All piping systems shall be carried internally as far as is possible, to avoid the necessity for trace heating of external piping.

5.1.22 Manoeuvring & Directional Stability

R5.46 Manoeuvring

The thrusters/propellers are configured for independent and integrated operation with the dynamic positioning control system through communication on a common dual redundant process network. The aft main propulsion is also configured shall be operated in free running mode for course keeping via the steering control system. Main propulsion systems are to be arranged for control by both the DP system and conventional ship's steering systems, hand steering and autopilot.

The vessel shall be capable of safely manoeuvring and berthing without the assistance of tugs in beam-on wind speeds up to 35 knots and at a water depth of at least 8.5m.

The choice of bow thruster arrangements is for the Contractor to propose. In any event the bow thruster(s) (when not in operation) shall not generate undue turbulence in the flow around and under the bow, nor shall they promote bubble sweep-down, which could degrade the performance of hull mounted sensors at passage speeds.

Tunnel thrusters, if fitted, shall be fitted with Shell closures to avoid bubble sweepdown. The closures shall be integrated onto the structure of the vessel and capable of resisting ice loading imposed.

Considering operation in the Antarctic waters remote from potential assistance, the vessel shall be designed with redundancy inherent in the design sufficient to allow the vessel to navigate to a safe port in the event of a fire or flooding damage. This is described in section 4.2.10

R5.47 Directional Stability

The vessel hull shall possess a good level of directional stability at speeds of 4 knots and above. The need for excessive helm movements when track-lining at speed could generate undesirable in-water noise levels and large transient changes in heading due to poor directional stability would lead to undesirable major on-line corrections to data streams from equipment such as swath bathymetry.

The directional stability of the vessel shall be verified through model testing, as described in Section 5.1.6. R5.6

The Contractor shall demonstrate though sea trials that the vessel can, under autopilot control, at all speeds of 4 knots up to 15 knots and maintain a true heading of the vessel within ± 3 degrees with the controlling helm angle not exceeding ± 3 degrees while operating in a sea state 2 at 45 degrees off the bow and wind speed up to 10 knots.

5.1.23 Lightship Weight & Deadweight

R5.48 Lightship Weight

The lightship weight shall be taken as the weight of the main hull and fixed outfit including all main items of scientific outfit ready for sea. Machinery fluids and domestic systems shall be taken at normal working levels with service tanks full.

Scientific winch wires and ropes shall not be included in lightship but shall be added as (effects of deployment of the heaviest wire shall be examined in the NERC Stability Requirements in section 5.1.25).

R5.49 Deadweight

With the vessel floating at the full load design draft of 7.0m, with zero trim and heel (with the moon pool closed) the deadweight of the vessel shall be not less than 4475t in sea water with SG of 1.025. The deadweight shall include fuel, oils, fresh water, heeling and stabilizer water, provisions and ships stores sufficient to meet the specified endurance and range, along with crew, scientists and their effects, leaving 1950 t available for Cargo (on deck and in the hold), AVTUR and science deadweight (including science equipment, stores, portable laboratories etc.)

In the above condition deadweight required to be carried is as follows:

Ship's Deadweight

• Lubricating Oil	33.8t
• Marine Gas Oil	1698t
• Fresh Water	211t.
• Water Ballast	360.9t (Including Heeling Water Tanks and Stabilizer Tank)
• Ship Stores	50t
• Crew and Effects	9.0t
• Provisions	162.0t

Cargo and Science Deadweight

• *Aviation Fuel*	545t
• *Cargo in Holds*	720t
• *Cargo on Main Deck*	280t
• *Science Hold*	200t
• *Science Stores*	100t
• *ROV Spread*	30.0t
• *Science Winch Cables*	75.0t
• *Cargo tender*	16.0t
• *Workboat*	10.0t

Achievement of the required deadweight is a Contractual requirement. The required scientific deadweight is small compared with overall displacement and therefore its achievement is very sensitive to errors/changes in the main fabric of the vessel. Weight monitoring and control during construction shall be a strict requirement.
Deadweight shall be shown in two parts:

Ship's Deadweight

The conventional items of ship deadweight (fuel, fresh water, provisions, stores, personnel and effects, marine spare parts, paint, etc) shall be included here.

The quantity of Marine Gas Oil required to be carried as Fuel shall be determined by the Range requirement. However, there shall be a requirement to deliver up to 840 tonnes of Marine Gas Oil to the bases in Antarctica. In this specific case the range of the vessel is reduced accordingly.

There shall be the capacity to carry at least 545 tonnes of Aviation fuel (AVTUR) with a flash point less than 60ºC but greater than 23ºC

The vessel is required to carry 1000 tonnes of Cargo on deck and in the hold. The vessel is required to have at least 2180m3 of enclosed net cargo volume, this shall exclude any area taken up with structure, insulation or otherwise unavailable for the storage of cargo.

Scientific deadweight will differ from cruise to cruise.

The overall scientific equipment deadweight shall be 405 tonnes and distributed as listed in the table above.

In the context of this type of ship the scientists will not be passengers, they will be working on the purpose of the ship.

Growth Margin
In addition to the deadweight required to be carried a 400 tonnes lightship weight growth margin shall be carried at the full load design draft of 7.0m with zero trim and heel. The growth margin shall be taken to apply at 1m above the working deck level or lightship centre whichever is worst, at midships and on the centreline.

5.1.24 Weight Control

R5.50 The Contractor shall install and properly maintain and update a detailed weight control regime during construction to ensure that the deadweight at the design draught and stability requirements are maintained and the NERC future growth margin is not eroded.

Weight control reports shall be required on at least a monthly basis throughout the design, construction and fitting out phases. This shall be part of the Statement of Management Requirements project management reporting system.

Vessel shall be built strictly in accordance with the scantlings as required by Class, plus any NERC's extras as specified herein.

Within 45 days of Contract signing, The Contractor shall submit to NERC a detailed weight estimate for the vessel in support of the information provided at the Tendering stage. Contractor shall be held responsible for any weight gain which may affect performance, deadweight or stability.

Contractor in exercising weight control during the period of design and construction will continuously update the predicted lightship weight, deadweight and associated centres and advise the NERC on a monthly basis or immediately in the event of any problem or difficulty arising.

5.1.25 Stability

R5.51 The stability characteristics of the vessel shall conform to the appropriate requirements of the IMO as administered and applied by the UK Maritime and Coastguard Agency (MCA) on behalf of the Falkland Islands Ship Registry (FISR), including the effects of icing accretion as defined in the IMO Polar Code the envisaged lifting operations.

The vessel shall be designed to have sufficient positive stability to meet the requirements of IMO as administered and applied by the UK Maritime and Coastguard Agency on behalf of the Falkland Islands Ship Registry (FISR). This shall include but not be limited to the requirements of the IMO SPS Code 2008, the Polar code and SOLAS

The loading conditions shall demonstrate that sufficient stability is maintained in the loading conditions with Ice accretion as defined in the Polar Code to comply with the requirements for intact and damage stability.

Stability during crane operations shall be verified in accordance with the requirements of the Intact Stability Code for Crane operations at sea.

The following NERC specific requirement shall be applied.

The vessel is station-keeping head up to a 30Kn steady wind with a scientific package hanging overside at the maximum capacity of the 'A' frame.

The vessel suffers a blackout and the vessel falls away to a beam on situation and begins rolling heavily.

The vessel is then hit by a wind gust of 55Kn at the moment that the vessel has rolled up-wind. The wind gust loading combines with the stored rolling energy to roll the vessel down-wind to some large angle which may submerge openings in the hull leading to damage and flooding which may present a serious risk to the safety of the vessel.

Since operations other than the overside lift could be being carried out at the same time, which in themselves may be hazardous to personnel (handling chemicals), an initial criteria for heel angle under overside load is set.

'The imposed static heel angle under overside lifting should not exceed 7.5 degrees or 50% of the angle required to dip the deck edge of the uppermost continuous weather deck whichever is the smaller.'

This is $\propto$ in the attached drawing

In the particular situation described in the above scenario the following angles are defined in reference to the attached drawing:

$\propto 2$ Is the static heel angle under the overside load and a 30Kn side wind load.

$\propto 3$ Is the static heel angle under the overside load and a 55Kn side wind sustained gust load.

$\propto$ de is the angle at which the edge of the uppermost continuous weather deck becomes submerged under free trim conditions.

$\propto$ dv is the angle at which water may enter the intact hull through, for example, vents, the covers of which have been left open. This not the conventional downflooding through unprotected openings conventionally considered at 40 degrees.

$\theta 1$ Angle of roll as calculated in IMO Resolution A.562 (14)

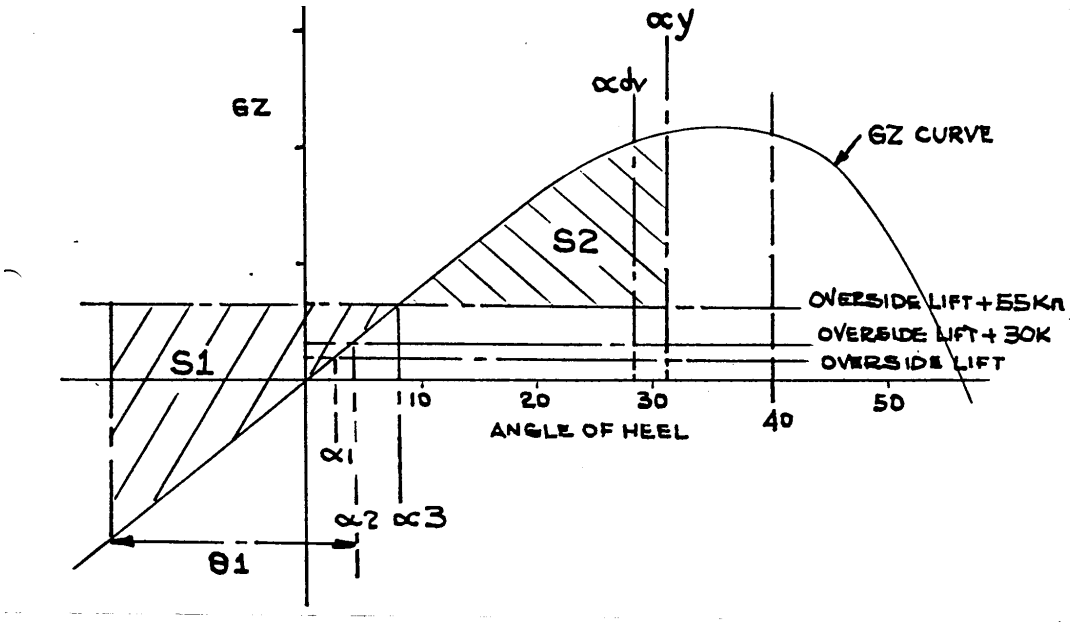
$\propto y$ Where the area S1 equals the area S2 then $\propto y$ is the roll back angel from an initial roll of $\theta 1$.

The specific criteria relating to this situation are:

∝3 is to be no greater than 15 degrees or ∝de whichever is the smaller.

∝y If it is greater than ∝dv then the Master should ensure that the relevant openings are covered during such operations.

In the event it must not exceed 40 degrees or the angle of downflooding possible through unprotected openings.



Every attempt shall be made within the vessel design to offset the asymmetry within the arrangement to minimise the lightship transverse centre of gravity. The use of a limited amount of permanent ballast is not precluded since these types of ship tend to produce lightship transverse centres of gravity off centre usually to the port side.

Every reasonable effort shall be made to avoid this but it shall be not be to the detriment of the scientific configuration or the performance of the vessel.

If solid ballast is proposed it shall be shown separately in all loading conditions and stability calculations, shall be properly secured and maintainable (including the steelwork in way), amenable to regular survey by authorities and capable of being adjusted at drydocking. The agreement of the NERC's representative shall be obtained before fitting permanent ballast.

Considering the vessel shall be required to transport and deliver bulk AVTUR and Marine Gas Oil to the bases, it is likely that the requirements of MARPOL for tankers of less than 5000 tonnes deadweight shall be applied.

In the context of this type of ship the scientists will not be passengers, they will be working on the purpose of the ship.

In addition the design shall conform to the requirements for Over-side Handling, see Section 6.10.

The practical application of the SPS Code shall be enhanced by the application of safety case principles related to the operations and operational areas. It is not intended to carry out a full safety case analysis, but to examine specifically identified risks and the mitigation thereof.

The vessel shall also be equipped with heel correction tanks to ensure a level heel prior to the vessel leaving port. The pair of heel correction tanks shall partially filled with fresh water on a permanent basis.

The angle of heel of the vessel shall not exceed 7.0 degrees when lifting a 50 tonne load either to port or starboard with the load centred 5.0m off the ship's side without utilisation of the heeling tanks. Roll damping tank shall be locked off during lifting operations.

The Contractor in submitting preliminary stability information shall include the angle of heel of the vessel when lifting a 50 tonne load port or starboard both with and without the utilisation of the heeling tanks.

Additional to the preliminary stability submitted with the Tender, the successful Contractor to submit to NERC for approval not later than 45 days after contract signing, predictions of lightship and conditions of loading illustrating the load departure and load arrival conditions, including the angle of heel resulting from the use of shipboard cargo crane operating with the specified Safe Working Loads.

When the vessel is substantially completed but before sea trials, an inclining experiment shall be performed on the vessel by the Contractor at his expense to ascertain the vertical and longitudinal positions of the centre of gravity and the lightweight of the vessel. The experiment shall be performed in the presence of the representative of the Flag Authority or their designated representative and the NERC representative. Certificates for inclining weights shall be provided.

Contractor to prepare and submit to the Flag Authority and NERC for approval a report of the inclining experiment detailing the lightweight and centres of gravity for the "as built" vessel.

Based on the approved lightship weight and centres, the Contractor to prepare a Trim and Stability Booklet in accordance with statutory requirements detailing the various operational conditions of loading and ballast for the guidance of ship's personnel.

The Stability Booklet to include all stability data necessary to permit the safe and efficient operation of the vessel including the operational requirements for utilisation of shipboard lifting appliances.

The Contractor to supply an approved computer based stability programme, compatible with the units, data and results of the approved stability booklet, complete with indications of ship survivability in all conditions of damage. Programme to utilise same tank capacity units as tank gauging system.

5.1.26 Heel Angle Control

R5.52 By virtue of its layout the vessel may not be balanced transversely in terms of weight distribution and the layout of portable equipment often leads to an imbalance causing a heel angle.

During mobilisation, demobilisation and at times at sea heavy items will be moved across the vessel leading to the possibility of imposed heel angles and vessel movements.

Such heel angles can interfere with the precise location of equipment and the ability for example of containers being properly entered into container guide and twistlock systems.

The ship shall be fitted with an anti-heel system consisting of wing tanks and a suitably rapid pumping system whereby an imposed heel can be counteracted sufficiently for equipment and c ontainer handling and location can be carried out safely and effectively.

Sailing conditions shall be capable of adjustment to no more than 1 degree heel angle. High and low level float switches shall be fitted in the tanks for control of the anti heeling system.

The tank heeling moments shall be designed based upon the transverse centre of gravity prediction for the ship, the distribution of the scientific deadweight loadings and using transient weight transfers of 20t containers using the ship's crane (including the effect of its boom weight). The Contractor shall be responsible for the effectiveness of the predictions and the effectiveness of the end result.

The pumping controls and remote valve controls shall be located in the wheelhouse overlooking the aft decks. A digital readout inclinometer shall be provided at this control station.

The tanks shall be considered as ballast tanks and shall be protected from corrosion. The cross over piping shall be capable of being positively locked using an additional manual isolation valve to prevent cross flooding when the system is not in use.

R5.53 Heeling and Trimming in Ice

The Heeling system or the Stabilizer tank system or a combination of the two shall be capable of being used to produce rapid heel to allow the vessel to free itself should it become beset in ice.

The system shall be designed to produce a rate of change of heeling moment capable of producing a vertical speed between the side of the ship and the ice of 1.2cm/sec, necessary to produce dynamic friction instead of the greater static friction in order to free the ship from the ice.

The vessel should be capable of changing its trim in order to present the optimum angle of attack of the bow to the ice in the expected range of loading conditions. The trimming tanks should have a capacity sufficient to change the trim by 1.5m.

5.1.27 Freeboard

R5.54 The Statutory Freeboard shall be in accordance with the International Load Line Convention 1966 and 1971 including 1975 amendments and revised protocol of 1988 as administered by the UK Maritime and Coastguard Agency including the effects of icing accretion as applicable to all vessels including fishing vessels.

The freeboard to the working deck shall be between 3.5m and 4.5m in all operational loading conditions

The doors between the scientific hangar and the main deck shall incorporate folding sills 600m height when deployed but capable of being folded flush into the deck, when not in use.

It is required that at working deck level (Main deck) operation of the laboratory and services spaces are minimally hindered by the need for weather tight divisions and doors with high sills. Where weather tight doors are required, these shall be fitted with Portable sills of regulation height that can be removed, while in port for loading the science equipment.

It is required that the positions of watertight bulkheads below the freeboard deck are arranged to provide an optimised arrangement of spaces (e.g. cabins) and facilities between them.

5.1.28 Design Life

R5.55 The Design Life of hull, machinery, systems and general outfit shall be a minimum of 30 years.

NERC have a very good standard of maintenance. However, obsolescence of equipment especially electronics and accompanying software / firmware, coupled with longer term difficulties in obtaining spare parts, especially worldwide, is an issue which shall require particular attention.

Hull plating up to the bulkhead deck shall be designed with a minimum thickness of 12mm. In addition a growth margin shall be considered as defined in section R5.48.

5.1.29 Noise & Vibration

The control and limitation of underwater radiated noise and also the noise levels on-board are of critical importance to the successful operation of this vessel. The contractor shall demonstrate all features that shall enable the compliance with both the Underwater Radiated Noise (URN) and also internal noise and vibration limits for the vessel.

The Contractor shall appoint an underwater noise, onboard noise and vibration specialist who will provide realistic technical requirements which will form part of the requirements to be met by equipment and system suppliers. These requirements shall include permissible noise limits for specified items of equipment or systems.

Sufficient predictive studies and testing shall be carried out to verify that the noise criteria are met. In case of novel, new or unproven solutions being proposed full scale Factory Acceptance Testing shall include verification of noise characteristics.

R5.56 Noise and Vibration

Maximum acceptable levels of noise and vibrations in machinery spaces are to be in accordance with those defined in this SoR Section 5.1.29 and compatible with the requirements for Underwater Radiated Noise.

The propulsion system, including propellers, propulsion drive motors and diesel alternators shall be designed and optimised to meet the noise criteria in each operating mode, see following table for guidance.

Operating mode	Power	Design Case
Free running in clear water	Transit at 13knots,	Fuel efficiency
Transit with risk of ice	1/3 of time using full propulsion power for transit at 3knots through 1m ice. Remaining 2/3rds of time using 4MW of propulsive power to transit through 0.5m ice at 4knots.	Bollard Pull
Alongside in port		Internal noise / external airborne noise* & pollution
Cargo transfer (at Research stations) at anchor or DP		Internal noise
Research, comprising • 80% at ~ 11knots acoustic survey / relocation • 10% at 6 - 8 knots towing devices • 10% stopped/DP mode for deployment/recovery of over the side devices		External underwater noise & internal noise for crew comfort

*Noise levels measured at a distance of 65m from the vessel are not to exceed 45dBA across the audible frequency range.

These criteria shall be met by the controllable pitch propeller control system being programmed with quiet mode and economy mode. Propulsion drive motors shall be designed for minimum noise under the conditions stated. It shall be noted that low external noise requirements are not applicable at full (ice breaking) power.

Consideration may be given to designating which diesel alternators are to be operated when low external noise conditions are required. In case that a solution is proposed that does not incorporate noise reduction measures on every alternator set there shall be sufficient reserve in power to continue operating in quiet mode in the event of a single failure.

Predictive studies shall be carried out as part of the detailed design of the power generation and propulsion systems. As far as practical the predictions shall be verified during Factory Acceptance Tests.

The forward thruster units shall be of low noise type fixed pitch.

Predictive studies shall be carried out as part of the detailed design of the power generation and propulsion systems. As far as practical the predictions shall be verified during Factory Acceptance Tests.

It shall be assumed that in DP mode the forward thruster units shall be of low noise type.

R5.57 Onboard Noise
As a research vessel a low noise environment is important to the successful operation of the vessel.

The vessel shall comply with the noise requirements of LR rules and regulations for crew accommodation comfort to achieve the class notation “CAC1”. All accommodation cabins on board shall be considered as Crew Cabins. The requirement to limit transient noise in Crew, Officer and Scientist cabins shall be included.

The Laboratory spaces shall be treated as office spaces with noise measurements taken without science deadweight items onboard.

The noise levels on board shall be assessed in the agreed sea trial condition (in compliance with the LR (CAC1) measurement requirements) without cargo on board.

The CAC1 requirements are not required to be met when the ship is operating in ice.

In addition the Contractor shall undertake trials at the following conditions to demonstrate the Noise Limits defined within LR (CAC1) for cabins are complied with in these conditions:-

- Whilst the vessel is in DP mode with [60%] load on all thrusters
- During sea trials for the Roll Stabilization Tank in at least a Sea State 3.

Noise and vibration calculations shall be carried out to ensure that the vessel, when delivered, shall comply with all the specified noise, vibration and underwater noise limits as set forward in the Statement of Requirements (SoR). This shall include finite element models to predict the vibration response both locally (for major equipment and structures) and globally (hull girder vibration).

In addition, airborne and structure-borne noise prediction models shall be used to assess noise control measures in all areas of the vessel and ensure compliance with the specified limits. Shipyard shall provide copies of these reports to the NERC representative for approval. Shipyard shall follow recommendations within the report. Underwater noise models shall be developed to demonstrate that the vessel shall achieve a DNV Silent (R) notation.

The noise and vibration criteria shall be determined by this SoR and relevant Rules and Regulations. Where there is a difference the higher standard shall prevail.

Sound Insulation Limits
The sound insulation requirements for noise transmission between adjacent areas, such as cabins, becomes important in this application, where the vessel shall be relatively quiet due to the low structure-borne vibration energy within the shell plating, the acoustic performance of the partitioning system becomes even more important – due to the enhanced audibility of various sources when background noise levels are low.

The sound insulation requirements for decks or partitioning materials are set out below.

Sound Insulation Requirements for NPRV

Area To Area	Building Element Sound Insulation (R_w) and in-situ Sound Insulation (R'_w)	
	Weighted Sound Reduction Index, R_w	Weighted Apparent Sound Reduction Index R'_w
All Cabins Areas to Cabin Areas (includes Hospital)	38	36
All Cabin Areas to Corridors	38	36
All Cabin Areas to Noisy Public Spaces (Mess rooms, Recreation Rooms, Bars, Cafes etc.)	50	48
All Cabin Areas to Machinery Spaces* (E.G. HVAC Rooms) Or Engine Casings	50	48
Conference Room/ Offices to Corridors	38	36

* **This does not apply to the diesel generator room where source noise levels are considerably higher than HVAC rooms etc.**

The weighted apparent sound reduction index values (R'_w values) shall be measured during harbour trials and compared with permissible values set forward above.

Onboard Vibration Requirements
The vessel shall comply with the vibration requirements of LR rules and regulations for crew accommodation comfort to achieve the class notation “CAC1”.

The Laboratory spaces shall be treated as “Accommodation and navigation spaces” with vibration measurements taken without science deadweight items onboard. The vibration levels on board shall be assessed in the agreed sea trial condition without cargo on board.

In addition the Officer, Crew and Scientist cabins, Mess rooms, Recreation rooms and scientific laboratories are required to comply with the vibration limits defined in PCAC 3 at speeds up to 13 knots (sea conditions as defined in PCAC).

Underwater Noise
The vessel shall be designed to meet all the requirements for compliance with DNV Silent (R) notation during surveys at speeds up to and including 11 knots in calm seas.

In addition the vessel is required to comply with the requirements of Silent (S) notation whilst towing seismic equipment (3 tonne towing load) at 6-8 knots in calm seas.

There are no underwater noise requirements during manoeuvring, DP operations, at speeds greater than 11 knots or operation in Ice.

URN & Self Noise Concept Considerations

Equipment to be protected:
Typical key acoustically based equipment which shall not suffer interference are:

- Scientific Echo Sounder — 10.2kHz, 12kHz, 38kHz
- Navigation Echo Sounder — 18 - 38kHz
- Sub Bottom Profiler (3.5kHz) — –1.5 – 7kHz
- Sub Bottom Profiler — 2 - 8kHz
- Multi-beam Echo Sounder (Full Ocean Depth) — 12kHz
- Multi-beam Echo Sounder (Shallow) — 40kHz to 100kHz
- Sidescan(towed astern) — ~100kHz
- USBL — 20 - 33kHz
- Transponders/Releases — 8 - 16kHz
- ADCP — 75 & 150kHz
- Net Monitor — 10kHz
- Multi-frequency Echo Sounder — 18, 38, 70, 120, 200, 333kHz

In addition underwater radiated noise shall not interfere with marine wildlife (fish and mammals).

In water noise and self noise are generated by a variety of ship sources and, from experience, the following comments provide a guide to some basic concepts which can be combined together to meet the requirements;

General
Consideration shall be given to engaging one experienced supplier to allow optimised integration of the propulsion systems.

Main Propulsion Propellers
Every effort shall be made to reduce the underwater radiated noise of this vessel and achieve Silent R notation at the survey speeds of up to 11 knots. In order to reduce

underwater radiated noise the vessel shall be driven by conventional propeller shafts with internally mounted Electrical propulsion motors.

The propellers shall also be constructed to meet the strength requirements of the ice class PC4. If this is considered to be significantly detrimental to the efficiency or noise generated by the propeller then a propeller meeting the criteria of PC5 will be considered. In this case evidence shall be provided for the selection of the propeller design criteria.

The ships propellers shall have the following key characteristics:

- Diameter shall be as large as possible with commensurately low revolutions while maintaining reasonable propeller immersion and hull tip clearance in excess of Class recommendations.
- Be designed to avoid cavitation at all "normal operational sea states" (Sea state 4 at 11 knots, any heading and at all associated shaft speeds.
- Manufactured and finished to meet, as a minimum, the requirements of ISO 484/1-1981(E) Class S tolerances.

Propulsion Motors

- The propulsion motors shall be specified, designed and installed to avoid the undue generation or transmission of noise
- The propulsion motors shall be resiliently mounted if required. Flexible mounting shall be designed taking into account propeller induced and motor induced frequencies and the requirements of Silent R.
- Critical torsional frequencies for propulsion train shall be calculated and approved.

