

**New Polar Research Vessel (NPRV)
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NPRV Typical Voyage Profile

From	To	Distance	Speed	Days at sea	In Port	Days in Port
Immingham	Portsmouth	370	13	1.2	Portsmouth	2.3
Portsmouth	Stanley	6853	13	22.0	Stanley	5
Stanley	Bird Island	697	13	2.2	Bird Island	3
Bird Island	King Edward Point	80	13	0.3	King Edward Point	2
King Edward Point	Signy	573	13	1.8	Signy	3
Signy	Stanley	651	13	2.1	Stanley Mob	4
Science	Science			27	Stanley Demob	4
Stanley	Rothera	1104	13	3.5	Rothera	5
Rothera	Stanley	1104	13	3.5	Stanley	4
Stanley	Halley	1573	13	5.0	Halley	8
Halley	Stanley	1573	13	5.0	Stanley Mob	4
Science	Science			45	Stanley Demob	4
Stanley	Rothera	1104	13	3.5	Rothera	5
Rothera	Signy	854	13	2.7	Signy	3
Signy	King Edward Point	573	13	1.8	King Edward Point	1
King Edward Point	Bird Island	80	13	0.3	Bird Island	2
Bird Island	Stanley	697	13	2.2	Stanley Mob	4
Science	Science			30	Or Move for Arctic	
					Stanley Demob	4
Stanley	Immingham	7253	13	22.0	Immingham	7
Immingham	Frederikshavn	386	13	1.2	Frederikshavn	21
Frederikshavn	Immingham	386	13	1.2	Immingham Mob	4
Science	Science			69	Immingham Mob	4
				Total Voyage Days	356.1	
				Science Days Total	171	
				Antarctic	102	
				Arctic	69	

The following are key operational considerations:

- Including, an ability to operate from a wide range of ports, noting that Unloading and Loading the vessel in the Antarctic must be self-sufficient, without the benefit of docks, shore labour or shore cranes.
- Capability for rapid demobilisation and mobilisation.
- The ability to be self-sufficient and flexible with the craneage requirements, including the ability to load/unload scientific cargo with minimum interference from the general cargo hold operations. Cargo and science equipment handling, mobilisation / demobilisation shall not conflict or require relocation of cargo or science outfit to enable the operation to take place.
- A fast changeover of transient scientific equipment, employing a 'plug and play' capability that permits:
 - ❖ Rapid and secure mounting of new equipment

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- ❖ Fast and efficient hook-up of new equipment to services using available 'plug in' points positioned at suitable locations.
- ❖ Suitability of service run routes and spare capacity to run new services.
- ❖ Ability to 'plug into' and integrate with existing ship systems.
- Sufficient and separate access for a rapid changeover of hotel and catering supplies.
- High levels of equipment reliability to avoid the need for repairs.
- In the case of service, maintenance and minor repairs being required:
 - ❖ The speed at which these can be carried out.
 - ❖ Accessibility of the ship's systems.
 - ❖ Equipment removal routes.
 - ❖ Availability of spares and materials at local ports.
 - ❖ Ability of the ship's staff to undertake the repairs without need for external support.
 - ❖ Ability of the local workforce to undertake the repairs without a need for special facilities.
- Speed and economy in the transit to and from the scientific site and research stations, moving the scientists in comfort and ready for work when the ship arrives on station. The ship will experience extremes in sea states and will require appropriate seakeeping capability to maintain speed, comfort and economy.
- Capability to deploy scientific equipment Worldwide, but mostly in Southern or Northern high latitudes and to conduct experiments efficiently and effectively over continuous 24-hour periods and in extreme weather and sea conditions once on station. Specific requirements are:
 - ❖ The ability to deliver on demand, continuous power to perform the experiments close to the maximum limit for long periods.
 - ❖ The ability to hold position in high cross winds and severe weather.
 - ❖ The ability to operate quietly with respect to Underwater Radiated Noise (URN).
 - ❖ The need to coordinate the ergonomics, human factors and space planning aspects of the ship design to permit the scientists to conduct their work efficiently.
 - ❖ The ability to support integrated experiments through universal data sharing and common computer and communications facilities.
 - ❖ The ship and its systems must support the science and special attention is required to ensure that the ship does not 'contaminate', interfere with or upset the experiments in any way.
 - ❖ The ship is to be capable of performing scientific operations through the moonpool in locations with ice present.

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4.6 OPERATING ENVIRONMENT

The Contractor will deliver a ship is able to operate effectively in the following extremes of the hostile environment hostile environment of the Antarctic (and Arctic) Regions, including operation south of 60 degrees South.

Operation in ice is implied by the areas of operation. The ice conditions to be included in the design should be determined by the itinerary and the worst case conditions expected at the time of year in which the vessel will be present. In addition ice conditions in areas where there is a desire to operate may be considered.

The vessel will be designed to survive all weather conditions that can reasonably be expected within the area of operations in the Antarctic and in transit to and from the UK.

In order to maintain the supply chain to the established Research Stations with a single vessel the period of operation in areas of ice may have to be extended beyond previous practice. An assessment of the ice conditions during that operating period should then guide the ice breaking capability.

To achieve the proposed itinerary there is 80 - 90% probability of encountering ice to call at Signy & Rothera and 100% likelihood to call at Halley. Ice may also be encountered elsewhere.

Capability for operation in tropical climates must also be foreseen to allow transit and possible deployment in hot conditions.

The environmental conditions should be identified for the various tasks to be carried out. In general the ship must be capable of effective operation in the following conditions.

- ❖ Ambient air temperature +45°C @ 65% Relative Humidity / -40°C &
- ❖ Sea water temperature +35°C / -2°C

Ventilation systems and Cooling installations to reflect the 'worst case' operating conditions as defined above

Operating Condition	Maximum limit of operation
Survival in transit.	<ul style="list-style-type: none"> • Not less than Sea State 9. • Worst conditions recorded in the area of operation.
Science & shipboard operations.	<ul style="list-style-type: none"> • Between and equal to Sea State 0 and the top of Sea State 5.
Conduct observation and monitoring activities.	<ul style="list-style-type: none"> • Between and equal to Sea State 0 and the top of Sea State 6. • Beaufort Force 8 wind.
Generic motion limits in operational transit.	<ul style="list-style-type: none"> • Not less than the top of Sea State 5.
Generic motion limits for "Vertical Replenishment".	<ul style="list-style-type: none"> • Not less than the top of Sea State 3.
Generic motion limits for "Helicopter" operations.	<ul style="list-style-type: none"> • Not less than the top of Sea State 3.
Generic motion limits for boat / ROV / Equipment Launch and Recovery. Generic motion limits "Boat/ROV/ Equipment Launch and Recovery" in for scientific equipment deployment.	<ul style="list-style-type: none"> • Not less than the top of Sea State 4 for tender launch and retrieval. • Not less than the top of Sea State 5.
Generic motion limits for "Survival Transit".	<ul style="list-style-type: none"> • Not less than Sea State 9.
Dynamic Positioning Operations, at least:	<ul style="list-style-type: none"> • Steady Wind Speed 30 knots, gusting 40 knots, on the beam. • Top of Sea State 5(4m) • 0.5 knot current on the beam

4.7 WHOLE-LIFE COSTS AND AFFORDABILITY

4.7.1 Total Cost of Ownership

The major costs over the whole life of the ship will be downstream from the delivery of the ship. Therefore the focus on ship design will be:

- The cost effective operation (e.g. fuel costs, manning requirements, etc.)
- The ease of maintenance (e.g. access and removal routes, use of standard tooling, use of problem prediction techniques – thermal imaging, vibration analysis, data for predictive maintenance systems, etc.)
- Flexibility of use (e.g. redundancy and spare capacity built-in, standard mountings, standard connections to services, etc.).

The procurement of equipment will focus on:

- Availability, Reliability, and Maintainability (ARM)
- Avoidance of obsolescence.
- Global availability and low cost of spare parts.

4.8 OPERATIONS – BASIC CONCEPTS AND OVERVIEW

The ship will be a platform for science and provide research station logistical support in a cost-effective and safe way with minimal impact on the local environment.

The ship will allow multi-role and multi-task scientific operations and that is capable of being changed during its life in an evolutionary manner to adapt to changing scientific and logistical needs.

All research ships grow in lightship weight during their lives and a growth margin will need to be built into the deadweight and stability considerations from the beginning. A lightship weight growth margin is therefore to be built into the design of the vessel to ensure that the full scientific and cargo deadweight can still be carried at the design draught even when the vessel is nearing the end of her service life.

FIGURE 1 shows graphically some of the key activities that the ship will be expected to support.



4.8.1 ROV (Remotely Operated Vehicle) Operations

The ship will act in full support of the National Marine Facilities 'ISIS' ROV and other proprietary vehicles. This is a self-contained package of equipment that will require tie-down arrangements, electrical power supplies and data connections.

4.8.2 AUV (Autonomous Underwater Vehicle) Operations

The ship will be required to support AUVs. These are self-contained packages excepting power supplies and control/data links that will need to be available.

4.8.3 Seismic Operations

The ship will be required to support seismic operations. These are self-contained packages excepting power supplies and control/data links that will need to be available.

4.9 SCIENTIFIC OPERATIONS

4.9.1 Scientific Moonpool, Closing Device and Overflow Arrangements

The scientific moonpool will be used to increase the operating conditions in which over the side work can take place safely. The scientific moonpool will be an integral part of a complex comprising hangar, transfer, storage / equipment preparation for deployment of over the side devices and the subsequent laboratory processing and sample storage.

The scientific moonpool will be located aft of sensitive sensors that may be subject to interference arising from the aperture/bottom shell hatch.

A scientific moonpool is identified for science use as a moonpool of about 4m x 4m clear opening.

The CTD may be deployed through the scientific moonpool. Other equipment may be deployed through the moonpool, including the following:

- Landers.
- Box corers.
- Small ROVs.
- HIBIS.
- Seabed Drill.
- AUVs.
- Other devices on a wire.

The moonpool should be designed to further still the wave action by the inclusion of a double shell, made up of baffle plate webs and stringers incorporating large free flow openings. A watertight bottom door is required to minimise resistance when free running and avoid ice accumulation. Means will be provided of avoiding ice accumulation within the moonpool.

Measures will be required to avoid wires snagging obstructions or the bottom doors, for example by means of a cursor arrangement.

The moon pool should be served by the same overhead transfer/hoist systems as the hangar space and Over the Side handling systems, as far as practical.

The moonpool should be provided with a moveable cover panel with aperture to allow the passing of the equipment wire to pass through it.

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The moonpool should be fitted with an overflow arrangement at its upper level water line in order to overflow and help keep the surface of the entrained water as clean as possible.

Sufficient mechanical / natural ventilation will be provided in Scientific Hangar to prevent piston effect and pressure variation from the scientific moonpool. Ventilation should be sufficient enough to avoid air piston effect in sea states (Hs) of 6m.

4.9.2 Working Decks – General Principles

The working deck level (about 4m above the normal waterline) must be arranged so that personnel and equipment access can be free flowing with the minimum of change from one level to another. Concentrating the main laboratory complex around midship or just aft will serve to minimise the impact of ship motions on both personnel and equipment operations thus opening up the operating weather windows.

Deck to deck heights will need to be varied in order to accommodate piping, air conditioning, electrical and data link pathways while maintaining adequate headroom. For example, a minimum clear headroom between deck head linings and deck coverings of 2.3m is required in scientific working areas and amenity spaces.

4.9.3 Working Decks – Layout

Most scientific work will be carried out at the aft end and along the starboard side. The port side of the ship is reserved primarily for ship type operations such as MOB/Workboat handling, but the aft end will also be used for the deployment of science equipment.

The ship is to be configured with a large open aft working deck connected to a relatively wide (4m) starboard side working deck leading forward to about midship. These working decks are to be at about 4m above the normal operating draft to minimise the dangers of pendulum action when deploying or retrieving equipment, while protecting personnel as far as possible from the shipment of seas.

The Aft Working Deck is to be broadly rectangular in plan form with clear access over both sides of the ship at the stern as well as over the stern.

The Starboard Side Deck is to have clear access overboard over a length of at least 45m and is to be contiguous with the aft deck. It will be sheathed with timber.

Coupled with over-side handling equipment (which may be fixed or portable) and craneage these deck areas will be loaded with scientific packages, containers and deployable equipment. Mobilisations and demobilisations are major and regular activities and the ship will be self-contained in terms of craneage. Easy handling of equipment and free flows into, between, and out of the Science Hangar, laboratories and service spaces of both hand carried and truckable items will be necessary.

The decks are to be essentially flat without shear or parabolic camber. Straight line camber should be considered for the main open working deck outboard side areas to assist in the shedding of shipped water or heavy rain. Between the aft pedestals and stretching forward to the superstructure the deck is to be flat. In any event experience has shown that very large deck drainage scuppers will need to be provided at strategic locations.

4.9.4 Work Spaces

Immediately adjacent to the working decks there will be an enclosed Science Hangar, which will provide a protected working environment where large and small pieces of equipment can be stored, opened up and worked upon. This will be a wet space not included within the enclosed superstructure. The space will be fitted with gantry crane beams allowing equipment transfer to and from the outside decks.

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The deck within the Hangar will be sheathed with timber.

Leading off the Hangar will be well fitted out mechanical / welding workshops: Rough Workshop and Science Workshop.

Electrical / Electronic Workshops will be located elsewhere in the laboratory suite.

The scientific moonpool will be located within the hangar.

The science hangar will provide space for the stowage of containerised laboratories,

A flush hatch, with integrated pallet lift will be located within the hold to allow transfer of equipment to and from the scientific hold.

CTDs retrieved either from overboard on the starboard side or the scientific moonpool will be received directly into the hangar. This will be located about midship or just aft of it where ship motions are least. Water sampling equipment will be deployed and retrieved directly overboard to starboard at that location.

4.9.5 Laboratories on Main Deck

The Laboratory Suite may be part of the enclosed superstructure in ship design terms but it will allow 'wet and dirty' activities such as the reception of biological or geological samples for cleaning and preparation for further detailed analysis in more specific laboratories which will be accessed via the Science Hangar as follows:

Wet Laboratory will have direct access from the Science Hangar and access to containerised laboratories within the Science Hangar.

Deck Laboratory will have direct access from Science Hangar and access from Wet Laboratory.

Controlled Temperature Laboratory will have direct access from the Deck Laboratory.

Controlled Temperature Laboratory / Chilled Sample Store will have direct access from the Deck Laboratory and will be a dual purpose space as required.

Main Laboratory will be accessed via a corridor leading off Science Hangar.

Clean Laboratory will have direct access through an air lock from Science Hangar.

4.9.6 Other Laboratories & Scientific Rooms

Salinometer Room on Main Deck level, which in turn will have good access to the Laboratory Suite, where the more specific and complex analysis techniques will be employed and data logging and archiving will take place.

Dark / Photo Room on Main Deck level will provide a light sealed environment for bioluminescence and photographic work.

Meteorological Laboratory will be located close to the Meteorological Platform to provide an adjacent space for sampling equipment.

Aerosol Laboratory will be located close to the Topside Sensor Platform.

Clean Seawater Sampling Room will be located close to the clean seawater intake and pump room and this will be provided with easy access from the main laboratory complex without passing through accommodation or machinery areas.

Gravity Meter Room will be located as near to the centre of motion of the vessel and waterline.

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Underway Instrumentation Control Room will be located next to main winch room with clear views over aft and starboard working decks, winch room and hangar.

Data Suite incorporating an IT/Antarctic Marine Engineering workshop to be located near to UIC room with a view over hangar.

Server Room to be located near the Data Suite.

4.9.7 Container Laboratories

Self-contained specialist Laboratory Containers will also be carried. These will be located within the science hangar, movable to adjoin and accessed directly from Wet Laboratory and on the open aft deck. All necessary service supplies will be provided for these in a 'plug & play' manner.

4.9.8 Scientific Ready Use Storage

Below the main deck will be a scientific store which will carry equipment in readiness for deployment on deck when required. Hatch access to the Hangar will be required under coverage of craneage. This store will also contain segregated storage for chemicals (unused and used) as well as scientific freezer cabinets for samples.

Provision will be made for the carriage of a number of stores and equipment containers (20' & 10' types) on the open decks, each of which will be easily accessed and under coverage of appropriately capable craneage and if necessary be moved into the Science Hangar.

4.9.9 Safety and Productivity

Operational safety is of primary concern since much of the work carried out by personnel is heavy and onerous particularly in high sea states and which, by its variety and unpredictable nature, is not generally conducive to automation.

Because a ship is continually moving, especially where the activities are carried out on station in heavy weather, and subject to extremes of temperature, physical fatigue of personnel is of primary concern in terms of safety and productivity. While this can be alleviated by careful ship design in terms of motion response and working locations, the off-watch situation must also be considered.

Disturbance of the off-watch crew and scientists by on deck activities, including DP operation, is to be avoided.

Since the vessel will operate on a 24/7 basis the reduction and control of noise and vibration within sleeping areas is paramount especially when operating in DP when the transient noise levels of thrusters can be seriously imposing. Likewise the tank stabiliser system must be configured and installed to minimise sleep interference.

The wheelhouse should be located as near midship as possible and as low as possible. The achievement of this will depend on the spatial configurations related to chosen length and breadth. The accelerations at the wheelhouse predicted in seakeeping calculations should be considered, during the design stage.

Compatible with the above positional requirement, the wheelhouse must also provide clear viewing as far as possible of the operational decks, and forward for a clear view of the ice surface 50m forward of bow. Clear eye-lines must be demonstrable over the fore deck and also over the starboard deck and the transom area without leaving the general location of the appropriate bridge controls. Full 360 degree conning must be arranged from the wheelhouse with, particularly, as close as possible to 360 degrees from the ship control console.

The exhaust funnel itself should not interfere unduly with this viewing and its design and position should preclude the pooling of exhaust gases on the aft deck. The

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suppression of noise from the exhausts and engine room fan systems is a major requirement in as much as they may impact on the operations of the aft working deck.

4.10 SHIP OPERATIONS

4.10.1 Computer / Data Network

A central computer server system will be the hub of the data retrieval and archiving system. Data systems, using CAT7 distribution systems, will be extensively distributed throughout the laboratories, working spaces and accommodation. These will be fully integrated in the initial design and will contain the provision of additional pathways and outlets for future use.

4.10.2 Service Runs & Capacity

Substantial and numerous scientific cable-ways will be incorporated throughout the ship to allow efficient and easy temporary, cruise by cruise, installations.

4.10.3 Ship's Effect on the Environment

The design of the ship and its facilities must minimise the environmental impact because:

- It is a NERC / BAS strategic priority to minimise the impact on the environment.
- NERC / BAS operations are bound by legislation (including the Protocol on Environmental Protection to the Antarctic Treaty, MARPOL, Polar Code etc).
- One of the prime activities of the ship will be the examination of pollutants and their affects on the oceans.
- If the emission of pollutants is not controlled the precise and critical measurements being made could be negated by the ship carrying out the work.

All potential sources of emissions or pollutants of whatever kind are to be identified and dealt with by careful design and the employment of conventional readily available means of, elimination, containment, conversion or destruction.

For example, where pollutants are unavoidable such as the diesel engine exhausts, ultra-low sulphur fuel will be used, smokeless engine technology is to be employed, exhaust gas NOx treatment (SCR type) is to be provided and the ejection of the final gases is to be away from areas where measurements will be made.

All overboard discharges are to be arranged on the port side to alleviate the possibility of cross-contamination of equipment being handled over the starboard side.

At times the ship will operate in areas where discharge of waste at sea is banned. The use of garbage treatment systems and on-board chilled storage will be required along with ease of internal handling and discharge.

4.10.4 Primary Power Generation

With the electrical power demand comprising propulsive power, thruster power, auxiliary ship services, domestic ship services, science equipment and services a diesel electric power plant operating under the power station principle is the required solution for the ship's power source. The requirement for redundancy propulsion requires separate generator spaces, motor rooms and twin screw propulsion. To reduce noise and vibration transmitted into the hull structure the generator sets are to be double resiliently mounted.

