UNIVERSITY - NATIONAL OCEANOGRAPHIC LABORATORY SYSTEM

UNOLS Council Meeting
September 13, 1989
Board Room
American Society of Association Executives
1575 I Street NW
Washington, DC

UNOLS Council members, representatives from NOAA and NSF and other observers met in Washington, DC at the American Society of Association Executives Building. The meeting was called by George Keller, Chair, at 8:30 a.m. Items on the Agenda (Appendix I) were called in the order reported herein.

ATTENDEES:

UNOLS COUNCIL:
George Keller, UNOLS Chair
Garrett Brass
Robertson Dinsmore
Paul J. Fox
Feenan Jennings
Robert Knox
Tom Malone
Art Maxwell
Worth Nowlin
George Shor
Jim Williams

OBSERVERS:
Dolly Dieter, NSF
Bruce Malfait, NSF
Lisa Rom, NSF
Elizabeth White, NOAA
Austin Yeager, NOAA
Bruce Cornwall, JHU/CBI

UNOLS OFFICE:
William Barbee
Barbara Funke

RESEARCH VESSEL OPERATORS COMMITTEE:

Jim Williams, RVOC Chair, reminded the Council that they had adopted UNOLS Research Vessel Safety Standards, revised in 1989, but that Chapter 11, covering **Radioactive Materials** was still being developed. **The completed Chapter 11, Radioactive Materials was adopted by the Council; the Council directed that the revised UNOLS Research Vessel Safety Standards, including Chapter 11, be produced and distributed to UNOLS Members, sponsoring agencies and others.**

The Agenda was presented for RVOC's meeting to be held October 3-5, 1989 in Miami, Florida. The Agenda emphasized safety, training and regulatory changes relative to marine operations at UNOLS Operator institutions.

An RVOC subcommittee on safety and training would be presenting a draft of a new Safety Training Manual for RVOC members' consideration. The manual, patterned after a safety and training manual published by the North Pacific Fishing Vessel Owners Association (NPFVOA), was being prepared under contract. The manual will be tailored to research vessels and their operations.

RVOC will also discuss and consider further aspects of a safety and training program, including production of training videos, formal training courses conducted by operators and training visits. RVOC will also hear a report on their efforts to compile statistics on injuries at sea and ashore.

Recently-proposed and newly-implemented regulatory changes affecting UNOLS vessels will be the second major emphasis at the meeting. During 1989, regulatory changes have been proposed concerning admeasurement of vessels and lifesaving equipment. These both may have some effect on UNOLS ships. Analysis of these proposed rules and their impact on UNOLS ships was contracted for through the UNOLS Office.

A major topic for the RVOC meeting was to be the twin issues of Zero Tolerance Policies for drugs on ships and testing for drugs among crews of vessels and marine personnel. Presentations were scheduled on these two issues, to be made by U.S. Coast Guard and Customs Bureau personnel. RVOC hopes to gain for all UNOLS Operators a clearer understanding of agency policies and practices.

Marine Operators are concerned about the enforcement of alcohol policies on their ships, especially in relation to personnel from institutions other than that of the Ship Operator. This concern reenforces the concern voiced at the July, 1989 UNOLS Council meeting. Pollution issues, especially concerning the disposal of plastics are also problems.

Jim Williams informed the Council that Bruce Cornwall, RVOC Vice Chair, would report for RVOC at the September 15, 1989 UNOLS Annual Meeting.

Dolly Dieter, NSF, advised the Council concerning an NSF-sponsored workshop held on safety in research diving. Diving safety is not covered comprehensively in UNOLS safety standards. NSF will try to obtain reports from their diving safety workshop that will be useful in formulating a revised UNOLS policy.

Jim Williams also reported that the MELVILLE was to arrive at the shipyard in Morgan City, Louisiana on September 15. Although the official delivery date for renovation work remains November 15, agreement was reached to deliver the ship early, thereby saving on operational costs and allowing early start on some pre-docking work (e.g., asbestos removal).

The final Ship Scheduling Meeting for 1989 was scheduled for September 14; there had been no Ship Scheduling Meeting since the July 1989 Council meeting. George Shor, Scheduling Committee Chair, reported to the Council on the basis of schedules and cost information compiled in preparation for the September 14 meeting and on conferences with agency representatives.

Not as much information on the status of science funding for individual 1990 projects as had been hoped for had yet been provided by agencies. (Note: additional information was provided at the September 14 meeting.) **Thus, there remained a significant number of projects still pending.** On September 13, there remained about 650 days of science projects still in a proposed status on UNOLS fleet schedules.

Based on preliminary summaries, costs projected for 1990 UNOLS fleet operations from NSF would be down nearly $2 million from July, 1989 estimates, while funds from ONR and from other sources remain unchanged from July estimates. **Although NSF has not provided firm estimates of their 1990 ship operations funds, UNOLS estimates would seem to match available agency funding (i.e., no funding shortfall).**

The mix of ships in operational status will change somewhat in 1990: MELVILLE will undergo shipyard renovation during virtually the entire year, KNORR will return to operations early in the year, BERNIER will hopefully be ready in February and THOMPSON remains under construction.

The Schedules of several large ships, MOANA WAVE, BERNIER and THOMAS WASHINGTON are heavily influenced by their need for and the availability of SEAMARC II. **Estimates are that large ship use will increase from 1,090 in 1989 to about 1,500 in 1990. Intermediate and smaller ship use appears level or slightly higher than in 1989.** (The 650 days scheduled but not yet funded could change those estimates significantly.) **It appears likely that some smaller ships (Class IV and less) may have schedule problems in 1989.**

In reference to Schedulers' difficulties in learning about science funding decisions in a timely manner, Worth Nowlin noted that WOCE is requesting early submission of proposals to participate in the WOCE program, thus assuring early determination and notification of ship

requirements. Other programs, RIDGE, JGOFS, etc., should be contacted considering similar policies.

George Shor announced that the Ship Scheduling Committee would choose a new Chair at their September 14 meeting. Their intent is to have a Chair and Vice Chair, alternating between east and west coasts.

ALVIN REVIEW COMMITTEE:

Feenan Jennings, ARC Chair reported that ALVIN had completed a six-months-duration overhaul and had been recertified.

The Navy had restructured the inspection/certification processs for ALVIN and there had been concern that the ALVIN Group might have difficulty in satisfying formal, highly-structured certification requirements. This turned out not to be a major problem, but because response time from the Navy inspection structure was longer than expected, the process delayed the first ALVIN project scheduled for 1989. **The ALVIN currently had a conditional certification.** Hull penetrators not replaced in the current overhaul were certified only after retesting.

During overhaul, 12 of 24 hull penetrators were replaced, the battery/power system was improved and rebuilt, a power system was provided onboard the ATLANTIS II, the hydraulic system was redesigned and reconstructed and modifications were made so that launch and retrieval will be ALVIN tail to AII's stern. These changes a basic 120-volt power system (converted to 28 volts where essential), onboard testing of ALVIN systems and components without reliance on the battery/power system, a simplified hydraulics system that includes a manifold to serve scientific equipment and increased safety and reliability in launching and retrieving.

