UNIVERSITY - NATIONAL OCEANOGRAPHIC LABORATORY SYSTEM

UNOLS FLEET IMPROVEMENT COMMITTEE

MEETING REPORT

February 5 - 6, 1996

Stennis Space Center
Building 1002, Room 162
Stennis, MS

Meeting Report
UNOLS
FLEET IMPROVEMENT COMMITTEE

Naval Oceanographic Office
Stennis Space Center
Stennis, Mississippi
5-6 February 1996

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1. OPENING REMARKS - The UNOLS Fleet Improvement Committee met in Room 162 at the Naval Oceanographic Center in Stennis, Mississippi on February 5 and 6, 1996. Captain Dieter Rudolph welcomed the FIC to NAVO and provided the opening remarks. He gave a brief description of the NAVOCEANO facility at Stennis Space Center and the status of the Navy's survey fleet and assets. A major initiative for NAVOCEANO is to initiate "cross-learning" projects. Data processing can be applicable as a cross-learning project by placing NAVOCEANO personnel on UNOLS ships and vice versa to observe different methods for handling data. The annual budget for operation of their survey ships is approximately $65 million.

2. INTRODUCTION AND WELCOME TO NEW FIC MEMBERS - Chris Mooers, FIC Chair, introduced and welcomed the new FIC members. New members include Bess Ward from the University of California, Santa Cruz (her areas of interest include molecular biology), Tom Weingartner from the University of Alaska (his areas of interest include Arctic physical oceanography), and Larry Atkinson is replacing the remainder of Don Wright's term (his areas of interest are physical and chemical oceanography). All other meeting participants (***Appendix I***) were introduced.

Chris reviewed the FIC subcommittees and task assignments. He emphasized that everyone needs to be involved in a significant fashion. The Fleet Improvement Plan (FIP) needs to be updated. This is a two-year process that should begin now. Improved science communication is needed in the development of the FIP update. Community awareness of UNOLS needs to be heightened. Open forums at ocean science conferences were suggested. Ken Johnson is writing an article on the state of UNOLS to be published in EOS.

The meeting agenda is included as ***Appendix II***.

3. STATUS REPORTS:

3.a. News from the UNOLS Council - Ken Johnson, UNOLS Chair, reported that the National Research Council OSB report on Arctic research facility needs has been published. The report endorses the construction of the USCG Ice Breaker HEALY, but emphasizes that the Coast Guard must work with the community during the vessel's construction and operations. UNOLS will establish a high latitude facility committee to work closely with the U.S. Coast Guard to advise on polar science operations and provide oversight of HEALY's construction with respect to science facilities. The USCG will provide most of the support for this new committee. The Ocean Sciences Division at NSF has shown interest in the committee and is working to help establish it.
Construction plans for an Arctic Research Vessel are on hold indefinitely.

Ken discussed the UNOLS report on Projections for UNOLS' Future. The report was prepared by a UNOLS Subcommittee chaired by Peter Betzer. There are still many unanswered questions mostly because of the uncertainties with NOAA's future, especially the fate of the NOAA Fleet. Ken and Jack Bash have been asked to attend a meeting in Washington, DC to discuss the future of NOAA's fleet operations and how its potential changes may impact the UNOLS Fleet. The committee briefly discussed UNOLS capability for performing fisheries oceanography.

In other UNOLS matters, ATLANTIS has been designated as the new deep submergence support platform to replace ATLANTIS II. An agreement was reached between ONR, NSF and WHOI to support the ship's modification costs.

The 1996 schedules are posted. All funded science ship days have been scheduled. The large ships have good schedules; however, most of the intermediate and small vessels are showing low utilization. CAPE HATTERAS will be tied-up for the year.

Ken reported that the MBARI's new swath vessel, WESTERN FLYER, arrived at Moss Landing on 2 February. The vessel is 119 feet in length and has a 56-foot beam. Its cruising speed is 14 knots.

A Diving Safety Meeting was held in October to review and update the 1990 diving report. Approximately 15 people attended including agency representatives, Michael Lang from Smithsonian, ship operators, dive officers, and divers. Changes have been drafted and are under review. A supplement to the 1990 report will be distributed which will provide the changes to the original report. One of the recommendations was the need to heighten awareness of diving safety. Ken Johnson has written a letter which will be distributed to ship operators expressing the need for diving safety.

The Department of Commerce (DOC) has approached UNOLS regarding their fisheries buy-out program. Under the program, DOC buys fishery vessels from commercial fishermen. The fishermen in turn must give up their licenses to fish. DOC has a formula for selecting which vessels to buy. The most attractive vessels are those yielding the biggest catches. Ships vary in age and size; from two to 40 years old and 60 to 220 feet in length. Prior to buying the vessel, the vessel owner has the option to cannibalize the vessel. The UNOLS Office has advertised to the community that these vessels can be made available to their institutions. Once a vessel is selected by DOC, the institution can negotiate directly with the fishermen regarding the degree of cannibalism. Last year, 13 ships were bought by DOC and destroyed. Most of the ships were concentrated in the N.E. Atlantic. Fifteen inquiries into the buy-out program have been received at the UNOLS Office.

3.b. Inventory of Small R/Vs - Jack Bash reported that most of the small boat inventories from the various U.S. geographic regions have been posted to the WWW. Those areas that have not been posted are almost ready for posting. FIC recommended that Jack add a disclaimer to the posting stating that these vessels are "available for scientific use, but their listing does not guarantee approval for federally funded programs."

3.c. Primer on Small R/Vs - Jack Bash reported that no further progress has been made in developing a primer. Bob Dinsmore has retired. Jack will assist in coordinating this effort. It was recommended that a volunteer from RVOC be sought to take over the project.

3.d. Point Paper on Safety Orientation - Suzanne Strom was not present, but she had passed her draft paper and comments to Chris prior to the meeting, see ***Appendix III***. Suzanne points out that it appears that not everyone is acutely interested in the safety problems. There is a need to elevate awareness of shipboard safety. RVOC is planning to produce a video highlighting important safety tips. FIC made a number of recommendations:

- Post signs on ships with simple safety reminders.
- Canvas the crews on what scientists tend to neglect in regard to safety
- Offer CPR classes.
- Require science parties to attend a safety briefing prior to setting sail.
- Establish physical standards for the science party, possibly with required physical examinations.
- Define the Chief Scientist's responsibility in regard to safety.

The safety orientation paper will be published in the UNOLS Newsletter along with a cover letter by Ken Johnson.

Joe Coburn provided an example of a European shipboard safety video. After viewing the video, FIC encouraged RVOC to proceed with the production of a safety orientation video.

<u>3.e. Report on Van Study</u> - Suzanne Strom provided the draft Van Study for FIC's review, see ***Appendix IV***. It was noted that USCG and ABS regulations regarding vans should be referenced in the study. (FIC members passed written comments to Chris, who in turned passed them to Suzanne.) NAVOCEANO offered to provide the ABS regulations to Joe Coburn. The draft study will then be provided to RVOC and RVTEC for their review. It was suggested that the study be completed for the summer UNOLS Council meeting.

<u>3.f. Nuclear Submarine Report</u> - Jack Bash reported that the Nuclear Submarine report is in its final review and is expected to be distributed in approximately six weeks.

<u>3.g. ARV Ocean Studies Board (OSB) Report</u> - Tom Weingartner provided a review of the National Research Council OSB report, *Arctic Ocean Research and Supporting Facilities - National Needs and Goals*. The report outlined three configurations to meet Arctic science needs:

1. Cease building HEALY and build the ARV,
2. Don't build the ARV, but operate HEALY in a dedicated research mode similar to the way the ARV would be operated, or
3. Retire one polar class vessel and build both the HEALY and ARV.

Although, the ARV is not a dead issue, at the present time configuration (2) is being pursued. NSF, USCG and UNOLS are forming a committee to be supported largely by the Coast Guard, to advise on Arctic science operations and provide oversight to the HEALY construction process. Tom Weingartner provided a comparison table of the ARV and HEALY along with summaries of why one vessel is better than the other, see ***Appendix V***. HEALY will be able to carry more scientists and is more ice capable, and the cost to NSF is less ($20,000 versus $33,000/day). The ARV is designed as a more capable science support vessel. Attributes include more/better science equipment, technical assistance, and crew experience. The laboratories are larger with a better layout. HEALY has no Baltic rooms (covered working deck areas for protection against harsh environment).

<u>3.h. Agency Reports -</u>

National Science Foundation (NSF) - Dolly Dieter provided the report for NSF. She began by explaining that NSF is operating under a continuing resolution until 15 March. It is very difficult to speculate what the continuing resolution will bring in terms of funding. If funded at 90% of the 1995 level, ship operations will most likely all be funded. At the present time, NSF is authorized to fund up to 75% of the 1995 level. At this time, there has been no future commitment for GLOBEC field work from NOAA. NSF is becoming very concerned.

Office of Naval Research (ONR) - Sujata Millick provided the report for ONR. She began by outlining the highlights of the 1995 CNO Executive Board (CEB) study. The Board met in the spring and has published its report. The study promotes Navy's role in oceanographic research. The study recommended that ONR maintain its ocean sciences budget at or above the FY96 level. In other matters, an agreement has been reached between WHOI, ONR and NSF to modify ATLANTIS to become the new support ship for ALVIN and ROVs. REVELLE delivery is scheduled for 8 June. The formula for funding ship time by ONR has changed. The Research Facilities program will now provide 80% of the ship time costs and the science programs will provide 20%. In the past, science programs provided roughly 45% of the cost. The effects of this change most likely will not be felt until 1997; however, some of the science program officers that are aware of the change have already requested additional ship time.

Naval Oceanographic Office (NAVOCEANO) - CDR Darrell Smith provided a report on NAVOCEANO's Survey Fleet and assets, see ***Appendix VI***. He first provided a list of points of contacts for each of the UNOLS Committees. Next he showed a map of the current locations of the survey vessels and aircraft. The assets are dispersed world wide. Darrell provided views of the profiles of each ship class. NAVOCEANO recently acquired the USNS WATERS. The vessel had been previously used by the Navy in SPAWARS operations. It is 457 feet in length and has four bowthrusters. The vessel will carry four HSLs and two ROVs for bathymetric survey work. A comparison table of the four classes of survey ships was provided. The KANE will be transferred to the Turkish Navy in the near future. The TAG-60 Class is still experiencing transformer problems and as a result is presently speed-limited. These problems are still being investigated. These ships are 329 feet in length and can carry 27 scientists. Other assets discussed included "SHOALS" which is a laser airborne sonar system and the Oceanographic Remotely Controlled Automation (OCRA), an AUV. ORCA looks similar to a torpedo with a mast. It is approximately 24-feet in length with a 21-inch diameter. It's mission is the cost-effective collection of hydrographic and oceanographic data. ORCA carries an ADCP and a CTD. The approximate cost of ORCA with a SIMRAD system is $2 million. Darrell Milburn from NAVOCEANO provided an additional report on new technologies and ORCA. A paper describing ORCA and its capabilities is included as ***Appendix VII***. FIC indicated that UNOLS would be interested in receiving NAVOCEANO's list of new technologies.

Oceanographer of the Navy's Office - Pat Dennis provided a brief report. The Oceanographer's modernization plan is expected to be complete in FY97 and result in a fleet of eight survey ships. The TAG-60 Class construction has proceeded and, by April, three ships will be delivered. TAG-63 is scheduled for delivery between October 1997 and February 1998. USNS WATERS will undergo yard work this year making it capable to support survey work. There is growing support for NAVOCEANO to work with UNOLS; however, potential conflicts with operations in EEZs will need to be investigated. If funding permits, and the timing can be accommodated, NAVOCEANO would like to experiment with utilizing UNOLS vessels. Pat concluded by reporting that NAVOCEANO was very encouraged by the CEB study and will work to build strong partnerships between Navy, industry, and academia.

3.i. Whither UNOLS - Peter Betzer reviewed the findings of the report, *"Projections for UNOLS' Future - Substantial Financial Challenges,"* see ***Appendix VIII***. The fundamental questions that the report attempts to answer is whether there will be sufficient science and operational funding in the future to support the UNOLS Fleet as currently configured; if not, what actions might be taken to maximize the effectiveness of the Fleet. A committee chaired by Peter was formed to address these questions and report their findings. Peter reviewed the specific charge to the Committee. The charge included five elements: (1) review Don Heinrichs' budget projections, (2) assess a general model for the UNOLS Fleet requirements for supporting science, (3) if an imbalance exists between requirements and resources, offer suggestions as to how to remedy the situation, (4) investigate what UNOLS operational/fiscal changes would work best, and (5) could fleet realignment lead to a more effective use of our ships? Table (1) and Figure (1) of the report show the trends in federal support over the past 27 years. NSF and "other" support has increased five-to-six-fold and ONR's support has remained the same. UNOLS Fleet operations support is projected to be level into the future. Under this scenario, by 1997 there will be a shortfall in funding of approximately two large ships and one intermediate.

One recommendation of the report is to build partnerships with other federal agencies. Unfortunately, NOAA's future plans are unclear. The USGS has provided some positive feedback. They may be interested in using 30 to 60 days of Class IV time each year. Ken Johnson plans to contact agencies after the report is distributed. The report should be ready for distribution by mid February.

3.j. ALVIN Support Ship Conversion - Joe Coburn reported that four parties (WHOI, NAVSEA, ONR and NSF) worked out an agreement with the shipyard, Halter Marine Inc., to modify ATLANTIS to be the new submersible/ROV support ship. The cost of the modification was negotiated at approximately $2.7 million and will be split evenly between NSF, ONR and WHOI. The A-frame from ATLANTIS II will be cross-decked. An area has been designated for battery storage, spares, etc. Shops for ALVIN and ROVs will be added along with an ROV hangar and hydroboom. The modifications will not impact the general oceanographic capability of the vessel. ATLANTIS was launched on schedule on 1 February. Builders trials are scheduled for December 1996. Delivery of the ship (with the ALVIN modification installed) is planned for 15 April 1997. ATLANTIS II is presently for sale and may be scrapped.

3.k. AGOR 24/25 Construction Update - Joe reported that REVELLE is scheduled to undergo builder's trials in March with delivery planned for June 1996. After transit to Scripps, the ship will have a fitting out period. The ship's 1996 schedule is very minimal. Since AGOR 23's delivery, most (if not all) of the major deficiencies in the ship's design have been addressed and corrected on AGORs 24 and 25. These include noise reduction, addition of a traction winch, bridge rearrangement, and transition to copper nickel piping. NOAA's AGOR construction is coming along. Launch is scheduled for May 1996 and delivery is planned for August 1997.

4. INITIATIVES:

4.a. Shipboard Technology Upgrades - Chris Mooers opened the discussion on shipboard technology upgrades by distributing an outline for a study plan (see *Appendix IX*). Rich

Findley informed FIC of the efforts of RVTEC. An ad hoc committee was suggested to study shipboard technology upgrades. Eric Firing was recommended to chair the committee. Bess Ward would address biological issues; Bob Detrick, geology; Peter Betzer, chemistry and a representative would be found to address engineering issues. A representative from NAVOCEANO would also be asked to serve on the committee.

Rich discussed the progress of JOI's development effort with SeaNet, see *Appendix X*. A prototype of SeaNet, which is a method of bringing Internet to sea, was installed on THOMPSON in October 1995 and has been used successfully from the Indian Ocean. Technical support for this program was provided by Andy Maffei, WHOI; Bill Martin, UW, and Mike Relander, UW. The system uses INMARSAT B. One problem encountered was the masking of the signal to the antenna causing a disruption in transmission. When the ship was positioned for a clear signal, the system worked faster than shoreside Internet. Rich presented an analysis of the economics suggesting a significant cost reduction over slower data transmission rates using the traditional Inmarsat A. Next steps in the SeaNet development include: (1) working closely with other UNOLS ships for further development of a standard B interface to SCN, (2) identifying a science cruise that requires high speed data requirements, and (3) identifying other UNOLS institutions planning upgrades to INMARSAT B to assist in data considerations.

4.b. UNOLS Fleet as Real-Time Data Platforms - Rich Findley reported that not much progress has been made on this subject but will be reported on at the summer FIC meeting. However, RVTEC is working on data standards which will be important when addressing real-time data collection. FIC member, Eric Firing, has been working with RVTEC on this issue. RVTEC has encouraged OSU to submit a NSF proposal for data standard development.

4.c. UNOLS Fleet as MG&G Platforms for NAVO - In Bob Detrick's absence, no update was provided.

4.d. White Paper on Regional Consortia - Chris Mooers had distributed a draft white paper on the use of regional consortia and the need to hold workshops to better define future R/V needs of regional consortia, see *Appendix XI*. All UNOLS operating institutions are presently members of one or more consortia, with the exceptions of Scripps and Hawaii. Chris asked the committee to review the white paper and provide comments.

4.e. Gravimeter MOU - Pat Dennis described the cooperative effort between NAVOCEANO and academia concerning the loan of NAVO gravimeters. An MOU has been signed with NAVO, NSF, ONR, and WHOI to coordinate this effort. A subcommittee, with Dan Fornari as Chair, has been established to oversee the loan process. Dave Epp, NSF; Dan Fornari, WHOI; and Robin Bell, LDEO have been key figures in making this arrangement for the academic fleet. The program is working well and could be an example for other cooperative efforts involving the loan of NAVOCEANO instrumentation.

5. COASTAL ZONE RESEARCH VESSEL (CZRV) PLANNING:

5.a. Scientific Mission Requirements - The action for CZRV Scientific Mission Requirements was assigned to Larry Atkinson. This is also one of the objectives for the MARCO workshop which is awaiting a funding decision.

5.b. MARCO Proposal Update - Larry Atkinson advised the committee that MARCO had not yet been informed by NSF as to the funding status of their proposal to hold a workshop and develop a science mission plan. Larry was tasked to review existing Science Mission Requirements (SMRs) as they apply to a CZRV and to MARCO. Jack Bash reported that Duke has received information from a naval architect that it is possible to add a mid-section to CAPE HATTERAS without causing the ship to exceed 500 gross tons (allowing it to remain uninspected). It is the intention of Duke to proceed with a proposal to NSF for a Phase I feasibility study, then, in Phase II, contract design, and, in Phase III, detail design for accomplishing the stretch, (see ***Appendix XII***). FIC recommended that Ken and Chris draft a letter to Duke encouraging them to communicate with MARCO regarding their plans for CAPE HATTERAS. Jack also reported that Skidaway was investigating the replacement of BLUE FIN. They have retained a naval architect and are looking at a mono-hull design of 87 feet for a replacement vessel, see ***Appendix XIII***.

5.c. Analysis: Assets, Capabilities, and Requirements - Chris Mooers lead an extended discussion on the makeup and distribution of the UNOLS fleet. This was stimulated by the report of "*Projections for UNOLS' Future - Substantial Financial Challenges*" (the Betzer report). The discussion also included the need to commence an update of the Fleet Improvement Plan for 1998. It was decided that an Interim Fleet Plan (IFP) should be written at the earliest possible date to address the problems cited in the Betzer report. This interim report would look at three funding scenarios. The scenarios would include the number and mix of ships, including general geographical location, that could be supported by the anticipated available funding. Science program projections for coastal and blue water science will be needed. The follow-on meeting of the UNOLS Council was to look at this tasking and provide a specific charge. The Committee plans to work on the various scenarios during the spring and exchange information via e-mail so that a well developed discussion and advanced draft set of scenarios will be the product of the summer FIC meeting. These would then be polished and presented to the Council for their summer meeting.

5.d. Regional Workshops - As discussed above, the funding for the MARCO workshop is yet to be determined. The committee decided to hold up planning for other workshops until results of MARCO's funding request for a workshop were known.

6. FLEET IMPROVEMENT PLAN 1998: Chris Mooers distributed a draft outline and schedule (see ***Appendix XIV***) for the Fleet Improvement Plan (FIP) 1998. A few items were added and additional adjustments will most likely be made after preparation of the IFP. Each committee member was asked to review the FIP outline and identify at least five items they could address. Each item would be one to three pages in length. At FIC's winter ('96/'97) meeting a rough draft should be reviewed with a full draft available by summer 1997 for review by the Council and others.

TWO NEW ITEMS WERE DISCUSSED:

(1) Post Cruise Assessments - RVOC has been working on a revised post cruise assessment form. The purpose is to encourage better feedback from the cruises. Peter Betzer volunteered to review this effort for FIC.

(2) UNOLS Image - Several FIC members expressed concern that the role and actions of UNOLS are not well known in the community at large and that we need to raise our visibility. Discussion followed and suggestions included developing a UNOLS poster. (Ken is writing an article for EOS about UNOLS. It was suggested that the Council should consider this matter, too.)

7. SUMMARY OF ACTION ITEMS:

7.a. Outstanding Action Items -

(1) Jack Bash will add a disclaimer to the Inventory of Small R/Vs.
(2) Primer on small R/Vs - Jack Bash and Chris Mooers will help coordinate; a volunteer from RVOC will be requested.
(3) Complete Safety Orientation Paper - Chris Mooers will forward comments to Suzanne Strom who will then complete report. Ken Johnson will write cover letter.
(4) Complete Van Study - add USCG and ABS regulations. Chris Mooers will forward comments to Suzanne Strom. Then the study will be forwarded to RVOC and RVTEC for final review.
(5) UNOLS Fleet as Real-Time Data Platforms - Rich Findley and Eric Firing.
(6) UNOLS Fleet as MG&G Platforms for NAVO - Bob Detrick.
(7) CZRV Science Mission Requirements - Larry Atkinson.