See Section 6.4.9

Main Power Generation

The arrangement of the propulsion drives, power management, electrical power generation and distribution shall be fully coordinated by a single entity.

The generating sets' shall be resiliently mounted on base frames on mass-damping rafts in turn resiliently mounted to a substantial tank top bedplate structure.

Sufficiently electrical generating capacity for survey operations shall be arranged with appropriate noise reducing features, including sufficient redundancy to allow operation with low Underwater Radiated Noise with one alternator set out of service.

In the power management analysis recognition might be taken of the specific power needs of the required speed range (up to 11knots) in order to limit the number of power generation units operating (therefore the level of noise generation). However this shall not be detrimental to the overall flexibility and power management of the system in serving all modes of operation.

All connections to the generator sets shall be flexible including the exhausts.

Exhaust silencers and the exhaust system shall be resiliently mounted throughout.

Turbochargers shall be sound proofed.

The windings of the generators shall be arranged to minimise the generation of structure-borne vibration and noise.

The structure of the Casings shall be substantial to minimise noise and vibrations Structural design shall be confirmed by Noise calculations and Finite Element analysis.

Factory acceptance trials of the various equipment elements shall include comprehensive noise testing.

Power Management System
The way that electrical power is distributed, converted into its various forms and managed shall be carefully considered. For example transformers shall be suitably designed for low noise and resiliently mounted. Harmonic distortions throughout the systems shall be minimised.

Auxiliary Machinery
The Contractor shall work with all the *Manufacturer*s to ensure that both air and structure borne noise is minimised. In particular start air compressors, air conditioning and provision room compressors, most especially those operating in stages, shall be specially considered.

Where possible machinery shall be installed with a means (fixtures) to measure vibration levels in service. Such facility shall be available on all pumps and major system fans with baseline signatures recorded and computer logged during Sea Trials.

Particular attention is to be paid to the noise generated by the hydraulic systems for the propeller pitch control.

Pumps in General
As far as possible all pumps shall be of the centrifugal type, running at the lowest available speed for the given duty and fitted with soft start.

They shall be ‘over-designed / sized’ to prevent cavitation noise.

They shall all be mounted on resilient mounts and flexible couplings to piping and electrics.

Intermittently operating pumps, most especially positive displacement types, are the worst offenders in terms of noise and these shall be specially considered.

Hydraulic pumps shall be gear type as far as possible. If it is necessary to fit positive displacement types they shall be carefully considered. All hydraulic piping shall be resiliently mounted using a proprietary clamping system and generously sized to reduce velocities and bends shall be a minimum of 5 times the diameter.

The propeller pitch control hydraulic system shall be specially considered to ensure minimum underwater noise.

Where vertical pump arrangements are used, the seatings shall be dynamically tested (stiffened if appropriate) to ensure no resonant behaviour at motor running speed or pump blade rate frequencies.

Structures
Steel structures in way of noise and vibration generating equipment shall be carefully designed and stiffened over and above that required by Rule where necessary.

Vibration analysis including Finite Element analysis shall be undertaken in accordance with Section 5.1.6 R5.6

Frames, beams, girders and pillars shall be arranged to minimise local vibrations, and to prevent excessive coupling of vibrations.

Structures in contact with the sea such as the double bottoms shall be particularly considered and the arrangement of tank contents in way controlled such that local changes in mass damping do not effect changes in the noise transmission to the sea.

Boundary structures in spaces where air borne noise is an issue shall be sound insulated. This includes deckheads, ship sides and tank tops. The application of noise insulation shall be determined by the Noise analysis.

Ventilation Systems
These shall be designed generally with a low to medium speed regime to limit noise.

Main ventilation fans shall be sound attenuated and where possible two speed so that a reduced duty may be achieved for quiet running.

Tank Stabiliser
The type of system chosen and its position shall be carefully considered.

The controlled U tube type system is to be fitted. All valves and air ducts shall be carefully designed and resiliently mounted and all connections shall be flexible in order to minimise noise generated

Acoustic Transducer Array Locations, Installation and Alignment
These notes do not substitute for specific guidance from the *Manufacturer* of systems such as the *Multibeams* and *ADCPs*. Each item transducer array shall need shall be considered individually.

The installation of transducer arrays shall be considered for optimum operation of the completed system at the design stage.

The sound velocity sensor shall be installed close to the transducer array or in a water source close to the transducer array.

Depending on the transducer array a fairing may be required to streamline the installed array to reduce noise and drag.

Transducer arrays shall be mounted as deep as possible, aft of the bow to avoid air bubble effects at the boundary layer during bow emergence events.

Propulsion noise is the dominant source of noise. Transducer arrays shall therefore be placed away from the propeller e.g. in the forward part of the vessel hull.

A position outside the direct line from the propeller(s) shall be considered.

Transducers shall be placed away from bow thrusters.

Protruding objects e.g. sacrificial anodes, other transducers, outlets and pipes cause unwanted turbulence shall be avoided.

Transducer arrays shall be nominally horizontal; under no circumstances shall the plane of the arrays be tilted backwards when the vessel is at speed. Stern trim is therefore acceptable while bow trim would not be.

*Manufacturer*s' tolerances (roll, pitch and azimuth) shall be adhered to.

A calibration shall be required both alongside and at sea to determine parameters such as:

- measurement of where sensors are located
- measurement of how sensors are orientated
- measurement of waterline vertical location
- alignment of angular measurement sensors
- determination of any offsets in sensor data
- determination of any time delays in sensor data

A Cartesian (XYZ) co-ordinate system shall be defined for the vessel.

Permanently marked reference points shall be established and noted on vessel drawings and on the vessel as required in the SoR.

*Manufacturer*s usually give maximum value accuracies, better accuracies shall be obtained if easily achievable.

Items which need shall be measured or located are:

- Transducer Array (including orientation)
- Motion Sensor
- Heading Sensor
- Positioning System Antenna
- Waterline

Mounting frames where used shall be rigid and not deflect or deviate from the *Manufacturer*s recommendation.

R5.58 In-Water Noise
The vessel shall be designed to meet the requirements of DNV Silent (R).

It shall be noted that the lower the underwater radiated noise the better the operability of the scientific research equipment will be.

The underwater radiated noise limits shall be met at all speeds up to 11 knots, with the vessel operating in calm conditions.

5.1.30 Electro- Magnetic Compatibility (EMC)

R5.59 The main power generation and propulsion system shall not create harmonic distortions within the power systems of greater than 3% as the target and 5% as a maximum under all conditions of switchboard loading and generator combinations.

5.1.31 Lifesaving Equipment and Boats

R5.60 Lifesaving equipment shall be in accordance with statutory requirements, to include the Polar code.

No exemptions with regard to the lifesaving equipment shall be used

The vessel shall have lifeboat capacity for the full complement in each lifeboat.

In addition to the lifeboat capacity davit launched liferafts shall be carried. These shall have sufficient capacity for the full complement of the vessel to each side.

The design of all lifesaving equipment shall include any necessary modification to ensure operation in all anticipated environmental conditions.

3 sets of Safety Plans for the vessel shall be framed and displayed in the following suggested locations: Wheelhouse, Lobby at Upper Deck & Alleyway Main Deck.

All lifesaving appliances and equipment shall be delivered at “Interim Delivery” with at least one year remaining on the certification.

5.1.32 Fast Rescue Boat(s)

R5.61 The vessel is required to have two rescue boats

The rescue boats are required to comply with SOLAS Chapter 3 regulation 26 as a Fast Rescue Boat.

The rescue boats shall be designed for operation in all anticipated environment conditions.

As well as lifejackets each member of the crews of the rescue boats shall be provided with an immersion suit suitable for the intended areas of operation.
EXAMPLAR: Norsafe 6.15m “Merlin” diesel and waterjet version TEK-044.

5.1.33 Fire Fighting & Detection

R5.62 These shall be generally in accordance with statutory requirements.

In the context of this type of ship the scientists shall not be passengers, they shall be working on the purpose of the ship.

The vessel shall be a Special Purpose Ship as defined under IMO complying with the IMO SPS Code 2008 and MGN 515.

The practical application of the SPS Code shall be enhanced by the application of safety case principles related to the operations and operational areas. It is not intended to carry out a full safety case analysis, but to carry out a Hazard Identification (HAZID) and Safety Assessment to identify risks and t he mitigation thereof.

The primary risk that shall be considered is;

- The possibility of a major fire occurring threatening the survivability of the vessel and its personnel at a r emote location where ready access to rescue services and emergency firefighting/towage is not available.

Mitigation of this risk shall be based upon:

- The proper provision of control zoning.
- The provision of appropriate fire detection equipment throughout the vessel and firefighting means suitable to the space being considered. The provision of automatic systems shall recognise the issues of consequential damage to the contents of the space being covered in case of inadvertent activation.

The Ship’s CCTV system shall be integrated into the fire detection system. The CCTV system integration shall comprise a repeater screen adjacent to the fire detection

panel. Unattended machinery spaces shall be monitored using infra-red cameras. The repeater screen should default to the alarm zone.

Provision for the integration of containerised laboratories and equipment containers into the fire detection and extinguishing (if provided) systems shall be provided.

Multiple sub-zones shall be incorporated in the detection system for operational and maintenance purposes and all interfaces shall be located in accessible areas.

R5.63 Fixed Extinguishing Systems

Bearing in mind the requirements of section 5.1.31 R5.61 the firefighting system within the accommodation, science labs and machinery spaces shall be provide by High Pressure Water Mist Fire Protection System.
Due to the complexity of the equipment within the Science Labs and their sensitivity to accidental release these spaces shall be protected by a Pre- Action water mist system, where system activation requires both a signal from the detection system and the heat activation of a sprinkler.

The type of fire fighting method for the different areas of the vessel is summarized in the following table:

Fire Fighting Method	Area to be Protected
Deluge with Foam	Heli-deck
Deluge	Heli-fuel Tank Area
	Heli-fuel Pump Unit
Dual Agent	Heli-fuel Dispenser Unit
High Pressure Water Fog (Water Mist)	Machinery Spaces
	Accommodation Spaces
	Switchboard Room
	Transformer Room
	Emergency Gen. Room
	Engine Control Room/ECR
	Paint Stores
	Chemical Stores
	Oxygen/ Acetylene Lockers
	Science Hangar
	Fuel System Room
	Ventilation Hood In Galley
	Laboratories
CO_2	Galley Deep Fat Fryer
Fire Fighting With Hose Reels	Located In Various Positions

R5.64 Fixed Extinguishing System in Engine Rooms, Boiler / Incinerator Room

Both Generator Rooms, Boiler Room, Incinerator room and Fuel System rooms shall be protected by a High Pressure Water Mist Fire Protection System. The system shall include the injection of foam below the floorplates / gratings.

The extinguishing system in these spaces shall be designed to extinguish fire above and below floor plate level.

The system shall consist of high pressure pumps, pressure cylinders, piping, section valves, sprinklers, inlet water treatment to ensure clean water, and necessary controls. The activation shall be fully automatic based on the use of sprinklers and compliant with MSC1/1387 Stainless steel pipes shall be used throughout the system.

The system shall be supplied with fresh water, with a connection to the sea water fire system as a back-up.

The system shall be equipped with means of ensuring fog discharge in case of a blackout of the vessel's electric system.

In addition a Fixed Water Based Fire Extinguishing System shall be fitted to protect all the main generators, as a local protection system acc. to regulation. The system shall be water fog base, shall be approved by the Classification Society and shall have both automatic and manual release capability. Activation of the system shall give a visual and audio alarm as required by the regulations. All piping for the system shall be stainless steel. Alternators and other electrical systems in way of the fixed water based Fire extinguishing system shall be protected from water ingress.

R5.65 Fixed Fire Extinguishing System in Accommodation and Science Spaces
All accommodation spaces, science laboratories, passageways, lobbies, staircases, and stores etc., (not including cargo holds, Heli hangars and AVTUR spaces) shall be protected by a high pressure fog type sprinkler system.

The system shall consist of high pressure pumps, pressure cylinders, piping, section valves, sprinklers, inlet water treatment to ensure clean water, and necessary controls. The activation shall be fully automatic based on the use of sprinklers having heat sensitive bulbs, and independent of any detection system. Stainless steel pipes shall be used throughout the system.

The sprinklers shall be of a type that can be detached by the vessel's crew. Bulbs shall be replaced by replacing the complete sprinkler head. The sprinkler shall use 2mm bulbs, providing for the fastest reaction possible in case of a fire.

Due to the complexity of the equipment within the Science Labs and their sensitivity to accidental release these spaces shall be specially considered. Measures should be put in place to limit accidental system activation, for example by installing a Pre-Action water mist system in these locations, where system activation requires both a signal from the detection system and the heat activation of a sprinkler.

Spaces sensitive to freezing for example spaces identified within the winterisation statement (e.g. hangar and winch room) and freezers shall be fitted with dry pipe systems in accordance with class requirements.

The system shall be equipped with means of ensuring fog discharge in case of a blackout of the vessel's electric system

Galley
The Galley shall be protected by the High Pressure Water Mist Fire Protection System.

Galley range canopies shall be protected by the High Pressure Water Mist Fire Protection System, arranged for manual release in the adjacent passageways.

The systems shall be complete with automatic closure of the dampers, in the exhaust duct.

The Deep Fat Fryer shall be protected with a Manual Fire Extinguishing System and associated arrangements as required by the Regulations.

A Fire Blanket shall be provided.

An electrical master switch for the shut-down of all Galley electrical equipment shall be provided outside the Galley main door.

Helicopter Re-Fuelling Station
The Helicopter Re-Fuelling Station(s) shall be specially considered and depending upon their arrangement appropriate Fire Extinction System provided as required by SOLAS II-2/18 and the Classification Society. The refuelling facilities shall be protected by a deluge system with a capacity of at least 10 litres per minute per sq. m.

A High Expansion AFFF foam system shall be provided for injection of foam into the firewater system. The deluge system shall be served by two pumps one of which is connected to the emergency switchboard.

Paint Locker
The paint locker shall be protected with a water spray Fixed Fire Extinguishing System.

Laundry Ducts
A fixed Fire Extinguishing System shall be fitted to the Laundry Dryer Exhaust Ducts. Appropriate Fire Dampers shall be installed at the lower and upper ends of the ducts.

R5.66 Foam Tank
A skid mounted foam tank unit shall be available to supply foam to deluge systems, DIFFS system etc. The arrangement shall consist of foam tank, nitrogen bottle (propellant), piping, control valve, etc. The foam tank unit shall be stowed at safe and readily accessible location. The foam generators shall be located in the protected space and shall be capable of being activated in manual mode, actuated from fire control station.

R5.67 Firefighting Systems on Aft Deck and Cargo Hold
In addition to the conventional fire safety features provided, the vessel shall be provided with fire protection systems to protect it from the added fire hazards associated with carriage of dangerous goods in packaged form including goods in freight container and portable containers both on deck and in holds. Suitable Fire fighting systems shall be identified by the Contractor. The 9 classes and subclasses of dangerous cargo as per IMDG code are given below:

A typical stowage schedule of IMDG class goods for the respective locations is as following Table:

Stowage Location	**IMDG Class Code**
Science hold	2.2 (Non-flammable, non-toxic gases)
	3 (Flammable liquids)
	8 (Corrosive substances)
	9 (Miscellaneous dangerous substances and articles)
	4.1(Flammable solids, self-reactive substances and solid desensitized explosives)
Cargo hold	2(Gases)
	3(Flammable liquids)
	4(Flammable solids; substances liable to spontaneous combustion; substances which, in contact with water, emit flammable gases)
	6.1(Toxic substances)
	8(Corrosive substances)
	9(Miscellaneous dangerous substances and articles)
Laboratory Space	3 (Flammable liquids)
	8(Corrosive substances)
	9(Miscellaneous dangerous substances and articles)

Explosive Locker	2.1(Flammable gases)
	2.2 (Non-flammable, non-toxic gases)
	9 (Miscellaneous dangerous substances and articles)
	1.4S (Explosives- Cartridges for weapons)

Firefighting provisions on deck and under deck (cargo holds) using appropriate firefighting media for dangerous goods code class 1-9 shall be pr ovided as per Emergency Schedule (EmS) for items grouped together using UN numbers in IMDG code EmS Guide.

Emergency Schedules for FIRE	**Location and Fire Fighting Media**
F-A (General Fire Schedule)	On Deck - Water Spray
	Under Deck- Cargo space fixed fire extinguishing system
F-B (Explosive Substances And Articles)	On Deck - Water Spray
	Under Deck- Cargo space fixed fire extinguishing system
F-C (Non-Flammable Gases)	On Deck - Water Spray
	Under Deck- Cargo space fixed fire extinguishing system
F-D (Flammable Gases)	On Deck - Water Spray
	Under Deck- Cargo space fixed fire extinguishing system
F-E (Non-Water Reactive Flammable Liquids)	On Deck - Water Spray
	Under Deck- Cargo space fixed fire extinguishing system
F-F (Temperature Controlled Self-Reactives And Organic Peroxides)	On Deck - Water Spray
	Under Deck- Under deck stowage is not allowed
F-G (Water Reactive Substances)	On Deck - Dry inert powdered material
	Under Deck- Fixed gas fire-extinguishing system
F-H (Oxidizing Substances With Explosive Potential)	On Deck - Water spray
	Under Deck- Water spray
F-I (Radioactive Material)	On Deck - Water spray
	Under Deck- Fixed fire-extinguishing system
F-J (Non-Temperature Controlled Self-Reactives And Organic Peroxides)	On Deck - Water spray
	Under Deck- under deck stowage is not allowed

The requirements of SOLAS Reg II-2/19.3.1.1 to 19.3.8 shall be applied wherever "x" appears in Table 19.3 below to all classes of dangerous goods , except as indicated by the notes.

Table 19.3 Application of the requirements to different classes of dangerous goods except solid dangerous goods in bulk

Class / Regulation 19	1.1 to 1.6	1.4S	2.1	2.2	2.3 *flammable*[20]	2.3 *non-flammable*	3 FP[15] <23°C	3 FP[15] ≥ 23°C *to* ≤ 60°C	4.1	4.2	4.3 *liquids*[21]	4.3 *solids*	5.1	5.2 *16*	6.1 liquids FP[15] <23°C	6.1 liquids FP[15] ≥ 23°C *to* ≤ 60°C	6.1 *liquids*	6.1 solids	8 liquids FP[15] <23°C	8 liquids FP[15] ≥ 23°C *to* ≤ 60°C	8 *liquids*	8 solids	9
3.1.1	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
3.1.2	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	-
3.1.3	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3.1.4	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3.2	X	-	X	-	X	-	X	-	-	-	X^{18}	-	-	-	X	-	-	-	X	-	-	-	X^{17}
3.3	X	X	X	X	-	X	X	X	X	X	X	X	X	-	X	X	X	X	X	X	X	X	-
3.4.1	-	-	X	-	-	X	X	-	X^{11}	X^{11}	X	X	X^{11}	-	X	X	-	X^{11}	X	X	-	-	X^{11}
3.4.2	-	-	X	-	-	X	X	-	-	-	-	-	-	-	X	-	-	-	X	-	-	-	X^{17}
3.5	-	-	-	-	-	X	X	-	-	-	-	-	-	-	X	X	X	-	X	X^{19}	X^{19}	-	-
3.6	-	-	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X^{14}
3.7	-	-	-	-	-	X	X	X	X	X	X	X	X	-	X	X	-	-	X	X	-	-	-
3.8	X^{12}	-	X	X	X	X	X	X	X	X	X	X	X^{13}	X	X	X	-	-	X	X	-	-	-
3.9	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
3.10.1	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
3.10.2	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X

Notes:

11 When "mechanically-ventilated spaces" are required by the IMDG Code.

12 Stow 3 m horizontally away from the machinery space boundaries in all cases.

13 Refer to the IMDG Code.

14 As appropriate to the goods to be carried.

15 FP means flashpoint.

16 Under the provisions of the IMDG Code, stowage of class 5.2 dangerous goods under deck or in enclosed ro-ro spaces is prohibited.

17 Only applicable to dangerous goods evolving flammable vapour listed in the IMDG Code.

18 Only applicable to dangerous goods having a flashpoint less than 23ºC listed in the IMDG Code.

19 Only applicable to dangerous goods having a subsidiary risk class 6.1.

20 Under the provisions of the IMDG Code, stowage of class 2.3 having subsidiary risk class 2.1 under deck or in enclosed ro-ro spaces is prohibited.

21 Under the provisions of the IMDG Code, stowage of class 4.3 liquids having a flashpoint less than 23ºC under deck or in enclosed ro-ro spaces is prohibited.

The dangerous goods shall be adequately separated from ignition sources and appropriate personnel protective equipment shall be pr ovided for the hazards associated with the carriage of dangerous goods.

The fire main on the aft deck shall either be a permanently pressurised system or fire pumps have suitably placed remote starting arrangements. The position of the hydrants on the aft deck and cargo hold is to be such that four jets of water, not emanating from the same hydrant, two of which must be from a single length of hose, can be directed to any part of the cargo space when empty.

As the vessel is designed to carry containers on top of aft weather deck, it shall be fitted with at least one water mist lance, in addition to all other fire protection arrangements that should be provided on board as per existing regulations.

In addition to the water mist lance, the vessel shall also be provided with a mobile water monitor tested and designed as per MSC.1/Circ.1472.

Sufficient access space to individual containers that may be involved in a fire regardless of its location shall be provided for fighting fires involving containers using water mist lance and mobile monitors.

Where spray nozzles or water drenching system or monitors are used, provision to remove excess water from the holds to prevent the build-up of free surface effect shall be provided.

The cargo hold space shall be fitted with a fixed fire detection and fire alarm system or a sample extraction smoke detection system.

All dangerous goods shall be adequately separated from ignition sources. Bulkheads forming boundaries between cargo spaces and adjacent spaces forward and aft of it be insulated to "A-60" class standard. Boundaries between the two cargo hold spaces shall be insulated to "A-60" class standard.

Appropriate personnel protective equipment (4 sets of chemical resistant protective clothing, 2 sets of SCBA) shall be provided both on deck and cargo hold area for dealing with the hazards associated with the carriage of dangerous goods.

Portable fire extinguishers with a total capacity of at least 12 kg of dry powder or equivalent shall be provided for the cargo spaces, both on deck and cargo hold. These extinguishers shall be in addition to any portable fire extinguishers required elsewhere.

As some gases are heavier than air and may accumulate in dangerous concentrations in the lower part of the ship, effective ventilation should be provided to remove low lying gas in the cargo hold.

R5.68 Heli-deck Fire Extinguishing

The size and capacities of firefighting equipment shall be in accordance with Classification Society and Authorities Rules and Regulations.

The helicopter deck shall be provided with Deck Integrated Fire Fighting System (DIFFS) capable of delivering foam and/or seawater in a spray pattern to the whole of the landing area. The DIFFS system shall be served by two pumps one of which is connected to the emergency switchboard.

For the purpose of extinguishing minor fires on the helideck, there shall be an approved combined foam/dry powder station with hoses and dual purpose nozzles ready for use, capable of reaching any part of the helideck. The quantity of dry powder shall be no less than 250 kgs and the capacity of the system shall be between 2 and 3 kgs of powder per second. The system shall contain not less than 250 litres of foam concentrate and be capable of supplying no less than 200 litres of foam solution per minute.

For the purpose of fighting a fire in the helicopter engines, there shall be two 10 kg CO2 extinguisher with an extension hose and nozzle capable of reaching the engines of the helicopter types which can land on the deck.

Two (2) hydrant cabinets, each complete with fire hose, nozzle and GRP cabinet shall be provided for the helideck. The pressure in the fire mains at the helideck shall be not less than 7 bars. The hoses shall be immediately accessible from the helideck without requiring passage through doors or hatches.

R5.69 Fire Detection Extinguishing System in Hangar
The ship shall have fire detection and smoke detection sensors in the hangar.

The ship shall be fitted with a flammable gases and vapours detection system in the hangar. The sensors for the flammable gases and vapours detection system shall be positioned no more than 100 mm above hangar deck level.

The hangar shall be equipped with an overhead water mist system.

The water mist system shall be operable from both inside and outside the hangar.

A minimum of two self-contained breathing apparatus (SCBA) shall be located in the hangar or adjacent to the hangar.

Two portable 5.5 kg CO2 extinguishers shall be mounted within the hangar area.

Two portable 9 kg Pyromet extinguishers shall be mounted within the hangar area.

R5.70 AVTUR Fuel Pump Room
The AVTUR fuel pump room shall be served by the foam and water deluge system.

R5.71 AVTUR Tanks
AVTUR Fuel tank(s) to be provided with inerting system compliant with Class and statutory requirements. Area around fuel tanks shall be protected by a deluge system with a capacity of at least 10 litres per minute per sq. m. The deluge system shall include sea water supply, foam liquid storage tank, and deluge nozzles. A High Expansion AFFF foam system shall be provided for injection of foam into the firewater system. Foam liquid tank shall provide 3% AFFF concentrated solution/water/foam mixture.

Foam concentrate (AFFF) shall be stored in a dedicated AFFF Stainless Steel Tank.

Placement of deluge nozzles shall ensure required water shall impinge the surface protected, due account for obstruction of nozzles shall be taken.

Type of nozzles shall be suitable for the individual fire scenario. Nozzles selected shall be suitable for the pressure of firewater supply from the Fire Main.

R5.72 Fire Fighters Outfits / Miscellaneous Equipment
Fire Fighters Outfits and Personal equipment shall be provided to meet the requirements of the regulations and CAP 437. Appropriate stowage shall be provided for the equipment.

A fire control plan shall be submitted to LR and/or Flag authority for approval. Approved copies of the plan shall be framed and hung in the machinery control station and the mess.

All necessary tools, spares, instruction manuals, etc. for the fixed fire protection installations and fire appliances shall be supplied and stowed onboard the yacht.
Safety training manuals as required by statute shall be provided.

A Remote SCBA air recharge facility shall be fitted within a Fire Locker, to the agreement of the NERC representative.

Emergency Escape Breathing Devices (EEBD's) shall be provided as required by the regulations.

R5.73 Hydrants, Hoses and Extinguishers
Fire pumps, as detailed in Section 6.4 shall be fitted and connected to the fire main, which shall be distributed throughout the vessel. The fire main system is detailed in Section 6.4.

Fire hydrants, to meet SOLAS and Classification Society requirements, shall be arranged throughout the vessel. The arrangement shall allow two jets of water, one from a single length of hose, to reach any part of the vessel accessible during navigation whilst all watertight doors and doors in main vertical zone bulkheads are closed.