The ship will possess a variety of demands upon its basic powering system: passage propulsion, underway survey, domestic loadings, and icebreaking. Whilst during

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science operations the greater power demand can come from other equipment (e.g. seismic air compressors) and main propulsion demand is relatively small. During dynamic positioning operations thruster demands become more significant.

The propulsive loads will be most significant during operation in ice. The design condition with maximum propulsive load is icebreaking in 1 m thick ice at 3 knots. This case coupled with electrical loads from auxiliary and domestic ship services, science equipment and services, and heating provides the maximum electrical power demand. Spare capacity to provide redundancy in power generation is required in all cases except this icebreaking condition since speed can be reduced in the case of generator failure.

A centralised Power Management System is to control the operations of the plant linked with a SCADA (Supervisory Control and Data Acquisition) system of control, alarm and monitoring combined with individual system controls all contained within one integrated package.

Between survey mode (at 6 to 8 and 11 kn) and ice breaking mode there is a significant variation in power demand. Power balances for the various operational modes must be considered carefully to ensure that the most desirable mix of generator numbers and capacity are chosen.

Variable frequency power generation (DC Switchboard) could be considered as one of the propulsion options.

The increasing dependence of science upon electronic data systems and sensors requires that the basic power supplies are highly reliable and free from the effects of harmonic distortions.

Power systems will be extensively distributed throughout the laboratories, working spaces and containers.

4.10.5 Main Propulsion System, Track-Lining and Dynamic Positioning

A Polar research ship has to travel long distances to (and from) the scientific sites at best speed and lowest fuel consumption in any weather and then maintain its position (Dynamic Positioning) or track-line as accurately as possible in high sea states continuing to work to the weather limits of the scientific equipment. In addition the suppression of in-water noise and interference to acceptable levels for acoustic measuring/signalling and biological sampling activities impact upon the choice of power and propulsion system fitted.

The propulsion system is also required to deliver sufficient power for icebreaking.

Considering these power requirements, the shallow draft and requirements for propeller tip clearance for quiet operation along with redundancy in propulsion a twin screw design is required.

The Underwater Radiated Noise requirements are applicable at survey speeds and not at transit and ice breaking mode. The propulsion systems and motors should be configured to provide quiet operation at these survey speeds.

The criteria for selecting the configuration of power generation and propulsion system should include the following:

- Noise and vibration affecting sensitive acoustic survey equipment.
- Underwater Radiated Noise affecting survey equipment towed behind the ship.
- Underwater Radiated Noise affecting wildlife surveys.

- Transmission of noise in accommodation spaces within the vessel.
- Reliability of machinery.
- Flexibility in operation.
- Redundancy in case of failure.
- Fuel consumption during the operating modes.
- Weight of the propulsion system.
- Reduction or elimination of harmonic distortion in the electrical system.

4.10.6 Hydraulic Power Requirements

A hydraulic power unit room will be provided the output of which will service points on the operating decks. Separate power packs will also serve over-side lifting equipment and the winch systems if required. All these systems will require water cooling to meet the operating environment conditions.

The location and local noise and vibration isolations of these power units and piping systems will be chosen to minimise the noise intrusion into laboratories, accommodation spaces and, of prime importance, into the water.

4.10.7 Topsides Sensor Platform

The wheelhouse top and an aerial platform will be locations for substantial sensor arrays for navigational, data transmission/receipt, communications, scientific sensors, etc. Separations and height variations will be necessary to prevent mutual interferences and to allow relatively free access of personnel to maintain the various sensors. The platforms will also be fitted with weather protected positions to be used for visual observations.

The configuration of the superstructure itself must be layered and raked towards the aft and not be an abrupt high bridge front since meteorological measurements will be carried out in the clean air at the foremost part of the ship and these can be severely affected by air flows and pressure regimes in front of and around superstructures.

A large meteorological sensor platform is to be located at the forward end and an air sampling system will be required deployable clear of any affects or contamination from the ship itself while sampling takes place under way. The foremast itself, while carrying the normal navigational lights, should be arranged to incorporate this facility.

Meteorological measurements at the forward end and operations in high latitudes with associated icing will drive the overall superstructure form in terms of smoothness of transitions and surfaces with minimum clutter.

4.10.8 Underwater Sensor Arrangements

The ship will be equipped with a variety of hull mounted acoustically based sensors and navigation aids. Their performances are susceptible to water turbulence, air bubbles entrained in the water, underwater noise radiated by the ship, internal noise and interference, and interactions. Assurance of their performances will be of paramount importance in the design. Some of these will also require changing out or maintenance both at sea and during mobilisation / demobilisation in port without the employment of a dry-dock.

A combination of permanent hull appendages and potential for retractable deployment systems (deployed through the scientific moon pool) will be necessary.

4.10.9 Over-side Lifting Systems

The ship will be equipped with specialised over-side lifting and equipment handling systems for lifting and towing over the stern and lifting and towing over the side.

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These will operate in combination with the Scientific Winch System. Their design will ensure that pendulum action can be reduced to the minimum.

Supporting structures for cranes and over-side handling equipment are to be built in from the outset and fully integrated wherever possible.

4.10.10 Scientific Winch System

The ship is to be equipped with a winch system for safe over-side handling of, and towage of, instrument packages to full ocean depth. A number of different steel and synthetic ropes and cables will be deployed over the stern 'A' Frame, through the scientific moonpool and over the starboard side.

The arrangement of winches, storage drums and sheaves will permit wires to be rigged in two or more positions simultaneously to allow for the efficient deployment of equipment and avoid delay between different deployments.

An efficient cable cleaning and treatment system is to be provided.

4.10.11 Helicopter Operations

Heli-deck

A range of aviation facilities are required.

- Winching spot (winching of individual personnel/light items).
- VERTREP (vertical replenishment - cargo slung in a net below the helicopter; assume 1500kg).
- Helideck - landing of a helicopter for personnel/cargo transfer.
- Helideck & hangar - landing of a helicopter for personnel / cargo transfer, onboard base for helicopter(s).
- Helideck with capability for use (landing/take-off & refuelling) by a SAR helicopter, e.g. Sikorsky S-92 (maximum take-off weight of 13t).
- Helideck and Hangar suitable for the operation of two Eurocopter AS365 N3 type helicopters of up to 5 tonnes maximum weight and based onboard.
- JET A1 (Aviation) fuel portable storage tank(s).
- Helicopter refuelling equipment, capable of operation in the Polar Climate.
- De-fuelling of helicopters.
- Access to allow the safe transfer of cargo (light loads) to the heli-deck for VERTREP operations (under-slung loads suspended below the helicopter).
- Suitable deck tie down points will be provided.

The heli-deck is to comply with the requirements of CAP 437 and ICS Guide to Helicopter/Ship Operations.

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4.10.12 Helicopter Hangar

A helicopter hangar to accommodate two helicopters is to be provided either adjacent to or below (accessed via a lift) the helideck. The dimensions of the hangar are to allow access for maintenance of the helicopters when both are in the hangar. The helicopter type will be of commercial specification and not have folding tail sections.

Hangar dimensions should be at least: length 13.6m; width 9.15m; height 5.25m to accommodate two Dauphin (Eurocopter type AS365 N3) type helicopter.

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

The hangar is to be multipurpose, used for portable laboratories/ cargo/science equipment stowage. Means to transfer and secure portable laboratories and cargo in the helicopter hangar will require special consideration.

An overhead multi-purpose gantry crane is required for overhaul purposes.

The hangar may be used to accommodate up to four standard 20ft ISO portable containerised laboratories/scientific stores. The Hangar area is to be equipped with plug and play connections for services.

The hangar outfit is to 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 helicopter servicing/maintenance.
- Services to support laboratories.
- Helicopter parts storage.
- Helicopter maintenance workshop.
- Hangar door(s) or hatch suitable for the adverse environment and helicopter down draft.
- Portable science laboratory transfer system (maximum weight 8t)
- Maintenance of climate as working space.

4.10.13 Helicopter Refuelling

Aviation fuel storage is required as well as suitable refuelling and de-fuelling facilities.

4.11 CARGO / CAPACITIES / OPERATION

4.11.1 Deck Outfit

The following features will be required:

- “A” frames to deploy survey equipment aft and over the starboard side.
- Space for containerised portable laboratories.

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- Fresh & Sea water supply for temporary portable laboratories.
- Drainage facilities from temporary portable laboratories.
- Compressed air supply.
- Electrical supply outlets.
- Hydraulic power supply outlets.
- Facility to carry packaged dangerous cargo, including approved portable fuel containers.

4.12 CARGO HOLDS, HEATING, COOLING & VENTILATION

4.12.1 Cargo Holds

Cargo holds will accommodate a mix of cargoes, including standard cargo containers, air transportable containers, break bulk, palletised cargo, oil drums etc.

Clear deck heights should be determined by an integral number of ISO standard cargo containers at least on one deck.

Cargo hold spaces will be subdivided to facilitate differing uses and environmental conditions to be maintained in each. This sub-division may be 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 will be designed accordingly, including the following:

- Ventilation.
- Safe access.
- Fire protection.
- Fire detection.
- Fire extinguishing.
- Safety systems required to meet the use of the cargo holds and the cargoes to be carried.

4.12.2 Insulation and Lining of Cargo Holds

The cargo holds will have thermal insulation on their deckheads (including cargo hatches) and protective linings to avoid cargo handling damage.

Areas of the cargo hold used for stowage of dangerous cargo will require structural fire protection according to the Regulations.

The science hold spaces are considered as working spaces and therefore require thermal insulation. Structural fire protection will be as required by the Regulations.

4.12.3 Ventilation of Cargo Holds

Cargo holds will be arranged with appropriate ventilation systems for the carriage of dangerous cargo.

4.12.4 Heating of Cargo Holds

Insulation/ventilation/heating of cargo holds is to comply with the Classification Notation requirements.

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Adequate ventilation and heating will be provided to allow the manned use of science holds as stores and workshops during operating conditions.

4.13 SCIENTIFIC HOLD

4.13.1 Scientific Hold

A science hold is required for the transport and storage of scientific equipment. This should be accessible at sea via stairway.

The Scientific Hold should be arranged with means to maintain its temperature above freezing.

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 onto the working deck/lab spaces UIC level at sea.

4.14 CARGO and ACCESS HATCHES

4.14.1 Cargo & Access Hatches

- Hydraulic operated cargo hatches are to be provided, serving the cargo hold spaces and scientific equipment hold.
- If the cargo holds are located below the working deck aft then flush cargo hatches should be arranged.
- Cargo hatches are to be arranged with clear working aperture to allow 20ft ISO cargo containers to be loaded through to be stowed in the cargo hold, using the ship's cargo crane. A simple skidding system may be installed for moving containers transversely below deck.
- The cargo hold hatch is to have clear opening of at least 10m in length by 6.5m in width.
- Main Deck hatch covers and working deck are to be installed with container securing and general cargo securing fittings. Containers will be stacked two high, stack weight to be 40 tonnes. The hatch covers will be designed to withstand the deck loading as per the main deck of 5 tonnes/m²
- Cargo holds are to have a single Tween Deck where appropriate, with hydraulically operated tween deck hatch covers with similar clear opening to the main hatch above, allowing 20ft ISO cargo containers to be loaded into the Lower Hold.
- Access hatches or panels are to be provided to facilitate transfer of largest parts for maintenance/repair.
- Cargo hatches to be provided with structural fire protection in accordance with regulations.
- The Scientific Equipment Hold hatches will be arranged so that they may be opened at sea to facilitate scientific activity on deck.

4.15 DECK CARGO

4.15.1 Cargo VERTREP Area

Capability for transfer of cargo to and from the vessel using helicopters is to be provided. This can take the form of a designated area in way of the cargo holds served by ship's main crane or provision on the heli deck for cargo transfers to the rest of the vessel. Depending on the ship's configuration the VERTREP area may be either separate or coincident with the heli-deck, according to the proposed design.

Cargo and personnel transfer systems by helicopter include the following:

- Transfer of personnel by helicopter using a winching area.
- Option of personnel and light cargo by helicopter landing on a heli-deck.

Either of the following options is acceptable

VERTREP area in way of cargo holds

An area will be designated and specially marked on the open deck, free of obstruction, that can be served by ship's crane(s) for cargo transfer in a cargo net or air transportable container slung below a helicopter. Maximum cargo load is 1500kg.

This area will be protected by AFFF fire monitors.

Cargo VERTREP area in way of heli deck

A suitable hatch is to be provided adjacent to the helideck. Hatch to be connected to a corridor for transfer of cargo and science equipment to the cargo holds and science hold.

A crane for transferring cargo up to 1500 kg to the centre of the helideck

4.15.2 Cargo Transfer Systems

Cargo and personnel transfer handling requirements will be subject to the specific location where the operation is required. The (potentially) hostile environment dictates that safety is a key factor in the transfer of cargo and personnel. The area of operation also demands high standards of environmental protection.

The ship must clearly be self-sustaining in terms of transfer systems.

It is a requirement that cargo may easily and safely be transferred around the ship, between above deck cargo stowage areas, cargo holds, aft working deck, helicopter VERTREP area and heli-deck.

The cargo loading/discharging will be arranged for transfers alongside the vessel, port and starboard. Cargo handling will not be required over the bow or stern.

4.15.3 Cargo Handling Monorail / Gantry Crane

Movement of goods within the ship, without the need for transfer via external means (jetty or boat) is required.

If the proposed design has an arrangement in which the accommodation block separates the cargo hold (forward) from the helideck (aft) or vice versa then a clear access tunnel route will be provided to facilitate transfer of cargo. This tunnel will have clear dimensions to allow fork lift truck operation.

4.16 AUXILIARY CRAFT

4.16.1 Auxiliary Small Craft - General Requirements

The vessel's operations will be supported by additional small craft stowed onboard and provided with safe handling and embarkation/ disembarkation arrangements.

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Where possible small craft should be stowed in recesses in the ship side and closed by soft covers, providing some environmental protection.

All service and support craft should be launched and recovered using a dedicated davit for safety of personnel. The use of dedicated deployment systems could be expected to improve operability.

Ambient conditions at Research Stations and in the Antarctic Region in general are such that safe embarkation/disembarkation of small boats must be specially considered. Special boarding arrangements, such as a gun port door/small boat berthing similar to those used on some cruise vessels are to be provided.

All the support craft and work boats will be designed to comply with an appropriate code in compliance with MCA requirements.

4.17 CRANES

4.17.1 Cranes & Gantries

Craneage is to provide self-contained operations both offshore and in port. The working decks and container stowage slots are to be completely covered by craneage of sufficient capacity. One of the cranes will be a heavy lift facility. In addition a handling system will be provided to move equipment into, out of and within the Science Hangar.

4.17.2 Cargo Cranes

A pedestal type knuckle boom deck crane(s) is to be installed serving:

- All areas where cargo may be stowed on the open deck.
- Cargo holds via the cargo hatches.
- Overside to load discharge to/from a quay/ice shelf, up to 12m from the ship side, port and starboard.

The deck service crane(s) are to be designed for use offshore, with capacity not less than SWL 50 tonne for use in harbour or sheltered waters with conditions up to sea state 2. Operating radius is to be determined by the above service requirements. A heave compensated whip hoist is to be provided with 5t capacity (offshore lifts) at maximum radius.

The crane(s) will be used for the following functions.

- Load/discharge cargo of up to 50t, including transfer of 20ft cargo containers of up to 30t from the quay to/from the cargo hold or deck cargo space.
- Load/discharge scientific equipment of up to 35t to any part of the working deck.
- Transfer of 20ft ISO cargo containers to / from the cargo tender (up to 20t) in sheltered waters
- Transfer of stores to / from the cargo tender (up to 10t) in sheltered waters.
- Operate at up to full load in sheltered waters/harbour conditions and at nominal load (5t) at sea (whip hoist).

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- Bulk material and fuel/potable water loading hose handling.
- Transfer of garbage.
- Lifting port & starboard side gangway into position.
- Carry out cargo / equipment transfers at established ports / harbours / jetties, which may have no other infrastructure.
- Personnel basket transfer using the whip hoist.

Some of these functions may be performed by an auxiliary deck crane(s).

Deck cranes are to be outfitted with an air conditioned operator's cabin providing good visibility of the load working area. Safety features are to failsafe. UHF radio, Talk back and PA communications are to be included. Operating limits for slew and luff angles are to be incorporated in each crane.

Crane location will take account of the clear zones required for helicopter operations (with crane stowed during helicopter operations).

4.17.3 Deck Cranes

If the cargo hold/open deck cargo stowage is separated from the helicopter VERTREP area a smaller capacity crane may be considered to serve this operation and general deck service. However this crane would also have to be designed for use at sea. In this case the second crane will have a capacity and radius to serve the heli-deck, open deck for equipment handling and overboard outreach to transfer items to the quay or cargo tender.

4.17.4 Working Deck Service Cranes

The Working Deck areas used for scientific work is the served by service cranes designed for use at sea for the movement of scientific equipment and deployment overboard. The number and outreach of the service cranes will be subject to the Working Deck arrangement, but at least two cranes are expected to be required.

4.18 BULK AVIATION FUEL

4.18.1 Bulk Aviation Fuel System

The vessel will have storage facility for at least 650 m³ for Aviation Fuel AVTUR with flash point 38°C in tanks for the purpose of resupplying aviation stations. In addition it will be possible to stow transportable 208 litre drums specially designed for storage of AVTUR fuel and equipped with suitable fittings, lifting and fixing arrangements and earthing. These containers will comply with the relevant Codes for the transportation of dangerous goods on vessels.

The vessel shall have the capability to deliver fuel ashore or to the cargo tender secured alongside.

Two nitrogen generators will be provided for:

- To supply the nitrogen blanketing gas to AVTUR tanks.
- To purge AVTUR transfer lines and hoses.
- To purge the AVTUR fuel manifold before and after disconnection.

4.19 STYLE

The ship will represent UK science. At times it is called upon to represent the UK on port calls worldwide and at international exhibitions. It should therefore possess a good style and quality in its interior and exterior design reflecting strongly the combination of form and function.

Meteorological measurements at the forward end and operations in high latitudes will drive the overall superstructure form in terms of smoothness of transitions and surfaces with minimum clutter.

Supporting structures for cranes and over-side handling equipment are to be built in from the outset and fully integrated wherever possible.

4.20 SECURITY

The ship will be called upon to visit areas where piracy, for example, would be a possibility. The potential for terrorist attack generally has to be recognised and the design must take into account all the security requirements of IMO and MCA promoted UK national legislation in this respect.

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

Company Confidential

NERC 2015



Section 5 – THE OVERALL & INTEGRATED REQUIREMENTS OF THE TOTAL SYSTEM

5. THE OVERALL AND INTEGRATED REQUIREMENTS OF THE TOTAL SYSTEM

5.1 REGISTRATION, CLASSIFICATION, REGULATION AND CERTIFICATION

5.1.1 Registration

R5.1 The vessel shall fly the flag of the Falkland Islands and be registered in the Falkland Islands Ship Registry (FISR), registered in Stanley.

The Vessel shall comply with specified, relevant National (UK MCA regulations) and International rules and regulations for worldwide operation for such vessel, including special requirements for Polar areas and operation in emission controlled zones applicable at the keel laying date or other relevant date based on those regulations which have been publically announced and issued but are not in effect at keel laying but which are due shall be in force before the expected Delivery of the Vessel.

5.1.2 Classification

R5.2 The Vessel shall be constructed under Special Survey of Lloyds Register and in accordance with its rules, regulations and requirements current at the date of execution of the Contract.

The entire system shall be designed and classified in accordance with the latest and prevailing revisions/versions of the following regulations and standards, as a minimum. Where new standards, requirements or guidelines are introduced, these shall be deemed to apply.

All equipment and systems shall comply with Classification Society Rules however where a higher standard is required by this SoR then the SoR shall prevail.

The vessel's hull, machinery, electrical systems and equipment shall be constructed and installed according to the following Lloyd's Register (LR) notations:

+100A1, Polar Research Vessel, Ice Class PC4, CAC1, LFPL, ECO (BWT, GW, OW, P, NOx3, SOx, IHM, R), Helicopter Landing Area, Winterisation D(-40), H(-40), IWS, LI

+LMC UMS, DP(AA), IBS, NAV1, PSMR*

Note, the temperature specified is intended to be considered as the Polar Service Temperature. Where the Contractor identifies a different PST based on a review of the anticipated operational area and season this is to be documented with supporting statistical temperature data.

