

Statement of Functional Requirements

1 Ship Design

101. Conformance with Statute and practice

The Vessel is to be suitable for classification as Foreign Going. The Contractor is to take into consideration, when designing the Vessel that it will occasionally operate in Antarctic waters and particularly sensitive sea areas including, but not limited to, Marine Parks, Great Barrier Reef, Ningaloo Reef, Marine Protected Areas, Antarctic Waters.

101.1. The Vessel shall be compliant with the requirements of the *Navigation Act (1912) Commonwealth of Australia as amended*, AMSA Marine Orders, International Association of Classification Societies (IACS), requirements under SOLAS and MARPOL. IMO Legislation and Conventions that come into force prior to the laying of the keel shall be taken into account and full compliance is required.

101.2. The Vessel shall be fully compliant with MSC.266 (84) Code of Safety for Special Purpose Ships, 2008 for carrying not more than 60 persons.

102. Classification

The Vessel will be classed with Lloyds Register or Det Norske Veritas. In the case of Lloyds Register, a Statement of Fact shall be provided by DNV or Lloyd's Register certifying compliance with DNV-Silent-R.

Lloyds Register	Det Norske Veritas
+100A1 +LMC UMS Ice 1C IWS EP Research Vessel DP (AM)	1A1 E0 Ice 1C BIS Clean Design SPS DYNPOS-AUT Silent-R ¹

103. Principal Dimensions

- Length Overall: ~85 m
- Beam: ~18.5 m
- Draft: >= 5.5 m (excluding appendages.)

104. Area of Operation

South Pacific, Indian and Southern Oceans

Lat 0° - 70°S

104.1. Conditions

- Operation in water temperatures of -2°C to +32°C;
- Operations in air temperatures of -30°C to +45°C; and
- Sufficient reserve stability to withstand 'freezing spray' conditions for a minimum of 12 hours, as per the IMO Intact Stability Code 2008-2009.

The Vessel shall be capable of efficiently conducting marine science, oceanographic and marine geophysical operations in the Pacific, Indian and Southern Oceans between the latitudes of 0° and 70°S. Without limiting the generality of this requirement the Vessel shall be particularly suited to operation in Australia's Maritime Jurisdiction and the Tasman, Arafura, Timor, Coral and China Seas.

105. Speed

105.1. Optimum Operational Speed 12kts in SS 6 WMO (see Annex 1 to this document)

The Vessel shall be able to run at 12kts in Sea State 6

Criteria:

- fully loaded with drop keel/s fully extended;
- salt water (SG 1.025);
- not to exceed 90% MCR;
- SS 6; and
- the sea-keeping characteristics identified in the Standard of Sea Keeping Performance attached.

105.2. Service speed 15kts in SS 2

The Vessel shall be able to run at 15kts in Sea State 2 to meet the requirements of the 'Concept of Operations'.

Criteria:

- Fully loaded;
- Salt water (SG 1.025);
- not to exceed 90% MCR; and
- SS ≤2.

105.3. Speed Control

- ±0.1 knot in the 0-5.9 knot range; and

- ± 0.2 knot in the 6-12 knot range.

Criteria:

- fully loaded;
- salt water (SG 1.025);
- not to exceed 90% MCR; and
- $SS \leq 4$.

An operating profile that includes 'on station' and / or slow speed manoeuvres for extended periods of time should be accommodated. The design impact on engines, water making capability, auxiliary machinery and services and other factors of this operating profile of this nature shall be taken into account.

106. **Range**

106.1. The range of the Vessel shall not be less than 10,800 nautical miles.

Criteria:

- Range calculation based on measured consumption at 12 knots under test conditions;
- 75% HVAC load;
- 10% fuel reserve; and
- Average SS4.

The achievable steaming range shall provide the ability to reach the extreme extent of Australia's maritime jurisdiction and to remain on station for no less than 30 days.

Propulsion fuel shall not be used as a primary form of ballast. The Vessel shall have sufficient ballast tanks to offset fuel consumed.

107. **Hotel Endurance**

60 days with a full complement (60) of crew and science personnel onboard.

108. **Dynamic Positioning**

108.1. Dynamic Positioning DPS 1 (IMO Class 1)

The Vessel shall include one or more retractable azimuth or similar bow thruster(s) capable of delivering adequate thrust when the Vessel is moving ahead/astern or holding station in head/tail current and sea (where tunnel thrusters may not be efficient).

Criteria:

- Auto selection of best available position;

- Multiple navigation inputs;
- Relative and absolute references;
- System design and operation minimizes noise, vibration, and adverse effects on the operation of acoustic systems; and
- System support for deep sea ROV operations.

109. **Heading Accuracy**

The Vessel shall be able to maintain a designated heading to an accuracy of (this may be confirmed by computer modelling):

109.1. Heading Accuracy $\pm 5^\circ$

Criteria:

- Sea states < 6;
- From 3-8 knot;
- While towing equipment; and
- Regardless of the direction of the wind and current.

109.2. Heading Accuracy $\pm 5^\circ$

Criteria:

- Sea state 7;
- From a minimum safe speed to 6 knots; and
- On the best available heading relative to wind and sea/swell direction.

109.3. Heading Accuracy $\pm 10^\circ$

Criteria:

- Sea state 8;
- From a minimum safe speed to 5 knots; and
- On the best available heading relative to wind and sea/swell direction.

109.4. Heading Accuracy $\pm 15^\circ$

Criteria:

- Sea state > 8;
- From a minimum safe speed to 4 knots; and
- On the best available heading relative to wind and sea/swell direction.

110. **Thrust and manoeuvring control**

Small adjustments to total thrust vectors shall be possible at all times.

110.1. Heading alteration 180 degree

Criteria:

- \leq SS 4;
- < 120 seconds; and
- Within a circle of two ship-lengths diameter.

110.2. Heading alteration 180 degree

Criteria:

- $>SS\ 4$ and $<SS\ 6$; and
- Within a circle of two ship-lengths diameter.

110.3. Tactical Diameter < 3 ships lengths

Criteria:

- 12 knots;
- calm conditions (no wind or current); and
- either direction.

111. Station Keeping and Track Following

111.1. Station Keeping $SS < 4$

Maintain a position and heading relative to a geo-referenced location 100% of the time.

Criteria:

- Any relative wind;
- Maximum excursion < 2 m; and
- Adverse current ≤ 1.5 kt

111.2. Station Keeping $SS = 4$

Maintain a position and heading relative to a geo-referenced location 100% of the time.

Criteria:

- Any relative wind;
- Maximum excursion < 5 m; and

- Adverse current of ≤ 1.5 kt

111.3. Station Keeping SS=5

Maintain a position and heading relative to a geo-referenced location 100% of the time.

Criteria:

- Best heading;
- Maximum excursion < 10 m; and
- Adverse current of ≤ 1.5 kt

111.4. Station Keeping SS=6

Maintain a position and heading relative to a geo-referenced location 100% of the time.

Criteria:

- Best heading;
- Maximum excursion < 20 m; and
- Adverse current of ≤ 1.5 kt

111.5. Unencumbered by Towed Equipment SS = <4

When unencumbered by towed equipment the Vessel's centre of motion shall maintain a straight line track without large and/or frequent heading changes.

Criteria:

- $< SS 4$;
- At any heading relative to prevailing wind and swell;
- Adverse current to 1.5 kt ; and
- Perpendicular excursions from desired track < 2 m.

111.6. Unencumbered by Towed Equipment SS = 5

When unencumbered by towed equipment the Vessel's centre of motion shall maintain a straight line track without large and/or frequent heading changes.

Criteria:

- SS 5;
- At any heading relative to prevailing wind and swell;
- Adverse current to 1.5 kt ; and

- Perpendicular excursions from desired track < 10 m.

111.7. Unencumbered by Towed Equipment SS = 6

When unencumbered by towed equipment the Vessel's centre of motion shall maintain a straight line track without large and/or frequent heading changes.

Criteria:

- SS 6;
- At any heading relative to prevailing wind and swell;
- Adverse current to 1.5 kt ; and
- Perpendicular excursions from desired track < 20 m.

111.8. While Towing

While towing the Vessel's centre of motion shall maintain a straight line track without large and/or frequent heading changes.

Criteria:

- < SS 6;
- At a steady speed of 5 knots;
- At any heading relative to prevailing wind and swell;
- Perpendicular excursions from desired track < 15 m;
- While towing:
 - a 25m x 42m x 400m trawl between the surface and 500m; or
 - a demersal trawl such as a McKenna Orange Roughy trawl to >= 4000m.

112. Sea-keeping

Attention to achieving the most sea-kindly design is essential. Vessel shall be a stable and comfortable research platform from which a wide variety of scientific equipment can be operated reliably. The design shall maximize the sea-kindliness of the Vessel and its ability to support scientific operations in sea states six and higher within the constraints of overall size.

Criteria;

- In accordance with the Standard of Sea Keeping Performance at Annex 1.

112.1. Primary activities as identified in the Concept of Operations in conditions up to SS 6

112.2. Secondary activities as defined in the Concept of Operations in conditions up to SS 7

In both the above operations the following shall be used:

- Roll and pitch dampening; and
- Bilge keels, anti-roll tanks or other methods to reduce the motions of the Vessel may be used to enhance sea-keeping.

113. Vessel noise, acoustic signature and DnV Silent-R compliance

113.1. Full DNV Silent-R compliance

The design shall clearly demonstrate the methods to be used to achieve full compliance with DNV Silent-R. The impact of strategies including but not limited to vibration damped diesel-electric drives through acoustically optimised, fixed blade propeller(s) and anti-vibration mounted main and auxiliary machinery and the extent of their implementation. Compliance is to be attained at 11 kt free-running with one drop keel fully deployed. It is not intended that the Vessel will need to comply with thrusters in operation.

A Statement of Fact shall be provided by DNV or Lloyd's Register certifying compliance with DNV-Silent-R.

114. Layout and General Arrangement

The design should conform to the configuration and general layout of a research vessel of this size and function in accordance with international best-practice for shipbuilding.

- Layout and location of scientific facilities to be based on provided scientific sample and people flow chart;
- Main scientific laboratories and workshops shall be arranged on not more than two deck levels with due consideration to ship movements;
- Hatch to engine room/engine store covered by ship's crane;
- Aft Deck control room with good visibility over the aft deck and the side working area, with remote operation of scientific winches and cranes;
- Main stairways shall be arranged in fore/aft direction;
- The Watertight Subdivision and Tank arrangement to facilitate damage stability GM requirements close to the intact stability requirements;
- Minimum clear ceiling heights: 2.10m in accommodation / 2.3m in laboratories, to allow for exposed cable trays etc. under the ceiling; and
- Two controlled roll damping tanks of different size preferred, with static heel capacity > 7°.

115. Hull Structure

115.1 Design Principles

- Hull strengthened to maximum loaded speed;
- Longitudinal strength based on not imposing significant load restrictions on operation; and
- Good structural continuity and transitions.

115.2. Shell plating and bottom structure

- Bottom structure forward to be specially strengthened for slamming and for dry-docking loads in areas fore and aft of the gondola and thrusters;
- Outer and inner bottom plating in way of main engine room and propulsion motor room to have thickness in excess of class requirement; and
- Double bottom height => 1800mm in way of main engine room, to facilitate minimum noise/vibration radiation.

115.3. Strength deck(s)

- Upper continuous strength deck to have longitudinal framing for maximum longitudinal strength and hull stiffness.

115.4. Bilge keels

- To be hollow plate construction with rounded edge and ends to minimize vortex shedding. About 25% of Vessel's length and location based on streamline tests

115.5. Welding

- All welding will be continuous, except in the superstructure, where intermittent welding may be permitted as per the Class rules. In any case, continuous welding will be carried out in wet spaces such as toilets, galley, laundry etc.

115.6. Source of Origin and Quality of Steel

- Contractor is to specify the country of origin and the grade and quality of the steel, to be used in the construction of the Vessel structure, prior to fabrication.

116. Underwater Coatings/Anti-Fouling

The minimum coating standard shall be in accordance with the requirements of the IMO PSPC, Resolution MSC. 215(82). The Contractor shall quote for both of the options below.

116.1 Underwater Hull Protection – 'Tin Free' Coatings

The underwater surfaces are to be prepared and coated using MARPOL compliant tin free coatings for a period of 60 month in water service.

117. Discharges

117.1. Overboard Discharges

There shall be no overboard discharges on the starboard side of the Vessel. Discharges from sinks, drains, sewage treatment systems, cooling systems, ballast pumps, fire fighting pumps, and other shipboard or science systems shall be on the side of the ship opposite to the Side Science Operations area.

117.2. Holding Tanks

Tanks capable of holding normal internal discharges for a minimum of 24 hours shall be provided. This requirement may be relaxed under conditions of torrential rain or heavy seas that could quickly fill these tanks. A design providing for zero discharges, including those from scuppers, on the side of the ship adjacent to the Side Science Operations area, when required for short periods during normal science operations shall be provided.

