

# Building Specification

## VS 470 MPOV MK III

Multi Purpose Offshore Vessel

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## INTRODUCTION

### Definitions

"As fitted plans" : Drawings and documentation showing the Vessel as built.

Approved : Means approved by the Class, Authority and/or Buyer.

Authority : National or international regulations to which the Vessel will be built.

Builder : Company contracted to build the Vessel for the Buyer.

Buyer : Company ordering the Vessel from the Builder.

Class : Classification Society responsible for approval of the Vessel according to a set of established construction rules.

Length (L) : As defined in the Load Line Convention.

Length (LOA) : Maximum length of the Vessel.

Load Line Convention: The International Load Line Convention signed in London on 5<sup>th</sup> April 1966.

Maker : Name of company that manufactures equipment which can be installed in the Vessel.

Maker's list : List of alternative makers which will be requested to offer delivery of defined equipment of parts for the building of the vessel.

### Units

#### Basic units

Quantity	Unit	Symbol
Length	Metre	m
Mass	Kilogram tonne	kg t (tonnes) 1 t = 1000 kg's
Time	Second	s
Electric current	Ampere	A





Temperature	Centigrade	C°
Force	Newton	N=kg*m/s <sup>2</sup>
Energy	Joule	J=Nm
Power	Watt	W=J/s
Pressure	Pascal Bar	Pa=N/m <sup>2</sup> 1 bar=10 <sup>5</sup> Pa
Frequency	Hertz Rpm	Hz=s <sup>-1</sup> Rotation pr.minute

### Other units

Quantity	Abbreviation	Unit
Barrel	bbls	1 bbls= 0.1590m <sup>3</sup>
Cubic feet	cu.ft	1 cu.ft = 0.0283 m <sup>3</sup>
Specific gravity	s.g	t/m <sup>3</sup>

### Abbreviations

AC	: Alternating Current
AIS	: Automatic Identification System
ANSI	: American National Standards Institute
ABCS	: Automated Bulk Hose Connection Stations
ARPA	: Automatic Radar Plotting Device
ASFA	: Automated Sea Fastening Arrangement
BHAB	: British Helicopter Advisory Board
BHS	: Bulk Handling System
BS	: British Standard
BNWAS	: Bridge Navigation Watch Alarm System
CAA	: Civil Aviation Administration
CCTV	: Closed Circuit Television
COLREG	: Convention on International Regulation for Preventing Collision at Sea
CPP	: Controllable Pitch Propeller
CPU	: Central Processing Unit
CRT	: Cathode Ray Tube
CT	: Current Transformer



D & ID diagram	:Duct and Instrument Diagrams
DC	: Direct Current
DEM	: Diesel electric / mechanical
DGPS	: Differential Global Positioning System
DIN	: Deutsche Industri Normen
DLL	: Defined Load Line
DNV	: Det Norske Veritas Region Norge AS
DO	: Grade of Fuel (Diesel oil) Sp.gr. 0.83 for design purpose only
DP	: Dynamic Positioning
DSC	: Digital Selective Call
E0	: Unmanned Engine room
ECDIS	: Electronic Chart Display and Information System
ECR	: Engine Control Room
EGC	: Enhanced Group Call
EMC	: Electro Magnetic Compatibility (the technology to minimize EMI/RFI)
EMI	: Electro Magnetic Interference
EPIRB	: Emergency Position Indication Radio Beacon
EX	: Explosion proof
FAT	: Factory Acceptance Test
FI-FI	: Fire Fighting
FMEA	: Failure Mode Effect Analysis
FO	: Fuel Oil
FP	: Fixed propeller
Fr. (fr.)	: Frame nos. indicate position from aft perpendicular
FRC	: Fast Rescue Craft
FU	: Follow Up
FW	: Fresh Water
GMDSS	: Global Maritime Distress and Safety System
GMS	: Global System for Mobile telecommunications
gp	: Refer to group number in the SFI system
GPS	: Global Positioning System
GRP	: Glass Reinforce Polyester
HCU	: Heave Compensating Unit
HF	: High Frequency
HiPAP	: High Precision Acoustic Position (transducer)



HPR	: Hydro-acoustic Positioning Reference
HT	: High Temperature
HVAC	: Heat, Ventilation and Air-Conditioning
I/O	: Input/ Output
IACS	: International Association of Classification Societies
IAS	: Integrated Automation System
IEC	: International Electro-Technical Commission
IES	: International Electrical Standard
IGBT	: Insulated Gate Bipolar Transistor
IGCT	: Integrated Gate Communicated Thyristor
IMCA	: International Marine Contractors Association
IMO	: International Maritime Organisation
INLS	: Refer to IMO resolution A.673 (16)
IOPP	: International Oil Pollution Prevention
IP rating	: Ingress Protection of enclosures
ISO	: International Standardisation Organisation
LAN	: Local Area Network, Data Communication Network
LCD	: Liquid Crystal Display
LO	: Lubrication Oil
LRIT	: Long Range Interception & Tracking
LRS	: Lloyds Register of Shipping
LT	: Low Temperature
MCC	: Motor Control Centre
MCCB	: Moulded Case Circuit Breaker
MCR	: Max. Continuous Rating
MCT	: Multi Cable Transit
MF	: Medium Frequency
MRU	: Motion Reference Unit
NBDP	: Narrow-Band Direct Printing terminal
NFU	: Non Follow UP
NMA	: National Maritime Administration
NMEA	: National Marine Electronics Association
NOx	: Oxides of Nitrogen
NS	: Norwegian Standard
NUC	: Not Under Command



ORO	: Oil Recovery Operations
P & ID diagr	: Piping and Instrument Diagrams
PEP	: Peak Emitting Power
PMS	: Power Management System
PPM	: Parts Per Million
PWM	: Pulse Width Modulator
QA	: Quality Assurance
QC	: Quality control
RAO	: Response Amplitude Operator
RB	: Regulatory Bodies
RFI	: Radio Frequency Interference
RMS	: Root Means Square
ROV	: Remotely Operated Vehicle
s.gp.	: Refer to sub group number in the SFI system
SART	: Search And Rescue Radar Transponder
SCR	: Silicone Controlled Rectifier
SFI	: SFI Group system, The Ship Research Institute of Norway
SOLAS	: Safety Of Life At Sea
SOPEP	: Shipboard Oil Pollution Emergency Plan
SBM	: Special Bearing Monitoring
SPM	: Make of instrument for shock pulse testing
SSB	: Single Side Band radio telephone
THD	: Total Harmonic Distortion
UPS	: Uninterrupted Power Supply
USCG	: United States Coast Guard
VAS	: Vessel Automation System
VDR	: Voyage Data Recorder
VDU	: Video Display Unit
VMS	: Vessel management system
VS	: Vik-Sandvik AS
WSD	: Wartsila Ship Design AS



## SFI Grouping System

### INTRODUCTION

#### **SFI-Grouping system**

The layout of the following specification is based on the SFI GROUP SYSTEM. This group system has been designed primarily to provide shipyards and shipping companies with a tool for the specification of ships and an estimation of shipbuilding costs.

The classification system is divided into the following Main Groups:

0. General
1. Ship, General
2. Hull
3. Equipment for cargo
4. Ship equipment
5. Equipment for crew and passengers
6. Machinery main components
7. Systems for machinery, main
8. Ship common systems

Each main group (m.gp., one (1) digit) is divided into groups (gp, two (2) digits). Each group is again subdivided into sub-groups (s.gp, three (3) digits).

Components specified twice or under different sub-groups shall only be delivered once.

Fig. 1



**Title: COMPONENT NUMBERING AND POSITIONING**

- □ □ SFI System  
1 2 3
- □ □ SFI Component  
4 5 6
- □ □ Number of Components / situation of Component  
7 8 9
- □ For Electro (e.g. sensor, transmitter, signal)  
10 11

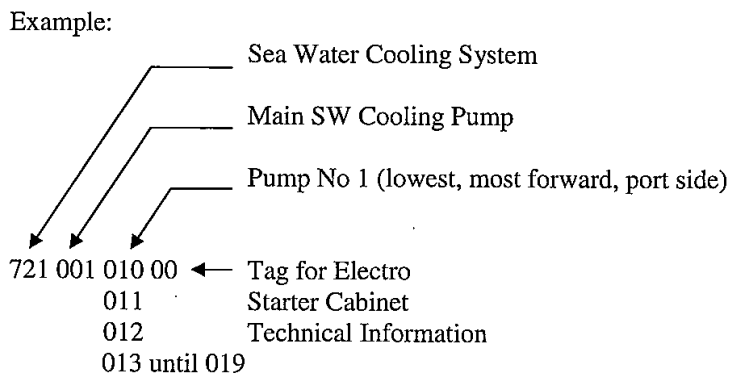
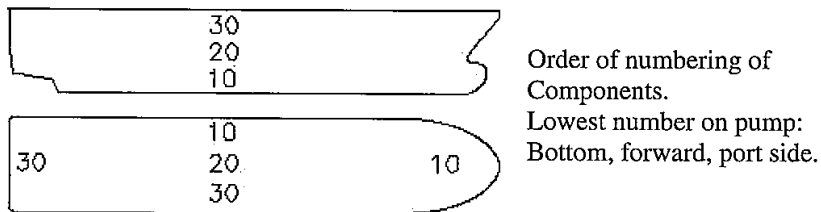


Fig. 1 SFI



## GENERAL

### 0.1 General

This specification together with General Arrangement no. 3720-101-001 from Naval Architects Wartsila Ship Design Norway AS, describes a Construction Diving Offshore Vessel, type VS 470 MPOV Mk III. The Vessel shall be designed to comply with the normal requirements within the offshore oil industry for such Vessels.

The Vessel shall be built for world-wide operation except for areas with ice.

### 0.2 Description

The Vessel shall be constructed with 1<sup>st</sup> deck, double bottom tanks and wing tanks.

1<sup>st</sup> deck shall be reinforced to bear a load of 10 tonnes/m<sup>2</sup>.

Deckhouses with accommodation on A, B, C and D -deck with wheelhouse on top.

A mezzanine deck with ROV control room and ROV office shall be arranged aft of superstructure.

Propulsion systems with two (2) main diesel engines driving independent propulsion systems.

Two electrical driven tunnel thrusters forward and two (2) electrical driven tunnel thrusters aft.

### 0.3 Design temperatures

The Vessel's machinery and equipment and related systems shall be suitable for service under the following conditions:

Criteria	Temperature
Maximum ambient air temperature	+ 38 °C - RH 90%
Minimum ambient air temperature	- 20 °C
Maximum temperature of seawater	+ 32 °C
Minimum temperature of seawater	+1 °C
Maximum space temperature in engine room	+ 50 °C

### 0.4 Main dimensions

Length over all	75.55	m
Length between p.p	64.50	m



Breadth moulded	19.20	m
Depth to 1st deck	7.60	m
Scantling draught	6.50	m
Summer draft	6.00	m
Frame spacing	0.60	m

### 0.5 Trial Speed

Speed shall be min.12 with closed moonpool if provided with main engine output 2x2320 kW.  
 The hull shall be cleaned and the trails carried out in calm sea with wind 2 Beaufort and at a draft of 4.00 m at Sea State 2.

### 0.6 Capacities

Dead-weight at loaded mean summer draft approx. 2500 tonnes

**Deck cargo capacities:**

Deck area approx. 680 m<sup>2</sup>  
 Deck area mezzanine deck approx. 120 m<sup>2</sup>  
 Cargo deck strength 10.0 Mt/m<sup>2</sup>

Tank contents	Approx. capacity in m <sup>3</sup>
Fuel oil total	1300
Fresh water	280
Water Ballast	1400
FO Settling	2 x 45
FO Service	2 x 20
Sludge	17
FO Overflow	33
Waste oil	13
Lube oil	30
Bilge/Oily water	36





Sewage tanks	28 + 30
Grey water tank	37
Hydr. oil	4

### 0.9 Accommodation

The Vessel shall have accommodation and certificate for Sixty (60) persons and one (1) Hospital, according to GA plan.

### 0.10 Classification

The Vessel with engines and equipment shall be built under the supervision of and in accordance with current IMO and SOLAS Regulations (including latest Amendments) and to Det Norske Veritas or any other IACS member.

The vessel shall fly Panama flag.

The Vessel shall be classed by Det Norske Veritas (DNV) to obtain the following notation:

*	Construction symbol.
1A1	Main character of class.
CLEAN	Requirements for controlling and limiting operational emissions and discharges.
DYNPOS AUTR	Redundancy in technical design and with an independent joystick system back-up.
E0	Instrumentation and automation to allow for unattended machinery spaces.
NAUT-OSV (T)	Bridge ergonomics for reduced workload and improved operational conditions in tropical waters.
COMF-V(3)	Covering requirements for noise and vibration.
DK (+)	Deck strengthening for heavy cargo.
SF	Compliance to damage stability requirements.



## 0.11 Rules

The Vessel with equipment shall be built according to the following Rules and Regulations:

- Flag State regulations.
- IMO Resolution MSC 235 (82) Guidelines for the Design and Construction of Offshore Supply Vessels 2006, where applicable.
- IMO Resolution MSC 267 (85) International Code of Intact Stability (2008 IS Code).
- IMO MSC.266(84) - Code of Safety for Special Purpose Ships, 2008- (for not more than 60 persons).
- International Convention of Load Lines of 1966 including subsequent amendments.
- International Convention on Tonnage Measurements 1969.
- International Convention for Preventing Collision at Sea 1972, COLREGS, as amended.
- International Convention for the Safety of Life at Sea, SOLAS 2009, with latest amendments.
- International Convention for the Prevention of Pollution from Ships - MARPOL 73/78 Annex I,II, III, IV, V and VI.
- Rules and regulations governing navigation of the Panama Canal and Suez Canal and Panama and Suez Canal Tonnage Regulations (Tonnage Certificates only).
- Maritime Labour Convention, MLC 2006.
- IMO NOx Technical Code - Technical Code on Control of Emission of Nitrous Oxides from Marine Diesel.
- IMO Noise levels - Code on noise levels on board ships. Resolution A.468 (XII).
- IMO ISPS Code - International Code for the Security of Ships and of Port Facilities.
- IMO ISN Code - International Management Code.
- IMO LSA Code - International Life-Saving Appliance Code, Resolution MSC.48(66).
- IMO FTP Code - International Code for Application of Fire Test Procedures, Resolution MSC.61(67).
- IMO FSS Code - Fire Safety Systems, Resolution MSC.98(73).
- IMO Resolution MSC 128(75) Performance Standard for a Bridge Navigation Watch Alarm System (BNWAS).
- IMO Alarms and Indicators - Code on Alarms and Indicators, Resolution A.830(19).
- International conference of standards of Training, certification and watch keeping for seafarers, 1995 (IMO, STCW).
- ISO Vibration standard 6954, 2000 "Guidelines for the measurement, reporting and evaluation of vibration with regard to habitability on passenger and merchant ships".
- Final Acts of the World Administrative Radio Conference, 1997.(The Vessel shall be equipped for area A3 acc. to GMDSS rules, and according to International registration 1973 and Radio regulations 1982).
- IEC/TC18 Regulation for electrical installation on board ships.
- IEE Recommendations for the Electrical and Electronic Equipment of Ships 6th Edition.
- IEC publication no. 60331, 60332, 60092 and 60533.
- Electromagnetic Compatibility of Electrical and Electronic Installation on Ships, IEC 533.
- BWM - International convention for the Control and Management of Ship`s Ballast water and Sediments, 2004.
- AFS - International Convention on the Control of Harmful Anti-Fouling Systems on Ships, 2001 - Annex 1 - Controls on Anti-Fouling Systems.
- IMO Resolution MEPC.179(59) Guidelines for the development of the inventory of hazardous materials.
- IMO MSC/Circ 645 Guidelines for Vessels with Dynamic Positioning Systems.
- IMCA M103 Guidelines for the Design & Operation of DP vessels.
- The Flag State Health Directorate (Building, cleaning, disinfection and maintenance of fresh water tanks).
- IMO Resolution MSC 215 (82) Performance Standard for Protective Coatings (PSPC) for dedicated ballast tanks.
- IMO - Guidelines for Emergency towing.
- US Coastguard Regulations for Foreign Flag Vessels, calling US ports regarding prevention of pollution by oil, sewage and garbage.
- IACS Standard, Accuracy in Shipbuilding.



## 0.12 Certificates

All necessary certificates, including classification reports shall be delivered with the Vessel, without any remarks.

Certificates shall be final or provisional according to standard from issuer.

All fees for approval of calculations, drawings and inspection both to Class and Authorities shall be included.

Certificates for the Vessel's hull, machinery and equipment shall be delivered with the Vessel in one (1) original and one (1) copy to the Buyer.

All certificates required shall be delivered, such as, but not limited to:

- Certificate of nationality.
- International tonnage certificate.
- Suez Canal Tonnage certificate.
- Panama Canal Tonnage certificate.
- Safety certificate for construction.
- Safety certificate for equipment.
- Classification certificate for Hull, Machinery and Electronic Equipment.
- Safety Radio certificate.
- Radio license.
- Builder certificate.
- Loadline certificate.
- Machinery certificates.
- IOPP certificate.
- EIAPP for engines.
- Machinery Emission Certificate in accordance with MARPOL 73/78, Air pollution Annex IV.
- El.plant (in acc to DNV regulations).
- Anchor- chain and wire certificates.
- Windlass.
- Crane and lifting appliance certificates.
- Pad eyes, lashing points and lifting eyes (shall be marked with SWL).
- Guide rollers (manufacturer's certificate).
- Bollards (manufacturer's certificate).
- Fairleads (manufacturer's certificate).
- CO2 certificate.
- AC/OX certificate.
- Deratting exemption certificate.
- Nationality certificate.
- Certificate of fitness CA 673.
- Certificate of compass.
- Certificate of seaworthiness.
- INLS certificate.
- Cargo gear record booklet.
- PSPC Certificate.
- List of Inventory of Hazardous Materials (in compliance with IMO res. MEPC.179(59)).
- Asbestos free certificate.
- Sewage certificate.

Calculation for tonnage certificate for Suez, and Panama (Suez lights not included, but sockets and brackets included, Panama fairleads included).



**Equipment certificates required by Class and Authorities shall be delivered, minimum but not limited to:**

- Life rafts certificates.
- Life saving equipment certificates.
- MOB boat and davit certificate.
- Fire appliance certificates.
- Air breathing app. Certificates.
- Lantern certificates.
- Medical certificates.
- Compass Adjustment certificate.
- Certificate for fresh water tanks.

**Document of compliance for:**

- IMO 468 (noise).
- ISO 6954(vibration).
- ILO regulations.

### **0.13 Drawings, Instruction Manuals etc.**

Approval of drawings:

All relevant design and arrangement drawings shall be submitted for approval to the Buyer or to the Buyer's representative in triplicate.

Buyer to undertake to dispatch one (1) approved or not approved copy with comments to the Builder within fourteen (14) days of receipt.

A detailed procedure between Builder and Buyer regarding drawing approval shall be agreed upon.

Full list of drawing, calculations, "as fitted plan", handbooks, manuals and other information shall be submitted for approval.

All correspondence between Builder and Authorities and Class shall be submitted in copy to Buyer.

Delivery of drawings:

At delivery of the Vessel, "as built" drawings shall be delivered with, one (1) paper copy for the Vessel and one (1) paper copy and one (1) CD rom to the Buyer.

All documentation for the Vessel and its intended operation required by Authorities shall be delivered.

### **0.14 User`s manual**

Three (3) copies users' manuals in English for all equipment and systems onboard the Vessel shall be delivered.

The users' manuals shall also be delivered on an electronic format, to the extent of availability.



### **0.15 Equipment list, instruction books**

The Builder shall deliver a equipment list with names, types and capacities for all equipment. Maintenance instruction and recommended spare parts, suppliers name, address, telephone, fax- and e-mail address shall be sent to the Buyers representative in due time.

### **0.16 Materials**

New, first class materials etc. shall be used, with a quality suitable for this type and size of Vessel, adapted to world-wide operation.

All steel materials for the hull shall be of ship's building quality with certificate from Class. Where aluminium is used, this will be saltwater durable according to Class regulations.

All wooden materials shall be dry and of good quality.

No materials containing asbestos shall be used.

Bolts and nuts on open decks shall be of stainless steel.

### **0.17 Workmanship**

The workmanship throughout shall be good marine standards, and particular care shall be taken to ensure fair lines and smooth surfaces.

All workmanship shall be carried out according to approved drawings and good shipyard practice. Steel work shall be carried out within latest issue of IACS standard.

### **0.18 Inspection**

Builder shall afford every facility for such inspection and provide suitable equipped offices for the Buyer's Representatives, with toilet and washing facilities, telephone, telefax services, high capacity multi-media Pentium PC with inkjet printer / plotter and high speed modem facilities with ISDN or similar telephone line, plans and document filing facilities, large pin board for pinning up drawings etc.

The offices shall be large enough to accommodate the Buyer's representative and his assistants. Minimum three (3) persons.

The Buyer may send to and maintain at the Builder's yard, at the Buyer's own cost and expense, one (1) or more representatives to act on behalf of the Buyer in attending the tests and inspections relating to the Vessel, it's machinery, equipment and outfitting, and in any other matters for which he is specifically authorised by the Buyer

### **0.19 Modifications**

The Buyer is entitled to request modifications or additional work. Such extra work shall only be carried out upon written request to the Builder.

All such work shall be carried out only according to separate written agreements.

For all modifications and changes the Change Order (CO) form shall be filled out and signed by both parties.

No work shall start before the CO is signed.

Agreements concerning additional work or changes to contain price, delivery conditions and information about whether the change/additional work leads to changes of deadweight, speed or other functions.

Changes being made during the building period, from contract date, in national or foreign rules and regulations or in the Class regulations, and require modification to the Vessel shall be carried out by the Builder.



The Buyer shall pay for these modifications.

For work of the type mentioned above, additional charges or reductions shall be calculated according to the stipulations of the main contract and forwarded to the Buyer for approval before the execution.

## **0.20 Spare parts**

Spare parts shall be supplied by the Builder according to Class, except for equipment supplied by Buyer. All spare parts, incl. Buyer's delivery, shall be well protected against corrosion and mechanical damages. Bigger parts shall be well clamped, and everything stored in shelves and/or cupboards.

## **0.21 Buyer`s supply**

Generally, Buyer's supply shall be as follows:

- Charts, general.
- Galley and pantry utensils.
- Casseroles.
- Glass, crockery and china.
- Office machinery not specified in this specification.
- Books and charts.
- Consumer goods.
- Loose lab. equipment.
- Linen.
- Mooring equipment, above class requirements.
- Wire for winches complete with necessary sockets/splices ready for spooling.
- Spareparts above Class requirements.
- Owner's flags.

The Builder shall receive, store and bring onboard, without extra charges, all goods and equipment delivered by the Buyer. Sufficient space for Buyer's supply shall be provided.



# 1 SHIP GENERAL

## 12 MODELS

### 127 Ship model

One (1) model per vessel ordered - of the Vessel in scale 1:75 shall be delivered to the Buyer's main office. For marketing purposes one model should be delivered to the Buyer's main office at the earliest possible convenience.

## 15 TRIALS AND TESTS

### 150 Trials general

All parts of the Vessel and all workmanship shall be inspected and tested. The Buyer's representative shall be present at all tests. All machinery shall be tested according to the accepted program of tests. All tests shall be accepted before the Vessel is handed over to the Buyer.

### 151 Machinery testing

The Buyer shall be notified latest fourteen (14) days before testing the machinery at the engine factory. Torsion and vibration calculations shall be carried out by the engine supplier and approved by the Class. All machinery shall be tested at the quay before the trial trip.

### 152 Inclining experiment

Capacity plan of all tanks shall be prepared. Preliminary stability calculations shall be prepared and submitted to the Buyer. The Vessel's light ship weight and location of centre of gravity shall be determined by an inclining experiment. A complete booklet showing capacities and centres of gravity of tanks shall be delivered together with the stability book. The stability book with all conditions and capacities shall be delivered with the Vessels. Final approved stability book shall be delivered to the Buyer latest three (3) months after delivery of the Vessel.



### **153 Fuel- oil, lub. oil and hydraulic oil**

The Builder shall supply fuel oil, lube oil, hydraulic oil etc. for tests and trials.

Type and quality of oil shall be decided by the Buyer from those recommended by the supplier of machinery. All consumption of oil concerning testing, flushing and trial trip, shall be covered by the Builder. Further, filling up all systems to working level, for lub. oil and hydraulic oil at delivery.

### **154 Dock testing and Trial trip**

Dock tests shall be carried out when systems are ready for testing, according to approved test program.

During these trials, all machinery, piping systems, equipment, deck machinery, control systems, air conditioning, galley and laundry equipment, ventilation, alarm systems, remote control systems, communication systems and all other equipment shall be tested to satisfaction of the Buyer, Class and Authorities.

- Electronic equipment, including navigation and communication shall be tested.
- Electrical plant shall be tested.
- Pump test including test of loading, discharging and ballasting system.
- MOB boat davit and MOB boat shall be tested.

All deck equipment and cranes to be tested.

Main propulsion machinery shall be tested at maximum practicable power levels.

Main generators shall be loaded to maximum possible level using Vessel's auxiliary load and thruster. Tunnel thrusters shall be tested.

Before trial trip all systems shall be commissioned and function tested at quay.

### **Open water sea trials**

Sea trials shall begin as soon as all basin trials have been satisfactorily completed and when the Builder declares that Vessel is complete and equipped in all respects and ready.

It is intended that the first part of sea trials shall be used mainly for running machinery, compass and controls adjustment, including joystick control system, anchor trials and any other tests considered appropriate.

During sea trials machinery and equipment shall be checked in operation. Electrical load with indicated machinery running shall be recorded at least every hour.

A technical trial trip shall be performed and the following tests shall be carried out and approved:

1. Progressive speed test and fuel consumption measurement at 20% - 100 % output of the main engine.
2. Crash stops ahead and astern.
4. Manoeuvring test.
5. Emergency stop.
6. Thruster tests.
7. Anchor test.
8. Steering gear test, including circle and eight (8) manoeuvre test to SB and PS.
9. Noise measurements.
10. Compass correction.
11. Test of heating/ ventilation/ Air-condition system.
12. Power management system test
13. Joystick test.
14. A stern manoeuvrability test with and without use of thrusters.
15. Illumination measurement of the Vessel.
16. DP test.

After trial trip, a report shall be made on all tests carried out during the trial.

This report shall be handed over to the Buyer. Any faults found during the trial shall be





corrected and if necessary, a new trial trip carried out before delivery of the Vessel.

