Replacement Capability Assessment Project

Phase II Consultation

MARINE
NATIONAL FACILITY

Statement of Requirements

Report of the Expert Working Group

CSIRO

Future Research Vessel

The Marine National Facility Steering Committee has tasked an Expert Working Group to develop a Functional Specification for future blue-water research vessel capability.

Membership

Captain Fred Stein, Director MNF; Chair
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Captain Steve Hunt, Australian Shipping Industry
Dr. Julie Hall, NIWA
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Scope

Australia's ocean territory runs from the high tropics to the Antarctic, and from the coast to the abyss. No single piece of research infrastructure could possibly cover all of this territory and the different kinds of science needed across this territory. The scope of the capability being defined here must be complementary to:

- the Southern Ocean and ice-capable research vessel capability utilised by the Australian Antarctic Division (currently RSV *Aurora Australis*), and
- the coastal research vessel capability of the Australian Institute of Marine Science (currently RV's *Cape Ferguson* and *Solander*), and various State Governments and Universities

Objective

To produce a Functional Specification for a broadly capable, multi-role, future blue water research vessel. The Functional Specification should be suitable for inclusion in a Statement of Requirements for the supply of the capability sought.

Terms of Reference

The advice provided must consider:

- the feedback provided to and recommendations arising from Phase I of the Project;
- The capability of the current vessel of the MNF, RV *Southern Surveyor* and of other vessels in the national "fleet";
- electronic sampling systems, including data acquisition and processing;
- mechanical sampling systems;
- laboratory requirements;
- Other capability – Space-based observing systems, aircraft, deep submergence facilities, AUV's, drifters & floats
- international trends in comparable types of capability; and
- a time horizon of approximately 10 years.

Process

The working group circulated a Request for Comments to:

- Commonwealth Government agencies with a stake in the operation of the MNF,
- State Governments,
- Universities with active marine science programs,
- Recent users of the MNF, and
- The Australian Marine Science Association

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The Future of Blue Water Research

Introduction

The Marine National Facility research vessel, *Southern Surveyor,* was built in 1971 and is approaching the end of its useful life. *Southern Surveyor* was built as a North Sea trawler. Prior to its conversion for use as a research vessel it also saw service as an oilfield Dive Support Vessel. It is a tribute to the vessel operators that its useful life has been extended well beyond its design life of 20 years.

The Statement of Requirements (SOR) attached to this report describes a replacement vessel. The replacement vessel is larger and more capable than *Southern Surveyor,* as it must be to support year-round operations in Australia's unique marine domain.

The Marine National Facility consulted with the marine science community in 2006 to identify the capabilities required to meet the demand for blue water research in coming decades. The science community identified the following requirements.

Operational Scope

- From the ice edge to the tropics throughout Australia's surrounding oceans.
- From the continental shelf to the abyssal plains.

Science Mission Requirements

- Support for a broad range of sophisticated scientific activities by multi-disciplinary research teams.
- 24 hour operation.
- Sea-keeping characteristics that maximise operational effectiveness.
- The ability to efficiently interface customized research systems with a core suite of sampling equipment and sensors.
- The ability to combine data from on-board observations with data from shore based models, space-based and autonomous sensors in real time.
- The ability to manage, visualise and communicate data and results in real time.

The provision of a safe working environment aboard a vessel that will routinely encounter the challenges of the Southern Ocean and the cyclones of Australia's Tropical North and the science community's vision of the tasks confronting it are the primary drivers of the design process.

Background

In early 2006 the NCRIS Strategic roadmap identified; *"...a blue water research vessel capability, ..."* as landmark infrastructure consistent with the NCRIS principle of identifying; *"… those capabilities that will provide the most strategic impact in terms of delivering national benefit, producing world-class excellence in both discovery and application driven research, and/or enhancing the overall capacity of the research and innovation system by providing enabling research platforms and promoting accessibility and collaboration.* "

However the Strategic Roadmap also stated that; *"It is not within the scope of the NCRIS Programme to provide a means whereby proposals for large-scale infrastructure proposals can be developed or considered by government."*
In response to advice that RV *Southern Surveyor* will reach the end of its useful life by July 2011 the MNF Steering Committee commissioned an Expert Working Group to consult with the Marine Science and Technology community in order to identify:

- The capabilities required to support blue water research in coming decades;
- A mechanism to efficiently deliver the capabilities sought to the research community.

The Expert Working Group's Report on Phase I of its consultation:

- Identifies in Attachment 4 the core capabilities that are key success factors for a broadly capable, multi-role, blue-water research vessel tasked to support provision of the scientific advice that informs and underpins the sustainable development of Australia's oceans by reference to the existing capabilities of *Southern Surveyor*;
- Confirms that an appropriately designed and operated vessel of ~80m will deliver >80% of the capabilities sought;
- Recommends that reservation of funding to support short-term access to specific, specialised capability is a more efficient and effective method of specialized capability delivery than its addition to a multi-purpose research vessel.

Having identified the core capabilities that will be key success factors for a future research vessel the Marine National Facility Steering Committee tasked the Expert Working Group to articulate the capabilities identified as a SOR for the supply of those capabilities.

Guiding Principles

1. The SOR should be suitable for inclusion in a Request for Tender for the supply of the capability sought.
2. The preferred means of acquisition is an open call to the market for the charter of a vessel that will deliver the desired capability as a package solution.
3. The SOR should explicitly identify the constraints, design features, core equipment, sensors and key systems required to deliver the capability sought.
4. The opportunities for potential suppliers to deliver innovative and cost effective responses to providing the capability sought will be maximised if the SOR is structured as a Statement of Functional Capabilities and not a detail design brief.
5. The broadly based capability sought will be most efficiently delivered by a solution that:
    - provides a suite of core functionality based on off-the-shelf technology engineered to be efficiently interfaced with customized research systems
    - is engineered to be efficiently re-configured to suit the needs of specific research missions by the addition and subtraction of modular units that provide research specific functionality
6. Change in research directions and technologies will occur during the life of a research vessel. Over the long term the most efficient platform will be one that is engineered by design to efficiently accommodate change.

Phase II Consultation

On 23 May 2007 the Expert Working Group circulated a Request For Comments (RFC) to 80+ representatives of the Australian Marine Science community. The MNF User Group were in particular asked for their views as were representatives of a broad cross section of research organizations including government agencies, universities and museums.

Stakeholders were asked to comment on an SOR for a Future Research Vessel. The SOR was developed from the Core Capabilities identified in the Report of Phase I of this consultative process. The SOR also incorporated feedback received following publication of the initial Report.

Responses to RFC

A mixture of individual and organisational responses to the RFC were received. All responses concurred that the Core Capabilities identified are appropriate in scope. A number of respondents provided feedback on specific features identified in the Statement of Requirements with:

- suggestions for amendment
- further detail of the functionality described
- the relevance of recommended functionality to specific research

The Future of Blue Water Research

Statement of Requirements

Following the receipt of feedback the Expert Working Group met to review the SOR in the light of the feedback from stakeholders. The attached SOR is the product of that review.

Structure of SOR

The attached SOR describes the core features of a vessel that will deliver the key capabilities sought. In addition the SOR describes the core science outfit proposed for a future blue water research vessel.

Modularity

Consistent with Guiding Principle 5 the science outfit described in Annexure 2 to the SOR identifies a number of research capabilities that if developed as modular systems will maximise the flexibility with which the proposed vessel may be efficiently configured to suit the need of particular voyages. In addition it is the view of the working group that the following systems have features that render them unsuitable to be permanently incorporated into the fabric of a research vessel.

- Trace Metal Clean Sampling System
- Radiation Laboratory
- Long Sediment Coring System

Modularisation of the systems identified below should not be interpreted as an indication that these systems are of lesser value to the research community. These systems fall within the envelope of the capabilities that a Marine National Facility should make available to blue water science.

Providing access to the full range of capabilities identified in the SOR will maximise the opportunity of the entire blue water science community to collaborate to investigate the many challenges that Australia's surrounding oceans offer. It will also maximise opportunities for the research community to attract international collaboration from researchers of the highest calibre and by so doing leverage international interest in key questions of strategic national significance.

Modular Science Outfit

The order of the list below is not an indication of relative merit..

- Trace Metal Clean Sampling System
- Radiation Laboratory
- Sediment Coring System(s)
- Trawl Winches
- Hydrochemistry Laboratory
- Seismic Acquisition System
- Remotely Operated Vehicle

Each of these systems has one or more of the following characteristics:

- It is particularly suited to modular deployment;
- It is unsuitable for integration into the fabric of a research vessel;
- While of particular value to a segment of the marine science community its use is not sufficiently frequent to warrant a permanent allocation of space.

Remotely Operated Vehicle

At this time the acquisition of a research ROV capability is outside the scope of this SOR. However, it is intended that a vessel with the core capabilities described be suitable to support the mobilization aboard and operation of a work class ROV at depths of 5000m+ .

Acknowledgements

Many people and organisations contributed a substantial amount of time, effort and wisdom to this report. The Expert Working Group would like to thank all those who responded to its Request for Comments. The Chair would like to thank the Working Group members for making their time and expertise available and notes that whatever wisdom may be found in this report are undoubtedly theirs while the mistakes are certainly his.

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APPENDICIES

ANNEXURES

VESSEL PARTICULARS

1. Classification§

1.1. +100A1+LMC UMS Ice 1C SPS

2. Principal Dimensions§

2.1. Length: 70 - 80 m
2.2. Beam: 17 - 20 m
2.3. Draft 5.5+ m
An alternative draft that achieves the sea-keeping characteristics identified in the Summary of Operational Performance will be considered by the proposal assessment process.
2.4. Depth, air draft
No constraint is placed on these parameters.

OPERATIONAL PERFORMANCE REQUIREMENTS

3. Area of Operation§

Primary Design Criteria

The vessel must 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 65°S and longitudes 50°E and 150°W. Without limiting the generality of the above the vessel should be particularly suited to operation in Australia's Maritime Jurisdiction and the Tasman, Arafura, Timor, Coral and China Seas.

3.1. Temperature
3.1.1. The vessel should be capable of operating in water temperatures of -2°C to +35°C
3.1.2. The vessel should be capable of operating in air temperatures of -30°C to +45°C.
3.1.3. Consideration should be given to the fact that the vessel may be required to withstand 'freezing spray' conditions on occasion for a minimum of 12 hours in the context of the vessel's stability.
3.2. Ice strengthening
It is desirable that the vessel have the capability to transit and conduct scientific operations in 2 tenths of first year ice. The vessel proposed should be designed to meet the criteria for the appropriate ice classification. Alternative Ice classification may be proposed. Consideration should be given to alternatives where requirements for the propeller and shaft are the only significant barrier to compliance with ICES 209 recommendations. The proposal assessment process will specifically consider the cost effectiveness of the Ice Classification and strengthening regime proposed in the context of its impact on functional delivery.

4. Speed§

Primary Design Criterion

An operating profile that includes 'on station' and / or slow speed manoeuvres for extended periods of time should be accommodated by considering its impact on the design of engines, water making capability, auxiliary machinery and services and other factors.

4.1. Condition for speed criteria compliance assessment
4.1.1. fully loaded
4.1.2. salt water (SG 1.025)
4.1.3. six months out of dock

4.2. Maximum speed
The vessel should be capable of reaching and maintaining a speed of 16kt through SS 5.

4.3. Optimum Operational Speed
The vessel should be designed for an optimum efficient operating speed of 12kt and should be able to sustain this speed through SS 6 while maintaining the sea-keeping characteristics identified in the Summary of Operational Performance

4.4. Speed Control
In SS 4 or less a designated speed should be capable of being maintained to a tolerance of:
- 0.1 knot in the 0-6 knot range
- 0.2 knot in the 6-12 knot range

5. Range§

Primary Design Criteria

5.1. The range of the vessel should be 10,000 nautical miles at 12 knots.

5.2. Propulsion fuel should not be used as a primary form of ballast; the vessel is to have sufficient ballast tanks to offset fuel consumed.

6. Science Berths§

6.1. 30+
The proposal assessment process will asses the cost effectiveness of options proposed.

7. Hotel Endurance

7.1. The vessel should have a hotel endurance of 50 days with a full complement embarked.

8. Manoeuvring and Control§

Primary Design Criterion

Manoeuvring controls should be positioned to provide an operator with maximum visibility of deck work areas and alongside science operations, especially recognising the need for an unobstructed view of the deployment and retrieval of equipment.

8.1. Navigation§
The ability of a vessel to follow a track or keep station is subject to the accuracy with which it's geographical or relative position can be measured.

8.1.1. Accuracy of positioning
3D geo-referenced instantaneous positions accurate to < 1m rms at the 3σ (99.7%) level.

8.1.2. Parameters measured
Heading, pitch, roll, heave, 3D linear and angular velocities & accelerations

8.2. Navigation Data Distribution
This may be provided by using a dedicated system or by serving an NMEA data-stream via ship wide LAN for display or use by client software. The ship's position and motion parameters should be available from all segments of the vessel's network. Position and motion parameters should update at a frequency that meets the most demanding requirements of the instruments fitted.

8.3. Heading Accuracy
The vessel should be able to maintain a designated heading to an accuracy of:

8.3.1. +/- 5º in the 0-12 knot range while towing equipment, regardless of the direction of the wind and current through SS 6

8.3.2. +/- 5º from a minimum safe speed to 9kt at best heading in SS 7

8.3.3. +/-10º from a minimum safe speed to 6kt at best heading in SS 8

8.3.4. +/-15º from a minimum safe speed to 9kt at best heading in SS 8 and above

8.4. Thrust and manoeuvring control

8.4.1. Exacting control over the propulsion and manoeuvring systems should be available at all times so that towed gear can be maintained at desired depths and configurations when external factors such as waves, wind and currents act on the hull. Small adjustments to total thrust vectors should be possible at all times.

8.4.2. The vessel should be capable of turning 180 degrees in two minutes or less in up to SS 4, while manoeuvring within a circle of two ship-lengths diameter. Apart from a specific time period, the vessel should be capable of making a similar manoeuvre in up to SS 6.

8.4.3. The vessel should be capable of performing a turn with a tactical diameter of less than 3 ship lengths at 12 knots, calm conditions (no wind or current), in either direction.

8.4.4. The vessel should be able to maintain track at a steady speed of 5 knots in SS 5while towing:

8.4.4.1. a 25m x 42m x 400m surface trawl

8.4.4.2. a mid-water trawl, such as an IYGPT(mouth size 160 m^2) at a depth of 500 metres

8.4.4.3. a demersal trawl such as a McKenna Orange Roughy trawl

8.5. Station Keeping and Track Following

8.5.1. Station Keeping

8.5.1.1. This vessel should be able to maintain a position and heading relative to a geo-referenced location in accordance with the Summary of Operational Performance 100% of the time in sea states through SS 5 at best heading.