In accordance with Winterisation statement Sections 6.1.14 and 6.4 Fire hydrants shall be located to minimise risk of exposure to low temperatures where freezing shall occur. Where this is not possible the exposed pipework and hydrants shall be equipped with trace heating as required by regulation to avoid freezing at the polar service temperature.

One fire hose of approved synthetic material and one approved type dual purpose nozzle shall be supplied for each fire hydrant on the ship. Couplings shall be of the instantaneous type and hoses shall be of approved length to allow two jets of water shall be directed at the seat of any fire.

Two readily accessible international shore connections shall be provided to enable the shore supply to be connected to the ship's fire main when in port.

Portable and non -portable fire extinguishers shall be provided and distributed throughout the cargo, science areas, working spaces, accommodation and machinery spaces to the requirements of the Classification Society and SOLAS.

Each machinery space shall have at least one portable foam applicator unit.

5.1.34 Fire Detection System

R5.74 All science laboratories, cargo and science holds, accommodation spaces, service spaces, store rooms, workshops, machinery spaces, within the hull and superstructure shall be protected by integrated addressable automatic fire detection systems which meet Class and Classification Society requirements.

Each science laboratory, cabin, control space, service space, stairway and passageway shall have at least one individual detector fitted. Cargo, Scientific Cargo and Machinery spaces shall be fitted with at least two sensors on each level of the machinery space of sub-divided machinery space and in the casings. The installation, number and type of sensors shall be selected from a range of equipment giving fast response for the area and fire risk designated.

Machinery space shall be protected with a mixture of UV flame detectors, heat detectors and smoke detectors. Detector sensitivity limits shall comply with Classification Society requirements.

Cargo holds shall be protected with a mixture of Ex Rated UV flame detectors, heat detectors and smoke detectors.

A fire detection system master panel shall be arranged in the wheelhouse, with visual and audible alarm, identifying the deck and compartment housing the source of the fire. A repeater panel, with identification only for sensors in alarm in machinery spaces, shall be arranged in the machinery control room. The fire detection system shall be linked with the alarm and monitoring system. Alarm acknowledgement shall be possible only at the Wheelhouse panel.

The fire detection system shall have a built-in uninterruptible power supply. The system shall be connected to the 24V DC supply.

Manually operated fire alarms consisting of bell push buttons (manually operated lever type in machinery spaces) shall be distributed throughout the accommodation, cargo holds science laboratories, machinery space and stores spaces. Alarm indication shall be arranged in the wheelhouse with alarm tones generated throughout the vessel.

A tone generated alarm, actuated from the wheelhouse, shall be distributed throughout the holds, accommodation, working spaces, science spaces, open deck areas, machinery space and machinery control room to SOLAS and Classification Society requirements.

This system shall provide a one -directional interface for providing fire alarm and trouble status indication via custom software that shall be used for mimicking fire alarms on designated computer screens throughout the vessel.

The fire detection system shall be capable of detecting and displaying a broken cable or bad sensor.

5.1.35 Quick Closing Valves

R5.75 All Fuel Oil, hydraulic oil, lubricating oil, AVTUR tanks shall be fitted with quick- closing valves in the outlet connections. These shall be controlled from the Safety Control Room.

5.1.36 Spare Parts and Tools

R5.76 Spare Parts List

Spare parts for all items of machinery shall be supplied within the contract price to meet Lloyd's Register guidance for unrestricted service

R5.77 Supply of Spare Parts

An itemised list of spare parts for main, auxiliary machinery and equipment suites (cranes, winches, etc) in accordance with *Manufacturer*s' recommendation for 2 years operations shall be supplied by the Contractor as one electronic copy. The list shall be provided at least 6 months prior to vessel interim delivery.

The Contractor shall be responsible for ensuring that sufficient spares are available for all tests and trials (including deep water winch trials) etc

The Contractor shall supply the following spare parts, all of which shall be preserved and packed for long term storage.

Propulsion System:

- Propeller blades – one set for each propeller
- Propeller blade seals – one set for one propeller
- Shaft seal – complete assembly

Main Generator Set:

- Cylinder head, complete assembly – one engine set
- Pistons, complete with rings – one engine set
- Main bearings – one engine set
- Fuel injectors / system – one engine set
- Turbocharger – complete assembly
- Alternator bearings – one set

Main and Auxiliary Switchboards:

- Main & auxiliary breakers – one of each type
- Spare drive unit (each size / model / type)

R5.78 Supply of Tools
All special tools required for overhaul of the main and auxiliary machinery shall be included within the contract price. The outfit of hand tools shall be provided by NERC.

The machinery manufacturer is to provide all special tools required to support the total overhaul of the engine type fitted. This is to include all special lifting devices with lifting gear certificates.

The shipyard is to provide secure sea stowage facilities in the engine room areas for all heavy tools and spare parts serviced by an overhead lifting/transfer system.

Stowage racks and lockers shall be provided by the Contractor for the special tools and outfit hand tools.

R5.79 Stowage of Spare Parts
The stowage positions of large and heavy items of spare parts shall be shown on a drawing submitted to the NERC representative, for approval.

Securing points shall be provided.

Machinery shall be supplied with spare parts to support it for 2 years continuous operation including all filter cartridges and associated parts for routine maintenance and any “insurance” items proposed by the engine manufacturers to reflect this duration of service.

Spare parts are to be stored in the designated store space within the engine room workshop plus the designated spaces where appropriate.

R5.80 Availability of Spare Parts
The suppliers of the main engine/shaft line equipment and the major auxiliaries, including auxiliary diesels, compressors, engine room pumps and HVAC systems, Cranes and Scientific Winch Systems, shall separately in their offers include a price for their recommended spares requirements for two years service. The availability of all items shall be stated, i.e. 'off the shelf' or 'lead time' to dispatch from *Manufacturer*.

5.1.37 Planned Maintenance System, Stock Control System & Lifting Equipment Register

R5.81 A planned maintenance system, stock control system and lifting equipment register complete with a net-worked work station located in the engineer's office shall be provided with the vessel.

This shall include stock code listings, Data packs (electronic and hard copy) shall be entered for all equipment on board. The system shall be compatible with existing systems used on board BAS ships utilising AMOS system.

The present supplier for the Marine Planned Maintenance Software and Stock Control System is:
SpecTec Ltd.
Address: The Lighthouse, 14 The Quays. Salford M50 3BF, United Kingdom
Tel: +44 161 888 2288
Fax: +44 161 888 2287

The present supplier for the Lifting Equipment Register is:
IMES Ltd
Address: Unit D1, Neville Shute Rd, Portsmouth, Hampshire, PO03 5RX
Tel: +44 (0)2392 699856
Fax: +44 (0)2392 699813
Website: www.imes-group.com

5.2 NERC STANDARDS

The Contractor shall conform to the NERC Standards embedded within the SoR.

NERC shall consider alternatives to the NERC Standards that, through the use of modern materials and production techniques, offer demonstrable improvement with regard to robustness, durability, and cost effectiveness.

Prospective Contractors shall submit tenders that are based on the SoR and the stated Standards. Any alternatives proposed shall be shown separately with clear statements of equivalent cost and technical advantage.

In the unlikely event that any of the NERC Standards create a conflict with the requirements of the Classification and Surveying Authorities then the requirements of the latter shall generally apply. In such event however it shall be brought to the immediate attention of NERC who shall discuss the issues with the Classification and Surveying Authorities directly.

All "Yard Standards" shall be submitted to the NERC for reference prior to construction. Only those yard standards submitted to the NERC prior to construction shall be deemed official Yard Standards.

Models – In addition to the typical modelling activity that the Contractor needs to undertake to assure himself and NERC that the design of the ship is sound, the Contractor shall undertake more in-depth modelling as described in Section 5.1.6.

A predictive weight control model to as high a level of accuracy as possible shall be produced and maintained for each stage in the ship's development and construction to ensure that the final draft, deadweight, sea-keeping and stability requirements shall be met. The predicted values of all design parameters supplied at Tender and the results of the model test programmes shall also be monitored and updated by the Contractor at appropriate points in the development and construction programme culminating in final validation in accordance with the requirements during the Tests and Trials Programme.

The Contractor shall demonstrate to NERC through modelling (e.g. 3D CAD) or other appropriate means that suitable ergonomic and human factors considerations have been applied to the design of the following areas:

- Wheelhouse
- Winch Control Room
- Science hangar
- Engine Control Room
- Galley

Other key areas where human factors and ergonomic considerations are important, e.g. emergency and secondary control stations.

Modelling (e.g. 3D CAD) shall be used to demonstrate that access to machinery for operation and maintenance in relation to adjacent machinery, ships structure, local piping and cable runs has been considered in the following areas:

- Engine Room
- Winch System including Wire Deployment Routes

5.3 TESTS and TRIALS PROGRAMME REQUIREMENT

Inspection, tests and trials of the vessel including her hull, machinery, equipment and outfits will be carried out by the Contractor or the Equipment manufacturers at their work shops or on board the vessel throughout the construction period of the vessel. This will be in accordance with the Contract, the Builders and/or the Manufacturers standards which will comply with the rules of the Classification Society and other rules and standards given in the contract.

In general Factory Acceptance Tests shall be carried out in accordance with manufacturer's standard and in compliance with Classification Society requirements. The procedures shall be submitted for review. In addition particular attention shall be paid to the following FATs which require specific procedures for this vessel.

NERC shall be informed of the shop test schedule (FAT's) at least 14 days in advance of the expected date of the shop test and the NERC's attendance shall be confirmed to the Contractor 5 days in advance of the date of the expected test.

Items subject to Liquidated Damages shall be specifically tested or otherwise demonstrated to confirm compliance with the requirements defined in this SoR. Where necessary means of correction for conditions at the time of test are required then this shall be agreed in advance of the test.

Factory Acceptance Tests – Specific Additional Requirements

Propulsion Motors

Factory acceptance tests of the propulsion motors shall include verification of predicted noise characteristics, using the electrical converters intended for installation on the vessel (or equivalent units).

Main Diesel Alternators

Factory Acceptance Tests shall include verification of predicted noise characteristics.

Piping Systems

Function & performance tests for all piping systems

Hydraulic Systems.

No hydraulic equipment is to be run before the whole hydraulic pipe work system has been thoroughly flushed. A flushing procedure and schematic sketch showing how this operation is to be carried out and what filters and magnets are to be used is required in advance. Flushing should ensure that a full flow is achieved through all parts of the hydraulic pipe work. This will have to be undertaken in sections to achieve the desired cleanliness results. System pumps should not be used for flushing purposes.

Science Hangar

- Science Hangar Doors
- Drainage arrangements
- Transfer of equipment – obstruction free

Working Deck (open deck & Science Hangar)

- Cargo securing device load test
- Dimensional check of securing systems
- Crane coverage
- Crane clash – crane with crane & cranes with other equipment / structures

Scientific Moonpool

- Cursor arrangement, operation and interface with top & bottom doors

Harbour & Sea Trials

Towards the end of the build period equipment will be progressively commissioned on board the vessel and subjected to firstly the HAT's and later the SAT's schedule laid out in this document. The progressive successful completion of these trials will lead eventually to NERC acceptance of the vessel.

THE OBJECTIVE OF THESE TRIALS IS TO DEMONSTRATE THAT THE VESSEL IS:

1) Complete and ready for sea in every respect.
2) Fit for purpose as described in the SoR.
3) Capable of providing a cost-effective, safe, flexible, and reliable platform appropriate to the role of the vessel as identified in this SoR.
4) Constructed to good internationally recognised western European commercial shipbuilding standards.
5) Compliance with all applicable Rules & Regulations.

WHEN STARTING SHIP TRIALS IT IS ASSUMED THAT:

1) Every major item of ships equipment has already been accepted at the makers "Factory Acceptance Tests" (FAT's) level as meeting the Statement of Requirements (SoR) and being fit for purpose.

2) All other smaller items of equipment supplied will be accompanied with the requisite type approval certificates and maker's factory test certificates.

3) The vessel's construction will be deemed to meet the SoR, provided that it is built in accordance with the latest revision of the plans submitted to NERC for Plan Review. The latest revision of plans will take into account all Plan Review comments that have been submitted to the shipyard by the NERC. The vessel's construction will also be supervised by NERC representative at the shipyard for ongoing compliance.

4) Thus on commencement of the ship trials the structure and equipment of the vessel will be substantially accepted, but have to be proven as a working series of integrated systems. This document is intended to provide the working framework for undertaking these system trials.

The Contractor shall carry out a comprehensive programme of tests and trials as part of the NERC acceptance of the ship. Schedule M1 Testing and Acceptance describes the requirements for testing and acceptance.

The shipyard is required to submitted a full copy of their own "TRIALS PROCEDURES DOCUMENT" that incorporates all FAT's, HAT's, SAT's, Sea trails, Ice trial and Noise ranging procedures for NERC to review and obtain their agreement 2 months before any tests or trials are due to start. This document shall be an evolving production as manufacture, construction and testing progresses and its satisfactory status, including satisfactory completion of such tests and trials already carried out, at any time shall be one of the requirements for payments shall be made under the Terms of Payment Schedule.

At this stage, the main tests and trials that shall be carried out by the Contractor include, but are not limited to, the following major risk areas:

1. On completion of construction, all oil fuel tanks, ballast tanks, water tanks and void spaces shall be pressure tested and inspected, according to Classification Society requirements and prior to the application of the paint system. Prior to testing all tanks shall be thoroughly cleaned with the removal of all slag, grit and debris followed by fresh water washing and drying. NERC representative to approve such tests and cleaning of each space before the paint system is applied.

2. All piping systems shall be hydrostatically tested according to Classification Society requirements, fully flushed and openings sealed to prevent ingress of foreign materials all in the presence of NERC's representative.

3. All lubricating, hydraulic and fuel oil systems shall be flushed with an appropriate flushing fluid after installation. After flushing, new filter elements shall be fitted throughout each system. Flushing to the specified standards shall be completed before connecting the system. For hydraulic oil systems the flushing shall be carried out by the equipment/system supplier.

4. Contractor to issue commissioning programme at least two weeks before commencement of commissioning. Contractor to prepare and submit to NERC for approval, detailed test protocols of parameters shall be measured and recorded during tests. Protocol to list specified and actual measurements obtained.

5. Machinery installation shall be tested on completion to demonstrate satisfactory working and compliance with specification requirements.

6. Electrical machinery, equipment and circuits plus alarm and monitoring system shall be tested after installation to demonstrate satisfactory workmanship and compliance with specified requirements.

7. The main propulsion alternator sets, auxiliary diesel alternator sets, azimuth units, bow thrust units, propulsion motors and associated drive units, switchboard and an cillary equipment, buoy crane, chain winch, towing winch and other equipment as required by the NERC , shall be subject to shop tests at manufacturers' works. A complete record of test data including verification of noise and vibration levels, shall be supplied to the NERC, who shall be invited to witness these tests.

8. The Contractor to give NERC a minimum of seven days notice of any shop test or trial of machinery and equipment.

9. Contractor to maintain a record of all tests and trials, including N.D.T. of structure, whether performed by him or manufacturers and shall be responsible for recording and collating all such data. Contractor to obtain from the manufacturers all readings and da ta of various tests performed prior to the installation of the equipment in the vessel and these shall be supplied to NERC prior to equipment installation.

10. All data recorded during the trials and commissioning of the vessel shall be neatly tabulated and analysed by the Contractor and issued as a trials report. Four (4) copies shall be forwarded to NERC at delivery of the vessel. Report to include:

    (a) Manufacturers' Test Reports of all engines, alternators, motors and equipment carried out before installation in the vessel.

    (b) Reports of all results obtained during commissioning including electric load tests and dock trials.

    (c) All data including infra red spectroscopy and vibration levels in accordance with class MCM notation shall be recorded.

    (d) Reports of all results obtained during sea trials.

11. Contractor to closely co-operate with equipment manufacturers to obtain operating range of speed, temperatures, pressure and other necessary data, shall be provided to NERC.

12. Contractor to supply at their expense, all fuel oils, lubricating oils, hydraulic oils, flushing oils and greases for the duration of the trials to and any subsequent re-trials. Brand and grade of oils and greases used during the trials to comply with NERC lubricating schedule and requirements in accordance with the Machinery & Equipment manufacturers recommendations for the intended service. Contractor to supply corrosion inhibitors and distilled water for the engine cooling systems until acceptance of the vessel by the NERC Brand and grade of each treatment shall be subject to machinery manufacturers and NERC approval.

13. After completion of trials and until acceptance, Contractor at his expense to maintain at normal operational level all header tanks, sump tanks and systems.

14. All expenses incurred in connection with the trials programme together with any retrials, shall be borne by the Contractor, who shall be responsible for the supply of all necessary instrumentation, fuel, lub. oil, fresh water, stores, crew, pilotage, towage, harbour dues, etc.

Factory Acceptance Tests (FATs)

The Contractor shall arrange and be responsible for comprehensive machinery and equipment tests and trials at *Manufacturer*s' facilities, involving both static and dynamic loading, to ensure the successful operation of the items under test prior to installation on the ship.

Some of these shall involve extensive integration testing of equipment, where test rigs and special measuring equipment is required to mock-up the actual arrangement and coupling of equipment on the ship and to simulate the loading. The prospective Contractors are requested to provide details in their tenders for conducting the following specific integration FATs, involving full-size mock-ups of the installation arrangements on the ship (Note that the full range of FATs shall include but not be limited to the following list):

Combined engine and generator operation tests

- *Propulsion motors*
- *Propellers*
- *Propeller Shaft*
- *Thruster Motors*
- *Scientific winch system operation tests including spooling of the working cables*
- *Hydrographic Systems*
- *Over-side lifting equipment*
- *Main Switchboards*
- *Cranes*
- *A full-scale bench simulation of the operation of the Propulsion Control System*

NERC shall be invited to witness all *Manufacturer*s' factory trials and a list of such trials shall be provided in the early stages of the contract. Where NERC choose to attend a trial, a representative from the contractor is also to attend.

Vessel shall be built under survey of Lloyds Register. Structural inspections and systems tests for Classification and Survey Authority requirements during construction

The Contractor shall arrange and be responsible for these tests.

Systems tests for NERC, Classification and Survey Authority requirements during commissioning.

In general Harbour and Sea Acceptance Tests shall be carried out in accordance with manufacturer's and Contractor's standard and in compliance with Classification Society requirements. The procedures shall be submitted for review. In addition particular attention shall be paid to the following tests which require specific procedures for this vessel.

FMEA Tests

FMEA tests shall include simulation of the faults and verification of the expected outcome and residual effective control.

Safety Case

- Simulation (as far as safe and practical of single failures identified in the Safety Case.
- Review and update as necessary of the Safety Case to reflect changes found during tests and trials.

Waste Management Systems

- Function and performance of waste handling, processing and storage systems.
- Extrapolation of the results of the tests to represent the conditions and requirements set out in this SoR.

Harbour Acceptance Trials (HATs)
The Contractor shall arrange and be responsible for these tests**.**

The prospective Contractors are requested to provide details in their tenders for conducting the following specific integration HATs (Note that the full range of HATs shall include but not be limited to the following list):

- Combined engine and generator operation tests
- Scientific winch system operation tests
- Hydrographic Systems
- Over-side lifting equipment
- Cranes
- Propulsion Control System
- Inclining experiment
- Bollard Pull test.

NERC shall be invited to witness all harbour trials and system commissioning tests and a list of such trials and tests shall be provided in the early stages of the contract. A representative from the contractor shall attend all harbour trials and tests.

Shallow Sea Acceptance Trials (SATs).

The Contractor shall arrange and be responsible for these tests.

The prospective Contractors are requested to provide details in their tenders for conducting the following specific integration SATs (Note that the full range of SATs shall include but not be limited to the following list):

- Combined engine and generator operation tests
- Scientific winch system operation tests
- Hydrographic Systems
- Over-side lifting equipment
- Cranes
- Propulsion Control System

NERC shall attend all sea trials and a list of such trials shall be provided in the early stages of the contract. A representative from the contractor shall attend all sea trials.

Instruments and Apparatus for the Sea Trial.

- The following data is to be clearly recorded for each trial manoeuvre.
- Date, Time, Ships draught and trim, Tidal speed and direction, Ships position, Speed, Propeller revolutions, and Rudder angle.
- The Depth of water in the sea trial area shall be measured by the vessels echo sounder.
- The Wind speed and direction shall be measured by the vessels anemometer and wind speed indicator.
- The vessels heading shall be measured by the vessels gyro compass.
- The vessels speed log shall be calibrated during the progressive speed test.
- An Independent DGPS (Differential Global Positioning System) shall be used for the speed test
- A computer aided data logging system shall be used for the manoeuvring trials.

1. When vessel is substantially complete, except for minor items of work, which at the discretion of the NERC , may be left unfinished until after trials and when the Contractor has made sufficient dock and sea trials shall be reasonably sure of the performance, the vessel shall be subjected to a sea trial in accordance with the approved trials programme. Prior to NERC sea trails, Contractor to prepare, sign and submit to NERC for approval a Certificate of Seaworthiness confirming condition of vessel, its operational status and seaworthiness.

2. Based on the inclined lightship particulars, the Contractor to submit for NERC approval a Trials Condition of Loading. The vessel shall be loaded and trimmed level to the design draft of 7.0m.

3. Trim/Draft Measurement. Prior to the sea trial the ship's draft shall be checked in the Forward, Aft, and mid ships Port and Starboard positions in the presents of the NERC's superintendent and the results recorded. The following information is to be given by the shipyard prior to starting sea trials on a marked up copy of the tank plan:

    - Total water ballast.
    - Total fresh water.
    - Total fuel.
    - Total lube/hydraulic oil.
    - Trials displacement.

4. Arrangements shall be made to obtain during the sea trials all data required to determine compliance with the contract requirements for speed, power, deadweight, internal underwater and external noise and also to obtain as far as practical any additional data which would be useful to NERC for subsequent operation of the vessel. Torsion meter shall be fitted to each propulsion drive shaft to record shaft powers.

5. At the commencement of sea trials, compasses, navigation and radio equipment shall be adjusted and calibrated.

6. After a work up of one hour at 25 percent, followed by one hour at 50 percent full power and one hour at 75 percent full power, an endurance trial shall be carried out of 12 consecutive hours duration at maximum continuous rating of the propulsion motors. During this trial, record shall be taken of the diesel prime movers, including fuel rack settings, turbo charger speeds, exhaust temperatures and exhaust back pressures. Pressures and temperatures of the various systems shall be similarly recorded. In addition full record shall be taken of each propulsion motor input kW, voltage, amperage, power factor, shaft speed, winding temperatures, conductor temperature, cooling air temperatures, etc.

7. No other trials shall be run in conjunction with the endurance trial except for the Class UMS trial, measurement of internal noise and vibration levels and the measurement of ventilation and air conditioning of the vessel.

8. The vessel shall be subjected to progressive speed trials consisting of six double runs over an approved measured mile to obtain curves of speed, power and propeller RPM utilising combinations of propulsion alternators.

9. During the progressive speed trial, full records of the diesel prime movers, alternators and associated systems and the propulsion system including propulsion motor input voltage, amperage, power factor, etc., shall be recorded.

10. From the data recorded on the speed trial it shall be demonstrated that the vessel at the design level keel draft of 7.0 metres when achieving a speed of not less than 13 knots, with the propulsion motors do not exceeding their predicted power requirement

11. The shipyard shall demonstrate that the vessel has good directional stability by conducting an Autopilot test to show that under autopilot control at all speeds from 6 knots up to 14 knots, the true heading of the vessel does not vary more than +/- 3 degrees with the controlling helm angle not exceeding +/- 3 degrees while operating in an area sea state 2 and wind speed no more than 10 knots.

12. Confirmation of redundant propulsion features shall include navigation under full power using one propeller only, powered from one Engine Room. This shall include safe locking of the propulsion shaft which is not running.

13. Effective operation of stability / heeling system and tanks.

14. Turning trials ahead and astern shall be carried out at two speeds of advance, i.e. five knots and full speed to both port and starboard. The diameter of turning circles, advance, transfer and time taken to complete the full circle shall be recorded.

15. Steering gear motor currents shall be recorded, together with time taken for helm amidships to hard-over and from hard-over port to hard-over starboard.

16. Emergency steering shall be demonstrated.

17. Slow speed manoeuvrability shall be demonstrated with and without joy stick control.

18. Turning trials shall be conducted to measure the rate of turn of the vessel, using one/two bow thrust units only. The vessel shall be positioned head to wind and with the unit(s) thrusting to port, the vessel shall be turned through 180 degrees. When the vessel has reached 180 degrees, from the original course, the thrust of the unit(s) shall be immediately reversed and the vessel returned to its original heading. The vessel's heading shall be recorded every 20 seconds. Test shall be repeated with unit(s) initially thrusting to starboard.

19. With the vessel proceeding ahead at full speed, the following stopping tests shall be conducted:-

    (a) Crash stop

    (b) Coasting stop

    (c) Turning circles (to port and starboard)

    Time and distances shall be recorded and plots prepared.

20. Dynamic Positioning (DP) trial to Class requirements in waters of more than 50m depth using all reference systems demonstrating redundancy in compliance with class FMEA.

21. Manoeuvring Trial. The shipyard is to demonstrate that the vessel is capable of being safely manoeuvred and berthed without the assistance of tugs in beam on winds up to 35 knots and a water depth providing 1.5m clearance under the keel.

22. During the endurance trial records of the noise level in each space of the accommodation, working spaces, machinery spaces and open decks shall be made by the Contractor and verified against the specified requirements.

23. During the endurance trial, measurement of vibration levels at agreed points throughout the vessel shall be made by the Contractor and compared against specified requirements. If excessive local vibration in structure, equipment and/or installations is noted during the trials, measurements shall be recorded by the Contractor and remedial action taken by the Contractor.

24. Other tests shall be carried out during sea trials to include the following:-

    (a) Anchor trials – lifting of both anchors singly and together with efficient self storage of cables and housing of anchors shall be demonstrated.

(b) Air conditioning and ventilation trials shall be conducted during the endurance trial, with air flows and temperatures recorded.

(c) Engine room ventilation trial shall be conducted during the endurance trial with the vessel proceeding at the 100 percent rating of the propulsion motors. Air supply and exhaust to the machinery spaces shall be measured and recorded by the Contractor. Air pressure in the machinery space shall be recorded and compared with the ambient pressure.

(d) UMS trial to Class requirements shall be carried out during the endurance trial.

(e) Lighting levels – accommodation, working spaces and external decks including aft working deck, overside working areas, tween deck, hold and heli-deck shall be recorded and verified against specified requirements.

25. During NERC sea trials, as part of the MCM Class notation requirements, vibration monitoring and infra red measurements shall be recorded and entered into the Planned Maintenance System (PMS).