#### **154.1 Noise and Vibration test**

The noise level shall be within COMF - V(3) and according to the International Maritime Organisation (IMO) Resolution A.468 (XII), 1981, entitled:

"Code on noise levels on board ships", should be followed for the normal sailing (propellers 80% loaded) condition, engine room fans and necessary equipment running, as well as the HVAC-system in the accommodation.

Noise level in the accommodation on the 1<sup>st</sup> deck can be accepted with higher than COMF-V(3), 10dB(A).

#### **DP condition**

All thrusters and propellers running at 40 % load, engine room fans and necessary equipment running, as well as the HVAC-system in the accommodation.

#### **Vibration levels**

Reference - ISO 6954 - Guidance notes on acceptable vibration levels and their measurement.

#### **154.2 FMEA of DP power and control system**

A failure Mode and Effect Analysis (FMEA) shall be performed according to procedures described in IMO MSC 97 (73) Annex 4, and Global Maritime.

The FMEA shall at least contain the following main chapters : Summary and Conclusion, Introduction, System descriptions, Supplementary information and FMEA test programme.

#### **155 Post Seatrial Inspection**

After the above Sea Trials the main engines and reduction gearboxes shall be opened up for inspection according to Class requirements.

All filters shall be controlled and cleaned.

All paper cartridge shall be renewed.

If any defects become apparent during the sea trials, these machinery parts shall be opened up for inspection, these shall be properly corrected and re-tested to the Buyer's satisfaction.

## **16 GUARANTEE**

#### **161 Guarantee**

See contract.



## 2 HULL

### 20 HULL MATERIALS

#### 200 Hull general

##### Slots, scallops

Slots and air holes and drain holes shall be provided where necessary, minimum radius 50 mm.

Openings / slots in upper part of tanks shall have area minimum the area of the vent pipe for the tank.

Openings / slots in the bottom of the tanks, longitudinal and transverse, shall have an area of min. 25 % above the dimension of the suction pipes.

Generally, non-tight structural members shall be provided with adequate access/lighting holes provided such holes are necessary or practicable and not detrimental to the structural strength.

In all tanks, outside areas and other areas likely to corrode, all free edges, included those in notches, shall be grinded to radius minimum R 2 mm, except behind insulated areas and oil tanks.

##### Manholes

Manholes with dimensions of at least 600 x 400 mm shall be arranged in all tanks and cofferdams.

Dimensions min. 500 x 700 mm for liquid mud tanks.

Manholes in 1<sup>st</sup> deck to have covers flush with the wooden plank.

Manhole covers for liquid mud tanks shall be provided with an inspection plug.

Manholes to double bottom tanks shall be raised flange type. Manhole covers shall be bolted and provided with lifting bars and bead welded contents label.

##### Welding general

All welding shall meet Class requirements.

Welding shall be carried out around all scallops, air- and drain holes and slots etc. the ends of all lugs for frames etc.

Lifting lugs, temporary lugs and all clips shall be cut off and remains shall be ground flush with the steel structure if not otherwise agreed.

#### 201 Hull materials

The hull shall be built of steel `Grade A`.

All materials shall be delivered with certificates according to Class.



### **203 Sandblasting, Priming and Painting**

All steel materials shall be sand/grid blasted to grade SA 2,5 and painted with zinc-silicate primer. The type of primer and thickness shall be suitable for the top coating.

### **204 Testing of Tanks, Bulkheads etc**

All tanks shall be pressure water or air tested according to Class requirements. No tank or compartment boundary connection shall be coated or painted (except for shop primer) until tightness testing has been completed and passed by classification surveyor and Buyer's representative. All decks, flats, shell, bulkheads, etc. shall be hose tested as required by classification rules.

### **205 X-ray and Ultrasonic testing of Hull parts**

X-ray and ultrasonic testing of hull parts according to Class requirements. Copies of tests shall be handed over to the Buyer's representative.

## **21 AFT BODY**

### **210 General from stern to frame 20**

The aft ship shall be designed for twin (2) propellers and twin (2) rudders.  
One (1) Steering gear compartment.  
Tanks for water ballast.  
One (1) anti-rolling tank connected to water ballast.  
One (1) Anti-healing tank.  
The Vessel shall have skeg keel in aft ship.  
Two (2) tunnel thrusters in skeg.  
Two (2) heavy shaft bracket. Strengthening of aft ship around rudder trunk and propeller tubes / brackets  
Pipes between propeller brackets and propeller tubes.  
Rope bins.

### **211 Shell plates**

Shell plates around rudder trunks, propeller brackets and stern tubes shall be increased locally with insert plates.  
Eye plates in shell above rudders, and propellers.

### **212 Steering gear room**

A steering gear room shall be arranged below 1<sup>st</sup> deck with foundations for steering gears, tanks, starters etc. Emergency exit hatch in 1<sup>st</sup> deck to steering gear room PS.



### **213 Skeg**

A centre skeg shall be arranged.

## **22 ENGINE AREA**

### **220 General, frame 63-89**

Tanks in engine area according to tank plan.

Cofferdams according to Class.

One (1) engine control room with switchboard and engine control stations.

Engine control room shall be sound insulated and shall have raised floor.

Double layer windows in engine control room. Windows shall be A60.

One(1) work station with table, chair and full height bookshelves in engine control room.

One (1) workshop in engine room.

### **221 Shell Plating**

Shell plates shall be according to the Class.

Marks in plates from lugs etc. shall be welded and grounded.

Shell plates from 1st deck level and 1000 mm below shall be increased to compensate for the lack of fender bars.

### **222 Bottom, keel**

Double bottom in engine room area.

Tanks in double bottom according to tank plan.

Longitudinal framing in double bottom with transverse girders.

### **223 Inner bottom**

Inner bottom shall have longitudinal framing and transverse girders.

Main engines and reduction gears foundations shall be an integrated part of the double bottom construction.

Necessary local stiffeners and support shall be arranged for foundation for auxiliary machinery on the tanktop.

Manholes on tanktop in engine room shall have a 75 mm coaming.

Keel plate in centre with thickness according to Class.

Tank no 202 and 206 to be used for fixed ballast.



### **226 Deck platforms**

Platforms in engine room according to engine room arrangement.

## **23 MIDSHIP/CARGO AREA**

### **230 General, frame 22 to 63**

Cargo (FO) tanks and ballast tanks according to General arrangement.

HP profiles shall be used as stiffeners in 1<sup>st</sup> deck inside tanks.

One (1) Overflow tank.

One (1) Propulsion room.

One (1) Void space, prepared for future Moon pool according to GA.

### **234 Deck**

1<sup>st</sup> deck shall be reinforced for a specific load of 10 tonnes/m<sup>2</sup> in deck cargo area.

Deck plate in 1<sup>st</sup> deck shall be 16 mm.

Foundations for deck stanchions, see item 315.

### **Mezzanine deck (aft of accommodation for ROV equipment).**

16 mm steel plate in mezzanine deck.

Maximum six (6) pillars below mezzanine deck. Deck strength 3 t/m<sup>2</sup>. Free height below mezzanine deck shall be min. 3500 mm.

### **235 Deck below 1st deck.**

Cargo area shall have a 2<sup>nd</sup> deck.

### **236 Bulkheads**

The vessel shall have transverse watertight bulkheads according to requirements.

Four (4) of the transversal watertight bulkheads shall be equipped with local- and remote controlled watertight doors.

### **237 HIPAP trunks**

Structure shall be prepared for future installation of 2 x HIPAP systems.



### **239 Bottom side tanks and top side tanks**

Double bottom tanks shall be arranged for WB. Wing tanks shall be arranged for WB.  
Void spaces and ducts for void U-tanks.  
All according to GA and tankplan.

## **24 FOREBODY**

### **240 General, frame 89 to stem**

Forebody from forward part of engine room to stem with tanks and 2 x tunnel thrusters.  
Soft nosed.  
Mooring rope bins in bosun store below C-deck with hatch Ø 300 mm in C-deck forward.

### **241 Shell plates**

Shell plating in way of anchor pockets shall be increased locally with insert plating.

### **242 Stores below C- and B-deck**

Shelves and bins in store according to agreement with Buyer.

### **243 Forecastle deck/C-deck**

Forecastle deck (C-deck) with reinforcement for windlass and mooring equipment.

### **246 Bow and stem section**

Soft nose bow.  
Horizontal stiffeners / girders in bow.

### **247 Chain lockers**

Two (2) self-stowing, watertight chain lockers shall be located forward as indicated on the General Arrangement. Increased steel plates in bottom and 200 mm of sides.  
Grating approx. 150 mm above bottom in chain lockers.  
Quick release arrangement for anchor chain fastening point to locker.



## 25 SUPERSTRUCTURE AND DECKHOUSE

### 250 Superstructure and Deck house

All arrangements shall be in accordance with GA.

#### Deck house on 1st deck shall include:

Casings and ventilation.  
Entrance to engine room from open deck through corridor. Remote emergency stops shall be arranged in corridor.  
Paint store.  
Incinerator/Garbage room.  
Deck workshop/store.  
Laundry.  
Store rooms.  
Spare part store.  
Electrical workshop.  
Hospital.  
Male change room.  
Female change room.  
Duty mess.  
CO2 room.  
Emergency control station.  
8 x Void buoyancy tanks/stores.

#### Deck house on A-deck shall include:

Casings.  
Gymnasium.  
Client office.  
ROV/Survey areas.  
Offices.  
Provision rooms.  
Galley.  
Mess room.  
Two (2) Day rooms.

#### Superstructure on B-deck shall include:

Casing.  
Emergency generator room.  
A/C plant room.  
Chemical store.  
Conference room.  
ROV office.  
Ships Office.  
Thirteen (13) x 2men cabins.  
Deck for MOB boat.

#### Superstructure on C-deck shall include:

Casing.  
Ten (10) x 2 men cabins.



Seven (7) One-men cabin.  
One (1) State cabin.

Superstructure on D-deck shall include:

Casing.  
Instrument room.  
Four (2) x State cabins.  
Four (4) One-men cabins.

Superstructure on bridge deck shall include:

Casings.  
Wheelhouse.

Top of wheelhouse:

Casing.  
Store room/Battery locker.  
Foundation for mast, antennas etc.

Height between decks:

1<sup>st</sup> deck to A-deck : 2800 mm  
A-deck to B-deck : 2800 mm  
B-deck to C-deck : 2800 mm  
C-deck to D-deck : 2800 mm  
D-deck to bridge deck : 2800 mm  
Bridge deck to wheelhouse top: 400 mm raised floor in wheelhouse +  
2800 mm net height inside wheelhouse  
Free-height below ROV mezzanine deck shall be 3500 mm.

## **253 Superstructure**

Superstructure on C-deck.  
The superstructure shall be made of steel and shall be well-stiffened and well integrated with the ship structure.  
All outer bulkheads shall have gutters.  
Stiffeners in front and side bulkheads shall have bracket connection to the gutters.  
Continuously welding of all stiffeners in deck house.  
Steel plates in front bulkhead shall be 2 mm above Class requirement.

## **254 Wheelhouse**

Wheelhouse on bridge deck.  
Wheelhouse shall be made of steel.  
Raised floor in wheelhouse for cable and ventilation ducting.  
Windows shall be welded to the wheelhouse bulkheads.  
Skylights / "Over windows" forward and aft.  
Platform on bridge wing to ship side SB and PS.  
Top of wheelhouse shall be strengthened for navigation equipment and antennas.  
Protection bars above aft wheelhouse windows.  
Platform and rails aft part of wheelhouse (use when cleaning windows).





Foundations for sat-TV and V-sat antennas on mast/wheelhouse.

## 26 HULL OUTFITTING

### 261 Hull marking

The location and marking of the marks shall be as follows:

Mark	Location	Marking	Height - mm
Funnel marks	Below wheelhouse - PS & SB	Bolted painted steel plate	1800
Bow mark	On shell plate at bow	Steel plate & paint	
Vessel Name	Bow Shell - PS & SB aft Shell - PS & SB	Steel plate & paint	700/500
Port of Registry	Aft Shell - PS & SB	Steel plate & paint	350
Tank Boundaries	Bottom & Side Shell as required PS&SB	Bead welds	
Draft Marks	Side Shell - Aft and forward PS & SB	Steel Plate & paint	
Freeboard Marks	Side Shell Midships PS & SB	Steel Plate & paint	
Thruster Positions	Side Shell - In Way of Thrusters PS and SB.	Steel Plate & paint	
Bottom Plugs	Bottom Shell - In Way of Plugs	Bead welds & paint	
Paint Mark (Division Line)	Side Shell - PS & SB (Lower Border of Topside Paint)	75 mm bead welds at 1 m spacing	
Frame marks	On PS & SB. Every tenth frame	Steel plate & painted	
IMO number	Bulkhead, forecastle and engine room bulkhead		
Bottom Equipment	On ship's side PS & SB.	Steel plate & paint	
VS 470 MPOV	Superstructure - PS & SB	Steel plate & paint	
Builder's plate	Superstructure - PS & SB	Steel plate & paint	
Owner's logo	Superstructure - PS & SB	Steel plate & paint	

### 262 Bottom plugs and Sea-inlets

Bottom plugs from all tanks in double bottom and side.

Sign showing the tank numbers at each bottom plug.

Two (2) sea-inlets combined with box cooler compartments (delivered by Builder) in engine room.

One (1) sea inlet aft.

One (1) sea inlet for emergency fire pumps aft.

All with strainer plate bolted and hinged to the shell.

All sea inlets shall be equipped with closing valves.

Each sea chest shall have connection for:



- Venting to open air (min. DN50.)
- Dosage of chemicals for anti-fouling and hot water from boiler.
- Different consumers with extension suction pipe.

### **263 Foundations**

All foundations on deck and engine room shall be strong with necessary support. Machinery and equipment shall be bolted to foundations.

"Chock fast" or steel shall be used where flexible mounting is not specified. Engine machinery, pipes and shaft generator to be installed with flexible mounting.

### **264 Bilge keel**

Bilge keels on each side shall be welded to a doubling plate. The bilge keels shall have scallops. The bilge keels shall be made in three (3) sections and shall be as deep as possible without extending below the baseline or outboard of the shear strake.

### **266 Hawse pipes, anchor pockets**

Hawse pipes between anchor pocket and B- deck shall be installed. Hawse pipes shall be min. 15mm thick. Hawse pipes shall be Round bars on bottom and top of the hawse pipes shall be installed. Anchor pockets on each side shall be suitable for deep sea Speck anchor.

### **267 Gutter bars, Bulwarks and Cargo rail**

#### **Gutter bars**

Gutter bars shall be arranged inside stiffeners on all exterior accommodation bulkheads and around all wet interior spaces.

Flat bar coaming around all opening in decks, around all external decks and around oily machinery.

#### **Bulwark/Railing**

Bulwark on C-deck with recesses for bollards.

Height of bulwark shall be 1200 mm.

A HP profile on top, support on each frame. Steps in way of mooring equipment.

Reinforcement around fairleads and mooring equipment.

Bulwark on 1st deck, stbd and port according to General Arrangement.

The bulwark on 1st deck shall be sloped inboards.

Railing around all open decks, deck openings etc. according to GA.

#### **Cargo Rail**

A transverse cargo protection bulkhead with openings on frame 67.

Openings in transverse bulkhead.



### **Buoyancy tanks**

Buoyancy tanks PS and SB, frame 04-67.  
Watertight doors in some buoyancy tanks, ref GA.  
Recess for vent. pipes.

### **268 Funnel**

One (1) funnel PS. The funnel shall be made of steel. Door in funnel at top of wheelhouse. The exhaust outlets shall be aft of the funnel.  
Ventilation outlets in funnel with closing device.  
Ladders/steps inside the funnel as necessary for access for maintenance/inspection.  
A platform shall be arranged between the funnel and deck house on top of the wheelhouse.  
One (1) ventilation duct for engine room ventilations SB side from 2<sup>nd</sup> deck to below C-deck. Ventilation inlet between B- and C- deck with stainless steel grids, water traps and closing device.

## **27 MATERIAL PROTECTION EXTERNAL**

### **Rooms without lining**

Lugs and steel eyes on external hull and rooms without lining shall be burned away and grounded. Cuts shall be filled with weld and ground flush. Sharp edges shall be rounded with grinding machine to radius min. 2 mm.

### **Rooms with lining**

Lugs and eyes shall be cut to the height of no more than 10 mm.

### **Tanks**

Cuts shall be filled with weld. Grinding where there are sharp edges to radius min. 2 mm.  
Lugs shall be removed and grinded in tanks, bilge areas and below floor plate levels.

### **270 Painting - General**

With the assistance of paint supplier a paint scheme must be prepared and submitted to the buyer for approval. The paint scheme should comply with this specification and all the applicable regulations in force. The approved painting scheme will be final binding document for the purpose of production.

All steel shall be sandblasted to grade SA 2,5 and primed with zinc primer. All painting work shall be carried out with good workmanship and according to common good practice.

Painting and material protection shall be carried out with brushing, rolling or spraying according to the paint manufacturer's recommendation for the different types of paint and material protection.

All sharp edges in tanks and outside structure shall be, radius minimum 2mm.

All external welds and damaged primer shall be sandblasted to SA 2,5, and touched up with zinc primer.

All internal welds and damaged primer shall be steel brushed and touched up with zinc primer.

All edges and welding seams shall be strip coated before next coating.

All paint work shall be carried out according to the paint manufacturer's recommendations. High-pressure spraying is applied all over where it is practical.

All areas shall be touched up with a primer paint before top coat is applied.



Parts of steel which shall be riveted or screwed together shall be painted same as weather deck on the mating areas, but not in oil tanks.

Specified MY thickness according to the paint specification shall be considered as minimum thickness. This Paint Specification is based on paint delivered by Jotun. Other paint manufacturers with equal standard can be used.

Colours shall be decided by the Buyer.

Supplier of paint according to Makers List.

All coated tanks shall be sand blasted to SA 2.5 prior to coating. Fresh water tanks, ballast tanks, brine-, liquid mud tanks and all coated product tanks.

The following paragraphs are for guidelines only. An approved specification prepared by the selected paint supplier will be binding and supersede all the recommendations contained here.

**271 Flat bottom, side bottom, sea chests, etc.**

(sharp edges etc. shall be rounded or smoothed. Min. radius = 2 mm)

Coat no.	Product		DFT Microns
1	Jotacote universal alu		250
2	Vinyguard Silvergrey 88 alu R.T.		50
3	AF Sea Omega light red		125
4	AF Sea Omega dark red		125
	Total		550

**272 Topside and bulwark, cargorail and winches**

(sharp edges etc. shall be rounded or smoothed. Min. radius = 2 mm)

Coat no.	Product		DFT Microns
1	Jotacote universal alu		125
2	Jotacote universal alu		125
3	Hardtop orange 430		50
	Total		300



### 273 External deck

(sharp edges etc. shall be rounded or smoothed. Min. radius = 2 mm)

Coat no.	Product		DFT Microns
1	Jotacote universal alu		125
2	Jotacote universal turquoise		125
3	Hardtop as green137		50
	Total		300

### 273.2 High temperature areas

Coat no.	Product		DFT Microns
1	Sølvalitt alu		20
2	Sølvalitt alu		20
3	Sølvalitt alu		20
	Total		60

### 273.3 Masts, cranes, funnels etc.

Coat no.	Product		DFT Microns
1	Jotacote universal alu		150
2	Jotacote universal buff		150
3	Jotacote universal PSO yellow 414		75
	Total		375

### 274 Bulwark inside and cargo rail

(sharp edges etc. shall be rounded or smoothed. Min. radius = 2 mm)



Coat no.	Product		DFT Microns
1	Jotacote universal alu		125
2	Jotacote universal buff		125
3	Hardtop orange 430		50
	Total		300

### 275 Superstructure, deckhouse

Coat no.	Product		DFT Microns
1	Jotacote universal alu		125
2	Jotacote universal light yellow		125
3	Jotacote PSO white		75
	Total		325

### 276 Galvanized items - External

All area shall be cleaned thoroughly, to remove oil, grease, salts and other contaminations. All exposed areas shall be painted. Galvanized items passing through tanks and behind linings not to be painted.

Coat no.	Product		DFT Microns
1	Jotacote universal, turquoise		100
2	Jotacote universal inner colour		100
3	Jotacote PSO Owners colour		75
	Total		275

#### 276.1 External aluminium

Coat no.	Product		DFT Microns
1	Jotacote universal, turquoise		100
2	Jotacote universal Owners		100
3	Jotacote PSO Owners colour		75



	Total		275
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**Galvanizing**

Hot dip galvanising shall be carried out according to ISO 1461. Minimum coating thickness 100 microns. Painting according to paint supplier's recommendations.

- All internal, external and tank ladders, safety hoops, handrails and stanchions, galvanized pipes etc. shall be dipped galvanized after fabrication.
- Where pipes are required to be galvanized, pipes shall be hot dipped galvanized after all bending, flanging and welding is complete. As far as practical final installation make-up pipes shall be returned for hot dip galvanizing after all hot work is complete.
- Touch up work if warranted to done with prior approval of owners representative.

**278 External cathodic protection**

Zinc anodes shall be placed on hull, tunnel thrusters, rudders, in the sea chests and in the internal cross-over. Anode-plan shall be worked out. The anodes shall be sized for a 3-year-life.

**28 MATERIAL PROTECTION INTERNAL**

**281 Accommodation, deck house, store rooms**

Coat no.	Product		DFT Microns
1	Jotacote universal alu		50
2			
	Total		

**281.1 Steel behind insulation/lining**

All areas shall be cleaned thoroughly to remove oil, grease, salt and contamination. Welding seams, rust and damaged shop primer shall be powertool cleaned to min. St 2.

Coat no.	Product		DFT Microns
1	Jotacote univeral alu		75



2			
	Total		

**282 Lowest part of engine room**

All areas shall be cleaned thoroughly to remove oil, grease, salt and contamination. Welding seams, rust and damaged shop primer shall be powertool cleaned to min. St. 2.

Coat no.	Product		DFT Microns
1	Jotacote uiversal alu		125
2	Jotacote universal white		125
	Total		250

**282.1 Engines**

Coat no.	Product		DFT Microns
1	Pilot II Green 131		40 my

**283 Internal bulwarks, engine room, accommodation, deckhouse,**

**storages, casing, funnel, tunnelthruster room, propulsion room, emergency generator room, cargo area, air handling room**

- and all other compartments containing equipment, workshops, miscellaneous internal areas, ventilation and air trunks and all other surfaces not specified.

All areas shall be cleaned thoroughly to remove oil, grease, salt and contamination. Welding seams, rust and damaged shop primer shall be powertool cleaned to min. St 2, sharp edges etc. shall be rounded to min. radius = 2 mm.

Coat no.	Product		DFT Microns
1	Jotacote universal buff		75
2	Pilot II white		40
	Total		115





### 283.1 Internal decks (where no flooring)

Coat no.	Product		DFT Microns
1	Jotacote universal buff		75
2	Pilot II Owners colour		50
	Total		125

### 283.2 Tanktop in cargo area, tunnel thruster room, propulsion room, stores etc.

Coat no.	Product		DFT Microns
1	Jotacote universal alu		125
2	Jotacote universal white		125
	Total		250

### 283.3 Cargo area inside

Coat no.	Product		DFT Microns
1	Jotacote universal alu		125
2	Jotacote universal buff		125
3	Hardtop Grey 38		50
	Total		450

### 285 Ballast tanks, oily water tank, chain lockers, , cofferdams, void spaces, roll reduction tank

Coat no.	Product		DFT Microns
1	Jotacote universal alu		200
2	Jotacote universal buff		150
	Total		350



### 285.1 Grey water & slop- sewage- water tanks

Coat no.	Product		DFT Microns
1	Tankguard storage red		200
2	Tankguard light red		200
	Total		400

### 286 Fresh water tanks

Sharp edges etc. shall be rounded or smoothed min. radius 2 mm.  
All areas shall be blast cleaned to SA 2 1/2 (ISO 8501 - 1:1988) after all hot work is completed.

Coat no.	Product		DFT Microns
1	Tankguard Aqua light red		225
2	Tankguard Aqua white		225
	Total		450

### 287 Fuel oil, lube oil, and hydraulic oil tanks

One coat of Chugoku primer compatible for oil tanks, shall be applied.  
After finalising all welding work in tanks, all welding seems and other areas where original zinc primer are damaged shall be wire brushed and thereafter the full tank carefully cleaned and all damaged areas re-primed.

### 289 Water ballast tanks

Sharp edges etc. shall be rounded or smoothed min. radius 2 mm.  
All areas shall be blast cleaned to SA 2 1/2 (ISO 8501 - 1:1988) after all hot work is completed.

Coat no.	Product		DFT Microns
1	Jotacote universal alu		200
2	Jotacote universal buff		200
	Total		400



## **29 MISCELLANEOUS HULL WORK**

### **290 Miscellaneous internal areas, vent and air trunks, all other surfaces**

All steel areas shall be thoroughly cleaned to remove oil, grease, salts and contaminations.  
Corroded areas shall be powertool cleaned to min. ST2 (ISO 8501-1:1988).  
Jotacote universal Primer buff 1 x 80 my  
Pilot II Gloss (to shade) 1 x 50 my

### **Woodwork**

Woodwork shall be painted as deck house where this is found suitable.

### **Untreated woodwork except wooden deck**

To be treated with oil or 2-3 coats Hardol or 2-3 coats Jotun Spontan Varnish.

### **Insulation**

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

### **Cables**

Cables shall not be painted, painting and overspray will have influence on the insulating quality. Any paint and overspray shall be cleaned off all cabling.

### **Consoles, furnishings and other surface finished equipment**

Bought in equipment with an approved surface finish shall not be painted.  
Any pain and overspray shall be cleaned off.

### **Pipes & channels**

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



## 3 EQUIPMENT FOR CARGO

### 30 HATCHES

#### General

All hatches shall be made of steel. Stainless steel in all movable parts.

Emergency hatches from steering gear room, cargo area, engine room and accommodation according to the rules.

All exits shall be fitted with opening mechanisms that are easily handled from the inside and outside. Exit hatches shall have contra-weight for easy opening.

Securing devices in open position for all hatches. Arrangement for locking with padlocks and according to the ISPS code.

#### On 1<sup>st</sup> deck

A flush hatch, 1600 x 2000 mm to be arranged for access to engine room, cut outs w/heavy grating in decks above 1<sup>st</sup> deck.

One (1) flush hatches 1800 x 2000 mm for access to 2<sup>nd</sup> deck in cargo area and one (1) 1800 x 2000 flush hatches in 2<sup>nd</sup> deck.

#### 304 Manholes

Manholes shall be arranged in all tanks, cofferdams, chain lockers etc.

Two (2) manholes in each large tank.

Manholes shall have handles where practical.