117.3. Discharges from engine exhausts

Discharges from engine exhausts, tank and sewage system vents, exhaust from fume cupboards, and ventilation systems shall be designed so they do not re-enter the ship's interior or ventilation systems, and so they can all be directed away from the ship with proper placement of the relative wind.

118. Anchors and Cables

118.1. Anchors, Cables and Chain Lockers

The Vessel shall have self-stowing chain locker(s). There shall be a minimum of 10 shackles of chain for each anchor. It is not envisaged that the Vessel will frequently anchor and no increase in size of anchor equipment above the Class equipment numeral shall be needed.

118.2. Forward Mooring Area

Anchor handling and forward mooring areas shall be enclosed.

119. Anchor Windlass

119.1. Windlass Design

The anchor windlass shall provide a chain lifter, mooring line drum and warp end on each side of the ship's centreline. It shall be possible to de-clutch each capstan independently from the windlass motor. It shall be possible to de-clutch each anchor gypsy independently from the windlass.

120. Mooring Arrangements

120.1. Mooring Winches

All mooring winch brakes shall, in the event of motive power failure, fail safe. Mooring winch drums shall be capable of storing the maximum amount of mooring line reasonably required and no less than 220 m.

Mooring station design shall provide fair leads for mooring lines to windlass/wire winch drum ends.

120.2. Aft mooring station

The Vessel shall have 2 capstans aft that provide for maximum free deck space and minimal interference with aft deck scientific operations.

120.3. Windlass and Winch Control Stations

Windlass and winch control stations shall be positioned so as to be protectively located in the event of cable or line failure and so as to have an unobstructed view of mooring lines and anchor wires/cables.

121. Bridge Environment

The bridge shall allow scientists and ship's officers the ability to consult and work collaboratively without interfering with ship's operations.

The Vessel shall maintain visibility through bridge windows under the most adverse conditions anticipated.

121.1 Direct Control of Main Propulsion

Direct control of the main propulsion and manoeuvring systems in an integrated system shall be immediately available at all bridge control stations.

121.2 The design makes provision for:

- There shall be provisions to prevent glare, such as by the use of blinds, and to prevent the backscatter of light from bridge onto the windows;
- There shall be provision for the prevention of condensation, 'fogging' or icing-up of bridge windows and a wash-down and wiper system;
- The bridge, including the bridge wings, shall be enclosed and stairs shall provide both interior and exterior access. Exterior access shall be on both sides; vertical ladders are not the preferred means of access; and
- There shall be a means of blocking light from entering the bridge at the interior access.

122. Bridge Consoles

On the Vessel's bridge, there shall be a central forward control station, port and starboard control stations and an aft control station.

122.1 Consoles, console positioning and visibility

Control stations shall be positioned to maximise the visibility of deck work areas and the ship's side during science operations and especially during deployment and retrieval of equipment.

Control consoles shall have a direct view of working decks to the maximum extent possible. Any area not directly visible from the bridge shall be monitored and displayed at control stations via the Workspace Monitoring system identified in paragraph 305.

- Bridge watch-keepers shall have 360° visibility by moving about the Vessel's bridge;
- **Central forward console**
An operator at this console shall have visibility from straight ahead to 22½°s abaft the beam on either side of the Vessel, with minimum movement

needed to look around obstructions, such as uprights for windows, enclosures and doorways;

- **Port and starboard control stations**

An operator at these consoles shall be provided with an unobstructed visible arc bounded by a sight-line aft across the longitudinal centreline of the Vessel aft to a sight-line forward across the Vessel's bow. The operator shall have full visibility of launch and recovery operations of gear and for monitoring wire angle during operations over the Vessel's side and for bringing the Vessel alongside;

- **Aft control station/DP Operations Station**

An operator at this control station shall have good visibility of all working deck areas. The aft station should be offset to starboard of centre for maximum view of the trawl deck and side scientific area;

- **Portable hand-held control units / alternate control stations**

Portable control units and or alternate control stations shall be provided where required to enhance visibility and communications with working decks during over the side equipment handling; and

- **Integrated bridge management**

An integrated bridge management and collision avoidance system shall be provided to support safe and efficient science operations. Autopilot and DP systems shall be integrated to the extent appropriate in accordance with accepted industry standards and provide control settings that deliver the standards of manoeuvring, control, station keeping and track following identified in this document. These systems shall also be designed to enhance manual control of the Vessel whenever needed.

123. **Monkey Island**

123.1. **Observation Station**

There shall be an enclosed area on the monkey island suitable for long periods of fixed lookout and recording during observations of marine mammals and seabirds.

Criteria:

- This Observation Station shall be clear of dangers such as radar scanners, satellite communications transceivers and other antennae;
- It shall provide comfort and safety for manning from dawn to dusk in SS ≤ 4;
- It shall have LAN connectivity (4 x RJ45 style outlets);
- It shall have a supply of UPS power (2 x 10A GPO);
- It shall provide an unobstructed view through a horizontal arc of 270° and a vertical arc of 135°; and
- Allow for meteorological Instrument mounting.

123.2 **Meteorological Instrument Mounting**

There shall be space to install, and service the meteorological instruments including radiometers (detailed below), aerosol samplers, and stabilised platform for Doppler Weather Radar. Separate platforms are needed for other scientific radars, lidar, and radiometers. All instruments and mounts shall be Owner Supplied with shipyard to install. Space on the port and starboard sides of the monkey island shall be made available for the following permanently mounted meteorological instruments:

- Eppley Precision Spectral Pyranometer (PSP), 2 of on 600mm diameter aluminium plate; and
- Eppley Precision Infrared Radiometer (PIR), 2 of on 600mm diameter aluminium plate.

124. **Masts**

Safe access to instrument locations up to SS 6 on the foremast, mainmast, and aerosol sampling mast. Both fore and main masts shall allow the maintenance of permanently fitted instruments and the fitting and removal of temporary instruments.

124.1. Masts shall have permanently installed redundant cabling

There shall be redundant cable trays, ducts, glands and junction boxes to facilitate the protected installation of temporary cabling and sampling lines. Redundant instrument, cable and sample tube mounting brackets & platforms.

124.2. Doppler Weather (polarmetric) Radar and X-band wave radar

A mounting location for a Doppler Weather (polarmetric) radar with an antenna diameter of 4 m at or close to the top of the main mast. In addition, space for an X-band wave radar should be available on the Monkey Island or Main Mast. The radars shall be Owner supplied with shipyard to install.

- Doppler weather radar requires access to ships attitude and direction measurement system (301.1).

124.3. Foremast

- Fitted to mount at least the following high quality meteorological sensors on crosstrees at heights of 18-20 m above waterline and forward of the foremast:
- Optical Scientific Inc Model ORG-815DR optical precipitation sensor
- RM Young type 50202 siphoning rain gauge
- Gill Instruments Model WindObserver II ultrasonic anemometer
- Vaisala HMT330 Temperature and Humidity sensor with Vaisala Type DTR502 radiation shield
- Provision of UPS power (2 x 10A GPO) and LAN outlets (4 x RJ45 style outlets);
- accommodate air sampling equipment so that the inlets of samplers have a minimum clear sky angle of 120 degrees;

- accommodate climate optical measurement equipment so that the instrument has an unobstructed view of the sky within 10 degrees of the horizontal (some obstructions from masts and guy ropes can be tolerated);
- accommodate climate optical measurement equipment on stabilised platform, with tracking stability better than 0.2 degree; and
- Stairway to mooring deck inside the mast base.

124.4. Aerosol Sampling Mast

An aerosol sampling mast approximately 10m high should be provided integrated with, the foremast with straight leads into the Aerosol laboratory situated in the forward end of the main superstructure.

- Accommodate air sampling equipment so that the inlets of samplers have a minimum clear sky angle of 120 degrees;
- Safe access is to be provided for cleaning of the inlets and sampling tube; and
- Sampling tube shall be stainless steel approximately 150mm internal diameter.

124.5. Main Mast

Provision shall be made at the top of the mainmast for the mounting of the following instruments:

- RM Young type 05106 wind monitor (2 of, located on a yardarm port and starboard sides);
- Vaisala HMT330 Temperature and Humidity sensors with Vaisala Type DTR502 radiation shield (2 of, co-located with wind monitors in the previous dot point); and
- Two Licor type 192-SA PAR sensors.

125. Working decks

125.1. Strength

The design shall state the range of compression and tension loads that working decks and trawl ramp cover must be able to carry a uniform distributed load of 5t/m².

There shall be hard points, in a suitable pattern, for fitting heavy modular scientific equipment and winches.

125.2. Design

Working deck shall incorporate design features that:

- Protect equipment and systems against hard contact with decks;
- Protect samples from contamination by contact with decks; and
- Provide shelter from the elements for persons conducting scientific operations in adverse environments.

126. **Foredeck**

126.1. Foredeck arrangement:

There shall be a helicopter winch area, suitably marked as "H - winch only".

There shall be flush deck mountings for 2 TEU's in a fore and aft configuration on the foredeck to conduct science operations. There shall be reasonable safe access to these containers from the superstructure. These laboratories would have the standard service suite of connections.

There shall be mountings located at or close to the bow for two booms capable of suspending an equipment package of up to 250 kg at 10-12m length. These booms shall extend forward at angles of between 30° and 60° from the centreline. The booms would only be deployed in sea states <2 and at Vessel speeds <3 knots.

There shall be an Aerosol laboratory (approx. 15m²) to be provided at the base of the foremast, either on the foredeck or on the mooring deck with safe access provided. The aerosol laboratory will be used primarily for sampling of aerosols underway and will be outfitted as in 426. There should be a straight run of sampling tubes from top of the foremast (<10m) to this laboratory.

126.2. Air Chemistry Laboratory

There will be a laboratory with a footprint of about 30 m² to be in the forward end of the superstructure preferably on either the foredeck or on the mooring deck level (refer 427). The Air Chemistry laboratory will be used primarily for atmospheric chemistry sampling underway and will be outfitted as in 427 and will be connected to the aerosol sampling tube after it passes through the Aerosol Lab. Sampling tube will be stainless steel approximately 150mm internal diameter

127. **Intermediate Decks**

127.1. Clear deck area

There shall be sufficient clear deck area for the installation of incubation tanks or the ancillary scientific equipment on decks at or below the level of the bridge (wheelhouse) deck and above the main scientific working deck.

Criteria:

- exposed to a maximum amount of sunlight at all Vessel headings;
- clear of funnel exhaust;
- an adjacent supply of raw seawater and clean seawater;
- overside drains sufficient to efficiently carry away seawater used to maintain incubators at ambient temperature; and
- Fitted to accept and secure one (1) of ISO TEU.

128. **Main Deck**

128.1 Arrangement of working spaces and services.

The main working deck(s) shall provide the following Scientific Operations Areas:

- A Trawl Deck;
- A Sheltered Scientific Area; and
- A Ship Side Scientific Operations Area.

129. **Trawl Deck**

129.1 Main deck aft – Trawl Deck

That portion along the centre of the main deck where nets may be handled extending from the aft side of the superstructure to the stern. A trawl deck, comprising a portion along the centre of the main deck where trawl nets, etc, may be handled shall extend from the aft end of the superstructure to the stern (length ~ 20m).

Criteria:

- Configurable to handle a variety of surface, demersal and mid-water trawls;
- Designed to accommodate appropriate winches/wires, and a net drum large enough to store an IYGPT, McKinnon Orange Roughy or similar trawl;
- Arrangements to accommodate the temporary fitting of knee-walls along both sides of the trawl deck to separate it from the rest of the main deck for safety reasons should be provided; and
- Winches may be located on the main deck or below deck or on the deck above.
- Removable bulwarks at stern ramp to be provided

129.2 Trawl Ramp

A stern ramp approximately 4 metres wide with an angle of 30° to 45° shall be provided. A flush working deck over the stern ramp shall be provided by fitting an in-fill, inset or cassette to fill the stern ramp making the aft deck flush. The strength of this in-fill is to be equivalent to that of the main deck. A primary stowage and alternate stowage location onboard the Vessel shall be nominated for this infill/cassette when it is not in use.

130. **Materials handling**

The storage areas must be accessible at all stages of a voyage.

130.1. Materials handling systems

Materials handling systems to facilitate the safe inter and intra-deck handling and transfer of heavy, bulky and or fragile equipment or samples shall be provided

External openings shall facilitate the safe handling and transfer of heavy, bulky and or fragile equipment or samples to or from working areas during a voyage

Alleyways, hatches and doorways connecting laboratory spaces with each other, with storage spaces and with working decks shall facilitate the safe handling and transfer of heavy, bulky and or fragile equipment or samples.

Lifting equipment is available at all stages of a voyage to handle and position heavy items on working decks. Door widths in passageways in science areas are to be maximised consistent with clear widths of adjacent alleyways.