26. On completion of sea trials, a partial examination of the main machinery shall be carried out. The parts shall be opened up for NERC inspection shall be finalised after satisfactory sea trials have been completed.

27. On completion of sea trials a partial examination of electrical equipment shall be made at the discretion of the NERC. In general, the examination to consist of visual examination of components through inspection openings and racking of switch gear from the working position. The parts shall be opened out for NERC inspection shall be finalised after satisfactory sea trials have been completed.

28. Electrical insulation measurements shall be taken before and after each trial for each item of electrical machinery and associated circuits where practical and recorded.

29. If departure of the vessel from the Contractor's yard exceeds seven days from the completion of the NERC's sea trials, a new set of insulation readings of major electrical equipment shall be taken and appended to the trials report.

30. If serious defects are noted during the sea trials NERC reserve the right to demand further sea trials to demonstrate that the rectification of defects has been carried out to the NERC satisfaction.

Underwater Radiated Noise Ranging - The Contractor shall arrange and be responsible for these tests.

Scientific Trials - The Contractor shall arrange and be responsible for these tests.

Deep Sea Acceptance Trials (D-SATs).
Deep Water Trials post Interim Acceptance – NERC shall be responsible for providing and arranging the vessel for these tests at a suitable geographic location. The Contractor shall be responsible for providing its and / or sub-contractor support for the specific elements of the vessel being tested. The systems requiring this approach are:

- Winch Systems
- Over-side Lifting equipment
- Hydrographic Suite

Noise and Vibration Measurements.

1. These tests are to be carried out in a systematic survey manner throughout the whole vessel using the ship GA drawing as a planning tool for the exercise.
2. All items of machinery are to be measured in their full operational running condition.
3. Particular attention is to be given to the aft HPU machinery and the cargo hold with HP seismic containerised compressors running. The aft accommodation on main deck is to be particularly addressed under these conditions
4. Special attention is also to be given to the main engines in a fully loaded condition.
5. Readings obtained from the uncoupled trial on the main propulsion electric drive motors are to be integrated into the overall N&V report.
6. Overall readings are also to be given for the machinery, laboratory and accommodation spaces.

Bubble sweepdown predictions shall be confirmed by the use of cameras attached to the hull in positions corresponding to those used as reference points in model tests and include the location of acoustic survey equipment, moonpool and propellers.

Underwater Radiated Noise Ranging - The Contractor shall arrange and be responsible for these tests. Sufficient testing shall be carried out to identify the noise characteristics of main sources of noise.

Ice trials
A comprehensive range of Ice trials shall be undertaken post interim acceptance. A program of ice trials is to be developed by the bidder as part of the tender package. The following is a list of Ice trials that should be considered for bidding purposes:

- Ice breaking trials shall be und ertaken with ice at a v ariety of thicknesses, up to 1.0m (to be measured at the test site).
- Backing trials are also shall be undertaken in the broken channel.
- Ridge breaking test and Ramming tests shall be undertaken.
- Manoeuvring tests including turning test and a breakout test shall be undertaken.

- Heel and trimming system shall be tested at this stage
- Deck heating systems shall be tested
- During the tests the stress monitoring system shall be used to monitor structural performance of the hull and the rudder stock.
- Ice thickness, snow depth and flexural strength shall be measured during the trials.
- Winterisation features shall be tested during the ice trials or during other occurrences of very low temperatures (below -20 degrees C).

Bollard Trials

A static bollard pull trial shall be conducted at the maximum rating of the propulsion motors, with the vessel securely attached to a fixed point ashore and respectively to the emergency towing arrangement. A dynamometer complete with calibration certificate shall be arranged at the shore end of the tow line and shall be free swinging. The length of the towline shall be at least five times the length of the vessel and the depth of water at the trial site shall be at least three times the draught of the vessel. Location of trial shall be to NERC's approval. Alternative thrust predictions with full scale verification may be proposed.

With the vessel stationary, the static thrust of each bow thruster unit to measured and verified against manufacturer's nominated thrust, to NERC approval.

5.4 TRAINING and HANDOVER REQUIREMENTS

Training of NERC staff shall be arranged directly between NERC and the relevant equipment suppliers. In doing this, NERC would wish to take advantage of any training provided by the equipment suppliers as an integral part of their supply.

Handover shall be done progressively. NERC ship operations staff shall be available as agreed with the Contractor during the latter stages of the build programme until acceptance. They shall be present to observe the progress and content of the various commissioning activities.

It is not NERC's intention at this stage to provide operational staff to the Contractor to participate formally in the safe operation of the ship during the sea trials, although NERC does anticipate that its operational staff shall be present to witness the trials.

5.5 REQUIREMENTS for DRAWINGS, MANUALS and DOCUMENTATION

5.5.1 ISM System Information

R5.82 All necessary information and data shall be provided for incorporation in the NERC fleet system. This shall include for example safety training information, machinery and equipment manuals and a technical library. This shall be supplied in both electronic and hard copy format. For example 5 sets of hard copy and two sets electronic. Drawings shall be in both hard copy and electronic in the latest release AutoCAD format.

A list of "As fitted drawings" shall be agreed with the Owner. These drawings shall be updated by the Contractor to account for any modifications or alterations made by the Contractor or his behalf during the guarantee period.

5.6 CONTRACTOR'S TENDER, SPECIFICATION and STANDARDS

The Prospective Contractor shall provide, with his Tender, a complete set of his detailed shipyard Building Standards as applicable to this vessel, details of their independently accredited shipyard QA system (which shall be subject to audit by NERC prior to Contract), Standard Tariff Rates, and a fully detailed Build Specification including the items referred to in this SoR and any others not mentioned but nevertheless required for the completeness of the intended supply.

The Specification shall contain at least:

- For each item or system;
- A description of its operating principles, outfit and performance.

A reference drawing (detailed general arrangement or schematic as appropriate).

Specifications of items of equipment and/or fittings including the proposed *Manufacturer* with the data sheets showing drawings, details of materials and performance characteristics.

The Specification shall be supported by a detailed overall general arrangement drawing, a lines plan, a proposed structural midship section, a structural section in way of the diesel generating power plant showing proposed unit supports and rafts, and preliminary profile and deck structural plans.

Detail to include *Manufacturer* and model number of all main items of equipment including pumps, outfitting details such as lighting, electrical fittings, etc.

Brochures shall be provided for all principle items of equipment and machinery proposed.

These documents shall be used in the Tender Evaluation process to judge the quality and comprehensiveness of the proposed supply and whether additional price allowances shall need shall be added in the Tender evaluation to ensure completeness. Where names of equipment suppliers are requested, then it may be appropriate to list more than one potential solution to maintain a competitive position with the suppliers. Any indication of prices quoted in the Pricing Schedule (Section 4 of the ITT documentation) shall be relate to the prices provided by the named supplier(s) and not a cheaper alternative.

If the Contractor's Tender contains exclusions or omissions then NERC shall apply suitable values for those items in the evaluation of pricing in order to assure like for like comparisons.

5.7 STANDARD TARIFF RATES

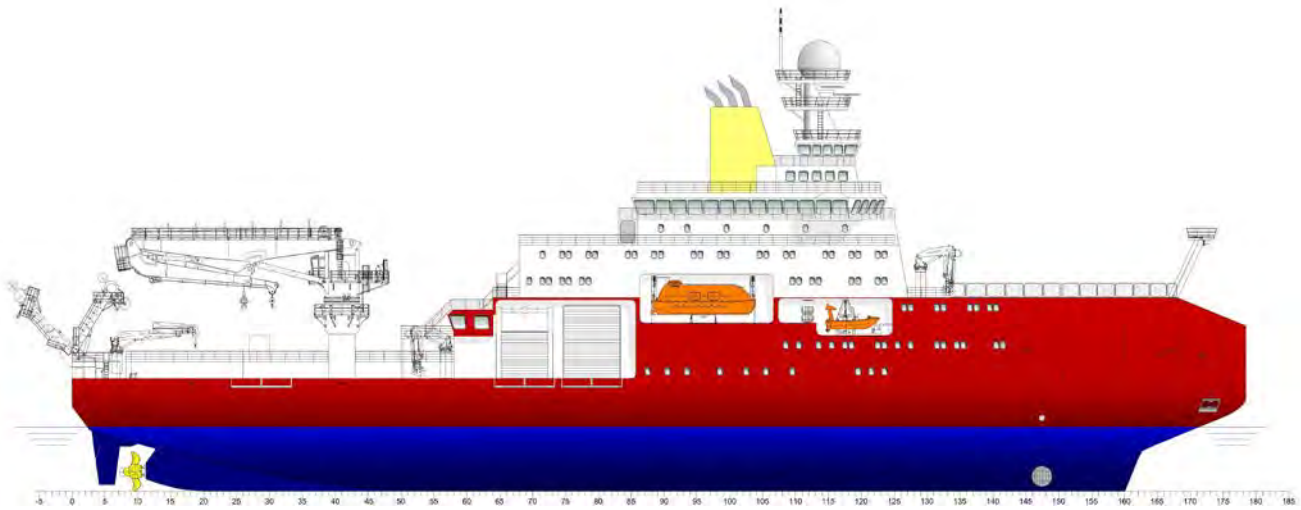
The prospective Contractor shall provide the standard tariff rates that are listed in the Price Schedule (Section 4 of the Contract Document).

SoR – New Polar Research Vessel (NPRV

STATEMENT of REQUIREMENTS (SoR) for the DESIGN and BUILD of the NEW POLAR RESEARCH VESSEL (NPRV)

Company Confidential

NERC 2015



Section 6 – THE REQUIREMENTS OF THE SHIP AND SHIP SYSTEMS

6. THE REQUIREMENTS OF THE SHIP AND SHIP SYSTEMS

6.1 HULL

6.1.1 Masts

R6.1 A fore mast and a main mast shall be fitted. They shall be of smooth construction with the minimum of clutter which might serve to promote the accretion of ice.

The masts shall carry the statutory lights and signals and shall be fitted with yards and halyards for flags and "Day Shapes". "Day Shapes", karabiner clips lines and cleats shall be provided. Ready safe access, by means of ladders and protected standing platforms, shall be provided to all lights to effect bulb changes and maintenance.

An exemption shall be sought by the builder against the provisions of Annex I.3 for the horizontal positioning of the masthead lights.

The mast shall provide a suitable location and foundation for the main radar and satellite communication domes and communication antennas. The location shall be determined in consultation with the Equipment suppliers.

The structure in way of the satellite and communication aerials shall be designed to minimise blind spots. Special attention shall be given to the location of the domes and antennas to ensure uninterrupted operation at 75 degrees latitude. Duplication to be undertaken if necessary. GMDSS Sea Area A1, A2, A3 & A4.

Special attention including, but not limited to Finite Element Analysis and stiff foundation shall be given to the design of the Mast structure to absorb accelerations imposed by operations at sea and in ice and for the avoidance of vibration of masts and associated structures.

The masts shall be un-stayed.

The main mast and foremast shall be of steel construction and retractable to allow unobstructed helicopter operations. Aluminium construction shall be considered if deemed necessary for weight control.

6.1.2 Aerial Platform

R6.2 A scientific aerial platform shall be provided at about midship, at a minimum of 4m above the highest superstructure deck and with a clear view all round. It shall be faired and structurally smooth to suppress ice accretion.

The platform shall be equipped with temporary scientific aerials and sensors installed on a cruise by cruise basis.

The platform may be incorporated in the main mast above the wheelhouse top with enclosed access from the wheelhouse or mounted separately.

Personnel access from below shall be via a mast house within which scientific junction boxes and power distribution boxes can be mounted and Roxtech or equivalent glands fitted to allow cable entries and exits to the platform.

Platform plating shall have flush matrix bolting system similar to other areas of the working decks, except that screw sockets may be M16, at 500mm spacing shall be provided with a total area of at least $10m^2$.

Access for personnel is required at all times and must not be prevented by operation of other equipment such as aerials, radar scanners, sound signalling and satellite equipment. A comprehensive aerial plan shall be prepared for the vessel showing all potential interactions of equipment and potential areas dangerous to personnel which shall be agreed with the Owner before implementation.

The aerial platform and main mast shall carry a substantial outfit of transceivers and antennae. These shall be both fixed and temporary installations (cruise by cruise). The Contractor shall be responsible for ensuring that all fixed equipment supplied under the Contract performs effectively and mutual interferences are eliminated.

Aerials and equipment shall be readily and safely lifted on and off the platform and lifting apparatus shall be supplied for this purpose.
See also 6.3.11

6.1.3 Meteorological Platform

R6.3 A meteorological platform shall be provided at the forward end of the vessel. It shall be located in a position such that atmospheric measurement instruments are free from air flow and chemical interference from the ship's bow structures. This shall be verified during wind tunnel testing. A basic criteria shall minimise the wind speed bias (relative to free-stream flow) at the locations where wind speed measurements shall be made - primarily the foremast location, the ideal is a bias < 1% of free stream flow. In general the bias will be smaller as the measurement location is moved up / forward. (See Section 5.1.6)

It shall be faired, with minimum surface area and structurally smooth to suppress ice accretion.

The platform shall have an area of a minimum of $5m^2$ may be incorporated in the fore mast.

Good permanent connectivity is required to the main laboratory (cable with many channels, mains power; 230V 50Hz, 230V 50Hz Clean and 115V 60hz supplies, Ethernet, stainless steel piping).

Cable trays and space for installation of temporary and permanent sampling piping and cables to be provided.

Personnel access shall be protected and is to be internal to the support structure.

Sensors and equipment shall be readily and safely lifted on and off the platform.

If the platform is incorporated with the foremast the forward navigation lights shall be mounted below the platform level and must have direct, safe, and easy access for bulb changing and maintenance.

If the platform is fitted in way of the heli-deck it must be retractable to avoid obstructions during helicopter operations.

6.1.4 Crow's Nest

R6.4 The vessel shall be fitted with a crow's nest. The crow's nest shall have sufficient space for at least 2 crew.

It shall have a repeater station for control of the main propulsion motors, propeller pitch and rudder angle as a minimum.

There shall be facilities to enable the control and co-ordination of UAV operations for either science or navigation.

6.1.5 U.K. Meteorological Office Weather Station

R6.5 NERC shall supply, free issue, a UK Met. Office standard weather station package (BATOS II) and the Contractor shall install.

It shall be mounted partly (wind sensor) on the forward meteorological platform and partly on the wheelhouse top and shall be connected to recording instruments to be mounted in the Wheelhouse.

The automatic weather station BATOS II is intended to be set up on VOS (Voluntary Observing Ships) and allows measurement of all the basic meteorological surface parameters. Manual observations may also be input, so that the station can send a complete SYNOP SHIP message.

The BATOS II system allows direct acquisition of digital sensors so that the sensor collector can be removed. Wiring and installation of the station are simplified.

New sensors are used: the wind sensor, which is a new generation of ultrasonic and digital sensors, and the combined pressure, temperature and humidity digital sensor (see next figs. 1 and 2).

Fig. 1: Components of the BATOS II system.

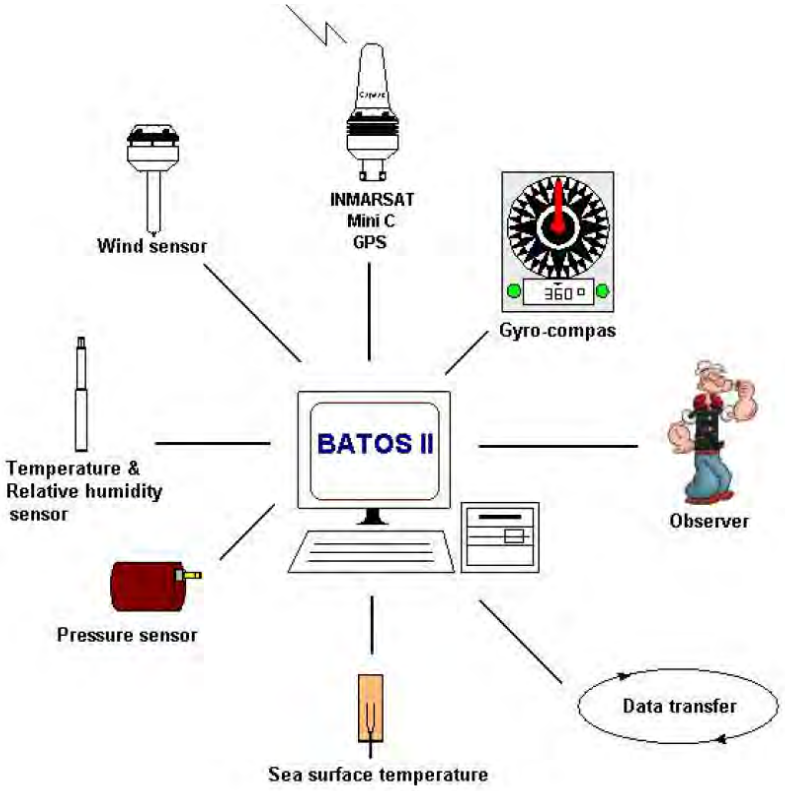


Fig. 2: BATOS II.

DESCRIPTION OF THE COMPONENTS

Pressure, Temperature and Relative Humidity

BATOS II: PTU 200 (Vaisala) is a combined sensor which consists of a pressure unit (PTB220 equivalent) and the HMP 45 D sensor for temperature and relative humidity measurement.

Ranges:

- pressure: 800 hPa to 1100 hPa
- temperature: -30 to 50 °C
- humidity: 0,8 to 100 %

Wind sensor

BATOS II: CV3F (LCJCAPTEURS)

- Speed range: 0 to 50 m.s-1
- Temperature range: 0 to 40 °C

Another ultrasonic wind sensor from GILL, suited for a larger temperature range, is currently under test and can be connected to the system.

Sea Surface Temperature

BATOS II: a hull contact sensor PT100 (SPCK PROSENSOR) is affixed on the hull of the ship and under the waterline.

- Range: -80 to 160 °C

Screen

BATOS II: the naturally ventilated multiplate screen Miniature Marine (SOCRIMA) is used to protect the HMP 45 D sensor.

- Enclosure: (Ø x H) 20 cm x 50 cm.

Transmission System

BATOS II: Inmarsat standard Mini C, transceiver, omni-directional antenna and GPS receiver in one single unit.

Sensor collector

BATOS: QLI50 sensor collector (Vaisala) acts as the interface between analog sensors and data collecting computer.

Software BATOS

BATOS II: version 2, linked to the sensor collector for data acquisition, calculates the true wind (from the apparent wind and the speed and heading of the ship), allows the input of human observations, checks quality and coherence of the data, creates and sends messages every one, three or six hours (using code 41) by communicating directly with sensors which shall be rated for operation at PST of -35ºC.

6.1.6 Wheelhouse

R6.6 A fully enclosed wheelhouse incorporating an integrated navigation and control system shall be arranged and comply with Regulation 19 and Annex 11 of SOLAS Chapter V – Shipborne Navigational Systems and Equipment.

Preference would be for a single supplier providing integration of all systems, i.e. VMS, Power Management System, DP, Navigation, Propulsion controls using common hardware, incorporating scientific instrumentation display and survey data transfer.

The Contractor shall be responsible for:

- The design of the bridge arrangements and the necessary consoles and equipment etc. to contain the equipment and set it up in an integrated manner.
- The fitment of all the equipment in a proper manner in accordance with the requirements of the Suppliers and the Surveying Authorities as appropriate.

Wheelhouse outfit shall include:

- Central control and monitoring console incorporating all controls, alarms and navigation equipment.
- DP Control Consoles.
- Bridge wing control positions with sockets for portable control panel for thrusters.
- Safety monitoring and control panel.
- Communications (GMDSS) console.
- Navigation console with ECDIS displays.
- Storage for navigation and safety outfit.

- 1 sideboard combination with sink and refrigerator.

- 2 pilot chairs adjustable type in way of central console (positioned to avoid operator's feet being placed on c onsoles). One of the chairs shall incorporate radar/ECDIS controls, autopilot and joystick functions in the armrests. The chair to be arranger for maximum view through forward windows.

6.1.7 Integrated Navigation System

R6.7 The Contractor shall supply and correctly install an integrated navigation system shall be installed which provides ergonomic and coordinated use of the navigation equipment described below.

The DP control station located in the starboard aft part of the Wheelhouse shall include display of basic navigation information, including ECDIS / radar display.

The integrated navigation system shall be using a dual redundant network (LAN), distributing internal and external data. The vessel's data (heading, course, speed, depth, Rate of Turn etc) shall at any given time be identical on all displays within the system

Central Alarm System and Bridge Alert Management shall be incorporated functions of the navigation system, and not individually wired / interfaced units.

Navigation data shall be made available in science project control stations, including the UIC Room and Main Laboratory. The data shall be available on a repeater basis only, with no remote control features. Repeater stations shall be allowed for in the following locations:

- Chief Scientist accommodation
- Data Suite
- UIC Room
- Laboratories

The navigation system shall include a (22 – 27") slave display for the Swath Bathymetry systems at both the main navigation console and DP control station.
The following additional requirements shall be satisfied.

a. ECDIS & Radar displays on Wheelhouse to be 27" minimum.

b. One dedicated Conning instrumentation display and four multifunctional ECDIS/Radar displays with built-in track, heading and c ourse keeping autopilot shall be included in the Navigation console. One ECDIS/Radar display shall be included at the Starboard Wing Control / DP station.

c. A slave ECDIS display (22 – 27") shall be included within the display / operation console in the Main Laboratory, see item R7.21 and R7.22.

d. The IBS shall have two DGPS units, 1 display at each console and patched out to the DP desk as required for DP operations (DP2)

e. A slave display (22 – 27") from the Swath Bathymetry Systems (R7.5) shall be included with the forward console or associated head-up display area.

f. A slave display (22 – 27") from the Swath Bathymetry Systems (R7.5) shall be included with the Aft DP Console head-up display area.

g. The ECDIS units shall have incorporated functions for planning surveys, and shall be accepting input of co-ordinates from the Laboratories (see item R7.5). The ECDIS/Radar stations shall also be capable of updating / displaying depth data from multi-beam echo sounders, and displaying identity and position of deployed scientific instruments (towfish, trawl sensors, ROV/AUV etc) with input from scientific system / hydro-acoustics

h. The CCTV system shall be interfaced with the ECDIS/Radar displays to allow the display of a CCTV picture in a closable window.

i. The table below shows the minimum equipment requirement, this shall be used as an illustration of the minimum standard and exceeded to meet legislation or above individual requirements.

EXEMPLARS of Equipment to be installed (see below):

Type of Equipment	**Make**	**Model**
BridgeLine Integrated Navigation System	Kongsberg	K-Bridge
ARPA Radars	Kongsberg	K-Bridge ARPA Radar
X-Band Radar Scanners	Kongsberg	X-Band Scanner and 25kW Transceiver
ECDIS	Kongsberg	K-Bridge ECDIS
Ice Radar	Rutter	Sigma S6 Ice Navigator
Master Gyro Compass	Sperry Marine	One Mechanical and One Ring Laser
Compass Monitor & Control Unit	Sperry Marine	NAVITWIN IV
Bearing Compass Repeater	Sperry Marine	
Digital Heading Repeaters	Sperry	
Magnetic Compass and Binnacle Stand	Sperry	Jupiter Compass & Navipol 1 Binnacle
Echo Sounder System	Kongsberg	EN 250
Digital Depth Repeater	Kongsberg	IR 301
Doppler Speed Log System	Kongsberg	Skipper DL 850
Dual Axis Digital Repeater	Kongsberg	Skipper CR401
DGPS Navigator	Kongsberg	Simrad MX420/8
Voyage Data Recorder	Kongsberg	
Forward Looking Sonar	Kongsberg	Simrad SX90
Weather Facsimile	Kongsberg	JAX-9A

6.1.8 Dynamic Positioning Equipment

R6.8 The Contractor shall supply and correctly install a Kongsberg K-Pos dynamic positioning and track-control system shall be provided. See section 4.2.5.

The vessel shall be Lloyds Register DP2 (DP(AA)) (Automatic and s tandby manual controls for position keeping and with position reference systems and env ironmental sensors) with enhancements for control, sensors and UPS. These enhancements shall be as per Lloyds Register DP2 (DP(AA)) requirements. A FMEA shall be completed in conjunction with the DP supplier by the Contractor prior to vessel handover. The system shall have a “Green” option for relaxing station keeping precision / tolerance.

The DP outfit shall include within the sensor provision:

a. Two Seatex Seapath 330+ system (L1/Glo+L1/L2/Glo with MRU5) with minimum antenna separation 2.5m.

b. A method of sharing with the two Seapath 330+ data with instrumentation in the Laboratories, see item R.7.4.

The Dynamic Positioning control station shall be located in the starboard aft part of the Wheelhouse with a clear view over the starboard side in the science working area of the vessel. The DP control station shall be provided with an ergonomic arrangement for the operator in a seated position. In addition some basic navigation functions shall be provided for a navigator to be seated alongside the DP operator and provided with independent propulsion, steering and thruster controls and radar repeater display.

A means for utilizing the DP joystick functions shall be arranged at the port and starboard docking stations (by a portable joystick) and in the navigation station (pilot chair).

6.1.9 Gyro Compass / Magnetic Compass & Autopilot

R6.9 The Contractor shall supply and correctly install three separate gyro compasses, located in at least two separate compartments, suitable for common use for the navigation, scientific and dynamic positioning systems.

One of the gyros shall be fibre-optic type and include output to ADCP, multi-beam echo sounder and gravity meter.

Gyro repeater shall be fitted in the aft steering gear rooms, in sight of the local steering control station.

Repeaters for taking bearings shall be fitted at bridge wings to comply with Regulations.

One magnetic compass shall be installed.

6.1.10 Echo Sounder (Navigation System)

R6.10 The Contractor shall supply and correctly install an Echo Sounder with recorder in wheelhouse. Scale ranges 0-100m and 0-2500m and with audio-visual depth alarm.

6.1.11 Anemometer

R6.11 The Contractor shall supply and correctly install an anemometer and display unit with true wind speed and direction indication shall be installed in the wheelhouse. Three wind sensors shall be installed (refer to section DP Reference system R5.53.

6.1.12 Speed Log

R6.12 The Contractor shall supply and correctly install a Doppler dual axis type with transducer and sea valve shall be installed. Display unit providing speed in knots and distance shall be fitted in the Wheelhouse. An interface shall be provided with the navigation system.

In addition an electromagnetic (EM) speed log shall be installed.