8.5.1.2. Dynamic Positioning System[§]
Dynamic positioning of the vessel should be provided using the best possible and multiple navigation inputs should be provided in both relative and absolute references. DP system design and operation should minimize noise, vibration, and adverse effects on the operation of acoustic systems as much as possible, and the impact of the design proposed will be evaluated by the proposal assessment process.

- Vessel should comply with standards for DP I
- DP system should be designed for cost effective upgrade to DP II

8.5.2. Track Following

8.5.2.1. The vessel should be able to maintain a heading and position relative to a geo-referenced track while maintaining an acceptable yaw angle (maximum acceptable yaw angle is 15º) in accordance with the Summary of Operational Performance.

8.5.2.2. Straight track segments should be maintained without large and/or frequent heading changes.

9. Sea-keeping[§]

Sea-keeping is the ability to put to sea and safely maintain program activities and tasks in the specified area of operation while maintaining comfort and safety. Attention to achieving the most sea-kindly design is essential, researchers typically only go to sea infrequently and a high incidence of motion sickness, fatigue and reduced operational windows can jeopardise program success.

Primary Design Criterion

Vessel design must address the need for a stable and comfortable research platform from which a wide variety of scientific equipment can be operated reliably. The design must *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.*

9.1. Motion criteria
Specifications should be confirmed as adequate and achievable during the earliest concept design phase. A table showing the practical effects of ship motion is included as Annex IV.
Alternative motion criteria that result in ship motions that allow personnel and equipment to work effectively can be utilized as long as the intent of the associated sea keeping specifications is not sacrificed.

9.2. Primary activities in conditions up to SS 6

9.3. Secondary activities in conditions up to SS 7

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

10. Hours of Operation

10.1. The vessel should be capable of 24 hour continuous operation

SCIENTIFIC REQUIREMENTS

11. Essential

11.1. All overboard discharges from sinks, drains, sewage treatment systems, cooling systems, ballast pumps, fire fighting pumps, and other shipboard or science systems should be on the side of the ship opposite to the Side Science Operations area to avoid contamination of samples or equipment being retrieved. Tanks capable of holding normal internal discharges for a minimum of 24 hours should be provided. 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 during normal operations, is desirable.

11.2. Discharges from engine exhausts, tank and sewage system vents, exhaust from fume cupboards, and ventilation systems should 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. Exhaust and air system discharges should be separated from sensor locations as much as possible.

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

12. Desirable

12.1. Meets ICES 209 vessel noise recommendations.
While this criterion is identified as desirable rather than essential the value of an acoustically quiet platform is significant. The vessel must be acoustically quiet, in hydro-acoustic bands and in these bands achieve ICES 209 performance or better. Vibration damped diesel-electric drives through acoustically optimised, fixed blade propeller(s) with anti-vibration mounted auxiliary machinery will contribute to this. Proposal assessment will specifically address cost benefit implications of full ICES 209 compliance.

REGULATORY REQUIREMENTS

13. Conformance with Statute and practice

13.1. The vessel should be classed as Foreign Going and must meet all requirements under the *Navigation Act(1912)C'th* as amended, International Association of Classification Societies (IACS), requirements under SOLAS, MARPOL and be suitable for, or classified for, UMS operation.

13.2. The vessel must meet all requirements for a vessel occasionally operating in Antarctic waters.

13.3. Safety and Security
The vessel should in particular incorporate state-of-the-art arrangements to ensure the safety and security of crew and researchers including but not limited a Ship Security Alert System.

COST

14. Total Cost of Acquisition

14.1. Cost Considerations
'Cost' is interpreted to mean the total cost for design, construction, outfitting and mobilization in 2007 dollars. Cost will be a significant factor influencing the selection of an appropriate vessel. Funding mechanisms available will determine the total budget for design, construction, and outfitting. The fiscal requirements of project management, outfitting and design assessment must be considered when assessing total project cost. Cost should be expressed as an annualized amount and an initial charter period of 10 years should be used as the basis for calculation. The design of the proposed vessel should carefully consider long term operating costs so that decisions are not made that would drive up annual operating and maintenance costs.

15. Maintenance and Life Cycle Costs

15.1. Life cycle operating costs associated with ongoing maintenance and the availability of parts, particularly for systems where change may have an impact on time-series oriented research, should be considered so that overall daily operating cost can be kept to minimum.

15.2. The annualized cost for the platform proposed should anticipate and be inclusive of the costs of dockings mandated by statute and required by a prudent owner operating in accordance with international best practice for maritime management.

15.3. The annualized cost for the platform proposed should anticipate and be inclusive of the cost of a mid-life refit undertaken in conjunction with the vessel's second routine docking. The proposal assessment process will consider the cost effectiveness of the refit proposal provided.

16. Redundancy and Reliability

16.1. Due to the nature of its work and remoteness of the areas in which it will be required to work the vessel and its systems should have a high degree of reliability.

16.2. The vessel should not be reliant on a single main engine or single auxiliary alternator.

16.3. Designs proposed should deliver an element of redundancy for mission critical systems. Possible redundancy strategies are duplication, carriage of an enhanced suite of spares, or the ability to re-task / re-configure equipment. Proposals should explicitly describe the strategies adopted to manage the risk of critical equipment outages. The proposal assessment process will consider the cost effectiveness of the redundancy strategies proposed.

ERGONOMIC DESIGN PRINCIPLES

17. General

17.1. Materials handling
There should be ergonomically appropriate means for transporting samples, equipment and stores between working deck areas, labs, workshops and storage areas. In particular:

17.1.1. storage areas should be accessible at all stages of a voyage and materials handling systems should be provided to facilitate the safe handling and transfer of heavy, bulky and or fragile equipment or samples to or from working areas during a voyage

17.1.2. external openings, and associated equipment handling systems, should be designed to facilitate the safe handling and transfer of heavy, bulky and or fragile equipment or samples to or from working areas during a voyage

17.1.3. alleyways, hatches and doorways connecting laboratory spaces with each other, with storage spaces and with working decks should be designed to facilitate the safe handling and transfer of heavy, bulky and or fragile equipment or samples

17.1.4. lifting equipment should be available at all stages of a voyage to safely handle and position heavy items on working decks

17.2. Integrated Workstations

The functions, communications, and layout of work stations should be carefully designed in accordance with international best practice to enhance and support interaction between ship and science operations. For example, ship course, speed, attitude, and positioning should be integrated with scientific information systems and the display of output from other systems such as radar, acoustic sensors and equipment status displays. Voice communication systems between the bridge, labs, working decks, and machinery spaces should be designed to effectively enhance ship and machinery control during science operations.

17.3. Noise

Where practicable noise levels on all open deck areas, in working spaces and accommodation spaces should not exceed those identified in AS/NZ 1269 as having the potential to contribute to long term hearing loss. Where the intrinsic nature of the operations in a particular area render this impractical (ie Main engine and other machinery spaces) the space concerned shall be clearly marked at all entrances and exits and precautions required to prevent damage to hearing clearly indicated.

DESIGN FEATURES

GENERAL

18. Like for Like

18.1. Where reference is made to a specific brand, model or type of equipment this should be read as an example of the functionality, accuracy and connectivity sought. Alternatives are acceptable but should deliver no less a standard of performance. The proposal assessment process will consider the cost effectiveness of alternatives proposed. Alternative proposals should expressly compare and contrast the performance of the alternate proposed with the brand/model/type of equipment identified in the specification.

18.2. In those instances where a specific item of equipment is sought this will be clearly identified.

19. Cabling

19.1. There should be easy 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. Strategies implemented to achieve this objective may include, fitted cable runs, dedicated ducting with redundant cabling, redundant glands through decks and bulkheads, accessible junction boxes, vertically aligned inter-deck closets, computer-room style flooring in appropriate areas and drop-down ceilings.

SERVICES

20. Electrical Supply§

20.1. A clean and stable supply of A/C electricity.

20.1.1. Power supply arrangements should be engineered to minimize electromagnetic interference with the electronic equipment onboard.

20.1.2. All Operations Room, laboratory, workshop, bridge & IT harness 240V power to be supplied via UPS with a cascading preferential trip system that secures functionality and protects data and equipment. The UPS system should be capable of delivering a minimum of 120 kVA.

20.1.3. 2 x 3 ph 32 A supplies available in the Scientific Operations Area.

20.1.4. Each container location to be provided with an individual supply of 240 V 15 A and an individual supply of 3 ph 415 V, 32 A.

20.1.5. Deck workshop should be provided with a 3 ph, 32 A, 415 V supply.

20.1.6. Supplies of 3 ph 415 V at 64 A and 200 A should be available from distribution boards adjacent to the After Deck & Side Science Area.

20.1.7. Supplies of 1 ph 240 V at 125 A should be available from distribution boards adjacent to the Aft Deck & Side Science Area.

21. Network Services§

21.1. The vessel should be fitted with an IEEE standard 802.3 compliant LAN with a bandwidth no less than that delivered by commercially available state-of-the-art off-the-shelf technology at the time of supply. Other networking technologies, such as that delivered by IEEE standard 802.11 may form part of the LAN delivery package. If state-of-the-art performance can be cost effectively achieved by some other technology an alternative may be proposed. The proposal assessment process will consider the cost effectiveness of the network architecture proposed.

21.2. Network design principles

The architecture proposed should accommodate and facilitate:

21.2.1. the probable evolution of network technology

21.2.2. the likely need for component replacement and/or upgrades

21.2.3. the challenges placed on IT by a shipboard environment

21.2.4. an environment that features a regularly changing user group

21.2.5. the routine connection and disconnection of user workstations running under a variety of operating systems

21.2.6. probable use as an element of a communications infrastructure

21.2.7. cost effective connection to a corporate WAN/GAN

21.2.8. secure segmentation of the network into discrete sub-networks

21.3. Network Administration

21.3.1. Servers and hubs should be located in dedicated spaces (machine rooms)

21.3.2. Machine rooms should be temperature regulated in accordance with IT industry practice, fitted with adequate capacity for the rack-mounting of equipment, adequate electrical supply and should be designed to facilitate cable management, maintenance, upgrades to cable harnesses and system growth

21.3.3. It should be possible, in so far as practical, to administer the network from dedicated workstation(s) located outside the machine room

21.3.4. Workstations primarily dedicated to network administration should not be located in spaces primarily used for the conduct of science operations

21.4. Servers

The network architecture proposed should accommodate and facilitate, with a minimum need for user interaction:

21.4.1. Scientific data communication, storage and backup

21.4.2. Personal data communication, storage and backup

21.4.3. Ship and Marine Operations data communication, storage and backup

21.4.4. Network administration, security and segmentation

21.4.5. The distribution and management of workstation software

21.5. Network Availability

Network design should maximize the availability of LAN connections and maximize connectivity. It may be anticipated that, if used as a communications infrastructure for intra-ship communication by a technology such as VoIP, demand for connectivity will be increased. As a minimum connectivity must be provided to:

21.5.1. Wheelhouse/Bridge

21.5.2. All cabins

21.5.3. All science spaces and offices

21.5.4. All lounges, meeting and public spaces

21.5.5. All working and machinery spaces

21.5.6. Container stowage locations

The proposal assessment process will consider the adequacy of the connectivity proposed.

22. Communications§

22.1. Intra-ship

22.1.1. Phone to all working, machinery, storage, accommodation, and recreational spaces

22.1.2. Shipwide Public Address – addressable and broadcast

22.1.3. Base Station UHF, simplex and full duplex modes

22.2. External Communications

22.2.1. Ability to transfer/receive data on a ship-to-ship or ship-to-shore data link. No less than 512kb bandwidth.

22.2.2. Email and Internet access.

23. Seawater§

23.1. Analysis Seawater
- 23.1.1. Supply should be clean of contaminants and debubbled
- 23.1.2. Flow > 40 litres/min @ ~35kPa.
- 23.1.3. Temperature change between point of seawater intake and points of supply < 0.5ºC
- 23.1.4. Supply to Hydrochemistry, General Purpose, Clean Wet Laboratory and Underway Seawater Analysis Laboratory

23.2. Circulating Clean Seawater
A continuously refreshed supply of seawater drawn from and returned to the immediate environment.
- 23.2.1. Flow > 200l/min @ > 35kPa
- 23.2.2. Pump(s) to be diaphragm type
- 23.2.3. Temperature change between point of seawater intake and points of supply < 0.5ºC
- 23.2.4. Supply to all plumbed laboratory spaces

23.3. Deck (Raw) Seawater
- 23.3.1. Supply should be free of gross contaminants but may be drawn from ER sea chests
- 23.3.2. Flow > 300l/min @600kPa
- 23.3.3. Supply to all external working decks, GP Wet laboratories, constant temperature and CTD laboratories
- 23.3.4. Not drawn from vessel's fire main

24. Laboratory Fresh water§

24.1. Laboratory Fresh Water
- 24.1.1. Flow > 40l/min @ 400kPa
  Pressure and flow to be maintained with 50% of valves fully open

24.2. Ultra-pure Fresh Water
A supply of de-ionized fresh water should be available to designated laboratories. A centralized system that distributes ultra-pure water to designated points of supply is preferred.
- 24.2.1. Flow > 200 l/day(total) @ 100 kPa

25. Vapour Management§

25.1. All Fume cupboards & Hazardous Materials lockers should be connected to a vapour management system designed to ensure that potentially hazardous and toxic vapours:
- 25.1.1. are not re-introduced to the ship's HVAC systems or the internal environment
- 25.1.2. are not inappropriately released to atmosphere

The proposal assessment processes will asses the cost effectiveness of options proposed.

26. Workspace Monitoring

26.1. All working areas and winches should be monitored by closed circuit TV or functionally similar technology

26.2. All unmanned spaces (as defined by the SOLAS convention) should be monitored by closed circuit TV or functionally similar technology

26.3. All PTZ capable cameras should be capable of operation from any workstation with appropriate client software

26.4. In all cases pre-emptive camera control should be available to designated workstations on the ship's bridge

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

26.6. Laboratory workspaces where operations involving substances that have the potential to evolve hazardous gases or fumes will be conducted should be fitted with appropriate air quality monitoring systems.

27. Seismic Air§

27.1. 2 x electrically driven compressors

27.2. Flow (each) 400ACFM @ 2000psi

28. Working Deck Services

28.1. The working decks should be provided with external connections for the ship fitted services required to support the nominated scientific equipment

28.2. The working decks should be provided with external connections for fresh water, ship service air, raw seawater and communications.

BRIDGE / WHEELHOUSE

29. General

Primary Design Criteria

The bridge should be designed to allow scientists and ship's officers the ability to consult and work collaboratively without interfering with ship's operations. One solution is a 'science' chart table for paper charts fitted with repeaters of the electronic chart system and ship's position.

