UNIVERSITY - NATIONAL OCEANOGRAPHIC LABORATORY SYSTEM

UNOLS FLEET IMPROVEMENT COMMITTEE

Meeting Summary Report

November 9-10, 1999

Monterey Bay Aquarium Research Institute
Moss Landing, CA

UNOLS Fleet Improvement Committee Meeting
November 9-10, 1999
Monterey Bay Aquarium Research Institute

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November 9, 1999

WESTERN FLYER Tour - The Fleet Improvement Committee (FIC) meeting participants convened at 8:30 am at the Monterey Bay Aquarium Research Institute (MBARI), 7700 Sandholdt Rd. Steve Etchmendy led the group on a tour of WESTERN FLYER.

Welcome and Introduction - Following the ship tour, the FIC met at the Moss Landing Chamber of Commerce to hold their business meeting. Larry Atkinson welcomed the Committee and reviewed the meeting agenda, ***Appendix I***. The agenda order was adjusted and the biennial review discussion was moved to the first meeting day. The agenda was followed in the order reported below. Participants of the meeting introduced themselves, see ***Appendix II***.

Accept minutes - The minutes of the November 1998 FIC meeting were accepted as written.

UNOLS Report - Jack Bash provided the UNOLS Report. UNOLS Office will transfer on May 1, 2000 to Moss Landing Marine Lab. Mike Prince will be the new Executive Secretary and Annette DeSilva will remain with the office as Assistant Executive Secretary. Over the past year and a half an external committee selected by NSF reviewed the academic fleet. One of their primary recommendations was to strive for excellence. The committee would like to see increased response for post cruise assessment reporting. This process is now voluntary. We are investigating ways in which to make the form easier to submit as well as more effective.

Jack reported that a UNOLS workshop titled, Developing Submergence Science for the Next Decade, "DESCEND" was held in October. It brought together 120 scientists, engineers, and agency representatives with an interest in submergence science. The focus of the meeting was to define future submergence science directions and identify the vehicles required to meet the future needs.

Jack reported on plans for a UNOLS Winch and Wire Symposium to be held on 30 November to 1 December. There has been a good response to the symposium from industry and technical personnel. Heroes have been selected for six different categories: the four basic science disciplines, one operator and one ocean engineer. A winch and wire questionnaire was distributed to the community. The results of the questionnaires will be used by each hero to compile a two-page issues paper. The symposium speakers will be asked to address these issues. The agenda for the symposium is posted on the UNOLS website. Jack encouraged members of the science community to participate.

Agency Reports:

National Science Foundation (NSF) - Dolly Dieter reported that 1999 was a good year for NSF facilities in terms of the budget. In addition to supporting their ship time requirements they were also able to support training, the Winch and Wire Symposium and the DESCEND Workshop. It appears that 2000 will strain the facilities budget. Presently there is approximately a $5M dollar differential between the projected costs and the budget. In personnel changes, Holly Smith has been hired as a science program assistant in the facilities section. Don Heinrichs will retire in the end of the year. A program assistant for Dolly has not yet been hired.

There was a question on the status of the NSF Ship Inspection process. Dolly reported that they are still defining the specifications for the contract.

Office of Naval Research (ONR) - Sujata Millick reported that ONR is also facing budgetary challenges. Navy ship time support is approximately $15M. The Navy will accept DURIP proposals for technical support. ONR is encouraging the community to apply for this support.

The question was asked how ONR plans to inspect the AGORs. Sujata reported that they are looking at this issue. They are considering a combination of the INSURV and science inspection.

Sujata reported that the Navy has approval to transfer MOANA WAVE to an organization in Alaska. The ship will be run primarily for training.

National Oceanic and Atmospheric Administration (NOAA) - A representative from NOAA was not present. Jack reported that UNOLS and NOAA have readopted the UNOLS/NOAA-OAR Memorandum of Understanding (MOU). A similar MOU has been drafted for the National Marine Fisheries Service (NMFS) and UNOLS. It is being circulated through NMFS and is expected to be reviewed favorably. Jack reported on the AMLR program. The original NOAA solicitation for an AMLR support vessel was awarded to a Russian ship. UNOLS had little time to respond to the solicitation. The first award has expired and a second solicitation is in progress.

UNOLS was given sufficient notification and a joint proposal was submitted by Scripps Institution of Oceanography (SIO) and Woods Hole Oceanographic Institution (WHOI). The proposal cost exceeded NOAA's budget and NOAA opened the solicitation commercially. WHOI and SIO again responded, but were disqualified because the commercial solicitation indicated that the proposal must include a liquidated damages clause. WHOI and the University of California cannot legally comply with this requirement. One of the reasons that the original proposal costs were high was because transit costs to the Antarctic were included. FIC suggested that if the community were aware of these transits well in advance, the legs would have a high potential of being used to support science. UNOLS could assist in this type of regional planning. It was also noted that by adding a fisheries capability to KNORR/MELVILLE the ship would likely attract additional users.

John Freitag reported that the UNOLS/NOAA-OAR MOU has had a very positive affect in collaborations. At the 1998 RVTEC meeting, Dennis Shields of NOAA offered information on their system for data collection. RVTEC was very interested in this and there has been continued sharing of information.

United States Coast Guard (USCG) - Phil McGilliavary gave the report for the USCG. A written report from CDR Wheeler is provided as ***Appendix III***. HEALY builder's trials were conducted in August and pre-acceptance trials were performed in October. The final delivery is planned for 9 November. Science trials are scheduled to begin in January and continue through June 2000. The ship is expected to be ready for science operations in spring 2001. The ship will do ice trials near Baffin Island and in the eastern Arctic. Transit to it to the ship's homeport in Seattle will be via the Northwest Passage.

Phil continued with a report on the science of opportunities and operations planned for POLAR SEA and POLAR STAR. Improvements to the POLARs include upgrading the e-mail system and other improvements to communication systems. They are also experimenting with a whale avoidance system.

Academic Fleet Review Recommendations and FIC's Directions for the Future - Dolly Dieter provided the report on the Academic Fleet Review recommendations. Her viewgraphs are included as ***Appendix IV***. The overall finding and recommendation of the report is that the UNOLS system is good and science access to the sea is being provided. The system should be maintained, but we should strive for excellence. Emphasis needs to focus on technical support improvements. The findings and recommendations of the review are outlined below:

Principal Findings:

- Current practices provide excellent access to the sea for U.S. researchers
- UNOLS services are meeting community needs and costs are comparable to other government and commercial operators.

Recommendations:
- The UNOLS system should be retained.

Programmatic findings:
- Potential for a near-term period of reduced use of UNOLS fleet by NSF grantees.
- Need for a strong continuing program for technology introduction, improvement of existing capabilities, and a more systematic approach to maintenance and upgrades.
- Need to enhance quality control, training and safety procedures, and to develop even higher standards for shared use facilities.

Recommendation:
- Launch a significant campaign to upgrade and strengthen the fleet to prepare for increasing technological sophistication and improve future productivity and quality of fleet operations.

Operational findings:
- Continue practice of competing the management of the UNOLS Office.
- Needs for specialized capabilities are met in special circumstances from outside the UNOLS system.

Recommendations:
- Use a cooperative agreement for support of the UNOLS Office to ensure necessary management oversight.
- Consider a trial including some commercial ship operators as UNOLS non-member operators to provide unique fleet capabilities.

Planning findings:
- Ocean scientists must assess the future needs and opportunities of the field to establish priorities. A broad vision is essential to anticipate future fleet requirements.
- Federal agencies must improve long range planning for facilities with twenty to thirty year life spans, that is beyond the scope of NSF and UNOLS alone.

Recommendation:
- NSF must accelerate and expand efforts to articulate a broadly based vision for the future of ocean science and technology.
- Federal agencies sponsoring research in oceanography should develop a long-range plan for modernization and composition of the oceanographic research fleet that reaches well into the 21st century.

Dolly reported on the NSF actions underway in response to the review. Initial actions include:

- Developing new cooperative agreements for ship operators, with increased emphasis on quality control and standards.
- Revising guidelines for management of shared use instrumentation to improve technology.

- Sponsoring workshops focussed on emerging technology and specialized capabilities.

In response to the recommendation to develop a long-range plan for the oceanographic fleet, NSF, ONR and NOAA plan to develop a cooperative plan in partnership. This is beyond the scope of NSF and UNOLS acting independently. NSF will take the lead in this effort with strong support from the Navy and NOAA.

Dolly reviewed the framework of the Long-Range Plan. The report should provide an overview of the fleet through 2030. They will focus on the next ten years with integrated assessments of science trends, ship capabilities and capital requirements. They expect that the document will be of modest length, 10 to15 pages. They would like to have the plan in place within the next eight months.

Larry Atkinson asked Dolly what the role of FIC would be in this activity. Dolly indicated that it would be useful for FIC to look at the future of the Fleet and try to determine the science capabilities that will be needed. They should try to identify the types of ships that will be needed for observations, ROV and AUV support, etc. However, Dolly indicated that the agencies need to take the lead in development of the long-range plan.

AGOR 26 Status Report - Sujata Millick began the AGOR 26 status report by announcing that the contract for construction of the ship has been signed. Lockheed Martin representatives gave a brief history of the program. A summary report titled "AGOR 26 SWATH Oceanographic Research Ship - Final Phase I Concept Design" was provided to meeting participants prior to the meeting and is enclosed as ***Appendix V***.

In January, Atlantic Marine Industries (AMI) was selected as the shipyard. The construction process will be an integrated process with Lockheed/Martin and AMI working together. The SWATH AGOR program master schedule was reviewed. As a first step they will be working with ABS to determine the approach for classing the vessel along with its approval process. They hope to establish an MOU with ABS. There will be an integrated master schedule between the shipyard and the naval architect. There will also be model testing to look at resistances. The load analysis for the ship will rely on previous model testing.

Tests and trials are planned after ship construction. Delivery is planned 23 months from the start of construction. AMI offered the shortest construction time since they work double shifts. The Navy is using a new process (A45) for procuring the ship. There will be no INSURV and no SUPSHIP activities during construction. The yard will be paid based on milestones and performance. Design modifications will need to be integrated into the design. On-site representatives from the Navy will have a dollar limit that they can authorize for design changes. No major changes are planned at this time. In the first two months there may be latitude for changes.

The report continued with a technical update. Originally, the AGOR 26 construction portion of the program was budgeted at $36M. It was soon learned that it would not be feasible to build a ship to meet the mission requirements and stay within the budgeted $36M. They were faced with the choice of either downsizing the ship or eliminating the equipment. Instead, additional funds for construction were requested and are likely to be awarded. All construction costs in excess of the $36M will be included as options to the contract. The ship was designed in consideration of adding these options. If the additional funds become available, the options will be exercised.

The design operational capabilities were reviewed, see ***Appendix V*** for details. The ship includes 68 tons of fixed equipment and 100 tons of variable load. The ship can accommodate a science party of 31. Crew size will be either 16 or 17.

Robert Hinton continued the report with a description of the ship's deck arrangements. These figures are included in ***Appendix V***. He noted that they are still examining ladder locations in an effort to add space to the labs. Passageway locations are not as optimal as desired, but are necessary to maintain the bulkheads. On the 01 level a working deck has been added. The standard shipload includes one drum of wire for the winch. If a scientist wishes to carry another wire, the weight will be applied to the science payload.

At the last FIC meeting there was concern over the ADCP selection. There was discussion on whether to install a newly introduced ADCP requiring a large space aboard the ship. A decision has been made to install a traditional system, but hold space available for the new ADCP. Overall, the ship's arrangements have not changed much since the last meeting, but some of the requested improvements have been incorporated.

Joe Coburn noted that in the AGOR 23, 24and 25 project there were funds for correction of deficiencies after delivery. This is not the case for the SWATH. It is hoped that deficiencies can be identified and corrected during the construction with throughout the process between the builder, the naval architect and the U.Hawaii on-site rep. If any one wishes to comment on the AGOR 26 design, they should send the information to Robert. Larry noted that this process will likely be the way of the future, we need to determine how to most effectively interact during the process in the future. Pete Kilroy (NAVSEA) noted that Robert is the on-site rep and he is there to provide continuous review and input. Robert writes weekly reports that are in the vault and can be commented on.

The ship's maneuvering system. The goal was to design the vessel to maintain station in 47 knots of wind. They wanted the ship to be able to turn through the winds. The ship was designed for a towing capability of 10,000 lbs. at 3 knots. The design includes a fixed pitch propulsion with forward azimuthing thruster and aft rudders. Various propulsion systems were examined and a tradeoff study was performed. The selected propulsion drive is electric with a 3-Megawatt capacity. The propellers are 11-ft diameter with 5 highly skewed blades. The rudders are located aft of the propellers.

The SWATH AGOR seakeeping performance was one of the most important design parameters. The goal was for the ship to be fully operational in upper Sea State 6 in best heading. The MIT WAMIT computer code was used to analyze seakeeping. At high SS6, pitch exceeded the goal which means that it would require large stabilizers. At low SS6, it was within the goal. At the completion of phase I, the ship meets all motion criteria with the exception of the 3 degree pitch requirement at zero speed. Additional review will be performed in Phase II to determine if more improvement can be achieved.

The ship characteristics were reviewed. The length overall is 182 feet and draft is 25 feet. Four endurance cases were analyzed with varying drafts, fuel loads and hotel loads. The desired range of 10,000 could be met if needed with the ship configured appropriately. Weights are critical for this vessel and they were still being studied. Large cargoes cannot be easily accommodated on SWATHS. Equipment for follow-on cruises will need to be shipped to port calls rather than carried aboard ship from cruise to cruise.

The Role of FIC in development of New Ships and Refits - There was a discussion continued on the role of FIC in development of new ships and refits. In many cases it will be the responsibility of the individual institution to initiate and carry out replacement plans and refits. These institutions should interact with UNOLS throughout the effort and seek community input. It was suggested that FIC issue guidelines for institutions on the proper path to follow in replacement planning. FIC should continue in their role of defining the science needs of the ships. RVOC deals with operations and RVTEC deals with technical issues. The FIC is the body that should be looking at science facility needs. Institutions are encouraged to interact with FIC. FIC is the link with the science community and should be a reference source. There was a discussion on how to approach fleet planning: There appears to be a few overlapping and conflicting roles. These roles include a pro-active role (e.g. Intermediate/regional ship planning), a gatekeeper to filter information to the community, and the role of collaborator. FIC should continue in their efforts of SMR development. It was suggested that a plan outlining FIC's role be developed. Larry, Jack, and Annette will draft a plan.

The UNOLS Biennial Review of Sea Going Oceanographic Facilities - Larry reviewed the topics of the Review document, see ***Appendix VI***. Authors and suggestions for authors were identified for the various sections. The document is posted on the UNOLS website. The first section addresses future research and systems. The Brewer/Moore report, which will synthesize the NSF Futures workshops, can be used to define future research requirements. "Future observing system needs and possibilities" is another topic in this section and John Delaney and Keir Becker were suggested as authors. The section on "General Information on the UNOLS Fleet" is subdivided into the following topics:

- State of the fleet and trends in fleet Use - Atkinson, DeSilva, Bash, Prince, Pittenger
- Historical perspective of fleet replacement and expansion - UNOLS Office and past Chairs
- New Assets - Chris Measures
- Trends in support of Research Vessels

The next section, "Specific Topics - new Types of Vessels" included the following topics and authors:

- Icebreakers – Jim Swift
- Seismic Vessels - Paul Ljunggren and John Diebold
- SWATH Vessels - Joe Coburn

Another section titled, "Impact Mission" includes the following topics and suggested authors:

- ROV's - Dana Yoerger
- AUVs - Jim Bellingham
- Ocean Observatories - Larry Clark, Dunneuber, Alan Chave
- Arrays (TOGA)

The Fisheries and Hydrographic Surveying section included the following topics:

- Fisheries surveys - Ned Cokelet, Caillet (MLML), Love (UCSB)
- Design Aspects - Tom Althouse
- Hydrographic Surveys - Sam DeBow

The final section of the report addresses "Technical Issues" and includes the following topics:

- New Regulations - Joe Coburn
- Shore Side Technical Support - John Freitag
- Ship supported technology - John Freitag

There was discussion on the goals of the report. The Goals are outlined at the beginning of the document, see ***Appendix VI***. The report can help to compare today's fleet with the capabilities needed in future facilities. The report will also stimulate the community to identify other tools that are not currently available.

East Coast Science Mission Requirements (ECSMR)- There was a discussion on how to proceed with the ECSMRs. The ECSMRs were drafted but need additional information. Larry requested that Annette attempt to update the SMRs and pass them to Mark Brzezinski and Dave Hebert for review.

Ship Design/Construction Project Updates:

CALANUS Replacement - The CALANUS replacement vessel is well into the construction phase. Delivery is anticipated in early 2000. The ship is a catamaran design.

Day Two - November 10, 1999

CAPE HENLOPEN Replacement Plans- Matt Hawkins (U.Delaware) reported on Delaware's plans for replacement of CAPE HENLOPEN. His viewgraphs are included as *Appendix VII.* Matt began by showing a map of the East Coast of the U.S. with the routine CAPE HENLOPEN operating area highlighted. Next he reviewed the preliminary time line for replacement planning and construction. The University of Delaware will provide financial support to begin the process. In 2000, the SMRs will be developed and conceptual design will begin. Preliminary design is planned for 2001with spec/bid/verify in 2002. Final design development is scheduled to begin in 2003. Construction is scheduled to begin in 2004 with delivery at the end of 2005.

The University of Delaware's Ship Advisory Committee (SAC) will establish a Delaware Research Vessel Review Committee (DRVRC). The DRVRC will be composed of sea-going scientists from the mid-Atlantic which represent CAPE HENLOPEN's normal user base. The Committee will be selected such that multiple disciplines in oceanography are represented. It will include users, another ship operator, and representatives from principle funding agencies. The committee will include approximately ten persons. Documents and plans proposed by the DRVRC will be presented to FIC for review. Matt showed a flowchart of the R/V design process. The process includes design and review iterations by DRVRC, FIC, and naval architect. He reviewed a table of the project tasks along with the responsibilities of the DRVRC, FIC, Marine Ops Naval Architect, and shipyard during each task. The tasks include SMR, concept design, preliminary design, spec/bid and verification, final design, and construction. There was some discussion on the role of FIC in this process. The FIC agreed with the process and their role as defined by the Delaware committee. They recommended that a fisheries capability for the ship be considered. It was also suggested to include ROV users in their planning stage. U.Delaware would like to have the SMRs in place by July 1st with a draft to FIC by May. This is a tentative plan.

WHOI SWATH - Joe Coburn reported on the status of WHOI SWATH design effort. His viewgraphs are included as *Appendix VIII*. At the last meeting, FIC recommended that this vessel be designated as a UNOLS Vessel. Joe reviewed the characteristics of the ship and the design process. A group of likely users were brought together on a number of occasions for input and design review. The design concept applies the SemiSWATH™ Concept with a variable draft and tandem strut. The design process includes conceptual and preliminary design development with user input, an independent review, model tests, finite element modeling, dynamic load analysis and ABS review. Model tests will examine resistance, speed and power, structural prying and squeezing loads, slamming structural loads, and seakeeping. Joe provided an illustration of the SWATH. He showed charts comparing the expected roll in a seaway for OCEANUS and the SWATH as well as the expected pitch in seaway. The SWATH performs better than OCEANUS and meets the SS4 design limit.

The ship's design calls for a length overall of 105 ft, which is similar in size to WESTERN FLYER. The beam is 51.5 ft. The operating draft is 13.6 ft and the transit draft is 9' 6". Joe showed the outboard profile and the main deck arrangements. The lab is almost the same size as OCEANUS and the main deck is a bit larger. It appears that this ship may be more comparable to OCEANUS in its capabilities than originally planned. The main limitations of the SWATH is the variable payload and the fewer bunks (OCEANUS has 18 berths and the SWATH has 12). WHOI has drafted deck layout options for buoy deployment. One of the major differences between OCEANUS and the SWATH is that OCEANUS can take four buoys while the SWATH can only carry one. WHOI also studied aft deck layouts for varying operations. WHOI is considering a transducer sword.

In assessing the design, WHOI feels their goals have been met. They are still looking at the manning requirements. They would like to operate with a crew of four and possibly six for longer offshore cruises. WHOI is working with the USCG on this issue. They are also looking into ABS and SOLAS requirements. Some of these requirements may have weight and cost implications.

WHOI is raising funds to support the ship's construction. Their goal is to raise $10M. Construction is estimated at about $7M. Model tests and model building have already been paid for. WHOI also paid Glosten to develop the model tests and oversee them. The question was asked about the comparison of the cost between a monohull and the SWATH. It seems that the construction cost of the SWATH is a bit higher for the same size monohull, but the capability of the SWATH is better in the intended application. It is a difficult comparison to make. There was a general discussion on whether FIC should be encouraging more SWATHS. The limitations of the design need to be recognized, such as, flexibility.

NOAA Fisheries Vessel Update- The status of the NOAA Fisheries RV which was presented at the RVOC meeting earlier in the month was reviewed. Hull and propeller model testing have been completed. NOAA issued an RFI to industry in July. NOAA is waiting for an appropriation for construction. They hoped to issue an RFP this month once the appropriation is received. They would like to make an award for construction by May 2000. The first ship is slated for Alaska and is scheduled to come on-line in 2003. The current plan calls for FRV-2 to be assigned to the Northeast coast and will come on line in 2004/5. Plans call for FR-3 to be assigned to the west coast and is scheduled to come on-line 2005. FRV-4 would be assigned to the Gulf of Mexico and come into service in 2006.

ALPHA HELIX Replacement - There were questions about replacement plans for ALPHA HELIX and GYRE. Plans are unclear at this time and no report was provided.

Near and Long-Term FIC Agenda - Various FIC activities were reviewed:

1. The role of FIC in new ship and overhaul design needs definition.

2. Membership - Larry reviewed the current FIC membership. It was suggested that a representative from the Gulf of Mexico be added to the Committee. We also need to review participation by Alaska on FIC.

3. Next Meeting - It was suggested that FIC's next meeting be aboard HEALY, perhaps during it's transit from Norfolk to Baltimore in March. Annette will contact the Coast Guard to request permission.

The meeting adjourned at 10:30.

Immediately following the meeting, FIC was invited to ride MBARI's SWATH vessel, WESTERN FLYER, in Monterey Bay.

Appendix I

Fleet Improvement Committee
Monterey Bay Aquarium Research Institute
November 9-10, 1999

Tuesday, November 9th

9:00 am **WESTERN FLYER tour** – Please convene at MBARI, 7700 Sandholdt Rd for the tour.

10:00 am **FIC Welcome and Introduction** - Larry Atkinson will welcome the Committee and review the meeting's agenda. The FIC meeting will be held at the Moss Landing Chamber of Commerce Building, 8071 Moss Landing Rd (a 5-minute walk from the ship).

10:10 am **Accept Minutes** - Accept the minutes of the November, 1998 FIC Meeting.

10:15 am **UNOLS Report** – Jack Bash will report on UNOLS activities over the past year and plans for the future.

10:30 am **Agency Reports** - NSF, ONR, NOAA, and USCG representatives will provide agency reports.

11:00 am **Academic Fleet Review Recommendations and FIC's Directions for the Future** – Dolly Dieter will provide a review of the recommendations from the Academic Fleet Review. Larry Atkinson will discuss the role and future directions of FIC.

12:00 pm **Lunch Break**

1:00 pm **AGOR 26 Status Report** – A report on the AGOR 26 Phase I Status will be provided by Navy and Industry representatives.

There will be an afternoon break.

5:00 pm **Adjourn Day 1 Business**

Wednesday, November 10th – **MBARI Harbor Conference Room**

8:30 am **The UNOLS Biennial Review of Sea Going Oceanographic Facilities** – Larry will review the report outline, timelines, and status. Assignments will be discussed.

10:30 am **East Coast Science Mission Requirements (ECSMR) Committee Report** – Development of the ECSMR has been stalled. Larry Atkinson will discuss any follow-up activities.

10:45 am **Ship Design/Construction Project Updates:**

- **CAPE HENLOPEN Replacement Plans** – Matt Hawkins will discuss plans and strategy for replacement of CAPE HENLOPEN.

- **NOAA/National Marine Fisheries Service Update** - A status report on NOAA's Fishery Research Vessel Construction project.
- **ALPHA HELIX Replacement Plans** - Tom Weingartner will report on the University of Alaska's plans for replacing ALPHA HELIX.
- **R/V SAVANNAH** - Report on the status of Skidaway's replacement vessel SAVANNAH.
- **CALANUS Replacement** - Report on the construction status of U.Miami's replacement of R/V CALANUS.
- **WHOI SWATH** - Joe Coburn will report of the status of WHOI's plans for construction of a regional SWATH vessel.

There will be a morning break.

11:45 am **Near and Long-Term FIC Agenda** - The committee will discuss FIC agenda items and assign tasks.

12:15 pm **General Business**

- Review of FIC Member Terms
- Scheduling of Next Meeting
- Recap of FIC Action Items

Adjourn FIC Meeting
WESTERN FLYER Cruise

FIC Members will have an opportunity to ride aboard WESTERN FLYER on the afternoon of November 10, 1999. Steve Etchemendy, MBARI, will host a reception (snacks provided, cash-bar) at the Whole Enchilada restaurant starting at 5:00 pm following the cruise.