System designs shall ergonomically:

- accommodate and facilitate scientific activities at each workstation;
- facilitate the efficient transfer of stores, samples and equipment between and within workstations on deck, in laboratories, to and from storage and between the shore and the ship; and
- flexibly support operations at each workstation.

131. Stowing and securing equipment

131.1. Stowing Containers aft deck

It shall be possible to stow and appropriately secure 6 or more ISO TEU's on Main/Upper aft deck. 'Double stacking' of containers in these areas may be considered. The standard of access to '2 high' containers shall be of the same standard as those stowed 'on deck'.

Criteria:

- with the ability to access two/four containers directly from the superstructure;
- all containers secured in a longitudinal direction;
- double stacking with proper fixation acceptable;
- with the maximum number of containers stowed and secured it shall be possible to;
 - safely access the containers in all weather conditions; and
 - safely transfer stores and samples to and from the containers in all but the most severe conditions;
 - connect each container to electricity, fresh water and clean sea water, shipboard LAN, shipboard liquid waste handling system, shipboard communications system;
 - without blocking access to hatches in the deck; and
 - continue to safely and effectively undertake a full range of science operations on the after deck.

131.2. An efficient system for securing equipment

There shall be an efficient system for securing equipment to all working decks that is no less effective than a closely spaced grid of threaded sockets with screw blinding plugs and eye bolts. The preferred option is for a 1.2m x 1.2m grid of threaded sockets with screw blinding plugs and eye bolts. An additional finer grid of 0.6m x 0.6m may be required over a significant part of the rear deck for securing user specific equipment. The exact layout cannot be ascertained until detailed deck plans are available.

Criteria:

- Equipment can be efficiently secured and unsecured;
- The integrity of the deck and its protective coatings is maintained;
- Secure footing on open decks is not compromised by the proposed securing system; and
- Trip hazards are not created by the proposed system.

131.3 The design shall describe

- The method used to determine appropriate deck loads; and
- The capability of decks and fittings to withstand clearly articulated ranges of compression and tension loads.

132. Fast Rescue Craft and Workboat

132.1 Fast Rescue Craft

- Fast Rescue Craft (FRC) of ~7.5 m;
- Fitted with diesel engines;
- Launch and recovery in SS ≤ 6 ; and
- SAR locker located with ease of access to FRC launching area.

132.2 Workboat

- Workboat of > 6 m fitted for general purpose scientific use; and
- Fitted with diesel engines.

133. Science Office

133.1 An office dedicated to the management of science activities

- Area > 15 m²; and
- Located within the accommodation below the bridge.

Outfit:

- Usual range of office equipment and services;
- 6m x 0.75m work desks, cabinets under, shelves above;
- 3 work places, 3 chairs; and
- 2 filing cabinets

134. Conference Facility

134.1 Conference Facility

- The mess and the adjacent lounge shall be capable of being opened into a conference facility with a combined area large enough to seat 60 people.

Outfit:

- Full range of audio/visual presentation & video conferencing equipment in the lounge area that can be viewed from the mess room with the folding wall open.

135. **Storage Areas – General**

135.1. Storage areas shall

- be well ventilated;
- facilitate safe access at all stages of a voyage and to facilitate mobilization and demobilization of the Vessel;
- contain appropriate shelving, racking, storage cabinets and lockers and associated securing arrangements; and
- be fitted and equipped in accordance with ergonomic and safe goods and materials handling principles.

136. **Hold Stowage**

136.1. Stowage for a minimum of 4 ISO TEUs of up to 2.9 m in height

The Hold stowage shall be well ventilated and include 2 reversible ventilation/extraction fans for four air-conditioned containers. The ventilation system to include Tropical/Antarctic operation modes.

The hold stowage shall be well insulated and the insulation protected with sheeting.

The hold arrangement must provide minimum 1.2m clear passage to the containers when the container doors are 90⁰ open, as well as access for securing, taking into account ships piping and other obstructions.

Provision for fitting removable stowage pens in parts of the hold not taken up by containers to be provided.

In-hold container positioning & securing equipment.

When units are stowed and secured it shall be possible to:

- safely and easily accessed containers at all stages of a voyage;
- efficiently transfer stores and samples to and from containers;
- connect the containers to;
- electricity (415 & 240 V);
- fresh water and clean sea water;
- shipboard LAN;

- shipboard liquid waste handling system; and
- shipboard communications system.

137. **Noise Accommodation and Open Decks**

137.1 Noise levels

On all open deck areas, in working spaces and accommodation spaces shall not exceed those identified in **AS/NZ 1269 and AS2254** (see table) as having the potential to contribute to long term hearing loss.

Table 1

Accommodation Areas	dB(A)
Cabins	60
Public Rooms	65
Hospital	55
Toilet Showers and Change Rooms	75
Laundaries	85
Deck Space	85
Working Areas	dB(A)
Work Shop	85
Control Rooms	75
Wheelhouse	65
Radio Room	60
Galley and Pantry	75
Machine Space	dB(A)
Continuously Manned	90
Unattended	110

138. **Accommodation General**

The accommodation layout shall accommodate a maximum of sixty (60) people. The crew of approximately twenty (20) shall be housed in single cabins and approximately forty (40) science personnel in accommodation configured as some combination of single and double berth cabins, with a minimum of 5 single berth science cabins (inclusive of Chief Scientist and Voyage Manager cabins).

- All accommodation shall meet AMSA standards and applicable regulations;
- All cabin accommodation shall as far as possible be provided with natural light;
- All crew cabins shall have natural light;
- All cabin accommodation, recreation, mess and galley spaces shall be situated, to the extent practicable, so as to minimize ship motions;
- To the extent possible, watchkeepers' cabins shall be located away from high traffic areas and offices;
- To the extent practicable cabin accommodation shall be separated from public and recreation spaces; and
- All cabin, recreation, public and working spaces shall be connected to a ship's telephone and public address system. (Need not include refrigerated spaces however these shall be fitted with refrigerated space alarms).

138.1 Cabins

- The Master, Chief Engineer, Chief Scientist, First Engineer, First Mate and Voyage Manager cabins be similarly arranged and provided with a day room/office in addition to a bedroom;
- All crew and science cabins, whether single or double berth, shall be provided with en-suite washroom facilities incorporating, toilet, shower, hand-basin and toiletries cabinet; and
- All cabins and lounges fitted with connections to ship's dedicated am/fm radio antenna, Ethernet port and television system using RG6 or better Low Smoke Zero Halogen (LSZH) coaxial cable.

138.2 Common Facilities

- The Vessel shall also be fitted with common toilets and sinks with ease of access from the working decks, all labs, mess/galley area and wheelhouse and one common W/C in the exercise room/sauna; and
- There shall be a change room dedicated to science party use located adjacent to the main working deck access. There shall be a change room close to the engine room access for the use of officers and crew.

138.3 Dining and Recreational areas.

- All cabins and lounges fitted with connections to ship's dedicated am/fm radio antenna and television system;
- The Vessel shall be equipped with a common dining area with cafeteria style service and seating for minimum of 30 at one sitting; and
- To the extent practicable the preferred locations identified in Table 2 in the accompanying document shall be observed.

Table 2

	Preferred Location
Freezer (galley; food only)	Near galley
Chiller (galley; food only)	Near galley
Ship's Mess with adjacent lounge	Near galley
General Stores	Main deck / Lower deck
Central Stores	Lower deck
Boatswain's Workshop & store	Focs'le - May be with Net Loft
Scientific Stores	Below working deck
Parts Stores	Near engine space
Immersion suit locker (x 2)	Adjacent to survival craft
Ship's Paint Locker	Upper deck
Science HAZMAT locker	Upper deck
FF Gear Locker	Upper deck
Garbage Handling Room	Lower deck, aft
Emergency Gen Room	Upper deck
Battery Room	Bridge deck

With reference to the above table; where dry stores are located separately from the mess/galley appropriate materials handling arrangements shall be made that minimise requirements for manual handling.

139. **Heating, Ventilation and Air-conditioning (HVAC)**

139.1. HVAC locations

- HVAC in all internal spaces other than machinery rooms and container hold storage.

139.2. Separation of accommodation and Laboratory HVAC systems

Criteria:

- Accommodation: $22^{\circ}\text{C} \pm 2^{\circ}\text{C}$;
- Laboratories: $22^{\circ}\text{C} \pm 1^{\circ}\text{C}$; and
- Relative Humidity: 50%.

HVAC design shall recognise and accommodate the differential heat loads generated in different working spaces. The navigating bridge, computer

machine room, acoustic transceiver room, the operations room, engine control room and spaces similarly fitted with significant amounts of electronic equipment that generate significantly larger heat loads than general accommodation spaces. These spaces shall, in order to avoid damage to sensitive electronic components, be maintained at temperatures appropriate to the optimum operation of that equipment.

140. Public and Administration Spaces

140.1. Lounges

The Vessel shall be equipped with at least three lounges. Seating shall be capable of accommodating no fewer than 15 individuals in each of two lounges. One lounge with a capacity for 30 people shall be adjacent to the mess so they can be combined to provide a conference facility.

The lounges shall preferably be on one deck and common for all onboard.

140.2. Accommodation and Work Areas

The accommodation and work areas, in addition to other spaces noted elsewhere in this document, and other spaces dictated by legislation and practice, shall include:

- A cafeteria style mess and galley;
- Exercise room with sauna and associated W/C;
- Ship's office;
- Engineering office (may be co-located with the ships office but if so shall provide discrete work stations); and
- Separate or combined laundry facilities for marine crew and science party.

Criteria:

- Marine crew laundry facilities shall include equipment capable of cost and time effectively laundering ship's linen; and
- Laundry facilities shall include washing machines dedicated to the laundering of 'dirty' work clothing.

140.3. Hospital

The Vessel's hospital shall be designed to take 2 berths and to accommodate the requirements of remote and extended voyages. The hospital wash space shall incorporate a bath and WC.

141. Access

141.1 Accommodation Ladders

The Vessel shall be equipped with accommodation ladders on each side of the Vessel. Boarding facilities, inclusive of accommodation ladders shall, to the extent practicable, accommodate wharves of varying height relative to the Vessel's boarding deck and ports with high tidal ranges. It is expected that the working deck aft shall not be suitable for access ladders.

141.2 Shore Connections shall be centrally located

All connections shall meet international standards:

- Electricity – 415v 3ph 50hz with sufficient power for 75% HVAC and normal in port hotel and mooring winch load power load. The unit to have indication of phase rotation and phase reversal capability;
- Fresh Water;
- Waste liquid such as dirty oil, bilges and sewage;
- Telephone/Facsimile lines (4 maximum);
- LAN hook up (2 x RJ45 style outlets);
- Fuel; and
- International shore connections (for fire main).

2. Ship Systems

201. Redundancy and Reliability

201.1. High degree of reliability

Due to the nature of its work and remoteness of the areas in which it shall be required to work, the Vessel and its systems shall have a high degree of reliability.

Machinery shall be from a proven manufacturer with good technical and spare parts support in Australia.

201.2. Main propulsion Generator Sets

The design shall deliver redundancy for mission critical systems

Generator sets shall be slow running, $\leq 1000\text{rpm}$, with in-line configuration and with as few cylinders as possible.

The make type and capacity of the main generators shall be sized to allow for optimum performance for the **Concept of Operations**. The arrangement may include using the same model of engine while varying the type of engine used. Performance over the range of operations shall be based on no more than 90% MCR on the running engines.

At all stages one main generator shall need to be on stand-by, except when ship is running at speed in heavy weather or at high transit speed.

202. Ship Equipment

All major items of machinery shall be fitted with 'hour meters' to assist in a time based planned maintenance system. Minimum requirement for running hour meters is the main generator sets, purifiers, main and auxiliary compressors, thruster units and electric driven pumps for the main and auxiliary units including the ballast pumps.

202.1 Thrusters

Thrusters should not impact on DnV Silent-R compliance or create bubble sweepdown (thrusters will not be operational during acoustic survey work).

202.2 Pumps

As far as possible all pumps shall be fitted with mechanical seals. All pumps shall be fitted with suction and discharge gauges.

203. Electrical Supply

203.1. A clean and stable supply of AC electricity shall be provided.

Criteria:

Supply shall conform to Australian Standards for domestic and industrial 415v/240v 50 cycle supply. Fully comply with Marine Orders Part 12. The

requirements include the use of double pole switches for the 240v power outlet systems. All power outlets are to be Australian standard and design. All 240v outlets shall be at least double outlets points. All wet space and external outlets are to be watertight connections.

- AC to be pure sine wave & frequency stabilized. Supply to heavy machinery need not be pure sine wave unless the machinery manufacturer's requirement contains a specific requirement to that effect;
- Deck supplies to have galvanic isolation from ship's mains;
- Earth leakage system provided that can be detuned for capacitive leakage from long cables in the water;
- Power supply arrangements engineered to minimize electromagnetic interference with electronic equipment onboard; and
- Power factor is to be maintained above 0.8 pf.