Tank name shall be welded beside manhole openings.

Steel coamings around flush manholes on tank top and decks.

### 31 EQUIPMENT FOR CARGO

#### 315 Cargo fittings on 1<sup>st</sup> deck

Deck arrangement shall include totally sixteen (16) cargo deck sockets with changeable caps. and casing stanchions.

Deck sockets and parts mounted in the deck shall be stainless steel (SWL 20 tonnes).

The cargo deck sockets must be flush with the deck.



### 316 Tarpaulins

Tarpaulins shall be arranged for:

- Searchlights
- Compass
- Mob boat

The tarpaulins shall be of Herquillite or similar quality.  
All tarpaulins shall have brass eyelets and lashings.

## 33 DECK CRANES

### 331 Offshore crane

#### Start Option

One (1) electro hydraulic knuckleboom deck crane on 1st-deck SB - side.

Main lift capacity:

- 60 tonnes at 12m radius.
- 27 tonnes at 20m radius.
- Hook speed max load: 0-25m/min.
- Hook speed light load: 0-50 m/min.
- Lifting height: 2000m.
- Outreach: 4.6 - 20.0m
- Fdyn: 1.3

Aux. hook capacity:

- 15 tonnes at 23m radius.
- Hook speed: 0-25m/min.
- Hook speed light load: 0-50 m/min.
- Lifting height: 100m.
- Outreach: 3.8 - 23.0m
- Fdyn: 1.54

Crane cradle shall be installed.  
The crane shall have self contained electro hydraulic power unit.

#### End Option

### 332 Auxiliary crane

One (1) electro hydraulic knuckleboom deck crane on C-deck PS:

- Lifting capacity: 3.0 tonnes (SWL).
- Working radius: 16.0 m.
- Hoisting speed: 30 m/min.
- Slewing time: 360° 40 sec.
- Wire length: 40 m.
- 3.0 tonnes hook with certificate.

Crane cradle shall be installed.



The crane shall have self contained electro hydraulic power unit.



## 4 SHIP EQUIPMENT

### 40 MANOEUVRING MACHINERY AND EQUIPMENT

#### 400 Maneuvring control

Manoeuvring control stations in wheelhouse for main propellers, tunnel thrusters and rudders.  
One (1) station forward wheelhouse, two (2) identical in aft wheelhouse and one (1) on each bridge wing according to GA and NAUT-OSV(T) notation. The manoeuvring system shall be electrical, Ref also SFI 790.

#### 402 Rudder

Two (2) high lift rudders with forged steel rudder-stock and with stainless steel liner and steel boxes. The rudder trunks shall be integrated parts of the aft ship. The rudder shall be fitted with eye for lifting and also fitted with filling and drain plugs.  
Watertight seal shall be fitted under each steering machine.

#### 403 Steering gear

Two (2) steering gears, electro-hydraulic, according to Class.  
Four (4) electro-hydraulic pumps. Rudder angle 2x45 degr.  
The steering shall be effected from control positions at bridge, see item 408.  
Alarm panel shall be installed at engine control room. All alarms and safety devices shall be according to Class and Authority.  
Oil reservoir with sight glass, level switch, drain plug and fittings.  
One (1) 200-litre storage tank for steering gear oil.  
The steering gears shall be connected to a Joy-stick control.  
It shall be possible to operate the rudders independent of each other and in parallel.

#### Starters and alarm system:

- One (1) panorama rudder indicator.
- Two(2) rudder indicators for mounting on console (One(1) forward and one(1) aft).
- Two (2) rudder control panels.
- One (1) synchronising unit/split rudder.



#### **404 Tunnel thrusters**

Two (2) tunnel thrusters forward with fresh water cooled motors. Each rating 800 kW.

Two (2) el. driven tunnel thrusters aft with fresh water cooled motors. Each rating 590 kW.

Tunnel thrusters shall have CP propellers.

Gratings in thruster openings, bolted on the propeller side.

Electro motors for tunnel thrusters (if feasible) shall have nipple for SPS Single Point Monitoring for bearings and vibration.

#### **405 Roll reduction tanks**

##### **Roll reduction tank**

One (1) roll reduction tank aft, below 1<sup>st</sup> deck according to General arrangement.

Damping device in the tanks.

The tanks shall be connected to the water ballast system.

A separate roll-indicator picture shall be included in the Vessel Management System indicating the rolling time, rolling angle, draft, trim etc. of the Vessel.

##### **Anti heel systems**

One (1) pair of water ballast wing tanks shall be arranged for anti heel operations, ref. GA.

The pump controlled anti-heeling systems shall primarily be designed to transfer water between the two (2) water ballast wing tanks.

- One (1) frequency controlled (variable rpm) pump with minimum capacity of 1000 m<sup>3</sup>/hr.
- The system shall be manually and auto remote controlled from the bridge.

#### **408 Dynamic positioning system**

##### **408.1 Dynamic positioning system**

A dual redundant Dynamic Positioning (DP) system, based on two (2) control computers shall be integrated as part of the IAS, i.e. the hardware and basic software, last edition on delivery, shall be identical with that of the Thruster Control.

##### **Operational Philosophy**

The operations shall be carried out with the Vessel in the DP mode and positioned close up to fixed installations.

The system shall be arranged for easy change-over from DP mode to manual mode by one (1) single operation of one bottom.

##### **Software**

The system software shall include all modes and functions necessary for an efficient operation.





## Basic Modes and Functions

The following operational modes shall be provided:

- Manual/Joystick Mode.
- Auto Mode.
- Stand by.
- Mixed manual and auto.
- Auto heading.
- Auto position.
- Auto track - high speed/low speed.
- Auto pilot.
- Stand by / Training.

Manual update of the Off-line Computer

## Thruster Allocation

Auto thruster allocation

Two (2) Operator selected allocation modes

## Others

- Power Load Monitoring and Blackout Prevention.
- Alarm System.
- Display System.
- Built-in Trainer.
- Special Functions.
- DP On-line Consequence Analysis Class II.
- In Class II Consequence Analysis, any single failure shall be taken into account.

## Capability Simulation

The operator should see the DP capability as a function of present environmental situation and the consequences of various possible failure situations. These failure situations shall cover the requirements of DnV as an extension to what is required by the classification authorities.

In addition the operator shall be able, from the present situation, to change/select any combination of:

- Thrusters
- Generators/bus ties
- Wind, wave and current

The operator shall also be able to display a vessel capability plot based on the selection of these inputs.

## Follow Target Mode

The Vessel shall be able to automatically follow a moving target and keep a constant position relative to the target by use of HPR (option) or Fanbeam position reference systems.

## Auto Track (Low Speed)

This mode shall enable the vessel to follow a predefined track between waypoints (leg) with a operator-defined speed (0 to 4 knots) and heading on each leg. Facilities shall be included for editing way-points, heading and speed.



### **Alternative Rotation Point**

This function shall provide the facility for defining rotation points in fixed positions relative to the centre of gravity of the vessel, even if this is outside the hull.

### **Motion prediction**

This function shall simulate the motion pattern of the Vessel.

### **Manual Bias**

Special function for over-riding of DP system.

### **Black box**

Function for storing (and possibility for "playback") of all DP and manoeuvring commands, events and operation.

### **Hardware**

- DP System.
- Two (2) identical DP Operator Stations shall be provided.
- One (1) DP Process Station shall be provided. (Dual computer unit and dual I/O).
- One (1) independent Joystick interfaced to the DP-system complete with connection sockets at three (3) different locations.

### **Peripherals**

One (1) printer (silent type).  
One (1) colour hard copy unit.

### **Interfaces**

#### Position Reference systems:

- Two (2) HiPAP SSBL and LBL (network interface only) Hipap Buyers supply.
- Two (2) DGPS (providing a NMEA-0183 interface).
- One (1) Fanbeam (Serial line).
- One (1) Radius 1000 with 500 transponder, Buyers supply. Yard to include interface only.

#### Sensors:

- Three (3) gyro compasses.
- Three (3) Motion Reference Unit.
- Two (2) Wind sensor.

#### Power Plant:

- Bus tie status.
- Generator effect.

#### Thruster/Propellers:

- Ready.
- Pitch/rpm setpoint and feedback.

### **Sensors and Position Reference Systems**

Sensors and position reference systems complete with all necessary controls, special cabling and interfaces to the DP and Thruster Control systems shall be supplied.



## Sensors

- Three (3) gyro compasses.
- Two (2) wind sensors.
- Three (3) motion reference units, pitch and roll accuracy of better than 0.1%, 1 MRU 2 and MRU 5 or equal.

## High Precision Acoustic Positioning Systems

The Vessel shall be prepared for future installation of 2 x HIPAP systems.

At present only pipe with blind flange thru vessel bottom and bulkheads shall be installed.

## Differential Global Positioning and Glonass Systems

One (1) DGPS/Glonass systems including:

DGPS/Glonass receivers with antenna, computer and operator interface.

One (1) Inmarsat demodulator/interface.

One (1) DGPS/Glonass systems including:

DGPS/Glonass 12 channel, dual frequency receivers with antenna, computer and operator interface.

One (1) Spotbeam demodulator and antenna.

## Fanbeam

One (1) Fanbeam laser system including:

- One (1) Fanbeam receiver with laser unit, display and control unit.
- Two (2) reflective prisms.

The fanbeam laser unit shall be remotely operated and shall have "tilt".

## 408.2 Joystick system

An independent Joystick system shall be installed, according to rules.

The Joystick system shall be interfaced to gyro, aft rudders and propellers and fwd. and aft tunnel thrusters.

The following modes shall be included:

- Joystick mode.
- Automatic Heading Control.
- Wind compensation.
- Auto pilot.

One (1) operator unit shall be mounted in the forward control station. One (1) operator unit shall be mounted in the aft station and one portable joystick unit shall be provided with a five (5) meter cable to plug into the bridge wing sockets.

## 408.3 Machinery system

Any requirements to machinery systems arising from the redundant equipment Class II and the Class notation AUTR shall be implemented such as for cooling systems, diesel fuel supply etc.



#### **408.4 Transponder launching system**

Foundation for one (1) gantry and transponder winch shall be arranged on C-deck.  
Electrical power for the winch shall be provided.  
Equipment shall be Buyers supply.

## **41 NAVIGATION EQUIPMENT**

### **General**

The Vessel shall be fitted out with navigation equipment with all necessary installation and systems for navigation and operation of this type of Vessel, according to rules and regulations.  
All cables for navigation installation shall be Class approved types and shall be fixed according to Class requirement and group 88 of this specification.

The bridge arrangement and antenna arrangement shall be approved by Buyer, Class and Authority.

All navigation equipment shall be of IMO approved type, supplied with IMO certificates, and shall be of high standard and of a recognised brand. The navigation equipment shall have all interfaces necessary to fulfil the requirement stated in Class and Authority rules.

### **410 Radar plants**

Both radar sets shall be equipped with performance monitor, daylight screen and shall be gyro stabilised. The antenna units in radar mast shall be fitted with minimum blind sectors (no blind sectors at all in front and on stbd. side). The radar antennas shall be installed for easy maintenance and service.

The following radar sets shall be supplied and installed:

One (1) radar 10 cm/ S band, IMO ARPA, 20 target. Antenna 12 ft.

Transmitter 30 kW, power supply 230 V.

Display LCD/TFT Maritime ECDIS 20.1"

One (1) radar 3 cm/ X band w/mini ARPA, 40 target. Antenna 8 ft.

Transmitter 25 kW, power supply 230 V.

Display LCD/TFT Maritime ECDIS 20.1".

One (1) radar slave display LCD/TFT Maritime ECDIS 19" for aft installation with interswitch to 10 and 3 cm radars.

Both radars shall be equipped with interfaces to gyro, speed log, autopilot, DGPS and AIS.

### **412 DGPS**

One (1) DGPS for navigation shall be supplied and installed on the bridge.

The DGPS shall be interfaced to the ARPA radar.

DGPS shall be interfaced to all relevant positioning, navigation and communication equipment (GMDSS).

The DGPS system for navigation shall have interfaces to Navtex, Inmarsat C, VHF/DSC, MF/HF DSC, both ARPA radars and other relevant positioning and navigation systems. 24V Supply from GMDSS battery.



## 413 Gyro plants, Auto pilot, Compasses

### Gyro compass

The following equipment shall be supplied and installed:

- Three (3) Gyro compass, common with DP.
- One (1) Analogue steering repeater in fwd. console, wheelhouse.
- Two (2) Digital repeater with rate of turn indicator for fwd. and aft overhead consoles.
- Two (2) Gyro repeaters for azimuth bearings on each bridge wing.
- Two (2) Gyro repeater in steering gear room.
- One (1) No voltage alarm in wheelhouse.
- One (1) Azimuth circle and azimuth mirror.

Gyro compasses accuracy should be class and prepared for DP suppliers requirements.

Gyro signal shall be transmitted to the Radars, satellite navigator, DGPS, course recorder and auto pilot system.

### Autopilot

The Autopilot shall be supplied from the 24V battery system on bridge.

One(1) Autopilot with high accuracy course-keeping, including the following functions and accessories:

- "Off-course" recorder/alarm.
- Override tiller.
- Continues speed adoption.
- Memory of the ship's actual behaviour.

One (1) Auxiliary Auto Pilot for control from aft console.

The Autopilot shall have interfaces to gyro compasses, speed log, magnetic compass, and DP system, Inmarsat C, DGPS and radars (plotting system).

### Magnet compass

One(1) Magnetic compass, 10" projector type, including the following functions and accessories:

- Illumination, 230V and 24V with dimmer switch.
- Azimuth mirror.
- Periscope reflector.
- Fluxgate coil for connection to autopilot ("off course" alarm).

## 414 Echo sounder, Speed log

### Echo sounder

The Echo sounder shall be supplied from the 230V main system or from 24V battery system on bridge.

The following equipment shall be supplied and installed:

- One (1) Echo sounder.
- Anchor watch alarm.

### Speed log

One(1) Doppler type speed log including the following functions and accessories:



- Dual axis.
- Bottom tracking and water mass tracking.
- Temperature measuring.
- Transducer.
- Signal splitter.
- Gate valve hull fitting.

Two(3) Speed and Distance indicators(steering console, aft console and DP desk).  
The Speed log shall be interfaced with both radar, autopilot and DP positioning system.

#### **415 Clinometer**

- One (1) Clinometer in wheelhouse.
- One (1) Clinometer in engine control room.

#### **417 Misc. nautical equipment**

- One (1) Ship clock of chrome metal with ship's name shall be fitted.
- One (1) Radar/signal mast as shown on the GA-plan. The mast shall be fitted with light and signalling equipment, blocks with lines for flags and day signals.
- Jackstaff shall be fitted forward.
- One set (1) Signal flags.
- Four (4) Thermometers.
- Three(3) 6" ship watches.
- Two (2) Binoculars 7 x 50 with case.
- One (1) Parallel ruler.
- One (1) Barometer.
- Three (3) Anchor signal balls.
- Three (3) Black signal beacons.
- One (1) Wind gauge with direction indicator common with DP.
- One (1) Bearing plate, Azimuth type.
- One (1) Weather facsimile.

#### **418 Radar, Signal and Antenna mast**

Mast for a.m. equipment shall be installed according to GA-plan.

#### **419 ECDIS, AIS, SSAS, VDR and SSRS**

##### **Electronic Chart Systems (ECDIS)**

Dual (2) Electronic Chart Systems shall be interfaced to the DP system,  
The systems shall have interfaces to DGPS, radars(tracked ARPA targets), gyro compass, magnet compass, speed log, echo sounder, autopilot and AIS.  
The system shall meet NAUT OSV.



### **Automatic Identification System (AIS)**

One (1) IMO approved AIS system with an antenna shall be installed for automatic information of the Vessel's identity, position, course, speed etc. according to IMO's requirement for this type of Vessel. The system shall be interfaced to necessary equipment for receiving the required information. The AIS shall be supplied from the 230V emergency supply system through the Ship's UPS system. The AIS shall be interfaced to radars.

### **Voyage Data Recorder (VDR)**

One (1) IMO approved Voyage Data Recorder (VDR) shall be installed for collecting and storing relevant ship's data and thereby facilitate the reconstruction of ship incidents at sea. (Maritime Black Box) The VDR shall be capable of collecting analogue, serial and digital data types and shall be designed and installed to meet the requirements specified in SOLAS V, IMO A.861.

### **Ship Security Alert System (SSAS)**

One (1) IMO approved Ship Security Alert System shall be installed on the navigation bridge.

### **Sound Reception System (SRS)**

One (1) SRS, according to IMO requirements shall be installed, for transfer of fog signals to the bridge.

### **Bridge Navigation Watch Alarm System (BNWAS)**

One (1) Bridge Navigational Watch Alarm System (BNWAS), according to IMO requirements shall be installed, for warnings to vessel master in case of the incapacity of the watch-keeping officer due to accident, sickness or in the event of a security breach, e.g. piracy and/or hijacking etc.

## **42 COMMUNICATION EQUIPMENT**

All systems mentioned in this section shall comply with the authority's rules and regulations.

Radio and communication equipment according to international rules and requirements, GMDSS rules for area A3.

### **421 Radio plant**

- One (1) HF/MF radio station, 150 W with DSC.
- One (1) Transmitter antenna AT82T.
- One (1) Antenna AT82.
- One (1) Power supply and equipment for GMDSS A3 station.
- One (1) Computer distribution unit DD-20 for NMEA.
- Two (2) Semi duplex VHF with within build call sign .A DSC.
- Four (4) Antenne AV7 VHF Dipol.
- Two (2) Inmarsat C with EGC receiver.

### **422 MOB boat radios, EPIRB, Radar transponders**

- One (1) Jotron automatic EPIRB.
- Two (2) Radar transponders.
- Three (3) Portable GMDSS-VHF.
- One (1) Jotron, Tron 45SX manual emergency beacon GMDSS.



#### **423 Local area network (LAN)**

Data communication network (LAN)

An on-board Ethernet data communication network of marine type shall be installed.

The network shall be the interface between all workstations onboard and shall consist of shielded twisted pair high quality Cat. 5 wire-braid armoring cables, network hub, multi-port repeaters and router according to manufacturer/ Buyer's standard, with interface to V-Sat system Ku-band and mobile telephone system for connection to e-mail system.

Arrangement drawing shall be approved by Buyer.

Wiring shall be provided to Data sockets in the following rooms:

- Engine Control Room(1 pcs.).
- All offices.
- Wheelhouse (2 pcs.).
- Captain, Master Chief Engineer and Owner's cabins.

#### **424 VHF, UHF and Mobile telephones**

- Three (3) Portable, ex proof UHF-Motorola.
- Three (3) Helmet equipment for Motorola.
- Two (2) Smoke diver helmet equipment.
- Foundation, cabling and the KU band equipment shall be installed.
- Two (2) Simplex VHF with handheld mic.
- Two (2) Remote connections to semi duplex VHF and speaker.
- Two (2) Antenne AV7 VHF Dipol.
- Two (2) Interfaces for fwd and aft VHF's for aft operator chairs.

#### **425 Calling, command and telephone systems**

Integrated telephone, PA and intercom system

The arrangement drawing with location of sub-stations shall be approved by Buyer.

A programmable integrated automatic exchange telephone, intercom, call logging and Public Address system approved by Authority and Class shall be installed, with capacity of minimum 40 lines, operation on 230V AC main supply and with 24VDC back-up supply (automatic change-over). Main station shall be located on the bridge.

The system shall be equipped with the following functions:

- Call transfer, take call, short message and programmable wake up call etc.
- Master and radio console station shall have group call facility.
- Communication between bridge and engine shall have first priority.
- Master stations shall be low-speaking with communication to all stations.
- Sub-stations shall be loud speaking with communication to bridge.
- All sub-stations in accommodation with possibilities for hands-free or private conversation by use of handset.
- Minimum six (6) speech channels.
- Call-logging system, programmable.

Sub-station shall be installed in the following rooms:

One(1) in each corridor.





One (1) in:

- Master/bridge
- Radio operation desk
- In each cabin
- In each office
- In each day room
- Mess room
- Conference room
- Hospital
- Changing room
- Galley
- Gymnasium
- Deck workshops
- Engine room
- Engine control room
- Instrument room
- Steering gear room
- Engine room workshop
- Emergency generator room
- Electrical workshop

Ten (10) external substations with separate loudspeaker, IP 56.  
Four (4) wireless headsets with microphones for high noise areas.

**Sound powered telephone**

The following sound powered battery-less telephones shall be installed:

- Between bridge and engine room.
- Between bridge and gear area.
- Between bridge and emergency generator room.
- Between bridge and engine control room.
- Between bridge and fire control station.
- Between bridge and steering gear room.

Relay for external signal device shall be fitted on telephones in engine room, engine control room, gear room and emergency generator room. Signalling device shall be fitted on telephones in the same rooms and shall be of an electronic siren type (yoda light).

**427 Light and Signalling equipment**

All systems mentioned in this section shall comply with the authority's rules and regulations.

**Lanterns**

Lanterns, cables and control panels shall be supplied from emergency generator in addition to main electrical supply. All navigation lantern stations to have duplex lanterns.

Control panels shall be fitted with audio and visual alarm, plug in type relays and shall be located on bridge.

All signal lamps, navigation lamps etc. shall be of cast brass/copper/bronze, min. IP 56 and solid construction.



### **Morse lamp**

One (1) Morse lamp shall be fitted in mast.  
One (1) Day Morse lamp, Aldis or equivalent.

### **Typhoon etc.**

One (1) thermostatic heated typhoon of enclosed type, with automatic fog signal.

### **Sound & visual signals**

One (1) Ships bell, 300mm, located on forecastle deck.  
One (1) Megaphone.  
Three (3) Anchor signal balls.  
Three (3) Black signal beacons.

### **Searchlights**

Three (3) Searchlights shall be fitted on the wheelhouse roof, one(1) located fore and two (2) aft with the following functions and accessories:

- Remotely (electrically) operated from inside bridge.
- Variable focus.
- Capable of giving 360° total coverage.

### **Signal flags, national flags**

Flag locker for all flags (50) shall be provided and located on the bridge.  
Six (6) flag lines with blocks shall be fitted to the yard arms of the main mast.

## **43 ANCHORING AND MOORING EQUIPMENT**

### **431 Anchor with chain and equipment**

#### **Anchors**

Two (2) stockless spec anchors in accordance with Class requirements grade K3.  
Two (2) anchor chains length in accordance with Class requirements.

#### **Chain cables and shackles etc.**

Anchor chain shall be Grade K3. Diameter in accordance with Class requirements.  
In addition, one Kenter type shackle shall be arranged between the gypsy and the cable stopper.  
Cable clench shall be fitted at the higher part of the chain locker and each chain shall be connected to the clench with two sets of end-links.  
Releasing of chain shall be possible from outside of the chain locker.

### **433 Windlasses with chain stoppers, rollers etc**

One (1) anchor windlass/mooring winch with closed gear box shall be installed on C-deck.  
The windlass / mooring winch shall be electro hydraulic driven, start/stop of HPU unit from bridge, and shall consist of:



- Two (2) declutchable cable lifters with band brake, (approx.) 12 tonnes pull at 0 - 14 m/min.
- Brake control : Manual.
- Brake holding load : According to Classification Society's requirements.
- Two (2) declutchable drums with dimension dia. 400 mm / dia. 1250 mm, length; 1000 mm.
- Manual brake control.
- Two (2) free end warping heads.
- Two (2) chain stoppers with lashing screw for chain Grade 3 steel stud link chain cable.

#### 434 Capstans and Tugger winches

##### Capstans

- Two (2) electro-hydraulic driven Capstans aft on 1<sup>ST</sup> deck.
- Capacity: 8 tonnes.
- Each Capstan shall have warping head.
- Brake control: manual.
- Protection bars and roller fairleads in cargo rail.
- Local control and remote radio control.

##### Tugger winches

- Two (2) electro-hydraulic Tugger Winches, pull: 10.0 tonnes.
- Wire capacity: 60 m.
- Local control and remote radio control. Constant tension function.
- Protection bars and roller fairleads aft of Tugger Winches.

##### Option

The hydraulic pipes shall be terminated at forward part of buoyancy tanks. Both tugger winches shall be stowed on 1<sup>st</sup> deck.

At the option of the Buyer the winches shall be installed at the hereby location, and commitment without any additional costs.

##### End option.

#### 435 Fixed mooring equipment

All bollards and chocks as required by Class and Panama authorities, minimum:

- One (1) bollards (ND 500) in center C-deck.
- Four (4) bollards (ND 400).
- Eight (8) Chocks (305 x 230).
- One (1) Double chock (355 x 255).
- Two (2) Roller fairleads.

Bollards shall be of welded design and shall be welded to a foundation on deck with eyes for stopper ropes welded to the base.

Three (3) horizontal rollers (mounted on top of bollards).

Two (2) double rollers recessed in top of bulwark.



#### **436 Loose mooring equipment**

The Builder shall deliver ropes and wire according to Class requirements. Synthetic lines shall be polypropylene type.

#### **437 Towing equipment**

Complete arrangement to fulfill IMO requirements for emergency towing.

### **44 REPAIR AND CLEANING EQUIPMENT**

#### **441 Repair and maintenance equipment**

- One (1) Lathe, 1000 mm centre distance, with standard equipment, 250 mm centre height.
- One (1) Drilling machine with standard equipment, 30 mm drills.
- One (1) Grinding machine with two (2) grinding discs of abt. 150 mm.
- One (1) Electric welding machine.
- One (1) Wash basin of stainless steel with hot and cold water, drain to bilge in engineroom.
- One (1) Steel topped bench with drawers and lockers underneath.
- One (1) Flexible lamp shall be fitted with the grinding machine.
- One (1) Flexible lamp shall be fitted with the drilling machine.

For propulsion machinery, auxiliary engines and separators, hand tools shall be delivered according to the manufacturer's standard delivery including special tools for removal of piston, liners, propellers, shafts, rudders, steering gears, thrusters etc.

All tools shall be located on tool boards, in shelves and in drawers/lockers arranged in the engine room workshop.

Lockers with sea fastening for total of ten (10) bottles shall be arranged on 1<sup>st</sup> deck (bottles delivered by the Buyer).

One (1) set gas welding and cutting equipment with 60 m hoses.

Welding benches shall be arranged in deck workshop.

Ventilation suction shall be arranged above welding bench.

Tray, abt. 1000 x 1000 mm, with 50 mm coaming for cleaning of big filters with drain to sludge tank shall be arranged below floor in engine room.

#### **444 Washing system**

A high-pressure washing system with hot and cold water shall be installed. The system shall be equipped with two (2) pumps, one (1) as stand-by pump, capacity approx. 2000 ltr/pr hours at 200 bars.

