UNIVERSITY - NATIONAL OCEANOGRAPHIC LABORATORY SYSTEM

UNOLS
DEEP SUBMERGENCE SCIENCE COMMITTEE MEETING

SUMMARY REPORT

May 28-29, 1996
Carriage House, Woods Hole Oceanographic Institution
Woods Hole, MA

DEEP SUBMERGENCE SCIENCE COMMITTEE
28-29 May 1996
Carriage House, Woods Hole Oceanographic Institution
Woods Hole, MA

MEETING REPORT SUMMARY

Appendices

I. Meeting Agenda
II. Attendance List
III. R/V ATLANTIS Update and Brochure
IV ALVIN Battery Evolution
V. ROV Information
VI. Summary of 1997 ALVIN/ROV Requests
VII. U.S. Deep Submergence Community Request for ALVIN Upgrades
VIII. Current Data/Video Systems and Options
IX. NSF Report
X. West Coast NURC

The following minutes represent a summary of the activities and discussions that took place at the DESSC Committee meeting that was held at WHOI on the 28-29 of May, 1996. The meeting followed the agenda, ***Appendix I,*** except as noted in these minutes. The attendance list for the meeting has been included as ***Appendix II.***

Tuesday, May 28

I. Welcome, Introductory Remarks, New Members, Agenda Items: Mike Perfit, DEep Submergence Science Committee Chair, called the meeting to order at 0830 hrs and welcomed the Committee and the new members, Patty Fryer, University of Hawaii and Marvin Lilley, University of Washington. Marv will need confirmation by the Council when it meets in July. Mike announced that J.C. Sempere regretfully resigned from the Committee having taken a position in industry. Marvin Lilley will be his replacement on the Committee. Mike also welcomed Barbara Moore of NOAA/NURP to the meeting.

The terms of Dan Orange, Jim Bellingham and Bob Collier will be up this year. All three are eligible for a second three year term. Dan and Jim agreed to serve and were confirmed by the Committee. Mike will contact Bob and encourage him to stand for re-appointment. (Bob has since agreed to serve another term.)

The UNOLS report was given by the UNOLS Chair, Ken Johnson. Ken reported that the publication, "Projections for UNOLS' Future - Substantial Financial Challenges", (referred to as the Betzer report) has been distributed to the community. It presents a projection of a significant shortfall in funding for the UNOLS Fleet by the year 2000 unless major changes are forthcoming. Finding new partnerships is one of the recommend efforts. This seems to be happening with NOAA and NAVOCEANO with both of these agencies looking toward UNOLS for ship time. Ken also noted the CORE efforts for a National Ocean Partnership Act which includes $7.5M in the 1997 budget for the Navy to use additional ship time for survey work. Ken reported that a UNOLS subcommittee consisting of himself, Bob Knox, Bob Wall and Jack Bash are meeting with NOAA to establish the process by which NOAA can make better use of the UNOLS Fleet. There will also be a subset of this group who will work with NOAA on fisheries issues and their need for ship time. The White Paper, "UNOLS: Celebrating 25 Years as the Nation's Premier Oceanographic Research Fleet", explains the advantages of using UNOLS vessels.

Ken told the Committee that UNOLS will be establishing another committee to work with the U.S. Coast Guard and their icebreaker fleet. The committee will be named the Arctic Icebreaker Coordinating Committee (AICC) and will be chaired by Jim Swift. Ken reported that the Fleet Improvement Committee (FIC) was developing an Interim Fleet Improvement Plan (IFIP) that would address the dynamic activities currently being experienced with respect to funding shortfalls and ship time availability. Also in this consideration is the 1997 DOD budget item that will authorize $45.5M for U of Hawaii to build a SWATH vessel.

II. Accept Minutes: The minutes of the December, 1995 and May, 1995 meetings were accepted as written. The community can access the minutes on the UNOLS WWW site (http://www.gso.uri.edu/unols/unols.html). From this meeting on, only the DESSC will receive a hard copy but the rest of the community will be notified that the minutes are on the WWW and a hard copy is available from the UNOLS Office. UNOLS has integrated their master address list with that of the RIDGE Office.

III. National Facility Operators Report: Rick Chandler opened with a brief summary of the 1996 schedule of the ATLANTIS II and ALVIN. This will be a short year with 49 dives and 93 operating days. AII will return to WHOI on 2 July after its final cruise. ALVIN will be off-loaded for overhaul and the ship will sail to a shipyard in the Gulf of Mexico for cross-decking the stern frame and other equipment.

Andy Bowen reported that the ROV/tethered vehicles have four funded cruises but the schedule is not fixed at this point. Discussion followed regarding the end of the year ROV operations. The tentative schedule for the summer to fall of 1996 looks good with Fornari, Johnson and Haymon cruises. There was discussion regarding where the Hey cruise could fit into the 1996 schedule. With a busy end of 1996 and a busier 1997 schedule coupled with the ALVIN overhaul, the DSOG operating personnel will be stretched tight.

Dick Pittenger passed out a brochure that documented the facilities and dimensions of the ATLANTIS (***Appendix III***) and reported that the conversion to a submersible/ROV handling ship is well underway. AII's A-frame will be installed on the ATLANTIS with some revisions. The hanger will be extended and winches/booms installed. The ATLANTIS will look like it was designed from the keel up as a support ship. The ATLANTIS is scheduled to be delivered by the shipyard 15 April '97 arriving at WHOI 6 May '97. After a short certification period during transit, ALVIN will be loaded aboard having completed its overhaul. The time for the integration of the ROV system into the new ATLANTIS is still unknown because of the busy ROV schedule projected for spring and summer of 1997. More discussion on the ROV cruise scheduling for that time period is necessary. The Committee stressed the need for testing the combined ALVIN/tethered vehicles operations before funded science programs begin. Funding constraints and a busy ROV schedule will make this difficult. The timetable for bringing the ship and deep submergence vehicles into service is included in ***Appendix III***. At the present time, the ATLANTIS is scheduled to be ready for science in June of 1997. Post shakedown availability and final contract trials for the ATLANTIS are scheduled for the window of 30 January '98 to 30 March '98.

Barrie Walden recently had provided the Committee with a study titled, "ALVIN Battery Evolution", which documents a study of power usage, battery types and future power possibilities for ALVIN (see ***Appendix IV***). Several members of the Committee praised Dudley Foster (author of the study) for the thorough and excellent work. A discussion of the study followed. The WHOI operators are currently testing Trojan batteries which seem highly promising and it appears likely that new batteries, (Trojan, Exide or Chloride Canada) will likely be installed during the next overhaul. New battery monitors will also be installed at this time. The Committee offered several suggestions concerning power use aboard ALVIN. These included the need to rewrite the information for ALVIN's different power requirements. Scientists need to know their options. There is a need for pilot and scientist training with regard to power usage and conservation. The possibility of adding a third battery was discussed, however, this increases weight requiring the need to add flotation. The Committee suggested that a discussion of the ongoing evaluation of battery technologies could be included at the next DESSC meeting. The timing for new battery configurations was discussed. No conclusions were reached, however, it appeared that the 1999-2000 overhaul period seemed most likely because of the necessity to do the required engineering and planning for any major battery/power change to ALVIN.

Barrie continued with a discussion of several upgrade projects funded as part of the imaging proposal. The only two items remaining to be completed from that work are the pan-and-tilt which has not progressed as quickly as originally intended because of a lack of shore-based engineering time and ongoing evaluation of commercially available pan and tilt mechanisms. One unit was tested during engineering dives in September, 1995. Discussions are ongoing with that vendor and MBARI regarding that product and WHOI is evaluating other options for building the pan-and-tilt in-house. Because of the current availability of the Osprey 3-chip camera on ALVIN since 1993, the purchase of a new 3-chip has been postponed until the 1996 overhaul to continue to take advantage of improvements in video technology and decreasing costs for these cameras. Both the pan-and-tilt and the new 3-chip color camera will be installed during the ALVIN overhaul. In addition, the new 3-chip camera will also be able to be used with Jason. WHOI was asked to provide the DESSC and NSF with documentation regarding their final implementation of a pan-and-tilt and purchase of a new 3-chip camera.

Andy Bowen provided the Committee with information about the ROV integration on the ATLANTIS. It is estimated that the time necessary to mobilize should be significantly less than that required for ALVIN. Power cables will be permanently installed which will facilitate installation. Port-side deployment of the vehicle is planned. The WHOI traction winch, which will have a fiber optic cable on it, will be mounted below deck. At present there are no plans for deploying the ROV concurrently with ALVIN although it was noted that Jason had operated concurrently with DSV TURTLE in the Gulf of California in 1993.

Andy provided a slide showing the DSOG Unmanned Vehicle Status. This is included as ***Appendix V*** and provides information on Jason/Medea, ARGO II and DSL 120. Andy continued with details on the Jason manipulator tests and the navigation upgrades carried out in 1995 and 1996. This information also is included in ***Appendix V***. The WinFrog navigation software system, purchased as part of the ONR-funded contribution to the DSOG navigation upgrade, is being installed and will work in parallel with the present DSOG navigation system until it has been thoroughly tested and incorporated. This navigation system will also be available for ALVIN when it is operating off the ATLANTIS. Recent upgrades and changes to the ROV systems will be incorporated into DSOG's "blue book" (and WWW site) on technical specifications early next year. The Committee noted that it will be very important to keep scientists aware of the changes in the systems and to make sure that new users are brought up to speed before using the equipment.