203.2. Uninterruptible Power Supply (UPS)

Operations Room, laboratories, workshop(s), hospital, bridge & IT harness 240V power to be supplied via UPS.

Criteria:

- UPS supply is through a cascading preferential trip system;
- UPS for science spaces to be 30kVA minimum;
- UPS (separate to science UPS) for DP and Vessel navigational and control systems to be sized as required by equipment manufacturer(s);
- UPS system capable of delivering a minimum of 200% of actual system load at time of final acceptance for a period of 2 hours;
- multiple UPS sub-systems are acceptable;
- UPS outlets for science spaces shall be single phase 10A or 15A Australian Standard GPOs and shall be red in colour; and
- There shall be no 3 phase UPS outlets.

203.3. Power Outlets – Minimum deck requirements

The minimum number of power outlets shall be:

- Each container location to be provided with an individual supply of 240 V 15A and an individual supply of 3 ph 415 V, 32 A;
- Deck workshop provided with 1 x3 ph, 32 A, 415 V 2 x 240v 15A supply;
- After Deck supply – 3 by 3 ph 415 V at 64 A. One 3 ph 415 V outlet to be fully isolated through a transformer for the connection of 3 ph underwater equipment. 2 x 240 V at 10A, 2 x 240v 15A, available from adjacent distribution boards;

- Ship Side Scientific operations area supply - 3 ph 415 V at 64 A and 200 A. (200A requirement may be met by supply of suitable circuit breaker in suitable enclosure). 2 x 240 V at 10A, 2 x 240v 15A, available from adjacent distribution boards;
- The seismic compressors will require 2 x 415v 3ph 260A circuit breakers housed within a suitable switchboard; and
- Enclosure of all electrical equipment including light fittings were located on open, exposed decks and/or laboratories that may be exposed to the weather shall be IP67.

204. Fuel Oil Systems

204.1. Fuel Oil bunkering system

The fuel oil bunkering and service systems is to be based on an overflow system to reduce the risk of an environmental incident. A dedicated overflow tank shall be part of the system. The Overflow tank shall have a high level alarm set at 10% capacity. The overflow pipework shall have a sight glass before entry to the overflow tank and the pipe shall be monitored for flow and the flow switch connected to the alarm system.

204.2. Fuel Oil transfer system

The fuel oil settling tank shall be connected to the overflow system. The fuel oil service tanks shall overflow to the settling tank.

205. Machinery Cooling Systems

205.1. High/Low Temperature Fresh Water Cooling System

Main and auxiliary cooling supplied by a 'fresh water' high and low temperature system. The central cooler shall have the sea water pipework kept as short as possible with the discharge to the port side of the Vessel. Pipework is to be configured to allow for the SW side of the main coolers to be back-flushed. Central coolers are to be plate type coolers Alfa Laval or similar each with 100% capacity and duplicated for maintenance. The 'flash evaporator' is to be aligned for maximum efficiency in the HT side of the system before the coolers.

205.2. Sea water cooling water system

All seawater piping to be in copper and nickel materials. Seawater velocities not to exceed 1.8m per second.

205.3. Other piping systems

Material to be solid drawn seamless mild steel schedule 40 hot dipped galvanised after fabrication. Electric resistance welded pipe will not be acceptable.

206. Compressed Air Systems

206.1 Main compressed air system

The main start air system shall be 30 bar, 2 main compressors shall start and stop automatically keeping the receivers between 20 and 30 bar. Two HP compressors are required, one compressor on line with one on standby, the

compressors cooled from the LT side of the fresh water cooling system. Two main receivers are required.

206.2 Working air systems

The working pressure shall be 7 bar. The air shall come from a dedicated 7 bar working compressor and air receiver. The instrument air shall be directed through a refrigerated dryer to remove water and through filter traps to remove any entrapped oil. Supply of 7 bar air shall also be possible via a duplicated reducing station from the 30 bar system.

207. Domestic Systems

207.1 Domestic Fresh Water

The Vessel shall have the capacity to produce at least 30t of fresh water per day. An arrangement that includes a flash evaporation system providing ~15 t/day of potable water for domestic use, laboratory and science works and that supplements the domestic supply is preferred. A reverse osmosis plant may be employed for providing ~15 t/day non-potable water for general use on the Vessel. The water provided from each system should be stored in separate tanks.

207.2 Sewage System

A reliable vacuum fresh water flushed toilet system shall be provided. The use of sea water for the toilet system shall not be accepted.

208. Working Deck Services

The working decks shall be provided with external connections for the ship fitted services including but not limited to:

- Fresh water;
- Ship service air;
- Raw seawater;
- Voice and data communications; and
- Electrical supply.

209. Workshops – General

Natural light shall be available for workshops (Not including the engine room workshop.)

Design and outfit in accordance with ergonomic and safe goods and materials handling principles

Workbench(s) of design appropriate to their purpose, shelving for manuals references and similar and facilities for the storage of tools, equipment and an appropriate ready use stock of spare parts and consumable items

Safety Showers and / or eye-wash stations appropriate to their use

210. **Workshops**

210.1. Deck workshop

Multi-purpose workshop designed to facilitate the servicing / configuration of heavy research equipment, .i.e. mechanical, electrical, pneumatic and hydraulic components.

- Area > 30 m²;
- Adjacent to the Scientific Operations Area;
- Configured so that it may be made weathertight pre & post equipment deployment and recovery;
- Vacant workstations for visiting technical support staff; and
- Proposals shall provide an assessment of the efficiency and cost effectiveness of the option to co-locate the deck workshop with the ship's mechanical workshop.

210.2. Engineers workshop

A workshop designed to support instruments and systems fitted to the Vessel, ship's machinery and equipment. The workshop shall be situated close to the engine room with easy access for heavy items of machinery and equipment.

- Area > 25 m²; and
- Full range of workshop machinery for fitting, turning and boiler-making including a welding bay for hot work with piped oxygen and acetylene.

210.3. Engineers Store/Spare parts Locker

Dedicated store for the storage of spare parts and consumables.

211. **Cranes, winches and equipment deployment – General**

The exact complement and configuration of cranes, winches and wires shall be finalized following final determination of the combination of technologies most suited to delivering the functional capabilities sought. The Vessel shall be provided with a suite of equipment and sample handling systems capable of delivering the functionality sought.

It shall be anticipated that a variety of sampling devices shall be deployed from cranes and winches. Responses shall demonstrate the cost effectiveness of the option(s) proposed in the context of the FRV Project's Key Design Principles.

- Fine control in heave & render across full speed range;
- Brakes capable of resisting render loads at least the equivalent of winch heave capability;
- The capability to finely position instrument packages & sampling devices;
- Heave compensation and/or tension control arrangements appropriate to their function on all cranes and winches;

- Facilities to measure wire tension, wire out, speed and angle and transmit this information in a compatible digital format to the ship's data acquisition system; and
- ***The use of electric crane and winch technology is preferred to help control hull noise for compliance with DnV Silent-R Alternative proposals may be considered but shall be justified on a case-by-case basis where present state-of-the-art electric motor technology shall not cost-effectively deliver the capabilities identified - Also see 404 winches – General***

212. Cranes

The Vessel shall be equipped with deck cranes with sufficient scope for full access to all work areas of the working decks, engine room hatch and provisions hatch. The 25t crane shall have ship-to-sea capability.

212.1. Crane – 25t swl

- This crane shall be designed, constructed, surveyed and certified in accordance with classification society requirements for offshore cranes;
- This crane shall service the ship's hold and container positions on the aft deck;
- This crane shall be suitable for the deployment and recovery of tethered and un-tethered submersibles;
- Static Load Capacity (in-port) > 25 tonnes SWL at least 12m and >5 tonnes SWL at least at 20m outreach; and
- For offshore operation Live Load Capacity > 5 tonnes SWL at 12 m (SS 6) Heave/tension compensated.

212.2. Utility crane

- Two utility cranes are required subject to the design proposed; and
- Static load capacity ≥ 5 t

212.3. Stores crane

Subject to the design proposed a dedicated stores crane may not be required as the utility crane may be able to provide this service. If a separate stores crane is required it shall be suitably sized and fit for purpose.

213. Vessel Operations Information Management Systems

Workstations shall be of standard design and provided with a suite of software designed to facilitate and automate their role. On board IT shall interface with Microsoft Windows compatible shore based systems for ship management and deliver automated functionality in areas such as reporting, inventory control and expenditure management.

213.1. Navigation

- Full ECDIS;

- Integrated position, velocity, and attitude and heading sensor system. The output from this system shall also be used by many fixed and mission specific scientific instruments; a means of distributing the output from this system throughout the Vessel shall be provided; and
- This requirement shall be read in conjunction and be implemented harmoniously with 301 below.

213.2. Stability

- A complete Class approved stability software package for the Vessel's stability; and
- The stability software shall include provision for damage and icing conditions.

214. Familiarisation, Training and documentation

214.1 Training owners personnel in the building yard

Training and Familiarisation with the following ship systems shall be provided for owner's personnel whilst the ship is in the building stage.

- Integrated navigation and ship control systems including system integration, system interactions, console layout and operation;
- Main propelling machinery control systems;
- Auxiliary machinery operation;
- Deck machinery operation;
- Dynamic Positioning system operation;
- Communication system operation; and
- Safety equipment operation.

214.2 Scientific equipment training in the shipyard commissioning stage

Training in the operation of in-scope, scientific equipment provided with the Vessel shall be provided for owners personnel.

215. Documentation and spare parts

215.1 Documentation

All machinery and scientific equipment shall be supplied with five (5) copies of all necessary test and manufacture certificates, operations manuals, maintenance manuals and spare parts manuals.

215.2 Spare parts

As the Contractor purchases machinery and equipment from the Maker's List, all machinery and equipment shall be supplied, subject to Owner's approval, with the manufacturer's recommended minimum spare parts based on two years operations with 300 operating days/year.

215.3 Special tools

Where the manufacturers have special tools required for service and maintenance then these tools shall be included in the supply.

Electronic Technology and Communications

301. **Precise Position, Attitude and Heading Measurement**

301.1. Precise Position, Attitude and Heading Measurement

A Kongsberg Seatex Seapath 300 with MRU5+ system shall be supplied and fitted by the builder to provide precise position, attitude and heading measurement;

This system shall interface to the Vessel's Dynamic Positioning system and to the scientific sensors as required;

- The MRU5+ Inertial sensor shall be mounted in the gyro room;
- The Seapath GPS antenna shall be mounted at the top of the main mast (or other location dependent on manufacturer recommendation) on a Kongsberg supplied 4.0m antenna mount boom;
- Provision shall be made at the top of the main mast for mounting of a Differential-GPS reception antenna (additional to the Seapath antennae).

302. **Scientific Cabling**

302.1 Temporary Scientific

There shall be efficient methods of running cables for mission-specific equipment in and between key areas such as working decks, masts, scientific work areas, labs, the bridge, IT machine rooms, and container stowage areas. Minimum size cable access from working decks to internal spaces 150mm diameter.

302.2 Fixed Scientific

There shall be fixed twisted pair cabling (10 pair minimum) to accommodate instrumentation signals that cannot be transmitted using the Vessel LAN, between the Operations Room and the following spaces:

- Aerosol Laboratory;
- Air Chemistry Laboratory;
- Network and IT Management Office;
- Data Processing Laboratory;
- Controlled Temperature Laboratory;
- Hydrochemistry Laboratory;
- Drop keel compartment ;
- Underway Seawater Analysis Lab;
- CTD room;
- Dirty Wet GP Lab;
- Clean Wet GP Lab;

- Clean Dry GP Lab; and
- Winch slip rings (for all winches fitted with conducting cables).

There shall be fixed twisted pair cabling (20 pair minimum) to accommodate instrumentation signals that cannot be transmitted using the Vessel LAN, between the Operations Room and the following spaces:

- Bridge;
- Transceiver Room;
- IT Machine Room;
- Sheltered Science Area;
- Gravity Meter Room

Criteria:

- Terminated on bulkhead mounted junction boxes with cable pairs numbered;
- The central Operations Room junction box shall have all cable groups clearly labelled indicating the space the cable originates from;
- Individual screened instrumentation pairs with overall screen;
- Cable to be Low Smoke Zero Halogen Class approved;
- Conductor size to be 0.5mm² minimum except for cables from winch slippings to the Operations Room, where conductor size and voltage rating should match the cabling installed on the winch; and
- Fibre Optic cable, in addition to copper twisted pairs, shall be installed from the Operations Room to the CTD and Towed Body winches.

303. Network and Computer Services

303.1. Specification

The Vessel shall be fitted with an IEEE standard 802.3 compliant LAN. The Contractor shall procure and install the ICT network infrastructure limited to cabling, power and equipment racks to the Owner's specification using licensed installers under the Owner's supervision.