Appendix II

FIC - Nov. 9-10, 1999

NAME	INSTITUTION/ORGANIZATION	PHONE/FAX/E-MAIL
Jack Bash	UNOLS	401-874-6825/401-874-6167/unols@gso.uri.edu
Mark Brzezinski	UCSB	805-893-8605/805-893-8062/brzezins@lifeoi.ucsb.edu
Joe Coburn	WHOI	508-289-2624/508-540-8673/jcoburn@whoi.edu
Annette DeSilva	UNOLS	401-874-6825/401-874-6167/unols@gso.uri.edu
Dolly Dieter	NSF	703-306-1577/703-306-3040/edieter@nsf.gov
John Freitag	URI	401-874-6579/401-874-6578/jfreitag@gso.uri.edu
Matt Hawkins	U of Delaware	302-645-4341/302-645-4006/hawkins@udel.edu
Dave Hebert	URI	401-874-6710/401-874-6728/hebert@gso.uri.edu
Robert Hinton	U of Hawaii	904-329-3263/rmhinton@bellsouth.net
Ken Johnson	MBARI	831-775-1985/831-775-1620/johnson@mbari.org
Pete Kilroy	Naval Sea Systems Command	703-602-3511/kilroypm@navsea.navy.mil
Steve Madden	NOAA/NAVSEA	813-828-8929/stephen.madden@noaa.gov
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Bill Smethie	LDEO	914-365-8566/914-365-8155/bsmeth@ldeo.columbia.edu

Appendix III

McGillivary, Philip

From: Wheeler, Stephen CDR
Sent: Friday, November 05, 1999 1:34 PM
To: 'Berkson, Jonathan'
Cc: McGillivary, Philip
Subject: RE: USCG Agency Report for UNOLS FIC

Importance: High

UNOLS FLEET IMPROVEMENT COMMITTEE
Coast Guard Agency Report
9 November 99

USCGC HEALY Update

Avondale Industries conducted builder's sea trials in the Gulf of Mexico with HEALY on 23-30 August and pre-acceptance trials on 11-13 October. Final delivery is anticipated for 9 November 99. Machinery/hull and science trials are planned for mid-January to June 99. The members of the AICC and RVTEC have been major players in the planning of these tests and the Coast Guard is highly appreciative of their efforts. Following warm water testing in the Gulf of Mexico, the Ice trials are planned for an area near Baffin Island in the eastern Arctic. After completion of the trials, HEALY will return to Seattle by transiting the Northwest Passage. The formal commissioning will probably be in September 2000. HEALY's first unrestricted science cruise is scheduled for early spring of 2001.

POLAR Class Update

POLAR SEA sailed for Operation Deep Freeze in the Antarctic in early November '98, then went straight to the Arctic for a funded spring science mission in the area of the St. Lawrence Island polynya. They returned to Seattle in mid-May '99. POLAR SEA is now undergoing phase two of their four phase "Reliability Improvement Project" in Todd Shipyard, Seattle. They will complete this work late this month, then move to the Coast Guard piers and continue maintenance until late March, when they will again start preparing for full operations. After POLAR SEA is available (early June), we will run a combination shakedown and science of opportunity (SOO) cruise. They will return to Seattle in late July or early August to prepare for the 6-month Antarctica mission commencing November 2000.

POLAR STAR departed Seattle for Antarctica on the second of November, for the annual science support and resupply mission to Antarctica (Operation Deep Freeze 2000). They have a fairly heavy science load this year. On the way in to McMurdo, POLAR STAR will be conducting katabatic wind studies, automatic weather station work (including new station insertions and repairs to established ones), will participate in the International Trans-Antarctic Expedition (ITASE) conducting climate and environmental change studies, will launch drifter buoys for NOAA and Lamont-Doherty, and will continue ongoing biology studies related to penguin populations, habits and habitats.

They are scheduled to arrive at McMurdo just after Christmas, and will immediately begin the standard logistics missions, such as opening the channel and pier, remote station refueling, and conducting resupply-ship escorts.

On the return trip in February, they will support an extensive Antarctic Pack Ice Seal study (called APIS), before returning to Seattle in mid-April. Following a month or two inport, POLAR STAR will also be available for summer Arctic operations. The Coast Guard is seeking interest for dedicated science support for this deployment.

USCG-NSF Memorandum of Agreement

In May, the Coast Guard and National Science Foundation signed a revised MOA for use of Coast Guard icebreakers for Arctic and Antarctic projects supported by NSF. The document is a vast improvement over the outdated version it replaced and formalized a variety of responsibilities and practices that had evolved over the years. A key point was that the incremental reimbursement agreement was maintained essentially unchanged. It calls for NSF to pay all fuel costs and a surcharge for helicopter and ship maintenance costs.

Appendix IV

The Academic Research Fleet Review: Committee Membership

Roland Schmitt, Chair

Earl Doyle, Steven Ramberg, Hugo Bezdek, Christopher D'Elia, Ellen Druffel, Larry Mayer, Georges Weatherly

Charge from Assistant Director, Geosciences

- **Review and evaluate the current Academic Research Fleet**
- **Review and evaluate management structure, existing capabilities and services and possible future changes**
- **Recommend actions to improve the organization, management and cost effective operation of the fleet**

Academic Fleet Review Report

"The goal of any research facility should be to find the optimum path to satisfy the needs of the research enterprise."

<u>Major themes</u>

- ➔ UNOLS system should be retained with increased emphasis on science support and continuous quality improvement
- ➔ technology and facilities support requirements for science programs continue to evolve and modify patterns of use of research vessels, including need for special capabilities from non-UNOLS institution ships
- ➔ capability, reliability, and technical support for shared-use shipboard systems are major user concerns
- ➔ quality-based systems for ship operations, instrumentation support, and technical services should be adopted fleet-wide, along with rigorous evaluations of performance
- ➔ entire UNOLS and operator system needs to be infused with an orientation toward continuous improvement and formal quality control programs
- ◆ ***UNOLS appears to be a well-suited vehicle to institute and evaluate such efforts in conjunction with the federal agencies.***

Academic Fleet Review

Principal Findings:

- Current practices provide excellent access to the sea for U.S. researchers
- UNOLS services are meeting community needs and costs are comparable to other government and commercial operators.

Recommendation:

- The UNOLS system should be retained.

Academic Fleet Review

Programmatic findings:

- Potential for near-term period of reduced use of UNOLS fleet by NSF grantees
- Need for strong continuing program of new technology introduction, improvement of existing capabilities, and more systematic approach to maintenance and upgrades
- Need to enhance quality control, training and safety procedures, and develop even higher standards for shared use facilities.

Recommendation:

- Launch a significant campaign to upgrade and strengthen the fleet to prepare for increasing technological sophistication and improve future productivity and quality of fleet operations.

Academic Fleet Review

Operational findings:

- Continue practice of competing the management of the UNOLS Office
- Need for specialized capabilities are met in special circumstances from outside the UNOLS system

Recommendations:

- Use a cooperative agreement for support of the UNOLS Office to ensure necessary management oversight.
- Consider a trial including some commercial ship operators as UNOLS non-member operators to provide unique fleet capabilities.

Academic Fleet Review

Planning Findings:

- **Ocean scientists must assess the future needs and opportunities of the field to establish priorities. A broad vision is essential to anticipate future fleet requirements.**
- **Federal agencies must improve long range planning for facilities with twenty to thirty year life spans, beyond the scope of NSF and UNOLS alone.**

Recommendations:

- **NSF must accelerate and expand efforts to articulate a broadly-based vision for the future of ocean science and technology**
- **Federal agencies sponsoring research in oceanography should develop a long range plan for modernization and composition of the oceanographic research fleet that reaches well into the 21st century.**

Ocean Sciences Actions:

Agree implementing Committee recommendations will enhance operations of the academic research fleet.

<u>Initial actions</u>

- ➔ **Developing new cooperative agreements for ship operators, with increased emphasis on quality control and standards.**
- ➔ **Revising guidelines, reviews and management of shared-use instrumentation to improve technology.**
- ➔ **Sponsoring workshops focused on emerging technology, specialized capabilities and improvements to basic systems.**
- ➔ **Recompeting UNOLS Office award as a cooperative agreement.**

<u>Developing actions</u>

- ➔ **Acceleration and expansion of science planning activities**
- ➔ **Long range planning for the modernization and composition of the fleet**
- ➔ **Trial participation of commercial operators to provide unique capabilities**

Academic Fleet Review Recommendation Long-range Plan for the Oceanographic Research Fleet

"The federal agencies funding research in oceanography should prepare and maintain a long-range plan for the modernization and composition of the oceanographic research fleet that reaches well into the 21st century."

"This is clearly beyond the scope of NSF and UNOLS acting independently. However, by virtue of its dominant funding role for the Academic Research Fleet, NSF should lead the effort with strong support from the Navy and NOAA."

Comment: NSF, ONR and NOAA plan to develop a cooperative plan in partnership.

LRP Scope and Procedures

-Definition of oceanographic research fleet addressed
e.g. UNOLS and NOAA research and fisheries ships

-Resource models for science funding and operations
e.g. Federal budget projections, other users, other

-Capitalization model
e.g. Federal role vs. institutional responsibilities

-Assessment parameters for science and operations requirements
e.g. Capabilities, distribution, upgrade/replacement timing, etc.

-Community input vs. federal managers
e.g. Reports, consultations, analyses

-Management model
Agency procedures to "certify" additions and deletions from research fleet

LRP Framework and Product

Outline

-Develop overview of research fleet through 2030. Focus on next 10 years with integrated assessments of science trends, ship capabilities and capital requirements.

Content

-Science-driven
Assessment of future ship usage trends from science directions and funding.

-Comprehensive
Analysis/recommendations to meet major needs of federal agencies using oceanographic research fleet.

-Resource-based requirements
Projected sponsor resources for sea-going research.

Overall goal

-Modest length document (10-15 pages) with agency goals, approaches and assessments clearly stated.

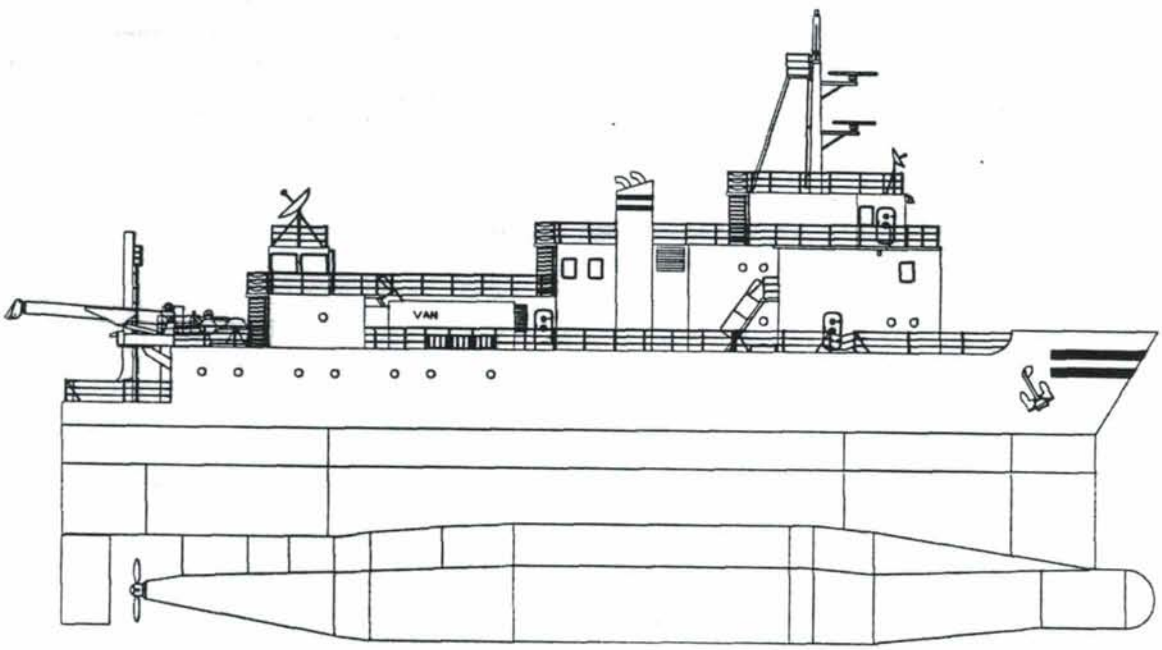
-Identification of action steps for next five years (and general procedures for updates, re-assessments, etc.)

-Completion of report in 6 to 8 months with information to other agencies via FOFCC.

Appendix V

AGOR 26
SWATH OCEANOGRAPHIC RESEARCH SHIP

FINAL PHASE I CONCEPT DESIGN



Prepared by
Office of Naval Research
Naval Sea Systems Command

October 1999

Table of Contents

1.0 Introduction and Background

This report provides a brief summary of the AGOR 26 SWATH oceanographic research ship design as it exists at the completion of Phase I on 10 March 1999. The AGOR 26 is scheduled to come on line in 2001 and will replace the R/V MOANA WAVE.

The Office of Naval Research (ONR), interacting with representatives of the academic research community and the Oceanographer of the Navy (N096), approved the Desired Operational Capabilities (DOC) for the AGOR 26 on 17 Nov 97, (Enclosure 1). The DOC describes the ship capabilities that are desired by the oceanographic community in order for the ship to perform its intended mission. Joint Industry-Government Integrated Product Teams (IPTs) worked to optimize desired ship capabilities within program budget.

The Operational Capabilities (OC) document, which describes the capabilities the ship is expected to achieve, was approved by the Oceanographer of the Navy on 14 July 1999, (Enclosure 2). The Phase II, Detail Design and Construction Agreement is expected to be awarded to Lockheed Martin in October 1999. The AGOR 26 will be constructed at Atlantic Marine Industries (AMI) located in Jacksonville, FL. LM has selected Guido Perla and Associates (GPA) as the design agent for the Phase II Detail Design and Construction.

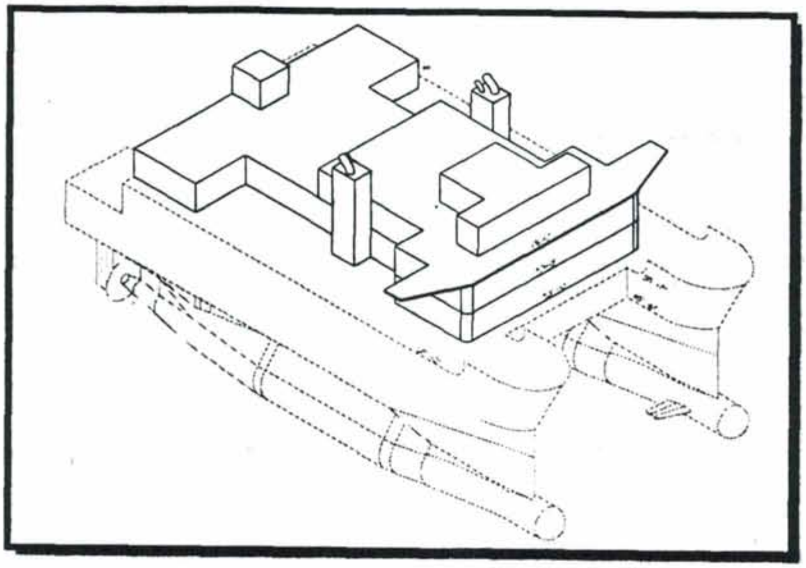
The University of Hawaii School of Ocean and Earth Science and Technology was competitively selected to operate the AGOR 26 in January 1998. After a competitive solicitation, Lockheed Martin Corporation (LM) was selected on 05 May 1998 to head the Industry Team for the Phase I effort. Below is a comparison of the Desired Operational Capabilities to the Phase I Concept Design.

Desired Operational Capabilities	**Phase I Design Capabilities**
• Fully operational is SS6 all headings	⇨ Fully operational in SS6 at all headings at 14-15 Knots. Operational in best heading on station
• Working Deck Area 2,000 sq ft	• Working Deck Area 2,000 sq ft
• Station Keeping +/- 50m in 6m seas	• Station Keeping +/- 50m in 6m seas
• Science payload of 100 tons	• Science payload of 100 tons
• Laboratory Area over 3,000 sq ft	• Laboratory Area over 3,000 sq ft
• Science Staff of 25 plus crew	⇨ Science Staff of 31 plus crew
• Speed of 15 Knots	⇨ Sustained speed of 15 Knots; survey speed of 12 Knots
• Endurance of 50 days at sea	• Endurance of 50 days at sea
• Range of 10,000 NM	⇨ Range of 10,000 NM at 11 Knots
• Scientific Stowage for 15,000 cu ft in below deck storerooms	• Scientific Stowage for 15,000 cu ft in below deck storerooms

2.0 Mission

The AGOR 26 is designed to perform general purpose oceanographic research in coastal and deep ocean areas. The ship will be capable of performing the following tasks:

- Sampling and data collection of surface, midwater, and sea floor parameters
- Launch, towing, and recovery of scientific packages, both tethered and autonomous, including the handling, monitoring, and servicing of ROVs and AUVs, deep sea moorings, and boats
- Shipboard data processing and sample analyses
- Precise navigation and station keeping and track-line maneuvering to support deep sea and coastal operations
- Long periods of operation at low speeds



3.0 Principal Characteristics

Dimensions:	
Length Overall	182 FT
Strut Length	172 FT
Lower Hull Length	171 FT
Beam	88 FT
Depth to 01 Level	50 FT
Draft at Load Line	25 FT
Displacement:	
Full Load	2,500 LT
Lightship	1,961 LT
Performance:	
Speed	15 Knots
Range	10,000 NM at 11 Knots
Endurance	50 Days

Certifications:	
ABS	✠A1 circle E, ✠AMS, ✠ACCU UWILD (underwater inspection in lieu of drydocking) unrestricted service Ice Class D0
USCG	Oceanographic Research Vessel (Subchapter U)
Accommodations	48 persons (17 crew)
Tons/inch	4.2

4.0 Mission Analysis

The overriding goal of the design team was to develop a ship with the most effective mission performance for the given program budget. To achieve this end, the design team worked closely with scientific personnel to determine the types of scientific research expected to be performed by this ship. Eleven typical mission scenarios were developed which reflect the types of research performed by the University in the past and expected to be performed in the future. Operational parameters were developed for each including speed-time profile, total days at sea, steaming range, number of personnel required, mission equipment required, space and weight requirements of equipment, and acoustical requirements. A systems engineering approach was used to assess the ship impacts of each mission and determine the minimum size of ship to perform the mission. As part of the analysis, the speed time profiles were varied to determine the benefits that could be gained by increasing or decreasing the ship's speed. Predictably, the longest range missions have the effect of forcing the ship size to be larger because of the increased fuel load required. The analysis also showed that most of the mission parameters are fairly constant for different missions with the exception of range. The following tables show the parameters assumed for the eleven missions and the various mission equipment required and its characteristics. A 100 long ton portable payload is assumed for all missions per the DOC. Portable payload is defined as mission-unique items of equipment that are not permanently built in the ship. Balance of 100 LT payload is held in reserve.

Mission Description	Low Spd Kts	Low Spd Days	Med Spd Kts	Med Spd Days	High Spd Kts	High Spd Days	Total Mission Days	Total Range NM	No. of Crew	No. of Pass	Portable Payload Required LT	Reserve Payload Available LT	Total Portable Payload LT
• HOT quarterly cruise with mooring	1	5	8	8	13	1	14	1968	16	25	17	83	100
• Bottom Observatory Service w/ ROV	0	4	6	1.3	13	6.7	12	2278	16	25	10	90	100
• Sidescan, seismics & sampling	1.5	3	8.2	21.3	13	3.7	28	5454	16	30	36	64	100
• Ocean bottom seismics	2	9	6	7	13	10	26	4560	16	25	28	72	100
• Biogeochemistry Flux Studies	0	14	8	11	13	7	32	4296	16	32	25	75	100
• Physical Oceanography	1	16	0	0	13	14	30	4752	16	24	25	75	100
• CTD, nets, moorings	1	10	10	12	13	8	30	5616	16	28	31	69	100
• Survey & Dredge	2	15	0	0	13	15	30	5400	16	25	25	75	100
• Air-sea Atmospheric Geochemistry	0	1	0	0	13	25	26	7800	16	28	10	90	100
• Trace Element Geochemistry	0	9	0	0	13	25	34	7800	16	28	31	69	100
• Marine Geophysics Survey	0	0	0	0	13	30	30	9360	16	25	24	76	100

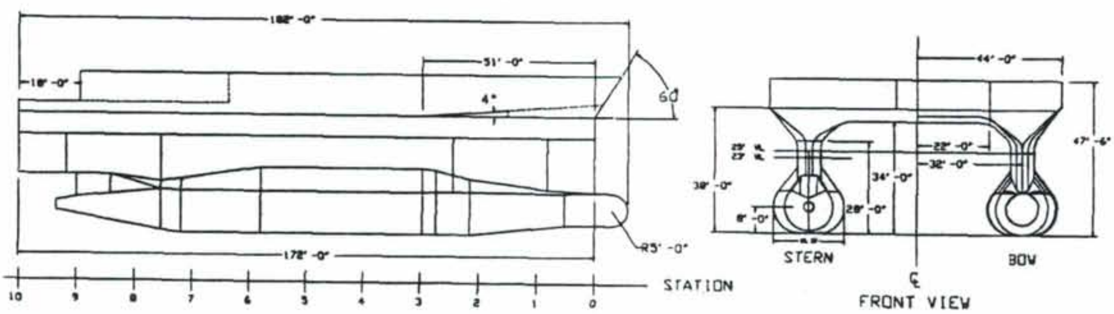
Item	Space ft.	Weight #	Removable	Installed	Provided	Power req.	ROM (k$)	Location-	% used	
CTD										
Winch DESH5	8x8	15000		yes	LM	75hp		aft deck		
2nd winch	8x8	15000	yes		UoH	50hp		aft deck		foundtion and serv. Connection
.322 em cable		2821	yes		UNOLS			aft deck		10000m
Handing sys.		15800		yes	LM	50hp		aft deck		Hydro Boom
Rosett	7h x4d	2500	yes		UoH			aft deck		
.25 wire		3609	yes		UNOLS			aft deck		10000m
Sonars										
Multib. Found.	~15x20			yes	LM					Foundation/cable way/space
Multib. Sys				yes	LM					
3.5Khz	2x2			yes	LM					
12Khz	2x2			yes	LM					
ADCP	2x2			yes	LM					
Vert. Ref. Sys.	1x1			yes	LM					
Dop. Sp. Log	1x1			yes	LM					
Instr. Well	30"D			yes	LM					
Main winch										for coring/dredge/nets,
DESH9/11	10x15x8h	58000		yes	LM	150hp		winch rm		9/16wire & .680 cable
9/19 wire		32900	yes		UNOLS					
.680 cable		32800	yes		UNOLS					
A-frame	20x10x22h	32000		yes	LM			aft deck		
A-frame power	3x8	2150		yes	LM	75hp		winch rm		hydro power pack
Side A-frame	12x8x12h	15000		yes	LM			aft side		
Imet tower	8x8			yes	LM			Forward deck		Foundation/services
Traction winch	~5x8	~25900		yes	LM	50HP		winch rm		replace DESH9/11
Uncont.sea W	2" serv.			yes	LM	1hp		Labs/aft deck		
Sci Fef/Frez	10x10		yes		UoH			aft deck		Power service for 8x20 iso van
Seismic sys	10x20	25000		yes	LM	2x150HP		below decks		LM provide In/power
Tie downs				yes	LM			deck/labs		Working deck 1"&labs3/8"
Unistrut				yes	LM			Labs		2' centers
Sci wireway				yes	LM					Labs/for&aft deck/bridge&mast
SIS				yes	LM			rm's/labs/decks/br/sonar space		
SATCOM M	2x2	200		yes	LM					
P-code GPS		5	yes		UoH					
Gravimeter	3x3	300	yes		UoH					
Magnetometer	3x3	300	yes		UoH					

5.0 Hull Form Development

A small waterplane area, twin hull (SWATH) type hull form was selected because it was mandated by the budget appropriation as the best form to achieve good operability in high sea states. The Phase I design goal was to develop a structurally sound, producible hull form that achieved as many of the desired capabilities as possible. The SWATH ships KAIYO and T- AGOS 19 were used as baselines to develop candidate hull forms for evaluation. These two modern SWATH ships represent two very different SWATH types - overhanging strut with conventional rudders (KAIYO), and short strut with inclined rudders located forward of the propellers (T-AGOS 19). Each of these hull types has specific advantages and disadvantages, which have been discussed at length in available literature. The overhanging strut hull form offers superior over-stern handling capability because the propellers are sheltered under the struts. However, the longer strut comes at the expense of some seakeeping performance. The short strut T-AGOS type hull form has better seakeeping capability.

The candidate hull forms were optimized for desired speed and displacement using computer resistance prediction techniques. SWATH ships have distinctive wave making resistance characteristics with noticeable peaks and valleys in the speed versus resistance curves. The candidate hull forms were adjusted to ensure that resistance peaks did not occur at operational speeds. This design process can result in some compromises. For example, a hull form optimized for the endurance speed of 11 knots may have unfavorable resistance at higher speeds, making the achievement of the top speed of 15 knots difficult. Similarly, a hull form optimized for top speed may have unfavorable resistance qualities at endurance speed, resulting in a fuel penalty the ship must live with throughout its operational life. For this program, the design team considered endurance fuel efficiency to be more important because operational cost is an important concern to the oceanographic community. However, it is expected that the ship will achieve its top speed of 15 knots or at least be relatively close.

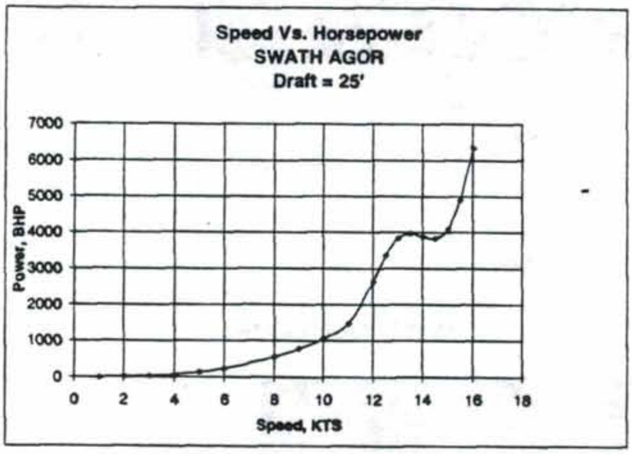
The candidate hull forms were evaluated in conjunction with the mission requirements analysis and a baseline size and displacement were established. Despite the seakeeping disadvantage, an overhanging strut type of hull form was selected as the only really suitable option for towing and handling of objects over the stern. To facilitate over side handling, the side deck edge of the ship is flared outboard to be vertically in line with the outboard side of the lower hulls. A producible hull form was developed using common shapes as much as possible. A solid computer model was constructed to provide a data file for all other necessary design tools and to create the lines drawing.

