on central location either outside Main deck or Shelter deck, inside accommodation or other suitable location.

All according to class requirements.

24V DC BATTERY SYSTEMS

Four (4) 24V DC battery systems, independent of each other, to be arranged. Circuits to be divided between the two systems in such a way that loss of one of the systems only causes minor problems for ships operation. Redundancy to be arranged between the two battery systems.

Components supplied from both 24VDC system, one main and one back-up, to be equipped with DC/DC insulating divisor

Two (2) independent 24 V DC batteries/ start system to be arranged for start of emergency/harbour aggregate.

One (1) independent 24 V DC battery system to be arranged for radio system.

Necessary battery system(s) to be arranged for DP system and Automation systems.

SPARE CABLES

A total of 40 spare cables to be laid between engine control room and wheelhouse, between engine control room and main azimuth thruster room and between engine control room and bow thruster room. All spare cable with to be earthed and meeting EMC requirement.

SHORE CONNECTION

A shore connection cabinet to be installed, with fuses and indication lamp.

Voltage: 3 x 440 V, 60 Hz.

Capacity: approx. 400 amp.

100 m shore connection cable , with sufficient capacity to be delivered. Arrangement for storing the shore connection cable to be made close to shore connection cabinet.

DISTRIBUTION PANELS

All distribution panels to be made of galvanised steel plates or aluminium. Distribution panels to be installed in dry locations.

All distribution panels, fuse boxes etc. to be countersunk into wall linings to avoid obstructions in the corridors.

Distribution circuits to have miniature circuit breakers/moulded case circuit breakers (MCB/MCCB). Spare capacity of 10% and spare space 10%.

MARKING OF ELECTRICAL EQUIPMENT

All electrical equipment except light fixtures, fire alarm sensors etc. to be clearly marked by engraved plastic signs, black text on white bottom of durable type. Inside switchboards, consoles, connection boxes etc. the marking can be more simple. Emergency signs to have white text on red bottom. All markings shall be easy to read.

Connection boxes behind wall/roof panels to be marked on outside of wall panels.

89 ELECTRICAL INSTALLATION

ELECTRICAL INSTALLATION GENERAL:

Marine type fluorescent lighting fixtures to be used throughout the ship. Incandescent lamps to be used only where it is impossible or impracticable to use fluorescent lighting fixtures, and for decorative purposes in accommodation. Enclosure according to regulations.

Electrical heating fans, 3 – 5 kw, to be mounted in bow thruster room, 2 x main azimuth propeller room, air dive control room, 2 x Dive hangar, 2 x Upper cargo hold, 2 x Lower cargo hold, emergency generator room, Paint store, 1 x each deck workshop, inside crane foundations and store wheelhouse top.

Electrical heating cables to be installed in all toilets/showers/ changing rooms/laundry.

Electrical installation shall be in accordance with the "proposal amendments to the SPS Code MSC.266(84).

ELECTRICAL INSTALLATION IN TECHNICAL ROOMS

Fluorescent lighting fixtures 2x18W to be mounted in engine room, bow thruster room, main azimuth propeller room workshops and in all other technical rooms. On weather deck, waterproof fluorescent lights and high pressure sodium lamps to be applied.

Generally, a minimum of 150 lux (average) light intensity to be measured 0,85 m above deck level in technical rooms. In engine control room minimum 300 lux (average) light intensity in front of main switchboard and above engine control room console to be measured.

6 receptacles 10A, 230V to be installed in engine room. In each of the workshops 4 receptacles 10A, 230V and 1 receptacle 16A, 440V to be installed. In addition 1 receptacle 32A, 440V to be installed in engine workshop. 4 receptacles 10A, 230V to be installed in cement room and 4 receptacles 10A, 230V to be installed in main azimuth propeller room. Minimum one receptacle 10A, 230V to be installed in each of the other technical rooms.

Light intensity approx. 150-200 lux in engine room and workshop, approx. 100 lux in other compartments.

2 off explosion proof hand lamps with approximately 50 m cable to be supplied for engine room.

All fluorescent lighting fixtures under main deck and in cargo rail to be mounted on rubber vibration compensators.

ELECTRICAL INSTALLATION IN ACCOMMODATION

Receptacle 32 A 440V to be installed:

1 off in deck workshop fwd main deck.

1 off in Engine room upper deck.

1 off in Engine lower deck

CABINS:

Two or three recessed down lights 2x18W, or LED lights.

One fluorescent lighting fixture 1x8W above each berth with 2-pole switch

One or more wall lamps

One desk light

230 V Emergency light.

Three or four spotlights for decorative lighting (- only in captain's and chief's cabins)

Two double receptacles, 230V.

One electrical heater 300W (- 2 electrical heaters in captain's and chief's cabins) In rooms where heating element is fitted in the ceiling ventilation unit, electrical heater is not necessary.

One 2-pole switch for ceiling lamps.

One 2-pole switch for wall lamps.

One 2-pole switch for spotlights (- only in captain's and chief's cabins).

One outlet for Radio/TV antenna.

One telephone station.

One alarm panel MAS ref 791 (- only in engineers cabins).

Spotlights and walls lamp in Capt. cabin and Chief Eng. cabin to have steeples dimmers.

TOILETS/SHOWERS:

One fluorescent lighting fixture 1x15W with shaver receptacle (with built-in isolating transformer).
One heating cable in floor.
One 2-pole switch for light.
One 2-pole switch and one step less regulator for heating cable.
Switches and regulator to be mounted outside the room but close to door.

CONFERENCE ROOM:

Recessed down lights 2x18W or LED lights. An average light intensity of minimum of 400 lux on tables to be achieved.
Three or four spotlights for decorative lighting.
Three wall lamps.
Four double receptacles, 230V.
Two electrical heaters 1000W.
One 2-pole switch for ceiling lamps.
One 2-pole switch for wall lamps.
One 2-pole switch for spotlights.
One outlet for Radio/TV antenna.
One telephone station.
One alarm panel MAS ref 791.
Spotlights and walls lamps to have step less dimmers.

OFFICES:

Recessed fluorescent lighting fixtures 2x18W, or LED lights. An average light intensity of minimum of 400 lux on tables to be achieved.
Four double receptacles, 230V.
Two electrical heaters 1000W.
One 2-pole switch for ceiling lamps.
One outlet for Radio/TV antenna.
One telephone station.
One alarm panel MAS ref 791.

MESS ROOM:

Recessed fluorescent lighting fixtures 2x18W, or LED lights. An average light intensity of minimum of 300 lux on tables to be measured.
Three or four wall lamps
Six double receptacles, 230V
Two electrical heaters 1000W
One 2-pole switch for ceiling lamps
One 2-pole switch for wall lamps
One outlet for Radio/TV antenna
One telephone station
One alarm panel MAS ref 791
Walls lamp in to have step less dimmers.

DAY ROOMS:

Recessed down lights 2x18W, or LED lights. An average light intensity of minimum of 200 lux to be measured 0,85m above deck level.
Five or six spotlights for decorative lighting
Three or four wall lamps

Six double receptacles, 230V
Four electrical heaters 300W
One 2-pole switch for ceiling lamps
One 2-pole switch for wall lamps
One 2-pole switch for spotlights
One outlet for Radio/TV antenna
One telephone station
One alarm panel MAS ref 791 (Common panel with mess room)
Spotlights and walls lamp to have step less dimmers.