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

29.2. There should be provisions to prevent glare, such as by the use of blinds, and to prevent the backscatter of light from bridge onto the windows

29.3. There should be provision for the prevention of condensation, 'fogging' or icing-up of bridge windows, and there should be a washdown and wiper system, consideration should be given to the provision of 'clearview' functionality

29.4. The bridge, including the bridge wings, should be enclosed and stairs should provide both interior and exterior access. Exterior access should be on both sides; vertical ladders are not to be used

29.5. There should be a means of blocking light from entering the bridge at the interior access

30. Bridge Consoles

30.1. Positioning and visibility
Control stations should 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. This should be accomplished with a direct view to the maximum extent possible and enhanced with closed circuit television systems or equivalent. On the vessel's bridge, there should be a central forward control station, port and starboard control stations, and an aft control station. Alternative arrangements providing equivalent functionality are acceptable.

30.1.1. Bridge watchkeepers should have 360º visibility by moving about the vessel's bridge

30.1.2. From the central conning position (central forward console), the operator should have visibility from straight ahead to 22½ºs 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

30.1.3. From the port and starboard control stations, the operator should 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 should 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

30.1.4. From the aft control station, the operator should have good visibility of all working deck areas. Any area not directly visible from the bridge should be monitored and displayed at the control station via the Workspace Monitoring system identified in paragraph 26

30.2. Portable hand-held control units / alternate control stations
Portable control units and or alternate control stations should be provided where required to enhance visibility and communications with the working deck during over the side equipment handling.

30.3. Integrated bridge management
An integrated bridge management and collision avoidance system should be provided to help ensure safe and efficient science operations. Autopilot and DP systems should 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 should also be designed to enhance manual control of the vessel whenever needed.

ANCHORS AND MOORING

31. Anchors and Cables

31.1. The vessel should have self-stowing chain locker(s).
31.2. There should be a minimum of 10 shackles of chain for each anchor.
31.3. Consideration should be given to an 'endless chain' configuration. If provided the anchor windlass must have the capability of recovering the full weight of anchor and chain rendered.
31.4. Anchor handling and forward mooring areas are to be enclosed.

32. Mooring Arrangements

32.1. All mooring winches should be of 'self-tension' or 'constant-tension' design, be incorporated into the vessel machinery alarm systems and in the event of motive power failure winch brakes should fail on
32.2. Mooring winch drums should be capable of storing the maximum amount of mooring line reasonably required and no less than 220 m
32.3. The anchor windlass should provide at least one horizontal capstan drum, two are preferred, that may be de-clutched from the anchor gypsies.
32.4. A single vertical windlass capstan should be provided at the aft mooring station
32.5. Mooring station design should provide fair leads for mooring lines to windlass capstans
32.6. Windlass and winch control stations should 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 cables

OPEN WORKING DECKS

33. Stowing and securing equipment[§]

33.1. It must be possible to stow a minimum of 6 ISO TEU's on the After Deck. When stowed and secured it should be possible to:
33.1.1. safely access containers in all weathers
33.1.2. safely transfer stores and samples to and from the containers in all but the most severe conditions
33.1.3. connect each container to electricity, fresh and clean sea water, shipboard LAN, shipboard liquid waste handling system, shipboard communications system
33.1.4. continue to safely and effectively use the after ½ of the after deck for science operations

33.2. Arrangements should be provided for securing equipment, instruments and systems to all working decks.
The securing design proposed should consider:
- 33.2.1. the need to rapidly mobilize and demobilize equipment
- 33.2.2. the integrity of the deck and its protective coatings
- 33.2.3. the need for secure footing and the avoidance of trip hazards
- 33.2.4. provisions for the protection of equipment and systems against hard contact with decks
- 33.2.5. the potential for the contamination of samples by contact with decks
- 33.2.6. the benefit of a closely spaced grid of sockets for the purpose of securing equipment to decks
- 33.2.7. the strength of the working deck and in particular its ability to withstand a clearly defined range of compression and tension loads. The proposal assessment process will asses the adequacy of options proposed.

34. Materials handling systems

The design of deck materials handling equipment servicing scientific workstations should:

34.1. accommodate and facilitate the proposed scientific activities at each scientific workstation

34.2. facilitate the ergonomic, efficient transfer of stores, samples and equipment between workstations and between the shore and workstations

34.3. be flexible in its support for operations at each workstation

35. Monkey Island

35.1. There should be a clear area on the ‘wheelhouse top’ equipped with two adjustable seats with adjacent small work surfaces of a type and design suitable for long periods of fixed lookout and recording during observations of marine mammals and seabirds. The area should be clear of dangers such as radar scanners, satellite communications transceivers and other antennae and provide adequate comfort and safety for manning from dawn to dusk in SS 4. The work area should be provided with LAN connectivity and a source of electrical supply. If enclosed an unobstructed view through a horizontal arc of 270º and a vertical arc of 135º should be available.

36. Foredeck[§]

36.1. Sufficient space should be provided on the foredeck to:
- 36.1.1. accommodate helicopter operations in accordance with AMSA Marine Order 57. Alternative location of an HLS is acceptable subject to non-interference with other functionality.
- 36.1.2. secure 2 ISO TEU’s and connect each to standard service suite(connection to shipboard liquid waste handling system need not be provided)

37. Intermediate Decks

37.1. Sufficient clear deck area should be available on intermediate decks for the installation of incubation tanks or other ancillary scientific equipment. Areas nominally designated for the installation of incubation tanks should, insofar as possible, be exposed to full sunlight and be clear of funnel exhaust and be adjacent to a supply of raw seawater.

38. After Deck[§]

38.1. Scientific Operations area
An open deck area on the main working deck that includes:
- 38.1.1. The Trawl Deck: ~100 m^2
That portion along the centre of the main deck including the stern ramp and the centre portion of the main deck where nets may be

handled. For safety reasons it should be possible to separate this area from the remainder of the main deck when trawling operations are taking place. The proposal assessment process will asses the effectiveness of options proposed.

38.1.1.1. The trawl deck should be capable of being configured to handle a variety of surface, demersal and midwater trawls.

38.1.1.2. Design features to accommodate appropriate winches, and a net drum large enough to store an IYGPT, McKinnon Orange Roughy or similar trawl should be provided.

38.1.1.3. Arrangements should be provided 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.

38.1.2. The stern ramp

An angled ramp centred on the vessel's stern leading from the design waterline to the main deck.

38.1.2.1. The design of this ramp should facilitate the deployment and recovery of:

- Nets
- Towed benthic and demersal sampling equipment.

38.1.2.2. The stern ramp should be provided with a means of covering the ramp that fits flush with the main deck, effectively extending the main deck to the stern of the vessel

38.1.2.3. Stern ramp covers should be mechanically operated and when stowed not affect usable deck space

38.1.2.4. The ramp should be fitted with a 'wave-gate' that effectively extends the bulwarks across the stern of the vessel and prevents seas running up the ramp and onto the main deck

38.1.2.5. An effective means of placing a temporary barrier across the stern ramp at the level of the ramp covers should be provided that:

- facilitates the launching and recovery of equipment
- provides an effective fall arrest barrier.

38.1.2.6. When stern ramp covers are in place the main deck area should be suited to:

- the deployment of equipment too large to be handled at the Side Scientific Operations area
- use as an alternative deployment location when the Side Scientific Operations area is used to house equipment that precludes its use for other purposes.

38.1.3. The Sheltered Scientific Area: ~25 m^2

Located on the main deck, outboard of the trawl deck, adjacent to and forward of the Side Scientific Operations area. Extends over 2 deck levels.

38.1.3.1. It should be equipped with:

- Workbenches
- Materials handling systems that provide the ability to transfer equipment of up to 5t to the ship side scientific operations area.

38.1.3.2. This sheltered area should be 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

38.1.3.3. The sheltered area should be fitted with a means of rendering it weathertight

38.1.3.4. The design of the sheltered area should facilitate its reconfiguration to suit the needs of a variety of research voyages

38.1.4. Ship Side Scientific Operations area: ~40 m^2

An open deck area located on the main deck, outboard of the trawl deck, adjacent to an Oceanographic Operations lab. The area should be suitable for the following overside operations:

38.1.4.1. Deploying, towing and recovering general instrument packages

38.1.4.2. Deploying and recovering oceanographic rosettes

38.1.4.3. Deploying and recovering fixed and drifting fishing gear, oceanographic gear (moorings), manned or unmanned, tethered or autonomous submersibles

38.1.4.4. Casting and retrieve plankton nets while the vessel is maintaining station

38.1.4.5. Deploying and retrieving bongo nets, tucker trawls, BIONESS, MOCNESS and other plankton, larval and egg sampling equipment while proceeding at 1-4 knots.

38.1.4.6. Deploying and retrieving a Continuous Underway Fish Egg Sampler (CUFES)

38.1.4.7. Deploying instrumented oceanographic moorings

38.1.4.8. Deploying and retrieving bottom grabs and gravity cores for benthic sampling

38.1.4.9. Deploying and retrieving fishing gear such as crab pots, gillnets and long lines

38.1.4.10. Deploying and retrieving acoustic calibration systems

38.1.4.11. This area should be serviced by equipment handling systems that will 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-5000kg

38.1.4.12. Instruments deployed from this area may require electronic communications between the instrument and the surface. Equipment handling systems servicing this area should be designed to facilitate and cost effectively maximize that communication capability.

The proposal assessment process will asses the effectiveness of options proposed.

INTERNAL SCIENCE SPACES

39. Minimum Requirement in all science working spaces within the accommodation

39.1. To the extent practicable science working areas, other than storage spaces, should be provided with natural light

39.2. Means to ergonomically site and adequately secure equipment and instrumentation

40. Operations Room[§]

40.1. Minimum size: 60 m^2.

40.2. The Operations room should be configured to facilitate the placement of instruments in racks to support different missions.

40.2.1. Racks must be accessible from the front and back to allow access to connections when instruments are installed.

40.2.2. Each rack should provide a supply of electrical power sufficient to operate the maximum number of instruments / systems that may be safely fitted to it.

40.2.3. Each rack should be designed to facilitate cable management

40.3. Computer room style flooring to facilitate cable management

40.4. Within the Operations Room, there should be multiple desk areas, ergonomic chairs, shelving with retaining bars suitable for equipment manuals and a chart table of no less than 2m x 1m.

41. Data Acquisition, Processing and Management§

On board DAPM requires three functionally distinct activities. The demands of each activity lead to a workspace design with distinctive characteristics. Separate workspaces should be provided for each activity.

41.1. Data Processing Laboratory§: 40m^2

Dedicated DP facility provided with workstations/printers/scanners/photocopiers & available to support full range of scientific and academic IT activity including voyage planning and assessment.

41.1.1. Benches/working surfaces >20 m^2

41.2. Network & IT infrastructure management office§: 15m^2

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

41.2.1. Management workstations

41.2.2. Co-located with IT machine room

41.2.3. IT support workshop & storage for ready use spare equipment and IT consumables

41.3. Machine Room§: 25m^2

IT Machine room housing network core infrastructure, communications, network, print and file servers, archive media writing devices and associated equipment. The IT Machine Room should be fitted with racks to facilitate the placement and securing of equipment.

41.3.1. Network routers / switches

41.3.2. Cable hubs

41.3.3. Racks must be accessible from front and back to allow access to connections and front panels.

41.3.4. Each rack should provide a supply of electrical power sufficient to operate the maximum amount of equipment that may be safely fitted to it.

41.3.5. Each rack should be designed to facilitate cable management

41.3.6. Computer room style flooring to facilitate cable management.

42. Laboratories

42.1. General

Unless otherwise specified laboratories should be each equipped with:

42.1.1. 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.

42.1.2. Hot and Cold domestic fresh water at sinks

42.1.3. Chemically resistant bench surfaces

42.1.4. Refrigerated (fridge + freezer) storage volume of ~0.5 m^3

42.1.5. Facilities for the safe storage of small quantities of hazardous materials

42.1.6. Where Clean Circulating Seawater is supplied to the space disposal facilities for significant volumes of clean, post analysis seawater (diversion to holding tanks not required – overboard discharge must conform with provision 11.1)

42.2. General Purpose Wet Laboratory(Dirty)§: 40 m^2

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.

42.2.1. Adjacent to the Scientific Operations Area and fitted with 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.

42.2.2. materials handling equipment (such as a roller conveyor) and arranged to facilitate the receipt of bulk samples, their sorting and sub-sampling

42.2.3. Facilities to continuously discharge biological waste material, waste water and or surplus sediment samples

42.2.4. Designed for and fitted to ease and facilitate clean up

42.2.5. Raw seawater supply to sinks

42.2.6. Bench surfaces of at least 15m^2

42.3. General Purpose Wet Laboratory(Clean)§: 40 m^2

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

42.3.1. Immediately adjacent to the Dirty Wet Lab

42.3.2. Designed to facilitate the transfer of samples from the Dirty Wet Laboratory

42.3.3. Clean Circulating seawater supply to sinks

42.3.4. Analysis seawater

42.3.5. Fume cupboard

42.3.6. Bench mounted laminar flow cabinet

42.3.7. Bench surfaces of at least 15m^2

42.4. Preservation Laboratory§: 15 m^2

Suitable for photography, preservation and storage of samples, handling and storing dry ice and liquid Nitrogen.

42.4.1. Co-located with clean GP Wet Lab.

42.4.2. Connected to vapour management system

42.4.3. Fume Cupboard

42.4.4. Sample Lockers: 3 m^3

42.4.5. This laboratory, contrary to provision 39.1, need not be provided with natural light

42.5. General Purpose Laboratory(Dry)§: 35 m^2

User configurable, plumbed laboratory space. No radiation work.

42.5.1. Fume cupboard

42.5.2. Bench mounted laminar flow cabinet

42.5.3. Bench surfaces of at least 12m^2

42.5.4. Analysis Sea Water

42.5.5. Ultra-pure Fresh Water

42.5.6. Clean Circulating seawater supply to sinks

42.6. Hydrochemistry Laboratory: 20 m^2

The Hydrochemistry Laboratory should be designed and fitted to facilitate seawater property analyses.

42.6.1. Fume cupboard

42.6.2. Bench surfaces of at least 10m^2

42.6.3. Analysis Sea Water

42.6.4. Ultra-pure Fresh Water

42.6.5. Clean Circulating seawater supply to sinks

42.7. Underway seawater Analysis Laboratory§: 10 m^2.

This facility should be designed and fitted to accommodate those instruments permanently fitted to measure seawater properties while the vessel is underway. The laboratory should be situated so as to minimize the time between the collection of seawater and its delivery to the laboratory.

42.7.1. Provisions to secure from ambient light. (Need not be provided with natural light contrary to provision 39.1)

42.7.2. Analysis Sea Water

42.7.3. Clean Circulating seawater

42.7.4. Ultra-pure Fresh Water

42.8. Controlled Temperature Laboratory§: 20 m^2

42.8.1. +35ºC – +2 ºC +/- 0.5º C

42.8.2. Need not be provided with natural light contrary to provision 39.1

42.8.3. Should be designed to facilitate use as a sample storage locker

42.8.4. Should be designed and fitted as a 'wet' work space

42.8.5. Clean Circulating Seawater

42.8.6. Raw Seawater

42.8.7. Should be designed for the fitment of removable benches at a variety of heights

42.9. CTD Compartment§: 30 m^2

A compartment adjacent to the Side Science Area.