A letter of endorsement shall be provided to confirm that the vessel complies with the requirements of the Det Norske Veritas (DNV) Silent R Notation at speeds as defined in section 5.1.29

5.1.3 National and International Regulations

R5.3 In addition to the Class rules, the vessel shall be constructed in accordance with, but not necessarily limited to, the latest of the following regulations:

- Falkland Islands Ship Registry (FISR) regulations
- MCA Merchant Shipping regulations
- IMO International Code for Ships Operating in Polar Waters (Polar Code 2015) (Incorporating final outcomes of MSC94 and MEPC 67 and 68) applied considering the vessel as a New Ship

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IMO Conventions

- International Convention for the safety of life at sea, (SOLAS 74/88) and associated protocols, with latest amendments in force up to the date of contract
- International Convention on Load Lines 1966 with Protocol of 1988, and its latest amendments
- International Convention on the International Regulations for Preventing Collisions at Sea (COLREG), 1972 and its latest amendments.
- International Convention for the Prevention of Pollution from ships (MARPOL 1973/1978) including Annex I, III, IV, V and VI with latest amendments in force up to the date of contract.
 - ❖ Noting that Regulation 2.2 of MARPOL Annex 1 will be applied for the carriage of MGO and AVTUR in Bulk.
- BWM - International convention for the Control and Management of Ship's Ballast water and Sediments, 2004.
- AFS - International Convention on the Control of Harmful Anti-Fouling Systems on Ships, 2001.
- Hong Kong International convention for the safe and environmentally sound recycling of ships, 2009
- International Convention on Tonnage Measurement of Ships 1969

IMO Codes

- IMO 2008 SPS Code – Code of safety for Special Purpose Ships, 2008, Resolution MSC.266(84) amended by Resolution MSC.299(87)
- IMDG Code International Maritime Dangerous Goods Code 2014 with its latest amendments..
 - ❖ See list of IMDG class codes and locations of stowage in paragraph 5.1.33 (R 5.67)
- IMO Resolution MSC. 267(85) International Code of Intact stability (2008 IS Code)
- IMO NOx Technical Code 2008 – Technical code on Control of Emission of Nitrous Oxides from Marine Diesels with its latest amendments
- IMO Noise levels - Code on noise levels on board ships. Resolution A.468 (XII) as amended by MSC.337 (91), noting also the requirements of the CAC (1) Class notation.
- IMO ISPS code - International Code for the Security of Ships and of Port Facilities, as relevant
- IMO ISM Code - International Safety Management Code.
- IMO LSA Code - International Life-Saving Appliance Code, Resolution MSC.48 (66) with its latest amendments.
- IMO 2010 FTP Code - International Code for Application of Fire Test Procedures, Resolution MSC.307(88)

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- IMO FSS Code - Fire Safety Systems, Resolution MSC.98 (73) with its latest amendments.
- IMO Code on Alerts and Indicators, 2009 (Resolution A.1021(26)).

IMO Resolutions, Circulars and Guidance

- IMO Resolution MSC 128(75) Performance Standard for a Bridge Navigation Watch Alarm System (BNWAS).
- IMO Resolution MEPC 163(56) Guidelines for ballast water exchange in the Antarctic Treaty Area.
- IMO Resolution MEPC.197(62) – 2011 Guidelines for the Development of the Inventory of Hazardous Materials – (Adopted on 15 July 2011)
- IMO Resolution MSC 215 (82) Performance Standard for Protective Coatings (PSPC) for dedicated ballast tanks. Amended by MSC.1/Circular.1381
- IMO Res. MSC.232(82) Adoption of the Revised Performance Standards for Electronic Chart Display and Information Systems (ECDIS) -(Adopted on 5 December 2006).
- IMO MSC/Circ 645 Guidelines for Vessels with Dynamic Positioning Systems – DP Class 2
- IMO MSC.1/Circ.1255 - Guidelines for Owners/Operators on Preparing Emergency Towing Procedures

International Electrical Regulations

- IEE Recommendations for the Electrical and Electronic Equipment of Ships 6th Edition.
- IEC/TC18 Regulation for electrical installation on board ships.
- International Electro-Technical Commission (IEC) Publication No. 60092 for Electrical Installations on Ships. With the exception that harmonic distortions within the main power systems shall be limited to 3% as the target and 5% as a maximum under all conditions of switchboard loading and generator combinations.
- Electromagnetic Compatibility of Electrical and Electronic Installation on Ships, IEC 61363-1:1998.
- Short circuit analysis shall be completed in accordance with IEC60533
- Power transformers included within the main and emergency electrical distribution system shall be constructed in accordance with IEC60076-11:2004
- IEC 60947-2:2004 - Standards for low-voltage switchgear and control gear.
- Mechanical noise criteria for electrical machines (shall be in accordance with the requirements of IEC 60034-9:2007 and BS DD IEC/TS 60034-17:2006).

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International Regulations and Conventions

- Final Acts of the World Administrative Radio Conference, 2012. (The Vessel shall be equipped for area A-1, 2, 3 and 4 acc. to GMDSS rules, and according to International registration 1973 and Radio regulations 2012).
- Maritime Labour Convention, MLC 2006
- Requirement of International Maritime Pilot Association (IMPA).

ISO standards

- ISO 8468 Ship's bridge layout and associated equipment, for one man watch on bridge arrangement.
- ISO 9241 Ergonomics of human-system interaction
- ISO 6954:2000, Mechanical vibration — Guidelines for the measurement, reporting and evaluation of vibration with regard to habitability on passenger and merchant ships

National Standards

- European Union's Council Directive 96/98/EC (Marine Equipment Directive)
- Rules and regulations governing navigation of the Panama Canal (dispensations shall be applied for where necessary) and Suez Canal and Panama and Suez Canal Tonnage Regulations.
- United Kingdom's Civil Aviation Authority (CAA) - CAP 437, 7th Edition, February 2013: & SOLAS Chapter II-2 Part G Regulation 18.
- International Chamber of Shipping (ICS) Guide to Helicopter / Ship Operations 4th Edition 2008
- Maritime & Coastguard Agency - Code of Safe Working practices for Merchant Seamen.
- HSE Lifting Operations and Lifting Equipment Regulations (LOLER) 1998.
- HSE - HSG221 Technical Guidance on the Safe Use of Lifting Equipment Offshore (in respect of design requirements).
- HSE Provision and Use of Work Equipment Regulations (PUWER) regulations L22, 1998
- HSE Manual Handling Operations Regulations 1992, third edition
- Canadian Arctic Waters Pollution Prevention Act

Special Rules and Regulations

The vessel shall operate in areas controlled by the Coastguard Authority of the USA (including Port Health and Canada. It shall be therefore be compatible with those regulations without requiring modifications.

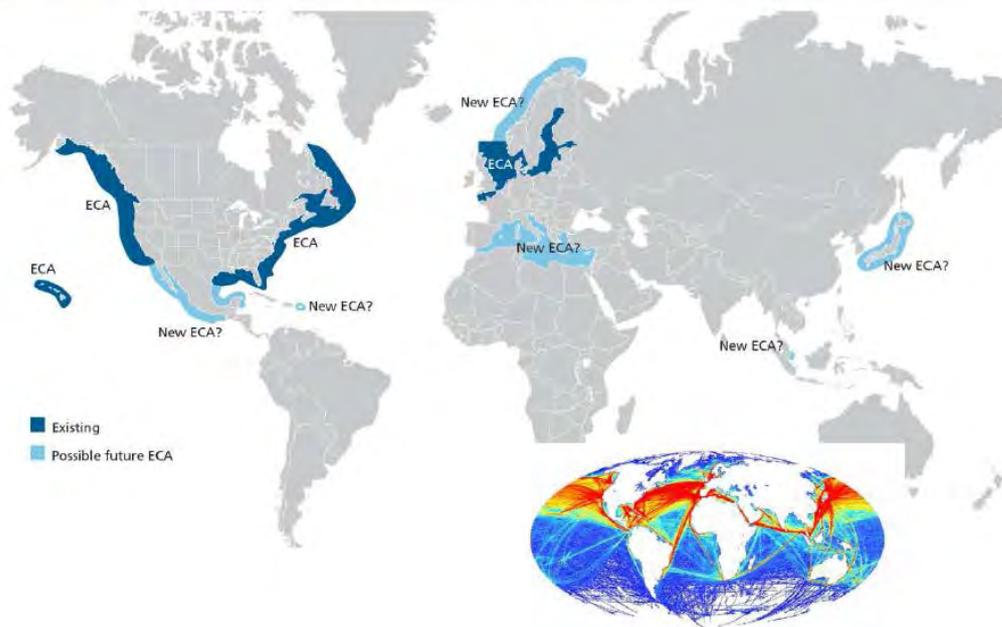
The vessel shall be able to meet Marpol ANNEX VI Regulations for the Prevention of Air Pollution. The vessel shall be able to operate in emissions control area (ECAs) where SO_x or NO_x emission is individually controlled and in areas where simultaneous SO_x and NO_x emission regulations are in place.

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The vessel shall be able to operate in SOx ECAs consisting of Baltic sea area, North Sea Area, United States Caribbean Sea and North American East Coast area.

In addition, the vessel shall be able to operate in NOx ECAs consisting of United States Caribbean Sea and North American area meeting IMO Tier III NOx emission standards. While in United States Caribbean Sea and North American area, the vessel shall operate meeting SOx and NOx emission simultaneously. The Contractor is to consider growth of the emission control area up to and including the keel laying date of the vessel. *EXEMPLAR*: Baltic and the North Seas becoming NOx ECAs.

Existing and possible new ECA's



Additional regulations are identified as follows:

- Protocol on Environmental Protection to the Antarctic Treaty
- Canadian Arctic Waters Pollution Prevention
- US Coast Guard Pollution Regulations without Certificate, but with letter of compliance (USCG CFR 33).
- Bio-security Handbook 1st Edition - September 2013 - BAS Environmental Office.

All costs of obtaining certification by other authorities shall be to the Contractor's account.

Ship Re-cycling "Green Passport"

As the Operator of a Government-owned vessel the NERC needs to comply with the guidance, legislation and strategy on "UK Ship Recycling" as developed by DEFRA (Department for Environment Food and Rural Affairs).

An extract from the UK Ship Recycling Strategy describes the requirements expected of a ship-owner during the design and construction of vessel.
"Design and Construction of Vessels"

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Compliance is required with criteria required by the IMO Guidelines or other relevant Standards including:

- Minimisation of hazardous materials used in construction of new vessels;
- Minimisation of potentially hazardous materials used in conjunction of new vessels;
- Design ship/equipment to facilitate recycling and removal of hazardous waste;
- Preparation of a Green Passport; [See Section 5 IMO Resolution A.962(23)]
- Minimisation of waste generation.”

References and Information

UK Ship Recycling Strategy, February 2007, available at

<http://www.defra.gov.uk/environment/waste/strategy/ship.htm>

<http://webarchive.nationalarchives.gov.uk/20130403045924/http://archive.defra.gov.uk/environment/waste/strategy/documents/shiprecycle-strategy.pdf>

UK Overview available at:

<http://webarchive.nationalarchives.gov.uk/20130403045924/http://archive.defra.gov.uk/environment/waste/strategy/documents/shiprecycle-strategy-overview.pdf>

International Maritime Organisation (IMO) Guidelines on Ship Recycling, 2003, available at

http://www.imo.org/includes/blastDataOnly.asp/data_id%3D11404/ResShiprecycling962.pdf

IMO Ship Recycling Regulation A Perspective, available at:

<http://www.imo.org/KnowledgeCentre/PapersAndArticlesByIMOStaff/Documents/The%20IMO%20ship%20recycling%20regulations%20-%20N.%20Mikelis.pdf>

IMO Recycling of Ships with Links

<http://www.imo.org/OurWork/Environment/ShipRecycling/Pages/Default.aspx>

Guideline for the Class Notation “Green Passport” ABS

http://www.eagle.org/eagleExternalPortalWEB/ShowProperty/BEA%20Repository/Rules&Guides/Current/158_GreenPassport/GreenPassportGuide

The Contractor shall initiate and maintain the “Green Passport” document for handover to NERC at “Interim Acceptance”. The Contractor shall engage the Classification Society to carry out the necessary surveys and issue certification.

Certificates in general

Items not specifically mentioned in this specification, but required by statutory regulations or for the safe and satisfactory operation of the vessel, shall be included.

The ship shall be delivered with all Classification and Statutory Certification and documentation giving evidence of compliance with the Rules and Regulations.

Certificates as listed below (1 original and 2 duplicates) shall be handed to NERC on delivery of the vessel.

Should the final certificate(s) not be obtained at the time of the Vessel's delivery, the Contractor shall provide preliminary / interim / short term certificates, provided that the Contractor at its expense shall furnish NERC with final certificates as promptly as possible.

National and International Certificates are to include but not limited to:

- Cargo Ship Safety Construction Certificate

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- Cargo Ship Safety Equipment Certificate
- Cargo Ship Safety Radio Certificate (GMDSS)
- Special Purpose Ship Safety Certificate (SPS)
- Licence for the Radio Station (Buyer's Application)
- International Tonnage Certificate 1969
- International Oil Pollution Prevention Certificate (IOPP)
- International Air Pollution Prevention Certificate (IAPP)
- Engine International Air Pollution Prevention Certificate (EIAPP)
- International Sewage Pollution Prevention Certificate
- International Load Line Certificate (alternatively issued by Class)
- International Antifouling System Certificate (AFS)
- International Energy Efficiency Certificate (IEEC)
- MLC certificate
- Statement of Compliance in accordance with the Ballast Water Convention 2004 or International Ballast Water Management Certificate, as applicable

Class Certificates

- Classification Certificate for Hull and Machinery including Electrical Equipment
- Classification Certificate for all component parts of the Vessel including main generator engines, generator, pumps, compressors, air bottles, winches windlass, electrical equipment etc. as relevant for the Main Class Certificate above.

Other Certificates, Statements and Declarations

- Compass adjustment Certificate
- Builder's Certificate issued by the Contractor
- Suez Canal Special Tonnage Certificate.
- Documentation for the Issuance of Panama Canal Tonnage Certificate (Certificate issued by Panama Canal Authorities as first passage) Including dispensations as required
- Engine International Air Pollution Prevention Certificate (EIAPP)
- Asbestos free statement from the yard
- Ship's Sanitation Control Certificate
- Inventory of hazardous material

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- Statement of Compliance in accordance with the Hong Kong Ship Recycling Convention
- Statement of Conformance for MARPOL 73/78 Annex V
- Ship Energy Efficiency Management Plan (SEEMP) (with input from Ships Staff)
- Noise Survey Report

Manuals to include but not limited to:

- Shipboard Marine Oil Pollution Emergency Plan (SOPEP)
- *Procedures and Arrangements Manual (P & A Manual)*
- Record of Approved Cargo Ship Safety Equipment
- DP Operational Manual from 3rd party.
- Failure Mode Effect Analysis for DP (FMEA) according to class
- Procedure & Arrangement (P&A) Manual as relevant
- Cargo securing manual
- Cargo gear booklet incl. pad eyes of 1 t and larger
- Ballast Water Management Plan
- Emergency Towing Booklet
- ISPS Manual to be prepared (with input from Ships Staff)
- Garbage Management Plan (with input from Ships Staff)
- Garbage Record Book (with input from Ships Staff)

As far as necessary and practicable NERC shall assist in obtaining necessary co-operation from national Authorities.

5.1.4 Certificate Book

R5.4 The vessel shall have a book of certification for equipment and materials built in to the vessel. This shall include, survey certificates for equipment surveyed by class at vendors works, type approval certificates (where applicable) for standard products such as life-saving appliances, lifting appliances, firefighting equipment, fairleads, bollards, guide rollers, navigation lights, davits, rescue boat, fire doors etc. Electronic copy on CD-rom or memory stick shall be supplied.

5.1.5 Hull Form & Hydrodynamics

R5.5 It would be a distinct advantage if the hull design could be based on an existing hull form which had been proven under the same or similar operating conditions and which could fulfil all the requirements of this SoR.

The hull form shall be designed to reduce the potential for macroscopic and microscopic bubble formation and subsequent bubble sweep-down below the flat of bottom. All possible means shall be adopted in the hull design to minimise the effects of bubble generation and sweep down on the performance of the hull mounted transducers.

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The hull form shall be designed with the propulsion system to break 1m ice having a flexural strength of 500 kPa with 20 cm of snow cover on top of ice at 3 knots.

Consideration shall be given to the inclusion of deadrise and shall help reduce resistance and enhance the manoeuvrability in ice. The vessel may at times be required to back up in ice and the after body shall be designed to allow this. It is expected that the hullform shall also include deadrise in the afterbody and ice knives to protect the rudders.

Chines may be incorporated in the above water form to assist in achieving internal deck areas and to control wetness and pitch response. However undue pitching and slamming accelerations both forward and aft shall be avoided.

The vessel shall have a full breadth transom stern in order to ensure sufficient working areas and the protection of the propulsion system from deployed wires.

The aft underwater form (section dead rise) shall be carefully considered to prevent stern slamming and excessive vertical pitching decelerations being imposed on personnel working on the aft deck.

The aft hull form shall be designed in co-ordination with the propellers and rudders for optimum underwater noise and fuel economy. The bottom extremity of the rudder and propeller tips shall both be above the level of the bottom shell of the vessel.

The propeller tip clearance shall be at least 1m to enable ice blocks to pass over the propeller.

General considerations for the Hull Design

- *The overall length of the vessel shall not exceed 128.2m*
- *The forward form shall be so designed to minimise bubble sweep-down*
- *A bulbous bow shall not be fitted*
- *The forward waterline forms shall exhibit smooth and gradual progress from the angle of entry back to the midship sections the object being to encourage any bubbles to travel around the vessel rather than being driven under it.*
- *The flat of bottom forward shall be restricted to just contain the plan form of the large swath bathymetry transducer arrays outboard of which the hull sections shall rise as steeply as possible so as not to constrain the natural flow of buoyant bubbles towards the surface.*
- *All equipment mounted forward of the transducers shall not allow entrainment of air when the bow emerges during heavy pitching nor shall such units project horizontal surfaces which might create local slamming areas as the bow plunges thus driving air bubbles into the water*
- *Sonar equipment shall be flush mounted in the hull. All other hull appendages shall be within the specified draft limits and not extend below the bottom shell of the ship.*

Hull Flare should be minimised in way of the working deck in order to ensure good visibility of floating devices and assist with their recovery on board. The difference between the beam at the working deck and that and the waterline shall not exceed 500 mm.

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Following the foregoing indications shall not necessarily guarantee that bubble sweepdown shall be eliminated. The contractor shall be seek all advice possible on this issue and carry out model tests to show for instance the flow lines around and under the proposed hull form while operating at different speeds in sample seaway conditions.

The bottom mounted sonar equipment shall operate without undue data drop-outs at speeds up to 11 knots in sea states up to Sea State 5 at any heading relative to the sea.

Generally the hull form below water shall be smooth (good shipbuilding standards) with no abrupt changes of curvature which might trigger turbulence over hull mounted sensors. All hull butt and seam welding shall be smooth (machine weld type finish) and not to protrude more than 3mm from the plate line. Plates of different thickness shall be arranged with the difference protruding into the moulded hull. All shell plating of different thicknesses are to be arranged with the difference protruding into the moulded line.

Poor welding in this respect shall be ground to an acceptable profile. Rippling between frames shall be limited to a maximum of 1/100th of the frame spacing and shall be smooth with no sharp peaks over the frames or block butt welds. No filler material shall be used.

Anchors shall be recessed to protect the anchor from any impacts with ice.

