NATIONAL CENTRE FOR POLAR & OCEAN RESEARCH
(Ministry of Earth Sciences)
Headland Sada - Goa

TENDER DOCUMENT

APPOINTMENT OF CONSULTANCY FIRM FOR CONSTRUCTION SUPERVISION OF OCEAN RESEARCH VESSEL

(Ref No: NCPOR/VOM-14016/1/2024 dated 02.02.2024)

February, 2024

NATIONAL CENTRE FOR POLAR & OCEAN RESEARCH
(Ministry of Earth Sciences)
Headland Sada, Goa
India - 403 804.

Ref. No. NCPOR/VOM-14016/1/2024 **Dated. 02.02.2024**

Sub: TENDER NOTICE FOR APPOINTMENT OF CONSULTANCY FIRM FOR CONSTRUCTION SUPERVISION OF OCEAN RESEARCH VESSEL

Sealed Proposals (BIDS) are invited from Indian Bidders in two bid system for the Appointment of Consultancy Firm for Construction Supervision of Ocean Research Vessel as per the scope of work given in this tender document, Technical specifications and the concept layout plan for guidance as enclosed. The bid shall be kept valid for acceptance for a minimum period of 90 days from the date of closing of proposal. National Centre for Polar & Ocean Research (hereinafter also referred as NCPOR) will make its best effort to complete the bid evaluation processes within this period. The bid should be as per the instructions and guidelines in this tender document. The brief information is provided below:-

1.	TENDER DOCUMENT No.	:	NCPOR/VOM-14016/1/2024 dated 02.02.2024
2.	Description of Services	:	Appointment of Consultancy Firm for Construction Supervision of Ocean Research Vessel
3.	Period of Completion	:	Vessel construction is estimated to take 36 months period OR completion of construction and delivery of the vessel or whichever is later.
4.	Pre-bid conference scheduled on	:	22.02.2024 (11:00 hrs IST)
5.	Last date and time of submission of bid	:	19.03.2024 (16:00 hrs IST)
6.	Opening date & time		
	a) Technical Bid	:	20.03.2024 (10:00 hrs IST)
	b) Price Bid opening date & time	:	Will be intimated to the technically accepted bidders.
7.	Bid Validity upto	:	90 days from the closing date of Bid
8.	Bid Bond / Bid Security amount (quoted currency)	:	INR 32,00,000/- (Indian Rupees Thirty Two Lakhs Only) PSUs are exempted from submission of bid bond.
9.	Performance Bank Guarantee	:	3% of the contract value valid upto 60 days beyond the warranty period. *(For information: shipbuilding period 3 years and warranty period 1 year).*
10.	Address for Correspondence	:	The Director, National Centre for Polar & Ocean Research, (Ministry Of Earth Sciences), Headland Sada, Goa, India. Tel :0832 - 2525501 Email :director@ncpor.res.in (Attn: Scientist I/c, Vessel Operation and Management, NCPOR, Goa. mmsubbu@ncpor.res.in)

11. BIDS will be governed by the "Scope of work" placed at Section-2, "Instructions to Bidders" at Section-5, "Evaluation of Bids" as at Section – 6, "Model Service Agreement format" at Section–8, "Terms of Payment" at Section-11 of this tender document.

12. a) Bidders must ensure that bids are submitted in accordance with the instructions mentioned at section 5 - Instructions to bidders. All terms and conditions stated in the tender document as well as in the Model Service Agreement are to be considered while submitting the bid.

    b) Criteria placed at Section -6 shall be the basis for evaluation of BIDS.

13. **Two Bid system** shall be followed for this tender. Bidders should take due care to submit BIDS in accordance with requirements in sealed covers.

14. Short-listed bidders whose bids will be considered as technically acceptable conforming to the desired specifications, will be given advance intimation for opening of price bids.

15. Any time prior to the deadline for submission of bids, NCPOR may, for any reason, or at its own initiative, modify the bidding documents by amendment(s) and same shall be informed to all shortlisted bidders. In order to allow maximum bidders, reasonable time in which to take the amendment into account in preparing their bid, NCPOR may at its discretion, extend the deadline for the submission of bids.

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PART A

SECTION 1 : INTRODUCTION

1.1 The National Centre for Polar & Ocean Research (hereinafter referred to as NCPOR) is the nodal organization for polar research in India which is an autonomous R & D institution which functions under the aegis of Ministry of Earth Sciences, Government of India. NCPOR also carries out frontline oceanographic research and exploratory programmes in tropical seas as well.

1.2 NCPOR is acquiring an Ocean Research Vessel as a part of the Deep Ocean Mission programme of India. For this purpose, NCPOR invites bids from reputed firms with relevant experience for awarding the work of CONSULTANCY FIRM FOR OCEAN RESEARCH VESSEL for technical control and support during the construction stage and for supervision of all shipbuilding activities.

1.3 The work has to be carried out and deliverables are to be submitted by Consultant according to the scope of the work specified in this tender document at Section 2.

1.4 NCPOR invites Bids for the provision of the above mentioned services. Bid complete in all respects and complying with all the requirements set out in this Tender Document should be sent in two cover system as specified in this document

1.5 Please refer to the 'Instructions to bidders' at Section 5 for filling and submitting Bid. The Bid should be received by **16:00 hrs** Indian Standard Time (IST) on **19.03.2024.**

1.6 The Technical bid shall be opened **on 20.03.2024 at 10:00 hrs** (IST) in the office of the NCPOR, in the presence of the bidders or their authorized representative(s), if any. No separate formal invitation shall be extended to the bidders for this purpose.

1.7 NCPOR reserves the right to reject any or all of the proposals received in response to this invitation of Bid without assigning any reasons whatsoever.

END OF SECTION 1

SECTION 2 : SCOPE OF WORK

2.1 INTRODUCTION TO SCOPE OF WORK

The consultant is required to supervise the construction of new research vessel at M/s Garden Reach Shipbuilders & Engineers Ltd, Kolkata in India to ensure that the vessel is built as per the agreed specifications, examine and certify the documentation provided by the yard, certify the tests and trials during construction till delivery and acceptance of the vessel.

2.2 SCOPE OF WORK

The consultant is expected to provide the following services:

2.2.1 The consultant should examine the specifications of ORV for which the contract has been concluded with the shipyard and should be closely associated with the shipyard during the design process and ensure the vessel is designed as per the specification listed in the contract. Any deviations from the contract specification should be brought to owners notice.

2.2.2 Review of preliminary/production drawings received form shipyard, pertaining to various systems on-board on behalf of owners as per classification society rules and regulations. Conflicting requirements in specifications noticed during the course of design, if any, should be presented to owner along with proposed solutions. Changes, if any, recommended by the yard should be examined by the consultant with respect to acceptability without compromising the capability of the vessel and shipbuilding contractual requirements. All changes should be presented to NCPOR with justifications for approval prior implementation.

2.2.3 Supervision during construction, Scrutiny of class, production and as-fitted drawings prepared by the yard in order to ensure that the vessel is built according to the agreed specifications and shipbuilding contract, advising NCPOR and the yard regarding changes during construction, participation and certification during shop tests, other tests during construction, basin trials, sea trials and any other tests and trials required prior acceptance of the vessel.

2.2.4 Undertaking quality checks, on incoming materials, inspection of hull during fabrication, fitting, erection, welding etc. Surface preparations and painting, installation/commissioning of all the equipment/machineries, its associated system including Piping/Electrical/HVAC, as necessary and recommending acceptance thereof, to the Owner, at appropriate stage and on completion of construction to ensure that the vessel is built as per good shipbuilding practices keeping in view of the nature of service, comfort conditions of the vessel and its occupants.

2.2.5 Checking the adequacy of safety precautions taken by the shipyard for ships and ships' equipment in the yard. Conduct a periodic safety patrol inside the shipyard premises to ensure that the workers and subcontractors engaged in building the vessel follow the applicable safety standard.

2.2.6 Conduct weekly safety review meetings with the Builder's designated safety supervisor and identify any potential safety risks.

2.2.7 Consultant should also ensure that all scientific equipment are preserved and installed in accordance with OEM recommendations. Consultant should also draw up the list of scientific equipment, for installation of which OEM reps have to be present.

2.2.8 In order to fulfill the obligations of the bidder with respect to the scope of work as indicated in this tender, the bidder shall position necessary manpower who are appropriately qualified and with adequate experience. For examining and vetting of all preliminary and production drawings submitted by yard, well experienced team in design (minimum 4 members, each having atleast 5 years experience in Hull-Outfitting/Piping-Machinery/Electrical-Electronics) should be available. The manpower deployment at the shipyard commencing from the day of steel-cutting during the various stages of requirements is as follows:

a. Naval Architects: with at least 5 years of site experience in ship construction (Hull/Outfitting/Accommodation etc) - 1 no.
b. Marine Engineer: With the rank of Chief Engineer (FG) in Merchant Marine with at least 5 years of site experience in ship construction (Piping/Machinery/HVAC etc) - 1 no.
c. Electrical/Electronics engineer: with at least 5 years of site experience in ship construction - 1 no.
d. Science Specialist Team (Atleast 3 experts in Science / Electronics / Mechanical) with proven experience in selection, installation, operation, maintenance and utilisation of scientific eqpt.
e. Paint application activities are to be monitored by Painting Supervisor qualified with NACE/FROSIO certification.

2.3 Relationship with Shipyard

The consultant and his representatives are responsible for and shall conduct the following tasks in maintaining cordial relationship with the shipyard:

1. Advise the shipyard and provide necessary data in order to direct the shipyard with the Owner's intentions, interpretations and recommendation, if necessary.

2. Assure at completion of construction of the Vessel that all necessary documentation is delivered to the Owner in accordance with the Shipbuilding Contract along with all required hull, machinery, electric material certificates and manufacture's machinery records.

3. Advise on any special requirements of the governing provisions under the Shipbuilding Contract or any provision or regulation (based on documents provided by Owner) applying in connection with the construction of the Vessel.

4. Site Supervision Team shall work in accordance with the shipyard's usual practice, and in such a way as to avoid any disturbance in the shipyard's production schedule.

2.4 DELIVERY (Output from the Consultant)

Unless otherwise directed by NCPOR, all deliverables, reports, data, drawings in hard and soft copies shall be delivered, transportation prepaid (if any) to:

THE DIRECTOR
NATIONAL CENTRE FOR POLAR & OCEAN RESEARCH
(Ministry of Earth Sciences)
Headland Sada, GOA – 403 804, INDIA.
Tel: 91-(0)832-2525501

END OF SECTION 2

SECTION 3 :DELIVERABLES

The following deliverables are required by NCPOR from the Consultant during the period of the Services:

3.1 The consultant should allocate necessary resources to supervise the construction at the yard and assist NCPOR in ensuring that the vessel is constructed as per the agreed specifications. The activities include the following:

a. Scrutiny of drawings submitted by the yard for approval of classification / regulatory authorities.
b. Scrutiny of production drawings made by the yard and submitting the same to owners.
c. Inspection of construction throughout the process.
d. Participation in shop tests for all equipment.
e. Participation in tests at component level and system level.
f. Participation in dock, quay & sea trials till delivery.
g. Certification of stages for release of payment to yard.
h. Certification of change requests and additional work / cost components including preparation of justification for the same.
i. Ensuring that the as-built drawings and documentation (specifications, test & trial reports, installation, operating and maintenance manuals for various equipment etc) made by shipyard are scrutinized, certified and delivered to the owners.
j. Approval of design optimization & changes proposed by yard in consultation with owners.
k. Project Monitoring for Cost & time control.
l. Periodical reportings.
m. Witnessing model testing.

3.2 The consultant will be responsible for the following:

a. Compliance with building contract and specifications.
b. Compliance with approved drawings, rules & regulations.
c. Quality checks to ensure that the vessel is built to the standard as expected by owners in accordance with highest level of good shipbuilding practice. The quality of construction shall be checked from the beginning with the scrutiny of class/production drawings for compliance of material specifications to inspections of received material before fabrication/placement on board and final fitment and installation followed up by adequate test & trails before passing the relevant material / fabrication/ fitment for stage payment to the yard.
d. For the purpose of ensuring good quality works the consultant shall employ appropriately trained and experienced employees to carry out the works, documentation and reporting.

3.3 The consultant shall furnish to owners weekly reports with necessary supporting documents and photographs in a suitable format as agreed between the consultant and the owner at the beginning. The reporting should include but not limited to the following:

a. Progress schedule (in a suitable project management system mutually agreed to upon).
b. List of drawings (Classification / production / OEM supply) scrutinized and approved along with comments. All the drawings made by the yard in this regard will need to be scrutinized by the bidder and submitted to owners.

c. List of deviations from the specifications and acceptance/rejection of the deviations along with reasons thereof.
d. List of non conformity to the quality checks (even if passed by the classification society) and recommendations to the yard for compliance along with reasons thereof.
e. Test & trial reports.

3.4 The consultant is to furnish the qualifications and experience of the persons to be deployed at site for carrying out the supervision activities for approval of the owners. All personnel deployed by the consultant for the purpose of fulfilment of obligations will need to be approved by the owner's prior deployment. The consultant shall, if necessary, agree to replace a resource, upon the request of the owners for under-performance / inadequate experience. Failure to provide necessary resources at the shipyard during all stages of construction will be termed as a breach of contract and will attract suitable penalty and or termination of contract by the owners without giving any reason thereof.

END OF SECTION 3

PART B

SECTION 4 :BID SUBMISSION FORM

No…… **Date:….**

To
THE DIRECTOR
NATIONAL CENTRE FOR POLAR & OCEAN RESEARCH
(Ministry of Earth Sciences),
Headland Sada, Vasco-da-Gama, GOA – 403 804, INDIA.

Ref No. NCPOR/VOM-14016/1/2024 dated 02.02.2024

1. Having examined the tender document including the Model Services Agreement (draft contract at section 8 of tender document) and all the Annexures for the Appointment of Consultancy Firm for Construction Supervision of Ocean Research Vessel, we, the undersigned, hereby offer to perform the Services in conformity with all the Conditions set out in the Tender Document including the draft contract.

2. We undertake, if our bid accepted, to perform the whole of the Services within the time schedule provided and at the rates quoted by us, if found acceptable to NCPOR. It is assured that the work will commence within 7 days of award of contract as per the tender.

3. We agree to abide by this proposal for a period of 90 days from the last date fixed for receiving the same and it shall remain binding upon us and may be accepted by you at any time before the expiration of that period i.e. till -------.

4. This bid is submitted under this covering letter reference ……dated ……., and the completed documents and information required as enclosed therewith, shall be read and construed as forming part of our Proposal.

5. We guarantee that the contents of the tender document and any other information received shall be used only for the purpose intended by NCPOR for bid submission.

6. Our address and contact details for further correspondence on this tender will be as under:

Signature……...
Name……..
For and on behalf of
……
……

Duly authorized to sign tender for and on behalf of the bidder
……
Date:……

END OF SECTION 4

SECTION 5 : INSTRUCTIONS TO BIDDERS

5.1 This Tender document is to be read along with the Notice Inviting Tender issued by NCPOR.

5.2 NCPOR reserves the right to reject any or all of the bids received in response to this invitation without assigning any reasons whatsoever.

5.3 NCPOR will not take cognizance of any internal arrangements as may be made by the bidder for the satisfactory completion of the work as per the terms and conditions laid down in this document. The successful bidder will be directly responsible for proper completion of the work.

5.4 The Proposal / Bid shall be prepared by and at the cost of bidder. NCPOR will not be responsible for any costs or expenses incurred by any bidder in connection with the preparation and delivery of his Proposal / Bid or for any other expenses incurred incidental to this bidding.

5.5 Details of bidder's experience and capabilities as sought at Section-7 should be attached as a part of documentation with the technical bid.

5.6 The scope of the required work is described in Part-A, Section-2.

5.7 The Bidder shall be deemed to have examined the Tender Document and to have satisfied themselves, so far as may be reasonable for an experienced Consultant before submitting the Proposal, as to the sufficiency and correctness of his proposal for the services being offered and of the prices quoted by him.

5.8 In formulating their proposal, bidders shall have full regard to the contents of the General Conditions of Model Services Agreement given in Part-B, Section 8. All bids will be deemed to have been made after taking into account all the provisions thereof.

5.9 The bidder must give a Guarantee that work will commence within 7 days of the award of the work and guarantee to the effect that the personnel are not preoccupied with other works that may hamper the progress of the work undertaken with NCPOR. No excuses of whatsoever shall be entertained by NCPOR once the contract is awarded to the selected bidder unless otherwise force majeure is established.

5.10 The successful bidder will have to execute an Agreement as set out in Part-B, Section 8 within 7 working days from the date of issue of duly signed letter of intent (LOI) by NCPOR. The Agreement duly signed and accepted by NCPOR shall include NCPOR's Tender Document and amendments if any, the bidder's offer, and other relevant documents as may be finally accepted by NCPOR.

5.11 The successful bidder will have to submit within seven working days of issue of the LoI, **Performance Guarantee** for 3% of the value of the contract. On receipt and acceptance of Performance Bank Guarantee, the Bid Bond shall be returned.

Such performance guarantee shall be –

(i) on demand from a reputed Bank (Scheduled commercial bank in India).

(ii) unconditional as per format at Part-B, Section-10

(iii) valid upto 60 days from the vessel's warranty period completion.

(iv) for the due performance of the Agreement by the Consultant, claimable by NCPOR only in the event of breach of any contractual obligations by the Consultant not satisfactory to NCPOR under the Agreement.

(v) for the due performance of the Agreement by the BIDDER, encashable by NCPOR only in the event of breach of any contractual obligations by the bidder not satisfactory to NCPOR under the Agreement and any violation of Integrity Pact.

(vi) Bank Guarantee (BG) shall be issued by the issuing bank to the swift account of the owner (NCPOR) in Owners bank as per the details below and swift message copy to this effect to be provided to NCPOR in time. All BG charges including the BG handling charges at Owners bank SBI, Vasco-da-Gama shall be paid by issuing bank.

Name of bank	State Bank of India
Address of Bank Branch:	Commercial branch, Shree Vidyadiraj Bhavan, Francisco Luis Gomes Road, Vasco-Da-Gama, Goa – 403 802. INDIA
Bank Branch Code:	04116
IFS Code	SBIN0004116
Swift Code	SBININBB229
Bank Account Number	10153336180 (Savings Bank Account)
Name of the beneficiary	National Centre for Polar & Ocean Research
PAN Number	AACFN4991P
TAN Number	BLRN01981A

Indian banks at their option may issue original BG on stamp paper in place of SWIFT option.

5.12 Bidders shall note that NCPOR shall not entertain any correspondence or queries on the status of the offers received against this tender, during the course of evaluation and thereafter.

5.13 Canvassing in any form by any bidder or by any other agency acting on behalf of the bidder after submission of bid may disqualify the said bidder. NCPOR's decision in this regard shall be final and binding on the bidder.

5.14 NCPOR shall not be liable for any obligation until such time it communicates to the successful bidder of its decision to entrust the tendered work and accepted by the party confirming to relevant provisions of this document.

5.15 Bidders shall also have to essentially sign an Integrity Pact (IP) as at Section 13 for participating in this Tender, duly signed by the same signatory who is authorized to sign the bid documents. All the pages of the Integrity Pact shall

be duly signed. The Integrity Pact would be implemented through a panel of two Independent External Monitors (IEMs) appointed by the Ministry of Earth Sciences. The names and contact details of the IEMs are mentioned in the Section 13. The IEM would review independently and objectively assess, as to whether and to what extent parties have complied with their obligations under the IP. Also, IEM would have access to all contract documents, whenever required. The bidders may raise disputes / complaints if any, with the IEM.

5.16 Force Majeure:

If, at any time, either the construction or delivery of the VESSEL, and in turn the Consultancy Services are delayed due to War, blockade, revolution, insurrections, mobilisation, civil commotion, riots, strikes, sabotages, lock-outs, acts of God or the Public enemy, plague or other epidemics, quarantines, prolonged failure of electric power supply, freight embargoes, earthquakes, tidal waves, typhoons, hurricanes; or by destruction of the bidder or works of the bidder, or of the VESSEL, or any part thereof, by fire, flood, or other causes beyond the control of the bidder, any other similar “Force Majeure” cause (each of which contingencies shall be due to “Force Majeure” as used in this Contract) which could not have been reasonably foreseen and eliminated by the bidder, then and in any such case, the completion date of the contract shall be postponed by the actual number of days lost to the bidder in completing the works due to such causes. No separate delays shall be counted in respect of two or more of the above causes occurring concurrently. The bidder shall be obliged to provide documentary proof that any delay falls within one or more of the above categories and where any delay falls within more than one category the bidder may only claim delay within one category.

5.17 **Pre-bid meeting**

5.17.1 Interested bidders may attend the pre-bid meeting to be held on **22.02.2024 at 11:00 hrs (IST)** at NCPOR, Goa, wherein NCPOR’s position on the issues raised by the bidders will be discussed / clarified. All the terms and conditions would be frozen after the pre-bid meeting. No change in TENDER conditions will be permissible thereafter.

5.17.2 The bidders are requested to submit any query / clarification request (if any) on bidding document, by e-mail to reach NCPOR **on or before 16.02.2024** for deliberation in the pre-bid meeting. Bidders’ queries must be organized in the same order as that of TENDER document.

5.17.3 Non-attendance at the pre-bid conference shall not be a cause for disqualification of a bidder. Every effort will be made to provide deliberation of pre-bid meeting proceedings to the best possible communication skill. Every bidder may avail the opportunity of pre-bid meeting to get first hand details of the proceedings, in their own interest.

5.17.4 Any modification of TENDER document, decided during the pre-bid meeting will be notified within 7 working days of pre-bid meeting to all bidders those who attended and will be posted on NCPOR website. Subsequent to the pre-bid meeting, all terms and conditions will be treated as frozen. If there are no

modifications envisaged in pre-bid meeting, there will not be any update in the website.

5.18 **Closing date**

Bid Proposal should be received from the bidders at NCPOR **upto 16:00 hrs Indian Standard Time (IST) on 19.03.2024**. Proposal or modifications to the proposal received after the closing date and time shall not be considered.

5.19 NCPOR shall not be responsible for the loss of the proposal or for any delay in postal/courier transit.

5.20 Proposal must not be sent by fax or e-mail. Such proposal shall be rejected.

General instructions for filling tenders

5.21 The proposal papers shall be filled-in, complete in all respects and shall be submitted together with requisite information and appendices, if any. It shall be complete in all respects and free from ambiguity, interpretation, change or interlineations. Quoted prices must not be indicated on any document other than the official form of price bid at Section 12.

5.22 The Bidder's offer and any annotations or accompanying documentation shall be in English Language.

5.23 The bidder's offer document shall contain page number on each page and shall contain signature of the bidder on each page of the document submitted under this proposal to NCPOR.

5.24 Bidders should indicate at the time of quoting against this proposal, their Company / Firm name and style, full postal and e-mail address, fax and telephone number(s). Similar information in respect of their authorized agents in India, if any should be provided.

5.25 The bid shall be kept valid for acceptance for a minimum period of 90 days from the date of closing of bid submission i.e. 19.03.2024. If any bidder desires to offer a longer validity period, it should specifically be mentioned in the proposal. Offers with validity of acceptance for less than 90 days shall not be considered. NCPOR will make its best effort to complete the bid evaluation processes within this period. Should the need arise; NCPOR may request bidders to extend the validity period of their proposals. For the bidders who do not agree to extend the validity, NCPOR shall not consider such proposal for further evaluation.

5.26 The bidder shall sign the proposal with the exact name and address of the firm, which is bidding for the tendered work.

5.27 The bid shall be signed by a duly authorized officer of the firm which is bidding for the tendered work, and in the case of a corporation, seal, or otherwise appropriately executed under seal.

5.28 Bidders shall clearly indicate their legal constitution and furnish documentary evidence thereof by way of authenticated copies of relevant documents and the

person signing the bid shall state his capacity and also the source of his authority to bind the bidder. The power of Attorney or authorization, or any other document constituting adequate proof of the authority of the signatory to bind the bidder, shall be annexed to the bid submitted. NCPOR may reject out-right any bid unsupported by adequate proof of the signatory's authority.

Quotation of prices

5.29 Bidders shall set their price/quotations in firm and fixed figures and without qualifications. Each figure stated should also be repeated in words and in the event of discrepancy between the amount stated in figures and in words, the rates quoted in words shall be deemed to be the amount stated and accepted. Tenders containing qualifying expressions such as "subject to availability", "subject to minimum acceptance", etc. or any conditional clauses invoked by the bidder shall be liable for disqualification and rejection. If the space in the proposal form or in the appendices thereto is insufficient, additional pages may be separately appended. These pages shall be consecutively numbered and shall contain the signature of the bidder.

5.30 Bidders shall be bound to keep the prices quoted in their Price Bids firm and without any escalation for any reasons whatsoever, until completion of the work assigned and specified against this Tender.

5.31 All the prices shall be necessarily be given in Indian Rupees only.

5.32 The quoted prices shall include all costs related to the man-hours, software, travel (domestic & international) and subsistence costs, consumables, document copies (soft copy / hard copy), deliverables etc.

5.33 Payment to the Consultant shall be made in accordance with the Terms of Payment given in Section 11 or modified in agreement during contract finalization**,** subject to the full satisfaction of NCPOR.

5.34 NCPOR will not pay any additional charges other than those provided for, in the Agreement. In particular, the following shall be to the account of the Consultant:

(i) Any additional man-hours spent because of any issues / comments raised by NCPOR and changes required for successful completion of the project.

(ii) Travel, accommodation and subsistence costs for discussions with NCPOR, attending design reviews at NCPOR or at any place in India. Travel, accommodation and subsistence costs for international visits related to model testing, FAT etc.

Payment of Duty and Tax

5.35 The import of any equipment / software as may be required by the bidder to complete the scope of the work will have to be arranged by the successful bidder and NCPOR will not provide any import license.

5.36 Payment of all duties and taxes as applicable in India will be to the account of the successful bidder who shall become the Consultant.

5.37 The bidder shall bear all Indian Corporate Taxes levied or imposed on the bidder under the Agreement, under the provision of Income-Tax Act 1961 or any amendment thereof and under the Company's (profit) Surcharge/tax 1964

or any amendment thereof on account of payments received by it from the NCPOR for work done under the Agreement. The applicable TDS as per Income Tax Act would be deducted at the time of payment. It shall be the responsibility of the bidder to submit to the concerned Indian Authorities the returns and all other connected documents required for this purpose.

5.38 The bidder shall also provide NCPOR such information as it may require in regard to the bidder's income and expenditure under the agreement for proper assessment of taxes and duties if required.

5.39 The bidder or his personnel shall bear all **personnel taxes** if any levied on the bidder's personnel.

5.40 Should the bidder fail to submit returns/pay taxes in time as stipulated under the **Income Tax Act** and consequently the Indian Income Tax Authority imposes any interest or penalty, the bidder shall pay the said interest / penalty.

5.41 NCPOR shall if so required, by the applicable laws in force, withhold from the amount due to the bidder, **income tax payable** by the bidder at the rate in force, and pay to the Indian Tax Authority directly. It shall be the bidder's sole responsibility to determine the amount of Taxes as due and admissible and the likely rate at which the deductions will be made on account of taxes etc. by NCPOR for payment to the Indian Tax Authorities.

INSTRUCTIONS FOR SUBMITTING TENDER

5.42 The scope of work is provided in Part A, Section 2 and deliverables at Part A, Section 3.

5.43 The offer should be submitted by the bidder separately as follows in two bid system:-

a) Technical and commercial un-priced bid
b) Price bid

One soft copy of technical bid is also to be submitted in flash drive.

5.44 The Technical bids shall be provided in one sealed envelope superscribed as "TECHNICAL BID" with the Tender No. NCPOR/VOM-14016/1/2024 dated 02.02.2024, date & time of closing of the Tender and the bidder's Name and address. The envelope should contain adequate information and documentation addressing the following in the same sequence, by way of illustration and not enumeration:

1. Bid Bond for a sum of Rs. 32,00,000/- (Rupees Thirty Two Lakhs Only) in original.
2. Complete and comprehensive details requested for, as per the format in Part B Section 7**,** including as separate appendixes any technical literature, brochures etc.
3. Work plan necessary to complete the tendered work, time schedules, expert manpower available and expert manpower that will be deployed for the project with Curriculum Vitae, Design Softwares available, etc.
4. Contact details of the bidders including the complete mailing, e-mail address, phone, fax numbers, and the details of the authorized representative(s) of the bidder who would be submitting the bid on behalf of the bidder.

5. Resume's and details of key personnel who will be involved in providing the services tendered for, on behalf of the firm / organization and organizational track record for this type of work.

6. Bid Submission form as at **Part B Section 4**, duly filled in and signed.

7. Unpriced commercial bid. This document should be exactly the same as the price-bid but with price alone removed.

8. Adequate proof of authority of the signatory to bind the bidder.

5.45 The Envelope Marked "**Technical Bid**" not containing any of the documents 1 to 8 in the above clause 5.44 is liable to be rejected.

5.46 The envelope marked "**Technical Bid**" shall contain only the above details and NOT the prices nor any references to the pricing. In case an envelope marked as "**Technical Bid**" contains the charges for the work or any direct or indirect reference to the quoted prices, the offer by the bidder will be rejected.

5.47 The **Price Bid** shall be submitted in accordance with the format in **Part C Section 12** in another sealed envelope marked "**Price Bid**" with the Tender No. NCPOR/VOM-14016/1/2024 dated 02.02.2024, date of closing of the Tender and the bidder's Name and address. The price bid should not contain any conditional clauses.

5.48 Price Bids must be submitted, duly signed by the Authorised Representative as per the Proforma given in **Part C Section 12** in the Envelope containing Price Bids only.

5.49 The bidder will not indicate separate discounts. Discounts, if any, should be merged in the rates against the quoted items. Discounts of any type separately shown will not be taken into account for Price Bid evaluation purposes.

5.50 The above said two envelopes should be sealed in another envelope. This envelope should clearly be superscribed as "**CONFIDENTIAL"** and **"TENDER FOR APPOINTMENT OF CONSULTANCY FIRM FOR CONSTRUCTION SUPERVISION OF OCEAN RESEARCH VESSEL". This envelope should be addressed to The Director, National Centre for Polar & Ocean Research, Headland Sada, Goa – 403 804, India. Tender reference No. NCPOR/VOM-14016/1/2024 dated 02.02.2024 and closing date and time should also be written on the Envelope.** Bidder desiring to effect hand delivery may arrange to drop Bids sealed as described above into the Tender Box kept at the room no. M102 in NCPOR office before the closing date and time.

5.51 The proposal documents MUST be submitted complete in all respects. Incomplete bids, late proposal or those not conforming to any of the instructions provided in this Tender document, would be summarily rejected.

Bid Bond

5.52 Bidders shall submit along with their Tender, a Bid Bond for a sum of Rs. 32,00,000/- (Rupees Thirty Two Lakhs Only) from a reputed Bank (Scheduled bank in India), initially valid upto 60 days from the date of bid validity i.e. bid bond to be valid till 14.08.2024. ***This bid bond in original shall be submitted along with the Technical proposal only in the envelope containing the Technical Specifications and marked "TECHNICAL BID".*** Offers without the Bid Bond in original in the Envelope containing the Technical Bid shall be summarily rejected. In case of extension of bid validity, the validity of bid bond also to be extended for the same period, maintaining 60 days more than bid validity.

Public Sector Units and Government firms are exempted from submission of bid bond.

5.53 The Bid Bond which shall be in the form of an irrevocable Bank Guarantee for the said amount shall specifically bind the Bidder to keep his offer valid for acceptance upto ninety days (90 days) and to abide by all the conditions of NCPOR's Tender Document in the event of NCPOR desiring to award the work against the said Tender to the said bidder. NCPOR should have an unqualified option under the said Bank Guarantee and claim the amount there under in the event of the bidder failing to keep the Tender valid up to the date specified or refusing to accept/carry out work and in accordance with the Tender if the NCPOR decides to award the work to the bidder. The Bank Guarantee for Bid Bond should be as per proforma given at **Part B Section 9.**

5.54 NCPOR shall arrange to release the Bid Bond in respect of the unsuccessful bidders as soon as possible after a decision is taken on the successful bidder. In case of successful bidder, on receipt and acceptance of Performance Bank Guarantee, the Bid Bond shall be returned.

5.55 Bid Bond be forfeited without any intimation in such cases as below:-

a) if a bidder withdraws its bid during the period of bid validity.
b) if a successful bidder fails to implement or execute the awarded contract / LoI.
c) if a successful bidder fails to provide Performance Guarantee.

5.56 **Completion time:** Bidders must undertake to complete all aspects of the work and making available to NCPOR all the deliverables (as detailed at **PART A section 3)** and to the complete satisfaction of NCPOR for deliverables within 01 (one) week after successful delivery of the vessel. Liquidated Damages as described at Section 8, Clause 15.0, sub-clauses 15.1 to 15.4 of the model agreement shall apply in the event of the bidder being unable to complete any of the assigned work, documentation and delivery within the stipulated period.

Agents

5.57 Bids submitted by the Agents / Representatives will not be considered. However, original bids of the principals if addressed to NCPOR but merely mailed by Agents/Representatives for ensuring proper delivery would be considered. No other modification of the principal's offer by Agent / Representative would be considered.

5.58 In the event a bidder is having an Agent/Representative (who is not an employee of the Bidder), the bidder should clearly indicate at the time of submission of his bid, the nature and extent of services to be provided by the Agent/Representative on behalf of the bidder and also the remuneration provided in the price quote submitted by the bidder. Should it be established at any subsequent point of time that the above statement of the bidder is not correct or that any other amount of remuneration either in India or abroad is being paid to anyone (who is not an employee of the bidder), the bidder is likely to have his bid rejected at the discretion of NCPOR. In such an event, NCPOR reserves the right to terminate the Agreement.

Modifications to bid

5.59 The bidder shall make no modifications to the bids after the closing date unless specifically requested for, by NCPOR. In case certain clarifications are sought by NCPOR after opening of bid, then the reply of the bidder should be restricted to the clarifications sought. Any bidder who modifies his bid (including a modification which has the effect of altering the value of his offer) after the closing date without specific reference by NCPOR shall make himself liable to be debarred from this tender and future tenders of NCPOR without notice and without further reference to the bidder. In such an event, the BID BOND against the current tender shall be forfeited.

Exceptions and Deviations

5.60 NCPOR expects the proposal as submitted by Bidder should meet the requirements, provisions, specifications etc. as stipulated in this tender document without any deviations and exceptions.

Date of Tender Submission

5.61 Proposal must be received at NCPOR on or before the closing day (1600 hrs IST) as specified in this tender document. In case of any unscheduled holiday on the prescribed closing day of the tender, the next working day will be treated as scheduled prescribed day of closing of the tender upto 1600 hrs IST. Bids or modifications to the bids received after closing date and time shall not be considered, and no alterations in the prices shall be considered. NCPOR reserves the right to extend the date of submission / closing of tender at the discretion of the Director, NCPOR, without assigning reasons with advertisement given in the newspapers and NCPOR website.

5.62 Once the technical evaluation is completed, the Price Bids of only those bidders who are found technically acceptable will be opened in the presence of Authorized Representatives of such bidder(s), if any.

5.63 The bidder shall note that any unsolicited post-tender reduction by them would disqualify them from participating in this as well as future tenders and will result in encashment of the Bid Bond.

Signing of the Agreement

5.64 Email or letter will communicate acceptance of the tender by NCPOR. In case where email communicates acceptance, a letter in confirmation of acceptance

of Tender will be forwarded to the bidder as soon as possible, but instructions contained in the email should be acted upon immediately. An acknowledgement with acceptance of above by the bidder to be communicated to NCPOR immediately.

5.65 The successful bidder shall be required to execute a formal Agreement in accordance with the requirement of NCPOR within 7 days from the date of issue of letter of intent by the NCPOR or within such extended time as may be permitted by NCPOR. For this purpose the successful bidder may depute his authorized representative along with power of Attorney.

Arbitration

5.66 All questions and disputes relating to the meaning of the specifications and instructions herein and as to the quality of work or as to any other question, claim, right, matter or thing whatsoever in any way arising out of or relating to the contract, designs, drawings, specifications, estimates, instructions, orders or these conditions or otherwise concerning the works or the execution or failure to execute the same whether arising during the progress of the work or after the cancellation, termination, completion or abandonment thereof shall be referred to a sole arbitrator for adjudication through arbitration. The arbitration shall be conducted in accordance with the provisions of the Arbitration and Conciliation Act 1996 or any statutory modifications or re-enactment thereof and the rules made there under and for the time being in force, shall apply to the arbitration proceedings. The seat of Arbitrations shall be New Delhi.

5.67 An officer not below the rank of Director, preferably drawn from the panel of Arbitrators drawn by the Government of India, if any, may be appointed to act as arbitrator by an appointing authority, which should normally be an officer not below the rank of Joint Secretary to the Government of India.

5.68 In case of merger of bidded companies after submission of bids and before opening of financial bid, bids of all merged companies, if technically qualified, will be opened for evaluation. If the financial bid of taken-over company is found to be lowest and selected for further processing, the company which took over the above selected merged company should accept the responsibility.

5.69 Prospective bidders should submit original (signed) proposal with all the documents systematically indexed for easy reference. A soft copy of the proposal with all documents may also be provided.

5.70 Prospective bidders should provide detailed description of the background and organizational setup. The description should include ownership details, date and place of incorporation of the firm, location of facilities etc. Corporate dossier on pen drive and print form may be included.

5.71 Prospective bidders to submit details of experience, infrastructure details, technical and commercial information as per formats specified at Section 7. A soft copy is also to be provided.

END OF SECTION 5

SECTION 6 : EVALUATION OF BIDS

TECHNICAL

6.1. The Technical bids will be **opened on 20.03.2024 at 1000 hrs (IST**) in the office of NCPOR, in the presence of the bidders or their authorized representatives or their Indian agents.

Evaluation of Technical Bids

6.2 The bids will be technically evaluated on the basis of the technical information provided in the Technical Bids only vis-à-vis its conformity with the terms and conditions set out in this Tender Document.

6.3 The bidders shall be required to give a **Technical Presentation** before a Tender Evaluation Committee at their own cost if called for. Any such requirement of the Technical Presentations shall be informed in advance.

6.4 Based on a Technical assessment of the bids vis-à-vis the requirements of the tendered work and the conformity of the bids submitted with the instructions provided in this Tender Document, a short-list of the bidders will be first drawn up.

6.5 Once the technical evaluation is completed, the Price Bids of only those bidders who are found technically acceptable will be opened for Price Bid evaluation in presence of Authorized Representatives of such bidder(s), if any, on a date and at a venue to be intimated by NCPOR to the short-listed bidders.

6.6 Evaluation Criteria

Bidders shall qualify through the criteria below:-

6.6.1 Qualifications/Experience of the Bidders

i. Company registered in India with minimum 10 years of experience in services provided related to shipbuilding consultancy or ship design consultancy or ship-construction supervision.

ii. Executed atleast two assignments during the last 15 years as on 31st December 2023 as a shipbuilding consultant for research/seismic vessels OR survey vessels OR passenger ships with length of above 60 mtrs OR offshore supply vessels with DP with length of above 60 mtrs OR Naval ships with length of above 60 mtrs, and the said vessels should have been delivered satisfactorily. Documentary evidence to this effect to be furnished.

iii. Experience of having executed supervision of construction of the qualifying vessels as at (i) above is necessary. Documentary evidence to this effect to be furnished.

6.6.2 Commercial Criteria.

The annual average turnover of the prospective bidder for any three years, out of last five years should be at least INR 6 Crores as on 31st March 2023. The annual reports with audited financial statements consisting of balance sheet, trading, profit & loss account and audit report for the three years should be enclosed.

6.7 Vital Commercial terms for Acceptance of Bids

The following vital commercial conditions should be strictly complied with, failing which the bid will not be considered:-

6.7.1 Offers must be kept valid for acceptance initially up to 90 days from the closing date of tender. Validity of offers for acceptance less than 90 days will not be considered. NCPOR shall make efforts to release the bid bonds of all those unsuccessful bidders at the earliest.

6.7.2 Original Bid Bond valid upto 60 days from the date of bid validity must accompany the technical bid. *Offers received without original Bid Bond will be rejected. Public Sector Units and Government firms are exempted from submission of bid bond.*

6.8 The following standard clauses of NCPOR as incorporated in this Tender Document are to be complied with in-toto, failing which the bid will be rejected:
(i) Submission of Bank Guarantee for Performance for execution of agreement as well as for satisfactory performance during Agreement period
(ii) Failure & Termination clause and Liquidated Damages clause
(iii) Jurisdiction clause
(iv) Force Majeure clause
(v) Arbitration clause
(vi) Total liability of Personal Income Tax on jobs executed in India
(vii) Warranty and Guarantee clause

6.9 **Payment of Duty and Tax**

6.9.1 The import of any equipment / software as may be required by the bidder to complete the scope of the work will have to be arranged by the successful bidder and NCPOR will not provide any import license.

6.9.2 Payment of all duties including Excise Duty, Customs Duty, Service Tax, Income Tax as applicable in India will be to the account of the successful bidder who shall become the Consultant.

6.9.3 The Consultant shall bear all Indian Corporate Taxes levied or imposed on the Consultant under the Agreement, under the provision of Income-Tax Act 1961 or any amendment thereof and under the Company's (profit) Surcharge/tax 1964 or any amendment thereof on account of payments received by it from then NCPOR for work done under the Agreement. The applicable TDS as per Income Tax Act would be deducted at the time of payment. It shall be the responsibility of the Consultant to submit to the concerned Indian Authorities the returns and all other connected documents required for this purpose.

6.9.4 The Consultant shall also provide NCPOR such information as it may require in regard to the Consultant's income and expenditure under the agreement for proper assessment of taxes and duties if required.

6.9.5 The Consultant or his personnel shall bear all personnel taxes if any levied on the Consultant's personnel.

6.9.6 Should the Consultant fail to submit returns/pay taxes in time as stipulated under the Income Tax Act and consequently the Indian Income Tax Authority imposes any interest or penalty, the Consultant shall pay the said interest /penalty.

6.9.7 NCPOR shall if so required, by the applicable laws in force, withhold from the amount due to the Consultant, income tax payable by the Consultant at the rate in force, and pay to the Indian Tax Authority directly. It shall be the Consultant's sole responsibility to determine the amount of Taxes as due and admissible and the likely rate at which the deductions will be made on account of taxes etc. by NCPOR for payment to the Indian Tax Authorities.

6.10 Price Bid Evaluation

The evaluation of the cost will be done based on the total cost. The total cost will be calculated from the information provided by the bidders in their Price bids as set out in Section 12. The bid conforming to the lowest cost would then be considered for award of work. The decision of NCPOR will be final and binding.

6.11 Additional criteria for bid evaluation

6.11.1 The following criteria shall also be adopted for evaluation of the bids:

a) Total cost can reasonably be determined from the bidder's response.
b) All necessary supporting documentation required for evaluation of the financial bid has been provided and is found satisfactory.

6.11.2 Any other matter, which arises at the time of evaluation, shall be decided by NCPOR.

6.11.3 The decision of NCPOR shall be final and binding.

END OF SECTION 6

SECTION 7 : BIDDERS EXPERIENCE & CAPABILITIES

Please provide details of the following (additional details may be furnished on separate paper together with Brochures, etc.). The details to be provided in the format supplied below. However, if the space provided for any particular item is inadequate, the information may be provided as an appendix on a separate paper, and reference about the appendix may be made in the appropriate column in the format.

A1	**Details of similar and bigger work carried out -RESEARCH VESSEL**	
	(Attach as much details, drawings as possible)	
A1.1		
	Type of work	
	Name of the vessel	
	Owner Name, Address, contact details	
	No./Year of Built	
	Port of Registry & Class and Class notation	
	Length	
	Draft	
	Beam	
	Major Deck Machinery details	
	Major Scientific equipment details	
	Tonnage Gross/Net	
	Engine & Generators (Make, Model & Capacity)	
	Propulsion	
	Cruising range & Speed	
	Fuel Capacity	
	Water Capacity	

A 2	**Other type vessel(s)**	
	(Attach as much details, drawings as possible)	
	Type of Vessel (s)	
	Name	
	Owner	
	No./Year of Built	
	Port of Registry & class	
	Length	
	Draft	
	Beam	
	Hull	
	Tonnage Gross/Net	
	Engine & Generators (Make, Model & Capacity)	
	Propulsion	
	Cruising range & Speed	
	Fuel Capacity	
	Water Capacity	

A 3	**Expertise Manpower available**	**No of persons and years of experience**
	1. Naval Architecture	
	2. Mechanical Engineering	
	3. Electrical and Electronics Engineering	
	4. Marine Engineering	
	5. Oceanographic Service	
	6. Construction Supervision	
	7.Project Management	

Indicate the number of personnel who will be deputed at the shipyard to undertake the scope of work, their qualifications and experience and their tenure at the work site in a separate table.

A 4	**Details of Execution of Completed projects**	
A 4.1	**Project Details**	
	Type of Project (Construction Supervision / Design etc)	
	Name of the client	
	Value of the project	
	Time frame as per agreement	
	Actual Completed period	
	Number of Staff deployed	
	Brief description of the Project	
	Actual services provided by the bidder	

A 5	**Client references**	
A 5.1	**Client Details**	
	Type of Project (Concept Design/Detailed design etc.)	
	Name of the client	
	Value of the project	
	Contact person	
	Address, Phone No, Fax No.	
A 5.2	Copy of Satisfactory Completion Certificate from Client enclosed (This certificate is must as per the tender evaluation criteria)	

A 6	**Financial turnover of the Company for the past five years**	
	Year	**Turn over in Indian Rupees**

A 7	**Quality Accreditation, if any.**	
	Accreditation Details	ATTACH COPY OF CERTIFICATE
	Issuing Authority	
	Accreditation Issued for (Departments)	
	Date of Issue	
	Certificate No.	

A 8	**Project Management Plan (PMP)**	
A 8.1	**Details of the PMP**	Work execution plan must be elaborated here. ATTACH Details such as scheduling of works, manpower deployment with names during construction, supervision and detailed management Plan

END OF SECTION 7

SECTION 8 : MODEL SERVICES AGREEMENT

APPOINTMENT OF CONSULTANCY FIRM FOR CONSTRUCTION SUPERVISION OF OCEAN RESEARCH VESSEL

AGREEMENT BETWEEN

(as 'CONSULTANT')

AND

NATIONAL CENTRE FOR POLAR & OCEAN RESEARCH
(Ministry of Earth Sciences)
Headland Sada – Goa

(as 'OWNER')

(Ref No: NCPOR/VOM-14016/1/2024 dated 02.02.2024)

(*NCPOR and CONSULTANT logos*)

CONTENTS

ANNEXURES

1 Introduction

1.1. AGREEMENT DATED THIS xxx DAY OF xxx 2024.

BETWEEN:

1.1.1 National Centre for Polar and Ocean Research, an autonomous society registered under Societies Registration Act, 1860 having its registered office at National Centre for Polar & Ocean Research, (Ministry of Earth Sciences, Govt. of India), Headland Sada, Goa – 403 804, hereinafter called as NCPOR, which expression shall include, unless repugnant to context, its successors and assigns, represented by The Director.

AND

1.1.2 ********* who are having their head offices located at ******* hereinafter called "The Consultant". M/s ** is represented by ~~xxxxxxx~~ holder of General Power of Attorney dated ~~xxxxxx~~ executed pursuant to Resolution No. _____ dated _____ passed by Board of Directors.

1.2. Whereas -

1.2.1 NCPOR requires Consultancy Services for acquisition of Ocean Research Vessel.

1.2.2 The Consultant agrees to provide the requisite expertise and personnel and carry out all the activities necessary for providing the aforesaid consultancy services in an efficient manner as defined at the scope of work at Part A Section 2 of this agreement.

1.2.3 The parties now wish to record the basis on which the services are to be provided.

NOW THE NCPOR AND THE CONSULTANT AGREE AS FOLLOWS:

2 Statement of Purposes

2.1 This Agreement is entered into by NCPOR and the Consultant to specify:-

a) The Services to be provided to NCPOR by the Consultant;

b) The amounts to be paid by NCPOR for the services rendered.

c) The terms and conditions under which the services shall be provided by the Consultant and the payment for the services provided shall be made by NCPOR as set forth in this agreement.

3 Definitions and interpretations

3.1. Definitions

In this CONTRACT, the following words shall have the meaning set out herein below:

"**Client Representative**", means the representative(s) duly appointed by NCPOR for the supervision of the Services as performed by the Consultant;

"Commencement date" means the date on which this agreement comes into effect pursuant to clause 4.1 of the agreement.

"Force Majeure" means but not be limited to any act, circumstances or event beyond the control of either party, including, without limitation, earthquakes, fires, tidal waves, tropical cyclones, other acts of God or the public enemy, plague, other epidemics, quarantines, war, blockade, revolution, riots, strikes, lock outs, insurrection resulting from rebellions, civil disturbances or orders from governmental authority. For the avoidance of doubt, equipment breakdown shall not be considered as Force Majeure event.

"Expiry Date" means the last date for the performance of any outstanding obligation under this agreement.

"Services" mean services to be rendered by the Consultant in accordance with the scope of work and deliverables; and all other associated activities.

"QC" means quality control.

"Consultant" means the successful bidder with whom this agreement is entered into.

3.2. Interpretations- In this Agreement, unless the context requires otherwise:

(a) words denoting the singular number shall include the plural and vice versa;
(b) words denoting any gender shall include all genders;
(c) where a word or phrase is defined, other parts of speech and grammatical forms of that word or phrase shall have corresponding meanings;
(d) words denoting natural persons shall include corporations and vice versa;
(e) references to clauses, sub-clauses, paragraphs, sub-paragraphs and annexures are to the clauses, sub-clauses, paragraphs, sub-paragraphs and annexures to this Agreement;
(f) headings are for convenience only and shall not affect interpretation;
(g) references to any party to this Agreement shall include the party's successors and permitted assigns;
(h) references to "NCPOR" shall include the Director of the National Centre for Polar and Ocean Research, or any representative duly appointed in writing;
(i) references to "Consultant" shall include any servant, agent, employee, invitee, Consultant or sub-contractor of the Consultant.

4 Terms of Agreement

4.1 This Agreement shall **come into effect** on the date of signature and subject to the termination provisions pursuant to clause 10 or to a variation of date pursuant to clause 18of this Agreement, shall end on the expiry date. The **expiry date** of this agreement shall be date of receipt of final payment by Consultant from NCPOR after satisfactory completion of services by the Consultant and acceptance by NCPOR as per this agreement.

4.2 The following documents form the Agreement between the parties and shall be read together as one document. However, in case of any conflict, this agreement shall prevail.

(a) This Agreement
(b) Tender document
(c) Technical and Price Bid submitted by the Consultant
(d) Committed manpower list, Tentative Time schedules etc. as submitted by the bidder/Consultant, with any changes or variations negotiated and agreed on by both parties;
(e) The letter of intent issued by NCPOR

(f) Performance Bank Guarantee provided by consultant.

5 Obligations of the Consultant

5.1 The Consultant agrees to provide to NCPOR the services specified in this Agreement as per the scope of ward at Part A Section 2 and deliverables detailed at Part A Section 3.

5.1.1 The Consultant agrees that the **work will commence within 7 days** of award of work and the Consultant is to ensure that personnel are not pre-occupied with other works in a way that would hamper this NCPOR work.

5.2 In performing the services and fulfilling all its obligations under this Agreement the Consultant:

5.2.1 warrants that the services to be provided will be to the satisfaction and approval of NCPOR; and

5.2.2 assumes full responsibility for providing all personnel, documentation, and equipment to undertake and complete the Services, and warrants that all facilities to be used will be suitable for their intended use under this Agreement ensuring that the quality of results will meet the requirements of NCPOR; and

5.2.3 undertakes to provide necessary calculations, reports and other documentation so that if built strictly according to the concept design and specifications as declared so by NCPOR; the vessel may be considered to meet the mission requirements.

5.2.4 assumes responsibility for the arrangement and costs of all access and other facilities that the Consultant would require to perform the Services under this agreement.

5.2.5 shall provide the services under this Agreement, acting in a skilful, diligent, professional, workmanlike, careful and proper manner and in accordance with any applicable laws and regulations of India and in conformity with standards and practices normally exercised by a professional in the performance of the same or similar services; and

5.2.6 agrees to comply with all **Laws and regulations of India** including, but not limited to, the laws in respect of statutory taxes and obligations; and

5.2.7 undertakes to ensure that all the relevant personnel of the Consultant have adequate understanding of the mandatory rules, regulations, IMO Codes and maritime industry standards and any other requirements pertaining to the services; and

5.2.8 undertakes to comply with the **Labour Laws of India** and provide to the personnel employed in India, conditions of service not less favorable than the conditions pertaining to an Indian under Indian laws; and

5.2.9 undertakes to complete all aspects of the work and make available to NCPOR **all deliverables as detailed at Part A Section 3** to the complete satisfaction of NCPOR; In order to avoid any conflict of interest on part of the consultant, the consultant undertakes **NOT** to accept any other work /consultancy from any other agency/company with respect to this project throughout the tenure of this contract unless permitted in writing from NCPOR.

5.2.10 undertakes to complete all deliverables within 01 (one) week after successful delivery of the vessel from the date of award of contract and agrees that the

liquidated damages as described at Clause 15.0 shall apply in the event of the Consultant not being able to complete any of the assigned work, documentation and delivery within the stipulated period.

5.2.11 undertakes to deliver, upon the completion of the work, all originals and copies of drawings, designs, charts, documents, reports, generated by the Consultant in the course of providing the services, along with the storage media and the particulars of the format of recording of the data, in a properly packed and secured manner to NCPOR ; and

5.2.12 is fully liable for compliance in all respects with, and giving of all notices and paying of all taxes, duties and fees as required by the provisions of applicable Indian laws; and

5.2.13 If any defects are noticed after delivery of the vessel, they shall be part of guarantee defects which are to be attended by the shipyard for which the consultant shall carry out necessary coordination with the shipyard.

Payment of duty and tax

5.3 The **import** of any equipment / software as may be required by the Consultant to complete the scope of the work will have to be arranged by the Consultant and NCPOR will not be responsible for arranging any import license or any other document for the purpose.

5.4 Payment of all duties and taxes as applicable in India will be to the account of the Consultant.

5.5 The Consultant shall bear all **Indian Corporate Taxes** levied or imposed on the Consultant under the Agreement, under the provision of Income-Tax Act 1961 or any amendment thereof and under the Company's (profit) Surcharge/tax 1964 or any amendment thereof on account of payments received by it from the NCPOR for work done under the Agreement. The applicable TDS as per Income Tax Act would be deducted at the time of payment. It shall be the responsibility of the Consultant to submit to the concerned Indian Authorities the returns and all other connected documents required for this purpose.

5.6 The Consultant shall also provide NCPOR such information as it may require in regard to the **Consultant's income and expenditure** under the agreement for proper assessment of taxes and duties, if required.

5.7 The Consultant or his personnel shall bear all **personnel taxes,** if any, levied on the Consultant's personnel. NCPOR shall have no liability in this regard.

5.8 Should the Consultant fail to submit returns/pay **taxes** in time as stipulated under the Income Tax Act and consequently the Indian Income Tax Authority imposes any interest or penalty, the Consultant shall pay the said interest/penalty.

5.9 NCPOR shall if so required, by the applicable laws in force, withhold from the amount due to the Consultant, **any tax payable** by the Consultant at the rate in force, and pay the withheld amount to the Indian Tax Authority directly. It shall be the Consultant's sole responsibility to determine the amount of Taxes as due and admissible and the likely rate at which the deductions will be made on account of taxes etc. by NCPOR for payment to the Indian Tax Authorities.

6 Obligations of NCPOR

6.1 NCPOR agrees to pay to the Consultant the total agreed price in the manner provided in this Agreement on complete satisfaction of the performance by the Consultant of its obligations under this Agreement.

6.2 NCPOR, at its sole discretion, may assist the Consultant in obtaining the necessary Government permit/authorizations facilitating the Consultant to provide the Services, if the Consultant furnishes full and relevant information in advance to NCPOR, but it shall not create any contractual obligation or liability against NCPOR.

6.3 Unless otherwise stipulated, NCPOR does not assume responsibility for the adequacy or accuracy of any of the information and data provided to the Consultant. It shall be the Consultant's responsibility to verify and supplement such information and data, and be responsible for the effect that such failure of verification may have on the cost of performing the services.

6.4 NCPOR, if required, may appoint a ‘Client Representative’ who will represent NCPOR to oversee the work progress.

6.5 NCPOR shall provide the list, specifications and makers list for the scientific equipment.

7 Indemnity

7.1 The Consultant shall indemnify and hold NCPOR harmless against any loss, damage, liability, cost or expense in connection with any claim or charge for damages arising out of:

7.1.1 The fault or negligence of the Consultant, including its officers, agents and other personnel and persons in contract with it in the performance of, or non-compliance with, this Agreement, as the case may be;

7.2 In particular, and for the avoidance of doubt, the Consultant shall indemnify NCPOR, against all losses, claims, damages and costs in relation to any of the following matters arising out of or in consequence of the performance of the services under this contract:

7.2.1 death or injury to any person;

7.2.2 damage or compensation to any person in the employment of the Consultant;

7.2.3 infringement of any protected rights;

7.2.4 professional liability.

7.3 The Consultant shall indemnify NCPOR against all claims in respect of or in connection with any damage to, or destruction or loss or loss of use of property belonging to and/or any death or personal injury to any third party (including in the case of a corporate person or firm, its directors, officers, employees, servants and/or agents).

8 Liability of Agreement

8.1 The liability of the Consultant arising out of this contract is limited in duration to a period coterminous with the period upto complete submission of all deliverables as per the scope of work and acceptance by NCPOR and is limited to the contract value.

8.2 Neither party will be liable to the other for any consequential damages or indirect loss in relation to the services (including loss of use, revenue, profit or anticipated profit or business interruption);

9 Use and ownership of information

9.1 The parties recognize that under this Agreement they may each receive trade secrets and confidential or proprietary information of the other party, including but not limited to information concerning products, customers, business accounts, financial or contractual arrangements or other dealings, transactions or affairs, reports, recommendations, advice or tests, source and object programme codes and development plans. All such information, which is either marked "Confidential" or stated at the time of disclosure and subsequently confirmed in writing to be confidential constitutes "Confidential Information". Each party:

9.1.1 acknowledges the **strict confidentiality** and proprietary nature of all Confidential Information and that no right, entitlement or interest in either party's Confidential Information is extended or conveyed to the other party except for the strict purposes of each party performing its obligations under this Agreement;

9.1.2 affirms that it shall not at any time (other than for the proper performance of its obligations under this Agreement) disclose, divulge, communicate, publish or make available in any way to any person or entity any of the Confidential Information. Nor shall either party at any time for that party's own benefit or the benefit of any other person, directly or indirectly, take advantage of or use or in any way exploit the Confidential Information;

9.1.3 undertakes to take all reasonable steps to preserve the confidentiality of the Confidential Information and each party shall indemnify the other party from all losses, damages and expenses it may incur or sustain as a result of any unauthorized use or disclosure of one party's Confidential Information by the other party;

9.1.4 binds itself, upon request by the other party and upon termination of this Agreement, to immediately deliver to the other party all material relating to that other party's Confidential Information (including all copies of such material);

9.1.5 acknowledges that the obligations of confidentiality imposed upon each party shall continue (unless the Confidential Information reaches the public domain other than through the receiving party's own fault) notwithstanding that this Agreement may in all other respects have terminated.

9.2 All intellectual property rights relating to those products or services created under this Agreement shall be the sole property of NCPOR.

9.3 Ownership of all Design documents and Drawings is assigned to NCPOR / Govt. of India and will not be used for any other commercial purpose.

10 Termination

10.1 The Parties may mutually agree to vary the period of agreement on acceptable terms by notice in writing between them.

10.2 This Agreement shall automatically be terminated on expiry of its term or any extension thereof.

10.3 NCPOR may terminate this Agreement:

- in the event of Force Majeure existing for a period longer than fifteen (15) days;

- If NCPOR considers that the performance of the Consultant is unsatisfactory and / or not upto the expected standard. In such circumstances, NCPOR shall notify the Consultant and specify in detail the defects and causes of dissatisfaction and shall reserve the right to terminate the Agreement after giving ten (10) days notice to the Consultant to rectify, at the cost of the Consultant, the defects and remove the causes of dissatisfaction within that period.

10.4 Notwithstanding anything contained herein, NCPOR may, at its sole discretion, terminate this Agreement by giving Thirty (30) days written notice without assigning any reasons, whatsoever.

10.5 In the event of any termination, the Consultant shall cease work as directed by NCPOR and shall forward to the NCPOR all data, reports, drawings and other documents pertaining to the services.

10.6 In all cases of termination herein set forth, the obligation of NCPOR to pay the charges shall be limited to the period upto the date of termination in conformity with the payment terms at clause 25.

10.7 Termination of this Agreement shall be without prejudice to any rights and remedies available to either Party prior to such termination.

10.8 If either party is in default under this Agreement on account of the failure to perform or observe any obligation or undertaking to be performed or observed on its part under this Agreement, the party not in default may, subject to Clause 10.9, by notice in writing to the other party, terminate this Agreement in whole or in part without prejudice to any right of action or remedy which has accrued or which may accrue in favour of either party.

10.9 Where the default is capable of being remedied, a party shall not exercise its rights to terminate this Agreement unless it has given to the defaulting Party a written notice specifying the default and requiring it to remedy the default within such time (being not less than five (5) working days) as may be specified in the notice.

10.10 If either party goes into **liquidation** or a receiver or receiver and manager or mortgagee's or chargee's agent is appointed or becomes bankrupt or enters into a scheme or arrangement with creditors, the necessary liquidating compensations will be made to the other party as per the liquidation procedures and rules as applicable in India.

10.11 The termination of this Agreement shall not affect those terms which, by their nature, are intended to survive termination.

11 Arbitration

11.1 If any dispute, difference, question or disagreement shall, at any time hereafter arise between the parties hereto in connection with or arising out of the Agreement or in respect of meaning of specifications, design, drawings, estimates, schedules, annexures, order, instructions, the construction, interpretation of this agreement, application of the provisions thereof or anything hereunder contained or arising hereunder or as to the rights, liabilities or duties of the said parties hereunder or any matter whatsoever incidental to this agreement whether arising before or after the completion of the work under this Agreement, which cannot be mutually resolved by the parties, the same shall be referred to arbitration.

11.2 The party desiring the settlement of dispute shall give notice of its intention to go in for arbitration clearly stating the point of dispute to be decided by arbitrators and

appoint its own arbitrator and call upon the other party to appoint its own arbitrator within 30 days. If the other party fails to appoint its arbitrator within stipulated period or the two arbitrators fail to appoint the third arbitrator, the court having jurisdiction shall appoint the second or third arbitrator as the case may be.

11.3 The arbitrator shall be appointed as per the provisions of the Arbitration and Conciliation Act, 1996.

11.4 If any of the arbitrators to whom the matter is originally referred to dies or refuses to act or resigns from the position of arbitrator for any reason, a new arbitrator shall be appointed by the respective party who made the earlier appointment or together by both the arbitrators, in the manner aforesaid. The arbitration Tribunal so constituted shall be entitled to proceed with the reference from the stage at which it was left.

11.5 The arbitration Tribunal shall conclude the arbitration proceedings at the earliest after entering into reference.

11.6 The arbitration Tribunal shall give reasoned award in respect of each dispute or difference referred to them.

11.7 The venue of Arbitration shall be New Delhi.

11.8 The provisions of the Arbitration and Conciliation Act, 1996 (as amended from time to time) and the rules made there under for the time being in force shall apply to the arbitration proceedings under this clause.

11.9 Dispute resolution legally covered under various clauses in the Merchant Shipping Act may also be considered.

12 Applicable Law & Jurisdiction

12.1 This Agreement, including all matters connected with this agreement, shall be governed by the Indian Laws both substantive and procedural, for the time being in force and as amended from time to time and shall be subject to the exclusive jurisdiction of Indian Courts.

13 Force Majeure

13.1 Any failure by a Party to comply with the terms of this Agreement shall be ignored and shall not be held against it as failure to comply if, and only if, and for so long as, compliance is hindered or prevented by reason of Force Majeure. Without prejudice to the rights of NCPOR to terminate this Agreement under Clause 13.3, that Party shall not incur liability for as long as the Force Majeure persists.

13.2 In the event of either party being rendered unable by conditions of Force Majeure to perform any obligations required to be performed by it under this Agreement, the relative obligations of the party affected by such Force Majeure shall, after receiving notice from NCPOR, be suspended for the period during which such cause lasts.

13.3 Upon the occurrence of any such condition of Force Majeure and upon its termination, the party alleging that it has been rendered unable as aforesaid, shall notify the other party in writing within 24 (Twenty-Four) hours of the alleged

beginning and ending thereof giving full particulars and satisfactory evidence in support of its claim.

13.4 During the period the obligations of the parties are suspended by Force Majeure, the Consultant shall not be entitled to any charges.

13.5 In the event of Force Majeure conditions continuing or reasonably expected to continue for a period of more than Fifteen (15) days, the NCPOR shall have the option of terminating this Agreement by giving Seven (7) days notice. If this Agreement is so terminated, either party shall pay to the other party, the money payable upto the date of such termination.

14 Continuance of the Work

14.1 Not withstanding any disagreement, dispute, protest, request for arbitration or court proceeding relating directly or indirectly to the works, the Consultant shall, at all times, proceed with the work in accordance with the determinations, instructions and clarifications of NCPOR. If the Consultant fails to proceed with the work, he shall be considered to be in default. In such an event, the Consultant shall be held liable for any costs and expenses arising from its failure to do so. During the period the Consultant is proceeding with the work, he shall be paid the undisputed portion of his admissible claim or payment, under the Agreement.

15 Liquidated Damages

15.1 If the Consultant fails to complete the work within the stipulated period and within the time frame agreed by him or at any time repudiates any part of this Agreement before completing such work, or if the performance of the vessel falls below the stated limits due to the fault of the consultant, NCPOR may without prejudice to any other rights or remedies available to it, recover from the Consultant, as ascertained and agreed, Liquidated Damages and not by way of penalty: -

15.1.1 The sum equivalent to 0.5% of contract price for each week’s delay or part thereof, subject to a maximum of 5% (five percent) of the contract price, even though, NCPOR may accept the work after expiry of the period stipulated for completion of the work. NCPOR is not liable to entertain any claims made by the Consultant in respect of the additional costs incurred, if any, due to the extension of time granted by the NCPOR.

15.2 NCPOR may arrange for the scope work in default by Consultant to be carried out elsewhere at the cost and risk of the Consultant. Decision of NCPOR, in this regard, both in respect of the need and cost, shall be final and binding on the Consultant. NCPOR in such an event may not at its discretion terminate the Agreement.

15.3 At the option of NCPOR, the amount to be recovered as Liquidated Damages may be recovered from the Consultant at the time of payment of any outstanding invoices to Consultant or from the Bank Guarantee and/or adjusted against any payment due to the Consultant without prejudice to any of the other rights/remedies available to NCPOR under the terms of the Agreement.

15.4 The remedy provided by this Clause is in addition to other rights and remedies available to NCPOR under the law or under this Agreement.

16 Assignment

16.1 The Consultant will not sub-contract the services under this Agreement.

16.2 In case of merger of companies, it shall be binding on the company which takes over the Consultant to accept the responsibility and adhere to the terms and conditions of this agreement and provide services as per the agreement. It shall be the responsibility of the Consultant to notify well in advance regarding the impending merger as also to notify the company proposing to take over about these provisions of the Agreement and obtain their written consent thereto before the merger is given effect to.

17 Warranty and Acceptance of Work

The Consultant warrants that the work will be performed and services rendered in accordance with this Agreement, National classification rules and good shipbuilding practices and standards.

18 Variations

18.1 This Agreement, as specified in Clause 4.2, is a constituent part of the Agreement between the Parties.

18.2 No variation in the terms and conditions of this Agreement will be valid unless made in writing by authorised signatories of both parties.

19 No agency

19.1 The NCPOR and the Consultant act independent of each other. Neither party is agent for the other and neither party has any authority to enter into any agreement, whether expressly or by implication, in the name of the other party, without that party's prior written consent for purposes connected with the performance of this Agreement.

20 Language for Communication

20.1 The language of the Agreement and of all notices and communications hereunder shall be in English.

21 Severability

21.1 Every term of this Agreement will be interpreted to the extent necessary to prevent it from being rendered invalid, voidable or unenforceable in the circumstances.

21.2 Notwithstanding Clause 21.1, if a term of this Agreement is to be rendered invalid or voidable on account of the presence of certain word or words, that word or words shall be deleted; and in any other case, the whole term shall be deleted, and the remaining terms shall continue to have full force and effect.

22 Waiver

22.1 A party's failure to require the other party to perform any of its obligations, or to claim damages for any breach under this Agreement shall not constitute a waiver of that party's right unless the waiving party acknowledges the waiver in writing, signed by a duly authorised person of the NCPOR or of the Consultant, as the case may be.

23 Time is the essence

23.1 Time shall be the essence as regards any date or period determined under this Agreement unless any date or period specified in this Agreement is varied or amended according to Clause 18, in which case time shall be of the essence as regards the varied date or period.

24 Public statements

24.1 This Agreement is confidential. Neither party shall publicize its existence or its terms. The Consultant shall not use the name or any trade mark or trade name, whether registered or not, of NCPOR, in publicity releases or advertising or in any other manner, including any customer lists, without securing the prior written approval of the NCPOR. The Consultant is allowed to use the name of the Project in its reference list.

25 Price and Payment Terms

25.1 Contract Price

The total Contract Price is Rs _____ (Words_____)

25.1.1 NCPOR will not pay any additional charges other than those provided for, in the Agreement. In particular, the following shall be to the account of the Consultant:

(i) Any additional man-hours spent because of NCPOR comments on the design.

(ii) Travel, accommodation and subsistence costs for any allied works, discussions with NCPOR and attending design reviews at NCPOR or anywhere in India. Travel, accommodation and subsistence costs for international visits related to model testing, FAT etc.

(iii) The price includes all costs related to the man-hours, software, travel and subsistence costs, consumables, document copies (soft copy / hard copy), deliverables etc.

25.2 **Currency**

25.2.1 All payments by NCPOR to the Consultant under the Contract shall be made in Indian Rupees.

25.3 TERMS OF PAYMENT

25.3.1 The Consultant shall submit invoices, complete in all respects for services performed on completion of stages as detailed at Part C Section 11 (*detailed payment stages may be appended to the agreement at the time of signing as per section 11*). The invoices shall be submitted for verification and payment to:

THE DIRECTOR
NATIONAL CENTRE FOR POLAR & OCEAN RESEARCH
(Ministry of Earth Sciences)
Headland Sada, Goa, INDIA – 403 804.

25.3.2 Payment shall be made in the following stages by NCPOR within 30 days of receipt of original invoice complete in all respects. Applicable taxes at source like

service tax, income tax etc, shall be deducted at source from the payment, as detailed in clauses 5.3 to 5.9.

25.3.3 Payment Schedules:-

(*as per tender section-11, to be appended at the time of signing the contract)*

26 Performance Guarantee

The Consultant should submit Performance Bank Guarantee from a Scheduled commercial bank in India within seven days of the date of LoI for 3% of the contract price.

Such guarantees shall be –

(i) unconditional as per format
(ii) valid upto 60 days from the vessel's warranty period completion.
(iii) for the due performance of the Agreement by the Consultant, claimable by NCPOR only in the event of breach of any contractual obligations by the Consultant not satisfactory to NCPOR under the Agreement.
(iv) Possible to extend the guarantee appropriately in case of any delays of shipbuilding and delivery.

27 Notices

27.1 Any notice given under this Agreement by either party to the other must be in writing and may be delivered personally or sent by email followed by post with advice of delivery. In the case of email, the notice will be deemed to have been given upon receipt of the correct answer-back or receipt code. Notices will be delivered or sent to the parties' addresses listed below or to any other address notified in writing by either party to the other for the purpose of receiving notices after the date of this Agreement.

27.2 The address for service to NCPOR is:

THE DIRECTOR
NATIONAL CENTRE FOR POLAR & OCEAN RESEARCH
(Ministry of Earth Sciences)
Headland, Sada
GOA – 403 804, INDIA
Tel: 91-(0)832-2520876

27.3 The address for service to the Consultant is:

Address of Consultant for the notifications to be sent:
XXXXXXXXXXXX

In witness whereof, the parties hereto have caused this AGREEMENT to be executed in triplicate by their duly authorized representatives at Goa.

For and on behalf of NCPOR

Name Designation
Place Date

Witness
Name & Address

For and on behalf of Consultant

Name Designation
Place Date
(Under General Power of Attorney dated executed pursuant to Resolution No._____ dated ******* passed by Board of Directors)

Witness
Name & Address

END OF SECTION 8

SECTION 9 :PROFORMA FOR BANK GUARANTEE FOR BID BOND

(To be stamped in accordance with the stamp Act)

To
NATIONAL CENTRE FOR POLAR & OCEAN RESEARCH
Headland Sada, Vasco-da-Gama, GOA 403 804, INDIA.

Whereas _____(Hereinafter called the "bidder") has submitted their bid offer no: _____ dated _____ for the services as Consultants for Research Vessels (Herein after called the "tender") against the NCPOR tender no. _____

WE_____ of having our registered office at _____ (Hereinafter called the Bank) are bound unto the NATIONAL CENTRE FOR POLAR & OCEAN RESEARCH, Ministry of Earth Sciences, Govt. of India having its office at Headland Sada, Vasco Goa 403 804, India (herein after called NCPOR which expression shall unless repugnant to the context or meaning thereof include all its successors, administrators, executors and assigns) in the sum of _____ for which payment will and truly to be made to NCPOR, the Bank binds itself, its successors and assigns by these presents. Sealed with the common seal of the said Bank this _____ _____day of _____20__.

THE CONDITIONS OF THIS OBLIGATION ARE:

1) If the bidder withdraws or amends, impairs or derogates from the tender in any respect within the period of validity of this bid offer.
2) If the bidder having been notified of the acceptance of his bid by NCPOR during the period of its validity and
   2.a) if the bidder fails to furnish the Performance security for the due performance of the contract, and/or
   2.b) if the bidder fails or refuses to execute the contract.

We undertake to pay NCPOR up to the above amount upon receipt of NCPOR's first written demand, without NCPOR having to substantiate its demand, provided that in its demand the NCPOR will note that the amount claimed by it is due to it owing to the occurrence of one or both the two conditions, specifying the occurred condition or conditions.

This guarantee is valid until the _____ day of _____ (Validity upto 150 days from the date of technical bid opening).

Signature of the bank

(Name of Bank Officer, Designation, Code No., Address & Telephone No.)

END OF SECTION 9

SECTION 10 :PROFORMA FOR PERFORMANCE BANK GUARANTEE

PERFORMANCE SECURITY BOND

(to be stamped in accordance with Indian Stamp Act)

To
National Centre for Polar & Ocean Research
(Ministry of Earth Sciences, Govt. of India)
Headland Sada, Vasco-da-Gama
Goa – 403 804. (INDIA)

Guarantee no :
Type of L/G :Performance Bond
L/G amount :
Date of Issue :
Expiry Date :

Dear Sir,

1. In consideration of **National Centre for Polar & Ocean Research** having its registered office at **Headland Sada, Vasco-da-Gama, Goa – 403 804 INDIA** (hereinafter referred to as "NCPOR" which expression shall unless repugnant to the context or meaning thereof, include all its successors, administrators, executors and assigns and having issued Notification of Award of Contract dated _____for entering into contract hereinafter called "CONTRACT" which expression shall include all the amendments thereto with M/s. _____ having its Head/Registered Office at _____ (hereinafter referred to as "CONTRACTOR" which expression shall unless repugnant to the context or meaning thereof, shall include all its successors, administrators, executors and assign and the Notification of Award of Contract/Letter of Intent having been unequivocally accepted by the Contractor resulting in a contract for a value at _____for providing services to NCPOR as Consultant for Research Vessels and the NCPOR having agreed that the Contractor shall furnish faithful performance of the entire contract for 3% of the value of the contract i.e. _____. We _____having its registered office at _____(hereinafter referred to as 'THE BANK" which expression shall unless repugnant to the context or meaning thereof, include all the successors, administrators, executors and assigns) do hereby guarantee and undertake to pay on demand to the NCPOR any money or all monies to the extent of _____ (3% of contract value)in aggregate on breach of contract by the contractor at any time without any demur, reservation, recourse, contest or protest and/or without any reference to the Contractor. Any such demand made by the NCPOR on the Bank shall be conclusive and binding notwithstanding any difference between the NCPOR and the Contractor or any dispute pending before any Court, Tribunal, Arbitrators or any other authority. We agree that Guarantee herein contained shall be irrevocable and shall continue to be enforceable till it is discharged by the NCPOR in writing.

2. The NCPOR shall have the fullest liberty, without affecting in any way the liability of the Bank under this Guarantee from time to time, to extend the time for performance of the Contract by the Contractor or NCPOR & Contractor may mutually vary the terms of the Contract. The NCPOR shall have the fullest liberty, without affecting this Guarantee to postpone, from time to time exercise power vested in them or of any manner and either to enforce or to forebear to enforce any covenants contained or implied in the Contract between the NCPOR and the Contractor or any other course of remedy or security available to NCPOR. The Bank shall not be released of its obligations under these presents by any exercise by the NCPOR of its liberty with reference to

matters aforesaid or any of them or by reason of any other act or forbearance or other acts of NCPOR or omission on the part of the NCPOR or other matter of thing whatsoever which under law would, but for these provisions have the effect of relieving the Bank.

3. The Bank also agrees that the NCPOR to its option shall be entitled to enforce this Guarantee against the bank as a principal debtor, in the first instance, without proceeding against the Contractor and notwithstanding any security or other guarantee that NCPOR may have in relation to the Contractors liabilities.

4. NCPOR shall have the unqualified option to operate this Bank Guarantee to recover Liquidated Damages as liable under the contract. In that case the Bank Guarantee amount shall thereupon be increased to the original amount by the Contractor or Contractor may alternatively submit Liquidated Damages recovered by NCPOR.

5. The Bank further agrees that the Guarantee herein contained shall remain in full force during the period that is taken for the performance of the Contract and it shall continue to be enforceable till all the dues of the NCPOR under or by virtue of this Contract have been fully paid and its claim satisfied or discharged or till the NCPOR discharged the guarantee in writing.

6. The conditions of the obligations are: -
(a) If the CONTRACTOR does not fulfil any of the conditions of the Contract.
(b) If performance of the services is not found satisfactory and hampers any function in any manner.
(c) And we (Name of the bank) hereby undertake to pay any claim under the Bank Guarantee on demand of the Director, NCPOR, Goa, without any reference to the Contractor a sum not exceeding .....(.....Only)for non fulfilment of any of the terms and conditions of the Contract as mentioned above.

7. We further agree that as between us and NCPOR for the purpose of this Guarantee any notice given to us by the NCPOR that the money is payable by the Contractor and any amount claimed in such notice by the NCPOR shall be conclusive and binding on us notwithstanding any difference between the NCPOR and the Contractor or any dispute pending before any Court, Tribunal, Arbitrator or any other authority. We further agree that this Guarantee shall not be affected by any change in our constitution or that of the Contractor. We also undertake not to revoke this Guarantee during its currency.

8. We _____ (the bank) further agree that if the demand is made by the Director, NCPOR, Goa for honouring the Bank Guarantee constituted by these presents we_____ (the bank) have no right to decline the same for any reason whatsoever and shall pay the amount within a week from the date of such demand.

9. We_____(the bank) further agree that a mere demand by the NCPOR is sufficient for us to pay the amount covered by the Bank Guarantee in the manner within the time aforesaid without reference to the CONTRACTOR and no protest by the said CONTRACTOR can be availed on ground for us to decline or fail or neglect to make payment to the NCPOR in the manner within time aforesaid.

10. Notwithstanding anything contained hereinabove, our liability under this Guarantee is limited to **_____** in aggregate and it shall remain in full force upto**_____ days (_____ days)** from **_____** unless extended further from time to time for such period as may be instructed in writing by **M/s. _____** whose behalf this Guarantee has been given. Any claim under this Guarantee must be received by us before _____ and if no such claim have been received by us on or before _____, the NCPOR's right under this Guarantee will cease. However, if

such a claim has been received by us on or before_____, all the NCPOR's right under this Guarantee shall be valid and shall not cease until we have satisfied that claim. The Bank confirms that this Guarantee has been issued with observance of the appropriate exchange control rules and regulation of the country.

11. We agree that this Guarantee shall be governed and construed in accordance with Indian Laws and subject to the Exclusive Jurisdiction of Indian Court. The Bank also agrees that courts in New Delhi shall have exclusive jurisdiction.

This guarantee is valid until the _____ day of _____20_____.

Date this *th ****, 20** at ---

WITNESS :

(SIGNATURE) (SIGNATURE)
NAME NAME& DESIGNATION WITH
BANK STAMP

OFFICIAL ADDRESS
(Name of Bank Officer, Designation, Code No., Address & Telephone No.)

END OF SECTION 10

PART C

SECTION 11 : TERMS OF PAYMENT

11.1 The Consultant shall issue invoices in the following manner for services performed on completion of stages. Invoices complete in all respects with supporting paid vouchers, if any, duly signed, shall be submitted to:

THE DIRECTOR,
NATIONAL CENTRE FOR POLAR & OCEAN RESEARCH,
(Ministry of Earth Sciences),
Headland Sada, Vasco-Da-Gama,
GOA – 403 804, INDIA
Tel: 91-(0)832-2525501

for verification and payment. Copies of the reports as indicated under deliverables, shall accompany the invoices.

11.2 Payment shall be made in the following stages by NCPOR. In case of any delay in ship building activities due to any reason, NCPOR will not entertain any additional claims from the consultants towards the delay.

Stage No.	Stages	Percentage Payments
1	Review of preliminary drawings	15 %
2	On starting of steel-cutting	15 %
3	On keel laying	15 %
4	On launching	15 %
5	On successful dock trials	15 %
6	On delivery and receipt of 'as-built' drawings	20 %
7	On completion of warranty period by yard	5 %

11.3 NCPOR will pay the amount of fees in Indian Rupees in which the prices have been stated in the Tender, for the services as per scope of work at part A, section 2, to the account of the bidder. Payment will be made on receipt of original invoices through online PFMS only, as far as possible within 30 days of receipt of original invoice complete in all respects. No letter of credit will be opened in advance. Taxes if any, to be deducted at source like service tax, income tax etc, shall be so deducted from the payment.

END OF SECTION 11

SECTION 12 : FORM OF PRICE BID

12.1 Bidders should quote the rates in lumpsum in accordance with the format given below.

12.2 The prices quoted shall include all activities required by the Consultant to meet his obligations, and shall include all expenditure but not be limited to professional fees, Statutory fees, communication cost, travel, accommodation, subsistence costs for its personnel for meeting with NCPOR officials at NCPOR premises or any place in India, hard copies of drawings, soft copies of drawings, miscellaneous expenses, remuneration to any external experts and consultants, professional taxes and personnel taxes, service tax if any. All applicable taxes that will be deducted by NCPOR must be added to the price and not shown separately.