42.9.1. The compartment should provide:

42.9.1.1. Facilities to store, secure and service a CTD rosette & attached sensors & sampling devices

42.9.1.2. Equipment handling systems for deployment and recovery of CTD systems and sampling rosettes

42.9.1.3. Facilities to store, prepare and sample a rosette including bottle storage

42.9.1.4. A design that facilitates the transfer of samples to the Hydrochemistry Laboratory and the Dirty GP Wet Laboratory.

42.9.1.5. Facilities to support the fitment of oceanographic sensors as required

42.9.1.6. Drainage. Note: while the compartment should be regarded as a 'wet' compartment drainage should accommodate the rapid removal of the total volume of seawater sampled by a 36 bottle rosette (~400l)

42.9.2. The compartment should be:

42.9.2.1. adjacent to the Hydrochemistry Laboratory

42.9.2.2. configured so that it may be made weathertight pre & post equipment deployment and recovery

42.9.3. Raw Seawater

43. Office and Conference spaces

43.1. Science Office§

An office dedicated to the management of science activities should be provided.

43.1.1. Fitted with usual range of office equipment and services.

43.1.2. The preferred location is adjacent to the Operations Room

43.2. Conference Room§

A conference room configured as a theatrette / lecture room should be provided. It may extend over two decks. It will also be available as a recreation facility. It should be designed to facilitate all-staff briefings and science presentations.

43.2.1. Sized to accommodate total complement of vessel

44. Storage Areas

The following storage spaces dedicated to support the vessel's scientific activities should be provided.

44.1. General Storerooms:

44.1.1. Contrary to provision 39.1, need not be provided with natural light

44.1.2. should be well ventilated

44.1.3. should be designed to facilitate access at all stages of a voyage and to facilitate mobilization and demobilization of the vessel

44.1.4. should be provided with appropriate shelving, racking, storage cabinets and lockers and associated securing arrangements

44.1.5. should be designed and outfitted in accordance with ergonomic and safe goods and materials handling principles

44.1.6. should be provided with appropriate materials handling equipment

44.2. Hold Stowage§

Hold stowage should be provided for a minimum of 4 ISO TEUs of up to 2.9 m in height. When modular units stowed and secured it should be possible to:

44.2.1. safely access modules at all stages of a voyage

44.2.2. efficiently transfer stores and samples to and from modules

44.2.3. connect the modules to:

- electricity,
- fresh and clean sea water,
- shipboard LAN,
- shipboard liquid waste handling system,
- shipboard communications system

44.3. Scientific store§: > 18 m^2

Dedicated to voyage specific scientific items such as equipment crates & boxes, sampling materials, and spare components.

44.4. Refrigerated Storage§

44.4.1. A walk-in refrigerated storage area should be located adjacent to the Wet Lab.

44.4.2. The refrigerated storage area should be divided into two chambers.

44.4.3. External Chilled Compartment: 10 m^3

44.4.3.1. Temperature controllable in the range 10º C to -4º C +/- 0.5º C

44.4.4. Internal Freezer Compartment: 20 m^3

44.4.4.1. Temperature controllable in the range -18º C to -20º C +/- 1º C

44.4.5. A chest-type ultra-cold storage facility should be provided. Located to facilitate the transfer of samples to and from laboratory spaces.

44.4.5.1. Volume: >2 m^3.

44.4.5.2. Minimum Temperature: -80º C.

44.4.6. Clean freezer storage.

44.4.6.1. Volume: ~2.5 m^3

44.5. Electronics store§: 10 m^2.

Dedicated to the storage of electronic, IT and acoustic equipment and components.

44.6. Scientific Deck Store§: 40 m^2.

Storage of large spares for equipment such as winches, lifting gear and nets.

44.6.1. The store should be provided with a workbench or benches

44.7. Rope locker§: 18 m^2.

Used for the secure storage of twine, cordage, shackles, chain, lifting and lashing tackle and similar items.

44.7.1. This locker should be co-located with Scientific Deck Store.

44.8. Scientific Hazardous and Dangerous Materials lockers: > 25 m^2

Used for the storage of hazardous and dangerous materials required for the conduct of the science being undertaken. This facility:

44.8.1. must comply with international best practice for the safe storage and handling of hazardous materials in organizations conducting research – subject to a review of dangerous goods separation rules two discrete spaces may be required

44.8.2. should provide for the storage of compressed gases brought aboard for scientific purposes

44.8.3. should be connected to the ship's domestic HVAC system(inlet only)

44.8.4. may be used for the storage of samples preserved in hazardous materials where samples do not require a climate controlled environment more demanding than that provided by the ship's domestic HVAC

44.8.5. should be connected to the vessel's vapour management system

44.8.6. is not for the storage of 'ships gear'

44.8.7. particular attention should be paid to the materials handling facilities required to transfer significant volumes of material to and from laboratory spaces in a safe and ergonomically appropriate manner during the course of a voyage

45. Workshops

The following workshops dedicated to support the vessel's scientific activities should be provided.

45.1. General

45.1.1. Workshops should where practicable observe provision 39.1 and be provided with natural light. It is acknowledged that this may not always be possible in the context of overall design.

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

45.1.3. Materials handling equipment

45.1.4. 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

45.2. Deck workshop[§]: 30 m^2

Multi-purpose workshop designed to facilitate the servicing / configuration of heavy research equipment. May be amalgamated / co-located with Mechanical Workshop. The proposal assessment process will asses the effectiveness of options proposed.

45.2.1. This workshop should be adjacent to the Scientific Operations Area.

45.2.2. This workshop should be particularly suited to facilitate work on mechanical, electrical, pneumatic and hydraulic components

45.2.3. The workshop should be configured so that it may be made weathertight pre & post equipment deployment and recovery

45.3. Instrument workshop[§]: 20 m^2

Dry electronics maintenance & servicing. Provides support for both instruments and systems fitted to the vessel and instruments and systems brought aboard by visiting scientists.

45.3.1. Sufficient space to accommodate visiting technical support staff.

45.3.2. This workshop should be adjacent to the Scientific Operations Area.

45.3.3. To the extent practicable co-located with deck workshop.

45.4. Mechanical workshop[§]: 25 m^2

Provides support for instruments and systems fitted to the vessel, instruments and systems brought aboard by visiting scientists and ship's machinery and systems.

45.4.1. Good materials handling facilities between workshops & from deck.

45.4.2. Full range of workshop machinery for fitting, turning and boilermaking.

ACOUSTIC SYSTEM INFRASTRUCTURE

46. Vessel noise and acoustic signature[§]

High vessel noise levels causes poor detection of all but the largest signals.

46.1. ICES 209 vessel noise recommendations.

As stated in 12.1, while this criterion is identified as desirable rather than essential the value of an acoustically quiet platform is significant. The vessel must be acoustically quiet, particularly in hydro-acoustic bands and in these bands achieve ICES 209 performance or better. Vibration damped diesel-electric drives through a large, acoustically optimised, fixed blade propeller with anti-vibration mounted auxiliary machinery will contribute to this. Proposal assessment will specifically address cost benefit implications of full ICES 209 compliance.

47. Sensor deployment Systems§

Means of placing acoustic sensors outside the 'bubble layer' and 'turbulent zone' surrounding the hull when the ship is underway should be provided. Total acoustic sensor mounting area of ~30 m^2 should be available. The proposal assessment process will specifically evaluate the cost effectiveness of alternative proposals. Means proposed may consist of one or a combination of:

47.1. A drop keel or keels§:

- 47.1.1. At full extension the drop keels should protrude no less than 4 m below the hull.
- 47.1.2. Drop keels should be capable of being withdrawn to the extent that sensor change out / maintenance may be undertaken when the ship is at sea. The drop keep compartment will need to be approximately 8 m^3, and will likely extend over 4 deck levels. The space they will occupy when retracted into the hull must be taken into account.

47.2. Moonpool with retractable sensor platform§:

- 47.2.1. The sensor platform when deployed should allow sensors to project up to 0.5 m clear of the hull.
- 47.2.2. The sensor platform should be retractable to a level that enables sensors to be changed / added when the vessel is underway.

47.3. Retractable Gondola§

This mounting strategy is most suited to larger fixed transducers that require accurate positioning in relation to the vessel's hull.
A transducer gondola that may be retracted fair with the hull has the potential to deliver:

- 47.3.1. moderate (0.6 – 1 m) deployment below the bubble layer
- 47.3.2. acoustic isolation from other transducers and the vessel's hull
- 47.3.3. a protected location when operating in ice, shoal depths, debris obstructed waters

48. Hull Mounted Transducers

Subject to final decisions on those systems fitted to sensor deployment systems transducers and appropriate hull mounting arrangements should be provided for:

- 48.1. multi-frequency scientific echo sounders
- 48.2. hydrographic and fish finding sonar
- 48.3. ADCP (both low and high frequency)
- 48.4. trawl mensuration system
- 48.5. multi-beam seabed mapping & classification system (May be gondola mounted subject to Ice Classification if gondola is retractable)
- 48.6. sub-bottom profiler(May be gondola mounted subject to Ice Classification if gondola is retractable)
- 48.7. multi-frequency hydrophones suitable for monitoring self noise and measuring ambient environmental noise
- 48.8. Ultra short baseline (USBL) acoustic positioning system
- 48.9. Moving Vessel Profiler (MVP) system

49. Transceiver Room§

- 49.1. A transceiver room adjacent to through-hull sensor deployment system(s) should be provided for other acoustic systems with separate transceivers and associated equipment.
- 49.2. Direct access should be possible from the Transceiver Room to the through hull sensor deployment compartment for access to the transducers so mounted.
- 49.3. The transceiver room should be fitted with a workbench and equipment racks

50. Transducer calibration

50.1. Facilities to calibrate transducers with standard acoustic calibration targets should be provided. This facility should provide:

50.1.1. A three point mounting system

OTHER DESIGN FEATURES

51. Cranes, winches and equipment deployment§

51.1. General
Winch outfit proposals will be assessed for cost effectiveness by the proposal assessment process.

51.1.1. Heave Compensation
It is preferred that all cranes and winches be fitted with heave compensation and/or tension control arrangements appropriate to their function.

51.1.2. Measurement
All winches & lifting systems should be fitted with facilities to measure wire tension, wire out, speed and angle and transmit this information to ship's data acquisition system.

51.2. Cranes
The vessel should be equipped with cranes with sufficient scope for full access to all work areas of the after deck. The cranes should have ship-to-sea capability.

51.2.1. Working crane

51.2.1.1. Static Load Capacity: at least 25 t at ~12 m

51.2.1.2. Live Load Capacity > 5 tonnes at 12 m (SS 6)

51.2.1.3. This crane should service the ship's hold

51.2.1.4. This crane should be suitable for the deployment and recovery of manned & unmanned, tethered and un-tethered submersibles.

51.2.2. Utility crane

51.2.2.1. At least one, more may be required subject to the design proposed

51.2.2.2. Static load capacity: 5 t

51.2.3. Stores crane
Subject to the design proposed a dedicated stores crane may not be required as a utility crane may be able to provide this service. If required a stores crane should be of the same type and capability as the above utility crane(s).

51.3. Winches

51.3.1. General
The proposal assessment process will consider the capabilities of systems proposed in the context of the cost effectiveness with which the package proposed delivers the functionality sought over the system's lifetime.

51.3.1.1. The exact compliment and configuration of winches and wires will be finalized by the proposal assessment process following final determination of the combination of winch and wire technologies most suited to delivering the functional capabilities sought. The ship should be provided with a suite of winches, fitted with appropriate wires capable of delivering the functionality below.

51.3.1.2. It should be anticipated that a variety of sampling devices will be deployed from each winch. Different sampling systems have different masses. This will affect the payload each sampling device is able to recover from the maximum depth to which it may be deployed. The proposal assessment process will consider the capabilities of the systems proposed in the context of the cost effectiveness with which they provide the functionality sought.

51.3.2. Two wire trawls

51.3.2.1. Catch Mass @ maximum depth:
1 t @ 4000 m

51.3.3. Towed seabed sampling capability

51.3.3.1. Sample Mass @ Maximum Depth:
Dredging: 1 t @ 5000 m
Benthic Sleds: 0.5t @ 5000m

51.3.4. Vertical sampling capability

51.3.4.1. Sediment Grabs

- Sample Mass @ Maximum Depth:
0.25 t @ 6500 m

51.3.4.2. Sediment Coring Systems

- Minimum Core Length @ Maximum Depth:
6 m @ 6500 m
- Preferred Core Length @ Maximum Depth:
30 m @ 6500 m

51.3.5. Net / Cable Storage: >10m^3

51.3.6. Deploy and recover towed bodies
The ability to deploy and recover towed bodies of < 0.75 t on electro-mechanical and or opto-mechanical cables of up to 5000 m in length. The proposal assessment process will specifically consider the cost effectiveness of proposals to deliver higher communications bandwidths.

51.3.6.1. Cable: 11.7 mm
Specifications no less than Rochester A276463

51.3.7. Deploy and recover CTD instruments / rosettes

51.3.7.1. Instrument Mass @ Maximum Depth
1 t @ 6500 m

51.3.7.2. Communications
Full duplex communication at > 9.6 kb.

51.3.7.3. Cable: 8.03 mm
Specifications no less than Rochester A216314

51.3.8. Handle equipment and samples on working decks

51.3.8.1. 2 x 5 t

51.3.8.2. 1 x 15 t

51.4. Overside equipment deployment and wire handling systems

51.4.1. Side Science Area

51.4.1.1. 1 x H / A frame
This system is primarily designated for the deployment of rosette samplers, CTD equipment, sediment grabs and sediment coring systems. Alternative deployment and recovery systems are acceptable. One example is a telescoping boom or gantry.

- Vertical Load Capacity: 2.5 t
- Minimum Clearance: 4.5 m
- Stand-off from ship side: > 2.5 m
- Aperture: >2.5 m

51.4.1.2. 2 x Towing Booms (one each side)

- 2D load Capacity: 2.5 t
- Stand-off from ship side: > 2.5 m

51.4.2. Aft Deck

51.4.2.1. 1 x H / A frame

- Load Capacity: 20 t
- Minimum Clearance: 6 m
- Fitted to provide attachments for multiple blocks

51.4.2.2. Gallows

- 2 x 30 t

52. Vessel Operations Information Management Systems§

As per SOLAS requirements

52.1. Navigation

52.1.1. Full ECDIS

52.1.2. Integrated position, velocity, attitude and heading sensor system. The output from this system will also be used by many fixed and mission specific scientific instruments; a means of distributing the output from this system throughout the vessel should be provided.

52.2. Stability

A complete software package for the vessel's stability should be provided. The package is to include provision for damage and icing conditions.