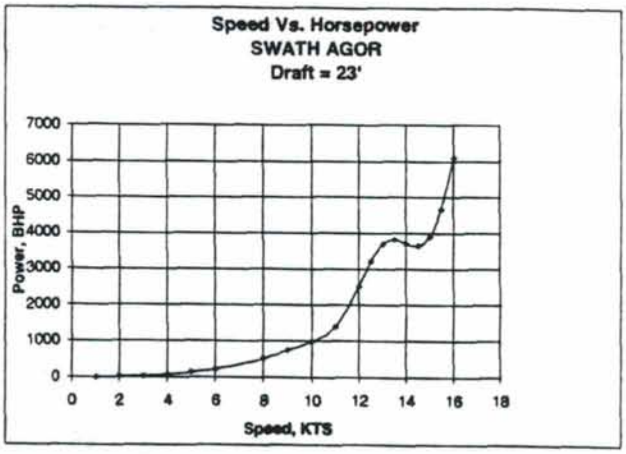


6.0 Speed Power Analysis

The speed power analysis was performed using computer prediction techniques. The computer code used for the prediction was validated against model test results for several SWATH ships found to have reasonably good correlation. The shaft horsepower analysis assumed a 6 percent margin on resistance, a wake fraction of 0.150, a thrust deduction factor of 0.100, and a transmission efficiency of 0.976. Required brake horsepower was determined by taking into account motor losses, power cable loss, SCR loss, generator loss, and an 11 percent power margin.

Graphic depictions are as follows:





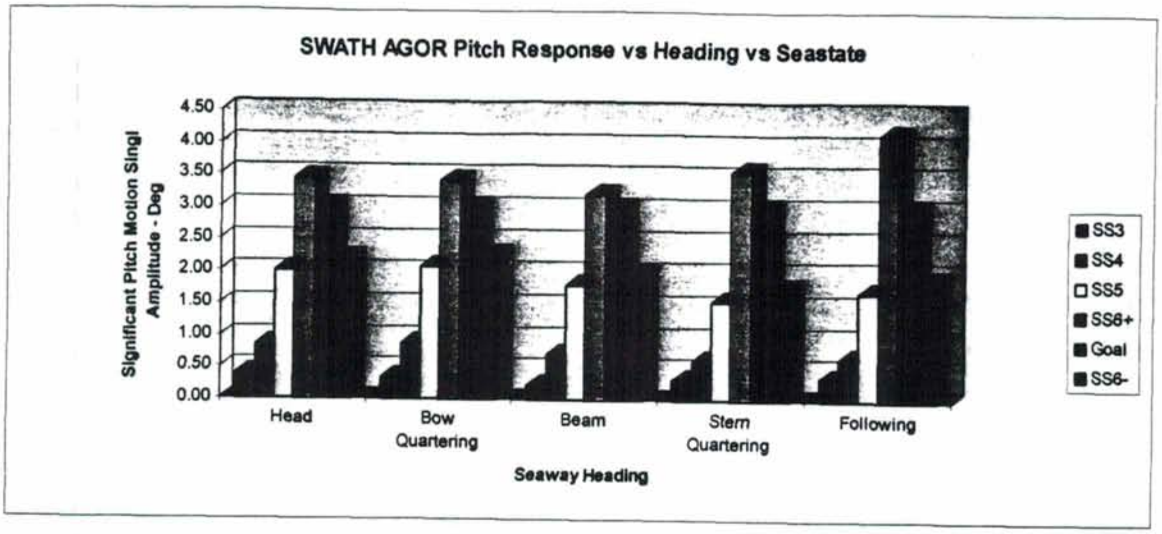
7.0 Seakeeping

Seakeeping performance was one of the most important design parameters for AGOR 26 since the main point of the program is to expand the oceanographic fleet's ability to perform research in higher sea states. The design goal for seakeeping was full operability in upper sea state 6 (SS6) in all headings. Full operability was defined as meeting the following motion limits:

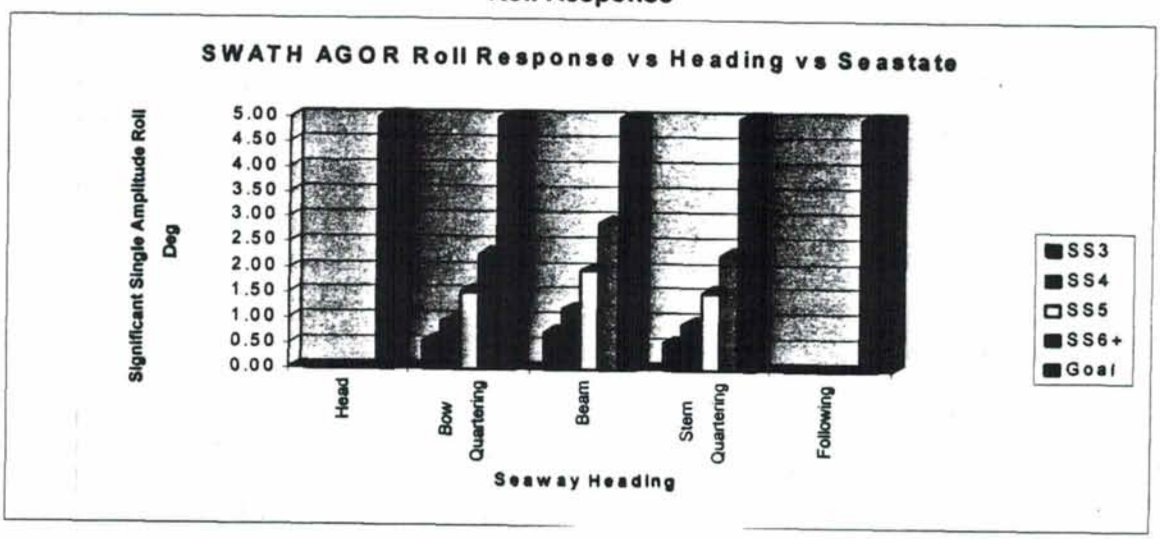
Pitch:	3 degrees
Roll:	5 degrees
Heave Acceleration:	0.4 Gs
Lateral Acceleration:	0.2 Gs

The seakeeping analysis was computer generated based on model test damping factors for similar hull forms and the MIT WAMIT computer code. At the conclusion of Phase I, the ship meets all motion criteria with the exception of the 3 degree pitch requirement at zero speed. The pitch requirement is met in lower SS6 but not in upper SS6, particularly in following seas. The computer calculated values were 3.41 degrees of pitch at best heading and 4.9 degrees of pitch at worst heading in upper SS6. Further review will be performed in Phase II to determine if more improvement can be achieved. Computer generated seakeeping predictions are shown in the following figures:

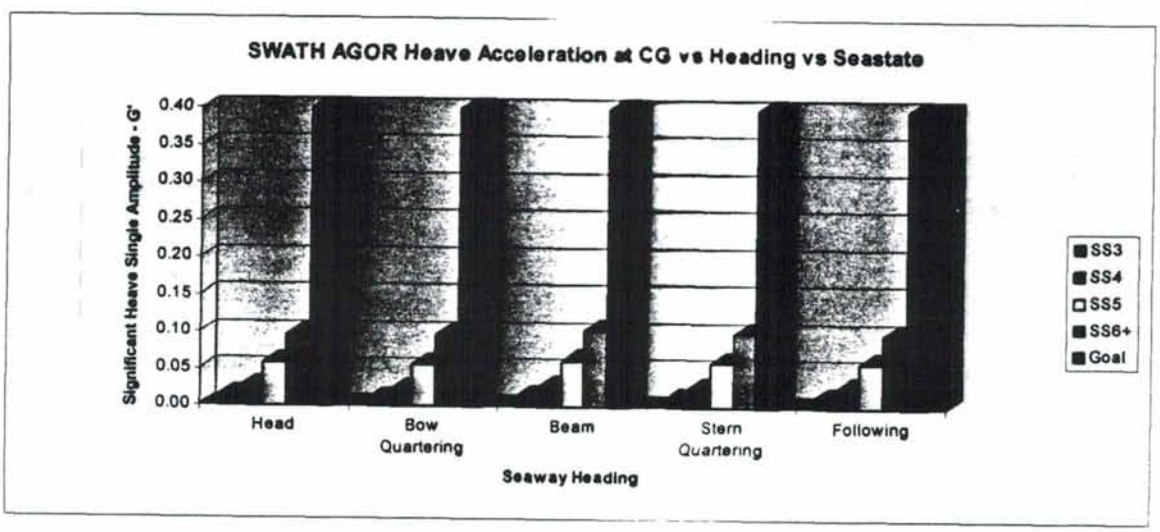
Pitch Response



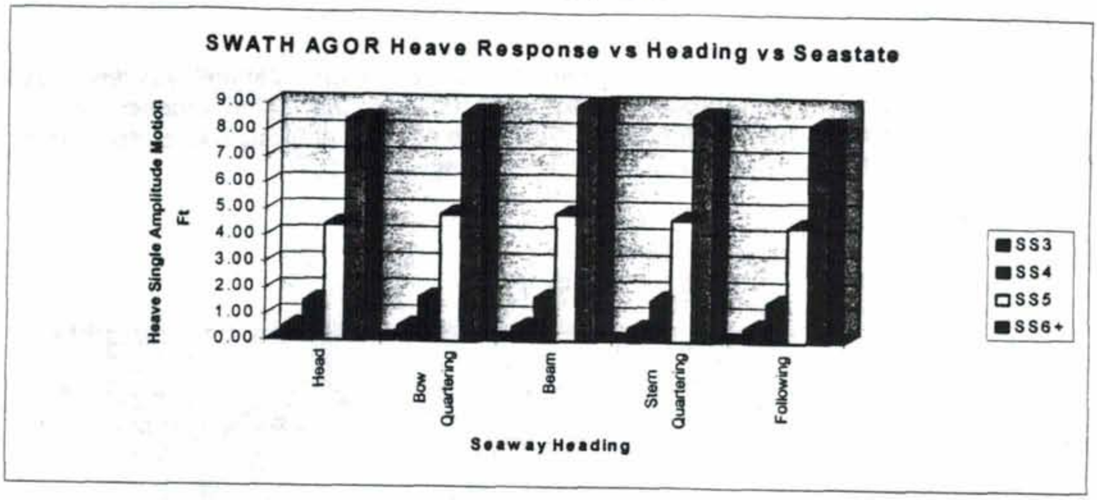
Roll Response



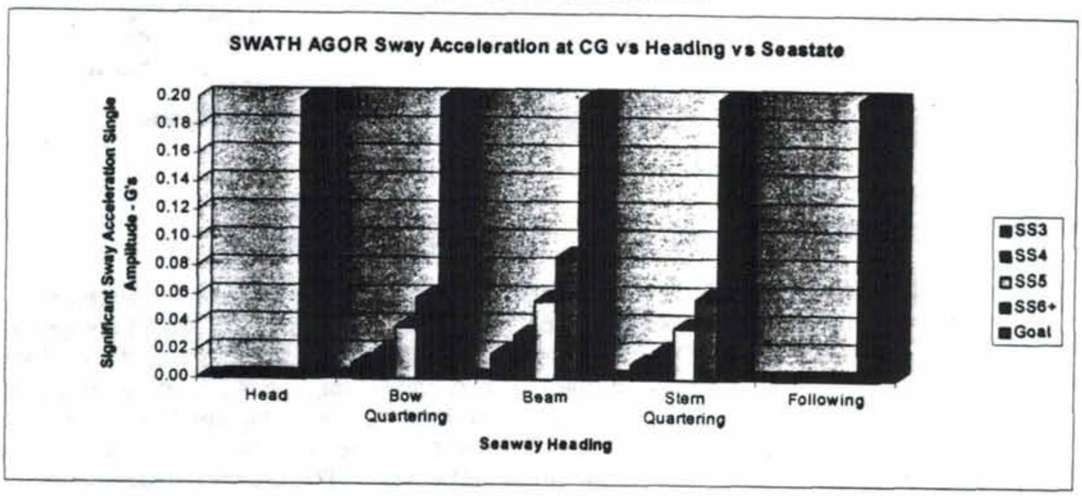
Heave Acceleration - G's



Heave Response

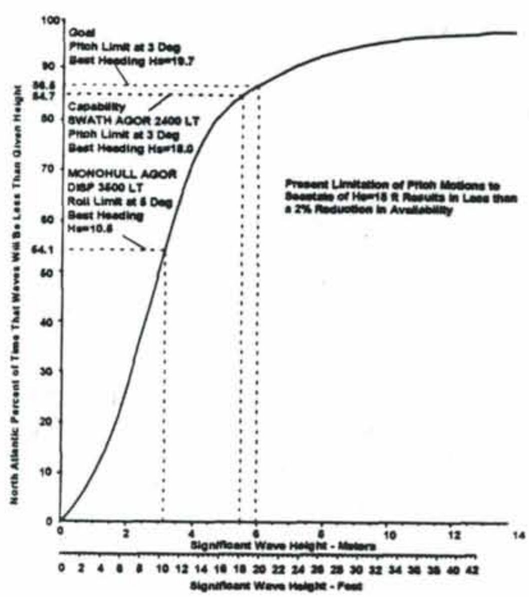


Sway Acceleration at CG



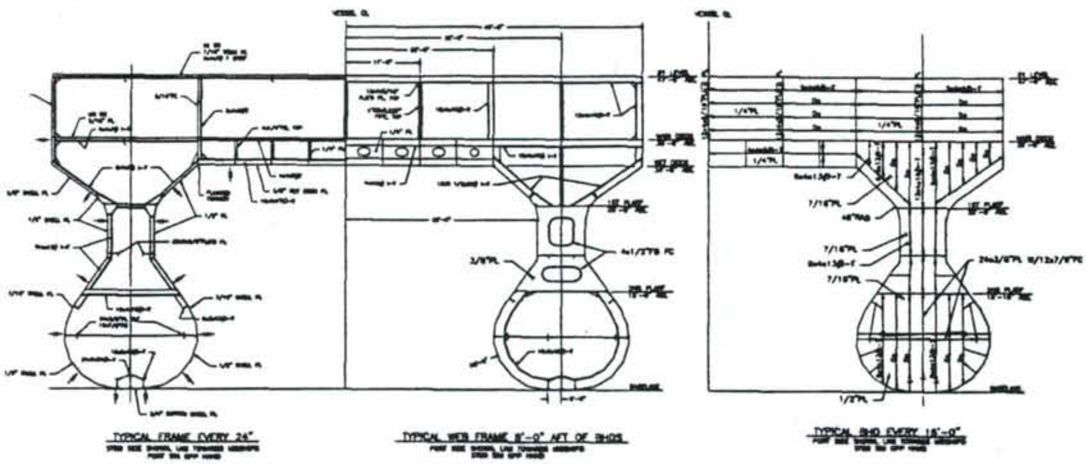
8.0 Wave Height

The following plot shows a curve of wave height versus percent time of occurrence. The AGOR 26 reaches the 3 degree pitch limit at a wave height of approximately 5.5 meters or 18 feet. The curve shows that this wave height will not be exceeded 84.7 percent of the time, meaning the ship should be operable this percentage of time. By comparison, a monohull AGOR is predicted to reach the roll limit of 5 degrees at approximately 3.2 meters of wave height. This corresponds to an operability of 54.1 percent.



9.0 Structural Design

During the Phase I structural design effort, a preliminary structural arrangement was developed based on the ABS load calculation procedures for SWATH ships. In addition, producibility features were incorporated wherever possible. A 3D finite element analysis was performed to verify the adequacy of the structure and to minimize weight.



10.0 Stability Analysis

An intact and damaged stability analysis was performed to determine subdivision requirements and to ensure the ship meets USCG requirements. The General Hydrostatics (GHS) computer program was used for the analysis. The intact analysis considered the departure and arrival load cases. In the departure condition, the ship carries full fuel and stores and is floating at its deepest draft of 25 feet. In the arrival condition, the ship's fuel and stores are nearly empty and the ship is ballasted to the minimum design draft of 23 feet. For the damaged stability analysis, a variety of damage cases were examined to determine the ones that govern. The damage cases were analyzed against the acceptance criteria of 46 CFR.

11.0 Weight Estimate

The Phase I design goals for weight analysis were to estimate an accurate weight for the feasible configuration, determine buoyancy requirements, determine LCG, VCG, and TCG values, and provide a input for the cost estimate. The weight estimate was developed using the following information:

- Group 100 (Structure) based primarily on shipyard estimates
- Used actual numbers when readily available ie. engine weights, propeller, shafting
- Used scaled AGOR 24 and TAGOS 19 weight data for similar systems
- Locations based on current arrangements
- Complement and consumables based on 17 crew, 31 science personnel and 50 day mission
- Fuel loads based on 10,000 NM (11 Kt speed and 350 kW hotel load)

An 8% margin was applied to the lightship weight. The LCB and LCG of the ship were adjusted in order to minimize trim for all loading conditions. As the weight estimate matures during Phase II, further tuning of LCB and LCG may be necessary.

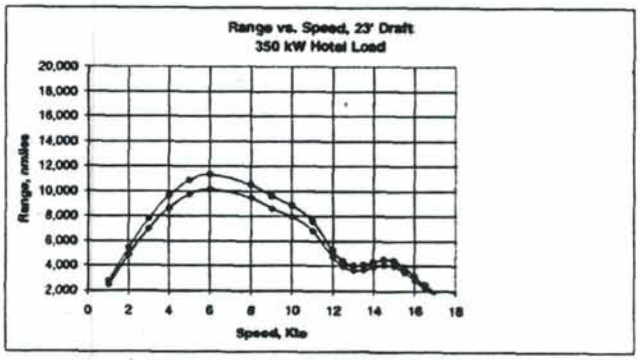
SWBS NO.	DESCRIPTION	WEIGHT LT	E C A	VCG FT	MOMENT FT-LT	LCG FT	MOMENT FT-LT	TCG FT	MOMENT FT-LT
100	STRUCTURE	1190.17		31.50	37490.36	80.47	95772.98	0.09	107.12
200	PROPULSION	95.06		12.26	1165.44	98.89	9400.48	-0.04	-3.80
300	ELECTRIC PLANT	114.40		44.92	5138.85	74.00	8465.60	-1.87	-213.93
400	COMMAND & SURVEILLANCE	17.11		29.49	504.57	53.85	921.37	-17.77	-304.04
500	AUXILIARY SYSTEMS	246.76		37.37	9221.42	88.02	21719.82	3.01	742.75
600	OUTFITTING AND FURNISHINGS	152.56		41.08	6267.16	79.44	12119.37	0.20	30.51
700	ARMAMENT	0.17		43.00	7.31	82.00	13.94	33.50	5.70
A	LIGHTSHIP W/OUT MARGIN	1816.23		32.92	59795.11	81.72	148413.56	0.20	364.29
	MARGIN (8%)	145.30		32.92	4783.61	81.72	11873.08	0.20	29.14
	LIGHTSHIP WITH MARGIN	1961.53		32.92	64578.72	81.72	160286.64	0.20	393.44
D00	ENDURANCE - FULL LOAD								
D11	SHIP'S CREW	1.42		40.00	56.80	80.00	113.60	0.00	0.00
D12	SCIENTISTS	5.89		40.00	235.60	80.00	471.20	0.00	0.00
D21	SHIP AMMUNITION	0.07		43.00	3.01	82.00	5.74	33.50	2.35
D29	SP. MISSION SYS & EXPENDABLES	100.00		43.00	4300.00	126.00	12600.00	0.00	0.00
D31	PROVISIONS	8.71		34.00	296.14	45.00	391.95	-0.83	-7.23
D32	GENERAL STORES	7.39		34.00	251.26	38.00	280.82	-0.83	-6.13
D41	DIESEL FUEL	383.00		12.00	4596.00	56.00	21448.00	0.00	0.00
D46	LUBRICATING OIL	2.68		12.00	32.11	70.00	187.31	0.00	0.00
D49	SPECIAL FUELS & LUBRICANTS	1.37		12.00	16.39	70.00	95.58	0.00	0.00
D51	SEA WATER	0.97		25.00	24.25	74.50	72.27	0.00	0.00
D52	FRESH WATER	22.28		36.27	808.10	12.00	267.36	0.00	0.00
D54	HYDRAULIC FLUID	1.56		30.50	47.58	57.50	89.70	0.00	0.00
D55	SANITARY TANK LIQUID	3.94		12.00	47.28	70.00	275.80	0.00	0.00
D	ENDURANCE-FULL LOAD	539.27		19.87	10714.51	67.31	36299.32	-0.02	-11.02
	WEIGHT, FULL LOAD	2500.80		30.11	75293.23	78.61	196585.96	0.15	382.42
D11	SHIP'S CREW	1.42		40.00	56.80	80.00	113.60	0.00	0.00
D12	SCIENTISTS	5.89		40.00	235.60	80.00	471.20	0.00	0.00
D21	SHIP AMMUNITION	0.07		43.00	3.01	82.00	5.74	33.50	2.35
D29	SP. MISSION SYS & EXPENDABLES	100.00		43.00	4300.00	126.00	12600.00	0.00	0.00
D31	PROVISIONS	8.71		34.00	296.14	45.00	391.95	-0.83	-7.23
D32	GENERAL STORES	7.39		34.00	251.26	38.00	280.82	-0.83	-6.13
D41	DIESEL FUEL	229.00		12.00	2748.00	56.00	12824.00	0.00	0.00
D46	LUBRICATING OIL	2.68		12.00	32.11	70.00	187.31	0.00	0.00
D49	SPECIAL FUELS & LUBRICANTS	1.37		12.00	16.39	70.00	95.58	0.00	0.00
D51	SEA WATER	0.97		25.00	24.25	74.50	72.27	0.00	0.00
D52	FRESH WATER	22.28		36.27	808.10	12.00	267.36	0.00	0.00
D54	HYDRAULIC FLUID	1.56		30.50	47.58	57.50	89.70	0.00	0.00
D55	SANITARY TANK LIQUID	3.94		12.00	47.28	70.00	275.80	0.00	0.00
D	ENDURANCE-CONDITION 2	385.27		23.01	8866.51	71.83	27675.32	-0.03	-11.02
	WEIGHT, CONDITION 2	2346.80		31.30	73445.23	80.09	187961.96	0.16	382.42

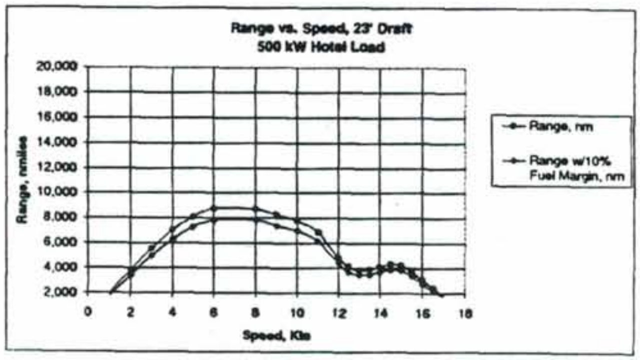
12.0 Range/Speed

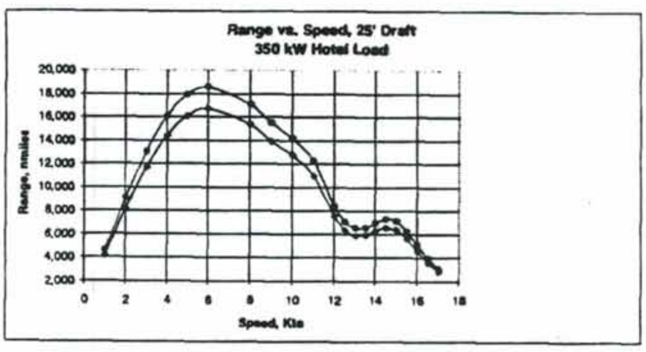
The design goal for range was 10,000 nautical miles at a reasonable, economical speed. Calculations were performed based on the computer generated speed power characteristics and electrical loads based on actual loads on large oceanographic ships. Early in the design process, it was determined that achieving the 10,000 mile range might be difficult because SWATH ships have generally higher resistance than monohulls and are much more weight sensitive. For a monohull, it is a fairly simple matter to add additional fuel because of their relatively high tons per inch immersion. For a SWATH ship, extra fuel results in a significant increase in draft, which can impair seakeeping performance by lowering the clearance between the cross structure and the sea surface. In addition, more ballast capability has to be provided in order to compensate for fuel burnoff. The design team determined that carrying the 10,000 mile fuel load at the design draft of 23 feet would result in a larger, heavier, and more expensive ship that might not be affordable within the program budget. Careful consideration of the mission analysis results proved helpful in solving this problem because they showed that only one mission actually required a range close to 10,000 miles. A couple of missions required ranges of 7800 miles, and the rest were 5600 miles and below. As a result, it was decided to design the ship to carry a lesser fuel load at the design draft, but have the capability of accepting additional fuel and operating at a deeper draft. The deeper draft condition would result in some impairment of seakeeping capability, but this would be a temporary condition on very few missions and would improve as the mission wore on and fuel was burned. Four endurance cases were calculated as follows:

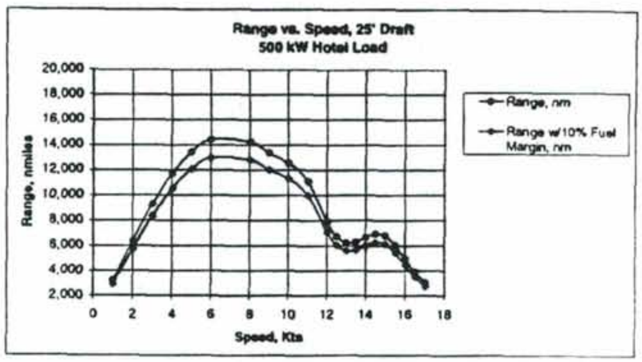
1) 23' design draft; 229 LT fuel load; 500 kw hotel load
2) 23' design draft; 229 LT fuel load; 350 kw hotel load
3) 25' deep draft; 383 LT fuel load; 500 kw hotel load
4) 25' deep draft; 383 LT fuel load; 350 kw hotel load.