7.b. New Action Items -

(1) FIC recommends that RVOC proceed with the production of a safety video.
(2) Letter to Duke concerning the CAPE HATTERAS stretch requesting an analysis of how this fits into the UNOLS Fleet (especially MARCO's plans), Ken Johnson and Chris Mooers.
(3) Shipboard Technology Upgrades - Form ad hoc committee to address upgrades; proposed members Eric Firing (Chair), Bess Ward, Bob Detrick, Peter Betzer, and an engineer (TBA).
(4) FIC members were assigned to investigate science programs prospects: JGOFS, Bess Ward; Global Ocean, Tom Weingartner and Bess Ward; MG&G, Bob Detrick.
(5) IFP Development - Develop, for the summer meeting, appropriate fleet size numbers and ship locations to meet National needs based on three funding scenarios (to be provided by Council tasking).

(6) 1998 FIP Update - In advance of the summer meeting, each FIC member is to identify five areas of the 1998 FIP for which they will take responsibility.
(7) Post Cruise Assessment Report - Peter Betzer will review RVOCs revised report form.

8. Strategic Plan:

8.a. How is it going? - Chris reviewed the FIC "Agenda for the Next Three Years" developed at the St. Petersburg FIC meeting in January 1995 (see ***Appendix XV***). Most action items were moving along on schedule; some have been completed. Continuing action items are noted in paragraph 7 above.

8.b. Venue and Dates for Summer Meeting - Larry Atkinson invited FIC to Norfolk and ODU. The time frame of this meeting was planned for the last week in June or the first week in July. Jack Bash was tasked to survey FIC as to the best dates.

8.c. Agenda and Special Guests - The major agenda item for this meeting will be the IFP discussed above. Additional suggestions included inviting ONR experts to speak on AUVs (Autonomous Underwater Vehicles) and RPA (Remotely Piloted Aircraft).

February 7, 1996

NAVOCEANO FACILITY TOUR

Captain Dieter Rudolph provided an overview of the NAVOCEANO facility, organization, and Fleet. Bob Barrett, Code N-5, provided an overview of the NAVOCEANO Fleet capabilities and assets. The TAGS 60 Class construction is coming to completion. These will serve as multi-purpose hydrographic survey ships. Approximately 95% of the data they collect is released. Data can be accessed on their WWW home page. In May, the USNS WATERS will undergo a yard period to make it capable as a survey ship. The ship is scheduled to be operational by 30 September 1996. The ship is 456 feet in length, has a 69 foot beam and berthing for 91 personnel (30 to 33 berths are designated for crew). A multibeam system will be installed. Lastly, Bob discussed the features of ORCA, which is 26 feet long, weighs 8600 pounds, and runs on diesel fuel. It can go 24 hours at ten knots. It is designed to be a cost-effective collection platform for hydrographic and oceanographic data. If the TAG 60 transformer problems are resolved, ORCA will be placed on the ship in April. Bob Starek, NAVOCEANO presented their Integrated Data Management System. It is a flexible system. The goal is to make it available on the WWW. Steve Lynch, NAVOCEANO, presented their visualization lab. He showed an impressive video made from data collected during a January cruise on KANE. Side scan and dredge data were collected. The video is a "fly-through" of the New River area off the U.S. East Coast. It took approximately one week to process the data. FIC then toured NAVOCEANO's super computer center and the Warfighting Support Center.

REVELLE/ATLANTIS TOURS

Meeting participants traveled to Halter Marine Inc. (HMI) in Moss Point, MS to tour REVELLE and ATLANTIS. Tours were provided by Ed Peterson, Scripps Shipyard Rep; John Thompson, WHOI Shipyard Rep; and Robert Camp, HMI.

APPENDIX I

FIC Meeting Participants - February 5-6, 1996

Name	Organization	Telephone/E-mail
Larry Atkinson	ODU	(804) 683-4926/atkinson@ccpo.odu.edu
Jack Bash	UNOLS	(401) 874-6825/unols@gso.uri.edu
Peter Betzer	U of So Florida	(813) 553-3940/prb@marine.usf.edu
Joe Coburn	WHOI	(508) 289-2624/jcoburn@whoi.edu
Patrick Dennis	CNO NO96/Staff	(202) 762-1019/dennis@onrhq.onr.navy.mil
Annette DeSilva	UNOLS	(401) 874-6825/desilva@gso.uri.edu
Dolly Dieter	NSF	(703) 306-1577/edieter@nsf.gov
Dick Evans	NAVOCEANO	(601) 688-4005
Rich Findley	RSMAS	(305) 361-4175/rfindley@rsmas.miami.edu
Ken Johnson	MLML	(408) 755-8657/johnson@mlml.calstate.edu
George Madden	NAVOCEANO	(601) 688-5293
Darrell Milburn	NAVOCEANO	(601) 688-4553
Sujata Millick	ONR	(703) 696-4530/millics@onrhq.onr.navy.mil
Chris Mooers	RSMAS	(305) 361-4825/cmooers@rsmas.miami.edu
Capt. Dieter Rudolph	NAVOCEANO	(601) 688-4203/dkr@navo.navy.mil
Cdr. Darrell Smith	NAVOCEANO	(601) 688-4370/CDR=D=SMITH%F%NAVO@navo1.NAVO.nav
Robert Van Olst	NAVOCEANO	(601) 688-5943
Bess Ward	UCSC	(408) 459-3171/bbw@cats.ucsc.edu
Tom Weingartner	U of Alaska	(907) 474-7993/weingart@ims.alaska.edu

APPENDIX II

MEETING AGENDA
FLEET IMPROVEMENT COMMITTEE
8:30 a.m. - February 5-6, 1996
Naval Oceanographic Office, Room 162, Stennis Space Center

MONDAY

(0830 to 0845) 1. Opening Remarks (CAPT Rudolph)

(0845 to 0930) 2. Introduction and welcome to new FIC members:

Bess Ward, UCSC
Tom Weingartner, UAF
Larry Atkinson, ODU

Review of subcommittees and task assignments.

(0930 to 1200) 3. Status Reports

a. News from the UNOLS Council (Ken Johnson)
b. Inventory of small R/Vs (Jack Bash)
c. Primer on small R/Vs (Jack Bash)
d. Point paper on safety orientation (Suzanne Strom)
e. Report on van study (Suzanne Strom)
f. Nuclear submarine report (Jack Bash)
g. ARV Ocean Studies Board report (Tom Weingartner)
h. Agency reports (NSF, ONR, USCG, NOO, CNMOC)
i. Wither UNOLS (Peter Betzer)
j. Report on ALVIN Support Ship Conversion (Coburn)
k. AGOR 24/25 Construction Update (Coburn)
l. Etc.(?)

(1200 to 1300) LUNCH

(1300 to 1430) 4. Initiatives

a. Shipboard Technology Upgrades (Chris Mooers & Rich Findley)
b. UNOLS Fleet as Real-Time Data Platforms (Eric Firing & Rich Findley)
c. UNOLS Fleet as MG&G Platforms for NAVO (Bob Detrick)
d. White Paper on Regional Consortia (Chris Mooers)

(1430 to 1700) 5. CZRV Planning

a. Scientific Mission Requirements (Larry Atkinson)
b. MARCO Proposal Update (Larry Atkinson)
c. Analysis: Assets, Capabilities, and Requirements (Chris Mooers)
d. Regional Workshops (Chris Mooers & Bess Ward)

TUESDAY

(0900 to 1030) 6. Fleet Improvement Plan 1998 (Chris Mooers)

a. Draft outline (see Attachment 1)
b. Draft schedule (see Attachment 2)
c. Assignments

(1030 to 1200) 7. Summary of Action Items (Chris Mooers & Jack Bash)

(1200 to 1300) LUNCH

(1300 to 1500) 8. Strategic Session

a. How is it going?
b. Venue and dates for summer meeting
c. Agenda for summer meeting, esp. special issues and guests
d. Needed initiatives
e. Etc.

(1500 to 1700) 9. "Safety valve: overflow"

APPENDIX III

DRAFT

Safety Position Paper for UNOLS FIC

Safe operation of UNOLS vessels is an issue of fleet improvement. During recent discussions of the FIC, various safety issues were raised. These issues may be particularly timely for several reasons. 1) The fleet profile is changing, with increased inclusion of smaller vessels and more specialized platforms. 2) Scientific operations at sea are continually evolving, often in the direction of increased complexity and expense. 3) Fleet users are changing. Multi-institution and multi-national user groups are now the norm on the larger vessels. Use of research vessels by students and other first-time or inexperienced users may be increasing; certainly NSF now stipulates that even the large vessels be used for undergraduate education on a regular basis. These changes are likely to accelerate due to the changing nature of national and international
support for ocean science. This position paper will outline some safety issues and pose potential solutions. It should be a starting point for future discussions and policy decisions on the part of the FIC and UNOLS.

A. Responsibility and liability for safety at sea: Historically and currently, the captain and his/her institution have been held 100% responsible for safe vessel operations. This includes responsibility for safe conduct of scientific operations. In practice this assumes a more detailed involvement in scientific activities than is practical or desirable on most cruises. Research cruises are perhaps unique in that they involve a mix of typical ship operations and scientific operations that may be technically and logistically complex. The current situation could cause the captain to play a much larger role in the conduct of science that the scientists want. Conversely, the chief scientist, who in actuality oversees the details of daily and hourly scientific operations, currently may not take an active part in safety-related training and decision-making.

Is it fair and proper to hold the captain completely liable for scientific operations at sea? To what extent should the chief scientist be responsible for safety? What are the trade-offs between liability and autonomy in the conduct of safe science? To what extent can or should UNOLS be involved in formalizing this partitioning of responsibility?

B. Actual and potential safety problems: It is important to determine whether UNOLS safety issues stem from actual or merely potential problems in conduct, training, and operation. Qualitative information suggests that the UNOLS fleet is actually quite safe relative to other fleets. The fleet has not been criticized for being unsafe, and the results of the last questionnaire indicated that the fleet was perceived as very safety conscious. According to Jack Bash, there have been 5 fatalities in the past 15 years. Three occurred during routine ship operations/maintenance and two during transit at night. Two small research vessels were lost at sea without a trace in about 1978. These vessels were from UNOLS institutions and, though technically they did not come under UNOLS rules, in at least one case the courts held their activity to the UNOLS safety standards. It is not clear how this safety record compares with that of other fleets, e.g. in terms of accidents or fatalities per hour of vessel operation time. A quantitative comparison may not be possible as records of exposure time, the denominator of the equation, apparently are not kept.

Potential safety problems may exist. These arise from the unique organization of a science mission. Ship time is expensive and scientists tend to work extremely long hours while at sea. Science operations may equal or exceed routine ship operations in logistical complexity, e.g. putting large pieces of expensive gear over the side in rough seas. Scientific personnel change frequently and nearly every cruise has untrained and inexperienced people in the scientific party. Currently there appears to be no mechanism or program that explicitly addresses the safety issues arising from these features of a research cruise. Should the FIC/UNOLS be involved in developing such a program?

Some considerations:

Pre-cruise training: Currently consists of a safety lecture by captain or first mate, generally on the first day of the cruise, as well as a fire and boat drill. The safety lectures I have heard have been thorough, but are mystifying to the seasick first-time sailor with no knowledge of the jargon. They may or may not cover aspects of scientific operations. Should a more rigorous safety training program be required?

Safety information: a copy of the Research Party Supplement to the RVOC Safety Training Manual theoretically resides in every stateroom of every research vessel. It is admirably free of jargon and touches on the major safety issues of sea-going research life. I had never heard of it, however, until I joined the FIC. This seems like a problem. How widely distributed is the Supplement in actuality? How can the research party be made aware of its existence? How can anyone be made to actually read it in the rush to load, set up, and get underway?

Diving operations model: the dive community has addressed the safety issue by instituting a set of training and procedural standards (Chapter 16, UNOLS Research Vessel Safety Standards). Research dives do not happen until the dive master has met with the captain and presented a dive plan and evidence of qualification for each of the divers. A single lead institution is designated for each cruise; the procedures and regulations of this institution govern the diving operation and this institution approves the dive plan of any scientist involved in diving work. Should this be a model for safety training for all ocean-going scientists? Training could consist of a short CPR-type class that explicitly addresses safety issues arising during oceanographic cruises. This could tie in specifically with the chief scientists' responsibility for the safe execution of scientific operations. It would also separate the safety training issue in space and time from the activities of loading and getting underway on the actual cruise.

C. Safety inspections: Non-Navy owned UNOLS vessels currently undergo safety inspections once every two years. These are conducted by NSF Inspection, under the auspices of the Facilities Section (headed by Dick West). The inspections are contracted out to ABSTEC, a part of the American Bureau of Shipping. Navy-owned UNOLS vessels are inspected every three years by the Navy's Board of Inspection and Survey (INSURV). UNOLS is working to alternate the NSF and INSURV inspections on Navy-owned ships.

Based on the ABSTEC report of the 18 May 1995 inspection of R/V OCEANUS, the NSF/ABSTEC inspections are extraordinarily thorough. Integrity of hull, tanks, piping and electrical systems are examined, as well as operational condition of all machinery (engines, ventilation systems, pumps, hydraulics, booms, frames and winches). Safety gear and crew safety training are assessed; realistic fire and man-overboard drills are conducted. A sea trial is conducted to evaluate the ship's performance under demanding conditions. Condition and functionality of living and working quarters are evaluated. The technical services in support of scientific operations are evaluated in a general manner. Finally, a detailed list of recommendations is provided. The information in the inspection report is a useful summary of the ship's capabilities and weaknesses.

Ability of the crew to assist with scientific operations is not evaluated except through UNOLS cruise assessments. It is probably inappropriate to include such evaluations in an already lengthy inspection process that deals primarily with the integrity and safety of the ship as a platform. This issue is intimately related to the issue of crew turnover (below).

D. Crew experience and turnover: One of the major strengths of the UNOLS fleet is the experience and dedication of the ships' crews. This relates closely to safety issues: experience with the range of scientific operations performed on research vessels translates directly into increased safety and better science. While most UNOLS vessels have retained a stable cadre of experienced, highly trained crew members, a few have not. How can high rates of crew turnover be dealt with? Is there some means of training new crew members to deal specifically with the requirements of working on a research vessel? Should there be some crew turnover rate beyond which a ship is reviewed regarding inclusion in the UNOLS fleet? How is this type of information obtained and who would keep track of it?

RECOMMENDATIONS

1) Potential safety problems do exist, especially with regard to scientific operations. UNOLS should be involved in creating or revamping safety standards for science at sea.

2) A copy of the RVOC Safety Training Manual, Chapter 1: Research Party Supplement should be sent to each chief scientist well before each cruise. UNOLS should also prepare a guide to safety training for the scientific party. This should cover general shipboard safety training as well as training in procedures that may be unique to a particular cruise (e.g. coring operations, deployment and recovery of large gear).

3) Communications between the chief scientist and ship's captain (and other key personnel) should be open and frequent prior to the cruise. As the ship's captain and home institution are likely to be held responsible for activities and accidents on shipboard, institutions should devise a means of evaluating the preparedness of each scientific party before the cruise. UNOLS should be involved in designing this evaluation procedure.

4) Some level of crew stability should be required for inclusion in the UNOLS fleet. UNOLS should put forward specific recommendations on this issue, and consider the most effective way of tracking crew stability and experience. This may be a simple matter of looking at employment records during the inspections.

APPENDIX IV

DRAFT
Summary of Van Design Information for UNOLS FIC
28 January 1996

INTRODUCTION

Scientists have been using vans for years to work at sea. There are a multitude of reasons why vans are valuable to sea-going scientists, with economy, efficiency, security, and compactness being just a few. The oceanographic community is committed to using vans at sea. This paper provides an overview of van design considerations for those desiring to develop this facility for their own use. As with ships, no one design can satisfy all requirements. Similarly, some designs have proven more successful than others. This paper is not intended to design 'a' van but to review van designs, illuminating their pros and cons.

Vans used for individual ships can afford to be designed with specialized equipment and tailored for that ship. Vans that are intended for world-ranging ships or the international community need to have a more generic design. As with ships, design features tend to be compromises between cost and sophistication. Simple, inexpensive designs may well suffice for single-purpose vans planned for single ship use. Significantly more thought and planning is necessary to design multi-purpose or multiple ship use vans, with international use demanding the most severe design considerations. As sophistication and versatility increase, so will cost. What follows is a summary of features available in van design. Pros and cons are discussed where appropriate. This information is intended to review existing van design and to guide future van construction.

1. Overall design.

A 20' length is the industry design standard and may facilitate shipping of the van. This size may be too large for use on the intermediate size class vessels. Some vessels have an 01 deck overhang which necessitates use of a 7' high van rather than the more standard 8' - 9'.

No one likes the idea of stacking vans while they are in use, but stackability for shipping to distant ports should be considered. Thus the frame should be of strong steel and the top should be reinforced. All exterior fittings should be recessed and there should be no exterior projections which could make the van awkward to stack or prone to damage during fork lifting, etc. Vans could be constructed with interior bolt-downs so that exterior mounted AC units could be secured and the van be made self-contained for shipping.

Fork lift slots in the van's bottom frame and lifting points for crane operation are important to allow loading options depending on port and facilities.

All construction materials, including hardware, windows, doors, plywood, paints, etc. should be marine grade. To reduce the possibility of standing in water or getting splashed by waves, exterior penetrations should be mounted as high as possible. Penetrations on the top will generally leak no matter what the sealing precautions.

A floor drain is essential. At the least, one should be able to hook up a length of hose so that material will drain over the side of the ship. It may be desirable to hook the drain to the ship's wastewater system. Depending on the proposed use of the van, the drain should have a shut-off valve and should drain to an isolated container (e.g. 55 gallon drum) for containment of hazardous materials.

2. Access/escape.

Doors for people: inward opening doors are not recommended They could lead to people being trapped in the van or squashed behind the door by waves. Sliding doors (WT) were suggested but would surely be a maintenance issue over time.

Doors for loading/unloading: double doors for loading and unloading large pieces of equipment should be considered. These could close over an interior, demountable bulkhead. Power, water and other connections could come out through this bulkhead and thus would not protrude from the van during shipping.

Windows: a window or windows improves the working environment and could be seen as a safety feature (emergency lighting during day, view of the deck). Conversely, windows take up valuable interior bulkhead area. Perhaps a window in the door should be recommended as a minimum.

Escape hatches: more than one. Given the variety of configurations the van might end up in while on various ships, it seems like two wall hatches and one hatch on top might not be excessive, while bearing in mind the potential for top hatch leaks. Top escape hatches should be located at a corner so as not to compromise the strength of the van top.

Ladder: undoubtedly someone will want to use the space on top of the van and a ladder will be mounted. This should be detachable for shipping. It should not be mounted next to a window (someone climbing the ladder could fall through the window - I saw this happen) or over an escape hatch.

3. Heating/cooling/ventilation.

Active air replenishment is recommended and the incoming air may need to be filtered. Air-cooled heat pumps for heating and cooling may be more reliable and convenient than water-cooled pumps. Modern water-cooled pumps have, however, performed well for some. The desirability of water- versus air-cooled pumps may depend on the environment (e.g. polar, tropical) in which the van will be used.

Given that vans are unlikely to be stacked while in use, the AC unit could be mounted on the top, then unbolted for shipping with a patch placed over the spot where the AC unit would normally go. Again, leakage could be a problem. The bulkheads should be insulated.

4. Power.

An uninterruptible power supply is desirable but may be impractical to maintain for the van alone. There could be a dedicated circuit in the van for attachment to the ship's UPS system.

The primary power supply should be compatible with the UNOLS fleet. The consensus seems to be 480VAC 3 phase with outlets inside the van for stepping down to 220v 3 phase and perhaps 110v 1 phase. Strip outlets will add to the flexibility of interior layout. If the van is to be used on foreign research vessels flexibility as to voltages, frequencies, connectors and wiring conventions could be built in, significantly increasing van cost. In general the electrical system design should be carefully thought out and designed with built-in flexibility, i.e. the internal electrical system should be readily reconfigurable. This is probably not compatible with imbedding the system in
the bulkheads. The van may need to provide for its own conditioned power. Both male and female external connections may need to be provided. Transformers, circuit breakers, distribution panels and adequate grounding need special consideration.

5. Other van - ship connections.

Water: there should be fresh and perhaps salt water hook-ups.

Communications: a link to the ship's communication system (phones, intercoms) and alarm system is recommended such that anyone working in the van can be contacted by ship's personnel and vice versa. An additional penetration for cables to
data loggers, antennae, etc. may be useful.

Connection to gas and compressed air may be required.

6. Emergency.

Emergency lighting is desirable but, again, may be impractical to maintain. Several flashlights mounted in convenient locations were suggested by several to be a realistic solution. The van should be equipped with a smoke detector and fire extinguisher(s). Tony Thomas recommends a 'panic button' mounted near the door which will interrupt power to the van.

7. Internal Outfitting.

Unistrut fittings are a good thing. The van should be well-lit and easy to clean, suggesting use of linoleum and similar materials.