52.3. Planned Maintenance System

52.4. Inventory and Asset Management System

52.5. Document Management System

53. Masts§

Both fore and main masts should be designed to facilitate the maintenance of permanently fitted instruments and the fitting and removal of temporary instruments. In particular there should be:

53.1. Safe access to instrument locations up to SS 6

53.2. Permanently installed redundant cabling

53.3. Redundant cable trays, ducts, glands and junction boxes to facilitate the protected installation of temporary cabling and sampling lines

53.4. Redundant instrument mounting brackets & platforms

54. Blast Freezer§

54.1. There should be a blast freezer with an internal volume > 1.5 m^3 with the ability to reduce the temperature of 150 kg of water from 20º C to -30º C in 1 hour.

55. Ice Machine§

55.1. The vessel should be fitted with an ice machine capable of making 500 kilos of ice per day.

56. Fast Rescue Craft and Workboat§

56.1. There should be a SAR FRC of ~7.5 m fitted for launch and recovery in SS 6.

56.2. The vessel should be equipped with a SAR locker located with ease of access to the FRC launching area

56.3. There should be a workboat of ~6m fitted for general purpose scientific use

56.4. Sea level access port

It is desirable that a watertight ship side access be provided close to the vessel's design waterline to facilitate:

56.4.1. workboat loading and unloading

56.4.2. in-water access to instrument packages

The proposal assessment process will specifically consider the cost effectiveness of proposals for a sea-level access port.

ACCOMODATION

57. General§

57.1. All accommodation should meet AMSA standards and applicable regulations

57.2. All cabin accommodation should be provided with natural light

57.3. All cabin accommodation, recreation, mess and galley spaces should be situated, to the extent practicable, so as to minimize ship motions

57.4. Master, Chief Engineer, and Chief Scientist cabins should be similarly arranged and provided with a day room and office in addition to a dedicated sleeping / personal recreation space

57.5. Consideration should be given to providing day/night cabins for other senior staff

57.6. Each cabin should be provided with individual en-suite washroom facilities incorporating, toilet, shower, hand-basin and toiletries cabinet.
57.7. The vessel should 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
57.8. There should be a change room dedicated to science party use located adjacent to the main working deck access
57.9. There should be a change room dedicated to marine crew use located adjacent to the main working deck access
57.10. HVAC should be provided through out the ship. Laboratory HVAC should be provided by a separate system
57.11. The vessel should be equipped with a common dining area with cafeteria style service and seating for minimum of 30 at one sitting
57.12. All cabins and lounges fitted with connections to ship's dedicated am/fm radio antenna and television system
57.13. To the extent possible, watchkeeper's cabins should be located away from high traffic areas and offices
57.14. To the extent practicable cabin accommodation should be separated from public and recreation spaces
57.15. All cabin, recreation, public and working spaces should be connected to a ship's telephone and public address system. (Need not include refrigerated spaces however these must be fitted with refrigerated space alarms)
57.16. To the extent practicable the preferred locations identified in Table 1 should be observed

Area	Preferred Location
Freezer (galley; food only)	Near galley
Chiller (galley; food only)	Near galley
Ship's Mess	Main deck
General Stores	Main deck / Lower deck[1]
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 & Hazmat Locker	Upper deck
FF Gear Locker	Upper deck
Garbage Handling Room	Lower deck, aft
Emergency Gen Room	Upper deck
Battery Room	Bridge deck

Table 1

NOTE: All storage areas should provide capacity for a vessel with 50 days hotel endurance.

58. Heating, Ventilation and Air-conditioning (HVAC) §

58.1. Accommodation and public spaces should be serviced by a heating, ventilation and air conditioning system that provides 22º C +/- 2º C
58.2. Laboratory spaces should be serviced by a heating, ventilation and air conditioning system that provides 22º C +/- 1º C

[1] Where dry stores are located separately from the mess/galley appropriate materials handling arrangements must be provided.

59. Public and Administration Spaces

59.1. The vessel should be equipped with at least three lounges. Seating should be capable of accommodating no fewer than fifteen individuals per lounge

59.2. The accommodation and work areas, in addition to other spaces noted in this SOR, and other spaces dictated by legislation and practice, should include:

59.2.1. A cafeteria style mess and galley

59.2.2. Exercise room with sauna and associated W/C

59.2.3. Ship's office

59.2.4. Engineering office (may be co-located with 58.2.4 but if so must provide discrete work stations)

59.2.5. Separate laundry facilities for marine crew and science party.

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

59.3. The vessel's hospital should be designed to accommodate the requirements of a Diver Medical Technician.§

60. Access§

60.1. The vessel should be equipped with accommodation ladders on each side of the vessel. Boarding facilities, inclusive of accommodation ladders should, to the extent practicable, accommodate wharves of varying height relative to the ship's boarding deck and ports with high tidal ranges

60.2. It should be possible to move between all enclosed working, storage and accommodation spaces without the need at any time to travel across unenclosed deck areas.

60.3. Shore connections for this vessel should be centrally located, of standard design and include:

60.3.1. Electricity

60.3.2. Fresh Water

60.3.3. Waste liquid such as dirty oil, bilges and septage

60.3.4. Telephone/Facsimile lines (4 min).

60.3.5. LAN hook up

60.3.6. Fuel

60.3.7. International shore connection

OPERATIONAL CAPABILITES

The vessel proposed should provide a stable, manoeuvrable, and quiet platform for the conduct of the following operations. They are not in priority order. It is not necessary that all operations be undertaken during the course of a single voyage.

- Acoustic habitat mapping
- Acoustic surveys in support of bathimetric, geomorphological and biological research using a combination of hull-mounted, drop keel mounted, and towed transducers
- Acoustic surveys of marine species
- Acquiring geological samples of the ocean bottom in depths of up to 5000m
- Acquisition of benthic samples of the ocean bottom at depths up to 6500 m
- Acquisition of up to 20-30 m core samples of the ocean bottom at depths up to 6500 m
- Bottom trawling to depths of up to 2500 m, preferably 3500+ m, using equipment such as the McKenna Orange Roughy trawl or similar gear
- Calibration of ship mounted transducers
- Conduct horizontal or oblique plankton tows using the MOCNESS or BIONESS plankton samplers or similar gear over the stern or over the side of the vessel
- Conduct oceanographic sampling with rosettes of up to 36 bottles and CTD instrument packages to 6500 m depth while continuously sounding. Process and cold store resultant samples
- Freeze and cold store samples for further analysis at shore based facilities
- Launch / tow / retrieve a broad variety of active and passive sensors and sensor platforms including magnetometers, hydrocarbon sniffers, sonar towfish, AUV's and UUV's
- Launch/tow/retrieve a variety of egg, larval, juvenile and adult fish sampling systems
- Marine mammal and seabird enumeration, identification, tracking, and bioassessment
- Mid-water and surface trawl using equipment such as the IYGPT mid-water trawl
- Monitor and continuously log environmental, meteorological, navigational, geophysical, biological, acoustic, oceanographic, and vessel data
- Physical, chemical, and biological oceanographic research and habitat mapping.
- Prawn trawl using conventional 'single gear' typical of that used in the Gulf of Carpentaria
- Recover, sort, weigh and conduct biological sampling of individual catches of up to 500kg
- Seismic surveys with up to 2 airguns
- Sorting, sub-sampling, assessing and storing seabottom geological and sediment samples
- Store samples in various preservatives in order to retain samples for further analysis at shore based facilities
- Support manned and unmanned submersible surveys including side or stern launched, recovered, and towed equipment
- The combination in real time of data from on-board observations with data from space-based sensors, autonomous vehicles and shore based models.

GLOSSARY, ACRONYMS & ABBREVIATIONS

GLOSSARY

Best Heading	That heading which, for the most adverse combination of relative wind direction, relative swell direction and relative current direction in a given sea state, results in the least magnitude of the vector sum(A_T) of the accelerations, A_x, A_y and A_z (measured at the furthest extremity of the vessel from its centre of motion).
Yaw	The angle between a vessel's centreline and the desired course made good.
Rosette	A series of 24-36 sampling bottles and a CTD sensor package mounted on a frame (approx. dimensions are 2 m diameter and 1.5 m height with the whole unit weighing ~800 kg) and deployed from the side. Once the target CTD depth has been reached, the rosette is brought back to the surface with stops to capture a water samples in the bottles. This sampling method requires a conducting winch wire and communications between the CTD and winch operators. Once the rosette has been recovered, scientists draw samples from the bottles for further study. Due to the level of precision required for this unit motion compensation should be provided for work in SS2 or greater. Often an acoustic altimeter is attached to the bottom of the rosette to monitor exact depth so that the instrument can be lowered to within a couple of decimetres from the sea floor.

BIOLOGICAL SAMPLING SYSTEMS

Mid-water trawls	IYGPT
Demersal/Bottom trawls	McKenna-Markey
Plankton Nets	Includes various smaller plankton nets that are stern or side deployed and lowered to target depth and towed vertically or obliquely (with the ship moving forward at 0.5-1.5 knots.) back to the surface. None of these nets require conducting cable. Nets may be outfitted with tripping mechanisms that require messenger deployment from the surface. Once recovered, nets are washed down with salt water and the contents in the cod end are preserved. These assorted plankton nets include the Bongo, NorPac, Scor, and ring nets. Dimensions are ~0.2-1.5 m diameter and nets are up to 3.5 m in length and 50 kg in weight.
Neuston Net	Surface net used to capture larval invertebrates and fish. Always deployed from the side and towed ~30 m off the quarter (out of the ship's wake) at 0.5-1.5 knots. Approximately 0.5 x 0.5 x 0.5 m and 30 kg.
Isaac-Kidd Trawl	Beam trawl with ~3 m x 2 m opening and operated off the stern at speeds up to 4 knots.
Tucker Trawl	A multiple net sampler capable of carrying up to three zooplankton nets. The unit is stern deployed and lowered into the water while the ship is moving forward at 1.5-2.0 knots. Nets are tripped via a messenger deployed from the surface along the non-conducting winch cable to a trip mechanism located above the net. Approximate measurements are 1.5 x 2.0 x 0.3 m, excluding nets, and about 150 kg.

BENTHIC SAMPLING SYSTEMS

Ponar Grab	Sampling unit that is stern or side deployed, lowered to the sea floor and tripped via a tension spring mechanism. Sediment is captured in the unit and brought back to the surface. Approximate dimensions: 0.3 x 0.3 x 0.3 m and 30 kg.
Smith-Mac Grab	Large benthic sampling unit stern or side deployed, lowered to the sea floor and tripped via messenger from the surface. Approximate dimensions: 1.5 x 1.5 x 1.5 m and 200 kg.
Benthic Sled	A sled-type sampling unit that is stern deployed and lowered from the surface to the sea floor. Once on the bottom, the sled opens a door to capture biota living on and above the sea floor. The sled is towed at 0.5-1.5 knots and requires a winch cable capable of towing a 1.5 t sampling unit over terrain that may include snagging objects such as large rocks, submerged logs, and mud. Dimensions are ~1.0 x 1.5 x 0.6 m.

ACRONYMS & ABBREVIATIONS

ACFM	Actual Cubic Feet per Minute
ADCP	Acoustic Doppler Current Profiler
AMJ	Australian Maritime Jurisdiction
AMSA	Australian Maritime Safety Authority
AUV	Autonomous Underwater Vehicle
AV	Audio Visual
BIONESS	Bedford Institute of Oceanography Net Environmental Sampling System The BIONESS is stern deployed and tows up to 10 zooplankton nets in sequence through various depths (usually 400 m to surface) and nets are tripped by the surface operator using a conducting winch cable. Tows are conducted at speeds of 1.5-2 knots. Tows typically take one hour to complete and an additional hour to setup and wash down the nets on deck. The BIONESS is outfitted with a CTD unit and possibly an OPC. Approximate measurements are 1.0 x 1.6 x 2.0 m, excluding nets, and about 500 kg.
CE	Chief Engineer
CMAR	CSIRO Marine and Atmospheric Research
CPS	Calibration Positioning System For positioning standard targets used to calibrate various types of underwater acoustic transducers and associated scientific echo sounder systems.
CTD	Conductivity Temperature Depth sensor. Physical and chemical oceanographic sampling instrument deployed from the side. Measures pressure, depth, salinity, and temperature. May also measure light transmission, fluorescence, oxygen, surface light, and other oceanographic variables. CTDs are usually enclosed in a cage (1.0 x 0.3 x 0.3 m) to prevent damage and most models require a conducting winch cable so that data can be displayed in real-time. CTDs are usually lowered to bottom depth at a descent rate of 1 m/s. To ensure clean profile data, a motion compensator unit is often used so that the CTD unit travels smoothly through the water. CTD units may be mounted in a rosette unit when bottle samples are required. CTD casts may sample down to 7000 m and take 5 hours to complete.

CUFES	Continuous Underway Fish Egg Sampler The CUFES is used to collect pelagic eggs of fish, and ancillary data at a nominal depth of 3 m from a moving research vessel. These samples and data are, in turn, used to investigate spawning habitat and estimate spawning biomass. CUFES consists of a submersible pump, concentrator, and sample collector. Water is continuously pumped at a capacity of 600-700 litres per minute from the 3 m depth and sent to the concentrator. Particles are concentrated by an oscillating net (e.g. of 500 micron Nitex mesh) in approximately 3% of the flow. The filtrate is discharged overboard. The concentrate passes to the sample collector where particles are retained over sequential sampling intervals (e.g. 5-30 min) on a cod end of the same size mesh as used in the concentrator. Fish eggs are usually counted at sea prior to preserving the sample. Simultaneously, ancillary data are continuously collected for date, time, position, temperature, salinity, and chlorophyll a fluorescence.
DAPM	Data Acquisition, Processing and Management
DMT	Diver Medical Technician
DP	Dynamic Positioning System
ECDIS	Electronic Chart Display and Information System
EEZ	Exclusive Economic Zone
EMI	Electro-magnetic Interference
ER	Engine Room
FF	Fire Fighting
FRC	Fast Rescue Craft
GAN	Global Area Network
GP	General Purpose
GPS/DGPS	Global Positioning System/Differential Global Positioning System
HLS	Helicopter Landing Site
HVAC	Heating, Ventilation and Air Conditioning
IACS	International Association of Classification Societies
ICES	International Council for Exploration of the Sea
IEEE	Institute of Electrical and Electronics Engineers
IMO	International Maritime Organisation
ISM	International Safety Management Code
ISO	International Organization for Standardization
IYGPT	International Young Gadoid Pelagic Trawl
LAN	Local Area Network; connections and server
LMC	Lloyds Machinery Certificate
MARPOL	International Convention for the Prevention of Pollution from Ships, 1973, as modified by the Protocol of 1978 (MARPOL 73/78)
MNF	Marine National Facility
MOCNESS	Multiple Opening and Closing Net Environmental Sampling System The MOCNESS is stern deployed and tows up to six zooplankton/larval fish nets in sequence through various depths. Nets are tripped from the surface using a conducting winch cable. Tows are conducted at speeds of 1.5-3 knots. Tows typically take one hour to complete and an additional two hours to setup and wash down the nets on deck. The MOCNESS is outfitted with a CTD unit and possibly an OPC. Approximate measurements are 1.5 x 2.5 x 0.3 m, excluding nets, and about 1000 kg.
MSI	Motion Sickness Incidence Ratio
MVP	Moving Vessel Profiler
NMEA	Combined electrical and data specification for communication between marine electronic devices
OPC	Optical Plankton Counter scanning unit used to measure concentration and size of plankton within the water column. This unit (1.0 x 0.3 x 0.3 m) may be mounted to a plankton net, such as the BIONESS, a CTD unit, or may be towed from the stern or side on its own using a conducting winch cable. The instrument can be towed vertically or obliquely, with the latter a more common occurrence.
PAR	Photo-synthetically Active Radiation

PTZ	Pan, Tilt, Zoom
RFC	Request for Comments
ROV	Remotely Operated Vehicle
SAC	MNF Scientific Advisory Committee
SAR	Search & Rescue
SC	MNF Steering Committee
SG	Specific Gravity
SOLAS	International Convention for Safety of Life at Sea
SOR	Statement of Requirements
SPS	Special Purpose Ship
SS *n*	Sea State. References to sea states (SS *n*) should be read as a reference to the state of the sea prevailing in the open ocean when a wind with the Beaufort strength indicated has been blowing for sufficient time to fully develop it.
TEU	Freight container meeting ISO standards and of standard dimension (3 m x 6 m) for temporary mounting of various lab/storage facilities on deck. Units typically require umbilical connection for 240 or 415 V power, fresh and seawater supply, and may require connection to liquid waste handling systems or over-the-side direct discharge.
UHF	Ultra High Frequency
UMS	Unmanned Machinery Space
UNCLOS	United Nations Convention on the Law of the Sea
UPS	Uninterruptible Power Supply
USBL	Ultra Short Base Line Acoustic Positioning System
UUV	Unmanned Underwater Vehicle
VoIP	Voice over Internet Protocol
W/C	Water closet (includes toilet, sink, and shower)
WAN	Wide Area Network
WOCE	World Ocean Circulation Experiment
XBT	Expendable bathythermograph
XTE	Cross Track Error. The perpendicular displacement from to the track it intends to follow of a vessel's centre of motion.