LOUNGE:

Wi. Equipment's as for Day Room.
Spotlights and walls lamp to have step less dimmers.

RECEPTION:

Recessed fluorescent lighting fixtures 2x18W, or LED lights. An average light intensity of minimum of 300 lux on tables to be measured.
Two double receptacles, 230V
One electrical heaters 1000W
One 2-pole switch for ceiling lamps
One outlet for Radio/TV antenna
One telephone station

GALLEY:

Fluorescent lighting fixture 2x18W, or LED lights. An average light intensity of minimum of 300 lux to be measured 0,85m above deck level.
Six double receptacles, 230V
One 2-pole switch for ceiling lamps
One telephone station
Panel for call system
Remote controls for galley ventilation fans
Power supplies for galley equipment
440V connections made by connection boxes.

DRY PROVISION / COLD STORE:

Ceiling fluorescent lighting fixtures 2x18W, or LED lights. (- Incandescent lamps in cold store)
Call system push-button / switch in cold store room.
One 2-pole light switch with indication (mounted in galley)

GYMNASIUM:

Recessed down lights 2x18W, or LED lights. An average light intensity of minimum of 200 lux to be measured 0,85m above deck level.
Six double receptacles, 230V
Two electrical heaters 300W
One 2-pole switch for ceiling lamps
One outlet for Radio/TV antenna
One telephone station
One alarm panel MAS ref 791

LAUNDRY:

Ceiling fluorescent lighting fixtures 2x18W, or LED lights. An average light intensity of minimum 200 lux to be measured 0,85m above deck level.
Two double receptacles, 230V
One 2-pole switch for ceiling lamps
Power supplies for laundry equipment
440V connections made by connection boxes.

WARDROBE:

Ceiling fluorescent lighting fixtures 2x18W, or LED lights. An average light intensity of minimum 200 lux to be measured 0,85m above deck level.
Two double receptacles, 230V
Tree 1000W electrical heaters to be installed.

STAIRWAYS AND CORRIDORS:

Recessed down lights 2x18W, or LED lights. An average light intensity of minimum 100 lux to be measured 0,85m above deck level.
One double receptacles in each corridor, 230V.
Distribution panels.
Connection boxes.

WHEELHOUSE:

Recessed ceiling fluorescent lighting fixtures 2x18W, or LED lights. An average light intensity of minimum 200 lux to be measured 0,85m above deck level.
Spotlights with dimmers above consoles, chart table and radio station.
Chart table lamp with dimmer.
Two outlet for radio/TV antenna.
2-pole switches for ceiling lights.
6 socket outlets for el heaters to be arranged.
Fire alarm central.
Necessary power supplies for bridge equipment.
Power distribution panels.
Bridge consoles.
Navigation- and communication equipment.
Control of navigation lights, search lights and other outside illumination.
Equipment mentioned other places in this specification.
5 pcs "Snake" light 24 V above bridge panels aft, fwd, chartable and radio station.

CORRIDORS/ESCAPE ROUTES:

Low level lighting or photo luminescent strip indicators in not more than 300mm above deck at all points of the escape routes to be arranged.

ELECTRICAL INSTALLATION DECKS OUTSIDE

External lights to be installed on all external decks, including cargo rail. An average light intensity of minimum 110 lux to be measured 0,85m above deck level. All lights to be waterproof and made of stainless material.
Deck lighting to be arranged in front on superstructure on each side, on forecastle deck, on aft side of the superstructure and in cargo rail aft both sides. Brass lighting fixtures (with 2x7W compact fluorescent lamp) to be mounted in front of superstructure. In sides and aft of superstructure and in cargo rail fluorescent lighting fixtures to be mounted.

10 off high pressure sodium lights of make Phillips, Aqua or similar to be installed.

3 off remote controlled searchlights, 2000 W (Halogen), make Norselight, Seematz or similar, to be installed on top of wheelhouse, one in front and one aft on each bridge wing. 1 off searchlight to be installed to fore position below helideck. The search light shall have a minimum light power of 1lux at a distance of 2300 m. According to IES. The searchlights shall be operated with joystick from inside the wheelhouse.

Searchlights shall be operated from both forward and aft centre bridge console. Two of the searchlights shall also be operated from the bridge wings and forward console. Port searchlight from port wing /forward console and starboard from starboard wing / forward console. Forward searchlight also to be operated from aft centre console.

All searchlights to have remote focus control on main panel.

Switches for controlling all outside illumination shall be located in wheelhouse. Grouping of lights according to closer agreement with the owner.

230V receptacles to be arranged for deck outside to be arranged, but receptacles shall be located inside technical rooms.

POWER SUPPLY FOR DIVING SWITCHBOARD

A main 440 V/ 60Hz main dive switchboard is to be arranged for dive equipment, and to be supplied from ships main switchboard. The switchboard to be delivered by dive supplier.

POWER SUPPLY ON CARGO DECK

10 off Power supply in cargo rail on main deck for containers to be mounted in two stainless steel cabinets, the cabinets to be placed on deck in accordance with Owners recommendations.

MAIN GROUP 9 DIVE & WROV SYSTEMS

90 GENERAL

The dive system is an integral part of the ship. The dive system shall be supplied under a nominated subcontract. The Nominated Subcontractor shall be the Owner or Owner's nominee or subcontractor. The Nominated Subcontractor shall take technical responsibility for the specification, supply, installation, commissioning and performance of the dive system.

The dive system will be specified, built and installed in accordance with the information provided by the Nominated Subcontractor and applicable DNV GL, SOLAS, IMO and IMCA rules, regulations and guidelines.

The Ship Builder shall, under the supervision of the Nominated subcontractor, receive, appropriately store and install all items of dive equipment into the ship.

The Nominated Subcontractor will provide all the engineering information required by the Ship Builder to specify, design, supply and install the ship/dive equipment interfaces.

The Ship Builder shall design, supply and install suitable foundations and personnel access for the dive system on the basis of dimension and weight information provided by the Nominated Subcontractor.

The Ship Builder shall prepare the areas of the ship to be fitted with dive equipment with ship services as required by the Nominated Subcontractor and DNV GL Class rules, including ventilation (in/out), power (440V-230V-24V), fresh and sea water, effluent system, drains, vents, fresh air supply for the compressors, firefighting systems and the fire alarm loop.

The Ship Builder shall supply and install all cabling, piping, outlets, breakers, valves, etc. to connect the dive equipment to the ship supplied services and interconnect between the items of dive equipment in accordance with the requirements specified by the Nominated Subcontractor and DNV GL. Routings shall be agreed with the Nominated Subcontractor and the quantities of materials determined by the Ship Builder to comply with the specifications defined by the Nominated Subcontractor.

Basically the boundary limit is the connection point on each item of dive equipment defined by the Nominated Subcontractor.

The Ship Builder shall install, hook up and undertake tests to verify the workmanship of the work associated with the dive system with the cooperation and supervision of the Nominated Subcontractor. The dive equipment will be formally handed over from the Ship Builder to the Nominated Subcontractor to enable the Nominated Subcontractor to undertake the commissioning and system testing with assistance from the Ship Builder to achieve DNV GL DSV-SAT and SURFACE class notation. It shall be the Nominated Subcontractor's responsibility to secure DNV GL DSV-SAT and SURFACE class notation with assistance from the Ship Builder to be confirmed and formally recorded within an Interface Schedule to be agreed at the outset of the project.