5.1.6 Model Test Programme

R5.6 Prior to the commencement of construction a comprehensive series of model tests shall be required to prove the hull design in terms of powering (moonpool open and closed), seakeeping, bubble sweepdown, cavitation performance, operation in ice and manoeuvring. The model test program shall be developed jointly between NERC and the Contractor reflecting the particular detail of the Contractor's design. It shall include however at least the following:

- The use of CFD techniques to optimise the hull form prior to model testing,
 - ❖ in particular validation of the hullform with respect to bubble sweepdown at two speeds and 3 sea states (Calm Water, Sea State 5 and 7)

Resistance testing of the basic hull form in calm water at five speeds at each of two draughts. A paint flow dispersion test, followed by dye injection tests shall be undertaken at 11 knots in order to determine the near-hull flow during the self-propulsion test and for the qualitative judgement of the bubble sweep down path, qualitative coverage by means of underwater video camera

- Self Propulsion testing of the hull and its propulsion system in calm water at two draughts at 6, 8, 11, 14 knots and in the sea trials condition.
- Tow Rope Pull Test
 - ❖ Tow rope test at design draught, three (3) low speeds (e.g. 2.0, 4.0 and 6.0 knots), seven (7) rpm settings each in order to determine the power consumption and tow forces under slow-speed towing conditions

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- Bollard Pull Test

Bollard pull test at design draught, at zero speed, seven (7) rpm settings in order to determine the power consumption and pull forces under bollard pull conditions. Alternative thrust predictions with full scale verification may be proposed.
- Wake studies and propeller cavitation tests (URN requirements) including pressure pulse measurements At 6, 8, 11, 14 and in the Sea trial condition.
- Seakeeping tests shall be undertaken at 5 speeds in irregular waves – head sea, bow quartering, beam, stern quartering and stern seas in three ITTC² with footnote no. 2 referring to the Bretschneider spectrum sea states preferably 3, 6, and (9 if possible at the chosen model scale). Seakeeping test to include:
 - ❖ Pitch, heave and roll measurements.
 - ❖ Flow lines and bubble sweepdown
 - ❖ Assessment of bow wetness and wetness on working deck aft.
 - ❖ Assessment of Crew and Scientist Comfort.
 - ❖ Helicopter landing areas acceleration.
 - ❖ Assessment of course keeping in stern and stern quartering seas.
 - ❖ Assessment of loss of speed.
- Rolling tests to prove performance of the stabilising system. Environmental conditions shall be agreed with the NERC's Representative.
- It is essential that the vessel has good directional stability. Free sailing manoeuvring tests shall be undertaken to prove speed control, steering ability, directional stability and to determine the vessels manoeuvring coefficients. Spiral Manoeuvre test shall be undertaken to demonstrate the vessels directional stability. The width of the hysteresis loop at zero helm angle shall not exceed ± 3 degrees. 10 degree / 10 degree zigzag testing is also shall be undertaken to demonstrate course keeping and directional stability of the hullform.

Ice Resistance Testing:- Ice resistance testing shall be carried out to demonstrate the vessels ice breaking capability:

- Ahead tests shall be undertaken at one draught, three ice thickness, at three speeds for each ice thickness, followed by backing tests in the broken channel.
- Subsequent propulsion test ahead in broken pack ice of approximately 8/10 concentration shall be arranged from the remaining ice sheet.
- Ridge breaking test and Ramming tests shall be undertaken using a free running model.

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- Manoeuvring tests including turning test and a breakout test shall be undertaken.

Wind Tunnel Testing; *Wind tunnel tests shall be undertaken for ship speeds of 0, 6 and 14 knots with wind speeds of 10 and 25 knots at relative wind angles of 270 to 90 degrees in 10 degree steps to determine that the forward met mast and the main mast met platform are in undisturbed air flow. The heading range required for acceptance is 270 to 90. Additionally exhausts from main diesel generator shall be included to confirm that exhausts are flowing clear of superstructure and machinery space ventilation intakes and air intakes. CFD analysis may be used to replace Air flow model testing.*

Airflows in way of helicopter landing deck shall be measured in accordance with CAP 437 requirements.

ANY FAILURES IN PERFORMANCE SHOWN UP BY THE TESTING SHALL REQUIRE REMEDY BEFORE HULL CONSTRUCTION COMMENCES. An allowance shall be made in the model test programme for possible hull modifications and retesting.

All models shall remain the property of NERC and shall be delivered with the ship.

The CFD studies and model testing shall, as far as practical, be carried out by a leading test facility for the purpose of ensuring consistency in approach and modelling.

EXEMPLAR: HSV A for CFD and model tank testing, including ice tank; MARIN for bubble sweepdown test.

EXEMPLAR: Force for air flow testing

Internal noise shall be modelled to predict noise levels in the accommodation and working areas of the vessel in transit, survey and DP operating modes.

EXEMPLAR:

Lloyds Register ODS

Bureau Veritas

DNV GL

5.1.7 Hull Design and Construction

R5.7 The hull and superstructures shall be of all welded steel construction, with the hull in a double hull configuration in accordance with the requirements of the IMO Polar Code with all oil fuel and cargo tanks inside the double hull.

All structural scantlings shall be determined for the maximum full load draft plus 0.5m.

The main hull shall have a shell plating thickness of at least 10mm throughout up to main deck level, subject to high tensile steel being used for the hull plating.

Material specifications shall take into account the areas of intended service. In particular the notch ductility of steels used shall be recognise the probable temperature ranges which could prevail.

A welding table is to be submitted which defines the steel grades to be used, their location and welding procedures.

In general, the hull shell plating and framing shall be constructed from high tensile steel to achieve the PC4 requirements with reasonable plating thickness. All Stainless Steel used shall be Marine Grade SS316L.

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Aluminium may be proposed for the wheelhouse and its supporting structure to one deck level downwards. The details of how this structure shall be designed to ameliorate all interactions, including the stresses due to thermal expansion and contraction of the different materials, across the interface between steel and aluminium shall be approved by NERC. The details of the construction shall be carefully carried out in order to prevent resonant vibrations due to high winds resulting in fatigue failures, and corrosion at the intersection between the two dissimilar metals.

Structures shall be designed carefully to minimise the possibility of resonant vibrations particularly those triggered by the following:

- Slamming loads at the bow and stern.
- Main engine driving frequency
- Main propeller blade passing frequency
- 50 & 60 Hz (Single phase electrical frequency)
- Bow and Stern Thrusters
- Any other clearly identifiable frequencies that can reasonably be expected to occur on board

Extensive vibration calculations, incorporating finite element methods, shall be carried out by the Contractor or by a specialist vibration consultant to show that the main hull critical frequencies shall be sufficiently clear of all major excitation frequencies as identified above. Please also see section 5.1.29 Noise and Vibration.

Hull and superstructure shall be designed to minimize structural discontinuities and stress concentrations.

All steel used in the construction of the vessel shall be manufactured in accordance with the requirements and inspection of the Classification Society.

Exposed corners of deckhouses, casings, funnels and ladderways shall be radiused a minimum of 75mm.

All free edges on steelwork throughout the vessel, including that in tanks and on weatherdecks, shall be well rounded to ensure good paint adhesion and to eliminate safety hazard – ground to a 3mm radius.

All integral tanks (oil fuel, water ballast, fresh water etc.) and enclosed void spaces etc, shall be arranged with air and drain holes, and openings large enough to permit access to all parts of the tanks for painting and maintenance etc.

The attachment of topsides equipment such as cranes, over-side lifting arrangements and containers shall be carefully considered in this respect of the loads imposed at the required survival condition.

The keel line plate width and internal structures shall be carefully considered in the design to cater for local load concentrations, hull girder shear forces, and to ensure that sufficient keel block areas can be applied (e.g. double blocking) in the region to prevent damage to both the hull and keel blocks. Allowable keel block loading pressure shall be taken as 100 tonnes /m².

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The rise of floor of the hull and internal structures shall allow the use of side blocks without the need for special cradling or side shores. A fully detailed docking and blocking plan shall be issued to the NERC for approval and required on delivery of the vessel.

R5.8 Hull Structure - General Requirements

The vessel shall be of all welded construction, in a double hull configuration. The structural work shall be executed in accordance with the Contractors standard practice, which shall be approved by the NERC Representative and Classification Society.

Continuity of the main structural members shall be maintained whenever possible and where unavoidably broken, for example in way of the moonpool, compensation shall be provided.

Insert plates and/or local stiffening shall be fitted as appropriate in way of shell and deck openings, and in way of all deck machinery, cranes, winches, davits, mooring equipment, masts, matrix fixing points, Where fitted, insert plates shall be chamfered at welded connection to adjacent plating to avoid abrupt change of scantling, all to Class approval.

Structural design in way of Yokohama fender locations is to be specially considered. BAS/NERC will provide details of the fender locations and fender design criteria during detailed design stage..

The hull structure shall be strengthened in accordance with the Class requirements applicable to the ice class as specified in Section 5.1.7.

The vessel shall be equipped with ice load monitoring system. The purpose of the ice load monitoring system is as a safety feature to allow calibration of operating procedures in ice.

The extent of measurement system should be such to meet the purpose above. In general the LR SEA(SEA ICE) requirements should be used as a minimum scope of system.

A plan indicating the proposed extent of the measurement system is to be submitted to BAS/NERC for approval.

The underwater shell plating shall be smoothly constructed to minimise turbulence over hull mounted transducers and to minimise hull flow induced noise:

- Construction indentations between framing shall be no more than 1/100th of the frame spacing.
- Weld beads, especially butt welds at right angles to the water flow, shall be of smooth profile and to extend no more than 3mm above the surrounding plate faces.
- Penetrations through the shell plating for intakes and discharges shall be smoothly finished with all sharp edges ground to a radius equal to the thickness of the plating as far as is possible.
- Where heavy compensation or ice resisting pieces are used in way of shell penetrations the outer surface is either shall be arranged flush with the plating line or the protruding edges shall be smoothly transitioned to the plating line with a chamfer of minimum 1:50.

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- Where transverse thruster units are employed the entries and exits shall have closures, designed to minimise the generation of turbulence and bubble sweepdown when the vessel is proceeding at survey speed.
- Where retractable thrusters units are employed they shall be fitted with faring plates which, when the thrusters are retracted, fit closely and are shaped fair with the surrounding shell plating.

R5.9 Scientific Moonpool

The scientific moonpool shall be used to increase the operating conditions in which over the side work can take place safely. The moonpool shall be an integral part of a complex comprising hangar, transfer, storage/equipment preparation for deployment of over the side devices and the subsequent laboratory processing and sample storage.

The moonpool shall be located aft of sensitive sensors that may be subject to interference arising from the aperture/bottom shell hatch.

The clear opening through the moonpool shall be not less than 4m x 4m.

The CTD may be deployed through the moonpool. Other equipment may be deployed through the moonpool, including the following:

- Landers.
- Box corers.
- Small ROVs.
- HIBIS.
- UAVs
- Seabed Drill
- Other devices on a wire.

The moonpool shall be designed to further still the wave action by the inclusion of a double shell, incorporating large free flow openings. A bottom door with inward opening doors is required to minimise resistance when free running and avoid ice accumulation. Means shall be provided of avoiding ice accumulation within the moonpool.

Measures shall be provided to avoid wires snagging obstructions or the bottom doors, by means of a cursor arrangement.

The moonpool shall be served by the same overhead transfer/hoist systems as the hangar space and Over the Side handling systems, as far as practical.

The moonpool shall be provided with a moveable cover panel with aperture to allow the passing of the equipment wire to pass through it.

R5.10 Dimensional Survey

During the course of construction dimensional surveys shall be carried out to ensure accuracy of the assembly of the hull is maintained within the tolerance specified in the Shipyard Construction Standards.

The Contractor shall determine the installation requirements for the survey hardware shall be installed in the recessed sensor bays on the bottom of the vessel.

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Dimensional surveys shall be carried out and the results submitted to the survey equipment supplier for their approval and confirmation of compliance with their tolerances.

R5.11 Sea Chests

To avoid clogging of the sea chests with snow and ice slush, sea chests of adequate size shall be located deep in the ship, and be provided with baffles, large vent pipes to eliminate air, and piping for the recirculation of cooling water from the heat exchanger, in accordance with the Polar Class requirements. A thermostatically controlled valve shall regulate the re-circulating flow based on water temperature in the sea chest. These features are not required for the scientific uncontaminated seawater.

Sea water may be discharged to either port or starboard sea chests, but sea water discharges are only permitted on the port side.

R5.12 Stern Ice Knife

The vessels rudders shall be protected with ice knives so arranged to prevent damage to the rudders when the vessel is backing up in ice.

5.1.8 Rudder

R5.13 The rudders shall be designed to ensure good manoeuvring performance.

Where practicable rudders shall align with the propeller shafts.

Two double plate, fully welded, (grade DH in compliance with PC4 ice class requirements), balanced, high efficiency twisted trailing edge rudders or fishtail rudder shall be arranged to maximise manoeuvrability. Final choice shall be made following Powering and Ice Model tests.

The rudders shall be designed to ensure maximum manoeuvrability, but, in any case, the ship shall meet the minimum manoeuvring requirements of MSC.137(76)

Slot welds shall be used for closing plate arrangements only.

Rudders shall be coated internally by filling, turning and draining with protective solution for long term preservation.

Rudders shall be arranged with filling and draining plugs.

All scantlings, rudder stock diameter and all materials shall be in accordance with Classification Society requirements and IACS PC4 Ice Class requirements.

Rudder stocks shall be properly machined for rudder support, bearings and electro-hydraulic steering gear and fitted with stainless lined in way of bearings.

Neck bearings shall be of material suitable for loads imposed with grease lubrication, watertight glands. All greasing shall be by an automatic greasing system.

System shall incorporate rudder stock stress measurement, along with display on bridge and output to the Autopilot and Dynamic Positioning system.

The steering system shall incorporate a warning to DP system and autopilot that too much rudder is applied.

Rudders shall be arranged to allow removal without raising the rudder stocks.

Rudders shall be pressure tested in accordance with Classification Society requirements.

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Rudders shall be aligned to provide minimum resistance as indicated by the model tests.

EXEMPLAR: Becker Marine Systems – Schilling type rudder or high efficiency twisted training edge rudder

5.1.9 Steering Gear

R5.14 The two rudders shall be operated by electro-hydraulic rotary type gear, with 2 x actuators and 4 x electro-hydraulic pumps (2 for each actuator) sized to suit required torque. The design, strength, power, etc. shall comply with the requirements of the Classification Society for the PC4 Ice Class Notation.

A fast acting torque-relief valve is to be provided to prevent over torque of the steering gear in heavy ice conditions.

In order to maximise the DP performance of the vessel, the rudders shall be capable of being operated independently and or synchronised with a maximum rudder angle shall be 65°. Limit switches for operation under Autopilot shall be determined during sea trials. The DP system shall be programmed with the predicted side thrust component of the propulsion systems derived from the rudders at various angles.

Steering gear systems shall be designed and rated for use as part of the DP thruster system and the continuous and frequent actuation command signals from the DP system. Hydraulic oil cooling systems shall be specially considered for this duty.

In open water conditions with maximum rudder torque, rudders shall be moved from +30° to -35° within 28 seconds with one pump of each actuator in service, at the vessel's maximum ahead speed.

With two pumps of each actuator running the time shall be 14 seconds.

Steering positions shall be arranged as follows:

- Wheelhouse by Lever, joystick, autopilot, or DP System
- Bridge wings by joystick
- Emergency position

An emergency steering position (wheel and hydraulic pump) with communication to the wheelhouse, shall be arranged, and it shall also be possible to manually operate the steering solenoids in an emergency.

Rudder angle indicators and compass repeater shall be arranged and clearly visible at all steering positions.

EXEMPLAR: Rolls Royce or Hatlapa

5.1.10 Superstructure and Deckhouses

R5.15 The superstructure refers to all of the vessel above the bulkhead deck. The superstructure shall include accommodation for ships personnel, recreation and working spaces, changing rooms, wheelhouse, operations room, aircraft hangar and workshops. The superstructure shall be constructed entirely from steel with scantlings to the requirements of the Classification Society and the NERC's Representative.

The deck plating shall be suitably reinforced under local loads such as cranes, winches, davits etc.

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5.1.11 Hull Preservation

R5.16 A full anti-corrosion paint system shall be applied to the vessel to allow a minimum of 5 years between dry docking and at least 30 years' service, including areas subject to ice abrasion.

The Contractor shall present NERC with a detailed paint specification for approval.

R5.17 Paint Preparation

Before painting, all new steelwork shall be grit blasting to SA 2.5 with a minimum profile of 40-60 microns, mill scale shall be removed and surfaces shall be immediately primed with one coat of shop primer compatible with the selected coating system.

Block constructions shall be subjected to grinding following fabrication to 'break' all sharp edges and smooth welding and any construction scars, complete grit blasting in a controlled environment to SA 2.5, and then immediately coated with the majority of the paint coatings prior to erection on the launching berth or dock.

All surface preparation, application of paint and measure for ensuring maximum adhesion shall be in accordance with paint manufacturers' recommendations.

In water ballast and other water or waste tanks all sharp edges shall be removed and rounded, with a minimum 3mm radius.

Where the shop primer is damaged by burning, welding, etc., the following treatment shall be carried out prior to the application of protective coatings:

- Generally: All welding beads, etc., shall be de-slugged, thoroughly cleaned by power wire brushing, needle gun or discing solvent washed and immediately stripe coated with construction primer. One additional priming coat shall be applied to weld beads on the exterior of shell painting.
- Exterior Hull: All exterior hull, exposed deck weld butts and seams shall be power wire brushed or grit blasted to SA 2.5 minimum standard, followed by the application of NERC approved primer followed by the immediate application of the first coat of the subsequent paint system.
- All other areas: All damaged areas of shop primer, i.e. weld seams, burn marks, rusted areas, mechanically damaged areas, etc. shall be cleaned to S.T 2 standard, followed by the application of the first coat of the subsequent paint system.
- All damaged and heat affected coatings shall be fully repaired to the satisfaction of the NERC representative.

Taking into account the expected lifetime of the vessel it is essential that the initial surface preparation and applied coatings are carried out under closely controlled conditions of humidity and temperature to assure future durability of the paint coatings.

R5.18 Paint Specifications

The underwater areas of the hull shall be coated with a vinyl ester resin base reinforced with glass flake. The particular application requirements shall be followed.

Coating of the underwater external hull shall be taken to a minimum of 2m above the scantling draft of 7.5m.

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Ice phobic paint coatings shall be applied to superstructure areas of the vessel which are identified as white in colour.

Ballast tanks shall be protected by a good quality painting system, intended to protect the steelwork for 30 years with a minimum of intermediate maintenance.

Peak tanks, wing tanks, double bottom tanks and those arranged for the carriage of salt-water ballast shall be coated with an approved high build epoxy coating. The paint supplier shall confirm that the proposed coating shall be compatible with the water ballast treatment system.

Paint used in machinery spaces and accommodation shall be of the fire-retarding type.

The Contractor shall obtain a long term warranty on the paint system. This may be based on a sliding scale of defect level for a minimum of ten years.

Contractor to supply stock coatings sufficient for a period of 12 months as defined/agreed with NERC and stowed on delivery.

Fresh water tanks shall be coated with epoxy polyamine certified for potable water tanks.

Fuel oil and daily service storage tanks shall be thoroughly cleaned and given one coat of mineral oil.

No painting shall be carried out in tanks until completion of tank testing and subsequent inspection and approval by NERC's representative.

An antifouling paint coating shall be applied, to be effective for 18 months.

Contractor to submit to the NERC for approval a complete Paint Specification detailing the paint manufacturer and product description, number of coats and D.F.T.

The Contractor's proposal shall be generally in accordance with the following:
EXEMPLAR: International Paint Specification.