Dan Fornari provided a demonstration and discussion of a remote temperature logger that will be used with the high-temperature, major fluid samplers. The device is based on an inductive couple link that will permit a small sending unit and sensor at the nozzle tip of each bottle to transmit the temperature of the fluid being sampled in real time to inside the sphere in order to maximize the quality of the samples. The logger was funded through a WHOI technical grant. The instrument was tested on the EPR during a dive series in April. With the exception of an alignment problem, which was resolved, the design works well. The unit is being modified so that it can also be used for Jason water sampling operations and it will be tested on the ROV cruise to Lucky Strike on the MAR in July, 1996 (as we go to press, reports from KNORR indicate that the water sampling and temperature measurements have been very successful).

A Benthos DSC Camera was tested on ALVIN with only marginal results A complete summary and interim report on digital imaging systems for the National Facility deep submergence vehicles has been completed and posted on the WHOI-DSOG web site (http://dsogserv.whoi.edu/HDTV/hdtv.htm) and distributed to DESSC and UNOLS.

The Committee broke for lunch.

Mike Perfit provided the Committee with recent ALVIN user comments. Most were quite laudatory praising the shipboard operations group and crew for professionalism and dedication. The few corrective comments were related to coordination of information and an apparent lack of communications. As in the past, concerns over morale of the shipboard technical group were sighted and the operator was asked to continue to make improvements in this regard.

IV. Review and Summary of Submitted Proposals: Jack Bash and Don Moller presented a summary of ALVIN/ROV requests for 1997. The summary included letters of intent. This summary is included as ***Appendix VI***. Dolly Dieter informed the Committee that science funding decisions were not yet complete for 1997. Even though funding decisions are not complete, the ROV schedule has the potential to be quite full in 1997. Possible scheduling conflicts in 1997 may mean that it will not be possible to integrate the ROV and tethered vehicles into the new ATLANTIS and ALVIN shipboard routine until later in 1997. There is a British governmental proposal to use the ROV system in the Western Pacific in early 1997 that is still under consideration. In addition, R. Ballard has also proposed a cruise in the Mediterranean for late spring/summer 1997. If these cruises materialize, they would provide funding from outside the normal sources and would help both the DSOG and the Class I ship operations. The schedule for funded cruises will depend on vehicle logistics, UNOLS vessel availability, and whether the British work is funded.

V. Presentation and Discussion of ALVIN Upgrade List: Dan Orange and Cindy Van Dover assembled a list of ALVIN upgrades which were developed from community input. The summary is included as ***Appendix VII***. A suggestion was made that ROV upgrades also be considered in the future as additions to the list. Upgrades have been ranked by priority based on compilation of the evaluations made by all the DESSC members. Significant discussion followed causing a reordering of some priorities and additions to the list. An updated list will result from these discussions and further study.

Barrie Walden replied to a number of points raised during the discussion of upgrades and informed the committee that his ALVIN group does not have a great enough number of engineers to integrate the navigation, data logger and video systems. The integration of the ALVIN organization with the ROV group provides an excellent pool of engineers. In the long run, this should help with improvements but additional funding is needed. For now, they must focus on the top priority overhaul tasks.

Discussion regarding the strategy to approach upgrades during overhaul continued during the second day of the meeting (also see Section VII). The Committee stressed that this overhaul period would be an opportune time to attempt some of the upgrades. In particular, upgrades to the batteries/power systems, digital imaging, vertical ballast system and the integrated video/navigation/data logger systems were noted as being first priorities (see ***Appendix VIII***). A lack of personnel because of the busy ROV schedule will limit the extent to which any upgrades can be accomplished during the upcoming overhaul. It was suggested that engineering studies should be part of the operations proposal for 1997 and beyond and that these studies should be initiated as soon as possible. D. Fornari, J. Bellingham and H. Milburn agreed to serve as the DESSC Technology Subcommittee to aid in writing the proposal and act as an advisory body to work with WHOI personnel. It was agreed that the subcommittee and WHOI operators would decide on a path to follow for the proposal before October when the proposal is due.

8:30 a.m. Wednesday, May 29

VI. Agency Reports:

NSF - Don Heinrichs first reported on staff changes at NSF (***Appendix IX***). Sandy Shor will move from the Ocean Drilling Program to be Instrumentation and Technical Services Program Director replacing Lisa Rom who will be on one year maternity leave from Aug '96-Aug '97. Sandy will also be Program Director of Interamerican Institute (IAI). Don followed with a summary of those NSF persons who will be the UNOLS Liaisons: Council, D. Heinrichs; RVOC, SSC and DESSC, D. Dieter; RVTEC, L. Rom/S. Shor; FIC, D. West.

Don reviewed the 1996 budget which has been approved by Congress. The Ocean Sciences budget is $194M which includes a $0.9 M or 0.5% increase. Ocean Science Research will receive a $2.3M increase, Oceanographic Centers & Facilities a $1.5M decrease and the Ocean Drilling Program received a $0.1M increase. NSF is planning to increase emphasis on research although funding is expected to be flat for the immediate future. Funding for unsolicited proposals will increase from $120.6 to $121.9M but imbedded in this figure is support for the Deep Submergence Facilities.

ONR - Sujata Millick gave the ONR report. She informed the Committee that the REVELLE is a fantastic ship. The ATLANTIS changes are going well. There will be no deep submergence science days funded by ONR in 1997. ONR funding for deep submergence science is not predicted to change much over the next few years. However, ONR will stay committed to supporting the facilities for ALVIN and Jason. The ONR budget for 1996 is level funded with $400M of which $100M will go to Ocean Sciences. The facilities budget is $5M.

NOAA/NURP - Barbara Moore (replacing Hank Frey) reported that NURP is in flux undergoing a reinvention of the way of doing business. The NURP centers have had abbreviated research programs this year because of funding problems. The six centers have not been included in the Administration's budget for 1997. The program is being revised with proposals from the National Level Advisory Council and the National Level Review Panel. The status of the budget will not be known until the fall. Barbara is confident that NURP will survive. She reassured the Committee of the importance of ALVIN to NOAA/NURP and their commitment for funding. The NURP budget summary is: FY 1994 - $18.1M; FY 1995 - $14.5M; FY 1996 - $12M; FY 1997 $0 (expecting a $12M markup from Congress).

Memo of Understanding (MOA) - The three agency MOA for the support of deep submergence science and facilities which had expired in 1995 has been extended for the present because of the current uncertainties in government funding.

Lead Federal Agency - This item was tabled.

Funding Paradigm - No action was taken on this item but there was discussion regarding funding deep submergence science in the future.

VII. Integrated Deep Submergence Facility: The Committee discussed the present status of the organization of the integrated Deep Submergence Facility. The Committee was not sure of the present form of the ALVIN and ROV groups, how they will be merged, and how many people are involved in the various shore-based and at-sea operations. DESSC requested that WHOI produce a white paper on the organization that would include a personnel wiring diagram, management structure outline, and task/responsibility summary for the various positions at the National Facility for Deep Submergence. The document should also include various scenarios as to how the organization of the facility will be implemented for the different shipboard and shore-side infrastructure and the mobilization plans that may be required when operating off the new ATLANTIS, and also when the ROV and tethered vehicles may be required to operate on another suitable UNOLS vessel. There was particular concern about the costs involved in maintaining the ROVs in a "fly-away" mode once they were integrated into the new ATLANTIS. Safety and reliability should be the highest priority. A funding strategy that takes into account the facility operational and ongoing engineering requirements should also be included in the plan so that operations in 1997 and beyond can be properly considered by the Federal funding agencies and DESSC. The Committee asked that a draft of the document be prepared for circulation to DESSC and the Federal agency representatives by September, so that a more final document would be available for the 14 December meeting of the DESSC with the deep submergence community.

The Committee broke for lunch.

VIII. Long Range Planning for Deep Submergence Research: The Committee discussed the long range plans for deep submergence research. Once the new ATLANTIS is ready for routine, global science operations, there should be a dedicated effort to carry out funded programs on the southern EPR. The ship and deep submergence vehicles are likely to head to the western Pacific if sufficient proposal pressure is demonstrated. The Indian Ocean should also be considered as an option. Coordinated operations with the Japanese could materialize for the Atlantic in 1998 and in the western Pacific in 1999.

The polar regions could be an area for NOAA/NURP ROV operations.

The Committee concluded that Mike should write a letter to the community with the possibilities of expeditions outside of the traditional areas to solicit possible interest. It was discussed that UNOLS could post a map on the Web with proposed cruises to stimulate interest in potential future operational areas.

Bob Stern, U of Texas, is coordinating a workshop in Japan funded by NSF and the Japanese (including JAMSTEC). Mike Perfit and Patty Fryer have been invited. Mike will provide an overview of the UNOLS deep submergence capabilities, the current status of the ATLANTIS, and the planned ALVIN overhaul. There will be a tour of JAMSTEC facilities. They will discuss the possibility of ALVIN working jointly with SHINKAI 6500.

The British are discussing the use of ALVIN for a BRIDGE project on the Mid-Atlantic ridge. Four biology proposals have been funded by BRIDGE which require five to six submersible dives. BRIDGE is considering the use of either ALVIN or NAUTILE to do the work in the summer of 1997. The British Broadcasting Company (BBC) has also expressed an interest in buying two ALVIN dives to be piggy-backed onto another program that is planning to visit a Mid-Atlantic Ridge high-temperature vent site, to do filming of a BBC television special entitled, "Earth Story".