Potential personnel problems within the ALVIN Group were brought to the ARC's attention by ALVIN users, from the ALVIN Group and by WHOI managers. Given that the ARC's role is limited to counseling, recommendations were made for an ALVIN Group-WHOI management meeting. The meeting appears to have resulted in solutions or progress on most issues.

The schedule of ALVIN operations for the remainder of 1989 was reviewed. (Only three ALVIN projects were scheduled for 1989, all in the northwest Atlantic.)

The ARC met in June, 1989 to review requests for ALVIN/ATLANTIS II use in 1990. Twenty-five requests were submitted for a total of 363 dives, mostly in the eastern Pacific. **The ARC recommended 15 requests for 205 dives.** Some uncertainty remains because of questions on the science funding related to several requests. **The tentative 1990 schedule would take up ALVIN operations in the Gulf of Mexico, following early-year ATLANTIS II shipyard overhaul. ALVIN operations would continue on the EPR north of the Equator, on the Gorda-Juan de Fuca Ridge system and, to finish the year, projects off the California coast.**

The ALVIN 25th anniversary is marked in 1989. Woods Hole Oceanographic Institution had made awards to Bud Froelich, ALVIN designer; Charles Monson, ONR's Program Manager for ALVIN acquisition; Al Vine, for the ALVIN concept and to Ruth Fye for her husband, Paul's contributions.

NSF awarded their Distinguished Public Service Award for ALVIN.

A 25th Anniversary ALVIN Symposium was to be held on October 16-18, 1989, in Woods Hole. The Symposium will be convened by Fred Grassle, and sponsored by NSF, ONR and NOAA. Its theme is an assessment of 25 years of research using ALVIN, featuring review papers by ALVIN users.

The ARC had scheduled its annual ALVIN Planning Meeting for December 3, in San Francisco. The Committee expects advance discussions of projects requiring ALVIN dives during 1991 and after.

Jim Eckman, Skidaway, whose term on the ALVIN Review Committee expired, has chosen not to continue on the Committee. The ARC recommended Gary Taghon, OSU, as a new Committee member. **The Council and UNOLS Chair confirmed and appointed Gary Taghon to a three-year term on the ALVIN Review Committee.**

FLEET IMPROVEMENT COMMITTEE:

Worth Nowlin, FIC Chair, reported on the Committee's 1989 activities and preliminary plans for 1990.

Current FIC membership is: Richard Barber, MBARI; Robertson Dinsmore, WHOI; Donn Gorsline, USC; Marcus Langseth, L-DGO; James Murray, UW; Worth Nowlin, TAMU; Bruce Robison, MBARI and Fred Spiess, Scripps. T. R. Treadwell has been executive secretary for FIC.

The Committee's objectives are to maintain a current UNOLS Fleet Improvement Plan, to continue to refine science mission requirements for all classes of vessels, to explore alternatives to new construction, to initiate design studies, to maintain awareness of novel vessel designs and applications and to serve as liaison and information resource for Federal agencies concerning the UNOLS fleet and ships.

A list of six FIC publications is Appendix II.

Committee activities in 1989 included:

- Complete science mission requirements for a manned spar buoy laboratory,
- Review and revision of science mission requirements for all vessel classes,
- Concept design for a small, general purpose SWATH (in progress),
- Modifications to concept design for intermediate four-strut SWATH (in progress),

- Develop mission profiles for research submarine,
- Recommendations on mid-life refits for CAPE class vessels,
- Recommendations on mid-life refits for OCEANUS class vessels,
- Science Mission Requirements for small to intermediate ice-capable research vessel for the western Arctic,
- Preliminary design for large, medium-endurance monohull research vessel,
- Review of CG plans for oceanographic improvements (including marine geology) for POLAR-class icebreakers,
- Completed draft 1989, revised Fleet Improvement Plan, and
- Worked with Federal funding agencies as appropriate.

During 1989-1990, the FIC plans to:

- **Issue the revised UNOLS Fleet Improvement Plan,**
- **Monitor current construction and renovation of large research vessels,**
- **Produce a concept design for intermediate, ice-capable general-purpose research vessel for the western Arctic,**
- **Prepare a compendium on small (less than Class IV) research vessels,**
- **Produce a concept design for a small, general-purpose SWATH,**
- **Pursue mid-life refit stream for OCEANUS class (WHOI),**
- **Complete the four-strut SWATH concept,**
- **Develop science mission requirements for submersible support vessel, and**
- **Consider recommendations on a research submarine.**

The FIC had considered rotation in its membership. Richard Barber and Fred Spiess had asked to step down. The FIC recommends as replacements Tom Royer, University of Alaska and Ken Johnson, Moss Landing Marine Laboratories. Additionally, Worth Nowlin had asked to phase out as FIC Chair. The FIC recommendations was that Donn Gorsline and Worth Nowlin be co-Chairs for 1989-1990. **The Council concurred, and UNOLS Chair George Keller appointed Tom Royer and Ken Johnson to the FIC, and Donn Gorsline and Worth Nowlin as co-Chairs.**

Earlier, the UNOLS Council had accepted a charge from NSF to develop means for improving the real-time reporting of selected meteorological

and oceanographic data. As a partial response, Worth Nowlin provided the FIC-sponsored report: **Meteorological Measurements from UNOLS Research Ships (Appendix III).** The report includes recommendations and requirement specifications for a complete system to sense, log, display on board and transmit appropriate meteorological and surface ocean data. **The Council agreed to providing the report to NSF.** Further consideration was deferred, pending assessment of the report.

It was also reported that NOAA has no current plans to provide SEAS units (for reporting meteorological data) to UNOLS vessels.

Worth Nowlin initiated a Council discussion on AGOR-24, its status in the Navy budget process and appropriate UNOLS action. The best information was that AGOR-24 remain in the budget projection for FY-1992 (as it had been reported at the July, 1989 UNOLS Council meeting) but that it was under scrutiny, and a more rigorous justification was being sought. **The Council agreed that a letter be sent Admiral Pittinger, Oceanographer of the Navy, reiterating UNOLS justification for AGOR-24 to support academic oceanography and urging that the Navy pursue acquisition aggressively.** Worth Nowlin added that the Navy should strongly consider the benefits of the Glosten preliminary design for a large, general-purpose oceanographic research vessel as an alternate to cloning AGOR-23.

CRUISE ASSESSMENTS:

Bob Dinsmore presented a summary of UNOLS Cruise Assessments that covered the first half of 1989. The summary (Appendix IV) includes returns for about 50% of the cruises completed by the fleet during January - June 1989. Rates of success during 1989 comparison with 1988:

	Jan-Jun 1989	Jan-Dec 1988
Fully Successful	84%	80%
Partially Successful	15%	15%
Unsuccessful	1%	5%
Of Time Lost*:		
Due to Weather	22%	20%
Due to Ship Problem**	16%	22%
Due to Science Problem***	14%	18%

* Time lost only on partially successful or unsuccessful cruises.

** Ship problems include ship equipment, instrumentation, personnel, propulsion, etc.

*** Science problems include project-furnished equipment, instrumentation, and experimental planning (e.g., there was no front to observe).

After discussion, the UNOLS Council directed that the summary, along with subsequent summaries, be published in UNOLS News, etc., as Chief

Scientist Cruise Assessments. Care should be taken to assure that reports of lack of success are appropriately laid to weather, operator, science party, etc.