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Where legislation does not explicitly restrict or limit the use of lead containing coatings it is the responsibility of the client to inform International Paint in writing of their specific requirements

Technical Specification with Description
BRITISH ANTARCTIC SURVEY
NEW BUILD VESSEL
Other Ports , United Kingdom
01-Dec-2014
UFG02116

Schemes

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Area	Description	Area m ²
Underwater Hull	An Intershield 163 Inerta 160 high solids, two pack abrasion resistant epoxy, specifically designed for vessels operating in ice, using Intergard 263 as a tie coat to the subsequent antifouling scheme.	0m ²
Moonpool Underwater Area	An Intershield 300 abrasion resistant epoxy underwater anti-corrosive scheme using Intergard 263 as a tar free tie coat to the subsequent antifouling scheme.	0m ²
Topsides	A high performance anti-abrasion and cosmetic finish system, using 2nd generation polysiloxane technology, for use on above water areas.	0m ²
Moonpool Above Water Areas	A high performance anti-abrasion and cosmetic finish system, using 2nd generation polysiloxane technology, for use on above water areas.	0m ²
External Decks	A high performance anti-abrasion and cosmetic finish system, using 2nd generation polysiloxane technology, for use on above water areas.	0m ²
External Decks under Wood	An Intershield 300 abrasion resistant epoxy anti-corrosive scheme.	0m ²
Helidecks	An Intershield 300 abrasion resistant epoxy anti-corrosive scheme with an Intershield 851 epoxy non skid finish coat.	0m ²
Deck Equipment - A frames	A high performance anti-abrasion and cosmetic finish system, using 2nd generation polysiloxane technology, for use on above water areas.	0m ²
Deck Equipment - Cranes	A high performance anti-abrasion and cosmetic finish system, using 2nd generation polysiloxane technology, for use on above water areas.	0m ²
Ext. Superstructure, Mast, Funnel Base, Internal Bulwarks	A high performance anti-abrasion and cosmetic finish system, using 2nd generation polysiloxane technology, for use on above water areas.	0m ²
Funnel Yellow	A high performance anti-abrasion and cosmetic finish system, using 2nd generation polysiloxane technology, for use on above water areas.	0m ²
Cargo Holds Dry	An Intershield 300 epoxy anti-corrosive scheme overcoated with a polyurethane finish, Interthane 990.	0m ²
Internal Superstructure behind linings	An Intergard 276 epoxy primer	0m ²
Internal Superstructure Exposed Bulkheads and Deckheads	An Intergard 276 epoxy primer overcoated with a conventional finish, Interlac 542.	0m ²
Internal Superstructure Exposed Decks	An Intergard 276 epoxy primer overcoated with a conventional finish, Interlac 665.	0m ²
Engine Room Exposed Bulkheads and Deckheads	An Intergard 276 epoxy primer overcoated with a conventional finish, Interlac 542.	0m ²
Internals of Vents, Intakes and Ducts	An Intershield 300 abrasion resistant epoxy anti-corrosive scheme.	0m ²
Engine Room Decks	An Intergard 276 epoxy primer overcoated with a conventional finish, Interlac 665.	0m ²
Engine Room Below Floor Plates	An Intershield 300 abrasion resistant epoxy scheme.	0m ²
Ballast Tanks	An Intershield 300 epoxy anti-corrosive scheme for long term protection.	0m ²
Voids	An Intershield 300 epoxy anti-corrosive scheme for long term protection.	0m ²
Grey Water Tanks	A one coat vinyl ester scheme suitable for the storage of Galley, Domestic and Laundry gray water.	0m ²

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Main Schemes		
Area	Description	Area m ²
Winch Room and Hangar Bulkheads and Deckheads	A high performance anti-abrasion and cosmetic finish system, using 2nd generation polysiloxane technology, for use on above water areas.	0m ²
Winch Room and Hangar Decks	An Intershield 300 abrasion resistant epoxy anti-corrosive scheme directly overcoated with an Interbond 501 finish.	0m ²
Hydraulic and Lub Oil Tanks	An Interline 704 high performance epoxy scheme suitable for the carriage of a wide range of cargoes.	0m ²
Aviation Fuel Tanks	An Interline 704 high performance epoxy scheme suitable for the carriage of a wide range of cargoes.	0m ²
Hardwood	An Interlac 678 clear varnish scheme for wood.	0m ²
Grey Water Tanks	An Interline 704 scheme suitable for use in Domestic Grey Water.	0m ²
Freshwater Tanks	An Interline 925, high performance epoxy scheme certified for the carriage of potable water.	0m ²

Alternative Schemes		
Area	Description	Area m ²
SWATH Bathymetry Gondola and Transducers - Intersleek	A fluoropolymer foul-release coating.	0m ²

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Underwater Hull

An Intershield 163 Inerta 160 high solids, two pack, abrasion resistant epoxy, specifically designed for vessels operating in ice, using Intergard 263 as a tie coat to the subsequent antifouling scheme.

Surface Preparations

Where necessary remove all weld splatter, smooth weld seams and sharp edges. Fresh water wash to remove all dirt and contamination, as necessary. Degrease according to SSPC-SP1 solvent cleaning. Ensure area is clean and dry prior to application. Blast to Sa2½ ISO 8501-1 or SSPC SP10. Apply the material before visible oxidation occurs.

If oxidation does occur, the entire oxidised surface should be re- blasted to the standard specified above.

Product	Paint Type	Colour	Coats	DFT Microns	Touch Dry 25°C	Hard Dry 25°C	Overcoating 25°C	
							Min	Max
Intershield 163 Inerta 160	Abrasion Resistant Epoxy	Black	FC	500	5hrs	48hrs	4hrs	3days
Intergard 263	Epoxy Tie Coat	Light Grey	FC	75	6hrs	16hrs	8hrs	7days
Interswift 6600	TBT Free Antifouling	Red	FC	100	2hrs		6hrs	ext
				675				

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MOONPOOL UNDERWATER AREA

An Intershield 300 abrasion resistant epoxy underwater anti-corrosive scheme using Intergard 263 as a tar free tie coat to the subsequent antifouling scheme.

Surface Preparations

Where necessary remove all weld splatter, smooth weld seams and sharp edges. Fresh water wash to remove all dirt and contamination, as necessary. Degrease according to SSPC-SP1 solvent cleaning. Ensure area is clean and dry prior to application. Clean welds, damaged and corroded shop primer by blasting to near white metal SSPC-SP10 or Sa2 1/2 ISO 8501-1 or by power tooling to Pt3 JSRA SPSS- 1984. For PVB and unapproved shop primer grit blast to Sa2 1/2 ISO 8501-1 or SSPC SP10. For optimised mechanical properties on typical zinc and iron oxide epoxy shop primers, grit sweep intact areas to AS.2 International Paint Sweep Blast Standards.

Product	Paint Type	Colour	Coats	DFT Microns	Touch Dry 25°C	Hard Dry 25°C	Overcoating 25°C	
							Min	Max
Intershield 300	Abrasion Resistant Aluminium Pure Epoxy	Bronze	FC	150	3hrs	6hrs	7hrs	14days
Intershield 300	Abrasion Resistant Aluminium Pure Epoxy	Aluminium	FC	150	3hrs	6hrs	7hrs	14days
Intergard 263	Epoxy Tie Coat	Light Grey	FC	75	6hrs	16hrs	8hrs	7days
Interswift 6600	TBT Free Antifouling	Red	FC	100	2hrs		6hrs	ext
				475				

Alternative Schemes - SWATH Bathymetry Gondola and Transducers - Intersleek

A fluoropolymer foul-release coating.

Surface Preparations

Where necessary remove all weld splatter, smooth weld seams and sharp edges. Fresh water wash to remove all dirt and contamination, as necessary. Degrease according to SSPC-SP1 solvent cleaning. Ensure area is clean and dry prior to application. Blast to Sa2 1/2 ISO 8501-1 or SSPC SP10. Apply the material before visible oxidation occurs. If oxidation does occur, the entire oxidised surface should be re-blasted to the standard specified above.

Product	Paint Type	Colour	Coats	DFT Microns	Touch Dry 25°C	Hard Dry 25°C	Overcoating 25°C	
							Min	Max
Intershield 300	Abrasion Resistant Aluminium Pure Epoxy	Aluminium	FC	125	3hrs	6hrs	7hrs	14days
Intershield 300	Abrasion Resistant Aluminium Pure Epoxy	Bronze	FC	125	3hrs	6hrs	5hrs	2days
Intersleek 737	Elastomeric Tie Coat	Pink	FC	100	2hrs	5hrs	12hrs	5days
Intersleek 970	Fluoropolymer Foul Release Coating	Red	FC	150	3hrs	6hrs	3hrs	ext
				500				

**New Polar Research Vessel (NPRV)
Statement of Requirements (SoR) Section 5**

TOPSIDES

A high performance anti-abrasion and cosmetic finish system, using 2nd generation polysiloxane technology, for use on above water areas.

Surface Preparations

Where necessary remove all weld splatter, smooth weld seams and sharp edges. Fresh water wash to remove all dirt and contamination, as necessary. Degrease according to SSPC-SP1 solvent cleaning. Ensure area is clean and dry prior to application. Clean welds, damaged and corroded shop primer by blasting to near white metal SSPC-SP10 or Sa2 1/2 ISO 8501-1 or by power tooling to Pt3 JSRA SPSS- 1984. For PVB and unapproved shop primer grit blast to Sa2 1/2 ISO 8501-1 or SSPC SP10. For optimised mechanical properties on typical zinc and iron oxide epoxy shop primers, grit sweep intact areas to AS.2 International Paint Sweep Blast Standards.

Product	Paint Type	Colour	Coats	DFT Microns	Touch Dry 25°C	Hard Dry 25°C	Overcoating 25°C	
							Min	Max
Intershield 300	Abrasion Resistant Aluminium Pure Epoxy	Bronze	FC	150	3hrs	6hrs	6hrs	7days
Interfine 979	Polysiloxane Finish	Black	FC	125	3hrs	4hrs	4hrs	ext
				275				

Moonpool Above Water Areas

A high performance anti-abrasion and cosmetic finish system, using 2nd generation polysiloxane technology, for use on above water areas.

Surface Preparations

Where necessary remove all weld splatter, smooth weld seams and sharp edges. Fresh water wash to remove all dirt and contamination, as necessary. Degrease according to SSPC-SP1 solvent cleaning. Ensure area is clean and dry prior to application. Clean welds, damaged and corroded shop primer by blasting to near white metal SSPC-SP10 or Sa2 1/2 ISO 8501-1 or by power tooling to Pt3 JSRA SPSS- 1984. For PVB and unapproved shop primer grit blast to Sa2 1/2 ISO 8501-1 or SSPC SP10. For optimised mechanical properties on typical zinc and iron oxide epoxy shop primers, grit sweep intact areas to AS.2 International Paint Sweep Blast Standards.

Product	Paint Type	Colour	Coats	DFT Microns	Touch Dry 25°C	Hard Dry 25°C	Overcoating 25°C	
							Min	Max
Intershield 300	Abrasion Resistant Aluminium Pure Epoxy	Bronze	FC	150	3hrs	6hrs	6hrs	7days
Interfine 979	Polysiloxane Finish	White	FC	125	3hrs	4hrs	4hrs	ext
				275				

**New Polar Research Vessel (NPRV)
Statement of Requirements (SoR) Section 5**

EXTERNAL DECKS

A high performance anti-abrasion and cosmetic finish system, using 2nd generation polysiloxane technology, for use on above water areas.

Surface Preparations

Where necessary remove all weld splatter, smooth weld seams and sharp edges. Fresh water wash to remove all dirt and contamination, as necessary. Degrease according to SSPC-SP1 solvent cleaning. Ensure area is clean and dry prior to application. Clean welds, damaged and corroded shop primer by blasting to near white metal SSPC-SP10 or Sa2 1/2 ISO 8501-1 or by power tooling to Pt3 JSRA SPSS- 1984. For PVB and unapproved shop primer grit blast to Sa2 1/2 ISO 8501-1 or SSPC SP10. For optimised mechanical properties on typical zinc and iron oxide epoxy shop primers, grit sweep intact areas to AS.2 International Paint Sweep Blast Standards.

Product	Paint Type	Colour	Coats	DFT Microns	Touch Dry 25°C	Hard Dry 25°C	Overcoating 25°C	
							Min	Max
Intershield 300	Abrasion Resistant Aluminium Pure Epoxy	Bronze	FC	175	3hrs	6hrs	6hrs	7days
Interfine 979	Polysiloxane Finish	Signal Green	FC	100	3hrs	4hrs	4hrs	ext
				275				

External Decks under Wood

An Intershield 300 abrasion resistant epoxy anti-corrosive scheme.

Surface Preparations

Where necessary remove all weld splatter, smooth weld seams and sharp edges. Fresh water wash to remove all dirt and contamination, as necessary. Degrease according to SSPC-SP1 solvent cleaning. Ensure area is clean and dry prior to application. Clean welds, damaged and corroded shop primer by blasting to near white metal SSPC-SP10 or Sa2 1/2 ISO 8501-1 or by power tooling to Pt3 JSRA SPSS- 1984. For PVB and unapproved shop primer grit blast to Sa2 1/2 ISO 8501-1 or SSPC SP10. For optimised mechanical properties on typical zinc and iron oxide epoxy shop primers, grit sweep intact areas to AS.2 International Paint Sweep Blast Standards.

Product	Paint Type	Colour	Coats	DFT Microns	Touch Dry 25°C	Hard Dry 25°C	Overcoating 25°C	
							Min	Max
Intershield 300	Abrasion Resistant Aluminium Pure Epoxy	Bronze	FC	125	3hrs	6hrs	7hrs	6mths
Intershield 300	Abrasion Resistant Aluminium Pure Epoxy	Aluminium	FC	125	3hrs	6hrs	7hrs	6mths
				250				

**New Polar Research Vessel (NPRV)
Statement of Requirements (SoR) Section 5**

HELIDECKS

An Intershield 300 abrasion resistant epoxy anti-corrosive scheme with an Intershield 851 epoxy non skid finish coat.

Surface Preparations

Where necessary remove all weld splatter, smooth weld seams and sharp edges. Fresh water wash to remove all dirt and contamination, as necessary. Degrease according to SSPC-SP1 solvent cleaning. Ensure area is clean and dry prior to application. Clean welds, damaged and corroded shop primer by blasting to near white metal SSPC-SP10 or Sa2 1/2 ISO 8501-1 or by power tooling to Pt3 JSRA SPSS- 1984. For iron oxide epoxy shop primer, ensure intact primer is clean and dry. For PVB and unapproved shop primer grit blast to Sa2 1/2 ISO 8501-1 or SSPC SP10. For high zinc shop primer grit sweep to Z- AS.2 International Sweep Blast Standards, or power tool to Pt3 JSRA SPSS-1984.

Product	Paint Type	Colour	Coats	DFT Microns	Touch Dry 25°C	Hard Dry 25°C	Overcoating 25°C	
							Min	Max
Intershield 300	Abrasion Resistant Aluminium Pure Epoxy	Bronze	FC	150	3hrs	6hrs		
Intershield 851	Epoxy Non-Skid	Green	FC	300	5hrs	16hrs	16hrs	ext
Intershield 851	Epoxy Non-Skid	Green	FC	300	5hrs	16hrs	16hrs	ext
				750				

Deck Equipment - A frames

A high performance anti-abrasion and cosmetic finish system, using 2nd generation polysiloxane technology, for use on above water areas.

Surface Preparations

Where necessary remove all weld splatter, smooth weld seams and sharp edges. Fresh water wash to remove all dirt and contamination, as necessary. Degrease according to SSPC-SP1 solvent cleaning. Ensure area is clean and dry prior to application. Clean welds, damaged and corroded shop primer by blasting to near white metal SSPC-SP10 or Sa2 1/2 ISO 8501-1 or by power tooling to Pt3 JSRA SPSS- 1984. For PVB and unapproved shop primer grit blast to Sa2 1/2 ISO 8501-1 or SSPC SP10. For optimised mechanical properties on typical zinc and iron oxide epoxy shop primers, grit sweep intact areas to AS.2 International Paint Sweep Blast Standards.

Product	Paint Type	Colour	Coats	DFT Microns	Touch Dry 25°C	Hard Dry 25°C	Overcoating 25°C	
							Min	Max
Intershield 300	Abrasion Resistant Aluminium Pure Epoxy	Bronze	FC	150	3hrs	6hrs	6hrs	7days
Interfine 979	Polysiloxane Finish	Caribbean Blue	FC	125	3hrs	4hrs	4hrs	ext
				275				

**New Polar Research Vessel (NPRV)
Statement of Requirements (SoR) Section 5**

DECK EQUIPMENT - CRANES

A high performance anti-abrasion and cosmetic finish system, using 2nd generation polysiloxane technology, for use on above water areas.

Surface Preparations

Where necessary remove all weld splatter, smooth weld seams and sharp edges. Fresh water wash to remove all dirt and contamination, as necessary. Degrease according to SSPC-SP1 solvent cleaning. Ensure area is clean and dry prior to application. Clean welds, damaged and corroded shop primer by blasting to near white metal SSPC-SP10 or Sa2 1/2 ISO 8501-1 or by power tooling to Pt3 JSRA SPSS- 1984. For PVB and unapproved shop primer grit blast to Sa2 1/2 ISO 8501-1 or SSPC SP10. For optimised mechanical properties on typical zinc and iron oxide epoxy shop primers, grit sweep intact areas to AS.2 International Paint Sweep Blast Standards.

Product	Paint Type	Colour	Coats	DFT Microns	Touch Dry 25°C	Hard Dry 25°C	Overcoating 25°C	
							Min	Max
Intershield 300	Abrasion Resistant Aluminium Pure Epoxy	Bronze	FC	150	3hrs	6hrs	6hrs	7days
Interfine 979	Polysiloxane Finish	RAL2001 Red Orange	FC	125	3hrs	4hrs	4hrs	ext
				275				

Ext. Superstructure, Mast, Funnel Base, Internal Bulwarks

A high performance anti-abrasion and cosmetic finish system, using 2nd generation polysiloxane technology, for use on above water areas.

Surface Preparations

Where necessary remove all weld splatter, smooth weld seams and sharp edges. Fresh water wash to remove all dirt and contamination, as necessary. Degrease according to SSPC-SP1 solvent cleaning. Ensure area is clean and dry prior to application. Clean welds, damaged and corroded shop primer by blasting to near white metal SSPC-SP10 or Sa2 1/2 ISO 8501-1 or by power tooling to Pt3 JSRA SPSS- 1984. For PVB and unapproved shop primer grit blast to Sa2 1/2 ISO 8501-1 or SSPC SP10. For optimised mechanical properties on typical zinc and iron oxide epoxy shop primers, grit sweep intact areas to AS.2 International Paint Sweep Blast Standards.

Product	Paint Type	Colour	Coats	DFT Microns	Touch Dry 25°C	Hard Dry 25°C	Overcoating 25°C	
							Min	Max
Intershield 300	Abrasion Resistant Aluminium Pure Epoxy	Bronze	FC	150	3hrs	6hrs	6hrs	7days
Interfine 979	Polysiloxane Finish	White	FC	125	3hrs	4hrs	4hrs	ext
				275				

**New Polar Research Vessel (NPRV)
Statement of Requirements (SoR) Section 5**

FUNNEL YELLOW

A high performance anti-abrasion and cosmetic finish system, using 2nd generation polysiloxane technology, for use on above water areas.

Surface Preparations

Where necessary remove all weld splatter, smooth weld seams and sharp edges. Fresh water wash to remove all dirt and contamination, as necessary. Degrease according to SSPC-SP1 solvent cleaning. Ensure area is clean and dry prior to application. Clean welds, damaged and corroded shop primer by blasting to near white metal SSPC-SP10 or Sa21/2 ISO 8501-1 or by power tooling to Pt3 JSRA SPSS- 1984. For PVB and unapproved shop primer grit blast to Sa2½ ISO 8501-1 or SSPC SP10. For optimised mechanical properties on typical zinc and iron oxide epoxy shop primers, grit sweep intact areas to AS.2 International Paint Sweep Blast Standards.

Product	Paint Type	Colour	Coats	DFT Microns	Touch Dry 25°C	Hard Dry 25°C	Overcoating 25°C	
							Min	Max
Intershield 300	Abrasion Resistant Aluminium Pure Epoxy	Bronze	FC	150	3hrs	6hrs	6hrs	7days
Interfine 979	Polysiloxane Finish		FC	125	3hrs	4hrs	4hrs	ext
				275				

Colour: B134

Cargo Holds Dry

An Intershield 300 epoxy anticorrosive scheme overcoated with a polyurethane finish, Interthane 990.