Two (2) pistols and 50 m hoses.

Hot and cold water supply for the high pressure washing machine.



#### **445 Incinerator**

One (1) incinerator, with capacity min. 500 000 kcal/h shall be arranged in separate room. Arrangement for burning of solid waste, plastic and sludge oil shall be included.  
One (1) sludge tank in incinerator room.  
The incinerator shall be in accordance with MARPOL 73/78, Annex II, reg. 16.

#### **446 Outfitting in store rooms**

Storerooms and workshops shall be arranged as shown on General Arrangement drawing. Arrangement and number of shelves shall be according to Buyer's advice.  
Paint stores shall be arranged with shelves and workbench.  
Steelwork benches in engine room workshop and in deck store / deck workshop shall be installed. The work benches shall have one (1) 6" vice per bench and two large drawers.

#### **448 Nameplates for Machinery, Equipment, Piping etc**

All valves, sounding pipes, covers, doors, starters, switchboard, manoeuvre desk etc. shall be marked with signs and have English text.  
The pipelines shall be marked with international colour system.  
All escape routes in accommodation and in machinery spaces (Emergency exits) shall be marked with illuminating signals at the floor level (Photo luminescent type material not requiring external power).  
Valves, doors and all external marking shall be fixed with screws. Accommodation internal doors marking shall be on plastic plates.  
External nameplates shall be of stainless steel and fixed with stainless steel rivets.  
All tank vent pipes, sounding pipes and loading points shall be colour marked.  
All ventilation openings on deck shall have labels with white text on red background (text according to drawings). Size abt. 150x80 mm.

## **45 LIFTING AND TRANSPORT EQUIPMENT FOR MACHINERY COMPONENTS**

#### **452 Travelling cranes and lifting equipment in engine room**

Two(2) trolley beams with 1000 kg hoisting gears for lifting parts from main engines, leading to the flush hatches in 1st deck.  
Lifting eyes marked with SWL shall be fitted above all heavy machinery and above all electrical motors above two hundred and fifty (250) kg.



## 5 EQUIPMENT FOR CREW

### 50 LIFESAVING EQUIPMENT

#### 500 General

All equipment shall be in accordance with the rules and regulations and with certificates.  
The Vessel shall be fully equipped for the total number of crew and passengers, totally sixty (60) persons.

#### 501 MOB-boats with equipment

One (1) MOB boat with certificate for six (6) persons. Driven by a diesel engine and waterjet. Min speed 25 knots fully loaded.

One (1) Single point davit.

The davit with winch shall be electro hydraulic, offload release hook, type Henriksen, certified for launching MOB boat.

#### 502 Life rafts with equipment

Life rafts according to rules for sixty (60) persons.

- Survival suits for sixty (60) persons.
- Four (4) life buoys with light and line.
- Two (2) life buoys with line.
- Two (2) life buoys with light and smoke signal.
- One (1) line-throwing appliance with lines.
- Life jackets for totally sixty (60) persons.

All equipment shall be of approved type.

All life belts, life buoys and survival equipment shall be marked with the ship's name and home port.

Safety-, danger- and rescue plans shall be put up on the wall.

Lockers for survival suits and life jackets shall be installed.

#### 503 Emergency marking

All escape routes (EMERGENCY EXITS) shall be marked with illuminating signs at the floor level. Under deck and in the engine room the escape routes shall be clearly marked by means of painted arrows pointing to the exits.



#### **504 Medicines and first aid equipment**

Medicines and first aid equipment according to rules and regulations.

#### **505 Loose fire-fighting equipment**

Fire extinguishers of acknowledged make shall be delivered in number and placed acc. to regulations. Glass cabinets containing axe and torch shall be fitted near exit doors to deck.

Fireman's equipment to consist of two (2) smoke diver sets with sufficient spare air bottles.

Compressor and facility for refilling of bottles shall be installed.

Hose stations shall be marked with "Fire Hose".

Hose station equipment in accommodation, if required, shall be kept in locker built in flush with bulkheads.

Fire hoses and nozzles acc. to rules and regulations.

One (1) international fire coupling.

## **51 INSULATION, PANELS, BULKHEADS, DOORS, SIDE SCUTTLES AND WINDOWS**

#### **510 General**

The accommodation shall be arranged for sixty (60) persons according to GA.

#### **511 Insulation, bulkheads and panelling**

Insulation against ship's side, outer walls and decks of 100 mm fireproof mineral wool mats.

The insulation shall be calculated for an inside temperature of +22°C and an outside temperature of -20°C (max. K-value: 0,75 W/m<sup>2</sup> ° C).

Insulation between decks in accommodation shall be 75 mm mineral wool mats.

PVC film between insulation and ceiling panels in bridge and instrument room.

A complete module based non-progressive incombustible partition and ceiling system shall be used for the whole accommodation. Panelling shall be 25 mm thick against outer walls and outer bulkheads, and 50 mm thick panelling between rooms in accommodation. Included in the system shall be all internal doors complete with frames and hardware. Surface material throughout the accommodation in accordance with the regulations. The ceiling panels shall be 100 mm wide, except in galley.

Special noise and heat insulation shall be provided against the ventilation room and the casing and emergency generator room.

Lining and ceiling in galley shall be of stainless steel.

#### **512 Doors with coamings in accommodation**

Doors in accommodation shall be type B - 15. Coamings shall be of steel.

Ventilation opening with closing valve in the lower part of the door. All accommodation doors shall have handles and a master-key system.

Doors to change room, ventilation room and stairways shall be A-0 steel doors.

Doors for galley and laundry shall have light opening of min. 730 mm.



Master key system for all doors.  
For remote controlled sliding doors, see sfi gp 236.

### **514 External doors with coamings**

Light opening about 730 mm for all external doors, except for doors to stores rooms etc. that shall be 650 mm.

Doors from open deck to wheelhouse shall be of aluminium with steel coaming.

Other doors from open deck to accommodation, storerooms etc. shall be steel doors with steel coaming. All doors with hooks, handles and master-key system.

Doors to accommodation shall have window with diameter min. 250 mm.

All movable parts shall be of brass / stainless steel.

### **515 Side scuttles and windows**

#### **Wheelhouse**

Windows in wheelhouse according to GA-Plan.

Blind covers according to the rules.

The window frames shall be welded to the wheelhouse. All windows to be protected from welding sparks and marks.

Straight-line type window wipers in accordance with NAUT-OSV.

Freshwater flushing shall be arranged for all windows.

The system shall be controllable from the aft console.

Heating in three (3) wheelhouse windows forward and three (3) aft and in accordance with NAUT OSV.

#### **Accommodation**

Portholes or windows in all living rooms, galley and mess room.

Portholes shall have a light opening of 400 mm.

Rectangular windows, min. 450 mm x 600 mm. At least one (1) hinged window/porthole in each cabin/accommodation room which is intended for vessel crew. All windows shall be of "weld-on type" with the main frame of steel and the glass frame of brass.

Portholes shall be operable with blind covers of steel.

Steel blind covers for windows in front bulkhead.

## **52 INTERNAL DECK COVERING, LADDERS, STEPS, RAILING**

### **521 Deck base covering, internal**

Steel deck in accommodation shall be covered with approx. 10-15mm Marine Elastic 4660 or equal underlay. Sound insulated floating floor on 1st deck and A- and B -deck in accommodation (except galley and provision room) and elsewhere if necessary to meet comfort Class.





### **522 Deck top covering, internal**

Vinyl covers in accommodation.

Plastic imitated ship flooring in wheelhouse, captain and chief engineers' cabins and mess- and dayroom, "shipdeck" flooring. Wheel house Ship deck flooring shall be made on the top of 19mm marine plywood without any undulation.

In galley and sanitary rooms, non-skid ceramic tiles laid in plastic cement.

Galley shall have gutters with a stainless steel grating above the gutters.

In engine control room, and switch board room there shall be raised floor with vinyl coverage of non-skid mats.

The vinyl shall be of Heavy Duty type.

### **524 Stairs, handrails in accommodation**

Ladders shall be of steel.

Handrails on both sides in all passageways and stairs.

Stairs in accommodation shall have light metal nosing.

Paint on floors in storerooms.

### **525 Floor plates, ladders and pl.forms in engine room**

Loose floor plates in engine room, cargo area and tunnel thrusters room shall be made of chequered 5 mm aluminium plates or galvanised gratings screwed onto steel beams. Steel floor plates only where required by Class for emergency exit in machinery spaces.

Above valves, mud boxes, filters etc.(steel plates shall only be used where aluminium are not approved by Class) removable floor plates shall be fitted. Further ladders, with open treads, steps, rail stanchions and handrails.

Grating and platforms where necessary for access.

### **526 Ladders, Platforms, Railings etc in tanks**

Good access shall be arranged to all tanks.

Steps, handrail etc. shall be fitted for internal inspection.

Ladders for access to tanks.

Platforms for cleaning freshwater tanks.

## **53 EXTERNAL DECKS**

### **531 Deck covering**

See paint specification Item 270.

All escape ways to have non skid coating.



### 533 Hand rails, Railings and Gates

Rails shall be provided on all decks where no bulwarks are provided.  
Storm rails shall be fitted outside of the accommodation.  
Pipes and stanchions shall be hot galvanised prior to mounting on the Vessel.

### 534 Ladders and Steps

External ladders shall have open treads and handrails on both sides of galvanised steel pipe. The ladders shall be bolted to clips welded to deck and shall be galvanised.  
One (1) vertical ladders from bridge deck to top of wheelhouse and from bridge deck to platform on top of wheelhouse.  
Suitable vertical steel ladders or vertical steps shall be provided for mast.  
Galvanised steel gratings on steel frames outside exterior accommodation doors.

## 54 FURNITURE AND INVENTORY

### 541 Furniture for Crew

Beds, writing desks, shelves, closet and similar in cabins, mess etc to be of laminated chipboard construction.  
Chairs, office chairs and sofas to be made of wood or steel construction with upholstery.  
Sofas in dayroom to have upholstery of foam plastic and covered with leather, fabric or PVC of suitable color.  
Chairs in mess room to have upholstery of foam plastic and covered with imitated leather or fabric.  
The tables to be made of chipboard plate, covered with plastic laminate on the upper side and contra laminate on the lower.  
Beds shall have dimensions min. 800 x 2000 mm.  
250 mm x 1000 mm lee board above mattresses and 1000 mm level with mattresses.  
Mattresses for all beds, 180 mm thick of good interior sprung quality with fire-resistant covers.  
Beds shall have two (2) drawers beneath. Drawers shall have lock.  
Free-standing furniture shall have means of securing.  
Safe in Captain's cabin with writing desk and chair.

#### Showers/Toilets shall have:

- Showers shall be recessed 150 mm.
- Minimum net height inside the wet room modules shall be minimum 2050 mm.
- One (1) Shower with thermostatic mixing valve.
- One (1) Hand basin.
- One (1) Toilet.
- One (1) Mirror with shelf and cupboard with positive catcher (not magnetic).
- Two (2) Towel hooks.
- One (1) Glass holder.
- One (1) Toilet roll holder.
- One (1) Shower curtain. Shower curtain to be mounded 10 cm inside of recess.
- One (1) Handle in the shower.
- One (1) Towel rail.

Cabins without bathroom shall have washbasin with cold and hot water.



## Hospital

### Hospital room on 1<sup>st</sup> deck with:

- One (1) table with drawers.
- Lightning powered from emergency generator and main generator.
- Wash hand basin with elbow taps for hot and cold water.
- Portable shower head with extending hose.
- Instrument table.
- Medical cabinet (locked).
- Communication to bridge.
- Two (2) lockers.
- One (1) chair.
- One (1) bed.

## FURNITURE IN CABINS

	State Cabins	Single Cabins	Double Cabins
Prefabricated toilet block	1	1	1
Bed	1	1	2
Chair	0	1	1
Easy Chair	1	0	0
Wardrobe	1	1	2
Desk	1	1	1
Book shelf	1	1	1
Sofa	1	1	1
Sofa table	1	0	0
Coat hook	2	2	4
Fridge (built-in) 40 l	1	0	0
Cupboard	1	1	1
TV	1	0	0

## Furniture in living quarters

### Mess

- Thirty-six (36) seats.
- Six (6) tables.
- One (1) hat rack with clothes hooks.
- Shelves.
- One (1) dispenser for cups, glasses and plates of wooden material.
- One (1) notice board (600 x 1000).
- Desk for food, cooled.
- Desk for hot food.



### **Dayroom I**

- Eight (8) sofa seats.
- Five (5) armchairs.
- One (1) book case, full height.
- One (1) cabinet for Hi-Fi and TV /video (with drawers).
- Two (2) tables.
- One (1) flower arrangement.

### **Dayroom II**

- Eight (8) sofa seats.
- One (1) cabinet for Hi-Fi and TV / video (with drawers).
- One (1) tables.
- One (1) flower arrangement.

### **Ship office (B-deck)**

- One (1) writing desk with drawers
- Two (2) computer tables
- Two (2) revolving chair
- Two (2) file cabinets (3 drawers)
- Three (3) coat hooks
- One (1) white board
- One (1) drawing locker
- Two (2) shelves (above desk)

### **ROV office (B-deck)**

- One (1) writing desk with drawers.
- Two (2) computer tables
- Two (2) revolving chair.
- Two (2) file cabinets (3 drawers).
- Three (3) coat hooks.
- One (1) white board.
- Two (2) shelves (above desk).

### **Client office (A-deck)**

- One (1) writing desk with drawers.
- Two (2) computer tables.
- Two (2) revolving chair.
- Two (2) file cabinets (3 drawers).
- Three (3) coat hooks.
- One (1) white board.
- Two (2) shelves (above desk).

### **2 x offices (A-deck)**

- One (1) writing desk with drawers.
- Two (2) computer tables.



- Two (2) revolving chair.
- Two (2) file cabinets (3 drawers).
- Three (3) coat hooks.
- One (1) white board.
- One (1) drawing locker.
- Two (2) shelves (above desk).

#### **Conference room**

- One (1) Conference table with eight (8) chairs.
- Three (3) coat hooks.
- One (1) white board.

#### **Male changing rooms, 1st deck**

Forty-six (46) lockers.

One (1) hand washing basin in stainless steel with three (3) mixing batteries.

One (1) toilet.

One (1) shower.

One (1) garbage bin.

Three (3) paper holders.

One (1) mirror.

#### **Female changing room on 1st deck**

- Twelve (12) lockers.
- One (1) hand washing basin in stainless steel with cold and hot water.
- One (1) mirror.
- One (1) toilet.
- One (1) shower.
- One (1) garbage bin.
- One (1) paper holder.

#### **Duty mess**

Two (2) L-sofas w/12 seats.

Two (2) sofa tables.

One (1) Coffe/Tea machine.

One (1) Sink w/hot and cold water.

One (1) drinking fontaine.

#### **Gymnasium**

- One (1) Exercise bicycle.
- One (1) Rowing exercise machine.

The gym shall be arranged with good ventilation.



## 542 Furniture in wheelhouse

Maneuver desks and consoles with hinged front and side doors shall be arranged according to class and IMO requirements, including:

- One (1) Radio table.
- One (1) Wheelhouse chair forward, sliding chair (leather cover).
- Two (2) Wheelhouse chairs aft with manoeuvre controls, sliding chairs (leather cover).
- Two (2) Chairs in radio area.
- Two (2) Lockers for flags (with door).
- One (1) Chart table with chart drawers, table to be suitable arranged in order to also be used as emergency common central.
- One (1) Chart lamp.
- One (1) Wash basin cold and hot water and with shelves.
- One (1) Coffee machine, 2 litres.
- One (1) Drinking water fountain (hot and cold water).
- One (1) Refrigerator, 50 litres.
- One (1) Whiteboard, 600 x 1000 mm.
- One (1) Garbage bin.

## 543 Mattresses

One (1) inner spring and polyurethane foam mattress of 180 mm thick of good quality with fire resistant cover shall be supplied for each bed. Mattresses shall be of standards commercial grade and furnished by the Builder. The mattress cover shall be made of cotton. Mattresses shall fit with a suitable clearance in berth.

## 544 Curtains w/equipment

Curtains and roller blinds fitted for all portholes and windows except wheelhouse and galley

Chart table shall be encircled by light proof curtains.

Transparent sunshield roller curtains on all windows in wheelhouse.

The roller curtains shall be recessed in wheelhouse ceiling when not in use.

Curtains on all beds in two (2) man cabins.

## 546 Entertainment equipment

### TV/video entertainment system.

TV antenna signals shall be taken from the V-Sat system (see group 424).

Four (4) tuners shall be installed on a rack. The central TV antenna system shall be distributed by sufficient numbers of amplifiers and antenna signal splitters around the Vessel with TV antenna sockets in all cabins, mess room and dayroom.

36" colour TV sets shall be installed in dayrooms and in state rooms. In day rooms and state rooms also a video player and DVD player shall be installed and connected to the antenna system.



## 55 GALLEY, PANTRY, PROV. AND LAUNDRY EQUIPMENT

### 551 Galley and Pantry

Layout of galley and mess shall be according to Buyer's approval.

Galley and pantry equipment shall be of good ships quality.

- Two (2) Refrigerators, one(1) in the mess room and one (1) in the galley, each 300 litres.
- One (1) Bain Marie with 4 trys minimum in mess room serving 60 persons for hot food.
- One (1) Combined steamer with capacity 8 l/l GN, min. 6 kW, water consumption: 25 litres/h. Including stand.
- Two (2) Galley range with four (4) burners and large size baking oven.
- One (1) Dishwasher, horizontal marine type.
- One (1) Coffee percolator, 5 litres.
- One (1) Micro wave oven in galley and one (1) in messroom.
- One (1) Mixmaster, type Kenwood chief or similar with standard delivery.
- One (1) Mixer, min. 10 litres, with ked/mix and grating attachment.
- One (1) Potato peeler, 5 kg/ min.
- One (1) Electric slicer.
- One (1) Salad bar with 4 trays minimum in mess room serving 60 persons for cold food.
- One (1) Baking tray in Sanipan with flour drawers below.
- One (1) Meat chopping block.
- One (1) Meat saw.
- Two (2) Big trash cans.
- One (1) Fat fryer with ventilation system.
- One (1) Convection oven.
- One (1) Stainless steel sink with two (2 ) basins of large and deep type and draining board.
- One (1) Stainless sink for hand washing.
- One (1) Garbage compactor.
- One (1) Garbage grinder.

Required lockers, shelves, drawers and benches shall be of stainless steel.

Bulkhead lining shall be of stainless steel.

### 552 Equipment / Outfitting in Galley

Galley in general shall be arranged as given on the arrangement drawing.

Arrangements taps for washing galley floor with warm / cold water.

All stainless steel worktops, sinks etc. shall have stainless steel fronts with drawers / cupboard doors fitted as appropriate.

All galley linings, ceilings and outfitting shall be stainless steel.

Stainless steel deep gutter with scuppers shall be arranged around perimeter of galley to provide good drainage.

Drawers and lockers shall be arranged as place permits, and to common practice.

One (1) working bench shall be arranged with drawers and lockers. Work benches and cabinets shall have exposed corners rounded wherever practicable. Working benches, shelves, drawers and lockers shall be of stainless steel.

Plug sockets for galley machinery shall be arranged.



A ventilation hood of stainless steel with grease trap channel / drain and removable filter of stainless steel mesh shall be arranged above the galley range, fat fryer and gyro pan and convection oven.

## **554 Freezing and refrigeration system**

### **Provision rooms**

Refrigerated and non-refrigerated dry provision stores shall be arranged with aluminium shelves minimum 600 mm as shown on the GA plan.

#### Temperatures:

Cold room: approx. -25° C

Cool room: approx. + 4° C

Dry provision room: approx. + 8° C, connected to the AC system.

### **Dry provision room**

Linings and ceilings for non-refrigerated dry provision store shall be 12 mm water resistant panels. Door shall be 700 x 1980 mm.

Dry provision room shall be connected to air conditioning plant and with separate extraction fan.

### **Refrigerated provision rooms**

Refrigerated spaces shall include cold and cool rooms.

All insulation shall be min. 200 mm mineral wool mats. Lining and ceiling shall be 12 mm water resistant panels.

All internal sealant shall be food safe silicon. All doors shall be 700 x 1980 mm clear opening.

The refrigeration plant shall be fresh water cooled and fully automatic, with one (1) working and one (1) standby compressor units. Each compressor of 100% capacity. Each compressor capacity is based on a maximum running time of 18 hrs per day.

Cooling of the chambers shall be direct expansion unit air coolers with ribbed copper tube cooling section and electric fan.

Automatic defrosting, door seal and sump drain heaters shall be fitted.

Door and fittings shall be of stainless steel.

Doors shall have handles on both sides.

Internal alarm in all provision rooms.

### **Refrigerated compartment alarm system**

Refrigerated compartment alarm system shall be provided as follows:

- Water-proof type push-button with lamp in each refrigerating chamber.
- Bells with a red pilot lamp in the corridor, galley and on bridge.
- Bells shall be clearly marked to indicate the nature of the alarm.

The system shall be fed from the 24 VDC supply system.





## 558 Laundry

### Laundry equipment:

- Three(3) Washing machines, fully automatic, each capacity of 7 kg.
- Three (3)) Tumble dryers, each capacity of 7 kg.
- One(1) Stainless steel washbasin.
- Two (2) Locker (shall be made of stainless steel).
- One (1) Ironing table.

All equipment shall be of marine type. All mounting frames shall be of stainless steel.

## 559 Garbage room

One (1) garbage room (combined with Incinerator room) on 1<sup>st</sup> deck with ventilation fan.

## 56 TRANSPORT EQUIPMENT FOR CREW

### 564 Gangway

One (1) light, aluminium gangway with handrails and safety net, length about 8 m shall be delivered.

One (1) Pilot ladder on each side.

Two (2) Platforms for gangway, one(1) each side on A-deck aft superstructure.

## 57 VENTILATION, AIRCONDITION AND HEATING SYSTEMS

### General

The ventilation system shall be design to:

Maintain acceptable working and living environment for personnel.

Maintain no- destructive condition for equipment.

Prevent formation of combustible mixture and maintain an atmosphere where the gas / air mixture is kept low during normal operation.

Prevent smoke spreading and keep enclosed escape ways free from smoke in case of fire.

### 571 Ventilation and Aircond. systems for Accomodation (HVAC)

The system shall have capacity to include the accommodation and the mezzanine deck.

Accommodation, navigation and control spaces shall be air conditioned from a central system:

Air conditioning Unit (HVAC), ..... 1 x 100 %.

Included also:

Chilled water units, ..... 2 x 60 %.

Defroster system for wheelhouse.

### Design Conditions



	Ambient conditions	Ambient conditions	Interior Condition	Interior Condition
Conditions	Temp °C	Rel.humidity %	Temp °C	Rel.humidity %
Summer primary data	+35	70	+22	50
Winter	-20		+20	50

Vendor specific HVAC specification to be prepared and submitted for approval. Final approved vendor specification will be binding and will supersede the guidance in this specification.

The cooling machinery shall be designed for fresh water-cooling, temp.: 38° C.

### Air condition plant

A fully automatic air-conditioning plant (HVAC) for heating, cooling and ventilation of accommodation shall be provided, in compliance with the relevant Regulations.

The plant shall be of modern design with special consideration towards energy recovery, low power consumption and low noise level in cabins.

The system shall be arranged with single- ducting and separate pre-heating element with Individual temperature controlling for each cabin / room.

Fans shall be frequency controlled.

The plant shall be designed for 50 (100) % fresh air supply, but also with possibility to run the system with variable ratio of re-circulated air, up to 50 %.

It shall be possible to control the ventilation system to ensure a comfortable temperature and sufficient changes of air without draft under the climatic conditions under which the unit is specified to operate.

The relative humidity shall not be below 30 % or above 70 %.

Engine control room / Switch board room 2 x 100% cooling capacity.

The following shall be included in the (HVAC) plant:

- Inlet section with dampers for mixing of fresh air and return air.
- Filter section.
- Cooling section.
- Hot water heating section.
- Fan section with two-speed motor.
- Outlet-/ sound damper section.
- Base frame.

Intake shall be of ample size and arranged with water trap and drainage to scupper. Air inlets shall be located so as to prevent water ingress hazards.

Exhaust from offensive odour rooms shall be routed to the outside and away from and over air inlets.

Air vents from health offices, galleys, laundries and lavatories shall be led in special ducts and never be re-circulated.

Axial fans shall be mounted by min. 5 mm soft packing and neoprene insulated bolts. Silencers shall be included for all axial fans.

Spare parts necessary to ensuring continuous operation of the plant shall be included.

Offensive odour rooms such as galley, garbage incinerator room, shall be under low pressure to prevent possible offensive odours to enter crew areas.

All ventilation openings shall have closing arrangement according to rules.



**Galley**

The galley shall have a separate supply and exhaust system with two (2)-speed fan motor. The exhaust system in galley shall be fitted with galley hood and fat filter above the galley range and convection oven and deep fryer. The galley hoods shall extend well outside the equipment it is designed to cover.

A sufficient number of cabin units with adjustable air-flow and with built in electric heater shall be fitted in all rooms.

The heaters shall be thermostat controlled and heating element shut off in case of fan stop. All sanitary spaces, change room, dayroom and laundry shall be fitted with separate exhaust system.

The air in conditioned spaces shall exhaust into corridors and private toilets through door louvers and under cuts.

The air in corridors shall exhaust naturally to open air exterior or shall be re-circulated back to the air-handling unit.

The air in hospital, laundries, change room, and sanitary spaces shall not be re-circulated.

A separate exhaust system for laundry including tumble dryers shall be provided. Fan with el.motor outside air-stream.

**Ducting**

Pre-insulated spiral ducting - outer and inner galvanized steel tube with intervening layer of mineral wool insulation. Duct fittings comprise either moulded internal mineral wool insulation with a lining of neoprene rubber or to be of double wall construction with intervening insulation depending on size and type.

**Cooling**

The cooling system shall be based on circulation of Chilled water.

Chilled water plant shall be provided, consisting of two (2) separate modules, each having minimum 60% of the total required need for cooling.

The cooling compressors / cooling units shall be located in engine room. The refrigerating fluid shall be R407c.

**Heating**

The AC unit to have a electric heating battery.

**572 Ventilation for the remaining parts of the vessel**

**General**

Ventilation shall be arranged for all daily accessible spaces. The listed rooms / compartments shall have mechanical ventilation indicated with min. air change rates in term of volume / hour.

For final determination of ventilation capacity for each area, a thermal calculation shall be executed taking into account a realistic number of people, electric load, heat radiation from equipment etc. and the heat transmission factors.