UNOLS ISSUES:

A report on UNOLS community interest in specialized facilities for research at sea, Laboratory-Grade Facilities at Sea, Deep-Sea Observatories and FLIP II (successor to FLIP) had been approved by the UNOLS Council at their July, 1989 meeting. The report had since been forwarded to ONR and to NSF, and acknowledged. The letter transmitting the report, together with responses to UNOLS' poll of the community were provided to Council members.

The disposal of plastics after use aboard UNOLS research vessels had become an issue. United States adoption of MARPOL international conventions virtually prohibits plastics disposal at sea. Further, many plastic packing containers (e.g., for expendable BT's) cannot be compacted aboard nor disposed of in many foreign ports. **One obvious tack is to eliminate, as insofar as practical, the use of plastic expendables on board research vessels.** The Council had directed that selected vendors be contacted and asked to consider the use of degradable (non-plastic) packing materials. No vendors had yet been contacted, pending development of an appropriate list of offending materials. **The Council suggested that RVOC should be consulted concerning a list of vendors/products whose use presented particular problems on UNOLS ships and on whom UNOLS might have reasonable leverage.**

George Shor reiterated his concern with the difficulty of enforcing accountability on personnel from another institution for institution policies governing liquor aboard ships. A first step must be to determine individual UNOLS Operator policies. **The Council directed that liquor policies from all UNOLS Operators be compiled, to be published in UNOLS News.** Further action was deferred, pending examination of that compilation of policies.

FUNDING AGENCIES:

NSF representatives reported that they had no firm new information on their FY-1990 budget (beyond that reported to the Council in July, 1989). At the same time, they reiterated that a best scenario for ship operations funding was **level with 1989.**

Copies were distributed of **NSF Support of Ocean Sciences, An Informal Guide, National Science Foundation, Ocean Sciences Division.** The Guide, widely distributed by NSF/OCE, provides information on proposal target dates, proposal preparation and review, major Ocean Sciences initiatives and agency-wide programs.

As of October 1, the following key personnel were to be in place: Grant Gross, OCE Director; Don Heinrich, OCFS Head; Bruce Malfait, Ocean Drilling Program Manager and Dolly Dieter, Ship Operations Program Manager.

Dolly Dieter briefed the Council on status of the FOFCC report on the Federal Oceanographic Fleet.

Draft findings and recommendations were:

- The Federal Fleet (including the UNOLS fleet) is well used by appropriate activities,
- A plan should be developed to facilitate academic use of Navy Deep Submergence Vehicles (principally SEA CLIFF and TURTLE),
- Plans should be developed for replacement/modernization of all segments of the fleet,
- NOAA requirements are greater than fleet capability; they should operate at full capability,
- Special platform requirements are recommended; FLIP II, ice-capable and SWATH platforms are considered, with varying recommendations,
- Major equipment/systems should be validated as national assets,
- FOFCC's 5-year projections on ship needs, recommended capabilities, plans and activities should be updated annually.

The final report was scheduled for December, 1990.

RADM Austin Yeager reported that NOAA had both House and Senate budget marks for 1990. NOAA would have funding level with 1989 (e.g., six ship lay-ups would continue through 1990). **NOAA 1991 budget submission was through the Department of Commerce, and had been received by OMB.** The 1991 budget submission is more favorable than that for recent years. If it holds, three of the six inactive ships could return to service in 1991.

A House bill to authorize modernization of the NOAA fleet appears hopeful. (Appropriations have not been advanced, however.)

There were no ONR representatives present.

Bob Dinsmore provided a summary of the Principal Characteristics of the Modified R/V MELVILLE and R/V KNORR (Appendix V). Work on the KNORR is progressing, with the new 34-feet-long section in place. Machinery is being delivered and installation has begun.

Asbestos removal on the KNORR cost a month's delay and an unanticipated $668,000. **Delivery date for the KNORR was set for March 30, 1990.** (The asbestos cost had strained funding; some desirable options may have to be delayed.)

The MELVILLE was to arrive at the yard on September 15. It was to go on the ways (a pad, actually) in November, 1989. Scripps had ordered SWATH mapping transducers for the MELVILLE from General Instruments.

The BERNIER's current plan to complete conversion and begin operations in February, 1990 did not appear likely. The National Oversight Committee was to meet in mid-October; bids and contract would be after that.

This was the last UNOLS Council meeting at which Bob Dinsmore, WHOI and Bob Knox, Scripps would be members. George Keller, UNOLS Chair, commended them for their valuable service to UNOLS and the community. The Council endorsed that commendation.

Other items on the agenda were deterred, and the meeting adjourned at 5:30 p.m.

APPENDIX I

AGENDA
Advisory Council Meeting
8:30 a.m.
September 13, 1989
Board Room
American Society of Association Executives
The ASAE Building
1575 I Street N.W.
Washington, D.C.

COMMITTEE REPORTS

RVOC. The UNOLS Council, at the July, 1989 meeting, adopted, revised **UNOLS Research Vessel Safety Standards.** The revised Chapter 11, **Radioactive Materials (1)** will be presented by Jim Williams for council adoption.

Jim Williams, RVOC Chair, will raise additional operations-related issues through a preview of the October, 1989 RVOC meeting agenda (2).

ALVIN Review Committee. Feenan Jennings, Chair, will report on the status of the ALVIN program for 1989 and 1990. New Committee member nomination, Gary Taghon, Oregon State University. (Council discussion, UNOLS Chair appointment.)

Ship Scheduling Committee. George Shor, Chair, will characterize 1990 schedules on basis of July, 1989 Ship Schedule meeting (3) and information on hand for the September 14 meeting. Discussion on selection of Ship Scheduling Chair, Vice Chair for 1989-1990.

Fleet Improvement Committee: Worth Nowlin, Chair, will report on the update **UNOLS Report on Fleet Improvement** and other FIC issues and actions; discussion of position, actions relative to AGOR-24.

Cruise Assessments. Bob Dinsmore will discuss assessments fleet wide for 1988 and first half, 1989.

UNOLS ISSUES

Several issues have recently been before the UNOLS Council. Status reports or action items.

LGAS. UNOLS has delivered the Knox Report to Eric Hartwig, and he has acknowledged it. Wrap-up correspondence is attached (4).

Plastics aboard UNOLS R/Vs. Issue was raised at July, 1989 Council meeting, and it was agreed to write selected vendors asking that they eliminate/minimize plastic containers, etc. NO ACTION YET TAKEN.

UNOLS-institution policy/rules concerning liquor aboard ships. Issue raised at July, 1989 Council Meeting. The Council agreed that there should be reasonable consistency among rules by different institutions, and agreed that the Council should encourage every UNOLS operator to establish and publish a policy concerning liquors aboard that institution's vessels. Scientific parties and others should be notified of and acknowledge in writing the liquor policy. (In reference to CG regulations.) Institutions must enforce whatever policy/rules that have been adopted.

George Shor will introduce a resolution (see [5]) that the Council (through the UNOLS Office) compile the set of UNOLS operator liquor rules and distribute them. If agreement is reached, the UNOLS Chair should announce Council actions at the September 15 Annual meeting.

Realtime reporting of Oceanographic Data. Issue raised at July Council meeting. A quandary concerning what data to report, how to report it and data specs. As part of the development of data requirements/specs, Worth Nowlin agreed to suggest appropriate met instrumentation specs (6).