SCIENCE MISSION SCENARIOS

The following mission scenarios are intended to demonstrate the work a blue-water research vessel may carry out. They do not represent all possible scenarios and are intended to serve as examples. Distances are in nautical miles (nm), speed in knots (kt).

PRIMARY MISSION SCENARIOS

Type of work	2D and 3D high resolution chirp sonar (deep towed) profiling		
Number in science party:	13		
Time of year:	Year round		
Area of operations:	AMJ		
Dist. from nearest port:	3000 nm	Transit speed:	15
Dist. Survey/towing:	4000 nm	Towing/survey speed:	4.5 - 5.5
Days on station	Days towing/survey	Days transit	**Total days**
3	30	17	**50**
Major or special equipment:	Research organization provides towed body, tow cable and winch and data acquisition system.		

Type of work	Core Sampling – up to 30 meter in up to 6.5km water depth.		
Number in science party:	20		
Time of year:	North of 30º S: April-Nov. South of 30º S: Dec-Mar		
Area of operations:	Continental Shelf & Slope		
Dist. from nearest port:	2200 nm	Transit speed:	15
Dist. Survey/towing:	-	Towing/survey speed:	-
Days on station	Days towing/survey	Days transit	**Total days**
20-35	-	13	**33 – 48**
Major or special equipment:	Dynamic Positioning Long Core deployment and recovery system		

Type of work	Launching & servicing deep ocean buoys		
Number in science party:	5		
Time of year:	North of 30º S: May-Nov. South of 30º S: Dec-April		
Area of operations:	Off Shelf. Southern Ocean, Indian & Pacific Oceans		
Dist. from nearest port:	1000 - 2000 nm	Transit speed:	12
Dist. Survey/towing:	300 – 1500 nm	Towing/survey speed:	1-4
Days on station	Days towing/survey	Days transit	**Total days**
2 – 4	1 - 2	4 – 8	**9 – 14**
Major or special equipment:	Dynamic Positioning Crane and A Frame SWATH Mapping Systems		

Type of work	Current meter moorings, ADCP / Sea Soar type survey, CTD transect, productivity experiments		
Number in science party:	30		
Time of year:	Spring or early summer, upwelling season or winter		
Area of operations:	Coastal shelf / slope South of 30º S.		
Dist. from nearest port:	50-500 nm	Transit speed:	12
Dist. Survey/towing:	5800 nm	Towing/survey speed:	8
Days on station	Days towing/survey	Days transit	**Total days**
4-16	10-30	0-4	**14 - 50**
Major or special equipment:	Crane and Aft A-frame for mooring work, ADCP, CTD, towed undulating profiler, incubators		

Type of work	Intensive biological and physical survey on the continental shelf break		
Number in science party:	30		
Time of year:	North of 30º S: April-Nov. South of 30º S: Dec-Mar		
Area of operations:	Shelf and Slope		
Dist. from nearest port:	50-500 nm	Transit speed:	12 knots
Dist. Survey/towing:	1300 - 7000	Towing/survey speed:	1-8 kt
Days on station	Days towing/survey	Days transit	**Total days**
6 - 16	14 - 30	0-4	**20 - 50**
Major or special equipment:	MOCNESS, light profilers, CTD/rosette, incubators, ship-to-shore data link for satellite data, ADCP.		

Type of work	Open Ocean Biophysical/Chemical Interactions		
Number in science party:	20+		
Time of year:	North of 30º S: April-Nov. South of 30º S: Dec-Mar		
Area of operations:	Southern Ocean, Indian & Pacific Oceans		
Dist. from nearest port:	300 nm	Transit speed:	12+ knots
Dist. Survey/towing:		Towing/survey spd:	6 knots
Days on station	Days towing/survey	Days transit	**Total days**
20 - 30	9 - 19	1	**30-50**
Major or special equipment:	SeaSoar, incubators, radioisotope lab container tracers, ADCP CTD		

Type of work	Geological survey / IODP Site Survey		
Number in science party:	30+		
Time of year:	All		
Area of operations:	AMJ Southern Ocean, Indian & Pacific Oceans		
Dist. from nearest port:	300 – 3600 nm	Transit speed:	15
Dist. Survey/towing:		Towing/survey spd:	
Days on station	Days towing/survey	Days transit	**Total days**
15 - 20	14 - 20	1 - 10	**30 - 50**
Major or special equipment:	Dynamic Positioning Long Core deployment and recovery system Crane and A Frame SWATH Mapping Systems Deep Ocean dredges Sub-bottom profiler Seismic survey		

SECONDARY MISSIONS

A vessel with the capabilities sought will have the ability to operate for extended periods in the remotest areas of Australia's seas and oceans. Its operational tasking will routinely see it operating in some of the world's most challenging ocean areas. It can reasonably be anticipated that, from time to time, the vessel will be called on to assist with searches for and the provision of assistance to persons and vessels in distress in remote locations. The vessel should be equipped to support such activity.

TOTAL YEARLY USAGE (DAYS)

Operational	300
Mobilization & Refit	65

SHIP MOTION CRITERIA

Source: Marintek

DESCRIPTION	CRITERIA RMS-Value	COMMENTS	REFERENCE
VERTICAL ACCELERATION			
Exposure: 0.5 hour 1.0 hour 2.0 hours 8.0 hours	0.10 g 0.08 g 0.05 g 0.03 g	10% motion sickness incidence ratio (MSI) (vomiting) among infrequent travellers & general public	ISO 2631/3 1987 & 1982
Simple Light work possible	0.27 g	Most of the attention devoted to keeping balance	Connoly 1974
Light manual work might be carried out	0.20 g	Causes fatigue quickly. Not tolerable for longer periods	Mackay 1978
Heavy manual work might be carried out	0.15 g	Limits in fishing vessel	
Work of more demanding type	0.10 g	Long term tolerable for crew	Payne 1976
Passenger on a ferry	0.05 g	Limit for persons unused to ship motions	Goto 1983
Passenger on a cruise liner	0.02 g	Older people. Lower threshold for vomiting to take place	Lawther 1985
ROLL:			
Light manual work	4.0°	Personnel effectiveness	Comsrock 1980
Demanding work	3.0°	Personnel effectiveness	Hosada 1985
Passengers on a ferry	3.0°	Short routes. Safe footing	Karppinen 1986
Passenger on a cruise liner	2.0°	Older people. Safe footing	Karppinen 1986
PITCH:			
Navy Crew	3.0°	Limits to avoid damage to personnel	Comstock 1980
Light manual work	2.0°	Personnel effectiveness	Hosada 1985
Demanding work	1.5°	Personnel effectiveness	Hosada 1985
HORIZONTAL ACCELERATION			
Passenger on a ferry	0.025 g	1-2 Hz frequency. General public	ISO 263/1
Navy crew	0.050 g	Non-passenger and navy ship	
Standing passenger	0.070 g	99% will keep balance without need of holding	Hoberock 1976
Standing passenger	0.080 g	Elderly person will keep balance when holding	Hoberock 1976
Standing passenger	0.150 g	Average person will keep balance when holding	Hoberock 1976
Standing passenger	0.250 g	Average person max. load keeping balance when holding	Hoberock 1976
Seated person	0.150 g	Nervous person will start holding	
Seated person	0.450 g	Persons will fall out of seats	

SUMMARY OF OPERATIONAL PERFORMANCE

Sea State		Relative Swell	0	1	2	3	4	5	6	7	8	9+
Mean Wave Height (m)			0	0.1	0.2	0.6	1	2	3	4	5.5	7+
Operability			100%	100%	100%	100%	100%[1]	100%[2]	98%[3]	85%[4]	100%[5]	100%[6]
Speed	(max) kt	Ahead	16	16	16	16	16	16	12	6-9	4-6	2-4
		Abeam	16	16	16	16	16	12	10	4-6		
Heading Stability	(0 kt to max) $^{o}_{rms}$	Ahead	± 0.5					± 0.5				
		Abeam	N/A					± 0.5	± 1.5			
Roll	(max) $^{o}_{rms}$	Ahead	<0.5									
		Abeam	N/A					<3				
Pitch	(max) $^{o}_{rms}$	Ahead						<2				
		Abeam										
Z axis acceleration	(max) g_{rms}	Ahead						<0.15				
		Abeam										
Y axis acceleration	(max) g_{rms}	Ahead										
		Abeam							<0.05			
Station Keeping	(max excursion) m	Ahead	1[7]				<5[8]	<5[9]	<20[10]			
		Abeam	N/A	1								
Track Following	(max XTE) m	Ahead	1[11]				<5[12]	<5[13]				
		Abeam	N/A	1								

[1] Fully operational for all but the most demanding deployments and recoveries.
Safe stern deployment & recovery of manned submersible / ROV / AUV to 3t

[2] Safe deployment & recovery of FRC to 8m including safe conduct of support operations for FRC activities.
100% of Underway science operations at 9 kt
CTD operations 90% of the time
Mooring deployments 75% of the time
Coring operations 50% of the time
ROV or other sensitive deployment operations 50% of the time

[3] Fishing Operations at speeds to 4kt
100% use of fixed acoustic sensors up to 8 kt
100% use of towed acoustic sensors up to 9 kt
CTD operations 50% of the time
Mooring deployments 25% of the time
Coring operations 20% of the time
Deploy / tow & recover instruments from side or stern @ 2-6kt

[4] Vessel can safely execute weather relative course change of 180º and manoeuvre at reduced speed. (Compliance may be reduced to 85% by stability related factors, i.e.: cargo stresses, water on deck, freezing spray)

[5] Vessel can safely lie hove-to

[6] As 5

[7] Adverse current of 6kt

[8] Current to 3kt

[9] At best heading. Current to 3kt

[10] At best heading. Current to 3kt

[11] Adverse current of 6kt

[12] Current to 3kt

[13] At best heading. Current to 3kt

Future Research Vessel

MARINE
NATIONAL FACILITY

Statement of Requirements

Annex 1

GUIDANCE NOTES

CSIRO

GUIDANCE NOTES

Item	Description		Note
Vessel Particulars			
1	**Classification**	+100A1+LMC UMS Ice 1C SPS	
2	**Principal Dimensions** Length Overall (LOA) Beam Draught	 70~80 m 17~20 m 5.5 + m	Draft is a design element that should be considered carefully as the overall design evolves. A shallower draft vessel is desirable for operations in shallow waters and to allow shallow depth mounting of ADCP transducers. A deeper draft could increase sea-keeping capabilities (that are a high priority for this vessel) and allow for increased endurance. Access to a wide range of ports of call should be considered so that the operation of this vessel is not restricted by a draft that precludes all but a few ports.
Operational Performance			
3	**Area of Operation**	Pacific, Indian and Southern Oceans Latitude Range: 0º - 65ºS Longitude Range: 50ºE - 150ºW	Ice strengthening provided should afford the capability to work in first year ice at the ice edge (<2/10). The capability to conduct work in all of Australia's oceans without the seakeeping and acoustic compromises to hull form that arise from higher levels of Ice Class is sought.
4	**Speed** Transit Speed Service Speed	 16 knots 12 knots	The distances involved in covering the Australian EEZ, Australian Antarctic Territory waters and research in locations such as the Western Pacific are extreme by any world standard. Faster transits will maximize research time by will reducing the time between surveys and between measurement stations.
5	**Range** @ 12 kt	 10,000 nm	The suggested range will deliver 'Ocean' class performance, providing the ability to reach, and remain on station for extended periods in all of Australia's seas and surrounding oceans. Judicious fuel planning on a vessel with these characteristics will deliver global reach.
6	**Science Berths**	30+ Options • 30% of cabins configurable as 2 berth • Toilet/Shower facilities shared between two cabins	An increase in science team numbers is the single most consistent request arising from the marine science community. 30+ berths will deliver greater scope for large multi-disciplinary teams, places for students and the ability to invite extensive participation from international collaborators. An option to configure science cabins as 1 or 2 berth has been proposed, as has configuring the vessel to accept additional accommodation modules.