Room/Compartment	Mechanical		Natural		Remark
	Suppy	Exh.	Supply	Exh.	
Navigation Bridge	10			x	Separate Cooling unit + HVAC, Defroster



Instrument room	8			x	Separate Cooling unit + HVAC
Bow Thruster room	8			x	
Main Engine room	x	x			Two(2) frequency controlled fans
`Cargo` Area	8			x	
El.Workshop	8			x	
General Store	6			x	
Engine Room Workshop	8			x	
Engine Room Stores	6			x	
Engine Control room	8			x	Separate Cooling unit
Provision Handling Room	10			x	Connected HVAC
Incinerator / Garbage Room		8	x		
Deck Workshop	8			x	
Paint Store		20	x		
Chemical Store		20	x		
Dry Provision	10		x		
Stores	6		x		
Emergency Generator Room					
Bosun Stores	6		x		
Switch board room	8			x	Fan-coil cooling unit
Propulsion machinery room	12			x	
Garbage room		10			

### 573 Ventilation for engine control room/ SW-board room

#### Switchboard room/ECR

A separate fan-coil unit, connected the chilled water system, shall be installed for the switchboard room. Fresh air supply shall be arranged from the engineroom ventilation system. The cooling capacity shall be determined after final decision of equipment and dissipated "wild heat" .

### 574 Ventilation Engine room

Fans (with capacity above 1000 m<sup>3</sup>/h) shall be resilient mounted and have "sound traps". The supply ducts to the engine room shall be branched off to secure satisfactory ventilation throughout the whole engine room. Each ventilation opening / outlet shall have removable / washable filters and direct outlet control. Amply dimensioned louvers for air inlet / outlet shall be provided, well-screened from exhaust and water spray. Fire dampers /hatches shall be fitted in all ducts between the engine room and the open air, and shall be remotely controlled by means of compressed air or hydraulic.



Outlet for the extraction fans shall be provided with oil drip pan and drain pipe line to engine room. Closing device shall be made of stainless steel.

### **Ventilating of the main engine room**

Two (2) off axial fans to be provided for air supply to engine room. One (1) fan to be of 2-speed type and one to be of reversible type.

Total air supply to be calculated on basis of design requirements in ISO 8861:1988. Effective drainage of seawater from the vent inlets to be arranged.

Distribution channels to be arranged in engine room for an efficient ventilation of the engine spaces.

### **574.1 Emergency generator room**

Emergency diesel generator room shall be mechanically ventilated in accordance with recommendation from supplier, with regard to radiator cooling of the generator.

Mechanical ventilation shall be provided by engine radiator fan.

In addition, one (1) el.motor driven axial flow supply fan shall be provided.

Natural supply air louvers shall also be arranged to cover emergency generator fan when the above supply fan is not operating.

### **574.2 Ventilation of propulsion room**

Separate supply fan and necessary ducting shall be provided for exchanging the air throughout the area, necessary ducting shall be arranged for good distribution throughout the whole area.

Fire dampers and watertight closing device shall be provided in accordance with relevant regulations.

### **575 Ventilation of cargo area**

Mechanical ventilation shall be provided by separate supply fan and necessary ducting for exchanging the air throughout the area.

Supply ducting shall be arranged for good distribution throughout the whole area.

Fire dampers and watertight closing device in bulkheads shall be provided in accordance with relevant regulations.

Capacity..... : ~ 10000 m<sup>3</sup>/h

### **576 Ventilation of thruster rooms**

Mechanical ventilation shall be provided by separate supply fan and necessary ducting for exchanging the air throughout the areas.

Supply ducting shall be arranged for good distribution throughout the whole areas.

Fire dampers and watertight closing devices shall be provided in accordance with relevant regulations.

Capacity each room..... : ~ 2000 m<sup>3</sup>/h



### **576.1 Paint store and chemical store**

Mechanical ventilation (under pressure) shall be provided by separate extraction fan (ex. Proof) with necessary ducting and watertight closing device in accordance with relevant regulations, both for outlet and inlet.

### **576.2 Deck stores and similar rooms**

Mechanical ventilation shall be provided by separate supply fan.

### **576.3 Workshops**

Permanent welding positioning in deck workshop shall have smoke extraction duct and fan.

### **576.4 Incinerator room**

One (1) exh.fan shall be provided for incinerator room.  
One (1) supply fan shall be installed, with capacity for the incinerator and ventilation of the room.

### **579 Natural ventilation**

The spaces served by natural ventilation - including the Acetylen/Oxygen store -shall be provided with top and bottom ventilation pipes.  
The air inlets and outlets shall have covers or goosenecks, with shutters, of watertight design where necessary.

## **58 SANITARY SYSTEM AND EQUIPMENT**

### **581 Sanitary supply system**

#### **Piping system**

Sanitary systems shall be based on fresh water.  
Piping system shall be divided into suitable sections with closing valves for each deck.  
All hot water lines shall have miniature ball valves at faucet connections.  
All pipes for hot and cold fresh water shall be of copper or approved plastic in accommodation.  
All hot water pipes shall be insulated and cold water pipe shall be sweat protected.  
All tapping locations in accommodation shall have both cold and hot water supply.

Two (2) hot water circulation pumps of centrifugal type shall be installed, each with 100 % capacity.  
The pumps shall take suction from the EI boiler and deliver to ring lines for hot water.  
One (1) FW transfer pump with capacity 50m<sup>3</sup>/h for transfer between the FW tanks.  
Bunker stations shall be arranged for FW on 1st deck, PS & SB side.

Faucet specifications:



- Low consumption water mixer faucets for showers fitted with shower device.
- Water mixer faucets for basins.
- Water mixer faucets for sinks.
- Faucet in laundry.
- Where necessary (in engine room, cargo area, propulsion room, laundry, galley etc.) faucet for hose connection shall be fitted.

Dimension and material throughout: 1/2" chrome plated brass.

One (1) wash-basin of stainless steel with water mixer shall be fitted in engine room.

Freezing secured fresh water tapping with hot and cold water shall be arranged outside superstructure according to Buyer's instruction. (One(1) located at the Fan beam)

One (1) of the wash basins of stainless steel shall be fitted in engine room.

### **Pressure sets**

A constant pressure system shall be installed with two (2) pumps, capacity: 2 x 6 m<sup>3</sup> /h - 60 mWG. Suction from F.W. tank's branck off valves on pressure side with pressure control valve, delivering to the F.W. tank in service.

The hot water to be supplied by two (2) off 300 l hot water tanks with electrical heating elements off approx. 10 kW each. the electric elements each. The hot water circuit, which is for domestic use only, has fresh water supply from vessel hydrophore system.

### **582 Sanitary discharge system**

One (1) sewage tank. Sewage discharge from washbasin, showers and sinks shall have sloped pipes to sewage tank.

A sewage vacuum discharge system for toilets shall be fitted.

One (1) sewage discharge pump capacity 20 m<sup>3</sup> /h 20 mWG.

One (1) ejector capacity 10 m<sup>3</sup> /h - 10 mWG.

A sewage treatment plant, with capacity for sixty (60) persons, USCG and IMO approved type II shall be installed. Possibility to by-pass sewage plant.

### **Gutter drain**

Indoor gutter drain shall be led to gutter on deck below, and eventually, to engine room bilge or nearest bilge.

Outdoor gutter drain shall be led to gutter on deck pads and eventually to 1st deck.

Drains shall be fitted behind lining.

### **Piping system**

Discharging pipes shall be galvanized steel pipes in accommodation.

Ability for flushing the discharge pipe from sewage treatment plant and sewage tank by fire-wash system.

The piping shall be fitted with one isolating valve and one (1) access flange on each line at each deck level.

### **583 Sanitary equipment**

All sanitary equipment shall be of good marine quality.

Deep bowl washbasins shall be of vitreous china.

Hand basins in engine room, changing room and laundry shall be stainless steel.

Basin in hospital shall be of stainless steel.



### **584 Drinking water system**

Two (2) drinking water units with UV and cool filter.

The units shall supply hot and chilled water. One (1) on bridge and one (1) in Duty mess.





## 6 MACHINERY MAIN COMPONENTS

### 60 DIESEL ENGINES FOR PROPULSION

#### 600 General

The propulsion system shall consist of two (2) main diesel engines and two (2) propellers.

Each system shall include:

CP propeller, propeller shaft, reduction gearbox with PTO and shaft generator, main engine with flexible coupling.

All machinery shall be of first class marine type. The system and lay out shall be arranged for safe operation and easy access.

All components and systems shall be designed to operate under the environmental conditions and Class / Authority requirements as described in Group 0.

Each main engine set shall form an independent unit, including all the required accessories to make the engines and support systems complete and operational.

Machinery and equipment shall be installed on solid foundation to minimise the effect of vibration, deflection in the crankshafts and couplings and misalignment etc.

For major machinery, such as reduction gearboxes etc. adjustable steel chocks shall be used. Main engines shall be resilient mounted.

#### 601 Diesel engines for propulsion

The diesel engines for propulsion shall consist of two (2) medium speed marine diesel engines.

Main engine rating (MCR) each 2320 kW at 900 rpm.

Fuel: MDO.

Each engine shall be flexible coupled to shaft via a reduction gearbox with vertical offset. Main engines shall be flexible mounted and have flexible connections to all pipe work leading to and from engines.

The main engine speed governors of electronic type, shall be fitted with necessary control and safety equipment.

Spare parts shall be supplied according to Class and suppliers recommendation.

### 63 PROPELLER PLANT, TRANSMISSION



### **634 Controllable pitch propeller plants**

Two (2) controllable pitch propellers shall be installed.

- Propeller diameter: 2900 mm.
- Material of hub: stainless steel.
- Number of blades: four (4), each propeller.
- Material of blades : Ni-Al-Br.
- Speed of propeller : 230 rpm, approx.

The system shall include:

Propeller shafts with couplings, bearings, bulkhead glands, stern tubes with linings and inner and outer seals with separate tanks for lubrication of inner seals, lube oil pressured tanks for outer seals and shaft brake.

High temperature sensors with remote temperature read-outs shall be installed in stern tube white-metal bearings, both forward and aft. All intermediate shaft bearings shall be oil lubricated sleeve bearings with oil bath, level glass - or other methods with similar result, equipped with temperature sensors for remote read-outs as well as local thermometer.

### **Pitch control system**

The main hydraulic pump for the servo and CP system, for each propeller pitch control, shall be mechanically driven by a PTO on the reduction gearbox.

One (1) electric motor driven stand-by pump shall be installed for each gearbox.

The stand-by pump shall start automatically, in the event of oil pressure drop.

Oil coolers shall be provided.

Control panels shall be installed in the wheelhouse (fore-and aft console) and in ECR.

Each control panel at least to contain the following function and equipment for each engine/gearbox/pitch control:

- Tachometer for engine speed.
- Tachometer for shaft speed.
- Pitch indicator.
- Clutch control.
- Indication/alarm lights/buzzer.
- Control switches.

In addition, the system shall be connected to the Joystick system.

An emergency control system(local) for operation of the engine speed, pitch control and clutch shall be provided.

### **637 Main reduction gears with thrustbearings and couplings**

Two (2) single input, single-out gearboxes with vertical offset and built in thrust bearing shall be installed. Gearbox shall have a PTO outlet for shaft generator.

Each main engine shall be connected to each gearbox by means of a hydraulic operated soft clutch and shall be provided with built in servo-mechanism for pitch propeller.

Oil coolers shall be provided according to Class and manufacturers requirement.

Flexible coupling between the main engines and shaft lines, and between the shaft lines and gear boxes.

Flexible coupling also between PTI and Shaft generator.



## 65 MOTOR AGGREGATES FOR MAIN EL. PRODUCTION

### 651 Motor aggregate

Two (2) diesel generator sets shall be installed having the following characteristics:

- Rating, approx. : 900 ekW.
- Voltage: See gr. no. 860.
- Speed: 1800 RPM.
- Fuel: MDO.

### Auxiliary systems

The diesel engines shall be complete with:

- Lube oil system with engine driven lube oil pump.
- Freshwater cooling system for the engine with engine driven cooling water pump.
- Fuel oil system with engine driven fuel oil pump.
- Air starting equipment according to class requirements.
- The gen. set (aux. engine and generator) shall be built on a common bed frame.

### Control and monitoring

Local instrument panel on engines shall be arranged with the following equipment:

Tachometer, lube oil pressure gauge, water thermometer, oil temperature gauge, hour counter and start/stop/emergency stop buttons, etc.

Following monitoring shall be arranged as a minimum for remote reading to monitoring system in control room:

- Lub.oil pressure.
- Low lub.oil pressure, shut down.
- Lub oil temperature.
- Fresh water temperature.
- High fresh water temperature, shut down.
- Exhaust temperature after turbo charger.
- Fuel oil leaking alarm.
- Over speed alarm.

Woodward (or equal) electronic governor system with remote control from main switchboard shall be fitted. The electronic speed governor shall be capable of regulating the speed of each diesel engine such that the generator shall meet the Class and Authority's requirement of speed drop.

Automatic stop of engine at very low lubrication oil pressure, very high water temperature and over speed shall be provided, with alarm connected to the alarm system.

Alarm and monitoring for low lubrication oil pressure, high cooling water temperature, low level in f.w. expansion tank, etc, according to Class and Manufacturers standard.

Spares according to the Class' request.

### Generator

- Generators: Synchronous A/C generator, designed for short time parallel running with the shaft generator.
- Protections: As regulations.
- Cooling: Air.
- Enclosure: IP 23.



The generators shall be arranged for parallel running with each other.

## 66 EMERGENCY GENERATOR

### 665 Harbour/Emergency generator

One(1) harbour - / emergency aggregate, shall be installed having the following characteristics:

#### **Type of engine**

- Rating (generator): 450 ekW, Voltage see gr. 860.
- Speed 1800 RPM.
- Fuel Marine diesel.
- Cooling Fresh water via Radiator.

Following monitoring shall be arranged as a minimum, both local and remote reading to monitoring system in control room:

- Lub.oil pressure.
- Low lub. oil pressure, shut down.
- Lub.oil temperature.
- Fresh water temperature.
- High fresh water temperature, shut down.
- Exhaust temperature after turbo charger.
- Fuel oil leaking alarm.
- Overspeed alarm.

One (1) electrical starting systems according to rules and one (1) hydraulic starting system.

Hand-operated L.O priming pump.

The emergency / harbour generator set shall be arranged for short time parallel running with the aux. generating sets.

The generator/engine in general shall be equipped as gr. 651, except for the safety devices (see 795).

#### **Mode selector switch**

A mode selector switch for emergency/harbour generator set operation shall be fitted in the Emergency switchboard. The selector switch shall only have two (2) positions, "Emergency" and "Harbour". Should inform VMS with an alarm if not in emergency mode.

The selector switch shall include the following functions:

- Very-high cooling water temperature safety shut-down devices (only activated in harbour mode).
- Automatic start and disconnection of main switchboard upon failure of the main source of power (only activated in emergency mode).



### **Emergency mode**

If a black-out occurs for the generator systems, the emergency generator set shall start automatically and connect to the Emergency switchboard, according to Class and Authority requirement. The connection between emergency switchboard and main switchboard shall be automatically disconnected, upon failure of the main source of power.

### **Ready to sail Emergency procedure**

Instructions containing information of required fuel oil tank level, position of mode selector switch, ventilation openings, valves, etc. shall be fitted at the emergency switchboard, to ensure that when the vessel is under way, all control devices are in correct positions for the independent emergency operation of the emergency generator set and emergency switchboard.

### **Harbour mode**

The generator set shall be arranged for short time parallel running with the aux. generating sets, when in harbour mode. The emergency switchboard and main switchboard shall be connected also when the diesel engine is running (feedback line). The feedback circuit breaker in emergency switchboard shall automatically trip at overload on the diesel generator set. This circuit breaker shall also trip at short circuit in the "feedback" line, and shall also be selective with the emergency generator circuit breaker.

A low level alarm shall be installed in the fuel tank for the emergency diesel engine. This alarm shall be activated before the fuel level is decreased to a level corresponding to 18 hours emergency service. Fuel tank level connected VMS system.

The noise requirements from the Authorities to be fulfilled with harbour aggregate having 100% load. The diesel engine and the generator shall be built on a common bed frame and to be flexible installed. Flexible pipes to be arranged for fuel oil and cooling water between engine and engine bed.

### **667 Shaft Generator**

Two(2) Shaft generators shall be installed and connected to the PTO on the reduction gearboxes. The shaft generator shall be flexible mounted.

The Shaft generators shall be equipped with necessary control equipment and automatic voltage regulation equipment.

The Shaft generators shall have following characteristics:

- Output Approx. 1600 ekW.
- Voltage 3 x 440 V, 60 Hz.
- Speed max. 1800 RPM.
- Protection IP 44.

An arrangement shall be fitted for overload prevention of shaft generators, by an automatic side thrusters pitch reduction equipment, for preventing black-out.

The shaft generators shall be controlled by the Power Management System. An arrangement shall be fitted for overload prevention of shaft generators, by automatic propeller pitch reduction equipment, for preventing black-out.

The shaft generators shall be fresh water-cooled and shall have stand-still heating, thermistors built-in to the stator windings and monitoring of the temperature of the shaft bearings, all connected to the Vessel's alarm and monitoring system.

The generator shall have sleeve bearings. The rotor shall be balanced for the actual RPM, necessary weights, and to be provided with necessary Class certificate.



Shaft generators shall have nipple for SPS Single Point Monitoring for bearings and vibration



## 7 SYSTEMS FOR MACHINERY COMPONENTS

### GENERAL

Piping system shall meet the requirements of the classification society unless higher requirements are explicitly stated in this specification. Piping shall be arranged according to good marine engineering practice, with the minimum practical number of bends of appropriate radius.

Piping carrying fluids shall not be arranged with flanges or pipe connections above switchboards. Expansion bends shall be fitted to preventing damage due to expansion of piping or movement of structure. Piping of ND 50 and above shall be connected by weld-on flanges; piping of smaller diameter by compression fittings.

After completion, piping systems shall be cleaned by circulating the related fluid through coarse - gauze slave filters fitted on the suction side of pumps. The filters shall be inspected and cleaned prior to sea trials.

All lube and hydraulic piping shall be thoroughly cleaned after final welding by immersion in acid and thereafter lubricated with oil prior to erecting and filling of systems.

Pipes shall be tested according to the Classification Society's rules.

Pipes, valves and fittings shall be supplied with certificates as required by the Classification Society.

In way of pumps, heat exchangers etc. the piping shall be arranged to permit overhauls of the unit with minimum dismantling of pipes.

External piping shall be fitted with drain plugs where necessary.

All pipes shall be fastened safely.

Colour marking for various pipe systems according to ISO standard type system.

Pipes shall be supported according to good practice in order to prevent damages from vibrations and other causes.

Hydraulic pipes in tanks and external pipes  $\leq 25$  mm shall be of stainless steel.

### Pumps

All pumps shall have mechanical seal type.

All pumps shall have casing of cast steel or bronze, impellers of bronze and shaft of stainless steel.

### MATERIAL GUIDE - ABSTRACT OF PIPE MATERIAL

GP	System	Dimension	Material	Standard Dimension	Standard Material	Remarks
381	Hydraulic pipes for valve control	All dim.(in tanks and on open decks)	Precision steel pipes	DIN 2391 NS 2503	DIN 2445 NS 1211	
403	Hydr. lines for steering gear	All dim.	Precision steel pipe	DIN 2391 NS 2503	DIN 2445 NS 1211	
434	Low pressure hydr. pipes	All dim. (Indoor/outdoor)	Steel	DIN 2448 NS 2501	DIN 1629 NS 12111	
434	High pressure hydr. pipes	All dim.	Precision steel	DIN 2391 NS 2503	DIN 2445 NS 1211	



554	Refr. Cooling (coolant side)	All dim.	Copper	DIN 1786 NS 2501		
571	Air condition system	All dim.	As for refr. syst.			
581	Sanitary supply	All dim.	Copper or plastic (approved type)			
582	Sanitary drain	All dim.(ab.freeboarddk.)	Blucher or equivalent		SS 316	
		All dim.(bel. freeb.dk.)	Galvanised steel	DIN 2448	DIN 1629	
70	Fuel oil	DN≤ 32	Precision steel pipe	DIN 2391	DIN 2445	
		DN≥ 40	Steel	NS 2503	NS 1211	
71	Lube oil	DN≤ 32	Precision steel pipe	DIN 2391	DIN 2445	
		DN≥ 40	Steel	NS 2503	NS 1211	
721	Sea cooling water	All dim.	Galv. steel	NS 2501	DIN 1629	
722	Fresh cooling water	DN≤ 32	Precision steel pipe	DIN 2391	DIN 2445	
		DN≥ 40	Steel	NS 2503	NS 1211	
731	Starting air	DN≤ 32, inside	Precision steel pipe	DIN 2391	DIN 2445	
		DN≤ 32, outside	Stainless st. ( AISI 316L)	DIN 2448	DIN 1629	
		DN≥40	Steel			
732	Service Air	All dim.,outside	Stainless steel			
		All dim., inside	Precision steel pipe			
734	Control air	All dim.	Copper, but stainless steel inside tanks			
74	Exhaust pipes, ME		Steel		DIN 1629	
74	Exhaust pipe aux. engines		Steel	DIN 2448/2458	DIN 1629	
801/803	General, Bilge and ballast	All dim.	Galv. steel	NS 2501	DIN 1629	Hot dip galvanized
804	Gutter pipes	All dim.	Galv. steel	NS 2501	DIN 1629	Hot dip galvanized
813	Fire & deckwash general service	All dim.	Galv. steel	NS 2501	DIN 1629	
814		All dim.	Hot dip galvanized			
815	CO2	All dim.	Galv. steel			
816	Foam	All dim.	Galv. steel	NS 2501	DIN 1629	
821	Air and sounding	All dim.	Galv. steel/steel	NS 2501	DIN 1629	
821	Sample lines		Stainless steel			





## **MATERIAL GUIDE - ABSTRACT OF VALVE MATERIAL**



SFI	System	Nominal Size	Description	Standard Material Body	Standard Material Garniture	Remarks
434	Hydraulic	All dim.	According to supplier`s standard			
444	High- pressure washing	All dim.	Ball valve	St. Steel	St. Steel	
70	Fuel Oil	DN≤40	Ball valve	Bronze	Bronze	
		DN>40	Butterfly valve	Cast iron	Al. Bronze	
71	Lube Oil	DN≤ 32	Ball valve	Bronze	Bronze	
		DN=40	Ball valve	Cast iron	Bronze	
		DN≥50	Butterfly valve	Cast iron	Al. bronze	
721	Sea Water Cooling	All dim.	Butterfly/gate valve Lined	Cast iron	Al. Bronze/ Buna-N	Valves on ship side and sea inlet to be Ductile Iron
722	Fresh Water Cooling	DN≤32	Globe Ball valve	Bronze	Bronze	Buna-N for temp. below 80°C, EPDM for temp. above 80°C.
		DN≥40	Butterfly/Globe valve	Cast iron	St.St	
731	Starting Air	DN≤32	Ball valve	Forged steel		
		DN≥40	Ball valve /Globe valve	Steel /Cast steel		
732	Service air	All dim.	Ball valve	Brass	Brass	
801	Ballast	All dim.	Butterfly valve	Cast iron	Al. Bronze/ Buna-N	
803	Bilge	All dim.	Butterfly valve	Cast iron	Al. Bronze/ Buna-N	
813	Fire and Deck wash hydrants	All dim.	Globe valve	Bronze incl. hose coupling	Bronze	NOR coupling no. 2
813	Fire & Deck wash, general service	DN≤40	Ball valve	Bronze	Bronze	
		DN>50	Butterfly valve	Cast iron	Bronze	
815	CO <sub>2</sub>	All dim.	Ball valve	Bronze	Bronze	
816	Foam	DN≤40	Ball valve	Bronze	Bronze	
		DN>50	Butterfly valve	Cast iron	Bronze	
821	Sounding	All dim.	Ball valve	Bronze	Bronze	Cylindric self closing cock w/test cock screw



## 70 FUEL OIL SYSTEM

### 700 General

A complete fuel oil service system with standby equipment for all main engines at 100 % MCR shall be provided in accordance with the class requirements.

Two (2) fuel oil service tanks, one (1) fuel oil settling tank and one (1) fuel oil service tank in emergency generator room.

All service and settling tanks shall have level gauges, quick-closing valves.

Waste oil and drip trays shall be made according to good marine standard.

Fuel oil transfer and service pumps, and fuel oil purifier shall have remote stop facilities outside machinery space according to requirement and regulations.

### 701 Fuel oil transfer and drain system

#### Bunkering and overflow system

Connections (stations) for diesel oil bunkering shall be provided on PS and SB with piping to a FO valve chest.

An overflow (over-bunkering protection) system shall be provided for all bunker, settling and service tanks etc. Each tanks shall be connected, via goose-neck to a common overflow and vent pipe, self-drained to a nominated double bottom overflow tank. (see also gr. 821). A sight glass and an overflow alarm shall be fitted in the last section before entering into the overflow tank. The system shall be designed with a safety factor corresponding to capacity of the bunkering line (150m<sup>3</sup>/hrs).

The nominated overflow tank shall be equipped with high level alarms.

#### Transfer system

A fuel oil transfer system shall be arranged with suction from storage tanks and discharge to settling- and service tanks. The system, including pump and valves, shall be locally manually operated.

The system shall include all storage tanks, one (1) settling tank, two (2) daily service tanks (PS and SB) and one (1) service tank for the emergency generator, all according to General arrangement / Tank plan drawing. The system shall be arranged for inter-transferring between all FO tanks.

Transfer pumping system shall include:

- One (1) transfer pump, with a capacity of 20 m<sup>3</sup>/h, 2 bar.
- A system for backup shall be in place.

Piping for fuel oil settling and daily service tanks shall be dimensioned for use of transfer pumps, based on a pumping capacity of 20 m<sup>3</sup>/h. All three (3) tanks shall be connected the common overflow system.



## **Drain system**

All fuel tanks in machinery spaces above double bottom tanks shall be equipped with drip trays of sufficient capacity for collecting any leakage of oil which may occur from valves, fittings etc. The drip trays shall be drained to the fuel oil drain tank.

Fuel oil service and settling tanks shall have an accessible drain (self-closing valve) fitted at the lowest point of the tanks, for removing water and sediment. These drains shall be arranged directly to the sludge tank. A separate fuel oil drain tank shall be arranged according to General arrangement drawing, for collecting of clean fuel leakage from diesel engines, drip trays and other equipment in the system.

## **702 Fuel purification plant**

One (1) fully automatic, self-cleaning purifiers for marine diesel shall be installed.

Capacity : min. 2000 l/h (effective throughput).