RVOC lay-up letter. UNOLS and the Council appears to be hung up on the RVOC-proposed lay-up policy. See p. 1, 2 of Ship Scheduling Committee Meeting Report (3). Council discussion on course of action.

SHIP ACQUISITION RENOVATION

Several acquisition or renovation actions are underway. Status reports.

AGOR-23. Keith Kaulum, Bill Barbee.

MELVILLE/KNORR. Bob Dinsmore, George Shor, Jim Williams.

BERNIER. Bob Dinsmore, NSF representatives on status of the conversion. See also the correspondence on UNOLS representation on the **BERNIER National Oversight Committee** (7). This issue seems to have been resolved.

AGOR-24. The FIC-developed statement of UNOLS position. Other developments.

UNOLS CHAIR REPORT

George Keller will preview his report to UNOLS (September 15 meeting), which will be in large part based on preceding reports and discussions. The Chair report is, effectively, the Annual Report of UNOLS and UNOLS Council activities. See UNOLS Meeting Agenda (8).

REMARKS FROM FEDERAL FUNDING AGENCIES

Information from Federal Funding Agencies (ONR, MMS, USGS, NOAA and NSF) on 1989 funding and forecasts for 1990 (and beyond). NSF/DPP report on RVIB. NSF/OCFS report on FOFCC Federal Fleet Report. (Keith Kaulum, Hawley Thomas, Bonnie McGregor, Austin Yeager, Don Heinrichs, Bruce Malfait, Dolly Dieter, Al Sutherland, others?)

UNOLS BUSINESS

Membership. Harbor Branch, University of Texas, Austin have been notified that their ships SEWARD JOHNSON, EDWIN LINK and LONGHORN are designated (provisionally re Harbor Branch) UNOLS vessels. Harbor Branch becomes an Operator and University of Texas remains one. Maine Maritime Academy notified their application for Membership was tabled in July. Former Associate Members have NOT been canvassed concerning their continuation as UNOLS members, participation in the National Ocean Program, significant funding. Further action.

Proposals to Host UNOLS Office/Executive Secretary. The UNOLS Chair will announce the open competition for the UNOLS Office at the September 15 Annual Meeting. NSF would like a single UNOLS-endorsed proposal by September 1, 1990, for establishment of the new Office by about May, 1991. See the proposed schedule for proposals, evaluations, etc. (9), and UNOLS Charter, paragraph 4g, p.5.

Candidates for UNOLS Council. A slate has been devised by the Nominating Committee (Brian Lewis, UW, Chair; Gary Brass, University of Miami/RSMAS; and Robert Thunnel, University of South Carolina) and distributed (10).

Calendar for UNOLS Meetings. The council should set a calendar for meetings 1989-1990:

UNOLS Council:	February 8, 9, 1990 - Austin, TX (set)
	June-July ?, 1990, ?
	September-October ?, 1990, Wash., D.C.
UNOLS Annual:	September-October ?, 1990, Wash., D.C.
	(adjoining UNOLS Council, Ship Sched.)

Ship Sched.:	July ?, 1990, Wash., D.C. (after Feb. 1 proposals are reviewed, announced) Sept.-Oct., ?, 1990 Wash., D.C. (adjoining UNOLS Council, UNOLS)
RVOC:	? (set by RVOC)
FIC:	? (set by FIC)
ALVIN Review:	Dec. 3, 1989, San Francisco-Planning June 20-22, 1990, Woods Hole-Review

A full meeting; may last beyond 5 p.m.

UNOLS FIC Reports

September 1988 - September 1989

Barber, Richard and T. K. Treadwell, Report of a Workshop on Mid-Life Refits and Improvements of Intermediate-Size Ships, UNOLS Fleet Improvement Committee Report, 19 pp., UNOLS Fleet Improvement Committee Office, Texas A&M University, College Station, TX 77843-3146, 1989.

Fisher, F.H., and F.N. Spiess, Draft Science Support Requirements for a Manned Spar Buoy Laboratory, UNOLS Fleet Improvement Committee Letter Report, 6 pp., UNOLS Fleet Improvement Committee Office, Texas A&M University, College Station, TX 77843-3146, 1989.

The Glosten Associates, Inc., Preliminary Design for Medium Endurance General Purpose Oceanographic Research Vessel, Final Report, File No. 8808, for the UNOLS Fleet Improvement Committee, 130 pp + 3 Appendices, UNOLS Fleet Improvement Committee Office, Texas A&M University, College Station, TX 77843-3146, 1989.

Johnson, Thomas C., Report on a Workshop on Improvement to the CAPE-Class Research Vessels, UNOLS Fleet Improvement Committee Report, 23 pp., UNOLS Fleet Improvement Committee Office, Texas A&M University, College Station, TX 77843-3146, 1989.

Royer, Thomas, *et al.*, Scientific Mission for an Intermediate Ice-Capable Research Vessel, UNOLS Fleet Improvement Committee Report, 17 pp., UNOLS Fleet Improvement Committee Office, Texas A&M University, College Station, TX 77843-3146, 1989.

UNOLS Fleet Improvement Committee, Scientific Mission Requirements for Oceanographic Research Vessels, UNOLS Fleet Improvement Committee Report, 36 pp., UNOLS Fleet Improvement Committee Office, Texas A&M University, College Station, TX 77843-3146, 1988.

METEOROLOGICAL MEASUREMENTS FROM UNOLS RESEARCH SHIPS

R. Weller, WHOI
P. K. Taylor, IOS

September 5, 1989

Meteorological Measurements from UNOLS Research Ships

I. Introduction

Observations of the basic meteorological variables at sea are extremely valuable, not only because they add to the data needed to understand air-sea coupling but also because they fulfill the immediate need for the data required to develop accurate weather forecasts. The ships of the UNOLS fleet have the potential of being especially attractive platforms from which to make accurate *in situ* measurements of the basic observables -- sea surface temperature, air temperature, wind velocity, barometric pressure, solar and longwave radiation, humidity, and precipitation -- and from which to make accurate estimates of the air-sea fluxes. They are attractive because: 1) They often travel paths through data sparse regions; 2) They are manned by crews, technicians and science parties with an interest in obtaining good meteorological data; and 3) Their operating schedules permit their sensors and electronics to be returned periodically for calibration.

This document will briefly discuss the uses of, and implied accuracy requirements for, meteorological data from the UNOLS fleet. On the basis of a review of three types of meteorological instrumentation packages developed in the U.K. and in the U.S. recommendations are made for equipping the UNOLS ships with meteorological systems. These systems comprise meteorological sensors, on board display and data recording software and hardware, and on board hardware and software for automated telemetry via Service ARGOS of averaged data. For this discussion, the UNOLS fleet is considered to consist of Large (greater than 200 ft and capable of global operation), Medium (150-200 ft, working near home port and not at high latitude), and Small vessels (local and coastal operation). Finally, some areas of concern that must be dealt with during the implementation are listed.

II. Meteorological Instrumentation for Ships

II.1 Accuracy Requirements

Meteorological data from the UNOLS ships would be of value for:

(a) initialization of atmospheric models;
(b) as a source of accurate estimates of the basic meteorological variables (air temperature, humidity, etc.); e.g. for comparison to values from ships of opportunity, output from atmospheric forecast models, or for satellite validation.
(c) to estimate the air-sea fluxes; e.g. to verify climatology or model derived flux values.