APPENDIX V

	Arctic Research Vessel	USCG Healey
Science Support		
Baltic Rooms	**Yes**	**No**
Specialized equipment (Multibeam, CTD, etc.)	**Yes**	**No**
Laboratories	**Larger**	**Smaller**
Deck Layout	**Better**	**Two decks, poorly arranged**
Heated Decks	**Yes**	**No**
Open Deck Space	**More and better**	**Less**
Technical Assistance	**Yes**	**Maybe**
Crew Experience	**Longer term**	**< 2 or 3 years**
Crew Attitude	**Better**	**O.K.**
Scientist Capacity	**36**	**Up to 50?**
Vessel Capabilities		
Ice Capability	**Good, up to 4 feet**	**Very good, > 4 feet**
Ice Channel Aft Clear	**Yes**	**No**
Ice Milling	**No**	**Yes**
Slamming	**Maybe**	**No**
Endurance	**90 days**	**65 days**
CASPPR	**Yes**	**???**
Days available for science	**270/year**	**144/year**
Organizational Factors		
Scheduling	**Excellent**	**Poor**
Long Range Planning	**Yes**	**Yearly?**
Memory	**Yes**	**No**
Costs		
To NSF	**$33,000/day**	**$20,000/day**
To taxpayer	**$33,000/day**	**$108,000/day**
Total Cost over 30 years	**$387,300,000 (8100 days)**	**$858,000,000 (4320 days)**

Why is the Arctic Research Vessel (ARV) Better Than Healey?

Science Support
- Equipment -
  - (Multibeam system, etc.)
- Technical Assistance
- Crew Attitude
- Crew Experience
- Laboratories
  - Larger
  - Better layout (See ARV Preliminary Design); Healey has labs over 2 decks
  - No Baltic rooms on Healey
  - Open deck space
- Organizational Factors
  - Scheduling (Repeated cruises rather than one time USCG expeditions
  - Long Range Planning
  - Memory

Costs
- Approximately 25% of the cost of the Healey

Why is Healey better than the ARV?

Science Support

- Can carry more scientists
- Is more ice capable? (Would still require an ice escort in multi-year ice)

Costs

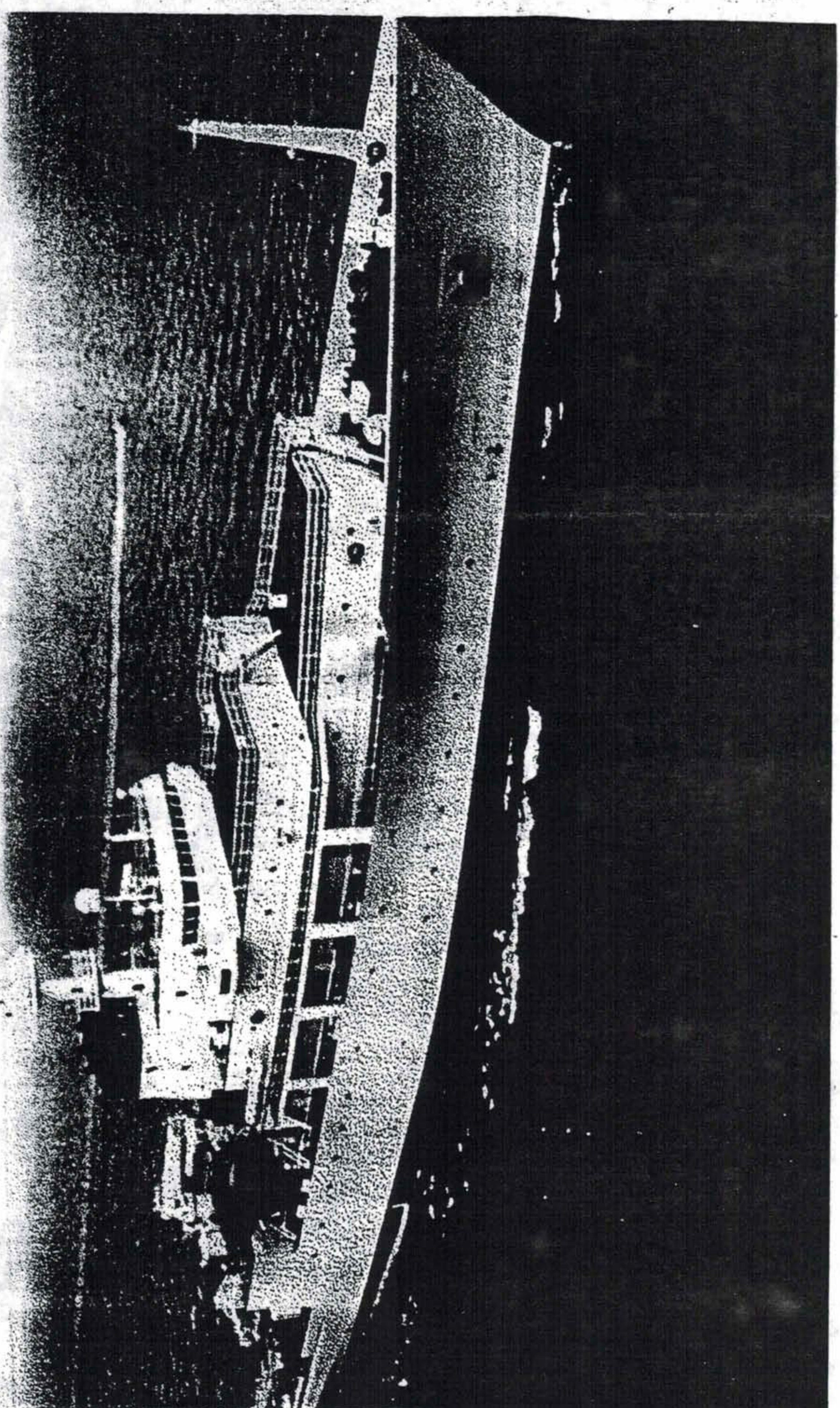
- Cost to NSF would be approximately $20,000/day (Actual costs?)

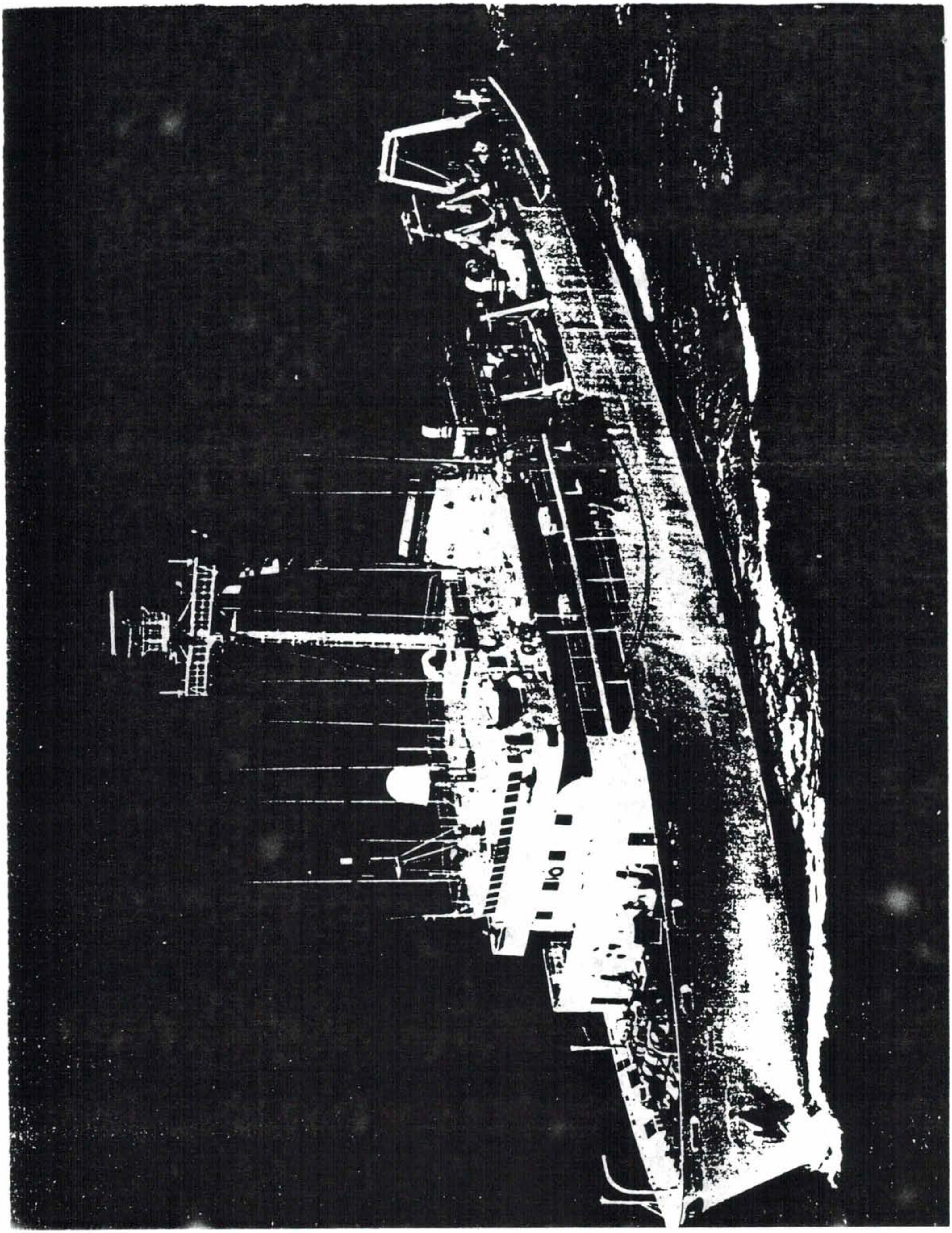
APPENDIX VI

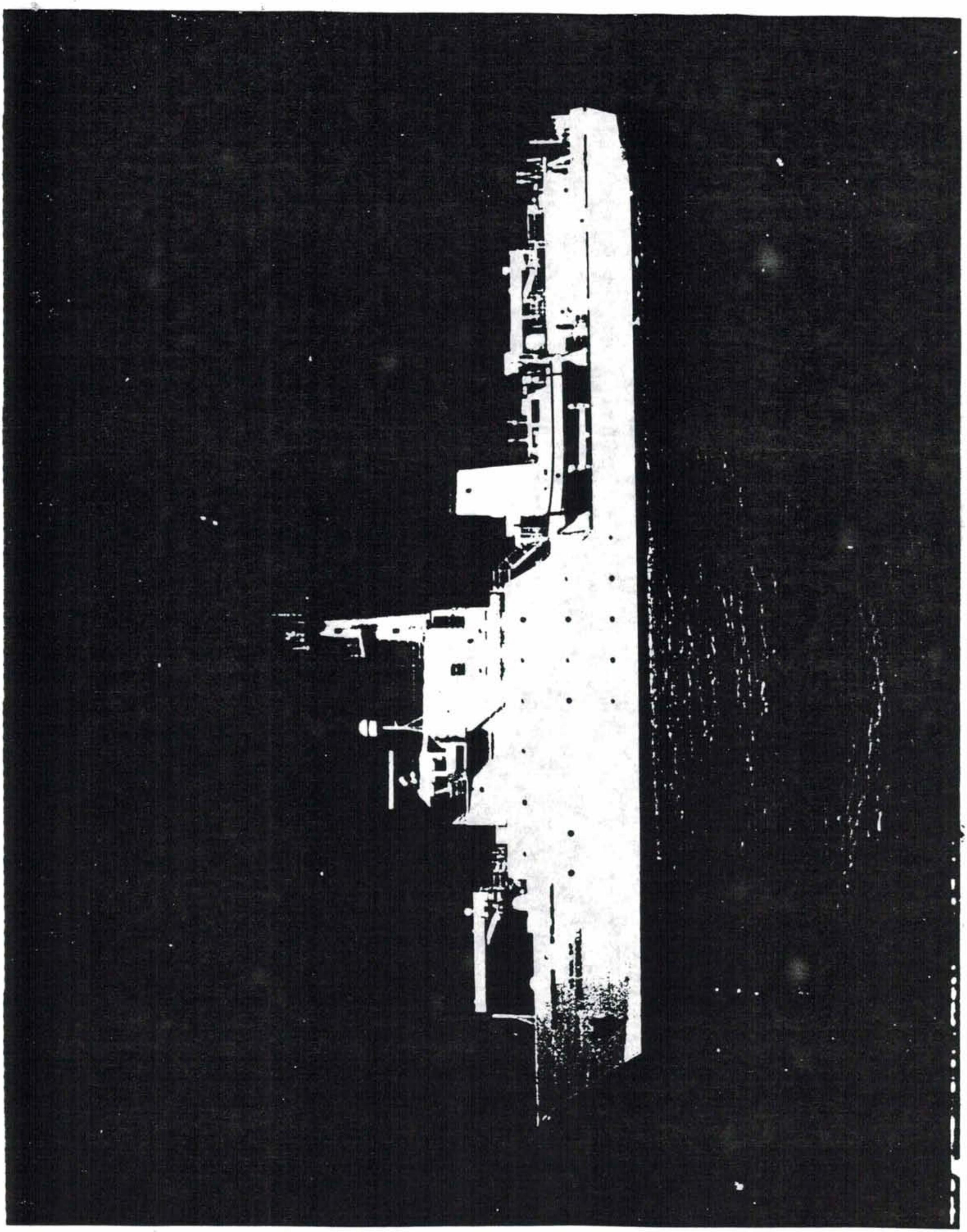
NAVOCEANO POC'S

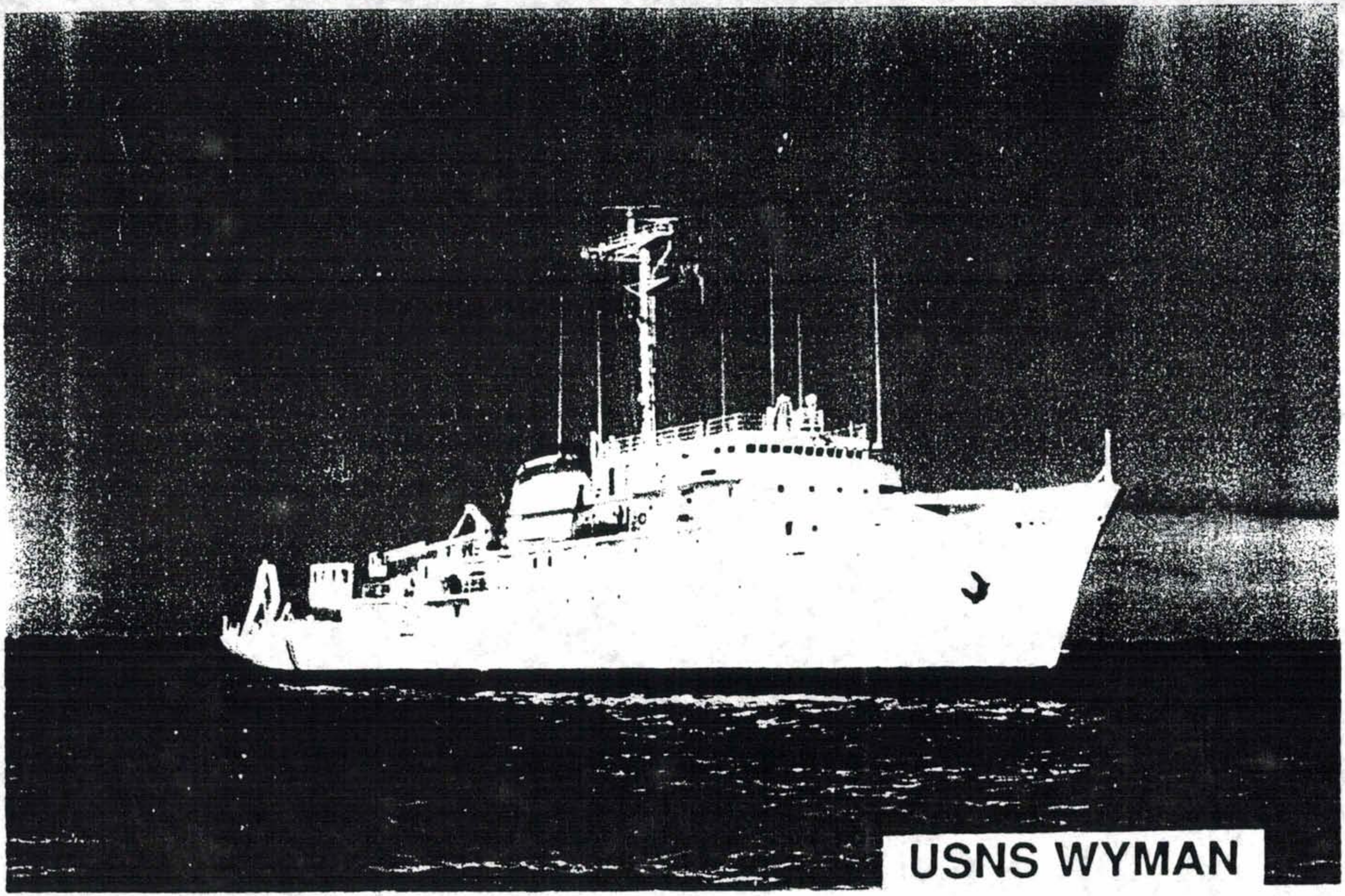
- Deep Submergence Science Committee
  - Mr. Carey Ingram (601) 688-4145
- Fleet Improvement Committee
  - CDR D. Smith (601) 688-4370
  - Mr. George Madden (601) 688-5293
- Ship Scheduling Committee
  - Mr. Charlie O'Neill (601) 688-4307
- Research Vessel Technical Enhancement Committee
  - Dr. Darrell Milburn (601) 688-4553
  - Mr. Marshall Paige (601) 688-4129
- NAVOCEANO Single POC
  - CDR D. Smith (601) 688-4370

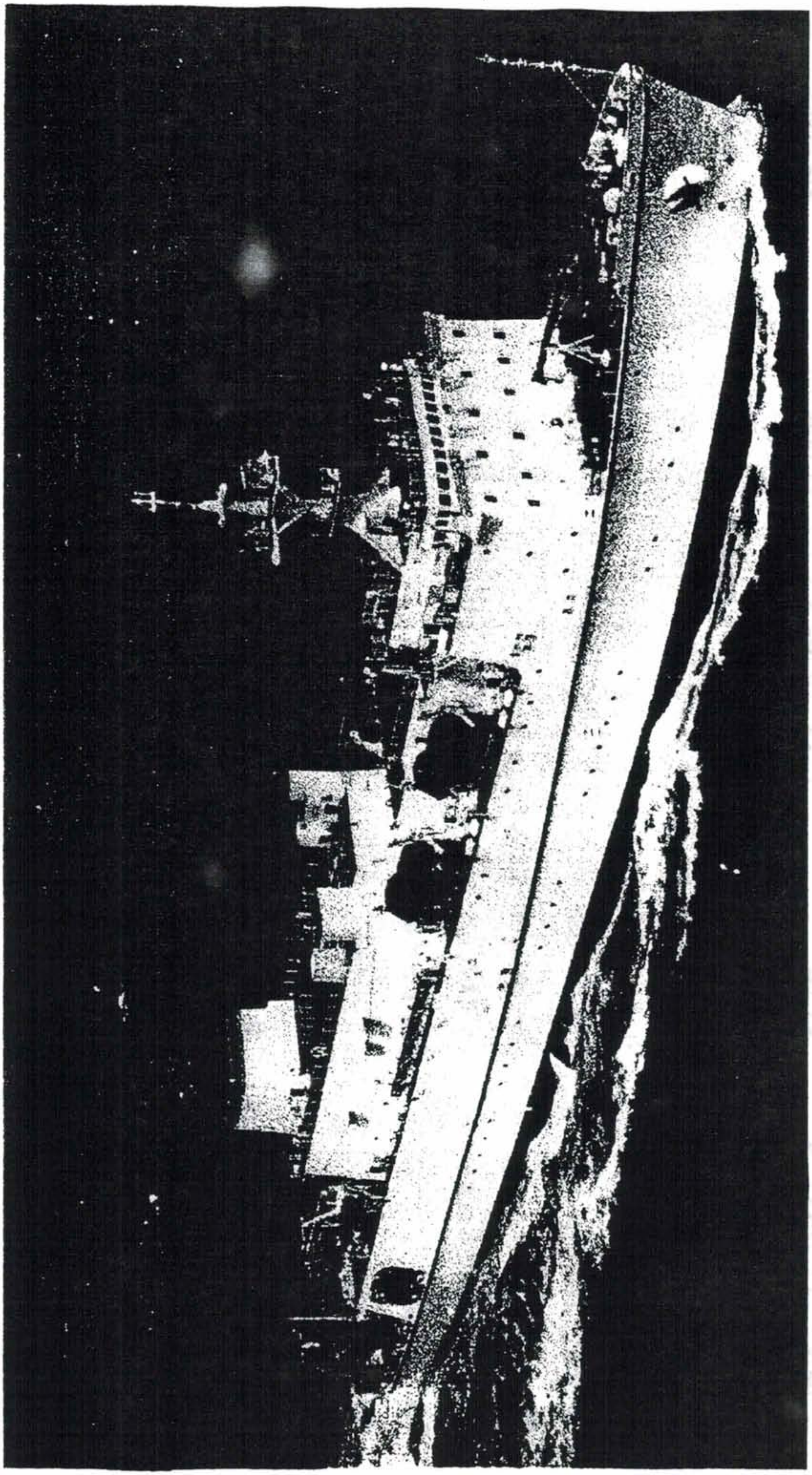
CURRENT LOCATIONS








USNS WYMAN



SHIP CHARACTERISTICS	WYMAN SILAS BENT KANE	MCDONNELL LITTLEHALES	PATHFINDER SUMNER	WATERS
Length (ft)	285	208	329	457
Displacement (tons)	2600	2054	5000	12,050
Cruising Speed (kts)	12	12	16	12
Cruising Range (nm)	12,000	12,000	12,000	14,000
Thrusters	Bent/Kane (bow)	No	bow	2 bow, 2 strn
Crew / Scientists	30 / 26	22 / 11	25 / 27	30 / 28
"A" Frame	Bent / Kane	No	Yes	2 tow booms
"U" Frame	Yes	No	Yes	Two
ADCP	Yes	No	Yes	Yes
Multibeam Swath (deg)	2 1/2 x 40	1 x 120	1 x 120	1 x 120
CTD	Yes	No	Yes	Yes
Core	Bent / Kane	No	Yes	Yes
Seismic	Bent / Kane	No	Yes	Yes
HSL's	No	Two	Two	Yes (4)
ORCA	No	No	Yes	Yes

APPENDIX VII

A Paper Reprinted from

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ORCA – Oceanographic Remotely Controlled Automaton

B. Bourgeois*, M. Kalcic* and M. Harris*

Abstract

The Mapping, Charting and Geodesy Branch of the Naval Research Laboratory at Stennis Space Center, Mississippi, is conducting a multi-year program for the development of unmanned, untethered sensor systems for the collection of tactical oceanographic data in littoral regions. The primary function of this program is the development of immediate force-multiplying survey capabilities for the collection of hydrographic data to support the U.S. Naval Oceanographic Office. This paper reviews the vessel, sensor systems, program progress to date and future plans for a comprehensive oceanographic survey system. The prototype platform currently in use for this project is the ORCA semi-submersible. The ORCA is an air-breathing vessel which travels just below the water surface. In contrast to a full-size survey ship, ORCA is able to collect bathymetric data of the same quantity and quality, but will have one-fortieth the life-cycle costs.