6.1.13 Radar Equipment

R6.13 The Contractor shall supply and correctly install a Category 1 radar installation shall consist of one (1) set of X-band, 3cm wave length radar (suitable for use with aviation operations), one set of S-band, 10cm wave length radar, each with performance monitoring and inter switch unit. An additional radar scanner (6ft) shall be fitted to support aviation activities and connected via the inter-switch unit to the wheelhouse radar displays and display in the Helicopter / UAV Control Desk in Wheelhouse Radar systems shall be able to display video from all three scanners simultaneously (user selectable on each display), and have means for seamless tracking of targets between scanners.

The radar installation shall include ice detection utilising Rutter Sigma S6 Ice Navigator software or equivalent

6.1.14 ECDIS - Electronic Chart System

R6.14 The Contractor shall supply and correctly install an integrated navigation system comprising redundant ECDIS electronic chart systems that meet the technical requirements for operation with electronic charts (vector & raster charts).

Electronic Chart Display Information System (ECDIS, Electronic chart system, interfaced together with LAN.

The track-keeping shall be capable of performing manual steering mode with constant radius turns and automatic track steering mode with way points in the ECDIS system.

Navigation system shall be interfaced to all radar displays and user generated synthetic maps shall be displayed both on ECDIS screen and on radar screens.

Tracked ARPA targets shall be displayed on ECDIS.

Navigation system shall be interfaced to following ship sensors:

- Radar displays.
- Gyro compass system.
- Speed log.
- Positioning devices.
- Echo sounder.
- Wind sensors.
- Steering system.
- Propulsion system.
- Alarm transfer system.

Two 22-27" EC monitors shall be installed in the bridge console. Track-keeping recording functions shall be included.

Bridge wing displays (22-27") shall be installed port and starboard, providing repeat information to that on the main console displays.

The navigation system shall incorporate means of accepting data from the Main Laboratory for survey planning purposes.

6.1.15 DGPS

R6.15 The Contractor shall supply and correctly install two DGPS Satellite navigation equipment sets complete with gyro, navigation system and DP system, log, interface including connection to autopilot.

DGPS Equipment – Requirements for NPRV

a) One C-Nav – 2050 Dual Frequency Receiver System(R) with C-NaviGator complete with all antennas (to include an L-Band antenna for high latitude operations) and interface cables. Corrections signals shall be distributed (via splitter or direct) to all GPS receivers. This unit shall be used for the Marine Outfit i.e. IBS and DP and Scientific Outfit e.g. PosMV. This unit shall be the primary differential correction system. (Supplier: C&C Technologies UK Ltd, +44 1284 703800, www.cctechnol.com). Correction Signal Subscriptions shall be arranged by NERC once the initial installation has been demonstrated as complete.

b) One Fugro SeaSTAR Differential Correction Receiver shall be provided with correction signals distributed (via splitter or direct) to all onboard GPS receivers. The unit shall be a Model 8200HP (SeaSTAR/SBAS/IALA enabled) or equivalent to be used for the Marine Outfit i.e. IBS and DP and Scientific Outfit e.g. PosMV. This unit shall provide redundancy in event of a failure with the unit described at 3.1 above. (Supplier: Fugro Survey Ltd, +44 1493440320). Correction Signal Subscriptions shall be arranged by NERC once the initial installation has been demonstrated as complete.

Tests and trials of the equipment shall be to the satisfaction of NERC.

6.1.16 Facsimile Receiver

R6.16 The Contractor shall supply and correctly install a Weather chart facsimile receiver set complete with printer.

6.1.17 GMDSS Station / Radio Equipment

R6.17 A GMDSS / radio station shall be installed, complete with curtains and local dimmable lighting.

See below for additional and specific Owner requirements. A display of position shall be included in close proximity.

GMDSS / Radio Equipment – *EXEMPLARS* for NPRV.

Type of Equipment	Make	Model	
GMDSS Console	Sailor	Sailor A4 Solution	
GMDSS Remote Alarm Panel	Sailor		
VHF DSC Tx/Rx Fixed	Sailor	RT4822	
VHF GMDSS Portable	Sailor (Thrane & Thrane)	SP3300	
Portable VHF	Motorola	MTS2000	
AIS Transponder	Kongsberg	AIS200	
UHF Portable x 10	Motorola	GP340	
SART	Jotron	TRONSART	Forward
			Aft
			P & S Lifeboat
Auto EPIRB (Above Aerial Platform)	Jotron	TRON 40S Beacon 2	
Manual EPIRB (Aft Wheelhouse)	Jotron	TRON 40S Beacon 1	
Navtex	ICS	NAV7	
Weather Facsimile	Kongsberg	JAX-9A	
Fax Machine	OKI	OKIFAX 4580	
SSAS(Ship Security Alert System)			
Air Band VHF Fixed	JOTRON	TR-710 MD	
Air Band VHF Portable x 3			
VHF Portable x 10	Sailor (Thrane & Thrane)	SP3300	
MF/HF DSC	Sailor (Thrane & Thrane)	HC4500/500W	
HF Radio Direction Finder	Argos		
Satellite Earth Station – Sat C	Sailor	H2095C	
Satellite Earth Station – Sat F	NERA	Fleet 77	
Marine Stabilised C-Band Communication System (V-Sat) Invsat SE2400	Orbit	AL 7108/9	

Statutory equipment requirements for GMDSS Area A1, A2, and A3 & A4 plus:

a) An “Air Band VHF” shall be provided. It is required for combined air/vessel sampling operations.

b) The table aforegoing shows the equipment fit which shall be considered a minimum standard.

c) Note need for two 500Watt MF/HF DSC.

6.1.18 Not Used
R6.18

6.1.19 Navigation System UPS
R6.19 The Contractor shall supply and correctly install an uninterruptable power supply (UPS) serving the key navigation equipment described in the above sections 6.1.7 – 6.1.17.

6.1.20 Additional Wheelhouse Requirements
R6.20 Arrangement of the wheelhouse shall be in accordance with ISO 8648. The wheelhouse shall have all round vision, including cargo, heli-deck and VERTREP areas.

Bridge wings shall be fully enclosed and extend beyond the ship side to provide a view of the whole of the ship side at its maximum beam. Internal and external access shall be arranged.

The safety monitoring and control panel shall be arranged with the following:

- Water tight doors - indication and control mimic panel.
- Fire alarm monitor and control (master panel).
- Fire doors - indication and control mimic panel.
- General alarm push button.
- Emergency stop of ventilation fans.
- Fire pump start/stop.
- Telephone (sound-powered and automatic).

In addition to normal navigation the Wheelhouse shall be used as a control centre for Dynamic Positioning, Cargo Operations, Survey, Science and Helicopter & UAV operations. This control position shall have a clear view of the Helideck.

The Wheelhouse shall provide good view for operations in ice the Sea Surface an unimpeded view 50m forward of the bow. This viewing shall be available at or close to the helm position so that the watch-keeper can monitor work being carried out while at the same time reviewing the ships instrumentation and radars.

Restrictions in view from the wheelhouse along a horizontal line shall be avoided.

A winching operations viewing position with full height windows shall be arranged with viewing over the transom and starboard side working deck.

Windows shall be sloped outwards to provide shading and rain protection. Horizontally sliding opening windows shall be provided at the bridge wings. Windows shall be heated and fitted full cover parallel action wipers, and an all-round fresh water window wash system with arrangement to prevent freezing. All window wash and wiper components must have appropriate safe and effective access.

The wings of the wheelhouse shall extend out beyond the line of the ship's side on each side to allow clear viewing of the sea surface at the waterline. The floorings of the extensions shall be fitted with viewing ports so that this viewing line can be attained directly below the bridge wings. These viewing ports shall be f itted with protective flooring sections for use under normal operations. These shall be close fitting to prevent glare from the over-side floodlighting interfering with night vision of wheelhouse personnel.

A cooling air flow shall be provided into the forward main console cabinets with appropriate filters.

All windows shall be fitted with anti-glare roller blinds (e.g. clear Mylar material with reflective outer coating).

The following additional requirements shall be satisfied.

- A slave display (22 -27") from the Swath Bathymetry Systems (R7.5) shall be included with the forward console or associated head-up display area.
- A slave display (22 -27") from the Swath Bathymetry Systems (R7.5) shall be included with the Aft DP Console head-up display area.
- An electronic means of planning surveys shall be provided accepting input of co-ordinates from the Main Laboratory (see item R7.5).

Additional items to those identified above which shall be included.

a) At the aft starboard DP console include a fixed UHF station.

b) At the starboard wing console include a fixed VHF

c) A chart area with curtains for night operations and local dimmable lighting.

d) An automatic switch shall be fitted on the door leading to the Wheelhouse to control night lighting.

e) A latchable gate (open & closed) shall be provided at the top of the stairway.

f) An additional island plotting surface and storage with storage drawers underneath located under PA and public entertainment equipment

g) Displays fitted with large (22 -27") flat screen VDUs across the front of the wheelhouse above the windows and across the rear of the wheelhouse above and around the DP control position. The wheelhouse deckhead shall be raised in way.

h) Two high quality adjustable helmsman chairs mounted on rails to be provided at the main console.

i) Two high quality adjustable helmsman chairs to be provided at the DP control station aft facing console.

j) A refreshment / pantry area.

k) Adjacent toilet compartment.

l) Enclosed access to the wheelhouse top via staircase.

m) Adequate secure bookcase stowage for almanacs and associated nautical publications.

n) An external walkway shall be ar ranged all round for window cleaning and external conning of the vessel. This shall not however intrude on the viewing of working decks from inside the wheelhouse.

o) Handrails shall be provided at the perimeter of the wheelhouse across and under all windows. Handrails elsewhere may be necessary determined by layout and design.

p) Helicopter and AUV Control Station with high quality adjustable chair.

q) Meteorological Weather Station with high quality adjustable chair.

r) "U" shaped sofa set with seating for 3 persons deep and 4 persons wide with two coffee tables.

6.1.21 Standard Clock System

R6.21 The Contractor shall purchase and correctly install a distributed clock system based on a master unit developed for marine use.

The standard clock system shall be installed for both ship and scientific use which will provide a time standard for all operations throughout the vessel. Time synchronisation shall be derived from the GPS.

There shall be at least 50 clock repeaters (slaves) distributed throughout the vessel with appropriate cabling from the master unit located in the Electronics Space under Wheelhouse or Wheelhouse. The clock repeaters need shall be appropriate for the application, humidity, flush mounted or panel mounted.

An NTP (Network Time Protocol) is required.

The system shall be supported by a dedicated UPS.

Locations: Wheelhouse, GMDSS Station, Helicopter Operations Desk, Captain, Chief Engineer, Chief Officer, 2nd Engineer, Ship's Office, Principal Scientist, Recreation Area, Coffee Area, Mess Room, Galley, Servery, Duty Mess / Coffee Shop, Purser's Office, Hospital, Dispensary, Safety Control Room, Science Hangar, Wet Laboratory, Deck Laboratory, Main Laboratory, Controlled Environment Laboratory, Core & Sample Chill Store, Data Suite, UIC Room , Aerosol Laboratory, Atmospheric Science Laboratory, Clean Laboratory, Science Laboratory/Store, Dark Room, Salinometer Room, Uncontaminated Seawater Laboratory, Gravity Meter Locker, Server Room, IT Workshop, Electronics Workshop, Deck Workshop, Science Workshop,, Fitness Centre, Engineer Room Workshop, Engine Control Room, Switchboard Rooms (2) Propulsion Motors Rooms (2) Steering Gear Rooms (2)

6.1.22 Electronic Equipment Room

R6.22 A room shall be provided immediately below the navigating bridge deck into which shall be installed electronic and communications systems (e.g. Inmarsat systems or similar, data communications systems, wheelhouse UPS systems, etc.).

The room shall have a minimum area of 25m^2 and an entry door width of at least 1m in width to allow equipment installation and removal.

There shall be sufficient data rack space for all satellite communications equipment – approx – 42U and HRPT (Dartcom) equipment – approx 21U.

Stauff rail systems shall be installed on the bulkheads.

A matrix bolting system, at least 5m^2 shall be fitted so that additional / temporary equipment can be mounted at a later date.

6.1.23 Electronic Workshop

R6.23 A room shall be provided immediately below the navigating bridge deck into which shall have an area of at least 25m^2 and a deck to deckhead height of at least 2.3m.

It shall have at least three work stations.

Racks shall be provided to stow aluminium boxes each 400mm x 400mm x 600mm.

Bench tops (inclusive of the workstations) of height 720mm and aggregating at least 6m in length with rubber mat working surfaces shall be provided. Lockable drawers shall be provided under the work bench. Two 4 inch engineers' vices shall be provided.

Two large lockable tool cupboards shall be provided.

Heavy wooden boards shall be provided on the compartment walls for mounting plastic storage bins and tool racks.

At least four heavy duty metal 230V (2 nos. 2A, 2 nos. 16A) power sockets shall be provided in addition to 18 - 230V domestics outlets and 10 – 110V, 60Hz outlets.

Power tools outlets 2 nos. 110V are to be provided.

An extractor fan and a hood shall be provided for removing fumes generated by soldering work over one work station position.

A common earth rail shall be provided over the bench tops.

Suitable lighting shall be provided for both general illumination and close up detailed work at the work stations.

Three laboratory style chairs of robust timber or metal construction with upholstered arms, seats, and backs and fitted with a means of tying down in heavy weather shall be provided. Covering materials shall be heavy duty breathable vinyl type or woven material. Height of chairs shall suit the heights of desks/benches.

6.1.24 Ship's Office

R6.24 An office shall be provided for the management of the vessel. It shall be located below the navigating bridge level.

It shall be outfitted with 3 workstation desks, 3 computers, bench tops, cupboards and at least 6.standard 4 drawer filing cabinets, desk chair with arms for each desk, a minimum of 2000mm length full-height bookshelves, notice boards.

‘

A lockable file storage shall be provided in support of the ship's office.

The office shall be fitted with lockable key cupboard.

Engine Room office functions shall be carried out in the Ship's Office.

The room shall have fixed desks, chairs, filling cabinets, large bookshelves for manuals, etc. and at least two P.C. workstations with appropriate power sources and securing arrangements for the computers.

One VMS machinery monitoring and control unit display repeater shall be fitted.

6.1.25 Purser's Office

R6.25 An office shall be provided for the Purser in which he can carry out his administrative tasks and receive and deal with ship's visitors. It shall be located next to or near the mess room area.

It shall be fitted with one work station with desk chair, shelving and a 4-drawer filing cabinets, a fixed table and chairs with fixings for 6 persons.

A small domestic fridge shall be supplied and fitted.

The office shall be fitted with lockable key cupboard and a notice board.

6.1.26 Public Toilets

R6.26 Public toilets shall be provided as follows:

- Main Lounge & Observation Lounge
- Wheelhouse
- Recreation Room & Muster Station
- Conference Room & Muster Station (near to)
- Mess Room & Galley (adjacent to, for use of catering staff)
- Engine Room (adjacent to)
- Main Deck easy access from Science Hangar and Laboratories – also shall be used by those working on the external Working Deck)
- Changing Room
- Fitness Centre (near to)

All public toilets shall complete with W.C(s) (European Style) vacuum type and small hand-wash basin(s) with comprehensive fittings as listed below, shall be arranged on each deck that contains working or public spaces positioned as far as possible centrally to those facilities:

- WC pan of vitreous enamel
- Substantial WC seat with vacuum venting
- Vacuum flush activation unit to one side of the WC clear from possibility of inadvertent operation.
- Toilet roll holder
- Bulkhead mounted toilet brush holder
- Grab rails
- Mirror (with light) at least 300mm x 500mm
- Space light fitting
- Wash down tap.
- Floor scupper drain with large water trap not susceptible to evaporation due to air conditioning
- Direct exhaust ventilation
- Coat hooks (2)

- Wash basin 600mm x 500mm minimum with hot and cold spring loaded non-percussive taps
- Soap dispenser
- Hand cleaner dispenser
- Paper towel dispenser
- Waste bin

6.1.27 General Storage & Lockers

R6.27 General lockable storage rooms and lockers shall be provided on all working and accommodation decks. These shall be fitted with appropriate storage racking and/or shelves and be well lit. Racking shall be robust and substantial, metal or timber, designed for heavy loading. The racking and shelving shall be easily cleaned and maintained. It is also to allow adequate ventilation of the stores.

- Baggage — with sufficient storage for a crew / scientist change.
- Clean Linen — on each accommodation deck
- Cleaning equipment — 1 each accommodation deck & Amenity area
- Stationery store — 1 near or part of ship's office,
- Electrical locker — on each deck, central to accommodation for local switching of domestic electrical circuits

Deck in each locker shall be bare steel painted or as appropriate for the purpose of the stores) and fitted with wood gratings.

The stores shall be fitted with fully sealed linings which can be easily cleaned and maintained.

Each locker to be fitted with a self-closing door, complete with lock and hold back.

A heavy weather gear locker / change area shall be arranged close to the open fore deck with a protected direct access to that area.

6.1.28 Laundries and Drying Rooms

R6.28 It is anticipated that individuals shall do their own laundry. Multiple smaller laundries for crew, officers, and scientists are therefore required along with a separate laundry for the ships linen, sheets etc.

Fully equipped laundry spaces shall be provided within the accommodation areas, one for the ship's use and others for the use of personnel onboard. .

The Ship's Laundry shall be fully equipped laundry shall be provided as a ship's laundry for linen, sheets, etc. Four Industrial type washing machines, each with13kg capacity and four dryers, each with 13kg capacity shall be provided along with a roller and hand ironing facility. The space shall have a heat extractor system.

The crew, officers, and scientists Laundries shall include two 6kg capacity industrial type washing machines and two 6kg dryers mounted above each other; they shall each also include an ironing facility.

One commercial type washing machine and one commercial type dryer to be located in the Engineers change room dedicated to washing boiler suits.

Each laundry shall have a stainless steel sink with hot and cold fresh water, worktop with cupboards below and wall mounted cupboards. Ironing facility to include storage for the hand irons and bulkhead mounted boards. Storage for detergent shall be provided.

Each laundry shall be fitted with a system for auto-filling washing machines with detergent and conditioner.

A “diluting” station for the chemicals (detergent/conditioner) plumbed into the ship’s water supply shall be provided in each laundry.

The Laundry floors covering of epoxy coating shall be well coved up at the perimeter boundaries, and scuppers shall be arranged to drain flood water.

Exhaust from tumble dryers to pass through easy accessible filters adjacent to unit.

Access doors shall have sufficient clear opening and access to permit the exchange of laundry equipment. Alternatively a bolted door frame may be proposed.

A heat extractor system shall be fitted to each laundry

6.1.29 Hospital, Dispensary & Medical Locker

R6.29 The hospital suite shall be arranged to meeting the requirements of a Special Purpose Vessel and be located with stretcher access to the heli-deck, rescue boat disembarkation position and casualty access routes.

The hospital shall comprise of a doctor’s office /treatment area along with a ward room. They shall be fitted out as a minimum in accordance with statutory regulations, the arrangement and fit out of which shall be to the approval of the Owner’s representative.

General

The ward and treatment rooms shall be fitted with a concealed oxygen supply from a suitably stowed local Oxygen bottle.

The doors to both the hospital and ward room shall be no less than 900mm wide and shall be so situated and arranged that a stretcher can be easily carried into it and placed alongside the beds.

Flooring shall be in epoxy coating coved up at the boundaries and properly sealed.

The ventilation of the hospital shall be supplied independently of all other areas. It shall have an independent air handling unit and fan. The toilets shall be independently exhausted to atmosphere using a separate dedicated fan.

Grey and black water discharges from the ward room and hospital area shall be led directly to the sewage treatment plant through independent piping.

Hospital Area

The hospital area shall be provided with a suitable medical bed, accessible from both sides.

The room shall be provided with a bathroom according to regulations with a door catch to be capable of being opened from the outside.

Ward Room

The ward room shall be accessed from within the hospital area.

The ward room shall be provided with a suitable medical bed accessible from both sides.

The ward room shall be provided with a private bathroom to the same standard but fitted with an easily accessible bath, door catch to the bathroom shall be capable of being opened from the outside.

An alarm shall be fitted communicating with the Medic's office and Medic's sleeping accommodation.

The ward room shall be lit to 300 lumens. A dedicated examination lamp shall be provided in way of the bed.

The ward room shall be equipped with a bedside locker fitted with a flat top and a shelf, a seat and a clothes locker

Dispensary / Medics Office
The Dispensary / Medics Office shall be located separately from but adjacent to the Hospital in a lockable compartment

The Dispensary / Medics Office shall be provided with a desk and chair along with two additional chairs for patients, ample shelving and lockers, suitable for storage of required medical equipment, a fridge suitable for storage of medicines, medical scales and a lockable ready use medical locker.

The medic's office / dispensary shall be lit to 300 lumens with 500 lumens in way of the treatment area.

It shall be supplied with medicines and medical equipment in accordance with the medical scales for the vessel type.

6.1.30 Working Deck Change Room, Drying Room & Toilet

R6.30 A changing room, drying room & toilet shall be provided in a location leading off the main working areas and close or direct access into the main accommodation and equipped with:

- Wet Gear Lockers.
- 75 full height lockable lockers. (width 400mm x depth 400mm minimum)
- Changing area with bench
- Shower, toilet and hand washing facilities.

The changing room shall be large enough to accommodate a typical deck working group of 22 persons at any one time.

It shall be equipped with a washing facility (basins and/or a central washing fountain), paper towel dispensers, waste bins, soap dispensers, coat hooks and bench seating for 4 persons.

Emergency eyewash station shall be arranged adjacent.

Two toilet compartments shall be provided leading off the change room.

A drying room (at least 4m^2 area) for heavy weather clothing and boots shall be provided leading off the change room equipped with suitable heating, ventilation and hanging arrangements.

A storm clothing room (at least 4m^2 area) for heavy weather clothing and boots shall be provided leading off the change room equipped with suitable heating, ventilation and hanging arrangements.

The flooring throughout the compartments shall be heavy duty non-slip epoxy coating, coved up at the boundaries, incorporating underfloor electrical heating. A scupper shall be provided for washing down drainage. A cold water hose connection shall be provided for washing down.

Bulkhead material shall be robust and easily kept clean.

6.1.31 Safety Control Room

R6.31 The Safety Control Room shall be located within an A Class steel enclosure above the bulkhead deck and to incorporate the following:

- Fixed firefighting systems controls such as Water Fog release, fan stops, fire dampers, fire door, and fuel quick close valve remote controls shall be arranged within the space with repeaters in Wheelhouse.
- Control station for Watertight Doors, and Remote Quick Closing Valves.
- Emergency communication systems

6.1.32 . Helicopter Reception Area

R6.32 A Helicopter Reception Area shall be provided, but may be incorporated within the Conference Room

It shall be outfitted with lounge type chairs (Sofas) 12 persons for along with an office desk and chair, with a bookshelf, notice board and whiteboard.

A 42" flat screen Full HD TV screen and video/DVD systems shall be provided mounted in a unit which shall include storage for media and general cupboard space.

6.1.33 Helicopter Operations

R6.33 A range of aviation facilities are required.

- Winching spot (winching of individual personnel/light items).
- VERTREP (vertical replenishment - cargo slung in a n et below the helicopter; assume 1500kg).
- Heli-deck - landing of a helicopter for personnel/cargo transfer.
- Heli-deck & hangar - landing of a he licopter for personnel/cargo transfer, onboard base for two Dauphin (Eurocopter EC365 N3) or equivalent helicopters of up to 5 tonnes maximum take-off weight.
- Heli-deck with capability for use (landing/take-off & refuelling) by a S AR helicopter, e.g. Sikorsky S-92.

The heli-deck shall comply with the requirements of CAP 437, ICS Guide to Helicopter / Ship Operations, Class and Statutory requirements for both Day and Night time operations.

To support helicopter operations the following features shall be required:

a) CAA compliant Heli-deck suitable for the operation of helicopters in the range mentioned above.

b) Helicopter refuelling module complete with hose reel to be ar ranged at forward end of landing area and capable of operation using AVTUR and AVCAT in the Polar Climate.

c) Two 3,000 litre Heli fuel tanks to be constructed in accordance with ASME VIII/BS.5500 on Deck 1. These shall be capable of being refuelled from aft AVTUR tanks.

d) Each heli fuel tank to be of stainless steel construction and to be fitted with the following:

- Access bolted manhole
- Inspection hatch
- Dipstick
- Vent
- Outlet/fill connections
- Contents gauge
- Automatic closure valves
- Heli fuel store to be arranged with natural supply and mechanical exhaust to statutory requirements
- Fan to incorporate intrinsically safe motor.
- External indication to be provided to show whether fan is off or on.

e) Supply line from tanks to be complete with filtration, pump module with remote start/stop and filling line savealls to statutory requirements.

f) Bonding cable to be provided at heli-deck area.

g) De-fuelling of helicopters.

h) Access to allow the safe transfer of cargo (light loads) to the heli-deck for VERTREP operations (under-slung loads suspended below the helicopter).

i) Recessed tie down points must be provided to suit the specified helicopters.

j) Safety nets to be arranged at perimeter of heli-deck. Nets of stainless steel framed construction, complete with 316 stainless mesh to be arranged to allow vertical stowage when heli-deck is not in use.

k) Access/escape ladders to the heli-deck to be provided as required by CAP 437 and Class requirements.

l) Heli-deck to be provided with suitable lighting for operations at night or in reduced visibility. Heli-deck lighting to consist of perimeter lights, obstacle lights, warning lights, etc., and to meet the relevant requirements in CAP437. The Helicopter Deck operational & obstacle lighting shall have an uninterrupted power supply source and be linked to the emergency generator. The helicopter lighting shall be controllable from the Helicopter Control/Flight Deck Officer position

m) Heli-deck to be provided with visual aids, including vessel identification maximum allowable weight, D value and aiming circle with "H". Deck to be non-skid finish

n) The details of the markings including size, colour, location and integration with the Lighting arrangements shall be detailed on a Deck Marking Plan which shall be agreed with the Owner's Representative

o) Fixed obstacles which present a ha zard to helicopters shall be readily visible from the air.

p) An illuminated windsock shall be provided for the Heli-deck. The wind sock shall be positioned in clean, unobstructed air. The wind socks shall be temporary items which are installed for flying operations. Suitable stowage in the vicinity of the mounting point shall be provided for each windsock.

q) Special consideration to be given to the arrangement of the heli-deck to prevent possibility of snagging during VERTREP operations.

r) The Structural arrangement and design features in the vicinity of the Heli-deck shall be considered to optimise a clean air flow over the landing zone. This shall be considered during Wind Tunnel Model Tests (Section 5.1.6).

s) The helicopter landing spot shall be capable of operating helicopters fitted with wheels or skids.

t) Locker for lashing storage.

u) The deck must be heated and have a de-icing facility, with non-slip surface.

v) Fire-fighting facilities shall be easy to operate and, where feasible, automated.

w) High expansion foam nozzles to be recessed into the Heli-deck to ensure the uniform application of foam to any part of the landing area.

x) Application rate of foam to be based on D value of 21.0 with stowage tank for foam concentrate and eductor.

y) Remote control of foam release to be arranged at Bridge and / or Helicopter control station.

z) System to be certified as operational down to air temperature of -40 deg C.

aa) The bridge / bridge wings shall have a direct view of the deck or alternatively have a TV facility to monitor deck activities.

bb) Two SOLAS approved Rescue Boats are required to be on standby during all flight operations.

cc) Stabilised horizon bar indication (illuminated) with luminescent panels at 1m intervals across the width of the superstructure, at a height of about 5m above the heli-deck.

dd) Gyro stabilized glide path indication to be fitted port and s tarboard. Location to be agreed with owner's representative.

ee) Red / green – stop / go lights located to be visible from any position on the heli-deck with control from the Wheelhouse, repeater at the helicopter flight control position.

ff) "Wave off" red light sited on superstructure in way of the heli-deck, controlled from the helicopter flight control position and illuminated when the stop/go lights are set to red.

gg) 28V DC; 300A double socket Ground Power Supply to be provided for helicopter starting.

hh) Drainage and containment of fuel spilled, up to the maximum volume arising from a S-92 aircraft. The Heli-deck Landing Area shall be protected at the deck edge by a large gutter. The deck shall drain rain water and any fuel spillage into the gutter. The gutter shall drain overboard via scuppers, which shall be independent of all other scupper lines. D etails of the scupper openings shall be agreed with the NERC's Representative. The scuppers shall be arranged to discharge overboard below waterline level with the minimum of shell penetrations.

ii) De-icing is required for the drain from the under-deck recess.

jj) Floodlighting the heli-deck.