The Canadian ROPOS will be used by several U.S. investigators including Mike Perfit, Marv Lilley and Dan Orange this summer during cruises on the German research vessel SONNE in the Northeast Pacific area. The majority of the costs for a new 5000+ meter cable were covered by the charter rate the Germans paid to use ROPOS. NSF, through a grant to R. Lutz, contributed about 25% of the charter costs for one leg of the cruise.

It was decided to reestablish the DESSC Coordinating Subgroups to help with global expedition efforts. Assignments to lead these groups were: Western Pacific, Patty Fryer; Southern EPR, Marv Lilley; Indian Ocean, Cindy Van Dover; Mediterranean, Dan Fornari; Polar regions, Dan Orange.

In the discussion beyond 2000 the Committee felt there was a need for more PR to the community and nation. We could use the WWW for more exposure and to attract children. Educational funds to support students and teachers could be available. Patty Fryer will check the NSF Education and Human Resources for possible funds and public relations. A DESSC initiated proposal may be appropriate.

Jim Bellingham reported to the Committee on the developments in AUVs. The thrust is to make these vehicles small and inexpensive. Their operating profile is designed for 30 to 100 hours and a unit cost range of $75-$85K. Many small vehicles are cheaper than one large ROV. They can be used in high latitude applications for rapid response and under the ice and are complementary to ALVIN and ROVs.

IX. Third Party Tools: The Third Party Tool Policy will need some revision. As presently written it conflicts with agency policies. A draft revision is being prepared by Dan Fornari to correct these inconsistencies. Dolly Dieter will be the NSF contact for the policy revision and Mike Perfit will follow up on the changes. Jeff Karson has an instrument that could qualify as a third party tool. The Committee will review the design specifications and report to Mike Perfit.

UNOLS homepage/WHOI homepage - Jack Bash reported that the shiptime request form is being tested for on-line application from the UNOLS homepage. The application should be ready to go this summer. The UNOLS Office also would like to put the ALVIN time-request on-line.

X. Other U.S. Deep Submergence Activities: MBARI - Dan Orange reported that Peter Brewer was stepping down as Director and Ross Heath is taking over as Interim Director for one year. Dave Clague will be heading the science department as a replacement for Bruce Robison. The WESTERN FLYER is undergoing sea trials and all seems to be going well. The future use of this ship for cooperative use is still under discussion.

NOAA/NURP - Gene Smith reported that NURP lost one third of its budget in 1996 from $18K to $12K. The program in the past did not tie into NOAA's plan, however, they plan to correct this. The Headquarters will be working with the NURP Centers to develop the plans. HURL is expecting summer operations with KOK/PISCES V and hopes to get outside funding.

U.S. Navy - Cindy Van Dover provided information about the Navy submersibles. Her presentation is included as ***Appendix X*** which includes the 1996 Navy field programs. Cindy reported that there is pressure increasing for deep water exploration in the Gulf of Alaska. The Navy vehicles will be brought to the Gulf in 1996 followed by a planned three year initiative.

XI. Other: A meeting between WHOI operators, Federal agency representatives (including program managers) and some DESSC members may be held in September prior to the UNOLS Annual meeting.

The meeting adjourned 4:45 p.m.

APPENDIX I

Agenda
DEep Submergence Science Committee

Carriage House, Woods Hole Oceanographic Institution
Woods Hole, MA
May 28-29, 1996

Day 1 - 8:30 a.m. - Tuesday, May 28, 1996

I. Welcome, Introductory Remarks, New Members, Agenda Items (M. Perfit, DEep Submergence Science Committee Chair)
1. Terms for J. Bellingham, R. Collier and D. Orange expire. All are eligible for re-appointment. Review and discuss re-appointments for membership.
2. UNOLS Report (K. Johnson, UNOLS Chair)

II. Accept Minutes of the December, 1995 DESSC Planning Meeting and the May, 1995 DESSC Meeting at WHOI.

III. National Facility Operators Report (WHOI personnel)
1. 1996 Operations Summary and Projections.
2. R/V ATLANTIS - Status, delivery and 1997-1998 logistics
3. ALVIN Overhaul Planning/Timing
4. Integration of ALVIN and tethered facilities at-sea ops.
5. Ongoing Upgrade/Development/Information Efforts
   a. ALVIN power
   b. Pan and Tilt for ALVIN and Jason
   c. Navigation Upgrade - Engineering Tests - Mar. '96
   d. Jason manipulator tests
   e. Remote Temperature Loggers
   f. Electronic still camera

IV. Review and Summary of Submitted Proposals (J. Bash/D. Moller/R. Chandler)
1. UNOLS Office and WHOI tabulation.
2. Comments by Funding Agency Representatives.

V. Presentation and Discussion of ALVIN Upgrade List (D. Orange & C. Van Dover)
1. WHOI response to DESSC prioritization.
2. Discussion of applicability of upgrade efforts to Jason and tethered vehicles.
3. Identification of Short-Term and Long-Term Upgrade Items and selecting lead DESSC members to follow through on various initiatives/proposals for upgrades.

5:00 - 7:00 p.m., Tuesday, May 28th
DEep Submergence Science Committee Social
Carriage House

Day 2 - 8:30 a.m. - Wednesday, May 29, 1996

VI. Agency Reports (Agency reps.)

1. NSF
2. ONR
3. NOAA
4. Discussion of Existing Memorandum of Understanding between NSF, ONR and NOAA.
5. Discussion of Need for Lead Federal Agency for Deep Submergence.
6. Funding Paradigm for Deep Submergence Facilities Support.

VII. Integrated Deep Submergence Facility

1. Critical operational and scientific needs - planning document
2. Funding Strategy

Lunch 12:15 p.m. - 1:30 p.m. - Executive Meeting

VIII. Long-Range Planning for Deep Submergence Research

1. 1998-2000 (M. Perfit and DESSC)
   Southern East Pacific Rise
   Western Pacific and Hawaii
   Indian Ocean
   Mediterranean
   Polar Regions
2. Traditional Operating Areas and RIDGE Observatory MAR, Juan de Fuca, Northern EPR, California
3. Collaboration with UK, Japanese, and French Programs
   a. JAMSTEC initiative (M. Perfit)
   b. BRIDGE activities (D. Fornari)
   c. Sonne/ROPOS cruises (D. Orange/M. Perfit)
4. Reestablish DESSC Coordinating Subgroups (to keep momentum going for global operations.
5. Deep Submergence Science Initiatives - Beyond 2000

IX. Third Party Tools

1. Discussion of revised policy.
2. J. Carson proposal review.
3. WWW pages

X. Other U.S. Deep Submergence Activities

1. NOAA/NURP (E. Smith)
   a. ALVIN support
2. U. S. Navy (C. Van Dover)
3. MBARI (D. Orange)
   Request for statement of intent/policy re: utilization of MBARI deep submergence facilities.

XI. Meeting End

1. Plans for next meeting: September?

APPENDIX II

NAME	AFFILIATION	TELEPHONE	FAX	EMAIL ADDRESS
John Bash	UNOLS	(401) 874-6825	(401) 874-6486	unols@gso.uri.edu
Jim Bellingham	MIT	(617) 253-7136	(617) 258-5730	belling@mit.edu
Andy Bowen	WHOI	(508) 457-2643	(508) 457-2191	abowen@whoi.edu
Rick Chandler	WHOI	(508) 289-2272	(508) 457-2107	rchandler@whoi.edu
Mary D'Andrea	UNOLS	(401) 874-6825	(401) 874-6486	unols@gso.uri.edu
Dolly Dieter	NSF	(703) 306-1577	(703) 306-0390	edieter@nsf.gov
Dan Fornari	WHOI	(508) 289-2857	(508) 457-2187	fornari@tone.whoi.edu
Patty Fryer	U of Hawaii	(808) 956-3146	(808) 956-6322	pfryer@soest.hawaii.edu
Don Heinrichs	NSF	(703) 306-1576	(703) 306-0390	dheinric@nsf.gov
Ken Johnson	UNOLS/MLML	(408) 755-8657	(408) 753-2826	johnson@mlml.calstate.edu
Marv Lilley	U of Washington	(206) 543-0859	(206) 543-0275	lilley@ocean.washington.edu
Hugh Milburn	NOAA/PMEL	(206) 526-6169	(206) 526-6744	milburn@pmel.noaa.gov
Sujata Millick	ONR	(703) 696-4530	(703) 696-2007	millics@onrhq.onr.navy.mil
Don Moller	WHOI	(508) 289-2277	(508) 457-2185	dmoller@whoi.edu
Barbara Moore	NOAA	(301) 713-2427 x165	(301) 713-0799	bmoore@rdc.noaa.gov
Dan Orange	MBARI	(408) 775-1761	(408) 775-1645	dano@mbari.org
Mike Perfit	U of Florida	(352) 392-2128	(352) 392-9294	perf@nervm.nerdc.uflorida
Dick Pittenger	WHOI	(508) 289-2597	(508) 457-2185	rpittenger@whoi.edu
Mike Purdy	NSF	(703) 306-1580	(703) 306-0390	mpurdy@nsf.gov
Sandy Shor	NSF	(703) 306-1581	(703) 306-0390	ashor@nsf.gov
Gene Smith	NOAA	(301) 713-2427 x164	(301) 713-0799	genesmith@rdc.noaa.gov
Cindy Van Dover	NURP/U of Alaska	(907) 474-5870	(907) 474-5804	vandover@ims.alaska.edu
Barry Walden	WHOI	(508) 289-2407		bwalden@whoi.edu
Carl Wirsen	WHOI	(508) 289-2307	(508) 457-2169	cwirsen@whoi.edu