Résumé

La Section de Cartographie et de Géodésie (Mapping, Charting and Geodetic Branch) du Laboratoire de Recherches Navales du Stennis Space Center, Mississippi, a entrepris un programme de développement de ses systèmes de senseurs sans équipage ni dépendance pour recueillir les données océanographiques tactiques dans les zones littorales. La fonction principale de ce programme est le développement de facteurs qui puissent multiplier de façon immédiate la capacité d'exécution de levés pour recueillir les données hydrographiques d'appui pour le US Naval Oceanographic Office. Cet article examine le vaisseau, les systèmes de détection, les progrès du programme à ce jour et les projets futurs pour un système complet de levés océanographiques. Le prototype de plate-forme utilisé normalement pour ce projet est l'ORCA, semi-submersible. L'ORCA est une embarcation avec système de circulation d'air qui navique juste en-dessous de la surface de l'eau. Comparé à un vaisseau hydrographique de dimensions normales, l'ORCA peut recueillir la même quantité de données bathymétriques, de qualité équivalente, mais son cycle de vie revient quarante fois moins cher.

Resumen

La Sección de Cartografía y Geodesia (Mapping, Charting and Geodesy Branch) del laboratorio de Investigación Naval de Stennis Space Center, Mississippi, está llevando a cabo un programa de varios años de duración para el desarrollo de sistemas de sensores no tripulados e independientes para la recogida de datos oceanográficos tácticos en regiones del litoral. La función principal de este programa es el desarrollo de factores que peudan multiplicar de una forma inmediata la capacidad para llevar a cabo levantamientos dirigidos a la recogida de datos hidrográficos en apoyo de la U.S. Naval Oceanographic Office. Este artículo trata del buque, de los sistemas de detección, del desarrollo hasta la fecha del programma y de los futuros planes para un extenso sistema de levantamientos oceanográficos. La plataforma prototipo usada normalmente para este proyecto es la ORCA semi-sumergible. La ORCA es una embarcación con sistema de circulación de aire que navega inmediatamente debajo de la superficie del agua. En contraste con un buque hidrográfico de dimensiones normales, la ORCA es capaz de recoger datos batimétricos de la misma calidad y en la misma cantidad, pero los costes de su ciclo vital están divididos por cuarenta.

1. Introduction

The Naval Research Laboratory (NRL), under a memorandum of agreement with the Naval Oceanographic Office (NAVOCEANO), is developing the first generation of the Oceanographic Remotely Controlled Automaton (ORCA). The mission of the ORCA is cost effective collection of routine hydrographic survey data. Acting as a "force multiplier" the vehicle will address worldwide survey requirements. Through combined funding from NAVOCEANO, the Center for Tactical Oceanographic Warfare Support (TOWS), NRL and ONR, the Mapping, Charting, and Geodesy Branch (MC&G) of NRL at Stennis Space Center, Mississippi is conducting the development of two ORCA systems. C&C Technologies Inc., in Lafayette, Louisiana, has performed the vessel modifications and has developed the integrated sensor and communication systems for ORCA.

The ORCA uses a semi-autonomous air-breathing vessel for sensor deployment, shown in Fig. 1. The vessel travels just beneath the surface using an above water snorkel for air intake, and has active attitude control to minimize platform motion, which is essential for acquiring accurate multibeam data. With this design, ORCA's stability matches that of much larger platforms (70+ meters) making it ideal for the collection of many forms of oceanographic data. The first prototype of this vessel was originally made by International Submarine Engineering (ISE) Ltd. in 1983[1]. The two vessels being used for this project were originally denoted "Sea Lions", manufactured for NRL in 1985 by ISE. In 1991 the Canadian Hydrographic Service (CHS) fielded a later generation of this vessel, known as the DOLPHIN, equipped with a Simrad EM100 bathymetry system[2]. This system configuration is currently in use by CHS through their primary surveying contractor Geo-Resources, Inc.

In 1992 NRL's MC&G Branch evaluated the CHS system[3] which ultimately led to the U.S. Navy's ORCA project. A primary consideration leading to this project was the projected cost savings over the use of standard hydrographic vessels as determined by Dinn et. al.[4]. A joint NRL/NAVOCEANO cost analysis determined that the ORCA will have one fortieth the life cycle costs of a full-size survey vessel, yet it is able to collect bathymetric data of the same quantity and quality. The ORCA vessel has been substantially changed from its original Sea Lion configuration, and the Simrad EM950 multibeam sonar is its primary sensor.

The planned operational scenario for the first generation ORCA is the collection of bathymetry and acoustic imagery in water depths up to 300 meters. The EM950 has a wider swath width than the EM100, and has the additional capability of providing collocated acoustic imagery of the sea floor. The first two ORCA systems are scheduled to be completed during fiscal year 1995, at which time one system will be delivered to NAVOCEANO, the primary Navy command for the collection, archiving, and distribution of oceanographic data. They will develop methods for ORCA deployment from: the new T-AGS

* Naval Research Laboratory, USA

[illegible] further system development and additional sensor integrations.

Bathymetry and acoustic imagery represent fundamental characteristics of the ocean environment which directly impact near-shore naval warfare activities such as mine and amphibious warfare. Regional conflicts have repeatedly demonstrated the need for these basic data and the consequences of their absence. Reliable bathymetric data has been found lacking in many conflicts; recent examples being Operation Desert Storm in the Persian Gulf, relief efforts in Somalia, and the restoration of democracy in Haiti. With current assets, NAVOCEANO has a 360-year backlog of coastal surveys in politically accessible areas[5]. Bathymetry primarily provides essential data for safety of the navigation in a region, but it also provides detailed information about sea floor morphology. Acoustic imagery can provide a rudimentary indication of sea floor composition and acoustic response.

2. Vessel Alternatives

The mission of ORCA is the cost-effective collection of hydrographic and oceanographic data. To carry out this mission it must be able to rapidly survey large areas. This requirement mandates relatively fast surface or near surface vessels with swath sensors of sufficient power to reach the sea floor. Data types that are viable for this mission include bathymetry, acoustic imagery, current profiles, sediment classification, surface water temperature, and surface optical properties of the water. Traditionally, these surveys have been executed using surface craft, which suffer from entrained air bubbles passing over the transducer faces, resulting in higher noise levels and reduced sensor ranges. Small craft are particularly affected by this, and have the additional disadvantage of poor stability which heavily degrades the performance of vertical reference units. Large survey ships reduce the stability problem but have high life-cycle costs.

The most restrictive vessel requirements are imposed by hydrography. The bathymetry data collected by ORCA will ultimately be placed into Defense Mapping Agency (DMA) databases for general distribution. As a result, the bathymetry data must meet International Hydrographic Organization (IHO) standards. In Special Publication No. 44 (1987) the IHO has established bathymetry standards requiring: 1) depth accuracy of 0.3 meters for depths from 0 to 30 meters and 1% for depths greater than 30 meters for at least 90% of the data; 2) Positional accuracy of 0.15% of the chart scale, for a 1:5000 chart this corresponds to a required accuracy of 7.5 meters. Complying with these accuracies requires the use of state-of-the-art bathymetry sensors, positioning systems and vessel attitude systems.

	Semi-submersible	Submersible
Real-time data & control	++	+
Stability	+	++
Mission duration	+	–
Speed	+	–
Launch & recovery	–	+
Electrical power	+	–
Sound velocity profile	–	+
Off-shelf sensors	+	–
Navigation Hazard	–	+
Accurate Positioning	+	–
Payload Size	+	–
Navigation	+	–

Table 1: Comparison of vehicle technologies

vessels are semi-submersibles and submersibles. Table 1 compares the two vessel technologies as applied to this mission. The exposed mast on the semi-submersible allows radio transmission for real-time data and vehicle control plus the use of differential GPS (DGPS) systems for accurate positioning. Real-time data and control is a significant element, as sophisticated survey instrumentation is typically designed to be operated with a human in the loop. Real-time data and control can be achieved with a submersible by using a signal-only tether, but this restricts its range and speed.

Both vessels offer the advantage of stability, but a semi-submersible's performance will ultimately be degraded in sufficiently high sea-states. A semi-submersible offers key advantages of payload size, long duration, electrical power and speed. As a consequence many off-the-shelf sensors are readily deployed with such a vessel. Duration, power, speed, and payload size continue to be drawbacks with submersibles, increasing overall survey cost. The ORCA vessel has proven difficult to launch and recover in contrast to most submersible designs due to its mast and keel configuration. Perhaps the most outstanding disadvantage of a semi-submersible is the fact that it is a potential hazard to surface craft navigation. This is a key advantage of a submersible, but the submersible must contend with a 3-dimensional vice 2-dimensional navigation problem. Accurate water column sound velocity profiles must be obtained for the collection of bathymetry data with multibeam systems; a possible advantage of a submersible over a semi-submersible is that it could navigate vertically to obtain its own sound velocity profile data.

NRL chose to proceed with a semi-submersible design primarily because it already possessed two Sea Lion vessels. In retrospect, and considering available submersible technology, this was the most effective approach. Overall power and size requirements of current off-the-shelf sensor systems capable of executing the mission have been restrictive. The power draw of the present sensor package is about 35 amps at 24 volts, and many of the sensors had to be repackaged to fit on the enlarged Sea Lion vessel. In most cases, sensor systems were 'split' such that the transducer and transmitter/receiver electronics are located on the vessel, and the data processing, control and display systems are located on the host ship. Significant engineering challenges had to be overcome just to allow the sensor systems in their present configuration to contend with the time delays imposed by the communications link. Elimination of the communications link between the vessel and topside portions of these systems would require extensive software development. NRL plans on using the lessons learned from the ORCA development to incrementally tackle the obstacles for fully autonomous survey operations, and to ultimately transition these systems to submersibles once the vessel technology is sufficiently mature.

3. ORCA Vessel

The current ORCA configuration is shown in Fig.1. Its overall length is 7.7m, and the main hull diameter is 99cm. Total height is 6.3m from the bottom of the keel to the top of the mast. The system's antennas extend another 2.7m above the top of the mast. Total vessel weight is approximately 4500 kg, including the sensor systems. There are two large dry compartments, each accessed through a hatch on the top of the vessel. The forward compartment contains the vessel control computer and sensor electronics and the aft compartment contains the propulsion plant. Each compartment contains a water level sensor and bilge pumping system. The propulsion plant is a 150h.p. Sabre diesel engine, with air intake at the top of the mast and submerged hydraulic pump providing power for all manoeuvring surfaces. The engine also drives a 24-volt, 100-amp alternator which provides ample electric power for the vessel and sensor systems. The standard vessel configuration allows speeds up to 12 knots, and it can be fitted with a lower pitch propeller and larger control planes for 6 knot operations. Sea-pressurized bladders contain 378 litres of diesel fuel allowing 24-hour continuous operation at 10 knots. When surfaced the vessel has a 2.1m draft. It is positively buoyant and is 'driven' below the surface; underway draft is operator selectable up to 6 meters.

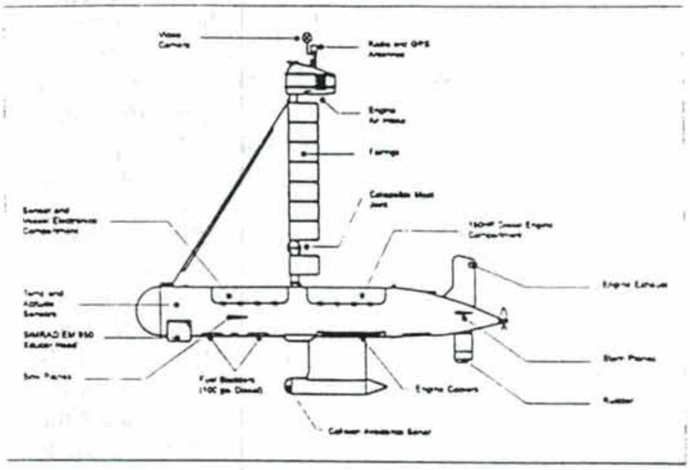


Fig. 1: ORCA Vessel Configuration

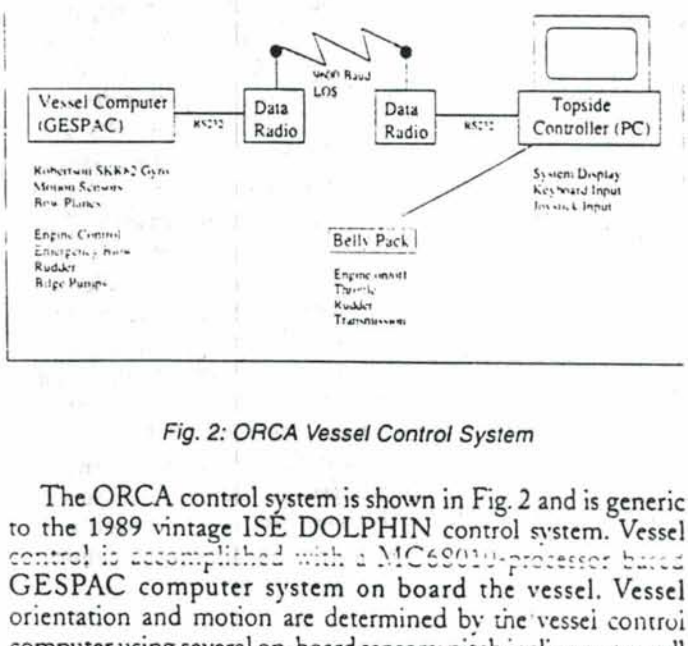


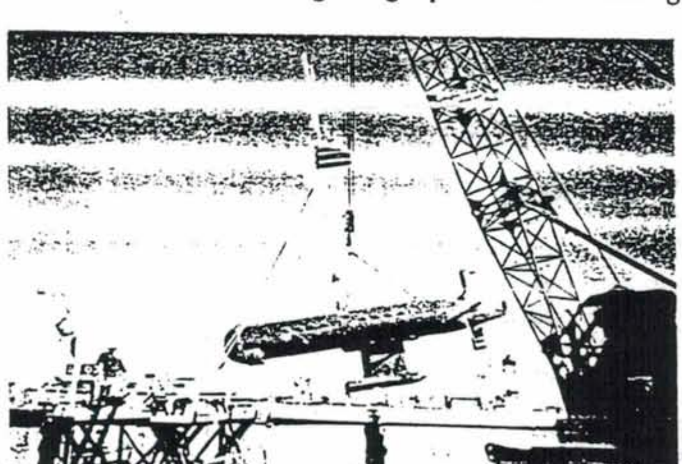
Fig. 2: ORCA Vessel Control System

The ORCA control system is shown in Fig. 2 and is generic to the 1989 vintage ISE DOLPHIN control system. Vessel control is accomplished with a MC68010-processor based GESPAC computer system on board the vessel. Vessel orientation and motion are determined by the vessel control computer using several on-board sensors: pitch inclinometer, roll inclinometer, three-axis angular rate sensor, vertical accelerometer, depth sensor, plane-position sensors and a gyroscope. Vessel manoeuvring is accomplished through the use of bow planes, stern planes and a rudder. The bow planes control depth and roll, the stern planes control pitch and the rudder controls heading. The GESPAC also controls engine speed and monitors its temperature, oil pressure, and alternator output.

An AT-PC based system on the host ship provides the interface to the GESPAC system for operator commands and vessel related parameter display. At present the topside PC is a stand-alone system and does not interface with the survey vessel depth and speed data to the survey system, and to allow navigation of the vessel using survey system-generated way-points and differential GPS position. Communication between the GESPAC and topside computers is handled by an FM radio. The radio provides a 9600-baud data link using the 420-MHz band and is manufactured by Data Radio Inc. The present radio has a power output of two watts providing a nominal 4.8km range. This unit will be upgraded to 15 watts with an expected range of 8+ km. An omni-directional antenna is used on both the ORCA and host ship for this system.

The ORCA control system provides several modes of vessel operation: belly pack; heading control; and way-point following, which will be added in the near future. The belly pack uses a portable control unit and umbilical cable allowing the operator to stay within sight of the vessel for close-quarters on-surface manoeuvring. It provides rudder control, throttle control, transmission control, and engine start/stop functions. Heading control is the normal mode of operation. In this mode the vessel is operated from the topside PC and the vessel pilot specifies the depth, heading and speed to be maintained by the vessel. In this mode the vessel control system will maintain the specified set points until commanded to do otherwise. All control functions are handled in the vessel computer providing fully autonomous operation. The way-point following control mode allows down-loading of a set of way-points into the vessel computer. The vessel will then autonomously navigate the track designated by the set of way-points. Way-point following has been implemented on the RMOP system[6], developed by the Coastal Systems Station in Panama City FL, but not on the ORCA. The control system includes fail safes for flooding, loss of radio contact, over-depth, and engine or computer malfunction. In the event that any of these occur the vessel surfaces and the engine stops. In the event of a flood in a dry space a compressed air system blows the ballast areas; as a further safeguard a 228-kg drop-weight in the keel is released if the vessel reaches a depth of 12 meters.

On shore ORCA is cradled by a custom trailer, which allows for transportation over short distances and positioning of the vessel at the operation site. Mobilization of the vessel has been performed using a 1 ton pick-up truck pulling the trailer for distances of less than 300km. For longer distances the vessel and trailer have been transported using Removable Goose Neck (RGN) tractor-trailer rigs where the total height above the ground (mast collapsed) is just within the 4.1m U.S. federal highway limit. NRL operations to date have launched and recovered ORCA pier side using a crane. CHS operations have been pier side and from a barge. Barge operations entail loading



Pierside ORCA deployment

the barge. Barge operations allow excursions into waters further from the shore while still providing a significant cost savings over maintaining a dedicated full-size hydrographic survey ship. For deployment from a survey ship, Brooke Ocean Technology Ltd., in Dartmouth Nova Scotia, has developed a DOLPHIN handling system. The system uses an articulated crane and allows launch and recovery of the DOLPHIN vessel from a surface craft, without personnel in the water, in up to sea state 5.

4. Bathymetry System

The portion of the sensor systems that are contained in the ORCA vessel are illustrated in Fig. 3 The center of the system is a SUN SPARC20 microcomputer. The SUN handles the tasks of data communication and relay for the various sensors as well as control of the sensors. The SUN does not have its own monitor, and the operator remotely logs into this machine via the topside SUN workstation. Sensing devices can send their data back directly over the ethernet link, or via an interface to the SUN workstation which then relays the data over the ethernet. At present this computer is minimally tasked, allowing for future uses such as data compression and storage, autonomous sensor control, and limited post-processing features.

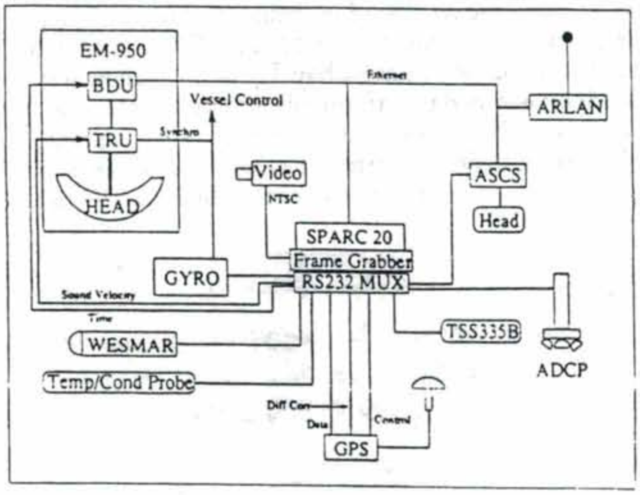


Fig. 3: ORCA Vessel Sensor Systems

Communications for sensor system control and data are handled by a high-speed radio link using the Arlan 620. The Arlan is a spread-spectrum radio (902-928-MHz) with a 1-watt amplifier and a HyperAmp-900 5-watt booster. This inexpensive wireless ethernet bridge uses an omni-directional whip antenna on the ORCA and host ship. The basic unit is FCC unlicensed (Part 15) and has a nominal 3.2-km range. With the licensed 5 watt booster (DoD only) the radio has been successfully tested at 8km with a 946-Kbit/sec data rate. The bathymetry/imaging system has the highest data rate demand, peaking at 150-Kbit/sec. The ARLAN has proven to be very reliable in this application, with a near instantaneous recovery time after a dropped link and a large data buffer which minimizes or eliminates loss of data.