Surface Preparations

Where necessary remove all weld splatter, smooth weld seams and sharp edges. Fresh water wash to remove all dirt and contamination, as necessary. Degrease according to SSPC-SP1 solvent cleaning. Ensure area is clean and dry prior to application. Clean welds, damaged and corroded shop primer by blasting to near white metal SSPC-SP10 or Sa21/2 ISO 8501-1 or by power tooling to Pt3 JSRA SPSS- 1984. For PVB and unapproved shop primer grit blast to Sa2½ ISO 8501-1 or SSPC SP10. For optimised mechanical properties on typical zinc and iron oxide epoxy shop primers, grit sweep intact areas to AS.2 International Paint Sweep Blast Standards.

Product	Paint Type	Colour	Coats	DFT Microns	Touch Dry 25°C	Hard Dry 25°C	Overcoating 25°C	
							Min	Max
Intershield 300	Abrasion Resistant Aluminium Pure Epoxy	Bronze	FC	150	3hrs	6hrs	7hrs	6mths
Intershield 300	Abrasion Resistant Aluminium Pure Epoxy	Aluminium	15% SC	0	3hrs	6hrs	7hrs	6mths
Intershield 300	Abrasion Resistant Aluminium Pure Epoxy	Bronze	15% SC	0	3hrs	6hrs	7hrs	6mths
Intershield 300	Abrasion Resistant Aluminium Pure Epoxy	Aluminium	FC	150	3hrs	6hrs	7hrs	3days
Interthane 990	Polyurethane Finish	White	FC	50	1.5hrs	6hrs	6hrs	ext
				350				

**New Polar Research Vessel (NPRV)
Statement of Requirements (SoR) Section 5**

INTERNAL SUPERSTRUCTURE BEHIND LININGS

An Intergard 276 epoxy primer

Surface Preparations

Where necessary remove all weld splatter, smooth weld seams and sharp edges. Fresh water wash to remove all dirt and contamination, as necessary. Degrease according to SSPC-SP1 solvent cleaning. Ensure area is clean and dry prior to application. Power tool clean all welds, damages and corroded areas to SSPC-SP3 or Pt3 of JSRA SPSS-1984 or St3 of ISO 8501-1. If any zinc salts are present on the intact shop primer they should be removed by high pressure washing or by cleaning with a nylon bristled brush and fresh water prior to application.

Product	Paint Type	Colour	Coats	DFT Microns	Touch Dry 25°C	Hard Dry 25°C	Overcoating 25°C	
							Min	Max
Intergard 276	Epoxy Undercoat/ Tie-Coat	White	FC	50	30mins	12hrs		
				50				

Internal Superstructure Exposed Bulkheads and Deckheads

An Intergard 276 epoxy primer overcoated with a conventional finish, Interlac 542.

Surface Preparations

Where necessary remove all weld splatter, smooth weld seams and sharp edges. Fresh water wash to remove all dirt and contamination, as necessary. Degrease according to SSPC-SP1 solvent cleaning. Ensure area is clean and dry prior to application. Power tool clean all welds, damages and corroded areas to SSPC-SP3 or Pt3 of JSRA SPSS-1984 or St3 of ISO 8501-1. If any zinc salts are present on the intact shop primer they should be removed by high pressure washing or by cleaning with a nylon bristled brush and fresh water prior to application.

Product	Paint Type	Colour	Coats	DFT Microns	Touch Dry 25°C	Hard Dry 25°C	Overcoating 25°C	
							Min	Max
Intergard 276	Epoxy Undercoat/ Tie-Coat	White	FC	50	30mins	12hrs		
Interlac 542	Alkyd Finish	Blued White	FC	60	8hrs	24hrs	24hrs	ext
				110				

**New Polar Research Vessel (NPRV)
Statement of Requirements (SoR) Section 5**

INTERNAL SUPERSTRUCTURE EXPOSED DECKS

An Intergard 276 epoxy primer overcoated with a conventional finish, Interlac 665.

Surface Preparations

Where necessary remove all weld splatter, smooth weld seams and sharp edges. Fresh water wash to remove all dirt and contamination, as necessary. Degrease according to SSPC-SP1 solvent cleaning. Ensure area is clean and dry prior to application. Power tool clean all welds, damages and corroded areas to SSPC-SP3 or Pt3 of JSRA SPSS-1984 or St3 of ISO 8501-1. If any zinc salts are present on the intact shop primer they should be removed by high pressure washing or by cleaning with a nylon bristled brush and fresh water prior to application.

Product	Paint Type	Colour	Coats	DFT Microns	Touch Dry 25°C	Hard Dry 25°C	Overcoating 25°C	
							Min	Max
Intergard 276	Epoxy Undercoat/ Tie-Coat	White	FC	50	30mins	12hrs		
Interlac 665	Alkyd Finish	Signal Green	FC	40	6hrs	24hrs	24hrs	ext
Interlac 665	Alkyd Finish	Signal Green	FC	40	6hrs	24hrs	24hrs	ext
				130				

Engine Room Exposed Bulkheads and Deckheads

An Intergard 276 epoxy primer overcoated with a conventional finish, Interlac 542.

Surface Preparations

Where necessary remove all weld splatter, smooth weld seams and sharp edges. Fresh water wash to remove all dirt and contamination, as necessary. Degrease according to SSPC-SP1 solvent cleaning. Ensure area is clean and dry prior to application. Power tool clean all welds, damages and corroded areas to SSPC-SP3 or Pt3 of JSRA SPSS-1984 or St3 of ISO 8501-1. If any zinc salts are present on the intact shop primer they should be removed by high pressure washing or by cleaning with a nylon bristled brush and fresh water prior to application.

Product	Paint Type	Colour	Coats	DFT Microns	Touch Dry 25°C	Hard Dry 25°C	Overcoating 25°C	
							Min	Max
Intergard 276	Epoxy Undercoat/ Tie-Coat	White	FC	50	30mins	12hrs		
Interlac 542	Alkyd Finish	Blued White	FC	60	8hrs	24hrs	24hrs	ext
				110				

**New Polar Research Vessel (NPRV)
Statement of Requirements (SoR) Section 5**

INTERNALS OF VENTS, INTAKES AND DUCTS

An Intershield 300 abrasion resistant epoxy anti-corrosive scheme.

Surface Preparations

Where necessary remove all weld splatter, smooth weld seams and sharp edges. Fresh water wash to remove all dirt and contamination, as necessary. Degrease according to SSPC-SP1 solvent cleaning. Ensure area is clean and dry prior to application. Clean welds, damaged and corroded shop primer by blasting to near white metal SSPC-SP10 or Sa2 1/2 ISO 8501-1 or by power tooling to Pt3 JSRA SPSS-1984. For PVB and unapproved shop primer grit blast to Sa2 1/2 ISO 8501-1 or SSPC SP10. For optimised mechanical properties on typical zinc and iron oxide epoxy shop primers, grit sweep intact areas to AS.2 International Paint Sweep Blast Standards.

Product	Paint Type	Colour	Coats	DFT Microns	Touch Dry 25°C	Hard Dry 25°C	Overcoating 25°C	
							Min	Max
Intershield 300	Abrasion Resistant Aluminium Pure Epoxy	Bronze	FC	125	3hrs	6hrs	7hrs	6mths
Intershield 300	Abrasion Resistant Aluminium Pure Epoxy	Aluminium	FC	125	3hrs	6hrs	7hrs	6mths
				250				

Engine Room Decks

An Intergard 276 epoxy primer overcoated with a conventional finish, Interlac 665.

Surface Preparations

Where necessary remove all weld splatter, smooth weld seams and sharp edges. Fresh water wash to remove all dirt and contamination, as necessary. Degrease according to SSPC-SP1 solvent cleaning. Ensure area is clean and dry prior to application. Power tool clean all welds, damages and corroded areas to SSPC-SP3 or Pt3 of JSRA SPSS-1984 or St3 of ISO 8501-1. If any zinc salts are present on the intact shop primer they should be removed by high pressure washing or by cleaning with a nylon bristled brush and fresh water prior to application.

Product	Paint Type	Colour	Coats	DFT Microns	Touch Dry 25°C	Hard Dry 25°C	Overcoating 25°C	
							Min	Max
Intergard 276	Epoxy Undercoat/ Tie-Coat	White	FC	50	30mins	12hrs		
Interlac 665	Alkyd Finish	Signal Green	FC	40	6hrs	24hrs	24hrs	ext
Interlac 665	Alkyd Finish	Signal Green	FC	40	6hrs	24hrs	24hrs	ext
				130				

**New Polar Research Vessel (NPRV)
Statement of Requirements (SoR) Section 5**

ENGINE ROOM BELOW FLOOR PLATES

An Intershield 300 abrasion resistant epoxy scheme.

Surface Preparations

Where necessary remove all weld splatter, smooth weld seams and sharp edges. Fresh water wash to remove all dirt and contamination, as necessary. Degrease according to SSPC-SP1 solvent cleaning. Ensure area is clean and dry prior to application. Close high pressure fresh water wash (3,000 psi/211 Kg cm²) using a fan jet lance holding the tip 150mm from and perpendicular to the surface overlapping each pass 30% removing all dirt, dust salt, partially hydrolysed antifouling layer and other surface contamination. Blast to Sa2½ ISO 8501-1 or SSPC SP10.

Product	Paint Type	Colour	Coats	DFT Microns	Touch Dry 25°C	Hard Dry 25°C	Overcoating 25°C	
							Min	Max
Intershield 300	Abrasion Resistant Aluminium Pure Epoxy	Aluminium	FC	150	3hrs	6hrs		
Intershield 300	Abrasion Resistant Aluminium Pure Epoxy	Aluminium	15% SC	0	3hrs	6hrs		
				150				

Ballast & Stability Tanks

An Intershield 300 epoxy anticorrosive scheme for long term protection.

Surface Preparations

Where necessary remove all weld splatter, smooth weld seams and sharp edges. Fresh water wash to remove all dirt and contamination, as necessary. Degrease according to SSPC-SP1 solvent cleaning. Ensure area is clean and dry prior to application. Clean welds, damaged and corroded shop primer by blasting to near white metal SSPC-SP10 or Sa2½ ISO 8501-1 or by power tooling to Pt3 JSRA SPSS- 1984. For PVB and unapproved shop primer grit blast to Sa2½ ISO 8501-1 or SSPC SP10. For optimised mechanical properties on typical zinc and iron oxide epoxy shop primers, grit sweep intact areas to AS.2 International Paint Sweep Blast Standards.

Product	Paint Type	Colour	Coats	DFT Microns	Touch Dry 25°C	Hard Dry 25°C	Overcoating 25°C	
							Min	Max
Intershield 300	Abrasion Resistant Aluminium Pure Epoxy	Bronze	FC	160	3hrs	6hrs	7hrs	14days
Intershield 300	Abrasion Resistant Aluminium Pure Epoxy	Aluminium	15% SC	0	3hrs	6hrs	7hrs	14days
Intershield 300	Abrasion Resistant Aluminium Pure Epoxy	Bronze	15% SC	0	3hrs	6hrs	7hrs	14days
Intershield 300	Abrasion Resistant Aluminium Pure Epoxy	Aluminium	FC	160	3hrs	6hrs	7hrs	14days
				320				

**New Polar Research Vessel (NPRV)
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Voids

An Intershiel 300 epoxy anticorrosive scheme for long term protection.

Surface Preparations

Where necessary remove all weld splatter, smooth weld seams and sharp edges. Fresh water wash to remove all dirt and contamination, as necessary. Degrease according to SSPC-SP1 solvent cleaning. Ensure area is clean and dry prior to application. Clean welds, damaged and corroded shop primer by blasting to near white metal SSPC-SP10 or Sa2 1/2 ISO 8501-1 or by power tooling to Pt3 JSRA SPSS- 1984. For PVB and unapproved shop primer grit blast to Sa2 1/2 ISO 8501-1 or SSPC SP10. For optimised mechanical properties on typical zinc and iron oxide epoxy shop primers, grit sweep intact areas to AS.2 International Paint Sweep Blast Standards.

Product	Paint Type	Colour	Coats	DFT Microns	Touch Dry 25°C	Hard Dry 25°C	Overcoating 25°C	
							Min	Max
Intershiel 300	Abrasion Resistant Aluminium Pure Epoxy	Bronze	FC	125	3hrs	6hrs	7hrs	14days
Intershiel 300	Abrasion Resistant Aluminium Pure Epoxy	Aluminium	15% SC	0	3hrs	6hrs	7hrs	14days
Intershiel 300	Abrasion Resistant Aluminium Pure Epoxy	Bronze	15% SC	0	3hrs	6hrs	7hrs	14days
Intershiel 300	Abrasion Resistant Aluminium Pure Epoxy	Aluminium	FC	125	3hrs	6hrs	7hrs	14days
				250				

**New Polar Research Vessel (NPRV)
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GREY WATER TANKS

A one coat vinyl ester scheme suitable for the storage of Galley, Domestic and Laundry gray water.

Surface Preparations

Where necessary remove all weld splatter, smooth weld seams and sharp edges. Fresh water wash to remove all dirt and contamination, as necessary. Degrease according to SSPC-SP1 solvent cleaning. Ensure area is clean and dry prior to application. Blast to Sa2½ ISO 8501-1 or SSPC SP10.

Product	Paint Type	Colour	Coats	DFT Microns	Touch Dry 25°C	Hard Dry 25°C	Overcoating 25°C	
							Min	Max
Interline 955	Glass Flake Vinyl Ester	White	FC	600	4hrs	5hrs	5hrs	2days
Interline 955	Glass Flake Vinyl Ester	Buff	15% SC	0	4hrs	5hrs	5hrs	2days
Interline 955	Glass Flake Vinyl Ester	White	15% SC	0	4hrs	5hrs	5hrs	2days
				600				

Winch Room and Hangar Bulkheads and Deckheads

A high performance anti-abrasion and cosmetic finish system, using 2nd generation polysiloxane technology, for use on above water areas.

Surface Preparations

Where necessary remove all weld splatter, smooth weld seams and sharp edges. Fresh water wash to remove all dirt and contamination, as necessary. Degrease according to SSPC-SP1 solvent cleaning. Ensure area is clean and dry prior to application. Clean welds, damaged and corroded shop primer by blasting to near white metal SSPC-SP10 or Sa2½ ISO 8501-1 or by power tooling to Pt3 JSRA SPSS- 1984. For PVB and unapproved shop primer grit blast to Sa2½ ISO 8501-1 or SSPC SP10. For optimised mechanical properties on typical zinc and iron oxide epoxy shop primers, grit sweep intact areas to AS.2 International Paint Sweep Blast Standards.

Product	Paint Type	Colour	Coats	DFT Microns	Touch Dry 25°C	Hard Dry 25°C	Overcoating 25°C	
							Min	Max
Intershield 300	Abrasion Resistant Aluminium Pure Epoxy	Bronze	FC	150	3hrs	6hrs	6hrs	7days
Interfine 979	Polysiloxane Finish	White	FC	125	3hrs	4hrs	4hrs	ext
				275				

**New Polar Research Vessel (NPRV)
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WINCH ROOM AND HANGAR DECKS

An Intershiel 300 abrasion resistant epoxy anti-corrosive scheme directly overcoated with an Interbond 501 finish.

Surface Preparations

Where necessary remove all weld splatter, smooth weld seams and sharp edges. Fresh water wash to remove all dirt and contamination, as necessary. Degrease according to SSPC-SP1 solvent cleaning. Ensure area is clean and dry prior to application. Clean welds, damaged and corroded shop primer by blasting to near white metal SSPC-SP10 or Sa2 1/2 ISO 8501-1 or by power tooling to Pt3 JSRA SPSS- 1984. For PVB and unapproved shop primer grit blast to Sa2 1/2 ISO 8501-1 or SSPC SP10. For optimised mechanical properties on typical zinc and iron oxide epoxy shop primers, grit sweep intact areas to AS.2 International Paint Sweep Blast Standards.

Product	Paint Type	Colour	Coats	DFT Microns	Touch Dry 25°C	Hard Dry 25°C	Overcoating 25°C	
							Min	Max
Intershiel 300	Abrasion Resistant Aluminium Pure Epoxy	Bronze	FC	150	3hrs	6hrs	7hrs	4days
Interbond 501	Epoxy Primer/Finish	Green	FC	150	8hrs	10hrs	10hrs	28days
				300				

Hydraulic and Lub Oil Tanks

An Interline 704 high performance epoxy scheme suitable for the carriage of a wide range of cargoes.

Surface Preparations

Where necessary remove all weld splatter, smooth weld seams and sharp edges. Fresh water wash to remove all dirt and contamination, as necessary. Degrease according to SSPC-SP1 solvent cleaning. Ensure area is clean and dry prior to application. Blast to Sa2 1/2 ISO 8501-1 or SSPC SP10. Apply the material before visible oxidation occurs. If oxidation does occur, the entire oxidised surface should be re-blasted to the standard specified above.

Product	Paint Type	Colour	Coats	DFT Microns	Touch Dry 25°C	Hard Dry 25°C	Overcoating 25°C	
							Min	Max
Interline 704	Epoxy Tank Coating	Pink	FC	125	3hrs	8hrs	9hrs	21days
Interline 704	Epoxy Tank Coating	Grey	15% SC	0	3hrs	8hrs	9hrs	21days
Interline 704	Epoxy Tank Coating	Pink	15% SC	0	3hrs	8hrs	9hrs	21days
Interline 704	Epoxy Tank Coating	Grey	FC	125	3hrs	8hrs	9hrs	21days
				250				

**New Polar Research Vessel (NPRV)
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AVIATION FUEL TANKS

An Interline 704 high performance epoxy scheme suitable for the carriage of a wide range of cargoes.

Surface Preparations

Where necessary remove all weld splatter, smooth weld seams and sharp edges. Fresh water wash to remove all dirt and contamination, as necessary. Degrease according to SSPC-SP1 solvent cleaning. Ensure area is clean and dry prior to application. Blast to Sa2½ ISO 8501-1 or SSPC SP10. Apply the material before visible oxidation occurs. If oxidation does occur, the entire oxidised surface should be re-blasted to the standard specified above.

Product	Paint Type	Colour	Coats	DFT Microns	Touch Dry 25°C	Hard Dry 25°C	Overcoating 25°C	
							Min	Max
Interline 704	Epoxy Tank Coating	Pink	FC	125	3hrs	8hrs	9hrs	21days
Interline 704	Epoxy Tank Coating	Grey	15% SC	0	3hrs	8hrs	9hrs	21days
Interline 704	Epoxy Tank Coating	Pink	15% SC	0	3hrs	8hrs	9hrs	21days
Interline 704	Epoxy Tank Coating	Grey	FC	125	3hrs	8hrs	9hrs	21days
				250				

Hardwood

An Interlac 678 clear varnish scheme for wood.

Surface Preparations

Ensure wood surface is clean and dry prior to application. For new wood it is recommended that the first coat is thinned 50% with GTA004 to give maximum penetration into the wood.

Product	Paint Type	Colour	Coats	DFT Microns	Touch Dry 25°C	Hard Dry 25°C	Overcoating 25°C	
							Min	Max
Interlac 678	Alkyd Varnish	Varnish	FC	25	4hrs	24hrs	24hrs	ext
Interlac 678	Alkyd Varnish	Varnish	FC	25	4hrs	24hrs	24hrs	ext
Interlac 678	Alkyd Varnish	Varnish	FC	25	4hrs	24hrs	24hrs	ext
				75				

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GREY WATER TANKS

An Interline 704 scheme suitable for use in Domestic Grey Water.

Surface Preparations

Where necessary remove all weld splatter, smooth weld seams and sharp edges. Fresh water wash to remove all dirt and contamination, as necessary. Degrease according to SSPC-SP1 solvent cleaning. Ensure area is clean and dry prior to application. Blast to Sa2½ ISO 8501-1 or SSPC SP10. Apply the material before visible oxidation occurs. If oxidation does occur, the entire oxidised surface should be re-blasted to the standard specified above.