The following graphs show the results of these calculations. On each graph there are two curves: one with a 10 percent fuel margin (based on UNOLS policy) and one without. An 11% power margin is assumed and a 2% fuel tail pipe allowance is included. The fuel consumption rate of the engines is assumed to be 0.388 lbs/horsepower-hour, based on T-AGOS 23 diesel generator fuel consumption rate at 50% of rated power. An allowance of 5% is included for hull fouling and sea state operation. The first graph shows the ship at the design draft of 23 feet and a 350 KW hotel load would be capable of about 7,000 miles at 11 knots. This performance would be insufficient for one of the missions and just slightly deficient for two others. The second graph shows that the range drops slightly to about 6,200 miles if the hotel load is increased to 500 KW. The last two graphs show that the range, when the ship is loaded to the 25 foot draft, is 11,000 miles at 350 KW hotel and 10,000 miles at 500 KW hotel load. This range would be sufficient for the longest mission. Of course, in actual operation, the ship could be loaded to any draft in between depending on the actual endurance required for the mission.









13.0 Mission Spaces

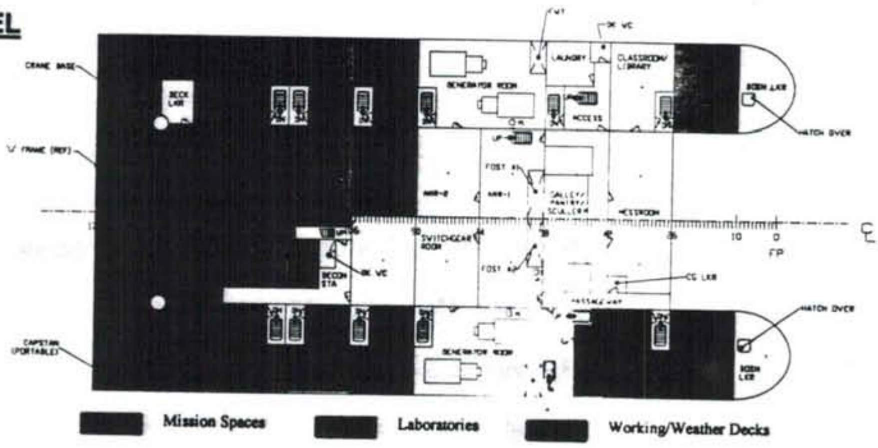
The Working Deck is approximately 2,000 sq ft and has flush deck bolt sockets installed one-inch diameter on two-foot centers to allow change out of equipment for varying missions. Enclosed spaces include a Staging Bay, office, storerooms, laboratories and other spaces which directly support the scientific mission of the ship. Additional space is allocated for (2) 20ft x 8ft ISO vans.

Nearly 3,000 sq ft is dedicated to laboratory spaces. Deck bolt sockets, 3/8 inch diameter on 2-foot centers, are installed in the scientific storerooms and laboratories. Laboratory spaces include: Hydrographic Laboratory, Computer Laboratory, Chemistry Laboratory, Wet Laboratory with six foot wide access from the weather, I-MET Lab, Lab #1, Lab #2, Lab #4, ET Shop, and the Staging Bay. The Scientific Information System (SIS) will be designed to support a network of computers, scientific instruments, and audio-visual monitors. Clean power will support a scientific load of approximately 100 kW, including a 12 kW Uninterruptible Power Supply (UPS) for fifteen minutes for scientific requirements.

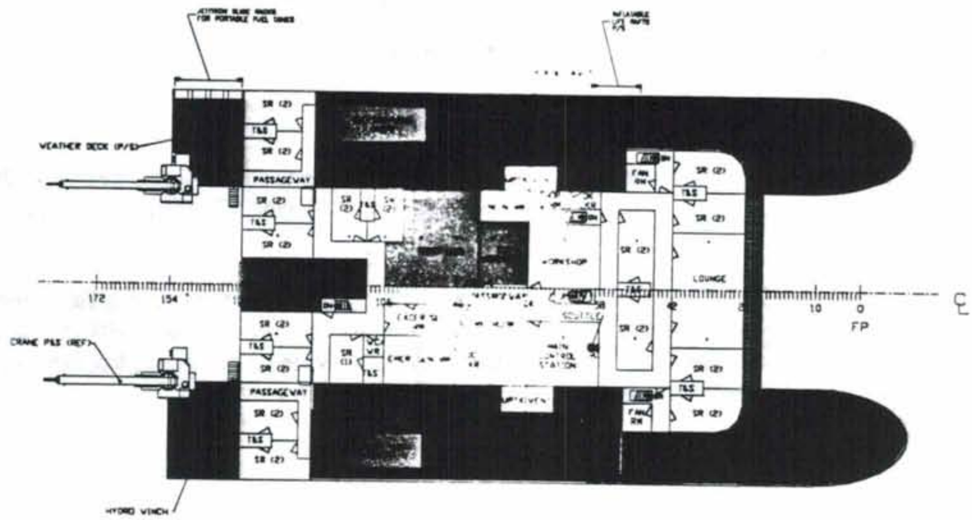
The Staging Bay is designed with a 10-foot wide access to the working deck aft and 15-foot clear head room. Scientific storerooms are designed for a minimum of 15,000 cu ft stowage. A library, conference room, science office and hazardous material locker are provided.

The ship in the full load condition will be capable of accommodating any combination of mission and scientific equipment payloads, including scientific vans for a maximum capacity of 100 LT.

01 LEVEL



MAIN DECK



14.0 Handling Equipment

The Working Deck area is designed to carry, launch, and recover equipment over-the-stern, including an 80-foot core sampler. Cranes, winches, stern U-frame, and other deck gear will be installed to permit conducting of a variety of oceanographic operations at sea, such as coring, water sampling, equipment implantation, and array and trawl towing.

(2) Telescoping Boom Cranes rated for lifting 20,000 lbs at a 30-foot radius and at least 5,000 lbs at a 40-foot radius. One crane located in the Working Deck area and the other port for towing over the side.

(1) Portable Deck Crane of the foldable boom and double telescopic type, HIAB FOCO Model 180 Sea Crane, or equal. Hydraulic extension of 46 feet 6 inches.

(1) Hydrographic Winch, Markey Machinery Company, type DESH-5 (electric), or Dynacon, or equal provided for conducting oceanographic operations over-the-stern.

(1) Traction Winch, Dynacon, or equal and one stowage winch will be provided and installed with appropriate cable runs to lead cables to the U-frame and the port crane.

(1) Hydraulically Actuated Stern U-frame provided on the transom to launch and recover oceanographic equipment and support running wire or cable from the traction winch. U-frame designed to handle 20,000 lbs and reach 12-feet beyond the transom.

USCG approved **Work/Rescue Boat**

15.0 Navigation Equipment

Integrated Bridge	Simrad Vessel Control System (VCS), or equal
Inertial Reference Unit	TSS, Inc. Model POS/MV 320, or equal
Gyro Compass	Sperry MD 37, or equal
Differential GPS	Model TBD
Dynamic Positioning System	Simrad SDP01, or equal
(2) Surface Search Radars	10-cm and 3-cm
GMDSS	Model TBD
Wind Speed/Direction System	Japanese Radio Corporation Model ILD-20 or Simrad-Taiyo Model TD-A202b, or equal

Communication systems will include: marine dial telephone system, shore telephone connection, INMARSAT connection, cellular connection, public address connection, RS-232 connection, AM/FM/SW receiver connection, login capability, seaphone connection, fax connection, station connections, and power connections.

16.0 Sonar Systems and Acoustic Characteristics

The AGOR 26 sonar suite consists of the following systems:

Multibeam Sonar (including Subbottom capability)	Simrad EM120, or equal
Shallow Water Multibeam System	Simrad EM 1002 (95 kHz), or equal
Echosounder	Simrad EA 500 or equal
Acoustic Positioning System (SSBL, LBL)	Simrad HPR 418 or equal
Acoustic Doppler Current Profiling System	Sontex 125, or equal

Shipboard systems will be carefully designed to avoid acoustical interference with these scientific sonar systems. Ship systems will be selected and designed to prevent distinct tonal contributions within 500 Hz of the operating frequencies of these sonars. In addition, ship systems (excluding the bow thruster) will be designed to produce a total noise level of no more than 59db at the sonar platform. This level was selected as a value that should be reasonably achievable with available technology and should provide good sonar performance. It is expected that the deep draft of a SWATH ship will allow the sonars to operate effectively at ship speeds up to 12 knots in SS6. The transducers for the sonars will be located in sea chests accessible from the Sonar Room, which will permit change out of these transducers from inside the ship while the ship is afloat. The propeller, which is expected to be the dominant noise source, will be designed to be cavitation free at the 12 knot survey speed.

The design team has performed extensive multibeam sonar system analyses to determine expected performance in various conditions. These analyses were based on experience from SWATH T-AGOS 19 noise measurements. The follow tables present the results of those analyses. The first table shows allowable platform noise for various depths of water and beam angles. For example, for adequate multibeam performance in a water depth of 6000 meters and a 45 off vertical degree beam angle (90 degree total coverage), the ship would be limited to 60dB of platform noise.

Allowable Multibeam Platform Noise (in dB re 1 µPa/ 1 Hz, at 12 kHz), Estimated for Cross-Hull or Hull-Grazing Noise Propagation, for Mapping with 1 degree Simrad EM120 Sonar, Assuming Soft Ocean Bottom.

Depth (m)	22 degrees off vertical	45 degrees off vertical	60 degrees off vertical
2000	99	88	76
3000	91	79	66
4000	85	72	57
5000	80	66	49
6000	75	60	43
7000	71	56	37
8000	67	52	32
9000	64	48	28

The next table shows predicted mapping depth for various bottom types, beam angles, and platform noise levels.

Predicted Maximum Mapping Depth (in meters) for 1 degree Simrad EM120 Sonar, Estimated for two Levels of Multibeam Platform Noise (in dB re 1 μPa/ 1 Hz, at 12 kHz).

Platform Noise:	66 dB			59 dB		
Bottom Type:	22°	45°	60°	22°	45°	60°
Soft	8500	5000	3000	11000	6000	3500
Medium	11000	6500	3500	11000	8000	4500
Hard	11000	10500	6000	11000	11000	7000

17.0 Propulsion System

The design team performed an extensive series of tradeoff studies aimed at determining the most efficient and effective propulsion system that could be afforded within program budget. The overall AGOR 26 program philosophy was that this ship should be a prototypical vessel and should incorporate advanced, innovative technologies wherever possible. At the same time, the reality of the firm program budget and the aggressive delivery schedule precluded radical departures from accepted practice. Studies included prime mover type, transmission system, and propulsive device. It was determined early on that the only feasible propulsive device for a ship of this size and speed would be a marine screw propeller. In addition, it was also determined that the prime mover would have to be an electric drive to meet requirements for maneuverability and precise speed control. In addition, electric motor drives are advantageous for a SWATH ship because the generating plants can be located in the box structure for easy maintenance. Diesel generating plants were selected based on efficiency and cost considerations.

A major effort in the propulsion system development was determining the most effective electrical system configuration. Existing ships in the oceanographic fleet use alternating current (AC) generators feeding silicon controlled rectifiers (SCRs) which convert the power into direct current (DC) for use by the propulsion motors. Recently, AC propulsion motors fed from cycloconverters or PWM drives have become more popular. Although these can offer some benefits in particular areas, the tradeoff studies determined that conventional DC drive motors were the best choice when all factors, including cost, were considered.

The design team also investigated different ways of transmitting power to the propellers. One particularly promising alternative was the podded propulsion device. This device is a fully azimuthing unit which contains the drive motor inside the underwater pod. The advantages of this method were increased maneuverability and reduced machinery space requirements inside the ship. However, cost considerations outweighed the potential benefits. The team also considered geared drives in order to reduce drive motor size and weight. However, this increased the complexity of the system and also created the possibility of an additional and significant underwater noise source. In the end, it was determined that direct drive DC motors would be the best propulsion option.

The selected system consists of an fully integrated electric system with four (4) 910 kW diesel generator sets providing power for propulsion and ship's service uses. An integrated electrical system has the advantage of a single bus supplying both propulsion and ship's service uses. This allows for the most efficient operation of the generating plants, particularly at low ship speeds. The propulsion motors are 1.5 MW DC units driven by 12 pulse SCRs. The 12 pulse SCRs were selected because they have smoother power characteristics than 6 pulse systems. The system is predicted to be capable of 15 knots at 100% power and 12 knots at 63% power. The ship service load was assumed to be a 24 hour load of 480 kW based on observed loading on the AGOR 23 and 24 Class. The generating plant is sized to allow a 20 percent growth in non-propulsion electrical loads. The ship's entire electrical plant will be designed in accordance with IEEE P45-1998, which is an commercial industry standard for ships.

Propulsion Equipment

- (4) 910 kW diesel generators sets driven by Caterpillar 3508B SCAC, Cummins-Wartsilla 8L170, or equal diesel engines
- (2) DC main propulsion motors and drives
- Norcontrol Data Chief 2000 Power Management System, or equal, which provides highly detailed monitoring and automatic control of the ship's engineering functions

Machinery Plant

The machinery plant is designed for unattended operation in accordance with regulatory body requirements. Although machinery spaces on large oceanographic ships are normally manned, this capability allows the option of leaving machinery spaces unattended for occasional periods, which helps to reduce ship manning requirements. The main propulsion motors are located to minimize shafting length. The four generators are distributed among two generator rooms, one of which is located on each side of the ship. Pump rooms are located forward and directly under the generator rooms. Two auxiliary machinery rooms are located inboard of the generator rooms to contain auxiliary machinery. Fuel handling equipment is segregated in Auxiliary Machinery Room #2. The Switch Gear Room is located directly below and forward of the Emergency Generator Room. The air conditioning system is a distributed chilled water system with individual fan coil units located in each space. This type of system is a necessity on most SWATH ships because of the need to minimize large size ducting penetrations of structural bulkheads.

Preliminary Propeller Design

A preliminary propeller design was developed based on standard series of propellers. The propeller was designed to minimize cavitation while maintaining a reasonable level of efficiency. A final design will be developed during Phase II and may incorporate model testing if necessary.

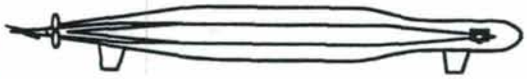
Expanded area ratio = 0.7
Number of blades = 5
Wake fraction = 0.150
Thrust deduction factor = 0.100
Transmission efficiency = 0.976
Diameter = 11.0'
Pitch to diameter ratio = 1.26
Number of props = 2.0

18.0 Maneuvering System

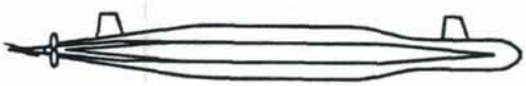
The design goal for maneuvering was to maintain station in 47 knot beam winds. This goal was achieved using a fairly conventional SWATH maneuvering and propulsion system consisting of fixed pitch propellers with aft rudders and a single azimuthing jet-type bow thruster located in the port hull. The azimuthing bow thruster also allows the vessel to tow 10,000 lbs at 3 Knots with the main propellers secured. The ship will be able to keep station +/- 50m in seas up to 6 meter significant wave height and a wind speed of 47 knots at best heading. The ship will follow a trackline over the bottom at best heading at any speed between .5 and 12 Knots with constant towing load of 10,000 lbs., in seas up to 6m high and 47 knot beam winds.

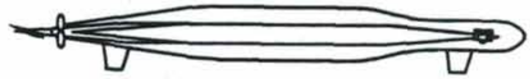
System design:

Propulsion Drive	Electric with 3 megawatt capacity
Fixed Pitch Propellers	11ft in diameter, 150 RPM with 5 highly skewed blades
Rudders	Located aft of propellers and 100 sq ft each
Azimuthing Bow Thruster	Located in the port lower hull, forward. 15,000 lb static thrust w/ electric drive

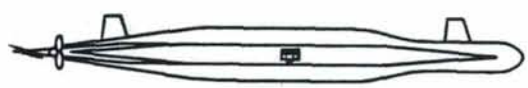


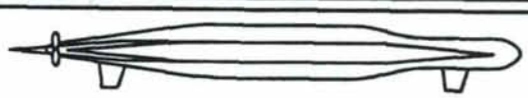
Case A Conventional Propulsion with Forward Azimuthing Thruster and Rudders



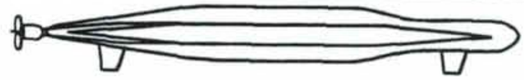


Case B Conventional Propulsion with Forward/Amidship Azimuthing Thrusters and Rudders

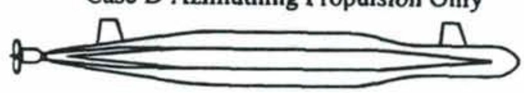




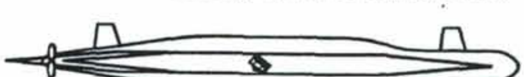
Case C Conventional Propulsion with Forward Tunnel Thruster and Rudders

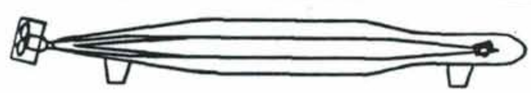


Case D Azimuthing Propulsion Only

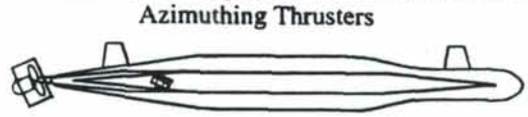


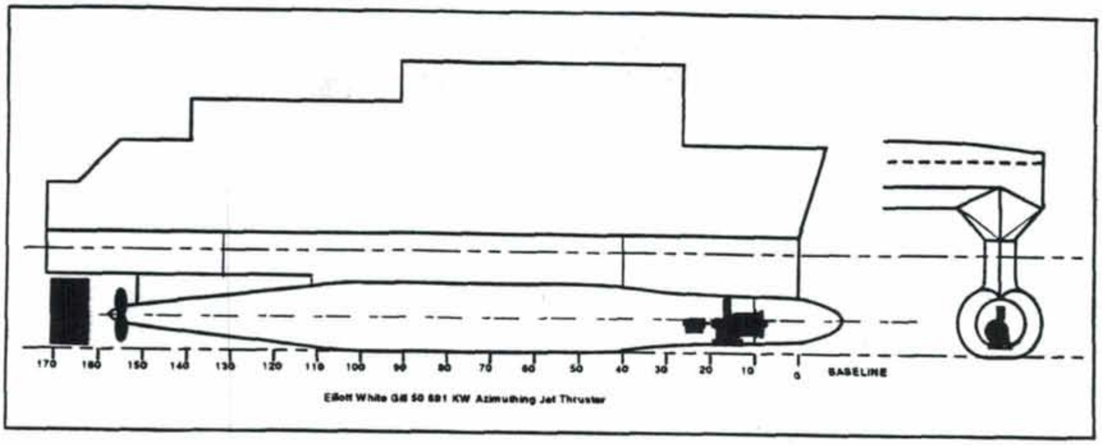
Case E Conventional Propulsion with Amidship Azimuthing Thrusters and Rudders





Case F Azimuthing Propulsion with Forward and Aft Azimuthing Thrusters





Elliott White Gill 50 591 KW Azimuthing Jet Thruster

SWATH AGOR
DESIRED OPERATIONAL CAPABILITIES

Approved:

R. Hayes — 14 Nov 97
R. Hayes
Oceanographer of
the Navy (N096)

Date

S. Millick — 11/14/97
S. Millick
Office of Naval Research

Date

D. Kitchin — 11/17/97
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CAPT, U.S. Navy,
Program Manager, Support
Ships, Boats and Craft

Date

SWATH AGOR
Desired Operational Capabilities

1.0 OVERVIEW

SWATH AGOR is to be a fully-equipped, small waterplane area, twin hull (SWATH) oceanographic research ship. This document provides a brief description of the desired capabilities of the ship. The primary goal of the SWATH AGOR is to extend the limited capability of monohulls for performing oceanographic operations in high sea states. It should be emphasized that these capabilities are not firm requirements and should be treated as goals. As the project progresses, required capabilities will be adjusted if it becomes apparent that some capabilities are not affordable. The Government will work with the industry team to determine acceptable requirement values. This document is not intended to convey all the information required to complete the design of the ship. Additional technical data will be provided after contract award.

2.0 OPERATIONAL CAPABILITIES

2.1 GENERAL CAPABILITIES

The mission of the SWATH AGOR will be to conduct general purpose oceanographic research in coastal and deep ocean areas. The ship should be capable of performing the following tasks:

a. Sampling and data collection of surface, midwater and sea floor parameters using modern scientific instrumentation
b. Launch, towing, and recovery of scientific packages, both tethered and autonomous, including the handling, monitoring and servicing of remotely operated vehicles (ROVs), autonomous underwater vehicles (AUVs), and boats
c. Shipboard data processing and sample analyses in modern, well-equipped scientific laboratories
d. Precise navigation and station keeping and track-line maneuvering to support deep sea and coastal operations
e. Long periods of operation at low speeds

2.2 SPECIFIC CAPABILITIES

The following specific capabilities are desired and are presented in order of priority. Although highly desired, these capabilities are not firm requirements and should be treated as goals.

a. <u>Performance in a Seaway</u>: Fully operational in sea state 6 (4 to 6 meter wave height; 28 to 47 knot wind) at all headings
b. <u>Exterior Working Deck Area</u>: 2,000 square feet of contiguous, exterior working deck area
c. <u>Station Keeping Capability</u>: +/- 50 meters in sea state 6
d. <u>Science Payload</u>: Capacity for 100 tons of temporary science equipment brought on board for specific missions and stored on deck and in storerooms.
e. <u>Length/Beam/Draft Limitations</u>: Ability to reduce draft to less than 17 feet for pier access in a light load condition. Ability to transit through the Panama Canal.
f. <u>Laboratory Area</u>: Total of 3,000 square feet divided among multiple labs and located adjacent to the working deck

g. Science Staff: 25 scientists and technicians in addition to the crew required to operate the ship.
h. Speed: 15 knots
i. Endurance: 50 days at sea.
j. Range: 10,000 nautical miles
k. Scientific Gear Storage Space :15,000 cubic feet in below deck storerooms

3.0 DESIGN CONSIDERATIONS

a. **Flexibility of Arrangement:** The paramount design consideration for general purpose research ships is flexibility of arrangement and configuration. It is important that the ship be designed for quick rearrangement of deck and laboratory equipment. To support this flexibility, design features in the past have included:

- Deck bolt grids in laboratories, storerooms, and exterior working deck areas
- Bulkhead and overhead mounted Unistrut channels
- Wireways and hangers for running temporary power and signal cables

Typically, very little equipment is permanently installed in labs, storerooms, and on working decks. Even mooring bits, bulwarks, and capstans are normally bolted down to permit removal and rearrangement. These bolt down grids may also be used to secure cranes, winches, cargo vans, and overboard handling gear. Laboratories are usually arranged with no permanently installed equipment other than ventilation, plumbing, and electrical services. It is important that these permanent services be located to minimize impact on lab flexibility. Bolted down portable equipment in labs has included work benches, shelving, cabinetry, fume hoods, freezers, sinks, and electronic gear.

b. **Commercial Standards for Construction and Operation:** The SWATH AGOR is to be designed and constructed to commercial standards. The ship will be classed by ABS as a SWATH vessel for unrestricted ocean service, operation with machinery spaces periodically unattended, and ice class C0. The ship will be certified in accordance with the Code of Federal Regulations, Title 46, Subchapter U, for international. The ship will be manned by a civilian crew. The crew size should be minimized through the use of automation.

c. **Maintenance, Reliability, and Supply Support:** The SWATH AGOR will be supported through commercial resources. The ship's crew will be capable of performing routine preventative and corrective maintenance procedures. Maintenance beyond the crew's capability will be commercially performed. The SWATH AGOR will operate independently without fleet support and will often be in remote areas for long periods of time. The ship is expected to average at least 280 days per year at sea with typical missions lasting up to 50 days. Low maintenance, high reliability, and/or redundancy are important to achieve these goals.

d. **Deck Space and Equipment:** Oceanographic operations typically involve handling instrumentation packages over the side, over the stern, and/or through centerwells. Open and uncluttered deck space is needed to handle the numerous pieces of oceanographic equipment. Overboard handling gear normally includes A-frames, U-frames, articulated davits, cranes, and telescopic hydrobooms. In addition, cranes may be used to handle instrumentation and stores on the working deck. Oceanographic winches are typically installed, either on deck or below deck, and used in conjunction with the overboard handling gear. Typically, working deck areas where overboard handling gear and winches are installed may need structural reinforcement.

e. **Environment:** The ship is intended to operate on any ocean and should be designed to perform missions in the full range of winter and summer conditions.

f. **Machinery Plant:** The propulsion plant should be designed to allow precise speed control and maneuverability and operate efficiently over the full range of speed. Ample and stable electrical power should be provided for mission purposes.

g. **Overboard Handling:** The hull form, appendages, and propulsors should be designed to allow safe overboard launch, towing, and retrieval of oceanographic equipment.

h. **Life Cycle Cost:** Life cycle cost should be considered in the selection of materials and equipment. The hull, propeller and machinery should be designed for low fuel consumption.

i. **Hull Mounted Sonars:** The hull, appendages, and propulsors should be configured to permit installation of hull mounted scientific sonars.

j. **Acoustic Performance:** The ship should be designed to meet sonar acoustic requirements. The hull, propulsors, and machinery should be designed for reduced transmission of noise into the water. The frequencies of a typical suite of sonars may range from 3.5 to 300 kHz. Design features may include physical separation between machinery and sonars, single or double stage machinery isolation mounts, and structural damping treatments. In addition, the hull and appendages should be designed to avoid surface bubbles becoming entrained in the flow over the sonar transducers.

k. **Human Engineering:** Human engineering should be considered in the design of controls, consoles, and equipment.

l. **Innovative Approaches:** In recognition of the developmental nature of this ship, innovative approaches using advanced technologies, such as the following, are encouraged whenever cost effective in terms of purchase price, integration and installation cost, or life cycle cost:

- High performance propulsion and power generation
- Fuel efficiency
- High reliability electronic components
- Advanced materials for ship structure
- Contra-rotating propellers
- Composite shafting
- Active motion control
- Hull sections shaped to improve overside handling and maneuvering to/from and tying up to piers

FOR OFFICIAL USE ONLY

OPERATIONAL CAPABILITIES
FOR
AGOR 26 OCEANOGRAPHIC RESEARCH SHIP

Concurred:

P.G. Gaffney, II — 7/14/99 Date
RADM, U.S. Navy
Chief of Naval Research (CNR)

D.P. Sargent — 7/14/99 Date
RADM, U.S. Navy,
Program Executive Office
Expeditionary Warfare (PEO EXW)

Approved:

R.D. West — 7/14/99 Date
RADM U.S. Navy
Oceanographer of
the Navy (N096)

AGOR 26
Operational Capabilities

1.0 OPERATIONAL REQUIREMENT

New fully equipped, small waterplane area, twin hull (SWATH) oceanographic research ship to extend the capability of performing oceanographic operations in high sea states.