These uses, and the implications for measurement precision etc. have been discussed in more detail in Taylor (1989). The greatest demand, in terms of the variables to be measured and the accuracy sought, is for the definition of the surface fluxes. Data adequate for that purpose will also be adequate for model initialization provided it is rapidly made available over GTS (Global Telecommunication System).

For routine measurement from ships the surface flux values will be obtained, using bulk formulae, from the basic meteorological observables. These are the sea surface temperature (T_s), air temperature (T_a), wind speed (U_w), wind direction (ϕ), barometric pressure (p_a), humidity (q_a) or dew point temperature (T_D) or wet bulb temperature (T_W), short wave radiation (SW), long wave radiation (LW), and precipitation rate (p_o). There should be care taken to minimize errors in the measurement of these basic observables, particularly systematic errors or biases that cannot be suppressed by averaging. The following accuracies should be sought:

Table of Accuracies

Observable	Target Accuracy
Wind speed, U_w	larger of 2 percent or .2 m s^{-1}
Wind direction, ϕ	2.8°
Air-sea temp. diff	0.5°C
air temp, T_a	0.25°C
sea surface temp, T_s	0.25°C
Humidity	
specific humidity, q	0.25 g kg^{-1}
relative humidity, RH	1.7 percent
dew point temp., T_D	0.3°C
Net shortwave, SW↑↓	10 W m^{-2}
Net longwave, LW↑↓	10 W m^{-2}
Barometric pressure	1 mb
Precipitation	1 cm $month^{-1}$

II.2 System Definition

Accurate shipboard meteorological measurements have been attempted by many investigators over the years. Some instrumentation systems are now in use, and other packages and sensor sets are now under development. The functional definition of a suitable system should include:

(a) A suite of calibrated, properly exposed meteorological sensors. This normally requires the use of two or three sensors for each variable to ensure good exposure for any relative wind direction. Calibration is required at frequent intervals (typically one to three months). The organization of a routine system for sensor maintenance and calibration should be an important part of the installation specifications.

(b) A link to the ship's navigation system. The direction of the ship's head, and the ship's velocity through the water, are required to correct wind velocities.

(c) Signal conditioning and transmission to the logging system. A particular problem for shipboard installations is to avoid interference from radio transmissions.

(d) Sampling, time stamping, filtering and averaging of the data. Typically data may be sampled once per second or faster, and the processed values averaged over one or more minutes.

(e) Conversion of the data to geophysical units. This may be performed either before recoding or on replay for data display. The correct calibration must be correctly associated with each sensor despite, for example, the replacement of a sensor due to failure in the middle of a cruise.

(f) Data recording. This must be reliable despite possible power supply fluctuations, etc.

(g) Data display. Normally the scientific party on the ship requires a display of present data and also to be able to recover previously recorded data. This must be possible without compromising the data recording.

(h) Transmission of the data to shore for system monitoring. If required this is normally accomplished through an ARGOS link.

(i) Transmission of the data on the GTS for use by Meteorological Agencies. This requires that the data be quality controlled and that a correctly coded message be assembled.

II.3 Examples of Meteorological Systems

To illustrate what is possible, SEAS, a basic system for preparing GTS reports and two systems which have been developed for use in WOCE are briefly summarized. These last two are "MultiMet" developed by IOSDL (Institute of Oceanographic Sciences Deacon Laboratory) in the U.K. and IMET, a new system of sensors and data loggers being developed in the U. S. Both the latter systems are capable of providing measurements for estimating the surface fluxes.

II.3.1 The NOAA SEAS System

The SEAS system is aimed at the preparation and transmission of a coded meteorological observation report over the GTS. In the basic implementation, the ship's officer manually reads wet and dry bulb thermometers situated in a screen or hand held psychrometer, reads the relative wind from an anemometer dial, and then enters these and other observations into a computer as prompted by the SEAS software. The computer codes the message and transmits it via GOES satellite to the GTS.

II.3.2 The IOSDL MultiMet System

Taylor (1987) and Birch and Pascal (1987) have described the hardware and software developed by the U.K. Institute of Oceanographic Sciences Deacon Laboratory for use on research ships, ships of opportunity, and moored buoys. MultiMet is an RCA 1802 microprocessor based data logger able to accept various inputs, sampling rates, and averaging intervals for various channels. Typically, analog, digital or frequency data can be accepted at 1 Hz for 50 seconds on up to 48 channels; data is recorded once per minute. Wind velocities are not vector-averaged. The time base is provided by a real time clock. Data is recorded on a Seadata cassette recorder or EPROM logger in engineering units (frequency counts, volts, etc.).

MultiMet is used with commercially available meteorological sensors. To minimize interference, signal conditioning is done as close to the meteorological sensors as possible. The sensor set is summarized in a table in the Appendix. Good sensor exposure is achieved by using multiple sensors, and if necessary, by use of a 10 meter mast designed to be mounted in the bow of the ship. A platform carries the sensors and can be raised and lowered on the mast, permitting easy servicing.

Data display on board the ship is provided by a software package, MetMan (METeorological MANagement), running on a BBC microcomputer system. Communciation

between MultiMet and the BBC micro is RS423 link. Communciation of the raw data to shore can be achieved via an ARGOS link inserted in the MultiMet logger.

The system has been used on several research ships, and since 1987, on a continuous trial on the Ocean Weather Ship Cumulus.

II.3.3 The WHOI IMET System

The IMET (Improved METeorological measurements; WOCE long-lead time development underway at WHOI) ship data logger/controller is an NEC APC-IV personal computer with optical disks (WORM) for on board storage of all data, an ARGOS PTT for automatic data reporting, and flexible sampling/logging software. The sensor set will provide measurement of wind velocity, air temperature, sea temperature, barometric pressure, relative humidity, incoming shortwave radiation, incoming longwave radiation, and precipitation. Each sensor will be mated to a microprocessor based module that will perform some sampling tasks, convert the raw sensor output to engineering units, and send the data digitally over RS-485 link to the APC-IV data logger/controller. Each module will have stored in EPROM the calibration of the sensor; sensors will remain with the same module for their entire life. Air-sea fluxes will be computed on board (using Large and Pond stability dependent algorithms for momentum, sensible, and latent heat and computing net shortwave using an albedo look-up table and net longwave by estimating outgoing longwave with an improved graybody algorithm being developed by Dickey at USC). Raw data and original sampling rate (as fast as every minute for 1 year) fluxes will be stored on the optical disk; several-hour averaged surface variables and fluxes will be telemetered via ARGOS. ARGOS data should be monitored (and quality checked so it will qualify for distribution via GTS) and archived at an accessible (dial-up and/or Ethernet) data base; such a land-based data acquisition and archiving system is in operation at WHOI.

Prototype IMET ship data loggers are complete. Test deployments began in November 1988, and test ship installations will be in operation in 1989. Sensors for all variables, including precipitation, are under test on land. Testing of the most promising of these will be continued on ship installations beginning in 1989. Special efforts are being made to develop relative humidity and precipitation sensors, to reduce errors in sea surface and air temperatures, reduce errors in short and long-wave radiation measurements associated with platform motion, and to develop a reliable system for use on ships and buoys.