Saturation Diving System

The dive system is a single diving bell, 18 man system capable of diving to 300msw. It is installed on multiple decks throughout the ship and is fully integrated with the ship's systems. The diving bell is deployed through the moon pool.

Two hyperbaric lifeboat's arranged on port and starboard side.

The Ship Builder is to arrange Power supply from main vessel switchboard to dive hangar with two switchboards for a total max power of approx. 700kW for the diving system, plus Emergency of approx. 300 kVA.(Max Power to be confirmed by supplier)

Switchboards (diving) to be provided by the Owner.

This section gives an outline of the materials and services to be provided by the Ship Builder with respect to the dive system installation. The exact interfaces are to be agreed and defined in an Interface Schedule produced by the Ship Builder and the Nominated Subcontractor. It should be read in conjunction with Equipment Technical Statistics/Interfaces provided by the Nominated Subcontractor which provides data on the size, weight and service requirements for all equipment and the Dive System drawings. Unless otherwise noted all services and materials described below are to be supplied by the Ship Builder.

The Nominated Subcontractor shall supervise the installation and hook up and undertake the commissioning in order to achieve DSV SAT and SURFACE notation. Hands-on labour is to be provided by the Ship Builder in support of the Nominated Subcontractor engineers and technicians. The Nominated Subcontractor will take responsibility for the Ship Builder supplied services system once accepted however normal warranty and latent defect provisions will apply. Regarding scope, details and interface to be discussed and agreed between Owner and Yard.

SECTION SUB-CONTENTS

Dynamic Analysis

Storage, Lifting Onboard and Fixing Down of Equipment

Construction of Foundations

Dive Chamber Alignment

Construction of Cursor and Gantry Rails

Thermal and Sound Insulation

Ventilation, Air Conditioning and Heating

General Lighting and Electrical Power Points

General L.P. Air Supply System

Moon pool Design

Water Supplies and Drains

Gas Exhaust pipes

Electrical Power Supplies and Cabling

Divers Intercom Communications

Dive System Hook-Up Cabling and Transits

Dive System Hook-Up Pipe Work Transits

Through Deck and Bulkhead Transits

Lifting Equipment and Load Test Points

A60 Areas within the Dive System

Fire Fighting

Ship Builder supplied items in support of Dive System

Drip Trays and Bunds

Local oxygen monitors

CCTV

Support for testing and commissioning

FMEA for Diving system to be provided by Owner.

DYNAMIC ANALYSES

The Ship Builder is to provide with the accelerations imposed upon the dive system at specific locations during:

- (a) "survival / Classification Society design case".
- (b) "operating limit / Classification Society design case"

These will be used in the design of the chamber complex and support equipment and the design of the SDC Launch and Recovery System.

The predicted water motion within the moon pool is also to be modeled during launching and recovery of the diving bell/cursor arrangement in order to define the accelerations imposed upon the SDC LARS.

STORAGE, LIFTING ONBOARD AND FIXING DOWN OF EQUIPMENT

The Ship Builder is to receive and store all items of diving equipment after delivery in an appropriate environment until it is to be lifted onboard the ship for installation. The Ship Builder must assume responsibility for the safe keeping of the equipment after delivery by Nominated Subcontractor to the Ship Builder. Equipment will be supplied protected and preserved to an appropriate standard. Handling instructions will be provided by the Nominated Subcontractor. Particular attention is to be given to avoid frost and condensation damage. A plan shall be developed for lifting all items of diving equipment onto the ship, positioning it correctly on foundations and fixing down. The Ship Builder will move all equipment onto the ship, locate and fix according to the agreed location plan. All fixing and mountings shall be supplied by the Ship Builder. The Ship Builder supply shall include all bulkheads, decks, floors, platforms, stairs, handrails, ladders, runways and cursor guide rails required on the vessel. Where equipment passes through bulkheads and decks adequate means of sealing the penetration are to be devised and installed by the Ship Builder.

CONSTRUCTION OF FOUNDATIONS

The Nominated Subcontractor will issue plans to the Ship Builder (to a schedule to be agreed) showing the seating details and imposed loads for the diving equipment. The Ship Builder is to make working drawings, manufacture and correctly locate these foundations in the ship and supply suitable hold down nuts, bolts and washers (Grade 8.8 minimum). If anti-vibration or noise mountings are deemed necessary these shall be defined and supplied by the Ship Builder. The Ship Builder is also to provide the runway beams and racks necessary to support the diving bell gantries.

NOTE:

1. Particular note should be made of the structural rigidity required between the runway beams supporting the SDC Trolley and the deck supports of the TUP Chamber. In order for the SDC to repeatedly mate to the TUP

Chamber the relative movement under operational sea states must be minimized in order to limit the loads induced into the pressure chambers when mated.

2. The chamber complex must be founded upon a very rigid substructure. This should be integrated into the deck structure. Therefore particular attention must be placed upon the chamber foundation/deck structure to minimize movement under operational sea states in order to limit the loads induced into the pressure chambers when mated.

3. It should be noted that the chambers and other pressure chambers require periodic hydraulic testing which significantly increases the chambers weights. This additional weight must be taken into account.

The following gives guidance on the relative deflections that can be tolerated by the chamber system.
HLB to Chamber

The HLB's will be supported from the local deck which must be of sufficient rigidity to limit the maximum deflection to 3mm under survival conditions between the support saddles. The deck must also be strengthened to accept the davit loads in accordance with SOLAS which will also provide the lateral and longitudinal constraint. All lateral loads under survival conditions are to be constrained at top of the HLB mate trunk. The Nominated Subcontractor will provide the conceptual design of the lateral constraint system which is to be integrated into the ships structure. This constraint will have freedom in the vertical direction.

CHAMBER FOUNDATIONS

One saddle of the TUP will be rigidly bolted to the deck. The other TUP saddle and all other chamber saddles will be guided only. Some rotational slippage will be allowed at each bolted flange joint to take account of some deck racking. The deck structure beneath the chambers should however be designed to limit the maximum vertical relative deflection to 3mm between the outer diagonal points within the area bounded by outer shell of the ship and between the frames forward most and after most of the chamber foundations. Local deflections between any two points within this area are assumed to reduce by the pro rata reduction in distance between the points. The relevant dynamic factors will have to be applied.

NOTE:

1. Under static condition the Ship Builder needs to consider the hydro test condition - this may be a worst case for the deck deflections.

DIVE CHAMBER ALIGNMENT

The Nominated Subcontractor will supervise the alignment and connection of the chambers with support from the Ship Builder. Final alignment will be achieved by The Nominated Subcontractor taking accurate measurements between each flange connection. Drilled spacer rings will be machined by the Ship Builder in 316L stainless steel to make up the gap. The rings will typically be 30 mm thick with an ID of 800mm and an OD of 900mm. The spacer rings will be sealed by O rings machined into both faces. The spacer rings will be supplied and fitted by the Ship Builder who will also complete the bolting/clamp assembly under The Nominated Subcontractor supervision. Bolts will be specified by The Nominated Subcontractor. It should be assumed that 7 spacer rings will be required.

CONSTRUCTION OF CURSOR AND TROLLEY RAILS

The Nominated Subcontractor will issue a detailed general arrangement to the Ship Builder showing the SDC Trolley support rails and moon pool cursor guide rails to be designed by The Nominated Subcontractor. The construction to be carried out by the Ship Builder in close supervision by The Nominated Subcontractor.