The following will be procured and installed by the Owner:

- Network switch hardware (including wireless hardware);
- Domain controllers;
- Mail server;
- Storage systems (Servers, NAS);
- Scientific data acquisition, logging and visualisation systems; and
- Business system computing platforms

Scientific computing platforms (excluding that covered in 309).

303.2. Network design principles

The basic Vessel network topology shall be:

- Network cable runs shall be located along passageways (not through cabins) and drop-down ceilings shall be provided to allow easy access;
- Closets for between-deck vertical runs shall be located directly on top of each other;
- UPS power (2 x 10A GPOs) shall be provided to each closet;
- Redundant fibre optic backbone of at least 10Gb capacity between decks;
- Each closet shall be fitted with a 19" style rack to house Ethernet switches;
- Horizontal cabling on each deck shall be Shielded Twisted Pair of Cat7;
- Horizontal cabling shall terminate on RJ45 style connectors;
- Terminations in closets for horizontal cabling shall be on 19" style rack mounted patch panels; and
- Cable glands through bulkheads shall be of a watertight design and Class approved.

303.3. Network Availability

The number of network outlets for connection of computing platforms and Vessel telephones is:

- Foremast: 4 x RJ45;
- Monkey Island Observation Station: 4 x RJ45;
- Aerosol Laboratory: 8 x RJ45;
- Science Office: 16 x RJ45;
- Air Chemistry Laboratory: 8 x RJ45;
- Wheelhouse/Bridge: 32 x RJ45
- All cabins: 2 x RJ45 per cabin;
- Combined conference/lounge/mess: 16 x RJ45;
- Other lounges: 4 x RJ45 per lounge;
- Network and IT Management Office: 16 x RJ45;
- IT Machine Room**: 32 x RJ45 per rack
- Data Processing Laboratory: 16 x RJ45;
- Operations Room: 16 x RJ45 per rack plus 4 x RJ45 for each workstation;

- Controlled Temperature Laboratory*: 4 x RJ45;
- Underway Seawater Analysis Laboratory: 8 x RJ45;
- Hydrochemistry Laboratory: 16 x RJ45;
- Salinometer room: 4 x RJ45;
- GP Dry Laboratory*: 16 x RJ45;
- GP Wet Laboratory (Clean)*: 16 x RJ45;
- GP Wet Laboratory (Dry)*: 16 x RJ45;
- GP Wet Laboratory (Dirty)*: 16 x RJ45;
- Preservation Laboratory: 8 x RJ45;
- CTD Compartment: 8 x RJ45;
- Sheltered Science Area: 16 x RJ45;
- Electronics Workshop: 16 x RJ45;
- Gravity Meter Room: 8 x RJ45;
- Transceiver Room: 16 x RJ45 per rack;
- Drop Keel Access Compartment: 4 x RJ45;
- All working and machinery spaces: 4 x RJ45 per space; and
- Container stowage locations: 2 x RJ45 per container.

Notes:

*The network outlets for laboratory spaces shall terminate in centrally located cabinets adjacent to temporary cable trays which allows for the routine connection and disconnection of voyage specific equipment.

**The IT Machine Room (to be co-located with the Operations Room, Data Processing Facility, Electronics Workshop and Network and IT Infrastructure Management Office) shall serve as the termination point, or network closet, for all network cabling associated with these spaces as well as fibre optic backbone termination.

304. **Communications**

304.1. Intra-ship voice

- Intercom: An intercom system dedicated to the support of science operations shall be procured and installed by the Contractor. The intercom must provide, as a minimum, communications between the Bridge, Operations Room, CTD compartment, Drop Keel compartment, Data Processing room, Electronics workshop, Winch control cabin, all laboratories and Sheltered science area. There shall also be voice communications stations adjacent to side and Stern A-frames. Designs may include systems that utilise the Vessel network infrastructure to improve system flexibility and

future expansion. Stations in exposed areas shall be salt-water resistant. The intercom system shall be of the broadcast type (i.e. non-addressable) such that all stations can hear a transmission from any one station.

- Telephone: The Owner shall procure and install a Voice over Internet Protocol (VoIP) telephone system. Note that network cabling, and other infrastructure for this system is to be supplied and installed by the Contractor as per section 303;
- Base Station, and hand-held UHF radios shall be provided by the Contractor.

304.2. External voice, data, radio and television

- The satellite communication hardware for data transfer and voice calls shall be Owner supplied.
- The Contractor shall provide unobstructed antenna mounting points suitable for the installation of a primary satellite communication system radome up to 3.65metres in diameter as well as a secondary system with a 1 metre diameter radome. Clearance zones to obstructions and other radiating equipment shall be compliant with the supplied product specifications.
- The Contractor shall procure and install a satellite based radio and Television reception system to the following general specification:
- Stabilised dish on monkey island, main mast or other suitable location (KVH Tracvision M9 or similar);
- Reception of Australian radio and television content via satellite;
- Cabling from a central satellite receiver to each lounge (RG6 or better);
- Television decoder box in each lounge area; and
- 2 x centrally located radio/tv decoder units with suitable suitable amplifiers and cabling (RG6 style or better) to each cabin.

305. Workspace Monitoring

305.1. All working areas and winches shall be monitored

- All working areas and winches shall be monitored by closed circuit TV or functionally similar technology;
- All unmanned spaces (as defined by the SOLAS convention) shall be monitored by closed circuit TV or functionally similar technology;
- All PTZ capable cameras shall be capable of operation from any workstation with appropriate client software; and
- Laboratory workspaces where operations involving substances that have the potential to evolve hazardous gases or fumes shall be fitted with appropriate air quality monitoring systems.

305.2 Camera Control

- In all cases pre-emptive camera control shall be available to designated workstations on the Vessel's bridge; and

- All captured vision shall be continuously recorded on a 7 day loop on a first-in, first-out basis.

306. **Electronic / Instrument Workshop**

306.1 Dry electronics workshop

Dry electronics maintenance & servicing workshop.

- Area > 20 m²;
- Floor to ceiling 19" rack for stowage of Owner supplied Electronics test equipment.
- Separate workstation/workareas for computer based work and equipment repair;
- Location adjacent to the Operations Room; and
- Compressed air supply (7 bar, 100 l/min, 1 outlet, clean air – can be same supply as specified for Air Chemistry and Aerosol Laboratories).
- UPS power is required

307. **Electronics store**

307.1. Electronics Store

- Area > 10 m²;
- Co-located with Electronics Workshop; and
- UPS power is not required.

308. **Drop Keel Sensor Deployment System**

308.1. Drop Keels

Incorporate 2 drop keels (referenced hereafter as Port and Starboard drop keels) sufficient to accommodate a variety of smaller transducers, as detailed in Reference 309 and located in accordance with manufacturer's and owner recommendations.

Criteria:

- At full extension drop keels shall protrude no less than 4 m below the hull ensuring transducers are clear of the bubble layer and turbulent zone;
- Drop Keels shall lock down securely to ensure transducers are repeatedly accurately referenced to the Vessel; and
- Drop keels shall be capable of being withdrawn to the extent that sensor change out / maintenance may be undertaken when the ship is at sea. The drop keel compartment shall need to be approximately 12 m³, and may extend over 4 deck levels. The space occupied shall be taken into account. Consideration must be given for safe handling by science personnel of transducers to and from the drop keel compartment. The largest transducer

anticipated to be handled to or from this space is 920 mm round x 250mm with a weight of 250 kg.

308.2. Forward Looking Drop Keel Camera

Provision on the port drop keel to mount an Owner supplied forward looking camera.

309. Transducers

The Contractor shall provide the acoustic systems identified below. Transducers, transceivers, workstations and software (including minimum practical software) shall be provided and mounted on the specified drop keel, fixed gondola or other type of mounting:

309.1. Multi-frequency scientific split-beam echo sounders:

- All to be on port drop keel;
- 18, 38, 70, 120, 200 and 333 kHz split-beam transducers; and
- Simrad/Kongsberg EK 60.

309.2. 12kHz transducer:

- Fixed gondola mount;
- Dual beam (Simrad 12-16/60 or similar);
- Passive/low power use for mooring deployment & recovery, acoustic release interrogation and pinger communication; and
- Available for active (bathymetry) use with Kongsberg EK60 or similar.

309.3. Fish finding sonar:

- Starboard drop keel mount; and
- Omni directional, stabilized full circle beam 114 kHz, Simrad SH90.

309.4. ADCP (both low and high frequency):

- Both on port drop keel;
- Teledyne-RDI Ocean Surveyor 75 kHz (owner supplied). Provision shall be made for the future replacement of the 75 kHz ADCP with a 38kHz RDI ADCP; and
- Teledyne-RDI Ocean Surveyor 150 kHz.

309.5. Trawl mensuration and monitoring systems:

- Starboard drop keel mount;
- Port and Starboard trawl type hydrophones;
- Contractor shall supply the following additional sensors as part of the trawl monitoring package:

- Distance sensor pair (for trawl door monitoring);
- Height sensor;
- Depth sensor (quantity 2);
- Fish concentration sensor (e.g. Trawleye or similar);
- Bridge display capable of displaying all sensors listed;
- A minimum of 5 battery chargers matched to the listed sensors;
and
- Scanmar MP4, Simrad PI or similar systems.

309.6. Shallow water multibeam scientific and fisheries echo sounder system:

- Fixed gondola mount;
- 70kHz - 120kHz, Simrad ME70 or similar.

309.7. Shallow water multibeam scientific echo sounder system:

- Fixed gondola mount;
- Capable of hydrographic soundings to IHO S44 (Order 1 Survey) standard;
and
- 0.5° x 1° 70kHz - 100kHz, Simrad EM710 or similar.

309.8. Medium depth multibeam system:

- Provision shall be made for fixed gondola mounting of a medium depth multibeam system, 10-4000 m 1° x 1°, 30-34kHz, Kongsberg EM302.
- Owner supplied and installed post delivery.

309.9. Full ocean depth multibeam system:

- Fixed gondola mount; and
- 1° x 1° 12 kHz, Kongsberg EM122. Note that this system defines the minimum length of the gondola at approximately 8m.

309.10. Sub-bottom profiler integrated with 12kHz multibeam:

- Fixed gondola mount; and
- Kongsberg SBP120 or similar.

309.11. Multi-frequency hydrophones:

Multi-frequency hydrophones suitable for monitoring self noise and measuring ambient environmental noise:

- Harris Acoustics Model 5050 hydrophone to be mounted on the starboard drop keel;

- Harris Acoustics Model 5050 hydrophone to be mounted on the Vessel keel near the bow;
- Harris Acoustics Model 5050 hydrophone to be mounted aft near the propulsion system(s); and
- The amplifier and processing hardware for the hydrophones shall be owner supplied.

309.12. Ultra short baseline (USBL) acoustic positioning system:

- Starboard drop keel mount;
- 7000 m capable; and
- Simrad/Kongsberg HiPaP, Sonardyne Ranger Pro (owner supplied).

309.13. Dual Axis Doppler:

- Fixed gondola mount; and
- Skipper DL850 or similar.

309.14. Bridge Sounder:

- Fixed gondola mount;
- Compliant with IMO Performance Standards for Echo Sounding Equipment Resolution A.224(VII);
- 50kHz Single Beam;
- Display on both aft bridge and central forward bridge control stations; and
- Kongsberg EN250 or similar.

309.15. Sound Velocity Probe:

- Port drop keel mount;
- Probe to measure sound velocity for use by multibeam systems; and
- Accessible at sea or in port for regular servicing.

310. Transceiver Room

A transceiver room adjacent to through-hull sensor deployment system(s) for those acoustic systems with separate transceivers and associated equipment.

310.1. Transceiver Room

A transceiver room located as close as possible to drop keel compartment and gondola cable trunk in order to ensure transducer cable lengths are kept to a minimum. Area > 20 m².

Outfit:

- Workbenches;

- Equipment racks & transceiver mounting arrangements; and
- UPS power required.

Criteria:

- HVAC as a laboratory space.
- The space to be protected by a dedicated FiFi fixed gas system.

310.2. Sounder Synchronisation System

The Contractor shall supply a Kongsberg K-Sync echo sounder synchronising system to minimise interference between adjacent frequencies and maximise collected data quality.

311. Transducer calibration

311.1. Transducer Calibration

Facilities to calibrate transducers with standard acoustic calibration targets.

Criteria:

- A three point mounting system; and
- Space for storage of calibration spheres in Transceiver room.

4. Science

401. Laboratory Fresh water

401.1. Laboratory Fresh Water

A reliable supply of potable freshwater shall be provided to all plumbed laboratory spaces, drop keel compartment and working decks. This requirement is additional to requirements under SOLAS and ordinary marine practice for the supply of domestic hot and cold fresh water.