The Simrad EM950 multibeam bathymetry and acoustic imagery system is the primary sensor on the vessel. It can operate in water depths from 3 to 300 meters below the transducer. It has selectable swath widths which are listed in Table 2. It uses a 95 kHz transducer with 120 dynamically roll stabilized beams and generates collocated bathymetry and acoustic image pixels. Its maximum ping rate is 4-Hz. The individual beams are 3.3 ships direction. The system uses a combination of zero phase crossing and peak detection algorithms for location of the bottom in each beam, which provides a depth accuracy corresponding to the larger of 0.3% water depth or 15cm. The system also features 190 degree embankment modes for surveying the side of a channel or along a port or starboard side embankment. With its semi-circular head design, water surface sound velocity does not affect beam steering angle for beams less than ±60 degrees. The Bottom Detect Unit (BDU) is connected directly to the ethernet link for data transmission and sensor control from the topside Operator Unit (OPU). The SUN provides time to the BDU and sound velocity profiles to the Transceiver Unit (TRU) via serial interfaces.

Angular Coverage	Horizontal Coverage	Depth Range
150°	7.4xD	3-200m
140°	5.5xD	100-250m
128°	4.1xD	150-300m

Table 2: EM950 Coverage

Numerous ancillary sensor systems are installed to support the Simrad system. A YSI-600 system measures surface water temperature and conductivity at the Simrad transducer. The YSI-600 interfaces to the SUN via a serial line. This data is used to compute the surface sound velocity needed to correct Simrad beam steering at angles greater than 60 degrees. A Robertson SKR82 gyrocompass provides true heading to both the Simrad and the ORCA control computer. The dynamic heading error of this gyro is 0.7 degrees rms x secant (latitude). At 45 degrees latitude this corresponds to a worst case error of one half of the outermost beam's footprint size. The gyro interfaces directly to the Simrad TRU and the vessel control computer via a synchro interface. A serial line is also connected from the gyro to the SUN to provide the topside survey system with instantaneous vessel heading. A TSS-335B vertical reference unit provides heave, pitch and roll data. The heave data is accurate to 5 cm and the roll and pitch data are accurate to ±0.1 degree. A Trimble DGPS Survey Module (DSM) receiver is used for vessel position. Its accuracy is 40 meters without differential corrections, and 0.5 meters with corrections. A GPS differential navigation beacon receiver is used on the host ship to receive the differential correction data, and this data is sent via the ethernet link to the vessel SUN and then via a serial line to the DSM. Data and control is provided by 2 serial lines from the SUN.

The portions of the sensor system that are located on the host ship are illustrated in Fig. 4. On the host ship communication for data and control is handled by an identical Arlan radio and power amplifier. A whip antenna is used on the host ship for this transceiver. The center of the topside systems is an identical SUN SPARC20 workstation, which is the primary control location for the entire system. Data from the various sensor devices is passed either directly over the ARLAN network (Ethernet No. 1) to ethernet capable devices or received by the SUN workstation and provided to the related units through serial links. The data from the vessel BDU is passed directly over the ARLAN network to the Simrad OPU without SUN intervention. A second ethernet link and serial line between the OPU and SUN provide control functions and passing of OPU processed data to the SUN. This second ethernet link also provides a data connection for the workstation running the Hydrographic Multibeam Processing System (HMPS) software. The SUN provides serial port inputs for the host ship GPS receiver, a navigation beacon receiver for GPS differential

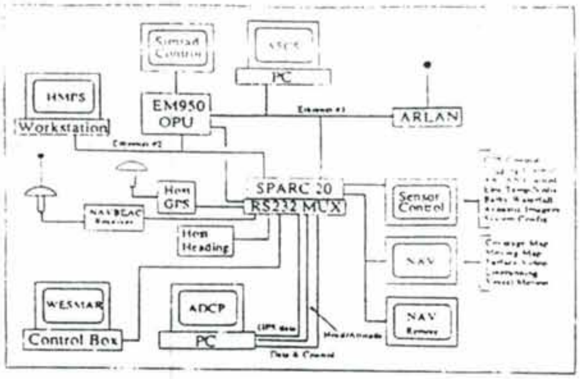


Fig. 4: ORCA Topside Sensor Systems

corrections, and for a host ship heading device (gyro or vector magnetometer). All collected data is logged to the SUN's hard drive, and may be subsequently copied to an 8mm tape drive.

The SUN workstation drives three monitors: one for survey control, and two for navigation display. One navigation display is located locally at the survey control station, and the remote unit is a repeater placed in the vicinity of the ORCA pilot. The survey control monitor is used for system configuration, control and monitoring. A variety of GUI tools are provided for the operator to configure both hardware and software. This monitor is typically used to: display system error messages; display the sonar imagery; monitor the GPS system; display the surface temperature, salinity, and computed sound velocity; monitor ORCA main bus voltage and electronics-bay temperature; control the mast-mounted video camera; monitor the ARLAN radio link; generate and edit survey tracklines and way-points; start/stop Simrad data collection; input sound velocity profile data. Operation of the Simrad EM950 is handled primarily through the OPU.

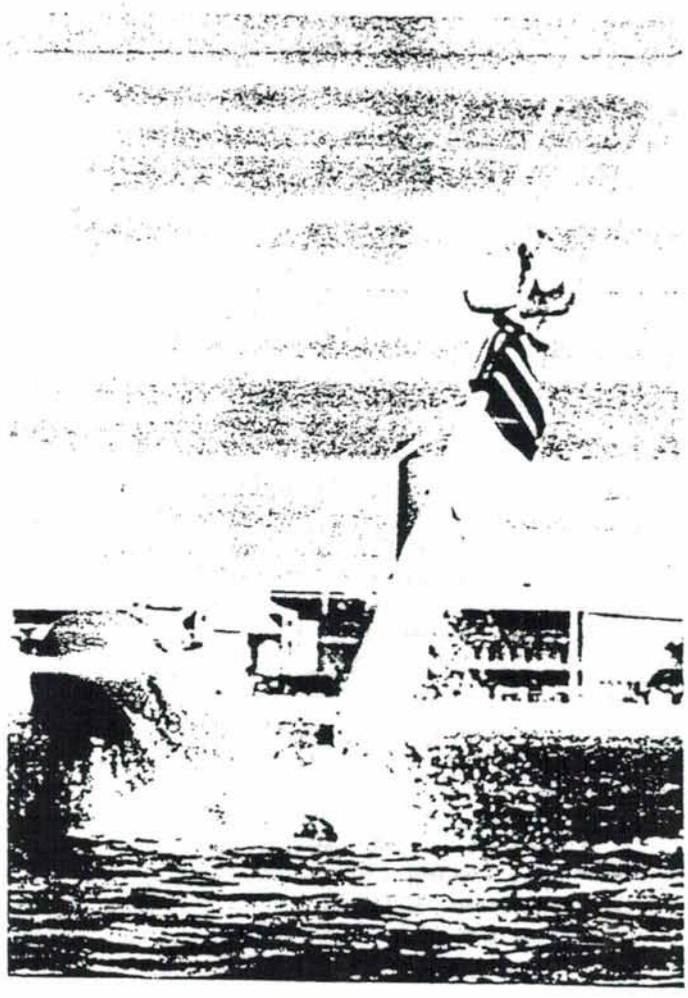
Track line software on the navigation monitor displays graphically and numerically the desired track lines and the host ship and ORCA position and heading relative to those lines. This software provides an overhead display of the survey region and a separate indicator for ORCA off-track distance and direction. Collected bathymetry data is superimposed on the overhead display which serves to identify gaps in the coverage. This provides an immediate check of data quality by observing the overlap area between adjacent swaths. A separate window provides a waterfall display of the raw bathymetry data as it is collected. The mast-mounted video display is also on the navigation monitor. A TSS window graphically displays vessel heave, pitch, roll and horizontal acceleration. For manoeuvring in restricted areas, an NRL-developed moving map window displays the local area shoreline, navigation aids and the actual position of the ORCA vessel using GPS updates. Other data [illegible]

ORCA keel; GPS computed speed and course made good; ORCA gyro heading; lat/long position; x,y,z position for the user selected projection; range and relative bearing of ORCA from the host vessel.

For post processing and final product production both the NRL developed HMPS and C&C Technologies' software were utilized during the February 1995 calibration trials. HMPS provides track line generation, swath data editing, sounding selection, navigation editing, and mosaic generation of surveyed areas. HMPS is the Navy standard multibeam post-processing system that generates selected soundings for delivery to the Defense Mapping Agency (DMA) and ultimate generation of standard nautical charts. The C&C software also provides for data editing and can generate coloured relief, 3D perspective and contour charts. The coloured relief charts grid the collected data in uniform pixel sizes allowing the presentation of detailed bottom morphology not obtainable with standard numerical depth or contour charts. Their software also provides for editing, mosaicing and production of acoustic images. Using the C&C software and a full size Hewlett-Packard colour plotter, same-day charts were produced aboard the host vessel during the February 1995 trials. By digitizing existing charts, C&C can combine shorelines and navigation aids with current survey data. This capability was demonstrated during a May 1995 calibration trial in Gulfport, MS. Likewise, Digital Nautical Charts (DNC) can directly provide this information where coverage is available.

5. Bathymetry Calibration Trial

Calibration trials for the EM950 were conducted in February, 1995 off the coast of Pensacola, Florida. Calibration evolutions included standard EM-950, NAVOCEANO and NRL-designed procedures. The goal of the calibration trial was to identify errors such at pitch and roll biases, gyro errors, positional error due to timing delays and overall system accuracy. Three primary sites were utilized for EM950 calibration. Pitch and time-delay tests were conducted in Pensacola Bay which has a 13m deep turning basin. Site 1, at 30°2'N and 87°11.5' to 14.0'W, is about 27nm SSE of Pensacola Bay. The site 1 shallow water area (30-35m) was used to perform roll and gyro calibrations. A star pattern was also run in this area by crossing over a point in eight different directions to determine the effects of prevailing seas and heading on vessel attitude motion. Site 2, at 29°28' to



ORCA emergency surface manoeuvre

1990 by the U.S. National Oceanic and Atmospheric Administration (NOAA) ship *Whiting* with the Hydrochart II 36-kHz multibeam system. Site 2 is 50nm south of Pensacola bay and was used as a deep-water (90-300m) calibration site for the EM950. Site 2 was subsequently surveyed with the NAVOCEANO vessel USNS *Pathfinder* on May 3, 1995 using the 12-kHz Simrad EM-121A multibeam system. At site 2, the same tracklines were run by all three vessels, with two additional cross-tracks run by the ORCA and *Pathfinder*.

Site 2 was used to evaluate bathymetry results from ORCA's EM950 with the NOAA Hydrochart II and the NAVOCEANO EM-121A data, and also to evaluate accuracy of the EM950 outer beams. The bathymetry comparisons are based on 12, 36 and 95-kHz systems, so uncertainty about sonar bottom penetration at these three frequencies is likely to affect the computed accuracies. Table 3 summarizes the results of the comparisons between the three systems. In Table 3 OR-PF refers to ORCA less *Pathfinder*, OR-WH to ORCA less *Whiting*, and PF-WH to *Pathfinder* less *Whiting*. For these calculations data was processed and resampled to a 0.01' grid. Comparisons were based only on real data points at each grid interval; interpolated points were not utilized. It is apparent from the percentage of negative residuals in Table 3 that the *Pathfinder* and *Whiting* sounded deeper than the ORCA and the *Whiting* sounded deeper than the *Pathfinder*. It's expected that the 12 and 36-kHz systems would sound deeper than the 95-kHz system. However, it is uncertain why the *Pathfinder* sounded shallower than the *Whiting*. The *Pathfinder's* EM-121 system was still undergoing acceptance tests at the time of the survey, and some problems were known to exists with timing offsets.

Residual	OR-PF	OR-WH	PF-WH
RMS	3.17	8.13	5.18
Mean res.	-3.11	-8.04	-5.05
Std dev. σ	0.59	1.16	1.19
σ (% depth)	0.28	0.55	0.55
% negative	100.00	100.00	99.97
minimum	-6.83	-13.9	-12.56
maximum	0.00	-0.07	0.01

Table 3: Depth Residuals Between Platforms in meters

Figure 5 shows the 25m contour lines for the three platforms. The ORCA 95-kHz system consistently sounded about 3m shoaler than the *Pathfinder* 12-kHz system, but agreed closely when this 3m bias was removed. Some of this 3m depth bias may have been caused by greater bottom penetration of the 12-kHz sonar into the predominately mud sea floor. In comparison with the *Whiting*, the ORCA data was 6-7m shoaler in the shallow regions (90m depth) and about 2-3m shoaler in the deeper regions (300m depth). The reason for this apparent difference in bottom slope is uncertain. Two factors may contribute to these differences; sound velocity data was obtained by the *Whiting* on the first day of the survey using a Conductivity/Temperature/Depth (CTD) cast. On the following days, expendable bathythermograph (XBT) sound profile drops were made and compared to the original CTD cast. According to the NOAA descriptive report for this survey[7], all comparisons were within the tolerances specified in the NOAA Standing Bathymetric Mapping Instructions. However, an error in the original CTD cast could introduce errors in the measured depths. A second possible explanation for the difference in apparent bottom slope involves vessel positioning. The *Whiting* survey was conducted in 1990 using STARFIX satellite navigation with daily DGPS comparisons, while the ORCA and *Pathfinder* range from about 75m at the northern edge to about 300m at the southern edge, a small error in north/south positioning could induce a significant depth error along this relatively steep slope. A contributing factor may also be mud slump during the 5 year period since the *Whiting* survey.

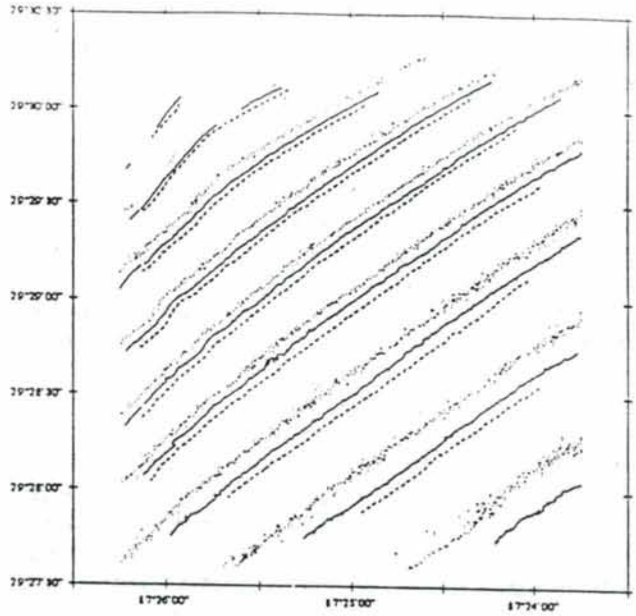


Fig. 5: Site 2 survey area near Pensacola, Florida, showing 25m contour lines for Whiting (dotted), Pathfinder (solid) and ORCA (dashed)

An analysis of overlapping beams for the EM950 was done for the site 2 data. The goal was to compare the center beams of tracks with the outer beams of adjacent tracks that overlapped the same area. Since the track spacing was not designed for the EM950 geometry there was not exact correspondence between center and outer beams. An allowance was made to compare any outer beams that were within 15m of the adjacent track's center beam. The 15m allowance, with a 3% slope, would allow differences within 0.5m. The mean difference was computed between line 4 outer beams and line 5 center beams, where the best overlap occurred. The mean difference was 0.35m, with a standard deviation of 0.43m. This is well within the International Hydrographic Organization (IHO) standard of 1% of true depth in this area (175-202m). For these observations, the 90% confidence interval is 0.35±0.7m. The same test applied to all lines, spanning 133 to 275m depths, yielded an average difference of -0.66m, with a standard deviation of 0.97m between the outer and center beams of adjacent tracks. There is at least a 90% probability that the true depth is within 1.6m of the estimated depth, e.g. within IHO specifications. The port and starboard beams were seen to vary in accuracy when compared to overlapping center beams. The port beams had a mean bias of -1.37m, which was significantly larger than the mean bias of 0.09m for the starboard beams. The observed difference in port and starboard bias could be attributed to roll bias.

The EM950 bathymetry showed good repeatability as measured from 168 observations over the area at the center of the star pattern at site 1. The mean depth measured in this area is 38.04m with a 0.15m standard deviation. The 90% confidence interval for the observed mean is ±0.24m which is well within the IHO standard requirement of ±0.38m. A line was run at site 1 to compare the data collected using different EM950 modes: 75°, 128°, 140°, 150° equidistant beam spacing (EDB) and 150°

at a 0.003' spacing. Table 4 shows the results of comparisons between the 150° EDB spacing and the other operating modes. The table indicates acceptable concurrence between the different system modes.

Residual	150° EAB	140°	128°	75°
RMS	0.19	0.17	0.15	0.11
Mean res.	-0.04	0.04	0.01	-0.06
Std dev. σ	0.19	0.16	0.12	0.10
σ (% depth)	0.50	0.43	0.31	0.26
% negative	60.74	36.97	17.96	73.53
minimum	-1.06	-1.31	-0.31	-0.53
maximum	1.15	2.15	2.89	0.48

Table 4: Depth Residuals Relative to 150° EDB in meters

The star-pattern data collected at site 1 also provided insight into the effects of sea-state on vehicle motion at different headings. It was observed that the ORCA pitches at a larger amplitude when running with the seas, as opposed to running into the seas, where it is much more stable. This is likely to be a consequence of the relative period of the waves as seen by ORCA. For short periods the variations in depth due to the waves will be filtered and ignored. When travelling with the seas the relative period is much longer, and the ORCA's depth control system will be more likely to attempt to follow the waves. These results are consistent with previous studies[3], and indicate that ORCA should not be run with the seas for surveys executed during high sea-states. During the data collection period the seas were running approximately 260° with a 4-5kt wind. The amplitude of the ORCA pitch was seen to be significantly larger for the 270° steered heading than for other headings.

In Pensacola Bay lines were run at different speeds over the edge of the turning basin to determine pitch and time-delay errors. During this evolution it was observed that vessel depth changed as a function of its speed, although the depth readout remained constant. This error rendered the data unusable since precise vessel depth was not known. It is believed that the problem resulted from relocation of the depth sensor ports on the vessel. Attempts have been made to correct this problem and the system will be retested during the next sea trial. In the event this problem cannot be completely resolved within the capability of the vessel's control system, vessel depth can be visually observed by marking the mast, and a table will be constructed for speed vs. depth.

Roll biases were determined by analysing data from both sites 1 and 2 using graphical and numerical methods being developed at NRL. The graphical method involved overlaying cross-track depth profiles for portions of reciprocal lines over a flat area and visually determining the offset. Since this offset is small, several roll bias estimates were used to iteratively correct the data and a 0.15 degree roll bias to starboard was found to empirically provide the best solution. Using the numerical method a roll bias estimate of 0.07 degrees to starboard was obtained, agreeing reasonably well with the graphical method. This bias is easily corrected with the Simrad software.

The gyro data for one of the site 1 lines is plotted versus time in Figure 6. The data shows an overall sinusoidal side-to-side motion with a peak magnitude of about 2 degrees, which is expected for an actively controlled vessel. Of concern however, is the anomalous flat spots observed for up to 3 second intervals. The data shown was generated by the EM950 which digitizes the gyro's synchro signal at a 0.1 degree resolution. While this apparent error did not significantly affect the computed bathymetry this anomaly will be investigated during the next sea trial by comparing the gyro's digitized output with that of the vessel heading at the sinusoidal peaks. As the vessel sways it may hang for several seconds at its maximum travel until the rudder action effects a return. However, this does not adequately explain the mid-cycle flat spots which are seen to be typically of shorter duration.

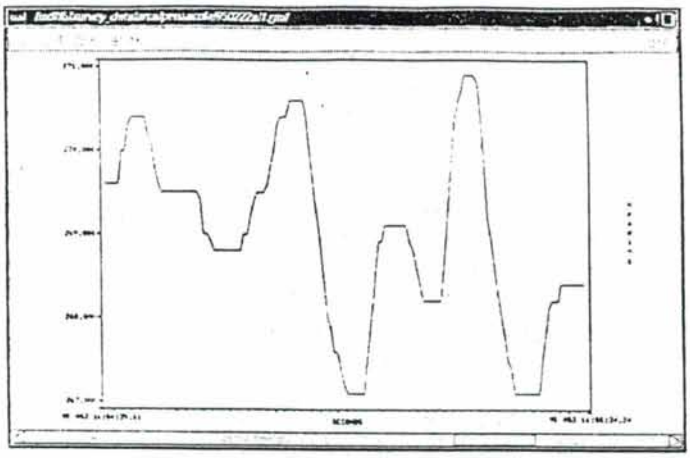


Fig. 6: Gyro Heading Versus Time

6. Additional Sensor Systems

For enhanced navigation safety, two additional systems have been added for obstacle avoidance. A mast-mounted video camera provides a real-time forward view above the surface of the water. The camera used is a Simrad OE 1359 CCD with a 90-degree view angle. This camera interfaces to the ORCA SUN workstation through a frame grabber and the video images are sent over the network using the "nv" network video tool, nv was developed for multicast applications, and provides data compression, variable size images, data rate control, and image contrast and brightness control. A 1-2 frame per second update rate has proven sufficient for the application and requires a data stream of about 70kbits/sec. The image from the camera is displayed on the topside SUN's navigation monitors. A planned upgrade of this system is the acquisition of a zoom and near-infrared capable camera.