Product	Paint Type	Colour	Coats	DFT Microns	Touch Dry 25°C	Hard Dry 25°C	Overcoating 25°C	
							Min	Max
Interline 704	Epoxy Tank Coating	Pink	FC	125	3hrs	8hrs	9hrs	21days
Interline 704	Epoxy Tank Coating	Grey	15% SC	0	3hrs	8hrs	9hrs	21days
Interline 704	Epoxy Tank Coating	Pink	15% SC	0	3hrs	8hrs	9hrs	21days
Interline 704	Epoxy Tank Coating	Grey	FC	125	3hrs	8hrs	9hrs	21days
				250				

FRESHWATER TANKS

An Interline 925, high performance epoxy scheme certified for the carriage of potable water.

Surface Preparations

Where necessary remove all weld splatter, smooth weld seams and sharp edges. Fresh water wash to remove all dirt and contamination, as necessary. Degrease according to SSPC-SP1 solvent cleaning. Ensure area is clean and dry prior to application. Blast to Sa2½ ISO 8501-1 or SSPC SP10. Apply the material before visible oxidation occurs. If oxidation does occur, the entire oxidised surface should be re-blasted to the standard specified above.

Product	Paint Type	Colour	Coats	DFT Microns	Touch Dry 25°C	Hard Dry 25°C	Overcoating 25°C	
							Min	Max
Interline 925	Epoxy Tank Coating	White	FC	300	8hrs	18hrs	18hrs	36hrs
Interline 925	Epoxy Tank Coating	Cream	15% SC	0	8hrs	18hrs	18hrs	36hrs
Interline 925	Epoxy Tank Coating	White	15% SC	0	8hrs	18hrs	18hrs	36hrs
				300				

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Product List				
Product	Colour	Sales Code	Volume Solids (%)	Volume (lt)
Interbond 501	Green	KQA103/A	80	0.0
Interfine 979			76	0.0
Interfine 979	White	SYB000/A	76	0.0
Interfine 979	Black	SY999/A	76	0.0
Interfine 979	Signal Green	SYL549/A	76	0.0
Interfine 979	RAL2001 Red Orange	SYF259/A	76	0.0
Interfine 979	Caribbean Blue	SYC935/A	76	0.0
Intergard 263	Light Grey	FAJ034/A	57	0.0
Intergard 276	White	EGA080/A	47	0.0
Interlac 542	Blued White	CGA042	46	0.0
Interlac 665	Signal Green	CLL549	48	0.0
Interlac 678	Varnish	HVA022	52	0.0
Interline 704	Pink	THA700/A	53	0.0
Interline 704	Grey	THA702/A	53	0.0
Interline 925	Cream	THA126/A	100	0.0
Interline 925	White	THA127/A	100	0.0
Interline 955	White	TEA600/A	85	0.0
Interline 955	Buff	TEA603/A	85	0.0
Intershield 163 Inerta 160	Black	ERA163/A	95	0.0
Intershield 300	Bronze	ENA300/A	60	0.0
Intershield 300	Aluminium	ENA301/A	60	0.0
Intershield 851	Green	ADA173/A	77	0.0
Interswift 6600	Red	BMA674	58	0.0
Interthane 990	White	PHB000/A	57	0.0

R5.19 Paint Application

The Contractor to arrange at his expense for a full time English speaking technical service representative of the paint manufacturer shall be present in the yard, during the preparation and application of all paint systems. The Contractor to submit C.V. of the proposed representative for NERC consideration and approval.

All paint materials shall be mixed in accordance with the manufacturer's recommendations and instructions. Paint materials not shall be thinned or added to in any way, unless on the instruction of the manufacturer's representative.

Prior to the application of the specified paint system, dirt and grease shall be removed from the primed surfaces using approved solvents and prepared areas presented for approval by NERC representative prior to application of coating.

Thickness of coating applied shall be monitored during application and checked against Paint Specification before application of the next coat. Results shall be presented to paint supplier's representative and NERC representative for approval before any remedial action is taken or the next coat applied. Any remedial action shall be undertaken by the Contractor at his cost.

During construction of the vessel and applying paint coatings the Contractor shall take special care that all hot work in a particular area is complete before application of coating.

Once tank spaces have been cleaned and coating applied to the satisfaction of the NERC representative, manholes serving the specific tank shall be closed.

The Contractor shall arrange strict control of access to areas where coatings are being applied and to ensure co-ordination of trades accordingly.

No paint runs, or rough/unsightly painting shall be accepted.

Special attention shall be given to the exterior underwater hull area:

- On the building berth, following the cleaning of welds and the application of the first coat, intermediate coats and one coat of anti-fouling shall be applied in accordance with the dry film thicknesses specified.
- Care shall be taken to ensure that all areas in way of building blocks are prepared and coated similarly.
- At pre-delivery dry docking, the anti-fouling area shall be fresh water washed to remove any contaminants. Damaged areas of the coating system shall be prepared and touched up in accordance with the paint specification and the requirements of the paint supplier's representative, followed by the application of the final full coat of anti-fouling to achieve full specification thickness.
- Areas in way of keel blocks shall be similarly treated.

All painting of steelwork within the vessel where specified shall be gloss finish and shall be free of surface imperfections, blemishes, runs and sags, etc.

No spray painting inside the accommodation/superstructure shall be permitted, except for the application of protective coating behind linings.

The Contractor shall make all necessary provisions to protect the cleaning and painting operation from the environment, to provide dry surfaces for the application of each new coat of paint and to provide the curing conditions required for the successful application of the paint system. Paint manufacturer's representative to confirm that conditions are suitable for the application of paints of varying specifications.

No paint shall be applied to outside surfaces during weather that might cause dust and dirt in appreciable quantities shall be blown/deposited upon wet paint.

No paint shall be applied to outside surfaces during weather which may cause the vessel shall be contaminated by overspray from this vessel or other construction taking place in the construction facility.

The finishing coats of paint not shall be applied in areas where equipment shall be installed, until after the termination of all installation work.

All installed equipment shall be adequately protected against entrance of dirt and dust during cleaning and touch-up operations and from paint during the subsequent application of the paint systems. After termination of the painting of structural steel, the protective coverings shall be carefully removed from the equipment, the equipment shall be thoroughly cleaned and painted parts of the equipment touched up in matching colours, or re-painted as may be required to restore to the original finish.

All seals, threads on securing toggles, screws, etc., not shall be painted.

Hatch and vent cover rubbers not shall be painted.

Where ventilation ducting is of mild steel construction, steel shall be primed and coated both internally and externally to NERC approval.

Any hardwood shall be coated as follows:

- 4 coats high quality wood stain such as Dek's Olja

Surfaces shall be lightly rubbed down between coats and left full gloss, well sealed around all securing.

5.1.12 Cathodic Protection

R5.20 An impressed current system shall be installed for the overall protection of the hull.

Additional hull anodes shall be fitted where necessary to suit a 5 year life cycle. Location of anodes in way of the thrusters and sea inlet boxes shall be specially considered.

Anode type, shapes, orientation and overall positioning shall be carefully chosen to prevent turbulence stimulation in way of hull mounted sensors. They are not to be located up-stream of scientific clean seawater intakes.

Zinc anodes shall be fitted in water ballast tanks.

Cathodic protection of heating pipes in water ballast and other water tanks shall be specially considered.

5.1.13 Hull Internal & External Markings

R5.21 In addition to Statutory markings clearly delineated hull datum markings shall be applied in all laboratories, working spaces, stores and scientific equipment rooms showing frame numbers and at least two datum points showing distances from the transom, the peak of the bow, the distance off centreline (port or starboard) and the height above the underside of keel. These shall be permanently affixed and be of durable material e.g. brass.

Clearly discernible hull markings shall be applied to the outside of the hull showing:

- Main Bulkheads
- Tank bulkheads
- Tank tops
- Deck lines
- Aft Perpendicular and Fore Perpendicular

These shall be made from steel plating 3mm thick fully welded in place with welds ground smooth.

Clearly discernible hull markings for the guidance of divers and the ship repairing dock master shall be painted across the flat of bottom and up the sides to just above the load waterline indicating the positions of:

- Thrusters
- SWATH Bathymetry transducer arrays
- Log
- Hull mounted transducers
- Transducer deployment positions.

Markings shall be on both sides of the hull.

Draft marks shall be applied at both sides of the bow, midship both sides and at the centre of the stern transom.

Drain plugs shall be fitted and marked with their associated space.

Sufficient external hull markings below waterline shall be made by using weld lines for the purpose of in water survey.

5.1.14 Winterisation

R5.22 The Winterisation Specialties included in the table below are provided to inform the bidder of appropriate methods to meet the functional requirements regarding equipment and systems as required by the Polar Code.

The Contractor shall develop a Winterisation Application Plan which will indicate how the functional requirements identified in the table below are addressed in the design and include any further mitigation measures identified by the bidder that are required to meet Polar Code requirements. The measures should generally follow those indicated in methods column in the table. However the bidder may propose alternative methods which meet the functional requirements. In such cases the alternative methods and justification are to be documented in the Polar Code compliance report. See also section on Polar Code compliance.

Proposed Winterisation Specialties

Equipment	Functional Requirement	Example methods to meet functional requirements
Exposed accommodation bulkhead / deckhead insulation	The insulation shall be calculated in accordance with the design conditions.	<ul style="list-style-type: none"> • 150mm minimum thickness of glass wool insulation or equivalent.
Exposed deck equipment	<p>Exposed deck equipment and machinery essential for the safe operation of the ship, not including equipment for undertaking science missions shall be designed and certified by the manufacturer to operate at the PST.</p> <p>To include, but not limited to: Exposed mooring winches / equipment Davits Accommodation ladder</p> <p>Deck equipment for science missions, including, but not limited to Science "A" frames, launching devices etc. are to be functional at -35⁰C</p>	<ul style="list-style-type: none"> • Minimize exposed machinery (e.g. enclosed forecastle) • Covers are to be provided • Associated exposed pipework and electrical equipment are to be heated • Winch motors are to be provided with standstill heating • Materials of equipment suitable for PST and manufacturer's statement provided
Exposed escape routes	Anti-icing measures to be provided to keep exposed escape route clear.	<ul style="list-style-type: none"> • To be wide enough so as not to hinder passage by persons wearing suitable polar clothing. • Provision of deck heating. • Provision of heating of steps and handrails
External doors, hatch doors and door seals	Protective locations or recessed as far as practical External doors and hatches for escape routes to be kept ice free.	<ul style="list-style-type: none"> • Protective locations • Low temperature packing (Teflon) • To be provided with trace heating to ensure access.

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Equipment	Functional Requirement	Example methods to meet functional requirements
Sea inlets for the cooling water system	<p>An ice free suction for main machinery and essential auxiliaries is to be maintained.</p> <p>Clogging of the sea chests with snow and ice slush is to be avoided.</p>	<p>Sea chests of adequate size shall be located deep in the ship, and be provided with baffles, large vent pipes to eliminate air, and piping for the recirculation of cooling water from the heat exchanger, in accordance with the Polar Class requirements. Ice sea chests should extend above the upper ice waterline to allow ice separation. A thermostatically controlled valve shall regulate the re-circulating flow based on water temperature in the sea chest. These features are not required in the scientific sea chest for uncontaminated sea water.</p> <p>Sea water.</p>
Non-essential exposed piping	Protected against fluids freezing in pipes.	<ul style="list-style-type: none"> • Drainage valves to be provided. • Pipework inclined to ensure drainage of fluids is possible
Exposed oil filling and transfer lines	Prevention of freezing of exposed filling and transfer lines used as part of the ship's resupply mission.	<ul style="list-style-type: none"> • Thermal insulation and trace heating arrangements are to be provided with the exposed oil fuel filling and transfer lines, and any sludge transfer lines
Deck air supply	Avoid freezing/clogging of on-deck machinery compressed air system components.	<ul style="list-style-type: none"> • Air dryer with dew point at or below PST.
Exposed deck cranes and cargo tender davits	Exposed deck cranes are to be fully functional at PST. Suitable provisions for cold start arrangements	<ul style="list-style-type: none"> • Winch motors are to be provided with standstill heating • Provision of low temperature oil and greases • Circulation of hydraulic oil • Heated cabins and controls where provided • Material to be suitable for PST.
Emergency generator	Emergency Generator to be capable of operating at the lowest external design air temperature.	<ul style="list-style-type: none"> • Emergency generator engine with fuel oil tank heater, fuel line insulation, lube oil pre-heater, coolant pre-heater, battery
Emergency generator room air intakes	Suitable arrangements to provide starting of emergency generator at PST.	<ul style="list-style-type: none"> • Emergency generator engine room heating provision shall be provided • Electric heater for room heating • Heated room air re-circulation • Air intake louver with electric control dampers for room air
Radar motors	Radars to be functional at PST.	<ul style="list-style-type: none"> • Manufacturer's statement of functionality at -35⁰C. • Electric heater to be provided

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Equipment	Functional Requirement	Example methods to meet functional requirements
Navigation air horn	Air horn to be functional at PST.	<ul style="list-style-type: none"> Manufacturer's statement of functionality at PST. Air dryer with dew point at PST.
Bow and the bridge wings	Searchlights suitable for ice navigation to be provided at the bow and bridge wings. Suitable for remote operation at PST.	<ul style="list-style-type: none"> Provided with a cover heating arrangements for the directional motor.
Closed circuit television systems fitted in exposed locations	CCTV suitable for operation at PST.	<ul style="list-style-type: none"> provided with heating arrangements heating arrangements for the directional motor.
Satellite /GPS motors/Radars/EPIRb	Satellite / GPS/Radars/EPIRb suitable for operation at PST.	<ul style="list-style-type: none"> heating arrangements for the directional motor. Low temperature grease
Lighting arrangements in working areas on the deck, in particular the helideck	Deck lighting to be functional at PST and suitably arranged to allow operations during darkness.	<ul style="list-style-type: none"> Lights to be located at accessible positions to facilitate ice removal Manufacturer's statement
Navigation lights	Navigation lights to be functional at PST.	<ul style="list-style-type: none"> Heating arrangements if LED type
Exposed speaker systems	External speaker functional at PST.	<ul style="list-style-type: none"> Manufacturer's statement
Fire main	Fire main to be operable at PST.	<ul style="list-style-type: none"> Routed through internal heated spaces as far as practicable Continuous circulation Trace heating Drains
Sea water suctions for fire pumps	Sea water suctions for fire pipes to be maintained ice-free.	<ul style="list-style-type: none"> Suction from engine room sea chest
Fire hoses	Prevention of used fire hoses freezing.	<ul style="list-style-type: none"> Additional hoses Drying space
Air intakes for accommodation and machinery spaces	Maintain ice-free intakes for engine intakes and ventilation.	<ul style="list-style-type: none"> Provision of heat tracing on intake grilles.
Exposed air vent pipe heads	Prevent over pressure of water ballast tanks and structural damage	<ul style="list-style-type: none"> Provision of heat tracing on water ballast tank air vent heads
Bridge windows	Prevent ice accumulation on bridge windows.	<ul style="list-style-type: none"> Hot air blowers for all windows Heated glass for main conning positions
Bridge window cleaning	Ensure operation of window cleaning at PST.	<ul style="list-style-type: none"> Hot air supply for clearing nozzles Heated window wiper motors Provision of hot water (fresh water) for spray

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Changing rooms	Provision of space to change into cold weather clothes	<ul style="list-style-type: none">• Changing room close to main external work areas• Heated space for drying and storing clothes
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Equipment	Functional Requirement	Example methods to meet functional requirements
Fresh water, grey water, cooling water, bilge water and ballast tanks adjacent to the shell above the ballast Waterline.	Prevent tank freezing.	<ul style="list-style-type: none"> • Tanks against side shell above BWL to be limited • Heating of tanks by heat coils
Helideck	Provision for de-icing the helideck	<ul style="list-style-type: none"> • Trace heating access routes • Additional Manual clearing by steam // warm water hose • Manual tools & other methods
Vessels thermal plant	Provision of medium for manual deck de-icing in safety critical areas	<ul style="list-style-type: none"> • Deck side steam to be supplied to critical areas related to safety and ice accretion. • Reach of stream hose not to be considered longer than 15m.
At appropriate locations (e.g. main deck, helideck),	Provision of tools for manual de-icing, including hot air / steam lances	<ul style="list-style-type: none"> • At least one set of tools at each storage location. <ul style="list-style-type: none"> ○ 3 shovels, ○ 3 hammers or mallets, ○ 3 scrapers. • Containers for the storage of de-icing compounds
Exposed cables and pipe	Protection of exposed cables and pipes from damage during manual de-icing	<ul style="list-style-type: none"> • Enclosed cableways • Steel Covers
Space heating	Maintain environment in emergency conditions for emergency operation and habitation	<p>List of spaces identified as being provided with secondary (redundant) heating in addition to HVAC:</p> <ul style="list-style-type: none"> • Wheelhouse • Hospital • ECR • Firefighting stations/ lockers and media • Citadel (survival) space i.e. Muster Station • Steering gear rooms • Paint store / battery room • Bosun store • Emergency Generator Room
Engine Room heating / supply air	Measures to reduce air exchanges in cold conditions Measures to ensure provision of intake air on main engine start-up	<ul style="list-style-type: none"> • Exhaust air mixing / re-circulation • Direct engine air ducting • Engine intake pre-heating

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Space Heating	Supply air heating to maintain adequate working conditions	<ul style="list-style-type: none">• Cargo Holds• Science Hangar• Winch Rooms• Science Hold• Engine Rooms (e.g. in low temperatures when one may be shut
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Equipment	Functional Requirement	Example methods to meet functional requirements
Lifeboat	Safe access and starting of lifeboat at PST.	<ul style="list-style-type: none"> • Lifeboat engine heating device • heater for lifeboat inside • Life boat engine arrangements suitable for starting and operation at PST. • Heat tracing for access hatch
Rescue boat	Safe access and starting of rescue boat at PST.	<ul style="list-style-type: none"> • Rescue boat engine heating device • Rescue boat engine arrangements suitable for starting and operation at PST.
Life boat davit, Rescue boat davit and Workboat davit	Functionality of lifeboat davit at PST.	<ul style="list-style-type: none"> • Cover with heating cable at the sheave of davit • Lifeboat Boat bay protected by Suitable Curtain covering • Cover with heating cable at the davit winch • Deck / handrail heating at the lifeboat boarding platform
Life raft	Functionality and access of life raft at PST	<ul style="list-style-type: none"> • Certified by manufacturer for operation at PST. • Lifeboat Boat bay protected by Suitable Curtain covering • Built in heating cable for life raft and (hydrostatic) release device

5.1.15 Principal Dimensions

The vessels principal dimensions shall be taken to apply to the vessel when loaded with a full load operating deadweight. This is defined in section 5.1.15

R5.24 Draft

The draft to the underside of the keel shall be optimised taking into account the following:

- The overall weight/ buoyancy requirements related to length and breadth (deck areas and facilities dispositions) and form coefficients.
- The seakeeping requirements.
- Minimising bubble sweepdown issues.
- The ability to ballast the vessel to optimal draft for bottom mounted equipment performance.
- The powering requirements in particular for fuel economy.
- Dynamic positioning current requirements.
- Port and areas of operational restrictions.

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- The designed full load operating extreme draft with the moonpool door closed shall not exceed 7.0m at level trim. This condition shall carry the Deadweight along with NERC growth as defined in section 5.1.23.
- The increases in draft due to ice accretion weights may be taken to apply above the 7.0m operating draft.
- The vessel shall be able to operate up to a draft of 7.5m, it is accepted that when operating in these conditions the vessel shall not be able to access all necessary ports.

R5.25 Length & Breadth

Length and breadth shall provide the key proportions of the vessel which define the spatial arrangements, the seakeeping abilities, bubble sweepdown issues, ice breaking performance speed/fuel economy, stability and, since cost is still conventionally seen by many as being driven primarily by length, a driver of the overall price of the vessel.

The key harbours in which the vessel intends to operate restrict both the maximum length and breadth of the vessel.

The length of the vessel shall not exceed 128.2m overall.