The SDC (submersible diving chamber) Trolley rails will be allowed to deflect by up to +/-1.5mm both laterally and vertically relative to the TUP chamber foundations under the most severe sea states for which the SDC is to be mated. Ship Builder will have to identify the relevant accelerations under the worst case. The SDC +

Cursor + Stand Off weight static weight can be assumed to be approx. 24 Tonnes. There will be no longitudinal constraint. The trolley rails are formed from deep beams integrated into the ships structure topped with high strength steel wear and guide surfaces.

THERMAL AND SOUND INSULATION

Thermal and sound insulation of an agreed type and quality is to be installed on bulkheads and decks shown on the arrangement drawings. It should be particularly noted that this vessel is to meet challenging noise requirements which limits the noise within the chambers to 60dB(A). This requires a specific design activity to ensure this requirement is met.

VENTILATION, AIR CONDITIONING AND HEATING

All diving equipment compartments are to be adequately ventilated and heated in accordance with all relevant regulations by the Ship Builder. The chamber deck spaces, winch drive rooms and all control rooms are to be air conditioned. The compressors are to have an independent air supply fed to their inlet manifolds from a clean upper deck space. Particular attention is drawn to the ventilation of the space surrounding the bell launch and recovery winches and power supplies.

NOTE:

1. Due to the quantity of gas held in the HP gas storage cylinders at the tween deck, the Chamber Deck(main deck) and the dive control room, consideration must be given to pressure relief or automatic closure to protect the HVAC ducting joining to other spaces in the event of catastrophic failure. Emergency relief to atmosphere is required in each of these compartments.
2. The use of electrical drive systems for the SDC LARS requires the dissipation of braking energy within the winch compartment. Particular attention is required in the ventilation of this area. 2 x 35kW braking resistors will be provided.
3. It should be noted that the action of the water surging within moon pool can create large volume changes within the compartment. This must be suitably equalized to atmosphere.
4. The HP Air Compressors are to have an independent air supply fed directly to the inlet manifolds from a clean upper deck space sited to minimize the likelihood of ingesting ships engine exhaust. A suitable inlet particle filter shall be provided.

GENERAL LIGHTING AND ELECTRICAL POWER POINTS

All diving equipment compartments are to be fitted with good general lighting. Lighting near the chamber and bell control panels is to be selected by the Ship Builder so as to give minimum electrical interference to sensitive communications equipment. Lighting within the all diving control rooms is to be dimmable. Lighting in areas where water deluge is applied shall be suitable for the location but shall at least meet IP54. The Ship Builder is to supply an emergency operated lighting system for diving equipment spaces.

General 220/110V power outlets are to be provided in all locations. The quantity and rating of the lights is to be agreed.

GENERAL L.P. AIR SUPPLY SYSTEM

The Ship Builder is to provide suitable working air supply for general services in the saturation, bell handling and dive machinery spaces. High volume air will also be supplied for moon pool aeration. For estimating purposes this can be taken as a flow of compressor capacity 2x1800 Nm³/hr at a supply pressure of 10bar. This high demand is intermittent and of short duration being only required during launch and recovery of the bell through moon pool. An air receiver of 2000ltr is to be fitted. The minimum air quality is as follows:

- Supply pressure range - 6.5 to 10 bar(g)
- Particle size - 15 micron or less
- Water pressure Dew point – 940ppm @ 6.9bar(g) or less

MOONPOOL DESIGN

The Ship Builder is to design and construct the diving moon pool in close liaison with The Nominated Subcontractor Ltd. It is to incorporate vertical guides for the SDC and cursor rails and an aeration system. The moon pool shall be fitted with its own aeration system. The aeration system is to consist of approximately 20 nozzles projecting into the moon pool near the bottom of the moon pool. The air supply pipe shall have an adjustable flow control valve which can be pre-set and a ball valve which can be operated remotely by an electrical signal. The moon pool remote control actuator shall be located in the Dive Control Room. See above for air supply requirements.

A conventional Clump Weight is to be stowed within the moon pool. Four pad eyes each rated to 5Te are to be provided close to the Moon pool coaming for the attachment of support chains to secure the Clump Weight for sea fastening.

The moon pool is to be provided with expansion tanks to reduce surge. The volume of the expansion shall be at least 50% of the volume of the moon pool. Baffles and rubbing strakes shall be fitted within the moon pool to reduce water slap and fend the clump weight during launch and recovery. No inaccessible spaces shall be left within the moon pool that may impede maintenance and inspection.

The Moon pool Hangar area is particularly prone to weathering due to salt spray from the open moon pool. A higher grade paint specification is to be used in this area.

WATER SUPPLIES AND DRAINS

All ship provided services are to be engineered by the Ship Builder and materials supplied by the Ship Builder with appropriate certification meeting the requirements for the vessel classification. These services are considered part of the ship and come under the vessel survey requirements. The required materials are to be supplied by the Ship Builders and installed and connected directly to the required equipment at an interface to be agreed. Local isolation and drain valves are to be provided. Adequate scuppers are to be situated throughout the diving compartment spaces for local oily drains from compressors and other equipment when draining down. Several Effluent Interlock Holding Tanks intercept all the waste from the dive system. These are vented tanks and can be safely discharged into the ship's vacuum black water system. Grey water discharges will be piped directly overboard. The Ship Builder is responsible for connecting to the 50mm discharge connections at the Effluent Tanks and the 100mm vents.

FRESHWATER COOLING REQUIREMENT

Two independent fresh water cooling supplies shall be provided by the Ship Builder. The maximum supply temperature shall be less than 37°C. Cooling water will be circulated around the various air compressors, gas compressors, hydraulic systems, braking resistors and HCU Chiller Units. The maximum supply pressure shall be 2.8bar. At least one of the independent fresh water supplies shall be maintained in the event of the ship being supplied from the Emergency Generator. The Nominated Subcontractor supplied HCU chillers shall be supplied by different systems to prevent a single point failure.

Where required, (The Nominated Subcontractor will specify the consumptions and locations), the Ship Builder are to design, supply, install, flush and test all fresh water supply requirements interface with the dive system.

FRESHWATER REQUIREMENT

Disinfected (chlorinated, de-chlorinated and UV-radiated) cold fresh water for washing, showering, etc. will be supplied from the ships potable water system to each Domestic Water Unit. Although safe to drink ordinarily bottled drinking water will be supplied to the divers.

It is recommended that the Ship Builder provide a 500ltr Hydrophore unit is provided and located adjacent to the Domestic Water Units to meet the peak in demand coming from the high flow showers and water pressure assisted toilet system.

Where required, (The Nominated Subcontractor will specify the consumptions and locations), the Ship Builder are to design, supply, install, flush and test all fresh water supply requirements interface with the dive system.

SEAWATER REQUIREMENT

Two independent filtered and UV radiated sea water supplies shall be provided to the dive system. The maximum supply pressure shall be 2.8bar. At least one of the independent supplies shall be maintained in the event of the ship being supplied from the Emergency Generator. The Nominated Subcontractor supplied HCU chillers shall be supplied by different systems to prevent a single point failure.

The filtered seawater should be exposed to UV-radiation. It should be possible to supply this system from an alternative source such as general service pumps or the fire main should a fire or flood in the engine room cause both seawater pumps to fail. This back up supply shall be regulated to 2.8bar before the inlet to the Diver Heating Units.

Where required, (The Nominated Subcontractor will specify the consumptions and locations), the Ship Builder are to design, supply, install, flush and test all seawater supply requirements interface with the dive system.