Description of activity: Supervision of shipbuilding and related activities.	**(Indian Rupees)**	
	In figures	*In Words*
From Date of Signing of contract upto Launching.		
From Launching to Dock Trials		
From Dock Trials to Sea		
From Sea Trials to Delivery		
From Delivery to Completion of warranty by Yard		
Others (Please specify)		
Taxes / Duties etc		
Total Cost		

Date:

Signature of the bidder

Name and full address

END OF SECTION 12

SECTION 13 : INTEGRITY PACT

Draft Format: PRE-CONTRACT INTEGRITY PACT

General

This pre-bid pre-contract Agreement (hereinafter called the Integrity Pact) is made on _____day of the month of _____2024, between, on one hand, the Director, National Centre for Polar & Ocean Research (NCPOR), Headland Sada, Goa, India (hereinafter called the "BUYER", which expression shall mean and include, unless the context otherwise requires, his successors in office and assigns) of the First Part and M/s_____ represented by Mr._____, Designation, (hereinafter called the "BIDDER" which expression shall mean and include, unless the context otherwise requires, his successors and permitted assigns) of the Second Part and is bidding for the tender no… published by NCPOR for Appointment of Consultant for Ocean Research Vessel.

WHEREAS the BUYER proposes to avail consultancy services for acquisition of an Ocean Research Vessel (hereinafter called the 'ORV' which expression shall mean and include, unless context otherwise requires) and the BIDDER is willing to offer / has offered the same and

WHEREAS the BIDDER is a private company/public company/Government undertaking/partnership/registered export agency, constituted in accordance with the relevant law in the matter and the BUYER is an autonomous R&D institute under Ministry of Earth Sciences, Government of India performing its functions in oceanographic and polar research.

NOW, THEREFORE,
To avoid all forms of corruptions by following a system that is fair, transparent and free from any influence/prejudiced dealings prior to, during and subsequent to the currency of the contract to be entered into with a view to :

Enabling the BUYER to provide consultancy services for acquisition of an ORV at a competitive price in conformity with the defined work scope by avoiding the high cost and the distortionary impact of corruption on public procurement, and

Enabling BIDDERS to abstain from bribing or indulging in any corrupt practice in order to secure the contract by providing assurance to them that their competitors will also abstain from bribing and other corrupt practices and the BUYER will commit to prevent corruption, in any form, by its officials by following transparent procedures:

The parties hereto hereby agree to enter into this Integrity Pact and agree as follows:

1. Commitments of the BUYER

1.1. The BUYER undertakes that no official of the BUYER, connected directly or indirectly with the contract, will demand, take a promise for or accept, directly or through intermediaries, any bribe, consideration, gift, reward, favour or any material or immaterial benefit or any other advantage from the BIDDER, either for themselves or for any person, organization or third party related to the

contract in exchange for an advantage in the bidding process, bid evaluation, contracting or implementation process related to the contract.

1.2. The BUYER will, during the pre-contract stage, treat all BIDDERs alike, and will provide to all BIDDERs the same information and will not provide any such information to any particular BIDDER which could afford an advantage to that particular BIDDER in comparison to other BIDDERs.

1.3. All the officials of the BUYER will report to the appropriate Government office any attempted or completed breaches of the above commitments as well as any substantial suspicion of such a breach.

2. In case any such preceding misconduct on the part of such official(s) is reported by the BIDDER to the BUYER with full and verifiable facts and the same is prima facie found to be correct by the BUYER, necessary disciplinary proceedings, or any other action as deemed fit, including criminal proceedings may be initiated by the BUYER and such a person shall be debarred from further dealings related to the contract process. In such a case while an enquiry is being conducted by the BUYER the proceedings under the contract would not be stalled.

3. Commitments of BIDDERs

The BIDDER commits itself to take all measures necessary to prevent corrupt practices, unfair means and illegal activities during any stage of its bid or during any pre-contract stage in order to secure the contract or in furtherance to secure it and in particular commit itself to the following:-

3.1 The BIDDER will not offer, directly or through intermediaries, any bribe, gift, consideration, reward, favour, any material or immaterial benefit or other advantage, commission, fees, brokerage or inducement to any official of the BUYER, connected directly or indirectly with the bidding process, or to any person, organization or third party related to the contract in exchange for any advantage in the bidding, evaluation, contracting and implementation of the contract.

3.2 The BIDDER further undertakes that it has not given, offered or promised to give, directly or indirectly any bribe, gift, consideration, reward, favour, any material or immaterial benefit or other advantage, commission, fees, brokerage or inducement to any official of the BUYER or otherwise in procuring the Contractor forbearing to do or having done any act in relation to the obtaining or execution of the contract or any other contract with the Government for showing or for bearing to show favour or disfavour to any person in relation to the contract or any other contract with the Government.

3.3 BIDDERs shall disclose the name and address of agents and representatives in India.

3.4 BIDDERs shall disclose the payments to be made by them to agents / brokers or any other intermediary, in connection with this bid/contract.

3.5 The BIDDER further confirms and declares to the BUYER that the BIDDER is the original consultant / service provider and has not engaged any individual or firm or company whether Indian or foreign to intercede, facilitate or in any way to recommend to the BUYER or any of its functionaries, whether officially or unofficially to the award of the contract to the BIDDER, nor has any amount been paid, promised or intended to be paid to any such individual, firm or company in respect of any such intercession, facilitation or recommendation.

3.6 The BIDDER, either while presenting the bid or during pre-contract negotiations or before signing the contract, shall disclose any payments he has made, is committed to or intends to make to officials of the BUYER or their family members, agents, brokers or any other intermediaries in connection with the contract and the details of services agreed upon for such payments.

3.7 The BIDDER will not collude with other parties interested in the contract to impair the transparency, fairness and progress of the bidding process, bid evaluation, contracting and implementation of the contract.

3.8 The BIDDER will not accept any advantage in exchange for any corrupt practice, unfair means and illegal activities.

3.9 The BIDDER shall not use improperly, for the purposes of competition or personal gain, or pass on to others, any information provided by the BUYER as part of the business relationship, regarding plans, technical proposals and business details, including information contained in any electronic data carrier. The BIDDER also undertakes to exercise due and adequate care lest any such information is divulged.

3.10 The BIDDER commits to refrain from giving any complaint directly or through any other manner without supporting it with full and verifiable facts.

3.11 The BIDDER shall not instigate or cause to instigate any third person to commit any of the actions mentioned above.

3.12 If the BIDDER or any employee of the BIDDER or any person acting on behalf of the BIDDER, either directly or indirectly, is a relative of any of the officers of the BUYER, or alternatively, if any relative of an officer of the BUYER has financial interest / stake in the BIDDER’s firm, the same shall be disclosed by

the BIDDER at the time of filing of tender. The term 'relative' for this purpose would be as defined in Section 6 of the Companies Act 1956.

3.13 The BIDDER shall not lend to or borrow any money from or enter into any monetary dealings or transactions, directly or indirectly, with any employee of the BUYER.

4. Previous Transgression

4.1. The BIDDER declares in bid that no previous transgression occurred in the last three years immediately before signing of this Integrity Pact, with any other company in any country in respect of any corrupt practices envisaged hereunder or with any Public Sector Enterprise in India or any Government Department in India that could justify BIDDER's exclusion from the tender process.

4.2. The BIDDER agrees that if it makes incorrect statement on this subject, BIDDER can be disqualified from the tender process or the contract, if already awarded, can be terminated for such reason.

5. Earnest Money (Security Deposit)

5.1. While submitting commercial bid, the BIDDER shall deposit an amount (as specified in Tender) as Bid Security Bond with the BUYER through the instruments as specified in the Tender.

5.2. The Bid Security Bond shall be valid up to a period, as specified in Tender, from the date of opening of bids and be suitably extended as requested by NCPOR.

5.3. In case of the successful BIDDER a clause would also be incorporated in the Article pertaining to Performance Bond in the Contract that the provisions of Sanctions for violation shall be applicable for forfeiture of Performance Bond in case of a decision by the BUYER to the forfeit the same without assigning any reason for imposing sanction for violation of this Pact.

5.4. No interest shall be payable by the BUYER to the BIDDER on Bid Security Bond for the period of its currency.

6. Sanctions for Violations

6.1. Any breach of the aforesaid provisions by the BIDDER or any one employed by it or acting on its behalf (whether with or without the knowledge of the BIDDER) shall entitle the BUYER to take all or any one of the following actions, wherever required: -

(i) To immediately call off the pre-contract negotiations without assigning any reason or giving any compensation to the BIDDER. However, the proceedings with the other BIDDER(s) would continue.

(ii) Forfeiture of the Security Bid Bond (in pre-contract stage) and/or Performance Security Bond(after the contract is signed) stand forfeited either fully or partially, as decided by the BUYER and the BUYER shall not be required to assign any reason therefore.

(iii) To immediately cancel the contract, if already signed, without giving any compensation to the BIDDER.

(iv) To recover all sums already paid by the BUYER, and in case of an Indian BIDDER with interest thereon at 2% higher than the prevailing Prime Lending Rate of State Bank of India. If any outstanding payment is due to the BIDDER from the BUYER in connection with any other contract for any other stores, such outstanding payment could also be utilized to recover the aforesaid sum and interest.

(v) To encash the advance Bank Guarantee and Performance Bond/ Warranty Bond, if furnished by the BIDDER, in order to recover the payments, already made by the BUYER, along with interest.

(vi) To cancel all or any other contracts with the BIDDER. The BIDDER shall be liable to pay compensation for any loss or damage to the BUYER resulting from such cancellation/rescission and the BUYER shall be entitled to deduct the amount so payable from the money(s) due to the BIDDER.

(vii) To debar the BIDDER from participating in future bidding processes of the Government of India for minimum period of five years, which may be further extended at the discretion of the BUYER.

(viii) To recover all sums paid in violation of this pact by BIDDER(s) to any middle manor agent or broker with a view to securing the contract.

(ix) In cases where irrevocable Letters of Credit have been received in respect of any contract signed by BUYER with the BIDDER, the same shall not be opened.

(x) Forfeiture of Performance Bond in case of a decision by the OWNER to forfeit the same without assigning any reason for imposing sanction for violation of this Pact.

6.2 The BUYER will be entitled to take all or any of the actions mentioned at para 6.1 (i) to (x) of this Pact also on the Commission by the BIDDER or any one employed by it or acting on its behalf (whether with or without the knowledge of the BIDDER), of an offence as defined in Chapter IX of the Indian Penal code, 1860 or Prevention of Corruption Act, 1988 or any other statute enacted for prevention of corruption.

6.3 The decision of the BUYER to the effect that a breach of the provisions of this Pact has been committed by the BIDDER shall be final and conclusive on the BIDDER. However, the BIDDER can approach the Independent Monitor(s) appointed for the purposes of this Pact.

7. Fall Clause

7.1. The BIDDER undertakes that it has not provided consultancy services/is not providing similar services at a price lower than that offered in the present bid in respect of any other Ministry/Department of the Government of India or PSU and if it is found at any stage that similar services or sub service was provided by the BIDDER to any other Ministry/Department of the Government of India or a PSU at a lower price, then that very price, with due allowance for elapsed time, will be applicable to the present case and the difference in the cost would be refunded by the BIDDER to the BUYER, if the contract has already been concluded.

8. Independent Monitors

8.1 The Principal appoints competent and credible Independent External Monitors for this Pact. The task of the Monitor is to review independently and objectively, whether and to what extent the parties comply with the obligations under this agreement.

Contact details of Independent External Monitors:

1) Sh. Ajay Kumar Lal, IRAS (Retd.),
DDA, HIG, Block 3A/101 A,
Motia Khan (Near Jhandewalan Temple),
D.B. Gupta Road, New Delhi – 110015
Email: ajay_k_lal@yahoo.com
Mobile No: 9560712003

2) Sh. Pavan Kumar Jain, IDSE (Retd.),
A-402, Shree Ganesh Apartments,
Plot No. 12B, Sector-7 Dwarka,
New Delhi – 110075
Email: mespkj@gmail.com
Mobile No: 9313498388

8.2 The task of the Monitors shall be to review independently and objectively, whether and to what extent the parties comply with the obligations under this Pact.

8.3 The Monitors shall not be subjected to instructions by the representatives of the parties and perform their functions neutrally and independently.

8.4 Both the parties accept that the Monitors have the right to access all the documents relating to the project/procurement, including minutes of meetings.

8.5 As soon as the Monitor notices, or has reason to believe, a violation of this Pact, he will so inform the Authority designated by the BUYER.

8.6 The BIDDER(s) accepts that the Monitor has the right to access without restriction to all Project documentation of the BUYER including that provided by the BIDDER. The BIDDER will also grant the Monitor, upon his request and demonstration of a valid interest, unrestricted and unconditional access to his project documentation. The same is applicable to Subcontractors. The Monitor shall be under contractual obligation to treat the information and documents of the BIDDER/Subcontractor(s) with confidentiality.

8.7 The BUYER will provide to the Monitor sufficient information about all meetings among the parties related to the Project provided such meetings could have an impact on the contractual relations between the parties. The parties will offer to the Monitor the option to participate in such meetings.

8.8 The Monitor will submit a written report to the designated Authority of BUYER/Secretary in the Ministry within 8 to 10 weeks from the date of reference or intimation to him by the BUYER / BIDDER and, should the occasion arise, submit proposals for correcting problematic situations.

9. Facilitation of Investigation

In case of any allegation of violation of any provisions of this Pact or payment of commission, the BUYER or its agencies shall be entitled to examine all the documents including the Books of Accounts of the BIDDER and the BIDDER shall provide necessary information and documents in English and shall extend all possible help for the purpose of such examination.

10. Law and Place of Jurisdiction

This Pact is subject to Indian Law. The place of performance and jurisdiction is the seat of the BUYER.

11. Other Legal Actions

The actions stipulated in this Integrity Pact are without prejudice to any other legal action that may follow in accordance with the provisions of the extant law in force relating to any civil or criminal proceedings.

The bidder shall not approach courts while representing any matter to IEMs and the bidder will await IEMs' decision in the matter.

12. Validity

12.1 The validity of this Integrity Pact shall be from date of its signing and extend upto 5 years or the complete execution of the contract to the satisfaction of both the BUYER and the BIDDER/Seller, including warranty period, whichever is later. In case BIDDER is unsuccessful, this Integrity Pact shall expire after six months from the date of the signing of the contract.

12.2 Should one or several provisions of this Pact turn out to be invalid; the remainder of this Pact shall remain valid. In this case, the parties will strive to come to an agreement to their original intensions.

13. The parties hereby sign this Integrity Pact at_____ on _____

BUYER	BIDDER
Name:……..	CHIEF EXECUTIVE OFFICER
Director	
National Centre for Polar & Ocean Research.	
Witness	Witness
1. _____	1._____
2. _____	2. _____

END OF SECTION 13

PART D

OUTLINE SPECIFICATIONS OF RESEARCH VESSEL

TECHNICAL SPECIFICATION

for

89.50 M OCEANOGRAPHIC RESEARCH VESSEL (ORV)

for the

National Centre for Polar & Ocean Research, India

Project reference: NCPOR/VOM-14/1/2022

G.A. No. enclosed	**15048-101-001-05**

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1. SHIP GENERAL

10. SPECIFICATIONS, ESTIMATING, DRAWING, INSTRUCTION COURSES

101. Contract/specific work, general design, model testing

This specification and General Arrangement Plan no. 15048-101-001-05, describe Oceanographic Research Vessel (ORV), which will be designed and built for world-wide service according to requirements of the Owner, the Classification Society and the National Authorities.

The vessel shall be multidisciplinary vessel utilised as national facility by Ministry of Earth Sciences, for Deep Sea Minerals investigations including Hydrothermal programme, PMN programme and other programmes of MoES etc. aimed for studying all living and non-living resources and other oceanographic R&D and exploration studies in Indian Ocean region. The vessel shall be registered in India and shall comply with all statutory and regulatory national and international requirements applicable at the time of construction and delivery. The living conditions including the ambience and look of the vessel and its interiors are to be so designed and constructed so as to match the standards as maintained by passenger liners. The vessel and equipment are to be designed / selected for a service life of minimum 35 years with normal maintenance. The vessel is expected to be at sea for about 300 days a year and should be capable of safe & environmentally friendly embarkation, stowage, carriage at sea and delivery of expedition.

Maximum operational depth for the vessel is 6000 m.

The Vessel must therefore be capable of functions such as:

1. Underway Swath Multibeam Surveys, Geophysical & Seismic surveys in coastal seas and deep waters.
2. CTD profiling, water sampling operations.
3. Biological sampling using vertical and horizontal sampling through various nets.
4. Surface and deep sea mooring operations / Data buoy operations.
5. Seabed samplings using corers and grabs. Rock dredging with chain bag dredges.
6. Underway Atmospheric observations, Upper air data collection etc.
7. Underway surface met and current measurements.
8. Deployment / retrieval of heavy test / protocol type equipment with DP.
9. Deployment / retrieval of submersibles(AUV, ROV, etc) in DP.
10. Onboard analytical works and data processing.
11. Training and education of scientists and technicians.

The ship to perform the above specified scientific operations by use of the scientific equipment specified in Annex 8 – List of Scientific Equipment.

Based on the above, the Builder to provide detailed operational plans for each scientific operation with the listed scientific equipment and the onboard scientific winches and handling equipment. The operations shall be illustrated or visualized to the Owner during the design phase and courses/training of crew and scientists to be arranged.

The ship to be completed and outfitted according to the best shipbuilding standard for modern, noise-reduced Research Vessels.

In this specification the metric system is used(means metric tons of 1000 kg).

Anything mentioned in this specification but not shown on the General Arrangement Plan are to be supplied and fitted.

In the event of discrepancies between this specification and any corresponding drawings, this specification shall prevail.

Should any equal equipment, system or material be specified more than once within this specification, in this specification and in any of the listed Annexes, in two or more of the listed Annexes, they are to be supplied and fitted only once.

The vessel will mainly be operating in tropic and sub-tropic areas as well as Antarctic areas. The vessel's systems and equipment shall therefore be capable of operating constantly under the following environmental conditions:

1. Seawater temperature: -2ºC to 32ºC.
2. Minimum air temperature: -20ºC
3. Maximum air temperature: +36ºC at 100% air humidity.
4. Maximum air temperature: +40ºC at 70% air humidity.

The vessel shall be capable of 45 days transit at 12 knots, with no less than 10% of the total fuel capacity remaining.

Speed
The vessel shall be capable (with gondala attached and drop keel retracted inside ship) of reaching a sustained maximum speed of 14.0 knots at 90% MCR of the rated propulsion power, under the following conditions: (Beaufort scale 3 conditions to be considered for the purpose)

1. Draught of 6.0 metres
2. 0.5 m significant wave height or less
3. Wind: 10 knots or less

The vessel shall have a sustained economic speed not less than 12 knots and a sustained minimum speed of 3 knots, under the same conditions as above.

The progressive speed test shall be carried out under the following conditions. Each double run to consist of one (1) run in a direction on the course and one (1) run in the opposite direction. The Vessel's speed shall be measured by means electronic measurement system (DGPS) and there shall be no correction on the results obtained upto sea state BF3. The measurement of propulsion motor's power shall be done by the Builder's torsion meter for which calibration certificate shall be provided from the manufacturer.

Following double run shall be carried out:

50 % of propulsion motors full load	: One (1) double run
75 % of propulsion motors full load	: One (1) double run

90 % of propulsion motors full load : One (1) double run (Contractual maximum sustainable speed)
Maximum output of propulsion motors full load : One (1) double run

Dynamic Positioning

The vessel in intact condition is to be able to maintain position upto the sea state 5.

Failure mode effect analysis (FMEA) to be carried out by third party approved by class.

Model testing

Model testing to be carried out at a recognized model test facility in order to verify that vessel performance requirements are met. The model test will be carried out in a standard towing tank in any organization with experience of undertaking such tests or any other towing tank facility confirming to ITTC standards of tank testing and extrapolation. The cavitation free performance should be demonstrated through model tests in depressurized towing tank/ cavitation tunnel. The actual performance of the propeller should be demonstrated as part of acceptance trials during the delivery of the vessel. Model testing to be carried out with gondola. Testing to include specific test as specified below.

Calm water tests
- Resistance tests, 1 draughts, speed range 8 – 16 knots, 1 knot increment.
- Propulsion tests, 1 draughts, speed range 8 – 16 knots, 1 knot increment.
- Paint test or CFD streamline verification.
- 3D Wake measurement, one speed, one draught
- Tow pull test, one speed, one draught.
- Bollard pull test, one draught.
- Report including high-res pictures of all speeds.

Seakeeping tests
- Roll Decay Test.
- Beam seas, 0 speed, 1 draught, 3 significant wave heights.
    - Active anti-rolling tank
- Beam seas, 0 speed, 1 draught, 3 significant wave heights
    - Empty anti-rolling tank
- Head, Bow quartering, Stern quartering and Following seas, 4 speeds, 3 significant wave heights, active anti-rolling tank.
- Video and pictures of all tests.
- Ink injection for visualization of bubble sweep-down behavior, alternatively other method with same result.
- Report.

Maneuvering tests:
- Standard maneuvering tests to be performed at one draught in order to verify the design related to IMO Resolution MSC.137(76) Standards for Ship Maneuverability. To include zig-zag tests, tactical diameter tests and crash stop tests. One draught.

Open water test of propeller:
The Builder to perform open water test of the design propeller. The result to be approved by the Owner.

Noise and Vibrations
Special attention shall be paid to the design, construction and outfitting of the vessel, to minimize underwater noise radiated into the water, as well as inboard noise.

An Owner approved Noise Consultant having specialized knowledge and practical experience of low-noise research vessels needs to be engaged by the Builder to oversee all aspects of implementing the noise specification in Annex 1 – Specification, Control and Measurement of Acoustic Noise and Vibrations.

Their responsibility must include provision of an overall noise reduction plan for the vessel, including the underwater and internal noise aspects; checking the design and calculations for the engine/alternator isolation system; assessment of suitability of machinery characteristics; advice on materials for noise reduction; carry out measurements of noise and vibrations as the building proceeds; give regular progress reports on the noise reduction measures; attend works testing of main machinery and any other critical items; carry out measurements of internal noise during trials and assess underwater noise levels in relation to the ICES Recommendation and other requirements given in this specification.

All required rotating and reciprocating machinery components incl. pumps and ventilation plants to be resiliently mounted except where otherwise specified. Stiffness of foundations and supports for all noise critical components as well as dimensioning of pipe systems to be especially checked by the Noise Consultant before procurement of materials and equipment and start of production.

Inspection trunk near propellers
A trunk with inspection glasses to be arranged close to propellers in the centre skeg for underwater inspection of propeller during operation. The trunk shall be built and arranged according to class requirements.

Electromagnetic compatibility / interference (EMC/EMI)
An Owner approved company specialized in EMC and the reduction of EMI needs to be engaged by the Builder to oversee all aspects of implementing the requirements in respect of Annex 2 – The Electromagnetic Environment Compatibility and Interference

Their responsibility must include; provision of an overall Precaution Schedule and an Interference Reduction plan for the vessel; involvement in the details of wiring layouts; assessment of interference levels from machinery; measurements of EMI on the completed vessel at agreed states of running, including MCR.

In addition, special attention shall be paid to the overall electrical supply system so that the electronic equipment on board the vessel can operate without mutual interference or interference caused by conducted or radiated electrical disturbances.

Main dimensions
In this specification all measurements are metric including metric tonnes at 1000 kg.

Length over all	89.50 m
Length between perpendiculars	81.00 m
Breadth moulded	18.80 m
Depth to tween deck	6.80 m

Depth to main deck	9.80 m
Depth to 1st deck	12.50 m
Depth to 2nd deck	15.20 m
Frame spacing	600 mm

Adequacy of the frame spacing needs to be ascertained during the structural design of the vessel in accordance with the classification society rules being followed for the construction of the ship. Further, the structural design needs to be vetted by the classification society.

International gross tonnage: approx. 5900 GT

Capacities
Tank capacities subject to final calculations:

Marine Diesel oil	approx.	760 m^3
Water ballast	approx.	850 m^3
Potable water	approx.	325 m^3
Lubricating oil	approx.	75 m^3
Hydraulic oil	approx.	10 m^3
Urea	approx.	40 m^3

Miscellaneous tanks as per enclosed tank capacity plan.

Scientific deadweight
The scientific deadweight shall be as follows:

Scientific equipment incl. wire and cables : 150 tonnes

Accommodation deck layout
Safe and comfortable accommodation to be arranged for 60 persons plus hospital as indicated on the enclosed General Arrangement Plan.

Capacity to consist of:
- 25 officers & crew
- 35 scientists

Provision to be carried for 45 days.

Towing
The Vessel shall have a Bollard Pull equivalent to a pull force of 35 Tons at a speed of 4.0 knots.

Propeller manufacturer to ensure the cavitation free performance of the propeller upto the speed of 14 knots (the speed can be amended to the speed at which low noise characteristics are required). Towing and propulsion predictions to be updated for actual design propeller by the propeller manufacturer. Alternatively, documentation by means of identical previous projects can be accepted (Ship and propeller).

Seakeeping
In 2 m significant wave height, at seas 30 degrees of the bow and at speeds less than 8 knots, the vessel is to meet the following motion characteristics limits:

- Vertical acceleration at forward perpendicular 0.25g
- Vertical acceleration at main console on Bridge 0.1g
- Lateral acceleration at main console on Bridge 0.05g
- Roll 4.0 degrees
- Pitch 1.5 degrees
- Motion Sickness Index (MSI) not more than 30% in 4 hours
- Slamming at 10% of "L" aft of forward perpendicular 10 per hour
- Deck wetness 10%

All values are given as root mean square (RMS).

The vessel shall be able to operate the scientific and acoustic sensors up to 3.25 m significant wave height.

Stability
During construction period, when this is found to be practical, the Builder shall arrange a preliminary inclining experiment in cooperation with the Designer in order to determine the preliminary centre of gravity for the steel hull with outfitting on board at this stage. Shipyard to provide periodic updates/reports on the lightweight of the vessel from the 3D production model used for detail design.

After completion of vessel a final inclination test is to be carried out by the Builder supervised by the Designer, and lightship weight centre of gravity is to be calculated. The inclining experiment shall be conducted by shifting weights and the Vessel's heel shall be measured using two (2) pendulums. The inclining test is to be witnessed and approved by the Authorities and/or Class representative.

The stability documents shall be prepared according to Class and Flag Authorities' Regulations for this type of vessel.

All ISPS requirements shall be complied with and all required facilities shall be made available.

Stability Software:
The vessel shall have onboard software/program to verify the vessel stability against the intact and damage stability criteria. The software shall have online draught readings fore and aft. A separate computer to be arranged at the Wheelhouse for this purpose.

Definitions and terms

"Owner"
Where the terms "Owner" is used, it refers to: **National Centre for Antarctic and Ocean Research, India**.

"Builder"
Where the term "Builder" appears, it refers to: "As per Shipbuilding Contract", which undertakes the full responsibility to carry out the complete construction of the vessel herein specified and designed.

"Design Consultant"/"Designer"
Where the term "Design Consultant" or "Designer" appears it means the firm appointed by the Builder to prepare, on the basis of present conceptual design documentation, Basic and

Detailed design documentation as required in order to build the Vessel according to this Specification, annex's to this Specification, enclosures to this Specification and other relevant documentation put forward by the Owner as basis for the shipbuilding contract.

"Noise Consultant"
Specialist noise reduction company/consultant specialized in acoustic research vessels, engaged by the Builder in order to ensure that the required efforts are taken in order to meet the given noise specification. See Annex I.

"Class"
Where the word "Class" is mentioned throughout this specification it refers to IRS and the other chosen class society as specified.

"ICES"
Where the word "ICES" is mentioned throughout this specification it refers to the International Council for the Exploration of the Sea.

"Good shipbuilding practice"
The term "good shipbuilding practice" refers to those engineering and construction details, which have proven to be effective and reliable in the maritime industry for seaworthy vessels.

"Approval" and "TBD"
Where such word as "approved" or "TBD" is used herein, the decision of the Owner's Representatives is intended. Where a decision is required from the Owner's Representatives, it shall be rendered as promptly as possible so that the Builder may proceed with its work.

"Interpretation
"Interpretation" of words and phrases of broad meaning in these specifications by the Builder are subject to approval by the Owner's Representatives prior to installation of items so described. Words and phrases include, for example: "adequate", "comfortable", "good marine quality", "necessary", "suitable", etc.

"Equivalent"
"Equivalent" equipment/standards/materials shall have comparable ratings, quality, material design and shall be proven in the marine industry.

"Flag Authority"
Where the term "Flag Authority" appears, it refers to: **The Maritime Authority of India.**

Abbreviations
Abbreviations and acronyms used in the specification;

AC	-	Alternating Current
A/C	-	Air Conditioning
Class	-	Classification Society
DC	-	Direct Current
DP	-	Dynamic Positioning
ECR	-	Engine Control Room
EMC	-	Electro Magnetic Compatibility
EMI	-	Electromagnetic Interference
ESD	-	Electro Static Discharge
EX	-	Explosive atmosphere

FAT	-	Factory Acceptance Test
FO	-	Fuel Oil
FW	-	Fresh Water
GA	-	General Arrangement
GRP	-	Glass-fibre Reinforced Polyester
HAT	-	Harbour Acceptance Test
USBL	-	Ultra Short Baseline Acoustic positioning unit
HO	-	Hydraulic Oil
HPR	-	Hydro-acoustic Position Reference
HP	-	High Pressure
IEC	-	International Electro-technical Commission
IMO	-	International Maritime Organization
IOPP	-	International Oil Pollution Prevention
KW	-	Kilo Watt
L	-	Load Line Length
LAN	-	Local Area Network
LED	-	Light Emitting Diode
LO	-	Lubrication Oil
LWL	-	Loaded Water Line
MCC	-	Motor Control Centre
MCR	-	Maximum Continuous Rating
MGO	-	Marine Gas Oil
MOB	-	Man Overboard
MoES	-	Ministry of Earth Sciences(Delhi, India)
NMA	-	National Maritime Authorities
t	-	tonnes
PA	-	Public Address
PLC	-	Programmable Logic Controller
PMN	-	
PMS	-	Power Management System
PPM	-	Parts Per Million
PS	-	Port side
SAT	-	Sea Acceptance Test
SB	-	Starboard side
SCR	-	Selective Catalytic Reduction
SOLAS	-	Safety Of Life At Sea
SW	-	Sea Water
SWBD	-	Switchboard
SWL	-	Safe Working Load
TS	-	Technical Specification(this document)
UPS	-	Uninterrupted Power Supply
URN	-	Underwater Noise Radiation
VDR	-	Voyage Data Recorder
WB	-	Water Ballast
WT	-	Water Tight

102. Drawing, ordering, etc.

Drawings and design documentation

All drawings and engineering work for the total construction, outfitting and testing of the vessel to be performed by the Builder and shall be the responsibility of the Builder. Owner to

be actively involved in detailed design of deployment and recovery systems, scientific systems and equipment, laboratories etc.

Before any building work of the Vessel starts, all Main Drawings and Documents shall be submitted to the Owner for approval.

The drawings shall be returned by the Owner within 14 calendar days after receipt in approved condition with eventual remarks, alternatively in refused condition, with the reasons given for the refusal and with eventual alternative proposals. Drawings which are not returned within the time limit to be regarded as approved.

Minor drawings to be approved on site by the Owner's local representative.

At delivery of the vessel, all drawings updated to "as-built standard", in hard copies and digital format, to be delivered by the Builder to the Owner, unless otherwise particularly agreed upon.

One Safety Plan and one Emergency Plan, digital format, to be delivered to the Owner for easy changes of symbols etc. onboard. The Emergency Plan to be completed by the Owner.

Approval of drawings by the Class and Flag Authority to be obtained by the Builder.

Builder shall provide necessary sets of all required plans for registration of vessel.

Two (2) copies of all sub-supplier manuals to be sent to the Owner, (one (1) to the main office and one (1) to the local representative).

Digital files of the drawings also need to be submitted to the owner in .iges / .dwg / .dxf format.

109. Maintenance, systems, instruction materials

Four sets of data books containing lists of all "as fitted" equipment and machinery onboard, make, type, capacities, service agents network, serial numbers etc. to be delivered with the ship.

Three sets of all instruction manuals and service/repair books, as well as workshop manuals to allow the Owner to undertake repair work, to be delivered with the ship.

The Builder shall work out an Equipment specification with a brief description of all equipment and with a statement of make, type, production number, supplier with postal address, e-mail address, telephone no., fax no. and other relevant information for effective maintenance of the Vessel.

The Builder shall ensure that the Vessel's crew have the necessary documentation on board for using the equipment fitted.

All plans and booklets, documents and drawings for the design, construction and operation of the Vessel, name and label plates, and any document required for implementation of this Specification during construction and inspection shall be in the English.

Electronic manual
An interactive electronic technical manual and spare part list to be provided for the main and auxiliary machinery, and other relevant equipment.

Courses
The Builder has to commit the suppliers of equipment listed below to include courses necessary for the Vessel's crew, Instrument technicians and Owner's Superintendents. The following courses to be held on board or onshore, depending on what is most practical:

- Cranes and other lifting gear/equipment.
- Winches with drives and remote controls, etc.
- Navigation and Communication equipment.
- Maneuvering equipment (Propulsion control, DP, etc.)
- MDGs and Main propulsion machinery.
- Misc. Auxiliary equipment.
- Misc. Electronic and electric equipment (servers, switchboards, etc.)

The courses to be of approved type if require by National Authorities, Class or Owner.

Engineering System Documentation
Beside equipment documentation, the Builder to ensure provision of engineering system documentation in the form of a comprehensive manual on each system.
As fitted drawings/schematic/layouts of Engineering systems are to be enclosed within these manuals (and not provided loose), in a manner that they can be easily removed/replaced.
Following details/drawings are to be enclosed within the manuals:

- System description and operating procedures, including system balancing (required where more than one (1) pump is installed in the system)
- Part numbers, vendor details, dimensional and material specifications (required for life-cycle support).
- Details of recommended repair procedures viz., welding/brazing and specifications of repair materials (welding rods, filler material etc.).
- Details of pipe hangers, bellows, flanges, gauges, valves and instrumentation used in the system.
- Systems component-wise drawings/details.

Drawings to be delivered with the Vessel
The Builder shall provide the Vessel/Owner with electronic version and three (3) copies of:

- All main drawings in final revision in files with index.
- User/Instruction manuals for all equipment.
- Armature lists for all pipes and valves.

The Builder to supply two(2) sets/licenses (AutoCAD) for pre-view and editing drawings onboard.

Further to be delivered:
- SOPEP manual (to be delivered to the Owner three (3) months prior to delivery of the Vessel).
- SOLAS manuals and instructions as per Ch. III Reg. 35 and Ch. II-2 Reg. 15.

Maker's List
A Maker's List is prepared, see Annex 7 to this specification.

Purchase routines
The Builder to select Makers among the listed alternatives.

If the Owner reject the Builder's choice of Maker, the Owner will carry the responsibility for any cost adjustment resulting from the rejection. Any such additional cost to be agreed in writing prior to the relevant selection/purchase.

For non-listed items, Builder shall select the same from reputed manufactures within the International Maritime Industry with proven performance, and obtain prior approval from Owner.

Prior to purchase of any equipment, the Builder shall present to the Owner relevant technical information about the equipment and it's supplier. The Owner shall have ten (10) working days to accept or reject the Builder's selection.

All substantial sub-contractors to be approved by the Owner.

If equipment listed in this specification is not relevant at the time of purchase due to:

1. The equipment is no longer in production;
2. The equipment is replaced by a newer generation;
3. Equipment from another Maker is more suitable for the purpose;
4. Delivery time will jeopardize the contractual delivery time stipulated in the contract. Builder to provide to the Owner a price blanked copy of offer to substantiate the change of equipment;

..then the Builder has the right to make use of other equipment than specified even if this to some extent differs from the specification as long as the intent of the specification is maintained and Owner's approval is obtained

Every attempt shall be made by the Builder to achieve a minimum number of types and sizes of spares, equipment and consumables. As far as possible unified electric motors, valves, pumps, starting devices, control instruments etc. are to be adopted. The Builder is responsible to arrange this also with their subcontractors.

Spare parts
Spare parts and other equipment exceeding Class requirements shall be delivered by Builder according to Makers' recommendations for two (2) years normal consumption.

Spare parts & Maintenance system
A Class Approved Spare part & Planned Maintenance system to be installed and implemented.

Data about all parts delivered with the different components, as standard spare parts, etc. ordered by the Owner until one (1) month before delivery, to be implemented in the system. This system shall be hosted in the PC network.
The computers to be delivered with separate UPS, Windows operating system and software.

112. Classification and statutory fees and certificates

The Vessel shall be classed under the Indian Register of Shipping with the following notations:

IRS 卐 SUL Ha(B)
卐 IY, SYJ, DP(2), IBS, EP, TCM
"Oceanographic Research Vessel"

In addition, it shall be classed through dual class under another IACS reputed class society with the following equivalent notations (DNV-GL notations given):

DNV+1A1, E0, ICE-1C, SPS, DYNPOS-AUTR, TMON, CLEAN, NAUT-AW, COMF-C(3)V(3), VIBR, SILENT-A.

The chosen additional class society may be either 1) DNV-GL, 2) BV, 3) ABS or 4) LRS.

The Vessel shall be built according to Class rules and regulations for international trade, valid at the date of Shipbuilding Contract enforcement.

All statutory class requirements as well as national and international regulations applicable on the date of signing of building contract of the Vessel to prevail.

The Vessel shall fly the Indian Flag. All statutory certificates shall be issued by Indian Register of Shipping, on behalf of the Government of India.

The Design of the Vessel shall, comply with the following:

- ICES (International Council for the Exploration of the Seas) CRR report 209.
- SOLAS Consolidated edition 2014.
- Convention on International Regulations for the Prevention of Collisions at Sea 1972, including later amendments, unless any specific exemption is requested.
- MARPOL, International Convention on Prevention of Pollution from Ships 1993, including later amendments.
- Revised Montreal Protocol, June 1993 on Ozone Depleting substances.
- International Telecommunication Radio Regulations Geneva 1974 & 1978.
- International Electro Technical Commission (IEC) Rules.
- IMO Resolution MSC.337(91) Code on Noise levels on board ships.
- Maritime Labour Convention 2006.
- IMO Resolution MSC.137(76) – Standards for Ship Manoeuvrability.
- IMO Resolution MSC.267(85) International Code on Intact Stability (2008 IS Code)
- IMO Resolution MSC.266(84) Code of Safety for Special Purpose Ships 2008.
- IMO International Convention on Load Lines, 2006
- IMO Ballast Water Treatment Convention
- IMO Regulations where specified.

The vessel and its' equipment will be delivered with all necessary certificates according to Flag, Class and other applicable regulations.

Statutory fees to Flag and Classification fees to be covered by the Builder.

118. Launching and delivery representation

The Owner's Representatives shall be given minimum 12 weeks' notice of launch and final dry docking of the vessel prior to delivery.

The Shipyard to arrange a christening ceremony when the completed vessel is officially handed over to the Owner. The Owner to be allowed to invite up to 30 guests for this ceremony and the Shipyard is to cover all expenses in connection with the ceremony and a subsequent dinner party.

12. QUALITY ASSURANCE, GENERAL WORK, MODELS

122. Work management, Fire guard, Supervision, Watch keeping

A comprehensive and effective system of fire detection, protection and fighting to be organized and maintained while the Vessel is under construction and outfitting. Shore water supply for fire-fighting shall be provided at all times while the Vessel is in the Builder. Suitable fire resistant covers to be used to protect intricate and vulnerable items of machinery and equipment from falling sparks or other potential sources of fire.

A Fire watch to be maintained continuously during welding operations. Insulation material to be removed within 1m of the welding spot.

Special restrictions against smoking to be enforced when danger of fire or explosion exists, as well as during fuelling or handling of volatile and flammable materials.

Bare lights are not to be used in freshly painted compartments or other spaces where a fire hazard may exist.

Owner's Surveyors

Owner's representatives shall be entitled to inspect the construction of the Vessel.
They shall have free access during working hours to the premises of the Builder's yard, where the Vessel or parts of it are being constructed.

Builder to provide separate offices for six (6) persons for the Owner's representatives at the yard. Two (2) offices shall be dedicated to the Owner's maritime group with reasonable access to the Vessel. Each office shall be equipped with at least two (2) telephones, one (1) fax machine, one (1) modern copy and scan machine A3-A4, broad band internet and one (1) coffeemaker. The Builder to provide a lunch room for eight (8) persons.

The Builder to provide four (4) furnished suites of apartments, including housekeeping services (regular cleaning of apartments, linens, towels etc) and transportation from the apartments to the shipyard.

The Builder shall assist Owner's representatives to obtain visas and permissions to enter and work in the Builder's country (if required).

123. Clearing, Cleaning and Sea trials

The vessel to be delivered from the Builder fully equipped as described in this specification and in seaworthy condition ready for service and with lubricating oil, hydraulic oil and refrigerant in the operational systems.

All tests and trials shall be completed to the full satisfaction of the Classification Society, Marine Survey Office and the Owner's Representatives.

Throughout the entire ship, all spaces, routes, functions, equipment and distribution boxes in accommodation, corridors, cargo spaces, machinery spaces, emergency exits, on external decks etc. to be properly labelled in English language according to lists approved by the Owner's Representatives. All equipment original plates and marking shall remain in the original language they are marked.

Marking of electrical cables will be done by means of plastic marker plates and resistant labelling. In machinery spaces and exterior areas, metallic marking shall be used.

Sea outlets and ventilation pipes will be marked on the open deck by means of brass labels.

Marking of piping and valves (colour and labelling) will be according to Owner’s standard.

All parts of the Vessel, including but not limited to structure, deck coverings, fittings, equipment, outfit, furniture, insulation, paint work, machinery, auxiliaries, appliances and apparatus, shall be maintained in a satisfactory condition during the entire period of construction and outfitting of the Vessel.

All dirt chips and scrap material shall be cleaned out at frequent intervals during the construction and outfitting work, and water shall be prevented from entering the Vessel as much as possible. Tanks and voids shall be cleaned, preserved and inspected by Owner and Class before being closed.

Rubbish shall be removed regularly from all spaces, including those which are to be permanently covered or which may become inaccessible. Piping and castings shall be cleaned of sand, scale, metallic chips, turnings and other foreign matter.

Special measures shall be taken to minimize damage during storage, installation and construction, and to prevent corrosion or other deterioration, especially to all unpainted, polished and movable parts.

If the time between launching and sea trial exceeds 120 days, the builder shall do the propeller polishing and examine the hull bottom by diver with video inspection and cleaning if necessary before the sea-trials.

Load trials of Generator engines with all safety checks shall be done at Quay before going for sea trials.

Switchboard operation, paralleling and load sharing in all modes of operation shall be done during Quay trials.

Cleaning of the Vessel before delivery

Upon completion of the Vessel, the entire Vessel including the accommodation, machinery areas, working and service areas, cargo and stores areas to be cleaned properly prior to handing over the Vessel to the Owner.

Tanks and void spaces to be properly cleaned before closing and used for the first time.

126. Assistance with Owner's supply

The Builder to assist the Owner with safe handling, storage and installation of any equipment supplied by the Owner. The assistance to include proper(covered and heated as required) storage of the specified equipment at arrival at Builder until installation in the ship.

127. Ship's technical data

Drawings to be delivered together with the ship:
Three sets of As-built drawings to be delivered with the ship. In addition two CAD-generated drawing sets (CD-ROM or other suitable storage unit) are to be provided.

Two (2) sets of the drawings to be delivered in archive-drawers and filed according to the SFI system. One (1) set to be placed in the Engine Control Room (ECR) and the other on the Wheelhouse.

Two (2) sets of all system drawings to be scaled to A1-format and plastic laminated. One (1) set of these drawings to be placed in the ECR.
In addition, when the main drawings are available electronically , these to be delivered the Vessel and Owner on a hard copy electronic format.
Four (4) models of the Vessel in scale 1:100 to be delivered in glass display cases. At delivery of the Vessel, the Builder to take digital photos and video of the Vessel in open water. Photos and video to be made available to Owner.

Drawings to be mounted on board the ship
The following drawings to be mounted on board the vessel:

- **1. Safety Plan** to be placed in accordance with international standards. Safety plans in tubes to be fitted outside according to rules.
- **2. Tank Capacity Plan** with dead weight scale**.**
- **3. Fuel Oil System.**
- **4. Water Ballast System**
- **5. Tank, Vent. and Filling Diagram**
- **6. Remote Sounding Diagram**
- **7. General Arrangement Plan**

128. Health, environment, safety

The Builder to take precautions as necessary to avoid personnel accidents for all persons involved in surveys and supervision of the vessel.

13. PROVISIONAL RIGGING

All provisional rigging and equipment needed during the entire construction period, external and internal, like provisional roofs, hatches, staging, gangways, ladders and provisional electric power, lighting, machinery, water, heating, ventilation plants, gas, oxygen, working air, tarpaulins, lifting and transport equipment to be supplied by the Builder.

All staging and rigging used during construction to be removed before delivery of the ship.

Brackets and temporary eye plates to be removed if necessary, and the base of these temporary eye plates to be repaired, primed and painted to the same standard as surrounding area.

14. WORK ON WAYS, LAUNCHING, DOCKING

141. Keel blocks, pillars, cushions

Precautions to be taken as necessary to avoid excessive pressure on the bottom or sides of the vessel from keel blocks and other supporting structures.

142. Launching arrangement with cradle supports

Temporary underwater protection to be applied after launching, including cathodic protection.

146. Gas freeing, tank cleaning

Prior to filling any of the tanks, the Builder to gas-free and clean all tanks for final inspection.

147. Berthing, anchorage

During the outfitting period the Builder to be responsible for the vessel being safely moored to the quay. During testing period the yard will ensure proper mooring and/or anchorage as necessary.

15. QUALITY CONTROL, MEASUREMENTS, TESTS, TRIALS

All functions of the vessel to be tested. A detailed testing procedure, worked out by the Builder, to be submitted to Design Consultants for recommendations prior to start of the test program. All trials/tests of scientific equipment/winches to be done in realistic conditions, in deep and shallow waters as applicable.

2. HULL STRUCTURE

20. GENERAL

The hull strength in general to be in accordance with the relevant class requirements and interpretations. Fabrication in general to be in accordance with IACS Recommendation "No. 47 Shipbuilding and repair quality standard", latest revision.

For reduction of underwater radiated noise (URN) in form of self-noise, there will be a fabrication requirement for the maximum buckling of shell plating below the waterline. Total buckling between two frames(600 mm), should be less than 2 mm and shall in any case be less than 3 mm.

Resonance between the hull structure and the main excitation sources, such as propellers, thrusters and diesel generating sets etc, is to be avoided. A separate vibration analysis to be carried out and the outcome to be incorporated in the design of the hull structure.

Detailed analysis of the foundations and adjacent structure of the main equipment is also to be carried out such as to ensure compliance with the specified noise requirements. Foundations drawings of all noise critical equipment identified by the noise consultant should be subjected to dynamic stiffness analysis by FEM. The design of these foundations should be vetted by Noise consultant.

201. Hull materials and general hull work, design principles

General hull work

Special attention to be paid to maintaining structural continuity. No girders, stiffeners, brackets or other supporting structures to be allowed to end on unsupported plate areas. Inserted thicker plates to be utilised rather than fitting doubler plates.

All flanges on girders, beams and brackets are in general to be 30 degrees sniped at ends. Fully sniped bracket-less end connections are to be avoided, except in way of dedicated buckling stiffeners.
Transitions between members of different thickness to be well tapered. Transitions between plating of different dimensions to be tapered as per Class requirements.

Stiffeners of type "Holland profile/bulb flat" to be used where possible.

All temporary brackets, cleats and lifting lugs shall be removed without damage to surface of plate. Damaged areas to be welded in, ground smooth, primed and painted to same standard as surrounding structure. Proper grinding to be carried out on all edges.

All steel to be shot blasted and shop primed before fabrication.
All galvanizing shall be done by hot dip-process.

X-ray ultrasonic or equal NDT testing of welding to be carried out as required by Classification Society.

All tanks and pipes to be properly cleaned and pressure-tested.

Welding:
The welding work to be carefully planned to reduce welding stresses and buckling.
All welding to be carried out in accordance with class requirements and approved welding tables.

Full penetration welds to be applied as per approved welding table.
Deep penetration welds to be applied as per approved welding table.
Double continuous welds to be applied as per approved welding table and on all external and wet structures.
Chain welds to be applied per approved welding table.
Slot welds could be applied after special considerations, but not in way of water ballast tanks.

Hull materials

All structural material to be of Class approved and certified quality.

Aluminium
To be utilized for the construction of :
- wheelhouse with radar mast
- the superstructure on deck 4.

Aluminium quality to be NV5083 or similar with minimum yield strength after welding of 125 N/mm2 (AlMg4.5Mn). In the transition between steel and aluminium structure, a class approved steel/aluminium bar (type Kelo or similar) where welding is possible from both sides to be utilized. Bimetallic strips to be used shall be as per class guidelines. Marine grade Aluminuim 6082-T5 may also be used subject to acceptance by class.

Shading / shelter is required at shipyard for protection of Aluminium fabrications.

Mild structural steel,
Strength properties
NV-NS or similar, with yield point not less than 235 N/mm2 to be used in all other areas of the hull, unless specifically noted otherwise.

- Bottom and side plating in anchor pockets and thicker insert plate in side shell below(area where anchors can touch).
- Window coamings in steel structure.
- All exposed steel inside grey and black water tanks.

High tensile structural steel
To be provided in plating and supporting structures of certain areas, such as:

- Crane foundations, if necessary
- Other specifically highly loaded structures, e.g reinforcements for winches, frames, block suspensions etc.
- Structural pillars, in general
- Other areas where dimensions should be reduced for space allowances etc.

Unless noted otherwise, high tensile steel is to be HT-36 or similar structural steel with yield point not less than 355 N/mm2 with approval of class.

Steel Grades

In general A-grade plating and profiles to be used.
B and D-grade plates to be provided where class requires such quality.
E-quality to be fitted in low temperature areas such as exposed structure in refrigerated areas.
Z-quality plating to be fitted where high tensile stresses occur at right angles to the plate.
Use of HT-32 steel may also be incorporated.

202. Transportation, sorting and storage of hull materials

Damage caused to the rust protective coating during transport, sorting or storage to be repaired by the Builder and treated with the original type of shop primer after proper cleaning.

203. Blasting, shop priming, rolling and cleaning of materials

All steel plates and profiles used in the building of this vessel to be shot blasted to standard SA 2.5 and zinc-epoxy-primed. The aluminium plates to be properly cleaned, primed and painted.

All exposed welding and damages to be sandblasted and primed after welding work. All scars to be welded and all sharp edges to be grounded (upto 2 mm radius) to Owner's representative's satisfaction.

204. Testing of tanks and bulkheads

All tanks and pipes to be properly cleaned and pressure- tested and inspected by Class and Owner's Representatives with written approval and signed tank test protocol. Pipe systems/modules to be tested prior to installation.

205. X-ray and ultra-sonic testing of hull parts

X-ray testing of welding and other NDT testing to be carried out as required by Classification Society Surveyors and Owner's representatives.

21. AFTBODY

216. Stern section

A continuous centreline stern plate 40mm thick and minimum 300mm deep to be arranged as basis for the aft peak structure. This plate to extend to the structural stern boss and further from the boss to the keel. Aft body to be provided with solid floors with cut outs on every frame. Notches for effective drain and ventilation of tanks to be provided.

A streamlined thick plated body to be arranged above rudders to ensure proper attachment to the hull, as well as to protect against ice wedging. Aft end to be arranged as an ice horn to protect the rudder when manoeuvring astern.

Stern boss according to class requirements to be arranged with sufficient length to provide a proper intersection with the shell plating.

23. HULL GENERAL

230. Design principles

Freeboard deck is defined as an imaginary deck level at a distance equal to one standard height from Load Lines Convention, below Main deck. Bulkhead deck to be Main deck.

Load line requirements for sill heights, hatch coamings, ventilator openings and other closing appliances to be measured from Lower deck level, as this deck will not be submerged. Class approval will be required for this general principle.

Hull to be strengthened for a maximum loaded speed of about 15. knots.
Spacing between ordinary frames to be 600 mm throughout the length.

Corrosion margins to be applied in way of ballast tanks by increasing plate thickness and scantlings as per class requirements.
In addition, urea tanks, if any, to have same corrosion margin as ballast tanks. Ice reinforcements to be fitted as per class requirement for relevant ice-class.

Minimum design loads

- Main deck(external part) to have a deck load capacity of ~~3,~~5 t/m2. Deck inside hangars to have 1,5 t/m2 deck load capacity.
- Store rooms to have a deck load capacity of not less than 1.0 t/m2
- All other design loads to be as per minimum class requirements.
- Semi-active anti-rolling tank to be designed for about 0.75 bar additional over/under pressure, depending on supplier's calculations.

Minimum plate thickness

Deck plating in way of accommodation areas is not to be less than 6.0mm
Deck plating in way of external hull structures not to be less than 7.0mm
Deck plating of wheelhouse top minimum 8 mm and funnel, masts, platforms etc not to be less than 5.0mm
Bulkhead plating in way of non-load carrying fire bulkheads not to be less than 5.0mm

Following areas to have increased plate thickness:

- Sea chest boundaries to be min 15.0 mm
- Sea-bays in way of retractable thrusters to be min. 15.0mm
- Below large winches, cranes, A-frames etc. plating to be increased, min 12.0mm.
- Thickness of steel plates around and inside the anchor pockets shall be 40% of chain diameter as given for K3 quality. Not to be less than 12.0mm. See also item 201 and 266.
- Chain lockers to be min 8mm, with perforated galvanized bottom plate 12.0mm
- 15.0mm keel plate to be provided, extending around moon pool for drop keels.
- Other areas of open parts of maindeck to be 10.0mm.
- Deck plating in way of mooring and towing equipment to be at least 10.0mm.
- Other areas where increased strength or stiffness is considered essential to be specially considered.

Longitudinal strength
Strength of hull girder to be based on still water design bending moments which will not impose significant operational strength restrictions on the loading of the vessel. The design of hull girder should be undertaken in accounting the effect of waves as indicated in the classification society rules. Longitudinal continuity to be provided for all longitudinal structural members in bottom and strength deck structures within 0,5L of the mid ship area.

231. Shell structures

Shell plating in general to be according to class requirements.

Transverse framing normally to be utilised throughout. Supporting stringers and web frames to be provided where relevant to reduce spans of frames.

Ice reinforcements to be built as per class requirements, with main and intermediate transverse framing. Load carrying horizontal stringers and vertical web frames to be provided to support the frames.

Shipside exposed to mechanical damage during over side handling to be increased above class requirements.

232. Bottom structures

A double bottom to be fitted, extending from the collision bulkhead to the aft peak bulkhead. Longitudinal side girders to be fitted as per class requirements. Continuity of such members to be maintained as far as possible. Steps in way of tank top(s) either to be arranged with a min. 1:3 taper or provided with large softening brackets of suitable capacity to transfer longitudinal stresses.

Bilge wells, manholes and other openings to be placed well clear off primary bottom structures and places for easy evacuation. Cut outs in bottom plating to be kept to minimum.

Bottom strength to be specifically considered for dry docking in way of thrusters and overhanging stem and stern, openings etc. Docking brackets to be fitted such as to transfer loads to primary bottom structure.

Bottom structure area to be specifically strengthened to resist slamming in the fore body as per class requirements.

Transverse stiffening with solid floors on every frame to be applied on inner and outer bottom.

Notches:
Structure in all tanks to be provided with notches in top and bottom such as to provide efficient drain and ventilation. Notches in solid floors in general to be with radius =0.25x depth of member or R75 whichever is the smaller. Corners of floors to have radius up to R100.

To provide a rigid foundation, the inner and outer bottom plating in way of diesel engines and electric motors for propulsion to have a thickness of at least 13 mm, and to extend longitudinally to the nearest transverse main bulkhead.

234. Strength deck(s)

In general longitudinal stiffening to be applied in way of strength deck(s). Cut-outs in strength deck(s) to be kept to minimum.

236. Transverse bulkhead and pillars

Watertight integrity
Watertight bulkheads to be arranged to suit the following requirements:
Main class requirements, damage stability, and SOLAS.

Tank bulkheads to be arranged as per tank capacity plan, with given density and pressure heads.

Protective cofferdams to be arranged in way of fresh water tanks as per class requirements.

In general, hull penetrations for protruding items such as rudder, propeller/stern tube, retractable thrusters and retractable hydro acoustic units shall be properly reinforced and provided with a watertight enclosure such as to form a double barrier against flooding in case of damage.

Structure
Non load carrying fire steel bulkheads to be arranged as per fire integrity plan, and to be of swedged or stiffened construction.

Transverse bulkheads normally to be provided with vertical stiffening.
Load carrying horizontal stringers and vertical web frames to be provided where needed to reduce excessive stiffener spans.

Pillars and supporting bulkheads
In general, circular or square pipes to be of high tensile steel HT-36 or equivalent steel. Pillars in accommodation to be square pipes, landing on doublers. Pillars elsewhere to be circular pipes. No hollow pillars to be arranged in tanks.

Supporting bulkheads for pillars and girders to be reinforced with increased stiffeners as necessary.

237. Longitudinal bulkheads

Longitudinal bulkheads normally to be provided with vertical stiffening throughout. Load carrying horizontal stringers and vertical web frames to be provided where needed to reduce excessive stiffener spans.

24. FORE BODY

Fore body to be provided with solid floors with cut outs on every frame. Notches for effective drain and ventilation of tanks to be provided. Horizontal stringers to be fitted as necessary for strength. The forward frame spaces to be arranged with horizontal breast hooks.

Upper Bow area to be additionally strengthened to resist bow-impact. This at least to apply for the area above the waterline forward of 0.1L aft of FP. This area to have plate thickness 1-2 mm in excess of class requirement. As far as practicable, frames to be aligned perpendicular to the shell, such as to form "radial frames". Load carrying stringers and web frames to be provided to support the frames. Frames, stringers and webs to have about 15% surplus section modulus.

Thrusters and hydro-acoustic transducers to be integrated into the fore body structure taking into account location and forces of docking blocks.

25. DECKHOUSE, SUPERSTRUCTURES

253. Superstructures, deck houses

All superstructures and deck houses to have external plating with stiffeners on the inside. Proper supporting structure to be provided below all superstructures and deck houses. Webs and girders in way of accommodation deck heads to be fitted with cut outs for cable trays and vent pipes, as well as for general weight reduction.

Net height from deck below to underside of girder flange in general not to be less than 2250mm (steel to steel)

Primary deck structure in deck head above switchboard rooms etc to be considered specifically to maximize available free deck height. Use of high tensile steel to be considered for this purpose. In way of low deck head accommodation areas, special bracket less end connections could be fitted.

Stairways and lift trunks between several decks in general to be arranged with a steel enclosure. Other areas to be provided with steel enclosures as per fire- and escape regulations.

In way of shipside and technical rooms, gutter bars to be fitted as per group 267.

26. HULL OUTFITTING

261. House and hull marking

The following to be marked on both sides by 5.0 mm steel plates welded to the hull:

- Name to be marked forward and aft, stb and ps.
- Port of Registry to be marked aft, stb and ps.
- Load marks according to Class requirements.
- Draft marks to be welded at forward and after perpendicular and Midship.
- Symbols for thrusters
- Symbols for other underwater protrusions
- Owner's emblem.
- Designer's ship type designation, stb and ps.

Ship name and homeport to be in both English and Hindi language.

The following to be marked on both sides by welds:

- Registration number to be marked as per regulations.
- IMO number to be marked as per regulations
- Colour sections and different coloured areas on the hull shall be marked with welding slots.
- Every 10th frame number to be indicated by welds above waterline.
- On the underwater part of the hull the corners of all tanks to be marked by welds.
- Bottom plugs fitted on each tank to be marked with tank number and content

The name of the vessel to be marked on Wheelhouse front, by letters of brass mounted on hardwood plate. Nameplate to be illuminated by led lights.

262. Bottom plugs sea chests, bilge wells

Bottom plugs
Bottom plugs stainless M42, according to NS2573 or similar to be arranged in way of all tank bottoms such as to facilitate effective drainage of tanks during docking. To be placed well clear of docking blocks. Two(2) sets of Keys for opening bottom plugs to be supplied and secured in workshop, clearly marked.

Sea chests
Sea chests to be arranged according to tank capacity plan. Hinged strainer plates of stainless steel with hole-area at least twice the total area of suction pipes according to Class requirements, to be properly fastened by stainless steel bolts and nuts with suitable locking arrangement, flush with shell plates. Sea chests shall have good drain of sea water and good venting for air escape.
Gap between strainer plate and shell plating shall be aimed as small as practicable.
A separate sea chest to be provided for Thermosalinograph.

Bilge wells
To be arranged on the following locations:

- Fore and aft in main engine room
- Fore and aft in propulsion room
- Bow thruster room
- Other technical wet rooms and compartments where normally needed and required,

263. Foundations

All foundations in general to be provided with notches to avoid water entrapment and provide drainage. All foundations on open deck to be made with large openings for easy cleaning and maintenance.

Cranes and overside-/stern frames.
Main cranes to have all integrated structural foundations extending between 2 decks. Thicker insert plates to be provided in decks as necessary to prevent buckling. Z-quality plating to be fitted where high tensile stresses occur at right angles to the plate.

Overside and overstern handling devices to be properly reinforced with appropriate strengthening and foundations.

Provisions for a mobile ROV LARS-system to be incorporated.

Thrusters
As far as possible azimuth thrusters, rudders etc. to be attached to the hull via shell and tank top plating. Special attention to be paid to preventing vibrations.

Winches
In general rigid foundations with small deflections to be arranged for all such equipment.

Mooring and towing equipment
To be reinforced for mooring and towing as per latest class and IMO requirements.

Foundations for noise critical equipment
Foundations for noise critical equipment to be analyzed for compliance with the given noise specification. As a minimum the following equipment must be given utmost attention:

Reinforcements for main propeller
Particular emphasis on the integration of the main propeller into the structure of the vessel.

Diesel engines
Rigid bottom girders to be provided in line with the generating sets, and as per class recommendations. Structural continuity to be maintained and proper fixation to engine room bulkheads to be arranged as far as possible.. Intermediate bracket floors to be provided as per class requirements. Flange of foundation to be properly supported by fitting tripping brackets in way of engine mounts.

Electric Motors for propulsion
Rigid bottom girders to be provided in line with the motor(s), and as per class recommendations. Structural continuity to be maintained and proper fixation to main bulkheads to be arranged as far as possible. Double bottom integrity to be maintained.

Auxilliary machinery

Smaller foundations for compressors, pumps and other such auxiliary machinery to be fabricated as a particularly rigid type with resilient mounting, with the aim to reduce noise and vibration levels to a level which is insignificant in relation to the given noise specification of the vessel.

Hydro acoustic equipment
For scope and installations of hydro-acoustic equipment, reference is made to Annex 6.

All hydro acoustic transmitters and receivers to be integrated into the hull by means of constructions which are suitably designed and attached to the hull. All necessary facilities to be incorporated as per group 414 of this specification.

2 retractable drop keels are also to be incorporated for mounting of a variety of transducers etc. The keels to be arranged in a trunk/moon-pool. Trunk to be arranged with adequate ventilation in top. See item 414.

Other equipment to be mounted in dedicated hull blisters of suitable construction.

264. Fenders and wear bars

In general, all fenders and wear bars to be fitted in accordance with drawings approved by owner.

Fenders
A fender construction to be mounted on the ship sides as per General Arrangement plan. To be made of steel half pipe approx dia. 260mm. Fairing for launching of rescue crafts to be fitted as required by regulations. End terminations to be of tapered construction. Intermediate carlings to be fitted on the inside of the shell plating, in line with the pipe edges, as required for strength. To be pressure tested and conserved.

Paint division bar
In addition one half round bar 60 mm x 30 to be welded on each side as per arrangement drawing.

Rope guard below Rudder and Propeller
Preparations for later mounting of a rope-guard made of pipe construction fitted to hull below rudder and propeller as indicated on GA plan, to be made. Preparation to allow for a later mounting of rope-guard by bolting(without welding to hull).

265. Bilge keel

Bilge keels to be fitted in way of the bilge. Longitudinal extent to cover about 30% of ship length and depth of keel to be about 450 mm. The keel to be positioned at the widest part of the bilge and shall be mounted approximately at right angles to the shell. The construction is to follow a streamline at the relevant location. Bilge keels to be continuous along the length. The shape and geometry of bilge keel shall be as per recommendations of the model basin.

Bilge keels to be of hollow plate construction, with triangular cross section.

Internal stiffening to be welded to a doubling plate which is welded to the shell plating. Closing plates to be mounted on the internal stiffening with a solid round bar of approx. dia. 50mm on the tip. Final closing by means of slot welding. End terminations to be of well rounded elliptical construction to minimize vortex shedding and cavitation. Intermediate carlings to be fitted on the inside of the shell plating, in line with the weld of the external doubling plate, as required for strength.
To be pressure tested and conserved.

Final execution to be confirmed by the designer.

266. Hawse pipes, anchor pocket

Thick walled hawse pipes to be arranged between chain stoppers and anchor pocket. The anchors (SPEK type) shall be recessed into the hull so that no part of the anchors will protrude from the ship sides. Additional plate thickness to be fitted in way of areas subject to damage or wear from the anchors. See also item 201 and 230.

267. Freeing ports, external gutter bars

Freeing ports
Aft working deck to be effectively drained by freeing ports on both sides of the deck. Total area to be according to Load Line requirements. Flaps of the none-return type to be fitted to owner's satisfaction.

Additional drainpipes of Ø 200 mm or equal size stainless steel channels to be arranged where needed, and to be led overboard approx. 600 mm above waterline.

External drainage, general
All external areas of the ship where water can accumulate to be arranged with proper drainage facilities to prevent permanent water entrapment.

External decks and platforms to be arranged with about 100mm gutter bars or upstanding edges which will collect water into external drain pipes as described under group 804.

Wheelhouse top, funnel top and other such areas with visor or bulwark constructions to be provided with similar drain pipes in addition to sufficient freeing port area to avoid water entrapment.

Hatch comings and other such constructions to be provided with drain pipes of suitable capacity to drain the water effectively overboard.

Recesses for stern-gate in front of the slipway and for the side-gate outside Main Hangar to be arranged with large drainpipes according to separate drawings.

Certain scientific areas will have specialized drainage facilities as per laboratory specification. For Geology lab / Wet core sample lab where the sediment samples washings shall be carried out, a suitable exclusive drainage facility (with settlement tanks etc) or any other alternate arrangement, may be provided to avoid choking of general drainage system.

Other measures where local drainage is required to prevent spill is also to be incorporated.

Internal drainage, general
In way of straight shipside where condensation is possible, about 100mm gutter bars to be fitted directly on the frames, such as to provide drain channels for condensation water. In way of curved shipside, brackets of same depth as member to be fitted between frame and gutter bar. To be led to bilge wells or outside.

Bulkheads and sides of technical rooms where washing or oil spill is possible are also to be provided with gutter bars of the same type. To be led to bilge wells with self closing valves.

Other measures where local drainage is required to prevent spill is also to be incorporated.

27. MATERIAL PROTECTION - EXTERNAL

The following external paint specification to be regarded as minimum requirements. Detailed painting specification showing make, overpainting interval, thinners etc. for the different paints to be worked out by the Builder and presented to the Owner for approval. Paint system maker to be agreed with the Owner.

External surfaces to be painted according to final paint specification and hull Marking drawing. Colours to be decided by Owner's Representatives.

After application of the last coat of paint to the underwater hull surface at block stage, the average hull surface roughness (AHR) shall be measured for reference and not to exceed 120 microns except welding beads, determined by means of BSRA procedure, and paint manufacturer’s recommendation shall be followed.

Painting scheme, external cathodic protection and MGPS system may be considered for 60 months service life. Warranty for hull paint and tank coat shall be 60 months.

Pre-treatment:
All sharp edges to be grinded on outside areas and in tanks to be coated. Lugs and steel pads on external hull, bulkheads and decks to be removed, and the surface to be ground flush. Cuts and scars to be repaired by welding and ground flush.

All steel to be delivered sandblasted to grade SA 2,5 and primed with primer of approved type. All painting shall be carried out in accordance to good workmanship and common practice.

Before coating is applied, steel surface and welding seams to be carefully cleaned by fresh water washing and/or degreasing in accordance with Yard standards.

All spray from welding to be removed, and welding seams to be free from pitting and edge grooves.

All external welds and damaged primer to be sandblasted to SA 2,5 or treated with mechanical tools according to paints suppliers and Yard instructions.

Preferably all welding to be finished prior to start-up of sandblasting.

All edges and welding seams to be strip coated before and between coating layers.
All paint work to be carried out according to the paint manufacturer's recommendations, and the paint to be applied as received from the manufacturer.

Oil, thinner and/or other drying liquids shall be added according to specification for the different types of coating.

Metalizing of hull :
The aft working deck area to be metalized. Area to include all hull structure below 2nd deck structure including decks, bulkheads, railing, masts, inside bulwark, complete stern gallows/A-frame support, complete transom stern, external shipside stb from forward of Main hangar to transom stern.

In addition following areas to be included:
- Ventilation ducts to engine and propulsion room.
- Bilge wells.
- Complete trunk for drop-keels.
- Deck inside Main Hangar.

For deck equipment like winches, cranes and frames, see specification for the individual equipment.

Metallizing to be carefully planned and executed after finishing of all welding and hot-work.

271. Bottom, sides up to loaded waterline, rudder, rudder trunk, sea chests, thruster tunnels

Stripecoat before each coat.

• Epoxy mastic	200 μm dryfilm thickness
• Epoxy tar free sealercoat	150 μm dryfilm thickness
• Tin free selfpolishing antifouling	150 μm dryfilm thickness
• Tin free selfpolishing antifouling	125 μm dryfilm thickness
Total	625 μm dryfilm thickness

272. Top sides with bulwarks ;

Stripecoat before each coat.

* pure epoxy	125 μm dryfilm thickness
* pure epoxy	125 μm ″ ″
* polysiloxane	100 μm″ ″
T o t a l	350 μm

273. External decks of steel ;

Stripecoat before each coat.

* pure epoxy	125 μm dryfilm thickness
* pure epoxy	125 μm ″ ″
* polysiloxane	100 μm″ ″

T o t a l	350 μm

Deck to be treated with anti-skid paint in major external transit areas.

274. Superstructure, deck houses, casing funnel, bulwark (inboard side)

Stripecoat before each

* Intershield 300 pure epoxy	125 μm dryfilm thickness
* pure epoxy	125 μm ″ ″
* polysiloxane	100 μm″ ″
T o t a l	350 μm

275. Wheelhouse and deckhouse on 4th deck in aluminium ;

Wheel house and deckhouse on 4th deck(aluminium) :

Pretreatment :

Acid washing, degreasing and high pressure cleaning.
Stripecoat before each coat.

* epoxy	50 μm dryfilm thickness	
* pure epoxy	125 μm	″ ″
* polysiloxane	100 μm	″ ″
T o t a l		275μm

276. Galvanising, nickel plating, metallising

External handrails and stairs to be hot-galvanised.

277. Other areas

Pretreatment :

Welding seams Sa 2 ½.
Oil, grease, salt etc. to be removed with strong detergent and high pressure cleaning.
Welding seams, rust and damaged shopprimer to be blastcleaned to min. Sa 2 ½ (ISO 8501-1:1988).

Main deck aft(open) and bulwark inside

Stripecoat before each coat.

• Epoxy mastic	150 μm dryfilm thickness
• Epoxy mastic	150 μm ″
• Polyurethane topcoat	50 μm ″
Total	350 μm

Deck components, not including equipment.

Stripecoat before each coat.

• Epoxy mastic	150 μm dryfilm thickness
• Epoxy mastic	150 μm dryfilm thickness
• Polyurethane topcoat	50 μm dryfilm thickness
T o t a l	350 μm

278. External cathodic protection, impressed current system

Impressed current corrosion protection system of sufficient capacity and extension to be arranged and fitted for protection of the underwater part of the hull. Exposed areas such as rudder, sea-water inlets, thruster tunnels, compartment for azimuth thruster propel, duct for drop-keels, grey-water tanks, etc. will have additional aluminium anodes fitted according to manufacturer's recommendations. The anodes shall be installed on a bended flat bar welded to the hull.

Capacity of system min. to be 50 mA pr. m^2 (2 electrodes and 2 reference electrodes).

28. MATERIAL PROTECTION - INTERNAL

The following internal paint specification to be regarded as minimum requirements. Detailed painting specification showing make, overpainting interval, thinners etc. for the different paints to be worked out by the successful Builder and presented to the Owner for approval. Paint system maker to be agreed upon with Owner.

External surfaces to be painted according to final paint specification and hull marking drawing. Colours to be decided by Owner's Representatives.

281. Accommodation, deck, houses, store rooms, Dry Lab and workshops.

Surface treatment
St. 2. Fats, oil, salt and other impurities to be completely removed before painting.
Welding seams and damaged areas to be power tool cleaned to St. 2 according to ISO 8501-1:1988.

Stripecoat before each coat.

• Urethane alkyd primer	80 μm dryfilm thickness
• * Alkyd based topcoat	50 μm dryfilm thickness
Total	130 μm dryfilm thickness

Steel behind insulation :
Pretreatment :

St. 2. Fats, oil, salt and other impurities to be completely removed before painting.
Welding seams and damaged areas to be power tool cleaned to St. 2 according to ISO 8501-1:1988.

Stripecoat before each coat.

• Urethane alkyd primer	80 μm dryfilm thickness

282. Engine room, propulsion room, etc.

Incl. steering gear room, winch drive rooms, thruster room, compressor/harb. gen. room, emergency gen. room, sonar room, separator room, ventilation room

Decks exposed for oil/deck below grating platfroms :
Pretreatment :

St. 2. Fats, oil, salt and other impurities to be completely removed before painting.

Welding seams and damaged areas to be power tool cleaned to St. 2 according to ISO 8501-1:1988.

Stripecoat before each coat.

• Epoxy mastic	150 μm dryfilm thickness
• Polyurethane	50 μm dryfilm thickness
Total	200 μm dryfilm thickness

Deck, sides and visible steel not exposed for oil :

Pretreatment

St. 2. Fats, oil, salt and other impurities to be completely removed before painting.
Welding seams and damaged areas to be power tool cleaned to St. 2 according to ISO 8501-1:1988.

Stripecoat before each coat.

• Urethane alkyd primer	80 μm dryfilm thickness
• Urethane alkyd topcoat	80 μm dryfilm thickness
Total	160 μm dryfilm thickness

Painting of pipes and components in engine room

Piping in engine and propulsion room to be painted in white colour except for fire main valves which shall be painted red. Flanges to be coated to suitable colour code.
All pipes to be marked according to owner`s standard.

285. Ballast, sea water and anti-rolling tank, cofferdams and chain lockers

Surface treatment

Welding seams Sa 2 ½. Oil, grease, salt etc. to be removed with strong detergent and high pressure cleaning.
Welding seams, rust and damaged shopprimer to be blastcleaned to min. Sa 2 ½ (ISO 8501-1:1988).

* pure epoxy	160 μm dryfilm thickness	
* pure epoxy	160 μm	″ ″
T o t a l		320 μm

286. Fresh water tanks, misc. tanks

Surface treatment

Welding seams Sa 2 ½. Oil, grease, salt etc. to be removed with strong detergent and high pressure cleaning.
Welding seams, rust and damaged shopprimer to be blastcleaned to min. Sa 2 ½ (ISO 8501-1:1988).

Tanks to be painted with non-solvent painting.

Stripecoat before each coat.

* Pure epoxy	300 μm dryfilm thickness

T o t a l 300 μm

287. Fuel oil and lubricating oil tanks

There will be no final coating in fuel, lubricating oil and hydraulic oil tanks. Cleaned and oiled only.

288. Internal cathodic protection

Internal cathodic protection to be fitted in sea chests and in cross over tank by means of sacrificial anodes for 36 months of operation.

289. Other internal areas

Main Hangar

Pre-treatment

Welding seams Sa 2 ½. Oil, grease, salt etc. to be removed with strong detergent and high pressure cleaning.
Welding seams, rust and damaged shopprimer to be blastcleaned to min. Sa 2 ½ (ISO 8501-1:1988).

Stripecoat before each coat.

- Epoxy mastic 150 μm dryfilm thickness
- Epoxy mastic 150 μm dryfilm thickness
- Polyurethane topcoat 50 μm dryfilm thickness

T o t a l 350 μm

Bio-Chemical Lab(1 & 2):

- Urethane Alkyd primer 80 μm dryfilm thickness
- Alkyd based topcoat 50 μm dryfilm thickness

T o t a l 130 μm

Wet Labs:

- Epoxy mastic 150 μm dryfilm thickness
- Epoxy mastic 150 μm dryfilm thickness
- Polyurethane topcoat 50 μm dryfilm thickness

T o t a l 350 μm

Anchoring and mooring room

Pre-treatment :

Welding seams Sa 2 ½. Oil, grease, salt etc. to be removed with strong detergent and high pressure cleaning.
Welding seams, rust and damaged shopprimer to be blastcleaned to min. Sa 2 ½ (ISO 8501-1:1988).

Stripecoat before each coat.

- Epoxy mastic 150 μm dryfilm thickness
- Epoxy mastic 150 μm dryfilm thickness
- Polyurethane 50 μm dryfilm thickness

T o t a l 350 μm

Azimut under water housing and trunk for dropkeels :

Pre-treatment :

Welding seams Sa 2 ½. Oil, grease, salt etc. to be removed with strong detergent and high pressure cleaning.
Welding seams, rust and damaged shopprimer to be blastcleaned to min. Sa 2 ½ (ISO 8501-1:1988).

Stripecoat before each coat.

• Epoxy mastic	150 μm dryfilm thickness
• Epoxy mastic	150 μm dryfilm thickness
T o t a l	300 μm

Stores rooms etc. with direct access to outside atmosphere

Pretreatment

St. 2. Fats, oil, salt and other impurities to be completely removed before painting.
Welding seams and damaged areas to be power tool cleaned to St. 2 according to ISO 8501-1:1988.

Stripecoat before each coat.

• Epoxy mastic	150 μm dryfilm thickness
• Polyurethane	50 μm dryfilm thickness
T o t a l	200 μm

Chain lockers, air ducts, void spaces and cofferdam

Pretreatment

St. 2. Fats, oil, salt and other impurities to be completely removed before painting.
Welding seams and damaged areas to be power tool cleaned to St. 2 according to ISO 8501-1:1988.

Stripecoat before each coat.

• Epoxy mastic	150 μm dryfilm thickness
• Epoxy mastic	150 μm dryfilm thickness
T o t a l	300 μm dryfilm thickness

Grey water and septic tank :

Surface treatment : Full blasting Sa 2 ½.

Stripecoat before each coat.

• Epoxy coating with high resistant chemical & solvents	150 μm dryfilm thickness
• Epoxy coating with high resistant chemical & solvents	150 μm dryfilm thickness
T o t a l	300 μm dryfilm thickness

29. MISCELLANEOUS HULL WORK

298. Fitting and joining of composite materials

In the transition between steel and aluminium structure a class approved steel/aluminium bar where welding is possible from both sides to be utilized.

3. SPECIALISED EQUIPMENT

30. HATCHES AND PORTS

In general hatches to be fitted as indicated on General Arrangement Plan.

Hatch cover in Main deck aft and hatches adjacent to engine room(s) to be of mild steel. Unless otherwise required by fire regulations or strength, other hatch covers in general to be of sea water resistant aluminium.

Stainless steel dogs and hinges to be used on all hatch covers and outside doors. Doors and hatches according to Class and Authority's Requirements. All hatch covers to be hinged and with locking device in open position. Hatch covers to be with lifting eyes. Hatch coamings in general to comply as per hull scantlings with Class Requirements. Securing arrangement and lifting lugs for covers to comply to Class Requirements. Size of hatches to be according to General Arrangement Plan.

302. Containerised laboratories.

Special provisions to be made for arrangement of four(4) mobile 20 feet containerized laboratories. Mounting system (twist lock sockets) for containerised labs. and all necessary support systems including 230 V AC-50 Hz, , computer network, seawater (from ship fire main system), freshwater, none-contaminated water overboard drain, phone, low pressure air etc. to be arranged. The containerised labs are Owner’s supply. Twist locks to be galvanised and welded on the deck.

304. Smaller hatches, manhole covers

Hatches to store rooms, etc. as shown on the General Arrangement Plan. All emergency hatches and doors to be open-able from both sides with locking arrangements for use in port.

Manholes:
Manholes according to international standard and with light opening 400 x 600mm to be provided for all tanks and voids in the hull. All manholes for tanks to be constructed for easy personnel evacuation. Larger tanks for FO bunker, WB and FW to be provided with two (2) access manholes each, with bolted plate covers. Smaller tanks like service tanks, void tanks and cofferdams to have one (1) access manhole each as principle, additional manholes if required.
Besides all manholes, tanks to be marked with tank number and tank content in accordance to relevant Class and regulations.

Manholes on tanktop in Engine room and Pump room shall have coaming with height approx. 75mm above tanktop. The same are valid for manholes on insulated tanktops and tank bulkheads elsewhere, if applicable.
Manholes on working deck and in cargo hold area shall be recessed flush with deck.
All manholes to be provided with exchangable pin-bolts of normal steel.
All manhole nuts to be of stainless steel. In general, handgrips to be fitted on all manholes, where practicable. If not practicable, threads for removable eyebolt to be provided.

Handgrips also to be fitted above vertical mounted manholes in- and outside of tanks, for easier access.

Emergency exits :
Hatches of approved type to be provided as per regulations and General Arrangement plan. Net openings 700x800 or 800x800 as per requirements. 600mm Coamings to be provided in general. Emergency hatches shall be able to be opened from both sides by one person.

305. Main Hatches

Hatches and bolted panels of approved type to be installed as per General Arrangement and regulations. Main hatches to be hinged and arranged as follows:

Tween Deck and below :	**Type of hatch:**	**Net opening(LxB mm):**
Frame 17-20, Stern thruster room	: Flush, steel hatch.	: 1500 x 1900
Frame 26-29, Propulsion room	: Flush, steel hatch.	: 1900 x 1500
Main deck :		
Frame 17-23, Scientific store ps	: Flush, steel hatch, hydraulic operated.	: 3500 x 3000
Frame 26-29, Scientific store stb	: Flush, steel hatch	
Frame 40-43, Geophysical Lab.	: Flush, aluminium hatch	: 1900 x 1800
Frame 55-58, to Engine room trunk	: Flush, steel hatch.	: 1600 x 1200
1st Deck :		
Frame 118-121, Bow Thruster trunk	: Flush, steel hatch	: 1750 x 1750
2nd Deck :		
Frame 118-121, Dry provision room	: Flush, steel hatch	: 1750 x 1750
3rd Deck :		
Frame 118-121, Anchor winch room	: With coaming, aluminium hatch	: 1750 x 1750

All hatches where applicable to be arranged with seawater resistant rubber packing and sufficient number of cleats. Hinges and eye-/ring bolts to be of marine type with stainless steel pins, stainless steel/bronze bushings and grease nipples.