APPENDIX III

Deep Submergence Science Committee

28, 29 May 1996
Woods Hole, MA

R. Pittenger

Woods Hole Oceanographic Institution

Features of the New Deep Submergence Facility (After Spring 1997)

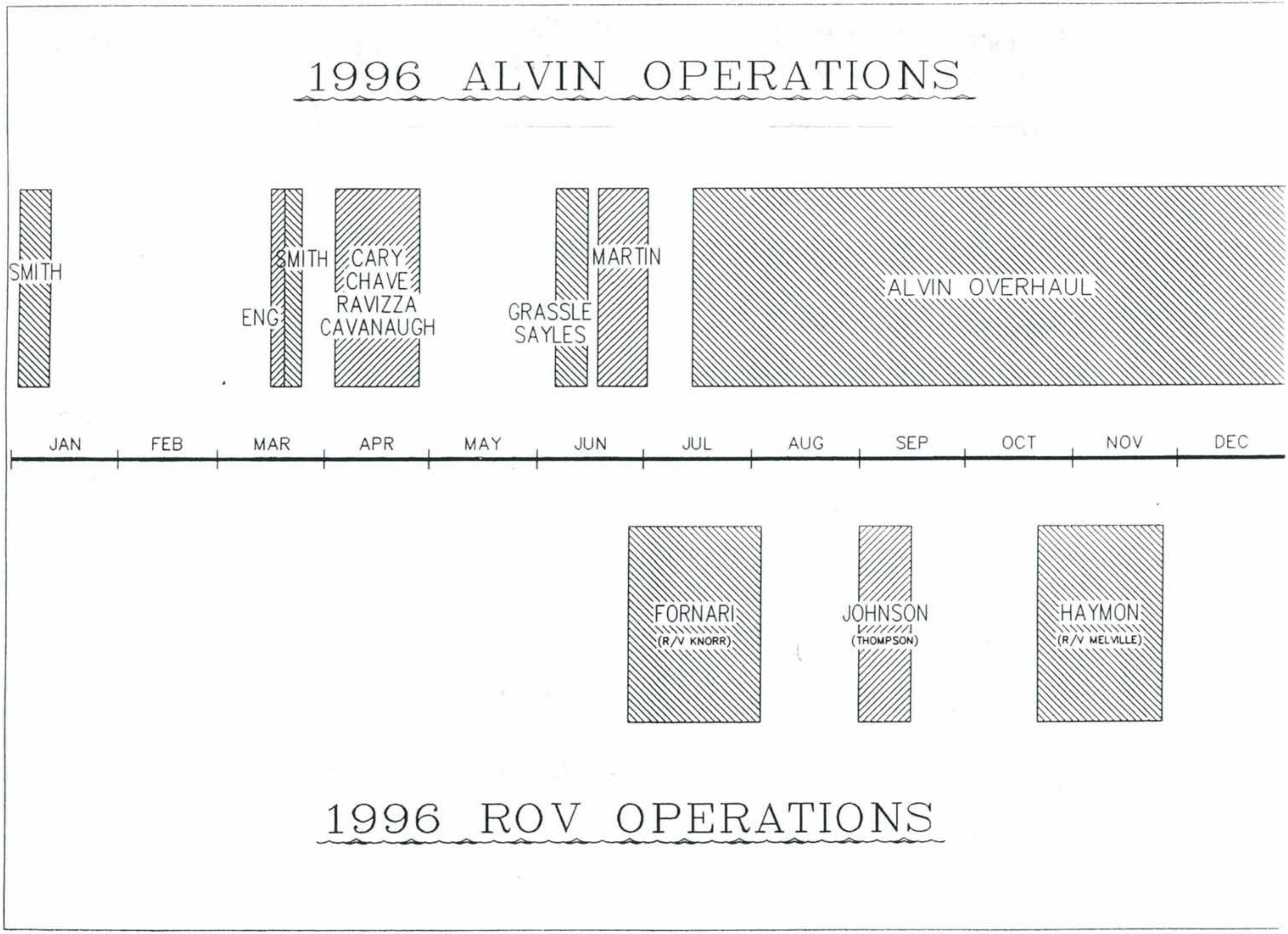
- *Atlantis*
  - ◊ Lab Space, General Purpose Capacity
  - ◊ Berthing
  - ◊ Endurance
  - ◊ Speed
  - ◊ Sea-keeping/Sea-kindliness
  - ◊ Power
  - ◊ Dynamic Positioning
- Combined Deep Submergence Operations Group
  - ◊ *Alvin*
  - ◊ *Argo II, DSL 120, Jason*
- ROV's also available in "fly-away" mode
  - ◊ For now?

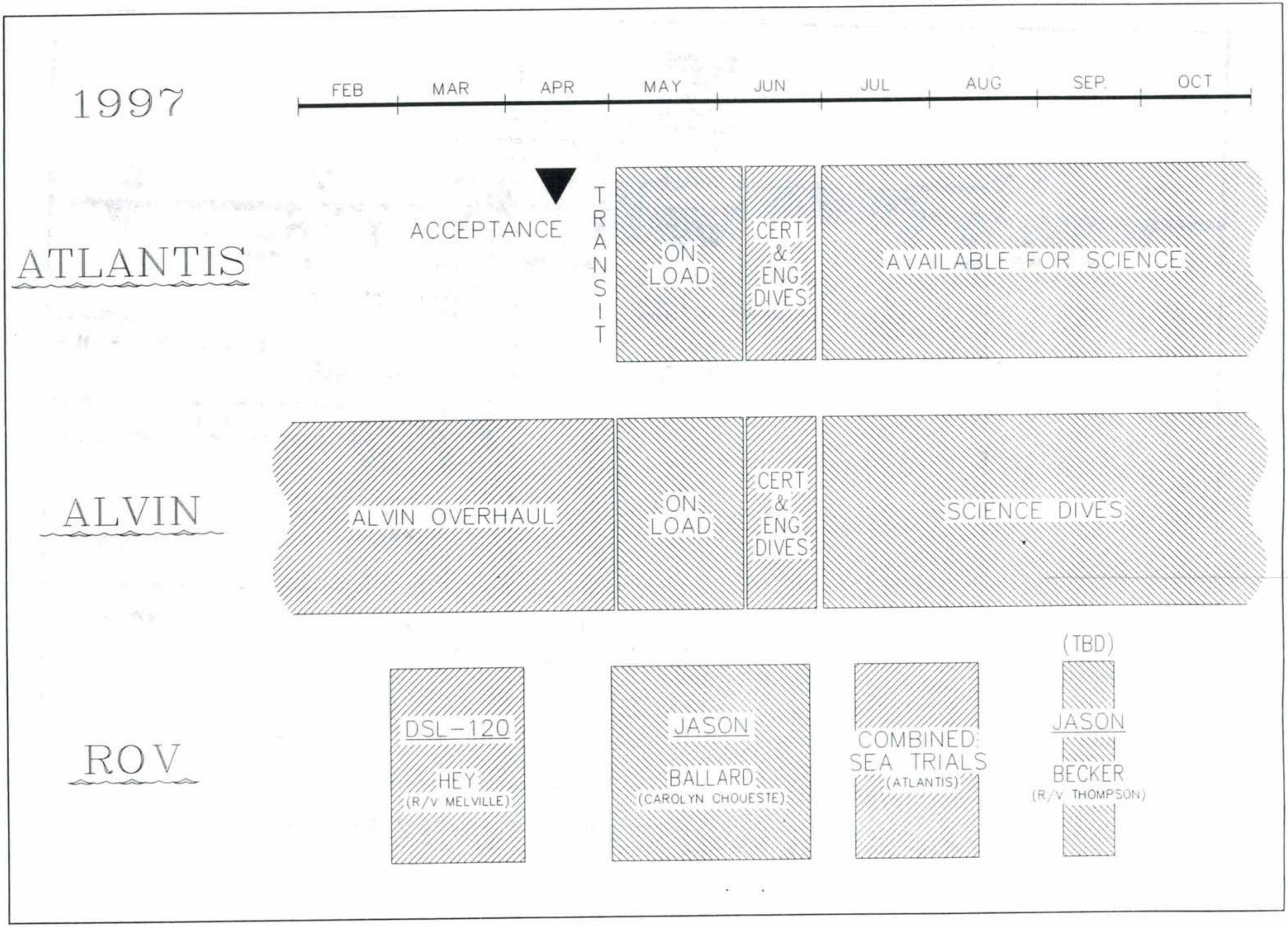
ATLANTIS

Schedule of Key Events

• *Atlantis II* out of service	Sept. '96
• *Alvin* Overhaul	Sept.'96 - Apr.'97
• *Atlantis* (AGOR-25)	
⇒Launch Date	1 Feb. 1996
⇒Conversion Complete	April '97
⇒Arrive WHOI	5/6/97
⇒DSOG Demo/Trials	5/20/97 - 6/3/97
⇒Available for Science (contiguous to USA)	June - Dec. '97
⇒Available for Science (unlimited)	> Feb. '98