GAS EXHAUST PIPES

Galvanized steel exhausts pipes of at least 150mm diameter are to be provided in each dive equipment compartment which are vented to atmosphere. These will be provided with numerous threaded outlets for connection to the following services as a minimum:

- Compressor auto dumps, vents and reliefs
- Effluent Tank vents
- Gas storage cylinder relief valves
- Gas Regulation Panel relief valves and vents

Separate exhaust pipe shall be provided for the chambers BIBS dump (Minimum 50mm).

ELECTRICAL POWER SUPPLIES AND CABLING

All ship provided services are to be engineered by the Ship Builder and materials supplied by the Ship Builder with appropriate certification meeting the requirements for the vessel classification. The diving equipment requires electrical power from the ship's main electrical distribution boards and emergency switchboard. These are to be supplied and connected to the diving system main switchboards (also supplied by the Ship Builder). The Ship Builder is also to deliver and install all interconnecting electrical equipment including cables, cable ties, cable ID's, transits for each item of equipment.

440 V MAIN POWER SUPPLY

The dive complex shall be supplied from two independent Electrical Distribution Boards via dedicated HV/440V transformers contained in separate A60 rooms.

For example: Both Electrical Distribution Boards contain some essential services and these shall be supplied from a dedicated Emergency Diving Generator to recover the bell and sustain life support.

EMERGENCY 440 V SUPPLY

The emergency source of power for diving services shall be approximately 600kVA (to be confirmed after final load balance calculations) to start and connect automatically within 45 sec of failure of the electrical supply from the main source.

230/115 VOLTS AND 24 VOLTS

Distribution boards will be located at dive and sat control levels for dive system 230/115V consumers. At these locations there shall be both UPS and normal switch boards.

Chamber 24VDC supplies shall be produced locally and the power supplies will be provided by The Nominated Subcontractor.

Consumers such as computers, control equipment and PLC's that require an un-interruptible power source will be supplied from UPS. The duration of these power supplies shall be a minimum of 30 minutes.

The failure effects of transformers or lower voltage distributions are to be no greater than the effects of failure of the main breakers supplying that panel.

DIVERS INTERCOM

The Ship Builder is to provide and install discrete communication between Dive Control, Sat Control and all required areas out with the chambers and SDC. Typically around 50 stations.

These communications may be integrated within the ships telephone/intercom system but the following channels must be hail able at all times ("hot lines"):

- Dive Control /Bridge
- Dive Control/Cranes
- Dive Control/Sat Control
- Bridge/Cranes

DIVE SYSTEM HOOK-UP CABLING AND TRANSITS

The Nominated Subcontractor will be responsible for defining and specifying all interconnecting wiring and fiber optics between the dive equipment. The Nominated Subcontractor have to undertake conductor sizing to satisfy the Classification Society and once agreed routes shall not be changed without formal change agreement between the Ship Builder and The Nominated Subcontractor. The Ship Builder is to supply, install and ensure the quality of workmanship of the cabling, wiring, fiber optics and support brackets. Ship Builder will connect all conductors directly into the Nominated Subcontractor supplied equipment and undertake all normal tests to verify the correctness and workmanship of the work in accordance with applicable rules.

Following installation and checking by the Ship Builder The Nominated Subcontractor will undertake independent checks to satisfy itself that the Ship Builder installed systems comply with the design and operational requirements prior to commencing commissioning of the services. A Permit to Work system shall be agreed between the Ship Builder and The Nominated Subcontractor prior to any power being applied to any diving related services.

It is desirable that all interconnecting services related to the dive equipment are segregated from ships services. Any wiring forming part of the safety critical monitoring and control system must be segregated and run on separate cable trays.

The Ship Builder is to cut and reinforce, as necessary, holes for the transit of cables through decks, bulkheads and stiffeners/beams. MCT frames and blocks will be provided by the Ship Builder where required

NOTE:

It is The Nominated Subcontractor' responsibility to achieve Classification of the diving installation, however the Ship Builder remains responsible for supplying materials in accordance with the requirements defined by The Nominated Subcontractor and of installing these materials to appropriate standards of workmanship. If there is shown to be a shortfall in these service due to the Ship Builder then the Ship Builder shall promptly rectify such defects as time will be of the essence.

The Ship Builder and The Nominated Subcontractor are to agree the pipe routes. The Nominated Subcontractor have to undertake line sizing to satisfy the Classification Society and once agreed routes shall not be changed without formal change agreement between the Ship Builder and The Nominated Subcontractor. Pipe work will be mainly SS316L however Tungum brass pipe work will also be used. The highest pressure pipe work will be 300bar.

As an Option in the accompanying Commercial Proposal, The Nominated Subcontractor can provide all the required stainless steel and Tungum pipe work including the flared pipe fittings, flanges, O rings, flange bolts, pipe clamps and valves for use by the Ship Builder. Our quotation is based on the pipe schedule and ECS schematic attached at ANNEX B+ DIVE EQUIPMENT INTERCONNECT PIPING MATERIALS.

The Ship Builder is to install and ensure the quality of workmanship of the pipe work and support brackets. The Ship Builder will connect directly to the Nominated Subcontractor supplied equipment. Where valves are required to be fitted into the line these will be supplied by The Nominated Subcontractor.

NOTE: If the pipe route is significantly different to that assumed for the pipe schedule or pipes are formed incorrectly which require the scrapping of pipe and fittings then this material is to be replaced by the Ship Builder at no cost to The Nominated Subcontractor. It must be noted that specific certification is required with these materials which extends normal delivery. The Nominated Subcontractor cannot accept responsibility for delays due to the wastage of piping materials.

Following gas pipework installation, initial cleaning and pressure testing will be undertaken by the Ship Builder (pressure testing to be witnessed by The Nominated Subcontractor). The Nominated Subcontractor will then undertake final flushing, cleanliness certification, final pressure and leak testing and final re-connection to the dive equipment and will offer the piping services to the Classification Society for acceptance. A portable Flushing and Test Workshop will be provided by The Nominated Subcontractor for this purpose. This requires 3 phase power and fresh water supplies and is to be located adjacent to the ship or preferably located on the Main Deck.

All hydraulic, waste and water services pipework will be supplied, installed, inspected, flushed, pressure tested and certified clean solely by the Ship Builder to the same standard as similar systems in the vessel.

It is desirable that all interconnecting services related to the dive equipment are segregated from ships services.

For guidance the bulk of the large bore pipe installation will be of welded construction conforming to the following specifications:

ANSI B16.9 or equivalent for reducers, tees, elbows, etc.
ANSI B36.10/19 or equivalent for schedule pipe work.
BS3799 or equivalent for threaded couplings, nipples, etc.

Material spec for above per ASTM A182 Grade 316L stainless steel or equivalent.

Small bore pipe work (25mm and less) will either be stainless steel or Tungum alpha brass tube using SS316L Parker Triple Lock 37o JIC flared fittings.

Material specs for stainless steel will be:

ASTM A276 / ASME SA479 or equivalent for bar stock adapters (straights) ASTM A182 / ASME SA182 or equivalent for forgings (elbows, tees, etc) for 316L grade stainless steel.

The Ship Builder is to cut and reinforce, as necessary, holes for the transit of pipe work through decks, bulkheads and stiffeners/beams. Penetration plates will be provided by the Ship Builder where required. It should be noted that pipe penetrations must at least equal the duty of the pipe run passing through the transit.