Precipitation sensors under test include the R. M. Young 50202 Capacitive-siphon gauge, the Scientific Technology ORG-705 Optical Rain Gage, and, for comparison, tipping bucket and standard collector gauges. The ORG-705 and R.M. Young 50202 are both being considered for use on ships and buoys; NDBC has done limited testing of them.

Wind sensors under test include R. M. Young cups (aluminum and plastic) and the R. M. Young 5103 Wind Monitor. Given the well-documented nature of cup anemometer overspeeding, more emphasis is being placed on use of the propeller-vane type of wind sensor. Tests are planned (in conjunction with Carl Friehe, U. C. Irvine) to further investigate platform motion-induced errors in wind velocity measurements. Some consideration must also be given to the error associated with the disturbance of the wind field by the ship itself.

Barometric pressure sensors under test include the Paroscientific 760-15A, the AIR AIR-DB-1A, the Setra Systems 270, the Aanderaa 2810, the Vaisala DPA-21, the Paroscientific 215AT, the Rosemount 1201F1B, the Heise 623, the Nova NPI-19B-101-AR, and the Omega PX93. Drift in these sensors is a problem being investigated. In addition, performance as a function of cost for various sensors is being studied. Improved pressure ports are being sought.

Solar radiation sensors under test include the Hollis MR-5 silicon cell, the Eppley 8-48, and the Eppley PSP. Longwave sensors (Eppley PIR) are being modified in cooperation with Dickey at USC and Eppley to improve their performance. Improvement is being sought by reducing platform motion-related errors. Prototype gimbal mounts for both short- and longwave sensors have been fabricated and will be tested on RV Endeavor in fall 1989.

Humidity sensors under test include the EG&G Dewtrak Dewpointer, the Rotronic MP-100F, the Vaisala HMP-35A, the General Eastern 850, the Hy-Cal Engineering CT-827-D, the Thunder Scientific PC-2101, the Phys-Chem Scientific CP-101-11 and CP-101-55, the Analite RHT-20C, the Sensor Instruments HT9-3, the General Eastern Dew-10 dewpointer, the Ophir IR-1000 optical infrared absorption hygrometer, the WHOI D10IQ dewpointer. The goal is to find a sensor that exhibits long term stability and the desired accuracy.

Improvements to T_a are being sought largely through better radiation shields. Shields under test include the R. M. Young 41002 Gill multi-plate, the R. M. Young 43408 Gill aspirated, the Met One 071A vane aspirated, the Met One 076 fan aspirated, WHOI vane aspirated, WHOI multiplate, and WHOI multiplate with solar powered fan.

The difficulty in measuring T_s is not in the accuracy of the sensor, but in dealing with near-surface temperature stratification. Sampling strategies to improve T_s on board a ship need to be considered. The best solution to date is the buoyant line trailed off to the side of the ship from a small boom (thus out of the wake) developed in the UK.

Based on tests to date, a basic IMET sensor set has been chosen:

Shortwave radiation	Eppley PSP
Longwave radiation	Eppley PIR, with USC/Foot modifications to thermopile, amplifier as above, extra channels of A/D to record dome and other temperatures
Wind	R.M. Young wind monitor with 9 bit direction encoder attached to shaft instead of potentiometer; 12 bit compass in module, which does vector-averaging
Air temperature	Thermistor or platinum RTD in multiplate shield
Sea temperature	Thermistor or platinum RTD; trailed as buoyant line
Relative humidity	Rotronics sensor in multiplate shield. Rotronics air temperature also logged
Barometric pressure	AIR sensor with Gill port.
Precipitation	R. M. Young self-siphoning gauge.

II.3.4 Comparison of SEAS, MultiMet, and IMET

The SEAS system is aimed only at preparing GTS messages. The disadvantage of using manually read sensors is that they must be safely accessible by the ship's officer under all weather conditions. This may result in poor instrument exposure. For use on the UNOLS fleet, particularly the Large and Medium ships, remotely read instruments with good exposure are desirable. These should include air temperature, humidity, sea temperature, and wind velocity averaged over a suitable interval (e.g. 10 minutes); air pressure also is required. Thus, the system would have to be incremented so that it would become similar to but more limited in sensing

capability than the IMET system for Small UNOLS ships, described below, but running the SEAS software for message coding.

The IOSDL MultiMet and the WHOI IMET systems have many similarities. Both use multiple sensors, and/or bow mast systems to ensure good exposure. Both use a dual processor system to ensure that sampling and recording continues uninterrupted on one system while the servicing of requests to display and process data initiated by the scientific crew is performed by the other system. For this the IOSDL system uses the MultiMet logger and a BBC computer; the WHOI system uses two NEC microcomputers, thus allowing some redundancy should one machine fail.

Many of the differences between IMET and MultiMet are due to the earlier design of the latter system. A new MultiMet system, now under development, is based on IBM PC/AT type microcomputers and will be more similar to IMET. It is also likely that the sensor suites will converge on a small number of sensor choices. Eventually the systems will require intercalibration to ensure a single homogeneous data set is collected during and after WOCE.

One fundamental difference between MultiMet and IMET concerns the conversion to geophysical quantities. The IOSDL system includes minimal signal conditioning at the sensors, performs the averaging etc. in the MultiMet logger, and records the uncalibrated data. This has the advantage for research use that different types of sensors can easily be attached to the MulitMet logger. However, a disadvantage for the use envisaged on the UNOLS ships is that calibration information is stored separately from the data, that is, within the MetMan display system. Experience has shown that maintenance of several systems on different ships has necessitated great care to ensure correct calibrations are used for each sensor. To this end it has been necessary to invest significant effort in a database of sensor histories and calibrations.

In contrast the IMET system uses modules attached to each sensor to individually calibrate, partially process, and perform signal conditioning. This ensures the use of the correct calibration and also minimizes the risk of corruption due to radio interference in transmitting the data to the logger. It is considered that, for installation on the UNOLS ships, the IMET type of system is likely to be more suitable than the MultiMet design.

III. Implementation

III.1 Recommended Installations

The recommended installation on the Large U. S. Research Vessels would include three sensor installations (port, starboard, and bow mast) and a sensor suite designed to provide the best

possible measurements of the surface variables. Two NEC APC-IV's would be used to provide redundancy and real-time access for the science party to the meteorological data. One APC-IV would carry on ARGOS telemetry and data logging at the standard rate and in the format to be provided by the other ships and buoys; the second APC-IV would be menu-driven and available to the science party and/or resident technician. The optical disks would be returned after one or more legs to be quality-checked and read into the data base. Also available for use on these ships would be a sensor suite designed for the best possible estimates of the air-sea fluxes (including towed SST sensor, infrared hygrometer and other relative humidity sensors, optical rain gauge, sonic anemometer). This additional sensor suite would be mounted for specific cruises where air-sea flux data would be of particular value, where intercomparisons would be run with the other sensors on board or where sensor development was being carried out.

The Medium ships would carry two sensor sets (port and starboard), though on some ships good exposure might only be ensured through adding a third sensor set on a bow mast. One APC-IV, providing real time displays, data logging, and data telemetry via ARGOS would be used. The second APC-IV for redundancy and use by the science party would not be standard equipment; the Medium ships would typically be closer to home port than the Large ships, permitting easier replacement of failed equipment and making it easier for the science party to board their own APC-IV for their own data display purposes.