Where applicable the gutter around the hatch cover to be provided with drainpipes in all four corners. Flush hatches to be arranged with flush dogs.

306. Side port

Side port outside Main Hangar stb, frame 55– 63. :
A hydraulic operated port to be installed in the shipside, with a steel roller on top. Length of port to be approx.. 4800 mm. Port to be integrated with the fixed deck railing. Roller to be mounted off centre of the gate in order to keep wire/ropes clear of shipside.

The port to be heavy built as a pontoon-construction of steel, with support guides made of polyamide at each end. Vertical movement by two (2) hydraulic cylinders. Bearings and movable parts in hydraulic cylinders to be of stainless steel and of necessary dimensions. Cylinder outer body to be galvanised.
Port to be controlled from aft console Wheelhouse and locally at the gate.

One (1) off horizontally mounted roller to be installed on top of stern port.
Diameter approx. 400mm, length approx. 4800mm, made of thick walled steel pipes. Bearings in each end of the roller with stub shaft of acid resistant steel in spherical roller bearings. Supporting rollers of stainless steel to be installed below the stern roller.

307. Cargo ports

Main Hangar port, stb :
A marine type roller-port of seawater resistant aluminium to be arranged.
Port to be electrically operated.

Size of port to be of approx. Width x Height : 5400 x 7600 mm(opening).

Port opening to be flush with maindeck(no sill). Port to enter into a channel recessed into maindeck when parked/locked. Channel to be arranged with drainage.

Main Hangar port, aft :
A marine type roller-port of seawater resistant aluminium to be arranged.
Port to be electrically operated.

Size of port to be of approx. Width x Height : 4300 x 4800 mm(opening).

Port opening to be flush with maindeck(no sill). Port to enter into a channel recessed into deck when locked. Channel to be arranged with drainage.

CTD Hangar port :
The CTD hangar port to be of side-hinged type, water-tight and made of steel. Size of gate to be approx. Width x Height : 3200 x 5200 mm(opening). Gate to be hinged in front and be able to open abt. 120 deg. Gate to be hydraulically operated with local control and hydraulically locking mechanism in open position.

Side-port in stb. Bulwark :
A two-folded hinged port to be arranged in stb. Bulwark at Maindeck as indicated on GA plan. Port to be made of steel, manually operated with locking device in both locked and opened position. Ports to be opened 180 deg. and parked in parallel to the bulwark. Cut-out in bulwark, deck and sides to be arranged with curvature in order to protect deployed cables and wires.

309. Hydraulic system for cranes and davits

Hydraulic system for winches (not being el. operated), A-frames, davits, cranes, ports, gates, hatches etc. to be built as a closed loop system and in accordance with advice from the final selected manufacturers. Capacity of plant to be calculated by Maker and approved by Owner.

Hydraulic Pumps
Min. two el. driven main hydraulic pumps to be fitted. The pumps to be cross connected and flexible mounted.
One filter-separator to be provided for continuous cleaning and water separation of the HP-hydraulic system.
Start and stop of pumps to be arranged from wheelhouse, from hangars, from ROV Control room, locally, and other places where necessary. Pumps to be arranged with frequency control and load sensing system.

One el. driven hydraulic oil transfer pump with capacity 1m³/h to be fitted.

Hydraulic Piping in General
Ermeto EO stainless steel pipes of type AlSl 316L and fittings of 316L stainless with stainless steel progressive snit ring to be used.

Clamps to be of type UCC with steel frame with soft rubber profile. To achieve oil-flow speed as recommended for low noise, pipes to be run in parallel where necessary.
Exact position of the hydraulic pipes and control valves to be agreed upon with Owners representative.

Oil Heat Exchangers
All hydraulic oil tanks to be equipped with self-contained thermostatic oil heat exchangers, level glasses, thermometers and level/temperature alarms/shut downs.

Noise Precautions
Particular care to be given to reduce the noise levels from hydraulic systems at the source, and where piping conducts noise through the vessel. For any hydraulic equipment, acoustic attenuators to be required in all systems.
With COMF Class in mind, noise reduction to be cared for, elastic mountings to be used for the hydraulic systems.

System to supply following equipment ;

- A-frame on stern.
- A-Frame in Main Hangar
- Side-port outside Main Hangar stb.
- Locking cylinders for drop keels
- Mooring capstans
- Hydraulic hatches
- Deck cranes aft and amidship.

Deck crane (provision crane forward) will have its own power pack.

32 SPECIAL HANDLING EQUIPMENT

320. Lifting lugs, pad-eyes, etc.

Certified lifting lugs to be fitted above all main machinery components, deck machinery, etc. where required for normal service and maintenance. SWL to correspond with the relevant equipment.

Pad-eyes, hooks, etc. to be arranged in stores, on deck, in hangars, all as required for the ship's operation and service.

A number of 30 pad eyes to be installed in hangars and on external deck areas. Lifting lugs to be certified for 1, 3 and 5 tons. Engine room and other technical rooms to be fitted with a total of about 30 pad-eyes.

Both inside the hangar, on external part of deck, scientific equipment stores and store for heavy scientific equipment, lashing points for containers and other loose equipment to be installed for easy operation.

ISO-standard twist lock sockets to be integrated into the deck structure where stowage of containers are intended as per General Arrangement plan. All necessary reinforcements to be fitted. Elephant foot or special fastening attachment to be fitted where needed.

Inside the Main hangar T-bars to be welded to deck. Bars to be well supported and used for securing wooden deck covering.

321. Cargo lifts

A small electric cargo lift to be arranged between Tween deck and Main deck in Main Hangar area as shown on GA plan. Lift to be used for transport of scientific samples, spares and other equipment. Lift to have a size of 1000 x 800 mm, and a SWL of 500 kg. Lift to be arranged with automated operation system, safety system(restricted operation without closing of doors, etc.).

323. Travelling cranes in cargo holds/hangars

Main Hangar(L13) :
A crane-beam with an electric travelling winch to be arranged in Main Hangar below 2nd deck as shown on General Arrangement Plan.

Beam length/winch operation area	: abt. 13 m.
Winch SWL	: 3 tons
Dynamic factor	: 1,8

Portable winch control for both travelling and hoist function to be arranged.
Beam and winch to be load tested and certified by Class.

Scientific Store(L19):
A crane-beam with an electric travelling winch to be arranged in Scientific Store, underneath Main Deck as shown on General Arrangement Plan.

Beam length/winch operation area	: abt. 9 m including 90 deg bend.
Winch SWL	: 3 tons
Dynamic factor	: 1,8

Portable winch control for both travelling and hoist function to be arranged.
Beam and winch to be load tested and certified by Class.

33. DECK CRANES

331. Deck cranes

Four(4) marine deck cranes for handling of research/scientific equipment, stores and provision to be installed as shown on the General Arrangement Plan.

General design criteria for Cranes, A-frames and Systems :
Cranes to be designed according to Class' regulations for Lifting Appliances.

All cranes to be designed for operation in-sea. Cranes to be designed for sea-state 3. Required dynamic load to be in addition to specified loads. Cranes to be designed for 3° trim and 6° list at full load.

Heating to be arranged for motors and manoeuvre valves for all cranes.

All crane blocks to be designed for both "compact wire" and "common wire".
Filter separator to be provided for each crane in order to obtain continuous cleaning of the HP-hydraulic systems.

Cranes to be arranged with local control from local platform, and by radio remote controls. One(1) off spare radio remote control panel to be delivered for each crane.

The cranes to be fitted with load indicators.

All cranes to be equipped with overload control for hydraulic cylinders, turning gear and winches.

Parking cradles for cranes to be arranged.

Hydraulic cylinders ;
Cranes to be equipped with cylinders especially made for marine use. Cylinders to have spherical bronze bearings at both ends. Piston rods to be off acid resistant stainless steel chrome plated quality.

Pipes and fittings :
Pipes and fittings to be made of acid resistant stainless steel AISI 316 L.

Power packs :

Cranes on aft deck to be connected to common hydraulic power pack. Crane on foredeck to be equipped with separate hydraulic power pack.
Electric motors min. to have protection class IP 55. Winding insulation class min. F. Electric motors to be arranged with heating elements. Motors to be 690 V, 50 Hz.

Material protection :
Cranes to be sandblasted to SA 2,5 and metallized to 100 microns. Further painting according to Paint Specification, item 27.

Crane no. 1 and 2 – Gantry – stb and ps stern
Deck Handling Cranes with elbow derrick.

Main technical data to correspond with following specification :

Lifting capacity	:	2,0 tons SWL
Max. working radius(wire)	:	12 m
Min. working radius	:	2,0 m
Hoisting speed	:	0-30 m/min.
Revolving speed	:	1 rpm/min.
Slewing sector	:	360 deg.
Winch capacity	:	2,0 tons SWL/20 m wire.

Swivel mounted with shackle for easy removal/installation and with hose & quick connection of hydraulic power.

Crane no. 3 – pos. 1st Deck, stb amidship
Deck Handling Crane with elbow derrick.

Main technical data to correspond with following specification :

Lifting capacity	:	10 tons SWL
Max. working radius(wire)	:	16,8 m
Min. working radius	:	2,80 m
Hoisting speed	:	0-30/60m/min.(1/2 speed)
Revolving speed	:	1 rpm/min.
Slewing sector	:	360 deg.
Winch capacity	:	10 tons SWL/60 m wire.

Crane no. 4 – pos. 3rd Deck, stb at bow
Deck Handling Crane with telescopic elbow derrick(similar to crane no. 1 and 2).

Main technical data to correspond with following specification :

Lifting capacity	:	2,0 tons SWL
Max. working radius(wire)	:	12 m
Min. working radius	:	2,0 m
Hoisting speed	:	0-30 m/min.
Revolving speed	:	1 rpm/min.
Slewing sector	:	360 deg.
Winch capacity	:	2,0 tons SWL/20 m wire.

334. Scientific Davits/Frames

General

- General design criteria, see item 331
- Frames to be arranged with radio remote controls as well as local manual controls.

- All hydraulic fittings, internal piping and hose ends to be Stainless Steel

- All bolts/shafts on drum brakes and joints (on the winches and handling equipment) to be Stainless Steel – this also applies to all cylinder piston rods.

- In addition to the handling equipments listed here, the Builder is to ensure that each of the scientific equipment that need to be deployed/recovered in sea should have adequate deployment / recovery systems and gadgets for safe operations.

Main A-frame at stern

One (1) off hydraulic operated A-frame to be installed above slipway in stern.
A-frame to be used for deployment of scientific equipment over stern and towing of equipment from dedicated winches on aft-deck over blocks suspended in the A-frame.
Frame to be operable between 90 deg. aftwards to abt. 45 deg. forward. Frame to have two aux. winches with block arrangement as indicated on GA plan.

- SWL to be 50 tons in any position.
- Horizontal operating range, from aft to forward position abt. 11,5 m.
- Operating height from deck to block support in upper position abt. 9,5 m.
- Width between legs abt. 6,5 m.
- Aux. winch capacity: 3 tons, 30m wire.
- Three (3) off eye pad for attaching wire/cable blocks for scientific use.

Frame to be connected to the common hydraulic system.

Main hangar telescopic A-Frame

One (1) off hydraulic operated telescopic A-frame to be installed on Main Deck inside Main hangar as shown on GA plan. Frame to be arranged with tilt-function and be operable from horizontal position in-wards to a position abt. 10 deg. above horizontal in out-ward position. Frame to have one aux. winch as indicated on GA plan.

- SWL to be 15 tons in any position with telescope fully retracted.
- SWL to be 10 tons in any position with the telescope fully extended.
- Telescopic range abt. 1,8 m.
- Horizontal operating range, from inward to outward position abt. 12-15,6 m(telescopic).
- Frame to be arranged for maximum lifting height within the hangar. Frame control system to be arranged with system that automatically adjust the height of the frame when entering into the hangar(avoid collision with top deck structure).
- Aux. winch capacity: 10 tons, 30m wire.
- Three (3) off eye pad for attaching wire/cable blocks for scientific use.

Frame to be connected to the common hydraulic system.

CTD hangar Frame
One (1) off hydraulic operated frame with elbow derrick to be installed on Main Deck inside CTD hangar as shown on GA plan. Frame to be operable from horizontal position out-wards to a position in-board as required for reaching CTD parking position(as indicated on GA plan). Block support in outer position to be as close to sea as possible, min. at CTD-hangar deck level.

- SWL to be 8 tons in any position.
- Operating outreach out of shipside approx. 3,4 m.

Frame to be connected to the common hydraulic system.

Seismic Towing Booms
A mechanically operated hinged towing boom to be arranged at Main deck level in the stern, on each side of the ship. Booms to be approx. 5 m long and arranged with a U-shaped pipe with top locking device(se GA plan) for towing(cable to run through the U-shaped pipe) of the outer umbilical cables(ref. item 487-Seismic Arrangement). Booms to be dimensioned for the operating forces resulting from the Seismic Arrangement prepared by the Builder.

Boom to be arranged with adequate locking device in open and parked position.

Corer Handling System(CHS)
The vessel to be arranged with a Corer Handling System designed to assemble/deploy/retrieve a piston corer of up to 30 m in length.
The CHS to allow for assembly of the corer with penetration weight onboard, to bring it overboard, to rotate it into vertical position, ready for deployment by use of the dedicated corer winch and side hangar A-frame. After operation the CHS to shall bring the assembly back into horizontal position before bringing it onboard again.

The CHS to be arranged on maindeck along with stb side bulwark as shown on GA plan.
The system to hydraulically operated, connected to the common hydraulic system.

The CHS typically to consist of following :
- One hydraulic corer platform with main hinge for handling of corer weight
- Three or more pivoting cradles with hydraulic winch
- One control block valve
- Removable bulwark may be considered taking operational convenience vs safety.

The hydraulic, hinged platform to be arranged with quick coupling for easy dismantling when system is not in use.

Complete system to be supplied from reputed manufacturer, see Annex 7 – Maker's List

Handling system for Magnetometer and Side-scan sonar
The Magnetometer and the Side-scan sonar are to be operated by the respective winches described in Annex 4, item 7 and 8.
The Builder to prepare for Owner's approval an arrangement for towing of the Magnetometer and the Side-scan sonar over the stern by use of suitable block and frames.
The Builder also to arrange for safe installation of the portable winches, either by use of container supports or dedicated permanent installed foundations, all according to class requirements.

Platform for other scientific handlings:

The Builder is to design and install extension / foldable platform (for 2 persons) on main deck, preferred location stern side and starboard side, for deployment of Argo floats / drifter/ uCTD and etc (though not indicated in the GA).

34. MASTS, DERRICK POSTS, RIGGING AND WINCHES

341. Masts, derrick posts

Radar mast :
The radar mast on wheelhouse to be made of aluminium and to be designed and arranged as required for the specified equipment.
Mats to include a "Crow's Nest"(CN), arranged for 2 persons. CN to be arranged with windows for 360 deg. view, with sun-protected glass, open-able windows for ventilation, etc. Foldable chairs for two persons to be arranged.

Deck house with bow mast and platform:

A deckhouse with bow mast and platform to be arranged in center bow area on 3rd deck as shown at GA plan. This deck house/mast will contain required navigation lights, stair entrance from 2nd deck and stairs up to the platform.

4. SHIP EQUIPMENT

40. MANOEUVRING MACHINERY AND EQUIPMENT

401. Rudder with welded parts

The vessel to be equipped with 2 high lift spade flap rudders, certified according to Class notation and regulations. Rudder to be optimized for low noise signature, as a minimum as follows:

- Well developed hydrodynamic shape, including rounded lower leading edge.
- Bearings in rudder stock to be of low noise type.
- Rudder carrier bearing to be of low noise type.
- Flap mechanism to be of low noise type.

402. Rudder carriers, rudder stock, rudder bearing

Watertight seals to be provided in boss and below steering gears. Dismantling eye plates to be fitted under stern. Details of rudder, rudder shaft, bearings and seals to be specially considered with respect to noise requirements.

403. Steering gears, rudder indicators

The steering gears to be of vane type electro-hydraulic driven by 2 pumps each. Size to suit the rudder and class of vessel. To be delivered complete with starter cabinets, alarm cabinets in steering gear room and on Wheelhouse. Pumps to be arranged with load-sensing system. Special low-noise pumps with frequency controlled electric motors to be delivered.

Number of steering positions in wheelhouse shall be 4. One each side, one in centre Forward and one in aft end.

Allow for each pump to be selected individually, and both together for quicker movement.

One panorama indicator plus 3 smaller units, to be installed in wheelhouse.
Emergency steering to be arranged in steering gear room with telephone connection to wheelhouse according to Class.

Gyro repeater, to be fitted in steering gear compartment.

Rudders to be interfaced to the DP contr.

404. Thrusters

The vessel to be arranged with:
- one retractable azimuth-thruster in bow
- one super-silent tunnel thruster in the bow
- one tunnel thruster in the stern.

Forward tunnel thrusters to be of super-silent low-noise type with double tunnel arrangement. Aft tunnel thruster to be of single tunnel type, optimized for low noise operation.

Azimuth thruster in bow :

Thruster to meet following requirements:

Type	Vertical thruster with motor on top.
Estimated thrust, static	147 kN
Voltage	690 V, AC 50Hz
Power abt.	830 kW based on DP duty, max 880 kW
Propeller speed, abt.	0-360 rpm.
Propeller diameter, abt.	1650 mm.
Pitch	Controllable pitch
Cooling	Freshwater cooling
Enclosure AC motor	IP 54

Frequency converter:

Drive	:	AFE drive
Voltage	:	3 x AC 690 V 50Hz
Cooling	:	FW cooling
Enclosure	:	IP44

To be located in the applicable transformer/ switchboard room on tween deck.

Bow tunnel thruster:

Thruster to meet following requirements :

Type:	Super-silent, double tunnel type
Estimated thrust, static	114 kN
Voltage/Frequency	3 x 690 V AC, 50 Hz.
Power, abt.	830 kW based on DP duty.
Propeller speed, abt.	0-300 r.p.m.
Propeller diameter, abt.	1750 mm.
Pitch	Controllable pitch
Cooling	Fresh water cooling
Enclosure AC motor:	IP 54

Frequency converter:

Drive	:	AFE drive
Voltage	:	3 x AC 690 V 50Hz
Cooling	:	FW cooling
Enclosure	:	IP44

To be located in the applicable transformer/ switchboard room on tween deck.

Stern tunnel thruster

Thruster to meet following requirements :

Type:	Single tunnel, low noise type

Estimated thrust, static	103 kN
Voltage/Frequency	3 x 690 V AC, 50 Hz.
Power, abt.	750 kW based on DP duty.
Propeller speed, abt.	0-364 r.p.m.
Propeller diameter, abt.	1750 mm.
Pitch	Controllable pitch
Cooling	Fresh water cooling
Enclosure AC motor:	IP 54

Frequency converter:

Drive	:	AFE drive
Voltage	:	3 x AC 690 V 50Hz
Cooling	:	FW cooling
Enclosure	:	IP44

To be located in the applicable transformer/ switchboard room on tween deck.

All motors to be equipped with:

- Winding temperature sensors/thermistors (3 off)
- Anti-condensation heater

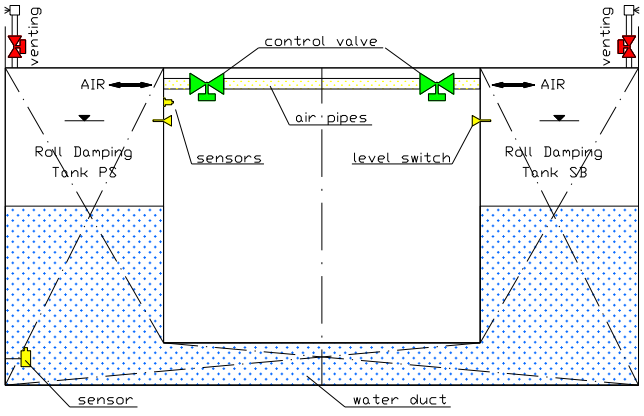
Thrusters to be controllable from 4 positions, Wheelhouse forward, aft and wings stbd. and port side. Control of thrusters to be variable / proportional and allow for any percentage of thrust to be left on. (i.e. not spring loaded lever operation).

405. Anti-rolling tank, stability control

The vessel to be arranged with an anti-rolling system according to below principal sketch.

The anti-rolling system featured by:

- U-shape tank system
- air duct system in upper part tanks
- installation of remote opera valves in air duct system
- fully automatic control system tank damping modulation
- continuous tank pressure a level monitoring



The anti-rolling system is based on a U-shape tank filled with seawater. Energised by roll movement of ship water is oscillating in the U-shape tank which is counteracting the rolling motion of the vessel. The system needs for functionality a minimum ship roll motion of approx. 1-1.5 degree.

The system is equipped with measuring devices to determine the tank water oscillation as well fluid level and pressure inside tank. All data are indicated on touch screen of control unit.

The side tanks are connected in upper part with air pipes for air exchange during operation. The air pipes are equipped with pneumatically driven butterfly valves. The valves are used to influence the water oscillation during operation and to close the air pipe system to prevent uncontrolled water flow when the system is not in operation.

- Max Air Consumption: 0,8 m³n/h; 8 bar
- Electric Power consumption: <1,5 kW
- roll damping tank system is designed for a natural oscillation period of approx 11,6 seconds
- side tanks are connected in upper part by an air duct system for air exchange during operation
- the air duct system is equipped with control valves of size DN 300
  - AR-TK: 4x pipe DN 300 with 2 valves per pipe
- tank venting pipes are equipped with valves for system function; valves are normally closed
- all valves are pneumatic operated --- connection to valve control cabinets by flexible cable HOCAB for pneumatic and electric connection
- average roll reduction performance of 35% to 50% in beam sea resonance condition is achievable depending on ship loading condition and wave height.

System to include :

1 pc Main Control Unit – Anti-rolling System for installation in ECR with:
- Anti-Rolling control unit with AR-HOMIP
- 10,4" touch screen for operation and visualisation

1 pc Wheelhouse Panel
- for installation in wheelhouse
- 10,4" touch screen for system information
- with buttons for operation and data indication

1 pc Valve Control Cabinet
- installation close to valves
- with electronic parts for valve control and sensor data processing
- solenoid valves of pneumatic operated valve actuators
- Voltage: 230 V / 50Hz

1 set Tank Sensors for Roll Damping Tanks
- for system control, continuous tank level indication, alarm, consisting of:
- 1 pc Tank Sensor, installation outside tanks,
- 1 pc Tank Sensor, installation inside tanks,
- 2 pc Level switches for Detection of High Water Level

408. Dynamic Positioning Systems

A dual redundant dynamic positioning system designed for all DP applications with the full range of functionality to be installed. System to be modular and use common building blocks for high flexibility, for future upgrades. The system to be designed to satisfy class notations equivalent to Dynamic Positioning Class 2 and specified class notation.

System to consist of a dual redundant controller unit and two operator stations. The controller unit to contain two powerful control computers and I/O units to provide an interface to position-reference systems, sensors and various types of propellers, thrusters and rudders. The operator stations each to contain a high-performance computer running

Microsoft Windows. High-resolution colour flat-screens, approved for maritime operations, provide the main graphic displays for presentation of data.

System to include :

Two (2)

K-Pos OS Operator Station – Built-in

- Joystick (3-axis) control
- Heading wheel
- Trackball
- Buttons and status lamps
- Colour display (24" LCD)
- Colour display (27" LCD)
- Type approved Microsoft Windows marine computer
- Dual LAN interface
- cWing Terminal interface (CAN)

One (1)

K-Pos DPC-2 Dual Redundant Controller Unit

- Dual real time processor
- General purpose analogue inputs and outputs with field termination
- General purpose digital inputs and outputs with field termination
- Isolated analogue inputs for thruster feedback with field termination
- Isolated analogue outputs for thruster commands with field termination
- Isolated serial inputs
- Dual LAN interface
- Dual power supply

Operational modes :

Joystick Mode

Manual positioning using the three-axis joystick (integrated joystick and rotate controller)

- Joystick Thrust Selection (Reduced, Full)
- Joystick Precision Selection (General, High-Speed, Low-Speed)
- Environmental Force Compensation
- Rotation Center for Joystick Manoeuvring

Mixed Joystick / Auto Mode

Enabling the operator to select any of the three degrees of vessel movements (Surge, Sway and Yaw), as manual and/or auto control.

This means that the operator can select automatic control of Sway and Yaw and manual control of Surge, or any other combination.

Auto Heading Mode

Accurate control of selected vessel heading.

- Present Heading
- Change Heading (Marked Heading, Change Heading Absolute, Previous Heading, Change Heading Incremental, Heading Wheel with Buttons Dec Set and Inc)
- Minimum Power Heading
- Set ROT
- Set ROT Acceleration

- Predefined Controller Gain Selection
- Heading Warning and Alarm

Auto Position Mode

Station keeping with control of selected vessel heading and position. The functions available for heading control are described under the Auto Heading Mode.

- Present Position
- Change Position (Marked Position, Change Position Absolute, Previous Position, Change Position Incremental, Change Position Range / Bearing)
- Set Speed
- Set Acceleration
- Position Warning and Alarm
- Predefined Controller Gain Selection
- Rotation Centre

Follow Target Mode

Automatic following a moving target, keeping the vessel within a "position window".

- Present Heading
- Change Heading
- Minimum Power Heading
- Change Reaction Circle
- Change Distance to Target
- Predefined Controller Gain Selection
- Rotation Centre

Auto Track (low-speed) Mode (for marine operations)

Track keeping in low speeds with DP control strategy.

Speed control:

- Automatic speed control (Waypoint Table, Operator Set)
- Manual speed control (Joystick)

Heading functions:

- Present Heading
- Change Heading
- System Selected Heading (Waypoint Table, Towards Waypoint, Minimum Power, Along Arc)
- Change Crab Angle (Set Crab Angle, Change Crab Angle by Heading Wheel with Buttons Dec, Set and Inc)
- Set ROT
- Set ROT Acceleration
- Manual Heading Control

Waypoint passing functions:

- Slowing down at each Waypoint
- Passing the Waypoint at a Constant Speed

  When passing the waypoint at a constant speed, the turn radius can be:
  - obtained from the waypoint table for each waypoint
  - specified online by the operator (common for all waypoints)
  - calculated automatically according to the vessel speed and requested ROT
- Wheel-Over Point Warning

- Stop at Last Waypoint
- Stop On Track
- Track Direction
- Leg Offsetting
- Cross-Track Warning and Alarm
- Predefined Controller Gain Selection
- Rotation Centre

Sensors :

Three (3)

Wind Sensors

- Stainless steel
- Wind Speed and Direction Sensor
- Wind Speed and Direction Indicator
- Junction box with 2m cable
- Serial line output
- Heating

Three (3)

Motion Reference Units

- Pitch, Roll and Heave sensor
- Mounting Bracket
- Serial and Analogue output
- Junction Box incl. Cable

Reference system ;

The vessel to be arranged with the required reference system. This to include :

1 x Differential Position System, with cabinet

- GPS L1/L2 + GLONASS L1/L2 + SBAS receiver
- Reception of multiple differential signals

1 x Acoustic positioning system retractable , gate valve, etc.

System further to include :

- A matrix printer
- An UPS, 3 kVA

System interfaces :

The vessel's DP system to include interfaces to following :

Three (3) Gyro Compass
Three (3) MRU
Three (3) Wind
Two (2) DGPS
One (1) Acoustic Positioning system.

41. NAVIGATION AND SEARCHING EQUIPMENT

410. General

The vessel to be arranged with an Integrated Bridge System (IBS) with IMO MSC 982 Ergonomic Criteria for Bridge equipment and layout. Final layout of Wheelhouse and consoles to be discussed and approved by owner. Layout and arrangement will include equipment and monitors from scientific echo sounders, sonar and others equipment to be integrated in Wheelhouse forward and aft according to owners approval. (also some description SFI 542)
The Navigation system shall comply with IBS, according to Colreg, SOLAS and IMO requirements

The IBS to be equipped with the followings subsystems (see 411 and 412):

- Radars System
- ECDIS System, and a separate Electronic charting system
- Automatic Identification System (AIS)
- Navigation Echosounder
- Electromagnetic Speed Log
- Gyro and Attitude Reference System
- DGPS system
- Auto Pilot
- Automatic Meteorological Station
- Voyage Data Recorder (VDR) System
- IBS Network
- Wheelhouse consoles
- Standard Magnetic Compass as per SOLAS.

411. Radars System

Navigation Radars

General
The radars system to meet IMO requirement. It shall have automatic plotting capability, ARPA system, tracking at least 20 targets and interfaced with VDR, Speed log, AIS, Gyro, ECDIS and DGPS. Radars to have inter switch between X band and S band radars, Slave radar at aft console and UPS for all radars.

The following radar set to be fitted:
1 off S band 30kW Radar. Output peak power to be 30kW with 12’ antenna.
1 off X band 25kW Chart Radar. Output peak power to be 25 kW with 8’ antenna.

Both Radar sets to allow for interface with either chart plotters.
Both radar systems shall provide for interface with ECDIS and superimposition of parts of the ENC(SENC) database and the voyage plan on the display.

3 off 23” day light color display with control panel, located two in main console in Wheelhouse and one in aft Wheelhouse.

412. Navigational system

The following navigation systems to be installed:

ECDISC and Chart System

1 off ECDISC / Master NAV Station, 23" conning display with approved Processor, software and necessary interfaces located in main console Wheelhouse.
1 off Conning Station / ECDIS Back-Up, 23" conning display with approved Processor, software and necessary interfaces located in main console Wheelhouse.
1 off Planning Station / ECDISC Back-Up, 23" conning display with approved Processor, software and necessary interfaces located in Acoustic centre room.

UPS for ECDIS are to be included.

A separate Electronic Charting system with maps to be supplied in addition to the ECDIS. System to be suitable for bottom-mapping etc. The system to be of best quality, compatible with the rest of the Owner's fleet.

Two(2) off flat screen monitors, one fwd and one aft on Wheelhouse. In addition to this, the display is also to be interfaced to LAN network which could be seen at any networked terminal onboard.

System to have display on monitors/screens throughout the vessel.
System to be approved by Owner.

Automatic Identification System (AIS)

1 off Class "A" Automatic Identification System with following characteristics:

- Interfaced with radars,ECDISC and GMDSS equipments according to IMO requirements
- To process information for 100 targets
- Panel control located in main console Wheelhouse

Long Range Identification and Tracking System (LRIT)

A LRIT system (satellite based) in accordance with IMO MSC.202(81) and SOLAS ChV/19-1 requirements to be installed.

Navigation Echosounder

1 off Navigation Echosounder approved by Class, located in main Wheelhouse console. Two nos transducers to be provided in fwd and aft of the vessel, able to be removed at sea for maintenance by providing gate valves for isolation.

Electromagnetic Speed Log

1 off electromagnetic speed log with the following characteristics:

- Providing speed over ground in both longitudinal and transvers direction
- Speed sensor shall be flash mounting
- Measuring up 16 knot
- 0.1 knot accuracy
- Outputs: 20 x NMEA 0183 RS 422, 6 x NMEA 0183 TTL, 2 x 100 pulses/nm, 1 x current or voltage (programmable)

- Display located in main console Wheelhouse
- Sensor to be able to be removed at sea for maintenance.

Display located in main Wheelhouse console, aft Wheelhouse console, stb and ps wing.

Attitude Reference System

2 off Attitude reference system with the following characteristics:

- The sensor units shall be optic fiber and free maintenance
- The sensor units shall be give position and rate motion information in three axis
- The sensor units shall be work in parallel, one as master and other as back-Up
- The motion accuracy shall be according to acoustic sensors requirement (Yaw, Pitch and Roll rate)
- The motion rate accuracy shall be according to acoustic sensors requirement (Yaw, Pitch and Roll rate)
- Each Gyro and Attitude Reference System shall be connected to both signal distributor equipment

Signal Distributor for Gyro and Attitude Reference System

2 off signal distributor with the following characteristics:

- Redundant capacity for signal distribution and change over capacity
- Each distributor signal shall be able to support 100% outputs and 10% extra capacity
- The inputs shall be according to the following:
  Gyro and Attitude reference System (2) in all formats
  DGPS (2)
  Electromagnetic speed log
  Steering gear feedback
- The outputs shall be according to the following:
  Digital gyrocompass repeaters – NMEA 0183 – TTL (12)
  Heading and turn rate, pitch, roll, X-Rate and Y-rate – NMEA 0183-RS 422 (2)
  Heading and turn rate, pitch, roll, X-Rate and Y-rate – NMEA-TTL (2)
  Heading and turn rate, pitch, roll,– NMEA 0183-RS 422 Serial Fast Signal (2)
  Heading and turn rate, pitch, roll, X-Rate and Y-rate–NMEA 0183-RS 422 Super Fast Signal (2)
  Outputs for user like Radars, SATCOM, DGPS – 6 steps/grades (2)
  Analogue output (± 10 V, 10 mA max) for X-Rate, Y-Rate – 10V, 10mA (1)
  Analogue output (± 10 V, 10 mA max) for turn rate – 10V, 10mA (1)
  Analogue output (4 to 20 mA) for turn rate (1)
  Serial output compatible for data recorder – RS 422 (1)
  Three contact for alarm system – Power failure, system failure and course out

Gyrocompass and repeaters

The following gyrocompass shall be installed

- Two (2) off Fibre Optic Gyro (FOG) compass, complete, consisting of:
  - Master compass
  - Electronic control and transmission unit with necessary output for radio and navigation equipment and input to MRU.
- 1 off Pelorus with bearing rose, azimuth device column mounted in Wheelhouse
- 4 off repeaters with bearing rose, console mounting in all consoles at Wheelhouse(main, stb, ps, aft.
- 1 off repeater with bearing rose, pedestal mounting in steering gear room
- 1 off Digital repeater at Acoustic centre.

DGPS

2 off DGPS with the following characteristics:

- Receive signal from satellites
- Have display for console mounting
- Have master selector
- Have outputs for external equipments
- Compatible with Z-Max Surveying System of Thales

The DGPS to indicate position and speed data to all systems and Scientifics LAN (NMEA 0183RS 422).
The DGPS to have interface ofr distribute NMEA signals to LAN.

Sound Signal Reception System (SSRS)

An acoustical electronic navigational aid that enables the officer on watch at a "Closed bridge" according to SOLAS, to hear environmental sound signals from other ships or foghorns that are audible outside the ship when standing inside a totally enclosed bridge space.
The system is monitoring, according to requirements, frequencies between 70 and 820 Hz.

Auto Pilot

Full operation control with manual and auto in both forward and aft Wheelhouse console.
Main characteristics:

- Manual and automatic control
- Process the following data: Ship speed, turn rate and ship maneuvering curve
- Capacity to fix limits to the turn rate
- Out course alarm when exceed a fixed value
- Integrated to GPS, DP system and other relevant navigation systems.
- Keep track within "cross track error" as 1 cable maximum (200yds)

Voyage Data Recorder System

The vessel shall be equipped with Voyage Data Recording system according to IMO A.861 requirements IEC 61996 and SOLAS Chap. V. Rule 20. VDR is to include float free capsule alongwith fixed capsule.

1 off Voyage Data recorder system with capacity to register and storage of the following information:

- Navigation data: Time, date, course, speed and geographic position
- Meteorological data
- To export file to external server

Central alarm System

1 off Central Alarm system for Bridge alarms and warnings to be provided according to class requirements.

All safety parameters including the exhaust gas temperature and alarms shall be integrated with the Central alarm and monitoring system.

IBS Network

The IBS network shall be Ethernet Cat 5e (see 423)

IBS Consoles (see also 791)
3 off consoles shall be installed in the Wheelhouse for IBS equipments according to following:

- Main console with 13 sections
- Aft Console with 7 sections
- Overhead console (One)

The lay-out will be approved by owner.

Radio Direction Finder VHF
1 off an integrated radio direction finder will be installed main console.

The ship will be equipped with:
(4) four off binoculars of marine type
(2) two off night vision binoculars and
1 off inclinometer to be mounted in wheelhouse.

414. Underwater equipment, echo sounders, speed logs, etc.

For details and specification of underwater acoustic equipment to be installed, reference is made to Annex 6 – Scientific Instrumentation for Oceanographic Research, Geology and Bathymetry.

DROP KEELS and ARRANGEMENT:
Two retractable drop keels to be fitted, as per GA-Plan, and to be constructed as an all welded steel structure with internal stiffening. Size of each keel to be abt. 3.3 m long x 1.0 m wide x 5.0 m high.

Horizontal section to be hydrodynamically shaped to reduce drag, avoid cavitation and prevent flow separation. Bottom edges to be well rounded to avoid turbulence and cavitation. Surface finish on drop keels base to be as per recommendation for acoustic transducers. The keels to be partly filled with permanent concrete ballast to ensure negative buoyancy.

In order to achieve positive pressure on the transducers surfaces, the bottom of the keel must be tilted forward max. 1.5°. This tilt shall cause the acoustic axis of the transducers pointing max. 1.5° forward relative to the vertical, when the vessel has "normal trim".

One(1) off electrically operated winch of suitable capacity for hoisting of each retractable keel, to be located as per General Arrangement. The lifting mechanism to be capable of fully raising or lowering the drop keel to/from retracted position within 60 seconds. One(1) off remotely operated hydraulic locking cylinder, suitable for locking the keel steplessly in misc. operating and retracted positions to be arranged. Cylinders to be of dimension CD200 ck-ck-250/160x640 RF or equivalent, with stainless cylinder pipe. The cylinder to be supplied from common hydraulic system, ref. item 309. The hydraulic pipes to be of stainless steel, and hydraulic hoses to have stainless steel couplings. One complete set of hydraulic hoses to be delivered.

A forward looking video camera for observing air bubble sweep down to be installed in front, close to the bottom on one of the drop keels. The camera shall be connected by cable to a monitoring system in the Acoustic Lab, with possibilities for video recording.

There shall be a mechanical safety arrangement securing the drop keels from falling out in case of wire or winch failure.
In addition, a mechanical locking system to be arranged for locking of the each keel in service position. System to consist of two hydraulic operated locking beams each arranged with two hydraulic cylinders for sliding the beam into locking-guide-plates on top of the keel.

Master controls for raising, lowering and locking the keels to be provided both on the Wheelhouse and locally. Position/locking indicators are to be provided on the Wheelhouse, in the Acoustic lab(control room) and locally.

The protruding keels shall bring the specified transducers 2.5 – 3 meters below the bottom of the vessel and with sufficient strength for rough weather operation up to 13 knots.

The bottom of the keels to be arranged in removable sections, i.e. Individual plates complete with instruments fitted, as required to suit each research task. All necessary facilities for such bottom equipment to be arranged so that instrumentation can be readily serviced and interchanged when the keel is retracted. The keel shall be hoisted high enough to get the bottom well above the sea surface for easy access to the transducers and interchanging of the removable sections.

The transducer compartments in the keel bottom shall be deep enough to give space for 30 cm sound absorbing material on the top of the transducers and to lead the transducer cables to the tubes through the keel, without stress.

In the side of the drop keels there shall be arranged hatches for inspection of the transducer compartments.

The transducer compartments shall have holes in the top for air to escape and holes in the bottom for draining when the keel are hoisted above the water line.

Between the keels and fixed points on the bulkheads in the moonpool, the transducer cables must be mounted in suitable flexible cable trays.

For the transducer cables, a sufficient number of pipes of adequate dimensions to be fitted. Normally one pipe for each transducer cable.

In addition, for stb keel :
- five (5) off pipes for spare, with dimension ø60 mm shall be included.
- four (4) off pipes for spare, with dimension ø150 mm shall be included.

In addition, for ps keel :
- five (5) off pipes for spare, with dimension ø60 mm shall be included.

Hinged, removable working platforms underneath the drop-keels in service position to be arranged. For operation of the platforms, one hand-held electric operated winch to be delivered to the Owner’s satisfaction.

The final configuration of the drop keels will be decided between the Owner, the Builder, equipment supplier and Designer:

GONDOLA and ARRANGEMENT:

One GONDOLA to be fitted, as per GA-Plan, and to be constructed as an all welded steel structure with internal stiffening. Size of the GONDOLA to be abt. 12 m long x 8 m wide. Height of the construction as abt. 0,6 m.

The GONDOLA to have a continuous center support as well as one additional leg-support on each "wing" of the GONDOLA.

The construction to be hydrodynamically shaped to reduce drag, avoid cavitation and prevent flow separation. Edges to be well rounded to avoid turbulence and cavitation. Surface finish on GONDOLAs base to be as per recommendation for acoustic transducers.

In order to achieve positive pressure on the transducers surfaces, the bottom of the GONDOLAl must be tilted forward max. 1.5°. This tilt shall cause the acoustic axis of the transducers pointing max. 1.5° forward relative to the vertical, when the vessel has "normal trim".

The transducer compartments in the GONDOLA bottom shall be deep enough to give space for 30 cm sound absorbing material on the top of the transducers and to lead the transducer cables to the tubes through the construction and the hull supports, without stress.

The transducer compartments shall have holes in the top for air to escape and holes in the bottom for draining when the keel are hoisted above the water line.

Between the keels and fixed points on the bulkheads in the moonpool, the transducer cables must be mounted in suitable flexible cable trays.

For the transducer cables, a sufficient number of pipes of adequate dimensions to be fitted. Normally one pipe for each transducer cable.

In addition, :
- five (5) off pipes for spare, with dimension ø60 mm shall be included.
- four (4) off pipes for spare, with dimension ø150 mm shall be included.

The final design, construction and arrangement of the GONDOLA to be decided between the Owner, the Builder, equipment supplier and Designer:

416. Video surveillance

One (1) off TV-surveillance system (CCTV), PC-based with central server and operator stations with 23" LCD monitors, touch screen or keyboard operation.
System to comply with IMO ISPS requirements. The CCTV system to have a recording facility.

CCTV Cameras to be installed (at least) as follows:
- One (1) camera in Wheelhouse wing PS to cover ship side and sea area
- One (1) camera in Wheelhouse wing SB to cover ship side and sea area
- Four(4) cameras covering aft and stb side working deck area
- Two (2) cameras in stern with extra zoom covering stern and sea area aft
- Four (4) cameras in Main hangar
- Two (2) cameras in Main Scientific store on Tween deck
- Two (2) cameras at gangway SB(forward and aft)
- One (1) camera in top of mast w/extra zoom

- Four (4) cameras in Engine room
- Two (2) cameras in Propulsion room

(Totally 23 cameras to be installed)
The camera types shall be approved by the Owner.
Exact locations to be agreed with between Builder and Owner.

Cameras to be of robust and solid design, of HD-quality suitable for marine applications. All cameras to be equipped with remote controlled pan-tilt-zoom control and wash/wipe for external cameras. Outdoor cameras are to be of infra red type.

Operating monitors/stations to be installed as follows:

- Three (3) on Wheelhouse
- Four (4) in officers cabins (Captain, Chief Officer, Chief Scientist, Chief Engineer)
- One (1) in Ship's Office
- One (1) in Scientific Data Processing Lab.
- Two (2) in ECR
- One (1) in ISPS desk
- One (1) in CTD hangar. Two (2) in Lounges(Scientist and Officer Lounge, Conference room).
- Five (5) in Laboratories according to Owner's instruction.

(Total 20 operating stations)

Manual and automatic camera selector for each monitor.
Separate IP-address to each camera.
One channel to have Nav/Depth/Met data display, one to have graphical map display of ship's location.
The TV-surveillance system shall be distributed on a parallel network, but it shall be interfaced with the distribution network and the maritime infotainment system.

417. Clocks, facsimile recorders, clinometers, trim and load computer, infrared camera, misc. nautical equipment

Clock of approved type to be installed in:

- Wheelhouse (2).
- Radio Room/Desk (1).

1 each Standard marine clock to be fitted in:

- Engine Control Room.
- Messrooms(2).
- Offices.
- Laboratories
- Scientific Data Processing Lab.(2)
- In ten(10) cabins(defined by Owner)

Time to be distributed via network system.
Different misc (a minimum list, also to be according to regulations with relevant certificates)

- Two (2) of Inclinometer, to be installed in ECR and main Wheelhouse
- Approved load/trim computer, installed in rd room/console - Wheelhouse

- Two(2) off stabilized infrared/night vision cameras to be mounted on wheelhouse top with monitor on the Wheelhouse, in forward Wheelhouse console. The system to be installed with remote control turn/tilt in Wheelhouse, to be used to detect canoes, small wooden boats etc. One of the IR cameras shall be integrated with the navigation system,. (approved by owner).
- Two (2) off binoculars – 7x50 with fixed mounted case
- One off night binocular, hand held type (approved by owner)
- Two (2) off barometer (ships type)
- Thermometers
- Complete chart room: Parallel ruler and others chart equipment/tools
- Complete set of update paper chart (to be discussed with owner)
- Megaphone, fog siren (hand held) etc
- Weather fax receiver
- Compasses

418. Radar, signal observation and antenna mast

Wheelhouse top, radar mast and additional signal mast on wheelhouse top to be arranged and outfitted with necessary foundations and cabling facilities etc. for all electric, electronic and mechanical equipment etc. All items to be mounted in accordance with suppliers recommendations and to be of high ship building standard and in accordance with separate antenna arrangement plan. Mast positions for TV and radio antennas to be arranged (for land and satellite).Ships common antenna and amplifier system to be of marine type.

42. COMMUNICATION EQUIPMENT

All GMDSS radio equipment will comply with and to be certified according to criteria for GMDSS A4.

The Radio Plant (VHF, MF/HF) to be of duplex type. Fixed UHF to be installed in main-, aft-, and DP consoles.

Four (4) off Portable waterproof VHF radios (walkie-talkies) for science team, with re-chargeable batteries & chargers.

421. Radio plant, GMDSS

A VSAT Satellite communication system to be installed comprising of:

- 1 off VSAT Ku/Ka-band parabolic radome antenna, ADU (above deck unit)
- 1 off VSAT 19 inch rack BDU (below deck unit) containing antenna control unit (ACU) and VSAT modem.

Cabling and necessary accessories to be included.

As back-up system :

- 1 off Satellite communication plant, Fleet broadband 500 to be installed.

The external communication capabilities will comply the following task:

- Ship - land – ship communications: Voice and data (Satellite INMARSAT/VSAT and MF/HF)
- Ship – ship communications: Voice and data (UHF, VHF)
- Ship – aircraft communications: Voice (VHF); Voice and data (UHF and HF).

To fulfil the tasks the ship will be equipped with the following equipment:

1 off GMDSS system with the following capabilities and equipments in console:

- Operations in Sea Area A4
- One (1) off Navtex receiver.
- Eight (8) off Portable waterproof VHF radios due to GMDSS A4 requirement. With re-chargeable batteries, chargers and emergency (lithium) batteries.
- Two (2) off Duplex VHF stations with Digital Selective Call (DSC), multi-watch and replay functions, fitted in forward Wheelhouse console. 230V AC power supply with 24V DC emergency supply from the radio telephone station batteries.
- Two (2) off VHF repeaters, one on each Wheelhouse wing manoeuvring station.
- Two (2) off MF/HF SSB duplex radio Telephony Station 250W with Digital Selective Call (DSC) and radio telex to be fitted on the Wheelhouse.
- One (1) off weather fax.
- Two (2) off Satellite communication station, standard C, to fulfil GMDSS A4 requirement, with telex and EGC receiver.
- One (1) off EPIRB Cospas/Sarsat free-float beacon to be fitted at an adequate place.
- One (1) off EPIRB Cospas/Sarsat manual beacon to be fitted at wheelhouse.
- Three (3) off Radar transponders to be fitted at wheelhouse (9GHz).

- Ship Security Alert System (SSAS)
- 1 off SSAS to be installed according to IMO ISPS code

423. LAN/Ethernet system

For specification of the vessel's Scientific LAN/Ethernet system, reference is made to Annex 3 – Computer Network and Data Handling Systems.

A network Category 7, min. 10 GB 500 MHZ STP cabling system to be installed to serve the vessel's Telephone/LAN and Entertainment system. The network to be distributed with RJ45 outlets in all cabins, offices, conference room, lounges, messroom, duty mess, control room, bridge and all laboratories. The network to be connected to the vessels main servers.

The system to be installed from RJ45 patch panels in 19" racks located in a central and dedicated room. Patch Panel for LAN will be in server room.

Final arrangement and distribution details to be worked out by the Builder and approved by the Owner. See SFI 425.

Separated networks of CAT 7 for use for in "operational part" of vessel, covering bridge and relevant cabins. See SFI 883.

424. VHF/UHF telephones

Following equipment to be delivered and fitted:

Eight (8) off Stationary UHF radio communication sets with "TL/BPL" to be delivered with 255 channels and programmed according to Owner`s satisfaction. Shall be installed:

- Three (3) on the Wheelhouse (1 in the DP position, 1 aft and 1 forward Wheelhouse console),
- One (1) in the Scientific Data Processing Lab. 3rd deck.
- One (1) in ECR
- One (1) in CTD Hangar
- One (1) at the ISPS guard desk.

Twelve (12) off portable UHF radio communication sets with selective calling to be delivered, with channels and programs according to Owner`s selection.

425. Communication and entertainment systems

Telephone System
The IP based telephones shall be distributed on network and shall also function as intercom between the stations listed in TS section 892,

Electrical supply: 230 volt, 1 Phase, 50Hz and DC 24 volts. The telephone to have interface with public address system. The telephone system to have automatic call accounting system with computer and printer supplied. Telephone system to be provided in all rooms listed below(ref also TS item 892):

Telephone to be located on:

- Working deck including loud hailer
- Main Hangar
- CTD Hangar
- Steering gear room (w/headset)
- Engine room (w/headset)
- Bow-thruster room (w/headset)
- Hydraulic room (w/headset)
- Other sampling equipment store(L18) (w/headset)
- Scientific store(L17) (w/headset)
- Winch drive room (w/headset)
- Workshops and store etc. (w/headset)
- Harbor generator room (w/headset)
- Transducer connection rooms(L22 and L23) (w/headset)
- Separator room (w/headset)
- Chilled water room (w/headset)
- Sewage treatment room (w/headset)
- Propulsion room (w/headset)

INFOTAINMENT SYSTEM

The infotainment system combines distribution of information throughout the vessel and entertainment like video and music for personnel off-duty. The information can consist of e.g. safety instructions for newly arrived personnel or messages from ship's officers to crew or scientific personnel. The system shall be suitable for maritime usage and be approved by the Owner. Gyro stabilized satellite antenna required.
The infotainment system must have capability to handle the following tasks:

- Public Address system approved by class
- Alarm, general alarm system and public announcements
- Radio distribution
- IP-TV distribution
- Internet communication
- Safety information
- Integration with IP-camera system
- Capacity for future expansions

PA System

The PA system utilize the distribution network to cover all cabins, public areas, corridors and alleyways etc and also to be used for fire- and general alarms.
The system to have the following features:

- Volume control
-
- Priority for essential stations
- Override for essential stations
- PA function divided in groups

Communication between Wheelhouse and engine control room to have preference and to be able to be kept as open communication.

Position, nos. and quality of PA speakers in following public areas to be carefully considered:
- Open deck areas
- Muster and Life raft stations

Cabling for PA system shall be included according to Class requirements.

Sound Powered Telephone system

This SPT system will permit voice communication between two stations by selectable call. This communication system will be in the following stations:

- wheelhouse,
- engine control room
- thruster room
- propulsion room
- steering gear compartment
- captain's cabin
- chief engineer cabin
- fire control station
- emergency generator room

Main station to be in forward Wheelhouse console and will have power supply from 24V DC system.

Visual and audible signals to be on common status light columns with Intercom system, engine alarm, fire alarm, etc.

Talk Back System
Talk Back system to be installed at 8 locations as to be identified by the Owners.

Audio Distribution System
This system will distributed voice communication receiving or transmitting trough the UHF, VHF, HF and SatCom equipments.

The system shall support at least six (6) audio units with his handset.

The locations of the user will be:
- Wheelhouse (2)
- Radio Room (1)
- Captain Cabin (1)
- Acoustic Operation station (1)

427. Light and signal equipment, lanterns, typhoons

Main navigation light control panel:
The panel to be equipped with change-over main switch for two separate power supplies, 230Vac and 230V emergency supply one directly from 230V main switchboard, and one from emergency230V switch board.

Emergency navigation light control panel:
Panel to have supply from Emergency Switchboard.

Both main and emergency lantern panel to have fault alarms with visual and acoustic signals.

Morse and manoeuvre lights to be controlled from the forward Wheelhouse console and aft Wheelhouse console.

"Aldis" signalling lamp to be delivered complete with battery and charger.

Arrangement and system to be in accordance with NMA Requirements.

All lanterns to be approved and to be delivered with certificate.

Typhoon
Typhoon of approved marine type with automatic controller to be fitted in radar mast. The typhoon will have built in heating and push button in fore and aft Wheelhouse console supplied by 24V DC system. Automatic fog signal.

Air pipe of steel with coupling from air system to be easily accessible and protected from freezing and water accumulation. Insulated where necessary.

Bell
One 10" ship bell of chromed brass with name of the vessel engraved to be fitted.

Flags
Standard international code flags, ensigns and international flags to be delivered.
Flag rack/locker to be delivered by the Builder and installed on the Wheelhouse.

Xenon hand lamp
Two standard xenon lamp to be installed

43. ANCHOR, MOORING AND TOWING EQUIPMENT

Anchoring, mooring and towing equipment to be fitted according to Class Requirements for this kind of vessel. Equipment number to be as requested by Class.

Approved class emergency procedure/certificate for "towing" and "be towed" to be delivered. The vessel to be equipped and arranged according to this procedure.

431. Anchors with chain and equipment

Anchor
2 off "short-shank" anchors with swivel shackle type A, fully balanced type, weight according to Class Requirements, to be delivered and arranged in hawse pipes and recessed into the hull so that no part of the anchor will protrude from ships sides. 1 spare anchor to be supplied and fitted.

Anchor chain
2 stud link chain cables according to Class - Steel grade K3.
2 forerunners

432. Windlasses with chain stoppers, rollers

One separate electric driven anchor windlass to be installed on 2nd deck and enclosed in deckhouse as per General Arrangement Plan. Windlass to be arranged with clutch for individual operation of the anchors. Windlass to have individual warping ends for mooring.

Chain stoppers
2 off chain stoppers with roller and lashing screws, for required chain diameter. K3 stud links chain cable to be installed.

Washing down arrangement to be provided, as well as drain from bottom of chain lockers.

434. Capstans, warping and mooring winches

Four(4) off electric vertical capstans to be fitted, two(2) on aft deck and two(2) on 2nd deck forward. Control to be on base at deck level. Drum to have 5 tonnes pull at speed 0 - 30 m/min.

Storage drums for mooring ropes to be arranged, two forward and two aft. In addition, one storage drum forward for storage of emergency towing rope. Size and location as agreed with Owner.

435. Fixed mooring equipment

Mooring bollards and chocks to be arranged according to Panama Canal Regulations and to Owner's satisfaction.

436. Loose mooring equipment

Loose mooring equipment to be arranged according to class requirements, but as a minimum to include : Ropes, mooring equipment incl. 8 fenders of 500mm diameter by 1000 mm length, 1 throwing lines hook, etc. to be delivered. In addition 4 off 80 mm diameter and 120 m long braided mooring ropes of polypropylene to be stored on reels aft. Forward stowing arrangements to be provided.

437. Towing equipment

Towline to be minimum 190 m with corresponding breaking strength of 406 kN, all according to requirements. Towing bollard to be fitted as per General Arrangement Plan.

438. Tarpaulins

Vinyl made tarpaulins to be made for each of the winches on open deck. Easy fastening arrangement to be made.

44. REPAIR/MAINT./CLEAN/WORKSHOP/STORE/OUTFIT, NAME PLATES

441. Machine tools, cutting and welding equipment

An Engine Room Workshop and an Electrical Workshop to be arranged on Tween deck as per G.A. plan according to best practice and in close co-operation with Owner.
Detailed arrangement drawings to be worked out for optimum utilization of the rooms.

Engine Room Workshops to include :

- One (1) off lathe with standard accessories, 150 mm centre height and 1200 mm turning length, equipment for cutting threads, 4-tool cutting steel holder, 1 self-centering chuck, 1 normal chuck, 1 plane wheel.
- One(1) off drilling machine, free standing type with water supply, size min 11/2".
- One (1) off double grinding machine 8".
- One (1) off milling machine.
- One (1) off pipe profile cutting machine.
- One (1) off 6" vice on each work bench.
- One (1) off Welding transformer with remote control and standard equipment, secondary connection on deck and in engine room and 3x20 m welding cable on reel.

- Welding station with welding table to be arranged at a convenient location in the workshop, ventilation see SFI 57.
- 10 off lockers of free standing type with shelves and drawers.
- Necessary shelves, small lockers etc. according to best practice.
- Wall mounted tool boards to be fitted above each work bench.
- Hydraulic press of 15t.
- One (1) off Grinding machine for HSS drills up to 30mm.
- One (1) off Transportable welding transformer, also suitable for TIG welding, incl. gas bottle.
- One (1) off Portable welding machine for aluminium to be delivered, complete and ready for use with necessary equipment, welding helmet with speed glass and two (2) gas bottles, ready for use.
- One (1) off Hydraulic pipe bending machine.
- One (1) off Pneumatic driven Test pump for fuel oil injection nozzles, with adaptors and pipe connections for all chosen diesel engines. Approved shielding to be included to the Owner's satisfaction.
- One (1) off Pneumatic driven pump for main diesel engine`s tightening tool.
- One (1) off Hand driven hydraulic pump and cylinder sets.
- One (1) off Calibrating instrument for temperature sensors.
- One (1) off Calibrating instrument for pressure sensors.
- One (1) off Multimeter.
- One (1) off Clamp-on Ampere meter (500A).
- One (1) off Megger (500/1000V).
- One (1) off Thermal imager.
- One (1) off Clamping tool for hydraulic hoses, mixed collection of hoses and fittings included.
- One (1) off Vacuum pump for refrigeration plants.
- One (1) off Service case for refrigeration plants, mixed collection of fittings to be included.
- One (1) off Electric pipe bender 0-40mm.
- One (1) off Electrical pressing unit for pipe couplings hot & cold water sanitary system. Mixed collection of pipes and fittings included.
- One (1) off Gas welding cabinet complete.
- One (1) off Welding Electrode cabinet complete.
- Two (2) off Automatic halogen detectors.
- One (1) off Electronic Engine peak meter for measuring Max. Pressures on Gen. Sets.
- One (1) off complete gas central on Main Deck aft SB, with outlets in Engine Room, Engine Room Workshop, Deck Workshop, aft Main Deck and Store for Heavy Scientific Equipment Pipes to be made of stainless steel. In addition 100m welding hoses for Acetylene and Oxygen to be delivered.Rooms for six (6) off Oxygen bottles and three (3) off Acetylene bottles to be arranged.
- Two (2) of feeler gauge.
- Two (2) of poker gauge.

Electrical Workshop

- One (1) off work bench with drawers
- One (1) off vice
- Electrical test switch board
- 2 off lockers

Deck Workshop

A Deck Workshop to be arranged on Main deck as per G.A. plan according to best practice and in close co-operation with Owner.
Detailed arrangement drawings to be worked out for optimum utilization of the room.

The Workshop to include :

- Work bench with drawers
- One (1) off 6" vice
- One (1) off wire splice vice approved by Owner
- Necessary shelves, small lockers etc. according to best practice.
- Wall mounted tool board to be fitted above work bench.
- 2 off lockers
- One off double grinding machine 8"

Equipment according to SOPEP plan to be delivered and stored. To be approved by the Owner.

Gas welding equipment :

Gas-welding and burning equipment complete with gas and oxygen hoses of 3x25m on reel to be fitted included complete cutting/welding equipment.

Two independent Central lockers for 3 gas and 6 oxygen bottles to be arranged with the bottles installed in a separate compartment according to authority requirements. Pipe lines to be arranged from the gas central to the engine room, propulsion room, aft deck, hangar and in workshops with necessary stop valves and connections. Pipes to be identified by means of painting in accordance with standard.

442. Engine- and Hand tools

For propulsion machinery, auxiliary engines and separators hand tools are to be delivered according to the Maker's standard delivery, including special tools for removal of pistons, frequency generator, crankshaft deflection indicator and torque setting wrenches for all engine torques.

443. Painting equipment

Paint store to be provided with automatic extraction system when a door is opened.

One (1) off portable HP air-driven spray painting system, complete incl. hoses, pistol, nozzles, etc. to be delivered and stored in the paint store. To be approved by Owner.

444. FW Washing system and Central Vacuum Cleaner

High Pressure Washer

Two (2) off identical FW washing machines of marine type to be installed at a suitable location with 4x30 m hoses on reel and two nozzles each.
Pressure: 150-220bar
Capacity to be sufficient to use two hoses simultaneously.

Fixed connections to be arranged in hangars, on working deck, external decks, engine room, propulsion room and other locations according to Owner's instruction, totally 15 outlets.

One (1) off portable washing system for chemical washing of SW coolers in the engine room to be arranged. System to be with a separate tub with pump.

One (1) off stationary washing machine for cleaning of separator and other machinery parts to be installed.

All piping/fittings/quick release couplings to be stainless steel.
Pipes for HP washing system to be "elastically" clamped with rubber packings. Suitable nos. and position of closing valves to be arranged specially for accommodation.

FW hose down system
In addition to the above, a separate FW hose down system for open decks to be arranged, enabling the crew to FW wash down the vessel externally with a hose system.
A separate pump of about 20m³/h 10bar and a dedicated piping system to be arranged with outlets on all decks from main deck and up, in a manner to cover all areas including Wheelhouse top/masts.
At least one "spring-loaded" hose reel with a hose of about 25-30m at each deck, or as necessary.

Central Vacuum Cleaning System
A hidden central vacuum cleaning system to be fitted covering all accommodation from Wheelhouse to ECR on Tween deck. Nos. of connections to be suitable for easy use of the equipment. Hoses with equipment to be fitted at each deck in the accommodation.

445. Incinerator and Compactor

Garbage Incinerator for wet waste (galley and mess rooms), paper and carton to be installed in location as shown on General Arrangement Plan. Incinerator to have possibility for burning sludge/oily water. Separate buffer tank for sludge to be provided.

One (1) off extra twin display for easy remote supervision of the incinerator to be installed in ECR.

Emergency stop switch to be installed outside the Incinerator room.

For the most economical operation and optimal efficiency of the incinerating plant, one (1) sludge tanks (approx. 400l) to be installed.
Tank to be equipped with heating elements, sludge circulation pump, level switches, necessary thermostats, necessary valves, level gauges and level transmitters connected to the control panels.

446. Outfitting in store rooms and workshops

Workshops to be arranged with shelves, drawers, working benches as per General Arrangement Plan.

In storerooms, shelves, benches etc. and possibilities for stowing stores and spares to be arranged according to the General Arrangement Plan.

Lifting gear and lifting gear runner to be installed in the deck work shop and the two scientific equipment stores.

447. Clamps/racks for spare parts

Clamps and racks for spare parts to be arranged in spare parts store and engine rooms as necessary as per General Arrangement Plan.

45. LIFTING AND TRANSPORT EQUIPMENT FOR MACHINERY COMPONENTS

451. Engine room lift

In general drilled eye plates for lifting and dismantling purposes etc. to be properly welded above heavy components throughout the vessel (above 50 kgs) according to regulations.

452. Travelling cranes and lifting gear in engine room

Aids for lifting heavier components to be arranged above main engines, auxiliaries, generators, motors, bilge pumps, hydraulic pumps, etc.

Above the main engines to be arranged traveller lifting system for pulling pistons, liners, cylinder heads, etc.

All lifting equipment to be tested in place onboard the ship when required by Class.

Lifting gear and lifting gear runner with lockable feature to run above main engines to platform deck in front of engines to be fitted, and to be certified for test load 3 tons.

The following hoisting equipment to be delivered:
- Two (2) off manually operated chain hoists of SWL 3t
- Four (4) off manually operated chain hoists of SWL 1t
- Two (2) off manually operated chain hoists of SWL 0,5t
- Four (4) off electric driven hoists of minimum SWL 1,5t
- Two (2) off Pull-Lift chain lever hoists (750kg x 1,5m)
- Two (2) off Pull-Lift chain lever hoists (500kg x 1,5m)

48. SCIENTIFIC DECK MACHINERY AND EQUIPMENT

482. Deck machinery and equipment for oceanographic/scientific operation

The vessel to be equipped with a modern scientific winch and handling system for oceanographic/scientific operations.

For further information regarding winches and installation, reference is made to Annex 4 – Scientific Winches, Cranes and Frames.

484. Laboratories and Scientific Rooms

The vessel to be equipped with laboratories and scientific rooms as shown on General Arrangement Plan and as required in order to conduct the specified research operations.

For further information regarding laboratories and its outfitting, reference is made to Annex 5 – Laboratories and Scientific Rooms.

All laboratories to have standard fitting facilities / frames for securely installing and sea-fasterning the scientific instruments that shall be brought by scientists for each cruise.

486. Auxiliary Vessel

One (1) off Workboat with davit designed for easy operation, to be supplied and installed by the Builder on PS as indicated on GA plan.

Boat to be of fully planning type with a deep V-bottom and suitable for high speed in adverse weather conditions.
Boat to be designed and manufactured according to latest SOLAS, Class and Authorities rules and regulations to be arranged as indicated on GA-plan.

Further requirements ;

- Capacity, minimum ten(10) persons.
- Length approx. 7.5 m
- Inboard diesel engine, min. 200 HP.
- Waterjet propulsion system.
- Hull and deck built of aluminium, buoyancy material polyurethane foam with reinforced PVC cover and fenders.
- Equipped with console and spray hood made of GRP, self-righting frame with inflation bag and CO2 bottle.
- Single point lifting hook made of galvanized steel, with approved off-load release mechanism.
- Other steel deck fittings made of stainless steel or galvanized steel.
- Self-bailing through transom stern
- Cockpit with remote centre engine- and manoeuvring controls, sheltered type with wind-screen and seating for 2 persons.

Spare parts according to Maker's recommendations for two (2) years normal consumption to be included.

Davit to have capacity for specified weight + 25% margin and be certified for lowering the Auxiliary Vessel with crew. Davit to be delivered fully painted, sandblasted and Zink Epoxy primed.

487. Seismic arrangement

According to item. 101, the vessel to conduct seismic 2D-surveys as part of it's operation.

The survey will be conducted with containerised equipment consisting of following :

- One(1) streamer winch

- Two (2) umbilical winches
- Two (2) gun arrays arranged on individual storage beams

The containerized equipment is Owner's Supply. Suitable container securing arrangement to be made by builder. Equipment to be arranged on maindeck, relevant deck supports and system connections to be arranged by the Builder.

The operation will further use following equipment/systems:

- The stern side-booms, ref. item 334-Scientific davits/frames.
- The built in seismic compressors with high-pressure air system, ref. item 735/736.
- The stern gantry cranes(2)
- The built in HP hydraulic system, ref item 309.
- Required power outlets
- Suitable launch and recovery system for safe airgun operation.

The Builder to prepare and present a complete and detailed arrangement and operation guide for the seismic operation for Owner's approval. Any equipment, supports, system and installations needed to perform the Seismic Operation not included in the Owner's Supplied containerized equipment, or specified in this technical specification (TS) to be included and installed by the Builder.

5. EQUIPMENT FOR CREW AND SCIENTIFIC PERSONNEL

50. LIFESAVING, PROTECTION AND MEDICAL EQUIPMENT

Lifesaving equipment to be according to SOLAS/SPS 2008 and National Maritime Authority's regulations.

In addition, the following to be supplied;
- 2 lifeboats with davits.

All live saving equipment to be of best quality and type to be approved by Owner

501. Life boats with equipment

Life boats:
Two enclosed, self-propelled lifeboats and corresponding davits to be installed, one on either side of the vessel. Each with a capacity to accommodate 100% of the total number of persons onboard. The life boats to fulfil requirements in SOLAS regulations. The starboard side life boat to satisfy IMO requirements for rescue boats.

Fast Rescue Boat/M.O.B. boat:
One approved FRC/MOB boat with davit system to be fitted according to Class requirements. Davit to be delivered fully painted, sandblasted and Zink Epoxy primed.

Boat to be of fully planning type with a deep V-bottom and suitable for high speed in adverse weather conditions.

Boat to be designed and manufactured according to latest SOLAS, Class and Authorities rules and regulations to be arranged as indicated on GA-plan.

Further requirements :
- Capacity, minimum six (6) persons.
- Length approx. 6.0 m
- Outboard engine, 75 HP
- Hull and deck built of aluminium, buoyancy material polyurethane foam with reinforced PVC cover and fenders.
- Equipped with console and spray hood made of GRP, self-righting frame with fixed foam capsize equipment.
- Single point lifting hook made of galvanized steel, with approved off-load release mechanism.
- Other steel deck fittings made of stainless steel or galvanized steel.
- Self-bailing through transom stern
- Cockpit with remote centre engine- and manoeuvring controls and seating for 2 persons.
-

The MOB boat to be equipped with rescue equipment to Owner`s satisfaction. Approved rescue hoop to be included.

Spare parts according to Maker's recommendations for two (2) years normal consumption to be included.

502. Life rafts with equipment

Free-fall life rafts of approved type to be installed on each side of the ship, incl. containers, foundations and lashings. All rafts to be delivered and arranged in such a way that launching is well clear off thrusters and sea outlets, according to Class-approved plans.

503. Lifesaving, safety and emergency equipment

To be arranged according to Class Requirements for such vessels.

Man overboard system
A man overboard (MOB) system are to be installed, provided with manual push buttons at suitable working areas where risk for man overboard situations, in addition to aft and forward on Wheelhouse. To be connected to the Vessel's general alarm system and interfaced with Vessel's position reference system.
Four (4) off person locators for use in MOB boat and working boat to be included.

Escape breathing apparatus
Approx. twenty (20) off Emergency Escape Breathing Apparatus to be installed to the Owner's satisfaction. To be of modern design, min. 15 minutes duty time.

504 Medical, first aid and dental equipment, medicines

Hospital :
A hospital to be arranged on 1st deck as shown on GA plan. The hospital to be arranged and equipped according to Authority requirements and normal standards for this type of vessel.

One CD showing first aid care and the use of different medical equipment to be provided.

Separate wall mounted 42" TV LED monitor to be arranged.

Medical cabinets with integrated lockable drug compartment and medical refrigerator, with sufficient shelving to arrange drugs and equipment in an orderly and logical manner, to be provided. Consideration should be given to ensure that the cabinet can be accessed in inclement weather; doors can be held open and drawers to be lockable in at least two positions.

One (1) off three-sectional treatment bench, hydraulically adjustable and with side
frames, ship legs and paper-roll holder to be provided.

Software/system to verify the maintenance and control of supplies, logistics and use of medicines and medical equipment to ensure an easy, secure and safe operation of the Hospital to be included. To be installed by the Builder.

Software/system including ECG belt and web camera, for safe transfer of text, picture and sound connected to emergency centre/doctor ashore, to be arranged by the Builder.

The Hospital to have attached WC & bathroom with shower as indicated on GA-plan.
A Hospital alarm system shall be supplied and installed with buzzer and indication light in Galley and on Wheelhouse. Push buttons shall be fitted at each bed and in WC and in bathroom. The buzzer and indication light shall be clearly marked. The system shall be supplied from the Vessel's 24V DC system.

Modern disposal facilities shall be provided for clearance of used medical stores/waste.
Modern medical and resuscitative, which are considered necessary for life/limb saving measures shall be provided to the Owner`s satisfaction.

Medical equipment :
1 Oxygen apparatus
1 Helicopter rescue stretcher.
2 First aid boxes incl. equipment to be placed in damage control parties (Owner's Supply).

Heart starters and training dolls for HLR (Heart and Lung Rescue) to be included.

Unit should be clearly labelled with pictogram signs and Green/white stripes or green lights should identify the location.

The Emergency safety showers to be fitted with manual valves (not self-closing) and shall be capable of delivering at least 114 litres/minute from a water pressure of minimum 30 psi. The shower nozzles to have an internal impeller that gives the water a swirling motion, creating a conical deluge appropriate for the intended use.

Ease of operation. Activation devices must be simple to use and easily accessible, even if the victim has impaired vision. Stay-open ball valves operated either by hand pull, lever or walk-on foot controls shall enable the safety showers to be operated quickly and efficiently delivering a continuous drench for up to 20 minutes, enabling the casualty to remove any contaminated clothing without having to hold on a spring return valve.

First Aid Kits
First aid boxes and eye cleansing water bottles in sufficient numbers shall be provided in working deck areas, galley, each workshop, CTD control room, each laboratory, Wheelhouse, ECR and in each wardrobe.

505. Loose fire-fighting apparatus and equipment for firemen's outfit

Fire extinguishers
Powder, foam, water and CO_2 extinguishers to be delivered according to NMA requirements. The extinguishers to be suspended on hooks and fixed with clamps. All extinguishers to be of approved type, and the location to be approved by Authorities.

Fire hoses with equipment
At each of the fire hydrants, a fire hose with length and diameter according to SOLAS to be arranged. The hoses to be equipped with combined jet nozzles and fog nozzles with pistol grip and coupling connections to the hydrant, size acc. to SOLAS.
One (1) off international coupling to be delivered, complying with the IMO Fire Safety System Code.

Fire axes
Fire axes to be delivered and suspended on bulkheads in accommodation and corridors according to relevant Class and regulations.

Fire-fighters outfits
Minimum two (2) sets of SOLAS approved fire-fighter outfits to be stored on board the Vessel, separated in different lockers, clearly marked.
Smoke diving equipment consisting of three (3) off complete smoke diver sets with six (6) off spare air bottles (composite) to be delivered for each set. Spare bottles to be placed in racks.
Each set to be equipped with superior VHF or UHF handsfree communication sets.

All equipment and locations to be approved by the Owner.

Breathing air compressor for refilling of air bottles to be delivered.

Miscellaneous
The Builder to deliver a simplified poster with safety equipment and escape routes for each cabin. (The poster also to be delivered electronically to the Owner for later changes).

All cabins to be provided with flashlight including battery charger.

506. Personal Protection Equipment

Personal health and safety equipment for the specified number of persons onboard to be arranged as per latest SOLAS regulations, including:

- Helmets

- Ear defenders/Protectors
- Safety boots
- Safety shoes
- Safety glasses

51. INSULATION, PANELS, BULKHEADS, DOORS

All material used for the accommodation such as insulation, furniture, coverings, etc. to be approved by Owner's representatives. Accommodation shall be built according to SOLAS Regulations Fire Class IC. Colours to be decided by Owner's representatives.

In general during selection of insulation, materials and equipment within the accommodation the Builder to carefully secure that the selected insulation, material and/or equipment are in conformity with the Noise Specification enclosed in Annex I to this specification.

A recognized specialist noise consultant to be engaged by the Builder to recommend and evaluate on all information regarding selection of insulation, materials, equipment, methods of installation, methods of insulation, etc. This also to include all relevant drawings supplied by Owner. All recommendations, reports and remarks given by the Noise Consultant to be available for Owner's representative.

All corridors, stairs and wheelhouse to be fitted with handrails according to Owner's representative's selection.

Free deck height (headroom clearance) in general to be 2100 mm in accommodation area. In mess room, lounges and gymnasium 2200 mm, if possible. Area above tread mills and combi trainer to be lifted if necessary and possible. In wheelhouse the ceiling to be 2250 mm, higher if necessary at ceiling consoles.

In laboratories the ceiling height to be minimum 2200 mm or increased to maximum where possible for installation of standard scientific cabinets and racks.

511 Insulation, partition bulkheads, panelling

Surface on all outer corners in corridors to be made of brushed, stainless steel with a radius.
Continuous profiles at top and bottom to be made of stainless steel. Special care to be taken during mounting of the profiles and panels to avoid rattling. Any suspensions /supports to be flexible (resilient) mounted to the beams.

In wet rooms (toilets, showers, wardrobes, laundries etc.) the prefabricated wall panelling to be of stainless steel with surface of vinyl.
In Galley, Scullery and provision rooms the prefabricated wall linings to have brushed, stainless steel surface.

In laboratories bulkheads to be made of high quality, easy to clean stainless steel panels, with brushed surfaces in wet labs, vinyl surfaces in dry labs, suitable for the intended purpose of these rooms.

Accommodation panels in living quarters, dry laboratories, Engine Control room and Switchboard room towards steel bulkheads and ship sides to be of 25mm thickness.
Accommodation panels in way of cabins shall be of 75 mm thickness, consisting of 2 x 25 mm panels with 25 mm air gap between. Elsewhere 50 mm high noise reduction panel system.
Noise insulation to be fitted above ceiling on top of cabin division walls.

Air space between insulated external ship sides or bulkheads and linings are to be ventilated by exhaust air from the accommodation room inside linings, above ceiling to corridor, to avoid condense problems in Antarctic areas.

Around all windows and portholes in cabins and common rooms, laminated plywood frames to be fitted. Plywood frames to be insulated to the same characteristics as lining. Stair trunks to be built of steel.

Ceiling
Prefabricated ceiling system of fire proof type, easily dismountable, to be mounted in all insulated areas with panelling and lining. Non-reflective, fire resistant ceiling in Wheelhouse.
In Galley, Scullery, provision rooms and wet laboratories the ceilings to have surfaces of brushed stainless steel. In dry laboratories the ceilings to have surfaces of vinyl covered stainless steel.
Any suspensions /supports to be flexible (resilient) mounted to the deck beams. Light fixtures to be flush mounted.

Thermal insulation:
The accommodation area including laboratories (ref. item 484) to be thermally insulated against shipside and open deck by use of rockwool (mineral wool) of minimum thickness 100+50mm according to separate insulation plan to be approved by the Owner during basic design work, typical density: ~30-35 kg/m^3. As thermal bridge the insulation to extend 600 mm inboard from outer boundaries at deck heads, ship sides and external bulkheads. Cold stores & freezer rooms to be insulated by use of prefabricated panels of appropriate type/thickness, suitable for ships. Special consideration to be made for insulating suspensions in aluminium structures, due to the high conductivity of aluminium.

To avoid condensation, the following technical rooms to be thermally insulated and lined against shipside and open deck by use of rockwool of thickness 50+50mm, typical density: ~30-35 kg/m^3:

- Steering gears room ceiling,
- Stores and electr. Rooms on Tween deck,
- Winch control room,
- All Laboratories,
- Workshops/repair rooms,
- Engine control room,
- Drop keel trunk,
- Ventilation rooms,
- Incinerator room,
- Paint store, chemical stores,
- Deck house on wheelhouse top.

Lining in these compartments to act as mechanical protection for insulation and to be of sheet steel or plastic laminate covered plywood approved by the Owner.

Acoustic insulation:
Acoustic insulation to be fitted as required in order to meet the given Noise Specification (Annex 1). The Designer based on recommendations from Noise Consultant to present a complete Noise Insulation Plan, covering both insulation to be fitted for reduction of internal noise and for external underwater radiated noise.

The entire Engine room and Propulsion room to be fitted with special acoustic insulation against ship sides, bulkheads, deck heads etc. and possibly also on tank top (if necessary) to achieve compliance with the noise specification.

Type and method of insulation to be according to instructions from Noise Consultant.

The following technical rooms to be acoustic insulated to minimise noise transmittal, according to separate insulation plan to be approved by the Owner during basic design work and also Noise consultant guidance:

- inside all ventilation fan houses (air inlets) on deck for minimising of external noise (special water proof damping mats may be used due to confined space),
- bow thrusters room deck head and bulkhead towards the accommodation,
- emergency generator room.

Fire insulation:
Fire insulation and fire boundaries to be according to requirements by SOLAS and as described in the “Fire integrity & insulation plan”, approved by class/authorities.

512. Doors in accommodation

Accommodation doors in general to be of B-15 standard. Doors in steel bulkheads to be of A0-A60 standard as required according to the fire rate of the bulkhead. Number of doors to be according to General Arrangement plan and separate door plans approved by Owner's representatives.

Clear opening of the doors to cabins to be 650 mm, to minor stores & toilets 600 mm and 700 mm to offices/ larger public rooms. Stretcher escape route from hospital to open deck to have doors of 800 mm width.

All doors fitted with hinges and lock of 1st class marine type. Master key system of approved type and subject to Owner's approval to be fitted for all locks. All doors to have an identification number with keys marked accordingly.

Cabins and office doors to be fitted with manually released hold back devices.

Doors between corridors, to stairways, to galley and to scullery to be of self-closing type and have magnetic hold back with automatic door release connected to fire alarm system.

513. Other internal doors

Doors in internal watertight bulkheads to be single lever operation.
Water tight steel doors in WT-bulkheads used for frequent passage while at sea shall be properly marked and with manually operated closing devices in accordance with SOLAS and Class Requirements.

Hydraulically operated water-tight sliding doors.

Water tight steel doors in WT-bulkheads used for frequent passage while at sea shall be hydraulic motor operated with push buttons, as well as local and remote manual operation and indication panel in accordance with SOLAS and Class Requirements.

514. External doors

All external doors to be of approved type and to comply with the Loadline Convention and Class Requirements. All hinges and handles to be of stainless steel. Doors to wheelhouse, accommodation spaces and to tempered/insulated rooms to be of insulated type. Doors to accommodation spaces and laboratories to have port light with dead light. Wheelhouse doors to have window.

All external doors accessing the ship to have means to be locked when not in use, by means of a lock device.

515. Windows and portholes

All windows to comply with the Load line Convention and Class Requirements. Size and location to be according to General Arrangement Plan and separate window plan.

Window and side scuttle coamings to be of stainless steel in way of steel structure, and to be of aluminium in way of aluminium structure. All windows and portholes to have frame retaining ring of brass or stainless steel and to be secured with stainless steel bolts onto compensating plate.

Windows and portholes to have provision for drainage from condensation and leakage.

All fixed windows in wheelhouse should be fitted with air heating diffusors. Wipers to be fitted according to class notation in front, aft and in bridge wing windows.

External freshwater spray arrangement with automatic air blowing system to be fitted for all windows. All to have drain pipe lead down to drain channel of min. 150 mm vertical flatbar welded to floor.

Opening windows to be arranged in wheelhouse, one per each side. All other windows and portholes to be of the non-openable type.

Storm deadlights of aluminium plates to be fitted for superstructure accommodation windows as required by Class or Authorities.

Clear view screen shall be provided on 2 nos. bridge front windows.

52. INTERNAL DECK COVERING, LADDERS, STEPS, RAILINGS

521. Internal deck base covering

Decks in the accommodation area to be covered with floating floor with noise absorbing insulation and steel plates (or equal) on top to be fitted as necessary to achieve compliance with the internal noise specification.

In wet rooms like toilets, showers, changing rooms, wet labs, laundries and galley ~50 mm cement to be laid and good drainage to be arranged. Rubber membrane to be applied on top of concrete, corners to be reinforced. A gutter with efficient drainage to be formed around the galley and wet labs.

In provision room ~50 mm cement to be laid on floors in addition to thermal insulation.

In other parts of the accommodation approx. 0-15 mm light weight cement of marine quality to be provided for smoothing purposes.

522. Internal deck top covering (linoleum, tiles, parquet etc.)

Following types of deck top covering to be arranged in following areas.