NOTE:

Life Support pipe work of typically 80mm nominal bore runs between each chamber and the HCU-ER units. This large bore pipe work is an extension of the chamber pressure boundary. It is understood that the deck under the chambers will be an A60 boundary and particular attention is to be paid to the means of penetration through the deck. Flexibility in the 80mm pipe work will be required to prevent bending stresses building in this critical life support pipe work. Flanges shall be O ring sealed. The Life Support pipe work is to be thermally insulated along the entire length from the chamber hull stop valve to the isolation valves on the associated HCU-ER.

NOTE:

It is The Nominated Subcontractor's responsibility to achieve Classification of the diving installation however the Ship Builder remains responsible for supplying materials in accordance with the requirements defined by The Nominated Subcontractor and of installing these materials to appropriate standards of workmanship. If there is shown to be a shortfall in these service due to the Ship Builder then the Ship Builder shall promptly rectify such defects as time will be of the essence.

CHAMBER THROUGH DECK AND BULKHEAD TRANSITS

It should be noted that the trunking connecting the outboard chamber to the Hyperbaric Lifeboat and the TUP to the Bell will penetrate the deck. A flexible deck penetration is to be formed in the deck for maintaining watertight integrity. This requires a coaming to be welded to the deck/bulkhead and a flexible gasket to be fitted to join to the flange on the HLB trunking.

LIFTING EQUIPMENT AND LOAD TEST POINTS

Suitable lift points and handling beams are required over certain items of equipment to assist in maintenance and operation.

Suitable pad eyes or test beams are to be provided at moon pool to provide fixing points for undertaking load tests on the Bell LARS. The following test loads will be applied:

SDC Lift Winch	approx.. 28 Tonnes each
Guide Wire Winch	approx.. 18 Tonnes each
Umbilical Winch	approx.. 6 Tonnes each

A60 AREAS WITHIN THE DIVE SYSTEM

The following are considered separate A60 areas as a minimum. This is subject to agreement with the Classification Society and in accordance with Class requirements:

The Chamber Deck area including the Chamber Control Room
Ancillary Machinery space immediately below the Chamber Deck
Winch Drive Rooms
All Dive Control Rooms

FIRE FIGHTING

The Ship Builder is to supply and install fixed water sprinkler systems over all the dive equipment except control rooms which are to have suitable FiFi installation similar to other control rooms. FiFi facilities within the chamber complex will be the total responsibility of The Nominated Subcontractor.

SHIP BUILDER SUPPLIED ITEMS IN SUPPORT OF DIVE SYSTEM

As well as the items specified elsewhere in this document, the Ship Builder is to provide the following normal services at no charge:

A location close to the ship for The Nominated Subcontractor site container/workshops.

Electrical power to the site container/workshops and to hand tools onboard in the diving spaces.

Air for hand tools onboard in the diving spaces.

Daily cleaning service in the diving spaces to carry away all waste/garbage.

Site heating, ventilation and lighting in the diving spaces.

Availability for The Nominated Subcontractor personnel to work 7 days a week, 12 hour shifts if deemed necessary by The Nominated Subcontractor.

Provision of an office at the yard for The Nominated Subcontractor site supervisor with telephone, e mail and fax facilities.

Special provision for the protection and covering against damage, dirt and dust of the diving system equipment during receipt, storage, installation and construction of the ship. Any damage to dive equipment due to Ship Builder personnel will be repaired or replace at cost to the Ship Builder.

Generally the provision for The Nominated Subcontractor personnel to carry out their installation and commissioning work in accordance with a normal schedule (yet to be discussed), with the full and friendly co-operation of the Ship Builder and without any extra charges from the Ship Builder unless specifically agreed in writing.

NOTE:

A normal installation and commissioning schedule is usually detailed to comply with and compliment the build schedule of the Ship Builder for the new build ship. The Nominated Subcontractor will discuss these details with the Ship Builder and also review the facilities at the Ship Builder and local accommodation etc., for the The Nominated Subcontractor personnel.

DRIP TRAYS

The Ship Builder is to provide and install drip trays and scuppers for water from the bell lift wires and umbilical.

LOCAL OXYGEN MONITORS

The Nominated Subcontractor will provide local O2 monitors and alarms for location in areas where the escape of low oxygen gas could present a hazard to life. The Nominated Subcontractor to supervise the Ship Builder to install oxygen monitors with local alarms and provide the required power supplies and cabling. The Local Oxygen Monitors form part of the vessel's systems and these are to be included in the vessel's systems and are not covered by the dive system classification.

CCTV

The Ship Builder is to provide and install various digital CCTV cameras around the dive system to provide visual information to the dive control rooms. The Nominated Subcontractor will supply the TV monitors integrated into the Chamber and Dive Control Consoles. Any additional monitors required by the Owner will be provided by the Ship Builder.

SUPPORT OF TESTING AND COMMISSIONING

In order to achieve Classification certain specialized tests are required following the installation of the dive system. These include:

- Nitrogen and Helium Pressure and leak testing
- Oxygen Cleaning and Verification
- Breathing machine tests for the various breathing systems including the diver gas reclaim system
- Modified Rhyme Test for all diver communications
- Calibration of the analysis systems
- Off gas testing within the chambers and breathing gas
- Testing of the Environmental Control System post installation
- Load testing of the SDC LARS

The Nominated Subcontractor will undertake to arrange for the above tests and where required specialist test contractors and test equipment will be required. The Ship Builder is to allow access by the specialist contractors and provide the space and required services for the test gases and equipment. In the case of the load tests the Ship Builder are to provide the test weights and temporary rigging for the tests which will be conducted by The Nominated Subcontractor and witnessed by the Classification Society in liaison with The Nominated Subcontractor.

FMEA

In order to achieve Classification an FMEA for the vessel will be required. The Nominated Subcontractor to provide the Dive System FMEA, however the Ship Builder will be required to provide The Nominated Subcontractor with the specifications and engineering information related to any services provided by the ship such as:

- Normal power supply
- Emergency power supply
- Electrical instrumentation and alarms fitted to the vessel that affect the dive system
- Cooling water system
- Sea water supply system
- Portable water supply systems
- Mooring pool aeration system
- Black and grey water systems that affect the dive system
- Vents and exhausts connected to the dive system
- Video surveillance systems that observe the dive system
- Ships communications that interface to the dive system
- Fire Detection and fighting systems around the diving equipment
- HVAC provisions around the diving system
- A60 bulkhead details around the diving systems

92 AIR/MIXED-GAS DIVING SPREAD

The Shipyard is to install the air dive facilities including the dive basket LARS and tool LARS if applicable. Supervision and labour by Flash Tekk.

93 WROV & OBS ROV SYSTEM

One -1- of WROVs and its launching and recovery system (LARS) will be Owner supplied. The WROVs to be arranged in the ROV hangar, ref. GA-plan.

One -1- of OBS ROV and its launching and recovery system (LARS) will be Owner supplied. The OBS ROV to be arranged on PS side Main deck, between frame 103 – 112, ref. GA-plan.

Builder shall undertake its installation and hook up with advice and assistance from supplier and Owner.

Owner will supply builder with relative specification of services required.

MAKERS LIST

Suppliers/makes not specified in this list should not be excluded if they are meeting requirements regarding quality, price, extent of delivery etc. The yard has the right to select among makes mentioned in this list. Some of the items may not be relevant for the project in question.