2.0 OPERATIONAL CAPABILITIES

The AGOR 26 will be a modern research ship capable of cost-effectively performing general purpose oceanographic research in coastal and deep ocean areas. The ship will be capable of performing the following tasks:

a) Sampling and data collection of surface, midwater and sea floor parameters using modern scientific instrumentation;

b) Launch, towing, and recovery of scientific packages, both tethered and autonomous, including the handling, monitoring and servicing of remotely operated vehicles (ROVs), autonomous underwater vehicles (AUVs), deep sea moorings, and boats;

c) Shipboard data processing and sample analyses in modern, well-equipped scientific laboratories;

d) Precise navigation and station keeping and track-line maneuvering to support deep sea and coastal operations;

e) Long periods of operation at low speeds.

3.0 OPERATING CHARACTERISTICS

Hull

a. <u>Design Guidance</u>. The AGOR 26 will be built to commercial standards, classified under ABS, ✠A1 circle E, ✠AMS, ✠ACCU, UWILD (underwater inspection in lieu of drydocking), unrestricted ocean service, and certified by USCG in accordance with the Code of Federal Regulations, Title 46, Subchapter U. The ship shall be equipped to satisfy Panama Canal Transit Regulations
b. <u>Ice Strengthening</u>. Ice Class D0

Propulsion

a. <u>Endurance</u>. The ship shall function continuously during a 50 day at-sea deployment without sustaining a system failure that cannot be corrected at sea, or that degrades services required for survival and return.
b. <u>Range</u>. The ship shall be capable of a range of 10,000 nautical miles at 11 kts.

c. Sea Keeping. Operational at 12 knots in Sea State 6 (SS6), 4 to 6 meter wave height; 28 to 47 knot wind. Able to launch and recover scientific equipment on station in a SS6 at best heading.
d. Station Keeping. The ship shall keep position at best heading within a 50 meter radius circle in seas up to 6 meter significant wave height and a wind speed of 47 knots.
e. Towing Capability. Ship shall be capable of towing scientific packages up to 30,000 lbs., including 10,000 lbs. at 10 kts and 25,000 lbs. at 2.5 kts.
f. Ship Control. Maximum visibility of deck working areas during deployment and retrieval of equipment; the functions, communications, and layout of ship control must allow the close interaction of ship and science operations. The propulsion plant shall be designed to allow precise speed control and maneuverability and operate efficiently over the full range of speed. Continuous variable speed control between 0 and 14 knots. Integrated Bridge System in which all machinery monitoring, navigation data sources, and ship control commands are interconnected.
g. Speed. 14 kts.

Electrical

a. Electrical System. Integrated Electric System shall be configured in accordance with IEEE 45-1998.
b. Clean Power. Provision shall be made for clean power to support a scientific load of approximately 100 kW; including a 12kw Uninterrupted Power Supply (UPS).

Mission

a. Exterior Working Deck Area. 2,000 square feet of contiguous, exterior working deck area designed with a minimum of permanently installed equipment to provide flexibility for operational requirements.
b. Van sites. Services and space to accommodate two (2) 20ft x 8ft ISO vans.
c. Laboratories. Total of 3,000 square feet divided among multiple labs and located adjacent to the working deck.
d. Scientific Storage. 15,000 cubic feet in below deck storerooms.
e. Over-the-Stern Handling. Working Deck area configured to carry, launch, and recover equipment over the stern, including an 80 foot core sampler.
f. Deck Equipment. A suite of modern cranes, winches, Stern U-frame and other deck gear provided to permit loading and unloading the ship without assistance and conducting a variety of oceanographic operations at sea, such as coring, water sampling, equipment implantation, and array and trawl towing.
g. Science Payload. Capacity for 100 tons of temporary science equipment brought onboard for specific missions and stored on deck and in storerooms.
h. Video/Audio/Data Network. Scientific Information System consisting of cables and junction boxes to support a network of computers, scientific instruments and audio-visual monitors.

Acoustic Characteristics

a. Shipboard Systems. The choice of shipboard systems, including hull, propulsors, and machinery, their location, and their installation shall be designed to not interfere with the operation of shipboard scientific acoustic systems.

b. Shipboard Sonar Systems. 1 deg x 2 deg Multibeam Sonar System, 95 kHz Shallow Water Multibeam System, Echosounder, Subbottom Profiler, Acoustic Position Indicator System, Doppler Current Profiling System. All installed sonars shall be designed to operate at ship speeds up to 12 knots.

c. Airborne Noise. The ship shall be designed to meet the noise levels recommended by the International Maritime Organization as contained in "The code of Noise Levels Onboard Ships and Recommendation of Methods of Measuring Noise Levels at Listening Post, Resolution A.468 (XII).

Electronics

a. Navigation and Positioning. Differential GPS with chart inputs capable of interfacing with the Dynamic Positioning System, Automatic Radio Detection Finder, Ship's Depth finding systems, Inertial Reference System with gyrocompass backup, Doppler Speed Log, and 10-cm radar and 3-cm radars.

b. Communications. Reliable voice channels for continuous communications to shore stations, other ships, boats and aircraft including satellite, VHF, FAX, aircraft transceivers, cellular phone, INMARSAT B, and high speed data communications links. Marine dial telephone system, public address system, and sound powered telephone system provided to ease communication throughout the ship.

Habitability

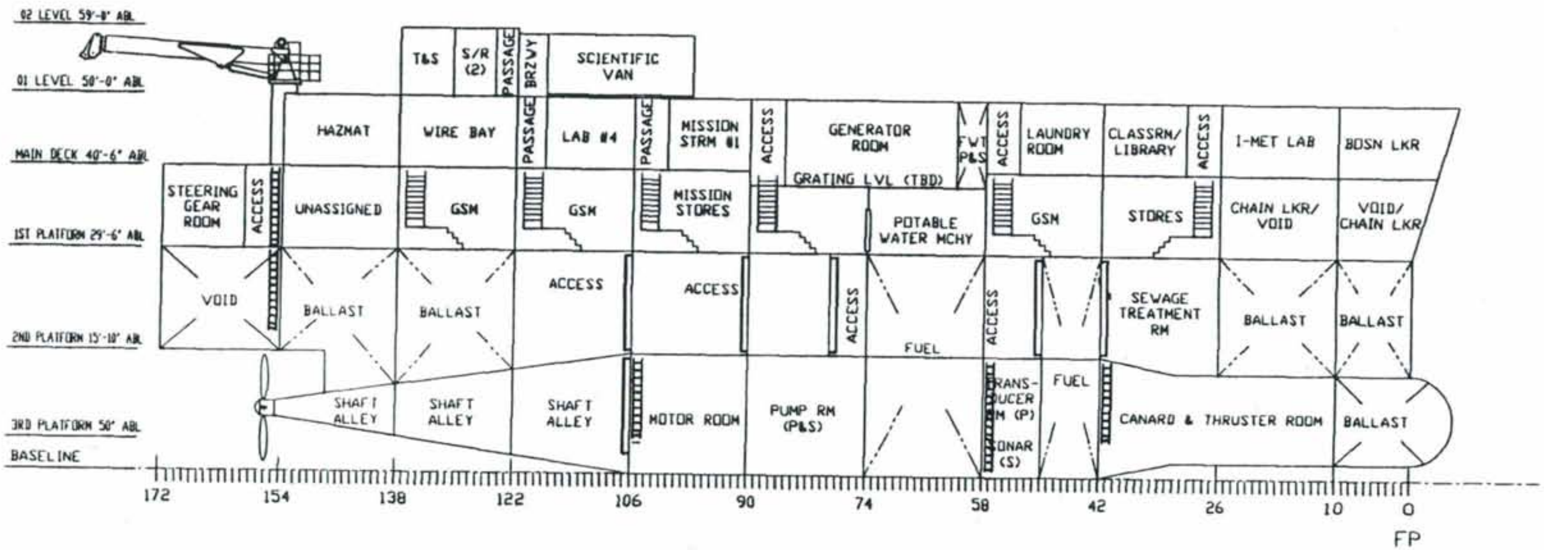
a. Accommodations. Permanent berthing accommodations and toilet/showers shall be provided for 48 persons.

b. Temperature and Humidity. Habitability areas and mission essential spaces shall be air-conditioned and shall be designed for a maximum external air temperature of 100 degrees Fahrenheit dry bulb (86 degrees Fahrenheit wet bulb), with a maximum sea water temperature of 85 degrees Fahrenheit, and a minimum external air temperature of 0 degrees Fahrenheit with a minimum sea water temperature of 28 degrees Fahrenheit. Air-conditioning for all laboratory spaces and interior scientific operations spaces shall be designed to provide maximum of 75 degrees Fahrenheit with maximum humidity of 55 percent. Heating for these spaces shall be designed to provide minimum of 70 degrees Fahrenheit. Other payload compartments shall be designed to maintain 70-80 degrees Fahrenheit dry bulb with maximum humidity of 55 percent.

4.0 INTEGRATED LOGISTICS SUPPORT

The ship shall be supported through commercial resources. The ship's crew will be capable of performing routine preventative and corrective maintenance procedures. Maintenance beyond the crew's capability will be commercially performed. The ship will operate independently without fleet support and will often be in remote areas for long periods of time. The ship is expected to average at least 280 days per year at sea with typical missions lasting up to 50 days. Low maintenance, high reliability, and redundancy are important to achieve these goals.

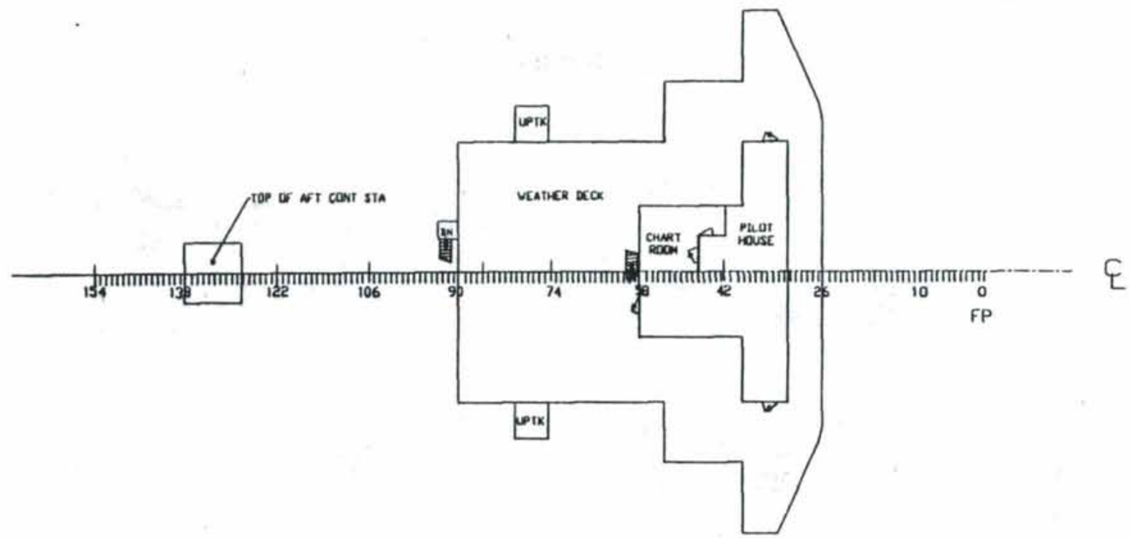
ELEVATION



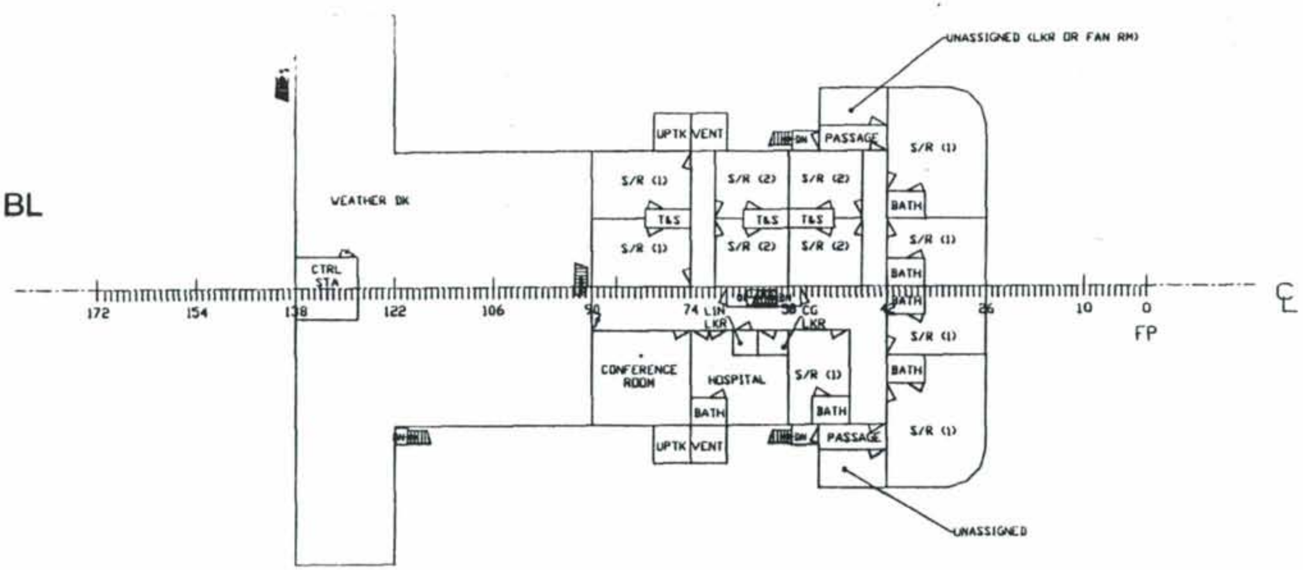
32' OFF CENTERLINE
PORT LOOKING OUTBOARD