All controls and alarms available in maker's control unit shall be fitted.

The purification plant shall have possibility for purifying from settling tank to service tanks, as well as from service tank and back to same service tank. The purifier shall also have possibility for purifying direct from fuel overflow to settling- or service tanks.

One (1) ample diesel sludge tank shall be provided in engine room, according to General arrangement plan.

## **703 Fuel oil service system**

All consumers, like main engines, generator sets and boiler shall be arranged for marine gas oil.

Service tanks on both port and starboard shall be arranged for full operation of all consumers.

From service tanks, individual branch lines shall be arranged to all consumers.

Approved valves of quick-closing type shall be arranged on tanks according to rules and requirements.

Supply lines to main engines shall be arranged for the following way of operation:

All engines shall be supplied from either port or starboard tank with necessary isolation valves for changing between.

Fuel return lines from engines shall be arranged according to supply lines, either flowing back to service tanks or to suction line. All return lines shall have continuous raising.

All consumers shall have duplex filters installed in supply lines.

## **71 LUB OIL SYSTEM**

### **711 Lub oil transfer and drain system**

Suitable lube oil storage tanks shall be arranged for main engines, auxiliary engine, reduction gears, hydraulic systems, tunnel thrusters, steering gears.

- The tanks shall be arranged with filling from deck, level glass, air-pipes, tapping cocks, manholes and drip trays.
- The lube oil tank in the double bottom to be heated.
- The drip trays shall be drained to waste oil/sludge tank.
- For the main- and auxiliary engines filling shall be arranged from the respective tanks.
- One (1) transfer pump, capacity 5 m<sup>3</sup>/h - 3 Bar for lub.oil.



- One (1) flow meter for measuring filling of oil to main engines.
- Connections from lube oil transfer suction line to lube oil separator suction side.
- One (1) sludge pump capacity 5 m<sup>3</sup>/h - 3 Bar with delivery to deck.
- Emergency stop of sludge pump on deck.

Following small storage tanks shall be arranged:

- In steering gear room, one (1) x 300 litres.
- In forward thrusters room, one (1) x 200 litres.
- In cargo area, one (1) x 200 litres, for stern tube.
- In cargo area, one (1) x 200 litres, for aft thrusters.

Drain trays shall be fitted below all storage tanks.

All tanks with filling from deck and with gauge glass.

Vent. pipes from small storage tanks shall only be locally on the tank area (not to deck).

### **712 Lube Oil Purification System**

Two (2) lube oil purifiers, automatic self-cleaning type, with capacity according to engine supplier's recommendations, shall be installed. EI heaters shall be included.

(The installation shall be considered after final decision of type of main engines).

The piping systems shall be arranged in such a way that it shall only be possible to have suction and delivery from the same main engine at the time.

All control valves shall be screw-lift type.

### **713 Lub oil system for propulsion machinery**

The lube oil systems lay out shall be in full compliance with the engine manufacturer's recommendation.

The main engines shall have dry sump with system tank located in tanktop below main engines.

## **72 COOLING SYSTEM**

### **720 General**

The main cooling systems to be divided into two separate systems, one system for port side main engine with connected equipment and one system for starboard side main engine with connected equipment.

The propulsion plant and auxiliary engines to be cooled by central plate coolers. Coolers and pump capacity to be rated according to sea water temperature of 32°C and freshwater low temperature of 37°C.



### **721 Sea water cooling system**

Sea Chests, engine room Two (2) sea chests to be arranged in engine room, one on each side, One (1) high suction and One (1) Low suction. Both sea inlets to be arranged with strainers. Both sea inlets to be connected to a crossover pipe or a crossover tank. A dosage system to be installed for engine room sea chests.

Arrangement for draining and venting of the cooling water piping shall be fitted.

A separate central cooling system shall be arranged in the aft part of the vessel with one(1) central cooler with back flushing and with two (2) seawater pumps.

### **Water intakes**

The two (2) sea chests compartments in the engine room shall be connected to each other via crossover. The different consumers, such as ballast water intake, and fire and wash water intake shall be arranged off the crossover pipe.

One (1) sea chest shall be provided aft, for emergency fire pump intake.

### **722 Fresh water cooling system**

The vessels propulsion system with engine driven equipment to be plate cooled.

The coolers to be dimensioned for 100% load of the systems.

Each cooler to have minimum 15% fouling factor.

Main engines and reduction gear to be connected to the plate cooler.

Each main engine to be arranged with thermostatically controlled electric preheating module in HT circuit.

All freshwater systems shall have anti-freezing medium.

A separate freshwater central cooling system shall be installed in aft cargo area for cooling of reduction gearboxes, shaft generators, side-thruster motors, The freshwater side shall have two(2) electrical driven freshwater pumps. One (1) acting as stand-by pump (fully interchangeable) and one(1) expansion tank.

A separate freshwater cooling system shall be installed forward for cooling of air-condition for accommodation and engine control room, side-thruster motors and provision cooling system.

The freshwater side shall have two(2) electrical driven freshwater pumps. One (1) acting as stand-by pump (fully interchangeable) and one(1) expansion tank.

In addition one(1) smaller el. driven freshwater pump for cooling of provision cooling system alone. These three (3) pumps shall be remote operated from ECR console.

Two (2) off Aux. Engine freshwater cooling systems shall be installed, with one(1) expansion tank for each aux. engine.

A pre-heater, including pump shall be installed for stand still purpose. The main HT pump shall be mounted on main engine. An electrical driven stand-by HT pump shall be installed. A HT cooler and lube oil cooler for main engine shall be installed.



## **73 COMPRESSED AIR SYSTEM**

### **731 Starting air system**

The main- and auxiliary engines shall be arranged for compressed air starting.

The starting air system including remote control etc. shall be arranged in accordance with the engine supplier's recommendations and the rules in force.

Two (2) start-air receivers, capacity according to rules in force.

Two (2) compressors, electrically driven with automatic start/stop, capacity: 2 x 35 m<sup>3</sup>/h - 30 Bar.

Compressors shall be air-cooled.

Separate line (8 bars) shall be routed from start-air receivers to the typhoon.

### **732 Service**

A system for supplying of service air (7 Bar) to workshops, cargo area, steering gear compartment, side thruster room, engine room (5 pcs) and decks (5 pcs) shall be provided.

Supply from start air system via pressure reduction valve.

One (1) service air compressor, screw type, capacity 50 m<sup>3</sup> /h - 8 bar, with dehumidifier and dozing apparatus for anti-freezing medium.

### **734 Instrument air supply system**

Control/instrument air shall be supplied from starting and service air system via reduction valve filters and dehumidifying device of adequate capacity.

## **74 EXHAUST SYSTEM**

### **743 Exhaust gas system**

Exhaust gas system from main engines, aux. engines, emergency generator diesel and the boiler shall be carried to atmosphere at the aft end of the funnel with watertight penetration.

Exhaust outlets shall be facing approx. 45 deg. out from the ship's side.

From diesel engines the piping shall be flexible suspended to the steel structure.

Attention shall be paid regarding expansion of the systems, necessary compensators shall be provided.

Silencers and spark arrestors in all exhaust systems from diesel engines min. 35 db noise reduction. The exhaust pipes shall be insulated (75 mm) and covered by galvanised steel plates.



## 76 DISTILLED & MAKE UP WATER SYSTEMS

### 761 Freshwater generators

One (1) Reverse Osmosis, fresh water maker, shall be installed.  
Capacity: 25 tonnes / 24 hrs.

Produced fresh water from the water makers shall be led through neutralizing filter to the fresh water store tank. In addition a separate pipe line, fitted with UV- sterilizers and carbon-filter shall be carried to scullery or dry provision room.

## 79 AUTOMATION SYSTEM FOR MACHINERY AND CARGO SYSTEMS

### 790 General

#### Construction and operation

Sufficient instrumentation alarms and control equipment for safe operation of the main engines and all auxiliaries shall be arranged in accordance with instrumentation list.

The control and instrument plant shall also be in accordance with requirements regarding "Dead man alarm" (applicable to Vessels above 500 gr.reg.t.)

All components and wires shall be clearly marked with number in accordance with the drawings. All name- and number-plates as well as reference shall be engraved laminated PVC unless otherwise specified.

Water and oil pipes inside the consoles shall be avoided. Necessary air pipes shall be separated or eventually shielded from electric and electronic equipment. Air ventilating pipes from pneumatic equipment shall be led outside of consoles.

#### Bridge consoles, general

On bridge there shall be installed two(2) manoeuvre consoles, one (1) forward and one(1) aft.

#### Bridge console / forward

Fwd bridge consoles shall have control and monitoring equipment for rudders, propulsion, side thrusters, navigation equipment, VHF, wipers, alarm panels, communication systems etc.

#### Bridge console / aft

Aft bridge consoles shall have control and monitoring for rudders, propulsion, side thrusters, navigation equipment, VHF, wipers, alarm panels, communication systems, cargo systems.

Following equipment shall be separately installed in wheelhouse:

- Fire alarm panel.
- Navigation lights (main /emergency).
- Signal lights.
- Distribution panels.
- Emergency stop system of aux.
- Panel for watertight doors.
- Emergency stop with running lights for cargo pumps.
- Hospital alarm.





### **791 Engine control room**

A control room with manoeuvring stand, control cargo pumps, alarm panel and main switchboard shall be arranged. The control room shall be air- conditioned and insulated against noise and heat.

### **Engine control room console**

Console shall have control and monitoring systems for main propulsion, aux. engine, electric system in accordance with supplier's delivery and required by the Classification Society.

Console shall have monitoring systems for side thrusters, steering gear, in accordance with supplier's delivery and required by the Classification Society.

### **792 Common automatic equipment, engine alarm etc.**

#### **Vessel Management System**

A Vessel Management System shall be installed to provide control, monitoring and alarm for fuel oil, ballast and freshwater system, tank monitoring and machinery alarm / monitoring.

All alarms related to the propulsion and main machinery shall be analogous when relevant. Instruments, sensors and control equipment shall be of simple, robust and standardised design.

Remote transmitters shall be used in order to avoid sensing lines carrying fuel, oil, steam or water being led into the control room.

Local instrumentation, such as thermometers, pressure gauges, etc., shall be provided as necessary for manual start up, control, and monitoring of equipment in the machinery spaces. Scale engraving shall be in metric units.

Pressure and temperature sensors shall be installed in places where there is minimal risk for damage during normal overhaul and maintenance. Temperature sensors shall be installed in wells and be capable of being withdrawn for replacement or calibration.

All components and wires shall be marked with numbers in accordance with the instrumentation list and installation drawings.

#### **System structure**

The system shall feature the following functions:

1. Multi-user system.
2. Provide users with a simple and correct overview of the various systems using system pictures/diagrams.
3. Shall be self-monitoring; i.e. it is equipped with alarms which monitor its own faults.
4. Divides the Vessel's machinery into System Failure group for internal watch and different display groups; i.e.:
  - Main engines.
  - Auxiliary Engines.
  - Thruster system.
  - Propulsion systems.
  - FW system - manual controlled.
  - Bilge system - remote controlled.
  - Fuel and BW system - remotely controlled.
  - Cooling system - manual controlled.
  - Fuel system - manual controlled.



- Lube oil system - manual controlled.
- Pressure air - manual controlled.

5.A simple and straightforward parameter adjustments; i.e. limit values, time delays, sensor calibration etc.

6.Provide users with a simple and correct overview of the various systems using system pictures/diagrams.Possibilities for inhibit of individual signals and listing of all inhibited signals.

7.Possibility for off scanning of individual signals and listing of all off-scanned signals.

8.Interlock function.

9.Group status-, alarm summary and event lists.

10.Bargraph presentation for a simple status presentation.

11.Printer for different types of reports and listing.

12.Action group function: i.e. input point status combinations give output action (open/close contracts).

13.Trends of analogue signals, inhibited and off-scanned signals, past events, also running hour etc. on motors above 100 kW.

14.Control, alarm and monitoring system shall interface following systems:

- Sounding system (group 381 and 821).

### **System pictures / mimic diagrams**

The system shall be provided with mimic diagrams/pictures for ballast system, cargo control system, propulsion plant, electrical power plant.

Other installed pictures which shall be available as follows:

- Tank sounding separate tanks.
- Tank sounding groups of tanks.
- System alarms.
- System configuration.

### **Tank group picture**

The alarm and monitoring system to receive tank data from sounding system.

This pictures display all information about the actual tanks, such as:

For each tank:

- Max. Cubic metres.
- Alarm limits.
- Density (Man./auto).
- Percentage of full tank.
- Level in metres.
- Cubic metres.

For the group:

- Max. Cubic metres.
- Percentage of full group.
- Cubic metres.

The information shall be presented graphically and numerically.

### **Operator station in wheelhouse**

Two (2) off monitoring units shall be installed.

Each unit shall include one (1) off colour monitor, one (1) off PC with keyboard, one (1) off pointing device and an alarm buzzer.



### **Operator station in engine control room**

Two (2) off monitoring units shall be installed.

These units shall include one (1) off colour monitor, one (1) off keyboard, one (1) off pointing device, one (1) off colour printer, one (1) off alarm printer and an alarm buzzer.

Watch and responsibility system to be combined into the common machinery alarm and monitoring system, according to Class requirements.

### **Engineer's alarm**

When the engine room is unattended, the alarms of the engine alarm system shall be extended to the following alarm panels:

- Alarm panel in cabins (Chief, 1<sup>st</sup>. Eng. and Electrician).
- Alarm panel in mess room.
- Alarm panel in each dayroom.
- Alarm panel in bow thrusters room.
- Alarm panel in thrusters room aft.

### **Deadman alarm**

The "deadman" alarm system required for operation with one (1) man only in engine room according to regulations.

- "Dead man system" ON/OFF panel (one off).
- "Dead man system" RESET panels (two off).

### **Engine rooms' alarm signals**

The following visible /audible alarm signals shall be arranged as follows: in steering gear room, red. gear room (cargo area), three(3) in main engine room and one(1) in each side thruster room etc. and shall be easy to identify:

- Abandon ship alarm.
- Automatic telephone alarm.
- Batteryless telephone alarm.
- Fire alarm.
- Engine alarm.
- CO<sup>2</sup> alarm.

The engine alarm and telephones' alarm shall be given by means of high intensity flickering lights and a sufficient number of small low noise alarm horns.

### **Instruments**

All instruments shall be of suitable construction for their maximum operating value. Scaling in ISO units, where suitable.

Local thermometers shall be of the liquid filled glass tube type.

Local pressure gauges shall be of the liquid filled type.



### **793 Automation equipment for propulsion machinery and transmission, engine telegraph etc.**

Two (2) electronic remote control systems (one (1) for each propulsion plant) for engine speed, clutch operation and pitch control with automatic overload protection shall be installed.

Remote control operations for main engines, CP propellers and shafts shall be fitted in the wheelhouse and in the engine control room. The remote control of engine speed shall be achieved by electronic governor.

The engine control system shall be designed according to Class notation requirement and for unmanned engine room operation.

The engine control room manoeuvring shall be actuated electrically with the regulating handle.

The wheelhouse manoeuvring shall be actuated electrically with the regulating handle.

The wheelhouse, engine control room and local manoeuvring (if applicable) shall include functions as follows:

- Control of propeller pitch.
- Speed regulating.
- Control of clutch.
- Emergency stopping (also for shaft generators).

Choice of remote control location shall be made in the Engine Control Room with confirmation from the wheelhouse. The control selection and confirmation procedure shall conform to the requirements of the Classification society.

Necessary instrumentation shall be provided at the engine side to support manoeuvring from the engine site. This shall include engine order telegraph repeater and RPM indicator.

Separate system for emergency control of main propellers shall be installed on bridge and in the engine control room.

### **Redundancy**

The remote control systems shall be designed and installed as two (2) electrically and mechanically totally independent plants. One (1) failure in one (1) plant shall not put the other plant out of operation and vice versa.

Each plant shall have two (2) galvanic isolated power supplies.

## **PROTECTION AND SAFETY DEVICE**

### **Emergency trip**

The main engines shall stop automatically with alarm under the following conditions:

- ME low lub. oil pressure.
- ME high coolant temperature.
- ME overspeed.
- Reduction gear, low oil pressure.
- ME high bearing temp (if recommended by supplier).

Manual emergency stop button shall be provided in the ECR and wheelhouse. Manual emergency lever (including stop position) shall be provided at the local control position.

### **Turning gear protection**

A system shall be arranged to prevent the engines from starting, when the turning gear is engaged (locking of starting control valve).



### Engine telegraph system

If a serious emergency situation should occur, with both the main- and the emergency control out of operation, the RPM shall be locally controlled. The order from the wheelhouse will then be given using the emergency machinery telegraph, and the RPM will be manually adjusted on the engine.

Telegraph system shall be provided in accordance with the propulsion control manufacturer's standard in accordance with Classification society requirements but will include, at a minimum following functions:

- Bridge console mounted double-faced transmitter/receiver.
- Engine control room console receiver with reply.
- Buzzer at bridge and engine control room consoles.
- Receiver near engine side, emergency operation.
- Telegraph logger on bridge control console.

The emergency machinery telegraphs - one port and one starboard - shall be independent of the Vessel's ordinary remote control system. They shall be connected to 24V DC battery systems. There shall be one(1) unit for each side in the forward bridge console, (the transmitter) and one(1) unit for each side in each control room (the receiver).

The receiver shall have acknowledgement push-button. The orders, given by operating a switch or push buttons in the wheelhouse transmitter, shall be visually shown on the receiver by means of clearly marked indication lamps. An audible signal shall be given when a new command is transmitted.

The orders shall be:

- Ahead full.
- Ahead half.
- Ahead slow.
- Stop.
- Astern slow.
- Astern half.
- Astern full.

### Revolution indicator for the main engines

Main engines revolution shall be indicated in the following locations:

- Wheelhouse console forward.
- Wheelhouse console aft.
- Engine side (each engine).
- Engine control console.

### Change-over of control position

Transfer of location for propulsion control shall be completed as follows:

Propulsion Control Transfer Positions		
From	To	Procedure
Local (Engine Side)	ECR	Position change over accomplished at Engine Side



ECR	Wheelhouse	Position change over accomplished in ECR with confirmation back from the wheelhouse
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The control selection and confirmation procedure shall conform to the requirements of the Classification society.

## 795 Electric generating plant

### Control and operation of generator sets

The diesel generator sets shall be started and stopped from the engine control room or from the engine side. The diesel generator set shall be started and connected automatically in the event of a dead bus for one of the two (2) shaft generators.

The diesel generator set shall automatically shut down in accordance with the manufacturer's design criteria. A shut-down condition shall be identified by an alarm connected to the Vessel Management System.

The diesel generator set shall be fitted with its own electronic governor, with the speed setting remotely carried out by the governor control switch on the engine control room main switchboard. Automatic synchronising, frequency control and preferential tripping shall be provided.

### Shaft generators

The shaft generators should only be used when requested shaft power is available on the main engine and the engine speed is locked in shaft generator mode.

The PMS system shall carry out synchronizing, closing and opening of generator breaker, automatic load-sharing and signalling to pitch control system for necessary pitch reduction (shaft generators).

### Load reduction/pitch reduction system

#### Main propulsion pitch control system:

A system for Load reduction/ Pitch reduction of the main propeller systems, to ensure sufficient power to the shaft generators, shall be arranged. The system shall be initiated by current measurement on the shaft generators, with an output signal to the pitch control system, for immediate pitch reduction (at 100 % load).

#### Thrusters pitch control system:

A system shall also be arranged for Load/ Pitch reduction of all thrusters (fwd./ stern thrusters). The system shall be initiated by kW- and current measurement on the shaft generators, with an output signal to the pitch control system, for immediate pitch reduction (at 100 % load).

### Blocking/interlocks of heavy consumers

An interlock system shall be arranged to prevent the tunnel thrusters, cargo pumps and cargo compressors to run when the diesel generating set is powering the actual busbar.

### Power Management System

The entire electrical power plant shall be automatically controlled by a Power Management System (PMS).

The power management system shall be provided with the following functions:

Automatic power management of the generators depending on the necessary power demand and the generators ability and stand by situation. The correct and suitable combination should automatically be established.

In case of starting of big consumers the available power should automatically be checked and if necessary the stand by diesel generator should be started automatically and connected to the switchboard. As soon as available power is accepted, the big consumers should start.



The PMS shall give signal to open the bustie at the following conditions:

- Short circuit on one busbar.
- Wrong busbar frequency.
- Reverse reactive power on generator(s).
- The PMS shall have possibilities for automatic load sharing of generators.

### **System structure, PMS**

The power management system shall ensure consistency and maximum efficiency of power generation equipment. The system shall be controllable from the CRT workstation located in the Engine Control Room.

The system shall perform at least, but not limited to the following functions:

- Automatic load dependent start and stop of aux. diesel generating set (including black-out start of stand-by generator).
- Automatic control and protection of aux. - and harbour diesel engines.
- Automatic speed/frequency control of aux. diesel generating set.
- Automatic operation of air circuit breakers for generators.
- Automatic generator off-loading prior to load free disconnection of generator circuit breakers.
- Automatic control and protection of shaft generators.
- Automatic control and protection of aux. generators.
- Automatic control of emergency/harbour generator (function disconnected in emergency mode).
- Automatic control of shore connection.
- Automatic control and protection of Main switchboard including operation of bus-tie breakers.
- Synchronizing of all motor operated breakers.
- Automatic load sharing and load control with software for black-out prevention caused by sudden overloads due to stop of generators.
- Heavy consumer control including start request and start accept of heavy consumers.
- Critical alarm handling / shutdown.
- Aux. pump control.
- Automatic preferential tripping of non-essential load.
- Mode selection; (Under Way, Standby, Cargo load/ disch.-, Cargo load/ disch. Harbour, Harbour resting (emerg./harbour gen.) and optional). Some of the mode may be combined if similar.
- Indication (mimic diagram of all necessary parameters for electric power plant in Ship's alarm system.

Reduction in propeller pitch/ loads, tunnel thruster loads, pitch or speed reductions, must be introduced in the period it takes to start and bring a new generator set on the line.

Each aux. diesel generator set shall automatically shut down in accordance with the manufacturer's design criteria. A shut-down condition shall be identified by an alarm connected to the Vessels Management System.

Each aux. diesel generator set shall be fitted with its own electronic governor, with the speed setting remotely carried out by the PMS or manual by the governor control switch on main switchboard.

### **Preferential Trip**

When the running generator (s) is overloaded, non-essential consumers shall be automatically tripped to prevent the complete power failure of the Vessel. The preferential tripping system of non-essential consumers shall be arranged according to class and suppliers recommendations, with alarm indication in the machinery alarm system.

The following non-essential consumers shall be tripped:

- HVAC system (A/C compressors and heating element).
- Galley equipment.
- Welding machine.



### **Aux. Engine Safety System**

A safety system for protection and control of the aux. engine shall be provided. The safety system shall control and protect the aux. engine in order to prevent faulty operation and/or major failure. The system shall automatically stop the engine upon critical failure that may lead to breakdown of the engines, so as very low lub. oil pressure, very high coolant temperature and overspeed, in addition to any further requirements according to the Class. Cables shall be hardwired to the shutdown solenoid.

The safety system for the aux. engine shall include alarm and monitoring of the engines as well. The alarm shall be clearly indicated on the safety system panel / cabinet. In addition a common alarm for each engine shall be given to the central alarm plant.

The safety alarm system shall be a separate system.

### **Control and operation of emergency generator set**

When the voltage of the main bus fails, the emergency generator set shall be automatically started with time delay and the emergency switchboard shall be energized automatically.

Safety devices for over-speed or loss of lubricating oil pressure (very low pressure) shall be provided on the engine and arranged so that the engine shall automatically shut-down in the event of either occurrence.

### **797 Automation for other machinery equipment**

#### **Remote manual control of pumps**

The following pumps shall be capable of being manually started and stopped from a remote operating station (ECR):

- Bilge and Ballast Pumps.
- Cargo Pumps.

#### **Local manual control of equipment**

The following systems shall be controlled from local (equipment supplied) systems:

- Hydrophore plant.
- Air condition and ventilation.
- Sewage plant.
- Starting air system.
- Lub oil system.
- Fuel oil and lub oil purifiers.
- Fresh water filling and transfer.
- Main DO Supply Pumps.
- Diesel Oil Transfer Pumps.
- Fresh Water Cooling Pumps.
- M.E. Jacket Water Pumps.
- Main Sea Water Pumps.

#### **Fuel oil transfer system**

Starting DO transfer pumps shall be a manual operation. However, the transfer pumps shall be automatically start and stopped upon detecting a low or high level in any tank served.





### **Purifier control system**

All purifiers shall be manually started and stopped.

However, the purifier control system shall provide automatic sludge discharging for all purifiers and by-pass the fuel oil to a selected tank upon detecting an abnormal condition.

### **Air compressor control system**

Main air compressors shall be stopped automatically at the following conditions:

- Discharge air temperature, high.
- Lubricating Oil pressure, low.

All air compressors shall be fitted with both automatic and manual controls. Manual stop/start buttons shall be provided for each air compressor and additionally, each compressor shall be automatically started/stopped by detecting the pressure of the air reservoirs.

### **Engine room bilge system**

The engine room oil/water separator pump shall be started automatically by detecting a high level in the bilge holding tank and shall be stopped automatically by detecting low level in bilge holding tank. If the separated water's oil content is higher than the set limit, the water shall automatically be returned to the bilge holding tank with alarm given.

High-level alarm shall be provided for bilge wells and bilge holding tank.

An automatic oil discharge control system shall be provided for the oil/water separator.

### **Remote level measuring system**

Remote reading of level of fuel oil cargo, day tanks, settling tank/liq. mud, ballast tanks, bilge water tank, fresh water tanks and big lub. oil tanks for main engine shall be installed. Operator Panels shall be integrated as part of Vessel Management System.

### **798 Cable leads and piping for automation systems for machinery**

Special care shall be taken to avoid electromagnetic interference (reference to Requirements in IEC 60533 concerning EMC, "Electromagnetic Compatibility of Electrical and Electronic Installations in Ships"). Coaxial terminating of screens shall be arranged.

Where necessary, multicore cables with twisted pairs shall be used. All cables to enter connection and termination boxes upward. Water pockets shall be avoided in the pipe systems for remote control and measuring.



## 8 SHIP SYSTEMS

### 80 BALLAST, BILGE AND DRAIN SYSTEMS, GUTTER PIPES OUTSIDE ACCOMMODATION

#### 800 General

See also Gr. 7, General.

Attention must be paid with regard to expansion of the piping. Pipes passing through tanks shall be provided with expansion bends, or approved bellows (Sliding joints are not permitted inside tanks). Piping crossing fuel oil tanks shall be all welded. Ballast-/ bilge piping inside ballast tanks shall have flange connections.