SFI	ITEM	SUPPLIERS/MAKERS	Remark
E	Green Passport documentation	Metizoft AS	
E	Maintenance System	Premaster – WWW.ONSOFT.NO or www.emarine.no	Owner Supply
264	Fenders	Rubber Design D Fender, Fentek, Hi-Tech Elomasters, Beite	
271	Paint	Jotun, International, Hempel,	
278	Cathodic protection Anti Fouling	Dimo, Cathelco, Wilson Walton, MME Group bv, Sargam Metals, ETC (UAE), Cathelco	
306	Small hatches, manholes etc.	Nor-Pro AS, Mac Gregor Ltd, Shipyard CMHI standard,	Yard to propose alternative supplier if preferred (Owner to approve)
307	Side Ports	TTS, MacGregor, Kongsberg Evotech, Wuxi Dongzhou, Zhongyuan China,	
331	Offshore Cranes	National Oilwell, TTS, MacGregor, Huisman	
331	Deck Cranes, type knuckle boom/foldable cranes	TTS ENERGY, Nat Oil, MacGregor, Palfinger, Acta, HS marine, Effer, Bergen Group Dreggen, M.E.P. Pellegrini	
332	Cargo Securing Winches	Zicom, Plimsoll, NAT OIL/Hydralift, Hattlapa, Rolls Royce Rauma, Odium, TTS, Ingsoland	
351	Loading / discharge pumps	Ing. P. Gjerdrum, Allweiler, Desmi, Itur	
381	Tank Sounding Sensor	Mork, Autronica, Hoppe, Emerson,	Yard to propose alternative supplier if preferred (Owner to approve)
404	Side Thrusters and Azimuth Thruster Fwd.	Rolls-Royce, Brunvoll, Schottel,	
405	Anti Heeling System	Ing. P. Gjerdrum, Hoppe, Framo (Frank Mohn)	
408	DP-System	Kongsberg Maritime, Rolls Royce Marine, Marine Technologies	
408	Joystick System	Kongsberg Maritime, Rolls Royce Marine, Marine Technologies	
411	Radar, VDR	Furuno, JRC, Kelvin Hughes,	Radar, nav, etc. should be a integrated system.

412	ECDIS	Furuno, Atlas, Tokimec, Sailor, JRC, Fugro SeaSTAR	Radar, nav, etc. should be a integrated system
412	GPS	Furuno, Kongsberg SIMRAD, JRC, Fugro SeaSTAR	Furuno for the ordinary navigation GPS and Kongsberg for DP GPS reference system
413	Gyro compass. Autopilot	Anschutz, Sperry, SG Brown, Tokimec, Cassens & Plath	
413	Magnetic Compass	Cassens & Plath, Anschutz, Tokimec, JRC	
414	Echo sounder	Furuno, Atlas, Sailor, SKIPPER(NOR), Kelvin Huges, JRC	
414	Doppler – Speed log	Furuno, Atlas, Anthea, Kelvin Huges, Simrad, JRC	
415	Loading computer SW system	MT ShipLoad, Seatex, RR, Kongsberg	
417	VDR	JRC, Furuno, Kongsberg Simrad, Atlas, Kelvin Hughes	
417	AIS	Furuno, Kelvin Hughes, Atlas, JRC	
418	TV/AM/FM Antenna and Socket outlet	Ship Equip, TIS, Elcome Marine, Furuno, JRC, Phonetech	
421	Radio Station	Sailor, Furuno, JRC	
421	Sat. Com. System, GMDSS, Navtex Receiv.	Sailor, Furuno, JRC	AIS, SSAS: Furuno, JRC, Sailor
422	Life Boat Transm., free float transm. (EPIRB)	Sailor, Furuno, Jotron, Mcurdo, JRC	
424	VHF and UHF	Sailor, Furuno, Motorola, JRC	
425	Telephone/Intercom/ CCTV	Clearcom Alcatel IP, TOA Electronic, Zenitel/Vingtor, Phonetech, Amplidan, NVEC, Panasonic, Sony, HERNIS, Nantong Harmor	
427	Light and signal equipment	Tranberg, Norselight, Warom China, Haixing China	
431	Anchors with chain and equipm.	Sotra Marine Produkter, HDCS, ASIAN STAR, Dea Han Anchor chanin, QINDAO Anchor, Young Yuan	Yard to propose alternative supplier if preferred (Owner to approve)
432	Windlass, mooring winches	Rolls-Royce Marine, Mac gregor – Cargotec, Norwegian Deck Equipment, Plimsoll, Odim, Nat oil Hydralift, Hatlapa, TTS	
433	Capstans/Mooring winches	Rolls-Royce, Mac gregor – Cargotec, Norwegian Deck Equipment, Plimsoll, Odim, Nat oil Hydralift, Hatlapa, TTS	

434	Tugger Winch	Zicom, Plimsoll, RRM/Odim, Hydralift, Ship's Equipment Center, Hallapa, Rolls Royce Rauma, Odim, TTS	
435	Fixed mooring equipment	Nor Pro, Young Nam(KOR), Zhong Yuan China	Yard to propose alternative supplier if preferred (Owner to approve)
445	Incinerator	Teamtec, Atlas, Detegasa, Kay Lindegaard Inchinerators,	
501	Lifeboats with davits	Harding, Eide Marine, Norsafe, Nibote	
501	MOB boat	Maritime Partner, Harding, Mare Safety, Noreq, MSI, Normar, Waverider, Vanguard, Norsafe, Brude Safety, Nibote	Solas approved davit type: NDM, Hydralift, TTS, Nanguard, Norsafe, Noreq, Maritime Partner, Mare Safety
502	Life rafts	Viking, DSB, RFD, Norsafe, Brude Safety	
503	Survival suits	Helly Hansen, Viking, Sea Master, Stearns	
505	EEBD (emerg escape breath device)	Draeger (Germany), Ocenco, Survitec	
510	Wall and Ceiling Accommodation System	Contech, Maritime Montering, Norac, BIP, STACO, Imac, NSS Japan, Promat, HBM	Yard to propose alternative supplier if preferred (Owner to approve)
511	Bath room Units	Contech, BIP, STACO, Maritime Montering, Norac, Promat, Sejin, HBM	Yard to propose alternative supplier if preferred (Owner to approve)
512	Inferior doors	Contech, COSMO, STACO, Maritime Montering, Norac, Alvedoor, Sejin, HBM	Yard to propose alternative supplier if preferred (Owner to approve)
513	A-60 and A-0 doors	Contech, COSMO, STACO, Sejin, Maritime Montering, Norac, Alvedoor, HBM	Yard to propose alternative supplier if preferred (Owner to approve)
513	Watertight sliding doors	IMS, Winel, Agua-Mar, Master Hydraulic, Tebul	
514	External steel- and GRP doors	Libra, Winell, ES Tech Marine Company	
515	Windows	Marine Aluminium, Altro(Bohamet), Wigo Windows / H.K. van Wingerden & Zn. BV, Jung Gong, Dae Kyo,	
515	Window Wipers	Wynn, Servi, Seematz,	
541	Sofas and chairs for crew	Maritime Montering, Maritime Møbler, STACO, VAD, VESTNES Innredning, Ekornes Contract, Norac, Ekornes, Ming Run China	Yard to propose alternative supplier if preferred (Owner to approve)
541	Tables and other furniture for crew	Vad, Maritime Montering, Maritime Møbler, STACO, VESTNES Innredning, Ekornes Contract, Sejin Technical, Norac, Ming Run China	Yard to propose alternative supplier if preferred (Owner to approve)