"Ship floor", ~3 mm heavy duty vinyl, wooden deck imitation:

- Wheelhouse
- All accommodation on 3rd deck
- All cabins
- Messrooms and lounges

Heavy duty vinyl, min. ~3 mm, all welded:

- All corridors
- All stairs
- Stores
- Hospital (wet room type)

Ceramic tiles with membrane in wet rooms like:

- Laboratories (where nothing else specified)
- Provision rooms
- Bath rooms
- Showers
- Galley
- Laundries
- Change rooms

- Sauna

Data floor, lifted, sections of 600x600 mm, anti-static type:

- ECR with offices
- Switchboard room
- Scientific Data Processing Laboratory

Class regulations shall be adhered in quality of vinyl floorings.

523. Internal gratings

Galvanised steel gratings to be provided where necessary in bow thruster room, engine rooms, workshops, stores rooms etc. in order to provide easy and safe access to all working positions.

Grooved rubber mats to be fitted on floor in Engine control/Electrical switchboard room and emergency Generator Switchboard.

524. Loose floor plates, platforms steps and ladders in accommodation.

To be fitted according to General Arrangement Plan.

On Tween-deck, the Engine Control Room, Winch Drive Room and Switchboard Room to have loose floor plates of height approx 300 mm. The plates in Winch Drive Room to be of non-skid heavy duty type aluminium. The plates to be screwed to profile made supports.

All stairs to be made of steel, with flooring and closed risers. Non-skid nose profiles on steps. Hand rails of hardwood to be provided on both sides of all stairways, on one side in corridors and at Wheelhouse internal.

Handrails to be mounted on wooden panel (200 mm wide) attached to wall panels. Colour to be approved by Owner.

525. Loose floor plates, platforms and ladders in engine/starters room

In engine room on tank top level and beside the main engine, non-skid heavy duty type plates of aluminium to be mounted. The plates to be screwed to supports.

All inspection hatches in aluminium floor plates to be hinged with 25 mm lifting hole.

Ladders from lower floor to platform deck each side of the Propulsion Room and Engine Room, with steps of galvanized prefabricated steel.
Railings in engine room of round steel bars with vertical steel bars between.

526. Ladders, platforms and railings in ballast and fuel tanks

To be fitted where necessary in order to provide easy and safe access.

Vertical ladder to be mounted in forepeak tank.

Steps or ladders also to be arranged in other tanks where practical and with height above 800 mm.

53. EXTERNAL DECK COVERING, LADDERS, STEPS, GANGWAYS

531. External deck covering

Aft working deck, external :
Metallized and painted according to Paint Specification.

External working deck, Hangar decks(Main hangar and CTD Hangar) :
To be arranged with wooden deck covering as indicated on General Arrangement plan. 2" x 6" pine-wood to be laid in sections in transverse direction and secured by T-bars welded to deck. Distance between T-bars to be approx. 1800 mm.
Deck underneath the wooden deck to be painted with suitable paint system before installation.

533. Handrails, railing, rail gates

Railing to be mounted as shown on General Arrangement Plan. Removable railing to be arranged around cargo hatches and other openings where necessary for safety reasons.

In way of steel structure railings to be built of hot galvanised piping, steel flat bars stanchions on every 2nd frame. In way of aluminium structure, railings will be of aluminium pipe and flat bar stanchion every 2nd frame.

Railings in engine room platform deck to be of round steel bars with vertical steel bars between.

534. External platforms, steps, ladders, and grating with equipment.

Location of ladders and stairs according to the General Arrangement plan
Outside ladders in general to be galvanised steel with non-skid bolted steps made of extruded plates. Ladders and stairs in way of aluminium structure to be aluminium where allowed by regulations.
Vertical ladders to have flat bar strings and steps of square bars.

54. FURNITURE, INVENTORY, ENTERTAINMENT EQUIPMENT

541. Furniture for crew, standard furniture

All furniture to be of marine standard and to be supplied as indicated on the General Arrangement Plan. All furniture and trim to be of high quality hardwood. All upholstery furniture to be fitted with cushions on seating and back made of soft "easy cleaning" material (real leather and/or heavy duty fabrics) according to Owner's Requirement. All equipment and furniture in general to be properly secured/sea-fastened.

Cabins to be equipped with: sofa/chair(s), table, work desk, book shelf, lockable wardrobe, two wall-mounted cloth hocks (mounted on doubling plate, not mounted adjacent to neighbour-cabin's bed) and bed with 2 lockable drawers under and bed side shelf, as indicated on the GA plan. Cabins to be equipped with a wall cabinet, if indicated on the General Arrangement. Double cabins to be arranged with a standard, two-height bunk bed.
In addition officer cabins to have separate sleeping room, if indicated on the GA plan.

Cabin bathrooms to have toilet, shower, porcelain wash basin, one toilet cabinet for each person, mirror and necessary hooks/hangers/grab rail. Floor to be heated and power outlet for hair dryer/electric shaver to be arranged.

All cabins to have a comfortable general illumination. In addition a good desk working light and reading lights for the seating and in all berths. A surplus quantity of power sockets and other service sockets to be arranged. All to be of marine type.

All draperies, curtains, covers for upholstered seating and other suspended textile material used in the cabins, public spaces, offices or other types of accommodation shall have the qualities of resistance to the propagation of flame which is determined in accordance with the IMO FTP Code / Res. A471(xii) as amended by Res. A563(xiv).

Lounges and mess-rooms:
Lounges, mess-rooms, conference rooms to have furniture of high standard with leather cushion of "hard wear" quality.

The following rooms to be arranged:

Scientists & Officers mess-room on 1st deck stb
Room to have seating capacity for 40 persons. Fixed mounted tables with fixed mounted swing-chairs to be arranged according to General Arrangement Plan. Tables to be of marine type with fiddles.
A pantry/desk with washbasin, cupboards, shelves to be arranged.

Crew mess-room on on 1st deck ps :
Room to have seating capacity for 12 persons. Fixed mounted tables with fixed mounted swing-chairs to be arranged according to General Arrangement Plan. Tables to be of marine type with fiddles.

Crew lounge on 1st deck ps:
The Lounge to have seating capacity for 10 persons. The lounge to be arranged with 4 rest-chairs with table and a L-shaped sofa with table, all arranged according to General Arrangement Plan. Tables to be of marine type with fiddles.
A TV-bench with cupboards and drawers to be arranged.

Conference room/Lounge on 1st deck stb:
A combined conference room and lounge to be arranged. Room to have seating capacity(meeting) for 12 persons. Meeting table and chairs to be arranged according to General Arrangement Plan. 10 additional conference chairs to be arranged.
A pantry/desk with washbasin, cupboards, shelves to be arranged.

Scientists & Officers Lounge on 1st deck stb:
The Lounge to have seating capacity for 20 persons. The lounge to be arranged with two groups of 4 rest-chairs with table, one U-shaped sofa with table and One L-shaped sofa with table, all arranged according to General Arrangement Plan. Tables to be of marine type with fiddles. A TV-bench with cupboards and drawers to be arranged.

Large conference capacity:
Between the Conference room and the Scientists & Officers Lounge a folding door to be arranged allowing the two rooms to form a large conference room/area with total seating capacity of 24 persons.

Deck Lounge on Main deck ps
The Lounge to have seating capacity for 6 persons. Fixed mounted tables with fixed mounted swing-chairs to be arranged according to General Arrangement Plan. Tables to be of marine type with fiddles.
A pantry/desk with washbasin, cupboards, shelves to be arranged.

Wardrobes:
The following wardrobes to be arranged:

Scientists & Officer Wardrobe:
Wardrobe with 35 lockers to be arranged on Main deck as shown on GA plan. Lockers to be well ventilated and radiators to be fitted under lockers for drying work clothes. One separate toilet to be arranged within the Wardrobe.

Wardrobe further to include;

- One(1) off triple stainless steel washstands
- Multiple type raingear/working clothes/boots dryer, consisting of "tree" type tube assembly with heater/suction fan.
- One(1) off emergency shower and 1 off eye/face wash fountains (see group 504).
- Two(2) off roller towels and soap dispensers
- Waste bins, hooks, mirrors, benches, etc.
- A drinking fountain.

Crew Wardrobe:

Wardrobe with 25 lockers to be arranged on Tween deck as shown on GA plan. Lockers to be well ventilated and radiators to be fitted under lockers for drying work clothes. One separate toilet and one broom closet to be arranged in the Corridor as shown on GA plan.

Wardrobe further to include;

- One(1) off triple stainless steel washstand
- Multiple type raingear/working clothes/boots dryer, consisting of "tree" type tube assembly with heater/suction fan.
- One(1) off emergency shower and 1 off eye/face wash fountains (see group 504).
- Two(2) off roller towels and soap dispensers
- Waste bins, hooks, mirrors, benches, etc.
- A drinking fountain.

542. Office equipment, furniture in wheelhouse, chart & radio room.

The wheelhouse to be designed for all-round visibility of horizon and working deck aft and stbd. Final layout and specification to be approved by the Owner.

The wheelhouse and radio room to be arranged with navigational consoles, chart table, navigational equipment, desks, drawers, benches and lockers, according to the General Arrangement Plan. Material and components used to be of best standard. Scientific consoles to be separated from operational systems.

All instruments in wheelhouse to be placed in consoles as agreed with Owner. Above the main and aft consoles a part of the ceiling to be raised to allow instruments, monitors, etc. to be fitted in overhead consoles within the operator sight line and reach. Required head clearance and sight lines to be obtained.

In total four (4) off "Captain's adjustable chairs" to be mounted on the Wheelhouse, two at main fwd. console, one chair in front of aft console and one at DP console stb wing. All chairs to be mounted on rails and with electrical drive. One fixed rotary chair for the chart table to be installed. Office desk to be equipped with one marine type office chair.

A small pantry with a sink and hot/cold water armature to be installed. Pantry to include coffee machine, a refrigerator a small sinkw/hot/cold water and required cupboards.

A table with 3 armrest chairs to be arranged on the Wheelhouse as shown on GA plan.

Lighting should be daylight fluorescent with dimming capability and separate red lights for night work. Indicator lights should be red wherever possible. A modular system should be used for all consoles/trunking to enable retrofits and extremely wide and easily accessed trunking should be provided to carry cabling to the ship's laboratories, where this does not compromise electromagnetic signature or fire regulations. Power and signal cabling should be trunked separately. Distribution boxes for wheelhouse equipment to be fitted in Converter/IT-room on wheelhouse top/electronics room on 4th deck.

All draperies, curtains, covers for upholstered seating and other suspended textile material used in the cabins, public spaces, offices or other types of accommodation shall have the qualities of resistance to the propagation of flame which is determined in accordance with the IMO FTP Code / Res. A471(xii) as amended by Res. A563(xiv).

543. Bedclothes, mattresses

Each bed will measure 800x2000 mm and to be equipped with spring mattress with mattress top of comfortable and fire-retardant type, approved for marine use.

Pillows, bed covers and linen og high quality, 2 complete sets for the total number of beds onboard to be supplied.are Owner's Supply.

544. Curtains

Window/port hole curtains or roller blinds and curtain in front of beds for the two-man cabins to be fitted to Owner's selection.

All windows in wheelhouse to be fitted with pull down «sun-screens» (roller type).

545. Decorations

Decorations supplied by Owner to be mounted by Builder.

546. Sports and Entertainment equipment

Gymnasium/exercise facilities:
A gymnasium to be arranged with high quality training equipment on Tween deck as indicated on GA plan. Gymnasium to have a separate wardrobe with 2 showers, a sink and a sauna.

In addition a table tennis room with high quality table and tennis set to be arranged on Tween deck aft as shown on GA plan.

547. Inventory, smaller items

Garbage buckets and wall mounted coat hooks to be fitted in each cabin and in offices. Public toilets to have mirror, garbage bucket, paper towel and soap dispensers.

Following safe deposit boxes to be installed:

- Captain's cabin
  Chief scientist cabin
- Ship's office

55. GALLEY, PANTRY EQUIPMENT, PROVISION PLANTS, LAUNDRY EQUIPMENT

551. Galley equipment

The following equipment to be installed in the galley:

- One(1) off galley ranges with 6 plates
- 1 off industrial oven
- 1 off frying pan (gyro type)
- 1 off combi dampers/Steam boxes(6x1/1GN)
- 1 off dishwashing machine of marine type
- 1 off refrigerator, ~450 litres
- 1 off deep fat fryer
- 1 off potato peeler with 30 cm. rack
- 1 off microwave oven
- Benches with drawers and cupboards units
- 1 off pan cupboard
- 1 off spray unit
- 1 off wash basin
- 1 off mixer, 30 litres
- 1 off hand operated water hose on reel (fresh water)
- 2 off wash sink/workbench top
- 1 off waste disposal unit

Galley and mess room utensils to be fitted according to First Outfit Section.

Efficient ventilation ducting system to be arranged in the galley. Extraction ducts to be built over the ranges. 1 service hatch to be arranged between galley and scullery with working table inside galley.

Complete galley plan including scullery with placing of equipment, benches, drawers, shelves and lockers to be prepared by the Builder and approved by the Owner before production/purchasing.

A working bench of stainless steel with pre-rinse shower and two (2) off large wash basins suitable for soaking of 1/1GN salvers to be fitted in Galley. Drawers and lockers to be arranged as place permits in galley, and to common practice. There will be arranged rib shelves for pots and pans. Other working benches to be arranged as available space permits, with drawers and lockers. One of the work benches to be with adjustable height. Work benches, drawers and lockers shall be of stainless steel. One (1) off knife rack to be arranged.

Garbage bag holders for different galley waste to be fitted. One (1) Food waste disposer/grinder to be integrated in one of the work benches.

Food waste handling system to be installed. One-way macerator system designed for hygienic transportation and treatment of food waste in compliance with IMO Marpol 73/78 Annex V. Food waste ground by local macerators in the galley and scullery to be transported by vacuum to a special holding tank, which is designed for food waste. Food waste is not defined as ‘sewage’ and should not be mixed with either black water or grey water.

Galley and Scullery floors are to have drain scuppers in each corner and gutters in front of all doors.
A large gutter around galley range, gyro pan and in front of combi dampers.
El-plug sockets for all galley machinery to be arranged.

552. Pantry and mess room equipment for preparation and serving

The following equipment to be installed in the serving area for the 3 different mess rooms:
Self-serving counters with cup boards and necessary equipment. Dirty area with rack for trays and garbage chutes.

554. Compartments for cold store

Provision rooms:

The compartment to be arranged as per General Arrangement Plan, and as following;

- Two (2) refrigerated stores, +2ºC and +4ºC
- One (1) freezer stores –25ºC
- misc. vegetable store

Shelves and racks to be arranged for all rooms. Material to be stainless steel or aluminium. Doors to have handles on both sides and anti-freezing heating elements in coamings. Alarm to be fitted as per class and/or Solas regulations.

The air-cooling units in Dry, Cold and Freezing provision rooms to be equipped with electric de-icing with drip-tray underneath. Drain from cooling batteries to scuppers inside each room. Drainpipes from cooling rooms to have water traps. Scuppers and drainpipes in Freezing room to have electric heating cables.

Complete refrigerating and freezing machinery with necessary automatic control and automatic defrosting of air coolers to be arranged in close connection to the above mentioned rooms. Temperature reading gauges in Galley. Remote temperature displays in ECR and at the compressors' control cabinet. Locked-in alarm panel for freezing rooms in Galley and on Wheelhouse.

Two FW cooled and air cooled provision compressors to be mounted. Each compressor shall have capacity to maintain the specified temperatures through 18 running hours per 24 hours. The compressors to be stand-by for each other. Each compressor to have frequency controlled speed. Cooling medium to comply with CLEAN class notation.

Sufficient spare refrigerant bottles to be delivered and stored to the Owner's satisfaction.

556. Dry provision room

Separate dry provision room to be arranged as per General Arrangement Plan. The provision room to be arranged with shelves and bins in stainless steel. Temperature ~10°C.

558. Laundry, linen and change rooms.

Ship's Laundry on Main deck to have the following equipment installed:

- 2 off washing machines type "Heavy Duty for Ships Laundry", ~10 kg
- 2 off clothes drier type "Heavy Duty for Ships Laundry" ~10 kg.
- 1 off iron and ironing board
- 1 off deep sink

Crew Laundry on 2nd deck to have the following equipment installed:

- 4 off washing machines, marine type, ~6 kg, mounted in rack with
- 4 off clothes drier marine type, ~6 kg.
- 1 off iron and ironing board
- 1 off deep sink

Working table and wall mounted cupboard to be provided for detergents, etc. Waste water to be drained to grey water holding tank.

Linen store room to have shelves for blankets, sheets and towels.

56 TRANSPORT EQUIPMENT FOR CREW AND PROVISIONS

564. Gangways with equipment

1 off hydraulic operated telescopic gangway system to be installed. Length of gangway to be approx. 9 m in length.

Gangway to be of type with hinged frame and weather-tight door, and to be parked in recess flush with shipside as shown on General Arrangement plan. Gangway to have fixed railing
System to include separate hydraulic power pack and control panel. System to be approved by Class.

1 off accommodation ladders made of aluminium with removable stanchions and with safety net to be arranged on 1st deck aft, ps. Gangway to be arranged with electrical motor driven winch and davit for operation of ladder.

Pilot rope ladders to be supplied and arranged for both stb and ps use.

57. VENTILATION AND HEATING SYSTEMS

Careful attention should be given to the application of acoustic damping and attenuation to the ventilation system and to the control and limitation of air velocities.

Recommendations and instructions from specialist noise consultant to be considered carefully and implemented as required in order to meet the noise criteria specified in Annex 1. All fans to be of special low noise type (low speed).

Weather louvers for inlet air to be of vertical type with mist eliminators. Inlet louvers to be equipped with filters to protect against salt in the air. Fixed installation to assemble filters for sand protection when necessary to be installed. Speed of inlet air through louvers not more than 4 - 5 m/s.

Max. flow velocity in ventilation ducts and pipes to be as follows:

- Ventilation ducts Engine-room/rooms outside accommodation:
  - max. 8 m/s.
- Ventilation ducts Accommodation:
  - max.12 m/s.
- Return air ducts in Accommodation:
  - max. 9 m/s.

Cooling to be based on chilled water, 6-12 dg. C and heating to be based on hot water 80-60 dg.C.

571. Ventilation air-condition systems for accommodation

The accommodation area to be provided with a one-string (duct) ventilation system with preheated or cooled air supply. The cabin units to be equipped with thermostatic controlled electric re-heater.

Special attention to be given to reduce/avoid condensation in general, and especially in rooms with electronic equipment(Server-rooms, rack rooms, converter rooms, etc).

The air handling units installed according the General Arrangement to consist of inlet section with dampers for setting amount of return, filtering section, preheating section for hot water, humidification section for steam inlet pipe, cooling section for chilled water, fan section with frequency controlled fan and a distribution section with sound trap.

Weather louvers for inlet air to be of vertical type with mist eliminators. Speed of inlet air through louvers not more than 4 - 5 m/s. The louver to have arrangement for sand-filter outside and demister-pad for removing water on the inside.

The cooling section contains heat exchanger for direct expansion. The inside of the AC-units to be of stainless steel. The outside to be of galvanized steel.

Each A/C unit has a drip separator and a condensate tray. The condensate is led to drains arranged in air condition and ventilation room.

Pre-insulated spiro tubes to be used for air supply, non-insulated pipes for outlets. All ventilation ducts to be provided with inspection hatches and fire flaps acc. to Rules.

Ambient conditions:

- For minimum and maximum ambient air temperatures, see gr. 101.
- For minimum and maximum ambient seawater temperatures, see gr. 101.
- For maximum air humidity see gr. 101.
- Inside conditions +21°C to +28°C acc. To Comf. Class requirements, see class notations.

Capacities for cooling, heating and humidification to be based on max. re-circulated air amount of 30%. Arrangement will ensure easy damper settings for approx. 40-100% fresh air supply. No re-circulated air from galley, toilets, wash and mess room is taken.

Supply units in accommodation to be sound insulated and adjustable. Return air from cabins led partly to toilet rooms and partly to corridors for further outlet to open air by suction fan (E-1).

Air humidifier:
To humidify the air in the AC-1 unit during the heating period, an electric powered low pressure steam humidifier unit with steam inlet pipe and automatic to be installed.

Specification for air pipe system:
Supply air ducts system to be of pre-insulated ductwork, consisting of spiro type inner/outer skin with 15 mm mineral wool insulation between. Inner tube fittings to be equipped with seals to prevent any leakage.

Exhaust air ducts system to be of spiro type. All fittings to be equipped with sealing to prevent air leakage.

572. Ventilation systems for galley, vegetable and provisions rooms

Galley
The galley to have a separate 100% fresh air AHU. The unit to have a capacity as per ISO-standards and maker's recommendation.
The unit to consist of:

- Inlet section
- Filter section with F7 pocket filter
- Heating section
- Cooling section with chilled water cooling
- Fan section with centrifugal fan and frequency controlled motor
- Galley exhaust fan to be of centrifugal type with motor outside of air stream. The fan motor to be frequency controlled.
- Exhaust air to be lead through a galley stainless steel hood with grease trap to open deck.
- Inlet louver to be fitted with sand-filters or equivalent and close-able arrangement. Fire-dampers to be installed according to regulations

Separate extractor ventilation fans to be arranged for the dry provision room.

Ventilation Systems for Dry Provision Room:
Separate fan coil connected to the chilled water system to be installed for Dry provision room. The unit to be housed within a cabinet and has a removable front panel and grille for ease of installation and maintenance.

Design criteria:

- For minimum and maximum ambient air temperatures, see gr. 101.
- For minimum and maximum ambient seawater temperatures, see gr. 101.

- For maximum air humidity see gr. 101.
- Inside condition Dry provision room appr. 10 degr.C

Ventilation Systems for Vegetable Room:
Separate fan coil connected to the chilled water system to be installed for Vegetable room. The unit to be housed within a cabinet and has a removable front panel and grille for ease of installation and maintenance.

Design criteria:
- For minimum and maximum ambient air temperatures, see gr. 101.
- For minimum and maximum ambient seawater temperatures, see gr. 101.
- For maximum air humidity see gr. 101.
- Inside condition Vegetable room appr. 6 degr.C

573. A/C systems for control rooms, Wheelhouse and Laboratories

Ventilation System for Laboratories:
In general all wet and dry laboratories, scientific rooms and stores within enclosed spaces to be designed for good working conditions with controlled inside temperatures connected to HVAC unit and/or separate cooling units cooled by chilled water system.

Reference is made to Annex. 5 – Laboratories, Scientific Rooms and Stores.

Scientific rooms not arranged with air-condition to be arranged with adequate mechanical ventilation.

When nothing else is specially stated, laboratories to be designed according to following criteria's:
- For minimum and maximum ambient air temperatures, see gr. 101.
- For minimum and maximum ambient seawater temperatures, see gr. 101.
- For maximum air humidity see gr. 101.
- Inside conditions +21°C to +28°C, according to Comf. Class.
- Humidity inside winter: Min 30% RH
- Humidity inside summer: max 50% RH

Ventilation System for Engine Switchboard room and Control Room:
Two fan coils with 100% capacity, one for operation and one for standby, connected to the chilled water system to be installed.

Fresh air Approx. 400 m3h to the control room to be supplied from the Accommodation AC unit.

As backup, one fan for supply of approx. 400 m3h fresh air to the room to be installed.
The unit is housed within a cabinet and has a removable front panel and grille for ease of installation and maintenance.

Design criteria:
- For minimum and maximum ambient air temperatures, see gr. 101.
- For minimum and maximum ambient seawater temperatures, see gr. 101.
- For maximum air humidity see gr. 101.
- Inside conditions +18degr.C to +25degr.C / 35% to 50% rh (cooling)

Ventilation system for Wheelhouse:
To cool and heat the wheelhouse a separate air conditioning/defroster unit designed for 100 % return air shall be installed. The unit to be equipped with dampers and re-heater for air to the defroster system for the windows. The unit is housed within a cabinet and has a removable front panel and grille for ease of installation and maintenance.

Fresh air to the wheelhouse to be from the Accommodation system.

Design criteria:

- For minimum and maximum ambient air temperatures, see gr. 101.
- For minimum and maximum ambient seawater temperatures, see gr. 101.
- For maximum air humidity see gr. 101.
- Inside conditions +21°C to +28°C, according to Comf. Class.
- Humidity inside winter: Min 30% RH
- Humidity inside summer: max 50% RH

Ventilation Systems for Scientific data processing lab/ Rack Room:
A separate AC unit connected to the chilled water and the hot water system to be installed. The unit is housed within a cabinet and has a removable front panel and grille for ease of installation and maintenance. Ventilation of rack room to be arranged with pressurised floor plating with chilled air inlet underneath floor plating and return air through cabinets. Air extraction on top of room.

Design criteria:

- For minimum and maximum ambient air temperatures, see gr. 101.
- For minimum and maximum ambient seawater temperatures, see gr. 101.
- For maximum air humidity see gr. 101.
- Inside conditions +21°C to +24°C
- Humidity inside winter: Min 30% RH
- Humidity inside summer: max 50% RH

Ventilation Systems for Winch Drive Room:
A separate fan coil connected to the chilled water system to be installed for Winch Drive room will be fitted. The unit is housed within a cabinet and has a removable front panel and grille for ease of installation and maintenance.

Design criteria:

- For minimum and maximum ambient air temperatures, see gr. 101.
- For minimum and maximum ambient seawater temperatures, see gr. 101.
- For maximum air humidity see gr. 101.
- Inside conditions max +27degr.C

574. Ventilation systems for engine room and propulsion room

Adequate ventilation to be provided in the engine/propulsion rooms to keep the maximum ambient temperature to a comfortable minimum according to ISO standard, both for engines and electric motors operating limits, and personnel working in the engine room.

The Engine room ventilation shall be in compliance to ISO 8861 standards. One of the E/R ventilation fan shall be reversible type and pneumatic type (with SS piping) closing arrangement shall be provided for E/R ventilation dampers.

The system to consist of a supply system and an exhaust system.

The air supply system for the engine room:
Two off axial flow dual low speed flow fans blowing air into the engine-room.

One of the fans to be of reversible type to allow extraction of fire extinguishing gas from the engine room, and one to be two speed.

The supply fans will blow air into the engine room in two separate ducts and split up in a series of ducts to distribute the air to key areas, e.g. diesel engine, generators, electric motors etc.

Sound traps to be mounted on all the fans from engine room to prevent noise.
Special consideration to be made in respect of acoustic insulation of ducts/trunks both internal and external. Air intake chamber to be equipped with air traps in order to reduce noise to open deck.

All ventilation trunkings to be fitted with fireflaps according to Class Requirements, and openings to atmosphere to be covered with "mushrooms" or vent grilles to prevent water entering the trunking. In addition to the fireflaps, the fans to be connected to the main fan stop on the Wheelhouse, and the fan emergency-stop system, associated with the fire extinguishing gas system.

Weather louvers for inlet air to be of vertical type with mist eliminators. Speed of inlet air through louvers not more than 4 - 5 m/s.
The louver to have arrangement for sand-filter outside and demister-pad for removing water on the inside.

The air supply system for the propulsion-room:

Two fan coils with 100% capacity, one for operation and one for standby, connected to the chilled water system to be installed.

One fan for supply of approx. 400 m3h fresh air to the room to be installed.

Design criteria:

- For minimum and maximum ambient air temperatures, see gr. 101.
- For minimum and maximum ambient seawater temperatures, see gr. 101.
- For maximum air humidity see gr. 101.
- Inside conditions max +27 degr.C.

575. Ventilation systems for rooms other than the accommodation

Other rooms and compartments on the vessel to be arranged with mechanical ventilation according to good marine standards and regulations regarding number of air changes per hour.

Two fan coils with 100% capacity each, one for operation and one for standby, connected to the chilled water system to be installed for the Bow thruster room and Chilled water room. Sewage treatment room to be equipped with two fan coils each with 60% capacity.
Other sampling equipment room to be equipped with two fan coils each with 60% capacity in addition to mechanical ventilation for fresh air.

One fan for supply of approx. 400 m3h fresh air to the bowthruster room to be installed.

Bow Thruster room and Wet laboratory compartment will be heated with electrical heater with thermostat controls.

To rise temperature in accommodation above preheated air supply temperature, central heating with electrical radiators to be installed in each accommodation compartment and in wheelhouse (Separate calculations to be made but as a minimum 500 Watts in cabins and 1000 watts in public spaces more the Wheelhouse to be used as a guidance). Radiators not to be located below opening windows. Radiator units of “slim type” to be installed, specially in wheelhouse. WC/toilets are not considered with radiators.

Gas store and balloon filling station and paint room to be equipped with mechanical ventilation ex. Proof exhaust fans.

577. Central Heating System

A closed pressurized Central Heating/Heat Recovery System based on thermal fluid (water/glycol) from recognized supplier, to be installed. The thermal fluid will be heated by Aux. boiler and heat recovery from diesel engines HT-cooling systems.

Working temperature: 110ºC
Working pressure: 3 bar

The system will serve:

- Ventilation and heating plant
- Pre-heaters/stand-still heating for main engines
- Domestic hot water
- Technical hot water
- Sludge tank
- Dirty oil tank
- Evaporator
- Hangars

The Central Heating System will first utilize the energy from the heat recovery
System, and uses the Aux. boiler only if heat from heat recovery system is not sufficient.
The system will be automatically controlled and monitored by an class approved control system and shall be interfaced to the IVCS, enabling operation from this system.

The circulation system is operated by two main circulation pumps. Running and stand-by functionality is built into the control system. Manual control and emergency control will be possible.

The system to consist of the following main components:

- F.O. heated Aux. boiler (SFI 641)
- Heat recovery HT heat exchangers (one for each engine)
- 2 x Circulation pumps
- Control system
- Remotely operated valves (flow control unit)

578. Chilled Water Plants.

Necessary cooling capacity for the accommodation and for the specified rooms for equipment requiring chilling, to be calculated.
There will be two chilled water plants onboard. Each system to have capacity of 60% of total calculated capacity.
The plants will be cross connected on the water-side, enabling additional back-up for important rooms and equipment.
Each chilled water plant will consist of two separate chilled water units of same size consisting of compressor fitted on common frame with condenser, evaporator and necessary equipment.

Technical data (each unit)

Number of units	:	2 (supplier to evaluate)
Compressor	:	Screw, with capacity control 10-100%
Rpm control	:	Frequency converter
Refrigerant	:	Compliant to Clean notation
Condenser	:	SW cooled (pumps to be frequency controlled)

Chilled water circulation system to consist of valves, valve manifolds, circulation pumps with controlled rpm, etc., according ventilation system supplier's/noise consultant recommendation and class requirements.

58. SANITARY SYSTEMS WITH DISCHARGES, ACCOMMODATION DRAIN SYSTEMS

Pipe velocity.
For various systems, the maximum velocities to be as follows:

- Sanitary freshwater (disch.): 2,5 m/s
  (suction): 1,5 m/s

581. Sanitary supply systems

Fresh water central filling station to be arranged on main deck on both sides. Capacity appr. 40 m3/h. The filling stations to have valves and strainers (Appropriate size mesh filters to be provided in specific areas as per design and equipment requirements) with by-pass possibilities. Filling lines to have proper locking device installed to avoid hazardeous materials in the water line. FW filling and distribution lines to be equipped with remote controlled valves, operated by the Pump and Valve Control system.

Piping and fittings to be of type profi-press stainless steel of suitable dimension and according to separate specification. Valves to be of ball type. To be divided in branches with separating valves.

Freshwater system to be installed with sufficient capacity for the crew members and laboratories of this type of vessel. Fresh water also to be arranged in CTD hangar and main hangar and on other locations where cleaning by fresh water is necessary.

2 off constant pressure circulating pumps (hydrophore pumps) each with capacity 6 m3/h 4 Bar
2 off hot water circulation. pump, each with capacity of 4 m3/h 1,2 Bar. These two pumps to be installed near the water heaters.
1 off UV-steriliser of sufficient size covering both hot and cold water supply to accommodation.
1 off De-hardening - mineralising filter
2 off water heaters, each tank with capacity abt. 500 L and with minimum 5 x 7 kW electrical heat elements and heating from central heating/heat recovery system.
2 off charcoal/paper filter units, or similar. One unit to be arranged as stand-by(7 filter cartridges AP110 and 30 filter cartridges AP 117 in each unit).
2 off FW transfer pump to be installed, capacity 15 m3/h – 3 Bar. One of the pumps to be arranged as stand by pump. Pumps to be able to transfer between all FW stores tanks. Remote operated valves to be installed.

The filter units to have drain pipes to bilge well. Ball valves to be included.

Stainless steel pipes (profi-press system) to be used for all hot and cold fresh water systems in accommodation up to 42 mm.
Pipes and fittings to resist up to 120°C and 16 bar. Both hot water and cold water pipes to consumers are to be thermally insulated and frost protected.

Pipes in accommodation, toilets and showers to be adequately covered/hidden.

All valves to be of approved type and suitable for the intended purpose.

All valves behind linings will be accessed by hinged flaps and must have identification plates attached.

582. Sanitary discharge

Vacuum system

A sewage vacuum discharge system to be arranged for almost all toilets in the Vessel.
Toilet flushing to be with FW.

Vacuum unit:
The sewage system to be arranged as a vacuum freshwater system. The ship to be equipped with vacuum stations, consisting of two vacuum generators. The vacuum stations to be designed for macerating and immediate delivery of the sewage directly on to a black water holding tank via a Sewage Treatment Plant (STP). Sewage treatment plant to have common black and grey water treatment.

The builder should provide the ISPPC certification for sewage treatment plants iaw MARPOL regulations.

Vacuum system to include two (2) off vacuum/macerator pumps operating independent of each other and with necessary control equipment, each pump with 100% capacity. Local shut-off valves for each pump for isolating when maintenance/repair. Manual back-up between the 2 pumps. FW-supply with shut-off valves to the vacuum/macerators to be installed.
Equipment for chemical cleaning and removal of urine salts in vacuum piping systems to be delivered. Circulation pump to be included.
One (1) off spare vacuum/macerator pump to be delivered.
GW from Hospital to be led separately to the sewage holding tank for treatment.

All Galley GW from the scuppers and sinks shall pass a grease separator before it is discharged to the GW tank. The separated grease to be pumped
to the sludge oil tank or to a grease holding tank.
Waste food from Galley and Scullery not to be mixed with GW system.

Sewage discharge line to deck also to be arranged, for shore connection via shut-off valve with MARPOL-flange.

Grey- and black water holding tanks to be atmospheric and properly vented and to be equipped with discharge pumps and level sensors, high alarm collecting tank/low level, allowing and efficient storage volume of sewage of at least 90% of the tanks gross capacity.
- One grey water discharge pump 10m3/h – 2bar to be installed.
- One black water discharge pump 10m3/h – 2bar to be installed.

Grey water and black water pumps to be connected to be back up for each other.

The system to be flexible in with regard to use of relevant tanks and well prepared for use when the vessel is in dry-dock.

The vacuum units to be incorporated in the ship's automation system.

Toilets
The vessel to be equipped with vacuum toilets in vitreous porcelain and vacuum scuppers on lower deck. Wall model types to be designed for full servicing of valve and mechanism from the back side. Flush valves, preferably membrane free low noise type, to be operated by electronic or pneumatic controller with a minimum of movable components.

The sewage treatment system to consist of following:
- One(1) off Vacuum station with 2 pumps
- One(1) off Sewage treatment plant with two (2) off built on discharge pumps
- 2 off Sewage discharge pumps for black water and grey water

Consideration should be given to shutting down sewage and grey water tank discharges for up to two days at a time, in order to facilitate environmental sampling. These services should therefore be capable of continuing to operate under these circumstances without compromising the normal routine on board the ship. The installation and arrangement to be of high standard and according to manufacturer's recommendation.

Sewage treatment unit of approved type. Capacity to treat sewage inflow from all persons onbord. Unit to be fitted with two discharge pumps. All pumps associated with vacuum-system to have stand-by units. Sewage treatment unit to have both FW and SW supply.

Toilet vacuum system shall have isolation facility for each deck.

Gravity type toilets(GT):
One public toilet on each deck to be of gravity type. This to include toilet on aft working deck, one within main wardrobes.

Sanitary system:
Fresh water to be supplied by pressure system to all toilets via stainless steel pipes. The sanitary piping and fittings to be of stainless steel with locking rings in each joining and led to an atmospheric vacuum collecting unit with effective sewage hold capacity. Vacuum toilets, wall mounted, with rubber connection to vacuum piping.

Pipe/valve to be arranged with cleaning connection for FW-flushing.

Waste water disposal from wash basins, galley and showers to be drained to holding tank with pump out port side.
All grey water drain pipes to be arranged with water traps.

All sanitary pipes in accommodation to be covered or concealed where possible.

All valves shall be of approved type and suitable for the intended purpose.

All valves behind linings to be accessed by hinged flaps with identification plate attached.

Vacuum system to be split with isolate valves for each deck. Details of vacuum-system to be submitted to Owner's Representatives for information and approval.

Sewage tanks, one for grey-water and one for black-water to be built in, as well as for treated sewage.

Discharge from wet lab.
The drains (chemical lab.) or bilge wells (wet labs.) will be connected to Bilge Systems, or drain system, see group 803 and 804.

583. Bath tubs, shower cabinets, WC, wash basins

In general, all toilets/showers in cabins to be built as pre-fabricated wet-units with stainless steelbase frame and stainless steel scuppers. Tiles on the floor. Extra care to be taken to avoid potential rusting in the units base frame.

Showers
Each shower shall be equipped with towel rack, clothes hooks, soap dish, shampoo holder, shower mat and sliding doors with locking clips **(not curtain**). All showers to have approved mixing valve, thermostatic type, with anti-scald protection. All fittings to be chromium plated.

Efficient floor drainage to be obtained from lowest level at recessed floor.
The doors to the WC and to shower rooms to be supplied with lock.

Toilets
The toilets are to be fitted according to International standard with paper holder, towel hook and hand grabs. Toilet cabinets to have mirror and shaving socket, turning towel rack, soap dispenser and one sink with H/C water taps of normal one-hand type, chromium plated.
Efficient floor drainage to be obtained from the lowest level at the floor.
Electric heating cables in all bathroom floors.

Easy access to the toilet vacuum valves from the alleyways to be provided, through hinged doors.

Washbasins
All wash basins in cabin bathrooms and in common toilet rooms etc. to be of porcelain, and one-hand mixing batteries to be applied. Visible armature in accommodation shall be of chromium plated metal.

584. Drinking water systems and coolers

8 Drinking water stands with cooler to be fitted in suitable locations agreed with Owner.

6. MACHINERY MAIN COMPONENTS

60. MAIN MACHINERY COMPONENTS, GENERAL REQUIREMENTS

General
All machinery to be designed and installed for normal operation with unmanned engine room in accordance with the rules and regulations as stated in this specification.

In general low frequency rotation of machinery and/or system is preferred and systems should be selected for their smoothness of operation. Balancing of all the rotating machinery, decoupling it from the hull with appropriate mountings is required.

Vibration calculations and measurements of the diesel generator sets and other machinery chosen shall to be carried out by the equipment supplier.

Torsion vibration calculations and measurements of the propulsion machinery to be carried by the Propulsion motors/propeller plant manufacturer.

All machinery equipment to be of first class for use on board ship and certified by Class.

- Arrangement to be planned for min. maintenance of the engine and machinery installations. Spare parts and tools according to Class recommendations.
- Arrangement in engine room, piping diagram, etc. to be approved by Owner's Representatives, Class and the Authorities.

Certification of equipment would be as per the class rule based on the class notation.

The equipment is designed for unrestricted service in environmental conditions as follows:

- Outside air temperature, max.: See item 101
- Outside air temperature, min.: See item 101
- Outside relative humidity, max.: See item 101
- Engine room ambient air temperature, max.: +45°C
- Engine room ambient air temperature, min. : +2°C
- Seawater temperature, max.: See item 101
- Seawater temperature, min.: See item 101

Engine room and propulsion-room area
The engine room and propulsion room to consist of two separate compartments, separated with a watertight bulkhead. Sound insulated bulkheads to be fitted between the rooms. Purifier-room to be separated from the engine room with direct access from the engine room.

General
All required pumps to be resilient mounted with flexible pipe connections according to Noise Consultant recommendation.

All pumps, also for circulation pump, to be equipped with manometers and vacuum gauges.

The pumps to be of vertical type, where possible.

In general rubber to be used between pipe clamps and pipes. Special consideration to be made in respect of clamping of pipes in noise critical systems.

Heat Exchangers, General
Generally heat exchangers to be of plate type.

Every heat exchanger installed to be equipped with thermometers at inlets and outlets on primary and secondary side.

All Heat exchangers shall be provided with 15% fouling margin. For SW heat exchangers shall have Titanium plates and FW cooled Heat exchangers shall be Stainless steel plates. They should have permanent arrangement for back flushing with three way valves at inlet and outlet manifolds.

Filters and strainers. General
These should follow the manufacturer's recommendations in respect of:

- Filter mesh size
- Filter type - duplex
- Number of filters

Manometers to be fitted before and after the filters and with pressure switches for alarms (as per class and standard shipping rules).

All filters and strainers to provided with vent. and drain cocks or plugs and saveall below, to be run down to sludge tank.

Engine control room(ECR)
A fully air-conditioned soundproof control room to be arranged as shown on General Arrangement Plan.

This engine control room to contain controls for main propulsion system, indicators for all running machinery, pressure, temperature, alarm panel, control panels, watch keeping, word desk, etc.
Engine control room to be arranged with floating floor.
Main engines primary functions to be monitored with visual display and with data print-out.
Fuel flow to main engines, torsion meter readings, tank soundings to be of an integrated computer system to give print-out of specific fuel consumption, daily fuel consumption and total remaining fuel on board.

Adjacent to the ECR an office to be arranged as shown on GA-plan. The office to be arranged for two persons, with tables, office chairs, archive cabinets in steel, shelves, etc., all as agreed with the Owner.

Switchboard room
Switchboard room to be arranged on Tween-deck as shown on General Arrangement plan and contain main electrical switchboard, group starters, sub. Switchboards, transformers, etc.

All switchboards and control desks to be resilient mounted.
All switchboards, Trafos, Converters etc. to be marine type and specially considered regarding available space in the relevant rooms where they are intended to be installed.

Noise and vibration
Propulsion motors, generating sets and all other significant rotating machinery to be mounted according to recommendations from Noise Consultant and Supplier in order to meet specified noise and vibration levels according to class requirements and separate Annex. Electrical components such as chokes, transformers, rectifiers etc. to be resilient mounted.

Machinery-room and propulsion-room to be equipped with sound traps for ventilation systems.

In addition to the specified requirements consideration should be given to the reducing of exposure of engine room staff to excessive noise levels when engaged on maintenance work.

The arrangement of machinery spaces to be generally such that noise sources whilst the vessel is operating at sea are contained in the main machinery space and noise sources normally operating in harbour are contained in an auxiliary machinery space.

The workshop boundary bulkheads to be acoustically insulated to reduce noise levels when the ship's staff carry out maintenance work at sea.

Particular attention to be given to selecting equipment with well-balanced components and inherently low levels of noise and vibration.

Appropriate silencing and vibration isolating arrangements are to be provided for the main sources of noise and vibration including main and auxiliary engines, all engine exhaust systems and silencers, air, compressors, fans, purifiers, hydraulic power packs and other such equipment.

The selection of main engines, propulsion motors and mounting system to be such as to eliminate transmission of structure bourn noise and vibration in the vessel.

Max. noise level requirements in engine room and propulsion-room to be in accordance with specified class notationfor the ship. The vibration and noise levels shall be recorded both during yard tests and during the sea trails under realistic operational conditions.

Where necessary structure-borne vibration from all reciprocating, or rotating machines should be controlled by the following means:

- Selection of inherently well-balanced machines
- Use of anti-vibration mounts, or isolators, selected base plates and support: such measures to be applied as required to machines, pipe work, exhausts, etc.

It is anticipated that noise and vibration critical reciprocating and rotating machines, including associated pipe work and services will need to incorporate single-stage isolation. A detailed and thorough analysis of the isolation system specified for the propulsion prime mover (s) is required in order to show compatibility with the noise specification and to ensure compliance with the requirements for limitation of vibration internal to the vessel. The analysis for the isolation system must show that any flexural responses of the diesel engine bedplate will be such that no resonance might arise near any excitation frequencies.

625. Main electrical propulsion system

General requirements:
The Vessel to be powered with two electric AC induction motors designed for marine propulsion, one motor on each shaft. Propulsion converters to be AFE.

Hinged stainless steel hatches with safety glass windows to be mounted for access to the heat exchangers/air filters and fan motors.

Thrust bearing of sufficient size to be fitted. Shaft coupling to be fitted for dismantling purposes during dry docking etc. Shaft coupling to be of shrinking type. Torsion meter to be fitted on shaft line. The motors should be step-less controlled and advice sought to establish the most efficient method of rectification. All generation and engine control systems to be designed on a unified basis with maximum compatibility criteria being used.

Vibration levels from the rigid bedplate must meet class requirements.
The motor rotor (complete) to be dynamically balanced at top speed to the best possible standard (ISO 1940 grade 1 or better).

Propulsion motors to be arranged with water cooling system (IC86W) and IP44 rating. H/F class has been selected. All switchboards to be designed to reduce noise generation at bus bars, panelling, inductive components, etc. A gear box may be included for the protection of motors.

All distribution transformers shall be built with particular attention to rigidity and clamping. They shall have air natural cooling and low flux density < 1,0 Tesla.

Propulsion Motors
AC motor designed for marine propulsion and AFE Frequency control.

Quantity: Two separated propulsion line propeller shafts.

Continuous rating approx.: 2 x 2000 kW at 160 rpm propeller speed and 900 rpm el-motor speed.

Speed variation: 160-0-160 rpm propeller speed.
0-160 r.p.m. against torque proportional to speed characteristics

Rating: Maximum continuous
Provisional supply: 690V
Enclosure: 690 V, IC86W, H/F , IP44. Freshwater cooling.
Rotation: Counter rotation according to hydrodynamic model test results
Mounting: Horizontal foot mounted with two endshields mounted oil lubricated sleeve bearings, standard single bare shaft extensions.
Insulation: Class H with F temperature rise in accordance with Class rules.
Ancillary fittings: Tacho generator rpm. feedback.
4-stator embedded temperature sensors - PT 100 type.
2- bearing temperature sensors - PT 100 type
Anti-condensation heaters 230 V AC.

Variable speed propulsion drive system:

Ratings approx.:	2 x 2000 kW
Speed range:	0-160-0 rpm
Supply:	690 V 3 phase 50 Hz
Configuration:	2 x AFE frequency drive
Specification:	British Standards or any equivalent international standards as per class requirement

RR for main propulsion machinery for unrestricted service.
Protection: IP23

Ancillary fittings: Local instrumentation, diagnostic display unit, indication lamps, control equipment for normal and emergency control selection of local/remote control. Interface equipment for remote control, cooler leakage detector, vibration sensors for motor bearings at both ends and necessary aux. equipment for control and interface to other systems.

Insulated 4 - 20 mA signals to be arranged for remote control and indications.

Necessary line chokes/interbridge reactors.

Panel mounted control panels for ECR and Wheelhouse consoles. Including start/stop control and necessary indication and instrumentation for each motor. Common manoeuvring controller with separate speed reference to both motors.

Propulsion motors are to be of high efficiency type. Insulation class F temperature Rise B. Local and remote monitoring of all parameters of motors are to be made available at various locations.

63. PROPELLERS, TRANSMISSIONS

631. Propeller plant

Main Propeller
The vessel to be equipped with two min. 5 blade slow running, open fixed pitch type propeller of NiAlBr or other suitable material for a low noise propeller. Propellers to be designed according to noise and class requirements.

During design of the propeller consideration must be given to all different operation specified for the vessel. A propeller inspection window with the requisite diameter as per class may be provided.

Propeller diameter to be approx. 3,3m.
The propellers should be made with appropriate anti singing measures incorporated. A propeller with bolted-on blades enabling later manual adjustment of pitch to be considered(in case of none-performance of propeller with respect to noise). In case of not meeting the performance requirements, Builder may re-design/modify the propeller as appropriate.

The propellers should be made with appropriate anti singing measures incorporated.

The construction of the propeller to be based on the requirements of Class and by the requirement for the lowest noise level as specified by the Noise Consultant. See relevant Annex for details.

Shaft vibration and torsional calculations to be carried out by the propeller manufacturer.

Brake to be arranged on tail shafts for locking propeller rotation, manual and electric operation.
Shaft earthing equipment for propeller shaft to be mounted.
Shaft power meter with integral measuring system for torque, r.p.m. and power to be mounted on the shaft.

637. Thrust bearing and coupling

Thrust bearing to be fixed mounted on propeller shaft. The thrust bearing to be of oil self -lubricated type with built on oil cooler.

Turning gear to be mounted on the forward flange of the thrust bearing.

Max. ambient temperature for the thrust bearing: +45oC.

Shaft earthing equipment for propeller shaft will be mounted.

Shaft power meter with integral measuring system for torque, r.p.m. and power to be mounted on the shaft.

644. Auxiliary Boiler

One (1) off combined oil-fired and electric hot water boiler to be installed with capacity sufficient to serve the intended purpose.

Fuel oil	: marine diesel/gas oil
Electric heating	: min 4 x 50kw
Oil fire capacity	:appr.. 400 kW

The boiler to include a fully automatic burner, necessary safety valves, safety thermostat, operating thermostats, alarms, water-level monitor, etc.
Common alarm outlet to be connected to the AMS.

Cleaning equipment and injection equipment for soot remover to be included for the boiler. Soot blower to be included for exhaust pipes and boiler.

The boiler to be insulated with minimum 50mm mineral wool and all covered with galvanised and painted sheet steel.

Spare parts for the boiler to be supplied according to Maker’s recommendations for two (2) years normal consumption.
One (1) fully automatic spare burner to be included for the hot water boiler.

65. MOTOR AGGREGATES FOR MAIN ELECTRIC POWER PRODUCTION

651. Motor aggregates

Four generating sets to be installed.

Where necessary structure-borne vibration from all reciprocating, or rotating machines should be controlled by the following means:

- Selection of inherently well-balanced machines
- Use of vibration isolators, selected base plates and support: such measures to be applied as required to machines, pipework, exhausts, etc.

It is anticipated that reciprocating and rotating machines, including associated pipework and services will need to incorporate single-stage isolation. The isolation system specified for the propulsion prime mover(s) will need to be assessed in order to comply with the requirements for limitation of vibration internal to the vessel. It must also be compatible with the noise specification. The flexural response of the diesel engine bedplate should be such that no resonance arises near any excitation frequencies.

General

Engine type : Medium speed (abt. 1000 rpm).
Number of engines : 4

The rotation of the engine seen against flywheel to be agreed upon.
The inscriptions on the diesel engine are in the English language.

Technical particulars

Cylinder configuration : In-line or V type is acceptable subject to Silent A compliance
Maximum Continuous Rating (MCR) : abt. 1600 kWe (generator)

The engines will be tested in the workshop in accordance with the requirements of the classification society and Suppliers standard, based upon the maximum continuous rated power stated above.

The fuel oil used during the test run is MDO. After test run, the fuel rack position will be limited as stated above.

NOx emissions

The engine complies with the maximum permissible NOx emission according to MARPOL 73/78 ANNEX VI.

Turbocharger cleaning device

Number per shipset : 1
Turbocharger water cleaning device for turbocharger turbine and compressor side:

- Dosing unit
- 10 meter hose with quick couplings

Exhaust gas bellow

Number per shipset: 4
Flexible expansion bellow after turbocharger, including counter flanges, gaskets, bolts and nuts.

Exhaust gas silencer with spark arrestor

Number per shipset: 4
Exhaust gas silencer with spark arrestor, complete with counter flanges, gaskets, bolts and nuts. Noise reduction approximately 35 dB(A).

Control and monitoring systems

Power Units

Number per shipset : 4

Power supply unit for supplying isolated dual 24VDC to the engine.
Cabinet for bulkhead mounting, protection degree: IP44
Main components:

- 230VAC/24VDC power supply converter
- 24VDC/24VDC power supply converter
- Miniature Circuit Breakers (MCBs) and terminals

Each converter is dimensioned for 100% load. Failure of one supply will cause automatic takeover by the second supply.

Power supply, needed from ship's system:

- Main: 230VAC / abt. 150W
- Backup: 24VDC/ abt. 150W.

All of these must be UPS battery backed up.

Power supply to diesel engine control to be adapted to engine supplier.

Electric motor starters
Starters for electric motor driven pumps
Number per shipset : 4
Motor starters included:

- engine built on pre lubricating oil pump (4 pcs)
  Features of the starters:
- local start and stop control
- standby-, remote- or automatic mode as applicable

Foundation
Flexible pipe connections, spare set
Number per shipset : 1
Spare set of flexible hoses including one for each type of pipe connections on engine(s).

Flexible pipe connections
Flexible hoses for all pipe connections on each engine(s).

Common base frame
Number per shipset : 4
Foundation for the engine and the alternator:

- Common base frame of welded steel
- The generator and engine will be mounted on the common base frame at factory
- Alternator fittings materials are included.
- Flywheel cover between engine and alternator
- A test run is carried out with the complete genset on the Maker's test bed.

Power Transmission
Flexible coupling (flywheel)
Number per shipset : 4
The final choice of flexible coupling will be based on the torsional vibration calculations (made after the order).
Bolts for connecting the coupling to the flywheel

Main alternators:
Silent pole brushless synchronous AC Generator designed for marine duty.
Quantity: 4 to run in parallel

Continuous rating abt.	: Four(4) x abt. 1600KWe
Speed max	: abt. 1000 rpm.
System	: 690 V 3 phase 50 Hz (1500 rpm)
Power factor	: Optimised to system (0,7 - 0,8)

Protection	: IP44
Type	: Horizontal shaft, foot mounted, salient pole, revolving field marine generator complete with AC exiter. PMG and fresh water cooled air cooler (IC81W) top mounted with double tube heat exchanger.
Bearing	: Two end frames mounted. Self lubricated. Sleeve bearing, insulated to prevent the flow of shaft current.
Insulation	: Class F with Class F temperature B rise in accordance with Class Rules.
Ancillary fittings	: 6-stator embedded temperature sensor - PT100 type

1- bearing temperature sensor - PT 100 type
1- air circuit temperature sensor - PT 100 type
Cooler leakage tray with overflow drain and leakage detector with alarm contacts.
Anti-condensation heaters 230V AC.
Reactance: To be optimised and matched to system.

The load sharing to be included in the diesel engine delivery based on isochronous load sharing and with drop regulation as back-up.

Two bearing sensors. Local and remote monitoring of all parameters of motors are to be made available at various locations. Automatic Voltage regulation AVR is to be included.

The Generator engine RPM and speed shall be from dual sensors.

665. Harbour generator

A harbour generating set to be arranged in a separate room as shown on General Arrangement plan.
The set to be arranged on a common bed-frame which is to be resiliently mounted on strong and stiff foundation/ seating in the ship structure.

Type	: Turbo charged 4-stroke marine diesel
Rotational speed	: 1800 rpm
Lubrication	: Wet sump
Fuel type	: MDO
Starting	: Direct compressed air
Cooling	: Freshwater
Silencer	: 35 dB

The aggregate to be arranged with standby function, automatic start, phasing in on the switchboard and connecting up to essential loads.
The motor aggregate to be arranged with stand-still heating according to the manufacturer's recommendations.
The engine to have separate exhaust thermometers on each cylinder and before and after turbocharger in addition to an exhaust gas temperature central being a part of the centralized alarm system.
Turbo chargers to be equipped for and arranged with water washing on both air and exhaust side.
Preheating/still-stand heating to be arranged for each engine with separate plate heat exchanger and freshwater circulation pump.
Hot water to the heat exchanger to be taken from the boiler's technical fresh water.

Alternator:
Salient pole brushless synchronous AC alternator designed for marine duty. Exciter to be “oversized” for handling of failure modes.

Power	:	1000 ekW
Speed	:	1800 rpm
System	:	690 V 3 phase 50 Hz

Power factor	:	Optimized to system, (cosfi=0,8)
Cooling	:	Freshwater-cooled air cooler top mounted with double tube heat exchanger.
Enclosure	:	IP44
Bearing	:	Two end frames mounted. Sleeve bearings.
Insulation	:	Class F

666. Emergency generator

1 off Emergency diesel engine driven electrical generator set to be installed and located as shown on General Arrangement, fire-insulated compartment if required according to Class.

The set to comprise a turbo-charged radiator-cooled diesel engine with an air-cooled generator, 25dB exhaust silencer and any other necessary equipment. The diesel engine to be air-cooled. The generator set to be electrical started with its own charging system and battery bank and charger / battery bank back up. The rating of the generator shall be based on the load analysis.

The engine and generator to be mounted on a common frame resiliently mounted to a stiff foundation to minimise the transmission of vibrations to hull structure

Pipe connections on the engine/generator set to be flexible mounted.

Alternator rating: Acc. to class requirements.

Voltage:	690 V - 3 phase
Frequency:	50 Hz.
Diesel engine fuel: Marine diesel oil.	

The generator set shall be arranged for both automatic and manual start.

7. SYSTEMS FOR MACHINERY MAIN COMPONENTS

General

During installation, any pipework should be planned so as to avoid sharp bends.

Radius on elbows for pipes of sea water, fresh water, sanitary (except vacuum system) to be considered. Low velocity or large radius bends to be installed. H.P. hydraulic systems will preferably be 2,5 times the diameter of the pipe where possible. Straight pipe spools with smooth bends to avoid noise to be installed before and after pumps, coolers, overboard valves and machinery. The stub piece between the overboard valve and side shell should be Sch 160. Standard T joints or stub in connections may also be used for pipe junctions as per class.

Flexible hoses to be used at transition areas between equipment and components. Saddle bends to be used for all pipe junctions.

In general rubber to be used between pipe clamps and pipes. Special consideration to be made in respect of clamping of pipes in noise critical systems. Flow rates should be calculated and verified during the design stages to ensure that they comply with specified design parameters.

All machinery systems and piping to be arranged in accordance with the best workmanship, properly clamped and with necessary amount of expansion bends all according to drawings approved by the Class, Owners and the Authorities. The installation to be properly planned to avoid vibration and for good access to dismantle the pipes. An adequate number of flanges to be provided to facilitate maintenance. Spectacle flanges shall be provided between the side shell and sea side valves for easy maintenance at sea. Overboard design shall be as per class requirements.

Where butterfly valves are chosen, Lug type to be used before and after pumps, and on connections to e.g. crossover tank.

Pumps in general to be resiliently mounted as recommended by the noise & vibration consultant. All pumps are to be provided with mechanical seals.

Pump fluid	Casing	Impeller	Shafting
Seawater (Cooling- and ballast water)	Cast iron	Al. Bronze or monel	Stainless steel
Fresh water (cooling water)	Cast iron	Al. Bronze	Stainless steel
Sea water (sampling water for the wet lab)	Nylon/PTFE	Nylon/PTFE	

Pipe velocity

For various systems, the maximum velocities to be as follows:

Sea water pipes (Galv. Steel) discharge:	2,5 m/s
suction:	1.5 m/s
Freshwater pipes pressure side:	2,5 m/s
suction:	1,5m/s
Fuel oil(MDO) pipes pressure/discharges:	2,5 m/s
suction:	1 - 2 m/s
Lub.oil pipes discharge:	2,5 m/s
Suction:	0,8 m/s
Exhaust lines:	30- 40 m/s
Bilge pipelines: Class Requirements or a maximum of 3,5 m/s.	
Non-toxic water:	3,5 m/s
Hydraulics high pressure:	3,5-4,0 m/s

All piping systems to be dimensioned according to Class Requirements for "Unmanned Machinery Space" and unrestricted service.

Steel pipes to be welded where necessary and galvanised afterwards. All pipes to have drainage connections where necessary.

Pipes to be marked to Owners' s standard with flow code and colour identifications.

All pumps to be equipped with manometers and vacuum gauges 100 mm minimum diameter to best practice.

The pumps will preferably be of vertical (if possible and practicable) type and to be flexibly mounted.

70. FUEL SYSTEMS

The fuel oil system to be in accordance with Class Regulations and requirements from suppliers of main engines.

Pipes to be of black steel. Valves to be of ball or globe type made of steel.

Fuel- and lubricating oil pumps:

Pump type	Casing	Gear	Idler	Rotor
Gear	Gun metal	Carbon steel		Carbon steel
Screw	Cast iron	Cast iron	Nitride iron	Carbon steel

701. Fuel oil transfer and drain system

Bunkering will be arranged at suitable locations on both sides. Filling capacity for fuel oil appr. 100 m³/h.
Flowmeters, test-cock and strainers to be fitted on filling pipes.
Safety valve on filling lines to be arranged with overflow to Overflow tank.

Filling pipes to be arranged from bunker stations on each side, to fuel oil valve manifolds in engine room. Remote operated valve chests to be installed. All fuel oil bunker tanks and overflow tanks to be connected to the valve chests. The system to be arranged for fuel oil to be pumped from one tank to another.

Black steel piping to be used in general, with thickness acc. to regulations.

Quick-closing valves for fuel oil pipes to be mounted on tank bulkheads of high tanks acc. to requirements.

Remote control panel to be mounted outside of the engine room.

Pipelines to be of seamless steel, flanged connections for DN40 and larger, and joints compression coupling with cast iron/steel fittings for smaller pipes.

2 off electrically driven MDO transfer pumps to be installed, each having a capacity of 30 m3/hr at 2 bar.

702. Fuel oil purification plant

Fuel oil separators to be installed to pump from resp. settling and service tank and discharge back to the same tanks. Also suction from fuel oil valve chest and drain tank to be arranged. 2 fuel oil separators to be installed. Separators to be back up for each other.

The separator system to consist of the following components:

- Two (2) off self cleaning fuel oil purifiers, capacity according to engine supplier's recommendations
- Two (2) off separate booster pumps
- Two (2) off electric preheaters, capacity acc. to purifier supplier recommendation

Two (2) off filter separators to be provided for continuous cleaning and water separation of the FO. Suction from resp. settling and service tanks and discharge back to the same tanks. Also suction from fuel oil valve chest and drain tank to be arranged.

One (1) off steel working bench with a steel wash basin and drawer to be arranged in Separator room. FO supply and drain to FO-drain tank be arranged.

703. Fuel oil supply systems

The main engines to be fed from daily service tanks, through duplex strainer, engine mounted duplex filters and engine mounted booster pump.

The fuel oil leakage from fuel nozzles of generator sets to be led back to the fuel oil drain tank, with double skin fuel oil pipes if required by class. FO drain tank is to be fitted with high alarm.

The service and settling tanks to be equipped with alarm for high/low level, quick closing valves, self-closing drain valve and other valves.

Each tank to be fitted with local level indicator gauge and connections to the remote sounding system.

Harbour Diesel Generator System to be provided with separate MDO service tank with capacity for minimum 24 hours normal load. Tank to be fitted with low level/high level alarm and automatic start and stop of filling pump.

One (1) pump for automatic filling of fuel tank for harbor generator to be arranged.
Capacity of pump approx. 1,5 m^3/ h - 3,5 bar.

Emergency Diesel Generator System to be provided with separate MDO service tank with capacity acc. to class requirement, fitted with low level/high level alarm and automatic start and stop of filling pump. Minimum capacity of service tank acc. to requirements from Class/Authorities, but not less than 24hours.

One (1) pump for automatic filling of fuel tank for emergency generator to be arranged.

Capacity of pump approx. 1,5 m^3/ h - 3,5 bar.
The same pump to be used for filling of MOB-boat and working boat. Remote control of pump to be arranged when filling boats by means of dispensing nozzle.

Pumps for harbour and emergency generator tanks to be cross connected as emergency backup for each other.

Incinerator System to be supplied with FO from a separate pump with suction filter on the day tank. Automatic start and stop. Capacity acc. to Supplier recommendation, see separate group.

71. LUBRICATING OIL SYSTEMS

Lubricating oil pipes to be of seamless black steel pipes.
Valves to be of ball or globe type made of steel.

711. Lubricating oil transfer and drain system

Lubricating oil storage tanks with filling pipes to be arranged from bunker stations PS/SB midship.

The transfer system to consist of the following components:

- 1 off lubricating oil transfer pump capacity 6 m³/ h - 3 bar for gensets.
- 1 off lubricating oil transfer pump capacity 0,5 m³/ h - 2 bar for thrusters.
- 1 off hydraulic oil transfer pump capacity 1 m³/ h - 2 bar for HPU's.
- 1 off lubricating oil transfer pump capacity 1 m³/ h - 1 bar for Steering gear.

Storage tanks, system tanks for different type of oils to be arranged. All tanks to be connected with filling and emptying arrangements. Approved level indicator, drain valve and drip tray to be mounted on each tank.

An electric driven pump to fill the Expansion Tank Steering Gear from the Storage tank to be installed.

For emptying of Sludge Tank a Sludge/Dirty oil pump with capacity appr. 5m3/h to be fitted with pipe and flange according to IMO, for delivering oil ashore.

On completion of work of all hydraulic system, the system shall be flushed up to with temporary filters and magnetic catchers complying with ISO/NAS 1638/SAE cleanliness class as recommended by maker.
a) The flushing of LO service line of Main engine and Azimuth, Bow and stern thrusters LO service line shall be done by the system oil up to cleanliness class as recommended by maker.
b) The flushing of Compressed air, LO filling/transfer system shall be blown by compressed air.
c) The hydraulic piping for remote control of valves shall be blown off by N2 gas.

712. Lubricating oil purification plants

A lubrication oil purifier system to be arranged for each of the main generator sets.
Each system to consist of the following components:

- One (1) off self cleaning lubricating oil purifier. Cap. according to rec. from engine supplier.
- One (1) off lubricating oil purifier pump (separate pump).
- One (1) off preheater, cap. acc. to purifier supplier's recommendations.

Off-line filter separators to be provided for continuous cleaning and water separation of each individual LO system on MDGs.
In addition two (2) off mobile type offline filter separator units to be provided, for miscellaneous purposes.

Connection points to be arranged for separation of the thruster oil systems.

The sludge tank for purifier plant to be equipped with high level alarm switch and hot water heating.

713. Lubricating oil systems for propulsion machinery and transmissions

Each diesel generator set to be of wet sump design and to have an independent lubricating oil system.

Each system to include:
- 1 off engine driven lubricating oil pump
- 1 off lubricating oil priming pump electrically driven
- 1 off lubricating oil filter, duplex type.

Lubricating oil system for the engines and thrust bearing to be in accordance with the manufacturer's recommendation. Standby lubricating oil pump to be installed for thrust bearing if required by class. Pump to be with automatic start/stop arrangement.

Drain pipes with valves to be arranged for easy oil change on thrust bearing, propulsion motor bearings and generator bearings.

The stern tube to be lubricated from a lubricating oil tank situated approx. 1,5 - 2 m above DWL. The system to include a lubricating pump sufficient for allowing for low revolution opertation of the shaft. Drain and air pipes to be arranged.

Breathing pipes from engines crank cases to be led to top of funnel. Pipes will have efficient drain.

On completion of work of all hydraulic system, the system shall be flushed up to with temporary filters and magnetic catchers complying with ISO/NAS 1638/SAE cleanliness class as recommended by maker.
a) The flushing of LO service line of Main engine and Azimuth, Bow and stern thrusters LO service line shall be done by the system oil up to cleanliness class as recommended by maker.
b) The flushing of Compressed air, LO filling/transfer system shall be blown by compressed air.
c) The hydraulic piping for remote control of valves shall be blown off by N2 gas.

714. Lubricating oil systems for emergency engine

Engine for emergency/harbour duties to be delivered with integral lubricating oil system, pre-warning and autostop system. Autostop system only to be active during harbour generator mode.

721. Sea water cooling system

Sea water is taken from the sea chests stbd. and port side connected by the "cross-over-tank" with independent inlets for each side (high and low).

Sea water cooling pipes all over vessel to be CuNi 90/10..

Valves to be of cast iron/Gunmetal or Bronze. Overboard and sea inlet valves to be of Nodular Cast Iron.

Stainless steel ship's side valves to be fitted from non toxic water supply.

Sea chests and crossover cofferdam to be fitted with sacrificial anodes to avoid corrosion of pipes and equipment.

Sea water inlet capacity to be adequate to supply all machinery running simultaneously.

Cooling system according to manufacturers' recommendation.

Two cooling water systems for main gensets to be arranged, one PS system and one SB system.
Each system to consist of the following components:
- 2 off central coolers with minimum 100% capacity for two genset.
- 2 off seawater pumps with 100% capacity for two genset.
- One common st.by pump to be arranged.

All pumps to be provided with continuous speed/adjustable speed controls.
Coolers to be arranged for backflushing to prevent ice blockage.

Separate SW aux cooling system to be arranged serving aux FW cooling system.
Two SW pumps and 2 central coolers to be arranged for the aux system.

Central cooling heat exchangers to be Titanium plate-type or rack coolers designed for maximum inlet sea water temperature as described Gr.101.

All pumps to be vertical mounted centrifugal type with electric motor and provided with automatic purging ejectors, with drain pipes to bilge well. All functions to be monitored in control room on mimic board showing all pump running conditions. All to be monitored and controlled as per requirements from Class.

Sea inlet valves on sea chest to be controlled as required by Class, and as a minimum from above floor plates with suitable indicators showing open/shut position. In addition the sea inlet valve to be remote operated from engine control room. Strainer plates of stainless steel with filtering area according to Class, and in any case at least three times the cross-sectional area of the pipes, to be provided and properly fastened to the hull shell plates.
Sea chests and crossover cofferdam to be fitted with sacrificial anodes to avoid corrosion of pipes and equipment.
Inlet strainers to be fitted, made of cast iron with strainers of AISI 316L. Thick walled corrosion pipes of mild steel to be arranged in all SW pipe systems. Sufficient number of spare corrosion pipes to be delivered to the Owner´s satisfaction.

A copper-ion-generator plant to be arranged for Engine room sea inlets, except for sea inlets for FW-makers and scientific purposes.
The plant to include dozing pump with control panel , dozing tank with copper anode and pipes with connections to each sea chest.
4 spare copper anodes to be delivered.
Sw inlet from cross-over-tank.
Capacity according to Maker's recommendations. Arrangement for cleaning of pipes to be included.

Pressure gauges to be liquid filled.

Separate SW Pumps for RSW-plant for laboratories, chilled FW water plant according to Supplier recommendations'

722. Fresh water and other cooling systems

Pipes to be of black steel. Valves to be of cast iron butterfly type with rubber coating. EPDM sealing to be used for HT systems.

Two FW cooling circuits to be arranged, one PS system and one SB system. It is important that leakage in one system do not affect the function of the remaining systems.

Each of the freshwater cooling systems to be according to engines suppliers recommendations.

Central fresh water cooler shall be provided with Automatic temperature control valve of electric or pneumatic type for regulation of cooling fresh water temperature.

Each engine to include:
- 1 off engine driven low temperature cooling pump
- 1 off engine driven high temperature cooling pump
- 1 off preheater.

Pump capacity according to engine manufacturer's requirements. The engines to be cooled by freshwater in closed system. The fresh water will be preheated by heat exchanger and circulated by electrically driven circulating pump. This to preheat engine prior to load being applied.

Venting to be arranged on the highest point of the pipes. Expansion tanks to be equipped with alarm for high and low level. Thermostatic "By-pass" valve to be situated before heat exchanger.

Auxiliary FW systems to be installed to cover cooling of e.g. Bow-thrusters-Stern thruster propulsion electrical motors, winches with drives, Thrust bearing, all refrigeration plants, HP oil cooler and other minor systems.

73. COMPRESSED AIR SYSTEMS

Pipes to be of seamless black steel. Valves to be of steel and globe type or ball valves to be used.

731. Starting air system

Starting air compressors of 30 bar pressure to be supplied to the starting valves on main engines and starting air bottles. The compressors to have double resiliently mounting. Typhoon to be supplied through reduction valve, 30-8 bar.

Pipes for starting air of "seamless high pressure type". Pipes for instruments and remote control to be of copper.

2 off starting air bottles to be arranged with capacity in accordance with Class requirements. Drainage of bottles to bilge and blow-off pipe to open deck to be arranged. Air supply to typhoon in signal mast from both bottles.

2 off air compressors air cooled for charging the air bottles

Automatic start/stop and automatic unloading with auto drain to be installed for both compressors.
One of the compressors to have el-supply from emergency switchboard,

Manometers showing pressure in both bottles, reduced air and control air to be fitted.

Operating air for valves on anti-rolling tank to be taken from starting air system reduced to 10 bar.

One (1) off specially designed small drain tank to be supplied. All drain pipes from starting and working air compressors, air bottles etc. to be led to this tank. Emptying arrangement to bilge holding tank and air vent pipe to be provided.

732-733. General purpose air system (low pressure)

Compressed air to be arranged for remote controls where required for the followings areas:

- Engine room: 4 outlets
- Propulsion room: 2 outlets
- Engine room workshop: 1 outlet
- Deck workshop: 1 outlet
- Electrical Workshop: 1 outlet
- Separator room: 1 outlet
- Winch drive room: 1 outlet
- Bow thruster room: 1 outlet
- Wet Lab.: 1 outlet
- CTD Hangar.: 1 outlet
- Hydrographic/oceanographic lab: 1 outlet

- Emergency Generator room: 1 outlet
- Harbour generator room: 1 outlet
- Main Hangar: 2 outlets
- Main deck Portside aft: 1 outlet
- Main deck Portside Fwd: 1 outlet
- 1st deck: 1 outlet
- Sew. treatment plant area: 1 outlet
- Electronic lab: 1 outlet
- Clean General purpose lab: 1 outlet.

Connections of "quick snap on"-type.

One working air compressor for working air with air bottle 500 litres to be provided at 8 bar.

Pipelines for domestic working air also to be supplied from the starting air system through two(2) off pressure reducing valves in parallel from 30 Bar to 8 Bar.

Air for instruments and remote controls to be taken from reduced pressure airline into control panel containing oil/dry filter, valves and manometers.

Air for evacuation of wash-down pipes for wheelhouse windows to be installed with outlets from 7 bar working air system. Solenoid valves to be used, remote controlled from Wheelhouse consoles.

Necessary ice-blowing and de-ice facilities to be arranged.

The control panel to be arranged with double set components and separate lines with 3-way valve. Instrument air to have system for removal of water from the air before going to instruments.

734. Instrument air supply system

Instrument air to be supplied from starting air system, by means of two (2) reduction valves 30-8bar and filter system, supplied by engine Maker. Back-up from working air system.
Two (2) off air cooling dryers and one (1) off 60l instrument air buffer tank to be installed. Each dryer also to be arranged as backup for the other.
One (1) off instrument air outlet with quick coupling to be arranged in Engine room.
Control air supply for anti-rolling and anti-heeling system to be arranged according to Maker's recommendations.

735. High pressure air compressors

Two(2) high pressure air compressors to be installed in the engine room. Compressor unit with el. motor to be installed on a common frame with flexible mountings. Compressors to be arranged with facility for analogous instrumentation and to have interface to ship alarm system. 2 nos control air de-humidifiers refrigerated type shall be provided after the pressure reducing manifold of main air compressor for control air.
The compressors to be operated locally and from the Engine control room.

Technical data :

Compressor :

Type:	Combined screw/piston compressor.
FAD:	25 m3/min / 883 cfm
discharge pressure:	138 bar(2000 psi) as well as 207 bar (3000 psi)
speed:	1500 rpm
power requirement (cmp)	391 kw

number of stages/cylinders:	4/2

Electric motor:

type:	AC, squirrel cage induction
power:	225-450 kW
speed:	750-1500 rpm
voltage:	3 x 690 V
frequency:	50 Hz
cooling:	water cooled
sea water flow:	appr. 68 m3/h

Yard to include complete installation of compressors with related systems. Spare-parts to be delivered as recommended by supplier.

736. High pressure air system:

A high pressure air system to be installed.

System to include :

- high pressure air compressors
- air bottles
- drain bottles
- valves
- air manifold
- piping system for ~~four(4)~~ two(2) gun winches(ref. item 487) on aft deck.

HP air piping

Pipes to be of stainless steel AISI 316 to ASTM 269 TP 316/DIN 2391 C. All the cross blocks, flanges , tee flanges and manifold to of AISI 316 or st 52.3 Stainless steel type GS-Hydro A/S or similar . Valves to be ball valve MKH or non return NRSF material AISI 316 type GS-Hydro A/S or similar.

All the pipes, valves and fittings to have working pressure 3000 psi (207 Bar) and to be certified.
A Fischer-valve with silencer to be installed. Outlet to be arranged in funnel.

Pressure test of air system :
After complete installation and approved by Owner`s Representative, a hydrostatic pressure test to be done of the total system.

Immediately after the test, all liquid to be drained from the system, all blanking flanges removed and pipe system carefully connected. When system is ready for operation a test-run of all compressors will be required as well as a final air-leak inspection and settings of pressure control valves.
Test pressure to be according to Class/supplier requirements.

Class surveyor and Owner's Representative shall be notified to participate during the test. Class surveyor to issue test certificates.

74. EXHAUST SYSTEMS AND AIR INTAKES

743. Exhaust gas systems for propulsion machinery

Exhaust pipes to be stainless steel on top of casing and appr. 2m below the top of casing or as far down as necessary for practical reasons.

Silencers to be installed with approved type vibration dampening supports.

In order to minimize back pressure on engine the exhaust-pipes to be as straight as possible. Silencers to be of 35 dB reduction type.

Expansion joints to be mounted in exhaust pipe lines where recommended by manufacturer.

The exhaust pipes to be insulated and covered by thin stainless steel plates. Thickness of insulation to be 50mm for all engines.

Removable insulation cushions and covers to be mounted on flanges and expansion joints.

A water trap, complete with drain cock, to be arranged in the lowest point of each uptake to prevent the ingress of water into the engines.

744. Exhaust system for motor aggregates

Exhaust pipes from harbour/emergency gen set to be arranged similar to what is described in gr. no. 743. Silencer with damping capacity 25 dBA to be installed for engine, to be supplied by engine makers.

Outside part of pipes to be of acid resistant stainless steel, and to have special bend down-and out to avoid water ingress.

745. SCR Catalytic System for NOx Reduction

Each generator sets exhaust gas system, except the emergency set, shall be fitted with a catalytic system to reduce the nitrogen oxide in the exhaust gas to comply with IMO MARPOL Tier III.
The installation consists basically of reactors, which are the core of the installation, injection units and compact units, where the urea solution is pumped and dosed for the desired NOx reduction. These compact units are provided with dedicated control cabinets. Alternatively the urea solution can be fed with separate pumping and dosing units, which are controlled be separated control units.

The system shall be installed in association and prior consultation with the diesel engine supplier.
Installing the system shall enable the optimizing of all engines in order to reduce the vessel's fuel consumption which, in turn, reduces the carbon dioxide emissions.

SCR to be installed before silencers in the lower part of casing as per recommendations form supplier. Urea water to be used as reducing agent.

System to include NOx monitoring system for each engine.

SCR to be installed before silencers in the lower part of casing as per recommendation form supplier.
The total noise attenuation 35dB shall include silencer and SCR and max back-pressure in exhaust system to be checked/approved by engine manufacturer.

76. DISTILLED AND MAKE-UP WATER SYSTEMS

761. Distilled and make-up water systems

Two Reverse Osmoses (RO) fresh water plants to be fitted complete with pipes and with necessary alarms etc., having a capacity of 2 x 20 tonnes/ 24 hours at 25 degr C seawater.

The installation to be capable of producing 100% clean water. The plant to be fully automatic in operation with salinity control and alarm. Separate SW inlet to be arranged from “clean” side of the vessel.

Electric preheater (7,5 Kw) to be installed for sea water to the RO unit to allow for high efficiency in cold water.

In addition to RO plants, one FW generator of waste heat/steam type may be installed.

79. AUTOMATION SYSTEMS FOR MACHINERY

Automation and instrumentation to be designed to comply with the Class requirements for "E0" for an unmanned engine room.

Centralised microprocessor based controls, instrumentation and monitoring equipment to be arranged suitably in console in control room and with VDU in wheelhouse console.

System arrangements to be such that no single fault, failure of power supply or system malfunction will prevent effective plant control being retained.

Control systems design to allow the operation of plant under automatic control across the full operating range with variables maintained at their set values.

All remotely controlled machinery, motors and equipment to be also capable of manual local control.

Cabling from sensors to output services (such as valve actuators) to be continuously monitored to detect both open and short circuits and defects in the field components.

Any fault condition in a microprocessor based system shall initiate an alarm, giving both the nature and location of the fault.

Where possible, safety systems to be designed as NO-circuits with loop monitoring (normally open) and alarm systems as NC-circuits (normally closed).

Consideration to be given in the design of all equipment to the environmental conditions of shipboard service and proven marine components to be employed. Particular emphasis to be placed on corrosion, temperatures, vibrations, shock effects, power supplied and electrical interference effects.

The automation and instrumentation plant to be based on a system with separate sensors for alarm circuits, safety systems and control loops.

Integrated control and Alarm monitoring system shall be provided for all power plant equipments with UPS.

Instrumentation:
Local instrumentation of good marine quality to be installed for local control of the machinery in case of emergency.

Local instrumentation to be provided to normal marine practice including pressure gauges on suction and pressure sides of all pumps.

All units to be in accordance with the SI system, except for pressure and speed where bar, r.p.m. and knot to be used respectively.

Instruments to have an accuracy of at least +/- 2% of full scale values.

The range of the gauges and transducers to be selected so that the normal operating range does not exceed 70% of the full scale reading. Pressure gauges for local measuring to be located either in the local panel or to be of bulkhead mounted type. Gauges and transducers to be flexibly mounted and provided with shut off and test cocks..

Thermometers for local measuring to be of the brass encased glass tube type, located direct in pipes, etc. In restricted spaces thermometers of the dial type may be used.

Temperature transducers to be of the PT100 type, except for high temperatures (above 200ºC), which are to be Ni/CrNi type (Thermocouples).

Pocket to be installed for all temperature sensing elements to permit removal of sensor during operation.

Pressure transducers to be of 4-20 mA type. Pressure transducers and pressure switches to be provided with test cocks.

All transducers, pressure and temperature switches, pressure gauges etc. to be grouped where practicable on bulkhead mounted plates.

Level sensors of analogue type located directly on tanks to be arranged for easy removal without draining the liquid from the tanks.

Level switches of magnetic type with test facility or equivalent to be located directly on tanks with possibility of replacing the switch element without draining the liquid from the tanks.

All sensors and instruments to be marked with unique identification number and display text.

791. Manoeuvring consoles. Main consoles

Manoeuvring Equipment on Wheelhouse:
Wheelhouse central system for main propulsions plant to be fitted in wheelhouse according to Class Requirements. The equipment to be arranged in main manoeuvring console with slave control in aft console and port and starboard Wheelhouse wing consoles.