A motion sensor shall be installed close under the centre of the heli-deck, with display of heave / pitch / roll adjacent to helicopter communications in the Wheelhouse. This requirement may be met by a signal from Position, Heading and Attitude system (R7.3)

A technical fresh water washing hose reel shall be installed, with capacity of 27 - 40 litres/minute.

A demineralised water washing connection shall be installed for compressor washing, with capacity of 27 - 40 litres/minute. An adjacent low pressure compressed air line is also to be fitted.

An electrical outlet shall be provided, rated at 110V, 60Hz, 15Amp.

Easy access shall be provided between the heli-deck and helicopter reception room which shall be connected to the accommodation areas of the ship.

The Helicopter Control / Flight Deck Officer position shall be located in an insulated, heated and ventilated space having a view of aircraft operations onboard and on the approach to the ship and having the following features. The control position can be integrated into the Bridge.

Equipment shall be provided to allow full control of all Helicopter Operations including Approach, Landing, Take Off, Fuelling, Fire Fighting and Communication.

- Direct communications with the Wheelhouse.
- Radio communications with aircraft. comprising Marine band VHF, Air band VHF Ground station and handheld, UHF base station
- PA announcement
- Stop / go repeater lights.
- Wind speed indication.
- Control of ship-based aeronautical navigation aids
- Glide slope indicator
- Heli-deck acceleration indication.

- CCTV monitor.
- Ship speed and course.
- Aircraft radar display.
- Seating for two persons.
- Heli-deck lighting controls.
- Man-overboard alarm.
- Fire monitor control and fire suppression system in the Helicopter Hangar

6.1.34 Helicopter Hangar, Workshop and Refuelling

R6.34 A helicopter hangar to accommodate two small helicopters shall be provided either adjacent to the heli-deck or below. The dimensions of the hangar shall allow access for maintenance of the helicopters when both are in the hangar. The helicopter type shall be of commercial specification and not have folding tail sections. Hangar dimensions shall be at least: length 13.6m; width 9.15m; height 5.25m to accommodate two Dauphin (Eurocopter type AS365 N3) type aircraft.

Provision shall be made for helicopter support equipment (starter generator, gantry cranes etc) and stowage of spares inside the hangar. A gantry crane or monorail with capacity of 2.0t and designed for use at sea, shall be installed in the hangar to assist with aircraft maintenance and multi-purpose operation. Storage for helicopter spares and tools shall be arranged on each side of the hangar. The hangar shall be provided with electrical power circuits as follows: 1 x.100A and 2 x 60A 440 VAC,10 x 30A 220 VAC (3 phase).

Suitable deck tie down points must be provided for securing the helicopter while on passage. The securing points shall be located 1m inboard of the hangar sides and arranged in 1.5m square pattern, fore/aft and athwartships over the whole deck. The working load shall be 56kN in any direction.

Hangar Doors (option if Helicopter Hangar and Deck are on the same level).

Secure electrically or hydraulically operated hangar doors shall be fitted, allowing either aircraft to be taken in or out of the hangar with Manual operation available. The hangar door shall be designed to withstand the expected environment and the local effects of aircraft down draft (taking into account the range of helicopters that may land on the heli-deck, including Super Puma). The hangar door shall be designed to cope with the following conditions, when in any position from fully open to fully closed:

- Rotor down wash of 36m/s, with gusts of up to 54m/s for up to a minute.
- Operation in wind speeds up to 60 knots from any direction.
- Withstanding a wind speed of 80 knots, gusting to 115 knots from astern without permanent distortion.

The hangar shall be well lit and have climate controlled conditions that allow routine onboard maintenance to be carried out.

The hangar shall be multi-purpose, used for portable laboratories / cargo /science equipment stowage. Means to transfer and secure portable laboratories and cargo in the hangar shall require special consideration. An overhead gantry crane is required for overhaul purposes. Overhead cranes and handling systems would also be multi-functional.

The hangar may be used to accommodate up to four standard 20ft ISO portable containerised laboratories / scientific stores (Max weight 8 tonnes) with means of transfer to and from helideck. The hangar area shall be equipped with plug and play connections:

The hangar outfit shall include the following.

- Permanent securing points in the deck for helicopters.
- Permanent securing points in the deck for containerised laboratories.
- Permanent securing points for cargo / scientific equipment.
- Services to support aircraft servicing / maintenance.
- Services to support laboratories.
- Aircraft parts storage.
- Aircraft maintenance workshop.
- Hangar door(s) suitable for the adverse environment and helicopter down draft.
- Maintenance of climate as working space.

Helicopter Refuelling

The helicopter fuelling system shall be designed in accordance with CAP 437 Chapter 7 requirements. The system shall consist of delivery pump, aircraft safety bonding system, flow meter, filtration unit, fuel monitoring unit, delivery hose, fuelling nozzle. The system shall be equipped with adequate weather protection.

The helicopter fuelling system shall be able to:

- re-circulates, cleans and conditions fuel held in the bulk storage tank to remove water and solid contamination,
- tests fuel for water and contamination,
- transfers fuel from the helicopter fuel service tank to the helicopter
- defuels the helicopter,
- transfers fuel from the storage drums to a fuel service tank,
- allows sampling of fuel from each tank in the system,
- transfers fuel between the helicopter fuel service tank and the ship's bulk aviation fuel storage tanks

The system shall be able to deliver fuel to the helicopter in the following modes:

- while on the flight deck or in the hangar with engines shut down,
- while on the flight deck with engines running;

The helicopter fuelling system shall:

- minimize the risk of spillage and contamination,

- prevent air locks, air pockets and inadvertent siphoning,
- include means for draining fuel from hoses,
- minimize the risk of over-pressurising any part of the helicopter fuel system,
- prevent fuel tanks from becoming over-pressurised,
- prevent overfilling of any part of the helicopter fuel system,
- be adequately electrically grounded in all modes of operation,
- not create a static electricity hazard due to fuel moving through the system.

Supply line from tanks to be complete with filtration, pump module with remote start/stop and filling line savealls to statutory requirements.

A fuel totaliser, measuring litres of fuel delivered shall be installed.

Heli fuel tank
A helicopter fuel drain/overflow tank shall be provided, with a capacity of not less than 5 m3 of fuel. The helicopter fuel drain/overflow tank shall be vented overboard in such a way as to minimise contamination of marine science samples. The tank shall be constructed in accordance with ASME VIII/BS.5500 on Deck 1. The tank shall be capable of being refuelled from aft AVTUR tanks.

Each heli fuel tank to be of stainless steel construction and to be fitted with the following:

- Access bolted manhole
- Inspection hatch
- Dipstick
- Vent
- Outlet/fill connections
- Contents gauge
- Automatic closure valves
- Heli fuel store to be arranged with natural supply and mechanical exhaust to statutory requirements
- Fan to incorporate intrinsically safe motor.
- External indication to be provided to show whether fan is off or on.

Helicopter workshop

1. A fully fitted helicopter workshop shall be arranged
2. The space shall be climate controlled, heated, but not air conditioned.
3. The following facilities shall be provided:

- Proprietary workbench with 150mm cast-steel vice and quick release action
- Overhead mounted adjustable work lamp fitted adjacent to the workbench
- Cupboards and Drawers for storage of tools and spares to the agreement of the Owner's Representative.
- Service air hose connection valve, with 15mm bore x 10 m long air hose and stowage.
- Power outlets for 230V, 110V and 28V DC shall be provided.
- The power supply shall be discussed and agreed with the Owner's Representatives and Helicopter Consultant.
- Wash basin with hot and cold water supply
- Technical Water supply
- Lockable cupboard space and shelving
- Electrical insulation mat.
- A socket shall be provided to allow a Lap Top Computer to be connected to the ships computer system and internet.

6.1.35 Small Boat Access

R6.35 Safe access to / from small boats, including cargo tender, work boat etc, alongside the vessel port and starboard shall be provided. This may take the form of a low freeboard boarding platform within the double shell of the vessel. Wide watertight shell doors shall open inboard to avoid any snagging obstructions to boats alongside,

Door shall be hydraulically powered, dogged and fitted with a strongback in accordance with class requirements. Remote indication of the door status and CCTV cameras shall monitor the shell doors from the Wheelhouse.

Access shall be via a stairway from above the freeboard deck level.

The boarding level shall avoid the use of further external ladders to transfer personnel between the vessel and small craft alongside.

The low level boarding arrangements may also be used as a r escue zone and for boarding pilots. Both low level access bays shall be arranged and equipped to comply with international requirements for pilot boarding.

Recessed flush mooring fittings shall be provided for securing small craft alongside.

The low level boarding platform shall be located in an area of parallel mid body of the vessel, avoiding the risk of small craft being swept under overhanging parts of the ship's structure and offering best shelter.

Cargo transfer by ship's crane into the cargo tender shall be possible in this location.

The access bays shall be self-draining overboard via non-return valves.

Starboard Side Low Level Access
The starboard side low level access shall have a clear opening in the side shell of 3m in length, to accommodate launch and recovery of autonomous devices. The low level internal access platform shall be at least 4m in length and 2m in width.

Access shall be via a stairway from the Main Deck. The opening in the deck for the stairway shall be closed by a hydraulically operated flush fitting watertight hatch designed for the same deck loads as in the surrounding deck.

Inclined runways to accommodate trolleys used for movement of devices around the deck shall be installed for controlled lowering / recovery onto the low level access bay and Contractor shall supply one trolley for this purpose.

Sideshell doors where required for access shall be hydraulically operated and shall secure watertight. The doors shall meet the requirements Classification Society and Owner's Representative. The minimum clear opening shall be 1000 x 2000 mm on the port side and 3000mm by 2000mm on the starboard side.

It is anticipated that an inward opening sideshell door shall be required for access to the cargo tender and workboat from the lower deck approx. 1.5m above the waterline.

Doors on the lower deck can be expected to be exposed to Ice loading. As such the side doors at this level shall be designed to take ice loadings in accordance with the adjacent sideshell structure. The above doors shall be hydraulically operated, dogged and to the requirements of the Classification Society. Door shall be fitted with a leak detection system and security cameras.

6.1.36 Duty Mess / Coffee Shop

R6.36 A Duty Mess / Coffee Shop shall be provided in a protected area leading off the main working deck. It shall also have close or direct access into the main scientific working spaces and the accommodation.

This shall allow personnel to take breaks during onerous or bad weather operations.

The Coffee Shop shall be equipped at least with;

- A work top with cupboards and drawers under for storage of cutlery, cleaning materials, a waste bin, beverages, and a domestic type refrigerator.
- A sink shall be incorporated in the worktop with hot and cold supplies.
- Two thermostatically controlled hot water boilers shall be provided on the work top plumbed into the ship's fresh water supply complete with an isolating valve and water purification filter.
- Wall cupboards above the worktop for crockery.
- A plastic cup dispenser.
- Bench seating upholstered in heavy duty vinyl material for a minimum of 6 persons along with suitable table
- Shelving for a CCTV monitor.

Flooring to be heavy duty vinyl with welded joints coved up at the bulkheads and around the furnishing plinths to facilitate cleaning.

6.1.37 Galley, Servery, Scullery & Daily Stores

R6.37 The Galley shall be equipped for full service for the specified number of persons on board, based on three hot meals per day, in Sea State 6. All working tables, lockers, refrigerators and counters to be made of stainless steel.

The Galley, Servery, Scullery and Daily Stores areas shall be arranged with consideration of the work flow, including provisions delivered by lift from the Provisions Stores one deck below and waste disposal.

The Galley shall have direct access to the mess room.

It shall be air conditioned and ventilated to the highest standards.

A Scullery area shall be provided as an annex to the galley. Consideration shall be given to the required work flow for dishwashing, drying and storage

Bulkhead linings and d eckheads shall be in stainless steel faced boarding, with all seams fully sealed against ingress of water / bacteria.

The construction of the Galley, Servery and Scullery shall be in accordance with the latest United States Public Health, Centre for Disease Control and Prevention, Vessel Sanitation Program construction guidelines.

The arrangement of all equipment and storage shall provide for easy and effective cleaning with no inaccessible areas.

The orientation of equipment in these spaces needs to be c onsidered at the design stage to prevent safety issues that might arise from items falling from oven shelves etc. For example the Combi oven shall be positioned so that the door can be opened from either the forward or the aft side.

All doors, drawers and cupboards shall have adequate locking arrangements to prevent self opening at sea.
Any residual gaps in the fit of cupboards, units, shelves etc., to bulkheads and linings shall be suitably filled. Gaps provided, such as between cupboard tops and deckhead lining, shall be large enough to allow effective cleaning (minimum 200mm).

Equipment and furniture shall be mounted on legs of sufficient height to enable spaces below to be easily and effectively cleaned. Where design of equipment does not allow adequate space below the equipment shall be mounted on a plinth and flooring coved up at the boundary.

Flooring shall be in heavy duty non-slip epoxy coating coved up at the boundaries and properly sealed. A comprehensive network of gulleys and drains shall be provided throughout the space to ensure rapid and effective draining of washing water particularly from corners and in heavy weather.

Lighting shall be comprehensive and of the required lux level. Fittings shall be IP56. Power sockets to be water proof type and located at least 600mm above the floor to prevent wash water ingress.

Ample stainless steel shelving shall be included on bulkheads.

A Servery area shall be integral with the Mess Room to allow easy and safe access, without tripping hazards, for persons carrying trays with hot food. It shall also provide dispensing areas for food and beverages outside normal Galley working hours.

All doors to be magnetic release fire doors. Doors shall have coaming that corresponds with the upstand required. As such a coaming of approx. 150mm is required.

A “diluting” station for the chemicals (detergent/conditioner) plumbed into the ship’s water supply shall be provided in the Scullery area.

All necessary electric power supplies, power sockets, water supplies and drainage requirements shall be provided.

Fabricated galley work / countertops and shelving shall be stainless steel, type 316L, of thickness at least 1.5mm with a continuous surface throughout.

The galley shall be arranged and equipped for full service of the full complement of 90 persons. As a minimum, the following equipment is required:-

Galley Equipment

Electric range, Handrail on the front and sides. Baking ovens under with temperature controls between 93°C and 260°C.

Two Deep Fat Fryers, 2 baskets, volume 15-18 Ltr, heating 12 KW electric, Thermostat controls.

(i) Bratt Pan, Manual Tilt, Thermostat controls.

(ii) Salamander / Grill, 5 position shelf runners, reversible close ribbed aluminium brander.

iii) A stainless steel stand with worktop and shelves under to support the Grill at eye level.

(iv) A stainless steel canopy shall be arranged over a c entral island incorporating the range, fryer, Bratt pan and salamander exhausting to atmosphere and connected to an electrically operated extractor fan. Canopy shall incorporate easily removable and washable stainless steel grease traps, fire damper, detergent washing arrangement, Flag Authority approved in duct watermist fire extinguishing apparatus and lighting.

(v) One Servery stainless steel counter unit with continuous surface incorporating:

A chill well, approximately 2m long, with access from back and front. Restraining bars on shelves. Sneeze screen to front, refrigerated cupboard under. Thermostat controls. Digital temperature displays. Fluorescent lighting over.

NB HEIGHT OF HATCH NEEDS TO BE ENOUGH TO ALLOW SELF SERVICE FROM TOP SHELF OF REFRIGERATED UNIT.

Servery to incorporate approved A0 fire Shutters.

EXEMPLAR: Bolton Gate

(vi) A dry heat Bain Marie, 4 x 1/1 gastronorm pan sections, with halogen lamp heating / lighting stainless steel canopy over. 1 no. heated cupboard under. 2 nos. heated plate lowerators 1 no.x 9” and 1 no. 7” diameter annexed. Thermostat controls. Digital temperature displays. Sneeze Guard. Approx length 2 metres.

(vii) Continuous stainless steel countertop with one shelf under to extend both sides of the Servery hatch to the forward and after bulkheads.

(viii) Undercounter freezer 0.6 cu.m capacity to be sited next to chill counter. Thermostat control. Digital temperature display.

(ix) Small wash hand basin. Hot and Cold Water Drain.

(x) Upright slimline refrigerator 400 Ltrs capacity. Thermostat controls 1 no. @ 3ºC and 1 @ 8ºC. Digital temperature displays. Lockable.

(xi) Upright slimline refrigerator 400 Ltrs capacity. Thermostat controls 1 no. @ 3ºC and 1 @ 8ºC. Digital temperature displays. Lockable.

(xii) Upright slimline refrigerator 400 Ltrs capacity. Thermostat controls 1 no. @ 3ºC and 1 @ 8ºC. Digital temperature displays. Lockable.

(xiii) *Fosters type freezer*
with Thermostat controls Digital Temperature displays.

(xiv) Combination Oven, 6 shelves. Cold water supply and drain.

(xv) Stainless Steel 3 shelf corner unit for stowing pots and pans. Approximately 3m in length and fitted with restraining bars

(xvi) Stainless Steel worktop reinforced for butchery work. Approximate length 3 metres.1 lockable drawer, size 1/1 gastronorm tray, under at each end with shelf under. Centre section under void to house two waste bins.

(xvi) Microwave oven. Commercial. Stainless steel. 1000w.

(xvii) Food Mixer / Mincer, bowl size 20 ltrs, floor or counter top standing.

Vegetable Preparation Area and Potwash

(xviii) Potato Peeler, 7kg, Cold water supply. Drain into sink.

(xix) Large Sink unit with drainer, stainless steel. Hot and Cold water supply. Waste mascerator under. Drain. (Potwash section)

(xx) Large Sink unit in continuous stainless steel surface tabling unit. Hot and Cold water supply. Waste macerator under. Drain. (For vegetable preparation)

(xxi) Stainless steel worktop and shelf under surround to Vegetable Preparation Area.

Scullery & Wash-Up Area

(xxii) Sink unit in continuous surface stainless steel worktop approximately 1 metre long with waste mascerator and c upboard under. Pre-rinse spray unit over. Hot and Cold water supply. Drain.

Salads/Soup/Beverages Island

(xxiii) One Chill well approximately 1000L x 800mmW x 150mmD, stainless steel, Thermostat control for 5ºC. Digital temperature display. Drain.

(xxiv) Countertop equipment:

- Cutlery Organiser, 6 Bin,
- Soup plate warmer, marinised, 430mm diameter,
- Soup Kettle, 350mm diameter,

- Pour-on Coffee maker,
- Carousel Cup holder, 350mm diameter
- Auto-fill Water Boiler, 17 ltrs rapid draw-off. Cold water supply. Drain.

(xxv) Chiller Cabinets: two refrigerated display cabinets with three shelves. Thermostatic control for 8°C and digital temperature display.

Snack Meals Facility

(xxvi) 1 Undercounter refrigerator, 0.7 m^3 capacity, temperature range +2/+8ºC. Digital display.

(xxvii) 1 Undercounter freezer, 0.25 m^3 capacity, 230V.

(xxviii)1 Commercial Microwave oven, 1000w.

(xxix) 1 Beverage Vending Machine. Cold water supply.

(xxx) 1 Drinking Water Fountain. Cold water supply. Drain.

(xxxi) 3 Electric Insect Killers, 3 tubes * 25 Watt.

(xxxii) 1 Meat Slicer, medium duty, cuts from 0-15mm, 10" slicer
To be sited in main fridges lobby.

(xxxiii) 1 Rotary toaster to be sited on the forward counter extension.

6.1.38 Mess Room

R6.38 A mess room shall be provided to accommodate at least 60 persons.

The total area of the dining section shall be a minimum of 110m^2

It shall be capable of being closed off temporarily for cleaning.

The room shall have direct access to the Galley, Servery and Scullery at meals times and shall be open for use at most times with 'snacking' arrangements and a hot and cold drinks facility.

A large flat screen TV unit (at least 42" screen size) with Video and DVD players shall be provided.

The whole area, including the Servery area, if provided separately, shall be fitted with high quality heavy duty presentational vinyl flooring.
***EXEMPLAR**:* Amtico Teak finish.

The whole area shall be provided with natural light by way of large fixed windows, 1100mm wide x 800mm depth spaced closely around the outside bulkheads. Close fitting roller blackout blinds shall be fitted to all the windows. All windows to have internal secondary glazed hinged windows integrated into the window box. These secondary windows shall be configured to reduce heat loss.

Lighting units shall provide comprehensive coverage of the whole space and circuits and switching provided for three levels of lighting.

6.1.39 Recreation / Coffee Area

R6.39 A well fitted out Recreation / Coffee Area including a stylish bar area shall be provided.

It shall be of minimum area 100m^2 including the bar. The space shall be light and airy.

The fully equipped bar counter and its dispensing and wash-up area shall be isolatable and lockable from the main area. It shall have a separate door for access and for stocking. The bar shall be equipped with;

- 3 wine cooler cabinets
- 1 Glass Washer
- 1 Ice Cube Machine
  EXEMPLAR Scotsman
- 1 Can Crusher

Above the cooler units an attractive open fronted display cabinet with storm rails shall be provided.

Two of the wine cooler cabinets shall be lockable.

Shelving suitable for soft drink cans.

Under the bar counter the table top shall be fitted with a sink with hot and cold taps and beneath that cupboards shall be fitted with glass racks.

In the main lounge area a combination of banquette seating, fixed bar stools and lounge chairs shall be provided for a minimum of 35 persons. Coffee tables shall be included. Provision of fixings to deck for all loose furniture (lounge chairs, tables) shall be provided.

A large flat screen TV unit with DVD shall be provided remote from the immediate bar area.

A stereo music system with speakers shall be included.

Fitted carpet to be laid over approved underlay.

Curtains shall be fitted to all sidelights.

Hat and coat hooks to be fitted adjacent to doors.

Bulkhead mounted paintings.

Notice Board shall be fitted adjacent to entrance.

The whole area shall be provided with natural light by way of large fixed windows, 1100mm wide x 800mm depth spaced closely around the outside bulkheads. Close fitting roller blackout blinds shall be fitted to all the windows.

All windows to have internal secondary glazed hinged windows integrated into the window box. These secondary windows shall be configured to reduce heat loss.

Power sockets shall be provided for all fitted units as well as 4 spares for future installations

Lighting units shall provide comprehensive coverage of the whole space and circuits and switching provided for three levels of lighting.

If this space is designated as one of the muster stations then access to lockers containing lifesaving appliances is required.

A Glass wall half height partition shall be provided to separate the Recreation area from the Coffee Area.

Coffee Area
A well fitted out coffee area shall be provided.

The space shall be light and airy.

The fully equipped coffee counter complete with dispensing and wash-up area shall be provided.

A sink with hot and cold taps shall be fitted under the counter as well as cupboards fitted with glass racks.

In the coffee area a combination of banquette seating, fixed bar stools and lounge chairs shall be provided for a minimum of 20 persons. Coffee tables shall be included. Provision of fixings to deck for all loose furniture (lounge chairs, tables) shall be provided.

A large flat screen TV unit with DVD shall be provided remote from the immediate bar area.

A stereo music system with speakers shall be included.

Power sockets shall be provided for all fitted units as well as 4 spares for future installations

Lighting units shall provide comprehensive coverage of the whole space and circuits and switching provided for three levels of lighting.

6.1.40 Conference Room / Muster Station / Helicopter Reception

R6.40 A Conference Room and Muster Station / Helicopter Reception shall be provided where meetings can be held and personnel can relax with reading material.

Video entertainment facilities shall be provided and general cupboard space.

It shall be fitted with the following:

- 16 stackable upholstered chairs with arms (secure storage lashing to be fitted), comfortable upholstered seating for a further 14 persons.
- 2 low coffee tables
- 4 tables 2m x 0.8m able to be grouped together into a conference table
- A 42” flat screen Full HD TV screen and video/DVD systems shall be provided mounted in a unit which shall include storage for media.
- A 1.8m interactive whiteboard and deckhead mounted XGA data projector system with retractable screen.
- Bookcases – totalling 4m long of full height deck to deckhead with lockable cupboards at first level to 900mm above the deck with a small worktop.

Provision of fixings to deck for all loose furniture (easy chairs, tables) shall be provided.

Lighting to be divided into four switchable sections and dimmers to be provided

If this space is designated as one of the muster stations then access shall be required to lockers containing lifesaving appliances.

6.1.41 Fitness Centre

R6.41 A fully equipped fitness centre shall be provided.

Clear headroom shall not be less than 2.3m.

It shall be sound-proofed to a high standard from the rest of the accommodation in accordance with LR CAC requirements.

A Changing Room shall be incorporated into the Fitness Centre.

A Sauna Room shall be annexed to the Fitness Centre.

All equipment shall be securely attached to the deck or deckhead as appropriate with adequate space around for use and maintenance.

Some items of equipment shall require power; this shall be provided with local surge suppression.

An equipment box shall be provided for the storage of mats, gloves, ropes, etc.

The design of the air conditioning and ventilation systems for such spaces shall be based upon detailed and realistic estimations of the local heat loads

A large flat screen TV unit with DVD shall be provided remote from the immediate area.