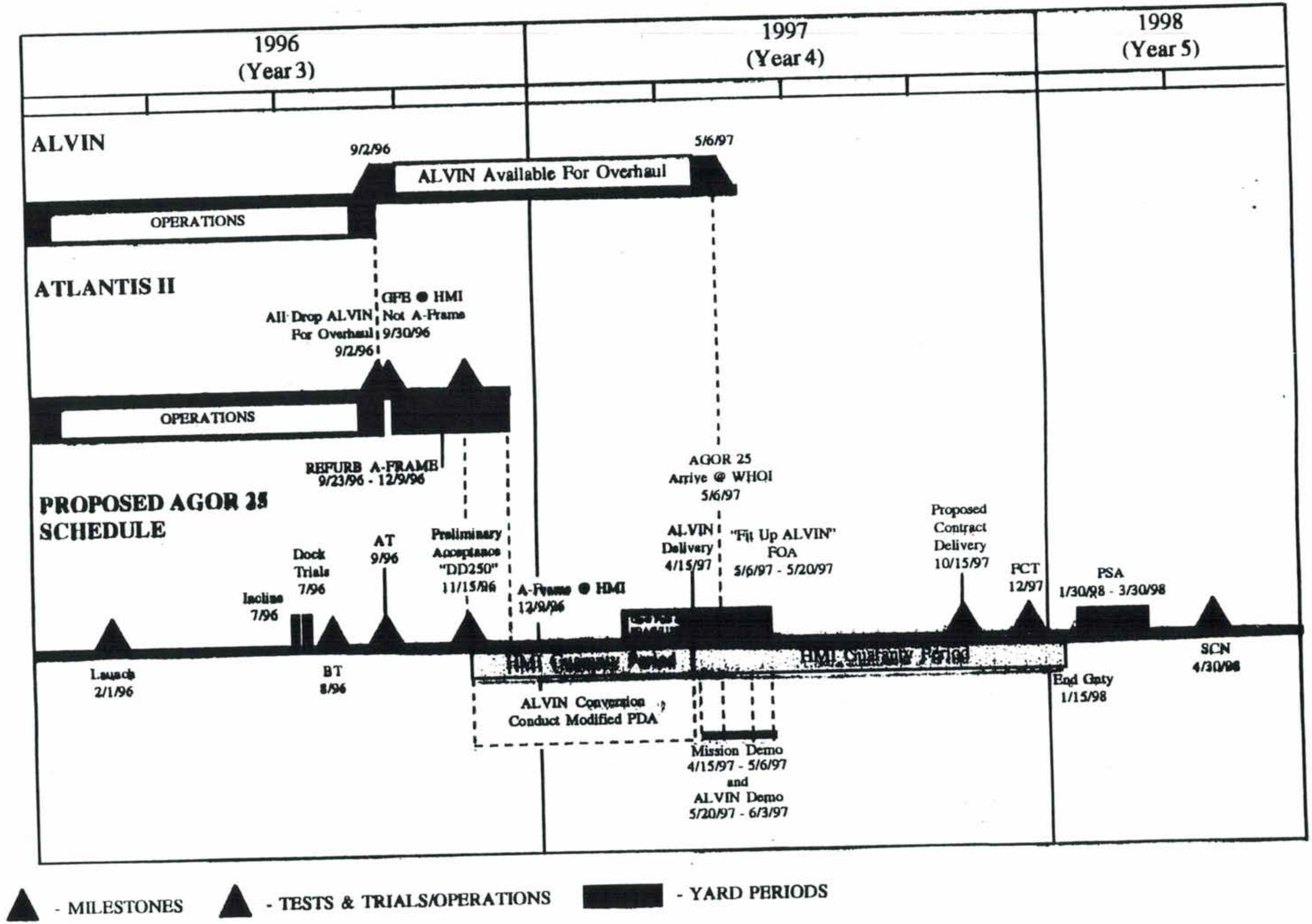
	Lulu	*Atlantis II*	*Knorr*	AGOR-25 *Atlantis*
LOA	**105 ft.**	**210 ft.**	**279 ft.**	**274 ft.**
Beam	**48 ft.**	**44 ft.**	**46 ft.**	**52.5 ft.**
Displacement	**480 Ltons**	**2,300 Ltons**	**2,685 Ltons**	**3,250 LTons**
Crew	**9**	**22**	**22**	**22**
Science:				
DSV/Tech	**9**	**9**	**13**	**13**
Party	**8**	**19**	**21**	**24**
Generators	**150 kw**	**600 kw**	**1,780 kw**	**2,145 kw**
Cruising Speed	**6.5 kts**	**10.5 kts**	**12 kts**	**12 kts**
Endurance	**20 days**	**30 days**	**60 days**	**60 days**
Range	**2,000 mi.**	**9,000 mi.**	**12,000 mi.**	**11,300 mi.**
Labs	**One Van**	**4 labs 1,031 sq. ft.**	**6 labs 1,981 sq. ft.**	**6 labs 3,890 sq. ft.**


1996 ALVIN OPERATIONS
SMITH
ENG
SMITH
CARY
CHAVE
RAVIZZA
CAVANAUGH
GRASSLE
SAYLES
MARTIN
ALVIN OVERHAUL
JAN
FEB
MAR
APR
MAY
JUN
JUL
AUG
SEP
OCT
NOV
DEC
FORNARI
(R/V KNORR)
JOHNSON
(THOMPSON)
HAYMON
(R/V MELVILLE)
1996 ROV OPERATIONS

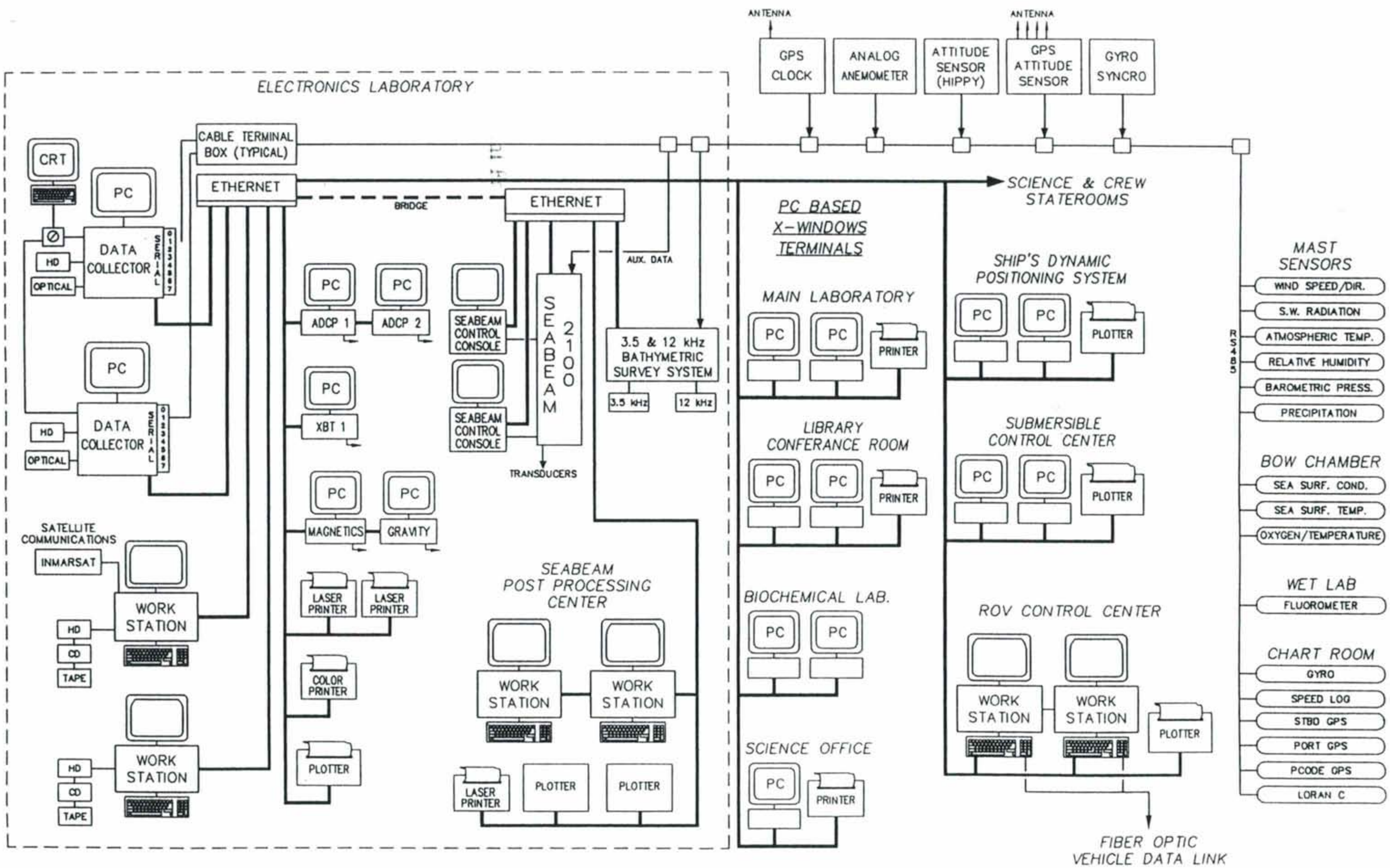

1997
FEB
MAR
APR
MAY
JUN
JUL
AUG
SEP.
OCT
ATLANTIS
ACCEPTANCE
TRANSIT
ON LOAD
CERT & ENG DIVES
AVAILABLE FOR SCIENCE
ALVIN
ALVIN OVERHAUL
ON LOAD
CERT & ENG DIVES
SCIENCE DIVES
ROV
DSL-120
HEY
(R/V MELVILLE)
JASON
BALLARD
(CAROLYN CHOUESTE)
COMBINED SEA TRIALS
(ATLANTIS)
(TBD)
JASON
BECKER
(R/V THOMPSON)