Pumps shall have non-return valves.

Clamps shall normally be bolted.

#### Material:

See list for piping material gr. 700. Additionally the piping shall be delivered with certificate according to requirement for Classification Societies.

All pumps shall have casing of cast steel or bronze.

#### 801 Ballast system

Two (2) combined ballast/fire pumps shall be installed.

The ballast system shall be arranged for complete inter-transferring between all the ballast tanks, roll reduction and anti heeling tanks, based on one-line system and double valve manifold.

The two (2) DB tanks used for fixed ballast shall not be connected to the ballast system.

The system shall have direct overboard discharges.

The system shall have remotely controlled valves and pumps, controlled from the vessel VMS system.

Piping material according to list of piping material gr. 7.

#### Specification of ballast/fire pumps.

					MATERIALS			
DESCRIPTION	QTY	CAPACITY (M3/H)	Head M.C.L	TYPE	PUMP CASING	LINER / IMPELLER	SPINDLES/ SHAFT	PRIME MOVER
BALLAST PUMPS	2	2 X 100	90	CENTRI-FUGAL	BRONZE	BRONZE	STAINLESS STEEL	EL. MOTOR



### **803 Bilge system**

The bilge pumping arrangement shall be according to SOLAS regulation 35-1, for passenger ships. The power bilge pumps shall be placed in separate watertight compartments and so arranged or situated that these compartments will not be flooded by the same damage.

The pumps available for bilge service shall be distributed throughout the watertight compartments.

All pumps, chests and valves shall be located inward of B/5 of the breadth of the ship.

The arrangements shall be such that at least one (1) bilge pump shall be available for use in all flooding conditions which the ship is required to withstand - the bilge pumps and their sources of power shall be so distributed throughout the length of the ship that at least one (1) pump in an undamaged compartment will be available.

Two (2) off Screw pumps and one (1) of Centrifugal pump with ring primer shall be arranged.

Capacity : According to class requirements.

Remote start/stop of bilge pump, also from aft part of cargo area.

Pressure gauge on bilge pipe in aft cargo area.

One (1) bilge ejector, capacity 30 m<sup>3</sup>/h shall be provided for suction from chain lockers and discharge overboard. The ejector shall be driven from hose from fire station.

### **Bilge lines**

Bilge suction shall be arranged from bilge wells and hollows in all compartments according to drawings approved by Classification Society and involved authorities.

Mud boxes shall be fitted to all branch bilge pipes from machinery spaces etc.

Discharge overboard, to oily-water collection tank and to International standard flanges on deck shall be provided.

### **Oily water separator**

One (1) oil water separator, USCG approved for engine room, capacity:1 m<sup>3</sup>/h 15 p.p.m. shall be installed.

Separate pump for discharging of sludge to deck shall be installed, capacity: 5 m<sup>3</sup>/h - 30 mWG. The bilge water separator shall be suitable for bilge water containing chemicals.

Connection from sludge tank, dirty oil tank, drain tanks and bilge water tank.

The pump shall have emergency stop on main deck, close to discharge outlet.

### **Alarms**

Alarms for high level in bilge wells in engine room, cargo area, side thruster rooms, steering gear room, emergency generator room and other watertight compartments under main deck shall be furnished.

Alarms shall be interfaced to Vessel Management System.

### **804 Scupper pipes outside accommodation**

Deck scuppers shall be arranged to give good drainage from all parts of decks. The possible trim of the vessel shall be taken into consideration.

Scupper pipes from weather deck shall be led inside ship's side and overboard just above water line.

Separate drainage shall be arranged at 1st deck from winch recess at the aft end of the superstructure, to overboard at both sides.

Drain pipes from top of funnel shall be led overboard.

Drain from air-condition units shall be led overboard.



## 81 FIRE AND LIFEBOAT ALARM SYSTEMS, FIRE FIGHTING SYSTEMS

### 810 Fire fighting general

Following fire-fighting systems shall be arranged:

Compartment	System
Main machinery space	CO <sub>2</sub> protected
Main engines and Boiler	Water mist
Switchboard room/ECR	CO <sub>2</sub> fire extinguishers
Accommodation	Portable extinguishers
Incinerator room	Water mist
Galley hood	CO <sub>2</sub> protected
Deep fat fryer	CO <sub>2</sub> /foam protected
Paint store	Sprinkler system, supplied by fire main
Chemical store	Sprinkler system, supplied by fire main

Fire hoses, Fire extinguishers, fireman's outfit, breathing apparatus, international connection, etc. shall be arranged according to regulations.

Water mist system to be manually controlled in fire control station and as required by Class.

### 811 Fire detection, fire and general alarm system

#### Fire detecting plant

##### General

One(1) Class approved Automatic Fire Detecting and Alarm System shall be installed according to Class and Authority requirement.

The central unit shall be located at the bridge, with sub-panel in engine control room(console).

The fire detecting and alarm system shall be of the 24 V automatic type covering accommodation as well as machinery spaces and control room.

The system shall be of the analogue addressable type. The central unit shall be fitted with internal 24V back-up battery, with normal supply fed from 230V emergency switchboard(automatic change-over).

##### Detectors

All detectors shall be of a Class approved type.

Smoke detectors of combined type (optical with heat element) shall be installed in all corridors and further in all spaces in which a fire might be expected to originate.

Heat detectors in cabins and day / mess rooms.

Manual call points shall be installed throughout the ship according to rules and regulations. The installation shall be according to Class and Authority requirement.



A combination of thermal rise detectors, smoke/ion detectors and manual call points shall be installed in the engine room, according to Class and Authority requirement.

At least one (1) smoke/ion detector shall be fitted behind main- and emergency switchboard.

### **Manual call points**

The manually operated call points for fire alarm shall be installed according to rules and regulations, and shall be installed at least as follows:

- One (1) - Wheelhouse.
- One (1) - Engine control room.
- Two (2) - Cargo area.
- One (1) - Emergency generator room.
- Two (2) - Each accommodation passage.
- One (1) - Galley.
- One (1) - Each passage/exit having entrance to engine room.
- One (1) - Steering gear room.

The call points shall be prominently marked and easily identified.

### **General alarm**

The general alarm with necessary equipment shall be incorporated in the fire alarm system.

### **Alarm bells and sirens**

Alarm bell/sirens shall be installed in the accommodation passages, engine control room, wheelhouse, engine room, cargo area, galley, emergency generator room and steering gear room.

The sound level of alarm bells/sirens shall be according to regulations.

Bells and electric horns/sirens shall sound continuously for fire alarm and intermittently for general alarm with signal generator.

Red flashing lights shall warn of fire in noisy areas where fire alarm bells are installed. This shall be accomplished by intermittent operation of general alarm lights.

Alarm bells etc. on each deck shall be supplied from more than one(1) source when more than one(1) unit is installed.

### **Emergency stop of fans and pumps**

Arrangement for manual stop of fans and pump shall be arranged outside engine room.

### **CO<sub>2</sub> release alarm system**

CO<sub>2</sub> release alarm system shall be installed as follows:

- One (1) - Limit switch CO<sub>2</sub> release box.
- One (1) - Electric siren, in engine control room.
- Two (2) - Typhoon, in the engine room.
- Visual alarm indications as needed throughout the Engine Room.

The system shall be fed from the 24V DC system with back-up from the 230V emergency supply system (automatic change-over).



### **813 Fire and washdown system**

Fire stations shall be arranged in engine room, accommodation and on decks according to rules. Each station shall consist of a glass fibre locker (with hinges of stainless steel) containing 15 m x 2 " artificial fibre hose and one(1) combined jet nozzle and fog-nozzle.

Additionally two(2) of stations (quick connection for hose) shall be arranged for wash down purposes.

Branch off lines, connected the hawse pipes for washing of anchor chain shall be arranged.

Necessary drain cocks shall be fitted to the fire main line.

Necessary insulation of valves shall be fitted.

### **Fire pumps**

The ballast pumps shall be arranged as combined fire pumps (see gr. 801).

The fire pumps shall have start/stop from the fire station in wheelhouse, engine control room and local.

#### Emergency fire pump:

One (1) emergency fire fighting pump, shall be installed.

Capacity: 40 m<sup>3</sup>/h - 7,0 bar

Pump shall have mechanical shaft seal.

The pump shall have el. motor powered from the emergency generator.

The pump shall be located in aft thrusters room and have separate sea suction and discharge to fire main line.

### **Fixed local application fire-fighting system**

In addition to fixed fire-extinguishing system hazard portions of the main engines, boiler and incinerator shall be protected by a fixed fresh water-based fire-fighting system.

The system shall have both automatic and manual release capabilities.

Separate pump, located outside the protected area shall be included.

### **815 Fire fighting system with gas**

CO<sub>2</sub> extinguishing system shall be arranged for engine room, galley hood and deep fat fryer.

The bottles for CO<sub>2</sub> fire extinguishing shall be placed in the separate room on 1st. deck.

## **82 AIR AND SOUNDING SYSTEM**

### **821 Air and sounding systems in tanks**

Sounding of tanks shall be integrated in Vessel Management System.

Air pipes shall be fitted to all tanks, cofferdams, stores, sea chests etc., and shall be carried above the deck to open air. Automatic vent head (approved type) shall be installed.

DB tanks used for fixed ballast shall be equipped with blind flanges at vent head flanges, for sealing of tanks after filling. Filling shall be done by fire hose through vent heads.

Small loose storage tanks shall have local vent pipes, not to deck.

ND 40 pipe with valve on all FW tank vent pipe.

All fuel oil tanks shall be connected to a common overflow system (see gr. 701) Each arranged with a loop before connected the overflow-/air pipe, on top. The overflow -/air pipe shall be arranged as a combined overflow and air/ventilation system. The pipe shall be arranged for self-drainage, with the lowest end connected to the overflow tank. The top end shall be extended to above deck for venting.

Separate air-/ventilation pipe to open deck shall be arranged from the nominated overflow tank, which shall be arranged with ventilation from both forward and aft of the tank.



Manual sounding shall be provided for all storage tanks.  
Remote sounding for all water ballast tanks, fuel and FW tanks with display in engine control room through Vessel Management system.  
Fuel oil service and settling tank, lub. oil storage tanks and hydraulic oil storage tanks shall have approved type of gauges glass.  
Cofferdams shall have manual sounding and vents to deck.  
Vents from sewage tank shall be carried to the top of the funnel.

## **83 SPECIAL COMMON HYDRAULIC OIL SYSTEMS**

### **831 Special hydraulic oil systems**

El. hydraulic power plants shall be installed for providing of hydr. oil to the following:

- One (1) hydraulic power plant for windlass.
- One (1) hydraulic power plant for capstans.
- One (1) hydraulic power plant for tugger winches.
- One (1) hydraulic power plant for crane.
- One (1) hydraulic power plant for MOB davit.

Some of these systems can be common systems, all depending of types and suppliers.

The power unit shall be fitted in steering gear room.  
Local and remote control of power unit.  
Densotape (grease tape) on external hydraulic connections (ermeto).

## **85 ELECTRICAL SYSTEMS, GENERAL PART**

### **850 Electrical system general**

#### **Class, Authority, approvals**

All electrical installation, systems, equipment, switchgear etc. shall fully comply with IEC Standards , NEK 410, Class and Authority, described in Main Group 0.

All important equipment shall be supplied with Class certificate, according to Class and Authority requirement.

Requirements in IEC 60533 concerning EMC, "Electromagnetic Compatibility of Electrical and Electronic Installations in Ships", shall be fulfilled as a minimum.

Electrical installations shall be designed to ensure proper operations when the Vessel is inclined as specified by the Class Society and regulatory body requirements.

The design of the electric plant including generators, motors and controllers shall be co-ordinated to insure that the voltage dip, when starting the motors with the highest inrush current shall not exceed 15 percent of the rated voltage.

Electrical and electronic equipment shall be designed, constructed and installed to tolerate transient AC voltage of -15%/+20% and frequency variation of  $\pm 10\%$ .

Voltage transients shall stabilize to steady state conditions within 2 seconds.



Frequency transients shall stabilize to steady state conditions within 5 seconds.

### **Marking of electrical system**

All electrical equipment shall be clearly and durably labelled for easy identifying with necessary information. All cables (in both ends), conductors and terminals also shall be clearly labelled for easy reference to drawings, etc. If both ends of the cable can be easily seen at the same time, only one(1) cable tag is required.

All switchboards, distribution panels, junction boxes, etc. shall be permanently marked at the outside using engraved durable labels (PVC or equal) fixed by screws in accordance with installation drawings.

All circuits and outgoing feeders shall be properly and permanently marked using engraved durable labels. Inside switchboards and distribution panels the marking may be of a simpler type (not necessary with engraved PVC labels).

Electrical equipment and measuring instruments shall be scaled in metric units.

All instruction manuals, drawings, diagrams, name plates, etc. shall be written in English.

### **General painting requirements for switchboards, panels, etc.**

All metal surfaces except stainless steel brackets shall be sandblasted to white metal and powder-coat painted with Epoxy paint. Alternatively, properly degreased and painted with two (2) coats of primer and at least one (1) top coat of Epoxy paint will also be accepted.

### **Terminals for control and signalling**

Terminals for control and signal cables shall be of the spring type terminals, not the screw type terminals.

### **Monitoring of dual supplies/speed sensors**

For equipment with dual supply or dual speed sensors for governors, an alarm shall be initiated when the equipment are supplied by the backup power or backup speed sensor.

### **Running of water pipes above essential electrical equipment**

Flanges for pipes containing water or other liquids shall in general not be fitted above switchboards, distribution boards, control panels, motors. If such flanges must be fitted above essential electrical equipment by any reason, they shall be protected properly to ensure no spraying of liquid from damaged flange.

### **General switchboard requirements**

Feeder circuits shall be protected by moulded-case circuit breakers with both time-over current and instantaneous trip features.

Moulded-case circuit breakers for motor circuits shall have a shunt trip coil or under-voltage trip coil for preferential trip or emergency stop, where required by the Class Society.

All moulded case circuit breakers including breakers in the group starter and group distribution panels shall have plug-in mounting. These breakers shall be removable from the panel front without de-energising the main bus.

### **Electrical load analysis**

A preliminary electrical load balance shall be worked out to indicate the load at the following conditions:

- Transit.
- Stand-by.
- Cargo load/discharge(harbour).
- Harbour manoeuvring.
- Harbour resting.
- Emergency power.
- ROV operation.





### Short Circuit and Device Evaluation Study

A short circuit study shall be performed to determine the maximum symmetrical and asymmetrical fault levels developed in the electrical AC system.

Protective device evaluation analysis shall also be performed, which shall compare the making and breaking ratings of the protective devices (fuses, breakers, etc.) to the available fault duties determined, shall be available at their location by the short circuit study.

This evaluation shall determine if the system protective devices can withstand the available short circuit duties that the system can deliver.

The study shall be based upon the one-line diagrams provided for the electrical system. Bus, distribution board and branch number identifications shall be assigned to the system for easy reference between the one-line diagram and the computer printouts.

### Voltage drop analysis

A Voltage drop analysis during start of large AC motors shall be performed, to ensure that voltage dip during the starting period of such motors shall not cause disturbance to other loads on the AC system and that the voltage drop is within the Class requirement.

### Emergency stops

Emergency stops shall also be provided for all machinery, stand-by pumps, fans, transfer pumps, separators, fuel shut-off valves and other auxiliaries as required by Class. The emergency switches shall be located in a safety station located outside engine room, in addition to the bridge.

All emergency switch functions shall be provided with loop monitoring according to requirement.

For ventilation in accommodation, emergency stop switches shall be provided on the bridge.

For cargo pumps, the following emergency stops shall be provided on the bridge:

- Fuel oil cargo pumps.
- Drill water.

### Electrical power system

Electrical plant for this Vessel to consist of the following main equipment, the capacities hereafter are given as guidance only:

Qnt.	Equipment	Capacity	Remarks
Two (2)	Auxiliary generator sets	900 ekW	440V,60Hz
One(1)	Emergency/Harbour diesel gen set	450 ekW	440V,60Hz
One(1)	440V Main switchboard		
One(1)	230V Ship Service switchboard		
One(1)	440/230V Emergency switchboard		
Two (2)	Transformers for 230V emerg. Distribution	440V approx. 100 kVA	
Two (2)	Transformers for 230V main distribution	440V approx. 150 kVA	
Two (2)	Shaft generators	1600 ekW	440V,60Hz
Two (2)	Tunnel motors	590 kW	



Two (2)	Starters, Tunnel motors	590 kW	
Two (2)	Tunnel motors	800 kW	
Two (2)	Starter, Tunnel motors	800 kW	

### 855 Administrative net work

A CAT 5 network shall be installed with two (2) connections in each of following locations:

- Bridge.
- Engine control room.
- Offices.
- Officers cabins.
- Dayrooms.

## 86 ELECTRICAL SUPPLY SYSTEM

### 860 General

The electrical plant shall be powered by two (2) aux. generators or by the Emergency/harbour generator, or by the shore connection.

#### Generating sets

- Aux. generators: 440VAC, - 60Hz
- Emergency/Harbour generator: 440VAC, - 60Hz

#### Main Distribution systems

Switchboard name	Voltage/frequency/ phase	Supply obtained from	Connected consumers
440VAC Main switchboard	440VAC-60Hz-three phase-three wire(+Gnd.)	440VAC Aux. generator	440VAC Power consumers
230VAC Ship Service switchboard	230VAC-60Hz-three phase-three wire(+Gnd.)	440/230VAC transformer	230VAC Power consumers
440/230VAC Emergency switchboard	440VAC 60Hz-three phase-three wire(+Gnd.) 230VAC-60Hz-three phase-three wire(+Gnd.)	440VAC Emerg. generator, or from 440V Ship Service switchboard	440/230VAC Emergency consumers
Battery systems	24VDC, two wire	Battery chargers or batteries	Automation/navigation/communication



### **440V AC Main System**

The 440VAC generators shall serve as the source of power to the system through the 440VAC Main switchboard.

The system shall provide power for all equipment connected to the feeder sections of the 440VAC Main switchboards as well as the 440/230V Emergency switchboard and 440VAC distribution panels ("P"). The system shall also supply the 230VAC Ship Service switchboard via two (2) transformers.

### **440 VAC Emergency System**

Normal power for the emergency switchboard shall be supplied from the 440V Main switchboard through a bus tie breaker. Upon loss of normal power, the emergency generator shall be automatically started and shall open the bus tie breaker to the 440VAC Main switchboard. Then the emergency generator breaker shall be engaged and supply power to the emergency consumers. The emergency generator circuit breakers shall be electrically interlocked in order to prevent damage to electrical systems.

During "in port" conditions, with main generators resting, the 440VAC Main power system shall be supplied by the harbour/emergency generator.

### **230 VAC Ship Service System**

The 230 VAC Ship Service system shall be supplied from the 440V Main switchboard via appropriate (440V/230 VAC) transformers. The 230 VAC systems shall serve all lighting circuits and other 230 VAC power consumers.

### **24 VDC System**

One (1) 24V radio battery GMDSS reserve source (normally the GMDSS radio station shall be fed from 230V main supply or 230V emergency supply).

One (1) 24VDC battery system shall be fitted for supply of 24V bridge equipment.

Two (2) 24VDC battery systems (redundant systems) shall be fitted for supply of 24V engine room/ECR equipment.

Two (2) 24VDC starting battery systems for emergency generator shall be fitted.

### **Welding transformer**

In workshop a welding transformer/rectifier shall be mounted. Capacity of approx. 250A welding current.

## **866 Batteries and battery charges**

### **Batteries**

All batteries shall be Marine Lead Acid Batteries and shall be so located that the batteries' temperature at all times remain within the manufacturer's specification. A location at open deck exposed to sun and frost shall normally not be accepted, without additional means to protect the batteries.

The following battery banks shall be provided and installed:

- One (1) x GMDSS radio equipment.
- One (1) x Fire detection plant (internal).
- One (1) x Alarms, controls, navigation & radio equipment on bridge (redundant systems).
- Two (2) x Alarms, control, monitoring equipment for engine room (redundant systems).
- Two (2) x Starting of emergency generating set (redundant systems).

### **UPS systems**

One (1) UPS shall be installed for Vessel Management System.

Two (2) UPS for Vessel Management operator stations and Buyers supplied PC's and for Intercom system.



All with capacity for minimum 30 minutes.

The power shall bypass the UPS in case of UPS failure.

The voltages shall be 24VDC unless otherwise specified by the makers of the receptacle equipment.

Capacity, discharge rate as well as number of sets for each of the above batteries shall be in accordance with regulations and maker's recommendation.

All battery banks for bridge equipment shall be mounted in heavy-duty fibre glass boxes with rubber waffle matting underneath them.

### **Battery chargers**

Each battery bank shall have separate charging device with volt and current control for high rate and trickle charging with uninterrupted power supply to the specified consumers.

Battery banks for bridge and engine room equipment shall have two (2) battery charges for each battery bank in order to get 100% redundancy of power for important equipment.

One (1) of the chargers for each of these battery banks shall be fed from the emergency switchboard.

Each battery charger shall be fitted in the vicinity of the respective battery in a dry area.

### **868 Shore Connection box**

440V Shore connection shall be connected to the 440V Main switchboard. The shore connection shall be interlocked with the 440VAC, aux. generator breakers and the Emergency/ harbour generator breaker to prevent parallel operation.

The following equipment for the shore connection shall at least be equipped in the 440V Main switchboard:

- Two (2) contactors for phase sequence shifting.
- Two (2) push buttons for connecting/disconnecting of shore supply.
- Two (2) indicating light ("shore power available"/"shore power connected").
- One (1) Phase sequence meter with relay for phase sequence shifting.
- One (1) Phase sequence selector switch.
- One (1) Ammeter.
- One (1) Ammeter switch.

In addition, a shore connection box shall be installed in a suitable location on 1<sup>st</sup> deck (e.g. in the emergency generator room).

Cable entry shall be provided at the bottom of the box for the temporary connection of the shore power cable. Cable entry with hinged cover shall be designed to facilitate ease of cable connection and hook up.

The connection box shall be fitted with followings:

- One (1) - 200 A moulded case circuit breaker.
- One (1) - Phase sequence indication lamps.
- One (1) - "Power On" indicating lamp.
- One (1) - Kilowatt-hour meter.

A 40 meters length of shore power connecting cable with 200 A capacity shall be provided and stored. Cable shall be securely stowed in an area protected from weather and seas.



## 87 ELECTRICAL COMMON DISTRIBUTION

### 870 Main Ship service and Emergency switchboards

#### General

The following switchboards shall be installed:

- One(1) 440V Main switchboard.
- One(1) 230V Ship Service switchboard.
- One(1) 440/230V Emergency switchboard.

The switchboards shall be of self-supporting dead-front, drip-proof, box frame construction with a drip-cover over the top and shall have hinged front panels that can be opened without disturbing the meters, pilot lamps, etc. mounted on them. Each access panel shall be provided with stays to hold access panels open. The switchboard shall be provided with insulated steel handrails in both front and back.

All switchboards shall be resiliently mounted on heavy-duty shock absorbers mounted on top and bottom of switchboards.

All MCCBs for motor starters shall be equipped with the ST motor characteristic.

#### Terminals

Cable terminals shall be of the solderless type and clearly marked with the circuit served.

#### Fuses

Control and instrument circuits shall be protected by mini circuit breakers except for circuits where the opening of the circuit could be hazardous. Current transformers for instrumentation shall not be fused.

#### Bus Bars

The bus bars shall have sufficient current-carrying capacity for continuous operation and provisions shall be made for withstanding mechanical strains created by electromagnetic forces by large motor starting currents or fault currents. The bus bars shall be made of copper and shall be provided with silver-surfaced connections.

Bus bar supports shall be provided with sufficient strength to withstand a short circuit of bus bars, and shall be made of moisture resistant materials.

#### Earth busbars

Copper earth-busbars shall be fitted throughout the switchboard and so arranged that running of earth conductors and connections shall be easy survey-able and easy accessible also after the installation of switchboard. Only one earth conductors for each screw in PE and IE busbar. PE and IE busbar shall be properly labelled and the connection to the hull shall be easy accessible. All earth connections onboard shall be accessible and shall be labelled.

#### Labelling

Labels shall be provided in English and shall identify all switchboard components, such as circuit breakers, control switches, instruments, indicating lights, terminal blocks, transformers, etc.

The nameplate on feeder circuits shall indicate the feeder designation, name of application, cable cross-section and ampere rating.



## 871 440V and 230V Main Switchboard

### General

The Aux. generator shall supply the 440V Main switchboard. The switchboard shall be equipped with two(2) separated bus-bars internal connected by one (1) motor-operated bus-tie breaker.

All circuit breakers on the switchboard shall be able to withstand the maximum short circuit capacity when generators are running, one (1) thruster is running and half of the cargo pumps and cargo compressors are running.

The Main switchboard shall be of the "dead front" type, arranged with necessary numbers of standardized, segregated, self supporting metal clad steel sheet compartments and fitted out with 4 bus-bar systems. The Main switchboard shall be air insulated and designed for ship operation and equipped with withdrawable motor-operated air circuit breakers for generators, thrusters and bus-tie breaker. The switchboard shall be designed for free standing mounting on vibration dampers.

The switchboard shall be tested according to IEC and Class requirement.

Connection of power cables shall be from the bottom only. Connection of auxiliary cables may be arranged from the side (arranged with throating) or bottom.

The generators shall be protected by draw-out type air circuit breakers of the trip free type and controlled by the switchboard automation system. The circuit breaker for the generators shall have an over current trip device with long time over current and short time delay trip action, and a magnetic coil for instantaneous trip and under-voltage trip.

Automatic earth fault monitoring shall be provided for all outgoing feeders/ busbar systems.

Necessary converters/ signal outputs shall be provided for propulsion plant, thrusters, etc

### Parallel operation of generators

The aux. generators shall be arranged for parallel running with automatic load sharing arrangement.

### Internal wiring

Auxiliary wiring inside the panel shall be of the insulated stranded copper conductor type. All wiring shall be halogen free and flame retardant type according to IEC 332-3C and approved by Class. Voltage class shall be 230V for all internal wiring. All internal wiring shall be terminated by ferrules.

### Moulded case circuit breakers (MCCB)

All outgoing feeders shall be provided with moulded case circuit breakers (MCCB) (except for thrusters which are provided with air circuit breakers).

All MCCB shall have plug-in mounting. These breakers shall be removable from the panel front without de-energising the main bus.

### Bus bar systems

The 440V switchboard shall be separated into four (4) bus bar systems and the 440V consumers shall be arranged between the busbar systems for maximum redundancy.