03/02 LEVELS

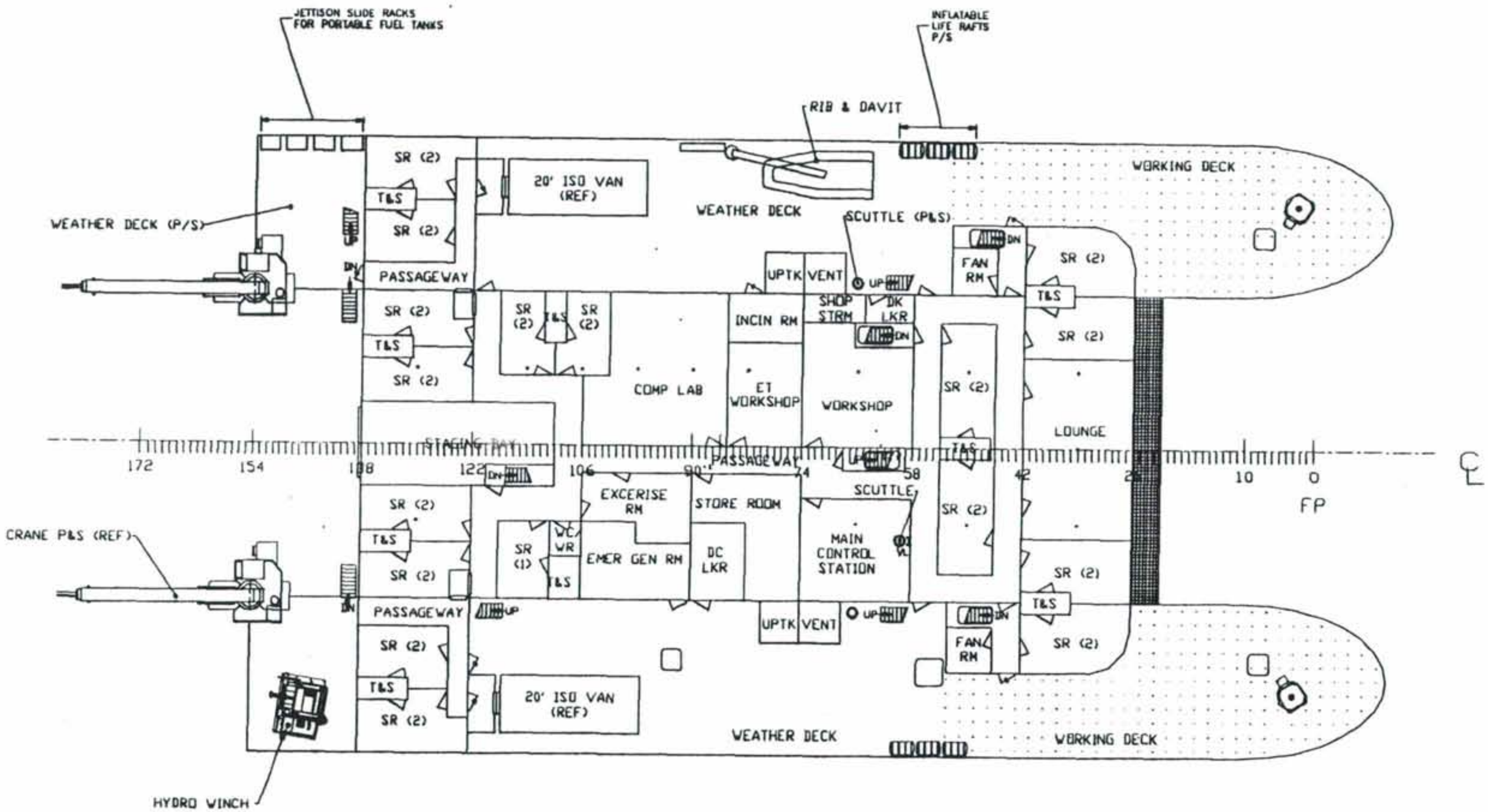
68 ft from BL



59 ft from BL

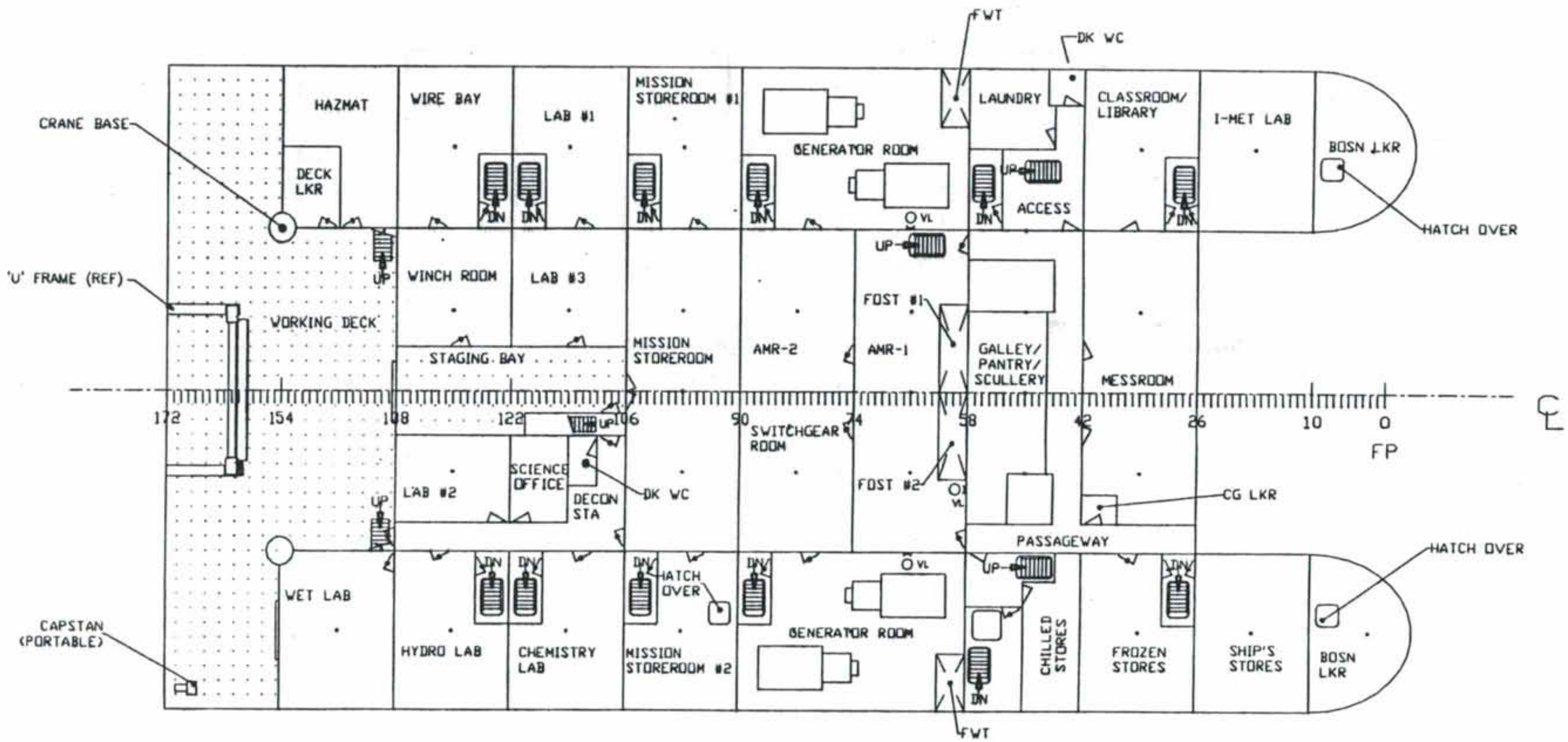


01 LEVEL



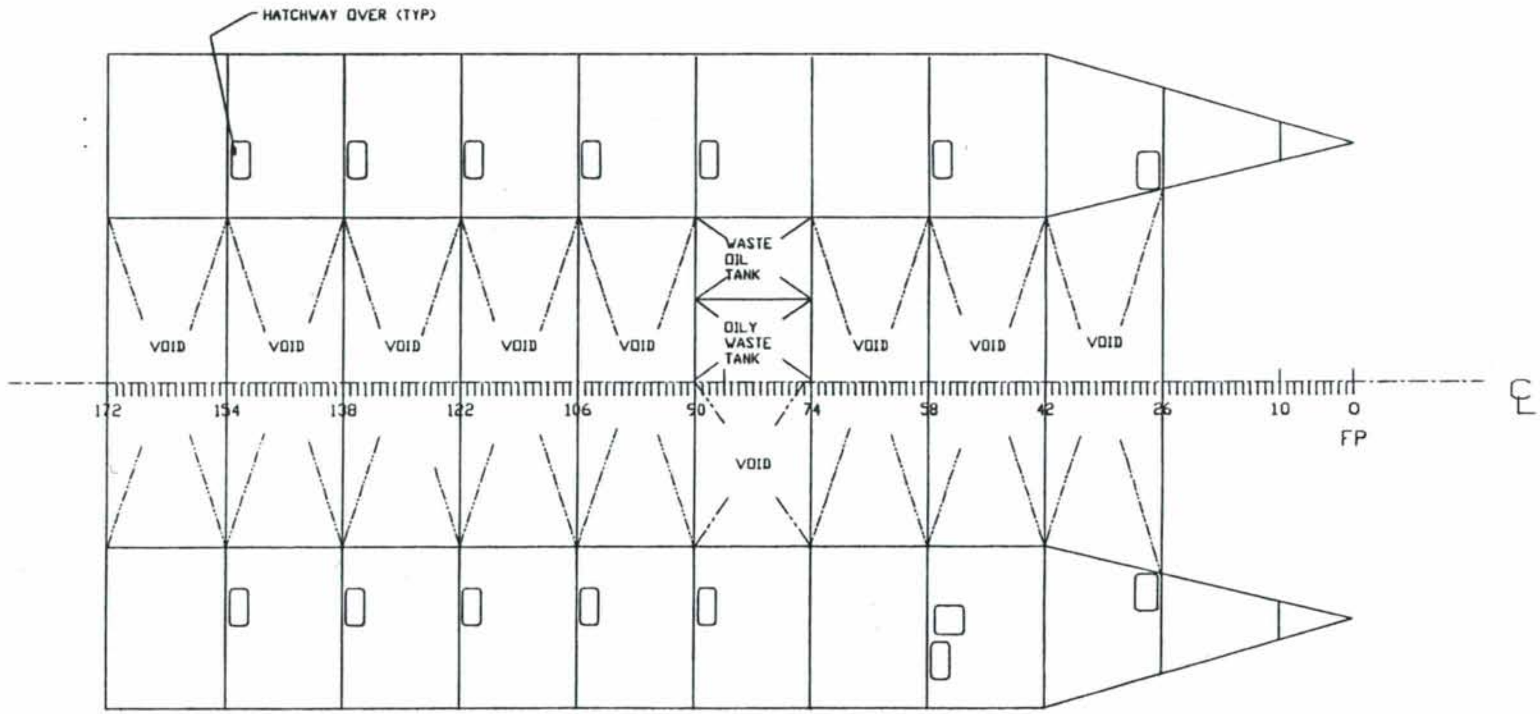
50 ft from BL

MAIN DECK



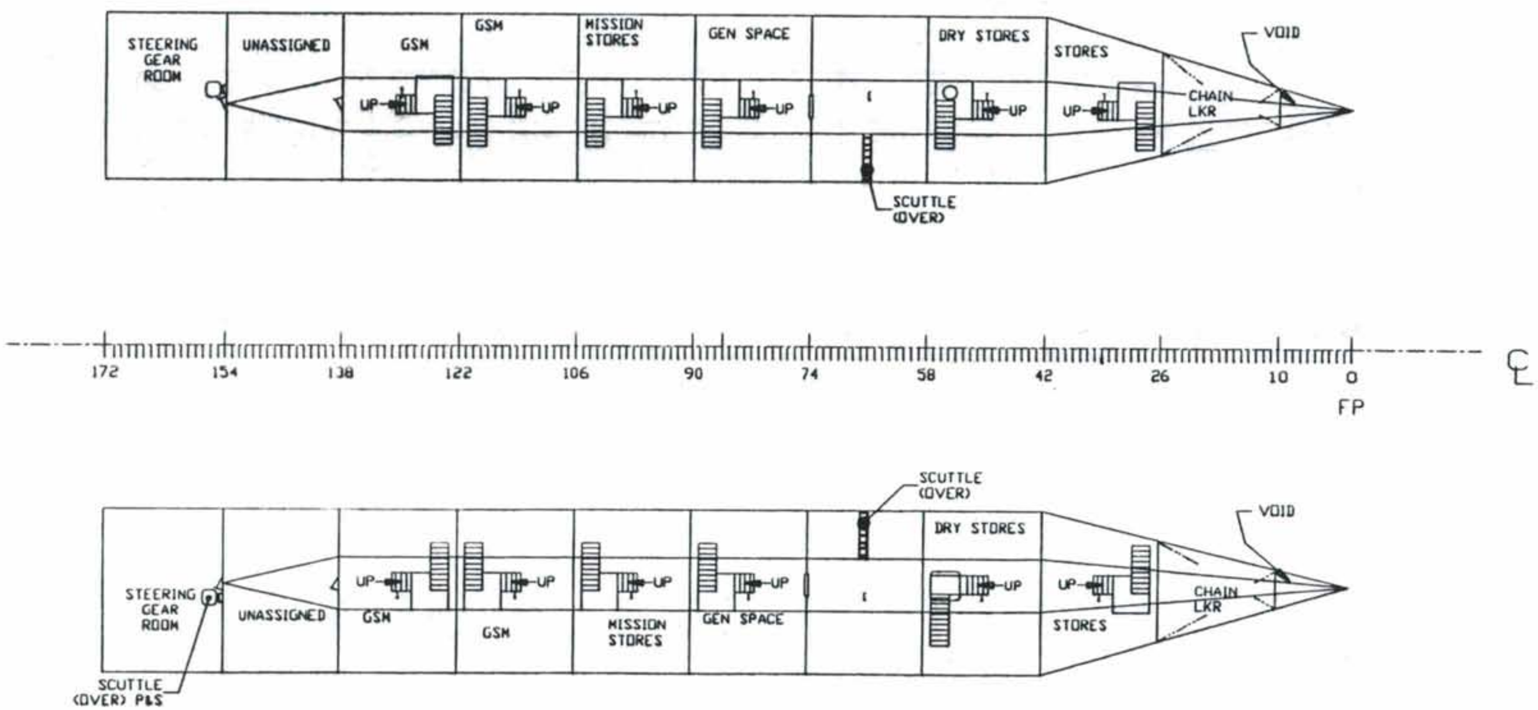
40.5 ft from BL

WET DECK



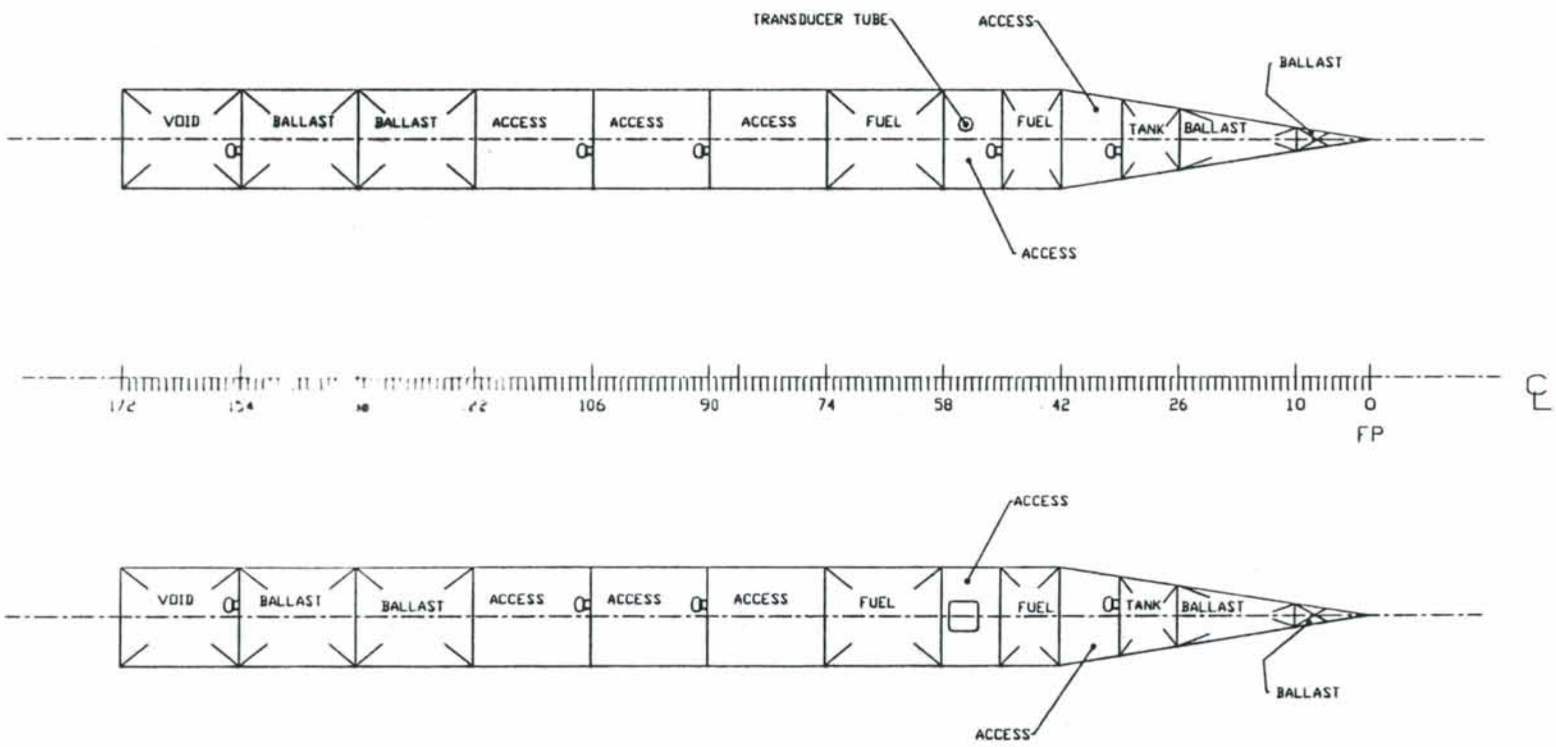
36.5 ft from BL

1ST PLATFORM



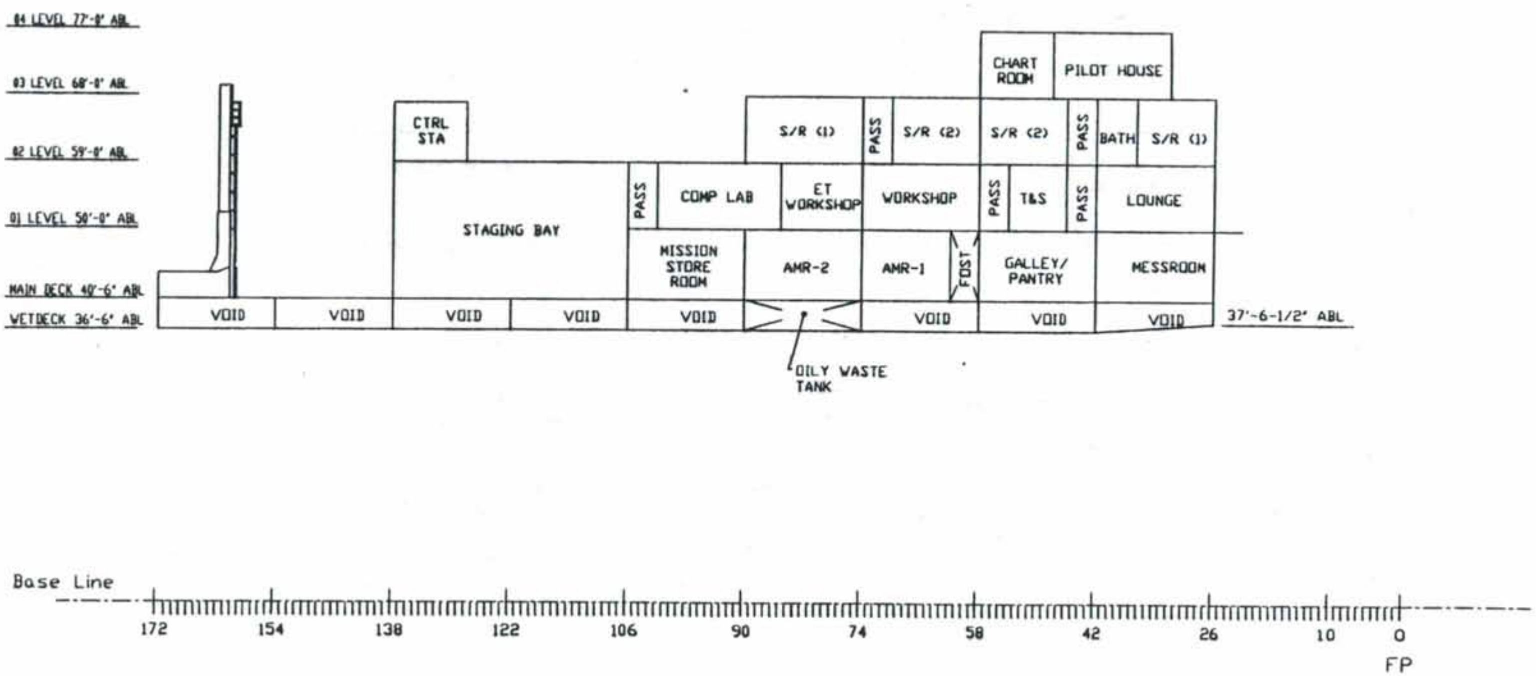
29.5 ft from BL

2ND PLATFORM

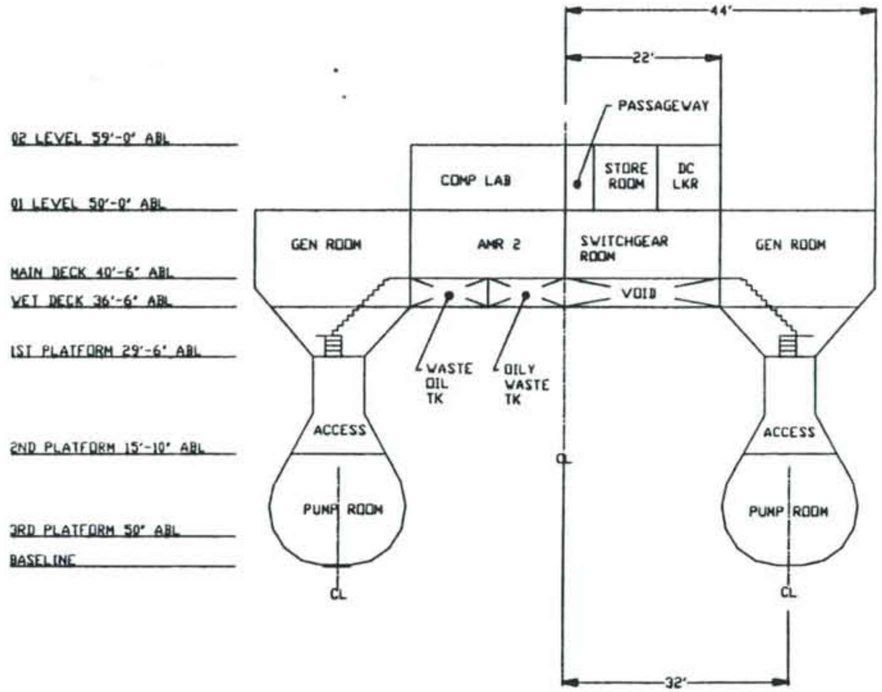


15.8 ft from BL

INBOARD PROFILE



MID-SECTION VIEW (BHD 90)



Appendix VI

To: Prospective Biennial Review Authors
From: Larry Atkinson, Chair, Fleet Review Committee
Subject: Ground rules for authors and other matters

In the past the FIC created a fleet improvement plan about every five years. With the passage of time and the changing environment for funding research vessels it became apparent that the existing mode of planning was not responsive to the realities. At the November 1998 meeting of the Fleet it was decided to publish a Biennial Review that would attempt to illustrate where the fleet is going and what needs should be addressed.

This memo is for you that have volunteered to write sections of the Biennial Review. It will help us avoid misunderstandings and provide guidelines for the whole process.

1. **The Review is a living document**. Once your section is ready and reviewed it will go into the UNOLS WWW site for the public. Most importantly, your writing will not have to wait for others to finish. You can finish your job and be done with it.

2. **It is your document**. We want the chapter to be yours with your view tempered by the accurate presentation of facts.

3. **We will help you**. There is a considerable amount of information available. We will help you find it, plot it, etc. as needed. We don't want you wasting your time on this aspect of the project. Either I, or Jack and Annette in the UNOLS office will help out. Just let us know.

4. **Length**. I don't image any of the sections being more than 5 single spaced (12pt) pages not including figures. Some chapters may be more and some may be less. That is your call.

5. **Review.** Wait! It is not a normal review. We will review only to make sure the facts are correct. The review will most probably provide missed information. The Council will review the chapters before making public again only for factual omissions. I believe the smart author would provide a draft version early on for informal review so the collective experiences of the Council and be taken advantage of.

6. **Format.** The format will be simple. We expect text in either Word or Wordperfect and to be relatively unformatted. "Keep it simple." We will do the formatting for the Website.

7. **Schedules.** My rule is that I don't care if you do something or not.... Just tell me as soon as a schedule must be changed, a deadline cannot be met, or, you just find you cannot do the job. We will mutually agree on a schedule and discuss it periodically.

8. **Final say.** As you may have guessed I'll act somewhat like an editor in that I can have final say on what goes and what stays.

The draft prospectus for the Review is attached. You should look over the whole thing to see how your chapter fits in.

After you have looked this over I would like to talk about it and come up with reasonable schedules.

The UNOLS Biennial Review of Sea Going Oceanographic Facilities
Prepared by the
Fleet Improvement Committee
of the
University National Oceanographic Laboratory System

Prospectus

Background: In the past the FIC created a fleet improvement plan about every five years. With the passage of time and the changing environment for funding research vessels it became apparent that the existing mode of planning was not responsive to the realities. At the November 1998 meeting of the Fleet it was decided to publish a Biennial Review that would attempt to illustrate where the fleet is going and what needs should be addressed.

Goal

The goal of this report is to inform the research community, funding agencies and operators on the state of sea going oceanographic facilities and how these facilities may meet future research needs.

The report will do the following:

1. Assess the capability of sea going facilities now and for the coming decade.
2. Report trends in research requirements and how the facilities will meet those requirements.
3. Inform researchers on coming changes in facilities and new technologies being included in ship design.
4. Advise funding agencies on future requirements and areas needing R&D.
5. Inform operators on future trends and global and regional scenarios so they may better plan their future.

The Review is organized into Sections and Chapters as detailed below. Since the *Review* will be published on the WWW all chapters need not be done at the same time and some chapters may be revised often while others are revised less often.

The chapters are as follows along with lead writers:

The Future

Future Research Requirements – Chairs of NSF Ocean Discipline review committees.

> This chapter will summarize the results of the NSF review of the future of ocean science so the following discussion of facilities is in the context of science requirements. It will answer the question "What are the new areas of research that oceanography will study in the coming decades?"

Future Observing Systems –

> This chapter would summarize the reality of what we will need in the future with what is possible. Discussion could range from maintenance of ocean observatories to high sea state observations from new hull designs. This chapter will answer the question "What new observing systems may become available that scientists will want to use?". Of course, we must note that new tools may change the scientific questions that are asked.

General Information on the UNOLS Fleet

State of the Fleet and Trends in Fleet Use- Atkinson, UNOLS Office and Dick Pittenger

What is the state of the fleet and what have been the trends in fleet use? This chapter will present the state of the fleet in terms of size and capability of the ships. The chapter will also look at trends in fleet use including the waxing and waning of large programs, the issue of more bunks per cruise, lab space, and sea state capabilities.

Historical Perspective of Fleet Replacement and Expansion – UNOLS office and past chairs

How did we get to where we are? In the past how did fleet expansions occur? What has caused change in the fleet over time?

New Assets

This chapter will present the ships that are now in the planning or construction phase. This would include the Hawaii Swath, Savannah, WHOI coastal Swath, etc. Because of the nature of the chapter it would require updating regularly.

Trends in support of Research Vessels (New Sponsorship)

In the past few years the research vessels have been acquired in a variety of ways ranging from local or state sponsorship to congressional mandate. What are the trends in this phenomenon?

Specific Topics – New types of vessels

Icebreakers – Jim Swift

This chapter will review the status of ice strengthened hulls for ocean research. Also considered will be: vessel needs in the Arctic and Antarctic, critical issues in research (polynas, etc.).

Seismic Vessels – Paul Ljunggren and John Diebold

This chapter will review the status and trends in vessels specialized for seismic observations. Special note will be made of the progress made in the petroleum industry.

Swath Vessels – Joe Coburn

SWATH vessels offer the oceanographic community the opportunity to work at sea in higher sea states than previously possible on small vessels. This chapter will review the successes and failures of SWATH vessels. The chapter will educate the reader on the attributes of SWATH designs. The status of SWATH vessels worldwide will be reviewed as well as the future in the US.

ROV's/ AUV's – Grassle, Bellingham, ???

Remote and autonomous vehicles present a new way of observing the ocean and place new requirements on the ships for deployment, retrieval and maintenance. This chapter will review ROV/AUV technology and the special requirements it places on ships.

Ocean Observatories - Molinari

The ability to leave instruments at remote undersea locations for months and years is changing the character of oceanography. What are the classes of observatories and what special demands to they put on the research fleet?

Fisheries and Hydrographic Surveying

Fisheries Surveys – Ned Cokelet

NOAA has the responsibility of assessing the state of the nations fisheries stock. NOAA is in the process of developing a new fleet of fisheries survey ships. How will this affect the research fleet and can research fleet be adapted to perform some of the NOAA required surveys?

Hydrographic Surveys – Sam DeBow

Hydrographic surveying used to be done solely by NOAA but is now being contracted out at an every increasing rate. How is this process affecting the UNOLS fleet and are there any opportunities there?

Technical Issues

New Regulations – Joe Coburn

Regulations are ever changing but recent and newly adopted rulings may well make fundamental changes in the way scientists work at sea.

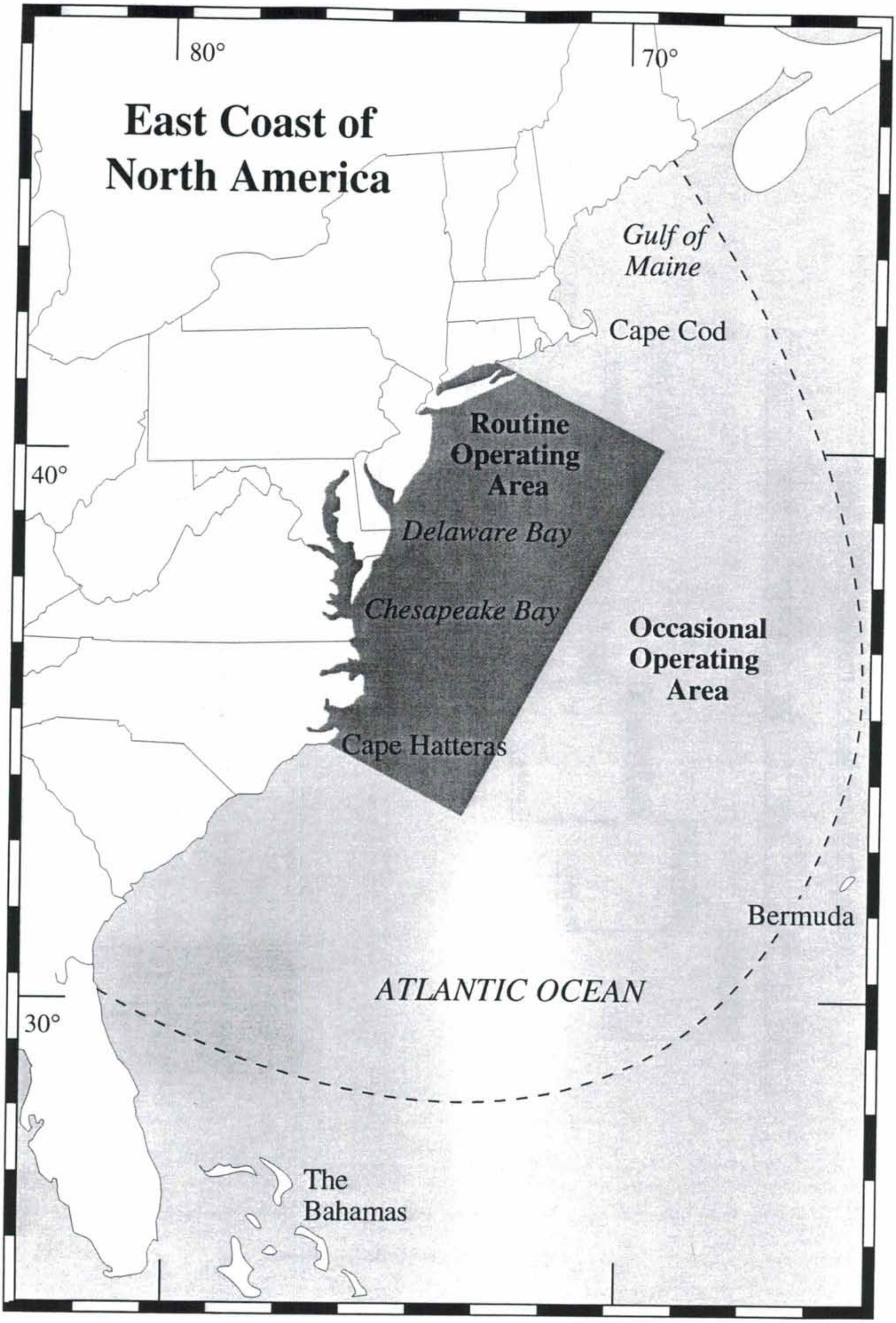
Shore Side Technical Support - ??

The support of technical experts at research ship home ports and at other institutions has grown to be an expected and valuable part of research ship operations. What have been the trends in this support and what may affect it in the future.

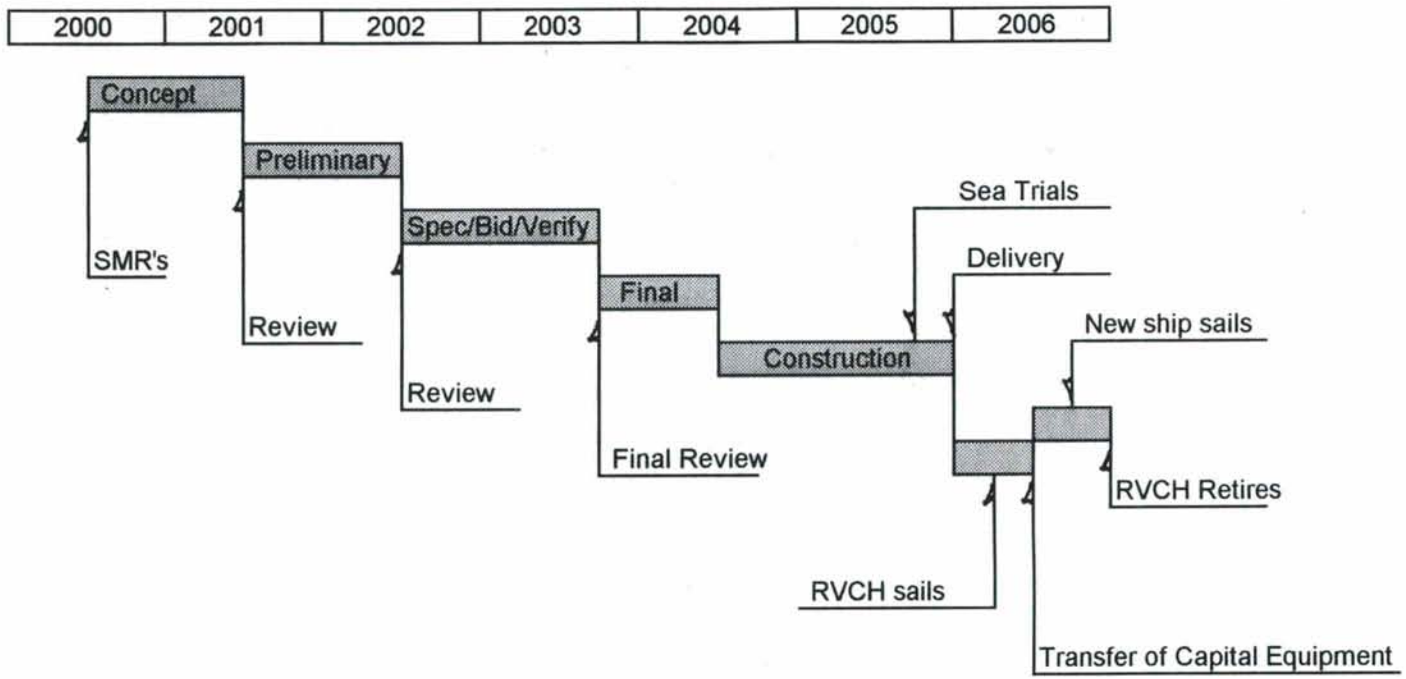
Ship Supported Technology - ??

On board ships we have evolved from a expecting merely depth and location to CTD's, ADCP's, meteorological and internet communications. What is supported at present and what will be needed in the future? How will these demands affect costs?