The Small ships would have reduced sensor sets (two wind, humidity, and air temperature sensors as those are most sensitive to flow disturbance and heat contamination, but one of each of the other sensors) and one APC-IV for real time display, data logging, and data telemetry via ARGOS. Their areas of operation would presumably not be characterized by being data sparse.

III.2 Cost Estimates

Work at WHOI is far enough along now to define some of the costs associated with implementation of the use of the Improved METeorological (IMET) or similar hardware on ships. The ship's home institution should anticipate start up and support costs; it should also be seriously committed to maintenance and calibration.

II.2.1 Start up costs:

This is one-time cost for equipment and training.

LABOR

Electro/Mechanical technician	2 man months
Engineering support	2 man months
Electronics technician	2 man months

PERMANENT EQUIPMENT	
Laptop computer	$3,100
NEC 5300 printer	895
Utility software	1,295
Optical disk with controller	4,000
Oscilloscope	4,765
Voltage calibration standard	2,065
Multimeter	1,395
Basicon Prom controller/programmer	855
Power supplies	1,150
Tools etc.	675
	20,195

III.2.2 Engineering support

Maintenance as well as upgrades and improvements to the system should be anticipated. Engineering support would require $12,000 for labor and $3,000 for materials per year.

III.2.3 Fabrication of IMET Large Ship Package

These are the costs for fabrication of an IMET ship package with ARGOS telemetry, short wave radiation, long wave radiation, barometric pressure, sea surface temperature, air temperature, relative humidity, precipitation, wind speed and direction, optical rain gauge, infrared hygrometer, sonic anemometer, and interface to ships navigation. The package will consist of the power system, data logger, three sets of sensors with digital data modules (except two radiation sensors, one precipitation sensor), mounting brackets, and weathertight housings. The compass may in some cases be replaced with the Note that some special sensors only have one sensor. Not included is the installation on the ship.

		Quan 1
LABOR (Man Months)		
Elect/Mech Technician		8
Engineering Support		2
MATERIALS		
Uninterruptible Power Supply	2@ 1,500	$3,000
Data Logger System		19,800
APC IV, printer, mem.	2@ 6,100	
PTT	2@ 1,000	
Optical Disk	2@ 1,800	
Standard Time Clock	2@ 1,000	
Sensors		87,000
Wind Velocity/Dir	3@ 1,000	
Short Wave Radiat	2@ 1,800	

Long Wave Radiat	2@ 2,400	
Air Temperature	3@ 400	
Sea Surface Temp	3@ 3,200	
Relative Humidity	3@ 800	
Barometric Press	3@ 1,000	
Precipitation	1@ 800	
Compass/Interface	3@ 1,000	
Optical Rain Gauge	1@ 4,500	
Infrared Hygrometer	1@ 14,500	
Sonic Anemometer	1@ 36,000	
Digital Data Modules		31,500
Wind/Compass	3@ 1,500	
Short Wave Rad	2@ 1,500	
Long Wave Rad	2@ 1,500	
AirTmp,RHum,Press	3@ 1,500	
Sea Surface Temp	3@ 1,500	
Precipitation	1@ 1,500	
Optical Rain Gauge	1@ 1,500	
Infrared Hygrometer	1@ 1,500	
Sonic Anemometer	1@ 1,500	
Navigation Interface	1@ 4,500	
Bow Mast (optional, need depends on exposure)		11,000
TOTAL		152,300

SPARE PARTS KITS FOR FIELD SUPPORT	
Data Logger Spare Parts Set	7,200
Sensor Spare Parts Set	12,800
Digital Data Module Spare Parts	7,200
	27,200/Kit

III.2.4 Fabrication of IMET Medium Ship Package

These are the costs for fabrication of an IMET ship package with ARGOS telemetry, short wave radiation, long wave radiation, barometric pressure, sea surface temperature, air temperature, relative humidity, precipitation, wind speed and direction. The package will consist of the power system, data logger, sensors with digital data modules, mounting brackets, and weathertight housings. If a bow mast is needed to obtain good exposure additional sensors may be needed to equip port, starboard, and bow mast locations. The compass interface could be replaced with an interface to the ship's navigation. Not included is the installation on the ship.

	Quan 1	Quan 10
LABOR (Man Months)		
Elect/Mech Technician	6	50
Engineering Support	1	2

MATERIALS			
Uninterruptible Power Supply		$1,500	13,500
Data Logger System		9,900	89,100
APC IV, printer, mem.	6,100		
PTT	1,000		
Optical Disk	1,800		
Standard Time Clock	1,000		
Sensors		23,800	214,200
Wind Velocity/Dir	2@ 1,000		
Short Wave Radiat	2@ 1,800		
Long Wave Radiat	2@ 2,400		
Air Temperature	2@ 400		
Sea Surface Temp (one spare)	2@ 3,200		
Relative Humidity	2@ 800		
Barometric Press	1@ 1,000		
Precipitation	2@ 800		
Compass/Interface	2@ 1,000		
Digital Data Modules		16,500	148,500
Wind/Compass	2@ 1,500		
Short Wave Rad	2@ 1,500		
Long Wave Rad	2@ 1,500		
AirTmp,RHum,Press	2@ 1,500		
Sea Surface Temp	1@ 1,500		
Precipitation	2@ 1,500		
Bow Mast (optional)		11,000	99,000
		62,700	564,300
Cost per System		62,700	56,430

SPARE PARTS KITS FOR FIELD SUPPORT	
Data Logger Spare Parts Set	3,600
Sensor Spare Parts Set	6,400
Digital Data Module Spare Parts	3,600
	13,600/Kit

Suggested spares support level would be 1 kit for 1 IMET System, and 2 kits for 10 IMET Systems.

III.3.5 Fabrication of IMET Small Ship Package

These are the costs for fabrication of an IMET ship package with ARGOS telemetry, short wave radiation , long wave radiation, barometric pressure, sea surface temperature, air temperature (two sensors), relative humidity (two sensors), precipitation, wind speed and direction (two

sensors). The package will consist of the power system, data logger, sensors with digital data modules, mounting brackets, and weathertight housings. Not included is the installation on the ship.

			Quan 1	Quan 10	Quan 25
LABOR	(Man Months)				
	Elect/Mech Technician		3.5	25	50
	Engineering Support		1	1	2
MATERIALS					
	Uninterruptible Power Supply		$1,500	13,500	30,000
	Data Logger System		9,900	89,100	198,000
	NEC APC-IV	6,100			
	PTT	1,000			
	Optical Disk	1,800			
	Standard Time Clock	1,000			
	Sensors		14,600	131,400	292,000
	Wind Velocity/Dir (2)	2,000			
	Short Wave Radiation	1,800			
	Long Wave Radiation	2,400			
	Air Temperature (2)	800			
	Sea Surface Temp	3,200			
	Relative Humidity (2)	1,600			
	Barometric Pressure	1,000			
	Precipitation	800			
	Compass and interface	1,000			
	Digital Data Modules		12,000	96,000	168,750
	Wind/Compass	3,000			
	Short Wave Radiation	1,500			
	Long Wave Radiation	1,500			
	Air Temp, Rel Hum, Press	3,000			
	Sea Surface Temp	1,500			
	Precipitation	1,500			
			38,000	330,000	688,750
	Cost per System		38,000	33,000	27,550

SPARE PARTS KITS FOR FIELD SUPPORT	
Data Logger Spare Parts Set	1,800
Sensor Spare Parts Set	3,200
Digital Data Module Spare Parts	1,800
	6,800/ Kit

Suggested spares support level would be 1 kit for 1 IMET System, 2 kits for 10 IMET Systems, and 5 kits for 25 IMET Systems.