Criteria:

- Freshwater quality shall be no less than that required by SOLAS;
- Flow > 40l/min @ 400kPa;
- Hot & Cold fresh water to Labs;
- Cold fresh water to Working Decks;
- Pressure and flow maintained with 50% of valves fully open; and
- Water to be sourced from a flash evaporator rather than a RO unit.

401.2. Ultra-pure Fresh Water

A supply of potable fresh water shall be available in the GP Wet Lab (Clean), GP Dry Lab, Preservation Lab, Controlled temperature lab and Hydrochemistry Lab via owner supply, individual water purification units in each laboratory.

Criteria:

- Feedwater for the Ultra-Pure fresh water system is sourced from a flash evaporator (ships potable water supply) rather than an RO system;
- Purification systems shall be capable of accepting a range of filter cartridge types appropriate to the research being conducted; and
- Water Quality > 18 Mohm cm-1.

402. **Laboratory Seawater**

402.1. Trace Metal Clean Seawater

Supply to Hydrochemistry, General Purpose Clean Wet Laboratory and Underway Seawater Analysis Laboratory.

Criteria:

- Supply clean of contaminants;
- Flow > 60 litres/min @ ~35kPa;
- Temperature change between point of seawater intake and points of supply < 0.5°C;
- Supply to General Purpose Clean Wet Laboratory, aft deck container location and Underway Seawater Analysis Laboratory;
- Provision for de-icing seawater inlets and removing biological fouling from lines;
- Inlet for this water to be on the port drop keel, and titanium delivery lines to the drop keel compartment. Distribution lines through the ship would be through rubber or metal-sheathed FPE (Pureflex) tubing or non-contaminating, sheathed polypropylene or polyethylene tubing.
- Provision for cleaning inlet pipework at sea to remove contamination; and
- The concentration of dissolved iron at a designated sampling location in the clean dry or wet lab should be within 0.05 nM of samples taken with trace metal clean sampling apparatus outside the Vessel; and
- Pump(s) to be diaphragm type that are inert for trace metals.

402.2. Circulating Clean Seawater

Supply to all plumbed laboratory spaces and deck incubation spaces of a continuously refreshed supply of seawater drawn from and returned to the immediate environment.

Criteria:

- Flow > 100l/min @ > 35kPa;
- Pump(s) to be diaphragm type;
- Inlet to be on port drop keel;

- Temperature change between point of seawater intake and points of supply < 0.5°C; and
- A strainer basket shall be supplied and fitted to the suction side of the pump and after the drop keel (within the drop keel compartment);
- Provision should be made at or near the inlet for an Owner supplied Seabird SBE38 intake thermometer, an Aanderaa Optode, and an electromagnetic flow meter; and
- Provision for de-icing seawater inlets and removing biological fouling from lines.

402.3. Deck (Raw) Seawater

Supply to all external working decks, GP Wet laboratories, constant temperature and CTD laboratories. Main deck and Side Science area shall have multiple raw seawater outlets.

Criteria:

- Flow > 300l/min @600kPa;
- Supply shall be free of gross contaminants but may be drawn from ER sea chests;
- Not drawn from Vessel's fire main; and
- Delivery volumes and pressures shall be maintained with a reasonable number of outlets simultaneously open.

403. Vapour Management

All Fume cupboards & Hazardous Materials lockers shall be connected to a vapour management system.

Criteria:

- The vapour management system prevents the reintroduction of vapours to the ship's HVAC systems or the internal environment;
- The vapour management system prevents the inappropriate release of vapours to atmosphere; and
- The vapour management system shall include in-place filtration by a proportion of installed fume cupboards and or laminar flow cabinets.

404. Winches – General

A variety of sampling devices shall be deployed from each winch.

Winch capability calculations shall take into account the varying masses of sampling systems when determining the payload each sampling device is able to recover from the maximum depth to which it may be deployed. Payloads stated **do not** include sampling system wires.

All winches are to be provided with an automatic freshwater cleaning system to clean rope of sea water before storage.

Also see 211. Cranes, winches and equipment deployment – General

405. **Winches and equipment deployment systems**

Contractors shall provide for a complete system for trawling that will meet the requirements in the Concept of Operations, including main trawl winches, trawl doors, net drum winch, gallows and blocks, additional winches as necessary, and a design that incorporates modular bulwarks on either side of the trawl ramp and modular knee boards. The design suggested shall however be fit for their mounting on and use from the Vessel proposed. The weight of a McKenna orange roughy trawl is about two tonnes and the trawl doors weigh about a tonne each. In-water drag is 3-4 tonnes. The IYGPT usually has a in-water drag of ~2 tonnes at a towing speed of 3 knots.

405.1. Two wire trawl (Two trawl winches and a net drum winch)

- Depth \geq 4000 m (minimum);
- Wire capacity \geq 8500m;
- Cookes Dyform 22mm 6 x 26 IWRC 1570/1770 Nmm² or equivalent wire rope;
- Catch Mass ~1 t;
- Maximum winch heave 30 tonne;
- Wire deployment and recovery speed controllable between 0 and \geq 100m/min;
- Trawl winches to be placed on deck below working deck with trunk access to gallows.
- Mid-water and demersal trawls such as an IYGPT, McKenna Orange Roughy trawl shall be fished from this system;
- Net storage winch drum 10 m³ capacity with a heave of 15 tonne.
- Net storage winch to be placed above the working deck on centre line.
- The trawl winch system should also be suitable for use with seabed dredges. They should have the capability of a 10t pull at the sea bed in water depths of 5000m to dislodge geological samples. A delivered force of 10t at the sea bed should be used as the limiting design parameter.

405.2. Heavy duty general purpose towing

- 8000m wire capacity;
- Payload \geq 1 t;
- 16mm 6x19 polycore wire rope.
- Winch located within main winch room.

- The system is intended as for general purpose use, e.g. benthic sled, towed cameras, small nets, etc.; and
- Wire deployment & recovery speed controllable between 0 and ≥ 100 m/min.

405.3. Vertical Sediment Grabs and Light Side Towing

- A general purpose winch for side deployment of light grabs, small nets, etc ;
- 2000m rope capacity;
- 8mm Dynex or similar rope (must be buoyant);
- Heave ≤ 1 t;
- Winch to be located in the main winch room for side deployment only.
- Wire deployment & recovery speed between 0 and ≥ 100 m/min.

405.4. Short Sediment Coring System

- Depth ≥ 7000 m;
- Core Length ≥ 8 m;
- For short core systems (~6m) "pull-out" loads of 8t should be used as the limiting design parameter. The design shall provide for the winches / cranes and wires required to deploy this equipment, the coring equipment will be Owner supplied. The system should be suitable for mounting the Owner's Supplied equipment and provide for proper operation.
- The design will utilize the long coring winch and components of the long coring deployment system.

405.5. Long Sediment Coring System

The design shall be exclusive of the coring system at wire end. The design shall provide for the winches / cranes and wires required to deploy and recover this equipment and may include proposals including small davits and tugger winches to facilitate moving the core barrel and weight over the side of the Vessel. The coring equipment will be Owner supplied. The design should be suitable for mounting the Owner's Supplied equipment and provide for proper operation.

- Depth ≥ 7000 m;
- Core Length ≤ 30 m;
- Core weights up to 4 tonnes;
- 20mm Dynex or similar synthetic rope (must be buoyant);
- Winch located in main winch room;
- Provision for coring rope to be used for aft deployment of other equipment;
- Wire deployment & recovery speed controllable between 0 and ≥ 100 m/min

- For long core systems (~30m) “pull-out” loads of 20 tonnes should be used as the limiting design parameter.

405.6. Drill Rigs and Vibrocore Capacity

Provision shall be made for the mounting and deployment of owner supplied drill rig and Vibrocorer with the following specifications:

- Geo-science submersible drill rig or GA Vibrocore tool (owner supplied);
- Drill assembly mass is 2.5 tonnes;
- Maximum pull-out draw 8 tonnes;
- Depth 500m maximum;
- Owner supplied winch with electro-mechanical Hydrocable sketch 1025 21mm diameter 15 tonnes breaking strain or equivalent, capable of supplying 415volts, 3 phase and 32 amps.

405.7. Instrument/Cable Storage >10m³

This area to be used for stowing instruments, cables, etc., when they are not in use on the rear deck. The area should be located below the aft working deck with hatch access.

405.8. Towed body deployment and recovery

- Towed Body Mass - Maximum 1 tonne;
- Cable length ≥ 5800 m;
- Cable type: Electro-Optical;
- Cable size = 10 mm;
- Cable specifications: Rochester A305382;
- Deck cable from slip-ring to Operations Room as per 302.2;
- Winch to be located in main winch room for aft deployment with provision for side deployment of equipment;
- Wire handling system needs to be independent of other systems;
- Wire deployment & recovery speed controllable between 0 and ≥ 100 m/min.

405.9. CTD instruments / rosette deployment and recovery

- Instrument Mass with full 12 litre sampling bottles on a 36 bottle rosette and ancillary instruments ~ 1 tonne;
- Maximum cast depth ≥ 6500 m;
- Cable size: ≥ 8.03 mm;
- Cable specifications: Rochester A216314;

- Deck cable from slip-ring to Operations Room;
- Wire deployment & recovery speed controllable between 0 and $\geq 100\text{m/min}$;
- Winch shall be of twin drum design;
- At least one of the wires from the twin drum system shall be able to be routed to both the CTD deployment and recovery boom and the side H/A-frame system;
- Options should consider location in main winch room or on deck above the CTD compartment;
- The CTD wire handling system needs to be independent of other wire handling systems;
- Alternative deployment and recovery systems, such as a telescoping boom or A-frame may be acceptable. The deployment and recovery system shall be capable of being used for towing the CTD package with side loading of up to 0.25 tonne.

405.10. Utility winches - working decks

- 2 x 10 tonne; and

406. Overside equipment deployment and wire handling systems

406.1. Side Science Area - H / A frame or equivalent system

This system which is to be independent of and aft of the CTD deployment system is primarily intended for the deployment of sediment grabs, sediment coring systems and small nets.

Vertical Load Capacity: 30 tonne;

- Clearance over deck > 4.5 m;
- Stand-off from ship side: > 2.5 m;
- Aperture: >2.5 m;
- Capable of being used for towing with side loading of up to 1 tonne. Construction must provide for rope to be fully clear of the A-frame when towing;
- Fitted to provide attachments for instrumented blocks;
- Mounting arrangements capable of holding a 1 tonne SWL owner supplied portable capstan at a later date; and
- It shall be possible to route at least one one of the CTD wires (refer 405.9) to the side H/A-frame for the purposes of towing instrumented net systems.

406.2. Long Sediment Coring H or A Frame System

- Utilise the CTD A/H frame or extendible boom arrangement;
- Vertical load capacity 30 tonnes;

- Clearance over deck ~3m;
- Standoff from ship side >1.5m;
- Aperture >2m;
- Core system mass ~4 tonnes;
- For long core systems (~30m) 'pull-out' loads of 20 t shall be used as the limiting design parameter; and
- Owner to supply core.

406.3. Side Towing Booms (one each side)

- 3D load Capacity: 2.5 t; and
- Stand-off from ship side: > 2.5 m.

406.4. Aft Deck

- H / A / inverted U frame;
- Load Capacity: 20 t;
- Clearance over deck > 8 m from blocks to deck;
- Approx. minimum arc of movement ~170°;
- Distance between legs of the H/ A/ inverted U frame should be as wide as possible; and
- Fitted to provide attachments for multiple instrumented blocks.

406.5. Gallows

If a modular two wire trawl system is proposed at 405.1 modular arrangements for trawl wire gallows may also be acceptable.

- 2 x 30 t.

407. Ship Side Scientific Operations area

407.1 Ship Side Operations

A multipurpose and multifunctional area of >40m² on the main deck, outboard of the trawl deck extending aft from the end of the superstructure past the Oceanographic Operations Laboratory and the Sheltered Scientific Area on the starboard side of the Vessel. Designs extending along a clear deck from the aft end of the superstructure to the stern would be preferred. The design of the sheltered scientific area shall facilitate its reconfiguration to suit the needs of a variety of research voyages.

Outfit:

- Equipment handling systems that support the above or similar equipment in two size ranges;

- Combined instrument and sample masses of 0-500kg;
- Combined instrument and sample masses of 500kg-10000kg; and
- Equipment handling systems should be designed to facilitate and cost effectively maximize communications between instruments and the ship.

408. **Laboratories – General**

All science working areas other than storage spaces should be provided with natural light unless otherwise stated.

Means to ergonomically site and adequately secure equipment and instrumentation shall be provided.

Pipes in deck heads within laboratories to be kept to a minimum and fully insulated to prevent condensation. The functions, communications, and layout of work stations shall be designed in accordance with international best practice to enhance and support interaction between ship and science operations.

Attached at page 57 is a flow chart of the movement of samples and people around the science laboratories and workshops.

The design shall provide an ergonomic layout for the science areas. Boxes on the flow chart with a common boundary need to be together, the wider the gap between the boxes the further the workshops/laboratories can be apart.