The main manoeuvring console to include at least the following equipment:

- Main propulsion control and indications
- Steering handle
- Rudder angle indicator
- Thruster controls
- Whistle control
- Internal communication equipment and external
- Steering gear panel including emergency control
- Engine order telegraph (emergency)
- Wheelhouse equipment for automation system according to Class Requirements for unmanned engine room operation
- Autopilots
- Equipment for Joystick/DP system
- Ships communication and navigation equipment

- Switch panels for light window heating, window washing and window wipers
- Morse key

Safety consoles to include:
- Fire alarm central
- Panel for internal watertight door
- Navigation light panel
- Switch panel for outdoor lighting

Two consoles arranged at Wheelhouse wings, as well as aft console to include following:
- Rudder angle indicator
- Thruster controls
- Main propulsion control and indicators.
- Steering handle.
- Whistle control.
- Internal communication equipment and external.
- Switch panel for deck light and window wipers and washing.
- Emergency stops for thrusters and propulsion.
- Possibility to connect joystick.

Manoeuvring Control Equipment in Engine Control Room:
One central control station to be arranged in engine control room. This control station to comprise the main electrical switch boards and the central control stations with electronic automatic overload protection. The system should preferably include:

ME/Power Management/mode control, stand-by and re-start control of pumps and ventilation control.

Power management system is to include heavy consumers.

Specification of Power Management System to be submitted to meet Class requirements as specified.

The PMS to handle:

- Load-dependent starting and stopping of generators (Load dependent stop shall be possible to disable)
- Automatic standby start after black-out and automatic sequential restarting of essential equipment.
- Sequential starting selection/automatic change-over of generators
- Monitoring of critical parameters
- Load and frequency control
- Heavy consumer control/preferential trip.
- Automatic synchronization and load distribution and sharing
- Selection of standby sequence
- Re-establish power after blackout
- Controlling generator voltage and reactive load distribution
- Load distribution of active power (kW) for symmetric, asymmetric or (fast) load
- Handling of heavy consumers
- Limitation of generated effect in order to meet restrictions regarding short circuit power (automatic load shedding)
- Start blocking by fault detection (short-circuit)

Speed control system of the generator sets to be supplied by engine supplier.
Regulation functions for load shearing to be agreed upon. Following regulation principles to be discussed: Droop or ISO synchronous or others.

Min. following functions to be available on operator station:

- Total available power
- Total power in consumption
- kW – meter each bus
- Bus breaker indication (open / closed)
- Control and open of the bus-tie breaker when load is different on the bus-bars.
- The function for start and stop of pumps etc to be based on the open circuit signal for the purpose that loss of PMS function will keep the consumers in operation.
- Start sequence selection.

792. Common automation equipment, engine room alarm

Computerised Control, Alarm and Monitoring System
For control, alarm and monitoring a distributed microprocessor based system to be installed.

The system to accommodate as a minimum all alarms and remote indications as well as remote and automatic control specified for unattended machinery spaces in accordance with Class notation.

The system to incorporate a visual and audible group alarm system with panels in chief engineer, 1st engineer's cabin, Electrician's cabin, Mess room, Engine room workshop and Wheelhouse
In engine room, propulsion motor room and bow thruster compartment sirens and rotating lamps to be arranged.

Light column with indication for fire, fire extinguishing, communication, engine alarm system.

The system to take care of the following tasks:

- Alarm and monitoring
- Mimic picture presentation (a number of 50 mimic pictures to be available)
- Power management control
- Main engines alarm and safety system
- Alarm printing
- Data logging
- Condition monitoring
- Trends
- Remote control
- Remote sounding of tank volumes with computer processing of contents etc.
- Level alarming.
- Maritime electronic log books

The automation system to handle approx. 1800 I/O.

The alarm system must give visual and audible alarm in case of failures to the systems.

Alarms to be shown on 19" VDU engineering work stations. The alarm can only be acknowledged from the station on watch and not until the sound transmitter has been set off.

Alarms which are not acknowledged within a certain time limit, must release a general alarm (ref. watch call system).

The work station on watch must be permanently indicated on all VDU-work stations.

Alarms must be shown both on special alarm-list pictures and at their approximate location on the related colour graphic mimic picture.

On the alarm list and the colour graphic mimic picture the status of the alarms (alarm / not acknowledged / acknowledged) must be shown. Flashing for not acknowledged, change of colour for alarm/not alarm.

The first up alarm not acknowledged as well as the total number of existing alarms must be permanently indicated on all VDU-work stations.

In the system it must be possible to suppress automatically alarms when these are non- essential-for example low pressure alarms from main engines must be suppressed when these are stopped.

All alarms must have a filtering function (i.e. time delay) preventing alarms under normal operation conditions. This applies for tank level alarms which must have a delay which is greater than the natural rolling time.

The alarm system must have a facility for alarm monitoring of exhaust temperatures of diesel engines based on deviation from average.

Manoeuvring alarm must be indicated by means of flashing and sound.

Manoeuvring alarms must be specified on the display of the operating panels.

Logging of engine alarms and events:

- The system to register all occurring and acknowledged alarms on a printer in chronological order.
- The chronological listing must always include substantial mode events like e.g. start, stop of diesel engines etc., date and time.
- Further it must be possible to print a list of existing alarms, both activated with fixed time intervals and activated by the operator.

Watch / responsibility panel, signal device etc.
This include:

- Watch / responsibility panel in ECR console, LCD type.
- Watch / responsibility panel in Wheelhouse console, LCD type.
- Alarm panel in cabins (Chief Engineer's cabin), LCD type.
- Additional buzzer units in Chief Engineer, 1st Engineer and Electrician´s bedrooms.
- Alarm panel in cabins (1st Engineer and Electrician), LED type.
- Alarm panel in mess room, LED type.
- Alarm panels in workshops, machinery room, Propulsion room, Switchboard room, Separator room and Bow thruster room.
- Alarm siren in engine workshops (Mechanical and Electrical), LED type
- Alarm siren in Engine room and Propulsion rooms
- Flashlights in Engine room, Switchboard room, Harbour generator room, Separator room, engine stores, Propulsion room and Bow thruster room
- "Dead man system" ON/OFF panel
- "Dead man system" RESET panels (two off)

The acoustic signal shall have a loudness that can be heard in the engine room when the machinery is in service. The system also to be connected to personal pagers of marine type, with working range all over the Vessel.

- Five (5) off pagers to be delivered with the ship. To be approved by the Owner.

793. Automation equipment for propulsion machinery and transmissions, engine telegraph

Wheelhouse consoles:
Generally 4 Wheelhouse consoles to be installed. Main console is the forward console. In addition consoles for manoeuvring and operation of vessel to be installed port and stbd. and in the wheelhouse aft.

Wheelhouse consoles shall be based on the arrangement shown on General Arrangement Plan and shall include all necessary equipment for proper manoeuvring and operation of the vessel in the intended modes. All to the satisfaction of the Owner.

In the Wheelhouse consoles all manoeuvring handles, revolution counters, rudder indicators and propeller r.p.m. indicators and all instruments to have interior light. All lights in the manoeuvring desk with the exception of the warning lights to be provided with stepless dimming.

2 UPS units to be installed for automation system, each UPS shall be able to cover the power demand for the automation system.

8. SHIP COMMON SYSTEM

80. BALLAST AND BILGE SYSTEMS, SCUPPER PIPES OUTSIDE ACCOMMODATION

General
Ships system to be built according to diagrams approved by Class, Owner's Representatives and NMA.

Pipe velocity
For various systems, the maximum velocities to be as follows:

- Bilge pipelines : Class Requirements or maximum 3.5 m/s
- Non-toxic: 3,5 m/s
- Hydraulics high pressure: 3,5-4,0m/s
- Low pressure: 2,0–2,5m/s

Water pumps

Pump fluid	Casing	Impeller	Shafting
Bilge water	Cast iron	Al. Bronze	Stainless steel
Sea water	Cast iron	Stainless steel	Stainless steel

Valves	Material
Bilge and ballast system valves below DN32	Gunmetal or bronze body – gunmetal valve & seat – gunmetal stem
Bilge and ballast system valves above DN32	Cast iron body – gunmetal valve and seat – gunmetal stem

Pipes	Material
Bilge and ballast system	Black steel, hot galvanized (DIN2448)
Fire and deck wash system	Black steel, hot galvanized (DIN2448)
Air pipes and sounding system Fuel-/lub oil tanks	Black steel
Air pipes and sounding system Sea-/fresh water tanks	Black steel, hot galvanized (DIN2448)
Pneumatic sounding system	Copper (outside tanks), stainless steel (inside tanks)
Hydraulic oil transfer system	Black steel according to (DIN2391)

801. Ballast systems

Two separate ballast pumps to be installed in the engine room. Each of these should have a capacity of 50 m³/h – minimum 2 bar, with suction from crossover tank. Pumps to be able to work together with ballast water treatment plant. Pump pressure to be adjusted to suit selected treatment plant. Possibilities for filling and emptying of ballast tanks via a separate ballast valve chest to be installed, complete with overboard valves etc. Pumps also to be manually connected to anti-heeling tank and anti-rolling tank for filling and emptying only. Start and stop of pumps to be possible from engine room and control room.

Attention should be paid to the fact that fixed ballast might be required around heavy machinery components in order to enhance the vibration/noise signature of the vessel. In addition it should be noted that any possible permanent list of the vessel to be corrected by means of concrete and/or other fixed ballast. The decision with regard to if and how much fixed ballast is required to be taken after final vibration and noise analysis and after the last preliminary inclining test described under item 152.

Ballast water treatment system
In accordance with IMO MEPC 126 (53) Annex 3 & 4 (or later amendments), an approved water ballast treatment system of "non-chemical" type to be installed.

The system will basically consist of:

- Filtering system
- UV treatment chamber
- Control system

Capacity about 50 m^3/h

802. Anti-heeling system

Suitable side tanks port and stbd. to be arranged as list compensation tanks with separate pipe and pump fitted to pump from port to stbd., stbd. to port with overflow pipe.

Pump to have capacity of 50 m^3/h and to be operated from wheelhouse and ECR. Operational panel in wheelhouse to be fitted with timer.

In addition to the heeling pump, a semi-active anti-rolling system to be installed, see separate group. See group 405

803. Bilge systems

Ship's bilge system to be installed according to Class with regard to numbers of, size and location of bilge wells.

Two bilge pumps, capacity 65 m^3/h - 2 bar as a minimum, or acc. to class requirement to be installed. Pumps of self -priming type to be installed. Additional Bilge pump outside engine room to be installed according to bilge pump numeral calculation.

In the system one (1) off centrifugal oily water separator of high speed type to be installed according to the Authority, Class and IMO Requirements and to be delivered with I.O.P.P. certificate for pollution prevention. The oily water separator to have capacity of 2,5 m3/h, and to be fully automatic and equipped with OCD 5 PPM automatic alarm control equipment.

Resilient mounting of separator to hull foundations to be arranged.
Back-flushing from hydrophore system to be arranged.

An extra suction pipe with hose and necessary valves for use when testing separator also to be arranged.

Control cabinet, operator panel, sampling cocks before and after the separation, and pump unit with variable speed control and protection against dry running to be included.

The following equipment to be delivered:
Safety box, flow meter, electric heater, Cleaning-in-place unit, chemical dosing unit, automatic self-cleaning filter in suction line, remote control and monitoring, polishing filter and data recorder.

BW-separator to pump from separate bilge water tanks and from engine room bilge, with NR-valve on each suction line to deliver separated oil to sludge tank and cleaned water to overboard.
One bilge water tank, of adequate size to be connected to the oily water separator. One bilge water settling tank of adequate size to be arranged.

Emergency bilge in engine room to be provided by one of the sea water cooling pumps if required by Class or Authorities.

In addition, one bilge ejector for chain lockers, thruster compartment and other forward compartments to be installed in the bow-thruster room, with capacity 10 m³/h - 2 bar, for pumping overboard driven by the fire and deckwash pump.

Bilge water tank, sludge tank, dirty lubricating oil tank and hydraulic oil tank to be provided with shore connection via a separate sludge pump 4.5 m3/h 2.5 bar, and will be equipped with international shore connection. Discharge of sludge to be arranged on main deck on both sides.

Bilge chest in engine room to be installed with the necessary number of valves according to diagram. Bilge pipes of black steel with material thickness according to regulations through double bottom tanks. Bilge pipes of galvanized steel in engine room, service rooms and elsewhere outside tanks.

Bilge well with mud box to be located in the Wet Labs with necessary sufficient size for sediment

804. Scupper pipes outside accommodation

Sufficient number of drainpipes to be led from the respective decks.

Aluminium pipes of marine quality to be used for aluminium superstructure. Galvanized steel pipes to be used for steel superstructure, Black thick walled pipes through oil tanks.

Inlets to be fitted with «cross» of round ARS steel to prevent blockage as per class requirement.

For installation of pipes, the ship's possible trim is to be taken into consideration. Generally the installation is to comply with good shipbuilding standard.

Drain also from platforms in signal masts to deck below. Drains from wing tank level in engine room to bilges.

Above main deck freeing ports to be arranged as per General Arrangement Plan and Loadline Convention.

All decks to be properly drained to avoid any retention of water. All outlets from drainpipes to be maximum 100 mm above waterline.

Internal drains in accommodation:

Drain pipes to be arranged from gutter ways in each deck level to gutter ways in deck below.

From gutter ways on lowest deck drains to engine room, or other service space with selfclosing drain -valves at outlets below freeboard decks.

Laboratories:

All laboratories to be equipped with bilge/drain/scuppers as appropriate.

81. FIRE AND LIFE BOAT ALARM, FIRE FIGHTING AND WASHDOWN SYSTEM

811. Fire detection, fire and lifeboat alarm systems

An automatic approved type fire alarm system to be installed.

Fire alarm central to be located at the Wheelhouse with slave panel in engine control room and connected to the Alarm and Monitoring system. The fire alarm system to be addressable. The system to have detector sensitivity control. General alarm to be activated from the engine room console and the Wheelhouse.

Analogue fire detectors shall automatically lead to fire alarm when:

- CO, Heat and smoke detectors reach a pre-set maximum temperature limit
- A combustion gas smoke detector is energised
- A manual fire alarm call point is activated
- System fault shall activate alarm at the automation system.

Alarm should be given by alarm bells and in engine room areas by air sirens. The fire alarm to be intermittent. Rotating beacons to be fitted in engine room, propulsion motor room and bow thruster compartment.

The installation shall be according to requirements and following table:

- CO, Heat and smoke detectors in all accommodation, scientific spaces and container laboratories. Smoke detectors and flame detectors to be fitted in engine rooms and similar machinery spaces.
- Manual call points in accommodation, corridors and in engine room, propulsion room and bow thruster compartment exits
- Alarm bells in accommodation corridors and scientific spaces.
- Alarm sirens and rotating beacons in propulsion, thruster rooms and in similar machinery spaces with rotating beacon.
- The fire alarm system to be interfaced with the PA-system.
- The system shall give fire alarm and general alarm in all cabins.

Equipment for testing and addressing of detectors to be included.
Spare parts according to Maker's recommendation for two (2) years normal operation to be supplied.

Lifeboat/general alarm push button to be mounted in Wheelhouse console to energise alarm sounders when activated. Alarm signal according to the Authority's Requirements.

The fire detection system to have built in monitoring circuits to ensure that the equipment at any time is in satisfactory condition and indicates any faults. Faults to be indicated on fire panels and by means of visual and audible signals.

Fire alarm system to be equipped with separate battery and charger.
The fire alarm system to fulfil the regulations related to the SPS code.

812. Emergency stop system, fuel oil pumps and fans

Emergency manual stop for ventilation systems/oil pumps/galley equipment etc. to be arranged according to Class and Authority's Requirements.

Fans to be automatically stopped in the event of fire extinguishing gas release.

All ventilation fans to be fitted with closing appliances of approved type for closing down the ventilation system in an emergency situation. In addition remote operated closing valves to be fitted on all fuel oil tanks in engine room and propulsion room.

813. Fire/deckwash system, emergency fire pumps

Two off fire/wash deck pumps to be installed. Capacity each (min.): 45 m3/h - 6 bar or acc. to Class requirements.

Pumps to be arranged in engine room and to deliver to the fire main/wash deck line.
All pumps to be of centrifugal type and to have automatic purging ejectors for self suction. Pump houses and impellers of NiAl-bronze, spindle of AISI 316L.

Main fire pumps to have remote start and stop buttons on the Wheelhouse, ECR, in the Work deck area and in the Wet lab and in other places to Owner's satisfaction.
Local start and stop in Engine room.

Sea water supply to be taken from the cross over tank in engine room.

Emergency fire pump to have remote start and stop on the Wheelhouse and ECR in addition to local start and stop. Separate sea chest for sea water inlet to be arranged

Necessary number of hose stations and hose lockers to be provided according to system drawing and Authorities' Requirements.
Each hose station to consist of a shut-off valve with hose connection, dummy plug, wrench and a properly marked hose cabinet with fire hose and adjustable spraying nozzle with pistol grip.
Hose stations to be arranged in CTD hangar and main hangar, and on other locations on deck where necessary for cleaning purposes.

Electrically driven emergency fire-pump to be installed in bow thruster room, capacity min. 30 m3/h - 6bar or acc. to Class requirements, supplied from the emergency generator. Sea water supply to be arranged from sea inlet in bow thruster room. Connection to main fire line according to requirements from Class/Authorities.

Washing of hawsepipes for anchors to be arranged from fire mains. 3 nozzles to be arranged for each pipe.
The system also to provide sea water to the Wet Laboratory.

815 Fire fighting systems with gas

The following rooms to be arranged with inert-gas fire-fighting system ;

- Operation centre
- Converter rooms
- IT rooms
- Winch Drive room
- Switchboard room
- Propulsion room

System to be according to Authorities and SOLAS requirements. Gas to be of make FM 200, Inergen, Argonite or similar. Facilities to be provided for weighing and test pressure control of gas bottles.

817. Fire-fighting systems with sprinkler and water mist

Water sprinkler systems:
Local fire-fighting systems with water sprinkler to be arranged for the following compartments:

- Paint store
- Chemical stores
- Gas bottle stores

The system to be arranged according to SOLAS and shall be operated from outside each of the protected spaces. The water sprinkler system to be connected to the main fire line.

Water mist systems:
A water mist system for high risk local protection and total flooding to be arranged according to SOLAS, Class and Authorities requirements.
The system to include:
One (1) off Filter/separator unit
One (1) off Pump unit with pneumatic pressure holding pump
One (1) off Water tank and high pressure pumps.
Water mist hull tank with capacity according to relevant Class and requirements, water mist feeding pump, SW supply from main fire pump systems, necessary nozzles, valves and pipes to be arranged.

The system to have electrical supply from both Main- and Emergency switchboards, with automatic change-over switches.

Control system to include local manual release buttons, control panel in ECR and control panel on Wheelhouse.

Protected spaces by total flooding are:

- Cargo holds (not required by SOLAS)
- Engine room, including exhaust casings
- Separator room
- Emergency/harbour generator room
- Switchboard and converter rooms (not required by SOLAS)
- Engine workshops & stores
- Propulsion room (not required by SOLAS)
- Incinerator room
- Other spaces if required due to high risk of fire according to Builder's risk analysis

Local fire fighting system with water mist to be arranged in Engine rooms and in Incinerator room, above following designated equipment:

- Each MDG
- Oil fired burner for boiler
- Emergency/harbour diesel generator
- Separators
- Incinerator

In addition:

- Galley and galley exhaust hood to be protected by means of the water mist system.
- Deep fat fryer to be protected by means of the water mist system.

The water mist system to have supply from a FW tank which always has a reservoir of at least 20 min engagement of the water mist system.
Automatic release signal from the fire alarm plant in case of fire to be arranged in each zone.
Automatic ventilation-stop at water mist release to be arranged.

Manual release by pushbuttons at control station in ECR, as well as from location(s) at the entrance to the protected zones, in addition to manual control by opening of by-pass valves at the solenoid valve for each designated area in the room where the water mist unit is located to be arranged.
Local system to be combined with the total flooding system, as described above.

The fire fighting system with water mist to be arranged in all accommodation spaces such as:

- Cabins
- Living and common rooms
- Escape ways (stairways and corridors)
- Service and stores rooms
- Laboratories

819. Portable fire extinguishers

All internal compartments to be equipped with portable extinguishers according to the Authority's Requirements and in accordance with SOLAS' requirements.

82. AIR AND SOUNDING SYSTEMS FROM TANKS TO DECK

821. Sounding systems

Electronic remote computerized sounding system of approved make to be fitted for all tanks. The system to be a part of the IAS system with continuous reading and different alarms and monitor displayed readings in engine control room, wheelhouse and office. Printer to be included for the three locations.

The system to have calibrated read-out in engine control room.

Double sensors, to be fitted in all tanks, except some minor system tanks, where one remote and one manual sounding devices are installed. In these tanks only one sensor will be fitted, with sounding pipe, provided as back-up. Voids and cofferdams to be equipped with one remote sounding device.

All fuel tanks in addition to be equipped with manual sounding, as far as possible with manual sounding pipes.

The day tank and day/settling tanks are to be equipped with magnetic level indicators in addition to one sensor in each tank. Minor system tanks in the double bottom engine room to be equipped with sounding pipes with valves in addition to one sensor in each tank. Sewage grey- and black water tanks to be fitted with three “see-glasses” in addition to one sensor in each tank.

822. Air/pipe filling system

All tanks to be equipped with air pipes and tank ventilation valve.

As far as it is practicable, the vents shall be located in the highest part of the tank. Special care shall be taken to provide air channels to all vent pipes. Air pipes shall be kept as nearly vertical as practicable and shall drain to the tank served. Goosenecks with ball float valve to be fitted on top of every air pipe, and shall be at least 760 mm above external deck.

Air pipes from fuel tanks shall be connected to a common overflow pipe on each side of the ship. These pipes to be led to overflow alarm-boxes and then drained down to separate overflow tanks for each type of fuel.. Air pipe to be fitted from the overflow tanks to above deck01. Terminating in a vent head with ball float valve and fitted with wire gauze.

From sewage and greywater tanks air pipes shall be carried to the top of funnel. Air pipes from top of greywater drain system also to be carried to the top of the funnel. Goose necks to be mounted on top.

83. HYDRAULIC SYSTEM

Pipes in general to be seamless black steel pipes for DN40 and larger, and stainless steel for dimensions below DN40.

To reduce the hydraulic noise, in general all hydraulic systems to have ample pipe dimensions. Pipe clamps to be with non-metallic grip and non-corrosive clamp. HP pumps to be elastic mounted to ship foundations.

Particular care to be given to reducing the noise levels from hydraulic systems at the source, and where piping conducts noise through the vessel.

The greatest care to be taken when installing the hydraulic systems to avoid any impurities during installation and to closely follow manufacturers` advice

On completion of work of all hydraulic system, the system shall be flushed up to with temporary filters and magnetic catchers complying with ISO/NAS 1638/SAE cleanliness class as recommended by maker.
a) The flushing of LO service line of Main engine and Azimuth, Bow and stern thrusters LO service line shall be done by the system oil up to cleanliness class as recommended by maker.
b) The flushing of Compressed air, LO filling/transfer system shall be blown by compressed air.
c) The hydraulic piping for remote control of valves shall be blown off by N2 gas.

831. Hydraulic oil systems

Hydraulic system for all winches (not being el. operated) to be built as a closed loop system and in accordance with advice from the final selected manufacturer.

The pump station to have remote start and stop in
Main hangar, CTD hangar, on Wheelhouse,
at the drop keels manoeuvring station, on Main Deck aft and other necessary places to the Owner’s satisfaction in addition to local start/stop.

One filter-separator to be provided for continuous cleaning and water separation of the HP-hydraulic system.

Pipes with valves and remote start/stop of transfer pump for filling of HO system tank from storage tank and for drainage of same to used HO tank to be arranged.

See also item. 309.

85. ELECTRICAL PLANT GENERAL

850. Electrical design requirements and standards

As guidance: Main distribution 690/440/230V.
The electrical system, equipment, components and materials to be designed, produced and installed in accordance with this specification, proven marine practice, Class Requirements, and furthermore with rules and regulations as stated in the general section.

The electrical installations and equipment to be compatible with the recommendations of the International Electrotechnical Commission (IEC), in particular publication No.60092 and Class rules.

In general, reference is made to Annex 2.

Consideration to be given in the design of all equipment to the environmental conditions of shipboard service, and proven marine components to be employed.
Particular emphasis to be placed on corrosion, temperatures, vibrations, power supplies and electrical interference effects.

Consideration to be given in the design and construction to reliability, safety, flexibility, redundancy, high quality and reduced maintenance and service.

As far as possible, the electrical equipment to be designed and located readily accessible for repair, removal and maintenance.

In general, electrical equipment and measuring instruments to be designed and scaled in SI-units, however, pressure to be scaled in bar.

All drawings, diagrams, instruction manuals, etc. to be in English language.

As far as practical, the generators, electrical motors, starters, switchboards, etc. to be to the same approved type and make.

Care to be taken that components such as instruments, transducers, pressure and temperature switches, limit and level switches, signal lamps, relay etc. are standardised wherever possible.

The cable installations to be in accordance with the instrumentation manufacturer's instructions.

Requirements in IEC 60533 concerning EMC, "Electromagnetic Compability of Electrical and Electronic Installations in Ships", to be fulfilled as a minimum. All electrical equipment, instruments, regulators, etc. should not be affected by induced current or radiation from other electrical or electronic equipment fitted onboard. Requirements from EMC consultant to be fulfilled.

Certain areas of the vessel will require specialised protection for susceptible equipment. These areas must meet IEC 60092-504A electrical installation in ship control and instrumentation appendices.

Colour marking of busbars and signal lights to be in accordance with IEC.

Prediction of Harmonics
Calculations on line harmonics/voltage and current distortion to be carried out after appointment of maker of electrical propulsion equipment.

With regard to propulsion motors powered via frequency converters, harmonics cannot be avoided in the electrical network. All electrical and electronic equipment powered from the propulsion and ship services network to be designed and constructed to operate on a network with at least 5% voltage distortion.

If necessary, harmonic filters to be installed for critical harmonic levels.

Design Conditions
The whole electrical installation and equipment to be suitable for operation in 45º C ambient air temperature.

Where the ambient temperature of some special spaces exceeds this value, all electric cables and equipment to be provided to suit this higher temperature, correction factor related to ambient temperature to be used in accordance to Class regulations.

All cables to be marine type cables and in general designed for 45º C ambient temperature and an operating temperature of 85º C for power, propulsion and lighting cables. Power and control cables shall have multi-core XLP/EPR insulation, metal wire armour with suitable sheathing in compliance to rules.

All electrical systems and equipment in hazardous areas to be explosion proof according to requirements from Authorities.

Cables penetrations shall be provided with MCT(multi cable transit) seals for water tightness and fire integrity in compliance to rules.

Electrical Tests
All tests, both at the maker's works and on the vessel, to be carried out in accordance with maker's practice and requirements of various Statutory Bodies.

Comprehensive test sheets to be made available for Owner's approval in sufficient time before the tests start.

Electrical Balance
Prior to ordering the motor aggregates, Designer to carry out a preliminary electrical balance at the following conditions:

- Transit max power
- Transit 11 knots
- Trawling
- DP operation (DP2 with open bus)
- WSF – Switchboard section out
- Harbour (hotel consumers)
- Ref to preliminary load analysis a detail load calculation has to prepared after size of consumers is decided.

Short Circuit Calculations
Final short circuit calculations to be carried out based to Classification Requirements with all main generators running in parallel.

The short circuit level on 690V/440V/230V main switchboards as well as emergency switchboard and distribution boards to be calculated and suitable circuit breakers to overcome the short circuit currents without damages in the whole electrical network to be installed.

Selectivity calculations based on data for installed equipment will also be prepared.

Generator reactance to be matched with consideration given to short circuit fault level and level of voltage distortion in the network.

Name and Label Plates
Name plates for electrical equipment to be on white resopal (or equivalent) boards with black letters in English language. (Red for emergency stop and yellow for trip functions). All sensors and transmitters to be marked with text and tag-number. All electrical equipment/cubicles to be equipped with related electrical circuit diagram in proper protection inside.

Electric Power System
Power distribution to be provided as follows:

- Diesel generators : AC 690V, 50 Hz
- Main Propulsion motors : AC 690V, 50 Hz
- Bow thruster motors : AC 690V, 50 Hz
- Stern thruster motor : AC 690V, 50 Hz
- Winches : 690V, 50 Hz
- Seismic compressors : AC 690V, 50 Hz
- Power ship service : AC 690/440V, 50 Hz
- Lighting : AC 230V, 50 Hz
- Emergency power : AC 690V, 50 Hz
- Emergency lighting : AC 230V, 50 Hz

- Clean power/UPS navigation and communication.: AC 230V, 50 Hz, DC 24V
- Control circuit : AC 230V, 50 Hz, DC 24V
- Control and monitoring : AC 230V, 50 Hz, DC 24V
- Socket outlets : AC 230V, 50 Hz
- Clean power/UPS scientific (UPS/Converter) : AC 230V, 50 Hz

The electrical power to be generated by three diesel driven generators and emergency generator.

Two ship service transformers, 690V/440V, to be provided, one to be sized to take the total load with the other one out of operation. Normal running condition is with open bus tie 440 V with both transformers connected.
One transformer 690V/230V for emergency switchboard to be connected.

Two ship service transformers, 690V/230V, to be provided, one to be sized to take the total load with the other one out of operation. Normal running condition is with open bus tie and 230 V with both transformers connected.

The power management system to start and stop the diesel generators on load demand.

Emergency switchboard to be supplied from 690V Main Switchboard with automatic change-over arrangement to emergency generator in case of black-out.

Clean power/UPS for navigation and electronic equipment for scientific research to be supplied from clean power/UPS system. Necessary static converter and UPS according to equipment to be installed.
Enclosures

Enclosures for electric and electronic equipment to be in accordance with the guidelines given.

Electrical Motors:

- Engine rooms : IP 23
- Under engine room floor : IP 54
- On deck : IP 56
- In vent.ducts. : IP 44

Electrical Equipment in General:

Engine rooms	: IP 44
Control room	: IP 23
Deck	: IP 65/67
Accommodation dry spaces	: IP 23
Accommodation wet spaces	: IP 44
Galley/Provision rooms	: IP 44

86. POWER DISTRIBUTION SYSTEMS

865. Transformers

Naturally air-cooled transformers with enclosure IP 23 to be installed for the following purpose:

- (2) Step down transformers for power supply. Arranged for parallel and single operation. Voltage: AC3 x 690V/440V, 50Hz
- (2) Step down transformers for lighting, arranged for parallel and single operation. Voltage: AC 3 x 690/230V, 50 Hz and AC 3 x 230V, 50 Hz.
- 1 Step down transformer for emergency lighting. Voltage : AC 3 x 230V, 50 Hz 3 x 690V/3x 230V, 50 Hz
- 1 Step down transformer for ROV Voltage : AC 3 x 440V, 50 Hz, 3 x 690V/3x 440V, 50 Hz

866. Batteries and chargers

Lead acid maintenance free batteries of latest marine type to be installed for the following systems:

- Control and Monitoring : DC 24V
- Radio Station : DC 24V
- Navigation/Comms. : DC 24V
- Fire alarm : DC 24V

Main systems:
DC10 – DC20 - 24 V DC System Wheelhouse
DC30 – DC40 - 24 V DC System Engine room
DC50 - 24 V DC System for Emergency diesel
DC60 - 24 V DC System Radio station

Calculations on capacities to be according to Class and Authority Requirements.

In all battery systems earth measuring equipment to be fitted. Battery switchboards as well as termination strips in junction boxes to be arranged for easy identification of earth faults without the necessity of dismounting wires.

Batteries to be actively loaded continuously during normal service.

Battery charging devices

Charging devices for continuous cycles to be provided as a balancing device with transformer and rectifier for each battery system.

Each battery to be permanently connected to the charging device with float and booster charging as well as A-meter and voltmeter. Each charging device to have manual control.

All battery chargers to be equipped with alarms for over/ under voltage, earth failure, power supply failure, battery failure etc. and connected via common system failure alarm for each system to the main alarm and monitoring system.

867. Clean power system/UPS

For 230 V, 50Hz:
Clean power/UPS supply to be arranged for all laboratories, hangars, engine control room, Wheelhouse, offices, sonar room and other places to the Owner's satisfaction.

The capacity of the UPS to min. 2 x 60KVA and have 100% back-up.
Minimum four (4) units to be installed, with separate distribution circuits, two (2) on each side of the bustie breaker, supplying two (2) separate UPS switchboards.
Two (2) off UPS units to be located in Winch Drive Room and two (2) off UPS units at 4th deck.
In case of breakdown of two (2) UPSs on the same distribution side, the others can supply all consumers by operating a manually operated lockable emergency breaker.

A "by pass" arrangement must allow the network components to receive power from the Vessel's 230V-50Hz net in case of breakdown of all UPSs.

Each unit to have an alarm output for common failure, and to be connected to the main AMS in ECR.

The UPS to be supplied from 690V Main switchboard.

The UPS should be able to deliver maximum load for 15 min.
The UPS to be fitted with necessary transformers.
3x690V,primary side
3x230V,secondary side.
Only first class batteries to be used. (Min 5-8 years lifetime)

Clean supply to be well separated from other electrical supply.

87. COMMON ELECTRIC DISTRIBUTION SYSTEM

871. Main and emergency switch boards, etc. Motor starters and overload relays

Switchboards
The following switchboards to be installed:

- Main 690V switchboard
- Main 440V switchboard
- Main 230V switchboard / 230V Power Distribution boards
- HP Power distribution boards 690V
- PP Power distribution boards 440V
- LP Lighting distribution boards 230V
- ELP Emergency switchboard 690/230V
- DC Battery switchboard 24V DC
- LP1 Navigation lights switchboard 230V / Navigation light control panel
- Shore connection box 440V

Main Switchboard
The main switchboard to be of the self-supporting enclosed dead front type made of steel profiles and plates, and located in E.C.R.

The switchboard to be suitable for the vibrations, movements and accelerations normal to a marine environment. The switchboard to comply with the requirements of the specified Classification Society.

Special attention shall be considered for vibration, and the switchboard might be mounted on dampers.

Instruments and equipment to be flush mounted and in accordance with IEC 92-302,-298,-439. Enclosure to be IP 23.

Colour marking of bus bars and signal lights to be in accordance with IEC standard.

The switchboard to have a light canopy in the front supplied from the emergency lighting circuit.

Connection for load bank shall be mounted in the 690V main switchboard.
The main switchboard to be arranged with access also from behind.

Panels to be hinged doors with door holders for easy access to instruments, fuses etc.

Instruments, equipment and wires to be marked according to drawings, instruction manuals etc.

The switchboard to be arranged for parallel operation between the 690 V diesel generators.

Protection for overload of generators by load control of propulsion motors and speed reduction on thrusters.

Diesel generators to be arranged for standby operation and for automatic control by Power Management System.

Space for cable entry from bottom of the main switchboard shall be prepared in accordance to reference of bending radius of the cable.

Switchgear
Circuit Breakers for Generators
For protection of the generators and switchboards circuit breakers of sufficient capacity to be installed. The circuit breakers to be withdrawable, electrically and mechanically operated, with electromagnetic short circuit trip.

Circuit Breakers for Propulsion Motors, Thrusters
For protection of the consumers and switchboards, moulded case circuit breakers of sufficient capacity to be installed. The circuit breakers to be withdrawable.

Generally the circuit breakers to be same make/size and interchangeable as far as practical.

Protection Devices Generators
Electronic protection relays to be installed for:
- Short circuit
- Over current with preferential trip
- Reverse power
- Differential protection
- Excitation loss
- Under voltage
- Earth fault detection
- Non-essential load trip in 2-step.

Protection Devices Consumers
Electronic protection relays to be installed for:
- Short circuit
- Over current

Shore Connection
(2) MCCB 300 A.3 x 440V 50 Hz
(1) Amp.meter connected to C/Ts with selector switch
(1) Voltmeter with selector switch 4-steps
(1) Phase sequence indicator with phase sequence guard
(1) Switch for control of contactors
(2) Lamps for control of contactors on/off

Shore connection to be interlocked against generator breakers and bus bar breakers. Key switch for interlock of bus bar breaker. Class/DG/IMO requirements to be met.

Shore connection to be fitted. A shore supply cable 40m of length and reel to be supplied.

230 V Section
Connected to 690V via transformers.

The 230 V switchboard to be made as a free standing switchboard or part of 690V switchboard.

Instrumentation:
(1) Voltmeter with selector switch 4-steps
(2) Amp.meter for transformers with CTs`and selector switch 4-steps
(3) Earth failure and insulation control

MCCBs for Outgoing Circuits.

Instruments
Generator Section. The sections to be equipped with:
- V-meter with selector switch, 4-steps
- 3x Amp-meter,
- Frequency meter
- kW-meter
- kVA-meter
- Hour counter
- Signal lights for breaker status
- Signal lights for anti-condensation heaters
- Push buttons and switches

Synchronising Section
The section to be equipped with:
- Double V-meter
- Double frequency meter
- Synchro scope with semi-auto synchronising and synchronising guard.
- Synchronising lamps and switch
- Switch for selection of auto/manual mode
- Switch for selecting of standby diesel.(Manual mode)
- kW-meter for each generator
- kW-meter for total power consumption
- Mimics for main breakers status in main switchboards and emergency switchboard.
- Earth faults indicators

Controls
Following controls to be installed in the synchronising section:
- Diesel governor speed setting
- Automatic/manual synchronising equipment
- Breakers control on/off

Necessary interlocks to be arranged for generators circuit breakers to avoid malfunction during manual operation.

Emergency Switchboard
The emergency switchboard, 3 x 690/230V, to be of the self supporting enclosed dead front type, located in the emergency generator room to be provided with front access.

Furthermore, as specified for main switchboard section General.

The emergency switchboard to be supplied from 690V switchboard with automatic change-over arrangement in case of black-out or failures.

The emergency light to be part of the normal lighting in accordance with Class and Authorities.

In corridors, control room and engine room a limited number of lamps to be installed supplied from 24 V DC for the transitional source of power. Alternative to separate 24 VDC installation can be with internal battery in a limited numbers of lighting fixtures and with capacity of 3 hours.

Switchgear
The emergency switchboard to accommodate following circuit breakers/switch fuses:
- Emergency generator
- Feeder breaker
- 1 x Transformer 690/230V
- 690V distribution

- 230V distribution

Emergency light to be supplied from 230V distribution panels and to be part of the normal lighting.

Instrument and Control
The switchboard to be equipped with:
- V-meter with selector switch, 4-steps
- 3x Amp.meter with selector switch, 4 steps
- Frequency meter
- kW-meter
- Earth failure insulation monitoring
- Hour counter
- Signal lights for breaker status
- Signal light for anti-condensation heaters
- Push-buttons and switches

Consumers
The emergency switchboard to feed following consumers:
- Emergency fire pump
- Bilge/ballast pump
- 1 Starting air compressor
- Emergency lighting
- Battery chargers
- Navigation equipment
- Navigation lights
- Communication equipment
- Steering gear pump

Emergency stop
Emergency stop switches to be arranged in wheelhouse for the following equipment:
- Ventilation in engine room
- Ventilation in propulsion room
- Ventilation in accommodation
- Fuel oil pumps/purifiers

Ventilation stop for areas with fire extinguishing gas protection also to have stop for releasing of lockers for fire extinguishing gas.
Furthermore shall emergency stop to be arranged according to Class Requirements. (Galley equipment etc.).

Emergency stop switches to be protected against unintended operation.

Electrical motors
The following motors to be rated at 690V, 50Hz 3-phase:
- Propulsion Motors
- Azimuth thrusters
- Stern and Bow thrusters
- Electric Winches

Medium size motors to be rated at AC 690V , 50 Hz, 3-phase. Smaller motors may be rated 440V 50 Hz or 230V 50Hz. 3-phase. Non-essential motors less than 0,5 kW may be rated at AC 230V, single phase.

All motors to be of international standard dimensions (IEC) and to comply with the following requirements:
- Squirrel cage single-or two-speed type.
- Direct on-line starting unless otherwise stated.

- Insulation Class F.
- Protection enclosure in accordance with guidelines given in enclosed scheme.

Anti-condensation stand-still heaters to be provided in the following motors:

- Thrusters
- Open decks motors

The number of different sizes and types of motors to be reduced to a practical minimum so as to increase the interchangeability and to reduce the number of spares. Electric motors for ventilators etc. to be of certified safe type (explosion-proof) according to requirements.

873. MCC and motor starters

All motors to be controlled by motor starters.

MCC starters to be of the fixed type.

As far as practicable the starters to be of same make and type approved and by Owner's Representatives.

In general starters to be arranged in MCC units. Local start/stop and indication to be arranged.

Starters to contain temperature compensated thermal overload relays and single-phase protection.

In general, the thermal range for motors overload protection to be chosen so that the nominal current of the motor will not exceed 80% of the maximum rated range.

Starters to be fitted with Amp.-meters and hour counters and with signal to automation system for the following motors:

- Thrusters
- Scientific winches
- Geophysical winches
- Aft crane
- Mid ship crane
- Bilge pumps
- Ballast pump

The starter to have Push-buttons for start/stop, running lamps and name plates.

Remote emergency stops of motors for ventilation, oil systems, over-board discharge etc. to be arranged according to regulations.

Wiring diagrams to be provided in each control cabinet.

In general, two types of starters to be installed:

- Starters for manual-automatic control with change-over switch.
- Starters for manual control only

Transformers to be fitted for control circuits. Starting device to be of a type to ensure starting voltage drop is under 15%. For small motors without remote control, local placed motor protection starters can be used. Auto transformer or Soft starter arrangement shall be provided for consumers above 60 KW and all high voltage motors to ensure the voltage drop in generators shall not exceed 15%.

875. Electrical distribution panels and boards

Distribution boards

All distribution boards for power to be located as near as practical to the area which they serve with moulded case automatic circuit breakers for outgoing consumers.

Distribution boards on open deck to be avoided.

Lighting distribution boards in the accommodation to be enclosed in lockers with locks and fitted with miniature automatic circuit breakers.

In each distribution board shall be located single line diagram and list of outgoing consumers to be fitted in plastic covers inside doors in each distribution board.

All galley equipment as oven, boilers, frying pans, deep fat fryers etc. Shall have separate complete switchboard. This to be equipped with emergency stop.

Main breaker and emergency stop to be arranged acc. to class requirements. All distribution boards to have 20% space capacity, after final installation

88. ELECTRIC CABLE INSTALLATION

880. Cable trays and cable installations

Cable Installations in general.

The following cable installation to be arranged:

Systems for Ship general power 690V/440V and 230 V and signal cable installations.

The cables to run on cable trays. In general cable will not be run below floorplates, but where required cable running below floor plating in engine room, etc. to be protected with pipes with sealed ends and drain holes.

Watertight penetrations to be of and in each penetration space for 10% spare cables to be provided.

Cable penetrations on deck to be sealed against the passage of gas or vapour according to Class.
Penetrations for single cables passing watertight bulkheads or deck to be with individual watertight glands.

Cables for generators and thruster motors to run on own cable trays.

Cables for instrumentation and communication to be kept clear of power cables in a minimum distance of 250 mm.

Cables for clean power to be kept clear of all other cables in a minimum distance of 500 mm where practical.

All cables to be accessible as far as possible. Cables trays in general to have 20% spare capacity. Additional cable trays to be arranged between laboratories for scientific instrument cables. See Annex. 5 – Laboratories and Scientific Rooms

All cable ends and conductors to be adequately marked at each connection point. Marking to be in accordance with drawings and international standards.

Cable runs to be accessible and kept away from excessive heat sources and from exhaust pipes as far as practicable and shall be avoided in spaces exposed to drip or accumulation of water or oily vapour.

As far as practicable cables exposed to risk of mechanical damage to be protected by flexible conduits, steel conduits or steel pipes etc. in order to withstand possible damage.

All cables on deck to be protected against mechanical damages and sufficiently well shielded to prevent the radiated fields from radio and radar sources being picked up and re-radiated inside the vessel.

The shielding should be adequate to prevent interference picked up inside the vessel from being radiated and interfering with radio reception.

Single cables on deck to be arranged in tubes as far as practicable.

Minimum cable distances on deck to be arranged as far as practicable.

Minimum distance from bulkheads for cable trays in engine room and on deck etc.:
- Cable trays below 300 mm: 100 mm
- Cable trays above 300 mm: 150 mm

Cable passing through non-watertight decks shall be protected by approved stuffing boxes.

Where cables pass through any other steel bulkheads or pipes, the holes are to be finished smooth and fitted with lead or nylon bushings.

Cables to plug sockets, switches, lamps etc. to be installed concealed as far as possible. If concealing is not possible, the wiring to be covered by special moulding in plastic or light alloy.

If the cables are to be fitted in bilges for sensors or light, they should be led in tubes under the floor, the tubes to be fitted with necessary drain holes.

Installation of cables in accommodation areas to be generally on cable trays.

Single cables may be fixed with clips on existing frames. The minimum distance for fixing the cables and pipes for lighting system in the accommodation should not exceed 20 cm. Metal covered steel band to be used for each meter.

Any junction box above ceiling to be properly marked. All terminals in junction boxes to be with pressure plates.

Cables shall be efficiently supported and secured without their covering being damaged.
Addressable flood alarm system (AFAS) to be provided as per rules.

883. Electrical systems, cables, etc. for generators` main switchboard etc.

Cables

All cables to be marine type cables designed for 45ºC ambient temperature and an operation temperature of 85ºC for propulsion, power and lighting cables. All cables to be screened where required from EMC consultant and with reference to installation of frequency drives.

All cables to have Class Certificate and in general with insulation of ethylene propylene rubber and with sheet of PVC according to IEC 60092-3 with amendments.

Specified cables

In accordance with IEC 60092-353/IEC-60332/IEC 60754/IEC 61034 MPRXCX, FM K HC or equivalent.

Cables for data transmission to maker's recommendation. Where recommended by maker, special cables may be used.

Cables for instrumentation and communication to be with twisted pair with common screening and in accordance to suppliers requirements.

3-phase circuit generally to be in 3-core cables, but single core in parallel may be used for the large power circuits.

Cables for portable lamps etc. to be oil resistant and not less than 1,5 mm.

For the installation of single core cables, this shall be with 3 core under 1 common clamp and with revolution in accordance with Class regulations.

Specified operating voltages
690V system: 1 kV
440V system: 0.6/1 kV
230V system: 0.6/1 kV
24V system: 60V

886. Special cable installations

Separate cable trays, cable ducts and cable pipes to be installed for special protected cables throughout the vessel.

Signal cables to transducer rooms, to dry lab/ acoustic operation room, and wheelhouse to run on separate cable trays easy accessible and with an excess for spare cables of minimum 10%. Ceiling plates to be easy demountable below these cable trays.

Arrangement for special protected cables throughout the vessel to consist of following systems:
- One system for clean power/UPS and fixed instrument cables.
- One system for special protected cables concealed in separate steel tubes and scientific cabling in ducts/cable trays with space and easy access for running of cables during operation.

Cabling and installation of radio communication equipment:
- Radio receivers and associated equipment should be sited if possible in a separate area and as high as possible in the ship away from sources of EMI. Careful attention must be given to the installation of this equipment particularly with regard to the safe distances for transmitter feeders.
- If radio frequency (RF) filters are used in the mains feed to transmitters care must be taken to ensure that the impedance's do not cause de-tuning.

89. ELECTRICAL CONSUMER SYSTEM

892 Installation in cabins and public rooms

Typical installation officer cabins with separate bedroom on 3rd deck:

Cabin:
Three (3) off or more down lights with LED lights
One (1) off or more wall lamps, LED or incandescent
Spotlights for special lighting
Wall lamps, down lights and spotlights to have step less dimmers
One (1) off Small refrigerator w/socket
One (1) off Desk light, with double poled switch, incandescent or LED light
Two (2) off Double receptacles, 230V–50Hz
One (1) off Double poled switch for ceiling lights
One (1) off Double poled switch for wall lamps
Two (2) off LAN outlets
One (1) off Computer system
One (1) off 42" LED TV set and Radio&DVD player(Rack type)
One (1) off LAN –outlet for IP-TV infotainment system
One (1) off Intercom/telephone
One (1) off battery less telephone (Captain's cabin, Chief engineer's cabin)
One (1) off Watch alarm (Engine officers cabins)
Infotainment system

Bedroom:
Two (2) off down lights with LED lights
One (1) off Fluorescent or LED bed lamp, with double-poled switch
One (1) off Double receptacle, 230V-50Hz
One (1) off Alarm panel in Engine officers' cabins (E0)
One (1) off Intercom/telephone

Typical officer and scientist single cabins on 2nd deck:
Two (2) off or more down lights with LED lights
One (1) off Fluorescent or LED berth lamp per bed, with double poled switch
One (1) off or more wall lamps, LED or incandescent
Wall lamps and down lights to have step less dimmers
One (1) off Desk light, with double-poled switch, incandescent or LED light
Two (2) off Double receptacles, 230V–50Hz
One (1) off LAN –outlet for IP-TV infotainment system One (1) off Double poled switch for ceiling lights
One (1) off Double poled switch for wall lamps
One (1) off 32" LED TV set and Radio&DVD player(Car type).
One (1) off Intercom/telephone
Two (2) off LAN outlets
One (1) off Computer system
One (1) off Small refrigerator w/socket
One (1) off Watch alarm (Engine officers cabins)
Infotainment system, ref item 425

Typical crew/scientist cabins on Tween and Main deck:
Two (2) off Down lights with LED lights

Two (2) off Fluorescent or LED bed lamps, one per bed, with double-poled switch
One (1) off Wall lamp, incandescent or LED light
Wall lamps and down lights to have step less dimmers
One (1) off Desk light, with double poled switch, incandescent or LED light
Two (2) off Double receptacles, 230V–50Hz
One (1) off Double poled switch for ceiling lights
One (1) off Double poled switch for wall lamp
One (1) off 24" LED TV set and Radio&DVD player(Car type)
One (1) off Intercom/telephone according to Annex 3
Two (2) off LAN outlets
Infotainment system, according to Annex 3

Toilets/showers:
One (1) off Fluorescent or LED mirror light fitting, with razor receptacle. (230V and 115V output from isolating transformer)
One (1) off Heating cable in the floor
One (1) off Double poled switch for light
One (1) off Step less reg.switch for heating cable
One (1) off Electric hand dryer (in common toilet rooms only)
Switches to be mounted outside the door

Mess rooms on 1st deck(2):
Down lights with LED lights
Wall lamps, incandescent or LED lights
Spotlights for special lighting (decorative purpose)
Wall lamps, down lights and spotlights in mess room to have step less dimmer
Four (4) off or more receptacles, 230V–50Hz
One (1) off Intercom/telephone
Two (2) off LAN outlets
One (1) off LAN –outlet for IP-TV infotainment system
One (1) off Alarm box (E0)
One (1) off Double poled switch for ceiling lights
One (1) off Double poled switch for wall lamps/spot lights
Infotainment system, ref item 425

Lounges on 1st Deck(2):
Down lights with LED lights
Wall lamps, incandescent or LED lights
Spotlights for special lighting (decorative purpose)
Wall lamps, down lights and spotlights to have step less dimmer
Six (6) off or more double receptacles, 230V–50Hz
One (1) off Intercom/telephone
Four (4) off LAN outlets
One (1) off Wireless network access point IEEE 802.11 a/g/n
One (1) off min. 55" LED TV
One (1) off LAN –outlet for IP-TV infotainment system
One (1) off DVD/Blue ray and Amplifier system
Necessary number of double poled switches for a practical segregating of lights
Infotainment system, ref item 425

Galley:
Ceiling LED light fittings
One (1) off Double poled light switch inside door

Necessary power supply for galley equipment
Galley equipment (440V) emergency stop button, just outside galley
Four (4) off or more double receptacles, 230V
One (1) off Intercom/telephone
One (1) off Radio/TV antenna outlet
One (1) off LAN –outlet for IP-TV infotainment system
One (1) off Panel for calling system with signal lamps and buzzer for locked-in alarm in cold stores rooms and Hospital call
Remote controls for galley ventilation fans

Dry provision, pantry - and cold storage rooms, each:
Ceiling LED light fittings for dry provision store
Ceiling LED or fluorescent light fittings for cold stores
One (1) off Galley calling pushbutton (switch) in cold storage rooms
Double poled switches, with control light, for light in provision room to be mounted in Galley.

Laundries, each:
Two (2) off or more LED light fittings
Power supply for laundry equipment
Two (2) off Receptacles for iron, 230V
One (1) off Intercom/telephone
One (1) off Double poled switch for light
Switches to be mounted outside the door

Corridors, escape ways and stairways:
Down lights with recessed LED lights
Receptacles in each corridor, 230V (Max. distance between, approx. 10m)
Fuse lockers
Connection boxes
Special Green emergency light panels, (LLLS)floor mounted, leading the way out.
Stairs and ladders: Light diodes in all stairs and ladders in accommodation.(LLLS)

Wheelhouse:
Down lights with recessed LED lights
Spotlights w/dimmer above consoles, chart table and radio station
One (1) Chart table LED or incandescent lamp and dimmer
One (1) Radio table LED or incandescent lamp and dimmer
One (1) Radio/TV antenna outlet
LAN outlets
Intercom/telephone
Necessary number of double poled switches for a practical segregating of lights
Power supply to equipment mentioned in Main gr. 4, item 41, 42, etc.
An adequate number of double/single receptacles,230V–50Hz
One (1) off Panel for calling system with signal lamps and buzzer for locked-in alarm in cold stores rooms and Hospital call.
Infotainment systemref item 425
Red nightlight with stepless dimmer on Wheelhouse and LLLS (Low Location Lighting System) to be arranged in staircase.

ECR/office
Down lights with LED lights
One (1) off Desk light, with double poled switch, incandescent or LED light
LAN outlets

Intercom/telephone
Computer system
One (1) off LAN –outlet for IP-TV infotainment system
One (1) off Small refrigerator w/socket
One (1) off Panel for calling system with signal lamps and buzzer for locked-in alarm in cold stores rooms.
An adequate number of double/single receptacles,
230V–50Hz for equipment mounted. To be approved by the Owner.

Conference room/lounge
Down lights with LED lights
Wall lamps, incandescent or LED lights
Spotlights for special lighting
Wall lamps, down lights and spotlights to have step less dimmer
Sufficient numbers of double receptacles, 230V–50Hz, as well as 230V–50Hz, to be approved by the Owner.
One (1) off interactive whiteboard, 100" with suitable projector to be mounted in scientific office
LAN outlets
One (1) off Wireless network access point IEEE 802.11 age/n
Necessary number of double poled switches for a practical segregating of lights
Infotainment system, ref item 425

893. Electrical lighting systems

Lighting general
The ship to be adequately lit with illumination levels as required by the National Authorities, and at least the following lighting levels measured 700 mm above deck:

- Engine control room: 300 Lux
- Lockers: 50 Lux
- Galley, pantry: 300 Lux
- Corridor, stairs: 100 Lux
- Engine rooms: 200 Lux
- Cabins: 200 Lux
- Dayrooms: 300 Lux
- Desk in offices: 300 Lux
- Bathrooms and toilets: 150 Lux
- Wheelhouse: 200 Lux
- Meeting rooms: 200 Lux
- Open decks: 75 Lux
- Open deck working area: 150 Lux
- By staircase-doors on deck: 150 Lux
- Workshops: 200 Lux
- Laboratories rooms: 300 Lux
- Writing/working desks: 300 Lux
- Drop Keel trunk in general: 150 Lux
- Drop keel trunk below keel (lifted): 200 Lux
- Bow thruster room: 150 Lux
- Lower Acoustic sensor room: 200 Lux
- Transducer connection room: 200 Lux

Lamps in alleyways, public spaces etc. where necessary, to be connected to different circuits. Circuits to be protected with double pole miniature MCB.

Lighting intensity measurements to be carried out before final approval of installation.

Lighting circuits and small 230 V consumers to have double pole switches.

Lights at embarking stations to be supplied from the emergency power system as well. Lights for escape routes to be supplied from emergency power system, according to class requirements.

Lighting installations
Lighting system with numbers and type of light fixtures to be approved by the Owner.

In engine rooms, galley spaces, store rooms etc. white light to be used.

In small rooms and as ornamental lighting, incandescent lamp fittings to be used.

Electric lighting, sockets and electrical heating to be installed according Owner approval.

All outside deck lighting and illumination to have central switch panel on Wheelhouse with separate switches for the following lighting fixtures:

- Deck lighting to be led light and floodlights led light.
- Search lights
- Three(3) off 1000-1500 W Xenon searchlight with remote control in wheelhouse (main, aft and stb control).
- Funnel lights on owners emblem.
- Floodlights to be provided for illumination of working are outside hull sides stb, astern and with workboat and MOB boat Working places on deck, such as windlass, winches and starboard side on Main Deck.
- Pilot lights
- Alleyways on decks
- Lighting main ladder

Degree of protection to be in accordance with table in this specification.

Light levels to be in accordance with table in this specification, and according to requirements from the Authorities.

Miscellaneous:

- Navigational and signal lights to be installed according to Rules and Requirements.
- Red lighting in the wheelhouse to be fitted with dimming equipment.
- All Instruments on Wheelhouse to be provided with interior lighting of non-blinding colour with dimming equipment. Decorative lamp(s) where necessary in dayrooms, cabins and mess rooms to be provided.

On Wheelhouse and in rooms with direct access to the Wheelhouse, light to be fitted with door switches and guide light.

Sight glass light and below floor plate lights in engine rooms to be fitted.

Special attention to be given with regard to lighting above rotating machinery.

Lighting fixtures
In general, energy saving lamps and tubes to be used, where incandescent lights are used, lamp holders to be of type E27.

All lighting to be protected against radio interference and for operation on net with frequency drives.

Special attention to be addressed in terms of harmonics distortion on the network and construction of lighting equipment.

In general, marine type light fixtures to be LED. These to be water-proof with protecting guard where necessary.

Degree of protection to be in accordance with table in this specification.

Plastic shades, where used, to be of heat resistant plastic.

Where necessary for protection from mechanical damage, shades of polycarbonate to be used.

Plug sockets
Degree of protection to be in accordance with table in this specification.

Type of plugs and sockets to be of IEC standard type throughout the Vessel.

230V + E plug sockets for vacuum cleaners etc. 16A to be installed at intervals of about 20 m in passageways

Sockets to be fed from separate circuits independent from lighting circuits.

230V + E plug sockets to be installed in all cabins and messes, dayrooms, in engine rooms, store rooms etc.

3 x 440 V + E. to be installed according to following:
- 1 off generator room
- 1 off propulsion room
- 1 off workshops(3)
- 1 off bow thruster room
- 1 off 4th deck
- 6 off for containerized laboratories
- For laboratories, see Annex 5.

Sufficient plug sockets to be installed in all areas. 230V + E Clean power/UPS plug sockets for electronics and scientific equipment to be installed where appropriate.
Sockets to be fed from clean power/UPS supply system.

All plug sockets to be marked with voltage and frequency, as well as switchboard and circuit number.

One (1) off Service cabinet with circuit breaker 400A in Main Hangar.
Supply: 3 x 440V from Main switchboard.

Three Phase Power supply arrangement for welding machine on weather deck is to be made.

Appendices to the Specification :

Appendix 1: Specification, Control, Reduction and Measurement of Acoustic Noise and Vibration.
Appendix 2: The Electromagnetic Environment Compatibility and Interference.
Appendix 3: Computer Networks and Data Handling Systems.
Appendix 4: Specification of Winches, Slip-rings and Cables for Towed and Vertical Profiling Equipment
Appendix 5: Laboratories, Scientific Rooms and Stores
Appendix 6: Scientific of Scientific Acoustic Instrumentation for Ocean Research, Geology and Bathymetry.
Appendix 7: Makers List.
Appendix 8: List of Scientific Equipment / specifications / makers list.

Appendix 1:

Specification, Control, Reduction and Measurement of Acoustic Noise and Vibration

Project reference:	**NCPOR/VOM-14/1/2022**
Project ID.:	**Construction and delivery of Ocean Research Vessel (ORV)**
Version	12.10.2023

References :
Technical Specification(TS), document no. 15048-101-002-04

1 INTRODUCTION

To ensure that the underwater acoustic instruments maintains optimum performance, it is essential that the vessels operate with reduced underwater radiated noise (URN). The frequency spectrum for bathymetry echo sounders extends from 10 kHz to about 300 kHz. The ORVs should have reduced URN in this part of the frequency spectrum. Sub bottom penetration echo sounders as may be used on the ORVs may receive echoes with frequencies as low as 300 Hz, so in such case it is also beneficial for this vessel type to have reduced noise in the low frequency range. Noise reduction is also important in order to ensure good conditions for the personnel on board, both at work and at rest.

The ORVs will undertake research tasks that necessitate compliance with Figure 1, Specification for ORV Underwater Radiated Noise (URN 1) which places a limit on the allowable levels of underwater radiated noise for the purpose of:

Ensuring that acoustic instruments can be used to their maximum capability

The levels are estimated based on DnV GL: “Rules for classification of ships, new buildings”, the “Silent class notation”. For ORVs the “Silent A” requirements are the bases and they are converted from Band Level to Spectrum Level by the equation[1]:

$$SPL = BL - 10 \log W$$

W = bandwidth (Hz) in each 1/3 octave band

Acoustic noise within the Vessels must be reduced sufficiently to comply with the stated requirements in specified areas. Recently Eurofleets2 has published “Guidelines and recommentaions for ship design on noise and vibration reduction”[2]. http://www.eurofleets.eu/np4/69

2 VIBRATION

Levels of vibration must be controlled to:

- Reduce excessive stresses in structural or mechanical components.
- Minimize adverse effects on the reliability and maintainability of machinery / equipment.
- Avoid interference with performance of staff duties.
- Prevent discomfort to personnel on or off duty.

2.1 CONTROL MEASURES

Structure-borne vibration from all reciprocating, or rotating, machines should be controlled by the following means:

- Selection of inherently well-balanced machines.
- Selection of a propulsion motor drive system with minimum torque pulsations.
- Use of anti-vibration mounts: selected base-plates and supports to be applied as necessary to machines, exhaust, etc.
- Use of flexible hose piping carrying fluids to and from reciprocating machines.
- Use of isolating material to reduce transmission of vibration on runs of pipe-work.
- Local natural frequencies should be calculated and the structure modified if the calclations indicate a risk for significant resonance. The structure does sometimes have to be shielded by an insulating cover. The need for such a cover is best determined through calculations.

2.2 MAIN ENGINES AND DIESEL GENERATING SETS

For the ORVs the URN is specified for the frequency range 1 – 100 kHz. I has been proved that it is achievable to build vessels with conventional propulsion system (diesel engine, reduction gear, controllable pitch propeller), and maintain the required noise specification “Specification for ORVs Underwater Radiated Noise (URN 1)”, see Figure 1, in this frequency range. Nevertheless, in order to obtain a propeller with a minimum of cavitation, great effort must be put into the design.

2.3 CALCULATIONS

Detailed response of foundations and hull plating in contact with water shall be calculated. Torsional vibration should be assessed in relation to the varying loads imparted to the crankshaft bearings. In addition, account must be taken of any pulsations due to the propulsion drives. All calculations should include free-running and loaded conditions. Copies of these calculations are to be supplied to the Owner representatives.

2.4 INTERNAL AIRBORNE NOISE

Airborne noise arising from direct path radiation (including structure borne noise), or from the transmission of vibration should be controlled to:

- Ensure safe working conditions.
- Provide conditions for efficient working on intellectual tasks.
- Ensure minimum disturbance to personnel from adjacent cabins or spaces.
- Prevent disturbance to the sleep of personnel.

Laboratories & other areas	**Deck**	**Specification**	
Meteorological lab	4th deck	55	dB(A)
Scientific data processing lab	3rd deck	55	dB(A)
Conference room/lounge	1st deck	55	dB(A)
Clean general purpose lab	1st deck	60	dB(A)
Physical oceanography labs	Main deck	60	dB(A)
Main hangar/sub-sampling room	Main deck	65	dB(A)
Bio-chemical lab I	Main deck	60	dB(A)
Bio-chemical lab II	Main deck	60	dB(A)
Geophysics lab	Tween deck	60	dB(A)
Wet Lab/ Core sample lab	Main deck	60	dB(A)

Table 1 Maximum allowed noise levels for laboratories and research accommodations

The maximum allowed noise levels for most of the accommodations on board are given in the actual comfort class notation specified for the Vessel. In addition, the Vessel has several laboratories and research accommodations. Recommended maximum noise levels for these spaces are listed in Table 1 below. It is required that these levels are met at the specified survey speed, 10 - 11 knots, of the Vessel, with all ventilation systems fully running. Careful attention should be given to the application of acoustic damping and attenuation to the ventilation system, and to the control and limitation of air velocities. Particular care should be given to reducing the noise levels from hydraulic systems at the source and where associated piping could conduct noise throughout the Vessel. Special attention should be given to inter-cabin isolation.

2.5 CALCULATIONS

To determine the degree of attenuation, isolation and insulation required to achieve the specified levels within the given areas, it is necessary to carry out appropriate calculations. The Owner representatives shall have access to all calculations.

2.6 INSTRUMENTS FOR MEASUREMENT OF AIRBORNE NOISE LEVELS

Instrumentation for vibration measurements should comply with the requirements of ISO 2631-1: 1997 (Evaluation of human exposure to whole-body vibration) and IEC TC 29. Vibration assessment of machinery will be undertaken at the vendor's works and during sea trials. The results should comply with the recommendations of ISO 20283. Non-sinusoidal, random, or broadband vibration is to be measured using narrowband analyzer with a filter of less than 1/3 octave.

3 EXTERNAL AIRBORNE NOISE

Special effort must be made to design the exhaust pipes and silencers in order to minimize the airborne noise, both from the main diesel engines and the harbor generator. Any kind of resonance effects must be avoided. Special care must be taken in order to avoid annoying low frequency sound in the frequency band 10 Hz – 100 Hz, and in this band the un-weighted sound pressure must not exceed 100 dB//20 µPa at the stern deck areas.

4 UNDERWATER NOISE

4.1 RADIATED LEVELS

The underwater-radiated noise level "Specification for ORVs Underwater Radiated Noise (URN 1)"at all free-running speeds up to and including 11 knots must not exceed:

130 – 22 log f_{kHz} (dB re 1 µPa (1 Hz band) @ 1 m	from 1 kHz to 100 kHz to allow full exploitation of the capabilities of advanced scientific echo sounders, sonar and acoustic navigation systems.

Compliance with the above levels will be assessed with the Vessel in normal trim and ballast; all ship's services operating normally according to survey mode, with sufficient propulsive power to exceed 11 knots and one drop keel fully extended.

4.2 Sources of Underwater Noise and Their Control

The overall signature of a vessel comprises noise from many machinery sources[3]. These sources are divisible into two main groups, those producing predominantly low frequency noise, and others that are high frequencies sources. The prime movers fall into the first category, but there is no clear distinction in the case of the propeller. All main and auxiliary machinery should be isolated from the structure of the Vessel.

Propeller cavitations are a wideband phenomenon with the potential to seriously interfere with the operation of acoustic equipment. In principle, a large diameter propeller should give the best performance. Appropriate anti-singing treatment is required. Selection of a suitable design in conjunction with the contours of the rear section of the hull, allowing generous hull aperture clearances, is particularly important. Tank tests capable of investigating wake distribution; cavitation inception and pressure fluctuations of a model propeller are expected to be performed by the Builder. Optimization of wake by CFD analyses is recommended.

Care is needed in the selection of all pumps because of their potential to cause high levels of underwater noise. During installation, pipe-work and ducting to and from pumps should be planned so as to maximize the radius of bends to reduce turbulence. At commissioning, flow rates should be carefully adjusted to the capacity required for the function.

4.3 Self Noise

Design and finish of the hull, its appendages and cavities, must be such as to minimize the generation of noise by cavitation, vortex shedding and turbulent flow. Bilge keels must be designed and positioned with care, the outer edges having a suitable radius.

Specified echo sounder and profiler transducers will be fitted to the drop keels and the gondola.
The housings of which must be faired within 3 mm over any 500mm span, be cavitation and turbulence free and be aligned with the water flow. Placement of echo sounder and profiler transducers in the drop keels shall be such as to minimize effects of local flow noise.

5 Measurement of Underwater Radiated Noise

Noise Noise ranging of the Vessel at an appropriate place in good weather conditions is required in order to carry out measurements in compliance with standard procedures as ISO PAS 17208 or the recently developed Bureau Veritas Rule Note NR 614: Underwater Radiated Noise (URN) (Edition October 2014). The noise range facility must have the capability to establish the Vessel's free-running noise signature at frequencies between 10 Hz and 100 kHz, with precision according to the actual standards, under a variety of operating states and speeds up to 13 knots.

In agreement between Builder and Owner, a test run program shall be made. Some of the conditions, e.g. at 11 knots speed shall be repeated in similar runs of which the average shall be the result. Some measurements will also be required up to full speed. The noise ranging should determine the spectrum

level of noise derived from one-third octave band measurements. In addition, narrow-band measurements are required to indicate the tonal content of the radiated noise up to a frequency of 10 kHz. Neither the navigational, nor the scientific echo sounders shall be running during any of the noise measurement procedures. For these measurements, confirmation will be required that the Vessel is fully ballasted and correctly trimmed. It must be in normal seagoing state with all services in working condition.

5.1 NOISE RANGING WILL INCLUDE:

i) Measurements with the Vessel static. These measurements will be required to an agreed sequence with the Vessel held securely whilst items of machinery are progressively and systematically started, stopped, or switched on and off as required, to determine their contribution to the overall signature.

ii) Underway runs over the noise range at specified speeds up to and including full speed. Measurements are to be provided for starboard, port and keel aspects for the Vessel signature.

a) With the starboard drop keel at agreed depths.
b) With the port drop keel at agreed depths.
c) With both drop keels at agreed depths.
d) At agreed speeds.

iii) Vessel drifting with main propulsion machinery running

a) Operation of the tunnel thrusters to an agreed program.

More than one noise ranging exercise may be necessary. Underway runs will be held to determine the initial free-running signatures at agreed speeds. If the first series of measurements (i) and (ii) above are satisfactory, the measurement program items (iii) to be executed.

If the first series of results are not satisfactory, any adjustments or modifications to improve the signature should be made based on the information obtained. Only when such adjustments or modifications are completed should further noise ranging take place.

The final series of noise ranging measurements will be for the purpose of confirming attainment of the "Specification for ORVs, Underwater Radiated Noise (URN 1)" at selected speeds up to and including 11 knots free-running with the Vessel in full seagoing state, fully ballasted and correctly trimmed with all ship's services operating normally. Measurements are to be provided for starboard, port and keel aspects of the Vessel signature.

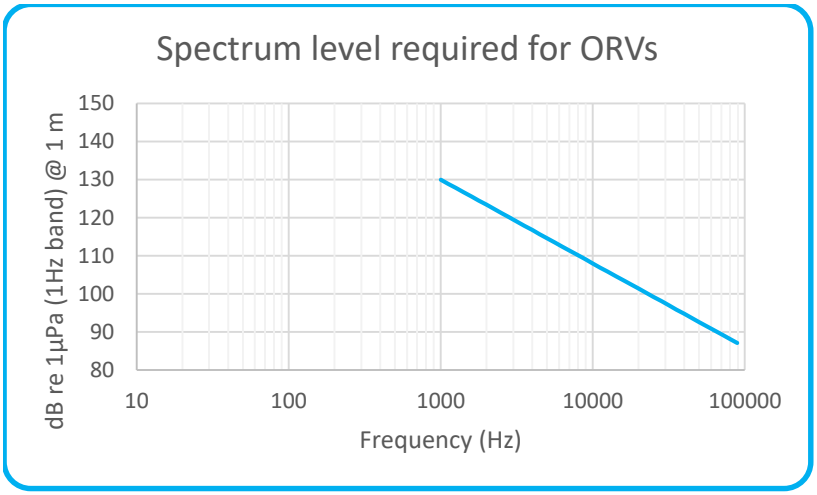


Figure 1 Specification for ORVs, Underwater Radiated Noise (URN1)

6 REFERENCES

[1]Urick, R.J., 1983. Principles of Underwater Sound. MacGraw-Hill Book Company.

[2]Knudsen, H.P., Nieuwejaar, P.W. 2014. Guidelines and recommendations for ship design on noise and vibration reduction. Eurofleets2, deliverable No. 11.1.

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Appendix 2:

The Electromagnetic Environment, Compatibility and Interference

Project reference:	NCAOR /
Project	Oceanographic Research Vessel (ORV)

References :
Technical Specification(TS), document

1 INTRODUCTION

Interference-free operation is essential for all electronic equipment onboard research vessels, but the electromagnetic environment is becoming increasingly severe, with the most onerous problems occurring in closed or self-contained systems, such as ships. To fulfill its many tasks, the ORV must function efficiently at all times, without any form of electromagnetic interference (EMI) to or between propulsion control systems, navigational, and scientific instruments. To achieve this, a strict regime of equipment selection, installation and wiring is required to ensure electromagnetic compatibility (EMC) throughout the Vessel. The designated company specialized in EMC/EMI, as stated in Technical specification, 101, shall lead the work to follow up the measures that are provided by this specification and associated standard.

1.1 DEFINITION OF ELECTROMAGNETIC COMPATIBILITY

IEC 60533 gives the following definition of EMC:
"*the ability of an equipment or system to function satisfactorily in its electromagnetic environment without introducing intolerable electromagnetic disturbances to anything in that environment*". The environment is the totality of electromagnetic phenomena existing at a given location.

disturbance is any electromagnetic phenomenon which might degrade the performance of a device, equipment or system, or adversely affect living or inert matter;

immunity is the ability of a device, equipment, or system, to perform without degradation in the presence of an electromagnetic disturbance.

2 SOURCES OF ELECTROMAGNETIC INTERFERENCE

2.1 ELECTROMAGNETIC FIELDS

Electromagnetic waves are comprised of electrical and magnetic fields. Both fields must be considered in order to prevent airborne radiation and conduction via cables. The operation of highly sensitive instruments and equipment in a research vessel such as the ORV raises particular difficulties. This is because the high concentration of such items, and the need to provide immunity between these items and against the high levels of harmonic energy in the electrical power generated and distributed throughout the hull.

The following items are important sources of EMI:

- Power supply outputs containing many high level harmonics
- Large magnetic fields from power cables
- Propulsion control systems: use of multi-phase thyristor or transistor control
- Electrical propulsion motors
- Bow thruster motors
- Multi frequency radio transmitters
- Radar transmitters
- Portable transceivers
- Navigational aids
- Fan motors
- Switched-mode power supplies

Most of the above listed items produce broadband interference, but the levels and frequency response may vary considerably. In addition, there are now many items of ships machinery operated or controlled by microprocessors, or computers, all of which generate EMI.

2.2 SUSCEPTIBLE EQUIPMENT

In close proximity to the sources of EMI there may be computers, radio navigation systems, sensitive radio receivers and/or hydro-acoustic instruments. In addition to being screened from direct magnetic fields these items must be protected from EMI conducted through and radiated from any cabling. It is not acceptable to connect any of the susceptible items to the Vessel's general electrical services common power supply. In addition to being sources of EMI, control equipment employing microprocessors and computers are themselves susceptible. It is vitally important that EMI does not affect or change the performance of such control systems.

The following items are susceptible to EMI:

- Navigational aids, including echo-sounders
- Engine room and propulsion control systems
- Scientific echo-sounders and other hydro-acoustic instruments
- Communication receivers
- Computers
- Internal communication systems

- Switched mode power supplies (used in many instruments and equipments)

3 CONTROL MEASURES

Intensive development of communication and data transmission systems, added to the greatly increased use of electrical machines and electronic units in recent years, means that close attention must be given to the electromagnetic immunity and compatibility of all the foregoing items. This involves the overall design of the electrical system, including the selection of machinery to meet the appropriate specifications.

The International Standard IEC 60533 "Electrical and electronic installation in ships – Electromagnetic compatibility" and the documents referred to in this standard, should be used as the reference document for EMC matters.

Cable types and cable installation should be in accordance with the requirements of the equipment supplier. Special attention is to be given to the cables between the propulsion motors and their power supply, taking into account any requirements of the motor manufacturers. Earthing of the cable screen is to be arranged with a metal clamp over the screen – no pigtails are to be mounted. Care must be maintained throughout specification and construction to ensure that the overall electromagnetic environment will be satisfactory for this vessel. The number; sophistication; transmission characteristics, and sensitivity of the wide variety of equipment to be fitted to the Vessel dictates that piecemeal remedies for the reduction of electrical interference, as often used in the past, are not acceptable. Such measures have proved increasingly ineffective and it is essential for preventative steps to be taken in the early stages of planning the design, building and outfitting of the Vessel. Annex B of IEC 60533 shall be used as reference document.

4 MEASURES TO ACHIEVE EMC

Annex C of IEC 60533 shall form the basis of the measures to achieve EMC.

4.1 DESIGNATED AREAS

Special attention must be given to some areas in order to protect susceptible equipment from radiated and conducted noise:

- Laboratories
- Wheelhouse
- Engine control room
- Transducer connection rooms
- Scientific data processing lab and Rack room

5 ELECTROMAGNETIC INTERFERENCE (EMI)

5.1 DESIGN AND CONSTRUCTION APPROACH TO REDUCTION OF EMI

During design and construction, the layout of cable runs must take into account coupling paths of an inductive or capacitive nature likely to have a deleterious effect on the operation of equipment. This must be reduced as far as practicable by using the information and guidance given in the IEC 60533. Cable ducting between laboratories must be dedicated to that purpose and provide adequate screening from adjacent ducting or cables carrying ships services. Equipment manufacturers should be consulted about the allowable proximity between their cables and others in the same ducting. A similar requirement exists for cables from slip ring winches and those running between laboratories and equipment on the bridge. **Transducer cables between hydro acoustic transducers and transceivers are very susceptible and shall be made as short as possible in order to minimize EMI. In case the transducer cables have to be extended beyond the standard length (25m), the extension cable must be of the same type as the original transducer cable.**

Measures should be taken to ensure that cables run over weather decks are sufficiently well shielded to prevent the radiated fields from radio and radar sources being picked up and re-radiated inside the Vessel. The shielding should be adequate to prevent interference picked up inside the Vessel from being radiated and causing interference with radio reception.

Manufacturers of motors and generators should be requested to supply details of the terminal, and radiated, levels of noise for each item. Transformers should be shielded to reduce the effects of inductive coupling to cables or equipment. Those transformers supplying designated or sensitive areas are to incorporate an earthed screen between primary and secondary windings.

Wideband interference from recurrent switching of power supplies by rectifiers, thyristors, high power transistors, or similar devices should be taken into account, and appropriate filtering and screening provided.

5.2 MEASUREMENTS

Three sets of measurements are required

A) With the vessel at Maximum Continous Rating (MCR) and all ships services operating
B) With the vessel running at 11 knots in survey mode
C) In thruster condition

Measurements are required to demonstrate to the Owners representatives that the EMC specification is met within the designated areas under the above conditions. Also, to show that EMI generated aboard the Vessel has been minimized in accordance with the appropriate Standard. Results of measurements to be presented in graphical and tabular form. Methods of measurement must have the agreement of the Owners representative.

Appendix 3

Computer Network and Data Handling Systems

Project reference:	NCAOR /...
Project	Oceanographic Research Vessel (ORV)

References :
Technical Specification(TS), document

1 INTRODUCTION

This document refers to section 423 in the Technical specification and it describes the network infrastructure included data management, cables, electronic devices and cabinets to be delivered and installed on board ORV. The installation shall comply with the IEC 60533 standard (Electrical and electronic installations in ships – Electromagnetic compatibility) with respect to cable categories, separation between cable categories and other aspects that may be relevant according to the standard.

The yard will install all the necessary ducting for the networks sensor cable routing to all equipment and sensors in labs and to accommodation and other places as required.

2 LOCAL AREA NETWORK (LAN)

The vessel shall have a modern and comprehensive LAN covering all spaces where it is thinkable to have data communication of any nature. The cables shall have high quality and be approved by DNV GL for maritime LAN installation. Cables of category 7 (Cat 7) is required. Each deck shall have a distribution cabinet with switches and patch panels as visualized in the attached block scheme.

Between the server and the distribution cabinets there shall be a network backbone consisting of a combination of Cat 7 and optical fiber cables.

3 BACKBONE NETWORK

The backbone network carries the communication between the servers and the switches on each deck and it shall have high degree of redundancy (ref. block scheme in attachment 1). The cables included in backbone network are as follows:

- 4 x fiber optic installation cable between server room and each deck
  - 9 µm/125 single mode OS2
  - 8 core
  - LC connectors
- 8 x Cat 7 cables between patch panel in server room and each deck
  - Cat 7 S/FTP SHF1 cable
  - 10 Gigabit/s Ethernet
  - SHF1 low smoke and halogen free sheet

- Fully screened
- Fully screened Cat 6a connectors
- Verified class EA link
- ISO/IEC 11801
- 900 MHz

Patch panels and switches to be installed in cabinets on each deck. Two high capacity routing switches to be installed in the network core, where the servers are connected. The routing switches function as gateways towards networks ashore, and to separate the networks on board, with respect to broadcast and security. The Owner shall approve cabinets, patch panels and switches.

4 DISTRIBUTION NETWORK

The distribution network serves several tasks and it covers the majority of rooms and spaces in the vessel (ref. block scheme in attachment 1). From patch panels on each deck, lay a minimum of 24 Cat 7 cables to outlet sockets in the various rooms. In this way, computers or other "end equipment" can be connected to the servers via distribution network, patch panels, switches and the backbone network. The specification for each cable between patch panels and outlets is as follows:

- 1 x Cat 7 cables between patch panel and outlet sockets
  - Cat 7 S/FTP SHF1 cable
  - 10 Gigabit/s Ethernet
  - SHF1 low smoke and halogen free sheet
  - Fully screened
  - Fully screened Cat 6a connectors
  - Verified class EA link
  - ISO/IEC 11801
  - 900 MHz

All cables to be terminated in RJ45 socket outlets (Cat 6 or Cat 7 compatible with Cat 6).

Option 1: future development may require higher bandwidth for data transfer, and a cable type with integrated fiber optical conductors, developed for maritime use with following specification, may be an alternative:

- Maritime LAN Cat.7 cable with SHF1 sheath + 2 single mode OS 2 fibers
- Halogen free
- Flame retardant
- DNV GL approved

The Owner shall approve the cable type.

5 WIDE AREA NETWORK (WAN)

For communication between the vessel and shore, the distribution network shall be connected to the VSAT satellite communication system (ref. BS 421) for access to Internet.

6 WIRELESS LOCAL AREA NETWORK (WLAN)

Some Wi-Fi areas in laboratories and public areas. WLAN connection ship-shore when in harbor. Based on IEEE 802.11

7 CHOICE OF NETWORK COMPONENTS

The network will be handling large amounts of traffic, such as video and graphics in "real time", and serving thin clients, workstations and logging equipment included acoustic instruments. The vessel shall therefore have a network where all computers have a 1 Gigabit/s network connection and a backbone network capable of handling up to and in excess of 100 Gigabit/s. The backbone network will be connected to all central server services with dual 10 Gigabit/s network interfaces. As the backbone network is made up of single mode fiber, the capacity is only limited by the interface technology of the end equipment (switches, routers, servers etc.), all of which are easily replaced.

Without this network, the Vessel will not function as a research platform, and the possibility that a malfunction in one component should potentially put the whole network out of order has to be reduced/eliminated to the extent possible.