II.3 Concerns

The following are important concerns with regard to the implementation:

1. Integration of shipboard meteorological data acquisition with ship's navigation is necessary. Good ship velocities are needed to convert relative wind to absolute wind vectors.

2. Flow disturbance by the ship itself as well as heat and smoke from the ship will degrade the meteorological data; care in sensor placement is equally as important as sensor choice.

3. Quality control by ship's resident technician, science parties, and those on shore checking the data so that it can be passed via GTS to the forecast centers is essential. A serious committment to operational support of the system by the marine operations department at tyhe ships' home institutions is also essential.

4. Calibration of the sensors should be standardized and carried out regularly. Comparison of IMET and MultiMet systems at sea is recommended at an early stage as a test of the validity of data from installations on UNOLS ships.

IV. References

Birch, K. G. and R. W. Pascal, 1987. A meteorological system for research applications - MultiMet. Fifth International Conference on Electronics for Ocean Technology, Edinburgh, 24-26 March 1987. London, IERE, pp. 7-12.

Foot, J. S., 1986. A new pyrgeometer. *Journal of Atmospheric and Oceanic Technology*, 3, 363-370.

Taylor, P. K., 1987. MultiMet and MetMan: The IOS Meteorological Instrumentation System General Description. Inst. of Oceanographic Sciences, Deacon Lab, Wormley, U. K.

Taylor, P. K. (Ed.), 1989. WOCE Surface Flux determinations - a strategy for *in situ* measurements, Rep. Working Group on in situ measurements for fluxes. To be published in WCRP Report Series, WMO, Geneva.

V. Appendix

MultiMet Sensors

Wet and dry bulb air temperature

Sensor Type	Electrically aspirated psychrometer using ceramic coated platinum resistance elements
Manufacturers	Vector Instruments Ltd., Rhyl, Clwyd. UK.

Sea surface temperature

Sensor Type	platinum resistance thermometer mounted either in a streamlined "fish" or in a trailed cable.
Manufacturer	IOS designed and built

Wind speed (average)

Sensor Type	"Porton" light-weight cup anemometer
Manufacturer	Vector Instruments Ltd., Rhyl, Clwyd., UK.

Wind direction (average)

Sensor Type	"Porton" light-weight wind vane
Manufacturer	Vector Instruments Ltd., Rhyl, Clwyd., UK.

Wind speed and direction (fluctuations)

Sensor Type	Propeller-vane anemometer.
Manufacturer	R.M.Young Company, Michigan, USA

Downward long-wave radiation

Sensor Type	Thermopile pyrgeometer.
Manufacturer	The Eppley Laboratory Inc., Rhode Island, USA

Downward shortwave radiation

Sensor Type	Class 1 Pyranometer (thermocouple type)
Manufacturer	Kipp and Zonen, Delft, Holland.

CRUISE ASSESSMENTS
FIRST HALF
1989

	Number Cruises	Number Reports	Fully Successful	Partially	Marginally	Unsuccessful	WX Problems	Ship Problems	Scientist Problems	PROBLEM AREAS
ATLANTIS II		1	1							
MELVILLE		4	3	1			1	1	3	Eng., Ger. Bottles, GPS, Echo Sounder
KNORR			(IN OVERHAUL)							
CONRAD		3	2	1					1	Dynamometer
WASHINGTON		4	4				1		1	Camera Strobe
MOANA WAVE										
OCEANUS		1	1							
ENDEAVOR		4	4				2	1		Winch
WECOMA		6	6					1		Wire
ISELIN		4	1	3			1	3	2	Engine (2), Winch, CTD, Block
NEW HORIZON		4	4				2	1		Science Liaison
GYRE		5	4	1			3	2	2	Winch (2), Salinometer, Magnetom.
POINT SUR		5	2	2		1				Moorings not located; too sm. sci. party
CAPE HATTERAS		7	7				3	1	1	Science Liaison; Cover
ALPHA HELIX			(LATE START)							
CAPE HENLOPEN										
SPROUL		4	4				2	1	1	Winch, Station Keeping, PDR Recorders
WARFIELD		19	18	1			2	1	1	Engine, Towed Fish (SP)
PELICAN		5	3	2			2	1	1	Short Crew; Air Conditioning; CTD
CALANUS		4	3	1			1	1		Depth Recorder
BARNES										
LAURENTIAN										
BLUE FIN		12	12							

9/1/89

PRINCIPAL CHARACTERISTICS AND CAPACITIES OF THE MODIFIED R/V MELVILLE & R/V KNORR

Length Overall (LOA)	278'-10"
Length Between Perpendiculars (LBP)	254'-0"
Beam, molded	46'-0"
Depth, Main Deck at Side	25'-0"
Depth, Main Deck at Centerline	25'-6"
Draft, Design Draft, molded	15'-6"
Draft, Loadline Draft, molded	16'-6"
Displacement, at Design Draft	2685 LT
Displacement, at Loadline Draft	2958 LT
Lightship Weight (est.)	1866 LT
Diesel Oil Capacity, Total	160,500 Gal
Diesel Oil Capacity, Burnable	141,000 Gal
Segregated Ballast Capacity	365 LT
Lube Oil Capacity	6,530 Gal
Potable Water Holding Capacity	15,900 Gal
Potable Water Generating Capacity	6,000 GPD
Treated Sewage Holding Capacity	8,220 Gal
Science Stores and Equipment Capacity	242 LT
Sewage Treatment Capacity	3,600 gal/day
Incinerator Capacity	1,500 lbs/day
Speed, Maximum	14.0 knots
Speed, Minimum	0.1 knots
Cruising Speed	12.0 knots
Fuel Consumption per day, cruising (12 knots)	3,400 GPD
Range, Cruising	11,900 n.m.
Economical Speed	10.0 knots
Fuel Consumption per day, economical (10 knots)	2,400 GPD
Range, Economical	14,100 n.m.
Endurance: Limited by Stores	45 days; may be extended to 60 days under exceptional circumstances
Type of Machinery	Diesel-Electric AC/SCR/DC
Propulsion Units	Twin Azimuthing Thrusters
Horsepower, Max. Continuous SHP per shaft	1500 HP
Bow Thruster	900 HP, Retractable
Electrical Generating Capacity (3 x 1090) + (1 x 560)	3830 kW
Power Required for Propulsion, Max	2050 kW
Available Electric Power, Min	1780 kW
In-Port Electric Load	414 kW

Shore Power Connection.....2 x 400 Amps

Accommodations: Crew/Scientists.....24/34

Laboratory Space.....3,680 sq. ft.
Scientific Storage.....1,320 sq. ft.
Main Deck Working Area.....3,764 sq. ft.
Main Deck Clear Length.....126 ft.

Gross tonnaage (Approx.).....2,200

jjk