A modified Wesmar model TCS600E scanning sonar has been mounted on the forward end of the keel to provide a forward view below the surface. This is a 60-kHz sonar with a mechanically scanned planar array. The sonar has a 15-degree beam and a maximum range of 1600 meters. The unit's control system allows manipulation of both lateral and vertical scanning directions. Data communications for the system are achieved by a serial link from the head of the sonar to the vessel SUN, and a serial link from the topside SUN provides to the sonar control unit. The control unit has its own display which will be positioned in the vicinity of the ORCA pilot. Ultimately it is desired to integrate the control and display functions of the unit into the topside SUN in order to eliminate the additional control box and monitor. The displays from the camera and sonar systems will provide the vessel operator on the host ship a complete 'look ahead' picture from the ORCA's perspective. Future plans for the obstacle avoidance system include the implementation of image-based autonomous obstacle detection using data from the camera and sonar.

Two oceanographic sensors are presently being integrated into the NRL vessel, the NRL developed Acoustic Sediment Classification System (ASCS) and an RDI 150-kHz Acoustic Doppler Current Profiler (ADCP). The ASCS uses a 30-kHz narrow-band pulse and provides a vertical profile of the sea floor sediments[8]. The processing algorithms generate acoustic the keel and is connected to the transmitter unit in the electronics compartment. The ASCS transmitter unit connects directly to the ARLAN ethernet link. An ethernet capable PC is used on the host vessel to: send commands; and to receive, post-process and display the data.

The ADCP provides current profiles and bottom tracking in water depths of over 300 meters. The unit is self contained and has been mounted along the aft end of the keel. A single serial link is used between the ADCP and the vessel SUN for control and data communications. On the host ship the SUN provides a serial link to the PC running the RDI Transect software. The Transect software performs post-processing and display of the collected data. Two additional serial links are provided between the topside SUN and the ADCP's PC. One provides GPS time, position, heading and velocity data, and the other provides ORCA gyro heading and TSS pitch and roll data.

A desired upgrade to the survey system is the integration of a strap-down inertial navigation system incorporating GPS, inertial and ADCP bottom tracking. Strap-down inertial systems such as the POS-MV[9] have already been demonstrated with Simrad bathymetry systems and allow survey data to be collected during vessel manoeuvres. The inability to survey during turns is a common drawback of contemporary survey vessels. Typically the vessel must maintain a constant heading for several minutes to allow the inertial systems to settle out after executing a turn. The POS-MV utilizes a ring laser gyro vertical reference unit and DGPS coupled through a Kalman filter. Incorporating the bottom tracking information from an ADCP will provide excellent short-baseline navigation accuracies. ADCP's have reported bottom tracking accuracies of .01% of distance travelled and can provide accurate positioning in areas where DGPS is not available. A related advancement is the integration of a multi-antenna GPS heading system. Off-the shelf systems can provide heading accuracies of 0.1 degrees with only a 1-meter antenna separation. These systems are more accurate and require less power and space than a gyrocompass.

7. Autonomous Survey Control

As seen in Figures 2 and 4, a large number of computer monitors are required to operate the system. The vessel pilot has three monitors, the vessel control monitor, the navigation monitor repeater, and the Wesmar monitor. The survey control station has the sensor control monitor, the primary navigation monitor, the Simrad control monitor, and a monitor for operating the HMPS system. The ASCS and ADCP systems each add their own monitor. The system as shown requires five trained operators to function. Figure 7 breaks the system down into functional elements and indicates which functions are presently handled by machines and which are handled by humans. This figure clearly displays that the operation of the survey system as a whole is very operator intensive, even with state-of-the-art sensor technology.

The vessel itself is an autonomous system, able to manoeuvre and maintain a dictated track. But at its current stage of development it is blind and deaf, requiring a human operator to perform the functions of obstacle recognition and obstacle avoidance. While automation of these functions is not a trivial task, it is an area of active research in the AUV and robotics communities and significant progress has been made. An incremental improvement in the system would be the automated recognition of potential obstacles using the video and acoustic images received from the sensors. The system would alert the vessel pilot of possible obstacles and leave the more difficult task ORCA vessel given the limitations of its sensory input; a surface radar would be required to provide the relative motion information needed to avoid other moving surface craft.

Automating sophisticated sensor systems may prove to be the most difficult aspect of converting this to a fully autonomous system. Generally each system requires an expert-in-the-loop observing system performance on the displays and modifying system or survey parameters through keyboard or control panel input. As an example, consider the execution of a bathymetry survey. A standard survey involves driving several parallel paths with a desired overlap in the coverage areas for data verification. To a great extent a parameter as seemingly trivial as path spacing cannot be pre-determined. The bathymetry system bottom coverage is affected by water depth, bottom slope, ambient noise and bottom reflectivity and these variables are not typically known *a priori*. Additionally, the direction of the waves may dictate the tracks chosen to minimize platform motion. The instrument operator must periodically inspect displays that give clues to data quality and adjust system parameters, trackline spacing and trackline orientation based on empirical observation and experience.

Full automation of the sensor systems will involve the development of expert systems to monitor the operation of each. Many of the systems already have some rudimentary capability for remote operational control from an external computer that could be utilized by a rule-based system. The majority of real-time status checking performed by the operator is done using displays of processed data, and intelligent signal processing algorithms will have to be developed to mimic the analysis performed by the operator. Many of the systems are PC based, prohibiting easy incorporation of supervisory control software. Consequently, the vendor software would have to be ported to a multi-tasking platform – a fairly simple evolution, but time consuming and costly. All of these developments would necessarily require a close liaison with the instrument manufacturer as substantial modification of the existing systems would be needed. Incorporation of these sensors into a fully autonomous submersible will require not only the advancements discussed, but also the integration of a significant amount of additional computational power into the vessel.

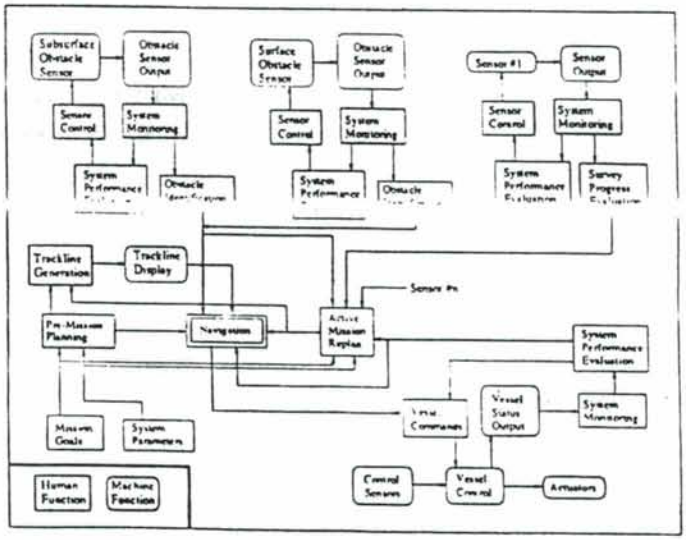


Fig. 7: ORCA Functional System Diagram

Work commenced on the ORCA project in February 1994. The two original vessels have undergone complete overhauls, and the forward halves of the vessels have been completely replaced to increase fuel capacity and enlarge the dry electronics compartment. The first vessel underwent a shakedown cruise in August 1994, and the second vessel in December 1994. The complete sensor system was installed in the first vessel and tested out of Gulfport, Mississippi in January 1995. It underwent a calibration trial operating out of the Pensacola, Florida Naval Air Station in February 1995. During the calibration trial the Simrad system was tested to its full depth capability of 300 meters. This operation included night time and foul weather conditions with launch and recovery performed pier side using a 30-ton crane. The operation also had a 21-hour duration trip to a survey site 50 miles out from the sea buoy. Charts were generated on site using data collected by the multibeam system of the various offshore survey areas and of the Pensacola Bay channel. Also during this mission the moving map display was demonstrated using a portable PC-based system. The software has since been modified to run on the ORCA's topside Sparc20 computer.

During the remainder of this year, NRL plans on field testing the RD Instruments' 150-kHz ADCP and the NRL-developed ASCS on the first vessel. The second vessel sensor system and the subsurface collision avoidance system are installed and underwent sensor pretrials and debugging in early May. Simple operations and manoeuvring of two ORCA's from a single host was also demonstrated during the May trial. By July 1995, a Simrad EM1000 sonar will be installed on ORCA #2, extending survey depth capability to 1000 meters. Calibration trials for this vessel are scheduled for July and September 1995 out of Pensacola, Florida. The July operation will include a demonstration survey using both ORCA vessels simultaneously collecting and transmitting hydrographic data to the same host ship. During this operation generation of same-day charts including navigation aids, shorelines, and other standard chart features will be demonstrated. Upon completion of calibration trials, ORCA #2 will be transitioned to NAVOCEANO.

The ORCA represents a new generation of forward deployable environmental sensor platforms capable of worldwide rapid response. It is capable of performing bathymetric surveys in conditions up to sea state 5. In addition to being as stable as a submerged hull. With this configuration there will be no entrained bubbles passing over the sensors, as is the case with surface craft, resulting in significantly improved sensor performance. Enhancing system responsiveness, sophisticated software has already been demonstrated which allows *same day* generation of charts from ORCA collected data

Acknowledgements

The authors acknowledge Mr. Landry Bernard of the Naval Oceanographic Office, Mr. Ken Ferer of the Naval Research Laboratory TOWS office, and Dr. Herb Eppert and Mr. Jim Hammack of the Naval Research Laboratory. The mention of commercial products or the use of company names does not in anyway imply endorsement by the U.S. Navy. Approved for public release; distribution is unlimited. NRL contribution number NRL/JA/7442-95-0036.

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APPENDIX VIII

FUNDAMENTAL QUESTIONS

(a) WILL THERE BE SUFFICIENT SCIENCE AND OPERATIONAL FUNDING IN THE FUTURE FOR OCEAN SCIENCE TO CONTINUE TO SUPPORT THE UNOLS FLEET AS CURRENTLY CONFIGURED?

AND , IF NOT

(B) WHAT ACTIONS MIGHT BE TAKEN TO MAXIMIZE THE EFFEFIVENESS OF THE U.S. OCEAN SCIENCE ENTERPRISE?

SPECIFIC COMMITTEE CHARGE

1. THE BUDGET PROJECTIONS OF DON HEINRICHS FOR UNOLS SHIP OPERATIONS, GIVING SPECIAL REGARD TO THE POSSIBLE EXPANDED PARTICIPATION OF SUPPORTERS/USERS, OTHER THAN NSF (I.E. ONR, NRL, NOAA, USGS, MMS, DOE, EPA AND NASA);

2. WITHIN REASONABLE BUDGETARY ASSUMPTIONS, ASSESS A GENERAL MODEL FOR THE UNOLS FLEET REQUIREMENTS FOR SUPPORTING SCIENCE. THIS ASSESSMENT SHOULD BE BASED ON THE MODEL THE UNOLS FLEET IMPROVEMENT COMMITTEE PROJECTED FOR THE YEAR 2000 BUT MODIFIED TO MORE ACCURATELY REFLECT CURRENT STATUS AND UPDATED PROJECTIONS;

3. IF ANY IMBALANCE EXISTS BETWEEN REQUIREMENTS AND RESOURCES, OFFER SUGGESTIONS AS TO HOW WE MIGHT BEST RECONCILE THE MISMATCH? (I.E. INCREASE THE USER BASE, REDUCE THE FLEET, AND/OR GO TO DIFFERENT MODES OF OPERATION);

4. WHAT UNOLS OPERATIONAL/FISCAL CHANGES WOULD WORK BEST FOR THE U.S. OCEANOGRAPHIC COMMUNITY?;

5. COULD FLEET REALIGNMENT LEAD TO A MORE EFFECTIVE USE OF OUR SHIPS? IF SO, WHAT ARE THE PARTICULAR CRITERIA THAT SHOULD BE USED TO EVALUATE THE MERITS OF SHIFTING SEA-GOING ASSETS.

FIGURE 1

TRENDS IN FEDERAL SUPPORT ($M) FOR UNOLS OVER PAST 27 YEARS

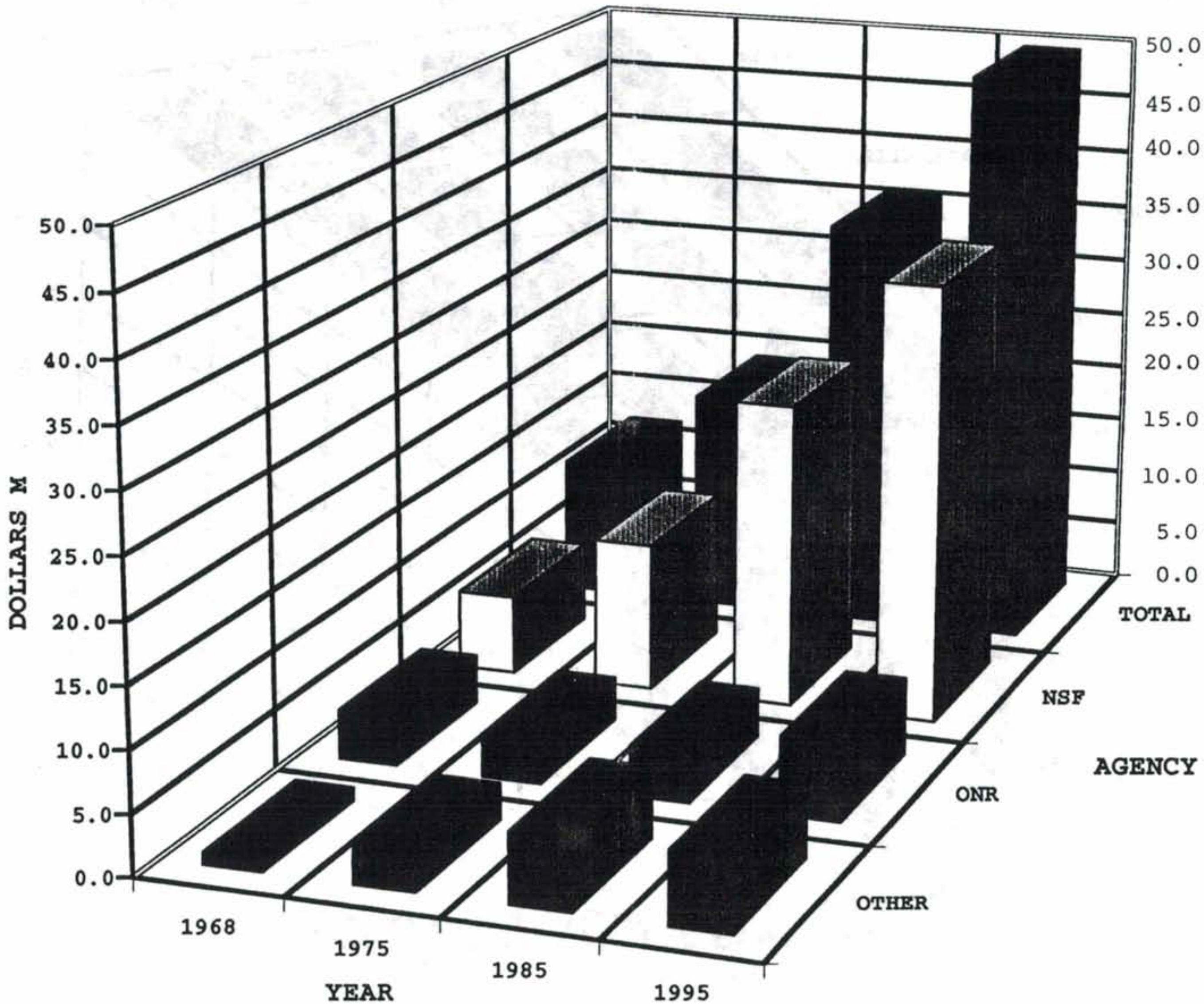


FIGURE 3

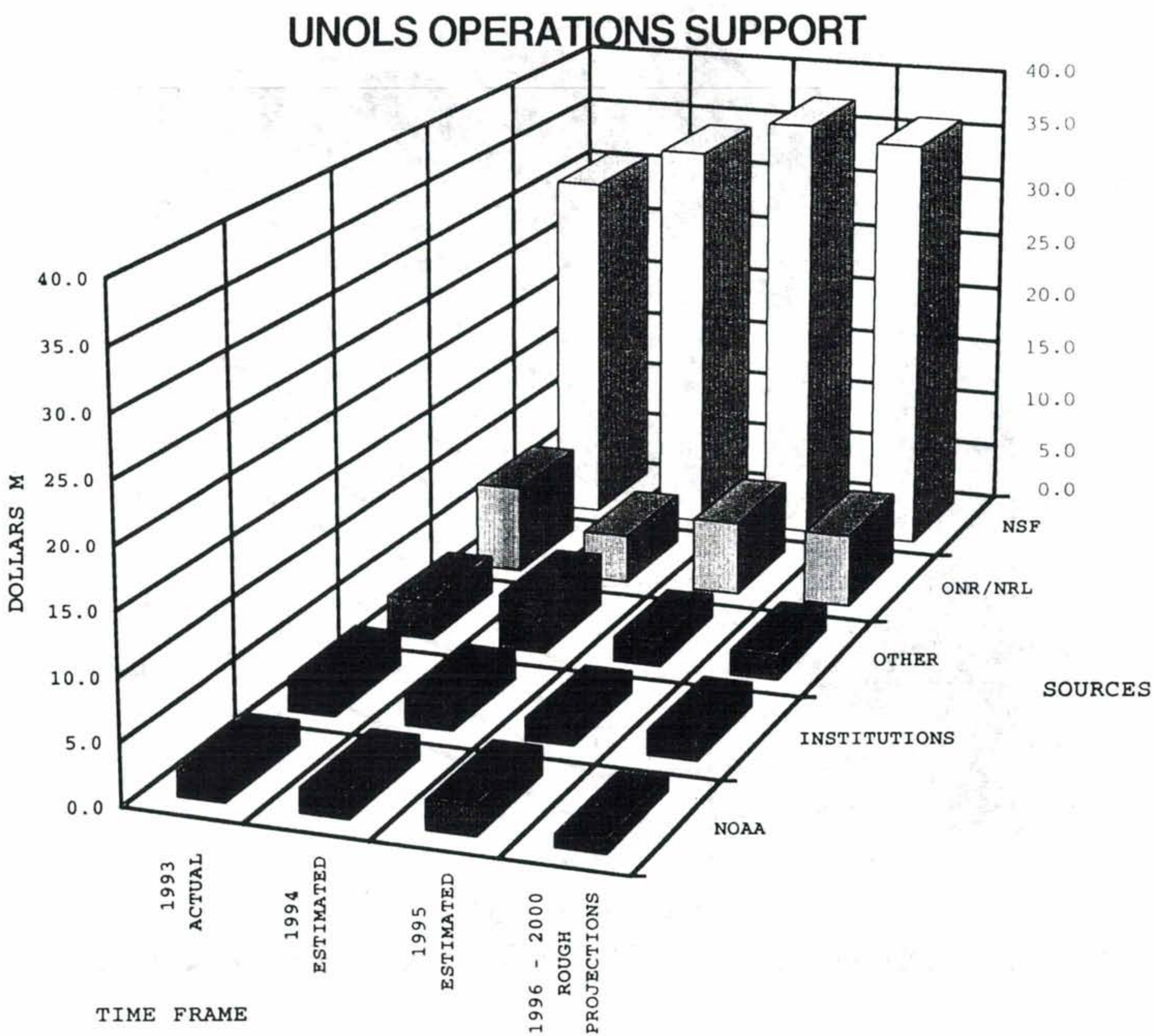

UNOLS OPERATIONS SUPPORT
DOLLARS M
40.0
35.0
30.0
25.0
20.0
15.0
10.0
5.0
0.0
NSF
ONR/NRL
OTHER
INSTITUTIONS
NOAA
SOURCES
1993 ACTUAL
1994 ESTIMATED
1995 ESTIMATED
1996 - 2000 ROUGH PROJECTIONS
TIME FRAME

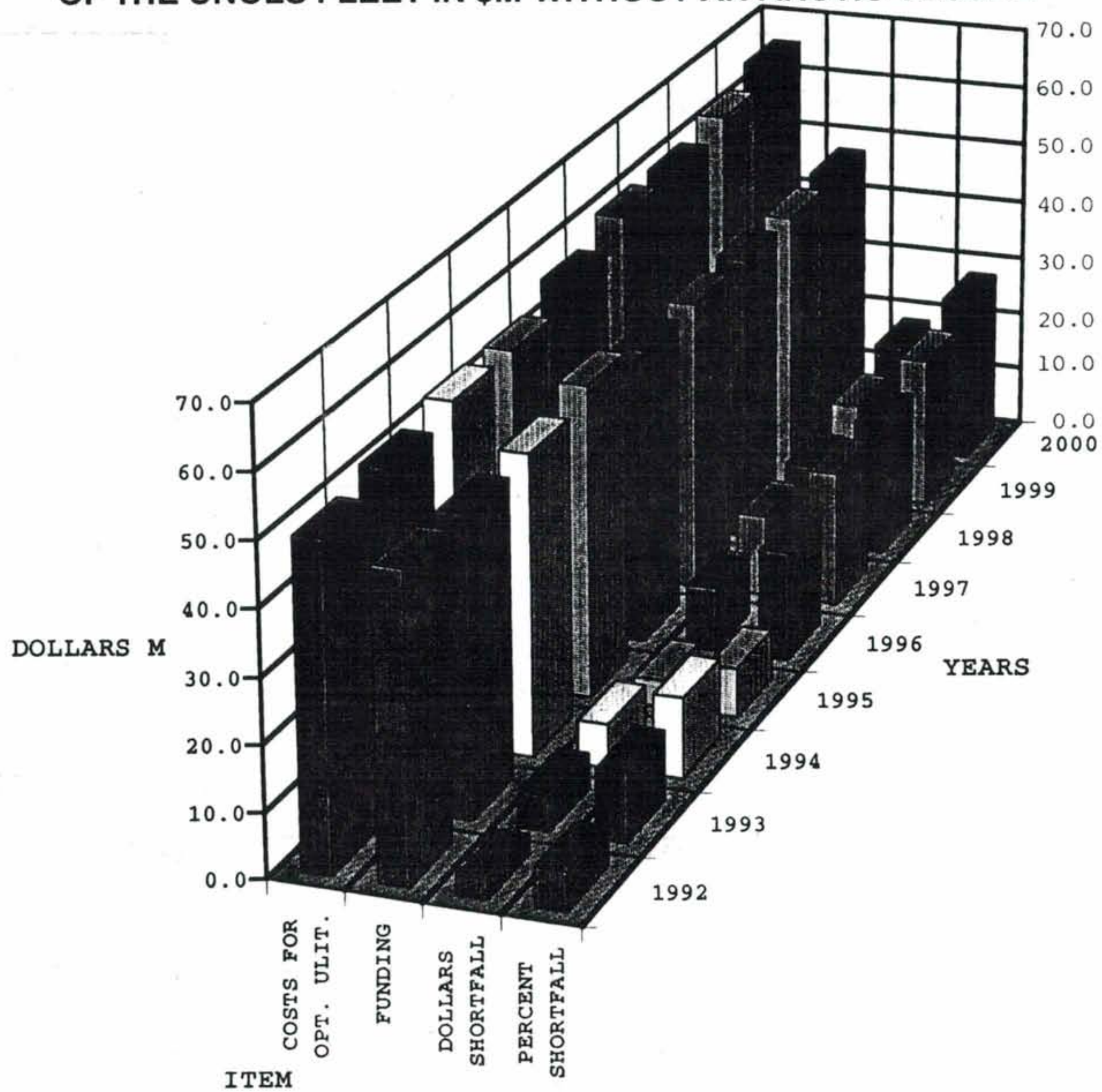
TABLE 4. Estimated Costs, Funding and Shortfall for the UNOLS fleet in ($M)

Year	Costs (4% Inc) for Optimal Utilization	Funding	($M)	Shortfall (%)
1992	49.7	46.8	2.9	6 %
1993	51.7	46.2	5.5	11 %
1994	53.8	47.1	6.7	12 %
1995	53.8	49.6	4.2	8 %
1996	57.1*	47.3	9.8	17 %
1997	60.5**	47.3	13.2	22 %
1998	60.5	47.3	13.2	22 %
1999	63.0	47.3	15.7	25 %
2000	65.5	47.3	18.2	28 %

Notes: Assumptions as in Table 3 of this report and in the FIC 1995 Plan (i.e *no resources for an Arctic Research Vessel*).