This is achieved by configuring the two routing switches as hot standby for each other. This is a software technology, which ensures redundancy. Routing switches has the ability to detect the state of each other, and determine if their partner is operating, as it should. All the switches on the other decks have two separate fiber connections to the network core, connected to each of the two routing switches. One connection to be active, and the other in standby. If one connection is broken the switch will continue transmitting on the other transparently.

The two mechanisms described, in the routing switches and in the switches, will ensure continuous and stable operation of the network.

8 FIELD-BUS NETWORK (OPTION 2)

The nature of research vessels is such that it is difficult to anticipate all kinds of future activities on board. It is also expensive and time consuming to install new cables at a later stage. Recent research vessels are therefore provided with so called "field bus network". In this context field bus means a network of different cable types configured as a star, with a patch panel in the center and a number of cabinets with terminals placed at "strategic" positions around the vessel. Typically 1 to 10 cabinets are installed on each deck, totally 20 - 30 cabinets. With a combination of Cat 7 (10 Gigabit/s) Ethernet cables / coaxial cables and fiber-optical cables, most signal types can be transferred through the field bus network. With this network it is possible to connect an instrument to the nearest cabinet in one position and to any of the cabinets in other positions, e.g. from the wheelhouse roof to a laboratory on a lower deck.

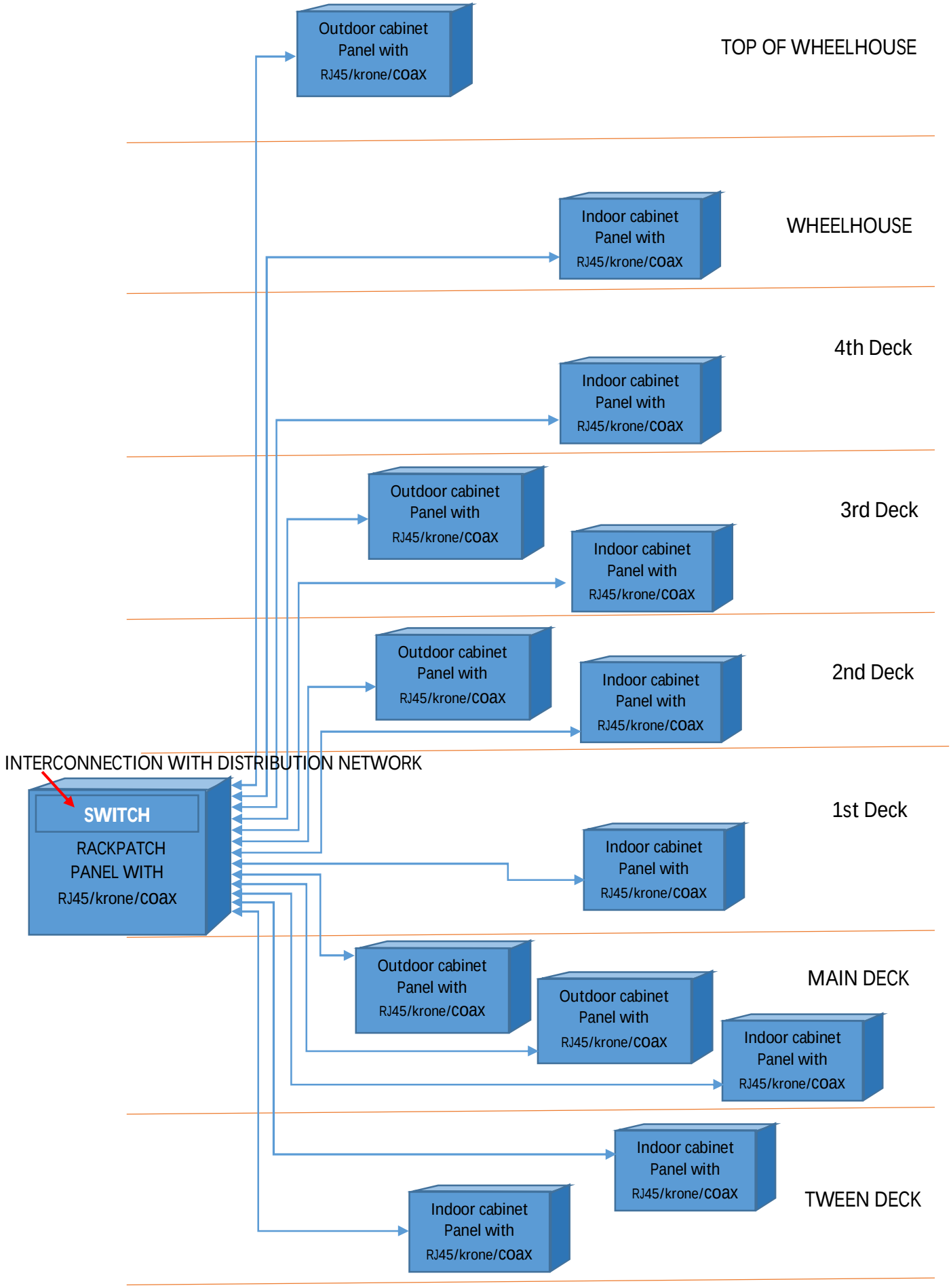

Figure 1. Principle diagram of Field bus network topology (the entire scope of the Field bus network is listed in table 1)

Between the central patch panel and each field bus cabinet, install following cable types:

Type A

- 2 x fiber cable, 9 µm/125 single mode OS2, LC connectors
- 6 x Cat 7 S/FTP SHFI cable, 10 Gigabit/s Ethernet, approved by DNV GL

Type B

- 2 x fiber cable, 9 µm/125 single mode OS2, LC connectors
- 6 x Cat 7 S/FTP SHFI cable, 10 Gigabit/s Ethernet, approved by DNV GL
- 1 x RG59 coax cable

Location	Deck	Cabinet type	Cabling type
Top of wheelhouse	Top of wheelhouse	outdoor	B
Wheelhouse – starboard side	Wheelhouse	Indoor	B
Wheelhouse – port side	Wheelhouse	Indoor	A
Wheelhouse – console in front	Wheelhouse	Indoor	A
Wheelhouse – console aft	Wheelhouse	Indoor	B
Outside balloon filling station	4th deck	Outdoor	B
Rack room	3rd deck	Indoor	B
Outside Scientific data processing lab	3rd deck	Outdoor	B
Main hangar	2nd deck	Outdoor	B
Anchor winch / mooring room	2nd deck	Outdoor	B
CTD hangar	1st deck	Outdoor	B
Clean general purpose lab	1st deck	Indoor	A
Main hangar / sub-sampling room	Main deck	Outdoor	B
Wet lab / core sample lab	Main deck	Outdoor	A
Bio-chemical lab 1	Main deck	Indoor	A
Bio-chemical lab 2	Main deck	Indoor	A
Outside Main hangar / sub-sampling room	Main deck	Outdoor	B
Stern deck, STB side	Main deck	Outdoor	B
Stern deck Port side	Main deck	Outdoor	B
Scientific store	Tween deck	Outdoor	B
Winch room W12	Tween deck	Outdoor	B
Other sampling equipment room	Tween deck	Indoor	A
Gyro/gravimeter room	Tween deck	Indoor	A
Winch drive room	Tween deck	Indoor	A
Engine workshop	Tween deck	Indoor	A
Engine control room	Tween deck	Indoor	A
Transducer connection room (drop keels)	Tween deck	Indoor	B
Transducer connection room (bow)	Tween deck	Indoor	B
Sea water laboratory	Tank top	Indoor	A

Table 1. Location and cabling to field bus cabinets. Exact locations to be agreed between Builder and Owner.

9 OTHER NETWORKS ON BOARD

In addition to the networks described above, there will be separate networks for:

- CCTV (IP cameras) as described in Technical specification 416. (interface with distribution network)
- Telephone system as described in Technical specification 425.

The network and cable types to be specified by equipment suppliers.

10 RACKS AND CABINETS

10.1 SERVER RACKS

Racks in the server room shall have high standard, suitable for maritime use, and have space for servers, backup systems, switches, patch panels and other rack-mounted hardware specified by the Owner. The racks shall have access from both sides and have good space for patch cords. The Owner shall approve all components.

10.2 DISTRIBUTION NETWORK CABINETS

- 19" rack with good space for switches and patch panel
- Large space for patch cords
- Resilient mount
- Sufficient earth connection

10.3 FIELD BUS CABINETS

The outdoor cabinets shall be made of stainless steel and have protection against condensation and moisture on the inside. Double walls are recommended. Cabinet specification:

Central patch panel:

- 19" standard rack, minimum 30 U high (1 U = 1.75 inches)
- High standard and suitable for maritime use
- Contacts: RJ45 (10Gb Cat.6a screened), high speed "krone" and coax connectors

Outdoor field bus cabinets:

- 19" cabinet, minimum 14 U high, minimum 60 cm deep.
- Stainless steel, (double walls)
- DIN mounting skids, RJ 45 panel and high-speed "krone" panel.
- Contacts: RJ45 (10Gb Cat.6a screened), high speed "krone" and coax connectors
- Outlet for stabilized power (220 VAC)

Indoor field bus cabinets:

- 19" cabinet, minimum 14 U high, minimum 60 cm deep.
- DIN mounting skids, RJ 45 panel and high-speed "krone" panel.
- Contacts: RJ45 (10Gb Cat.6a screened), high speed "krone" and coax connectors
- Outlet for stabilized power (220 VAC)

11 DATA HANDLING

The Builder shall provide a marine data management system, approved by the Owner, for collecting and storing all data from the vessel's navigational, meteorological and scientific sensors and instrumentation installed onboard. The system utilize primarily the distribution network, but serial lines (RS232) may be necessary to use in some cases. The data management system shall have following features:

11.1 SPECIFICATIONS

1. Easy to install and operate.
2. Central storing of data in a SQL database.
3. Server with large file backup capacity of minimum 50 TB (terabyte), expandable up to 100 TB.
4. Data backup system.
5. Software that enables system manager to collect and store data from all individual equipment and distribute the data to different clients.
6. Hardware interface to all equipment and sensors.
7. Tagging of all kinds of scientific data, with reference data (time, position, course, speed etc.)
8. System and sensor monitoring mechanism along with security software and hardware capability.
9. The system shall be complete with data interface boxes, acquisition terminal for each lab, connectivity to central MDM server, server and clients.
10. Automatic logging with options for selecting equipment /sensors.
11. Modular system, expandable (for future adding of equipment). Each lab should have a terminal and possibility to connect additional instruments in that lab.
12. The system shall be of a rugged design that can cope with the continuous operations for long durations i.e. for more than a month.
13. Report manager, extract data from database

11.2 INSTALLATION

To be installed onboard by OEM including interfacing with all scientific data acquisition systems and Navigation and other sensors onboard. The tentative networking points are as below.

1. Chief of Expedition
2. Dy Chief of Expedition
3. Conference room
4. General Purpose / Data processing (in labs) – 6 nos.
5. Navigational data
6. Each of scientific equipment that collect underway and stationary data

11.3 ACCEPTANCE TEST

Software operation, equipment/sensors interfaces, data storage & distribution demonstrated to the satisfaction of the Owner.

11.4 TRAINING

Onboard extensive training to be provided by OEM during the sea trials.

11.5 WARRANTY

Two years from the date of acceptance. Warranty to cover repairs, spares requirement, replacement of non-functional system / faulty parts.

Appendix 4:

Specification of Winches, Slip rings and Cables for Towed and Vertical Profiling Equipment

Project reference:	**NCPOR/**
Project ID.:	**Oceanographic Research Vessel (ORV)**

References :
Technical Specification(TS), document

1 BACKGROUND

The scientific winches and handling equipment on board research vessels are important equipment for the scientific operations. It is therefore utmost important that the capacities and functionality of this equipment is such that the hadling of equipment over the side and over the stern can be done in a safe and efficient manner. This annex is meant to be used as a description of the winches to be delivered with the Vessel, and a guide for the Builder in the planning, detailed engineering, procurement and installation processes for this equipment.

2 GENERAL

All winches for scientific use to be delivered by the Builder and installed complete with the specified oceanographic wires, cables, ropes, blocks / sheaves, slip-rings, junction boxes and signal distribution cables ready for operation. Cables and slip-rings shall have high quality and to be approved by the Owner. Each winch on board to have separate drive units, and each winch to have local control in addition to remote control in winch control cabin and on bridge.In case of electrical winches, sufficient frequency converters shall be included. For hydraulic operated winches, A-frames and cranes, sufficient hydraulic aggregates shall be included. All winch drives to be installed in a humidity controlled and air-conditioned winch drive room in compliance with manufacturer's requirements.

Builder shall ensure that all components of winch system (winches, blocks, sheaves, rollers etc.) are designed according to wire/cable manufacturer's requirements. It is essential that the sheave groove design is correct for each specified cable and that the cable sheaves or blocks have diameters (D) large enough to comply with the recommended minimum bend radius of the cable with diameter d. For oceanographic cables the relation D/d is typically between 40 and 50. All sheaves and blocks shall be certified, delivered with certificates and marked with Working Load Limit (WLL).

In order to ensure even spooling of the cables/wires, independent of the cable/wire diameter, the level wind shall have separate drive and be electronically controlled. It is preferable to make the drums as long as possible in order to minimize the number of layers for best possible spooling. All winch drums shall have a margin in capacity in order to protect the cable / wire.

All winches shall have sensors for speed, length paid out and tension. In addition, displays with readout of these parameters shall be installed in positions where they are easy to read by the winch operator. Data output for logging shall be provided.

All equipment included in this specification shall comply with the following criteria:

- Operating voltage: 690 VAC, 50 Hz
- Ambient temperature for equipment installed outdoor: -20ºC to +36ºC, 100% relative humidityand to +40ºC at 70% relative humidity.
- Ambient temperature for equipment installed I hangars: -20ºC to +40ºC, 50% relative humidity
- Operating temperature for equipment installed under deck / indoor: 0oC to +40oC with 50% relative humidity.
- All electrical equipment, motors and junction boxes shall have sufficient enclose rating for protection against humidity and intrusion of solid objects (IP standard).
- Design, production and testing of winches and handling equipment in compliance with the classification society.
- Winches, handling equipment and all components involved in hadling shall be certified.

In order to save space, the slip-rings for the scientific winches should be installed in compartments inside the drum shaft. All winches, even those specified with wire, shall have compartments for electrical/optical slip-rings in case of future conversion from wire to cable. The specified data are approximately and the exact specification must be worked out in conjunction with the actual supplier.

Signal cables from the stationary junction box on each winch, included single modus fiber cables, shall be laid to a central patch panel an from there to a selection of laboratories, operation centre and wheelhouse.

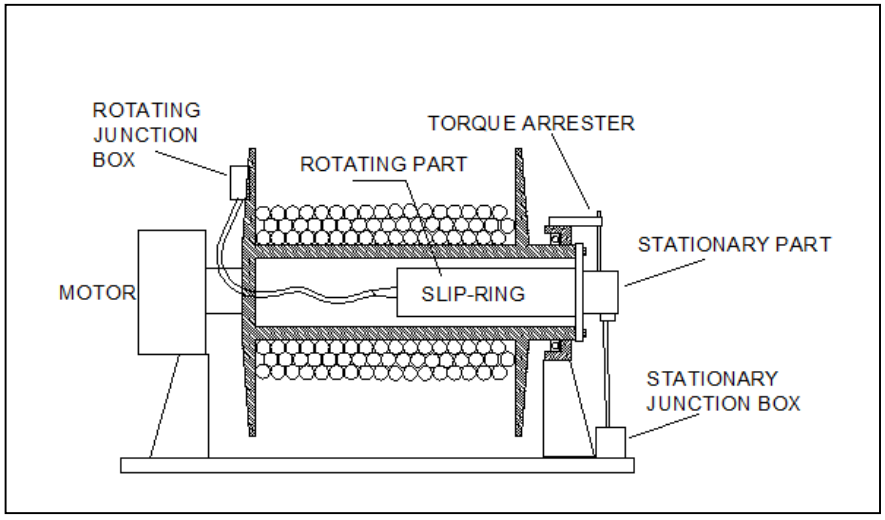

Figure 1: Principle of slip-ring mounted inside cable drum

3 W01 MULTI-PURPOSE TOWING WINCH

The multi-purpose winch shall be used for towing different kinds of scientific equipment, dredging and for vertical operation of gravity corers, benthic grabs etc. For future needs for conversion from wire to cable, there shall be compartment for electrical / optical slip rings.

Location		Stern deck
Winch type		Direct Pull Winch with side right angle spooling
Power source		electrical motors with frequency converter drive
Pull capacity		250 kN on first layer
Tension		Adjustable
Max. weight of payload in air		Limited by block WLL, stern A-frame/LARS capacity and winch pull capacity
Drum capacity		10000 m, 18 mm Ø wire
Level wind		Separate motor drive, automatic adjustment according to cable diameter, LeBus sleeve
Wire delivered and and installed		10000 m, 18 mm Ø, oceanographic wire
block diameter		Min. 500 mm
Slip-ring unit		Prepared compartment for el./opt. slip-ring
Max speed		120 m/min
Speed control		Stepless zero to max
Brake		included
Local control		Speed and brake
Remote control		Speed, tension and brake
Active heave compensation (AHC)		Yes
Operation		Local, remote and radio control

4 W02 CTD WINCH IN MAIN HANGAR

This winch shall be permanently installed in the Main Hangar and interact with the A-frame which must be prepared for safe handling of the payload during launch and recovery . Both CTD with water bottle carousel and different kinds of plankton samplers included remote operated multinet can be operated by this winch.

* 11.43 mm is a standard “off the shelf” dimension

Location		Main hangar
Winch type		Direct pull winch with over right (or left) angle spooling.
Power source		Electrical motors with computer controlled frequency converter drive
Pull capacity		80 kN SWL on first layer
Tension		Adjustable
Max. weight of payload in air		Limited by block WLL, davit/LARS capacity and winch pull capacity
Drum capacity		10000 m, 11,43 mm Ø cable

Level wind		Separate motor drive, automatic adjustment according to cable diameter, LeBus sleeve
Cable delivered and installed		10000 m, 11.43* mm Ø, stainless steel armoured CTD cable (coaxial cable with center conductor and shield)
Cable block diameter		Min. 500 mm
Slip-ring unit		Electrical unit with 4 rings. Compartment for optical/electrical unit to be prepared
Max speed		120 m/min
Speed control		Stepless zero to max. Constant speed independent on layer number.
Brake		included
Local control		Speed and brake
Remote control		Speed, tension and brake
Active heave compensation (AHC)		Included
Operation		Local, remote and radio control

5 W03DEEP SEA CORE WINCH (TRACTION WINCH)

The Deep Sea Core Winch to be permanently installed in the Main Hangar. The winch shall work in conjunction with the A-frame (or sliding jib boom) over the side. Handling (launch and recovery of the Deep Sea Core) is specified in Technical Specification, section 33, Deck Cranes.

The piston core sampler must be prepared on deck in horizontal position laying in cradles with sufficient space for installing the liners etc. Thereafter it must be brought outside the ship side and turned to vertical position before wire / rope is paid out. For recovery the corer must be handled in the opposite way, turned from vertical to horizontal position, brought inside the ship side to the cradles.

The winch must be special designed for core operations, espescially with smooth speed and tension control. In order to save weight and to minimize backlash during operations, the winch must be suitable for operating synthetically rope. The wire/rope shall have minimum diameter 20 mm, but greater diameter is desirable due to minimizing backlash effects when piston corer is released or pulled out of the seabed.

For great depths it is recommended to use synthetical rope since the weight of the steel cable in addition to the weight of the payload will limit the operational depth.

Location		Main Hangar
Winch type		Traction winch
Power source		Electric drive on both tractionheads and storage drum
Pull capacity		100 kN
Tension		Adjustable
Max. weight of payload in air		>3 t Limited by block WLL, davit/LARS capacity and winch pull capacity
Drum capacity		8 000 m of min 20 mm Ø wire / rope
Level wind on storage drum		Separate motor drive, automatic adjustment according to cable diameter, LeBus sleeve

Wire / rope delivered and installed		8000 m of min 20 mm Ø synthetically rope with jacket
Wire block diameter		According to vendor's recommendtaion
Slip-ring unit		Compartment for slip-rings included
Max speed		120 m/min
Speed control		Stepless zero to max
Brake		included
Local control		Speed and brake
Remote control		Speed, tension and brake
Active heave compensation (AHC)		Included
Operation		Local, remote and radio control

6 W04 CTD WINCH IN CTD HANGAR

This winch shall be permanently installed and work in conjunction with the launch and recovery system (LARS) in the CTD Hangar. The payload (CTD and water bottle carousel) shall be hoist to the block or to a buffer beneath the block without any risk of overloading the cable. Payload brought over the bulwark to 3 m outside the ship's side before cable paid out. NB the payload lowered with constant speed independent on layer number.

* 11.43 mm is a standard "off the shelf" dimension

Location		CTD hangar
Winch type		Direct pull winch with over right (or left) angle spooling.
Power source		Electrical motors with computer controlled frequency converter drive
Pull capacity		80 kN SWL on first layer
Tension		Adjustable
Max. weight of payload in air		Limited by block WLL, davit/LARS capacity and winch pull capacity
Drum capacity		10000 m, 11,43 mm Ø cable
Level wind		Separate motor drive, automatic adjustment according to cable diameter, LeBus sleeve
Cable delivered and installed		10000 m, 11.43* mm Ø, stainless steel armoured CTD cable (coaxial cable with center conductor and shield)
Cable block diameter		Min. 500 mm
Slip-ring unit		Electrical unit with 4 rings. Compartment for optical/electrical unit to be prepared
Max speed		120 m/min
Speed control		Stepless zero to max. Constant speed independent on layer number.
Brake		included
Local control		Speed and brake
Remote control		Speed, tension and brake

Active heave compensation (AHC)		Included
Operation		Local, remote and radio control

7 W05MAGNETOMETER WINCH(PORTABLE)

The winch is used to handle a towed magnetometer, used in geophysical surveys for measuring the Earth's magnetic field and to detect magnetic anomalies of various types.

Location		Stern deck
Winch type		Direct pull winch
Power source		Electric with frequency converters
Pull capacity		20 kN on inner layer
Tension		N/A
Max. weight of payload in air		1000 kg
Drum capacity		1000 m of 10 mm Ø (approx.) cable
Level wind		Separate motor drive, automatic adjustment according to cable diameter, LeBus sleeve
Cable / wire		As per eqpt OEM requirements
Wire block and level wind sheave diameter		As per eqpt OEM requirements
Slip-ring unit		Electrical slip-ring unit with 8 rings
Max speed		120 m/min
Speed control		Stepless zero to max
Brake		Included
Local control		Speed and brake
Remote control		Speed and brake
Active heave compensation (AHC)		N/A
Operation		Local, remote and radio control

8 W06SIDE SCAN SONAR WINCH(PORTABLE)

The winch is used to handle a towed side scan sonar for different kinds of seabed surveys.

Location		Stern deck
Winch type		Direct pull winch
Power source		Electric with frequency converters
Pull capacity		30 kN on inner layer
Tension		N/A
Max. weight of payload in air		1000 kg
Drum capacity		5000 m of 11 mm Ø (approx.) cable
Level wind		Separate motor drive, automatic adjustment according to cable diameter, LeBus sleeve
Cable / wire		As per eqpt OEM requirements
Wire block and level wind sheave diameter		As per eqpt OEM requirements
Slip-ring unit		Electrical slip-ring unit with 8 rings
Max speed		120 m/min

Speed control		Stepless zero to max
Brake		Included
Local control		Speed and brake
Remote control		Speed and brake
Active heave compensation (AHC)		N/A
Operation		Local, remote and radio control

9 W07 SCIENTIFIC MOORING WINCH (PORTABLE)

The mooring winch is used for deployment and retrieval of current meters (and other instruments) rigs. The moorings can be deployed in different ways. The common most way is to hoist the anchor (and the acoustic release) overboard and attach the instruments successively as the anchor is lowered. Finally, when the top buoy is attached, the rig is released and falls to the bottom. For this method it is important that the rope goes over a block several meters above deck in order to make it easy to pull the rope close to the bulwark.

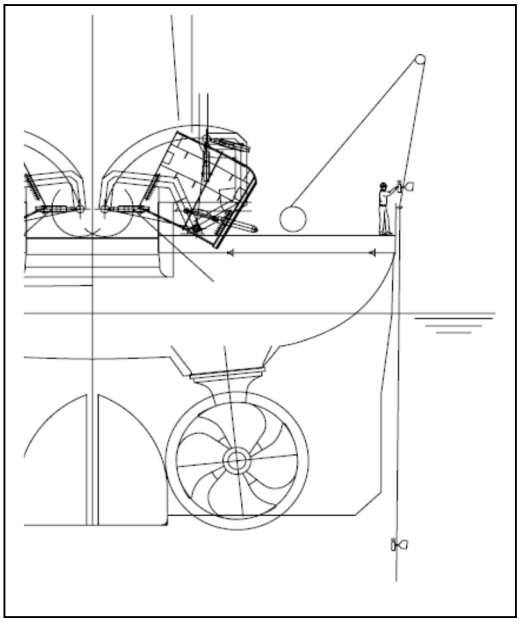

Figure 2: Principle of deployment and retrieval of current meters

Another method is to first deploy the buoy from the stern when the vessel is moving slowly forward. The instruments can then be attached to the rope in horizontal position without heavy load. Finallly the anchor and acoustic release is launched. The mooring winch can be used for both deployment methods and there must be arrangements for installing it either for deployment over the side or over the stern. The winch must have level wind with opening wide enough for shackles, swivels etc. to pass through.

Location		Foundations and power outlets prepared at the stern and by the over side A-frame

Winch type		Direct pull winch with a horizontal capstan attached to the drum which can be engaged by a clutch mechanism. The drum may be designed to FREEWHEEL with a necessary brake system.
Power source		High or medium pressure hydraulics
Pull capacity		20 kN on inner layer
Tension		N/A
Max. weight of payload in air		1000 kg
Drum capacity		5000 m of 6 mm Ø (approx.) wire rope
Level wind		Wide enough for shacles ans swivels to pass through
wire		TBD
Wire block and level wind sheave diameter		N/A
Slip-ring unit		N/A
Max speed		60 m/min
Speed control		Stepless zero to max
Brake		Included
Local control		Speed and brake
Remote control		Speed and brake
Active heave compensation (AHC)		N/A
Operation		Local, remote and radio control

Winch no	Pull force (kN)	Equipment	Cable/wire spec.	Cable content	Approx cable/wire dimension (mm)	Cable/ wire length (m)	Approx. cable/wire weight (kg/km) in water	Approx. Cable/wire /rope breaking strength (kN)	Max. recom-mended working load (kN)	Slip-ring unit	Slip-ring content	Zone
W01	250	Benthic dredges and grabs, gravity corers etc.	Steel wire	N/A	18	10000	1000	240	170	Compart-ment	N/A	Stern deck
W02	80	CTD Water bottle carousel / plankton nets	Stainless steel armouredca ble	2 x el.	11.43	10000	406	84.5	20	Electrical	4 x el.	Main hangar
W03	100	Heavy duty piston core sampler	Steel wire or synthetical rope with jacket	N/A	20	8000	Steel wire:1200 Synth. Rope: 50	300 /200	200 / 100	Compart-ment	N/A	Main hangar
W04	80	CTD Water bottle carousel / plankton nets	Stainless steel armouredca ble	2 x el	11.43	10000	406	84.5	20	Electrical	4 x el.	Water sampling room /CTD hangar
W05	20	Magneto-meter	As per eqpt OEM req	As per eqpt OEM req	10	1000	As per eqpt OEM req.	As per eqpt OEM req.	As per eqpt OEM req.	As per eqpt OEM req.	As per eqpt OEM req.	Portable/ Stern deck
W06	30	Side Scan Sonar	As per eqpt OEM req	As per eqpt OEM req	11	5000	350	70	20	Electrical	4 x el.	Portable/ Stern deck
W07	30	Moorings	Various rope and wire	N/A	6	5000	100	30	15	N/A	N/A	Portable/ Stern deck

Table 1. Overview of the scientific winches.

Control Station / Winch	Stern deck	Main Hangar	CTD Hangar	Winch control cabin	Wheel-house
W01 Deep Sea Sampling Oceanographic Winch					
Speed		X		X	X
Brake		X		X	X
Tension		X		X	X
W03 CTD Winch in Main Hangar					
Speed		X		X	X
Brake		X		X	X
Tension		X		X	X
W02 Deep Sea Core Winch					
Speed		X		X	X
Brake		X		X	X
Tension		X		X	X
W04CTD Winch in CTD hangar					
Speed			X	X	X
Brake			X	X	X
Tension			X	X	X
W05 Magnetometer Winch					
Speed	X			X	X
Brake	X			X	X
Tension	X			X	X
W05 Side Scan Sonar Winch					
Speed	X			X	X
Brake	X			X	X
Tension	X			X	X
W06 Scientific Mooring Winch					
Speed	X	X		X	
Brake	X	X		X	
Tension	X	X		X	

Table 2: Positions of remote control for scientific winches

Appendix 5:

Laboratories, Scientific Rooms and Stores

Project reference:	NCPOR / ...
Project	Oceanographic Research Vessel (ORV)

Introduction :
This Appendix describes the outfitting of Laboratories and other Scientific Rooms and Stores onboard the vessel.

For identification purpose, all scientific rooms listed in this Annex to be considered as "Laboratories".

References :
Technical Specification(TS), document

Appendix 3 - Computer Network and Data Handling Systems

Appendix. 8 – List of Scientific Equipment.

484. Laboratories and Scientific Rooms

The vessel to be equipped with laboratories and scientific rooms as shown on General Arrangement Plan and as required in order to conduct the specified research operations.

This to include following laboratories and scientific rooms;

Room No. ;	Name of Room:	Deck :
L1	Balloon Filling Station	4th
L2	Gas Storage	4th
L3	Scientific Data Processing Lab.	3rd
L4	Atmospheric Science Lab.	1st
L5	Clean General Purpose Lab.	1st
L6	Winch Control Cabin	1st
L7	Core Sample Store	M
L8	Wet Lab./Core Sample Lab.	M
L9	Bio-Chemical Lab. 1	M
L10	Dark Room	M
L11	Electronic Workshop 1	M
L12	Bio-Chemical Lab. 2	M
L13	Main Hangar/Sub-Sampling Room	M
L14	CTD Hangar	M
L15	Wet Physical Oceanographic Lab.	M
L16	Dry Physical Oceanographic Lab.	M
L17	Scientific Store	Tw
L18	Other Sampling Equipment Store	Tw
L19	Scientific Freezer	Tw
L20	Geophysics Lab.	Tw
L21	Gyro/Gravitymeter Room	Tw
L22	Transducer Connection Room I	Tw
L23	Transducer Connection Room II	Tw
L24	Seawater Sampling Lab.	T.Top

Scientific equipment in Laboratories :
For all scientific equipment to be installed/arranged/used in the laboratories, reference is made to Appendix. No. 8 – List of Scientific Equipment.

General outfitting :
All laboratories, scientific rooms and stores in general to be arranged for highest flexibility with respect to accommodation. Bench system, drawers, cupboards, wall cupboards, shelves to be of a system that allows repositioning within the room, with adjustable legs and adjustable height of benches, etc. Units to have a minimum of legs and legs to be of none-corrosive material/stainless steel.
Adequate numbers of wall mounted cupboards to be provided in each laboratory. Wall cupboards in general to have sliding doors with glass.

Any laboratory area which are exposed to seawater or chemicals to be lined with acid resistant stainless steel from the floor level to the ceiling.

Work benches and overhead storage:

All work benches to be made of acid proof and corrosion proof material, with underneath storage facilities.

Quality of bench plates will vary depending on use in the different laboratories. Where seawater resistant material is required a quality made of natural minerals and acrylic resins to be used. On some benches plates of plywood to be mounted on top of original bench plate. This for bolting of equipment to the bench and for later renewal of plywood plate.
Arrangement for easy fastening of instrument on benches to be arranged for all benches.
Wet benches to be of special design with a coaming of 10-20 mm in front and approx. 150 mm in sides and rear edge.

Drawer units, racks etc. to be flexible mounted underneath bench-plates, not floor mounted.
Floor mounted equipment(refrigerators/freezers, etc.) to be mounted on pedestals to avoid corrosion. Washstands, cooling/freezing cabinets, heating/drying cabinets and air extraction cabinets to be fixed mounted.

All laboratories to be arranged with secured overhead storage for files and documents.

Chairs:
Two types to be delivered, one at normal seating height and one higher at standing level. Chairs to be of a suitable, adjustable type for use in laboratories, no wheels.

Unless otherwise noted, each laboratory to be arranged with workstations/chairs for min. 6 persons.

Final outfitting of laboratories including furniture, benches, shelves, etc. to be arranged according to final layout drawings.

Drainage :

All laboratories, stores and workshops to be arranged with an efficient and adequate drainage arrangement. All parts of the room including all corners to be drained.

Min. 4 drains to be arranged in each wet laboratory/room/store, enabling efficient drain in all vessel’s trim and list conditions(both forward and aft trim, stb and ps list).

Dry laboratories/rooms/stores to have min. 2 drains each.

For Geology lab / Wet core sample lab where the sediment samples washings shall be carried out, a suitable exclusive drainage facility (with settlement tanks etc) or any other alternate arrangement, may be provided to avoid choking of general drainage system.

Ventilation and Air-conditioning:
All laboratories, scientific rooms and scientific stores to be connected to the ship's common ventilation and air-condition system, or be arranged with separate air-condition units, unless otherwise noted. For further reference, see TS, item 573 or as specified for the individual item in this document.

Special ventilation/extracts for laboratories will vary depending on type of laboratory. Spot extracts, spot supply, cooling, heating to be arranged as specified for each individual laboratory/room in this Annex.

All extraction cabinets, washstands to be of acid and seawater resistant material. Extraction cabinets also to have cupboards with air extraction.

Ventilation ducts from all laboratories to be made of stainless steel.

For further details regarding ventilation and air-conditioning, see Main Specification, item 57.

Scientific gas system:
Gas lines to be arranged from gas storage on 4th deck to each laboratory as specified.
Lines for nitrogen, helium, hydrogen, CO2 and synthetic air to be laid. Piping to be of seamless acid resistant steel(AISI 316). Gas quality 6.0.
In laboratories gas outlets to be arranged below cable trays, approx. 200 mm below ceiling. All outlets to be arranged with stop valve and with valve with manometer at end outlet.

Electric installations:
Electric cable trays with double plug sockets to be mounted approx. 150 mm below ceiling. A number of 16 Amp/230 V 50 Hz circuits and a clean power/UPS circuit to be arranged for each laboratory.

Adequate number of Heavy-duty 440-Volts, 3 Phase weather –proof power sockets to be arranged on open deck for operation of portable equipment.

Water supply :
All wet laboratories to be arranged with sink(s) with both seawater and hot & cold freshwater connections. All laboratories to be arranged with sink(s) with hot and cold freshwater connection.

Lighting arrangement:
All laboratories to be arranged with adequate lighting arrangement, see TS, item 893.
Special attention to be given to all work benches/stations. Additional lighting to be arranged underneath overhead cupboards/cabinets/shelves.

The vessel's laboratories, scientific stores and rooms to be arranged and outfitted as follows:

484.001 Lab. no. L1 Balloon Filling Station.

Type of lab.	:	Dry laboratory
Function of lab.	:	For preparation & launch of sondes and data reception pertaining to upper air data collection using sondes.
Arrangement	:	Lab. to be arranged with benches along walls with drawers and shelves underneath, wall cupboards, shelves, etc. for the best utilization of the space and to meet the purpose/function of the lab. Arrangement and outfitting to be approved by the Owner. An external free and vertically open area outside of the laboratory of 3 x 3 m to be arranged for deployment of equipment(see GA plan).
Scientific equipment	:	See Appendix 8 – List of Scientific Equipment
Air-condition	:	See TS, item 573
Gas outlets	:	N/A
Electrical	:	10 combo 15/5 Amp sockets.
Clean power	:	See TS, item 867
Data/network	:	See Appendix 3.
Telephone	:	According to item 425/ Appendix 3
Other	:	Eye shower, fire extinguisher, first aid equipment.

484.002 Lab. no. L2 : Gas Storage

A gas storage for scientific gasses to be arranged on 4th deck as shown on GA plan. Gas storage to have capacity for min. 30 gas bottles Hydrogen gas. Rack system for bottles to be arranged.

Complete piping system from the storage to outside balloon filling station(L 01) to be arranged.

Storage to be arranged with adequate ventilation/exhaust system, detection system for gas leakages, fire alarm system, fire-fighting system, etc.

Entrance door to the storage to be min. 2 m wide.

484.003 Lab. no. L3 Scientific Data Processing Lab.

Arrangement :
The Scientific Data Processing Laboratory 3rd deck to be arranged with following;

- Centre for acoustics data detection/collection
- Data logging area
- Rack room
- Copy & printer area

Room to be arranged with 17 working positions as indicated on GA plan.
Desks with cupboards and drawer sections below, tables, furniture, racks, etc. as indicated on GA-plan. Chairs of high standard and quality(marine type, no wheels) to be supplied in a number of 17.

Data racks :
Following 19" racks to be installed ;

Acoustic centre	5 racks
Data logging room/area	2 racks

All racks to be of high standard and suitable for marine use.
Racks to be mounted on rigid supports, levelled with the lifted floor. If required racks also to be supported in deck above to avoid vibrations, etc.

Racks to be mounted without internal side plates.

On all surrounding bulkheads and above work benches cable ducts/lanes to be arranged for power outlets(clean power/UPS) and data/network connections. Power cables also to be arranged for racks in all compartments(below lifted floor).

Scientific equipment	:	See Appendix 8 – List of Scientific Equipment
Air-condition	:	See TS, item 573
Gas outlets	:	NA
Electrical	:	40 combo 15/5 Amp sockets.
Clean power	:	See TS, item 867
Data/network	:	See Appendix 3.
Telephone	:	According to item 425/Annex 3
Other	:	Fire extinguisher, first aid equipment.

484.004 Lab. no. L4 Atmospheric Science Lab.

Type of lab.	:	Dry laboratory
Function of lab.	:	For collection of all underway and stationary surface met and upper air data.
Arrangement	:	Lab. to be arranged with benches along walls, free-standing tables, drawers, cupboards, wall cupboards, shelves, etc. for the best utilization of the space and to meet the purpose/function of the lab. Arrangement and outfitting to be approved by the Owner.
Scientific equipment	:	See Appendix 8 – List of Scientific Equipment
Special ventilation	:	A system with spot extractions to be arranged for each working position.
Air-condition	:	See TS, item 573
Gas outlets	:	N/A
Electrical	:	10 combo 15/5 Amp sockets.
Clean power	:	See TS, item 867
Data/network	:	See Appendix 3.
Telephone	:	According to item 425/ Appendix 3
Other	:	Eye shower, fire extinguisher, first aid equipment.

484.005 Lab. no. L5		**Clean General Purpose Lab.**
Type of lab.	:	Dry laboratory
Function of lab.	:	For installation of general purpose equipment.
Arrangement	:	Lab. to be arranged with benches along walls, free-standing tables, drawers, cupboards, wall cupboards, shelves, etc. for the best utilization of the space and to meet the purpose/function of the lab. Arrangement and outfitting to be approved by the Owner. 1 sink/washstand to be arranged with hot, cold water supply.
Scientific equipment	:	See Appendix 8 – List of Scientific Equipment
Special ventilation	:	A system with spot extractions to be arranged for each working position.
Air-condition	:	See TS, item 573
Gas outlets	:	N/A
Electrical	:	10 combo 15/5 Amp sockets.
Clean power	:	See TS, item 867
Data/network	:	See Appendix 3.
Communication	:	According to item 425/ Appendix 3
Other	:	Fire extinguisher, first aid equipment.

484.006 Lab. no. L6 Winch Control Cabin

A winch control cabin to be arranged on 1st deck as shown on the GA plan. Room to be arranged with large windows for optimal view to surrounding deck areas. Windows in control cabin to have sun/heat reducing glass fitted as well as sun protecting roller curtains.

Cabin to be arranged with controls for all scientific winches and frames.

Cabin to have displays for CCTV arranged above windows.

Cabin to be arranged with a self-contained air-condition unit as well as a separate exhaust fan. Heating to be arranged.

Cabin to be connected to the ship's internal communication system, network and have adequate number and type of power outlets.

The room further to be arranged with a control desk for mounting of winch controls, shelves and rack according to final layout drawings approved by Owner.

484.007 Lab. no. L7 Core Sample Store.

The core sample store to be arranged as a fully insulated refrigerated store. Temperature to be kept at a constant temperature of 4 degree centigrade.
Racks to be provided for approx. 100 pipes of 1 meter length and 6 inch diameter each.
Additional racks to be provided for small samples in boxes or miscellaneous arrangement.

Room to be arranged with remote temperature display and alarm for high temperature.

484.008 Lab. no. L8 Wet Lab./Core Sample Lab.

Type of lab.	:	Wet laboratory
Function of lab.	:	For sub-sampling and processing of wet samples.
Arrangement	:	Lab. to be arranged with benches along walls, free-standing tables, drawers, cupboards, wall cupboards, shelves, etc. for the best utilization of the space and to meet the purpose/function of the lab. Arrangement and outfitting to be approved by the Owner. This to include : - 1 sink/washstand to be arranged with hot & cold FW and SW supply. - Water purification system with sink - Vacuum pump filtration unit with a sink - Additional 1200x750 mm work benches - Auto Clave, floor mounted, and sink - Sitting for 6 persons
Scientific equipment	:	See Appendix 8 – List of Scientific Equipment
Special ventilation	:	A system with spot extractions to be arranged for each working position.
Air-condition	:	See TS, item 573
Gas outlets	:	One pressurized air outlet
Electrical	:	10 combo 15/5 Amp sockets.
Clean power	:	See TS, item 867
Data/network	:	See Appendix 3.
Communication	:	According to item 425/ Appendix 3
Other	:	First aid equipment.

484.009 Lab. no. L9 Bio-Chemical Lab. I

Type of lab.	:	Wet laboratory
Function of lab.	:	For Biology and Chemistry treatment and analyses of wet samples.
Arrangement	:	Lab. to be arranged with benches along walls, free-standing tables, drawers, cupboards, wall cupboards, shelves, etc. for the best utilization of the space and to meet the purpose/function of the lab. Arrangement and outfitting to be approved by the Owner. This to include : - 4 sink/washstand to be arranged with hot & cold FW and SW supply. - Sitting for 6 persons - 2 additional work benches 1200x750 mm table top
Scientific equipment	:	See Appendix 8 – List of Scientific Equipment
Special ventilation	:	A system with spot extractions with Hepa filter to be arranged for each working position.
Air-condition	:	See TS, item 573
Gas outlets	:	An arrangement for four(4) gas cylinders to be arranged close to this laboratory. Four separate gas lines with required valves etc to be arranged from cylinders to the laboratory.
Electrical	:	10 combo 15/5 Amp sockets.
Clean power	:	See TS, item 867
Data/network	:	See Appendix 3.
Communication	:	According to item 425/ Appendix 3
Other	:	Eye shower, fire extinguisher, first aid equipment.

484.010 Lab. no. L10 Dark Room

Type of lab.	:	Dry laboratory
Function of lab.	:	Lab to be arranged for photo equipment in order to take photos in the dark.
Arrangement	:	Room to be arranged with a desk for arrangement of the photo equipment. Cupboard to be arranged below desk. Room to be arranged with red lighting, with dimmer.
Scientific equipment	:	See Appendix. 8 – List of Scientific Equipment
Special ventilation	:	NA
Air-condition	:	See TS, item 573
Gas outlets	:	NA
Electrical	:	Adequate power outlets.
Clean power	:	NA
Data/network	:	See Appendix 3.
Communication	:	NA
Other	:	NA

484.011 Lab. no. L11 Electronic Workshop

Type of lab.	:	Dry laboratory
Function of lab.	:	The main function for this room is to repair, maintain and calibrate electronic equipment and instruments.
Arrangement	:	Workshop to be arranged with benches along walls, drawers, cupboards, wall cupboards, shelves, etc. for the best utilization of the space and to meet the purpose/function of the room. Arrangement and outfitting to be approved by the Owner.

		Workshop to be equipped with standard electric test, calibration and service equipment/gadgets. This to include : - Insulation tester - Multimeter - Marine test case - Electrical tester - True RMS AC/DC Clamp meter - Insulation tester, Megohmmeter 50-100V - Thermographic camera - Battery test equipment - Test equipment for pressure switches/sensors - Test equipment for tem sensors
Air-condition	:	See TS, item 573
Special ventilation	:	NA
Air-condition	:	See TS, item 573
Gas outlets	:	NA
Electrical	:	5 combo 15/5 Amp sockets.
Clean power	:	See TS, item 867
Data/network	:	See Appendix 3.
Communication	:	According to item 425/ Appendix. No. 3
Other	:	Fire extinguisher, first aid equipment.

484.012 Lab. no. L12 Bio-Chemical Lab. II

Type of lab.	:	Wet laboratory
Function of lab.	:	For Biology and Chemistry treatment and analysis of wet samples.
Arrangement	:	Lab. to be arranged with benches along walls, free-standing tables, drawers, cupboards, wall cupboards, shelves, etc. for the best utilization of the space and to meet the purpose/function of the lab. Arrangement and outfitting to be approved by the Owner.

This to include :
- 4 sink/washstand to be arranged with hot & cold FW and SW supply.
- Sitting for 6 persons
- 2 additional work benches1200x750 mm table top

Scientific equipment	:	See Appendix. 8 – List of Scientific Equipment
Special ventilation	:	A system with spot extractions with Hepa filter to be arranged for each working position.
Air-condition	:	See TS, item 573
Gas outlets	:	One pressurized air outlet
Electrical	:	10 combo 15/5 Amp sockets.
Clean power	:	See TS, item 867
Data/network	:	See Appendix 3.
Communication	:	According to item 425/ Appendix 3
Other	:	Eye shower, fire extinguisher, first aid equipment.

484.013 Lab. no. L13 Main Hangar

Type of lab.	:	Wet laboratory
Function of lab.	:	The Main hangar to be arranged midship on Main deck as indicated on GA-plan, and consist of an covered area where the winches is placed on main and 2nd deck level. The Main Hangar is a space where in-sea scientific equipment is prepared for deployment either over the stern or over the side, such as ROV, Video grab, Corers, CTD and other scientific equipment.
Arrangement	:	Hangar to be arranged with work benches and secures shelves for storage of various equipment. Arrangement and outfitting to be approved by the Owner.

This to include :

		- 2 sink/washstand to be arranged with hot & cold FW and SW supply
Scientific equipment	:	See Appendix. 8 – List of Scientific Equipment
Special ventilation	:	NA
Air-condition	:	NA
Gas outlets	:	Four pressurized air outlet
Electrical	:	15 combo 15/5 Amp sockets. Two of Heavy-duty 440-Volts, 3 Phase weather –proof power sockets to be arranged within the hangar for operation of portable equipment.
Clean power	:	NA
Data/network	:	See Appendix 3.
Communication	:	According to item 425/Appendix 3.
Other	:	Eye shower, fire extinguisher, first aid equipment.

Hangar to be arranged as a wet laboratory but have additional drainage capacity according regulations.

484.014 Lab. no. L14 CTD hangar

Type of lab.	:	Wet laboratory
Function of lab.	:	The CTD-hangar to be arranged midship stb on Main deck as indicated on GA-plan, and consist of an covered area where the CTD winch is placed on 1st deck level. The CTD-hangar is a space where CTD's are prepared for deployment, deployed and retrieved from.
Arrangement	:	Hangar to be arranged with work benches and secured shelves for storage of various equipment. Arrangement and outfitting to be approved by the Owner. This to include :

- 1 sink/washstand to be arranged with hot & cold FW and SW supply
- Fresh water connection/hose for wash-down

Scientific equipment	:	See Appendix. 8 – List of Scientific Equipment
Special ventilation	:	NA
Air-condition	:	NA
Gas outlets	:	Two pressurized air outlets
Electrical	:	5 combo 15/5 Amp sockets.
Clean power	:	NA
Data/network	:	See Appendix 3.
Communication	:	According to item 425/Appendix 3.
Other	:	First aid equipment.

Hangar to be arranged as a wet laboratory but have additional drainage capacity according regulations.

484.015 Lab. no. L15 Wet Physical Oceanographic Lab.

Type of lab.	:	Wet laboratory
Function of lab.	:	For handling of wet sampling equipment, collecting water samples and biology samples.
Arrangement	:	Lab. to be arranged with benches along walls, free-standing tables, drawers, cupboards, wall cupboards, shelves, etc. for the best utilization of the space and to meet the purpose/function of the lab. Arrangement and outfitting to be approved by the Owner. This to include : - 1 sink/washstand to be arranged with hot & cold FW and seawater supply. - 1 common 6 feet x 19 inches vertical panel rack to house all the deck units of wet area - Sitting for 6 persons

- Storage space for approx. 30 bottles of 10 litres each
- Adequate number of work benches with 4 feet x 2.5 feet table top

Scientific equipment	:	See Appendix 8 – List of Scientific Equipment
Special ventilation	:	A system with spot extractions to be arranged for each working position.
Air-condition	:	See TS, item 573
Gas outlets	:	NA
Electrical	:	10 combo 15/5 Amp sockets.
Clean power	:	See TS, item 867
Data/network	:	See Appendix 3.
Communication	:	According to item 425/ Appendix. 3
Other	:	Eye shower, fire extinguisher, first aid equipment.

484.0016 Lab. no. L16 Dry Oceanographic Lab.

Type of lab.	:	Dry laboratory
Function of lab.	:	For equipment related to collection of underway oceanographic dat.
Arrangement	:	Lab. to be arranged with benches along walls, free-standing tables, drawers, cupboards, wall cupboards, shelves, etc. for the best utilization of the space and to meet the purpose/function of the lab. Arrangement and outfitting to be approved by the Owner.

This to include :

- 1 sink/washstand to be arranged with hot & cold FW and seawater supply.
- Sitting for 5 persons
- Adequate number of work benches with 4 feet x 2.5 feet table top

Scientific equipment	:	See Appendix. 8 – List of Scientific Equipment
Special ventilation	:	A system with spot extractions to be arranged for each working position.
Air-condition	:	See TS, item 573
Gas outlets	:	NA
Electrical	:	10 combo 15/5 Amp sockets.
Clean power	:	One circuit with clean power/UPS with 3 double sockets.
Data/network	:	See Appendix 3.
Communication	:	According to item 425/ Appendix 3.
Other	:	Eye shower, fire extinguisher, first aid equipment.

484.017 Lab. no. L17 Scientific Store

Arrangement	:	The room to be arranged as a general store for scientific equipment.
Special ventilation	:	NA, see TS item 575
Air-condition	:	NA
Gas outlets	:	Four(4) pressure air
Electrical	:	10 combo 15/5 Amp sockets.
Clean power	:	NA
Data/network	:	See Appendix 3.
Communication	:	According to item 425/ Appendix 3.
Other	:	Fire extinguisher, first aid equipment.

484.018 Lab. no. L18 Other Sampling Equipment Store

Arrangement	:	The store to be arranged at Tween deck level as shown on GA plan. The store to be split in two where the stb side part is connected to the ship's air-condition system. As an alternative, a separate air-condition unit to be arranged. Both parts to be arranged with heavy-duty shelves along fore and aft bulkhead. Two (2) levels of shelves w/800 mm depth, with a height interval of about 1m, the lower shelf will be located approx. 600mm above the finished floor. All shelves to be fitted with wooden frames (two (2) superimposed planks). The deck space below the shelves will also be used as a shelf and will also be fitted with two (2) removable frame planks. A matrix lashing-down points to be arranged in both parts of the store.
Special ventilation	:	NA, see TS item 575
Air-condition	:	Half of the Store to be arranged with Air-Conditioning. See TS, item 573.
Gas outlets	:	Four(4) pressure air
Electrical	:	10 combo 15/5 Amp sockets.
Clean power	:	NA
Data/network	:	See Appendix 3.
Communication	:	According to item 425/ Appendix 3.
Other	:	Fire extinguisher, first aid equipment.

484.019 Lab. no. L 19 Scientific Freezer

Room to be used for freezing and storage of samples.
Racks and shelves to be arranged with pen boards in aluminium.

Room to be insulated for a temperature of 4°C and equipped with approved freezing door as per drawing. Walls and ceiling to be water proof plates.

Floor to be concrete above insulation with slope to a necessary number of drains. Concrete to be covered with water proof epoxy resin intended for low temperatures.

Emergency alarm according to regulations to be installed. Remote temperature control and high-temperature alarm to be arranged.

Refrigerant to be R507 and capacity of plant to be freezing of 5000kg/24h down to 4°C in addition to maintaining samples at the same temperature. Evaporators to be with fans.
Plant to be with automatic de-icing. Drain with heating cable to be arranged.
Freezing compressor plant, see item 554.

484.020 Lab. no. L20 Geophysics Lab.

Type of lab.	:	Dry laboratory
Function of lab.	:	For underway Geophysical and Bathymetry data collection.
Arrangement	:	Lab. to be arranged with benches along walls, free-standing tables, drawers, cupboards, wall cupboards, shelves, etc. for the best utilization of the space and to meet the purpose/function of the lab. Arrangement and outfitting to be approved by the Owner. This to include : - 1 sink/washstand to be arranged with hot & cold FW supply. - Adequate number of work benches with 1200x750 mm table top - Sitting for 6 persons
Scientific equipment	:	See Appendix 8 – List of Scientific Equipment
Special ventilation	:	NA
Air-condition	:	See TS, item 573
Gas outlets	:	NA
Electrical	:	30 combo 15/5 Amp sockets.
Clean power	:	See TS, item 867
Data/network	:	See Appendix 3.
Communication	:	According to item 425/ Appendix 3.
Other	:	Fire extinguisher, first aid equipment.

484.021 Lab. no. L21 Gyro/Gravitymeter Room

Arrangement & Function :
A dedicated room for the Gyro and the Gravitymeter to be arranged on Tween deck amidship as shown on GA plan.

Required power and signal cables to be arranged as required for the installed equipment.

Steel foundation for the installed equipment to be arranged.

Special ventilation	:	NA, see TS item 575
Air-condition	:	See TS, item 573.
Clean power	:	See TS, item 867
Data/network	:	See Appendix 3.
Communication	:	According to item 425/ Appendix 3.
Other	:	Fire extinguisher, first aid equipment.

484.022 Lab. no. 22 Transducer Connection Room I

Arrangement & Function:
Transducer Connection Room I is placed in front of the drop keel trunk on Tween deck as shown on GA plan.

The room to be dedicated for mounting of connection boxes and other related equipment to the acoustic equipment installed in the drop keels.

The room to be connected to the ship's ventilation and air-condition system.

Adequate number and type of power outlets to be arranged as well as network connections.

Special ventilation	:	NA, see TS item 575
Air-condition	:	See TS, item 573
Clean power	:	See TS, item 867
Data/network	:	See Appendix 3.
Communication	:	According to item 425/ Appendix 3.
Other	:	Fire extinguisher

484.023 Lab. no. 23 Transducer Connection Room II

Arrangement & Function:
Transducer Connection Room II is placed in front of the accommodation on Tween deck as shown on GA plan.

The room to be dedicated for mounting of connection boxes and other related equipment to the acoustic equipment installed in the gondola and in the hull.

Adequate number and type of power outlets to be arranged as well as network connections.

Special ventilation	:	NA, see TS item 575
Air-condition	:	See TS, item 573
Clean power	:	See TS, item 867
Data/network	:	See Appendix 3.
Communication	:	According to item 425/ Appendix 3.
Other	:	Fire extinguisher

484.024 Lab. no. L24 Seawater Laboratory

To provide the capability of monitoring temperature, conductivity and salinity of SW while underway, and to supply uncontaminated water for chemical analysis, two (2) off pumped water supplies to be fitted, with intakes situated approx. 2, 4 and 7m below the waterline. The intakes 2m and 4m below the waterline to be on SB side at about frame 102-107.

One intake(7m below waterline) to be located in SB drop keel, with flexible hose connection.

Each of these intakes to be fitted with a 200 ltr air trap. From the air traps also unfiltered SW supply to be installed. Possibility to ventilate the air trap to be arranged. Supplies to be pumped to Laboratory no. xx where the water will pass through removable filters and through the Thermosalinograph sensor units.

All pumps, piping and fittings to be of inert materials. The pipes should not run through heated spaces prior to passing through the Thermosalinographs. Pipes and fittings are to be thermal insulated. Two (2) off duplicate pump systems will be required. Pumps to be of screw type.

Constantly flowing water from the SW laboratory to be led to a drain tank with High Level Alarm and automatic and manual discharge. The drain tank also to have emergency bilge possibility, ref. item 803.
5 spare discharge pipes with blind plugs to the tank to be included.

The non-toxic supply will also be provided by this system and alkathene pipes of potable water quality and other non-toxic taps and fittings to be used throughout. Flow rates required for the non-toxic system as a whole are variable from 0 – 200 ltr/min.

Two (2) off frequency driven pumps to be placed in L xx and two (2) off frequency driven pumps in the drop keel duct, (one (1) off to be back-up)
The pumps to be made of Titan material. Pumps to be mounted as low in hull as possible.

Type of lab.	:	Wet laboratory
Arrangement	:	Lab. to be arranged with a bench, drawers, wall cupboards, shelves, etc. for the best utilization of the space and to meet the purpose/function of the lab. Arrangement and outfitting to be approved by the Owner.
Scientific equipment	:	See Appendix. 8 – List of Scientific Equipment
Special ventilation	:	NA
Air-condition	:	NA
Gas outlets	:	One pressure air connection
Electrical	:	10 combo 15/5 Amp sockets.
Clean power	:	See TS, item 867
Data/network	:	See Appendix 3.
Communication	:	According to item 425/ Appendix. 3
Other	:	First aid equipment.

Appendix 6:

Specification of Scientific Acoustic Instrumentation for Ocean Research, Geology and Bathymetry

Project reference:	
Project ID.:	**Oceanographic Research Vessel (ORV)**

Reference :
Technical Specification(TS), document

1 INTRODUCTION

Acoustic methods for ocean research, geology and seabed mapping have been videly used for several decades. The instruments are highly developed and delicate and the vessels, in which they are installed, must be designed with the aim to achieve optimum performance of them. In order to ensure that the underwater acoustic instruments maintain their optimum performance, it is outmost important that the Vessel itself is noise reduced and that the hull is shaped in a way that air bubble sweepdown is minimized. The specifications of acoustic equipment to be considered in conjunction with the specifications provided at Annex 8.

2 GENERAL

Transducers can be installed in different ways dependent on the type and size. The main conditions which must be taken into account in the design of the transducer arrangements are to keep them away fror noise sources and to avoid swept-down airbubbles. For the smallest transducers, retractable drop keels have been used in order to bring the transducers beneath the most serious airbubble layers in bad weather contiditions, on most new-built research vessels the last 25 years. For the great, deep sea multibeam transducers, so called gondolas have been used as compartment for them in order to avoid disturbances by svept-down airbubbles.

All transducers used for bathymetry and seabed mapping shall have motion compensation by means of the ship's attitude sensors.

The Builder shall deliver the instruments specified in this document installed complete, calibrated in compliance with the vendor's requirements and ready for service. All components that are necessary for the systems to work properly, even if not mentioned in this document, shall be included. The delivery shall include training of personnel, harbor acceptance test (HAT) and sea acceptance test (SAT).

2.1 DROP KEEL FEATURES

The drop keel arrangement and main features are described in Technical Specifications, 414.

2.2 GONDOLA FEATURES

The gondola arrangement and main features are described in Technical Specifications, 414.

2.3 MEASUREMENTS OF TRANSDUCER POSITIONS

The xyz distances between motion reference unit (MRU, part of the attitude sensor) and all Bathymetric and profiling transducers shall be measured and documented in compliance with IHO S-44 standard.

2.4 TRANSCEIVER INSTALLATIONS

The transducer cables are extremely susceptible to electromagnetic interference, EMI, and shall be as short as possible. The transceivers must therefore be located near the transducers installations. Pipes for transducer cables from multi beam transducers must be designed in compliance with vendor's requirements.

2.5 WORK STATIONS ARRANGEMENTS

Modern electronic instruments as echo sounders are usually operated by means of a computer or PC-based workstation. *The acoustic instruments for scientific use have potential of generating huge amount of data, and the Owner shall approve the storage capacity of the provided equipment*. The Builder shall install suitable racks or consoles for the workstations, approved by the Owner, in the Geophysics Lab, tween deck. All workstations communicate with servers, marine data management system and mass storage units via the distribution network. In addition to the workstations for operation of the instruments, the Builder shall provide on-line computer workstations for post processing of acoustic data with adequate software. A matrix system for presenting a selection of workstation displays, including acoustic instruments, CTD, chart machines and others, on a split screen in the Scientific Data Processing Lab and other laboratories via distribution network, shall be provided. The matrix system shall be designed in conjunction with the Owner.

2.6 REFERENCE DATA DISTRIBUTION

All acoustic instrument systems need input of reference data from navigation and attitude sensors. Reference data includes time, position, course, speed, distance, 1PPM, yaw, roll, pitch and heave. The reference data are distributed on different signal carriers, Ethernet or serial (RS232 and RS422), dependent on the specific instrument. Some systems receive attitude data in the transceiver unit and others in the processor unit. It is preferred to have the reference data lines from the sensors collected in a central unit with the necessary signal splitters, switches etc. for distribution of reference data to the instrument systems (signal distribution box).

2.7 PERIPHERALS

The Builder shall provide the peripherals necessary for production of high quality data from the acoustic instruments. This include:

- Sound speed sensors, hull mounted
- Sound speed profiler
- Displays
- A0 plotter (colour) for chart production etc.
- Printers for echogram printouts

3 DEEP SEA ECHO SOUNDER

With reference to Appendix 8 of Technical Specifications.

4 SHALLOW WATER ECHO SOUNDER (TWIN TRANSDUCER, AFT AND BOW)

For navigation in shallow water, in harbors etc. an echo sounder with relatively high frequency and high resolution and two transducers, one near the bow and one in the aft part, shall be installed complete.

5 PINGER TRANSDUCER

A transducer, which can pick up signals from a pinger attached to an underwater device for tracking its current dept.

6 DEEP WATER MULTI BEAM ECHO SOUNDER

With reference to Appendix 8 of Technical Specifications.

7 SUB BOTTOM PROFILER

With reference to Appendix 8 of Technical Specifications.

8 SHALLOW WATER MULTI BEAM ECHO SOUNDER

With reference to Appendix 8 of Technical Specifications.

9 POST PROCESSING WORKSTATION WITH SOFTWARE

One “state of the art” workstation with sufficient software for post processing data from the bathymetric echo sounders, approved by the Owner, shall be delivered.

10 ACOUSTIC DOPPLER CURRENT PROFILER (ADCP) 75 KHZ

With reference to Appendix 8 of Technical Specifications.

11 ACOUSTIC DOPPLER CURRENT PROFILERS (ADCP) 300 & 75 KHZ

Complete ADCPs operating at 300 kHz and 75 kHz, with specifications as provided at appendix-8 of Technical Specifications, to be installed in one of the vessel’s drop keels.

12 ATTITUDE SENSOR

With reference to 412 in Technical Specification

13 SIDE SCAN SONAR

With reference to Appendix 8 of Technical Specifications.

14 SYNCHRONIZING (TRIGGER CONTROL) SYSTEM

The Builder shall deliver and install a programmable system for triggering transmitters of all specified acoustic instruments. The system shall insure that each instrument transmit in a programmed sequence in order to minimize interference between the various instruments. The system shall be flexible and programmable to allow multiple pulses in the water column as well as prevent new transmittal until last sound pulse has extinct. The trigger signal types may be various, TTL, RS232, RS422 or others.

15 NAVIGATIONAL ECHO SOUNDER

With reference to 412 in Technical Specification

16 DOPPLER SPEED LOG AND ELECTROMAGNETIC LOG

A complete dual axis speed log system to be installed. The doppler log shall measure speed through water (STW) and speed over ground (SOG). Interface: Ethernet and NMEA 0183 output.

Electromagnetic Log with reference to 412 in Technical Specification

17 HYDRO-ACOUSTIC POSITION REFERENCE (TRANSDUCERS FOR DP SYSTEM)

Refer to 408, Dynamic Positioning Systems, Reference system in Technical Specifications.
One(1) high precision hydro acoustic position reference system with Super Short / Ultra Short Base Line (SSBL / USBL) shall be complete with hoist control and motorized gate valve.
Minimum requirements for the SSBL/USBL system is:

- Range: approx. 4000 m in a volume that includes -1° to +90° vertically and 360° horizontally.
- In order to avoid multipath disturbance, the multi beam transducer must be positioned about 5 m below the hull.
- The system shall be used for positioning of underwater vehicles such as ROV, camera pods etc. with a position accuracy of 0.2 %.
- The system shall have interface with RS232/RS422 and Ethernet and must be integrated with the ship's DP system.

The system must communicate with the following NMEA telegrams:

- PSIMSNS (values from attitude sensor)
- PSIMSSB (position for transponder)

Two (2) off Mini transponders complete, with chargers, shall be included. One of the transponders to have a depth rating of minimum 4000 m and the other shall have a depth rating of minimum 2000 m.

Appendix 7 : Makers List

1. Ship General

Noise & Vibration Consultant
DNV GL, Department for Noise and Vibrations, www.dnvgl.com
TSI S.L., www.tsisl.es
SEDS
IRS

EMC Consultant
Applica Test & Certification, www.applica.no
TUV Rheinland (India) Pvt Ltd.
Rohde & Schwarz India Pvt. Ltd.
Sameer Labs, Vizag

Model test facility
Maritime Research Institute Netherlands, www.marin.nl
The Hamburg Ship Model Basin, www.hsva.de
CTO S.A, www.cto.gda.pl
Krylov State Research Centre, www.krylov-center.ru www.
IIT Chennai,
NSTL, Visakhapatnam
SSPA, Sweden

Repair and maint. equipment
Unitor www.unitor.com
Tess www.tess.com
Gedore www.amelsbeek.nl

2. HULL STRUCTURE

Paint systems
International AS, www.international-marine.com
Jotun, www.jotun.com
Hempel, www.hempel.com
Sigma, www.ppgpmc.com
KCC
Chugoku Samhwa

Cathodic protection
Jotun AS www.jotun.no
Wilson-Walton Int. www.corrpro.com
Corrintec sales@corrintec.co.uk

Cathelco
K.C.
M/s Sargam Cathodic Protection, Chennai

3. SPECIALIZED EQUIPMENT

Hangar doors/Shutter doors
SP www.spconsulto.com
TTS / Cargotec's MacGregor
M/s L&T Ltd

Crane suppliers
MacGregor-Triplex AS, www.macgregor.com
TTS SHIPS EQUIPMENT AS, www.ttsgroup.no
Palfinger Marine, www.palfinger.com
Seaonics AS, www.seaonics.com
Liebherr www.liebherr.com
National Oilwell Varco www.nov.com
Cargotec AS www.cargotec.com
Triplex www.triplex.no
Hydralift AS
Huisman
Techcrane International www.techcrane.com
Sormec www.sormec.net
Heila cranes www.heila.com
Appleton Marine www.appletonmarine.com
Geeta engineering
Bhavani engineering
Masada

Scientific davits/frames
MacGregor-Triplex AS, www.macgregor.com
TTS SHIPS EQUIPMENT AS, www.ttsgroup.no
Triplex www.triplex.no
Rolls-Royce AS www.rolls-royce.com
Hydralift Marine AS
INDUSTRIAS FERRI
InterOcean Systems www.interoceansystems.com
Pellegrini Marine Equipments www.offshoremarinecranes.com
Kley France http://kleyfrance.fr

Caley Ocean Systems http://caley.co.uk
Deck Marine Systems

Cargo Lift
Kone, Finland
Techwind, Poland
Lift emotion, Netherlands

4. Ship equipment

Rudder supplier
Van der Velden Barkemeyer Schiffstechnik Gmbh, www.vdvelden.com
Rolls-Royce Marine, www.rolls-royce.com
Becker Marine Systems, www.becker-marine-systems.com
Kankaanpaa Works
BOT Groningen
Hatlapa
Aker Pusnes
Remontowa Hydraulic Systems http://rhs.rh.pl/en
Wills Ridley www.willsridley.com

Steering gear
Van der Velden Barkemeyer Schiffstechnik Gmbh, www.vdvelden.com
Rolls-Royce Marine, www.rolls-royce.com
Becker www.becker-marine-systems.com
Kankaanpaa Works
BOT Groningen
Hatlapa
Aker Pusnes
Remontowa Hydraulic Systems http://rhs.rh.pl/en
Wills Ridley www.willsridley.com

Tunnel thruster supplier
Brunvoll AS, www.brunvoll.no
Wärtsilä Marine, www.wartsila.com
ZF Marine, www.zf.com
SCHOTTEL, www.schottel.de
Rolls-Royce AS www.rolls-royce.com
winchBerg Propulsion www.bergpropulsion.com
Thrustmaster www.thrustmaster.net
Nakashima

Azimuthing thruster supplier
Brunvoll AS, www.brunvoll.no
Wärtsilä Marine, www.wartsila.com
ZF Marine, www.zf.com
SCHOTTEL, www.schottel.de
Rolls-Royce AS www.rolls-royce.com
Berg Propulsion www.bergpropulsion.com
Thrustmaster www.thrustmaster.net

Roll Stabilisation
Hoppe Bordmesstechnik GmbH, www.hoppe-marine.com/
Solmar Ltd. www.solmar.is
Rolls-Royce AS www.rolls-royce.com

Dynamic Positioning System supplier
Kongsberg Maritime, www.kongsberg.com
Rolls-Royce Marine, www.rolls-royce.com
Marine Technologies LLC, www.marine-technologies.com
Converteam www.converteam.com
Alstom www.alstom.com
Wartsila www.wartsila.com
L3

Radar systems
Kongsberg Maritime, www.kongsberg.com
Wärtsilä SAM Electronics, www.sam-electronic.de
Furuno, www.furuno.com
Raytheon Anshutz http://www.raytheon-anschuetz.com
JRC www.jrc.co.jp
M/s Marine Electricals

Navigational systems
Kongsberg Maritime, www.kongsberg.com
Wärtsilä SAM Electronics, www.sam-electronic.de
Furuno, www.furuno.com
Raytheon Anshutz http://www.raytheon-anschuetz.com/
JRC www.jrc.co.jp
HDW-Hagenuk www.hdw-hagenuk.de
Consilium Marine
Kelvin Hughes
L3 Comm
Atlas Elektronik

Underwater acoustic equipment, echo sounders, multi-beams
Kongsberg Simrad, www.simrad.com
Teledyne Marine, www.teledynemarine.com
Furuno www.furuno.no
Atlas www.stn-atlas.de

Video surveillance
Hernis, www.hernis.com
Kongsberg, www.km.kongsberg.com
Zenitel (Vingtor), www.zenitel.com

Radio plant, GMDSS
Kongsberg Maritime, www.kongsberg.com
Inmarsat, www.inmarsat.com
Wärtsilä SAM Electronics, www.sam-electronic.de
Wärtsilä SAM Electronics, www.sam-electronic.de
Furuno, www.furuno.com
JRC

Communication and Entertainment system
Kongsberg Maritime, www.kongsberg.com
Inmarsat, www.inmarsat.com
Cobham www.cobham.com/
Wärtsilä SAM Electronics, www.sam-electronic.de
Furuno, www.furuno.com
Ratheon www.raytheon.com
VICO www.vico.no
Radio station Sailor www.sailor.no
Atlas Elektronik
Consilium Marine
Kelvin Hughes
HDW-Hagenuk
Zenitel
MRC

Calling command/telephone etc
Zenitel www.zenitel.com
Jotron Phontech, www.jotron.com
Gitiesse (Imcos), www.gitiesse.com

Navigaton lights

Tranberg, www.tranberg.no
Glamox(Aquasignal), www.glamox.com
Tranberg www.tranberg.no
Aqua Signal www.aquasignal.net
Steenhans info@radioholland.nl
Norselight www.norselight.com
Daeyang

Windlass with chainstopper
Ibercisa Deck Machinery, www.ibercisa.es
Rapp Marine AS, www.rappmarine.no
Seaonics AS, www.seaonics.com
Karmoy Winch AS post@karmoy-winch.no
Rolls-Royce AS www.rolls-royce.com
Hatlapa Ridderinkhof www.rotor.nl
Kangrim
GC Tech
Hydralift ASA
SEC
Geetha engineering
Bhavani engineering

Trawlblocks, other fishing blocks
Mollerodden, www.mollerodden.no
Brdr. Markussen Metallvarefabrikk(BMM), www.blueline.dk
WESTCON

Deck machinery/winches for fishing operations
Rapp Marine AS, www.rappmarine.no
Ibercisa Deck Machinery, www.ibercisa.es
Seaonics AS, www.seaonics.com
Romica Engineering Ltd. www.romica.co.uk
DMT Marine Equipments

Deck machinery/winches for oceanogr. Operations
Rapp Marine AS, www.rappmarine.no
Ibercisa Deck Machinery, www.ibercisa.es
Seaonics AS, www.seaonics.com
Rolls-Royce AS www.rolls-royce.com
Dynacon www.dynacon.com
Hydralift Marine AS

Macgregor www.cargotec.com
Triplex www.triplex.no
Karmoy
ODIM
SEC
Kley France http://kleyfrance.fr
Hawboldt Industries http://hawboldtind.com
Deck Marine Systems

LARS and winches for CTD
Rolls-Royce AS www.rolls-royce.no
Macgregor offshore marketing@macgregor-group.com
Schilling Robotics www.schilling.com
Hydralift ASA
Deck marine systems
DMT Marine Equipments

Auxiliary vessel
Maritime Partner AS, www.maritime-partner.com
Palfinger Marine, www.palfinger.com
Survitec Group, www.survitec.no

GPS/DGPS
Furuno www.furuno.no
Sailor www.sailor.dk
JRC www.markoni-marine.com
Trimble www.trimble.com
Northstar Technologies www.navcen.uscg.mil
VICO www.vico.no
Kongsberg
HDW-Hagenuk
Consilium Marine
Kelvin Hughes
C-Nav / Oceaneering

Fog monitor
Kverner Eureka www.akerkvaerner.com
Droplet Measurement Technologies www.dropletmeasurement.com

Gyro compass and autopilot
Kongsberg Navigasjon www.kongsberg-simrad.com
Anschutz www.gyrosystem.com

Sperry www.sperry-marine.com
Plath-Navpilot
Tokyo Keiki www.tokimec.co.jp
Raytheon www.raytheon.com
VICO www.vico.no

Magnetic compass
Plath Cassens&Plath www.cassens-plath.de acc
Bergen Nautic System www.nautic.no
VICO www.vico.no
Lillie &Gillie

Log, Doppler
Log Furuno www.furuno.no
Ben www.marine-netguide.com
Atlas www.stn-atlas.de
Skipper

Electronic Chart Plotter
VICO www.vico.no
Navionics www.navionics.com

C-Map
Radio station Sailor www.sailor.no
Furuno www.furuno.no
VICO www.vico.no
Kongsberg
HDW-Hagenuk
Consilium Marine
Kelvin Hughes

Satellite Communication
General Dynamics
Thales
Selex Communications
Astrium
Seatel
Sailor
Thrane & Thrane
JRC
Furuno

Weather fax
Furuno www.furuno.com
VICO www.vico.no
JRC
NAVTEX
Japan Marina Company (JMC)

Emergency radio direct finder
Sailor www.sailor.no
Furuno www.furuno.com
VICO www.vico.no
EPIRB JOTRON www.jotron.com
ACR Electronics
SART JOTRON www.jotron.com
JRC www.markoni-marine.com

Voyage Data Recorder
Nautic system www.nautic.no
Broadgate UK www.broadgate-uk.com
VICO www.vico.no
Kongsberg
Raytheon
HDW-Hagenuk
Consilium Marine
Furuno

Automatic Identification syst.
JRC www.markoni-marine.com
SP Sailor www.sailor.dk
VICO www.vico.no
Kongsberg
Raytheon
HDW-Hagenuk
Consilium Marine
Furuno
Kelvin Hughes
SAAB

Bridge dead man Alarm
SAAB www.saab.se

Norcontrol www.norcontrolit.com
VICO www.vico.no
Kongsberg
Raytheon
HDW-Hagenuk
Consilium Marine
Furuno
Kelvin Hughes

VHF/UHF
Furuno www.furuno.no
Motorola www.motorola.com
Ratheon www.raytheon.com
Atlas Elektronik
Sailor
JRC

Portable VHF Tranceiver
Jotron www.jotron.com
JRC www.markoni-marine.com
Motorola www.motorola.com
Telephone/Intercom Vingtor www.jotech.no
Steenhans info@radioholland.nl
Atlas Elektronik
Sailor
Furuno

Anchors, Chain and equipment
Barthels + Lüders www.barthels-lueders.com
Balmoral www.balmoral-group.com
Sotra Marine Produkt AS www.sotra.net
Wortelboer
Asian Star
FMAC
Hyundai Cast Steel
Vicinay
Kum Wha
M/s Indian Chain Pvt Ltd
M/s Govardhan Das
India Chain Pvt Ltd
GRSE Deck Machinery Unit

Window wipers
Atlas/Wynn www.atlas.de
Decca www.decca.no
Hepworth-UK www.b-hepworth.com
Jung-A marine

Econometer AM
Instrumentering am.instrumentering@mimer.no
EM Electronics AS www.eme.no

Main Console Engine room
Rolls Royce www.rolls-royce.com
Wartsila www.wartsila.com
L3 Mapps

Sonar
Kongsberg

5. EQUIPMENT FOR CREW AND PERSONNEL

Lifeboats
Norsafe AS, www.norsafe.com
Harding Safety AS, www.harding.no
Xervo, www.xervo.dk
Brude Safety AS www.kopas.no
Norpower www.norpower.no
Viking
Hydramarine AS
Nor Marine
Maritime partner www.maritime-partner.com
Mare Safety www.mare.no
Noreq www.noreq.no
NED-DECK
HATECKE
CERTASA
Schat-Harding
Fassmer

Wheelhouse chairs
Sørlandets Aluminiumsprodukter www.norsap.no

Aluminiumsprodukter www.norsap.no
Nordic Supply www.nordicsupply.no
Skipper www.seimi.com
Alu Design & Services AS www.aludesign.no
Cleeman Chair Systems GmbH
Portner GmbH
Hoze Co Ltd

Lifeboat davits

Norsafe AS, www.norsafe.com
Harding Safety AS, www.harding.no
Vestdavit AS www.vestdavit.no
Davit International
NED-DECK
HATECKE
CERTASA
Schat-Harding
Fassmer
Geetha engineering

M.O.B./Rescue Boat

Maritime Partner AS, www.maritime-partner.com
Palfinger Marine, www.palfinger.com
Survitec Group, www.survitec.no
Mare Safety AS, www.maresafety.com

Rescue boat davit

Maritime Partner AS, www.maritime-partner.com
Harding Safety AS, www.harding.no
Norsafe AS, www.norsafe.com
Palfinger Marine, Austria

Liferafts & davits

VIKING Life-Saving Equipment, www.viking-life.com
Survitec Group, www.survitec.no
Palfinger Marine, www.palfinger.com
Geetha engineering

Accommodation system, inslulation, partition bulkheads, panels

Maritime Montering AS, www.maritimemontering.no
RM Ship Interior AS, www.rm-group.com
System Norac www.norac.no
Isolamin www.isolamin.se
Dampa www.dampa.dk
ROV Schilling Robotics www.schilling.com
IKM Subsea www.ikmsubsea.com
Sonsub www.sonsub.com
Oceaneering www.oceaneering.com
SBA Interior www.sba.fi
HBM Ltd www.hbm.cn
Lautex Oy. www.lautex.com
MBM Srl www.mbmsrl.net
Staco Co Ltd www.staco.co.kr
Wartsila
STX Finland cabins
Parmarine Ltd www.parmarine.fi
BN Bip

Doors in accommodation

Baggerød Horten AS baggerod@baggerod-nordam.no
Norac www.norac.no
Alvedoor AB www.alvedoor.se
Locking system Trio Ving www.ship-technology.com
Norac www.norac.no
PANELFA www.panelfa.com
Staco
BN Cosmo

Watertight doors, hydr. Operated

IMS Technologies AS, www.imsgroup.no
Winel B.V., www.winel.nl
Schoenrock schoenrock-hydraulik@t-online.de
Tebul

Main Cargo Hatch Covers

Cargotec AS www.cargotec.com
Macgregor SP www.spconsulto.com
TTS
SMS

External doors

LIBRA-PLAST AS, www.libra.no

NORPRO Ship Equipment, www.norpro.no
Winel B.V., www.winel.nl
ALJO www.aljo.de
BoMek www.rappmarine.com
Momek www.momec.com
LIBRA www.libra.no
UCALSA & YARD
BOHAMET www.bohamet.com
Staco
BN Cosmo

Windows and portholes
Bohamet, www.bohamet.com
CC Jensen, www.cjc-windows.dk
Wigo, wigo.nl
Marine Aluminium www.marineal.no
Trinoxx www.trinoxx.nl
Lubmor www.bmn.gda.pl
Samgong
M/s Hiral Enterprise
M/s Rakme

Galley equipment supplier
Beha-Hedo Industrier AS, www.beha-hedo.com
Mare Safety AS, www.maresafety.com
Edco www.edco.no
Electrolux www.electrolux.no
Refrigerators Miele www.miele.de
Foster www.foster-uk.com
Caterform www.caterform.co.uk
Hobart www.hobart.no
Bohnhoff Hamburg www.bohnhoff-hamburg.com
Loipart Ltd www.loipart.fi
Metos Oy AB www.metos.com
M/s Sushma & Co Electricals pvt Ltd

Provision Cooling Compressors
Novenco, www.novenco-marine.com
TEKNOTHERM Marine, www.teknotherm.no
AERON AS, www.aeron.no
Heinen & Hopman, www.heinenhopman.com

Sabroe www.sabroe.dk
Carrier www.simex.no
Bitzer www.bitzer.de
Burkhardt
ELGI Compressor

Gangways
UNDERTUN, www.undertun.com
Marine aluminium www.ham.no
Lemvik
Fassmer
MME
Hindustan Shipyard Ltd
Geeta Engineering

Ventilation air-condition system for accommodation
Novenco, www.novenco-marine.com
TEKNOTHERM Marine, www.teknotherm.no
AERON AS, www.aeron.no
Heinen & Hopman, www.heinenhopman.com
Rapid Marine www.rapidoffshoremarine.com
GRENCO IBERICA www.grencoiberica.es
Noske Kaeser
Hi Air
M/s Johnsons Control
M/s ACCEL

Air-condition for Control rooms, Wheelhouse and Laboratories
Novenco, www.novenco-marine.com
TEKNOTHERM Marine, www.teknotherm.no
AERON AS, www.aeron.no
Heinen & Hopman, www.heinenhopman.com
M/s Johnsons Control
M/s ACCEL

Ventilation system for Engine and Propulsion room
Novenco, www.novenco-marine.com
TEKNOTHERM Marine, www.teknotherm.no
AERON AS, www.aeron.no
Heinen & Hopman, www.heinenhopman.com
Rapid Marine www.rapidoffshoremarine.com
GRENCO IBERICA www.grencoiberica.es
Noske Kaeser
Hi Air
Flaktwoods