### Generator panels

One (1) generator panel shall be fitted for each generator. Each generator panel shall contain equipment for protection and control of the respective generator.

The control equipment installed in the front of the panel shall at least contain the following:



- One (1) Ammeter (scale min. 130% of the rated full load).
- One (1) Voltmeter (scale min. 120% of the rated voltage).
- One (1) Wattmeter (scale min. -15/+150% of the rated full load).
- One (1) Frequency meter (scale min. +/-8% of the nominal frequency).

Necessary push buttons and indication lamps for the generator breakers and control equipment.

### **Feeder section**

The 440 VAC feeder panel shall at least be provided with the following:

One (1) - Insulation level meter with earth indication lamp (for each busbar system)

Necessary numbers of triple pole moulded case circuit breakers (plug-in type) according to single line diagram and systems/equipment described in specification.

### **230V Ship Service switchboard**

The 230V Ship Service switchboard may be a part of the 440V switchboard.

Bus-tie breakers shall at normal operation be open and the switchboard shall be supplied from two (2) transformers, feeding each section of the 230V switchboard. The transformers are fed from the 440V Main switchboard.

All circuit breaker shall be of moulded case plug-in type.

### **Bus bar systems**

The 230V section shall be separated into two (2) bus bar systems and the 230V consumers shall be arranged between the two (2) sections for maximum redundancy.

The 230 VAC feeder panel shall be provided with following:

- One (1) - Ammeter with a selector switch for reading each phase current of the transformer's secondary circuit.
- One (1) - Voltmeter with a selector switch for reading each phase.
- One (1) - Insulation level meter with earth indication lamp (Class approved).

### **872 440V/230V Emerg. switchboard**

The switchboard shall normally be supplied from 440V main switchboard.

All circuit breakers shall be able to withstand the maximum short circuit capacity when

Two (2) off generators are running in parallel. 230V section shall fed from two (2) 440/230V transformers, supplied from the 440V section of the 440/230V Emergency switchboard.

### **230VAC Feeder Panel**

The 230 VAC feeder panel shall be provided with followings:

- One (1) - Ammeter with a selector switch for emergency transformer.
- One (1) - Voltmeter with a selector switch.
- One (1) - Insulation level meter with earth indicating lamp.
- Necessary number of triple or two (2) pole moulded case circuit breakers.
- Two (2) - Spare breaker.

The 230 VAC feeder panel shall be fed from the 440 VAC feeder panel of the emergency switchboard via the emergency transformers.



## 874 Motor starters

### General

In general, starters shall be of a drip-proof type and shall be of suitable construction for either deck or bulkhead mounting.

Starters shall be of electro-magnetically operated type, except starters for non-essential motors of 0.2 kW and less, that may be manually operated with moulded case circuit breakers or protectively fused line switches.

Hr. counter on all motors, not included in the Automation system, above 20kW

In general, starters below 10 kW shall be of direct-on-line starting type.

Star Delta starters between 10 kW and 50 kW. Soft start above 50 kW.

Where excessively high starting current of the large motors could cause voltage drop of the switchboard bus bars more than 15 %, the starters for those motors shall be of star-delta reduced voltage starting type or auto transformer starting type. If star to delta starters is used, means should be provided to prevent transients on the main power network.

Tunnel thruster shall have auto-transformer starting.

## 875 Distribution boards and panels

### General

All distribution panels shall be made of aluminium or steel with painted surface.

Drawings indicating system and circuits shall be put inside all terminal boxes and distribution boards.

### Earth busbars

Copper earth-busbars shall be fitted and so arranged that running of earth conductors and connections shall be easy survey-able and easy accessible also after the installation of switchboard. Only one earth conductors for each screw in PE and IE busbar. PE and IE busbar shall be properly labelled.

### Earth leakage switches

Earth leakage switches (30mA) shall be fitted for all feeders supplying floor-heating cables.

### 440V distribution board

The 440V distribution boards for supply of 440V power consumers shall be located where necessary around the Vessel.

### 230V distribution board

The 230V distribution boards for supply of low consumption- and domestic equipment shall be located where necessary around the Vessel, with at least one (1) 230V distribution board fitted on each deck level.

230V distribution panels for engine room may be centrally located in the Engine Control Room. 230V distribution panels for accommodation shall be located in a central position on the deck served.

### 230V AC Emergency distribution board

230VAC Emergency distribution boards shall be fed from the emergency switchboard, and shall supply all necessary Emergency consumers around the Vessel, if not supplied directly from the emergency switchboard.





### **Navigation light panel**

Two (2) Signal light distribution panel shall be supplied from both the main switchboard and emergency switchboard.

### **24V DC distribution boards**

Five (5) dead-front type battery switchboards shall be provided for the 24V battery distribution systems (switchboards on bridge shall be recessed type).

The distribution boards shall be denominated as follows:

- 24VDC Distribution board for GMDSS console.
- 24VDC Distribution board for consumers on bridge.
- 24VDC Distribution board No.1 for consumers in engine room.
- 24VDC Distribution board No.2 for consumers in engine room.
- 24VDC Distribution board No.1 for Vessel Management System.

Distribution boards for ROV and Deck in stainless steel lockers.

Two (2) identical distributions boards shall be installed. One (1) to feed connection point on aft accommodation and port side of deck, and one (1) to feed connection point on SB side of deck.

Each distribution board to supply the following via individual breakers:

- 440VAC, 3ph, 300A to 440V Socket Station at each connection point.
- 230VAC, 3ph, to transformers for 230VAC socket stations and 230VAC UPS.
- 110VAC, 3ph, to transformers for 110VAC socket stations.

## **88 ELECTRICAL CABLES AND INSTALLATION**

### **General**

Cables supplying a single load, in general, shall have a continuous current carrying capacity of the connected load.

Cables supplying multiple loads, in general, shall have a current carrying capacity calculated without consideration of demand factor and/or diversity factor to the total connected loads.

The voltage drop on all power and lighting circuits from main bus bars to the final termination point shall not exceed 6% of the nominal voltage, except for DC circuits, where a maximum voltage drop of 10% of the nominal voltage is allowed.

The type of cables and installation inside switchboards, starters, panels, etc. shall be provided in compliance with the regulations of the Classification Society and the requirements of Section and its various subsections.

Power cables and signal cables shall be run, fixed and connected according to maker's Installation Manual and according to IEC 60533 regarding EMC. Distance between power cables and signal cables shall be sufficient to avoid interference.



### **Cable and wire marking**

All cables, conductors and terminals shall be clearly and durably labelled for easy indication and drawing reference.

### **Routing of cables**

In general, all cables shall be supported by continuous corrosion resistant steel metal hangers, ladders or cable trays as far as possible. Metal hangers, ladders or cable trays also shall be provided in bends in order to get a continuous support. Expansion joints shall be provided where required. No cables shall be run on unpainted steel.

In the engine room, machinery spaces and other wet rooms, all cable hangers, ladders and trays, including their fixing devices, shall be made of galvanized steel.

On weather decks all cable hangers, ladders and trays shall be made of stainless steel or Class approved non-metallic materials with equal properties.

When fixed to aluminium structures, aluminium alloy cable ladders and trays shall be used.

Cable installation on weather decks shall be minimised. Cables shall be run through galvanized steel pipes or protected cable trays and shall be as short as possible. Cables shall be provided with heat shrinkable tubes to seal the cable and gland transition for all weather deck installation.

All cables shall be routed in a way that protects them from mechanical damage. If this is not possible, they shall be protected from damage by steel covers.

### **Painting of cables**

No cables shall generally be painted, as painting may impair the properties of the outer protective sheathing and prevent the possibility of distinguishing power and control cable types by different colour coding system of outer sheath, regarding proper separation of cables. If cables shall be painted, by any reason, it shall be documented that the painting not will impair the properties of the outer protective sheathing.

### **Separation of cables**

Where a system shall have duplicated supply and/or control cables, for safety reason (steering gears, etc.), the cable routes shall be located apart from each other.

### **Cable inlets**

On external decks or other exposed area, cable inlets shall only be from the bottom of equipment through a watertight gland. Goose-necks on external decks shall be fact aft.

Goose necks pipes on open deck shall be faced aft.

### **Cable bundles and fixing of cables**

Power cable of maximum six (6) cables or signal cables of maximum 15 cables shall be bunched together by one (1) clamp.

If bunching of larger formations is used for cables expected to be under full load simultaneously, a correction factor of 0.85 shall be applied.

The cables shall be fixed with a fixing point ratio at least according to the table below:



Cable runs	Maximum distance between plastic securing strips	Maximum distance between stainless steel securing strips	Remarks
On top of horizontal ladders/trays	0,5M	1M	
Hanging below horizontal cable ladder	0,3M	0,7M	
On vertical cable ladder	0,3M	0,7M	Stainless steel clamps or band can also be used.

When cable runs are subjected to water splashing on weather decks they shall be secured by stainless steel securing strips, clips, saddles or bands. The maximum distance between fixings of cable and its support (cable trays or pipes) shall be 500 mm.

Fixing of single core cables laid in trefoil formation for 3 phase installation used for e.g. generators, tunnel thruster, etc. shall be fixed by use of specially made safety clamps (type Alcatel/Nexans Safety Clamps or equal). The maximum distance between the clamps shall be 0,2m, to withstand the thermomechanical and electromagnetic short-circuit forces.

#### Single core cables

To avoid undesirable inductive effect, single core cables should normally not be used for AC installation onboard this Vessel, other than for Short-circuit proof installation.

#### Earthing

Generally shall all metal parts of the electrical installation, other than current carrying parts be earthed. Earthing may, however, be omitted for double-insulated equipment, bearing housings, low voltage equipment etc.

#### Electric equipment enclosure

All electrical equipment in machinery or similar spaces shall have at least IP 44 enclosures unless otherwise specified.

Equipment under floors and other wet places shall have minimum IP 55 enclosure and equipment on deck shall be of minimum IP 56 enclosure.

#### Cable types

All cables shall be marine type weather resistant cables designed for 55°C ambient temperature and a temperature class of 85°C for propulsion, power and lighting cables.

All cables shall have Class certificate and shall in general be constructed by use of tinned stranded copper conductor, insulation of Cross linked Poly-Ethylene (XLPE) or Ethylene Propylene Rubber (EPR) and with outer sheet of EVA cross-linked rubber.

All power cables shall be produced and tested in accordance with the following international standards: IEC 60092-352 (insulation material), IEC 60092-359 (sheathing material), IEC 60331 (fire resistant), IEC 60332-3 (fire retardant), IEC 61034 (low smoke), IEC 60754-1 (halogen free), IEC 60754-2 (no corrosivity).

All control and signal cables shall be produced and tested in accordance with the following international standards: IEC 60092-352, IEC 60332-3 (fire retardant), IEC 61034 (low smoke), IEC 60754-1 (halogen free), IEC 60754-2 (no corrosivity).

For easy identification and separation of signal, control and power cables, the outer sheet of cables should be coloured in different colours (Two colour standard to be used).



### **Spare cables**

Unused wires/cables shall be earthed/short circuited in minimum one end. Where possible, both ends shall be earthed, short circuited and marked.

## **880 Cableways**

### **General**

All cables shall be effectively supported and secured without damaging the outer covering of the cables. Cable groups shall be supported on metal hangers, ladders or cable trays, located away from exhaust or hot pipes, and shall be installed clear of steel hull structure, in order to permit painting of the surrounding structures.

Cable ladders shall preferably be fitted with "Z"-rungs for possibilities to run cables on both sides of the cable ladders.

Cable trays shall below 1<sup>st</sup> deck be insulated from 1<sup>st</sup> decks girders and stiffeners, due to welding on 1<sup>st</sup> deck.

### **882 Cableways in accommodation**

The cable trunks shall have removable hatches for easy excess. Distribution boards shall be located in cable trunks at each deck.

Cables in the whole accommodation shall be concealed in conduits behind ceiling and lining. Halogen free plastic conduits, wall boxes and ceiling boxes shall be used. Where it is impossible to run conduits behind linings, cable ducts with colour matching the wall shall be used.

Main cable trays shall mainly follow the corridors where the junction boxes for the concealed installation shall be placed, above removable ceiling or behind removable linings.

Panel work in accommodation, covering cable runs, shall be easily removable.

One (1) pipe from engine control room to bridge deck for spare cables.

### **883 Cableways on external decks**

Cable installation on weather deck shall be minimised. For protection of vertical single cable penetration, galvanized pipes with cable gland on top shall be installed. The pipes, which shall be equipped with swan neck, shall have a high of 900 mm above the actual deck level and shall be strongly welded to the deck.

Cables on weather decks shall be properly protected against mechanical damages.

All cable trays and cable ladders shall be of stainless steel. Cables shall be secured by means of securing strips, clips, saddles or bands of stainless steel.



## 89 ELECTRICAL DISTRIBUTION SYSTEM

### General

The following general items are valid for the complete electrical and automation installation throughout the whole Vessel (see also group 88). For distribution panels, see group 875.

### Degree of protection

All electrical equipment shall at least fulfil the Class requirement regarding enclosure degree of protection in relation to location of equipment.

In addition to Class requirement, all weather deck control stations and instrumentation, and all socket outlets, enclosures, junction boxes, floodlights, fluorescent lights and other light fittings shall have IP66/67 rated degree of protection.

Equipment in dry accommodation spaces shall have IP 20 rated degree of protection or better.

Equipment in engine rooms shall have IP 44 rated degree of protection or better.

### Lighting systems

#### General

Explosion-proof fluorescent lights shall be provided in gas-hazardous spaces.

Lighting control panels shall be installed in the wheelhouse and suitable locations as appropriate.

When control panels are located remote from the area served, sub panels with switches and breakers shall be provided as appropriate in the area served.

Permanent lamps shall be fed from the 230 VAC normal supply system unless otherwise specified.

#### Lighting equipment

High quality fluorescent fixtures of recognized standard type, constructed for marine use shall be used throughout the whole Vessel except for rooms where wall lamps or special exclusive lamps shall be fitted. Fluorescent fixtures shall not be equipped with power compensation capacitors, due to the risk of harmonic resonance.

Lighting fixtures exposed to mechanical damage shall be protected with guards for incandescent lamps and polycarbonate globes for fluorescent lamps.

Fixtures for exterior applications shall be constructed of stainless steel, bronze, polycarbonate or iron free aluminium. Fixtures for interior locations shall be constructed of steel or aluminium.

Lighting fixtures and accessories exposed to water and water spray shall be watertight.

The bodies of switches, plugs, receptacles, junction boxes, etc., may be constructed of synthetic resins, cast brass, stainless steel or steel plate. Stainless steel or cast bronze material shall be used for these applications in areas exposed to the weather.

#### Junction boxes

Junction boxes may be provided for cable joints, where necessary, but in general, the numbers of junction boxes should be restricted to a minimum.

Junction boxes shall be clearly marked with PVC labels designating voltage and feeder circuit/system. If junction boxes are concealed behind ceiling or lining, the labelling should be located on the outside of such panels.

Junction boxes in engine room shall be located above fixed flooring, except connections to equipment mounted below the fixed flooring



### **Switches**

Switches used for lighting branch circuit shall be of 16A double pole type and the material of body shall be synthetic resin or cast brass.

Switches shall be flush mounted in the accommodation and other areas where bulkheads are finished with joiner work or panels and surface mounted in other areas.

For ceiling lights in other cabins/rooms, one (1) switch shall be fitted near the entrance door.

For engine room lights and passage lights, moulded case circuit breakers on distribution boards shall be used as switches.

A deck-light switching panel for all outside lighting shall be arranged on the bridge.

### **Receptacles**

In general, receptacles shall be double type 15A DIN type, 3-pole(2p + earth). Earth pin shall be used as earthing connection for metal frames of portable appliance.

In accommodation

Receptacles of a sufficient number, voltage and capacity are shall be provided throughout the working and living spaces of the Vessel.

### **Wheelhouse**

At least five (5) receptacles shall be installed around in the wheelhouse for various purpose. In addition, at least one (1) twin receptacle shall be installed inside each bridge console(fore and aft).

### **Engine room/workshop**

Sufficient numbers of receptacles for portable tools, etc. shall be fitted in engine room and workshops.

### **Receptacles for external deck**

One(1) DIN-type twin socket outlet with cover shall be fitted inside each corridor entrance on all decks.

One (1) watertight socket outlet (single) with screw cap shall be fitted in a protected place on the forecastle deck.

Two(2) watertight socket outlets(single) with screw cap shall be fitted on 1st deck in a protected place aft of the superstructure(SB/PS).

### **Reefer sockets**

Three (3) reefer sockets, 230V, 60Hz shall be arranged below mezzanine deck.

### **Emergency lighting and lighting distribution**

Emergency lighting shall be installed throughout the vessel according to Class and Authority requirement.

Emergency lighting shall normally be used as general illumination purpose and fed from the emergency switchboard via each emergency lighting distribution panel.

Where rules and regulations require lighting fixtures supplied from two (2) separate circuits, one (1) of them shall be connected to the emergency supply system.

Around outside aft deck, in corridors at each deck, in each stairway and escape routes, some light fixtures with built-in chargeable batteries (3 hours capacity) shall be mounted as part of the emergency light system, approx. 17 units (depending of arrangement).

Emergency lighting circuits shall be provided as partial lighting in at least the following areas:



- Wheelhouse and communications spaces.
- Hospital.
- Mess room.
- Galley.
- Passage ways.
- Staircases.
- Engine Room.
- Engine control room.
- Working deck.
- Emergency generator room.
- Steering gear room.
- Thruster area.
- Cargo area.
- At MOB station.
- Engineers cabins.

Lifeboat light, life raft light, chart light, bunker lights, instrument light, navigation and signal light shall also be fed from the emergency switchboard.

**Illumination levels**

In general, rooms and spaces shall be effectively illuminated according to the following standard. The figures given are the average horizontal illumination levels with a tolerance of 10% at the stated measuring points.

Average illumination levels shall be:

Compartment/area	Illumination level in lux	Remarks
Engine rooms	200	300 at control panels
Machinery rooms	200	
Engine Control Room	250	
Workshops	250	
Stores	150	
Galley	250	
Mess and day room	150	
Cabins	150	
Laundry	150	
Wheelhouse(night operation) (at shore)	10 150	Special red ceiling lights Ordinary lights
Cargo compartments	150	
Refrigerated chambers and dry provision store	150	
Working deck area	100	
Mooring stations	100	
Toilets	150	



Emergency generator room	100	
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## 891 Electrical lighting systems for engine room etc

### General

In general, machinery spaces, stores, thruster rooms, workshop, etc, shall be illuminated by two (2) x 18W fluorescent light fittings. Other light fitting types may be used for special illumination purpose.

### Working light

A sufficient number of working light shall be fitted in engine and workshops.

Flexible working lamps shall be fitted on all machine tools as well as on all working benches.

### Lighting fixtures in machinery spaces, engine room, stores, etc.

Machinery space lighting shall be so arranged that failure of one branch circuit shall not cause complete darkness in the said space.

Engine room, cargo area, storerooms, workshops etc. shall be provided with high quality fluorescent fixtures of the following types:

- Two (2) x 18W with polycarbonate shade, IP 44 enclosure.

### Lighting ECR

Flush mounted fluorescent fittings of two (2)x18W shall be installed in the ceiling in engine control room.

## 892 Electrical lighting for superstructure/accommodation

### Wheelhouse lighting

Fluorescent light fittings shall be used as general lighting in the wheelhouse (2x18W).

Down light fixtures of fluorescent type (11W) shall be installed above all control consoles with separate dimmer switches for each console.

In addition to the ordinary lighting, special red lighting to preserve the night vision shall be installed for the wheelhouse, toilet in wheelhouse and the chart space. Approx. eight (8) fluorescent light fittings, 1 x 18W, recessed type, shall be installed in the ceiling for this purpose. The red lighting shall be supplied from the emergency switchboard and shall be provided with dimmer switches, giving a variable red lighting.

The door between wheelhouse and corridor below shall be provided with a door switch for switching off the bright light in corridor while the door is open, preventing bright light from the said area to come into the wheelhouse.

### Bath and toilet rooms

One (1) lighting fixture 1 x 18W including a socket outlet with isolating transformer (shaver outlet), shall be mounted above the mirror. Additional ceiling light of recessed type shall be fitted, if necessary (IP44).

All switches shall be located outside the bath and toilet rooms.





## **Cabins lighting**

The light installation shall be according to the lux levels indicated in the table above.

The following equipment shall be installed in each cabin as a minimum:

- One(1) x Fluorescent fitting, 2x18W of recessed type shall be installed in each room (cabin and bedroom). Sufficient numbers of 230V downlights may also be used as an alternative, if more appropriate.
- One(1) x Fluorescent berth light, 1 x 8W, with diffuser, shall be installed above each berth (head end), with on/off switch fitted on the front. Shall be connected to the emergency lighting circuit.
- One(1) x Wall lamp of ornamental type.
- Three (3) x Twin receptacles (230V) for radio, refrigerator, hair dryer etc., one (1) of them shall be installed above the table.
- One(1) x Fluorescent fitting, 1x18W, mounted above the desk (below book shelf), with switch fitted on the front.

The additional equipment shall be installed in the officers' cabins/clients cabins:

- Two(2) x Wall lamps of ornamental type.
- One(1) x Flexible table lamp, 1x18W.
- One(1) x Downlight, 1x13W.
- One(1) x Twin receptacles(230V).

Ceiling lights in cabins shall have on off switch at cabin door and by the bed.

## **Mess room / day rooms lighting**

Two (2) x 18W recessed fluorescent lighting fixtures, with silver/aluminium metal screen shall be used as ceiling lights. In addition, down-light /low voltage illumination shall be arranged, for illumination of special area.

Necessary amount of ornamental type wall and/or table lamps shall be arranged to give a comfortable environment (depending of room size, design and arrangement).

The lighting shall be so arranged that failure of one branch circuit shall not cause complete darkness in the room.

Fluorescent ceiling light, down lights, wall and table lamps to have separate switches arranged at each entrance.

All lights shall be regulated by means of dimmer switches.

## **Offices**

Two (2) x 19W recessed fluorescent lighting fixtures, with golden metal screen to be used as ceiling lights.

One (1) light fixture with flexible arm shall be fitted above each writing desk.

## **895 Electrical lighting system for weather decks**

### **General**

Deck lighting in working deck area shall comply with Rules.

High-pressure sodium floodlights shall be fitted for lighting of fore-, side- and aft decks and other open deck areas.

All floodlights, searchlights and fluorescent fittings in the forecastle area must be given special protection against sea spray.

Part of the deck light shall be fed from the emergency switchboard.

A switch control panel for all deck lighting shall be fitted in the wheelhouse.



### General deck lighting

High quality 2 x 18W and/or 2 x 36W fluorescent lamps made of polycarbonate or stainless steel shall be installed as general illumination on outside decks. For exposed deck area in front and stbd./port sides of superstructure, fluorescent lighting of type brass luminaries.

Cables shall pass through accommodation with short cable pipe connections to the lighting fixtures. Cables between lighting fixtures shall be protected by steel conduits. No bare cables shall be run on deck. Flexible/movable lamps shall be connected via junction boxes with flexible cable entering box through covered cable gland.

### Lifeboat/Life raft Embarkation Lights

One (1) 300 W, halogen floodlight with local switch shall be fitted at MOB boat and one (1) 300 W on SB side (Gangway light).

One (1) 2x18 W, fluorescent fixture with built-in battery pack(3 hours), shall be fitted at each life raft storage space as suitable, controlled from the wheelhouse light control panel.

The lights shall be fed from the 230 VAC emergency supply system.

### Floodlights

High-pressure sodium and halogen floodlights shall be provided for deck illumination. Sodium vapour type floodlight shall be provided for working deck area/after deck. Lighting shall be controlled from the lighting control panel in the wheelhouse.

Illumination levels shall be according to the lux table above.

The following floodlights shall be fitted:

- Eight (8) units 2 x 400W High-pressure sodium floodlights.
- Two (2) units 1 x 400W High-pressure sodium floodlights.
- Six (6) units 1 x 1000W Halogen floodlight.

## 897 Electrical heating equipment

### General

230V AC power to be used for heating of electric motor and generators.

440V or 230V to be used for space heating.

El. heating floor in bathrooms.

### Electric space heating

Electric heaters to be installed for sufficient heating of the compartments specified below.

The following heaters to be installed as a minimum:

Compartment	Heater type	Approx. Power	Remarks
Wheelhouse	Panel heater	4 x 2kW	Common thermostat
Emergency generator room	Fan heater	2 kW	IP 44



Steering gear room	Fan heater	2.5 kW	IP 44
Thruster room fwd	Fan heater	5 kW	IP 44
Cargo area	Fan heater	3x5kW	IP 44
Bosun store	Fan heater	5 kW	IP 44
Deck stores	Fan heater or panel type	3 kW	IP 44
Propulsion area	Fan heater or panel type	2x3 kW	IP 44
Chemical store	EX heater	1 kW	EX approved
Paint store	EX heater	1 kW	EX approved
Cabins and accommodation	Panel heaters	1-2 kW	

Electric heaters above 1000 watt shall be regulated with at least 2 steps. All heaters shall be thermostat operated. If one compartment contains more than two electric heater(e.g. wheelhouse), the heaters shall be controlled by one 2-step thermostat.

## 898 Electrical Motors, General

### General

Motors shall be of squirrel cage induction type designed for 440 VAC, three phase, 60 Hz, except for motors less than 0,4 kW, or motors for domestic service of small capacity, which may be 220 VAC single phase or three phase type, in accordance with manufacturer's standard and IEC standard.

All major electrical motors shall in access of build in termic protection have PTC sensors built into the wire windings and one in spare when possible.

### Enclosure

In general, motors shall be of the semi-enclosed drip-proof construction.

The enclosures of motors shall be cast iron or aluminium alloy, unless inherent in equipment design.

The motor enclosures shall have the following requirements, or better:

Compartment/area	Degree of protection	Remarks
Below the lowest floor in engine room, and thruster room	IP56	Totally enclosed fan cooled type
Machinery areas	IP54	
Weather deck	IP56	Enclosed watertight construction
Accommodation/dry area	IP23	

Motors for workshop equipment, and for galley-, laundry- and other domestic equipment , shall be according to manufacturer's standard.



### **Insulation**

Stator windings shall be treated with insulating varnish to resist oil and water. Generally, motors shall be designed and constructed into class "B" (for motors below 45kW) or Class "F" insulation (for motors above 45kW).

The motors shall be designed for ambient temperature of 55°C.

The motors shall comply with Class requirement and IEC standard.

### **Space Heater**

Stator winding heating type or element type space heater shall be provided for all motors of 50 kW and above, for all motor exposed to the weather and for all motors for standby pumps.