Item	Description		Note
8	**Manoeuvring and Control** Navigation Data Dynamic Positioning	 Position to <1m heading, pitch, roll, heave, 3D velocity & accelerations DP I	 Serial & Network distribution High quality DP is required for many sampling and coring applications and is a significant OH&S issue with the deployment of bottom located sampling systems. System should be capable of supporting deep sea ROV operations. System design should be amenable to cost effective upgrade to DP II.
9	**Sea-keeping**		Sustained wind velocities in the Southern Ocean are amongst the highest in any of the world's oceans. Northern Australian waters routinely experience category 4 and above cyclones. The vessel must be suited to working in these environments.
Services			
20	**Electrical Supply** UPS 3ph, 415 V 1ph, 240 V	 240 V x 120 kVA After Deck: 32 A, 64 A, 200 A Containers: 32 A Deck Workshop: 32 A Domestic Supplies as per Australian Standard After Deck: 125 A	AC to be pure sine wave & frequency stabilized in accordance with Australian Standards for domestic and industrial supply. 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.
21	**Network Services**	Bandwith >10 GB	Ship wide network backbone to provide 10 GB or better bandwidth in accordance with state of the art commercial standard at time of acquisition. Connection provided to all working spaces and containerized laboratories.
22	**Communications** Internal External	 Ph + PA + UHF Phone & Data > 512 kbps	Connection provided to containerized laboratories

GUIDANCE NOTES

Item	Description		Note
23	**Sea Water** Analysis Circulating Raw	 40 l/m @ 35 kPa 200 l/min @ 35 kPa 300 l/min @ 600 kPa	Analysis and Circulating seawater systems: • intake point to be as far forward as practicable to facilitate collection of undisturbed water from just below surface • supply should be free of contaminants, particularly anti-fouling paint and iron. • handled through trace-metal clean pipework, machinery and fittings (diaphragm pump preferred) • provided with an efficient means of cleaning intake and distribution pipework to a defined standard After deck and Side Science area to have multiple Raw seawater outlets. Delivery volumes and pressures should be maintained with a reasonable number of outlets simultaneously open.
24	**Laboratory Fresh Water**	Fresh Water >40 l/m @ 400kPa Ultra Pure (de-ionized) >200 l/d @100 kPa.	A reliable supply of freshwater should be provided to all plumbed laboratory spaces and working decks. This requirement is additional to requirements under SOLAS and ordinary marine practice for the supply of domestic fresh water. The standard of freshwater supplies to laboratory spaces should be no less than that required by SOLAS. Delivery volumes and pressures should be maintained with a reasonable number of outlets simultaneously open. As the vessel will be operated in remote areas appropriate provision should be made for redundancy in fresh water generating plant. Hot & Cold to Labs Cold to Working Decks GP Wet Lab (Clean), GP Dry Lab & Hydrochemistry Lab. 200 l is total daily requirement. Purification systems should be capable of accepting a range of filter cartridge types appropriate to the research being conducted.
25	**Vapour Management**		Uptake from Hazmat lockers and fume cupboards. Proposals for in-place filtration by a proportion of installed fume cupboards and or laminar flow cabinets are acceptable.
27	**Seismic Air**	2 x Compressors of 400ACFM @ 2000psi	100% redundancy of supply to 2 airguns @ 10s firing rate.

GUIDANCE NOTES

Item	Description		Note
Open Working Decks			
33	**Stowage - Aft**	TEU	Aft Deck x 4, Side Science Area x 2. Options to increase the number of containers that may be stowed in these areas by 'double stacking' should be considered. Where these options are explored access to '2 high' containers should be of the same standard as those stowed 'on deck'.
36	**Foredeck**	TEU Helicopter operations	2 Container stowage & HLS may be mutually exclusive
38	**After Deck**		Persons conducting scientific operations in this area may require shelter from the elements when the vessel is working in adverse environments. Designs proposed should accommodate this need.
	Trawl Deck	~100 m^2	Clear area exclusive of stern ramp and after deck area outboard of the trawl deck.
	Sheltered Scientific Area	~25 m^2	2 Deck levels (~4.8 m) in height. Weathertight closing. Fitted to serve as hangar.
	Ship Side Scientific Operations Area	~40 m^2	Persons conducting scientific operations in this area may require shelter from the elements when the vessel is working in adverse environments. Designs proposed should accommodate this need.
Internal Science Spaces			
40	**Operations Room**	60 m^2 Central Video Primary Systems Interfaces Voyage Tracking & Management Configurable space for user equipment	This is the central location for acoustic and electronic data acquisition and science operations management The Operations Room should be provided with permanently installed interfaces to intra-ship communications systems and video monitoring systems (access to video streams from all spaces need not be provided, video streams from all science working areas must be available). It should be adjacent to Electronics & Data Processing facilities.

GUIDANCE NOTES

Item	Description		Note
41	**Data Acquisition, Processing and Management**		
	Data Processing Lab	40 m^2 Printers/scanners/photocopiers Spare workstations for user IT Worktables	Dedicated DP facility to support full range of scientific and academic IT activity including voyage planning and assessment. Adjacent to Operations Room
	Network & IT infrastructure management Office	15 m^2	A network and IT management office providing workstations dedicated to network, communications & IT infrastructure management IT support workshop & storage for ready use spare equipment and IT consumables Co-located with machine room
	Machine Room	25 m^2 Equipment Racks Network routers / switches Cable hubs Computer room style flooring	IT Machine room housing network & IT core infrastructure Network, file, communications and print servers
42	**Laboratories**		
	GP Wet Laboratory - Dirty	40 m^2 15 m^2 benches Roller Conveyor Raw Seawater Hot & Cold Fresh water Fridge/Freezer	The 'Fish Lab / Fish sorting room' complex aboard *Southern Surveyor* is increasingly used as a general purpose 'wet' laboratory space and configured as required. An increase in the total space from 55m^2 to 80m^2 recognises that a greater number of scientists aboard future capability is proposed in conjunction with a configuration that supports a two stage sample handling regime. The 'exterior' GP Wet lab to be provided with direct access to the working deck and appropriate materials handling access both from the working deck and to the 'interior' GP Wet Lab. Configured for 'dirty'/noisy activities and sample pre-processing such as primary catch / sample sorting & cleaning, core sectioning etc.
	GP Wet Laboratory - Clean	40 m^2 15 m^2 benches Analysis seawater Clean Circulating Seawater Hot & Cold Fresh water Ultra-pure Fresh Water Fridge/Freezer	The 'interior' GP Wet Lab configured for 'clean' activities such as sediment sorting, core assessment or fish & biota, assessment, measurement and taxonomy. Either a variety of bench heights to accommodate seated and standing working postures or the ability to adjust bench heights should be provided.

Item	**Description**		**Note**
	Preservation laboratory	15 m^2 Sample Lockers: 3 m^3	Suitable for storage of preserved samples, handling and storing dry ice and liquid Nitrogen. Co-located with clean GP Wet Lab.
	GP laboratory(dry)	35 m^2 12 m^2 benches Fridge/Freezer Analysis seawater Clean Circulating seawater Hot & Cold Fresh water Ultra-pure fresh water	User configurable. No radiation work. Either a variety of bench heights to accommodate seated and standing working postures or the ability to adjust bench heights should be provided.
	Hydrochemistry laboratory	20 m^2 Analysis Sea Water Ultra-pure Fresh Water Clean Circulating seawater Hot & Cold Fresh water Fridge/Freezer	Designed and fitted to accommodate the equipment and instruments required to undertake the manual analysis of seawater. Either a variety of bench heights to accommodate seated and standing working postures or the ability to adjust bench heights should be provided.
	Underway seawater Analysis Laboratory	10 m^2 Analysis Sea Water Circulating seawater Ultra-pure Fresh Water	Located to minimize transit time of Circulating Seawater from point of intake to distribution to instruments. Designed and fitted to accommodate instruments permanently fitted to measure seawater properties while the vessel is underway.
	Controlled temperature laboratory	20 m^2 +35º C – +2 º C +/- 0.5º C 'Wet' workspace Hot & Cold Fresh water Clean Circulating Seawater Raw Seawater	For experiments requiring constant temperatures to be sustained outside the typical operating range of HVAC system. Configurable for storage of non-hazardous samples such as seabed cores. Fitted with light banks with the ability to controllably simulate the provision of natural light. Designed for the fitment of removable benches at a variety of heights.

GUIDANCE NOTES

Item	Description		Note
	CTD Compartment	30 m^2 Equipment handling systems: for rosette and sensor deployment and recovery Drainage: Wet compartment. Scuppers capable of handling significant volumes of free water	Sized to accommodate a 36 bottle rosette or frame Facilities to store, secure and service a CTD rosette or other oceanographic sensors or sampling devices Designed to facilitate transfer of samples to Hydrochemistry Laboratory and Dirty GP Wet Laboratory Configured to be made weathertight pre & post equipment deployment Adjacent to Hydrochemistry Laboratory
43	**Office and Conference Spaces**		
	Science Office	15 m^2	Dedicated space provided for management of the science team Adjacent to Operations Room
	Conference room	~70 m^2 (Multipurpose Space) Full range of AV presentation & video conferencing equipment	Configured as theatrette / Lecture Room with seating for total compliment of vessel and designed to facilitate all-staff briefings/debriefings & science presentations. Available as recreation venue.
44	**Storage Areas**		
	Hold Stowage	4 x ISO TEUs Connections to: • Electricity (240&415 V) • fresh & clean seawater • LAN • waste handling system • communications	Stowage hold should accommodate 2.9 m (9' 6") TEUs and provide: • Container positioning & securing equipment • Access at all stages of voyage • HVAC • Facilities for efficient stores / equipment / sample handling
	Scientific Store	>18m^2	
	Refrigerated Stores	30 m^3 Chiller: 10 m^3 10º C to -4º C +/- 0.5º C Freezer: 20 m^3 -18º C to -20º C +/- 1º C Clean Freezer storage: ~2.5 m^3	Volume optimized for maximum usability. A chest-type ultra-cold storage facility should also be provided. Located to facilitate the transfer of samples to and from laboratory spaces. • 2m^3. • Minimum Temperature -80º C. Some voyages may require that samples be kept in 'clean' refrigerated conditions to eliminate the possibility of sample contamination. It is proposed that this be provided by dedicated domestic freezers. Space for these should be identified and fitted with a 240 V supply.
	Electronics Storeroom	10 m^2	Electronic, IT and acoustic equipment and components.

Item	Description		Note
	Scientific Deck Store	> 40 m^2 Workbenches	Also serves as workshop for lifting & lashing equipment, materials handling systems and trawl gear.
	Rope Locker	18 m^2	Secure storage for twine, cordage, shackles, chain, lifting and lashing tackle and similar items. Co-located with Scientific Deck Store
	Hazmat Locker(s)	> 25 m^2 Environment Controlled Exhaust linked to vapour management system.	Storage of hazardous and dangerous materials required for the conduct of the science being undertaken. Conforms with international best practice for the safe storage and handling of hazardous materials in organizations conducting research. Two discrete spaces may be required. May be used for the storage of samples preserved in hazardous materials where samples do not require a climate controlled environment more demanding than domestic HVAC. Provision should be made for the storage of compressed laboratory gases. Should be designed and fitted to facilitate the ergonomically appropriate transfer of significant volumes of material to and from laboratory spaces in a safe manner during the course of a voyage.
45	**Workshops**		
	Deck Workshop	30 m^2	Adjacent to main working deck with provision for heavy equipment access & servicing / configuration. Sufficient space to accommodate visiting technical support staff. May be amalgamated / co-located with Mechanical Workshop. Adequate space for both functions must be provided.
	Instrument Workshop	20 m^2	Dry electronics maintenance & servicing workshop. Sufficient space to accommodate visiting technical support staff. To the extent practicable co-located with deck workshop. If not, good materials handling facilities between workshops.
	Mechanical Workshop	25 m^2 Shared with ship staff • Lathes, milling & shaping machines • Welding & cutting facilities • Grinding machines	Support for instruments and systems fitted to the vessel, instruments and systems brought aboard by visiting scientists and ship's machinery and systems. Appropriate materials handling facilities.

Item	Description		Note
Acoustic System Infrastructure			
46	**ICES 209**	Compliant	Must be compliant in hydro-acoustic bands. Full compliance preferred.
47	**Sensor Deployment Systems**		One or a combination of the deployment strategies below. Proposals should identify the strategies adopted to best locate acoustic sensors with reference to: • the need for multi-beam transducers to be accurately referenced to the vessel • the ability to change/service sensors underway • minimizing potentially vulnerable protuberances from the hull
	Drop Keel(s)	2(?) ~15 m^2 Sensors to 4 m clear of hull Underway sensor changes OK	The use of drop keels to mount those sensors that benefit from being outside the turbulent layer is now an industry standard.
	Moonpool sensor trolley	~3 m^2 Sensors 0.5 m clear of hull Underway sensor changes OK	Smaller sensors Most amenable to rapid change-out / reconfiguration.
	Retractable Gondola	~15 m^2 Sensors 0.6 m clear of hull	Capability to protectively relocate transducers in shallow, ice & high debris conditions while maintaining accurate position reference.
49	**Transceiver Room**	~20 m^2 Workbenches Equipment racks & transceiver mounting arrangements	HVAC as laboratory spaces Adjacent to through-hull deployment system

Item	Description		Note
Other Design Features			
51	**Cranes, winches and equipment deployment**		
	General	All winches should have fine control in heave & render across full speed range & brakes capable of resisting render loads at least the equivalent of winch heave capability. Winches should be capable of finely positioning of instrument packages & sampling devices. It is preferred that all cranes and winches be fitted with heave compensation and/or tension control arrangements appropriate to their function. All winches & lifting systems should be fitted with facilities to measure wire tension, wire out, speed and angle and transmit this information to ship's data acquisition system. In order to reduce the potential for oil spills and contamination electric winch technology is preferred. Alternative proposals will be considered where the present state-of-the-art will not cost-effectively deliver the capabilities identified.	
	Cranes After Crane Utility Cranes	 1 Lifting Capacity in Port: 25 t @ 12 m Lifting Capacity at Sea: 5 t@ 12 m to SS 6 1-2 5t @ all reaches	All cranes should have ship to sea capacity. Should be able to service full scope of working deck, container stowage areas and provide ship-to-sea and ship-to-shore equipment and container handling. Heave compensation fitted to support ROV/AUV launch/recovery. If two fitted they should be of the same type and capability.
	Winches		The winch technology employed will have an impact on the sampling strategies available to researchers. Traction winches: • deliver constant tensions across a the full range of wire out • may be relatively simply re-configured for different wire diameters and types • store cable at lower tensions, simplifying cable spooling & replacement Drum winches • Are relatively mechanically simple • Can deliver greater line speeds
	Dredging / Trawl	No: 2 / Wire: 7000 m / Max Heave: 30t Dredging: Payload @ Max Depth ~1 t @ ~5000 m	A variety of sampling devices will be deployed from the ship's winches. Different sampling systems have different masses. This will affect the payload each sampling device is able to recover from the maximum depth to which it may be deployed.