M/s Johnsons Control
M/s ACCEL
M/s Engie Axima India Pvt Ltd
M/s Flakt Group India Pvt Ltd

Chilled water plants
Novenco, www.novenco-marine.com
TEKNOTHERM Marine, www.teknotherm.no

Vacuum sewage system supplier
Jets Vacuum, www.jetsgroup.com
Evac, www.evac.com
HDW www.hdw-hagenuk.de
Hamworthy
Aquamar
AcoMarine

Sewage treatment unit
Jets Vacuum, www.jetsgroup.com
Wartsila Hamworthy, www.wartsila.com
Detegasa, www.detegasa.com
ORCA daco@bgnett.no
Hamworthy AS www.hamworthykse.com
Norsk Atlas AS www.heco.dk
EVAC
ALFA LAVAL
GEFICO
HAMMAN
Aquamar
AcoMarin

6. MACHINERY MAIN COMPONENTS

Main diesel engine supplier
Wärtsilä Marine, www.wartsila.com
MaK, www.marine.cat.com
Caterpillar, www.marine.cat.com
MAN Diesel & Turbo, http://dieselturbo.man.eu/
Yanmar www.yanmar.com/in/
Daihatsu

Main electrical propulsion system

Ingeteam, www.ingeteam.com
Siemens, www.siemens.com
Main propeller supplier
Wärtsilä Marine, www.wartsila.com
Scana, www.scana.no
Rolls-Royce AS www.rolls-royce.com
Schottel www.williamknudsen.no
MAN www.mandiesel.com
Berg Propulsion www.bergpropulsion.com
Fincantieri Mechanical Division
ABB
GE

Auxiliary boiler
Parat Halvorsen, www.parat.no
Ulmatec Pyro, www.ulmatec.no/ulmatec-pyro-as
Pyro pyro@pyro.no
Aalborg Industries AS www.aalborg-industries.dk
Thermax
GESAB
S-MAN
Kangrim

Main generator supplier
Ingeteam, www.ingeteam.com
Siemens, www.siemens.com
Wartsila www.wartsila.com
Rolls-Royce AS www.rolls-royce.com
MAK www.caterpillar.com
MAN engines www.man-engines.com
Converteam www.converteam.com/GE
MTU www.mtuonsiteenergy.com
CAT www.cat.com
Mitsubishi
Cummins India Pvt Ltd, Pune
Wabtec

Harbour diesel generator
Wärtsilä Marine, Finland
Caterpillar, USA
MAN Diesel & Turbo, Germany
Yanmar, Japan
ABC, Belgium

Daihatsu, Japan
Cummins

Emergency diesel generatorset supplier
Cummins, www.cummins.com
Caterpillar, www.marine.cat.com
MAN www.mancraft.no
MTU www.mtu-online.com
Wartsila www.wartsila.com
Converteam www.converteam.com
Volvo-Penta
Cummins www.cummins.com

Transformer
Siemens www.siemens.no
ABB www.abb.com
HDW Hagenuk www.hdw-hagenuk.de
Noratel
Schneider Electric
Converteam/GE
Marine Electricals
L&T
Wave Electronics

7. SYSTEMS FOR MAIN MACHINERY AND COMPONENTS

Fuel oil/ Ballast/ Bilge valve chests
Rolls-Royce Marine, www.rolls-royce.com
Ahlsell AS –SIP type valve chest, www.ahlsell.no

Fuel oil/Lub. Oil separators
Alfa Laval, www.alfalaval.com
GEA Westfalia Separators, www.gea.com
Westfalia www.gea-westfalia.no
Mitsubishi www.goltens.com
Samgong Korea

Plate cooler supplier
Alfa Laval, www.alfalaval.com
GEA heatexchangers(now Kelvion), www.kelvion.com
Sperre pleat coolers, www.sperre.com/pleat
Danfoss (Sondex)

Starting air compressors
Sperre compressors, www.sperre.com
Wartsila Hamworthy, www.wartsila.com; Hatlapa www.hatlapa.de
Atlas www.atlascopco.no
Sauer & Sohn.
Hatlapa www.hatlapa.de
M/s Burkhardt compresors, Pune
M/s ELGI

Main Reduction Gears
Wartsila www.wartsila.com
Renk www.renk.de/
MAN www.mandiesel.com
Scana Volda www.scana.no
Flender www.flender.com
Rentjes www.reintjes.com
Twindisc www.twindisc.com
ZF

Working air compressor
Tamrotor, www.tmc.no
Atlas Copco, www.atlascopco.com
Kaeser, www.kaeser.com
Sperre www.sperre.com
Hatlapa www.hatlapa.de
Sauer & Sohn
M/s Burkhardt compresors, Pune
M/s ELGI

SCR Catalytic system
To be supplied by main genset supplier
YARA Environmental Technologies GmbH (Former H+H), www.noxcare.com

Fresh water generators
Alfa Laval, www.alfalaval.com
Gefico, www.gefico.com
Enwa, www.enwa.no
Wartsila Hamworthy, www.wartsila.com
Nirex www.plateheatexchanger.net
Sondex www.sondex.dk
GEA, Germany

RO fresh water maker
Norwater, www.norwater.no
Gefico, www.gefico.com
Enwa, www.enwa.no
Rochem www.rochem.com
Techno Process Eq. India
RWO
Krosys
Pall
SLCE www.slce-watermakers.com

Automation system for machinery
Kongsberg Maritime, www.kongsberg.com
Rolls-Royce Marine, www.rolls-royce.com
Siemens, www.siemens.com
ABB, www.abb.com

Bridge consoles
Kongsberg Maritime, www.kongsberg.com
Rolls-Royce Marine, www.rolls-royce.com
Furuno, www.furuno.com
Maritime Montering AS, www.maritimemontering.no
Raytheon www.raytheon.com
HDW-Hagenuk www.hdw-hagenuk.de
Consilium Marine.
Kelvin Hughes
L3 Comm
Atlas Elektronik
Marine electrical

Main Shaft Propellers
Wartsila www.wartsila.com
Rolls-Royce AS www.rolls-royce.com
Schottel www.williamknudsen.no
Scana Volda www.scana.no
MAN www.mandiesel.com
Berg Propulsion www.bergpropulsion.com
Fincantieri Mechanical Division
Geeta engineering
Meghna engineering

UV Filter
Norsk Atlas AS arne.overaa@norsk-atlas.no
Norsk Vannbehandling AS www.novafiltration.com
Alfa Laval www.alfalaval.com

STX
Kapp Aluminium

Bilge ejector
HDW www.hdw.de
Teamtec AS www.teamtec.no
Primetec, Chennai
M/S CRYSTAL TCS
Ellehammer
Saxena Marine

Firefighting plants Co2
Unitor www.unitor.com
Heien Larssen www.heien-larssen.com
Ajax fire protection system www.ajaxbb.nl
AUTRONICA
Zeal Marketing, Mumbai
Tyco
Minimax
Fire-eater
Temasistemi

Battery chargers/rectifiers
Siemens www.siemens.no
Mastervolt www.mastyervolt.com
Ellego Powertec Oy
Eaton Power Quality
Emerson
MGE
L&T, Mumbai
Waves Electronics
Marine Electricals Pvt. Ltd., Mumbai

Electric motors
Siemens www.siemens.no
ABB www.abb.com
Converteam/GE www.converteam.com
Wartsila www.wartsila.com
Stads AS Norway
SAM Electronics
VEM

Ballast Water Treatment System
Optimarin www. Optimarin.com
Alfalaval www.alfalaval.com
Wartsila www.wartsila.com
Hamworthy
Hyda Marine
Pan Asia
MIURA www.miuraz.co.jp/en/bwts/
Alfa Laval, Pune
VACMAN, Mumbai

8. SHIP COMMON SYSTEMS

Pumps in general
Allweiler, www.allweiler.no PG Gjerdrum, www.pg-marinegroup.com
Azcue pumps, www.azcuepumps.com
Grundfos
Garbarino
Leistriz
IMO
Frank Mohn
Desmi www.desmi.com
Wartsila Hamworthy, Finland
Hamworthy
KSB Pumps

Anti-heeling pumps
Frame www.framo.com
Hamworthy www.hamworthy.com
Allweiler www.allweiler.com
Hoppe Marine

Oily water separator supplier
Alfa Laval, www.alfalaval.com
GEA Westfalia Separators, www.gea.com
Marinfloc, www.marinfloc.com
Victor marine
DVZ, Germany
Jowa AB, Sweden
Detegasa, Spain
RWO Veolia, Germany

Fire detection systems

Autronica Fire Alarm system www.autronica.no
Tyco Fire alarm system www.tyco.no
Thorn Security, www.thornsecurity.net
Norcontrol www.norcontrolit.com
Autronica www.autronica.no
Moland 23erald.albretsen@molandaut.no
Unican www.uniscan.com
Consilium www.consilium.se
Unitor www.unitor.com
Toyo www.toyovalve.co.jp

External Fire-Fighting

Kvaerner Oilfield Products www.kvearner.com
Fire-fighting Systems FFS www.fifisystems.com
Thune-eureka AS www.teco-maritime.no
Seaplus
Kongberg Maritime

Fire-fighting system with inert gas

Wilhelmsen Technical Solutions, www.wilhelmsen.com
Tyco (Inergen), www.tycofis.co.uk
Novec 1230, www.3m.com

Diving equipment

Divex www.divexglobal.com
Drass www.drassgaleazzi.com
Comanex www.comanex.fr
Interspiro

Breathing Apparatus

Unitor www.unitor.com
Viking www.viking-life.com

Fire-fighting system with sprinkler and water-mist

Hifog, www.marioff.com
Ultrafog, www.ultrafog.com
Tyco water mist systems, www.tyco.com
FineFog, www.desmi.com
Wilhelmsen, Norwayto
KIDDIE
MINIMAX
TYCO

Remote Tank sounding system.
Xtronica, www.xtronica.no
Emerson, www.emersonprocess.com
Honeywell Marine, www.honeywellprocess.com
Rolls Royce www.rolls-royce.com
Kongsberg www.kongsberg.com
SAAB www.saab.se
IBERFLUID www.iberfluid.com
Scanjet Macron

Incinerator
Teamtec www.teamtec.no
Hamworthy www.hamworthy.com
Atlas www.heco.dk
Kangrim
GC Tech
Detegasa, Spain

Waste compactor
EDCO Marine www.edco.no
USON MARINE www.usonmarine.se
DELITEK www.delitek.no
Orwak
Deerberg Systems

Electrical Switchboard supplier (Full Package, Lead Contractor)
Wärtsilä Marine, www.wartsila.com
Siemens, www.siemens.com
ABB, www.abb.com
Rolls-Royce Marine, www.rolls-royce.com
HDW Hagenuk www.hdw-hagenuk.de
Converteam/GE
L-3 Offshore
Wartsila
Hyundai
KT Electric
Samsung
SAM Korea
Marine Electricals Pvt. Ltd., Mumbai
Waves Electronics
BHEL

L&T

Electrical Systems

Siemens www.siemens.no
ABB www.abb.com
Converteam www.converteam.com/GE
Stadt AS www.stadt.no
Wartsila www.wartsila.com
Rolls-Royce AS www.rolls-royce.com
STX OSV Electro
L&T
BHEL,
Marine Electricals

Freq.-converters

Siemens www.siemens.no
ABB www.abb.com
Vacon www.vacon.com
Wartsila www.wartsila.comm
Converteam www.converteam.com/GE
Stadt AS www.stadt.no
Omron
Danfoss

Power management system supplier

Wärtsilä Marine, www.wartsila.com
Siemens, www.siemens.com
ABB, www.abb.com
Rolls-Royce Marine, www.rolls-royce.com
L&T
BHEL,
Marine Electricals

Electric cables

NEXANS, www.nexans.com
Draka, www.draka.no
Helkama, www.helkamabica.com
Alcatel/STK www.alcatel.com
AEG www.aeg.at
Siemens www.siemens.no
LS Cable
Kukdong cable
M/s Thermo Cables

M/s APAR Industries
M/s Siechem
M/s Radiant Cable
Polycab
Quadrant

Cable Penetrations
Roxtec, http://www.roxtec.com/
MCT Brattberg www.mctbrattberg.com
CSD www.csd.no
Lighting fixtures
Glamox, www.glamox.com
LightPartner, www.lightpartner.de
Aqua Signal www.kellox.no
Luminox

Lighting fixtures
Glamox, www.glamox.com
LightPartner, www.lightpartner.de
Aqua Signal www.kellox.no
Luminox
Daeyang
Wiska
Arvin
Ajmera
Ray Enterprise
Mcgeoth Marine
Penta

External work- and search lights
Luminell, www.luminell.com
Glamox(Aquasignal), www.glamox.com
LightPartner, www.lightpartner.de
Aqua signal www.aquasignal.net
Norselight www.norselight.com
IBAK MARINE
Tranberg
Ray enterprises, Haryana
Manish industries
Wiska
Arvin
Ajmera
Ray Enterprise
Mcgeoth Marine

Penta

Integrated Controls And Alarm System
BjorgeSteinco www.steinco.no
Norcontrol www.norcontrolit.com
Autronica www.autronica.no
Simrad
Rolls-Royce Umas www.rolls-royce.com
Lyngs
Siemens www.siemens.no
Kongsberg www.kongsberg.com
ValMarine www.valmarine.com
IMTECH www.imtech.eu
Stadt AS www.stadt.no
L-3 Mapps www.mappsL-3.com
L&T
BHEL,
Marine Electricals

Anti-rolling / Anti-heeling tank systems
Hoppe www.hoppe-bmt.de
Solmar Ltd. www.solmar.is
Rolls-Royce AS www.rolls-royce.compumps
Intering
Wartsila

Flowmeters
Avery Hardoll www.cobhamfluidsystems.com
GF marine gmflate@online.no
Lindflaten AS firmapost@lindflaten.no
Metso EH
Aqua Metro
Rockwin
Scientific devices India
Hi tech instruments
VAF
Emerson

Valves and Actuators
Clausen,Kaldager&Co alvestad@tech.no
Amri sales@amrivalves.com
Stavanger Rørhandel AS vidaro@stavanger.rorhandel.no

Airtorque
Pleiger
Damcos
ARIArmaturen
GS-Hydro
Emerson
Seil-Seres
LK Valves
Meson
Besi
Dikkan
Danfoss
Delval Flow Controls
Econosto

Butterfly and ball valves
Keystone www.varco1.com
Witzel www.wouterwitzel.com
Stavanger Rørhandel AS vidaro@stavanger.rorhandel.no
SIGEVAL www.sigeval.com
MACASA
Keystone Valves
GS-Hydro
Westad
Allweiler AS firmapost@allweiler.no
Karmoy Winch AS post@karmoy-winch.no
M/s GDPA - Kolkata
M/s Leader Valves Limited, Jalandhar.
M/s SANDER MESON INDIA Pvt ltd, Goa, India
Mohan valves and engineering works Palghar, Maharashtra
M/s Sunmetaliks
M/s MEW Engg. Gujarat
M/s Delval flow controls
M/s ROTOR-K, Bangalore
Emerson Damcos
ARI Armaturen
Meson
Delval Flow Controls
Econosto

Wind speed indicator

Walker Marine www.walkermarine.com
Yokogawa www.yokogawa.com
Consilium Marine
Deif
Gill
Vaisala
Lambrecht
Furuno
Kelvin Hughes

Satellite TV
Sea Tel www.general.no
Applied Satellite Technology www.satcomms.com
VICO www.vico.no
JRC
Life boat radio trans

Laundry equipment
Miele www.miele.de
Electrolux www.electrolux.no
AEG www.aeg.n
BOSCH
IFB
STEFAB

Drinking water system and coolers
Edco www.edco.no
Oasis
HUMA AS www.huma.no

Bilge ejector
HDW www.hdw.de
Teamtec AS www.teamtec.no

Firefighting plants Co2
Unitor www.unitor.com
Heien Larssen www.heien-larssen.com
Ajax fire protection system www.ajaxbb.nl
AUTRONICA

Shafting

Geeta engg
Meghna engineering
Wartsila Kongsberg Maritime
Schottel
ScanaVolda
MAN
Berg Propulsion

Capstans
Geeta engg
Bhavani engineering
Hemant engineering
Meghna Engg.
GRSE Deck Machinery Unit

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Appendix 8:

List of Scientific Equipment

Introduction :
This Annex describes the Scientific Equipment to be supplied for the execution of scientific operations onboard the vessel:

- within the laboratories
- physical in-sea operations over the side or the stern
- acoustic in-sea operations
- collection of upper air data
- meteorological investigations

References :
Technical Specification(TS), document

Annex 3 - Computer Network and Data Handling Systems

Annex. 5 – Laboratories and Scientific Rooms - ORV

OCEAN RESEARCH VESSELS (ORV) – SCIENTIFIC EQUIPMENT

- All scientific equipment shall be designed (and be suitable) for operation under marine conditions.

- The shipyard which will build the vessel shall be responsible for procurement, storage, obtaining interface information, functional design, Factory Acceptance Test (FAT), Installation, commissioning, Harbor Acceptance Test (HAT), sea trials (SAT) and training onboard by OEM for all the scientific equipment. The shipyard shall conduct separate sea-trials to demonstrate the proper functioning of the scientific equipment. This shall be after the ship's general sea-trials and any intermediate sea trials.

- **Installation:** During all stages of the installation at the shipyard, the manufacturer's engineer will ensure proper installation procedures are followed by the yard for each equipment as specified in this specifications.

- **Harbour Acceptance Test (HAT)** All the scientific equipment and systems shall be commissioned and tried out at Harbor in floating condition. A HAT according to schedule recommended by OEM shall be conducted and the system shall be commissioned by the shipyard.

- **Sea Acceptance Test (SAT)** Detailed Sea Acceptance test (SAT) shall be conducted to qualify the system for its functionality and application and to comply with the specification in total. Equipment that require SAT in deeper waters and specific site conditions to prove the equipment compliance to specification, shall have to be arranged by shipyard in such areas suitable to the yard including the local government approval if any for such testing. In case of non-availability of such site near the yard or due to local government restrictions to such tests, the SAT for such equipment have to be planned in Indian waters with the presence of OEM and yard representative at yard cost. Yard and the vendor will satisfy the buyer's representative with regard to the performance of the system in total. NCPOR and OEM representatives shall be present for SAT. Complete sea-trial schedules for sea-acceptance tests for each equipment are to be provided by the Builder in advance to NCPOR.

- Builder to make schedules for Acceptance tests for each equipment in consultation with NCPOR and accordingly the sea-trials to be planned.

- Sufficient GPS/DGPS/Gyro/motion sensors etc to be provided for giving feed to scientific equipment wherever required.

- Laboratories to have following facilities.
  Fresh Water supply to all wet labs and working main deck
  Seawater supply to all wet labs and working main deck
  Compressed air supply to all wet and dry labs
  Basic Navigation & weather parameters and Depth displays in all labs and all other operational areas including main deck and other 5 points to be identified.

- **Training** The training should be covering the deployment, calibration, functionality, operation principle, data acquisition, post processing and general maintenance / trouble shooting of the system shall be conducted by OEM expert without any cost to NCPOR. At least one expert from OEM for each equipment shall be present and assist during onboard training (post SAT) for NCPOR scientists for the functionality, data acquisition and processing and basic maintenance.

- **Spares & accessories** All necessary accessories, spares and consumables required for installation and uninterrupted operation till warranty period to be supplied as part of the scope. All necessary cables, glands, connectors, terminations and other accessories necessary for the normal operation of the system onboard should be supplied though it may not be mentioned in this specifications. Any sub-system that is required for the operation or a function requested in this specification must automatically be included in the scope of supply and must not be added as additional after the order and delivery of the system.

- **Manuals** Two sets of operation, technical and installation manuals should be provided as part of the standard scope of the supply. The manuals also should cover all aspects of the system like calibration, post-processing, servicing and troubleshooting, etc and should be made available in both hard and soft copies.

- **Language**: For all equipment, the display panels, functional menus, software inputs / outputs, functions and all manuals shall be in English.

- **Makers list**: The shipyard should acquire the scientific equipment from the makers list provided for each equipment.

- **Central Data Logging System:** All underway data acquisition systems to be connected to central data logging (Marine Data Management System) for online storage of data for archival purpose.

- **Computers & peripherals**: The computers, printers and any other peripherals as may be required for each equipment, irrespective of whether it is mentioned in the specifications or not under such equipment, should be part of supply. This is in addition to the computers and peripherals for general purposes as mentioned at sl.no. 77 below.

- All equipment should be compatible to power supply of 230VAC/50 Hz.

- The builder is to provide Competent service facility to be available in India for each equipment. Addresses to be provided for each equipment in the offer.

- All scientific equipment should have handling systems fitted onboard e.g. coring, dredging, seismic operations etc. Builder is responsible for operational facilities for each equipment. Operations model (a graphical presentation) of each sampling equipment operation and overboard operations to be provided to ensure that the handling facilities and location designs are feasible ones.

- All movable equipment should have identified space onboard for storage when not in use. Identified space for spares and consumables for each equipment is required.

- Established maintenance schedules, calibration schedules for each sensors / equipment (wherever applicable) as per OEM are to be provided.

OCEAN RESEARCH VESSEL (ORV) – SCIENTIFIC EQUIPMENT

The below listed Scientific Equipment to be supplied and installed in the specified laboratory or scientific room in consultation with NCPOR:

Item	Atmospheric Sciences	No.(s)
1.	Automatic Weather Station (AWS) with data loggers	2
2.	Radiosonde(with launching / Gas storage & filling facilities)	1
3.	7 channel Aethalometer	1
4.	Scanning mobility particle sizer (SMPS)	1
5.	Micropulse Lidar on inertial platform	1
6.	Three wavelength Nephelometer	1
7.	Polarimetric Doppler Weather Radar (S Band)	1
8.	Microwave Radiometer	1
9.	Shipborne Radar wind profiler	1
10.	Cloud Condensation Nuclei (CCN) counter	1
11.	Eddy Covariance Flux System (ECFS)	1
Item	**Biological / Microbiology**	**No(s)**
12.	Multi Plankton Net Sampler	1
13.	Cold Incubator	1
14.	Laminar Flow	1
15.	Bongo Nets	2
16.	Fluorometer	1
17.	Water purification system	2
18.	Bright field epifluroscence research microscope	1
19.	Stereozoom Binocular microscope	1
20.	Vaccum pump with filtrations units	4
21.	Flow Through Vaccum Pump	2
22.	pCO2 Measuring System	1
23.	Epifluorescence up-right motorised microscope with image analysis software	1
24.	Gel Apparatus	1
25.	HT nets (both 20 and 200 µm mesh sizes with flowmeters)	2 each
26.	Autoclave (bench top)	1
27.	IOSN Net	2
28.	Epibenthic Sledge	1 set
29.	Microplate reader (absorbance, luminescence, fluorescence)	1
Item	**Physical Oceanography**	**No(s)**
30.	Outboard Bucket Thermometer	2
31.	Acoustic Doppler Current Profiler :300 & 75 kHz	1 each
32.	LADCP 300kHz	1
33.	CTD system; One system with 24 nos. 5 litres bottles, and second with 12 nos. 10 litres bottles. (5 nos. each extra bottles))	2
34.	Portable CTD	1
35.	Underway CTD system (with additional EcoCTD sensors)	1
36.	XBT/XCTD System	1
37.	Wave Recorder	1
38.	Thermosalinograph	1
39.	Salinometer	1
40.	Vertical Microstructure profiler	1
41.	Combined CTD+SVP profiler	1
Item	**Chemistry**	**No(s)**

42.	pH meter	1
43.	Spectrophotometer	1
44.	Auto Titrators	2
45.	Gas Safety Burner	1
46.	Autoclave	1
47.	Temperature Controlled Centrifuge	1
48.	Auto Analyser	1
49.	Ovens (upto 60°C and upto 300°C)	2
50.	Gas chromatograph	1
51.	Analytical Balances	2
52.	Laminar Flow	1
53.	Ultrasonic Bath sonicator	2
54.	Cooling Water Bath	1
55.	Hot plate with stirrer	2
Item	**Geophysics**	**No(s)**
56.	Single Beam Echo Sounder	1
57.	Multibeam Echo Sounder – Deepwater	1
58.	Multibeam echosounder – Shallow Water	1
59.	Sub-Bottom Profiler	1
60.	Magnetometer	1
61.	Gravimeter	1
62.	Towable Side Scan Sonar	1
63.	Multichannel seismic system	1
Item	**Geology**	**No(s)**
64.	Multi Sensor Core Logger	1
65.	Gravity Corer	2
66.	Piston Corer	1
67.	Box Grab/Spade Corer	1
68.	Core Splitting Machine	1
69.	Sediment Grab	5
70.	Hot Air Ovens	2
71.	Chain Bag Dredges	5
72.	Rock Saw	1
73.	Transmitted and Reflected light polarizing Microscope	1
74.	Grinder, Polisher & Cutter for Thin Section preparation	1 set
Item	**General Purpose(for scientific/laboratory use)**	**No(s)**
75.	Scientific Winches/A-frames	Misc.
76.	Onboard Data Management System (ODM system)	1
77.	Desktop Computers, Printers & copier machines	Misc.
78.	Deep Freezer -20°C	4
79.	Deep Freezer -40°C	2
80.	Refrigerators	4
81.	Fumehood (General + non-metallic)	2
82.	Large cold storage room for samples (4°C)	1
83.	Ice Maker	2
84.	Portable Modular Over-The- Side Pole mount	1 set

The detailed specifications of the scientific equipment and other scientific facilities and makers list are as below:

Atmospheric Sciences

1. Automatic Weather Station (AWS) - 2 nos.

Features	Specification
Type	Real time, Marine environment use.
Sensors	WMO standards for specifications of sensors. Radiation sensors: upward looking downward looking Pyranometer for global irradiance measurement (direct, diffused & reflected solar radiation from sea surface) in the approx. range 0.20–4 µm, upward-looking and downward looking pyrgeometer to measure downwelling and upwelling longwave radiation in the range approx. 4 µm to 100 µm. Ultrasonic wind speed & direction sensor (0.01m/s to gale force winds, 0-359deg direction range, Corrosion-free polycarbonate exterior), Air temperature (-40 to 40deg C, accuracy of ±0.1degC) and relative humidity sensor (0-100%, accuracy ±2%) with radiation shield, atmospheric pressure (barometer class A, range 900-1100 hPa, one digit precision), precipitation (heated tipping bucket stainless steel sensor with Teflon coating), GPS, Compass (Zeno systems), with AC power supply from ship's generator, all sensors mounted on heavy duty marine-grade tower. Cloud height (Ceilometer), visibility, GPS, Compass (Zeno systems). All sensors mounted on heavy-duty marine-grade tower. Peripheral equipment such as a stabilized power supply providing power to the various parts of the station, a realtime clock, and built-in test equipment for automatic monitoring of the status of vital parts of the station. For specific applications, local terminals for the manual entry and editing of data, display devices and printers, or recorders are to be added to the station. Software for data acquisition, processing, displays and transfer.
Hardware	Data Storage in PC / LAN through Datalogger / CPU. Data transfer through cables and Bluetooth.
Installation	Sensors installed in close combination, but not affecting each other, directly connected to a central processing unit (CPU) by means of shielded cables. By yard under the supervision of OEM expert. One to be mounted at the bow of the ship and other above the ship's bridge.
Ethernet	An Ethernet connection for the system to be added on ship's LAN for connectivity with a centralized data archival system.
Warranty	Two years from the date of successful acceptance. Warranty to cover repairs, spares, replacement of non-functional system / faulty parts.

Acceptance / Training	OEM to prove the satisfactory performance of the system onboard. Onboard training to be provided to scientists/ representatives in operation, data processing, maintenance and trouble-shooting.
Makers list	1. M/s Gill Instruments Ltd 2. M/s R.M. Young Company 3. M/s Vaisala 4. M/s Aanderaa 5. M/s Coastal Environmental Systems 6. M/s Environdata 7. M/s Kipp & Zonen (Radiation Instruments) 8. M/s Eppley (Radiation Instruments)

2. Radiosonde with Launching and Gas Storage & filling facilities – 1 set

Features	**Specification**
Type	Digital
Temp Sensor	Type: capacitive wire Measurement range -90 … +60 °C; Resolution 0.1 °C
Humidity Sensor	Type thin-film capacitor, heated twin sensor Measurement range 0 … 100 %RH; Resolution 1 %RH
Pressure Sensor	Type silicon Measurement range 1080 … 3 hPa; Resolution 0.1 hPa
GPS receiver	Yes
Balloon launch facility	Balloon launch facility to be provided with 30 Hydrogen gas cylinders storage near Balloon launch pad.
Hardware	Suitable PC and printer. 75 sets of sensors / balloons and other consumables. Ground station with antennas and software.
Inputs	Ship's all Navigational data
Installation	By yard under the supervision of OEM expert.
Ethernet	An Ethernet connection for the system to be added on ship's LAN for connectivity with a centralized data archival system.
Warranty	Two years from the date of successful acceptance. Warranty to cover repairs, spares requirement, replacement of non-functional system / faulty parts.
Acceptance / Training	OEM to prove the satisfactory performance of the system onboard. Onboard training to be provided to scientists/ representatives in operation, data processing, maintenance and trouble-shooting.
Gas storage	Gas storage room for 30 Hydrogen cylinders with racks and safety precautions.
Makers list	M/s Vaisala M/s Lockheed Martin M/s Graw

3. 7-Channel Aethalometer - 1 no.

Specifications	• Real time continuous measurement of mass concentration of Black Carbon particles • With 7 channels • Full Spectrum 7-Wavelength analysis: UV – IR, 1 Hz data rate
Ethernet	An Ethernet connection for the system to be added on ship's LAN for connectivity with a centralized data archival system.

Installation	By yard under the supervision of OEM expert.
Warranty	Two years from the date of successful acceptance. Warranty to cover repairs, spares requirement, replacement of non-functional system / faulty parts.
Acceptance	OEM to prove the satisfactory performance of the system onboard.
Makers list	M/s Magee Scientific. (model AE33)

4. Scanning Mobility Particle Sizer (SMPS)- 1 no.	
	Equipment should be of equivalent specifications as below.
Specifications	Scanning Mobility Particle Sizer Spectrometer • Specs: 167 channels • Broad size range: from 1 nm to 1,000 nm • ISO 15900:2009 compliant • Fast measurements: <10 second scans • Wide concentration range up 10^7 particles/cm^3
Accessories	1) Advanced Aerosol Neutralizer 2) Differential Mobility Analyzer 3) Differential Mobility Analyzer 4) Electrostatic Classifier 5) Scanning Mobility Particle Sizer 6) Nanometer Aerosol Sampler (to deposit particles on TEM grid) 7) Maintenance Kit
Ethernet	An Ethernet connection for the system to be added on ship's LAN for connectivity with a centralized data archival system.
Installation	By yard under the supervision of OEM expert.
Warranty	Two years from the date of successful acceptance. Warranty to cover repairs, spares requirement, replacement of non-functional system / faulty parts.
Acceptance	OEM to prove the satisfactory performance of the system onboard.
Makers list	1) M/s TSI Inc. 2) M/s Brechtel

5. Micropulse Lidar on inertial platform - 1 no.	
Specifications	• Continuous unattended monitoring of cloud and aerosol profile in the atmosphere • Range resolution: 15/30/75 m • Detection range : upto 25 km.
Ethernet	An ethernet connection for the system to be added on ship's LAN for connectivity with a centralized data archival system.
Installation	By yard under the supervision of OEM expert. Installation on inertial platform.
Warranty	Two years from the date of successful acceptance. Warranty to cover repairs, spares requirement, replacement of non-functional system / faulty parts.
Acceptance	OEM to prove the satisfactory performance of the system onboard.
Makers list	M/s SigmaSpace Corp. (Model: MPL)

6. Three wavelength Nephelometer - 1 no.	
Specifications	Measurements of the light scattering coefficient of atmosphere and laboratory aerosols. Required for measurements related to climate, visibility and air quality.
Ethernet	An ethernet connection for the system to be added on ship's LAN for connectivity with a centralized data archival system.
Installation	By yard under the supervision of OEM expert.
Warranty	Two years from the date of successful acceptance. Warranty to cover repairs, spares requirement, replacement of non-functional system / faulty parts.
Acceptance	OEM to prove the satisfactory performance of the system onboard.
Makers list	1. M/s TSI 2. M/s Ecotech

7. Polarimetric Doppler Weather Radar (S-band) – 1 no.	
Specifications	•High-precision, real-time monitoring of precipitation intensity (mm/h) •Output of moving velocity of nimbus •Dual polarimetric Doppler information (Zdr, Kdp) for computing diameter of precipitation particles as well as discriminating types of precipitation (rain, snow, etc.) •3D scan to observe the vertical structure of a cumulonimbus clouds
Ethernet	An ethernet connection for the system to be added on ship's LAN for connectivity with a centralized data archival system.
Installation	By yard under the supervision of OEM expert. Installation on Gyroscopic stabilized platform onboard ship.
Warranty	Two years from the date of successful acceptance. Warranty to cover repairs, spares requirement, replacement of non-functional system / faulty parts.
Acceptance	OEM to prove the satisfactory performance of the system onboard.
Makers list	M/s Vaisala M/s EEC M/s. Gammatronics M/s. Barron

8. Microwave Radiometer - 1 no.			
Specifications	• Measurements during both cloudy and clear air • GPS • Rain effect mitigation • Frequency agility • All-sky pointing		
Calibrated Brightness Temperature Accuracy	0.2+0.002(TkBB-Tsky)		
Long term stability	< 1.0 K /year		
Resolution	0.1 to 1 K		
Brightness Temperature Range	0-400 K		
Optical resolution and side lobes	22-30 GHz (K-band) 51-59 GHz (V-band)	4.9-6.3° 2.4-2.5°	-24 dB -27dB
User selectable integration time	0.01-2.5 seconds		

Frequency Agile Tuning range	Water vapor bands 22-30 GHz Oxygen bands 51-59 GHz
Calibrated Channels	22-30 GHz 21 Channels 51-59 GHz 14 Channels
Accuracy of surface sensors	Temperature (-50 to 50 C), 0.5° C @ 25°C Relative Humidity (0 to 100%), 2% Barometric pressure (800 to 1060 mb), 0.3 mb
Ethernet	An ethernet connection for the system to be added on ship's LAN for connectivity with a centralized data archival system.
Installation	By yard under the supervision of OEM expert.
Warranty	Two years from the date of successful acceptance. Warranty to cover repairs, spares requirement, replacement of non-functional system / faulty parts.
Acceptance	OEM to prove the satisfactory performance of the system onboard.
Makers list	1. M/s Radiometrics 2. M/s RPG Radiometer

9. Shipborne Radar Wind Profiler – 1 no.	
Type	Unattended, real-time operation. Software to be included.
Frequency	Frequencies suitable for boundary layer wind profiling at sea, like 915 MHz or 1290 MHz
Antenna	Phased array, microstrip, with solid-state phase shifters
Beam Steering	Real-time Full Motion Compensation, multiple-azimuth, multiple-zenith, full beam steering 40° cone above radar
Ethernet	An ethernet connection for the system to be added on ship's LAN for connectivity with a centralized data archival system.
Installation	By yard under the supervision of OEM expert.
Warranty	Two years from the date of successful acceptance. Warranty to cover repairs, spares requirement, replacement of non-functional system / faulty parts.
Acceptance	OEM to prove the satisfactory performance of the system onboard.
Makers list	1. M/s DeTect Inc. 2. M/s Scintec

10. Cloud Condensation Nuclei (CCN) Counter– 1 no.	
Specifications	For measurements of CCN at different super saturations ranging from 0.1 to 2.0
Ethernet	An ethernet connection for the system to be added on ship's LAN for connectivity with a centralized data archival system.
Installation	By yard under the supervision of OEM expert.
Warranty	Two years from the date of successful acceptance. Warranty to cover repairs, spares requirement, replacement of non-functional system / faulty parts.
Acceptance	OEM to prove the satisfactory performance of the system onboard.
Makers list	M/s Droplet Measurement Technologies

11. Eddy Covariance Flux System (ECFS) – 1 no.	
Features	For the direct measurement of turbulent fluxes at 20 Hz frequency
Installation location	Ship bow mast, along with an AWS system for direct comparison between bulk and direct fluxes
Sensors	Wind Speed – Gill Sonic Anemometer (R-350) InfraRed GAs (IRGA) analyser – Licor Li-75RS Motion Sensor Package – Microstrain 3DM-GX5-35
Hardware	All the data from the above three sensors (Sonic Anemometer, IRGA and motion sensor pack) should be stored in a centrally placed datalogger. The ECFS to be with uninterrupted power system (UPS) supply to avoid voltage fluctuations. There should be a centrally placed data visualization unit where real-time data can be viewed, downloaded and sensor specifications can be changed/modified.
Installation	At the ship bow mast, pointing outwards, directly facing the wind to avoid flow contamination
Warranty	Two years of standard warranty after acceptance.
Makers	M/s LI-COR M/s Gill Instruments Limited M/s Subctech

Biology / Microbiology

12. Multiple Plankton Net Sampler - 1 set	
Features	**Specifications**
Details	• Multi-net. Midi-size
	• Net frame made of stainless steel with pressure capsule motor unit, integrated depth meter 0-3000m, canvas part with zip fasteners, net opening 50x50cm (=0.25m^2). Power supply: batteries
	• 5 net bags with zip fastener, length 250cm, end of net 11cm diameter, mesh size 200μm
	• 5 plastic net bags, 11cm diameter, side window covered with sieve gauze
	• 5 buckets with holders made of stainless steel
	• Bridles (2 nos.)
	• V-fin depth depressor and Stainless steel supports.
	• Deck command unit with push button control for net changing, depth indication, indication of battery status, interface to PC. Display: LCD super twist with LED backlight. Power supply: 85-260V AC
	• Electronic flowmeter Online-version
	• Offline-set with programmable depth depending sampling intervals, storing of measured data, data transfer to PC (enables operation without conductor cable)
	• CT-set integrated into motor unit of multinet, additional electronics board conductivity sensor 0-65 mS/cm, accuracy +/- 0.01 mS/cm, Temperature sensor -2 to +32 0C, accuracy +/- 0.005 0C. Data rate: 1Hz (1 data /Sec)
	• Spare net Part Of medium size with zip fastener, length 250 cm, end of the net 11cm dia. Standard mesh size 200 microns - 2 nos.
	• Spare Canvas part for Medium size (250cm) – 2 nos.
	• Spare Plastic Net Bucket for medium size (250cm) Consisting of Fixing Ring with over centre fasteners and PVC Net Bucket with side window cover with sieve gauze. – 2 nos.
Installation	By yard under the supervision of OEM expert.
Warranty	Two years from the date of successful sea acceptance. Warranty to cover repairs, spares requirement, replacement of non-functional system / faulty parts.
Sea Acceptance	OEM will conduct sea acceptance test on completion of ship's construction. The system will be accepted only after satisfactory completion of Sea Acceptance Test and demonstration of system capabilities with the samples collected from sea. Any shortcomings should be attended and set right for accepting the system.
Training	Onboard training to be provided to scientists/representatives in operation, maintenance and trouble-shooting.
Makers list	• M/s Hydro-Bios.

13. Cold Incubator - 1 no.	
Features	**Specification**
Capacity	400 litres
Finish	SS
Temp range	0 deg C to +50 deg C
Other features	Auto Defrosting, shelves, Temp. control / alarm, Digital display
Installation	By yard under the supervision of OEM expert.
Warranty	Two years from the date of successful acceptance. Warranty to cover repairs, spares requirement, replacement of non-functional system / faulty parts.
Acceptance	OEM to prove the satisfactory performance of the system onboard.
Makers list	1. M/s Esco 2. M/s Thermo 3. M/s Merck 4. M/s Shel Lab

14. Laminar Flow - 1 no.	
Features	**Specification**
Description	• For Microbiology use • Vertical Flow Clean Air • 99.99% filtered air • About 8" access opening • Clear side panels for high visibility • Stain less steel work surface • pressure gauge for filter load • Pre-filters for incoming air
Installation	By yard under the supervision of OEM expert.
Warranty	Two years from the date of successful acceptance. Warranty to cover repairs, spares requirement, replacement of non-functional system / faulty parts.
Acceptance	OEM to prove the satisfactory performance of the system onboard.
Makers list	1. M/s NuAire 2. M/s Esco 3. M/s Thermo

15. Bongo Net - 2 nos.	
Features	**Specification**
Specifications	• Double net ring of stainless steel • 60 cm diameter each • Nylon webbings and zip fasteners • Two Nets of 250 cm length, standard mesh size 200 microns • Two PVC net buckets with distance rod • V-Fin Depressor • FlowMeter - (for horizontal and vertical operation with back-run stop facility) • with mechanical counter-5 digits, diameter of impeller 75 mm • Spare Net for Bongo Net - Mesh size 200 micron – 4 nos. • Spare Net for Bongo Net - Mesh size 100 micron – 4 nos. • Spare Net bucket for Bongo Net - Mesh size 200 micron – 2 nos.

	• Spare Net bucket for Bongo Net-Mesh size 100 micron – 2 nos. • Set of two Spare Nylon webbings and zip fasteners for Bongo Net – 4 nos.
Installation	By yard under the supervision of OEM expert.
Warranty	Two years from the date of successful acceptance. Warranty to cover repairs, spares requirement, replacement of non-functional system / faulty parts.
Acceptance	OEM to prove the satisfactory performance of the system onboard.
Makers list	1. M/s Hydro-Bios

16. Fluorometer - 1 no.

Features	**Specification**
Detection limits	Extracted Chlorophyll *a* : 0.025 µg/L Rhodamine WT : 0.01 ppb Fluoresce in Dye : 0.01 ppb
Linear Range	Extracted Chlorophyll *a* : 0 - 250 µg/L Rhodamine WT Dye : 0 - 250 ppb Fluoresce in Dye : 0 - 200 ppb
Light Source and Detector	Light Emitting Diode and Photodiode
Installation	By yard under the supervision of OEM expert.
Warranty	Two years from the date of successful acceptance. Warranty to cover repairs, spares requirement, replacement of non-functional system / faulty parts.
Acceptance	OEM to prove the satisfactory performance of the system onboard.
Makers list	M/s Turner Designs; Model: Trilogy

17. Water Purifying system - 2 nos.

Features	**Specification**
Specifications	Resistivity, MΩ•cm @ 25 °C 18.2 TOC, ppb (µg/l) < 5 Bacteria, cfu/ml < 0.1 * Particulates > 0.22 µm, Particulates/ml < 1 * Pyrogens (endotoxins), EU/ml < 0.001 ** RNases, ng/ml < 0.01 ** DNases, pg/µl < 4 ** (*) With Millipak Express 0.22 µm or Biopak end filter (**) With Biopak end filter Resistivity, TOC and bacteria levels match the requirements of Type II water as described in ISO® 3696, ASTM D1193 (Type II resistivity, TOC, HBC Table 1 specification), and Purified Water as described in USP, EP. Min 2 litres/min flow rate and 50 litres reservoir capacity.
Installation	By yard under the supervision of OEM expert.
Warranty	Two years from the date of successful acceptance. Warranty to cover repairs, spares requirement, replacement of non-functional system / faulty parts.
Acceptance	OEM to prove the satisfactory performance of the system onboard.
Makers list	M/s Merck Millipore

18. Bright Field Epifluroscence research microscope – 1 no.	
Optical system	Infinity corrected system
Focus	Fully motorized; with facility for Vertical stage movement (coarse <25 mm and fine 1 µm) Z-stacking facility for multi-foci imaging
Stage rotation	270 degrees
Illuminator	Built-in-Koehler illumination for transmitted light 12V 100W halogen bulb
Revolving nosepiece	Interchangeable sevenfold Revolving nosepiece with DIC/analyzer slot.
Objectives	PLAN ACHROMAT 4X/0.1 SEMI APOCHROMAT OBJECTIVES 10X NA 0.30 SEMI APOCHROMAT 20X/0.5 SEMI APOCHROMAT OBJECTIVES 40X NA 0.75 (SPRING) SEMI APOCHROMAT OBJECTIVE 100X NA 1.3 (SPRING)
Observation tube	Trinocular tube Three position prism for selection of light path for 100%observation
Stage	Ceramic-coated coaxial stage with right hand low drive Control, with torque adjustment for X&Y movement levers
Condenser	Swing Out Condenser
Illumination	Fluorescence illumination of 100Watts Mercury with Eight Position Filter Unit to accommodate various Fluorescence filters**,** built in field stop, aperture stop. Filters should be of high transmission efficiency, Narrow band Pass type for bleed through free detection of fluorescence dye such as DAPI, FITC and TRITC
Camera	>5 MP Peltier cooled CCD camera, Resolution up to 2560 x 1920 Pixel in 10bit per RGB color channel; Imaging software
Installation	By yard under the supervision of OEM expert. To be installed in dark room.
Warranty	Two years from the date of successful acceptance. Warranty to cover repairs, spares requirement, replacement of non-functional system / faulty parts.
Acceptance	OEM to prove the satisfactory performance of the system onboard.
Makers list	1. M/s Carl Zeiss 2. M/s Leica 3. M/s Nikon 4. M/s Biotechnologies Inc

19. Stereozoom Binocular Microscope – 1 no.	
Optical system	Universal infinity corrected system
Zoom ratio	15:1 or better with magnification range of 7X to 90X or better
Focus	Coarse and fine resolution unit
Objectives	Plan apochromat 1x objective and 2x objective
Eyepiece	10x with micrometer
Optical resolution	800 lines or better
Observation tube	Trinocular head
Digital Camera	Dedicated Digital camera with 5.24 Mega pixel resolution with control unit to be connected to PC.
Illuminator	a) high grade transmitted light with 30W illuminator b) reflected cold light source with bifurcated fiber guide arms 12V 100W halogen bulb with green and blue filter (two sets each of halogen bulb for 30w illuminator and 100 w for fiber illuminator)
Installation	By yard under the supervision of OEM expert.
Warranty	Two years from the date of successful acceptance. Warranty to cover repairs, spares requirement, replacement of non-functional system / faulty parts.
Acceptance	OEM to prove the satisfactory performance of the system onboard.
Makers list	1. M/s Carl Zeiss 2. M/s Leica 3. M/s Nikon 4. M/s Biotechnologies Inc

20. Vaccum pump with Filtration unit – 4 sets	
Specifications	• High capacity vacuum pump • Dual/parallel pump head configuration • 50 LPM free air capacity • Maximum 200millibar vaccume generator • Maximum pressure 4.1 bar with ¼ hp capacity
Installation	By yard under the supervision of OEM expert.
Warranty	Two years from the date of successful acceptance. Warranty to cover repairs, spares requirement, replacement of non-functional system / faulty parts.
Acceptance	OEM to prove the satisfactory performance of the system onboard.
Makers list	1. M/s Millipore 2. M/s Cole Parmer

21. Flow Through Vacuum Pump – 2 nos.	
Specifications	Flow Rate: 3.8 to 4.0 L/min
Material in contact with the liquid filtered	Polyoxymethylene (POM) Polytetrafluoroethylene PTFE Ethylene Propylene Diene Monomer (EPDM) Nitrile Butadiene Rubber (NBR) Polypropylene (PP)
Tubing connection	Hose barb for 10mm ID tubings (NPS 3/8 or DN10)
Protection Type & Class	IP64, III
Installation	By yard under the supervision of OEM expert.
Warranty	Two years from the date of successful acceptance. Warranty to cover repairs, spares requirement, replacement of non-functional system / faulty parts.
Acceptance	OEM to prove the satisfactory performance of the system onboard.
Makers list	1. M/s Millipore 2. M/s Sartorius

22.	**pCO2 Measuring System – 1 no.**
Specifications	• The system should include *pCO_2*analyzer, • Atmospheric gas sampler, • Seawater sampler • The instrument should simultaneously and/or standalone measure atmospheric and seawater *pCO_2*.
pCO_2 analyzer (water sampler)	NDIR detector based analyzer, ≤ 1 min equilibration time, ± 1% accuracy. Measuring range 0-3000 ppm, resolution < 1 ppm, resistant to fouling and corrosion, High sampling frequency (< 1 min), multiple units (ppm, µatm
CO_2 analyzer (air samples)	CO_2: ± 1% accuracy, Measuring range 0-3000 ppm, resolution < 1 ppm, H_2O: 0-60 mmol/mol, ± 1.5% accuracy resistant to corrosion, splash proof, high sampling frequency (< 1 min), multiple units (ppm, µatm)
Working temperature range	-2 to 35°C
Sensor specifications	Pressure (flow): 0-10 dbar, 0.2% accuracy, 0.03% resolution, 50 msec frequency Temperature: -2 to 35°C, 0.003°C, 0.005°C, 50 msec Conductivity: 0-64 mS/cm, 0.003 mS/cm, 0.001 mS/cm, 50 msec Oxygen: 0-50 ppm, 0.1 ppm, 0.01 ppm, 3 sec RH: 0-250% sat., 1% sat, 0.1% sat., 3 sec pH: 0-14 pH, 0.01 pH, 0.001 pH, 3 sec Redox: -1000 to 1000 mV, 1 mV, 0.1 mV, 3 sec
Oxygen sensors (Optode)	Includes sensor, interface cable and flow assembly
Turbidity meter	Turbidity sensor with requisite mounting and interface accessories and spares
Installation	By yard under the supervision of OEM expert.
Warranty	Two years from the date of successful acceptance. Warranty to cover repairs, spares requirement, replacement of non-functional system / faulty parts.
Acceptance	OEM to prove the satisfactory performance of the system onboard during sea-trials.
Makers list	1. M/s Contros GmBH 2. M/s SBE, USA 3. M/s Pro Oceanus

23. Epifluorescence up-right motorised microscope with image analysis software – 1 no.

	Equipment should be of equivalent specifications as below.
UPRIGHT MOTORIZED MICROSCOPE WITH FLUORESCENCE & CAMERA	Microscope stand for transmitted and reflected light microscopy including touch-panel controller; Control unit for focus, Interface cable for communication; Motorized multi-position revolving nosepiece with connecting cable and a slot for er analyzer or DIC slider, including including spacer for specimen holder; Interface cable for CAN communication; Lamp house for 100W halogen or equivalent with connecting cable; Interference light balance daylight filter; Widefield ergonomic trinocular tube having 3-way light path distribution for simultaneous observation & imaging of the specimens. Widefield eyepiece 10X FOV 22mm.
MOTORIZED XY ULTRASONIC STAGE & MOTORIZED CONDENSER	Motorized ultrasonic stage, including controller, specimen holder, power supply; Universal motorized condenser with multi-position turret for optical elements, including indication plate; Dry top lens; Control box for motorized units; DIC ATTACHMENT: DIC prism slider for transmitted light, Analyzer for transmitted light. OBJECTIVES: Universal Plan Semi Apochromat Objective 4X/0.13, WD 17mm. Universal Plan Semi Apochromat Objective 10X/0.3, WD 10mm, Universal Plan Semi Apochromat Objective 40X/0.75, WD 0.51mm Spring. Universal Plan Semi Apochromat Objective 40X/0.75, WD 0.51mm Spring. Universal Plan Semi Apochromat Objective 100X/1.30, WD 0.2mm
COLOR COOLED HIGH RESOLUTION CMOS CAMERA WITH IMAGE ANALYSIS SOFTWARE	Single chip color CMOS Cooling system: Peltier device 1/1.2" 2.3M Color global shutter CMOS Pitch : 5.86um Acquisition diagonal : 13.4mm Peltier Cooling 24bit RGB, 8/16 bit mono:(64bit) 60fps : 1920 x 1200, 60fps : 1920 x 1080, 60fps : 1600 x 1200, 60fps : 960 x 600 (2x2), (32bit) 30fps : 1920 x 1200 @ 32bit 24/48bit RGB, 8/16 bit mono. 5760 x 3600 (1x1) 3x3 3CMOS, 5760 x 3600 (1x1) 3x3, 2830 x 1800 (1x1) 3x3 resize, 1920 x 1200 (1x1) 3CMOS, 1920 x 1200 (1x1), 1920 x 1080 (1x1), 1600 x 1200 (1x1), 960 x 600 (1x1), 960 x 600 (2x2). With Direct image video port. C mount adapter. Perpetual Software License. Slice view for orthogonal plane viewing of 3D or time laps data sets. Voxel view for isosurface and volumetric rendering of 3D & 4D data set. Z- Stack. Multidimential xyzt & wavelength. Manual assisted panaromic imaging. Live Debluring. Fluorescence unmixing. Bright field unmixing. Kyomograph. Colocolization. Object counting. Movie playback, Tile view, Snap/ movie acquisition, Time lapse at specified interval, multiple image alignment, EFI imaging, views of 3D images, Image processing- Geometry/ combine/filter processing. Region and line measurements. Interactive measurements. Camera to be capable for Monochrome and colour mode.
Installation	By yard under the supervision of OEM expert.
Warranty	Two years from the date of successful acceptance. Warranty to cover repairs, spares requirement, replacement of non-functional system / faulty parts.
Acceptance	OEM to prove the satisfactory performance of the system onboard.
Makers list	M/s Olympus M/s Leica M/s Nikon

24. Gel apparatus: 1 no.

Gel apparatus	Mini Horizontal Electrophoresis System, includes 8- and 15-well Combs, 7 x 7 cm UV-Transparent Tray, Casting Gates, Mini-Gel Caster. Should include a buffer tank, a safety lid with cables and a leveling buffer
Gel Documentation System	Chemiluminescense Documentation System with UV Trans 25 x 30 cm for RAPD and RFLP/AFLP; Optional: Dual EP UV for TLC / Multicolour Western. Motorized zoom lens-F590 emission filter, 4 positions filter wheel, INFINITY - CX5/WL Xpress+PAD-26M, > System packaged with UV-Pad-26.M, >UV 312nm-Filter size 21x26cm. CX5 camera: Scientific grade camera, 5 megapixels resolution extendable to 20 megapixels, Passive cooling, 16-bit – 65 536 grey levels, USB-3 connection, Motorized zoom lens with feedback, Imaging modes: Auto-exposure, Auto-focus, Auto-lighting, Applications: Ethidium bromide, Sybr-Safe, Sybr-Green, Gel-Red, Gel-Green, Sybr-Gold, GFP, Pro-Q Emerald, Sypro ruby, FITC, DAPI, Smart Darkroom technology: Steel and stainless steel darkroom for long lasting robustness. Wide access door with UV safety shut-off, Software control of lighting, White light led panels with automatic intensity adjustment, 4 positions filter wheel includes UV-cut off filter, Slide-out UV table, Includes Bio-Vision software: Software with multiple user license for image acquisition with full GLP compliance. Molecular weight and distance calculation, band quantification, text annotation and image enhancement
Installation	By yard under the supervision of OEM expert.
Warranty	Two years from the date of successful acceptance. Warranty to cover repairs, spares requirement, replacement of non-functional system / faulty parts.
Acceptance	OEM to prove the satisfactory performance of the system onboard.
Makers List	M/s Thermofischer

25. HT Nets - 2 nos.

Features	Description
Type	20 and 200µm, and analog flow meters (with back-run stop facility)
Installation / Acceptance	Acceptance on satisfactory operation during seatrials.
Spares	5 spare nets. 2 flow-meters
Warranty	Two years from the date of successful sea acceptance. Warranty to cover repairs, spares requirement, replacement of non-functional system / faulty parts
Makers list	Any reputed Indian makers

26. Autoclave (Bench Top) - 1 no.

Features	Description
Type	~50-60L Capacity, Exhaust air filteration, with mesh baskets
Operating temperature range	Sterilising: 105 ~ 135°C Heating: 45 ~ 100°C Warming: 45 ~ 95°C
Installation / Acceptance	Acceptance on satisfactory operation during seatrials by OEM.
Spares	5 spare air Filters.
Warranty	Two years from the date of successful sea acceptance. Warranty to cover repairs, spares requirement, replacement of non-functional system / faulty parts
Makers list	Any reputed maker

	M/s Tuttnauer Microbiology International M/s Priorclave

27. IOSN Net - 2 nos.	
Features	**Description**
Type	Net with a mouth area of one square meter and a total length of 5 meters. About 110cm –Net ring with slings etc.
Mesh Size	200 and 225 µm
Installation / Acceptance	Acceptance on satisfactory operation during seatrials by OEM.
Spares	5 spare nets
Warranty	Two years from the date of successful sea acceptance. Warranty to cover repairs, spares requirement, replacement of non-functional system / faulty parts
Makers list	M/s Hydro-Bios M/s KC Denmark

28. Epibenthic Sledge - 1 set	
Features	**Description**
Type	Structure: Comprises aluminium runners to slide along the seabed. These house a stainless steel case (double) that only opens on contact with the bottom. with a multimedia recording system to the upper part of the sled, consisting of: • Underwater video camera (6000m rated; self-contained, programmable, FOV: Ultra wide, 64Gb or more storage, 1080p, LiPo battery, LED light: 2000 lumens or more). • sled attachment accessories. • Including a two-point bridle of stainless steel cable and an anti-twist shackle for attaching it to the main line. • Including rod for attaching a flow meter. • The rectangular net of the epibenthic sled with a reinforced cod end. • Structure of the sled made of naval quality aluminium and AISI 316 stainless steel. • Special plastic-coated aluminium for marine conditions. • Quick mounting collector base in AISI 316 stainless steel. • Rubber canvas net protector. • Plankton net made of Nytal and polypropylene canvas. • Double mouth 60x21cm o 200µm o 500µm • Flow Meter (with back-run stop facility). Epibenthic sledge net: 60cm x 21cm mouth Bucket : • Epibenthic sledge rectangular net 60x21cm 259cmL 200µm • Epibenthic sledge rectangular net 60x21cm 218cmL 500µm
Installation / Acceptance	Acceptance on satisfactory operation during seatrials by OEM.
Spares	200µm - 5 spare nets & 2 spare buckets. 500µm - 2 spare nets & 2 spare buckets. Shackles, slings and other routine use consumables – 5 set
Warranty	Two years from the date of successful sea acceptance. Warranty to

	cover repairs, spares requirement, replacement of non-functional system / faulty parts
Makers list	M/s KC Denmark M/s Aquatic Bio Technology

29. Microplate Reader (Absorbance, Luminescence, Fluorescence) - 1 no.

Features	Description
Absorbance Module	Detector Top-reading, head-on photon counting photomultiplier tube (PMT) Light Source Xenon flash lamp Spectra Range 200–600nm Filter Wheel 9 absorbance filters included Wavelengths included 230, 260, 280, 320, 405, 450, 490, 560 and 600nm 10nm band pass Detection Limit 0.1 O.D. Dynamic Range 0–4.0 O.D.
Luminescence Module	Detector: Top-reading, head-on photon counting photomultiplier tube (PMT) Wavelength Range 350–700nm Detection Limit 3 × 10-21 moles of luciferase Linear Dynamic Range 9 logs Cross-talk Less than 3 × 10-5 (white, 96-well plate, Corning 3912) Filtered Luminescence Built-in filter paddle
Fluorescence Module	Detector PIN-photodiode Light Source Wavelength-matched LED Read Position Top reading Wavelengths selection Filter module with 5 standard excitation and emission filters. Empty filter positions are available for custom excitation and emission wavelengths. Wavelengths included UV (Ex: 365nm, Em: 415–445nm) Blue (Ex: 475nm, Em: 500–550nm) Green (Ex: 520nm, Em: 580–640nm) Red (Ex: 627nm, Em: 660–720nm) AFC (Ex: 405nm, Em: 495–505nm) Detection Limit 2fmol fluorescence dye/200µl Linear Dynamic Range >6 logs (assay dependent)
Accessories	With Injector, heating and shaker system
Installation / Acceptance	Acceptance on satisfactory operation during sea-trials by OEM.
Spares	For 2 years routine usage
Warranty	Two years from the date of successful sea acceptance. Warranty to cover repairs, spares requirement, replacement of non-functional system / faulty parts
Makers list	M/s Promega

Physical Oceanography

30. Outboard Bucket Thermometer - 2 nos.	
Features	**Description**
Type	Meas. Range: -10…+40°C Scale division: 0.5°C, precision: ±0.5 °C
Installation / Acceptance	Acceptance on satisfactory operation for data collection during seatrials by OEM.
Spares	5 spare thermometers.
Warranty	Two years from the date of successful sea acceptance. Warranty to cover repairs, spares requirement, replacement of non-functional system / faulty parts
Makers list	M/s Theodor Friedrichs

31. Acoustic Doppler Current Profiler (ADCP)- 1 no.	
Features	**Specification**
Operating Frequency	300 and 75 kHz
Vertical Resolution	Depth cell size (8m, 16m)
Range	165 m, 560-700m
Velocity Accuracy	± 0.5 cm/s
Max Ping rate	2 Hz
Maximum altitude precision	<2cm/s
Dynamic range	80 dB
Precision	±1.5dB
Beam Angle	~ 30°
Configuration	4 –beam phased array
Communication	RS232 /RS422 ASCII
Temperature Sensor inbuilt	Range : -5 to 50^{o}C
Precision:	±0.1^{o}C
Resolution	0.03^{o}C
Tilt sensor	Range:±15°C, Accuracy:±0.5°, Precision:±0.5°, Resolution: 0.01
Post processing Software	Advanced Software for Vessel mount data acquisition system, data display, export and processing of the data.
Hardware	Corresponding work stations / computers to collect and process data
Inputs	Gyro compass NMEA 0183 Speed Log DGPS Motion sensor NMEA 0183
Installation	By yard under the supervision of OEM expert.
Ethernet	An ethernet connection for the system to be added on ship's LAN for connectivity with a centralized data archival
Warranty	Two years from the date of successful acceptance. Warranty to cover repairs, spares requirement,

	replacement of non-functional system / faulty parts.
Acceptance / Training	OEM to prove the satisfactory performance of the system onboard. Onboard training to be provided to scientists/representatives in operation, data processing, maintenance and trouble-shooting.
Makers list	M/s Teledyne RD instruments M/s Kongsberg Maritime Rowe Technologies -Supporting documents (proof of satisfactory performance) to be provided for equipment fitted in RV and operated for 2 or more years.

32. Acoustic Doppler Current Profiler (Lowered) – 1No.

Frequency:	300 kHz
Max Profiling Range	150m or more
Velocity Accuracy (typical)	±1.0% of measured velocity ± 0.5 cm/s
Velocity Range	±0.5% of measured velocity ± 0.5 cm/s
Ping Rate (typical)	2 Hz
Beam Angle	20°
Depth Rating	6000 m
Standard Sensors	Temperature, Tilt, Compass
Communications	Serial RS-422 or RS-232 ASCII or binary
Post processing Software (Perpetual License)	Advanced Software for Vessel mount data acquisition system, data display, export and processing of the data.
Hardware	Corresponding work stations / computers to collect and process data
Warranty	Two years from the date of successful acceptance. Warranty to cover repairs, spares requirement, replacement of non-functional system / faulty parts.
Acceptance / Training	OEM to prove the satisfactory performance of the system onboard. Onboard training to be provided to scientists/ representatives in operation, data processing, maintenance and trouble-shooting.
Makers list	M/s Teledyne RD instruments

33. CTD System - 2 nos.	
Features	**Description**
UW unit	UNDERWATER UNIT for 911plus CTD – Includes modular dual Temperature and Conductivity sensors with TC Duct, SBE 5T submersible pump, 8 differential input, low pass-filtered A/D channels, water sampler modem channel, stainless steel guard cage, SEASOFT software, and complete documentation, Titanium housing, 10,000 meter depth rating (standard connectors). All sensors to be integrated with necessary interfaces and mounting accessories. With Suitable PC and printer.
Pressure sensor	0-10,000 psia (6,800 meters) pressure sensor
DO sensor	SBE 43 Dissolved Oxygen Sensor (Profiling Configuration), 7000 m (standard connectors). Cable &mount included.
Nitrate	Limit of Detection: 0.5 µM (SW with T/S corr. processing), 2.0 µM (SW processing) Range of Detection: 3000 µM Accuracy: ± 2 µM (±0.028 mg/l-N) or ± 10% of reading Precision (short term): 0.3 µM (SW with T/S corr. processing), 2.4 µM (SW processing) Drift (per hour lamp time): 0.3 µM (SW with T/S corr. processing), 1.0 µM (SW processing) Maker/model: Seabird deepSUNA, Rated upto 2000m
pH	Measurement Range: 0 to 14 pH, ± 1250 mV O.R.P. Accuracy: ± 0.1 pH, ± 1.0 mV O.R.P 1200 m depth rating Maker/model: SBE 27 pH / O.R.P (Redox) Sensor
Bottom Contact	Bottom Contact Switch module (standard connector, cable and mount included)
Chlorophyll & Turbidity	WET Labs ECO-FLNTU(RT)D, Deep Chlorophyll & Turbidity sensor, 50 µg/l & 25 NTU, 6000 meter
PAR sensor	Biospherical QSP-2300L Quantum Scalar (4 pi) PAR (log amp) sensor, 7000 meter
Altimeter	Benthos PSA-916D Altimeter, 6000 meter
Deck unit	DECK UNIT for 911plus CTD – (Version 2) includes IEEE-488 and RS-232 interfaces, water sampler modem channel, NMEA 0183 DGPS interface, A/D input channel for Surface PAR reference sensor, ASCII serial data output port, CTD pressure signal output, audible bottom contact alarm, audio tape interface, 115/230 VAC (switchable) input power, AC power cord, serial data cable, NMEA test cable, remote output cable, rack mount kit, SEASOFT software, complete documentation.
Remote Depth Readout	REMOTE DEPTH READOUT – CTD accessory in spray-proof plastic box for mounting at winch operator's station. Provides real-time digital display of depth (meters) of CTD Underwater unit, or pressure, or altimeter height above seabed (9999.9 max). Includes alarm buzzer, 100 meters of neoprene cable, and complete documentation. The SBE 14 can be driven from the SBE 11plus Deck Unit's serial ASCII output port, or it can also be driven from SEASAVE via a computer COM port. Specify SBE 14 Interface Selection to determine which cable is supplied.
AFM	SEARAM (Version 2) Memory and Carousel Auto Fire Module for 9plus Underwater Unit – Includes 16 MB memory, rechargeable Ni-MH (nickel-metal hydride, 8.0 Ah) battery pack and 2 hour fast charger,

	SEARAM to CTD jumper cable and mount kit, 20 meter data I/O cable (PN 801380) for connection to computer serial port, dummy plugs, SEASOFT software, and complete documentation. Misc. connector selections. Titanium housing, 7000 meter depth rating
Water Sampler	CTD-1 CAROUSEL WATER SAMPLER (standard) – 24 Multibottle sampler (5 litres) in basic configuration for use with modem-equipped 911plus CTD. Includes electronics/release with mounting hub, adapter plates, lifting bail, guard frame, CTD extension stand, and complete documentation. Titanium housing, standard connector, 7000 m, 24-bottle positions, 5-litre size including 24 nos. 5 litres Teflon coated bottles. CTD-2 CAROUSEL WATER SAMPLER (standard) – 12 Multibottle sampler (10 litres) in basic configuration for use with modem-equipped 911plus CTD. Includes electronics/release with mounting hub, adapter plates, lifting bail, guard frame, CTD extension stand, and complete documentation. Titanium housing, standard connector, 7000 m, 12-bottle positions, 10-litre size. including 12 nos. 10 litres Teflon coated bottles.
Spare Bottles	30 nos. 5 litres Teflon coated bottles. 20 nos. 10 litres Teflon coated bottles.
Temp. sensor	70 ms time response, modular sensor (square wave output) used on 911plus CTD, certified stability of 0.001 C in six months. Includes complete documentation. Titanium housing, 10,500 meter depth rating
Cond. Sensor	Modular sensor (square wave output and isolated electronics), range 0 – 7 S/m, used with pumped CTDs. Includes complete documentation. Titanium housing, 10,500 meter depth rating
Software	SEASOFT modular program for instrument communication and data retrieval, real-time data acquisition and display, data processing and plotting. Additional features include the ability to send commands to close water sampler bottles on an SBE32 Carousel Water Sampler, save NMEA navigation data with the CTD data, output data to a remote display, and setup alarm parameters.
Wall-mount for bottles	Wall-mounted bracket for 24 nos. – suitable for mounting 5-litre & 10-litre bottles to be installed in the designated laboratory.
Spares	• One additional spare set of temperature and conductivity sensors, Standard Seabird spares with dummy plugs splicing kit, pig tails etc. • Additional frame (bottom mounted for increasing height of original frame) to be provided for mounting additional sensors e.g. LADCP etc. (One each for both frame sizes)
Networking	Ethernet connection for the system to be added on ship's LAN for connectivity with a centralized data archival system for CTD data archival and DGPS input to CTD data acquisition system.
Installation / Acceptance / Training	Installation at yard. Acceptance on satisfactory operation for data / water sample collection during seatrials by OEM. Training to be provided in operation, maintenance and trouble-shooting during sea-trials.
Warranty	Two years from the date of successful sea acceptance. Warranty to cover repairs, spares requirement, replacement of non-functional system / faulty parts.
Makers list	M/s Seabird USA.

34. Portable CTD - 1 no.	
Features	**Description**
Portable type CTD	CTD, which measures conductivity, temperature, and pressure and provides high accuracy and resolution, reliability, and ease-of-use. Data is recorded in memory and can also be output in real-time in engineering units or raw HEX. Alkaline D-cells or better for power for profiling for up to 60 hours.
Temperature sensor	Measuring range -5 to +35 °C, accuracy ± 0.005 °C
Conductivity sensor	Mesuring range 0 to 9 S/m, accuracy ± 0.0005 S/m
Pressure sensor	Strain gauge 0 to 10,500 m, accuracy Strain gauge ± 0.1% of full scale range; Quartz± 0.02% of full scale range
Chlorophyll & Turbidity	WET Labs ECO-FLNTU(RT)D, Deep Chlorophyll & Turbidity sensor, 50 µg/l & 25 NTU, 6000 meter
pH	pH sensor
Auxiliary sensors	DO, PAR, Nitrate, altimeter etc.
Software	Software package for setup, data upload, real-time data acquisition and data processing
Interface	RS-232 interface, internal memory and internal alkaline batteries (can be powered externally)
Charging option	Rechargeable batteries and charger
Protection	Stainless steel protection cage
Installation / Acceptance / Training	Acceptance on satisfactory operation for data collection during seatrials by OEM. Training to be provided in operation, maintenance and trouble-shooting during sea-trials.
Warranty	Two years from the date of successful sea acceptance. Warranty to cover repairs, spares requirement, replacement of non-functional system / faulty parts
Makers list	M/s Seabird USA

35. Underway CTD (EcoCTD configuration) - 1 no.	
Features	**Description**
Underway CTD	Power supply (a compact power supply for all system components), Main winch (for past and safe probe displacement and retrieval), rewinder and a CTD (with glass coated thermistor) probe system.
Main instruments (Equivalent or better)	1) an RBR Concerto^3 for conductivity, temperature and pressure, with datalogger 2) JFE-Advantech Rinko III for dissolved oxygen saturation 3) Sea-Bird Scientific WetLabs BB2F ECOPuck measuring backscatter at two wavelengths (470 and 700 nm), and fluorescence
Accuracy	Conductivity-0.03 S/m, Temperutre-0.01°C, Pressure- 1dbar and salinity-0.02 (psu)
Resolution	Conductivity 0.0005, Temperature 0.002, pressure ~0.5 dbar and salinity 0.005
Range	Conductivity 0 to 9, Temperature -5 to 45°C, pressure 0 to 2000 m and salinity 0 to 42.
Drop speed	3 – 4 m/s
Depth range	2000 m
Battery life	12 hrs of continuous use
Memory and	Internal memory for storing ~ 60 casts data, Integral Bluetooth

connectivity	antenna with 50 m range.
Spares	2 Spare CTD probe system and spares of all the plugs and other connectors
Networking	Ethernet connection for the system to be added on ship's LAN for connectivity with a centralized data archival system for data archival.
Installation / Acceptance / Training	Acceptance on satisfactory operation for data collection during seatrials by OEM. Training to be provided in operation, maintenance and trouble-shooting during sea-trials.
Warranty	Two years from the date of successful sea acceptance. Warranty to cover repairs, spares requirement, replacement of non-functional system / faulty parts
Makers list	M/s Ocean Science Group

36. XBT / XCTD System - 1 no.

Features	Description
Type	XBT/XCTD probes data acquisition system along with the hand held launcher with 30 m cable, and Laptop.
Temperature resolution	0.01°C
Temperature Range	-5 to 35°C
Conductivity resolution	XCTD -0.01 mS/cm, XCTD 1-0.017 mS/cm
Conductivity range	XCTD -20 to 75 mS/cm, XCTD 1- 0 to 70 mS/cm
Probes	• Two sets of Test probes • 50 XBT probes • 10 XCTD probes
Networking	Ethernet connection for the system to be added on ship's LAN for connectivity with a centralized data archival system for data archival and DGPS input to XBT/XCTD data acquisition system.
Installation Box	The probe launcher and cable storage box to be provided inside lab near to the operation area.
Installation / Acceptance / Training	Acceptance on satisfactory operation for data collection during seatrials by OEM.
Warranty	Two years from the date of successful sea acceptance. Warranty to cover repairs, spares requirement, replacement of non-functional system / faulty parts
Makers list	M/s Lockheed Martin Sippican

37. Wave Recorder - 1 no.

Features	Specification
Type	Wave Height Meter for measuring wave amplitude and period.
Accuracy	~ 3% of measured wave height
Resolution	1.4 cm
Output	Through RS232
Software	Suitable software for processing the data
Inputs	Ship's all Nav. data
Installation	By yard under the supervision of OEM expert.

Ethernet	An ethernet connection for the system to be added on ship's LAN for connectivity with a centralized data archival system.
Warranty	Two years from the date of successful acceptance. Warranty to cover repairs, spares requirement, replacement of non-functional system / faulty parts.
Sea Acceptance / Training	OEM to prove the satisfactory performance of the system onboard at sea. Onboard training to be provided to scientists/ representatives in operation, data processing, maintenance and trouble-shooting.
Makers list	M/s The Tsurumi-Seiki Co., Ltd M/s OceanWaves GMBH

38. Thermosalinograph - 1 no..

Features	**Specification**
Conductivity Sensor	Range: 0 -7 S/m or better. Accuracy: 0.001 S/m or better. Resolution: 0.0001 S/m or better.
Temperature Sensors	Range: -5 to +35 deg C or more. Accuracy: 0.01 deg C or better. Resolution: 0.001 deg C or better.
Sample interval	3 seconds or longer in steps of 1 second
Remote temperature sensor	near seawater-intake and interfacing for the same.
Spare	One set of temperature and conductivity sensor
Software	for real-time acquisition / display, transmission, upload, processing / plotting of variables.
Interface	Real-time data transmission to Computer through RS 232 Serial port. PC also to be part of supply. NMEA port for online Nav. Data input.
Internal Memory	Internal memory for storage of data (for periodic upload to computer) for storing data of 24 hours or more.
Seawater pump	Should be part of supply and be installed for Thermosalinograph.
Installation	By yard under the supervision of OEM expert.
Ethernet	An ethernet connection for the system to be added on ship's LAN for connectivity with a centralized data archival system.
Warranty	Two years from the date of successful acceptance. Warranty to cover repairs, spares requirement, replacement of non-functional system / faulty parts.
Sea Acceptance / Training	OEM to prove the satisfactory performance of the system onboard at sea. Onboard training to be provided to scientists/ representatives in operation, data processing, maintenance and trouble-shooting.
Makers list	M/s Seabird USA

39. Salinometer - 1 no.

Features	Specification
Specifications	• Measurement Range: 0.004 to 76 mS/cm, 0.0001:1.15 Conductivity Ratio • Accuracy: ± 0.003 Equivalent PSU • Resolution: 0.0003mS/cm • RS232C and IEEE 488 Interfaces • Temperature Stability: ± 0.001^{0}C • Technical Manual • Certificate of Calibration • Report of Calibration • Conductivity Cell • Maintenance Kit • Thermistor Kit • External Sample Pump • Standard Seawater ampoules – 30 nos.
Installation / Acceptance	To be installed onboard by OEM and the operation demonstrated with sea-water for acceptance.
Training	After installation, the training should be provided for calibration, functionality, operation & operation principle, data acquisition, post processing and general maintenance/trouble shooting of the system shall be conducted by OEM expert
Warranty	Two years from the date of acceptance. Warranty to cover repairs, spares requirement, replacement of non-functional system / faulty parts.
Makers list	M/s Ocean Scientific International Ltd

40. Vertical Microstructure Profiler along with deployment accessories - 1 no.

Features	Description
Model Name	VMP 250 (TurboVMP) Vertical Turbulence Profiler
Standard sensors	2x Shear Probe, 1x Micro-temperature (FP07), 2x Accelerometer, 1x Pressure, 1x Tilt sensor
Optional sensors	Conductivity-temperature combo sensor, Fluorometer-turbidity combo sensor, Micro-conductivity sensor, Additional Micro-temperature (FP07)
Uprising profiling kit	Floatation, ballasting, and weight release hardware for uprising measurements.
Model Designations	VMP-250-IR (Internal Data Recording) VMP-250-RT (Real-time data transmission)
Depth Range	0 - 1000 m
Sampling rate	512 Hz / 64 Hz fast channel/slow channels
Data Acquisition	Internal recording (Real-time transmission, optional)

Sensor Specifications	Range	Accuracy	Resolution	Bandwidth
Velocity Shear Probe	0 - 10 s-1	5%	10-3 s-1	0.1 - 100 Hz
Micro-Temperature FP07	-5 - 35 ºC	0.01 ºC	10-5 ºC	0 - 25 Hz
Pressure	50 / 100 bar	0.1% FS	5 × 10-4 bar	0 - 5 Hz

Accelerometer	±1g	2%	3 × 10-5 g	0.1 - 100 Hz
Micro-Conductivity SBE7	0 - 70 mS/cm	0.005 mS/cm	0.001 mS/cm	0.001 mS/cm
CT sensor Conductivity Temperature	2 - 65 mS/cm -3 - 45 ºC	0.01 mS/cm 0.01 ºC	0.001 mS/cm 0.001 ºC	0 - 16 Hz
FT sensor Fluorescence Turbidity	0 - 400 ppb 0 - 1000 FTU	1% of FS 0.3 FTU or 2% of Measured Value	0.01 ppb 0.03 FTU	0 - 100 Hz

Networking	Ethernet connection for the system to be added on ship's LAN for connectivity with a centralized data archival system for data archival.
Installation / Acceptance / Training	Acceptance on satisfactory operation for data collection during seatrials by OEM. Training to be provided in operation, maintenance and trouble-shooting during sea-trials.
Warranty	Two years from the date of successful sea acceptance. Warranty to cover repairs, spares requirement, replacement of non-functional system / faulty parts
Makers list	M/s Rockland Scientific

41. Combined SVP+CTD profiler – 2 nos.

Features	Description
General	Equipped to measure seawater sound velocity, conductivity, temperature, and pressure. digital time of flight sound velocity sensor
Depth Rating	6000 m
Accuracy	Sound velocity: ±0.02 m/s Conductivity: ±0.01 mS/cm Temperature: ±0.01 ^{0}C Pressure: ±0.01 %
Software	OEM provided software for system setup and for visualizing data
Warranty	Two years from the date of successful sea acceptance. Warranty to cover repairs, spares requirement, replacement of non-functional system / faulty parts.
Makers list	M/s Valeport M/s AML Oceanographic

Chemistry

42. pH meter- 1 no.	
Features	**Description**
pH standards solutions	pH 4, 7, 9
pH Range (1, 2 or 3 point cal)	0 to 14 pH
Resolution	0.001 / 0.01 / 0.1pH
Accuracy	±0.1pH
mV Range (Abs & Rel)	0 to ±1999.9mV
Calibration	1, 2 or 3 point pH
Outputs	Analogue, RS232 and IrDA printer interface, Alarm
Clock	24 hours, hrs/min/sec or day of month/month/year, leap year corrected
GLP	Calibration reminder interval (1 to 999 hours)
Ethernet	An ethernet connection for the system to be added on ship's LAN for connectivity with a centralized data archival system.
Warranty	Two years from the date of successful acceptance. Warranty to cover repairs, spares requirement, replacement of non-functional system / faulty parts.
Acceptance / Training	OEM to prove the satisfactory performance of the system onboard. Onboard training to be provided to scientists/ representatives in operation, maintenance and trouble-shooting.
Makers list	1. M/s Oakton 2. M/s Orion 3. M/s Merck 4. M/s Hanna Instruments HI 9813-6N pH/EC/TDS Meter

43. Spectrophotometer - 1 no.	
Features	**Specification**
Double Beam	Yes
Baseline stability	Yes
Wavelength Range	190 to 1100 nm
Wavelength Stability	0.1 nm Increments
Wavelength Accuracy - At 656.1 nm - Full Range	 ± 0.2 nm ± 0.5 nm
Wavelength Repeatability - At 656.1 nm - Full Range	 ± 0.1 nm ± 0.2 nm
Spectral Bandwidth (from 200 to 680 nm)	< = 1.8 nm
Photometric Readout	-0.300 to 3.000A or 0.0 to 200%T
Photometric Accuracy (at 1A with NIST 930D solid filter at 546 nm)	± 0.005A
RMS Noise (at 0A, average of 10 standard deviations of 10 readings at 0.05	< 0.0002A RMS

sec intervals, at 500 nm)	
Stray Light (measured using NaI at 220nm, per ASTM E387-84)	< 0.05%T
Stability (0A, constant ambient conditions, measured for one hour at 340 nm after one hour warmup)	< 0.003A/hr
RMS Baseline Flatness (from 200 to 900 nm, at 0 A)	± 0.001A RMS
Scanning Speeds	120, 240, 600, 1200, 2400 nm/min
With	Integrating Sphere attachment
Others	Suitable PC and printer.
Installation	By yard under the supervision of OEM expert.
Ethernet	An ethernet connection for the system to be added on ship's LAN for connectivity with a centralized data archival system.
Warranty	Two years from the date of successful acceptance. Warranty to cover repairs, spares requirement, replacement of non-functional system / faulty parts.
Acceptance / Training	OEM to prove the satisfactory performance of the system onboard. Onboard training to be provided to scientists/ representatives in operation, maintenance and trouble-shooting.
Makers list	1. M/s Shimadzu 2. M/s Thermofisher 3. M/s Merck

44. Auto Titrator - 2 nos.	
Specifications	• Fixed volume dosing. • Time-controlled dosing. • Dosing according to dosing rate.
Resolution	10000 impulse for the 100% of burette volume
Excahnge unit	20 ml or 50 ml? Maximum volume display: ~1 L
Storage temerature	-40 °C to 40°C
Ejection and refill time	Ejection time with analogue operation: 20 S to 20M Refill time: 20 S
Ambient temperature	5 to 60°C
Installation	By yard under the supervision of OEM expert.
Warranty	Two years from the date of successful acceptance. Warranty to cover repairs, spares requirement, replacement of non-functional system / faulty parts.
Acceptance	OEM to prove the satisfactory performance of the system onboard.
Makers list	M/s Metrohm

45. Gas Safety Burner - 1 no.	
Specifications	• Safety Burner should have a graphical user interface. • Flame monitoring and overheating protection feature for use in biosafe cabinet. • Automatic unit switch off feature. • Operation modes with foot switch and button. • With 2 nozzles – Propane/Butane and for other gases. • With connector for dia. 10 mm gas tube and safety tubing for the same (dia. 10mm, 2.0m long) • Tube adapter of diameter 10 mm should be supplied. • The burner should be enclosed in a smooth, chrome plated metal housing which should be easy to clean and should be both UV and solvent resistant. • With wind shield, Foot switch and connecting cable.
Installation	By yard under the supervision of OEM expert.
Warranty	Two years from the date of successful acceptance. Warranty to cover repairs, spares requirement, replacement of non-functional system / faulty parts.
Acceptance	OEM to prove the satisfactory performance of the system onboard.
Makers list	1. M/s Progen Scientific 2. M/s United Scientific Equip 3. M/s Thomas Sci

46. Autoclave - 1 no.	
Features	**Specification**
Capacity	50 litres
Baskets	SS wire baskets – 2nos (minimum)
Operating temperature range	Sterilising: 105 ~ 135°C Heating: 45 ~ 100°C Warming: 45 ~ 95°C
Printer	Built-in thermal printer
Maximum operating pressure	0.25MPa or above
Display	Digital LED or Analogue
Other features	Timer, exhaust control, safety devices, pressure gauge
Installation	By yard under the supervision of OEM expert.
Warranty	Two years from the date of successful acceptance. Warranty to cover repairs, spares requirement, replacement of non-functional system / faulty parts.
Acceptance	OEM to prove the satisfactory performance of the system onboard.
Makers list	1. M/s Thermo Scientific 2. M/s Astell Scientific 3. M/s Esco Scientific

47. Temperature controlled Centrifuge - 1 no.

Features	Specification
Max speed	30000 rpm
Max. capacity	6 x 100 ml (fixed angle)
Temp range	0°C to +40°C
Required accessories	1. 1 Angle Rotor 12 x 1.5/2.2 ml, max. 25,000-30,000 rpm 2. 1 Angle rotor for 12 Greiner tubes 15ml, Max. rpm 12,000-15,000 rpm 3. 1 Angle rotor for 6 x 50 ml, Max. 20,000 – 22,000 rpm 4. 12 Adapters for PCR-vial 0.2 ml 5. 1 Swing-out Rotor for micro titer plates max. 3000-4000 rpm 6. 12 Rubber case (15 ml) for corex glass tube
Display	Graphic display of all parameters that ensures quick and easy programming. The parameters displayed should include speed, RCF, time, temperature, rotor, integral, acceleration and braking rates plus a real time graph of the run.
Other features	• Single knob operation / keypad operation • Free programming of all parameters • Maintenance Free, noiseless, brush-less motor drive • Large size LC Display Screen • Pre selection of run parameters in terms of rpm and rcf • Self diagnostic error messages & audible alarm • Short run function with display of run time in seconds • Magnetic rotor identification • Run time preselection from 5-10 hrs or continuous run • Motorised lid locks and inter lock • Should operate on 230V/50 Hz • Pre selection of run parameters in terms of rpm and rcf
Installation	By yard under the supervision of OEM expert.
Warranty	Two years from the date of successful acceptance. Warranty to cover repairs, spares requirement, replacement of non-functional system / faulty parts.
Acceptance	OEM to prove the satisfactory performance of the system onboard.
Makers list	1. M/s Sigma Instruments 2. M/s REMI 3. M/s Eppendorff 4. M/s Thermo Scientific 5. M/s Nuaire Lab

48. Auto Analyser - 1 no.

Capability	Fully automated continuous flow analyzer for nutrients and wet chemistry analysis. The system should be capable to analyse nitrate+nitrite, nitrite, ammonium, phosphate and silicate in sea water. Methods of analysis for each parameter to be supported with application document. Manifolds to be supplied with pre connected tubes, relevant accessories like PC-controlled heating bath, cadmium column, connectors etc. For Total Nitrogen the module should have built in (in-line) UV- digestion facility. Flow cells are to be of coated black glass to avoid interference of external lights during analysis for better accuracy.
Working ranges	No. of channels: 5 1. Nitrate-nitrite: 0 – 50 µM 2. Nitrite: 0 – 10 µM 3. Ammonia: 0 – 5 µM 4. Phosphate: 0 – 5 µM 5. Silicate: 0 – 150 µM
Sampler, Random Access, PC controlled	4 removable racks, with 35 sample positions each and 10 ml tubes. Total sample cups 140 numbers. XYZ full random access capable. 11 positions with 35 ml containers for supply of calibrates, QCS. 9 separate positions for 10ml tubes for working standards. Four channel built-in rinsing pump. User selectable pump tube sizes for required rinsing liquid volume. Supply of one rinsing liquid. Glass rinsing vessel with continuous liquid level and two waste outlets for self cleaning. Sample uptake with single Stainless steel syringe. Automatic pre and post dilution of samples. Automatic preparation of working standard solutions for chemistry calibration.
Analytical module	This module should be a single unit for all the channels. Module Holder for five Chemistry channels. (specified above). Proportioning pump 2 X16 channel with single pump deck. 2 X 10 stainless steel pump rollers. Multi speed pump function with standby/analyse/fast rinse positions. Built in 10-channel high precision air injector. Built in air supply pump. Pressure regulator for air segmentation. Inlet for supply of external inert gas. Two positions for dual channel temperature control included in chemistry module. Five separate glass waste receptacles. Separated compartments for electronics, chemistry and detector heads. Housing according to CE and CSA regulations
Data Acquisition software and computer	Interface with Data Acquisition with software. Interface for automatic data acquisition and control of Continuous Flow Analysers. Includes data handling software package to operate future firmware upgrades by USB memory stick. With workstation PC with 24-inch dual display & other accessories. Printer compatible for the Analyser.
Photometer, one each per channel	Digital Photometer Detector with Turbo Matrix Correction for correction of salinity effect in seawater samples with different salinity concentrations, capable of being analysed in a single run. Consists of a photometer head with insert board and cable. Wave length selection by insert of interference filters. Wavelength range 340-1050 nm. Accommodation for one flow cell of 50 mm path length. Software controlled automatic baseline and peak height settings. Software controlled lamp switching on-off. 20 bits high resolution absorption recording. Detection range upto 6.5AU. Signal/noise ratio <0.0003AU.