Appendix VII


East Coast of North America
80°
70°
40°
30°
Gulf of Maine
Cape Cod
Routine Operating Area
Delaware Bay
Chesapeake Bay
Cape Hatteras
Occasional Operating Area
Bermuda
ATLANTIC OCEAN
The Bahamas

Preliminary Time Line - New Ship (University of Delaware)



Note: The "Design-Bid-Verify-Construct" Method Used for Discussion
- Good Control Over Design Process
- Lowers Technical Risk and Exposure to Claims at Construction

PROPOSED DESIGN PROCESS
New Research Vessel
University of Delaware

1) University of Delaware's Ship Advisory Committee (SAC) establishes the Delaware Research Vessel Review Committee (DRVRC).

The DRVRC will be composed of sea-going scientists from the mid-Atlantic which represent the R/V Cape Henlopen's normal user base. The committee will also include sea-going scientists or representatives from the other principle funding agencies, and one representative from a fellow ship operating institution. The DRVRC will be chosen such that multiple disciplines in oceanography are represented.

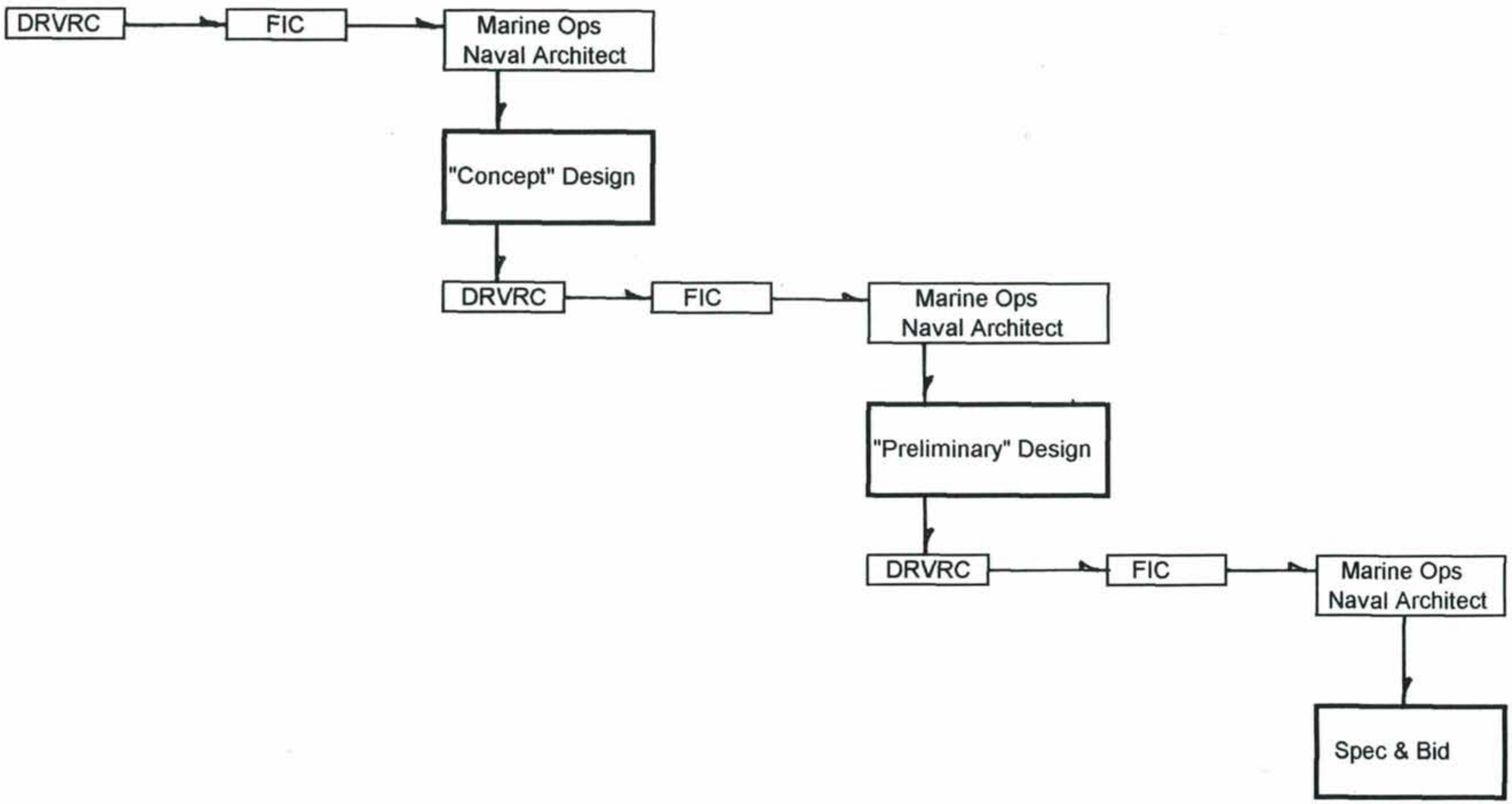
- University of Delaware
- University of Maryland
- Old Dominion University
- Smithsonian Institute
- Virginia Institute of Marine Science
- Rutgers University
- Ship Operating Institution
- Navy (NRL, NAVO)
- NOAA
- NASA

Total Persons (~10)

2) Documents and Plans proposed by the DRVRC will then be presented to FIC for review and comment.

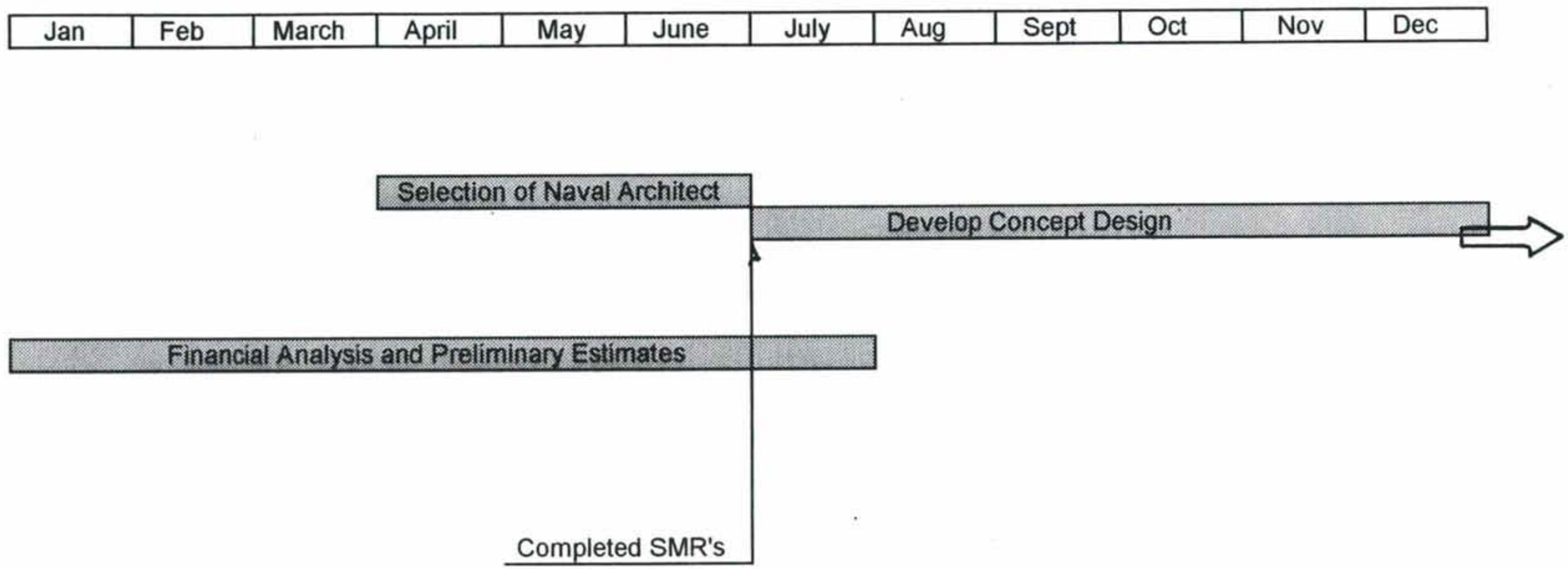
3) Marine Operations and Naval Architect will implement recommendations and make final decisions on how to best follow recommendations.

University of Delaware R/V Design Process



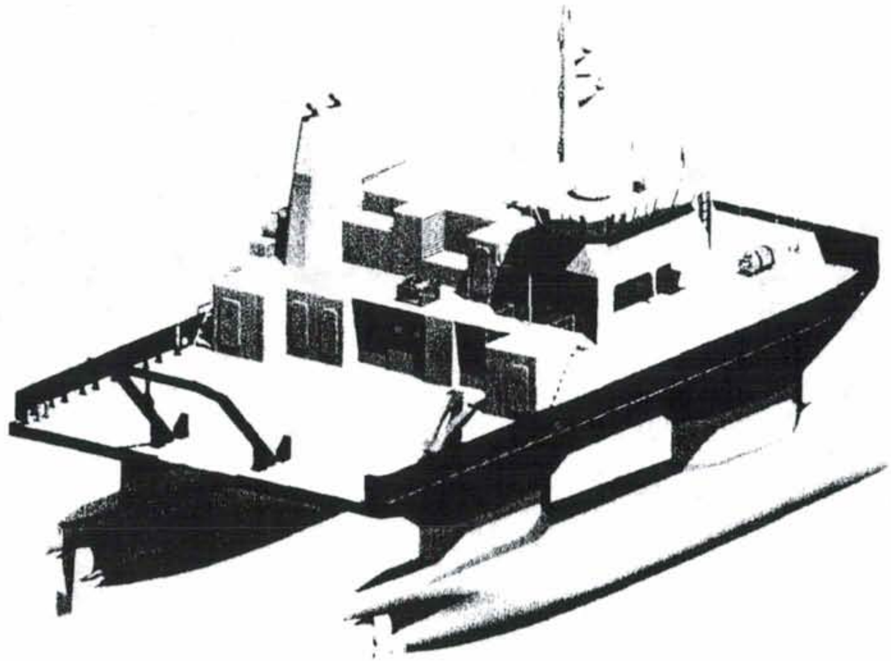
	Role in Design Process			
	DRVRC	FIC	Marine Operations Naval Architect	Shipyard
Science Mission Requirements	Develop	Review/Comment	Follow	None
"Concept" Design	Review/Comment	Review/Comment	Develop	None
Preliminary Design	Review/Comment	Review/Comment	Review Comments Make Changes Develop Preliminary	None
Spec/Bid and Verification	None	None	Implement	Verify
Final Design	Review/Comment (If Required)	Review/Comment (If Required)	Review Comments Make Changes Develop Final	Comment
Construction	None	None	Supervise	Construct

Preliminary 2000 Schedule



Appendix VIII

Coastal Research SWATH



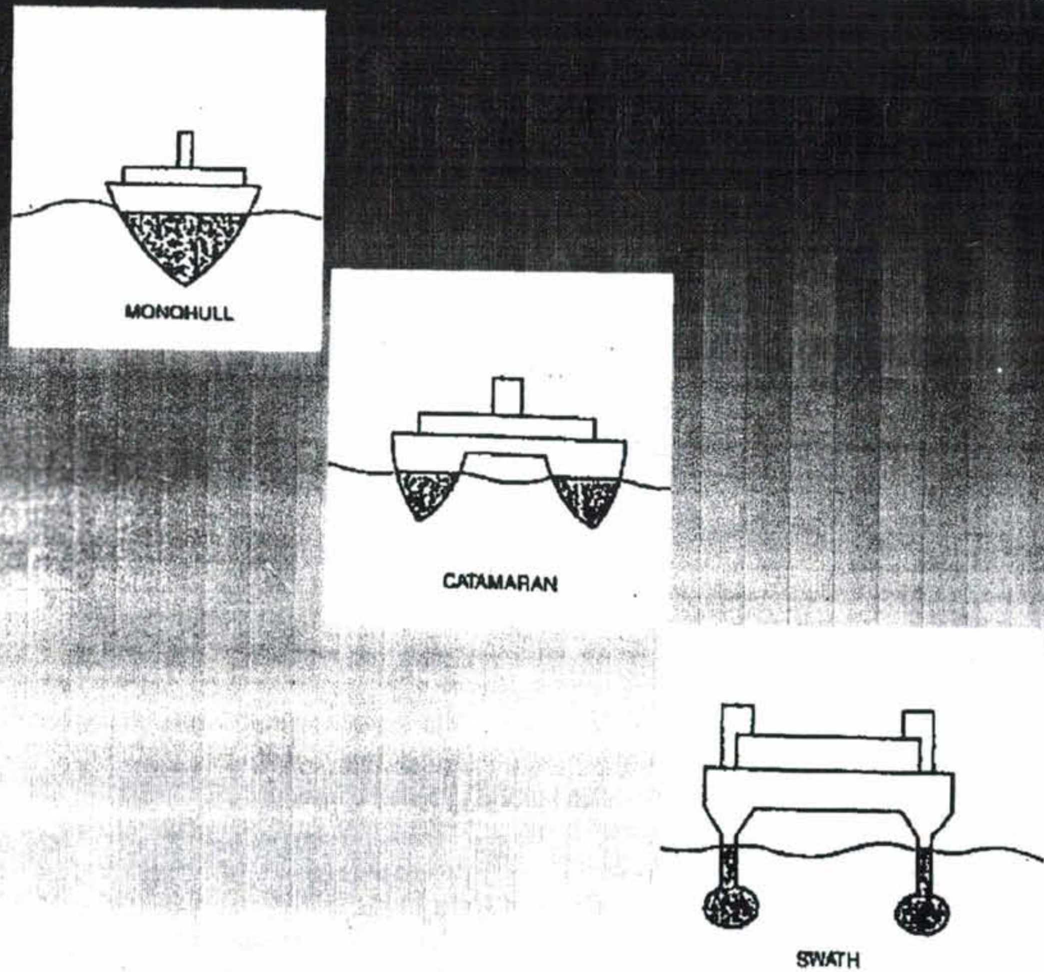
Coburn, Gaul & Hurley; *Design of a SWATH Coastal Research Vessel*

What is a SWATH ?

Small

Waterplane

Area



Coburn, Gaul & Hurley; *Design of a SWATH Coastal Research Vessel*

Design Summary

• Length, Overall	105 feet
• Beam, Overall	51.5 feet
• Draft, Transit, Full Load	9.5 feet
• Draft, Operations	13.5 feet
• Displacement Normal Operations Draft	418 LT
• Power (total) Main Engine Generators, 2	1,600 kW
• Propulsion Motors, 2	1,100 HP ea.
• Speed Transit draft, Clean Hull Trial conditions	13 knots
• Speed In-Service, SS-4	11-12 knots
• Bow Thruster Motor	275 HP
• [illegible]	

Design Concept

- SemiSWATH™Concept
  - variable draft
  - tandem strut
- Steel struts & lower hull; Aluminum deckhouse
- Diesel-electric propulsion, integrated with ships service

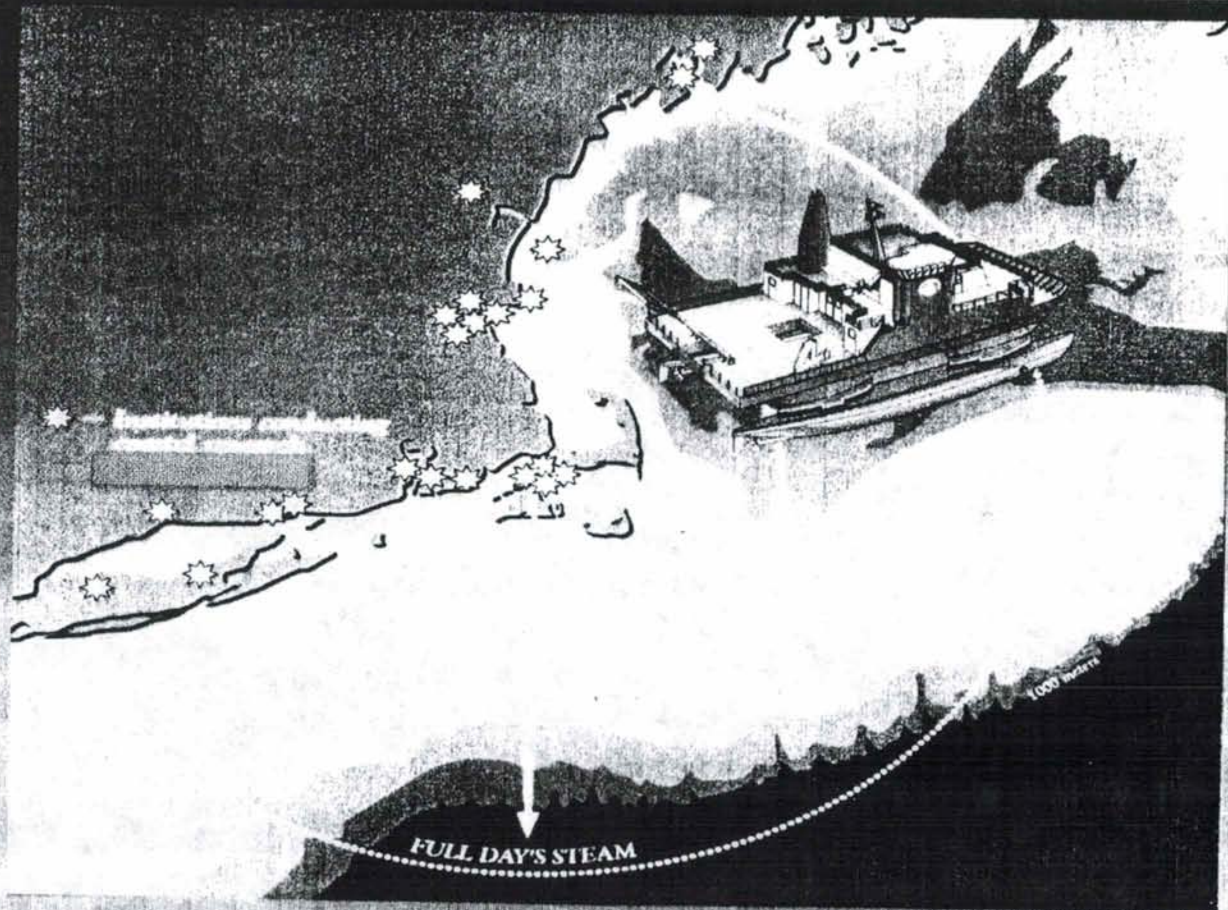
Additional Design Requirements

- Laboratory Space
  - 300 sq. ft. minimum
- Working Deck
  - 2000 sq. ft. minimum; clear unencumbered deck space
- Science Outfit
  - High flexibility - all winches, cranes, frames, etc. to be totally portable through the use of deck bolt-downs.
- Stationkeeping
  - Dynamic positioning in 35 knot wind, 1 knot current, m[illegible] excursion +/- 50 meters; all headings SS3, best heading [illegible]
- Acoustically "quiet"

Mission Requirements

- Seakeeping
  - SS5; Work on Georges Bank in winter.
- Size
  - Not to exceed 300 GRT. Minimum draft not to exceed 10 feet.
- Range & Endurance
  - 1000 nautical miles & 15 days.
- Variable Deck Load
  - 20 long tons
  - Capability for one std. 8' x 20' portable deck [illegible]
- Speed
  - [illegible] knots cruising [illegible]

Coastal SWATH Operating Area

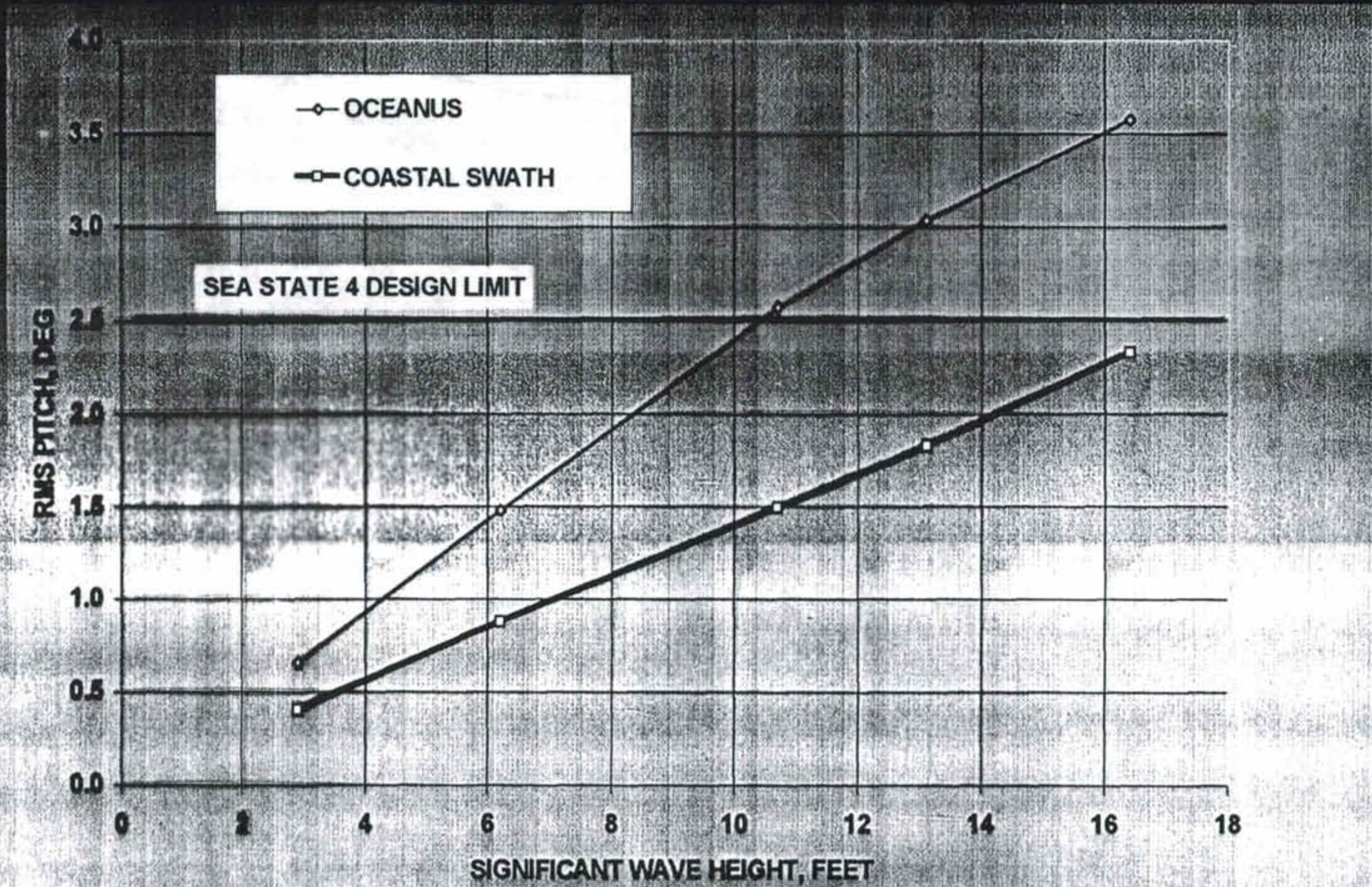


Coburn, Gaul & Hurley; *Design of a SWATH Coastal Research Vessel*

Design Process

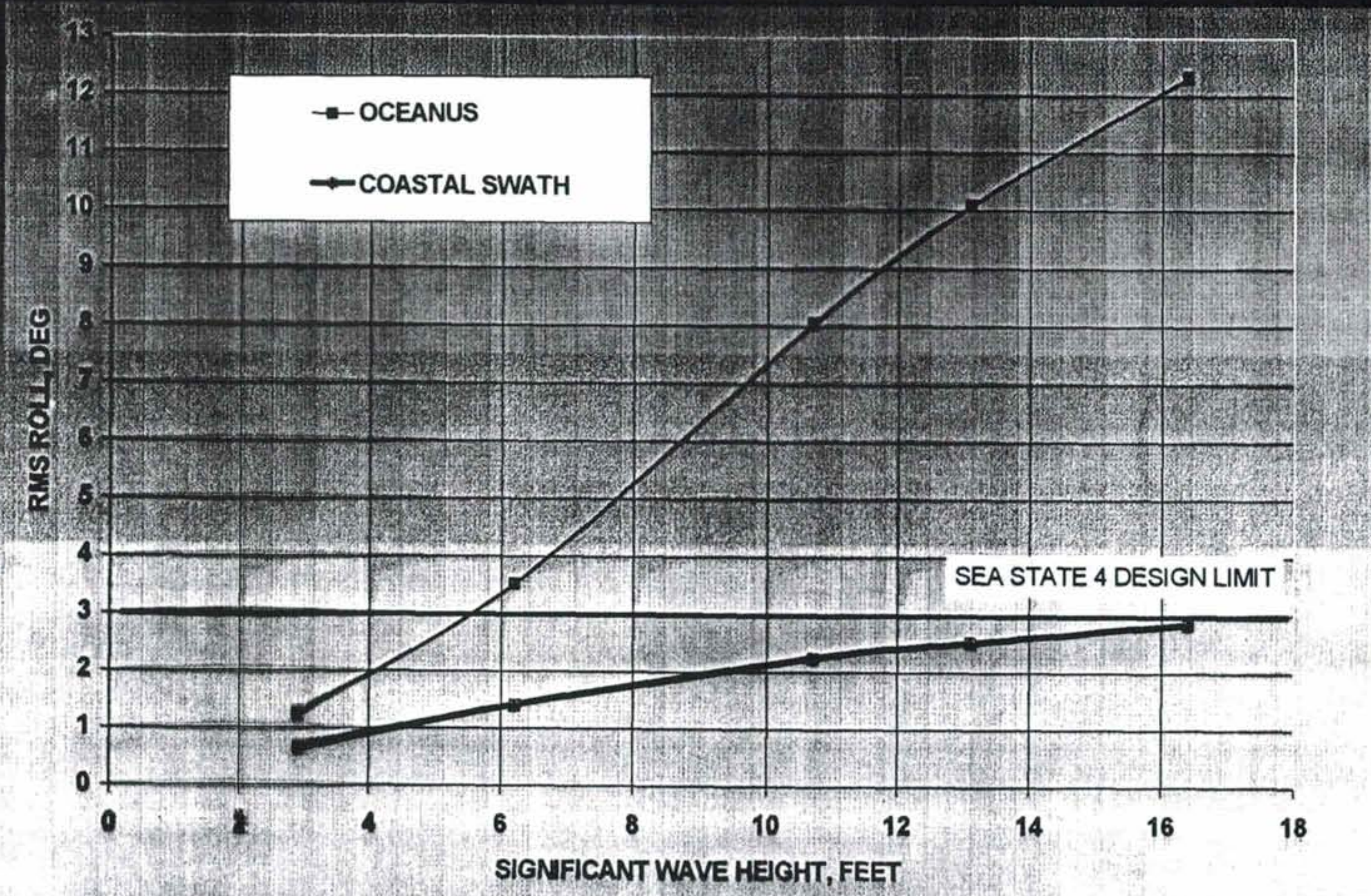
- Conceptual & Preliminary Design
  - User input
- Independent Review
- Model Tests
  - Resistance, speed & powering
  - Structural prying and squeezing loads
  - Slamming structural loads
  - Seakeeping
  - Natural [illegible]
- Finite element model
- Dynamic Loads Analysis