20 Nov 95

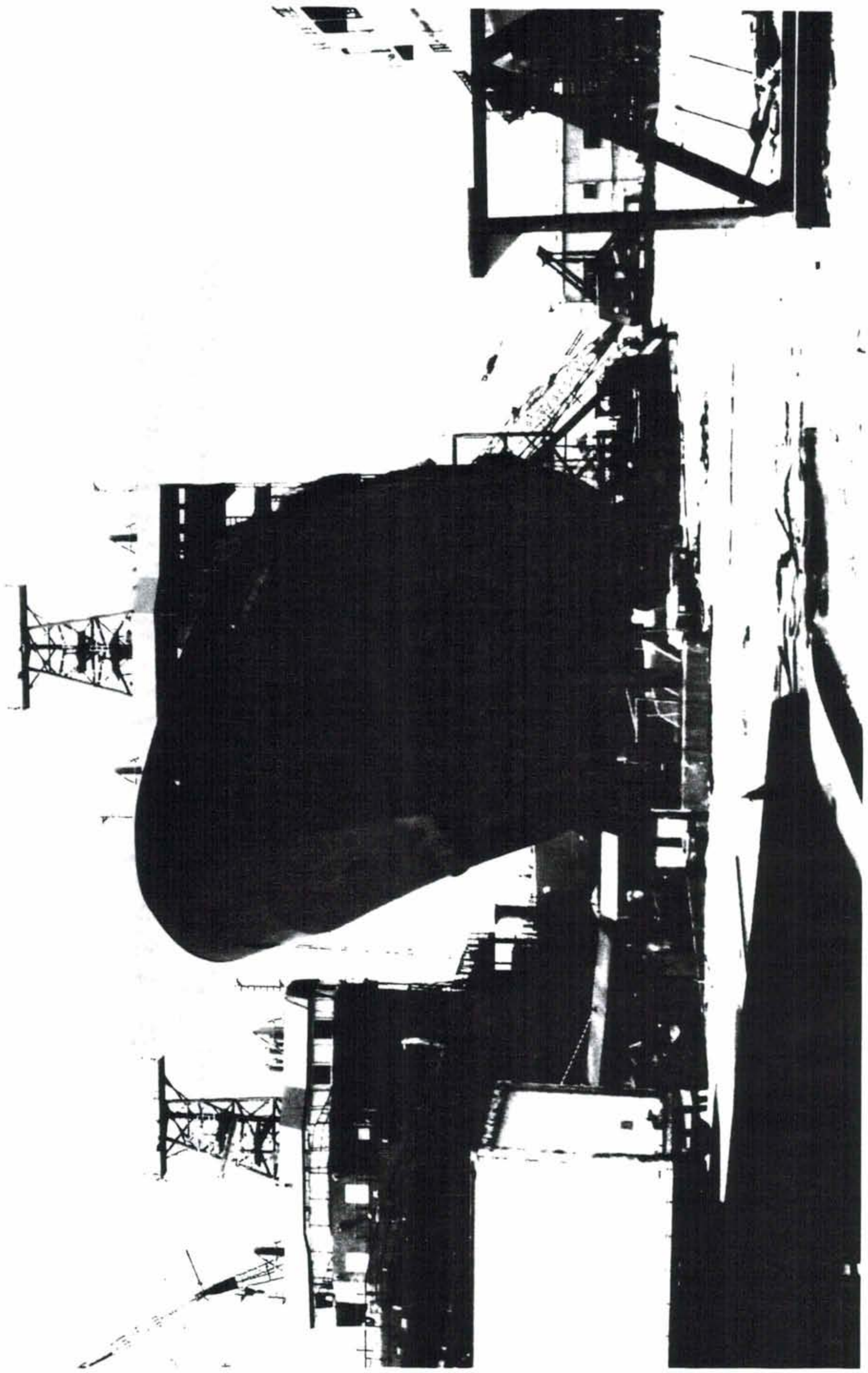
AGOR 25/ATLANTIS II/ALVIN Schedule



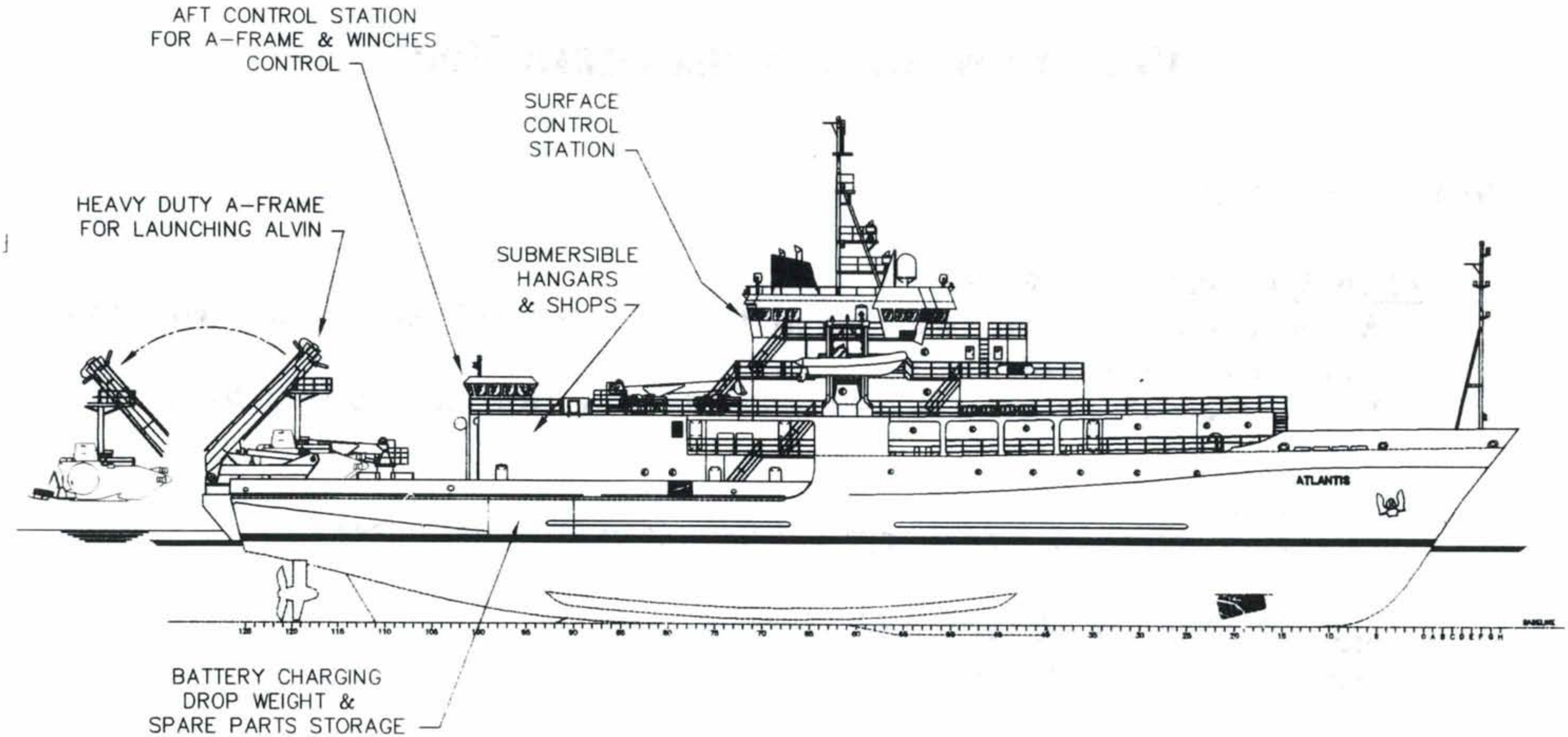
ATLANTIS SHIPBOARD INFORMATION SYSTEM



BETSEY DOHERTY date 02/10/95
file: INFOSYS revised 01/23/96
SSSG\AGOR



Outboard Profile of *R/V Atlantis* with Deep Submergence Modifications Highlighted



ATLANTIS OUTBOARD PROFILE STARBOARD

Plan View of *Atlantis* Main Deck

New Features:

Alvin A-Frame and Tracks

- A-Frame will be taken from *Atlantis II*, completely refurbished and new, more powerful hydraulic system.
- Positive control traversing and track system to move *Alvin* into and out of hangar.