FIGURE 4

ESTIMATED COSTS FOR OPTIMAL UTILIZATION, FUNDING, AND SHORTFALL OF THE UNOLS FLEET IN $M WITHOUT AN ARCTIC VESSEL



APPENDIX IX

UNOLS Technology Upgrade Study Plan (DRAFT)

(Chris Mooers/2FEB96)

LEAD	TASK
FIC	● Purpose, etc. ● Scope: R/V's in the "Information Age" - supplementation w/ROVs, AUVs, etc. complementation w/other observing systems (e.g., moored and drifting buoys, satellites, etc.)
RVTECH	● Present Technology - standard - special
RVTECH/FIC	● Technology Possibilities & Prospects - "on the shelf" - "on the horizon"
FIC	● Scientific Needs
FIC/RVTECH	● Priorities, Phasing, Requirements (resources, etc.)

APPENDIX X

SeaNet Update

Richard Findley

SeaNet - What is it?

- Method of providing INTERNET connectivity between the shore side INTERNET and the ship board LAN (local area network)
- Designed to be used with different physical links.
  - INMARSAT, Iridium, Satellite Cellular, Cellular

Hardware

- Uses off the shelf hardware
  - ABB NERA INMARSAT Saturn-B
    - Two voice channels
    - FAX
    - High speed 64 kbit ISDN line
  - SeaNet Comunications Node (SCN)
    - SparkStation 5

Software

- Uses Standard Software Protocol
  - TCP/IP
  - PPP
- Specialized routines
  - Standard-B I/O module was designed by Steve Lerner at WHOI

Background

- Funds for system provided by NSF
- Test Cruise
  - JGOFS, Process 6 aboard RV THOMPSON
  - Barney Balch Chief Scientist
  - Gulf of Oman
- Technical Support
  - WHOI -- Andy Maffei
  - UW -- Bill Martin, Mike Relander

Installation

- Installed October 1995 in Oman
  - Had some initial problems interfacing Saturn-B to ship's gyro, due to incomplete or incorrect documentation.
  - RS232 NEMA interface to gyro would be more straight forward if available.
  - Unable to install with minimum obstructions specified by NERA

Operations

- Generally system worked as advertised.
- Voice quality was acceptable, but not as good as Standard "A"
- High Speed Data (HSD) is more sensitive to physical obstructions than voice.
- Problems with antenna pointing into obstructions on some headings.

PPP and TCP/IP Connections

- With no obstructions, it worked very well.
- FTP, WWW, e-mail, telnet etc. worked "better than at home"
- Setup times on ISDN/PPP connection was on the order of 5-10 seconds (Standard-A takes much longer)

Standard-B Rates

- Voice
  - Ship-Shore $5.50/min.
  - Ship-Ship $11.00/min.
- HSD (64 kbit/sec ISDN)
  - Ship-Shore (peak) $17.50/min.
  - Ship-Shore (off peak) $10.50/min.

Example Transfer Rates (preliminary)

- Standard-A BLAST/US Robotics Sportster modem @9600 baud
  - Transfer speed = 593 bytes/ sec
    - $.0002/byte @ $7.00/min
- Standard-B FTP file transfers with HSD
  - Transfer speed compressed = 8000 bytes/sec
    - $.00005/byte@ $17.50/min , $.000035/byte@$10.50/min
  - Transfer speed no-compression =5000 bytes/sec
    - $.0001/byte@$17.50/min, $.00006/byte@$10.50/min
- In all cases, file is an 81K GIF satellite image

Results

- System is capable of providing high speed interactive INTERNET access at sea.
- Potential to save money
- Automation is not possible on THOMPSON at this time due to problem with antenna obstructions.
- System is portable, it could be installed on other UNOLS ships

Next Steps

- Continue to work closely with other UNOLS ships, with further development of of standard-B interface to SCN.
- Identify a science cruise that requires high speed data requirements (Prefer THOMPSON).
- Identify other UNOLS institutions planning upgrades to INMARSAT-B, to assist in data considerations

APPENDIX XI

University of Miami

From: Prof. Chris Mooers

To: Prof. Ken Johnson
Dr. Don Heinrichs
Mr. Jack Bash

Subj: Regional workshops

Date: 25-Sep-95

1. Enclosed are draft guidelines for the regional workshops which we plan to ask the regional consortia to organize. I broadened the focus to include regional as well as coastal oceanography.

2. I think there was enough positive discussion (including from Dick Pittenger and Bob Knox in the aftermath) at the UNOLS Annual Meeting that it is important to follow-up promptly. It appears that we are heading for six workshops:

NECOR
MARCO
SECOR
Scripps plus CENCAL
(With Ken's blessing, I have approached Bob Knox on this.)
NORCOR
(I plan to ask them to include Hawaii due to Alaska's affinity for them.)
Great Lakes

Scheduling will be a problem so they don't occur simultaneously and so that an ad hoc subcommittee of FIC can attend.

3. Thus, I would appreciate your comments on any of this, especially the guidelines, by ***COB FRI, 19 SEP 95***.

Chris

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DRAFT

Guidelines for UNOLS Regional Consortia Workshops on Coastal and Regional Oceanography

(Prepared by Prof. Chris Mooers, FIC Chair/25SEP95)

1. The goal of these workshops is to seek community input, on a regional basis, for defining national facility needs for coastal and regional oceanography. This planning effort is a follow-up to the Williamsburg Workshop of February 1993, for which an UNOLS report exists.

2. The results will be organized into a UNOLS/FIC report, which, in turn, will feed into the 1997 UNOLS Fleet Improvement Plan.

3. The facilities focus should include regional observing systems (e.g., telemetering moored and drifting buoys), research vessels, special platforms (e.g., barges, piers, jack-up rigs, AUVs), information management systems, etc.

4. The workshop participants should include representatives from ship-operating institutions ***and*** non-ship-operating academic institutions, plus appropriate federal and state organizations.

5. ***As a minimum***, each workshop report should include an assessment of the following
   a. existing facilities
   b. scientific topic areas and likely research programs
      - over the short-term (next 5 to 10 years)
      - over the long-term (next 10 to 40 years)
   c. by comparing a. and b., define facility needs, especially for research vessels

6. An ad hoc committee of UNOLS/FIC will attend each of the regional workshops as observers to seek and offer cross-fertilization opportunities.

7. Each regional consortium is encouraged to follow the lead of MARCO and submit a modest proposal to NSF for workshop support.

8. The aim is to complete a series of six regional workshops by the autumn of 1996.

UNIVERSITY OF MIAMI

17 August 1995

Dear Colleague:

As Chair of UNOLS FIC, I have been charged by the Council to prepare a white paper (a recently revised version of which is enclosed) on the role of regional research vessel consortia in UNOLS.

At our July FIC meeting, I was asked to extend the white paper to include : (1) a historical perspective on each consortium; (2) their present status, including members; (3) your perspective on the pros and cons of such consortia; and (4) your perspective on their capabilities and limitations. Hence, I would appreciate receiving a response from you on these topics by ***31 August***. To compare how the various consortia are constituted and structured, I would also appreciate receiving a copy of your charter, MOU, or equivalent founding document. Of course, your comments on any aspect of the white paper would be welcomed, too.

You may be interested to know that FIC is conducting an analysis of the so-called "Coastal Zone Research Vessel" topic, including existing and prospective capabilities and needs. Part of our planned approach is to work with regional consortia (where they exist) to create a national perspective over the course of the next year or so.

Sincerely,

Chris Mooers

Christopher N.K. Mooers
Chair, UNOLS FIC

cc: Dr. Ken Johnson, UNOLS Chair
Mr. Jack Bash, UNOLS Executive Secretary

Enc.

P.S. I have (perhaps) arbitrarily designated a POC for each consortium on the enclosed mailing list. If this is mis-directed, please rectify among yourselves. While I hope each designated POC will accept the burden of a detailed response, others are welcome to offer comments, too.

Rosenstiel School of Marine and Atmospheric Science
Ocean Pollution Research Center, MSC 132
4600 Rickenbacker Causeway
Miami, Florida 33149-1098
Office 305-361-4825
Fax 305-361-4701

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REVISED DRAFT

White Paper on UNOLS Regional Research Vessel Consortia

Chris Mooers, FIC Chair

16 AUG 95

<u>Background</u>. Recently, UNOLS has suddenly entered an era of rapid change: no-growth funding levels at NSF, etc., with possibilities of downsizing and realignment on the horizon. In the same era, the US Navy has decommissioned its research vessels and NOAA may be following suit. Furthermore, the character of ocean science is changing with major themes in global and coastal ocean science emerging, with new satellite and other autonomous observing systems, an enlarged research populace, and the emergence of computer modeling.

This is an era when the concept of shared resources (ships, instrumentation, marine technicians, etc.) may have new meaning and urgency, especially when considering the needs for expensive technology and the more competitive research funding situation. The shared-resource approach is timely with the trend for the scientific user-base being evermore dispersed institutionally and the rise of non-ship-operating institutions.

There may also be new opportunities in regional ocean science and coastal ocean science, especially if improved, coordinated efforts can be engendered and maintained. On the regional and coastal ocean scales, research vessel inventories need to encompass a spectrum of vessel sizes and types.

Historically, the UNOLS community has seen regional consortia develop, mainly in association with efforts to acquire a new research vessel. None of the present consortia (see Appendix) can be said to be fully functional. Remarkably, a 1972 UNOLS study (enclosed) outlined the need and potential for regional consortia for coastal ocean research; the concepts articulated then seem very relevant today.

Vision. Now is the time to cultivate a new stage of development for the existing (and largely moribund) regional consortia. They should be based on well-rationalized geographical domains and cover the full spectrum of research vessels. Their major attributes could include:

1. One or more ship-operating institutions involved as principals
2. One or more academic institutions involved as principals
3. A non-exclusionary nature by offering associate membership to non-ship-operating regional institutions.
4. A level of 'jointness' associated with the ship operations; e.g.,
   - regional scheduling
   - pooling of instrumentation
   - pooling of marine techs

- coordinating shore support (i.e., maintenance and repair)
- long range planning of vessel and facility requirements, design, upgrading, equipage, training, regional telemetered data, data processing, etc.
- proposal preparation

5. Regional faculty (user) oversight
6. Regional management (administrative) coordination
7. A possible focus on intermediate and small R/Vs; however, large R/V's, specialized platforms, and other facilities could be included

Note: Items 1 to 6 are considered highly desirable conditions; large R/Vs may need special consideration.

New management mechanisms need to be evolved and codified. For example, past consortia may have remained embryonic because member institutional commitment was lacking. A system of membership dues (to defray costs of meetings, etc.) might make the difference. (It may be best for UNOLS to propose a template for consortia.) Clearly, there must be a balance between the needed management controls of ship-operating institutions and the oversight required by the regional community of scientists served.

REVISED DRAFT

Another need is for NSF, ONR, NOAA, and other agencies to provide moral support of regional consortia, which needs to be backed with financial inducements.

Plan-of-Action. Several steps need to be taken. First, the UNOLS Council needs to discuss and possibly endorse this regional consortia concept, and modify it as necessary. Second, UNOLS needs to consider possible guidelines for the formation and operation of consortia. Third, agency moral and financial support must be obtained. Fourth, one or more consortia should be encouraged to "step out" with revitalization. Fifth, their progress should be monitored, the guidelines modified, and the overall UNOLS community should be kept informed of progress and problems.

REVISED DRAFT

APPENDIX

Existing Regional Consortia and Other Institutions Shown in Regional Groupings

NAME	MEMBERS	STATUS	R/Vs
NECOR	WHOI URI LDEO		Atlantis II, Knorr, Oceanus, Ewing, Endeavour
MARCO	ODU VIMS U. Delaware U. Maryland Rutgers U. Bermuda Biological Station Duke U.	starting up	Cape Henlopen, Ridgley Warfield, Weatherbird II, Cape Hatteras
SECOR	TAMU UT (Austin) RSMAS	MOU '87 revitalization under way	(Gyre), (Iselin), Calanus,
	LUMCON		Pelican
	UT (Galveston)		Longhorn
	Skidaway		Blue Fin
	HBOI		Seaward Johnson, Link, Sea Diver
NORCOR	U. Washington OSU U. Alaska		Thompson, Wecoma, Alpha Helix, Barnes
CENCAL	MLML NPS UCSC UCSB USC	operating since '85	Point Sur
"SOCAL"	SIO		Melville, New Horizon, R.G. Sproul, (Revelle)
	U. Hawaii		Moana Wave
"Great Lakes"	U. Michigan U. Wisconsin ??		Laurentian

Note: North Carolina (Duke U. plus state universities) operate Cape Hatteras and Louisiana (LUMCON: state universities plus Tulane U.) operate Pelican. However, these consortas are not included above because they are state-based rather than regional in nature.

April 12, 1972

REPORT OF UNOLS WORKING GROUP ON COASTAL ZONE RESEARCH VESSELS

1. Purpose of Report

The purpose of this report is to inform the UNOLS Members and Advisory Council of the efforts and recommendations of the Working Group for discussion and further guidance at the UNOLS Meetings, May 3-5, 1972.

2. Background

The need for coastal zone research vessels to meet the needs of academic research institutions was raised at the first UNOLS Meeting in November 1971 at LaJolla, California. Such vessels, it was envisioned, should be more capable than those presently used in the growing efforts of institutions responding to the existing and documented needs of coastal zone research. At subsequent meetings the UNOLS Advisory Council directed that a Working Group be formed to examine the needs for Coastal Zone research facilities, and ships in particular, and to develop a plan to implement those needs.

3. Members of the Working Group

Dr. R. J. Wold, University of Wisconsin-Milwaukee, Chairman
Dr. W. S. Gaither, University of Delaware
Dr. M. Gilmartin, Stanford University
Dr. D. W. Menzel, Skidaway Institute of Oceanography
Dr. R. E. Smith, State University System of Florida
Dr. G. H. Savage, University of New Hampshire
Captain T. K. Treadwell, Texas A&M University
Mr. John Dermody, University of Washington

Captain R. P. Dinsmore, Executive Secretary, UNOLS

4. Meetings

The Working Group has held two meetings to date; the first on March 14-15, 1972 at the University of Delaware, Lewes; and the second at the University of Wisconsin at Milwaukee on April 12, 1972.

5. Goal of the Working Group

The Working Group considered that the recommendations should be directed principally to academic research needs, both basic and applied, including the role played by graduate research. Emphasis is to be placed on multi-institutional operational arrangements. Three major components are recognized, viz: vessels and other platforms, shore facilities and support systems. These components are further developed in Appendix II.

6. Requirements for Coastal Zone Research

In considering the needs for coastal research facilities the Group concurred that science as well as other socio-economic requirements cannot be disassociated from facilities and currently are being documented by past and present efforts, and this group should not endeavor to "re-invent the wheel" in defining the research needs for the Coastal Zone. The Group compiled and reviewed a series of Federal, regional and industry reports on the problems and needs for coastal zone research and from this compiled a listing of facility requirements vis-a-vis academic research disciplines. A synopsis of requirements is given in Appendix I. A non-exhaustive but comprehensive list of reports is given in Appendix IV.

7. Concepts of a Coastal Zone Research Vessel

In the course of its progress the Working Group established the following points of agreement.

a. That coastal research vessels under consideration should be cooperative vessels to serve the research needs of a group of institutions. Institutional vessels operated for and by a single laboratory, whether or not use is shared as determined by that laboratory, are not within the scope of this report. However, the numbers and availability of such vessels should be included as a factor in assessing the total facility needs of a particular area.

b. That the general size (and inferred capability) of a coastal cooperative research vessel is somewhere between 70-ft and 120-ft., and that it be specifically adapted for coastal applications.

c. That the coastal cooperative research vessel should be of the modular-concept where standardized, transportable vans, labs, or other components would be equally adaptable to shore use as well as shipboard.

d. That ship operations be regional in concept. A regional approach would better respond to regional research needs as well as improve such matters as data management, equipment standards, etc.

e. That a regional cooperative research vessel (as well as associated facilities) should be managed and operated by a capable institution within the region, but its use be controlled by a regional review group on behalf of the regional needs and scientific merit. Such regional facilities would be coordinated nationally through UNOLS.

8. Regional Concept for Facility Operation

The Group considers that the regional approach for operating and controlling a coastal zone research vessel is the optimum arrangment. Being responsive to a region would responsibly tie together many of the problems of the region into common efforts. As a regional responsibility portions of operating support could be more readily identified.

Coastal zone facility scheduling requires considerable flexibility. Projects tend to be short in duration and sometimes have very short lead times.

A regional policy group should be made up of individual users. This regional association will determine overall scheduling policies based on regional needs and/or scientific merit. Direct operations and maintenance would be assigned to a participating institution or institutions within the region who would operate the facility on behalf of the region.

The size and scope of regions tend to become arbitrary matters and precise lines are usually difficult to fix. A certain amount of overlap probably is both necessary and good and therefore regional lines should not be drawn too strictly. The Group concurred generally that regions might comprise New England (Maine to Block Island), Mid-Atlantic (Block Island to Cape Hatteras), Southeast (Cape Hatteras to Florida), Gulf of Mexico, Great Lakes, Pacific Southwest and the Pacific Northwest. Additionally, because of the intensity or focus of problems "mini" or "sub-regions" may emerge. The seven major regions are portrayed as Appendix III.

Within a region the plans for ship acquisition and operation based on cooperative multi-institutional use should be developed as a coherent effort on the part of the region based on a needs analysis. Once established, a regional arrangement could serve as a focus for the development and support for other kinds of research facilities.

9. Conclusions

In response to its charge the Working Group concluded

(a) That capable multi-purpose ships are a fundamental need for coastal research. However, it is often institution arrangements and not ships which are lacking.

(b) That interest of the scientific and regional community, within given geographical regions, can best be served by a multi-institutional, cooperative ship facility.

(c) That Coastal Facility needs should include more than ships alone and that ships, even though of principal concern, must also include associated elements of laboratory interfaces as well as instrument standards, calibration and repair, as well as data processing and techniques. Furthermore there is a need to consider specialized coastal facilities such as coastal drilling rigs, habitats, submersibles, and even large, low-cost mobile barges.

(d) That there be a strong recommendation whereby the acquisition of, and support for, regional cooperative coastal research vessel systems be assigned a singularly high priority; and that operational funding for such vessel systems be established from a broader base than the usual NSF-ONR sources and that assured funding be sought from additional Federal, regional and state sources.