542	Wheelhouse chairs, office furniture	Nor-Sap, Maritime Montering, Maritime Møbler, STACO, R-RM, Kongsberg, Marine Technologies, Norac, Ming Run China	Yard to propose alternative supplier if preferred (Owner to approve)
543	Mattress	Stjernemadrassen, Ekornes Contract, Maritime Montering, Maritime Møbler, VAD, VESTNES, Sejin Technical, Ming Run China	Yard to propose alternative supplier if preferred (Owner to approve)
546	Entertaining Equipment	BAZEPORT, Panasonic, Sony, Samsung, LG,	Yard to propose alternative supplier if preferred (Owner to approve)
551	Galley Machinery	Mare Safety, METOS, Staco, Maritime Montering, Arox, Beha Hedø, Loipart	Yard to propose alternative supplier if preferred (Owner to approve)
552	Galley Equipment	Mare Safety, METOS, Staco, Maritime Montering, Arox, Beha Hedø, Loipart, Miele	Yard to propose alternative supplier if preferred (Owner to approve)
553	Pantry Equipment	Mare Safety, METOS, Maritime Montering	Yard to propose alternative supplier if preferred (Owner to approve)
558	Laundry Equipment	Edco, Miele, Electrolux	
564	Pilot Ladder - Gangways	Gurskoy Sveiseindustri, MME Group, Undertun, Jiang Yin China, Dongtai Yuan Yang	Yard to propose alternative supplier if preferred (Owner to approve)
566	Helicopter Deck	Marine Aluminium, BAYARD Aluminum, ASTECH Aluminum, HELEDEX, Offshore Marine, Aluminium Offshore, Northsea China	Yard to propose alternative supplier if preferred (Owner to approve)
571	Ventilation system	AERON, YORK Noveco, VIKING, Hi-Air Korea	
581	Calorifier	Thermax, Energy Pack, Sushma	
582	Vacuum toilet plant	JETS, Hamworthy	
582	Sewage treatment plant	JETS, Hamworthy	
625	Electric Propulsion Equipment	Siemens, ABB, RR	
634	Propulsion – Propeller plant	Rolls-Royce, Steerprop, Schottel, ABB, Brunvoll	
648	Automatic oil Fired Water Heater	Pyro, Aalborg, Saacke, Greens	Yard to propose alternative supplier if preferred (Owner to approve)
651	Main Generator Engine	MAK, Caterpillar, Wartsila, Rolls-Royce Co. Bergen Diesel, MAN DIESEL (WEICHA),	
651	Alternator of Main	Siemens, ABB, Rolls-Royce Scandinavian Electric Systems,	
652	Emergency generator Dive	Caterpillar, Volvo-Penta, Cummins, Yanmar	

665	Ship Emergency generator / Harbour generator	Caterpillar, Volvo-Penta, Cummins, Yanmar	
702	FO Separators	Alfa Laval, Westfalia Seperators, Sam Gong(KOR),	
722	Fresh Water Cooling – Box Coolers	NRF, Weka Boxcoolers, Bloksma, VDL Klima bv,	
731	Starting Air Compressors	Sperre, Tamrotor, Tanabe, Hamworthy, J P saur & Sohn, Atlas, Ingsoland	
731	Working Air Compressors	Atlas Copco, Sperre, Tamrotor, Sperre, Tanabe, Hamworthy, J P saur & Sohn, Ingsoland	
	Instrument Air Dryer with 1 x 60 ltr air buffer tank	Sperre, Tanabe, Hamworthy, J P Saur & Sohn, Atlas, Ingsoland	
744	Exhaust system for main engines – Purification system - Option	Hug Engineering AG, Caterpillar, Shinrox	
761	Fresh Water maker	Alfa Laval, Enwa, Technicomar, Coffin World water systems, RWO, Rochem	
791	Bridge and ECR consoles	Siemens, ABB, Rolls- Royce Marine, Kongsberg Maritime, MT Ilc	Yard to propose alternative supplier if preferred (Owner to approve)
792	Alarm, monitoring and Automation System, Watch Keeping Receiver	Kongsberg Simrad, Honey-well, Høglund Automation, Siemens, RRM, Furuno, Sailor, JRC	
800	Pumps	Ing. Per Gjerdrum, Allweiler, Hamworthy, Garbarino, Desmi, ITUR	
801	Ballast water treatment plant	Ing. Per Gjerdrum, Hyde Guardian, Optimarin, MMC,	
803	Bilge Water Separator	Westfalia Bilgemaster, Alfa laval, RWO, DVZ, Hamworthy, Heli-Sep, Detagasa, Taiko	
811	Fire alarm plant	Autronica, Kongsberg, Unitor, Heien Larsen, Tetra Fire, Danfoss-Semco, Tyco, Conslium	
814	External Fire Fighting	Jason Engineering AS, Fire Figthing Systems AS	NA
817	Fire Fighting - Watermist	Marioff, Semco, Unitor, Heien Larssen, Tetra Fire, Danfoss-Semco, NK Limited, Jeitek, Novenco	
821	Tank Sounding System	Xtronica. Autronica, RR, Kongsberg, Siemens, ABB	Yard to propose alternative supplier if preferred (Owner to approve)
88	Chargers - Rectifiers	Eltek, Victron Energy, Anda Olsen*, Ruite China,	
88	Main and emergency switchboard	Siemens, ABB, RR Marine, Hareid Group	
88	Secondary Switchboard	Hareid Group, ABB, Siemens, Terasaki, Shivtech, Marine Electricals, RRM, Ruite China	

88	Starters	Siemens, ABB, RRM, Hareid Group, Daeyang Elec, Terasaki, Ruite China	
88	Shore connections	Hareid Group, Terasaki, Shivtech, Marine Electricals, ABB, Siemens, Ruite China	
88	Vessel Services Transformers	Siemens, ABB, Terasaki, Marine Electricals, Static Transformer, Kongsberg	
88	Cable – Power and communications	Nexans, Wilson Cables, Universal, Radiant, Uni Flex,	
88	Cable - Power	Nexans (only), LS Korea	
88	Searchlight Type joystick control	Wynn, Glamox, Norselight, Seematz, Aqua Signal, Warom	
88	Lightning	Glamox, Norselight, Aqua Signal, Warom,	
89	Consoles – Bridge & ECR	Hareid Group, Terasaki, Shivtech, Marine Electricals, ABB, Siemens, Kongsberg, RR	
91	Diving system equipment	Flash Tekk	Saturation and surface equipment - OFE
92	Air Dive Spread	Flash Tekk	OFE
93	WROV & OBS ROV	Kongsberg Evotec, , Schilling	ROV LARS manufacturers – OFE
95	Provision Lift	Heisplan AS, Luts, Kone, An Hai	
96	Hydraulic hatches /Hangar doors	TTS, MacGregor, Kongsberg Evotec, Wuxi Dongzhou China	
98	Remote control Valves, Controls	ELTORQUE, Keysung / ACE, Brey Korea valves, Electric Actuators with Can Do, Emmerson	
99	Torque & Power Measurement system	Binsfeld(USA), Kongsberg, Siemens, ABBor similar	
101	FMEA – Ship (marin side)	Sebastian, GL Noble Denton, CMAR	
101	FMEA – Diving	OFE	
102	UPS	International makers only	
103	Cable and Electric Penetrations - MCT	Roxtec,	