The breadth shall be of course be sufficient to ensure adequate stability for the over-side lifting tasks while providing a sea-kindly relatively low acceleration roll response for safety and habitability purposes. The beam of the vessel shall not exceed 26.0m.

R5.26 Trim

The vessel shall be designed to minimise ballast and achieve level trim in the contract departure condition, with 7.0m draft.

The generation of fore and aft trim during fluids consumption shall be minimised by careful disposition of fuel, fresh water and also minimised ballast tank capacity (e.g. fore and aft peak tanks).

If trim is unavoidable then the working freeboard at the transom shall be maintained and not change by more than 0.5m under normal operating conditions. No mixed fluid use of tanks shall be accepted.

The ballast system shall incorporate a ballast water treatment system so that ballast exchange shall be un-necessary.

The vessels ballasting system shall be capable of trimming the vessel in order to maintain the design ice breaking draught forward and to maintain sufficient propeller immersion aft in all operational loading conditions.

R5.27 Depth

Depth to the working deck shall be the combination of the Summer Load Draft and the desired working freeboard to the working (Main) deck (not necessarily the Statutory Freeboard).

The working freeboard is a compromise between protecting equipment and personnel from shipment of water in a seaway and the need to minimise pendulum actions on equipment being transferred to and from the sea as well as being able to use grapples or grab hooks to capture floating equipment while working over the bulwarks.

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The working freeboard in all departure and arrival conditions specified in the stability book shall neither exceed 4.5m nor be less than 3m (or the statutory minimum freeboard).

5.1.16 Speed

R5.28 Overall Requirements

The following speeds shall be achieved with the vessel in level trim at the design draught.

The economic cruising speed shall be no less than 13.0 knots in head seas of Sea State 4 (ITTC2 conditions) while minimising propulsion motor power and fuel consumption.

The vessel is to be capable of sustaining no less than 11 knots in Sea State 2 or less (ITTC2 conditions) while operating in quiet mode (Silent R) as defined in section 5.1.15.

The vessel is to be capable of sustaining no less than 11 knots in head seas of Sea State 6 (ITTC2 conditions).

The vessel is to be capable of sustaining no less than 10 knots in head seas of Sea State 7 (ITTC2 conditions).

The vessel shall be capable of breaking 1m ice speeds of no less than 3.0 knots using 100% propulsion power. Ice to have the following properties:

- flexible strength of 500 kPa, snow coverage of 20% of the ice thickness and a frictional coefficient of 0.1.

Some redundancy shall be provided in the electrical power generation system which will allow effective passage through ice of the above characteristics.

Acceptance of the vessel speed shall be based upon calm water sea trials at 11 and 13 knots with performance in head seas extrapolated at higher sea states based on the results of model scale tank testing.

Fuel consumption shall be verified by a 4 hour endurance sea trial in calm water at 13 knots with a clean hull. Model test results shall be used to calculate performance in waves

The Vessel shall be designed to demonstrate a thrust of not less than the requirement of breaking ice as defined above when loaded to a moulded draught of 7.0m in conditions not exceeding Sea State 2 with the propulsion motors operating at not more than 100 percent MCR. Alternative thrust predictions with full scale verification may be proposed.

R5.29 Speed Control

Over and above the requirements for Dynamic Positioning fine control of the ship's speed shall be required at various speeds.

In the speed range 1 knot to 8 knots the average speed over the ground, defined simply as distance / time, shall be not vary more than ± 0.25 knots on a continuous basis in sea state 4. The trial shall be based upon a 2 hour time duration.

R5.30 Range

Range of 19,000nm is required at an economic cruising speed of 13knots, calculated with a 15% sea margin. Range shall be calculated based on Fuel consumptions and propulsive powers determined during sea trials and hotel loads determined from the Electrical load balance.

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5.1.17 Endurance

R5.31 Overall

An endurance period of at least 60 days is required.

Vessel to include tankage and store capacity sufficient in volume to allow the vessel to be capable of independent operation at sea to fulfil a 60 day science cruise or resupply voyage with full complement onboard based the operating profile specified in 4.5 in head seas of Sea State 4 (ITTC2 conditions). Space onboard and an allowance within the deadweight capacity shall be available for provisions for 180 days.

Waste disposal arrangements, complying with MARPOL and Antarctic Arctic Pollution prevention requirements, shall be adequate for a minimum of 60 days south of 60 degrees south.

R5.32 Fuel

The first choice fuel shall be used is Gas Oil with an ultra low sulphur content of less than 0.1%. Systems and machinery are however shall be designed to accept Marine Diesel Oil (MDO) which it may be necessary to load in remote areas. Bunkering shall be by pipeline, road tanker or barge alongside. Bunker line diameters shall be sized for barge deliveries with portable reducers to accept road tanker couplings.

Typical survey cruise profiles are provided so that judgements can be made as to consumption.

Total capacity shall be defined by the worst case range calculation based on either 19,000nm range or the worst case Cruise Profiles including a 15 % Sea Margin and a minimum reserve remaining in the tank of 10%.

The vessel is also required to deliver Marine Gas Oil to bases via hoses from the bunker station. The vessel shall therefore have to comply with Class and Flag State requirements to perform this function.

R5.33 Fresh Water

Fresh water storage capacities shall be at least 330 tonnes. The fresh water included in the contract deadweight departure condition at a draft of 7.0m shall not be less than 210 tonnes.

R5.34 Provisions

Storage areas, volume, stores deadweight and environmental controls shall be appropriate to properly provide 180 days endurance based on a ships complement of scientists and crew of 90.

R5.35 Not Used.

5.1.18 Seakeeping

R5.36 The ability of the vessel to continue to operate safely and effectively in high sea states and high wind conditions is one of the principle scientific requirements. The proportions, form and powering of the vessel shall be concentrate upon this requirement. A high incidence of seasickness, fatigue and a reduced operational window could jeopardise the success of a scientific cruise.

The contractor shall confirm the seakeeping criteria are achievable in consideration of other conflicting requirements, at the earliest stage of the design.

Furthermore, the contractor shall account for motion induced sickness, based on criteria in ISO 2631/3 and BS 6841. This could be by the use of a series of Motion Sickness Incidence (MSI) plots.

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The achievement of the sea-keeping criteria shall be confirmed throughout the design and construction by initial detailed calculations, model tests, regularly reported weight control and finally sea trials.

R5.37 Ship Stabilisation

A passive gyro controlled tank type stabiliser shall be required for roll stabilisation. It shall be optimised on the range of Metacentric Height (GM) predicted for the vessel with a biased ability to allow adequate stabilisation at the highest predicted values plus design margins. Its developable power to resist wave action shall be at least an equivalent moment to that required to induce a static heel of 3 degrees on the vessel at the largest value of the product of displacement and metacentric height for conditions predicted during seagoing operations. Its location shall be carefully considered for effectiveness, static stability and particularly noise in relation to accommodation, scientific spaces and instrumentation.

The stabiliser supplier shall demonstrate an acceptable track record in the design and operation of his units on ships of similar type and service. Its design and its positioning shall include noise and vibration suppression measures to minimise interference with the sleep patterns of any personnel occupying cabins in the vicinity.

The tank shall utilise the ship side tanks port and starboard. with an unimpeded cross duct arranged within upper part of the double bottom tank.

Tank shall be fitted with integral air duct complete with pneumatic valves arranged port and starboard.

The system shall be equipped with measuring devices to determine the tank water oscillations and the fluid level and pressure inside the tank

Tank system to use fresh water.

Remote control panel shall be fitted in the wheelhouse.

Tank system shall be capable of being "locked off" during lifting operations.

R5.38 Deck Wetness

Dryness of the aft working decks is a pre-requisite. The 3.5m – 4.5m working freeboard quoted in section 5.1.16 is a compromise derived from experience. The working decks shall be further protected by solid bulwarks and any gates shall be likewise solid.

Sufficient freeing ports shall be provided with suitable means to prevent the accumulation of ice from blocking them.

Wetness of the foredeck area is also shall be minimised by suitable design of the forward end of the vessel.

Deck wetness both forward and aft shall be minimised by incorporating the conclusions of computational seakeeping analysis and model tests into the design at an early design stage.

Statutory rule bow height shall be considered only as a minimum. Actual designed bow height shall most likely be substantially greater. An enclosed mooring deck shall be provided to protect fore deck fittings and provide a personnel refuge. This shall have suitably sized openings for rope handling and for underway viewing of the forward waterline for scientific observations of marine animals.

These openings shall be closable using dogged, externally flush, substantial weather tight doors. Platforms shall be provided in way of these openings to facilitate their safe use. On each side of the vessel one of these openings shall be a vertically orientated

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platform (complete with deployment mechanism and protective guard rails for use during mooring operations or scientific equipment deployment at sea. The science platform shall extend to the maximum beam of the vessel.

R5.39 Ship Motions & Habitability

The Contractor shall demonstrate that the sea keeping of the vessel is such that performance degradation of the crew and scientists shall be kept to a minimum in the range of anticipated working sea states and ship speeds. In this regard the following sea-keeping criteria shall be applied:

- Maximum Vertical Acceleration (RMS) +/- 0.15g
- Maximum Horizontal Acceleration (RMS) +/- 0.05g
- Maximum Roll Angle (RMS) +/- 3.0 deg (Stabilised)
- Maximum Roll Angle (RMS) +/- 5.5 deg (Unstabilised)
- Maximum Pitch Angle (RMS) +/- 2 deg

NOTE;

$$H_{(1/3)} = 2 \times RMS$$

$$H_{(1/10)} = 2.54 \times RMS$$

$$H_{(1/1000)} (H_{max}) = 3.72 \times RMS$$

- Probability of Slamming 0.02
- Probability of Deck Wetness 0.00

The ship shall provide a stable safe platform during scientific operations and a comfortable living space during transit. With this in mind the criteria shall be met under the following conditions:

Scientific Operations

- 0 knots in Sea State 6 (Hs = 6m), all headings
- 8 knots in Sea State 4 (Hs = 2.5m), all headings

R5.40 Transit

Vessel motions shall be within the above limits with the vessel in transit at 13 knots in Sea State 4 (Hs = 2m), headings within ±15 deg of head and astern seas These criteria shall be applied in the wheelhouse, the galley, all scientific working areas, all scientist cabins and on the aft working deck.

5.1.19 Dynamic Positioning DP(AA)

R5.41 The vessel shall be capable of being Dynamically Positioned.

A Dynamic Positioning system including sensors and position reference systems shall be fitted in compliance with the requirements of a LR DP (AA) system.

The DP / PMS/ and Thruster Control System are to be on a common Dual Redundant Process network (LAN)

The system shall utilize advanced DP/PMS interface were thruster set points are sent from DP to PMS.

This increases load stability because the PMS knows what is coming and can better predict load requirements

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Advantages:

- Run with fewer engines online
- Optimal load on each engine
- Lower fuel consumption
- Lower running hrs --> Reduced maintenance cost.

Remote diagnostics shall be provided for all systems.

In addition a joystick control system, which is part of the dynamic positioning system, shall be fitted in the wheelhouse see section 6.1.8.

The DP system shall be used to maintain station in order for the following operations to be safely and effectively supported maintaining position:

- Cargo discharge alongside ice shelf (in relatively clear water).
- During cargo/fuel transfer to the cargo tender or the shore.
- At sea position keeping for science work.
- At sea track following a ROV or similar device (at depths to 6500m) - track follow mode.
- Position keeping for deployment of small boats.
- Over the side (stern or moonpool) operations.
- Seabed coring operations to 6500m.
- Seabed deployment operations to 6500m.
- Re-acquisition of previously visited seabed locations.
- Track-lining for seismic and sonar operations.
- Station-to-station moves by entering a series of way-points.

Seabed operations shall be navigationally positioned relative to the vessel using both ultra-short base line (USBL) and long base line (LBL) systems. These shall be integrated into the dynamic positioning system (along with the DGPS) as required.

The vessel shall NOT be required to support human occupied submersible or diving systems. However it shall possess sufficient levels of redundancy to protect the large capital value items being deployed.

Under DP in the following condition shall be demonstrated by calculation (calculation based on Pierson wave spectrum) with wind wave and current are coincident.:

Condition 1 (All thrusters running)

- Top end of sea state 5, which equates to a SWH of 4m
- Steady Wind Speed 30 gusting 40 knots from any direction.

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- Current equal to 0.5 knots at 90 degrees (i.e. on the beam)

Condition 2 (All thrusters running) in this case the vessels heading may be selected to give best station keeping ability:

- Top end of sea state 5, which equates to a SWH of 4m
- Steady Wind Speed 30 gusting 40 knots
- 2 knots current 45degrees to this

The vessel shall be required to maintain a fixed position or track follow, subject to the deployment.

The DP capability shall be:

- <300m water depth Maximum foot print would be 3m
- >300m would be 5% of water depth, up to a maximum of 20m (this diameter of plot)

A consequence of DP(AA) is provision of single redundancy. The DP capability is therefore identified with any one failure. This shall include the worst case thruster unit.

The DP(AM) capability (case 1 & 2) when all thrusters are available should meet the conditions specified. In addition the capability with the worst case failure should be determined based on failures defined within a FMEA undertaken in accordance with LR Rules for DP(AA).

The DP capability shall be determined in both DP(AA) and DP(AM) modes. The DP performance shall be predicted by an approved simulation method using the results of model tests.

The DP capability is required for both redundant and non-redundant modes. The reference to DP(AM) is not a Classification requirement, however it may be used in operations where redundancy is not important to the integrity of the systems or equipment.

The DP capability (case 1 & 2) shall be met with one main diesel alternator not running, but available. Generator sets running should not be required to run at above 90% MCR. It is not expected that this would be the determining requirement for the installed power generation.

A capability report shall be presented by a specialist independent of the DP equipment supplier or designer. This shall comprise a detailed evaluation and report on the effect of the failure of each part of the DP system and related equipment down to individual equipment item level, calculated and tabulated in accordance with the methods and recommendations of an independent verification authority. This report shall confirm the maximum external force the ship can withstand without losing position. The maximum external force (combination of wind, waves and current loads) shall be presented in a graphical form as a function of incidence angle.

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The required accuracy of the DP system in each operating mode is unlikely to affect equipment power, but may affect operating (fuel) cost. If less accuracy in station keeping is acceptable a greater drive off distance and longer time to recover to the required position may allow smoother and more efficient power delivery. Selective response (accuracy) shall therefore be provided.

The system shall include facilities for automatic heading and adjustable turning point, and can be used in DP and manoeuvring operating modes. The DP system shall be programmed with at least three turning positions, centred on configurable positions.

The DP system shall also be configured for variation in draft. FMEA for the DP and complete integrated system delivery shall be carried to meet the Class requirements as soon as practical following the basic engineering phase.

The DP performance shall be based on the propulsion and thruster capacity calculated to be necessary to meet the open water speed, ice breaking and manoeuvring criteria specified in section 5.1.16.

At least two thrusters shall be provided at the forward end of the vessel and two aft.

At least one of the forward thrusters shall be operable for berthing in shallow water locations and shall not protrude below the maximum operational draft of 7.0m when used for berthing and shallow water manoeuvring.

The vessel shall be capable of being driven only utilising the forward thrusters to provide an alternative means of propulsion which would propulsion without turning the shafts for example when working with nets.

There is no specific minimum speed requirement when the ship is powered only by the forward (or aft) thruster units.

The type of thrusters used shall take into account the requirements with regard to entrained air and bubble sweepdown and its effect on the sonar performance

Dynamic positioning in ice shall not be required, although the thrusters shall need shall be operable in waters with ice to enable mooring.

It is foreseen that the vessel may be in DP mode with some influence from ice. The DP system should therefore be provided with the selection of an ice mode. It is recognised that this may not be fully developed at the time of Contract Award, but it should be foreseen within the timescale of the delivery of the vessel.

5.1.20 DP System Description

R5.42 The system contains two control computers and necessary units which interface to reference systems, sensors, and thrusters. The main control desk shall include two operator stations each with Joystick control. The main features are as follows:

Dual Redundancy

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

System modes and functions

- ❖ **Low power mode**
Model Predictive Control “Green DP Mode”, which operates on model based predicted vessel behaviour caused by actual weather condition, and optimised for station keeping within a user defined operational area with minimum power consumption.

- **Auto Position mode**
- **Follow ROV mode**
- **Barge / Cargo Tender Moored Alongside**
- **Variable Draft Mode**
- **Thruster Run In Mode**
- **Auto-Track low and high speed mode with possibility of importing waypoints directly from ECDIS system**

The joystick high-Speed mode allows the operator to manoeuvre the vessel manually at normal cruising/manoeuvring speeds.

The auto track modes (low-speed, move-up and high-speed) make the vessel follow a specified track described by a set of waypoints. All Auto Track modes are for marine operations only and are not to be used for navigation purposes

- **ICE mode**
Special DP control functions (ICE mode control)
 - ❖ Ice load tracking
 - ❖ Ice load compensation
 - ❖ Detection of ice drift changes
 - ❖ Built-in procedures for heading and position changes
 - ❖ Operator guidance (ICE mode guidance)
- **Capability Analysis.**

R5.43 DP Position Reference System and Sensors

The following position reference systems and sensors shall be provided:

- 2 x Gyro Compass and a 3rd input from Position, Heading & Attitude System(R7.3)
- 3 x Wind Sensor.
- 1 x high accuracy hydro-acoustic positioning systems with hull units and gate valves with hydraulic actuator with interface for a second unit.
- 2 x DGPS that can accept GPS, GLONASS, L1 and L2 signals

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- 2 x Motion Reference Units (MRU5) for Pitch, Roll, Yaw and Heave and a 3rd input from Position, Heading & Attitude System(R7.3)

The DP system shall have available spare inputs for possible future additional reference/input signals.

R5.44 Joystick Control

An independent Joystick control system with automatic heading control including Position Keeping functionality shall be provided. The main components shall be an Operator Terminal, with joystick (3-axis) control and heading wheel for mounting in console and Controller Unit in wall mounted cabinet, with power supply from external UPS.

Three plug-in points shall be provided around the Wheelhouse for use with a portable joystick. The portable joystick terminal shall be connected to the main DP system.

5.1.21 Ice Strengthening & Protection

R5.45 The vessel shall be expected to carry out extended cruising and delivery of logistic supplies to BAS Antarctic Research Stations in extreme Polar conditions in Antarctic (and Arctic Waters) including operation south of 60 degrees South. The hull is required shall be suitably strengthened to withstand anticipated ice loadings. It shall be constructed to the rules and requirements of LR Polar Class PC4 for Year-round operation in thick first-year ice 1m thick which may include old ice inclusions.

The vessel's structure and systems shall be designed to operate at the Polar Service Temperature (PST) (-35deg C) defined in the Polar Code. It is the Contractor's responsibility to confirm this PST using temperature statistics for the areas and seasons of operation described in section 4.

In order to ensure sufficient ductility the steel material grades for plates and stiffeners shall be as per requirements of the Polar Class notation for operating that region of the vessel and plate thickness. High tensile steels in the ice belt region in order to avoid excessive steel weight and production difficulties. Transverse framing including the use of half frames shall be a requirement. Corrosion allowance shall be applied in accordance with the LR rules.

Where heavy ice resistant shell inserts are fitted the outer surface shall be arranged flush with the plating line i.e. the Plates of different thickness shall be arranged with the difference protruding into the moulded hull.

The vessel shall be double skinned in accordance with the requirements of the IMO Polar code in order to ensure that all possible minor damages to the sideshell envisaged by the polar code are survivable.

The vessel shall have deployable underwater appendages and sensors and equipment fitted flush with the bottom shell which shall be vulnerable to damage. The proper protection of these items through for example robust structural design and ice windows or suitable valves shall be a requirement since the equipment shall be expected to operate under these conditions both effectively and without damage.

Special attention shall be paid to seawater injection systems in terms of ice fouling. Port and starboard suction shall be provided and an isolatable sea bay shall be incorporated such that, in severe mush ice conditions, the main seawater circulation system can be re-circulated through the sea bay temporarily using the keel plating as a cooler. A means of clearing ice from all intake boxes shall be required.

Superstructure, masts, mast platforms, etc. shall be designed so as not to promote the accretion of ice, and to withstand the additional loading of ice accretion.