Attachments

Tentative Recommendations

Appendix I -- Development of Academic Research Requirements for Coastal Zone Vessels

Appendix II -- Component Listing of Regional Cooperative Coastal Zone Research Facilities

Appendix III -- Map--Proposed Coastal Research Regions for Cooperative Coastal Research Facilities

Appendix IV -- (Separate Distribution -- limited) Compilation of References Documenting Research Requirements in the Coastal Zone.

April 12, 1972

RECOMMENDATIONS OF UNOLS WORKING GROUP ON COASTAL ZONE RESEARCH VESSELS

The Working Group recommends:

1. That there be established within UNOLS a category designated Regional-Cooperative Coastal Zone Research Facility, hereinafter designated Cooperative Coastal Research Facilities. Cooperative Coastal Research Facilities may be either multi-purpose or specialized ships or platforms.

2. That Cooperative Coastal Research Facilities shall be multi-institution facilities operated within designated geographic regions serving the research requirements of academic and related institutions conducting basic and applied research in response to regional needs.

3. That Coastal Research Regions be established along geographic lines approximately as follows:

   - New England Region (Maine to Block Island)
   - Mid-Atlantic Region (Block Island to Cape Hatteras)
   - Southeast Region (Cape Hatteras to Florida)
   - Gulf of Mexico Region
   - Great Lakes Region
   - Pacific Southwest Region
   - Pacific Northwest Region

4. That within a stated geographic region the community of academic research users be represented by a regional organization which shall seek to identify the regional research requirements and develop a system approach to the acquisition and operation of regional facilities. Within a region facilities may be operated on behalf of participating users to meet regional needs by one or more member institutions.

5. That priority attention at the outset should be directed not only to multi-purpose ships which should have a capability inferred within an approximate size range from 70 to 120 feet, but also to specialized vessels such as coastal drilling rigs, undersea-habitat systems and floating laboratories.

6. That Cooperative Coastal Research Facilities be of a modular concept where standardized, transportable vans, labs or other components would be equally adaptable to shore use as well as shipboard and also between vessels wherever possible. They should include such support systems as navigation, communications, data processing, technicians and technical standards. Where possible, uniform standards should be set which might apply not only to coastal research craft but to ocean-going ships. The role for developing such standards could be assigned to the Research Vessel Operators Council (RVOC).

7. That the scheduling and use of a Cooperative Coastal Research Facility be controlled by a regional organization. Facility use should be awarded on the basis of regional needs and scientific merit.

8. That funding for the support and operation of Cooperative Regional Research Facilities be developed taking into consideration the obligations Federal, State and Regional Agencies which have responsibilities and needs to support Coastal Zone Research.

9. That the aforementioned system be implemented effective in 1973. This should be accomplished in two ways:

   (a) By the commitment of funding by appropriate Federal, Regional and State Agencies for the operation of Regional-Cooperative Coastal Zone Research Facilities when such facilities are identified and a regional plan is approved.

   (b) By the acquisition of at least two ships (multi-purpose or special purpose) from Federal FY-73 ship construction funds.

April 12, 1972

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APPENDIX I

DEVELOPMENT OF ACADEMIC RESEARCH REQUIREMENTS FOR COASTAL ZONE RESEARCH VESSELS AND OTHER FACILITIES

COMPARTMENT & DISCIPLINE	GENERAL & SPECIAL REQUIREMENTS
1. Bedrock and deep sediments Geology Geophysics Geochemistry Rock mechanics Mineral extraction	General requirements for accurate navigation, capability of towing and lowering survey instruments, and obtaining long (piston) cores. Special requirements for deep drilling, with accurate station-keeping and heavy lifting capability.
2. Superficial sediments and Sediment/Water interface Physics of sedimentation and compaction; boundary layer flow; bottom friction; density currents. Mechanical properties in situ and in samples; engineering measurements. Chemistry, particularly of sediment/water exchanges and chemical history of the drainage basin. Biology, bottom fauna, microbiological conversions; biogeochemistry; demersal populations and fish.	General requirements as for 1, except that shorter cores are needed, with provision for keeping interface intact. The principal surveying instruments will be in the Sonar class; and, as for compartment 1 also, the data reduction and plotting requirements will be extensive. In addition to handling of special grabs, dredges, trawls, and suitable winches, a special requirement will be the placement on the bottom and recovery of in situ devices for short-term (e.g. cameras to observe animal (behavior) or long-term observations (e.g. sediment/water exchan of oxygen and other substances; near-botto flow; sedimentation and re-suspension). Placement of such devices must be carrie with minimum disturbance. Placement and recovery of underwater habitats or diver stations is another possible special requirement.
3. The water/shore interface-beach studies Physics - sediment transport; wave action. Engineering, see 7 Chemistry, sorting and exchange, placer deposits, calcareous deposits. Biology, attached algae; inshore fauna; fish spawning activities.	Special platforms (e.g. towers, shallow draft boats) will be required for near-sh studies; and these may have to be carrie either on road trailer or be carried or towed by a larger vessel. Divers and di support will also be needed.

Compartment & Discipline
continued

4. The Water Column

Physics: radiation fluxes; distribution of physical properties; water motions (periodic, "steady", turbu- lent) on space scales ranging from whole-basin dimensions to those of local turbulence and short waves, and short waves, and on time scales ranging from months to seconds; processes of stratification and destrati- fications; upwelling; internal wave generation and decay.

Chemistry: distribution and ex- changes of dissolved materials; turbu- lent diffusion of conservative and non- conservative substances.

Biology: growth, distribution, and decay of components of the food web, from micro-organisms to fish.

Engineering: behavior of moored, towed, and self-propelled objects and research platforms.

General & Special Requirements
continued

General requirements are for (1) station keeping ability, in all but the roughest weather, and winches for lowering and raising water bottles, sampling pumps, electronic probes, and plankton nets; (2) ability to tow probes and sampling pumps, nets and midwater trawls, at known constant or varying depths, sometimes at ship's cruising speed; and (3) ability to place and remove moored instruments buoys, and sampling gear--again in all but the roughest weather, and with mooring arrange- ments to stand exposure for several months. To match the data gathering capability of probes, towed sensor packages, and moored instruments, a data reduction system must be provided on ship, and on shore, and perhaps with ship-to-shore links.

Special requirements will be for synoptic or quasi-synoptic surveys, cooperatively with other vessels, with aircraft, and with satellite survey boats carred by a "mother" research ship. Communications between craft (air & water) and between craft and moored or drifting instruments will be needed.

Special craft or structures will be desired for some studies, i.e. stable towers or floating platforms (moored and unmoored) for offshor work, perhaps some with diver habitat facilit Towing, placing, tracking, and recovering such structures will also be a required capability. Special sonars will be developed for plankton and fish surveys.

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APPENDIX II

Component Listing of Regional Cooperative Coastal Zone Research Facilities with the Scope of the Working Group on Coastal Zone Research Vessels

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A. Vessels and other platforms-

1. These should be multipurpose as far as reasonably possible.
2. Operating economy must be a major consideration in the design.
3. Containerized labs should account for the major portion of the lab space aboard a vessel or platform. These labs must be quickly interchangeable. They should be considered as a facility a particular investigator can use 12 months of the year. These labs must be no larger than what can be transported by truck without special permits.
4. The operating crew must be a minimal size.
5. The maximum duration at sea should be on the order of two weeks.
6. Other platforms:
   a) Spartan Barge - Self-powered, A frame ability, capable of being moored in fast-running currents.
   b) Submersible - Inexpensive with maximum depth capability of 800'
   c) Semi-submersible - Mobile stable platform
   d) Habitat - Mobile shallow water capability, 100-150' depth.
   e) Jack-up units - Shallow water only
   f) Aircraft

B. Shore Facility -

1. The shore facility should be completely compatible with vessels. It is a component of a total system.
2. Should have containerized handling capabilities.

C. Support Systems -

1. Navigation
2. Communications
3. Data Processing including software
4. Technicians
5. Oceanographic equipment standards lab

Compartment & Discipline continued

General & Special Requirements continued

5. The Air/Water Interface

As the site of exchange of radiation, energy, materials and momentum, this interface will receive increasing attention. Although the main emphasis will be on physical processes and exchanges, some attention will be paid to chemical (materials exchange) and biological aspects (neuston community) of this interface.

Engineering aspects will be concerned with wave and wave forecasting.

Many of the general requirements for 4 will apply to this compartment also, with the qualification that the sampling and measurements are required in the air also. To some extent, the research vessels and satellite survey boats can be instrumented, but much reliance will have to be placed on measurements on moored or drifting platforms or on towers, or on free-fall devices.

Special requirements will be a ship-borne instrument and data-gathering system, in which the observations are not seriously influenced by the presence or motions of the vessel.

6. The Meso-Scale Region of Water Atmosphere Interaction

Studies of marine meteorology on scales of up to, say, ten times the basin dimensions; shore and lake breeze phenomena; weather modification; structure of storm systems; including the basin responses to periodicity, divergence, and curl of the wind stress.

Although a large part of the observing network may be land based, measurements will also be made from craft (water and air) and from in-water structures. Sonde measurements of the lower atmosphere (up to 1000m?) will be needed on synoptic measuring grids.

7. Engineering Studies

including coastal engineering and ice research. For improvement of navigation, port and marina development, and control of shorelines, research and engineering applications are needed in such subjects as ice breaking techniques, ice forecasting, dredging and landfill, shore erosion, wave forecasting and behavior of materials and structures in the lakes.

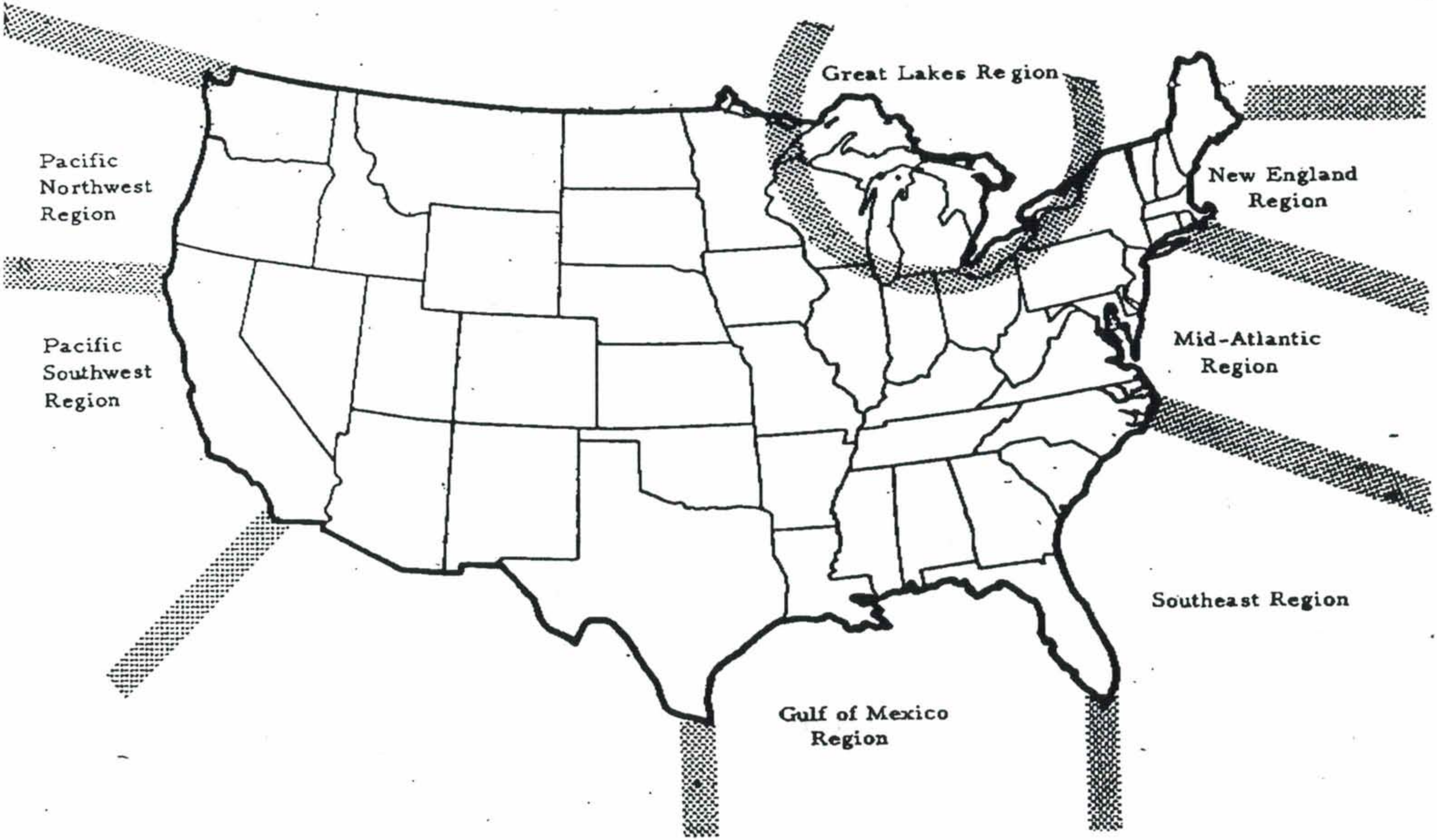
The general requirements are similar to those of Compartment 3, i.e., working platforms in shallow nearshore waters--also space on shore for pilot experiments, assembly of large structures or components and the ability to tow such to the sites being studied.

Special requirements will vary with the project, but could include large physical models (of ice breakers, shore protection structures, harbor marinas and airports).

APPENDIX III

April 12, 1972

PROPOSED COASTAL RESEARCH REGIONS
FOR
COOPERATIVE-COASTAL RESEARCH FACILITIES



APPENDIX XII

R/V CAPE HATTERAS

DUKE / UNIVERSITY OF NORTH CAROLINA
OCEANOGRAPHIC CONSORTIUM

Duke University Marine Laboratory
135 Duke Marine Lab Road
Beaufort, North Carolina 28516
Phone (919) 504-7583 / Fax (919) 504-7651

Memo to: Unols Fleet Improvement Committee February 2, 1996

From: Quentin Lewis, Marine Superintendent

Subject: R/V CAPE HATTERAS midlife refit

At the present time, conditions look favorable for a stretch of the HATTERAS in 1998, assuming both NSF approval and funding. Tidewater Naval Architects of Norfolk, Virginia, was hired in late 1995 to perform an initial feasibility study of the HATTERAS concerning a midbody extension. Two items were addressed:

1) What is the largest midbody that can be added keeping the vessel under 500 Gross tons (the cutoff point for Uninspected Vessels)?
2) Could any midbody be added and still allow the vessel to retain its current uninspected status?

The answer to #1 is that, based on preliminary tonnage calculations, a 23 foot midbody could be added.
The answer to #2 has not been officially received yet, but all indications from ABS and USCG are that a midbody could be added without a vessel status change.

We are planning to officially propose Phase I (Feasibility study) to NSF this spring. If this is approved and completed in 1996, then Phase II (Contract Design) and Phase III (Detail Design) would be proposed in January, 1997. During 1997, Phase II and III would be completed, and Shipyard Bid Packages sent out by November, 1997. Phase IV (Construction) would be proposed late in 1997. If funded, the actual midlife would be completed during the first half of 1998.

Items to be included in the midlife refit (with stretch) are:
Addition of 16 - 20 scientific berths
Renovation of ship's HVAC system (switch from central units to compartment units)
Addition of bow thruster
Renovation and reorganization of Main Lab and Wet Lab spaces
Renovation and addition of space in Cold, Frozen, and Dry Galley Stores
Addition of Scientific Storage space

Ship's propulsion and electrical systems have been previously determined to be adequate for up to a 24 foot midbody.

APPENDIX XIII

Date: 2 February 1996

To: UNOLS

From: Rick Jahnke, Skidaway

SUBJECT: BLUE FIN REPLACEMENT

The Skidaway Institute of Oceanography has initiated the process to procure a new research vessel. This vessel will be used for a variety of research and educational activities primarily within the South Atlantic Bight region. It is anticipated that no single type of activity will dominate the vessel use and that the design and outfitting of the vessel will need to be flexible to accommodate a variety of instrumentation and personnel needs.

After reviewing a variety of ship types, it has been decided that a monohull offers the flexibility in payload and operations that best meets our needs. While SWATH vessels clearly offer certain advantages for underway survey work, on station stability and payload appeared unsatisfactory for our purposes (especially in the size of vessel we considered).

We are presently reviewing a conceptual design that has been submitted to SkIO by Intermarine, a local shipyard. This design describes a 87' monohull constructed of fiberglass reinforced plastic. Propulsion is still under discussion but their present recommendation is twin water jets driven by Detroit Diesel engines. Without propellers and rudders, the draft would be slightly less than 6', facilitating work in the shallow estuaries and sounds of the SAB. The boat could be operated by a crew of 2 on short trips and up to 4 on longer trips. Accommodations are currently 18, 4 reserved for crew, 14 for science. Deck outfitting would include a stern A frame, starboard J frame, three winches (trawl, hydro, conducting) with 1000 m of wire each, and a crane with approx. 25' reach mounted on the main deck. Roll would be slowed by a 10 cubic meter stabilizer tank. Cruising speed is 12 knots. The present estimated cost is $2.2M and we are presently negotiating with the state to get as much of this up front as possible.

APPENDIX XIV

ATTACHMENT 1

DRAFT OUTLINE FOR UNOLS-FLEET IMPROVEMENT PLAN 1998

Executive Summary

I. Background
  - A. FIC
  - B. Purpose and objectives of update
  - C. UNOLS Fleet
  - D. Utilization and cost trends
  - E. Support trends

II. Trends in Oceanography and Facility Needs
  - A. Coastal Oceanography
  - B. Polar Oceanography
  - C. Physical Oceanography
  - D. Biological Oceanography
  - E. Chemical Oceanography
  - F. Marine Geology and Geophysics
  - G. Marine Meteorology
  - H. Ocean Acoustics and Optics
  - I. Global Oceanography
  - J. Fisheries Oceanography
  - K. Impact of new technologies
  - L. Agency science plans for big and small science programs
  - M. R/V needs for the next five-to-ten years AND beyond
  - N. Etc.

III. Trends and Issues Regarding the UNOLS Fleet
  - A. Future funding
  - B. Future costs
  - C. R/V retirement projections
  - D. New construction priorities
  - E. Interagency cooperation & support
  - F. Regional distribution
  - G. Modes of operation
  - H. Special platforms
  - I. Deep submersibles
  - J. ROVs, AUVs, etc.
  - K. Real-time data acquisition and dissemination
  - L. Needed technology upgrades
  - M. Etc.

IV. Findings and Recommendations

Appendix I: CZRV analysis, etc.
Appendix II: Regional consortia
Appendix N: Others

ATTACHMENT 2

DRAFT UNOLS - FIP98 Development Schedule

1. Agree on tentative outline - Winter 1996

2. Make homework assignments - Summer 1996

3. Draft homework submitted - Winter 1997

4. Draft FIP assembled and submitted for review - Summer 1997

5. FIP finalized - Autumn 1997

APPENDIX XV

FIC AGENDA FOR NEXT THREE YEARS - The remainder of the meeting was spent in considerable discussion on the action items that the FIC would be addressing in the next three years. The letters with recommendations for FIC from Don Heinrichs, Ken Johnson, Joe Coburn and Marty Mulhern were all reviewed. It was decided to divide the agenda items into three priority categories immediate: mid-range and long term. An outline of these agenda items follows:

A. IMMEDIATE

1. Coastal Zone Research Vessel (CZRV) activity.
    a. Scientific Mission Requirements
    b. Primer on Small Research Vessels
    c. Inventory of Small Research Vessels
    d. Analysis: Assets, Capabilities, and Requirements
        (1) Synthesis of Williamsburg Workshop Report
        (2) Regional SMRs (types A, B, and C)
        (3) Regional Inventory of Assets and Capabilities
        (4) Regional Science Plans and Requirements
        (5) Analysis of Assets/Capabilities Versus Plans/Requirements

    (ACTION: Completed - 1996)
2. Quantitative Analysis of Recent (3 to 10 year) R/V use by Ocean Region
3. Customer Satisfaction Survey Questionnaire

    (ACTION: Chris Mooers to revise, circulate to FIC for comment, and present to FIC Council at April meeting; aim for results by July FIC meeting.)
4. Chief scientists' responsibility for safety orientation, etc.

    (ACTION: Ad hoc subcommittee of Suzanne Strom, Chair, Peter Betzer, Joe Coburn, and Rich Findley to develop a point paper by July FIC meeting.)

B. MID-RANGE

1. Evaluation of NSF Inspection (ABSTECH) process. Does it need more teeth?

    (ACTION: Jack Bash discuss with Dick West and invite him to meet with FIC.)
2. Arctic Research Vessel oversight activity
3. Development of a long range science plan (especially for Class I/II vessels) in coordination with post-SFOFC activity.
4. Nuclear Submarine report and follow-up action

    (ACTION: Chris Mooers to call Garry Brass regarding moving forward.)
5. Use of UNOLS vessels as continuous data collection platforms (IMET/ADCP/MULTIBEAM/etc.)

    (ACTION: Chris Mooers to contact Mel Briscoe, OES/NOS.)

C. LONG TERM

1. Specialized Facility Oversight (FLIP/AUV/etc)
2. Involvement in mid-life reviews for NEW HORIZON, CAPE HATTERAS, POINT SUR
3. Fleet Improvement Plan update by summer 1997
4. FIC oversight on new vessel acquisition (MARCO CZRV/ RSMAS Catamaran/SOEST SWATH plus University of Hawaii and University of Miami.)

   (ACTION: Ken Johnson to write letters.)
5. Joint effort with DESSC on ALVIN replacement.

The meeting was adjourned at 1530 hrs.