A stereo music system with speakers shall be included.

A water fountain shall be fitted in the space.

A paper roll towel dispenser shall be fitted in the space.

The following fitness equipment is required to be fitted:

- Multi-gym 1
- Leg Press for use with Multi-gym (BSLP40S) 1
- Treadmill 2
- Elliptical 1
- Semi-Recumbent Cycle 1.
- Rowing Machine 1
- Airstepper 1
- PU Punchbag* 1.
- Fitness Bag Mitts 3
- Folding Aerobic Mats 2

* The punch bag shall be used either in the Scientific Store. Robust hanging points shall be provided in both spaces, suitably located to provide space around when in use.

6.1.42 Accommodation Arrangement, General

R6.42 Accommodation is required for:

- Marine crew for the basic operation and maintenance of the ship 28
- Scientists / Personnel in transit / Aviation and its support (5) 60
- Additional personnel (e.g.) 2
  Total **90**

The marine crew and maximised number of ship based scientists shall be accommodated in single cabins, outfitted in accordance with MLC 2006 crew and scientist accommodation regulations, including external positions with natural light.

All cabins shall be provided with en-suite toilet/bathrooms installed with electrically heated floors.

The accommodation standard shall be appropriate to Northern European crew, similar to offshore support vessel and RRS Discovery standard.

Cabin	Personnel	Number of cabins	Number of berths
	Marine Crew	**28**	**28**
Single bedroom with separate dayroom	Captain/Chief Engineer 1st Officer / 2nd Engineer	4	4
Single combined dayroom/bedroom	Officers	7	7
Single combined dayroom/bedroom	Petty Officers, Crew, Medic & Cadets	17	17

Cabin	Personnel	Number of cabins	Number of berths
	Scientists & Support staff		**62**
Single bedroom with separate dayroom	Chief Scientist	1	1
Single combined dayroom/bedroom	Scientists	10	10
Single combined dayroom/bedroom (similar to Officer's Cabin)	Lab Manager	1	1
Single combined dayroom/bedroom (with additional Pullman berth)	Scientists / support technicians / scientists in transit	25	50
Total berths			**90**

6.1.43 Officer's & Crew Accommodation

R6.43 Single occupancy cabin accommodation shall be provided for:

4 Petty Officers plus Cadet	Bedroom	Private shower/toilet
11 Crew and Medic	Bedroom	Private shower/toilet

UMS alarms panels/displays shall be provided in Engineers' accommodation and the lounge, mess, video room and fitness centre.

The following minimum gross room areas (excluding toilet compartments) shall be provided. Entry lobby areas in excess of 1.5m^2 are not to be taken into account. The differentials illustrated by the figures shall be maintained.

Captain/Chief Eng.	Dayroom 20m^2
Captain/Chief Eng.	Separate Bedroom 8m^2 excluding toilet Compartment
Chief Off / Second Engineer	Dayroom 15m^2
Chief Off / Second Engineer	Separate Bedroom 5.5m^2
Officers	Cabins 14m^2
Junior Officers	Cabins 11m^2
Petty Officers	Cabins 11m^2
Crew	Cabins 10m^2

Cabins shall be located as far from the bow of the ship as practicable in order to reduce the effects of ship motions on sleep patterns and comfort.

Cabins shall be either located away from or protected from sources of noise and vibration especially those of a transient nature e.g. machinery, public amenity spaces, tank stabilisers, thrusters.

All these cabins shall have a high level of natural light by way of windows or portlights.

6.1.44 Scientist's Accommodation

R6.44 Single occupancy cabin accommodation shall be provided for:

Principal Scientist Day room	Bedroom	Private shower/toilet
Laboratory Manager	Bedroom	Private shower/toilet
Scientists (10)	Bedroom	Private shower/toilet
Additional Scientists etc	Double Cabin	Private shower toilet

The following minimum gross room areas (excluding toilet compartments) shall be provided. Entry lobby areas in excess of 1.5m^2 are not to be taken into account. The differentials illustrated by the figures shall be maintained.

Principal Scientist	Dayroom 15m^2
Principal Scientist	Separate Bedroom 8m^2 excluding toilet Compartment
Laboratory Manager	Cabin 14m^2

Scientists	Cabins 8m^2

Cabins shall be located as far from the bow of the ship as practicable in order to reduce the effects of ship motions on sleep patterns and comfort.

Cabins shall be either located away from, or protected from, sources of noise and vibration especially those of a transient nature e.g. machinery, public amenity spaces, tank stabilisers, thrusters.

The ultimate aim is for all these cabins to have a high level of natural light by way of windows or portlights.

Where shared shower and toilet facilities are provided these are not to be accessed directly from the cabins. Access shall be via a lobby also equipped with a main entry door which shall provide the necessary privacy.

6.1.45 Alleyways

R6.45 Alleyways shall have the following minimum clear widths between handrails:

Accommodation	900mm
Thoroughfares	1000mm
Working	1500mm

They shall be lined where appropriate. As a minimum corridor within all accommodation, office and science labs shall be lined.

Working and thoroughfare alleyway bulkheads shall be protected from impact damage by fixed timber or synthetic rubbing boards (taking into account spread of flame issues) from skirting up to 800mm above the deck.

All alleyways shall be fitted with storm rails, single rails where widths are nominally up to 1000m and rails either side on wider alleyways where the width is greater than 1000mm.

A longitudinal Stores Alleyway with clear width of at least 1800mm shall connect the Science Hangar, Provisions Stores, Ship's Stores, Laboratories and pallet lift.

All valves, rodding points, junction boxes and other features installed behind linings shall have their positions clearly marked on the linings surfaces and have appropriate fire resistant access panels fitted where regular access is required.

In addition to emergency lighting Low Location lighting to be provided marking escape routes in accordance with SOLAS requirements.

6.1.46 Stairways

R6.46 At least two main stairways shall be arranged as fire protected accesses from deck to deck up through the vessel and superstructures, one for each Fire Zone within the accommodation. Back to back stairs are not acceptable except on a local deck to deck basis and as agreed with the Owner.

Main working stairway width shall be at least 1m wide. Other stairs shall be a minimum of 900mm clear width and in accordance with the IMO Fire Safety Systems Code.

Handrails shall be fitted on both sides. These shall be of stainless steel with a high presentational style.

Doors providing access to the stairwells shall be fitted with magnetic holdbacks controlled centrally at the fire control console in the wheelhouse.

Each stairway exit and entrance shall be provided with a profile and colour coded decks illustration with a location marker and the current deck clearly marked.

In addition to emergency lighting Low Location lighting to be provided marking escape routes in accordance with SOLAS requirements.

6.1.47 Engineer's Change Room & Toilet

R6.47 An engineer's changing room shall be arranged with access to the engine control room and machinery spaces on the one hand and a main access alleyway or main stairway on the other hand.

The flooring shall be heavy duty non-slip ceramic tiling, coved up at the boundaries. A scupper shall be provided for washing down drainage.

The changing room shall be fitted a separate shower room and toilet with a wash hand basin.

The changing room shall be fitted with 10 steel lockers.

The room shall be fitted with two large wash hand basins and a deep sink.

There shall be a washing machine and drying machine, complete with power and water supplies, for washing dirty boiler suits.

A system for auto-filling the washing machine with detergent and conditioner shall be provided.

A "diluting" station for the chemicals (detergent/conditioner) plumbed into the ship's water supply shall be provided.

6.1.48 Engine Control Room

R6.48 A well-lit, sound insulated and air-conditioned engine control room shall be arranged with access from each Engine Room via an air lock. The ECR shall be arranged for remote control of all necessary machinery as well as monitoring of the machinery.

The room shall be equipped with an ergonomically designed control console with VMS machinery monitoring and controls, PMS and equipment displays along with a computer work station and three chairs. All consoles to be fitted with safety hand rails.

The console shall incorporate work stations in the form of kneehole type desk tops with drawers.

Machinery console to contain propulsion machinery controls, Auxiliary machinery controls, Alarms and monitoring. The following to be provided as a minimum:

- Propulsion machinery controls and instrumentation incl. emergency telegraphs
- Power generation, distribution and indication mimic panel including power consumed and available
- Auxiliary services controls and instrumentation
- Instrumentation and alarm system monitor and data logger
- Remote start/stop controls of generator sets, steering, and pumps.

- Telegraphs
- Start/stop push buttons for all auxiliaries used for propulsion.
- Hand, auto, standby selector switches for standby equipment.
- Machinery spaces CCTV monitor and camera controls.
- Start/stop push buttons for all ventilation fans.
- Remote instrumentation to conform to the equipment manufacturer's recommendations for efficient and safe operation of remote controlled equipment.
- Duty Engineer alarm selector
- Telephone and talkback.
- Alarm annunciator/VDU/print-out data logging system
- Machinery space fire alarm display panel
- Watermist / Highfog release
- Clock
- Inclinometer

All relevant instruments shall be incorporated in the machinery control console. All indicating instruments, where fitted, shall have their normal operating range marked with a green quadrant, the upper limit being indicated by a red graduation on the scale.

All machinery spaces shall be provided with a communications system with the MCR and Bridge and other areas that meet current regulations. If these are in a noisy area a sound deadening booth shall be provided.

Room lighting shall be carefully arranged to prevent glare on the displays.

Lighting units shall be individually switchable and dimmable.

One stainless steel sink with hot and cold water supplies and one iced water fountain to be fitted inside the machinery control room. Machinery control room to be fitted with one "dry-wipe" white notice board.

All equipment housed within the control room to have a stove enamelled factory finish of identical colours. Colour co-ordination to be Builder’s responsibility. Colour choice to be Owner's decision.

Deck head in control room to have a suspended ceiling with recessed light fittings.

At least two. 4 gang 230V power sockets shall be installed.

Flooring within the control room shall be 'penny rubber' vinyl tiling. This system may be arranged as a combined false/floating floor to facilitate the leading of cabling to and from the control console and equipment. The floating floor may be installed on the underlying deck structure with the false floor mounted from the upper layer of the floating floor. To limit high localised loads on the floating floor, the false floor supports shall incorporate spreader plates at their base.

A machinery and equipment data store shall be arranged and fitted out with filing cabinets and bo okshelves to store drawings, instruction manuals and paperwork associated with I.S.M.

6.1.49 Engineering Work Shop

R6.49 An Engineering Work Shop shall be incorporated in or next to the engine room at platform level with a clear direct and suitably sized access to the engine room and other auxiliary machinery spaces.

This room shall be acoustically lagged so that sound levels do not exceed prescribed levels.

The room shall be air conditioned and suitably ventilated. Dedicated ventilation and exhaust shall be applied to local areas as necessary, for example, welding stations.
The room shall be fitted with double doors into the engine room store.

A means shall be provided to safely and easily transfer heavy and bulky equipment and machinery from the Engine Rooms and auxiliary machinery rooms into and around the workshop and back again.

Floor areas shall be completely clear of up-stands and trip hazards. A plane painted steel deck would be acceptable providing the coating is non-slip especially under wet or oily conditions. Duck boards shall be provided in way of machine tools. The proposed arrangement shall be submitted to the NERC representative for approval.

The following equipment shall be fitted into this room as a minimum, the proposed arrangement being submitted to the purchaser's representative for approval:

- Steel heavy duty workbench at least 5 m long with lockable draws under and 6 inch engineer's vices (minimum 2).
- Steel heavy duty workbench with raised edges and drain facility approx 1m square for dirty work cleaning and disassembly work e.g. cylinder heads.
- Universal machine tool, with lathe minimum 300mm swing 1.5m bed
- Vertical Milling machine 1m bed.
- Pedestal drill deck mounted with variable speed control
- Electric grinder deck mounted.
- 3 and 4 jaw chucks, face plates, steadies, machine vice, basic selection of cutting tools, all safety guards and coolant systems for each of the above machines.
- Welding machine for stick welding in a welding booth fitted with safety curtains and an extractor fan plus a steel bench with a 6 inch vice fitted. A timer facility shall be fitted to the workshop fire alarm system such that welding or burning work can be carried out without triggering the alarm system.

At least 4 electric safety stops strategically installed around the workshop to stop the machine tools in an emergency.

At least 10 double heavy duty metal 230V power sockets around the workshop over benches and in user friendly positions.

At least 4 nos. 110V power points.

Heavy wooden boards for installing tool racks and a pl astic bin storage system for consumable items shall be provided in way of work benches.

Six heavy duty lockable tool cabinets.

Torque wrench calibration equipment.

Portable Oxygen / Acetylene set complete with nozzles, hoses, gauges etc.

Oil test kit.

6.1.50 Electrical Workshop

R6.50 An Electrical Workshop shall be incorporated.

It shall have a minimum gross area of 8m2

This room shall be acoustically lagged if necessary so that sound levels do not exceed prescribed levels.

The room shall be air conditioned and suitably ventilated. Dedicated ventilation and exhaust shall be applied to local areas as necessary, for example, soldering and cleaning stations.

Floor areas shall be completely clear of up-stands and trip hazards. A plane painted steel deck would be acceptable covered completely with insulating matting with welded joints. The proposed arrangement shall be submitted to the purchaser's representative for approval.

A wooden workbench shall be fitted made from good quality timber with a rubber mat working surface, it shall include lockable drawers and larger storage cupboards at the bottom of the bench, above the bench a f ixed test panel containing all appropriate voltages and controllable variable AC and DC voltage source, also all types sockets fitted to the ship and fully fitted with all voltage and current meters etc.

Within the workshop there shall be a heavy wooden shadow board fitted of reasonable size to store hand tools and a p lastic bin storage system to store small consumables such as nuts, bolts, washers, fuses, starters, crimps, tie wraps etc.

A small hand vice shall be fitted to the workbench and a designated soldering area with fume extraction shall be supplied.

The stores area shall be racked out with plastic boxes of a size that can be manoeuvred easily by one person; these shall be used to store spare gear.

The following additional equipment shall be fitted into this room as a minimum, the proposed arrangement being submitted to the NERC's representative for approval.

- Fluke meter
- Fluke scope – preferred instead of a "normal" oscilloscope
- Fluke clamp meter
- Megger (250V, 500V & 1000V capability)
- 4-20 milli-amp source test generator
- Resistance box
- Hot box – up to 600 degrees for testing probes (PT100 and Thermocouples etc)

- Thandar or equivalent regulated DC power supply (1-30VDC)
- A thermal imaging camera to assist in monitoring and diagnostics.
- Full set of appropriate electrical tools with required insulation properties up to 1000V
- Appropriate spare cable and cable management sundries

At least 10 double heavy duty metal 230V power sockets around the workshop over benches and in user friendly positions.

At least four 110V power points.

6.1.51 Cargo Holds

R6.51 Two cargo holds shall be arranged for the carriage of general cargo, including vehicles, 20ft ISO cargo containers, aviation fuel in drums and dangerous goods. The cargo holds shall be dimensioned for an integral number of 20ft containers. The difference between the volumes of the two cargo holds is not to exceed 40%.

Each cargo hold shall be divided by a tween deck, having a hatch cover of similar opening to that of the main cargo hatch above.

It is expected that the volume of goods shipped in 20ft ISO containers will increase, with an equivalent decrease in break-bulk and loos items. 20ft ISO cargo containers shall be loaded through the hatches and stowed transversely. A simple skidding system shall be arranged to move loaded containers outboard from the hatch opening. Container securing fittings shall be installed in each container position to restrain containers at sea.

General cargo lashing fitting shall be installed to safely secure general cargo, vehicles and drummed products (standard oil drums dimensions).

Cargo hold spaces shall be subdivided to facilitate differing uses and e nvironmental conditions to be maintained in each. This sub-division is required to accommodate the required number of drums of aviation fuel.

As the cargo holds will be used for the carriage of dangerous cargo they shall be designed accordingly, including the following:

- Safe access.
- Fire protection.
- Fire detection.
- Fire extinguishing.

Regulations require that all dangerous goods shall be adequately separated from ignition sources. Bulkheads forming boundaries between cargo spaces and spaces forward and aft of it be insulated to "A-60" class standard. Boundaries between the two cargo hold spaces shall be insulated to "A-60" class standard.

Where structural fire protection or thermal insulation is applied to the bulkhead or deckhead within the cargo hold it shall be adequately protected against mechanical damage due to cargo handling.

6.1.52 Scientific Hold

R6.52 A Scientific Hold is required for the transport and storage of scientific equipment. This shall be accessible at sea via a stairway.

The Scientific Hold shall be arranged with means to maintain its temperature above freezing. Mechanical ventilation is required.

The Scientific Hold is to include the following features:

- Climate control to maintain acceptable working conditions.
- May be used as a working space at sea to prepare scientific equipment.
- Mechanical handling to move equipment between the Scientific Hold and Science Hangar.
- Ease of access between the Scientific Hold and laboratory spaces.
- Access hatch with minimum clear opening of 2m x 3m, which may require to be opened at sea.
- Minimum deck area of 120m^2.

The Scientific hold shall be designed to include the following:

- Adequate lighting for a working space
- Safe access.
- Fire protection.
- Fire detection.
- Fire extinguishing.

A cargo lift shall be installed for the transfer of items between the Scientific Hold and Science Hangar. Safe Working Load shall be 2 tonne. This lift is not required for use by personnel. All necessary safety features shall be incorporated, including guard rails at Main Deck level, safety gate(s) with safety interlock, safety cage and interlocked gate(s) at lower level. Fixed control stations shall be located at both upper and lower levels.
The lift shall be arranged to allow for rolling access, such as with a pallet truck, at both levels, requiring flush lift platform / deck at both levels.

It shall also be possible to transfer items to and from the Scientific Hold using a crane in the Science Hangar.

The Scientific Hold shall be provided with moveable partitions to facilitate stowage and securing of items stowed within it. The partition system and deck shall be provided with cargo securing points, such as D rings welded to the deck. Partitions shall be of approximately 3m x 3m in deck area and 2m in height. The partition system shall be capable of manual handling. It shall be p ositively secured both when deployed and when stowed to provide a more open hold space. A clear deck area shall be available for stowage of larger items (up to the maximum that can be lowered through the hatch.

The deck of the Scientific Hold shall be of steel and coated with a hard wearing slip resistant paint finish, suitable for application in cargo holds.

A number of segregated chemical storage lockers shall be incorporated in the Science Hold. Each locker shall be arranged for secure stowage of drums of chemicals, for example 20 nos. 20 litre drums of a product. Allow for ten chemical lockers, however some may be located outside the Scientific Hold in an accessible position on the Main Deck. The purpose of these lockers is to provide safe, segregated storage for chemicals for use in the laboratories as and when required. These chemical lockers are in addition to ready use chemical lockers to be located in each laboratory. Chemical lockers shall be constructed using approved materials and coatings to contain leakage and resist corrosion.

The Scientific Hold shall be provided with means of securing against unauthorised access. However escape shall remain possible with hatches / access secured.

6.1.53 Bosun's Store(s)

R6.53 Bosun's store(s) shall be provided with direct access to the aft working deck.

In total they shall have at least 6m of bulkhead racking, full height deck to deckhead and hooks for equipment.

Racking shall be substantial and robust to accommodate heavy shackles, etc.

The space(s) shall be well lit with deckhead lighting units.

Deck shall be bare steel painted anti-slip.

6.1.54 Mooring Deck Forward

R6.54 The Mooring deck shall be enclosed, with the exception of openings for access to assist mooring and anchoring operations and mooring fairleads.

Mooring equipment shall be located within this enclosed deck to ensure effective and efficient mooring and anchoring of the vessel.

Access ports shall be provided in way of the fairleads to facilitate the handling of mooring lines. These doors shall be fitted with hinged doors which can be secured in open and closed positions. The doors shall be close fitting to prevent entry of green seas, but are not required to be watertight or weather tight. The strength of the doors shall be consistent with the location on the ship and the surrounding structure. Opening and closing shall be a manual operation.

Two bottom hinged observation platforms shall be fitted, one port and one starboard, in a position from which mooring and anchoring may be observed, including the stowed position of the anchor, sufficient to confirm its security. The observation platforms shall be provided with guard rails. Mechanical assistance shall be provided to facilitate opening and closing.

The mooring deck space below the fore deck shall be outfitted with anchor winches, mooring rope handling systems, and racks in which ropes and equipment can be stowed.

Windlass

Two stepless variable speed self-tensioning electric or hydraulic windlasses complete with de-clutchable cable lifters for anchor handling, de-clutchable rope stowage drums for mooring lines and warping drum shall be installed on the mooring deck port and starboard. Mooring drums shall be sized for stowage of one mooring rope.

Windlasses shall be capable of lifting anchor with maximum chain out.

Windlass to be fitted with screw band brakes arranged for local control – brake drum surfaces to be stainless steel SS316.

Windlass to be arranged for local control from pedestal mounted controllers positioned within reach of crew member working either port or starboard warping drum and to incorporate emergency stops.

Winch foundations shall be reinforced with underdeck stiffening as necessary.

"Cable out" meters shall be arranged in wheelhouse.

Chain Stopper
Roller type cable stoppers to be fitted at the head of each hawse pipe, arranged for local control of the stopper bar.

Stopper bar to be complete with positive means of holding bar in closed position.

Each roller to be complete with Devil's claw designed and fitted to prevent anchor movement in a seaway.

The mooring arrangements of chocks, bits and pedestal fairleads shall be such as to promote ease of handling and deployment of ropes with minimum use of stoppers.

Since the mooring deck forward shall be enclosed a number of openings shall be provided in the side shell (at least 4) to assist rope handling etc. Two outward openings Platforms are required for viewing mooring operations and for use to facilitate sea mammal studies. Doors shall be fitted to form closures when not in use. These shall be robust with heavy duty clips to resist the substantial sea loadings which occur from experience.

The space shall be provided with freeing ports,

The space shall be well lit using IP56 Fluorescent fittings.

Eight each of water proof power sockets 230V & 110V supplied from local distribution boards.

Service air connections to be provided distributed around the space.

6.1.55 Mooring Deck Aft

R6.55 Mooring capstans, bollards and fittings shall be fitted to allow safe deployment and securing of the hawsers. The arrangement shall facilitate proper setting of the lines, avoiding chaffing of the hull. The number of hawsers used for mooring it to be as per Classification Society recommendations. Panama Canal and Suez Canal approval of the mooring arrangement shall be obtained. The arrangement shall be to the Owner's agreement.

The mooring arrangements of chocks, bits and pedestal fairleads shall be such as to promote ease of handling and deployment of ropes with minimum use of stoppers.

Capstans
Two electrically or hydraulically driven vertical mooring capstans shall be fitted on the Main Deck aft for mooring operations outboard sides of the pedestals, one port and one starboard. The motors and piping shall be arranged internal to the pedestals. The hydraulic power unit shall be located close by down below. The controls shall be mounted on the bulwark close to the capstans..

Capstans to be capable of pull 12 tonne at a speed of 0 to 33m/min. Slack rope speed to be 50m/minute.

Capstans shall be arranged for variable stepless speed and dual rotation.

Deck pedestal mounted controller to be arranged adjacent to each capstan complete with emergency stops.

Electric drive motor, IP65 rating, gearing and brake to be arranged under deck.

6.1.56 Bollards and Fairleads

R6.56 Sufficient number of mooring bollards, fairleads, warping rollers and chocks shall be arranged to allow safe deployment and securing of hawsers.

All welding and sharp corners on bollards shall be ground to a smooth finish to prevent damage to wire, hawsers etc.

Bollards of double leg type on single base plate to be positioned forward, amidships and aft as required for efficient mooring

Panama fairleads of cast steel construction to be arranged in way of mooring decks forward, amidships and aft to suit mooring arrangement.

Pedestal mounted roller fairleads to be fitted as necessary for alignment to warping drums and capstans.

Underdeck stiffening shall be arranged in way of all bollards and roller fairleads.

Structural arrangements of bollards and fairleads shall be in accordance with the requirements for Emergency Towing of the vessel.

All Mooring winches, bollards and fittings shall be fitted to allow safe deployment and securing of the hawsers. The arrangement shall facilitate proper setting of the lines, avoiding chaffing of the hull. The number of hawsers used for mooring it to be as per Classification Society recommendations. Panama Canal and Suez Canal approval of the mooring arrangement shall be obtained. The arrangement shall be to the NERC's agreement.

6.1.57 Mooring Rope Stores

R6.57 Rope bins for secure stowage of mooring lines to be provided forward either on the mooring deck or in separate rope stores.

Mooring Rope Stores shall be arranged at the bow and stern for the protected storage of mooring ropes with direct access to decks, etc. as permitted by the final arrangement. Ropes to be flaked out on steel racks for ease of stow and deployment.

Doors or Hatches for access to the open deck to be weathertight with coaming as required by loadline requirements. The store shall be mechanically ventilated, with natural supply and mechanical exhaust. Deck to be bare steel and painted with anti-slip.

6.1.58 Anchor Pocket, Hawse Pipe and Chain Locker

R6.58 Anchor pockets of sufficient size for housing the anchors within the line of the shell to be arranged in each bow. The pockets shall be designed to avoid excessive flat surfaces at the aft end of the recess to minimise the effect of heavy head seas. Fore and aft corners of pockets shall be radiused to adjacent shell. Design of pocket to ensure adequate anchor tip clearance to accommodate wear in hawse pipe and anchor.

Shell insert of increased scantlings to be fitted in way of anchor pockets – extending below pocket down to waterline.

Hawse pipes to be of rolled steel plate.

Hawse pipes to have a solid bar of convex section arranged at shell and deck to take the bearing of the cable.

Anchor pockets and hawse pipes to be carefully lined off at ship to ensure that anchors shall fall freely of their own weight, clear of the hull and to ensure easy lead of cables to windlass.

Stainless steel sliding plate cover and guides to be fitted over top of hawse pipe port and starboard at Deck level. Cover plates to be complete with locking pin and stainless steel keep chain.

Deck Wash to be fitted to each hawse pipe complete with isolating valves, operable from the Forward Mooring Deck adjacent to windlass.

Chain Pipe / Spurling Pipe
Chain pipes to be arranged port and starboard from the Forward Mooring Deck down to the chain lockers.

Bottom of each chain pipe shall be positioned over the mid area of the chain locker for self-stowing of the cables.

The bottom end of each chain pipe to be carried below the line of the beams and to be well reinforced with bell mouth.

Stainless steel plate covers to be provided at Mooring Deck level in way of each chain pipe.

Chain Locker
Chain lockers shall be constructed, stiffened externally to give a clean internal structure and to be of sufficient capacity to allow for the effective self-stowage of the specified length of cable.

Chain lockers shall have permanent centreline division of sufficient height to segregate port and starboard cables. Centreline division shall be of steel arranged with hand/foot holes for access.