Expected Pitch in a Seaway



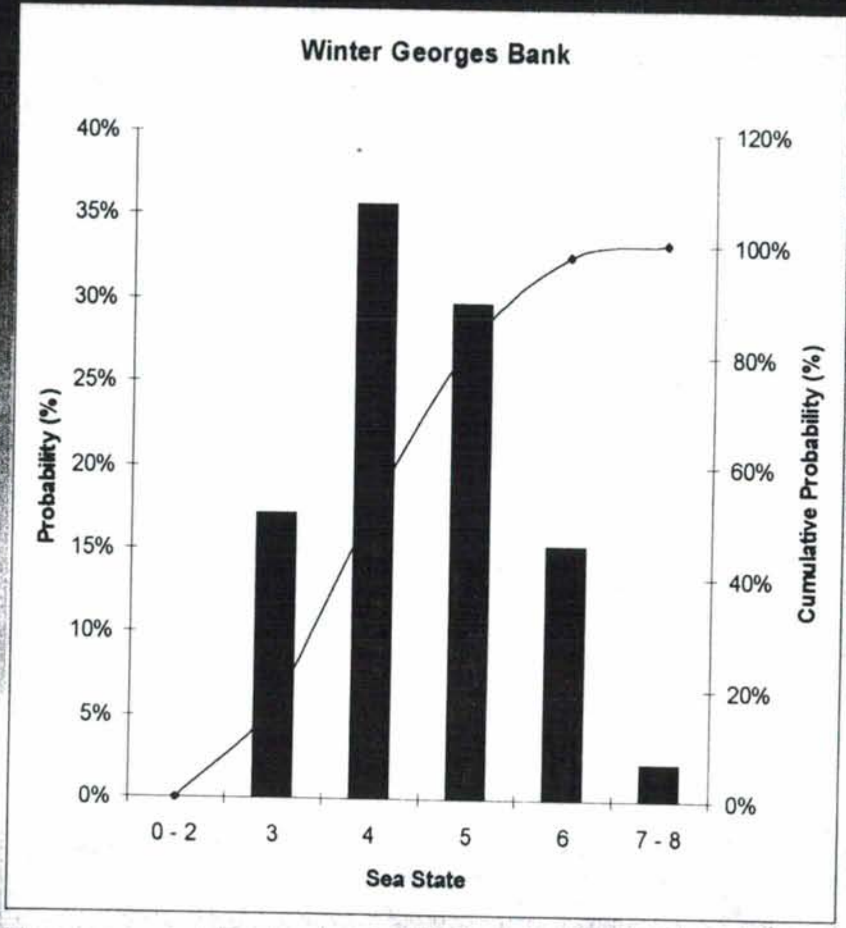
Coburn, Gaul & Hurley; *Design of a SWATH Coastal Research Vessel*

Expected Roll in a Seaway



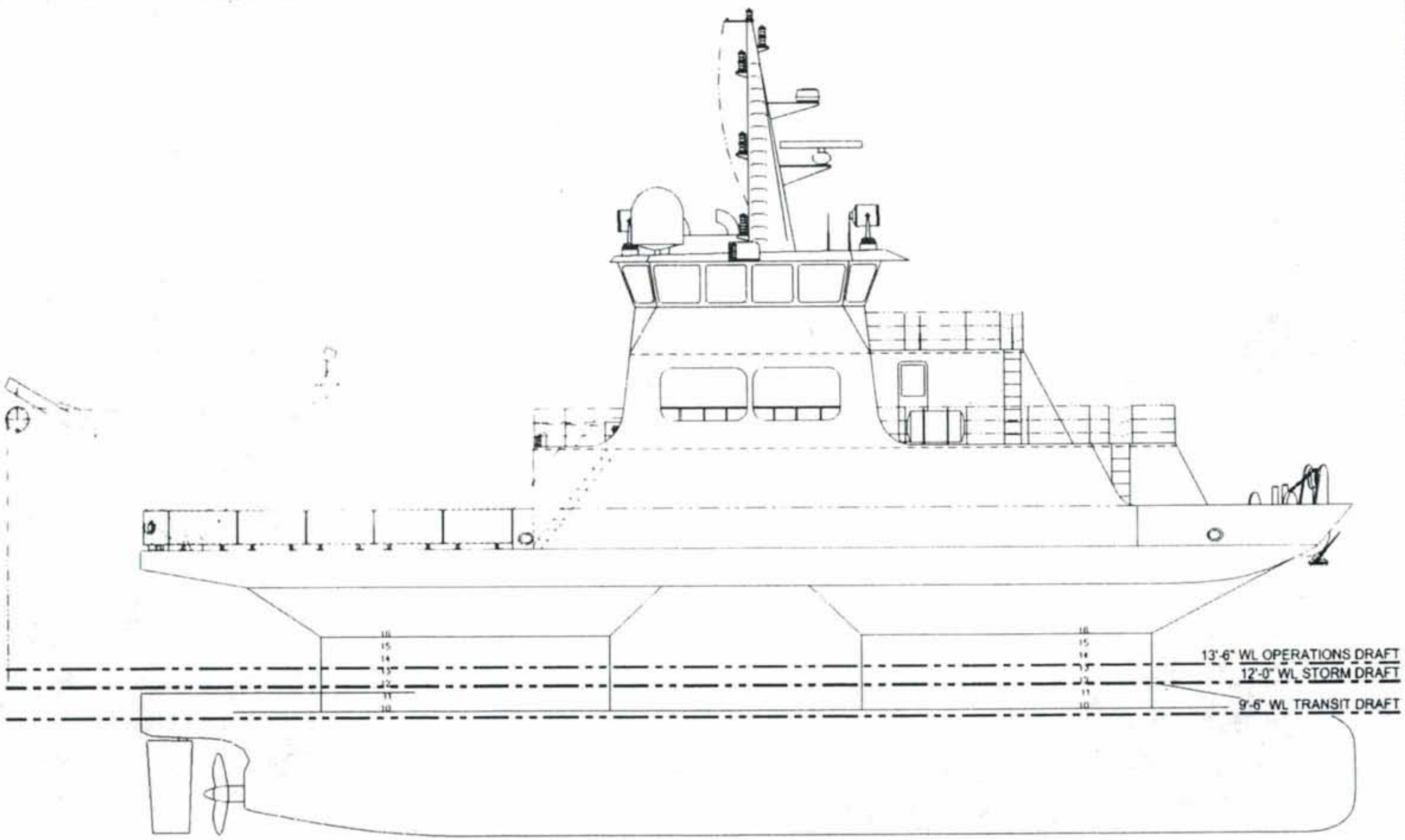
Coburn, Gaul & Hurley; *Design of a SWATH Coastal Research Vessel*

Design Operating Conditions



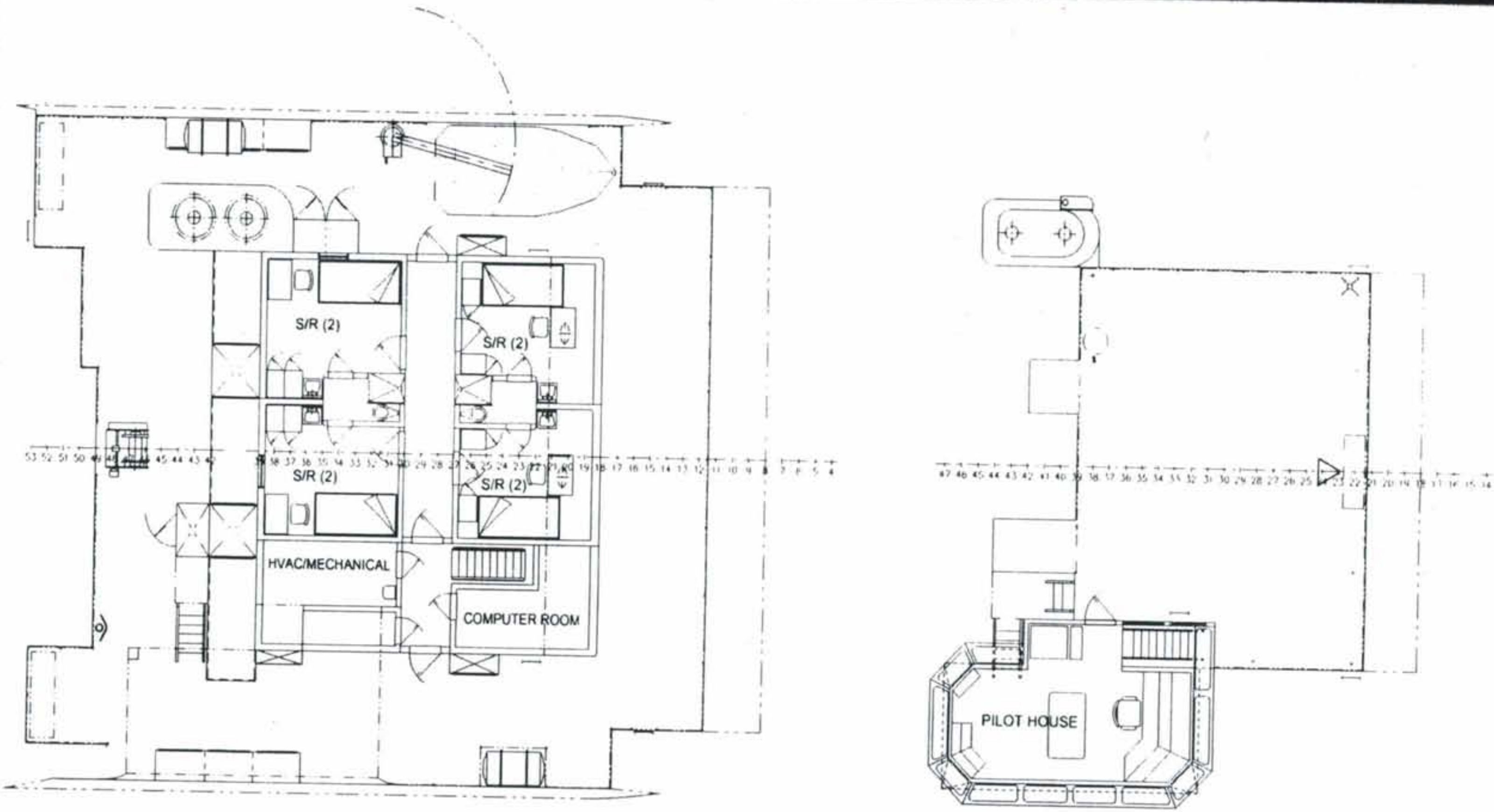
Coburn, Gaul & Hurley; *Design of a SWATH Coastal Research Vessel*

Outboard Profile



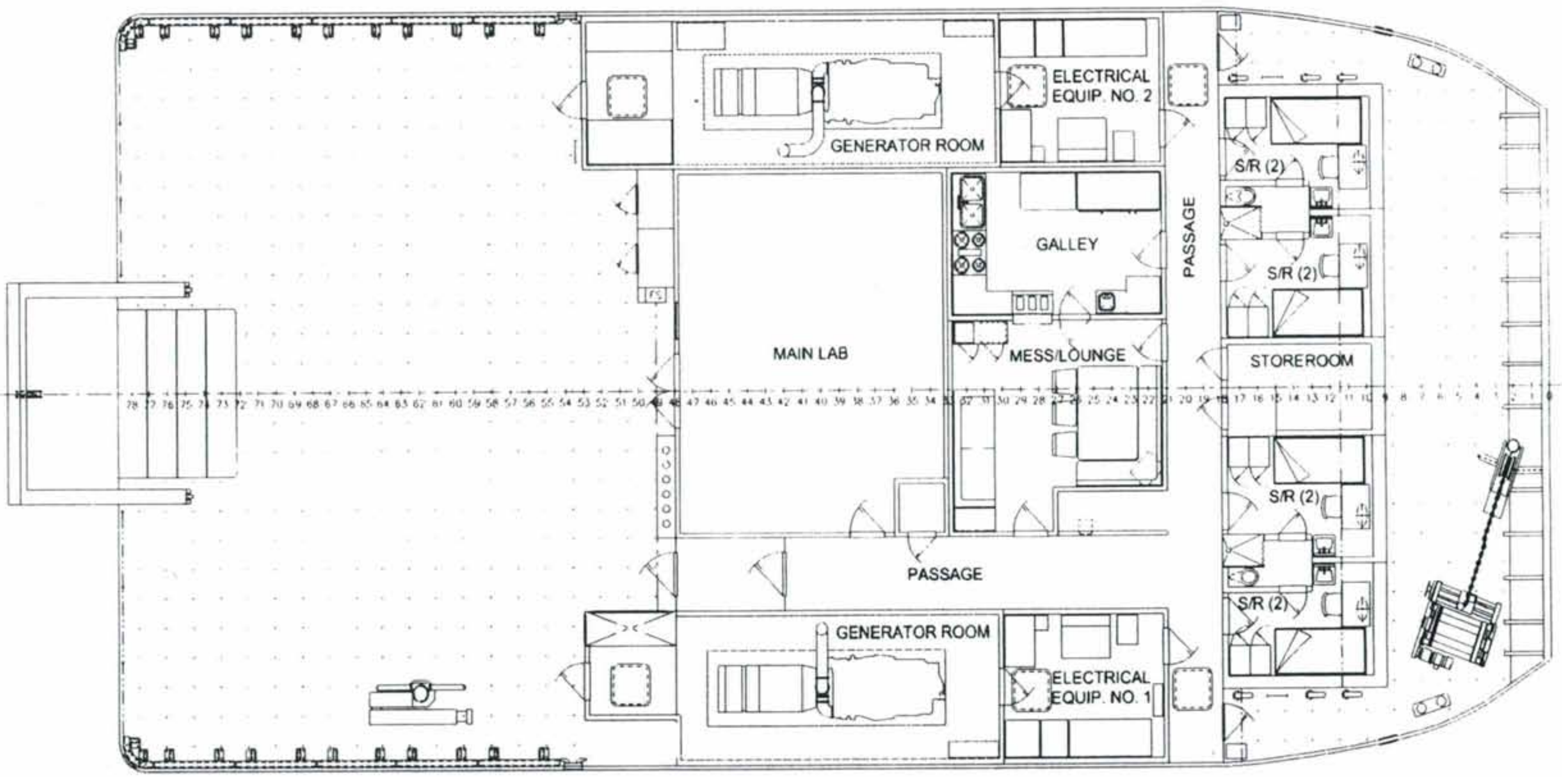
Coburn, Gaul & **Hurley**; *Design of a SWATH Coastal Research Vessel*

Upper Decks Arrangements



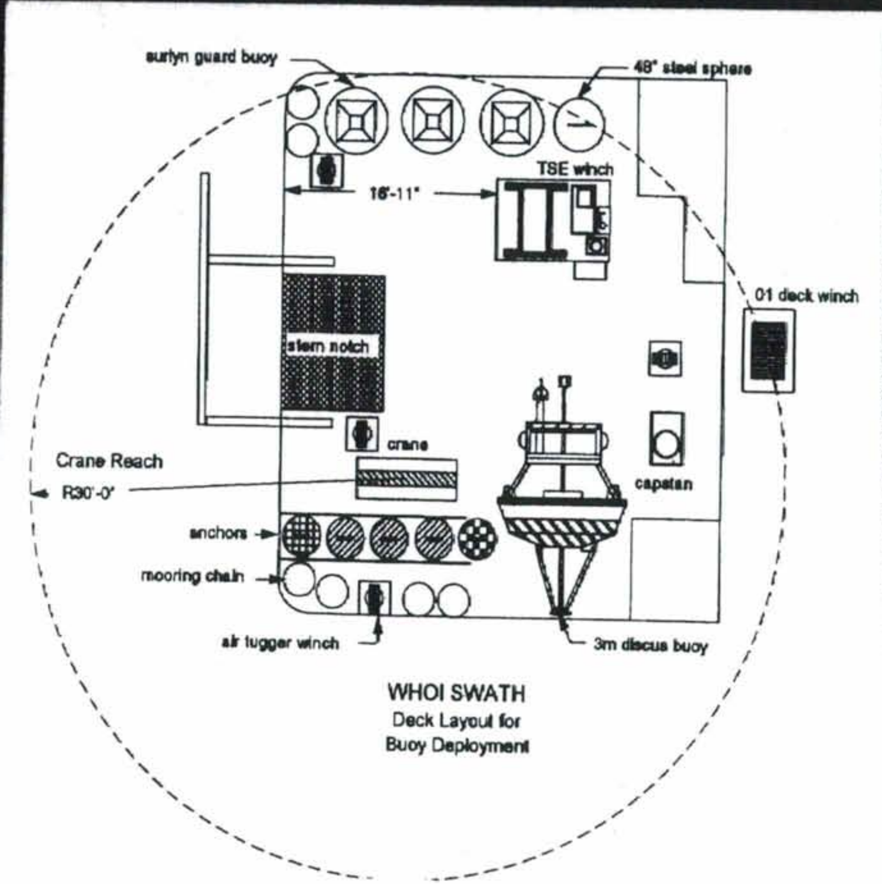
Coburn, Gaul & Hurley; *Design of a SWATH Coastal Research Vessel*

Main Deck Arrangement



Coburn, Gaul & **Hurley**; ***Design of a SWATH Coastal Research Vessel***

Deck Layout for Buoy Deployment



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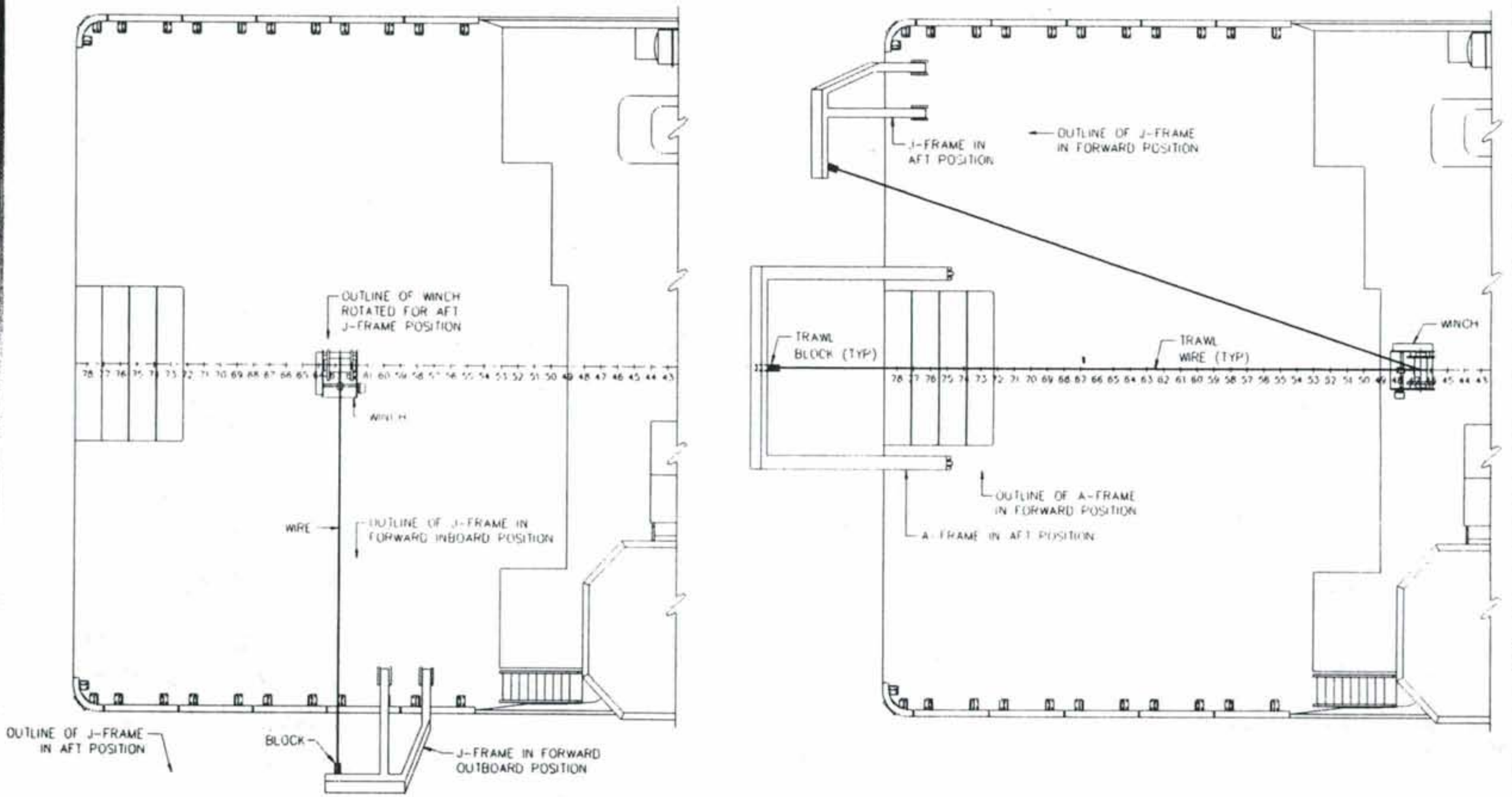
Deck Layouts for Varying Operations



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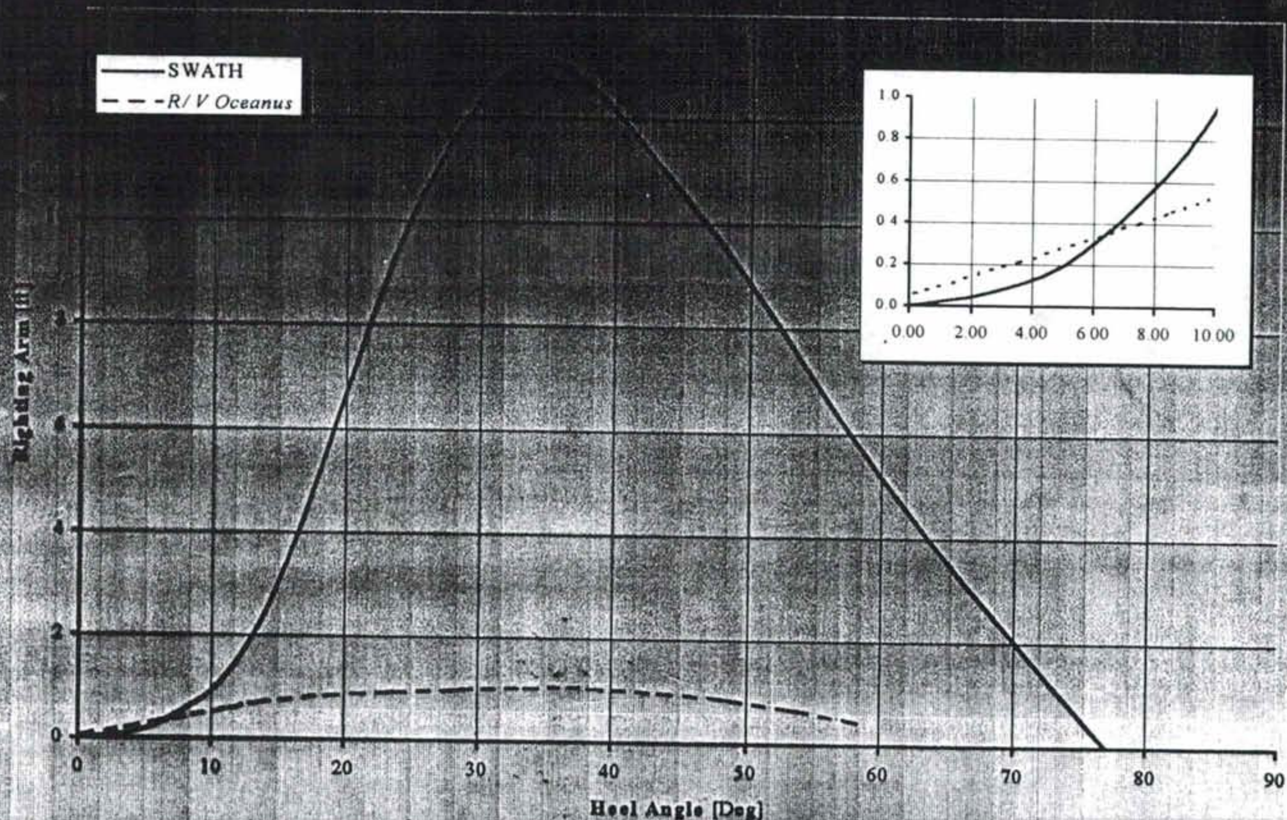
Design Assessment

- ☑ Seakeeping
- ☑ Operating Costs
- ☑ Variable Payload
  - ☒ 19 tons vs. 20 ton goal
  - ☑ Variable draft concept offers much flexibility
- ☑ ABS & SOLAS Certifications
- ☑ Dynamic Positioning
- ☑ Speed
  - Calm water max speed a little below goal
  - ☑ 11 Knots in SS4, 8 knots in SS6 far exce [illegible]
- ☑ No Centerwell

Costal Research SWATH Stability



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