Alvin Hangar

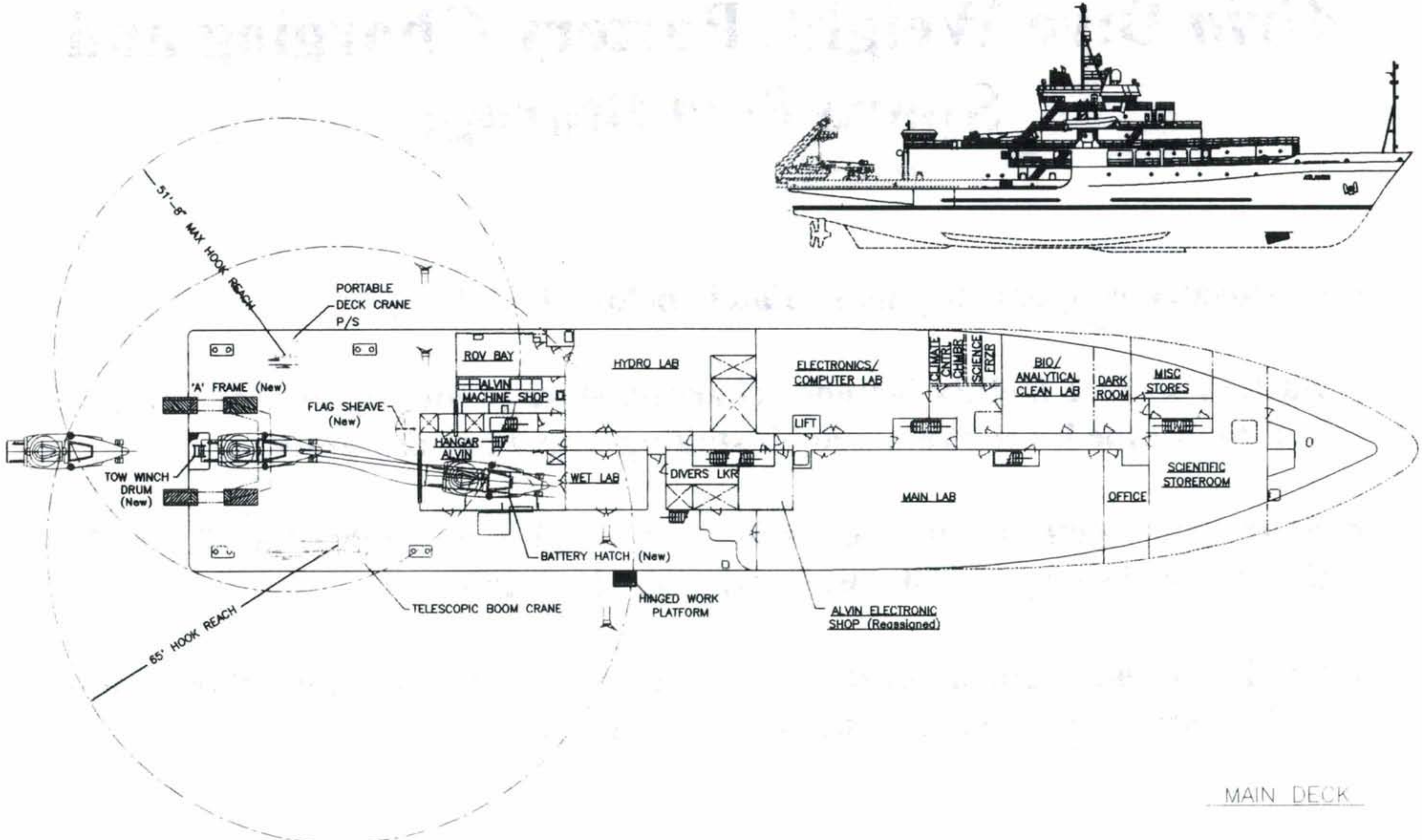
- To provide secure, covered storage and easy access for maintenance.

Shops (Mechanical, Electric, and Electronics)

- Near hangar for efficiency.

ROV Bay

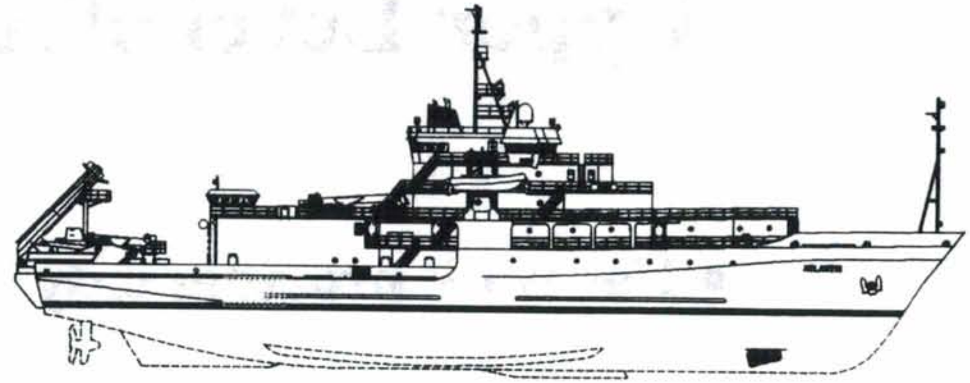
- For Storage and maintenance of WHOI ROV's.

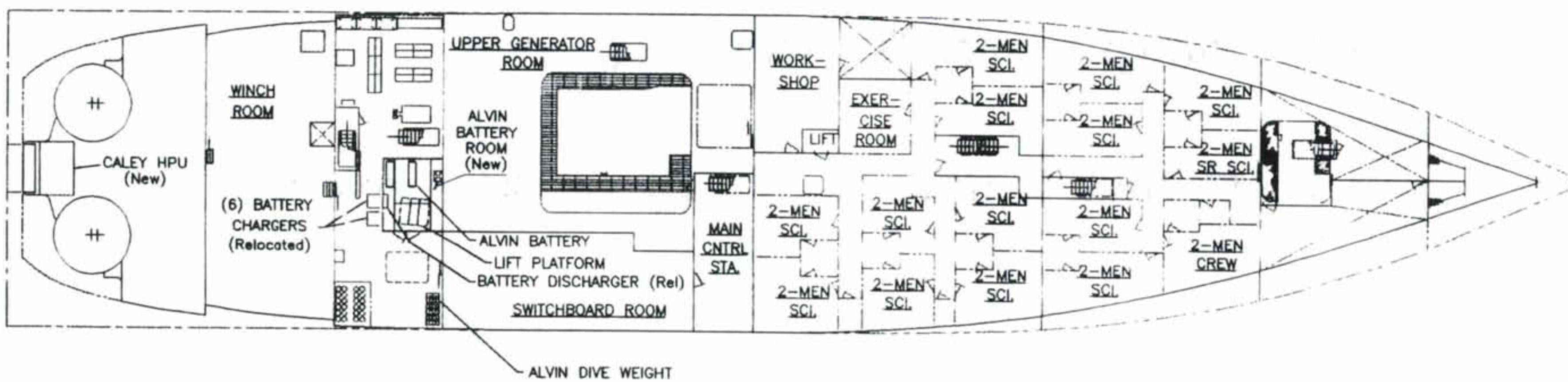

51'-8" MAX HOOK REACH
PORTABLE
DECK CRANE
P/S
'A' FRAME (New)
FLAG SHEAVE
(New)
ROV BAY
ALVIN
MACHINE SHOP
HANGAR
ALVIN
HYDRO LAB
WET LAB
DIVERS LKR
ELECTRONICS/
COMPUTER LAB
LIFT
CLIMATE
CNTRL
CHMBR
SCIENCE
FRZR
BIO/
ANALYTICAL
CLEAN LAB
DARK
ROOM
MISC
STORES
MAIN LAB
OFFICE
SCIENTIFIC
STOREROOM
TOW WINCH
DRUM
(New)
BATTERY HATCH (New)
HINGED WORK
PLATFORM
TELESCOPIC BOOM CRANE
65' HOOK REACH
ALVIN ELECTRONIC
SHOP (Reassigned)

MAIN DECK

Alvin Dive Weight, Battery Charging and Spare Part Storage

- Co-located conveniently immediately below *Alvin* hangar.
- Battery service facility includes charger, storage for replacement battery and hydraulic lift for removing/installing heavy battery units.
- *Alvin* uses 1,000 lbs. of steel as descent weights on each dive. Typically the ship will carry 75,000 lbs. of expendable weights.
- Having an adjacent dedicated large spare parts storage for submersibles will greatly enhance the at-sea groups' efficiency.

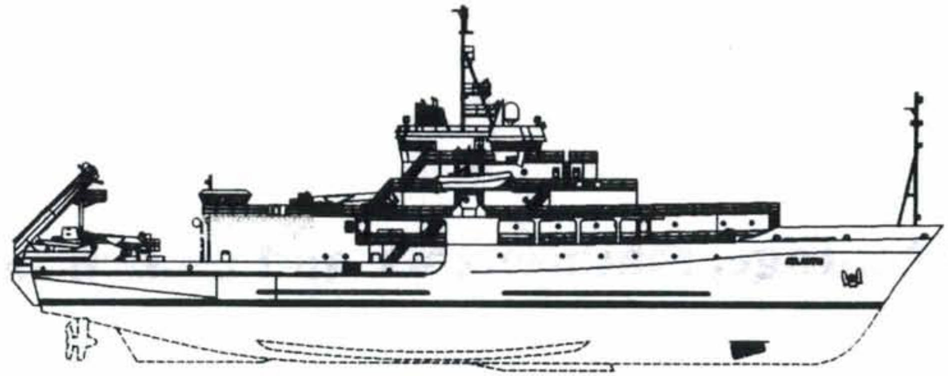


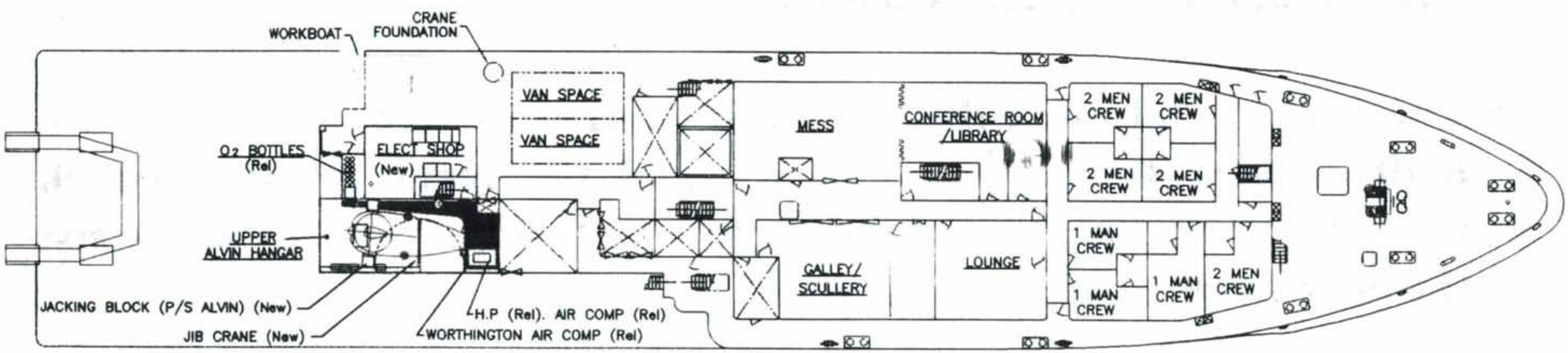


1ST PLATFORM DECK

Upper Level of *Alvin* Hangar

- **Cat-walk provides easy access to submarine.**
- **Adjacent shop.**
- **Air compressors for servicing *Alvin*.**
- **Work boat is used in *Alvin* launch/recovery.**