GUIDANCE NOTES

Item	Description			Note
		Trawling: Payload @ Max Depth ~1 t @ ~4000 m Benthic Sleds: Payload @ Max Depth ~0.5 t @ ~5000 m Wire deployment & recovery: >100 m/min		Typically dredging is conducted at greater maximum depths than demersal or mid-water trawling, in addition: • Obtaining geological samples with dredges places shock loads on wires and winches. The combination of winch and wire should be optimised to deliver the energy required to separate samples from the surrounding substrate without exceeding design safety factors. These loads are typically the limiting factor on winch design, not payload recovery. Winch/wire combinations should accommodate delivered forces at the seabed of up to 10 t. • While of typically greater mass than rock dredges benthic sleds are generally not intended to deliver shock loads to the surrounding substrate. Accordingly recoverable payloads may be greater than that identified. Towed seabed sampling systems should be designed in the context of the demands of geological sampling Payloads recovered with research trawls have the potential to be many times greater than those recovered when dredging due to the greater apertures of trawls and the greater holding volume of nets. Typically however the biological processing capability of a research vessel will limit the desired size of catches. In addition the typically shallower depths at which research trawling is conducted in comparison to dredging delivers an increased potential payload due to the reduced weight of trawl wire streamed as does the intrinsically neutrally buoyant nature of the sample. When trawling maximum winch load will often occur when recovering a catch to the deck. This is not typically a limiting factor with 'research scale' biodiversity sampling. Winches capable of supporting geological seabed sampling at maximum wire out (~7000m = ~5000m water depth) are capable of supporting both benthic sleds to maximum wire out, surface, demersal and mid-water trawling to the typically shallower depths at which it is conducted. Maximum trawl depths considered achievable are based on a depth to wire out ratio of 1.7:1.0.
	Vertical Sampling	Cable 7000 m	Max Heave 30 t	Sediment coring system proposals should consider and accommodate to the extent practicable the range of coring strategies available:

GUIDANCE NOTES

Item	Description				Note
		Grabs: Sample Mass @ Max Depth ~0.25 t @ ~6500 m Sediment Coring: Min Core Length @ Max Depth 6 m @ ~6500 m Preferred Core Length @ Max Depth 30 m @ ~6500 m Cable deployment & recovery: >100 m/min			• Gravity • Piston • Multi • Vibra Recoverable core length is affected by both the ability to recover cores aboard and the mass of sampling systems. Both should be considered in proposing a design. It may be appropriate that coring and grab sampling is conducted by separate systems. For long core systems (30m) 'pull-out' loads of 20t should be used as the limiting design parameter. Coring system proposals should: • Provide for the ability to detect relatively minor changes in tension that may occur when sampling devices enter soft sediments and 'pull-out' loads on core samplers that may be an order of magnitude greater than steady state operating loads. • Carefully consider the material used to deploy coring devices.
	Net(storage) Winch	No	Volume	Max Heave	A winch suitable for the storage of wires or nets.
		1	10 m^3	15 t	
	Towed Body Winch	No	Wire	Max Instrument Mass	A winch suitable for the deployment and recovery towed bodies of < 0.75t on electro-mechanical cables of up to 5000 m in length.
		1	5000 m	0.75 t	
		Wire deployment & recovery: >100 m/min Communications Bandwidth: >9.6 kb (full duplex) Cables Electro-mechanical 11.7 mm			Proposals to deliver higher bandwidths are sought. Functionality may be delivered by suitable traction winch that provides multiple functionality. Positioned to serve stern deployed equipment. Cable specifications no less than Rochester A276463.
	CTD/Hydrographic	2	7000 m	1 t	

GUIDANCE NOTES

Item	Description		Note
	Winch	Wire deployment & recovery: >100m/min Communications Bandwidth: >9.6 kb (full duplex) Cables Electro-mechanical 8.03 mm	Proposals to deliver higher bandwidths are sought. Functionality may be delivered by suitable traction winch that provides multiple functionality. Positioned to serve side science area / hydrographic A-Frame. Cable specifications no less than Rochester A216314.
	GP Winches	No / Wire / Max Heave 2 / 60 / 5 t 1 / 60 / 15 t	Positioned to facilitate aft deck equipment and sample handling.
	Overside equipment deployment and wire handling systems		
	Oceanographic A Frame	Clearance: 4.5 m Outreach: 2.5 m Inreach: >2.5 m Aperture: >2.5 m SWL: 2.5 t	Alternative deployment systems may be proposed. Associated winch(es) should be heave compensated. Located adjacent to side science area.
	Side Towing Booms	2 Outreach: 2.5 m SWL: 2.5 t (2D)	Towing booms symmetrically located on each side of the vessel. Located adjacent to side science area. Booms should be efficiently removable. SWL should represent capability to withstand lateral (aft directed) and vertical loads.
	H / A-Frame	Clearance: >7 m Outreach: >4 m Inreach: >5 m Aperture: >80% of beam @ stern SWL: 20 t @ centre	Multiple block attachment lugs positioned to provide fair leads from winches. Positioned as close to the stern as practicable.
	Trawl/Dredge Gallows	2 x 30 t	Positioned to provide fair leads to trawl / dredging winches
52	**Vessel Operations Information and Management Systems** Planned Maintenance System Inventory and Asset Management System Document Management System Navigation: Full ECDIS		Senior staff should be provided with a standardized IT workstations and a suite of software designed to facilitate and automate their role. On board IT should interface with shore based systems for ship management and deliver automated functionality in areas such as reporting, inventory control and expenditure management. Integrated position, velocity, attitude and heading sensor system providing information to integrated navigation and positioning system.

Item	Description		Note
	Integrated Navigation Sensor System Stability		Kongsberg Seapath or similar system would fulfil these requirements. Outputs from this system should be distributed throughout the vessel. A complete software package for the vessel's stability. The package should include provision for fishing, damage and icing conditions.
53	**Masts**		Fore and main masts designed to facilitate the maintenance of permanently fitted instruments and the fitting and removal of temporary instruments.
54	**Blast Freezer**	1.5 m^3 20º C -> -30º C 150 kg/hr	Co-located with refrigerated sample storage.
55	**Ice Machine**	~ 0.5 t / day	Co-located with dirty GP wet lab or materials handling facilities for ice delivery.
56	**FRC and Workboat**	1 x FRC @ ~ 7.5 m 1 x Workboat @ ~6 m	Safe launch & recovery to SS 6. Associated SAR locker.
Accommodation			
57	**General**	Cabin accommodation provided with natural light. Cabin accommodation, recreation, mess and galley situated to minimize ship motions. Services in cabins: • Phone + PA • Network • TV • Radio	
58	**HVAC** Accommodation Laboratories	 22º C+/- 2º C 22º C+/- 1º C	 Individual control of cabin temperature preferred but not mandatory. HVAC design must recognise and accommodate the differential heat loads that will be generated in different working spaces. The navigating bridge, computer machine room, acoustic transceiver room, the operations room and spaces similarly fitted with significant amounts of electronic equipment will generate significantly larger heat loads than general accommodation spaces. These spaces must, in order to avoid damage to sensitive electronic components, be maintained at temperatures appropriate to the optimum operation of that equipment.

GUIDANCE NOTES

Item	Description		Note
59	**Public and Administration spaces**	• Lounges – 3 • Cafeteria style mess • Exercise room + sauna • Ship's office • Engineering office Hospital fitted to accommodate DMT.	 Hospital with capability to accept Diver Medical Technician and associated equipment if required by voyage.
60	**Access**	Movement between all enclosed working, storage and accommodation spaces should be possible without the requirement at any time to travel across unenclosed deck areas.	

MARINE
NATIONAL FACILITY

Future Research Vessel

Statement of Requirements

Annex 2

SCIENCE OUTFIT

CSIRO

Item	Description		Note
Core Science Outfit			
The items below represent the core science functionality with which it is intended to equip a future Marine National Facility research vessel to deliver the capabilities sought. Alternatives are acceptable. The proposal assessment process will assess the cost benefit of alternative proposals for provision of the functionality sought. Proposals should describe the performance of each sensor in terms of its operational range, accuracy and precision.			
40	**Operations Room**	Primary Systems Interfaces Voyage Tracking & Management Configurable space for user equipment	This is the central location for acoustic and electronic data acquisition and science operations management The Operations Room should be provided with permanently installed interfaces to fixed equipment.
41	**Data Acquisition, Processing and Management**		
	The functionality required to fuse and display data from on-board observations with data from space-based sensors, autonomous vehicles and shore based models in real time may be delivered by the combination of a shipboard Data Acquisition, Processing and Management System with both a high level data fusion and visualization capability and a high bandwith ship-shore communications capability. Present satellite communications systems offer the bandwidth necessary to deliver both now-cast model data generated by shore based high-performance computing systems and processed satellite imagery and data to a vessel in near real time. The hardware and software requirements of both the shipboard DAPMS and data fusion / visualization elements of this capability are the subject of current research by MNF staff.		
	Data Processing Lab	Workstations (PC / UNIX / Linux)	Dedicated DP facility to support full range of scientific and academic IT activity including voyage planning and assessment.
	Network & IT infrastructure management Office	Archive media writing facilities	
	Machine Room	High Performance CPU's Mass storage Network routers / switches Cable hubs	
42	**Laboratories**		
	GP Wet Laboratory - Dirty	Data Acquisition system	
	GP Wet Laboratory - Clean	Data Acquisition system Fume Cupboard Laminar flow cabinet	
	Preservation laboratory	Fume Cupboard	
	GP laboratory(dry)	Fume Cupboard Laminar flow cabinet	

Item	**Description**		**Note**
	Hydrochemistry laboratory	Fume Cupboard	
44	**Storage Areas**		
	Refrigerated Stores	Clean Freezer storage: ~2.5 m^3 Ultra-cold storage: ~2m^3 -80º C	Some voyages may require that samples be kept in 'clean' refrigerated conditions to eliminate the possibility of sample contamination. It is proposed that this be provided by dedicated domestic freezers. A chest-type ultra-cold storage facility should also be provided. Located to facilitate the transfer of samples to and from laboratory spaces. Space for these should be identified and fitted with a 240 V supply.
	Acoustic instrument management		
	Acoustic instrument synchronization	Control interface in Operations Room	**High noise levels causes poor detection** To reduce interference in acoustic data a system should be provided to synchronize and selectively activate all acoustic systems.
	Transducer calibration	Remote control of target position Control interface at the acoustic system workstation in the Operations Room	Facilities to calibrate transducers with standard acoustic calibration targets should be provided
	Scientific Equipment & Sensors		
	Acoustic Instruments		To the extent practicable acoustic technology should be from the same manufacturer to allow for easy integration of data
	Multi-frequency scientific echosounder: 18, 38, 70, 120, 200 and 400 kHz split-beam transducers.		Simrad/Kongsberg EK60 or similar

Item	Description	Note
	Multibeam swath mapper(s): 15-250 m 0.5ºx0.5º 100-250kHz 10-4000 m 1ºx1º, 30 kHz + raw data logger Full Ocean Depth, 12 kHz	Simrad/Kongsberg EM1002 or similar Simrad/Kongsberg EM300 or similar Vessel niche perceived to be Shelf/Slope and deep ocean. Existing SWATH capabilities extend to 4500 m max with limited efficiency. Adding an EM 2000 or similar system will permit 0-250 m to be surveyed more efficiently. Augmenting 30kHz & 100-250 kHz systems with a 12kHz system will allow effective mapping of deepwater areas (Blue Water) while maintaining a higher resolution capability for areas in the 150 m to 3000 m range. However transmit and receive arrays for a 12 kHz system are in the order of 9 m^2 in size and will occupy substantial hull real estate. The cost effectiveness of this option will be assessed by the design assessment process
	Sonar(s) Multi-beam, directional, steerable, 90 kHz Omni directional, stabilized full circle beam 20-30 kHz	 Simrad/Kongsberg EM2000 or similar Simrad/Kongsberg SP70 or similar
	Net mensuration system	Simrad & SCANMAR provide appropriate systems
	Trawl monitor sonar system	Simrad FS20/25
	ADCP Low frequency High Frequency	RD Instruments Ocean Surveyor or similar
	USBL Acoustic Positioning system: 7000 m capable	Simrad/Kongsberg HiPaP or similar
	12 kHz transducers	Mooring deployment/recovery Acoustic release interrogation CTD pinger
	Sub-bottom profiler	Kongsberg PS018 or similar Options to house transducers separately from multi beam should be explored.
	Hydrophone(s) Multi-frequency	Suitable for monitoring self noise and measuring ambient environmental noise
	Environmental Sensors	
	Ocean / Atmosphere flux sensors	

Item	Description	Note
	Long-wave radiation Short-wave radiation Photosynthetically Active Radiation (PAR)	
	Automatic Weather Station Wind Speed and Direction Air Temperature / Humidity Rainfall Barometric Pressure Atmospheric aerosols	
	Expendable Bathythermograph	CMAR Blue Devil XBT System or similar
	Winch parameter mensuration Wire Tension Wire speed Wire Out Wire angle	All winches
	Specimen measurement Electronic balances 4 x 1 g to 6 kg. 1 x 10 g to 60 kg. 3 x Electronic measuring boards.	 Marel M1100 indicator with PL2210 Marine Scale or similar Marel M1100 indicator with PL4200 platform Marine Scale or similar Scantrol, Limnoterra or similar
	Hydrochemical property measurement Automated nutrient analysis Nitrate + nitrite: 0.040 µM Nitrite: 0.012 µM Phosphate: 0.030 µM Silicate: 0.040 µM Ammonia: 0.040 µM Oxygen: ±0.40 µM	An automated analysis system that delivers results in accordance with the WOCE standard (1% of deep ocean values). Measurement capability should achieve or exceed the approximate values shown. Lachat or similar
	Underway Measurement System Seawater temperature and conductivity Fluorescence pCO_2 Dissolved O_2 Transmissivity Turbidity	An underway measurement system that carries out continuous measurement of the desired parameters. FerryBox or similar
	CTD Rosette and sensors	

Item	Description	Note
	24 Bottle Rosette to 10 l	Seabird SBE911 or similar
	Rosette Sensors Conductivity Temperature Pressure PAR Dissolved O_2 Fluorescence Transmissivity Turbidity Altitude above sea floor Vertical Current Profiler EH (Oxidation)	All instruments rated to max deployable depth. Communications arrangements to provide redundant channels.
Modular Science Outfit		
The items below represent science functionality that may be modularised. The proposal assessment process will assess the cost benefit of alternative proposals for provision of the functionality sought. Proposals should describe the performance of each system and the mobilisation and de-mobilisation requirements of each system. Systems need not be discrete. It may be assumed that the core capabilities of the research vessel are available to support the operation of modularised science packages.		
51.3.4.2	**Sediment Coring System(s)**	• Minimum Core Length @ Maximum Depth: 6 m @ 6500 m • Preferred Core Length @ Maximum Depth: 30 m @ 6500 m
51.3.4	**Trawl Winches**	The fitment of trawl winches (and net storage winch) may be modularised. The functionality delivered by a modular system should be no less than that provided by a permanently fitted facility.
	Radiation Laboratory	This capability must be modularised. The modular package proposed should also provide for the storage of radioactive materials prior to their use and the storage of any wastes generated.
	Trace Metal Clean Sampling System	A CTD system suitable for taking trace-metal clean seawater samples. This system should comprise both CTD rosette / sensors and an appropriate winch / deployment system.
42.6	**Hydrochemistry Laboratory**	While a hydrochemistry laboratory has been identified as a core capability alternative proposals are sought for the modularisation of this capability. The functionality delivered by a modular system should be no less than that provided by a permanently fitted facility.
	Seismic Acquisition System	To be determined

Item	Description	Note
	Remotely Operated Vehicle	At this time ROV capability is outside the scope of this SOR however the core capabilities identified are intended to support the mobilization aboard and operation of a work class ROV at depths of 5000m+.