Unless otherwise specified, each laboratory should be each equipped with:

- Two sinks with corrosion resistant discharge lines that may be diverted to a holding system to ensure toxic substances are not discharged into the ocean;
- Hot and Cold domestic fresh water at sinks;
- Two fume cupboards connected to the vapour management system;
- Chemically resistant bench surfaces;
- Refrigerated (fridge + freezer) storage volume of ~0.5 m3;
- Facilities for the safe storage of small quantities of hazardous materials compliant with: international best practice for the safe storage and handling of hazardous materials in organizations conducting research;
- Safety Showers and / or eye-wash stations appropriate to their use;
- Where Seawater is supplied to a space disposal facilities for significant volumes should be provided (diversion to holding tanks not required – overboard discharge should conform with provision 117.1);
- Flush 500x500 matrix tie down points in central part of floor (clear of permanent bulkhead mounted benches) for fitting/ reconfiguring racks and benches. Blanking caps or screws to be provided;
- Matching recessed C-channels in ceiling for fitting racks, cable trays etc;

- Horizontal/vertical C-channels on walls for fixing equipment;
- 7 bar oil free/dry compressed air supply;
- Desks and benches fitted with 22mm replaceable protective plywood sheeting for fixing equipment; and
- UPS to all laboratories.

409. **Sheltered Scientific Area**

409.1 Starboard Side Sheltered Scientific Area

The design of the sheltered scientific area shall facilitate its reconfiguration to suit the needs of a variety of research voyages. Extending over 2 deck levels.

On the main deck, outboard of the trawl deck, adjacent to and forward of the Side Scientific Operations area.

Area >25 m²

Suitable for:

- storage, preparation and maintenance of science equipment;
- use as hangar space for ROV / AUV systems;
- Working with biological samples;
- Working with geological and sediment samples; and
- Filling, handling and releasing radiosonde balloons.

Outfit:

- Workbenches;
- Materials handling systems that provide the ability to transfer equipment of up to 10t to the ship side scientific operations area and the stern;
- Configured so that it may be made weathertight pre & post equipment deployment and recovery;
- Secure storage of helium bottles; and
- Fume cupboards, refrigerated space, and hazardous materials storage not required; and
- A combination of UPS and non-UPS 240V 10A and 15A GPOs and two 415V 32A power outlets are required.

410. **Conductivity Temperature Depth (CTD) Instrument Compartment**

410.1 CTD Compartment

A compartment adjacent to the Side Science Area, designed to facilitate transfer of samples to Hydrochemistry Laboratory and the GP Wet Lab (Dirty).

The compartment shall be regarded as a “wet” compartment, however drainage shall accommodate the rapid removal of the total volume of seawater sampled by a 36 bottle rosette (~400l)

Area >30 m²

Immediately adjacent to the Hydrochemistry Laboratory.

Outfit:

- Facilities to store, secure and service a 36 bottle CTD rosette & attached sensors & sampling devices;
- Equipment handling systems for deployment and recovery of CTD systems and sampling rosettes;
- Facilities to store, prepare and sample a rosette including bottle storage;
- Facilities to support the fitment of oceanographic sensors as required;
- Potable cold water;
- Raw Seawater; and
- High capacity drainage.

Criteria:

- Minimum width > 5m at CTD sampling location exclusive of bench space;
- Sized to accommodate a 36 bottle rosette or frame;
- Configured so that it may be made weathertight pre & post equipment deployment and recovery;
- Vertical extension over two deck levels to facilitate rosette handling may be required;
- Fume cupboards, refrigerated space, and hazardous materials storage not required; and
- A combination of UPS and non-UPS 240V 10A and 15A GPOs.

411. **General Purpose Wet Laboratory (Dirty)**

411.1 GP Wet Lab (Dirty)

Multi-purpose workspace where samples including fish and plankton catches, sediment and geological samples may be received from working decks sorted, sub-sampled and processed.

Area > 40 m²

Direct access to the Sheltered Scientific Area and rear deck for ease of handling large samples.

Outfit:

- Facilities to continuously discharge biological waste material, waste water and or surplus sediment samples;
- Designed for and fitted to ease and facilitate clean up;
- Raw seawater supply to sinks;
- Bench surfaces of at least 15 m²;
- 3 hazardous materials lockers (419.4) for separate storage of small volumes of hazardous materials;
- 7 bar oil free/dry compressed air supply; and
- A combination of UPS and non-UPS 240V 10A and 15A GPOs.

Criteria:

- Deck access sized and positioned to provide easy traffic flow and ability to transport scientific equipment and biological samples easily to and from working decks to the lab;
- materials handling equipment (such as a roller/conveyor) and arranged to facilitate the receipt of bulk samples from the side science area and rear deck, their sorting and sub-sampling; and
- Configured so that it may be made weathertight pre & post equipment deployment and recovery.

412. Preservation Laboratory

412.1. Preservation Lab

Suitable for photography, preservation and storage of samples.

Area >15 m²

Close to GP Wet Lab (Clean).

Outfit:

- Connected to vapour management system;
- 2 hazardous materials lockers (419.4) for separate storage of small volumes of preservatives (formaldehyde and alcohol);
- 7 bar oil free/dry compressed air supply;
- Deionised fresh water from a stand-alone purification unit;
- Fume Cupboard; and
- Sample Cabinets > 3 m³ connected to vapor management system.

Criteria:

- Provision of natural light is not required;

- Ability to completely darken room for photography; and
- Fitted for handling preservatives, dry ice and liquid Nitrogen with good laboratory ventilation to prevent buildup of toxic gases.
- UPS not required.

413. **General Purpose Wet Laboratory(Clean)**

413.1. GP Wet Lab (Clean)

Multi-purpose workspace where samples may be assessed under clean conditions, data recorded and analysed.

Area >40 m²

This lab shall be adjacent to the GP Dry Lab, and could be adjacent to the General Purpose Wet Lab (Dirty) and CTD compartment.

Outfit:

- Clean circulating seawater supply to sinks;
- Trace Metal Clean seawater;
- Fume cupboards;
- 3 hazardous materials lockers (419.4) for separate storage of small volumes of hazardous materials;
- Deionized fresh water from a stand-alone purification unit;
- 7 bar oil free/dry compressed air supply;
- Bench mounted laminar flow cabinet; and
- Bench surfaces of at least 15 m²
- Criteria:
- Designed to facilitate the transfer of samples from the Dirty Wet Laboratory and the CTD compartment; and
- A combination of UPS and non-UPS 240V 10A and 15A GPOs.

414. **General Purpose Dry Laboratory(Clean)**

414.1. GP Dry Lab (Clean)

User configurable, plumbed laboratory space.

Area >35 m²

Outfit:

- Fume cupboards;
- Bench mounted laminar flow cabinet;

- Bench surfaces of at least 12 m²
- A variety of bench heights to accommodate seated and standing working postures or the ability to adjust bench heights shall be provided;
- Trace Metal Clean Sea Water;
- Ultra-pure Fresh Water;
- Deionized fresh water from a stand-alone purification unit;
- 7 bar oil free/dry compressed air supply;
- Clean Circulating seawater supply to sinks; and
- No radiation work.

Criteria:

- A combination of UPS and non-UPS 240V 10A and 15A GPOs.

415. **Hydrochemistry Laboratory**

415.1. Hydrochemistry Laboratory

A workspace designed and fitted to facilitate seawater property analyses and, when not in use for hydrochemistry analyses, as a general purpose clean laboratory space.

Adjacent to the CTD compartment.

Area > 24 m²

Outfit:

- Fume cupboard;
- 2 hazardous materials lockers (419.4) for separate storage of small volumes of hazardous materials;
- Bench surfaces of at least 10 m²;
- 7 bar oil free/dry compressed air supply;
- Deionized fresh water from a stand-alone purification unit;
- Potable hot and cold water; and
- Clean Circulating seawater supply to sinks.

Criteria:

- Temperature: 22° C +/- 1°C.; and
- A combination of UPS and non-UPS 240V 10A and 15A GPOs.

415.2. Salinometer room

A workspace designed and fitted to facilitate the analysis of seawater salinity. Requires higher temperature stability than provided in the Hydrochemistry lab – standalone AC.

Co-joining Hydrochemistry lab.

Area $\geq 6\text{m}^2$

Minimum bench length 3m – along one bulkhead.

Outfit:

- Drain (no sink required).
- Temperature control: $22^{\circ}\text{C} \pm 0.5^{\circ}\text{C}$
- A combination of UPS and non-UPS 240V 10A GPOs.

416. Underway Seawater Analysis Laboratory

416.1. Seawater Analysis Lab

A facility designed and fitted to accommodate those instruments permanently fitted to measure seawater properties while the Vessel is underway.

Area $> 10\text{m}^2$

Adjacent to the Hydrochemistry Laboratory.

Outfit:

- Trace Metal Clean Sea Water;
- Clean Circulating seawater; and
- Ultra-pure Fresh Water;
- 7 bar oil free/dry compressed air supply;
- 3/8" Dekobond tubing supplying air from aerosol mast;
- Fume cupboard and refrigerated storage are not required.

Criteria:

- Provisions to secure from ambient light. Provision of natural light is not required;
- Situated so as to minimize the time between the collection of seawater and its delivery to the laboratory;
- Temperature: $22^{\circ}\text{C} \pm 1^{\circ}\text{C}$; and
- A combination of UPS and non-UPS 240V 10A and 15A GPOs.

417. Controlled Temperature Laboratory

417.1. Controlled Temp Lab

Area >20 m²

Designed, when not in use as a constant temperature laboratory, to facilitate use as a sample storage locker particularly suited to sediment core samples.

Entrance with air lock.

Outfit:

- Designed and fitted as a 'wet' work space;
- Bench surfaces of at least 10m²;
- Clean Circulating Seawater;
- Deionized fresh water from a stand-alone purification unit;
- 7 bar oil free/dry compressed air supply; and
- Raw Seawater.

Criteria:

- Provision of natural light is not required;
- Temperature controllable between +2°C and +35°C ± 0.5° C; and
- UPS required.

A variety of bench heights to accommodate seated and standing working postures or the ability to adjust bench heights shall be provided.

418. Refrigerated Storage

Walk-in refrigerated storage close to the wet laboratories.

UPS not required.

Criteria:

- A combination of non-UPS 240V 10A and 15A GPOs are required; 415 volt power if required for the large freezer, ice machine or blast freezer.

418.1. External Chilled Compartment

- Volume > 10 m³

Criteria:

- Temperature controllable in the range 10° C to -4° C ± 0.5° C.

418.2. Internal Freezer Compartment

- Volume > 20 m³

Criteria:

- Temperature controllable in the range -18°C to $-20^{\circ}\text{C} \pm 1^{\circ}\text{C}$.

418.3. A chest-type ultra-cold storage facility

- Volume $> 2\text{ m}^3$; and
- Located to facilitate the transfer of samples to and from laboratory spaces.

Criteria:

- Minimum Temperature: -80°C ; and
- Equipped with temperature alarms.

418.4. Clean Freezer Storage

Volume $> 2.5\text{m}^3$ Temperature $-20^{\circ}\text{C} \pm 1^{\circ}\text{C}$.

418.5. Blast Freezer

- Internal volume $> 1.5\text{m}^3$
- Capable of reducing the temperature of 150 kg of water from 20°C to -30°C in one hour; and
- Co-located with walk in freezer space.

418.6. Ice Machine

- 500 kg/day; and
- Co-located with the GP Wet Lab or materials handling facilities for ice delivery.

419. Scientific Stores

UPS not required in Scientific Stores.

419.1. Science store

- Area $> 18\text{ m}^2$ preferably near the laboratory complex.

419.2. Scientific Deck Store

Area $> 40\text{ m}^2$;

- Workbench or benches and located on the main deck; and
- Configured so that it may be made weathertight pre & post equipment deployment and recovery if it opens to the main deck.

419.3. Rope locker

- Area $> 18\text{ m}^2$; and
- Co-located with Scientific Deck Store.

419.4. Scientific Hazardous and Dangerous Materials lockers:

Scientific Hazardous and Dangerous Materials lockers each with approximate volume of 1 m³ for the laboratory storage of small volumes of hazardous materials. Separate lockers are to be provided for acids, bases, solvents, formaldehyde and alcohol.

Laboratory requirements:

- GP Wet Lab (Dirty) – 1 acids locker and 2 general purpose lockers.
- GP Wet Lab (Clean) – 1 acids locker and 2 general purpose lockers.
- Preservation lab – 2 general purpose lockers (formaldehyde and alcohol).
- Hydrochemistry lab – 1 acids locker and 1 general purpose locker.

Outfit:

- Compliant with international best practice for the safe storage and handling of hazardous materials in organizations conducting research;
- Connected to the Vessel's vapour management system;

420. Seismic Air

420.1. Electric Driven Seismic Compressors

The Owner will purchase 2 x Hamworthy 4 TH 565E seismic air compressors and 2 x soft starter units.