	Modules with Flowcell and Filters for: Nitrate-nitrite Ammonia-Total N Orthophosphate-Total Phosphate Silicate Urea
Kit, two sets	Accessories, Analyzer Start-up kit, consists of pump tubing, sleeves, 100 nos. sampler cups, tool kit and spare part kit. Spares include tubings for different parameters, needle, Cadmium granules, Cd column and all glass coils.
Others	Any other essential item to make the system fully working to be supplied as part of equipment.
Installation	By yard under the supervision of OEM expert.
Warranty	Two years from the date of successful acceptance. Warranty to cover repairs, spares requirement, replacement of non-functional system / faulty parts.
Acceptance	OEM to prove the satisfactory performance of the system onboard.
Training	Onboard training to be provided to scientists/ representatives in operation, maintenance and trouble-shooting.
Makers list	M/s Skalar Analytical

49. Ovens (upto 60°C and upto 300°C)– 2 nos.	
Specifications	1. Digital precision oven, inner chamber of SS304 0.8 mm thick, outer body of mild steel 1.0 mm thick powder coated, temperature 5°C above ambient to 250°C, with built in temperature indicator cum controller and motor and blower to have uniformity, neat heating capacity ~ 50 litres ,with internal stainless steel adjustable trays (304) 2. Digital precision oven, inner chamber of SS304 0.8 mm thick, outer body of mild steel 1.0 mm thick powder coated, temperature 5°C above ambient to 250°C, with built in temperature indicator cum controller and motor and blower to have uniformity, neat heating capacity ~ 400 litres ,with internal stainless steel adjustable trays (304)
Installation	By yard under the supervision of OEM expert.
Warranty	Two years from the date of successful acceptance. Warranty to cover repairs, spares requirement, replacement of non-functional system / faulty parts.
Acceptance	OEM to prove the satisfactory performance of the system onboard.
Makes List	Any reputed Indian makers

50. Gas chromatograph - 1 no.	
Specifications	Gas Chromatography system with FID/ECD detectors and Purge & Trap sample introduction (Equivalent to Agilent 8890 or better) - With control and post-processing software (perpetual license & 3 years subscription, if any) - full-function touch screen for a visual report of the system configuration, method, routine, status etc. - with setup for reliability and longevity against gas contaminants such as particulates, water, and oils. - Capillary Flow Technology (CFT) modules, which are oven mountable and very low thermal mass, provide unique gas flow connections for multi-dimension gas chromatography, comprehensive two-dimensional gas chromatography with flow modulation, and back flush at the beginning, middle, or end of an analytical column. - Smart Keys, included with GC columns, provide information such as column usage with default parameters for configuration that helps automate method setup. - Oven: Programmable Oven from ambient to 350°C with facility to fix both capillary as well as packed columns. - Spares and consumables: Advanced electronic pneumatic controllers such as Helium Conservation Module, Hydrogen Sensors, and Alternate Carrier Gas Solutions, dramatically reduce the amount of helium used offering flexibility, cost savings, and higher levels of safety. Detectors: - Auto-ranging FID provides the ability to detect and quantify from percent levels to parts per billion (ppb) in a single injection. - Single-filament TCD, which does not require a separate reference gas or manual potentiometer adjustment, yet provides a stable baseline with a minimal amount of signal drift commonly seen with valve switching. - ECD to provide trace-level analysis of halogenated organic compounds and aromatic pollutants. Sample introduction: Direct injection as well as facility to introduce sample via gas-sampling loop and purge and trap (P&T) system. *Specifications for P&T system*: • Electronic Mass Flow Controller for precise and accurate delivery of purge gas • Superior U-shaped trapping technology to adsorb VOCs of interest while minimizing retention of water and unwanted compounds • Ultra-fast trap heater for rapid desorption of compounds from the trap and fast delivery to the GC • Inert sample pathway to ensure low carryover • Reduced trap cooling times for faster run times and higher sample throughput • Foam detection and prevention, and sparge vessel heating options available • Full diagnostics capabilities built into the software Others: - Browser based interface for remote connectivity to enable the user to monitor GC system, check system logs, and perform diagnostics tests,

	from inside or outside the laboratory and remote maintenance. - Provision for built-in intelligence autonomously monitoring system for the health of the system, alerts the user of potential issues before they affect chromatographic performance, and offers helpful step-by-step guides to resolve issues.
Installation	By yard under the supervision of OEM expert.
Warranty	Two years from the date of successful acceptance. Warranty to cover repairs, spares requirement, replacement of non-functional system / faulty parts.
Acceptance	OEM to prove the satisfactory performance of the system onboard.
Makes List	1. M/s Agilent Technologies (model 8890) 2. M/s Shimadzu GC 3. M/s Varian Technologies 4. M/s Perkin Elmer India Ltd. 5. M/s Thermo-Fisher Scientific

51. Analytical Balances - 2 nos.	
Specifications	weighing balance for weighing in grams up to a max. of 250 g
Installation	By yard under the supervision of OEM expert.
Warranty	Two years from the date of successful acceptance. Warranty to cover repairs, spares requirement, replacement of non-functional system / faulty parts.
Acceptance	OEM to prove the satisfactory performance of the system onboard.
Makes List	Any reputed Indian makers

52. Laminar Flow - 1 no.	
Specifications	Horizontal laminar flow with HEPA filter to remove particles down to 0.2 um. Class 100, Filter condition indicator. Enclosure for bench top use. Horizontal Swing door for maximum accessibility during sample placement. Two utility ports with iris openings for passing electrical connections or tubings. One UV Light & four Flourescent Light., powder coated supporting base.
Installation	By yard under the supervision of OEM expert.
Warranty	Two years from the date of successful acceptance. Warranty to cover repairs, spares requirement, replacement of non-functional system / faulty parts.
Acceptance	OEM to prove the satisfactory performance of the system onboard.
Makes List	Any reputed Indian makers

53. Ultrasonic bath sonicator – 2 nos.	
Specifications Type-1	Ultrasonic Power: 40 Watts to 100 Watts - Tank Size: 200 x 100 x 70 mm - Tank Capacity: 1 Litre (approx.) - Tank Material: 304 SS - Frequency: 34 +/- 3KHz - Generator: Built-in (Card Type) - Outer Cabinet: 304, 20G - Input Supply: 230V, Single Phase

	- Timer: Digital 0 - 30 min. - Heater: Thermostatically controlled 100W to heat up liquid up to 65° C - Lid: SS 304, 20G - Full Working Instructions Manual
Specifications Type-2	Tank Size: 6" x 5" x 2.5", tank Capacity: 1.2 ltr, SS 304 moulded, Enclosure M S powder Coated, power: 45 watts
Installation	By yard under the supervision of OEM expert.
Warranty	Two years from the date of successful acceptance. Warranty to cover repairs, spares requirement, replacement of non-functional system / faulty parts.
Acceptance	OEM to prove the satisfactory performance of the system onboard.
Makes List	M/s Thermo Scientific M/s Biomall M/s Spectra Lab Instruments

54. Cooling Water-bath (5 to 100°C) - 1 no.	
Specifications	Capacitiy 15 Ltrs., temperature Range : 5°C to 100°C, temperature Stability : +/- 0.1°C
Installation	By yard under the supervision of OEM expert.
Warranty	Two years from the date of successful acceptance. Warranty to cover repairs, spares requirement, replacement of non-functional system / faulty parts.
Acceptance	OEM to prove the satisfactory performance of the system onboard.
Makes List	Any reputed Indian makers

55. Hot plates with stirrer- 1 no.	
Specifications	Temperature range: ambient to 150°C, with magnetic stirrer.
Installation	By yard under the supervision of OEM expert.
Warranty	Two years from the date of successful acceptance. Warranty to cover repairs, spares requirement, replacement of non-functional system / faulty parts.
Acceptance	OEM to prove the satisfactory performance of the system onboard.
Makes List	Any reputed Indian makers

Geophysics

56. Single Beam Echo Sounder - 1 no.		
Sr. No.	**Features**	**Description**
1	Operational Frequency	Wideband, Channels: 3 or more; Range: 12-15kHz, 30-40kHz and 100-200kHz
2	Operational Depth	Full ocean depth
3	Mounting of the receiver	Preferably on a 19" rack.
4	Display	19" LCD monitor
5	Hard Disk Storage space	Minimum 1TB
6	Display Range on screen	Minimum: 50 meter full screen Maximum: Full range of the system The system to have manual and outranging for display
7	Sound Velocity	Manual feed: 1400 – 1600 m/sec Auto: Input from SVP/CTD
12	Bottom Slope Information	To be provided.
13	Data Replay	Data replay facility to be possible on the system.
14	Maximum ping rate	30 per second or more for relatively shallow water operations.
15	Data Storage formats	Storage of Raw data, history, xyz ascii, text ascii, echogram, and any other format as per designers on the data acquisition PC
16	Annotation Facility	Fix mark or annotation facility both internal and external to be available.
17	Interfaces	**Input:** Facility to input NMEA from positioning system, LAT, LONG from DGPS/GPS, CTD, SVP, motion sensor, annotator input. These could be either on Ethernet OR as serial or compatible input wherever applicable. **Output:** • Depth data with navigation string stamp to internal data logger, Ethernet output of the same string to a marine data management system, only depth data to a central navigation & depth display unit, • Output data to be available for logging in a centralized data logging server. • A facility for tapping raw analog output of the echogram in 0 – 10 volts DC scale on a BNC OR an latest connector to be provided. • A 2 or 3 channel thermal recorder (e.g. ULTRA 120 type) or similar COTS printer to obtain real time hard copy of the data. • Suitable PC.
18	Repeaters	5 repeaters/Helmsmen displays in the locations specified by the NCPOR (one on wheelhouse and other 4 in laboratory spaces namely in physics, Geology, sampling deck and winch control room.
19	Pinger & multi-pulse	Facility for detecting 12 KHz pinger signals attached to a sampling device. The system to have multi-pulse option for faster tracking of the bottom in the deep-water operations. Two suitable deepwater 12 KHz pingers with 6000m depth rating of reputed brand also

		should be part of supply.
20	System synchronization	The system to be suitable for interface with external synchronization unit with other acoustic systems onboard.
21	Installation	By yard under the supervision of OEM expert.
22	Warranty	Two years from the date of successful sea acceptance. Warranty to cover repairs, spares requirement, replacement of non-functional system / faulty parts.
23	Sea Acceptance Test / Training	OEM will conduct Sea acceptance test (SAT) on completion of ship's construction. The system will be accepted only after satisfactory completion of SAT and demonstration of system capabilities at sea including pinger operation. Any shortcomings should be attended and set right for accepting the system. Extensive training to be provided by OEM during sea-trials on operation, maintenance and trouble shooting.
24	Makers list	1. M/s Kongsberg 2. M/s Teledyne 3. M/s Wartsila Elac Nautik

57. Multibeam Echosounder - Deepwater - 1 no.

Sr. No.	Features	Description
1	Frequency	Typically 12 – 15 kHz
2	Range	Full Ocean Depth
3	Resolution	~ 1 deg X 1 deg
4	Swath Coverage	4 times the depth or better (equidistance and equiangular mode)
5	Imagery Incl.	Side Scan, Back Scatter and Water Column Imaging
6	Sound Velocity System	• Surface Probe • Vertical Profiler – Preferred Sensor type: Digital Time of Flight; OEM: Valeport
7	Motion Compensation	Full (Integrated Motion and Heading Sensor: Ixblue OCTANS or better)
8	DGPS	With SAT based corrections (Trimble or CSI Wireless or better) with 3 years signal subscription.
9	Time correction	Lantime server based.
10	Peripherals	• Online track plotter print for bathy and sidescan with ref stamps. • Storage capacity minimum 4 TB. • Redundant storage for data. • All displays (acquisition and processing) shall be TFT and min of 24". • Illuminated Chart board.
11	Operational Environment	Roll: +/- 15° ; Pitch: +/- 10° ; Yaw: +/- 10°; Sea state: up to 4 ; Region of operation: Tropical seas.
12	Interfacing	Serial or compatible interface for ship motion data, gyro compass data, nav data, surface sound velocity data, sound velocity profile and other geophysical data acquisition units like gravimeter and magnetometer. A dedicated real-time serial data distribution box with <10ms latency is to be provided
13	Ethernet	An ethernet connection for the system to be added on ship's LAN for connectivity with a centralized data archival

		system.
14	Installation	Installation under expert supervision of equipment OEM with special consideration of the sophisticated hydro-acoustic and constructional requirements of the vessel.
15	Software	• Acquisition software: Proven software of equipment OEM or other reputed softwares. • Realtime data display. • Processing Software (Perpetual license with 5 years subscription): Min. 2 Units, Latest PC based (Editing & Plotting : CARIS HIPS & SIPS, Visualisation: QPS-Fledermaus with GIS+Midwater, and Geocoder toolbox). • CARIS Onboard360 (Collect +Process) with Workstation & integration to other sensors e.g. MBES, SBES, Navigation & SV sensors etc. (Perpetual license with 5 years subscription):
16	Nav terminal	Integrated survey planning, Electronic Nav Charts, online bathymetry monitoring etc. 3 helmsman displays at determined locations including wheelhouse. Nadir depth displays min 3 nos.
17	Printing & Plotting facilities	• Printing: Multifunction (A3 size; print –scan-copy) Color Laserjet printers (for each Post processing unit). • Plotters: Latest Colour A0-size plotter facility.
18	Sea Acceptance trial	OEM will conduct Sea acceptance test (SAT) on completion of ship's construction. The system will be accepted only after satisfactory completion of SAT and demonstration of system capabilities at sea. Any shortcomings should be attended and set right for accepting the system. SAT protocols to be provided during the offer.
19	Warranty	Two years from the date of successful sea acceptance. Warranty to cover repairs, spares requirement, replacement of non-functional system / faulty parts.
20	First Bathy Survey support	OEM to provide an engineer to sail onboard for confirming system performance and training / acclimatization to our scientists in regular survey cruise (About one-month duration) anytime within first one year period after sea-acceptane.
21	Makers list	1. M/s Kongsberg 2. M/s Wartsila Elac Nautik 3. M/s Teledyne

58. Multibeam Echosounder– Shallow Water - 1 no		
Sr. No.	**Features**	**Description**
1	Frequency	Typically 100 – 250 kHz
2	Range	Depth 1m – 500m with swath coverage of 4 times the depth or better.
3	Resolution	~ 1 deg -1deg
4	Imagery Incl.	Side Scan and normalized backscatter
5	Sound Velocity System	Profiler – Preferred Sensor type: Digital Time of Flight; OEM: Valeport
6	Motion Compensation	Full (Integrated Motion and Heading Sensor: Ixblue OCTANS or better)
7	DGPS	With SAT based corrections (Trimble/CSI Wireless or better)

8	Peripherals	• Online track plotter print for bathy and sidescan with ref stamps. • Storage capacity minimum 4 TB. • Redundant storage for data. • All displays (acquisition and processing) shall be TFT and min of 24".
9	Interfacing	Serial or compatible interface for ship motion data, gyro compass data, nav data, surface sound velocity data, sound velocity profile etc
10	Operational environment	Roll: +/- 15° ; Pitch: +/- 10° ; Yaw: +/- 10° Sea state: up to 5 ; Region of operation: Polar and Tropical seas.
11	Installation	Installation under expert supervision of equipment OEM with special consideration of the sophisticated hydro-acoustic and constructional requirements of the vessel.
12	Software	• Acquisition software: Proven software of equipment OEM or other reputed softwares. • Realtime data display. Processing Software (Perpetual license with 5 years subscription): Min. 2 Units, Latest PC based (Editing & Plotting : CARIS HIPS & SIPS, Visualisation: QPS Fledermaus with GIS+Midwater and Geocoder toolbox).
13	Nav terminal	Integrated survey planning, Electronic Nav Charts, online bathymetry monitoring etc. 3 helmsman displays at determined locations including wheelhouse. Nadir depth displays min. 3 nos.
14	PC's, Printing & Plotting facilities	Printing: Multi-Function Device-MFD (A4 size; print –scan-copy) Color Laserjet printers (for each Post processing unit). Plotters: Latest Colour A0-size plotter
15	Ethernet	An ethernet connection for the system to be added on ship's LAN for connectivity with a centralized data archival system.
16	Sea Acceptance trial	OEM will conduct Sea acceptance test (SAT) on completion of ship's construction. The system will be accepted only after satisfactory completion of SAT and demonstration of system capabilities at sea. Any shortcomings should be attended and set right for accepting the system. SAT protocols to be provided during the offer.
17	Warranty	Two years from the date of successful sea acceptance. Warranty to cover repairs, spares requirement, replacement of non-functional system / faulty parts.
18	First Bathy Survey support	OEM to provide an engineer to sail onboard for confirming system performance and training / acclimatization to our scientists in one-month regular survey cruise anytime within first one year period after sea-acceptane.
19	Makers list	1. M/s Kongsberg 2. M/s Teledyne

59. Sub-Bottom Profiler – 1 no.

Sr. No.	Features	Description
1	Frequency of operation	Adjustable in 0.5 kHz steps typically from 0.5 to 6 kHz; Parametric type
2	Range	Full Ocean Depth , more than 6000m
3	Resolution	~ 3 deg or better

4	Penetration	150m or more
5	Motion Correction	HRPY
6	Motion compensation	Full (Integrated Motion and Heading Sensor: Ixblue OCTANS or better)
7	Operation Modes	Multi-pulse / parametric and conventional
8	Inbuilt/integrated	Narrow Beam Echosounding (for Full Ocean depths)
9	Data output	SEG-Y and OEM format
10	Options	Water Column Imaging, Marine Mammal Protection
11	Software	Integrated data processing System and plotting facilities
12	Data acquisition / processing system	Acquisition display shall be dual displays (for NBS and SBP seperately). Multifunction Color Laserjet printer for Post processing unit.
13	Data storage	Storage capacity of storing atleast 3 months data with reduantant storage space. Additional DVD RW storage media with enough consumables for one year operation. Suitable PC and printer.
14	Ethernet	An ethernet connection for the system to be added on ship's LAN for connectivity with a centralized data archival system.
15	Input	Facility to input NMEA from positioning system, LAT, LONG from DGPS/GPS, CTD, SVP, motion sensor, annotator input. These could be either on Ethernet OR as serial input wherever applicable.
16	Installation	By yard under the supervision of OEM expert.
17	Sea Acceptance / Training	OEM will conduct Sea acceptance test (SAT) on completion of ship's construction. The system will be accepted only after satisfactory completion of SAT and demonstration of system capabilities at sea. Any shortcomings should be attended and set right for accepting the system. SAT protocols to be provided during the offer. Training to be provided for operation, maintenance and trouble shooting during the sea-trials.
18	Warranty	Two years from the date of successful sea acceptance. Warranty to cover repairs, spares requirement, replacement of non-functional system / faulty parts.
19	Makers list	M/s Teledyne, Edgetech

60. Magnetometer - 1 no.		
Sr. No.	**Features**	**Description**
1	Operating Principle	Self-oscillating split-beam Cesium Vapor (non-radioactive)
2	Operating Range	~20,000 to 100,000 nT
3	Temperature Range	-35°C to 50°C operating, -45°C to 70°C storage
4	Error in Heading	Around ±1 nT (over entire 360° spin)
5	Absolute accuracy	<2 nT throughout range
6	Tow Cable & Winch	Kevlar Reinforced multi-conductor tow cable of 500m with portable electric winch
7	Peripherals	DGPS Input; Log, Display & Processing software including

		suitable latest PC and MFD printer
8	Networking	Ethernet connection for the system to be added on ship's LAN for connectivity with a centralized data archival system.
9	Installation	By yard under the supervision of OEM expert.
10	Warranty	Two years from the date of successful sea acceptance. Warranty to cover repairs, spares requirement, replacement of non-functional system / faulty parts.
11	SAT / Training	OEM will conduct Sea acceptance test (SAT) on completion of ship's construction. The system will be accepted only after satisfactory completion of SAT and demonstration of system capabilities at sea. Any shortcomings should be attended and set right for accepting the system. SAT protocols to be provided during the offer. Training to be provided for operation, maintenance and trouble shooting during the sea-trials.
12	Makers list	1. M/s Geometrics 2. M/s marine Magnetics

61. Gravimeter - 1 no.		
Sr. No.	**Features**	**Description**
1	Range	~20,000 milliGals (worldwide)
2	Drift	Upto 3 milliGals/month after aging
3	Temperature Setpoint	46° to 55°C
4	Stabilised Platform	Roll ±25°, Pitch ±22°, Period ~4 minutes, Damping ~0.7 of critical
5	Recording Rate	1 Hz with Serial Output (Rs-232)
6	Performance	Resolution : 0.01 miliGals Static Repeatability : 0.05 miliGals Dynamic Repeatability : 1.0 miliGals or better 50,000 Mgal Horizontal Acceleration : 0.25 miliGals 100,000 Mgal Horizontal Acceleration : 0.50 miliGals 100,000 Mgal Vertical Acceleration : 0.25 miliGals
7	Accuracy	< 1.0 miliGals at Sea
8	Temperature	5° to 45° C Operating, -10° to 50° C Storage
9	Peripherals	DGPS Input; Log, Display & Processing software including latest PC and printer
10	SAT / Training	OEM will conduct Sea acceptance test (SAT) on completion of ship's construction. The system will be accepted only after satisfactory completion of SAT and demonstration of system capabilities at sea. Any shortcomings should be attended and set right for accepting the system. SAT protocols to be provided during the offer. Training to be provided for operation, maintenance and trouble shooting during the sea-trials.
11	Networking	Ethernet connection for the system to be added on ship's LAN for connectivity with a centralized data archival system.
12	Installation	By yard under the supervision of OEM expert.
13	Warranty	Two years from the date of successful sea acceptance. Warranty to cover repairs, spares requirement, replacement of non-functional system / faulty parts.

14	Makers list	M/s Scintrex Micro-g Lacoste

62. Towable Side Scan Sonar - 1 no.		
Sr. No.	**Features**	**Description**
1	Frequency	Dual (100 kHz & 400kHz)
2	Range	~600m @ 100kHz and ~200m @ 400kHz
3	Depth Rating	500m or more
4	Motion Sensors	RP & Heading
5	Other sensors	Pressure and Integration with Magnetometer
6	Tow Cable & Winch	Suitable coaxial/fiber cable of 500m with portable Electric winch
7	Peripherals	DGPS Input; Log, Display & Processing software including latest PC and MFD printer
8	Networking	Ethernet connection for the system to be added on ship's LAN for connectivity with a centralized data archival system.
9	Installation	By yard under the supervision of OEM expert.
10	Warranty	Two years from the date of successful sea acceptance. Warranty to cover repairs, spares requirement, replacement of non-functional system / faulty parts.
11	SAT / Training	OEM will conduct Sea acceptance test (SAT) on completion of ship's construction. The system will be accepted only after satisfactory completion of SAT and demonstration of system capabilities at sea. Any shortcomings should be attended and set right for accepting the system. SAT protocols to be provided during the offer. Training to be provided for operation, maintenance and trouble shooting during the sea-trials.
12	Makers list	1. M/s Klein Marine Systems 2. M/s EdgeTech

63. Multichannel Seismic System – 1 no.		
Sr. No.	**Features**	**Description**
1.	General	➢ The whole system is to be customized as containerized in order to accommodate (a) Streamer winch (b) Gun array and (c) recording / processing module ➢ One unit of the whole system is adequate enabling us to load in either one of the vessels (of opportunity) ➢ Compressor and handling facilities are to be fitted inbuilt in the ORV. ➢ The bidder shall provide an integrated solution including all the necessary hardware and software needed for successful multi-channel seismic data acquisition.
2	Steamer System	➢ No. of streamers: 1 ➢ Active Streamer length : 3 km + 3 km + 2x deck cable + lead-in cable ➢ Hydrophone per sections : 8 minimum ➢ No. of channels : 480-960 ➢ Streamer type : Solid streamer, digital

		telemetry ➢ Streamers sections : 100 m / 150 m long. ➢ Streamer Depth Control system: minimum every 300m with compass ➢ Tail Buoy, with very good GPS tracking system ➢ Recording system with storage and acquisition software
3	Seismic Source	➢ AIRGUN SOURCE GUN SYSTEM – 2 sub-arrays of 5 gun positions each, with gun controller, Command and Control software ➢ Preferable total volume (cu. in.) : 3000-4000 ➢ Guns pressure: 2000 psi
5	Compressor	Specification to be decided based on the gun volume and recharge time
6	Desktop Computers	One (1) computer for seismic data acquisition. One (1) computer for navigation QC, & streamer depth control. One (1) computer for gun controller. Two (2) dedicated workstations for seismic processing and interpretation. All computers to be with 24”Dual-display A-0 plotter & Two (A3 & A4 size; one each) MFD color laserjet printers
7	Software	Acquisition software & gun controller software from OEM. Real-time navigation software Seismic processing: Landmark ProMAX, Interpretation : Schlumberger Petrel/IHS Kingdom) All software to be perpetual license with 5-year subscription services
8	Makers list	M/s Sercel M/s Teledyne Marine M/s ION Geophysical M/s Geometrics M/s Seamap

Geology

64. Multi Sensor Core Logger - 1 no.		
Sr. No.	**Features**	**Description**
Core logger capable of studying core material, including whole or split rock core samples and whole or split unconsolidated sediment samples in plastic or metal liners.		
1	Core dia.	Upto 6 inches, both whole and split core.
2	Core length	1.5 metres
3	Core pusher	Yes
4	Scan speed	Minimum 4m per hour.
5	Sensors / Measurements	Near-infrared & visible spectrophotometry, bulk density, non-contact resistivity, core dia and imaging, gamma density, P-wave velocity (Vp), shear wave velocity (Vs), electrical resistivity, magnetic susceptibility, natural gamma spectroscopy, line-scan imaging, colour spectrophotometry, X-ray fluorescence, infrared spectroscopy
6	Software	Latest software for real time data display, data storage and processing.
7	Installation	By yard under the supervision of OEM expert. Field-rugged and complete with anti-vibration mounting
8	Sea Acceptance trial / training	OEM will conduct Sea acceptance test (SAT) on completion of ship's construction. The system will be accepted only after satisfactory logging performance on the cores collected during sea-trials. Any shortcomings should be attended and set right for accepting the system. Training to be provided for operation, maintenance and trouble shooting during the sea-trials.
9	Warranty	Two years from the date of successful acceptance. Warranty to cover repairs, spares requirement, replacement of non-functional system / faulty parts.
10	Makers list	M/s Geotek

65. Gravity Corer - 2 nos.		
Sr. No.	**Features**	**Description**
1	Corer Type	1.5 T (comprising 75 Kg lead weights with 20 extra lead weights)
2	Corer Length	6m. Two corer barrels of 3m also to be provided, compatible with the entire assembly.
3	Core Diameter	Outer Diameter ~130-140mm
4	Features	Orange peel core catcher Carver (nose piece) for protecting the corer steel tube Extendable with coupling device for double length
5	Spares	core catchers 25 nos, core heads 10 nos, core pipes 10 nos and core liners 100 nos
6	Acceptance	To be delivered onboard. Shall be checked and accepted if satisfactory.
7	Makers list	Any reputed Indian makers

66. Piston Corer - 1 no.

Sr. No.	Features	Description
1	Corer Type	Modular; typically in 6m Modules, with handling facility
2	Coring Length	30m (adjustable in 6m sections)
3	Core Diameter	~100-110mm
4	Portability	Suitable transport containers to be provided for the corer.
5	Corrosion Protection	AISI 316 stainless steel or equivalent
6	Standard features	Storage racks, tools and spares, Cradle for launching, 4 sets of 6m core barrels (i.e. 12 nos), Two Corer heads (including weights), 50 nos. 6m core pipes, sufficient core catchers and other consumables for three years.
7	Accessories	Hydraulic Core Extrusion Device, Longitudinal Liner Cutter
8	Handling	Onboard mechanized handling system fitted to vessel for sampling operations to be fitted and will be part of scope.
9	Installation	Installation by OEM and yard including the handling system.
10	Sea Acceptance / Training	The system to be operated to the full capacity and sample collected by the OEM to the satisfaction of Owners during the sea trials. Training to be provided in operation, maintenance and trouble shooting methods during the sea-trials.
11	Warranty	Two years from the date of successful sea acceptance. Warranty to cover repairs, spares requirement, replacement of non-functional system / faulty parts.
12	Makers list	1. M/s Geo-Marine Survey Systems 2. M/s Oktopus-mari-tech 3. M/s KC Denmark 4. M/s OSIL

67. Box Grab (Spade Corer) - with various buckets – 2 sets

Sr. No.	Features	Description
1	Frame	Hot dip galvanized tubular construction.
2	Construction	• Constructed around Reineck Principle • Steel construction with SS sample boxes • Aluminum pulleys • SS wire rope slings – 5 sets • All fasteners to be supplied in Stainless steel. • Weight stand: To accommodate lead bricks of 75 kg. each • Fixture for Bottom water collection to be provided • Tools for assembly
3	Rating	Full Ocean depth
4	Sample Box	"C" type with lids – 200 mm x 300 mm x 450 mm – 10 Nos (Stainless Steel), 1- large size, 1000cm^3, 600 cm^3. With Hydraulic carriage for carrying sampling tube with samples
5	Lead ballast weights	– 75 Kilos x 10 Nos. = 750 Kilos
6	Spade	Steel hot dip galvanized with rubber plate seal.

7	Acceptance	To be delivered onboard. Shall be checked and accepted after satisfactory seatrials.
8	Makers list	Any reputed Indian makers

68. Core Splitting Machine – 1 no.

Sr. No.	Features	Description
1	Type	Bench Top with self contained wet tray
2	Liner Cutting Mechanism	Vibratory cutters and hooked slitting blades
3	Liner length accepted	Length: up to ~160 cm; Diameter: Upto ~20 cm
4	Sediment Splitting Mechanism	Thin wire, with electro-osmotic power supply
5	Features	Suitable for all Plastic liners, Splitting suitable for X-ray fluorescence, and high resolution magnetic susceptibility
6	Installation / Acceptance	To be installed onboard by OEM and the operation demonstrated by splitting core pipe with sample for acceptance.
7	Warranty	Two years from the date of acceptance. Warranty to cover repairs, spares requirement, replacement of non-functional system / faulty parts.
8	Training	Training for operation, maintenance and trouble shooting by OEM expert during sea-trials.
9	Makers list	1. M/s Geotek 2. M/s Avaateck

69. Sediment Grab - 5 nos.

Sr. No.	Features	Description
1	Grab Type	Van Veen bottom grab
2	Corrosion Protection	Galvanised / electropolished Steel parts, AISI 316 stainless steel
3	Sample capacity	250 cm^2, 1000 cm^2 (2 nos. each) & 2000 cm^2
5	Accessories	Carriage for sample transport and depressor weights.
6	Acceptance	To be delivered onboard. Shall be checked and accepted after satisfactory sea-trials / training.
7	Makers list	Any reputed Indian makers

70. Hot Air Oven - 2 nos.

Features	Specification
Specifications	• Micro Controller Based Vertical Oven • Volume: atleast 90 Liters • Temperature: Ambient + 10^oC to 300^oC • 2 shelves made of Stainless Steel • Adjustable Shelves position • Digital display for SET as well as PROCESS values • Temperature resolution of 0.1 ^oC • Temperature accuracy of 1% of set value • Insulation with high grade glass wool

	• Audio Visual on temperature deviation from SET values • Outer Door should be lockable • Inner chamber should be stainless steel • Outer body should be stainless steel • Double walled construction • Heaters evenly distributed with blower for uniform heating • Backup controller to prevent any accident due to voltage or current surge • IQ, OQ has to be done at site.
Installation	By yard under the supervision of OEM expert.
Warranty	Two years from the date of successful acceptance. Warranty to cover repairs, spares requirement, replacement of non-functional system / faulty parts.
Acceptance	OEM to prove the satisfactory performance of the system onboard.
Makers list	1. M/s Thermo Scientific Heraeus 2. M/s Biotechnologies Inc., 3. M/s Shel Lab

71. Chain Bag Dredge - 5 nos.

Sr. No.	Features	Description
1	Dredge Type	Steel Box type body and chain bag collector; front equipped with forward facing steel teeth and rear end is blocked by a chain bag. Box and chain and accessories are of hot dip galvanized steel.
2	Dimensions	Mouth typically ~1m by ~0.5m, Chain bag ~ 2m. Typical mesh size of chain bag ~5cm
3	Sample capacity	~ 1 T
4	Facilities	Weak link, safety line, additional hooks for depressor weights, depressor weights. Spare accessories.
5	Acceptance	To be delivered onboard. Shall be checked and accepted if satisfactory.
6	Makers list	Any reputed Indian makers

72. Rock Saw - 2 nos.

Sr. No.	Features	Description
1	Type	Bench Top with self contained wet tray
2	Casing	fully-enclosed, Clear Plastic hood/ Glass window
3	Saw size	professional quality ~14-18" saw
4	Motor	Typically 1.3 to 1.5 hp; Power supply 115/230V, as required
5	Features	Precision fully-adjustable carriage ball bearings and independent fixed-rate power feed with automatic shut-off and safety switch, Sealed Ball bearings and Belt Guard
6	Installation	By yard under the supervision of OEM expert.
7	Acceptance trial / training	OEM will prove the performance onboard with the rock sample. Training to be provided for operation, maintenance and trouble shooting during the sea-trials.
8	Warranty	Two years from the date of successful acceptance. Warranty to cover repairs, spares requirement, replacement of non-functional system / faulty parts.

9	Makers list	M/s Hillquist M/s ASC scientific

73. TRANSMITTED AND REFLECTED LIGHT POLARIZING MICROSCOPE with digital camera for reflected and transmitted light microscopy with PC - 1 no.

Sr. No.	Features	
1	Both manual and automatic mode of operation.	
2.	At least 5 position center- able nose piece.	
3	Strain-free objectives (magnification as per need ranges from 1x to 100x. example; 1X, 2X, 5X, 10X, 20X, 50X and 100X or similar combinations).	
4	Advanced colour temperature controller.	
5	Oblique LED light illumination and LCD display.	
6	Manually height-adjustable.	
7	Integrated focus stop prevents objective and sample collisions.	
8	Focusable Bertrand lens and extended field of view.	
9	Built-in analyzer, and integrated pinhole for examining small grains.	
10	Orthoscopic and conoscopic optics.	
11	Both reflected and transmitted light option.	
12	Color coded objectives and condenser diaphragms.	
13	Field view at least 25 mm.	
14	Accessory plates (lambda, quarter lambda and quartz wedge, etc).	
15	X/Y positioning by object guide.	
16	Can be used for fluid inclusion studies.	
17	Suitable high resolution compatible digital color camera with high definition live image 1920x1080p, 30fps - JPG images with max. 5 Mpixels - MP4 movie clips with max. 2 Mpixels	
18	Workstation (Processor i7 or better, RAM 8gb or more, HDD 1 TB or more, DVD Writer, graphics card-4 gb, display size 24-inch dual display etc.) with latest windows operating system and image analysis software with all spares and accessories must be provided. The image analysis software should be capable of capturing images through the camera, image processing (brightness, contrast, color, sharpness, LUT transform, inversion etc.) and editing, and morph metric analysis (shape, area calculation etc.). The CCD camera must be operate-able through the software.	
19	Two years of comprehensive warranty.	
20	Installation	By yard under the supervision of OEM expert.
21	Makers list	M/s Olympus M/s Zeiss M/s Leica

74. GRINDER , POLISHER, CUTTER (for Thin Section preparation) -1 no.

Grinder, polisher, cutter for cutting and polishing of rocks for making thin sections for petrological studies

Sr. No.	Features

Abrasive Cutter machine for precise cutting of rocks		
1	Rock cutting unit: minimum 10” cutting wheel	
2	Recirculating intake hose	
3	Recirculating tank	
4	Internal water supply and proper drainage system	
5	Sound rating	≤76 db under no load at a distance of 1m
6	A vise table and rock clamp Kit.	
7	Capacity to cut a rock piece of 80-90mm dia atleast	
8	Standard features	Table should be made out of corrosion resistant steel bands. It should be possible to replace these steel bands in the event of damage or wear. CE or ISO certified. Machine should have holders for easy movement of samples during cutting operation. Machine should have controller for motor as well as sample movement speed during cutting.
9	Installation	By yard under the supervision of OEM expert.
10	Accessories	Fluid for lubrication
11	Warranty	Two years from the date of successful sea acceptance. Warranty to cover repairs, spares requirement, replacement of non-functional system / faulty parts.
12	Makers list	M/s Buehler M/s Struers

S.No.	**GRINDER POLISHER WITH POWER HEAD -1 no.**	
	Features	Descriptions
1	Platen Diameter	8in [203mm], 10in [254mm]
2	Platen Wheel Speed	10-500rpm in 10rpm increments
3	Wheel Direction	Clockwise or Counter-Clockwise
4	Water Supply Hose	0.25in to .30 in OD tube
5	Water Supply Pressure	40-100psi [25-60bar]
6	Membrane Control Panel	LED displays, Units: Metric or Imperial
7	Touchscreen Control Panel	Full color LCD Screen; water resistant
8	Base Sound Rating (1.5ft, 0.5m)distance no load	≤60dB @ 100rpm
9	Base & Head Sound Rating	≤62dB @ 100/30rpm
	Specifications	**Power Head**
10	Speed	30-60rpm in 10rpm increments
11	Central Specimen Force	5-60 lbs [20-260N]

12	Single Specimen Force	1-10 lbs [5-45N]
13	Central Force Specimen Capacity	1in, 1.25in, 1.5in, 25mm, 30mm, 40mm and large or irregular specimens
14	Single Force Specimen Capacity	1in, 1.25in, 1.5in, 25mm, 30mm, 40mm
15	Compliance	CE; EC applicable directives
16	Accessories	Circular and rectangular holders for moulds and thin sections. 2 x 3in Glass Slide Holder, 27 x 46mm Glass Slide Holder, 28 x 48mm Glass Slide Holder, Retaining Rings (Qty 6). 8in Aluminium Plate, 10in Aluminium Plate, diamond paste, corundum sheets
17	Installation	By yard under the supervision of OEM expert.
18	Makers list	M/s Buehler M/s Struers

General Purpose

75. Scientific Winches, A-frames

1. Hydraulic Deep sea-bed sampling oceanographic traction winch of SWL 25 tonnes capacity loading with continuous length of 10,000m Galvanized steel wire rope of 18 mm diameter or more with 25T SWL, for deep sea dredging / coring operations
   Winch should include length, speed, tension read-outs, heave compenstion and auto tension control provision.

2. Hydraulic winch of 10 tonnes SWL with 15 tonnes side A-frame/Zibboom and 8000m 18mm wire rope for coring operations over ship side.

3. Hydraulic 2 nos CTD traction winches, to handle CTD operations with 10000m CTD conductor cables (Rochester part no: A305625, 11.43mm dia) and slip rings. A mechanised docking mechanism to be provided to bring the CTD system on deck and for launching/Recovery (LARS). Winches should include length, speed and tension read-outs and 10000m CTD conductor cable on each winch.

4. 2 nos portable electric winches (2 tons) for Magnetometer and Side Scan sonar with slip rings.

5. Scientific Mooring winch (portable): Capacity of hold 5000m of 6mm wire rope and have a line pull of around 3 Tons with a horizontal capstan attached to the drum which can be engaged by a clutch mechanism. The drum may be designed to FREEWHEEL with necessary Braking system. Speed 0-60 mm/min. Winch to have base plate and quick connect Hydraulic lines and situated minimum 15m to 20m behind stern A-frame.

6. Hydraulic STERN A-FRAME: SWL 50 Tons size vertical clearance 10m, horizontal clearance: 6m; Minimum horizontal outreach of 8m. A-frame to have central sheave for deep sea wire rope and brackets to attach two 5 ton blocks on either side of central sheave. A-frame requires 2 tugger winches to be fixed on the A Frame. This Auxillary tugger winches should have 30m of 14mm dia wire wound on 2 layers, and capable of 3T SWL. Maintenance platform for tugger winch and sheaves to be integrated part of A frame.

7. For operation of CTD through both CTD winches: CTD davit in way of CTD-hangar operates as Launch & Recovery System (LARS); SWL- 6 tonnes, outreach about 4-5m, clear height and width according to equipment and operation plan. CTD operation area to be clear of obstructions and directly accessible from the wetlabs.

8. Winch capable of deploying constructor-class ROVs, with 30mm diameter wire enabling real-time data transfer. Capable of handling up to 10 tons.

9. Suitable machineries and handling facilities to be provided for the piston coring operations.

10. Radio remote controls for all the machineries including cranes.

Installation	By yard under the supervision of OEM expert.
Warranty	Two years from the date of successful acceptance. Warranty to cover repairs, spares requirement, replacement of non-functional system / faulty parts.
Acceptance /	OEM to prove the satisfactory performance of the system

Training	onboard during the sea-trials. Onboard training to be provided in operation, maintenance and trouble-shooting methods.
Makers list	1. M/s ODIM 2. M/s Dynacon 3. M/s Rapp Marine 4. M/s Ibercisa

76. Onboard Data Management System (ODM System) - 1 no.	
Specifications	The ODM system is the main server / distributor and archives all data obtained from different navigational, meteorological and scientific sensors installed onboard. The basic components of the systems would be as follows: 1. The server with large file backup capacity of minimum 300 TB, expandable upto 500 TB. 2. Software that enables system manager to collect and store data from all individual equipment and distribute the data to different clients. 3. Hardware interface to all equipment and sensors (LAN with 100MB/1GB type or better) 4. Data Backup system 5. System and sensor Monitoring mechanism along with security software and hardware capability 6. The system shall be complete with data interface boxes, acquisition terminal for each lab, connectivity to central ODM server, server and clients. 7. Automatic data logging with options for selecting equipment / sensors. 8. Provision to be made for connecting extra equipments in the existing data logger. Each lab should have a terminal and possibility to connect additional instruments in that lab. 9. Navigational, weather and hydrographic instruments data storage, processing & handling. 10. The system shall be of a rugged design that can cope with the continuous operations for long durations i.e. for several months. 11. The yard will install all the necessary ducting for LAN / sensor cable routing to all equipment and sensors in labs and to accommodation and other places as required.
Installation	To be installed onboard by OEM including interfacing with all scientific data acquisition systems and Navigation and other sensors onboard. The tentative networking points are as below. 1. Chief of Expedition 2. Dy. Chief of Expedition 3. Conference room 4. General Purpose / Data processing (in labs) – 6 nos. 5. Navigational data 6. Each of scientific equipment in this list that collect underway and stationary data.
Acceptance Test	Software operation, equipment/sensors interfaces, data storage & distribution demonstrated to the satisfaction of NCPOR.
Training	Onboard extensive training to be provided by OEM during the sea trials.
Warranty	Two years from the date of acceptance. Warranty to cover repairs, spares requirement, replacement of non-functional system / faulty parts.

Makers list	1. M/s Kongsberg Marime 2. M/s Werum, Germany 3. M/s Optimare, Germany

77. Desktop Computers (20 nos.) and Printer (15 nos.) for General Purposes

In addition to the dedicated computers to the scientific equipments and other systems onboard following General purpose computers are required.

1. Chief of Expedition – 1 no.
2. Deputy Chief of Expedition – 1 no.
3. Master – 1 no.
4. Chief Engineer – 1 no.
5. Owner's rep – 1 no.
6. Engine office – 1 no.
7. Deck office – 1 no.
8. Purser office -1 no.
9. Bridge – 1 no.
10. Conference room – 1 no.
11. General Purpose (in labs) – 10 nos.

Printers For General Purpose – 15 nos

Printers : Multifunction (MFD) Colour Laser printer with scanning facility.

In addition to the dedicated printers to the scientific equipments and other systems onboard following General purpose computers are required.

1. Centralized Heavy duty machines – 3 nos.
2. General printers in labs – 3 nos
3. Chief of Expedition – 1 no
4. Master – 1 no
5. Chief Engineer – 1 no
6. Owner's rep – 1 no
7. Engine office – 1 no
8. Deck office – 1 no
9. Purser office -1 no
10. Bridge – 1 no
11. Conference room – 1 no

Copier Machines – 3 nos.

Features	Specification
Configuration	All the computer systems / printers hardware and software should be the latest configuration at the time of delivery and can vary for the best.
Softwares	Standard utility software should be part of supply.
Other features	• Trackball, • DVD Read/write • USB, serial and parallel • Other items as required for the system functionality.
Installation	By yard under the supervision of OEM expert. CPUs should be placed in one place in each lab. Only monitors to be placed on tables for use.
Ethernet	An ethernet connection for the systems to be added on ship's LAN for connectivity with a centralized data archival system.
Warranty	Two years from the date of successful acceptance. Warranty to cover repairs, spares requirement, replacement of non-functional

	system / faulty parts.
Acceptance	OEM to prove the satisfactory performance of the system onboard.
Makers list	1. M/s HP 2. M/s Wipro 3. M/s Lenovo 4. M/s IBM 5. M/s Dell 6. M/s Sony

78. Deep Freezers -20°C : 4 nos.

Specifications

- Microprocessor / Microcontroller based Deep Freezer – Vertical type
- Volume: 450 L
- Temperature: -20°C
- Minimum Shelves required: 8
- 4 individual internal doors made of stainless steel
- Shelves position should be adjustable
- Digital Display should be available for SET as well as PROCESS values
- Insulation: High Density Polyurethane
- Audio Visual Alarms on temperature deviation from SET values
- Refrigeration system should incorporate environment friendly gas
- Compressor must be hermetically sealed and air cooled
- Outer Door should have lock facility
- Calibration certificates must be provided
- Calibration should be carried out at site
- Interior of the system must be made of Stainless steel
- Exterior of the system must be duly powder coated
- Suitable stabilizer should be supplied with the system

Installation	By yard under the supervision of OEM expert.
Warranty	Two years from the date of successful acceptance. Warranty to cover repairs, spares requirement, replacement of non-functional system / faulty parts.
Acceptance	OEM to prove the satisfactory performance of the system onboard.
Makers list	1. Voltas 2. Blue Star 3. Elanpro 4. Celfrost

79. Deep Freezers -40°C : 2 nos.

Specifications

- Microprocessor / Microcontroller based Deep Freezer – Vertical type
- Volume: 450 L
- Temperature: -40°C
- Minimum Shelves required: 8
- 4 individual internal doors made of stainless steel
- Shelves position should be adjustable
- Digital Display should be available for SET as well as PROCESS values

• Insulation: High Density Polyurethane • Audio Visual Alarms on temperature deviation from SET values • Refrigeration system should incorporate environment friendly gas • Compressor must be hermetically sealed and air cooled • Outer Door should have lock facility • Calibration certificates must be provided • Calibration should be carried out at site • Interior of the system must be made of Stainless steel • Exterior of the system must be duly powder coated • Suitable stabilizer should be supplied with the system	
Installation	By yard under the supervision of OEM expert.
Warranty	Two years from the date of successful acceptance. Warranty to cover repairs, spares requirement, replacement of non-functional system / faulty parts.
Acceptance	OEM to prove the satisfactory performance of the system onboard.
Makers list	1. Voltas 2. Blue Star 3. Elanpro 4. Celfrost

80. Refrigerators - 4 nos.	
Features	**Specification**
	▪ Spark-free interiors, for reduced risk of internal explosion ▪ Automatic temperature control ▪ Thermostat mounted outside cabinet ▪ Tough white exterior ▪ Easily cleaned, molded plastic interior ▪ Lockable door for product security ▪ Evaporator design minimizes temperature gradient ▪ Adjustable shelves ▪ CFC-free and HCFC-free refrigeration system and insulation ▪ Laboratory rated ▪ Vertical model
Temperature display	Digital controller
Defrost	Automatic
Amps breaker	13
Capacity	450 to 500 L
Temperature range	3-7 deg
No. of shelves	4
Door	Solid with lock
Installation	By yard under the supervision of OEM expert.
Warranty	Two years from the date of successful acceptance. Warranty to cover repairs, spares requirement, replacement of non-functional system / faulty parts.
Acceptance	OEM to prove the satisfactory performance of the system onboard.
Makers list	1. Samsung 2. LG 3. Voltas 4. Haier 5. Whirlpool

	6. Godrej 7. Electrolux

81. Fume Hood (General & Non-Metallic)- 2 nos.		
Sr No	**Specification**	
1	External Dimensions ~(W x D x H):1500mm x 900mm x 2450mm. (Height including working area height;720mm, Base cabinet and top filters/duct assembly)	
2	Internal Dimensions ~(work Area): Width:950mm Depth:800mm Height:720mm	
3	Exhaust Volume 750CFM Air Down flow velocity: 0.30 m/s Air Inflow velocity: 0.50 m/s	
4	100% Poly-Pro seam welded construction longer lasting, metal free construction	
5	100% clean air HEPA filtration and true Laminar Air Flow	
6	Large HEPA Filters: 99.99% Efficient On 0.3 Microns	
7	Separator-less HEPA Filter Media	
8	Polypropylene construction for excellent chemical resistant properties.	
9	Air baffling for a proper horizontal airflow pattern	
10	Integral vapor-proof fluorescent lighting.	
11	Duplex electrical outlets should be available in 220V AC versions	
12	Vertical sliding safety glass sash.	
13	polypropylene base cabinets	
14	All necessary spare parts/ accessories should be provided.	
15	construction (Exterior) polypropylene durable with rigid structure, construction (Interior) Chemical & Heat Resistant, Fire Retardant, Smooth Finish, Easily Cleanable Panels Made out of durable special material, Interstitial 3-point suction system (for light, normal & heavy fumes) with baffle to ensure smooth and immediate exhaust of fumes, chemical resistant splash & spillage proof joint less PP worktop. 18 – 20 mm thick counter-balanced Vertical sash. Toughened Float Glass sash with smooth and light sash operation, air Suction Capacity 1000 CFM, individual ON / OFF switch for Tube Lights	
16	Installation	By yard under the supervision of OEM expert.
17	Warranty	Two years from the date of successful sea acceptance. Warranty to cover repairs, spares requirement, replacement of non-functional system / faulty parts.
18	SAT / Training	OEM will conduct Sea acceptance test (SAT) on completion of ship's construction. The system will be accepted only after satisfactory completion of SAT and demonstration of system capabilities. Any shortcomings should be attended and set right for accepting the system.
	Makers list	1. M/s Esco Scientific

		2. M/s Biotechnogies Inc 3. M/s Nuaire Lab 4. M/s JISICO Lab

82. Large cold storage for samples - 1 no.

Specifications

- Minimum 1.5m x 1.5m area approx.
- 4 deg C temperature.
- Stainless steel racks with anti-roll stoppers.

Installation	By yard under the supervision of OEM expert.
Warranty	Two years from the date of successful acceptance. Warranty to cover repairs, spares requirement, replacement of non-functional system / faulty parts.
Acceptance	OEM to prove the satisfactory performance of the system onboard.
Makers list	Yard to design and fabricate with expert firms.

83. Ice maker - 2 no.

Temp. range	-1 to 0 deg
Quantity	EA
Cooling method	Fractional freezing
Storage capacity	20 kg
24 hrs production	25 kg
Installation	By yard under the supervision of OEM expert.
Warranty	Two years from the date of successful acceptance. Warranty to cover repairs, spares requirement, replacement of non-functional system / faulty parts.
Acceptance	OEM to prove the satisfactory performance of the system onboard.
Makers list	Any reputed makers.

84. Portable Modular Over-The- Side Pole mount - 1 set

Specifications	Modular Over-the-Side pole mount for easy installation, disassembly and transportation • Operation speed 4 knots or more; Survival speed 7 knots or more • Deployment length from pivot: 10 meter or more (in modular sections) • Drag and vortex reducing design suitable for marine use i.e. corrosion resistance etc. • Standard base plates for Sonardyne and Teledyne ADCP's (6000m range or more) to be provided.
Installation	By yard under the supervision of OEM expert.
Warranty	Two years from the date of successful acceptance. Warranty to cover repairs, spares requirement, replacement of non-functional system / faulty parts.
Acceptance	OEM to prove the satisfactory performance of the system onboard.

Makers list	M/s Sonardyne M/s Teledyne

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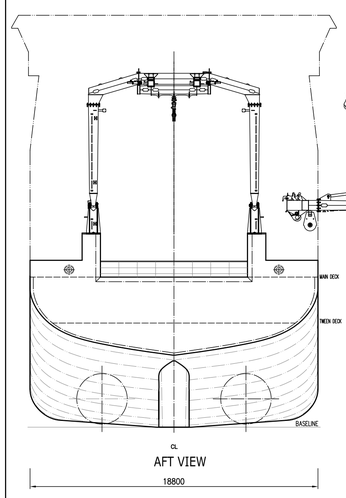
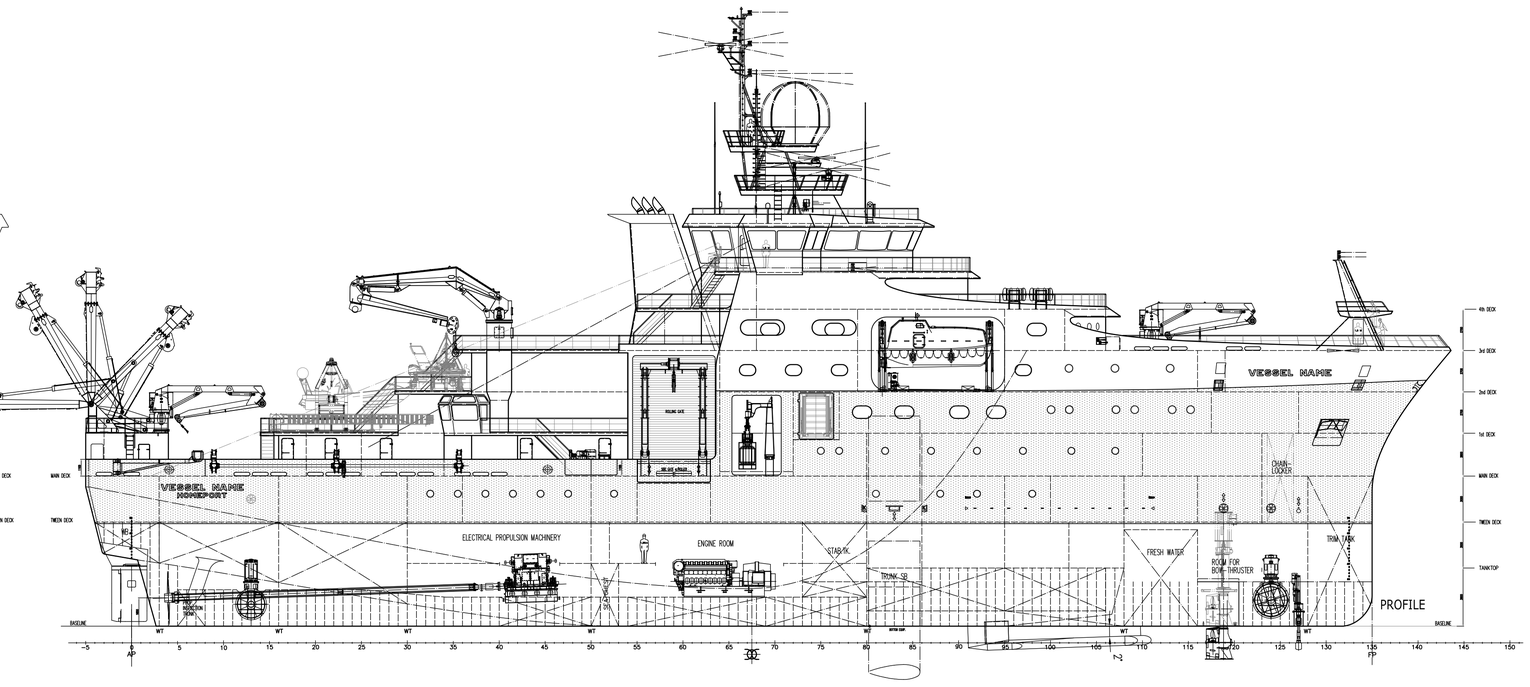
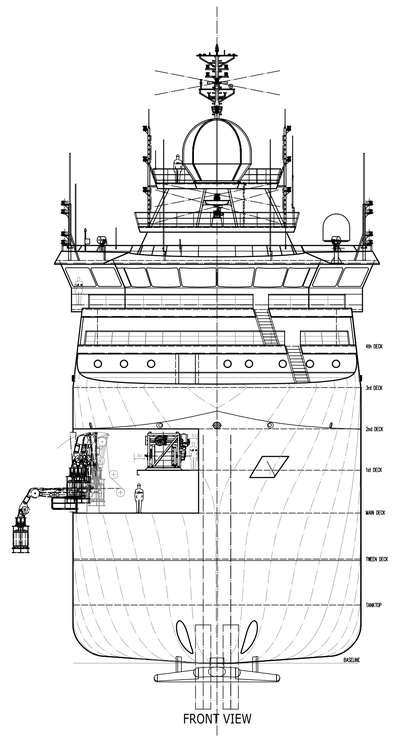


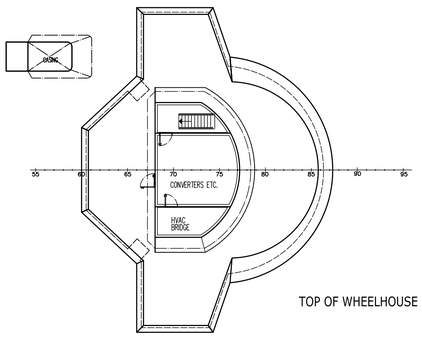
AFT VIEW

18800

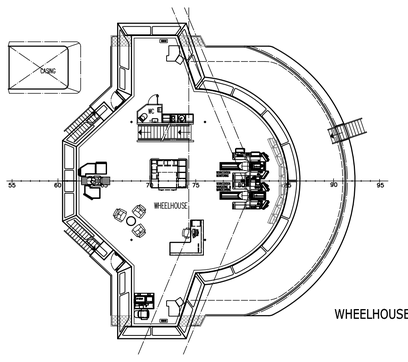




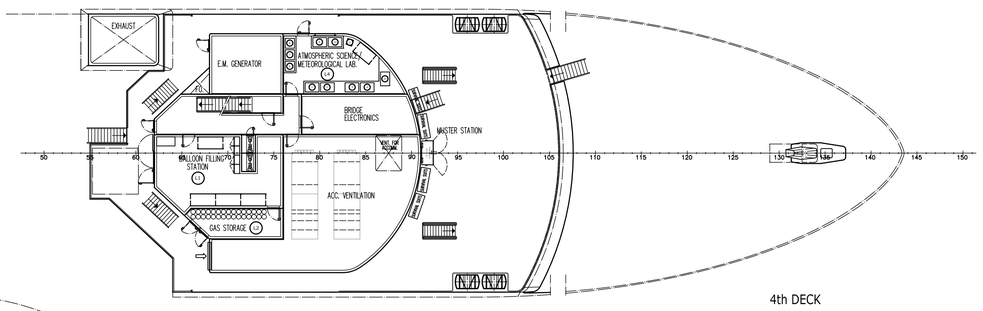
FRONT VIEW



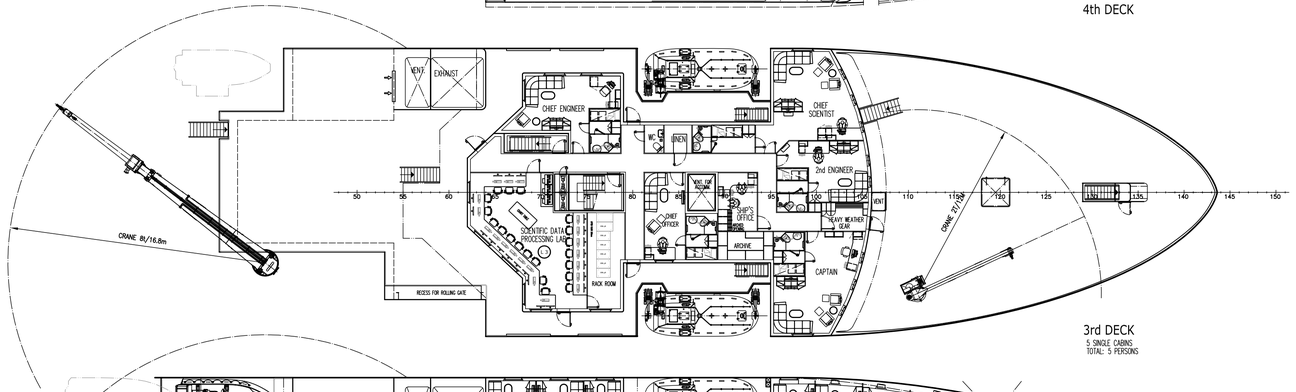
TOP OF WHEELHOUSE



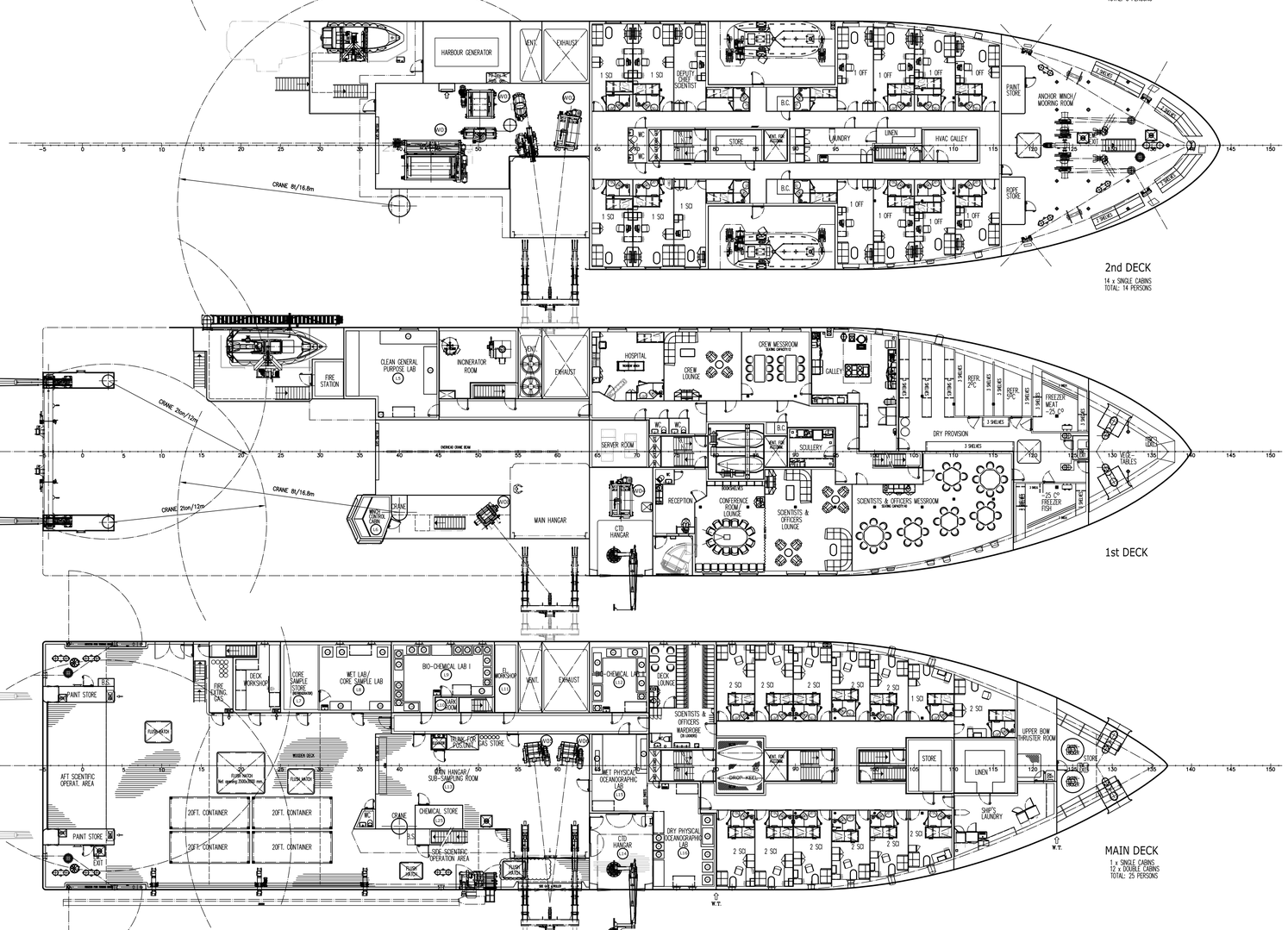
WHEELHOUSE



4th DECK

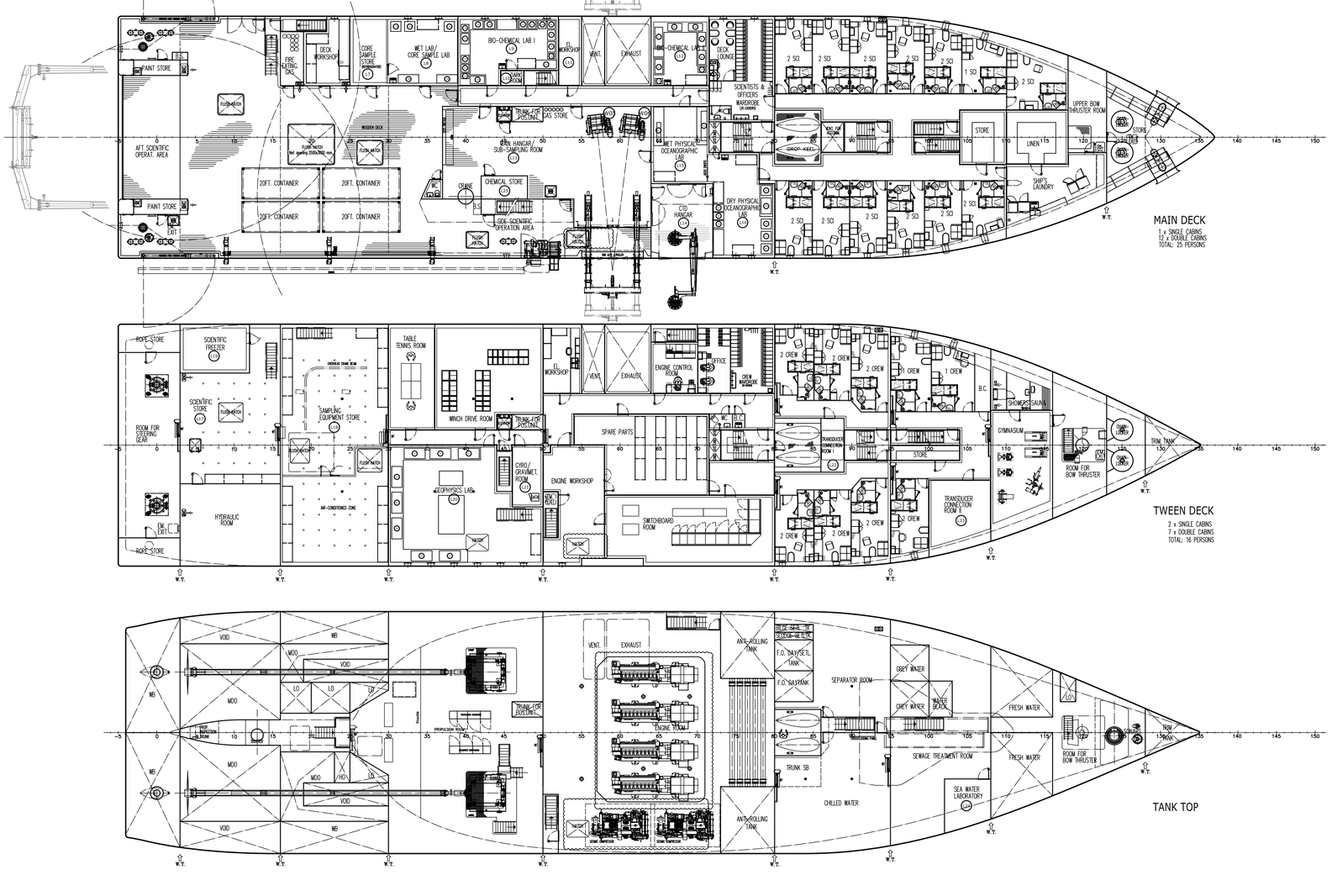


3rd DECK
5 SINGLE CABINS
TOTAL: 5 PERSONS



2nd DECK
14 x SINGLE CABINS
TOTAL: 14 PERSONS

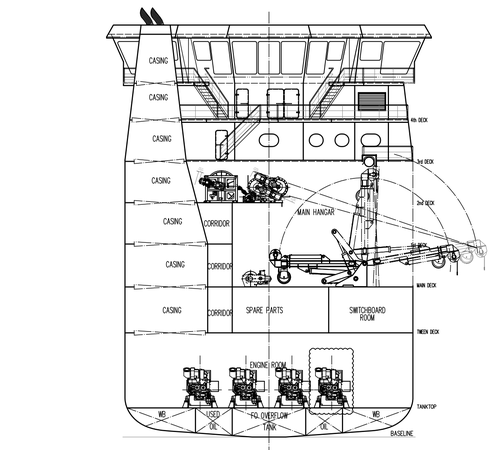
1st DECK



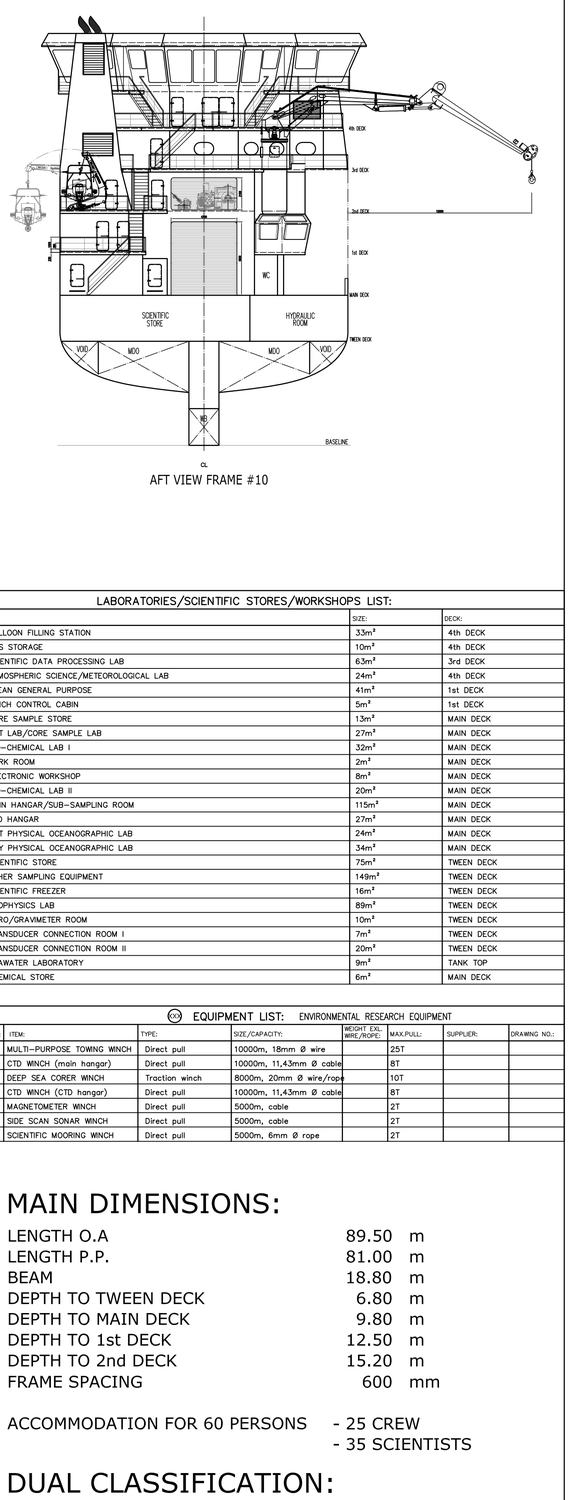
MAIN DECK
1 x SINGLE CABINS
12 x DOUBLE CABINS
TOTAL: 25 PERSONS

TWEEN DECK
2 x SINGLE CABINS
7 x DOUBLE CABINS
TOTAL: 16 PERSONS

TANK TOP



AFT VIEW THROGH MAIN HANGAR/CASING



AFT VIEW FRAME #10

LABORATORIES/SCIENTIFIC STORES/WORKSHOPS LIST:

POS.NO.:	ID:	SIZE:	DECK:
L1	BALLOON FILLING STATION	33m²	4th DECK
L2	GAS STORAGE	10m²	4th DECK
L3	SCIENTIFIC DATA PROCESSING LAB	63m²	3rd DECK
L4	ATMOSPHERIC SCIENCE/METEOROLOGICAL LAB	24m²	4th DECK
L5	CLEAN GENERAL PURPOSE	41m²	1st DECK
L6	WINCH CONTROL CABIN	5m²	1st DECK
L7	CORE SAMPLE STORE	13m²	MAIN DECK
L8	WET LAB/CORE SAMPLE LAB	27m²	MAIN DECK
L9	BIO-CHEMICAL LAB I	32m²	MAIN DECK
L10	DARK ROOM	2m²	MAIN DECK
L11	ELECTRONIC WORKSHOP	8m²	MAIN DECK
L12	BIO-CHEMICAL LAB II	20m²	MAIN DECK
L13	MAIN HANGAR/SUB-SAMPLING ROOM	115m²	MAIN DECK
L14	CTD HANGAR	27m²	MAIN DECK
L15	WET PHYSICAL OCEANOGRAPHIC LAB	24m²	MAIN DECK
L16	DRY PHYSICAL OCEANOGRAPHIC LAB	34m²	MAIN DECK
L17	SCIENTIFIC STORE	75m²	TWEEN DECK
L18	OTHER SAMPLING EQUIPMENT	149m²	TWEEN DECK
L19	SCIENTIFIC FREEZER	16m²	TWEEN DECK
L20	GEOPHYSICS LAB	89m²	TWEEN DECK
L21	GYRO/GRAVIMETER ROOM	10m²	TWEEN DECK
L22	TRANSDUCER CONNECTION ROOM I	7m²	TWEEN DECK
L23	TRANSDUCER CONNECTION ROOM II	20m²	TWEEN DECK
L24	SEAWATER LABORATORY	9m²	TANK TOP
L25	CHEMICAL STORE	6m²	MAIN DECK

EQUIPMENT LIST: ENVIRONMENTAL RESEARCH EQUIPMENT

POS.NO.:	QTY.:	ITEM:	TYPE:	SIZE/CAPACITY:	WEIGHT EXL. WIRE/ROPE:	MAX.PULL:	SUPPLIER:	DRAWING NO.:
W01	1	MULTI-PURPOSE TOWING WINCH	Direct pull	10000m, 18mm Ø wire		25T		
W02	1	CTD WINCH (main hangar)	Direct pull	10000m, 11,43mm Ø cable		8T		
W03	1	DEEP SEA CORER WINCH	Traction winch	8000m, 20mm Ø wire/rope		10T		
W04	1	CTD WINCH (CTD hangar)	Direct pull	10000m, 11,43mm Ø cable		8T		
W05	1	MAGNETOMETER WINCH	Direct pull	5000m, cable		2T		
W06	1	SIDE SCAN SONAR WINCH	Direct pull	5000m, cable		2T		
W08	1	SCIENTIFIC MOORING WINCH	Direct pull	5000m, 6mm Ø rope		2T		

MAIN DIMENSIONS:

LENGTH O.A	89.50	m
LENGTH P.P.	81.00	m
BEAM	18.80	m
DEPTH TO TWEEN DECK	6.80	m
DEPTH TO MAIN DECK	9.80	m
DEPTH TO 1st DECK	12.50	m
DEPTH TO 2nd DECK	15.20	m
FRAME SPACING	600	mm

ACCOMMODATION FOR 60 PERSONS - 25 CREW
- 35 SCIENTISTS

DUAL CLASSIFICATION:

1. IRS ✠ SUL Ha(B)
   ✠ IY, SYJ, DP(2), IBS, EP, TCM
   "Oceanographic Research Vessel"

   AND

2. DNV ✣1A1, E0, ICE-1C, SPS, DYNPOS-AUTR, TMON, CLEAN, NAUT-AW, COMF-C(3)V(3), VIBR, SILENT-A

..OR EQUIVALENT NOTATIONS FROM EITHER LR, BV or ABS

REV:	DESCRIPTION:	DATE APPR:	DATE REV:	SIGN:
01	COMMENTS INCLUDED		18.12.15	TSO
02	COMMENTS INCLUDED		19.02.16	TSO
03	VARIOUS ADJUSTMENTS ACCORDING TO OWNERS' COMMENTS		27.05.16	TSO
04	COMMENTS INCLUDED		13.07.16	TSO
05	COMMENTS INCLUDED		29.09.16	HOH

ORDER: 89.5m OCEANOGRAPHIC RESEARCH VESSEL

YARD NO.: -

FORMAT.: AO

TITLE: GENERAL ARRANGEMENT

SCALE: 1:200

DATE: 07.09.15

SIGN.: TSO

CHECKED: HVL

PROJECT NO.: 2015048

ALTERNATIVE DRAWING NO.:

DRAWING NO.: 15048-101-001-05

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NATIONAL CENTRE FOR ANTARCTIC & OCEAN RESEARCH