Each chain locker to be fitted with a galvanised heavy steel portable false floor, having 30mm diameter drain holes. False floor to be positioned 250mm above locker bottom, arranged to allow removal for cleaning.

Chain Lockers shall be lined with removable hard wood protection plates or tough wear resistant plastic such as UHMW Polyethylene.

Provision shall be made for securing cables to strong points on the bulkhead of the chain lockers. Securing arrangements shall be such that each cable may be slipped from within the Rope Stores.

One bilge ejector, capacity approximately 10m^3/h, shall be provided for drainage of the chain lockers. The bilge ejectors of bronze and driving water supplied from the fire main.

Watertight access hatches complete with stainless steel hinges and dogs shall be arranged.

Bolted watertight access to be arranged to give access below false floor.

Anchors and Cables
Three stockless high holding power (HHP) anchors Classification requirements shall be supplied with two stowed in anchor pockets, within the line of shell.

Spare anchor shall be stowed in secure stowage in accessible position onboard.

Anchor cables shall be of European manufacture and of special steel grade U3 of diameter in accordance with Classification requirements for the anchor weight specified

Chain length shall exceed Class requirements with the addition of one length per side.

Adapter pieces shall be fitted direct to each anchor.

Prior to installation, the anchors and cables shall be thoroughly de-rusted and coated in accordance with the paint specification.

Appropriate links either side of joining shackles between each length of cable shall be wired and painted white to signify the length of cable deployed, marked to NERCs' approval.

6.1.59 Emergency Towing

R6.59 The vessel shall have the capability to tow another vessel and to be itself towed. It shall be capable of receiving tow in conditions up to Sea State 4. The quick release hook shall be complete with remote release from the wheelhouse.

Emergency towing equipment shall be supplied and stowed onboard where it is available to be rapidly deployed.

An estimate of bollard pull shall be provided and demonstrated during harbour/sea trials.

6.1.60 Ship's Stores

R6.60 A general ship's storage space shall be provided complete with racking and shelving.

The space shall have a minimum floor area of 20m^2

6.1.61 Catering Stores

R6.61 A catering storage space shall be provided complete with racking and shelving. The stores shall be located close to the point of use.

The space shall have a minimum floor area of 20m^2

A water hose connection shall be provided.

The space shall include at least 2 double heavy duty metal 230V power sockets.

6.1.62 Beer Store

R6.62 A beer storage space shall be provided complete with racking and shelving.

The stores shall be located close to the point of use (bar) and stores loading / handling.

The space shall have a minimum floor area of minimum 18m^2

The base of the racking/shelving shall be duckboard.

The space shall have a locking hasp and customs sealing point.

The space shall have a low door threshold or ramps to allow the use of a pallet truck.

6.1.63 Bond Store

R6.63 A bond storage space shall be provided complete with racking and shelving.

The stores shall be located close to the point of use (bar and amenity spaces) and to be lockable (hasp) and sealable to international Customs standards (sealing point).

2 domestic 230V power sockets to be provided

The space shall have a minimum floor area of 18m^2

6.1.64 Dry Provisions Stores

R6.64 Provisions stores shall be provided for the endurance specified in Section 4.2.5:

A dry provisions storage space shall be provided complete with full height racking and shelving.

The stores shall be located close to the point of use.

Stores shall be constructed in compliance with the latest United States Public Health, Centre for Disease Control and Prevention, Vessel Sanitation Program Construction Guidelines.

Shelving shall be of robust and substantial stainless steel construction, designed to be easily cleaned with all seams and joints sealed and no sharp edges or protrusions.

Shelves shall be easily removable and fitted with removable storm rails. No perforated plate or mesh material shall be used for shelving.

The spaces shall be air-conditioned and ventilated.

The shelving shall be enclosed by stainless steel meshed bulkheading including doors complete with locking arrangements.
Low door threshold or ramps shall be provided to allow the use of a pallet truck.

A separate air-conditioned lockable store of 2.5m^2 for high value items is required.

6.1.65 Refrigerated Stores

R6.65 Refrigerated provisions stores shall be provided for the endurance specified in Section 5.1.17:

Minimum store room volumes shall be as follows;

Meat	-25ºC	70m3
Fish	-25ºC	70m3
Dairy	+2ºC	50m3
Vegetables	+2ºC	90m3

1. The stores shall be located close to the point of use and fitted with suitable racking and duckboard flooring. Racking and shelving shall be robust and removable (stainless steel easily and safely cleaned) and conform with the strictest hygiene standards including USPH. Keep battens to be fitted to all shelves. Locked-in alarm bell pushes to be fitted in each chamber with visual/audible alarm fitted in the main working alleyway at Main Deck level.

2. One thermometer, vapour pressure dial type to be provided for each chamber with the dials grouped together adjacent to galley entrance. Temperatures shall be recorded on the SCADA, with local alarm.

6.1.66 Engine Room Stores

R6.66 An engineer's storage space shall be provided complete with robust steel racking and shelving fitted with storm rails.

Length of the racking to be at least 15m fitted with 3 shelves and 800mm deep.

The stores shall be located close to the point of use (machinery rooms and engineers workshop).

The space shall have a minimum floor area of 25m^2

A storage locker or cage is required for spare filter cartridges.

Within the engineering workshop or elsewhere in a clean dry space close to the engine room there shall be an injector fuel test booth.

This shall be 2m x 3m in plan form.

It shall be fitted with a steel work bench with the top covered in a hard wood surface to protect highly machined parts. The bench shall be fitted with a 4 inch engineers vice and an injector test pump (supplied by the engine *Manufacturer*) and all necessary tools for fuel pumps and injectors overhaul. A shadow board for tools shall be fitted above the work bench.

There shall be lockable cupboards and draws under the bench to store tools and spares and a plastic bin storage system fixed to a bulkhead to store spares (O- rings etc).

Provision for racking for storing fuel injectors.

Four heavy duty metal 230V power sockets.

The space shall be lockable.

The room shall be protected from dirt and dust.

A high level of lighting (500 Lux) and power points are required.

6.1.67 Ship's Chemical Store

R6.67 Chemical stores shall be provided with an aggregate floor area of 10m^2.

The space may be in a space separated from the main area of the Scientific Stores.

It may be sealed compartment with steel boundaries or alternatively it may be a cage constructed from heavy duty steel mesh. If it is a cage then it must have a steel coaming plate at least 300mm high all round in order to contain any spillages or leakages. It shall have a suitable sized lockable door.

Steel racking shall be provided designed to hold storage containers of dimension 620 x 620 x 420mm high which shall be manhandled in and out of the racks and store space. They shall be retained securely in the racks against heavy weather movement.
Separate storage for inflammables and acids/corrosives.

The space shall be fitted with explosion proof light fittings and mechanical ventilation.

6.1.68 Ship's Oils Store

R6.68 Safe and lockable storage shall be provided for up to 10 nos. 45 gallon drums and 40 nos. 5 gallon drums.

These may be s towed in spaces separated from the main area within the Scientific Stores.

Stores protected by a 100mm save-all to contain spillages.

6.1.69 Waste Management

R6.69 A garbage room equipped with incinerator and compacted waste storage garbage containers shall be installed to process refuse from the accommodation area.

The garbage room shall be ventilated and cooled to max +5°C. Storage of compactor cans pending their unloading for disposal in port shall be arranged to minimise handling.

A waste compactor shall be installed with capacity to process the waste from the personnel onboard.

The transport routes for disposal of garbage in the incinerator and to the open deck for transport ashore shall be specially considered to minimise handling.

A Galley Waste system shall be installed with sufficient capacity to process and store galley waste products during the period the vessel is likely to be south of 60°S. The system shall include shredders, macerators, transfer system, de-watering and storage systems.

Since the vessel works close to shore at times and in restricted areas where waste discharges are strictly controlled, a waste and garbage system shall be installed whereby these can be segregated, dealt with and stored safely and hygienically awaiting the opportunity to discharge them appropriately.

Typical Types of Waste

Non-Hazardous Waste

Aluminium Cans & Foil, Biological Waste, Micro-organism Cultures, Building & Demolition materials, Cardboard, Chemicals, Clothing, Fabric & Rags, Good quality clothing, Waste clothing & fabrics, Composite Packaging, Electrical and Electronic Equipment, Flares, Food, Contaminated packaging, Food, Dried or tinned, Food – Wet, Poultry, Meat on the bone, Cooking Oil, Grey Water, Clean, mixed glass, Laboratory Glassware, Pyrex, Incinerator Ash, I.T. /Computers/ Printers, Light bulbs, Metal, scrap , General scrap, Skips, Paper, Plastics, General, clean , Plastics contaminated with food, Oily plastics, Non-recyclable plastic,, Rope, Solar Panels, Tetra-pak, Toners and Inkjet Cartridges, Vermiculite, Water seeking paste , Wood, including packing cases.

Hazardous Wastes

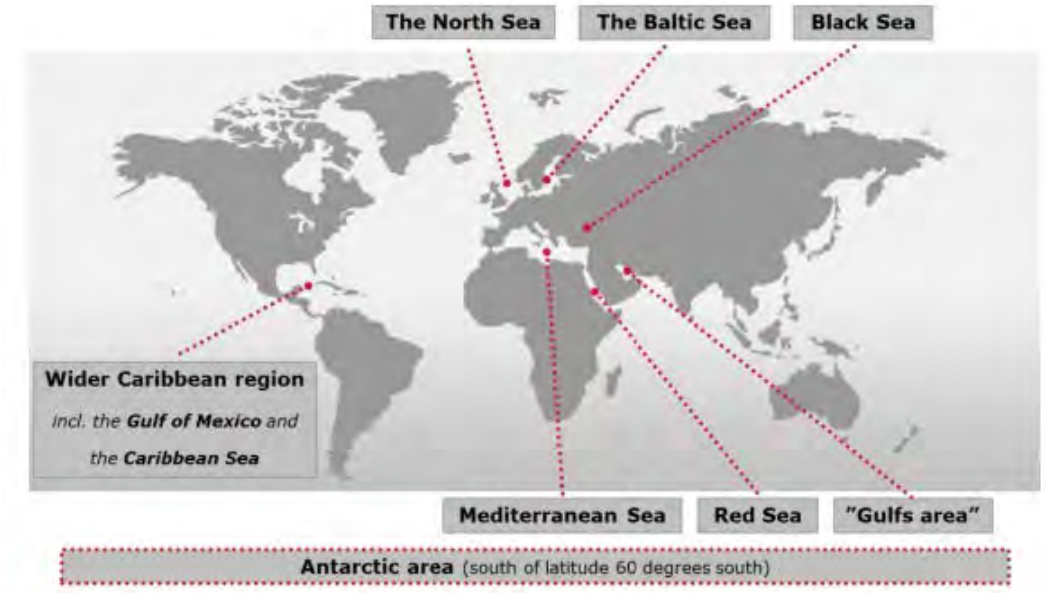
Aerosols, Antifreeze, Asbestos, Batteries, Wet Cell, Lead-acid , Dry Cell, Lithium, Dry cell, Nickel Metal Hydride , Dry cell, Other, Chemicals, Individual Chemicals, Mixed Chemicals, Clinical waste , Compressed gas cylinders, Fire extinguishers, Detergents & Disinfectants, Drums (Empty), AVTUR, MGO Drums, Petrol Drums, Explosives, Fluorescent Tubes & Lamps, Intact Bulbs, Broken Bulbs, Fuel and Oil , Diesel, MGO, AVTUR, AVCAT and Paraffin, Petrol, Lubricants & Engine oil, Oil Filters, Fuel/oil soaked rags and absorbents, Fuel/oil soaked clothing, Glue, Lighter, Mercury, Paint, Thinners & Stripper, Photo-chemicals, Radioactive waste , Scientific Radioactive Waste, Ionisation Chamber Smoke Detectors, Sanitary Protection & Condoms , Sewage & Urine, Science Cruise / Ship's Laboratory Waste , Waste Electrical and Electronic Equipment (WEEE).

The system shall require spaces for machinery and chilled storage

EXEMPLAR: Uson Marine waste management equipment and systems

General System Description (USON Marine):

The following presents a waste handling philosophy for a Polar Research Vessel and it describes the different types of waste expected to be generated onboard. The specification also describes a waste handling system based on authority requirements and regulations additional to common practice, for waste segregation, waste handling and waste reduction. The philosophy and proposed waste handling system reflects normal operation of the vessel.



Food waste shall be ground by local macerator(s) and/or food shredder in the galley and transported by vacuum to a de dicated holding tank, which is designed for food waste. This makes it possible to run the system when the vessel is operating within an area where discharge is prohibited.

Food waste - IMO Marpol 73/78 Annex V
A special designed holding tank for the ground food waste shall be installed if the system shall be used when the vessel is;

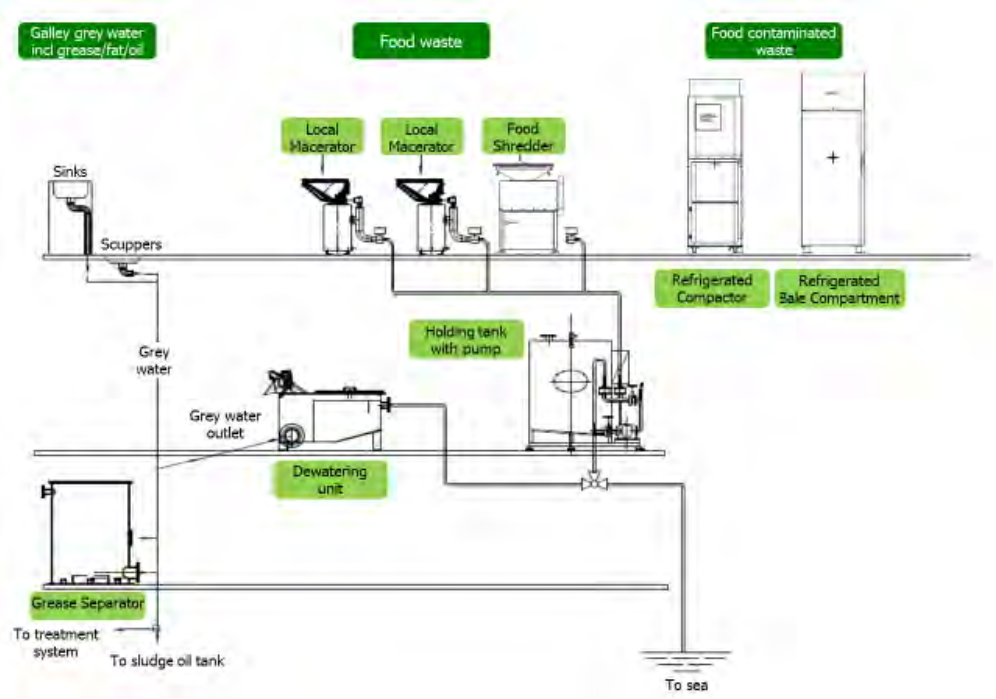
(a) in port,

(b) less than 3 nautical miles from the nearest land *outside Special Areas* or

(c) less than 12 nautical miles from the nearest land *inside Special Areas*

- **Food waste** is regulated under Marpol 73/78 **Annex V**
- **Black water/sewage** is regulated under Marpol 73/78 **Annex IV**
- **Grey water** is not regulated under Marpol 73/78
- **Grey water *mixed* with food waste** is regulated under Marpol 73/78 **Annex V**

All galley grey water from the scuppers and sinks shall pass a grease separator before it is discharged to the grey water tank. The grease/fat/oil is pumped to a grease holding tank. Discharge from dish washer shall by-pass the grease separator.



Dry solid waste – Accommodation waste
The systems for dry solid 'accommodation waste' shall include marine compactors & baling presses, glass crushers and shredders, reducing the volume of ship-generated garbage by approx 80% (depending on the fraction).

Waste handling stations for sorting different waste fractions shall be strategically located. From these waste shall be delivered to a garbage handling room for processing and storage. The garbage handling room shall be located in the area where most of the waste is being generated – close to the galley and the accommodation area.

The complete system shall assist the crew in collecting, sorting, treating and storing the waste onboard and help them to comply with regulations worldwide. The treated waste is transported onshore for recycling.

Waste recycling
A strategy of waste segregation and recycling shall be adopted and documented in the Garbage Management Plan according to the IMO Marpol Guideline for Annex V.
Recyclable wastes are:

- plastic,
- metal such as aluminium,
- glass,
- cardboard & paper.

Flow chart and waste volumes – BEFORE and AFTER treatment
The table below shows a simplified flow chart of waste handling, typical waste volumes generated as well as the residual volume after treatment. The figures are dependent on the vessel type.

POB: 90 Days: 60	Volume Per POB per DAY litre	Volume Tot POB Tot DAYS m^3		Intial Process System		End Process System	Vol. Red %	Storage Volume litre	Residual Volume m^3	Bales/ Sacks/ Bins #
Food Contam. Waste	4	21,6	→	UKP-6060 Compaction	→	URB-3 Storage	80%	85	4,3	51
General Waste	4	21,6	→	UMS-2530 Shredding	→	UMCC-4 Compaction	80%	160	4,3	27
Soft Plastics	1	5,4	→		→	UMCC-4 Compaction	80%	160	1,1	7
Hard plastics	3	16,2	→	UMS-2530 Shredding	→	UMCC-4 Compaction	80%	160	3,2	21
Cardboard	4	21,6	→		→	UBP-80 Compaction	80%	500	4,3	9
Tins & Cans	2	10,8	→	UMS-2530 Shredding	→	UMCC-4 Compaction	80%	160	2,2	14
Wood	2	10,8	→	UMS-2530 Shredding	→	UMCC-4 Compaction	80%	160	2,2	14
Glass	0,3	1,6	→		→	U-80 Crushing	80%	80	0,3	5
Dangerous Waste						UOR Storage		200		
Total (Dry Waste)		110							21,9	

Capacity - Holding tank for food waste (with vacuum transport)

People on board	60+30=90
Volume of food waste	1 litres / (POB & DAY)
Volume of food slurry	1.5- 2 litres / (POB & DAY)
Recommended tank volume	10.8 m3 = 10,800 litres.
Estimated holding time 10,800/200 =	approx. 60 days

Capacity – Grease separator

Peak flow capacity, M1	1 litre/s
Volume of galley grease, fat and oil*	30 ml / (POB & DAY)
Storage capacity, M1	80 litres
Estimated holding time 80/3 =	approx. 25 days

(*) Average value

Waste management system

Waste handling stations for segregation and handling of different types of waste shall be strategically located throughout the vessel and shall be delivered to an indoor garbage handling room for processing and storage. Garbage handling room shall be sufficiently ventilated or refrigerated. All processing equipment shall be s uitable for offshore and marine installation and shall be verified through a 'Verification Report' from a classification society.

Discharge criteria for garbage handling as regulated by IMO MARPOL 73/78 Annex V and recommendations from ISO/TC8/SC2 (Marine Environmental Protection) and ISO 21070 (Management and handling of ship generated garbage). The waste handling system shall be designed for operation at heavy seas. All electrical systems shall be compliant with the IEC 60092 standard.

The vessel shall in general be constructed in such a way that complete removal and/or reuse and recycling of materials and facilities is possible in a cost efficient and environmentally sound manner. Pollution prevention shall satisfy regulatory requirements, reduce long-term liabilities and satisfy owner's HES directives.

A procedure for garbage sorting, volume reduction and increased waste recycling shall be available in addition to the Garbage Management Plan required by IMO MARPOL 73/78, Annex V.

Food waste system
Food waste shall be disposed into collection stations in form of 1 l ocal macerators placed in suitable areas of galley and pantries. The local macerators shall be connected to a food waste system which shall be designed for hygienic transportation and treatment of food waste fulfilling the regulations stipulated by IMO Marpol 73/78 Annex V, U.S. Coast Guard, IBAMA and other relevant regulations and standards.

Each local macerator shall be equipped with a remote operation box with full flush, half flush and s top button. It shall also be supplied with labyrinth designed hopper with removable top and i ntegrated water nozzles for hygienic and s afe operation. Local macerator shall be approved to ground the food waste to pieces less than Ø 25 mm and rating shall be minimum 2.2 kW.

The ground food waste is transported by wet vacuum in 50 mm piping, to minimize the risk for blockage in the piping system, to a skid-mounted holding tank in stainless steel AISI 316, with a designed volume of holding time for POB 90 during 60 days. The tank shall be equipped with a water cleaning nozzle, a mixer and shall be designed to avoid sedimentation. The vacuum pump shall be reversible for transport both to and from the holding tank. The food waste shall be possible to discharge overboard or to port. The ground food waste shall not be mixed with either grey water or black water.

The system shall have possibility for remote control and supervision with possibility of discharging holding tank, blocking any manual or auto discharges and actual monitoring the level of food waste in the tank. The control system shall be integrated to the ships control system to allow for access from bridge, ships office and engine control room.

The food waste system shall have a GPS Discharge Control system ensuring that food waste is discharged into sea only when allowed according to IMO Marpol 73/78 Annex V, MEPC 62, ISO 21070, local rules and regulations. Further, the system shall automatically empty the food waste tank prior to entering a forbidden area.

All discharges of the food waste tank shall be logged electronically in the system with the following parameters: Date and time, Discharge volume, GPS position The information shall be logged for two years in compliance with the requirements for Garbage Record Book

Food shredder
One of the collection stations placed in the galley, pantry or preparation room shall be equipped with a food waste shredder which includes a macerator that is approved for discharges according to Marpol 73/78 Annex V. The unit shall have a two stage process where shredding is followed by macerating. The two stage process shall be synchronised by the food waste control systems. Minimum power capacity of shredder shall be 3 kW with minimum shaft torque of 1 700 Nm, minimum shredder area of 250 x 300 mm and hopper volume of minimum 25 litres. The shredder and shredder housing must be water tight and withstand a minimum inner pressure of 2.5 bars.

The shredder shall be of slow rotating type with maximum 25 rpm for heavy duty shredding together with minimum noise level. The material in the shredder knives shall be of homogenous extreme high strength hardened steel (Hardox 500).

The included macerator shall have a minimum power capacity of 2.2 kW. The shredder must be able to shred big bones, fish skins and all other types of food waste without any risk of clogging or blocking. Integrated hot water flushing with spraying nozzles shall be provided in the shredder. The food waste shredder shall be equipped with remote operation box with full flush, half flush and stop button.

Grease separator
All galley grey water from the scuppers and sinks shall pass a reinforced plastic (GRP) or stainless AISI 316 grease separator prior to discharge to grey water tank or sewage treatment plant. Outlet from food waste disposer or dishwasher shall not be routed to the grease separator.

The grease separator shall work by a combination of centrifugal and gravity separation and no heating, steaming, chemicals or insulation shall be needed for the separation process. The grease separator shall be of cylindrical shape with inlet in tangential direction to the cylindrical wall surface with separation efficiency of minimum 99%.

The separator shall be equipped with grease level alarm, mixer, hot water cleaning nozzle and ventilation. A goose neck, designed according to manufacturer instructions, shall be installed at the outlet to maintain a constant water level inside the separator during operation. Accumulated grease/oil shall be removed without opening the top cover using gravity.

Galley compactor for food contaminated waste
Food contaminated waste shall be compacted in a refrigerated sack compactor of stainless steel which shall maintain a temperature 4°C or below to avoid odours. The compactor shall be of electromechanical type with a, by third party, proven press power of minimum 4 tons. The compactor shall be designed to be suitable for installation in galley environments and shall be designed in accordance with US Public Health Regulations. It shall have arrangements for drain of condensations water.

Accommodation Waste
Multi chamber compactor for different fractions of waste
A multi chamber compactor with three chambers to compact dry general waste in a sack, bale cardboard, bale plastic and compact metal tins & cans shall be used. The unit shall have the possibility to bale with baling bands. The unit shall have an anvil for compaction of metal tins and cans. It shall be possible to extend with additional chamber at a later stage. The press head is moved sideward by a strong enough electrical motor to ensure safe and comfortable operation. It shall be bolted to deck, have safety catch for the doors, when in open position, and have two handed operation of the press head for safe operation in high seas.

The compactor shall be of electromechanical type to eliminate any risk for hydraulic oils leakage or any potential deterioration over time. The press force, proven by Class Society, shall be of minimum 5 tons. The compactor shall have function for double stroke and possibility to stop in stay-and-hold position for increased compaction and safety at high seas. The unit shall be equipped with indication of full chamber. The volume of the ready bales/sacks shall be about 160 litres with approximate weight of 30-60 kg.

The product shall be verified by a Class Society with regards to safety functions, noise level, safe operation during inclination (22.5 degrees) and press force.

Baling press for cardboard
Cardboard shall be treated in a baling press with lockable door. It shall have sufficient capacity and size of baling normal cardboard boxes without need of compaction prior to disposal in the unit. The unit shall have the possibility to bale with baling bands. It shall be bolted to deck and have safety catch for the door, when in open position, for safe operation in high seas.

The compactor shall be of electromechanical type to eliminate any risk for hydraulic oils leakage or any potential deterioration over time. The press force, proven by 3rd party, shall be of minimum 17 tons. The compactor shall have function for double stroke and possibility to stop in stay-and-hold position for increased compaction and safety at high seas. The unit shall be equipped with indication of full chamber and shall have function for semi-automatic ejection of the bales. Bale size shall be 1200 x 800 mm to be suitable for euro pallets.

The product shall be verified by a Class Society with regards to safety functions, noise level, safe operation during inclination (22,5 degrees) and press force.

Glass crusher
A glass crusher shall be installed and shall produces pieces of about 40 mm to make the glass acceptable for recycling. The volume reduction shall be approximately 80%. No glass smoke is provided after crushing the glass bottles. The machine shall be fitted with a level indicator that stops the machine when the bin is full to prevent overfilling.

The crusher shall start automatically when the protecting lid is lifted and shall be equipped with timer to ensure that all bottles fed are being crushed. The user shall be protected by glass splinters at all times.

The product shall be verified by a Class Society with regards to safety functions, noise level and safe operation during inclination (22,5 degrees).

Mini shredder for mixed waste
A mini shredder shall be installed to shred various waste types. The hopper shall be designed to ensure that shredder teeth cannot be reached during operation and shall be equipped with an inspection window to follow the shredding process. The material in the knives shall of homogenous extreme high strength hardened steel (Hardox 500).

The shredder shall be of electromechanical type to eliminate any risk for hydraulic oils leakage and shall be equipped an electronic overload control. When overloaded the shredder reverses to release the material and starts again. The shredder shall be of self-cleaning type. Minimum power capacity shall be 3 kW.

The product shall be verified by a Class Society with regards to safety functions, noise level and safe operation during inclination (22,5 degrees).