The Contractor is to fabricate and install the foundations to suit the 2 Hamworthy 4 TH 565E with resilient mounting devices fitted, to allow Owner to install the compressors at a later date.

The power supply cables and the main circuit breakers up to the compressors are to be purchased and fitted by the Contractor. The freshwater cooling system for the compressors to be installed and blanked with isolation valves adjacent to the compressor foundations. The 2000 psi air lines from the compressors are to be led through the main deck on the Port side and duly isolated with valve and blanks.

421. Gravity Meter Room

421.1 Gravity Meter Space

This space is not to be outfitted as a laboratory. An area of ~4m² housing an Owner Supplied gravity meter shall be located in a temperature controlled room (22°C ± 1°) near the centre of motion of the Vessel as possible, and in close proximity to pitch and rolls sensors. It could be mounted in the ships gyro room if this is in a suitable location. A combination of non-UPS and UPS 240V 10A and 15A GPOs are required.

422. Operations Room

422.1 Centrally located operations room

Adjacent to Electronics Workshop & Data Processing facilities

Statement of Functional Requirements

This is the central location for acoustic and electronic data acquisition and science operations management.

Remote operation of CTD and towed body winch from operations room with change-over to local control

Rack cabinets with transparent doors and sides to minimize noise; cabinets may then also require dedicated mechanical ventilation

Area approximately 50 m²

Outfit:

- Instrument mounting 19" style racks configured to be available for mission specific equipment;
- Racks shall be accessible from the front and back to allow access to connections when instruments are installed;
- Each rack shall provide a supply of electrical power sufficient to operate the maximum number of instruments / systems that may be safely fitted to it;
- Each rack shall be designed to facilitate cable management;
- Temperature regulated in accordance with IT industry practice;
- Computer room style flooring to facilitate cable management;
- Shelving with retaining bars suitable for equipment manuals;
- A chart table of no less than 2m x 1m;
- Permanently installed interfaces to intra-ship communications systems and video monitoring systems;
- Flush 500mm x 500mm matrix tie down points in central part of floor for fitting/ reconfiguring racks;
- Matching recessed C-channels in ceiling for fitting racks;
- Horizontal/vertical C-channels on walls for fixing equipment;
- About 10 workplaces, chairs and 13 racks;
- About 21m x 0.75m work desks, cabinets under, shelves above, replaceable protective plywood sheeting for fixing equipment; and
- Below ceiling cable trays for scientific cabling; and
- UPS required for all work areas and racks but this space is not to be outfitted as a laboratory.

Access to video streams from all spaces need not be provided, video streams from all science working areas shall be available.

423. **Data Processing Laboratory**


423.1 Data Processing Lab

Dedicated facility fitted to support a full range of scientific and academic IT activity including voyage planning and assessment. Owner will procure and install computing platforms and peripherals for this area.

Area >40m².

UPS required but this space is not to be outfitted as a laboratory.

Outfit:

- Printers
 - Scanners
 - Photocopiers
 - Benches/working surfaces >20 m²
- 
- Owners supply

424. **Network & IT Infrastructure Management Office**

424.1 Network & IT Infrastructure Management Office

A network and IT management office providing workstations dedicated to network, communications & IT infrastructure management. The Owner will procure and install the computing platforms associated with this area.

Area >15m²

Co-located with IT machine room.

UPS required but this space is not to be outfitted as a laboratory.

Outfit:

- At least 5m² of desktop suitable for computing platforms; and
- IT support workshop & storage for ready use spare equipment and IT consumables.

A network and IT management office providing workstations dedicated to network, communications & IT infrastructure management.

425. **Machine Room**

425.1 IT Machine Room

IT Machine room housing network and IT core infrastructure, communications, network, print and file servers, archive media writing devices and associated equipment. The IT Machine Room shall be fitted with the maximum practical number of floor to ceiling 19" style racks to facilitate the placement and securing of equipment.

Area > 25m².

Co-located with network & IT infrastructure management office.

UPS required but this space is not to be outfitted as a laboratory.

Outfit:

- Network cable hubs/patch panels; and
- 19" Instrument mounting racks.

Criteria:

- Temperature regulated in accordance with IT industry practice;
- Racks shall be accessible from the front and back to allow access to connections when instruments are installed;
- Each rack shall provide a supply of electrical power sufficient to operate the maximum number of instruments / systems that may be safely fitted to it;
- Each rack shall facilitate cable management; and
- Computer room style flooring to facilitate cable management.

The space is to be protected with a dedicated FiFi fixed gas installation.

426. **Aerosol Laboratory**

426.1 Aerosol Laboratory

Laboratory located on the foredeck or mooring deck at the base of the foremast with safe access from the mooring deck. Sampling mast must provide direct atmospheric air feed to the aerosol lab without bends.

Area ~15 m².

UPS required but this space is not to be outfitted as a laboratory.

Outfit:

- Bench surfaces of ~3 m²;
- Accommodate 3 standard instrument racks;
- Space to secure 2 standard gas cylinders ("G" size, approximately 1.5m tall by 0.25m in diameter);
- Access to mast to service inlets;
- One sink with hot and cold fresh water, and drains;
- Two computer workstations;
- Flush 500x500 matrix tie down points in central part of floor for fitting/reconfiguring racks;
- Matching recessed C-channels in ceiling for fitting racks, cable trays etc;

- Horizontal/vertical C-channels on walls for fixing equipment;
- Desks and benches fitted with 22mm replaceable protective plywood sheeting for fixing equipment;
- 7 bar oil free/dry compressed air supply; and
- External pump house (1 m³) to be waterproof, with a 240v electric fan to cool the pump house.

Criteria:

- Temperature 22°C ± 1°C;
- Racks shall be 19" style;
- Racks shall be accessible from the front and back to allow access to connections when instruments are installed;
- Each rack shall provide a supply of electrical power sufficient to operate the maximum number of instruments / systems that may be safely fitted to it;
- Each rack shall facilitate cable management; and
- Computer room style flooring to facilitate cable management.

427. Air Chemistry Laboratory

427.1 Air Chemistry Laboratory

Laboratory located at the forward end of the superstructure on the foredeck or mooring deck level taking atmospheric air via the aerosol sampling mast after passing through the aerosol lab. An adjacent pump house is needed to draw air from the mast head inlet and deliver this to the Air Chemistry laboratory. The outlet of the pump is vented to the outside environment. The lab will be used primarily for atmospheric chemistry sampling underway (refer 126.2).

Area ~30 m².

UPS required but this space is not to be outfitted as a laboratory.

Outfit:

- Bench surfaces of ~5 m²;
- Accommodate 5 standard instrument racks;
- Space to secure 5 standard gas cylinders ("G" size, approximately 1.5m tall by 0.25m in diameter);
- Provision for an adjacent external pump house (1 m³);
- One sink with hot and cold domestic fresh water supplied;
- Deionized fresh water from a standalone purification unit;
- Two computer work stations;

Statement of Functional Requirements

- Flush 500x500 matrix tie down points in central part of floor for fitting/reconfiguring racks;
- Matching recessed C-channels in ceiling for fitting racks, cable trays etc;
- Horizontal/vertical C-channels on walls for fixing equipment;
- Desks and benches fitted with 22mm replaceable protective plywood sheeting for fixing equipment;
- 7 bar oil free/dry compressed air supply; and
- External pump house (1 m³) to be waterproof, with a 240v electric fan to cool the pump house.

Criteria:

- Temperature 22oC ± 1oC
- Racks shall be 19" style;
- Racks shall be accessible from the front and back to allow access to connections when instruments are installed;
- Each rack shall provide a supply of electrical power sufficient to operate the maximum number of instruments / systems that may be safely fitted to it;
- Each rack shall facilitate cable management; and
- Computer room style flooring to facilitate cable management.

Seakeeping Performance, Annex 1

BACKGROUND AND PURPOSE

This Standard of Seakeeping Performance, Annex 1, is a high level specification giving additional detail to criteria 112.

The criteria and requirements set out in this document are based largely on DEF (AUST) 5000. (2003), which is the current set of seakeeping standards for procurement of Australian naval vessels. Further information regarding DEF(AUST)5000 requirements can be downloaded at the following website:

http://www.navy.gov.au/Publication:Maritime_Materiel_Requirements_Set

DEFINITIONS AND TERMS USED

The term significant wave height when used for spectral purposes shall be defined as 4 times the square root of the area under the spectrum, regardless of spectral broadness.

Deck wetness for transit criteria shall be measured at the Forward Perpendicular (FP).

Deck wetness for equipment deployments shall be measured at the location of areas manned to undertake the task.

Slamming shall be measured at the worst location, nominally 20% LWL aft of FP.

Emergence for transit criteria shall be measured at 25% of prop diameter below top of propeller disk(s).

Emergence for sonar shall be measured at the forward intersection of the sonar dome with the hull.

Any Helicopter criteria shall be measured at the centre of the helicopter winch area.

Motion Induced Interruptions (MII) shall be calculated in accordance with Annex A.1.8 of DEF (AUST) 5000, 2003, using a lateral tipping coefficient of 0.25.

Motion Sickness Index (MSI) for transit shall be measured at all regularly occupied operational and accommodation spaces, and calculated in accordance with Annex I of DEF (AUST) 5000, 2003.

Motion Sickness Index for equipment deployments shall be measure at the location of areas manned to undertake the task.

Single Significant Amplitudes (SSA) vertical acceleration and Lateral Force Estimator (LFE) for survival transit shall be measured at the bridge and any other space required to be manned during transit.

ASSUMPTIONS FOR ALL ACTIVITIES

Motion control systems may be used when assessing seakeeping performance.

All measurements and analyses shall be required to withstand scrutiny from independent authorities appointed by the Owner.

LIMITING CRITERIA

	transit	survival	Equipment L&R	Hull-mounted active sonar	Hull-mounted passive sonar	Helicopter Operation
Deck wetness per hr	30		0.5			
Slamming per hr	20					
Emergence per hr	90			24	90	
MSI (% in 4 hrs)	20		20			
MII per minute	1		0.5			
SSA vertical velocity (m/s)						2.0
SSA vert. accn (g)		0.6				0.4
SSA LFE (g)	0.2	0.3				0.125
SSA roll (deg)	8			15		
SSA pitch (deg)				5		

Table A1 – Limiting Criteria

Note that for launch and recovery of Fast Rescue Craft (FRC), relative motions of both vessels shall be considered.

Limiting criteria for fishing operations and towed sonars have not been specified. In the absence of other information, the criteria for equipment launch and recovery may be used as a guide.

SEA CONDITIONS

All references to Sea State (SS) in this document relate to World Meteorological Organisation (WMO) Sea State Code definitions. Seakeeping shall be tested against the following additional spectra:

- Long crested bi modal in period;
- Short crested (cosine squared +/- 90 deg) single mode;
- Short crested bi-modal in period;

Statement of Functional Requirements

- Short crested bi- modal in direction and period, representing the condition of southern ocean swell with wind-waves just prior to passage of a cold front.

Using the long-crested single mode deep water Bretschneider formulation. The assessment will be carried out with reference to Table 3 attached below.

OPERABILITY

Assessment shall be carried out at two loading conditions – full load and 20% load.

Operability shall be determined at best available heading.

	Significant wave height (m)	Average period (s)	ship speed	Operability %
transit	6	9.5, 10.5	4, 8, 12	100
survival	14.0	11, 12	Not specified	100
Stern L&R of ROV	2.5	7, 9	4, 8, 12	100
L&R of FRC	4.0	8, 10	4, 8, 12	100
General Science deployments	4.0	8, 10	8	100
	6.0	9.5, 10.5	4,8	95
CTD operations	4.0	8, 10	0	90
	6.0	9.5, 10.5	0	50
Mooring deployments	4.0	8, 10	3	75
	6.0	9.5, 10.5	3	25
Coring operations	4.0	8, 10	0	50
	6.0	9.5, 10.5	0	20
ROV and other sensitive operations	4.0	8, 10	<3	50
Fishing operations	6.0	9.5, 10.5	4	98
Hull-mounted acoustic sensors	6.0	9.5, 10.5	12	100
Towed acoustic sensors	6.0	9.5, 10.5	<8	100
Helicopter Operation	1.25	6.5, 7.5	<3	95

Table A2 - Operability

Irrespective of seakeeping performance criteria listed in this document, the Vessel and the persons on board shall be capable of withstanding a southern ocean storm of severity Sea State 8, retaining the capability of subsequently returning to safe haven unaided.

REFERENCES

DEF (AUST) 5000. (2003) ADF Maritime Materiel Requirement Set Vol 3 Part 6: Seakeeping.
RAN document A016464, 28 May 2003

Similar coloured boxes mean spaces should be on the same deck level
Sample flow patterns

BOXES NOT TO SCALE!