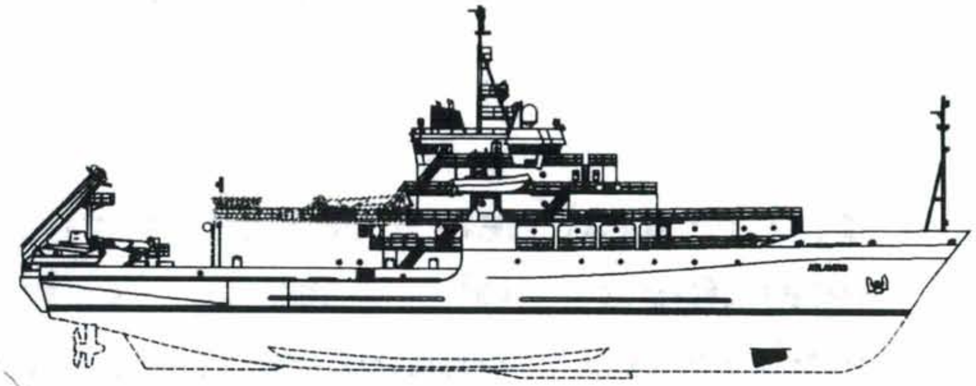


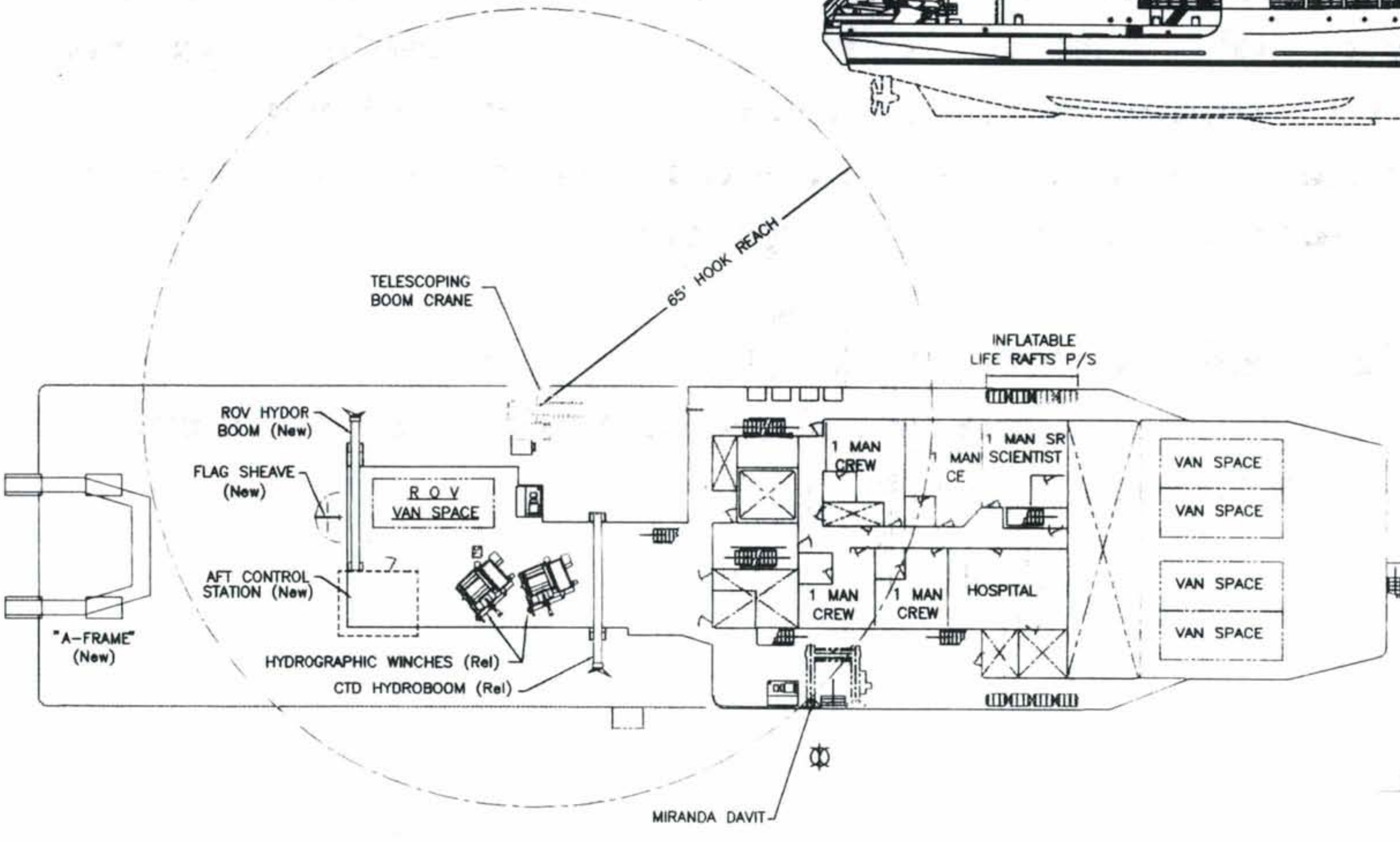


FOCSLE DECK (01 LEVEL)

Remotely Operated Vehicle (ROV)

- **Storage, maintenance and launch facilities will be provided.**
- **An innovative scheme to launch these vehicles from the port side (from a new dedicated hydroboom).**
- **The control station will house the control for the A-frame, both hydrobooms, both hydrowinches, and the large traction winch (located below decks). Remote controlled video cameras will assist the operators.**





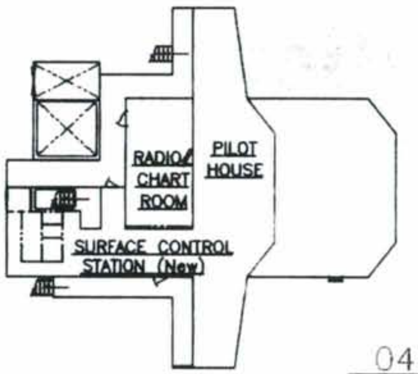
TELESCOPING BOOM CRANE
65' HOOK REACH
INFLATABLE LIFE RAFTS P/S
ROV HYDOR BOOM (New)
FLAG SHEAVE (New)
R O V VAN SPACE
AFT CONTROL STATION (New)
"A-FRAME" (New)
HYDROGRAPHIC WINCHES (Rel)
CTD HYDROBOOM (Rel)
1 MAN CREW
1 MAN SR SCIENTIST
MAN CE
1 MAN CREW
1 MAN CREW
HOSPITAL
VAN SPACE
VAN SPACE
VAN SPACE
VAN SPACE
MIRANDA DAVIT

02 LEVEL

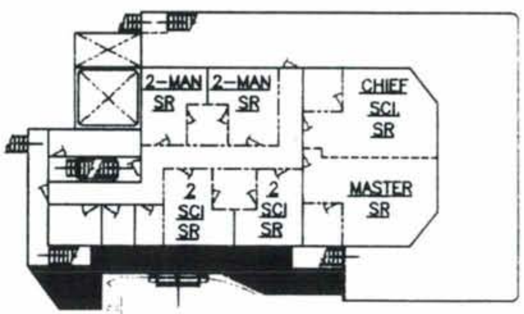
Alvin Surface Control Station

- **The central nerve center (surface control station) for *Alvin* dive operations will contain navigation and plotting systems, underwater communications equipment for talking to the submarine during dives, video monitoring equipment for dive and recovery sequences, and radio equipment.**

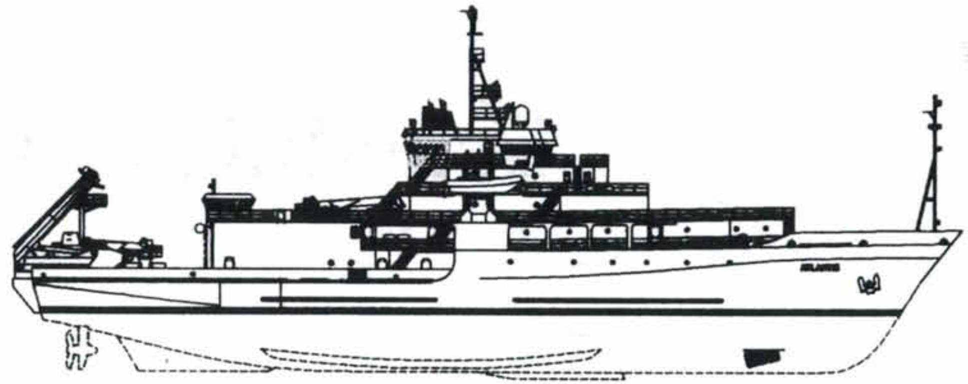
- **The surface control station is located adjacent to the bridge to facilitate coordination between the ship control and submersible control stations.**



04 LEVEL

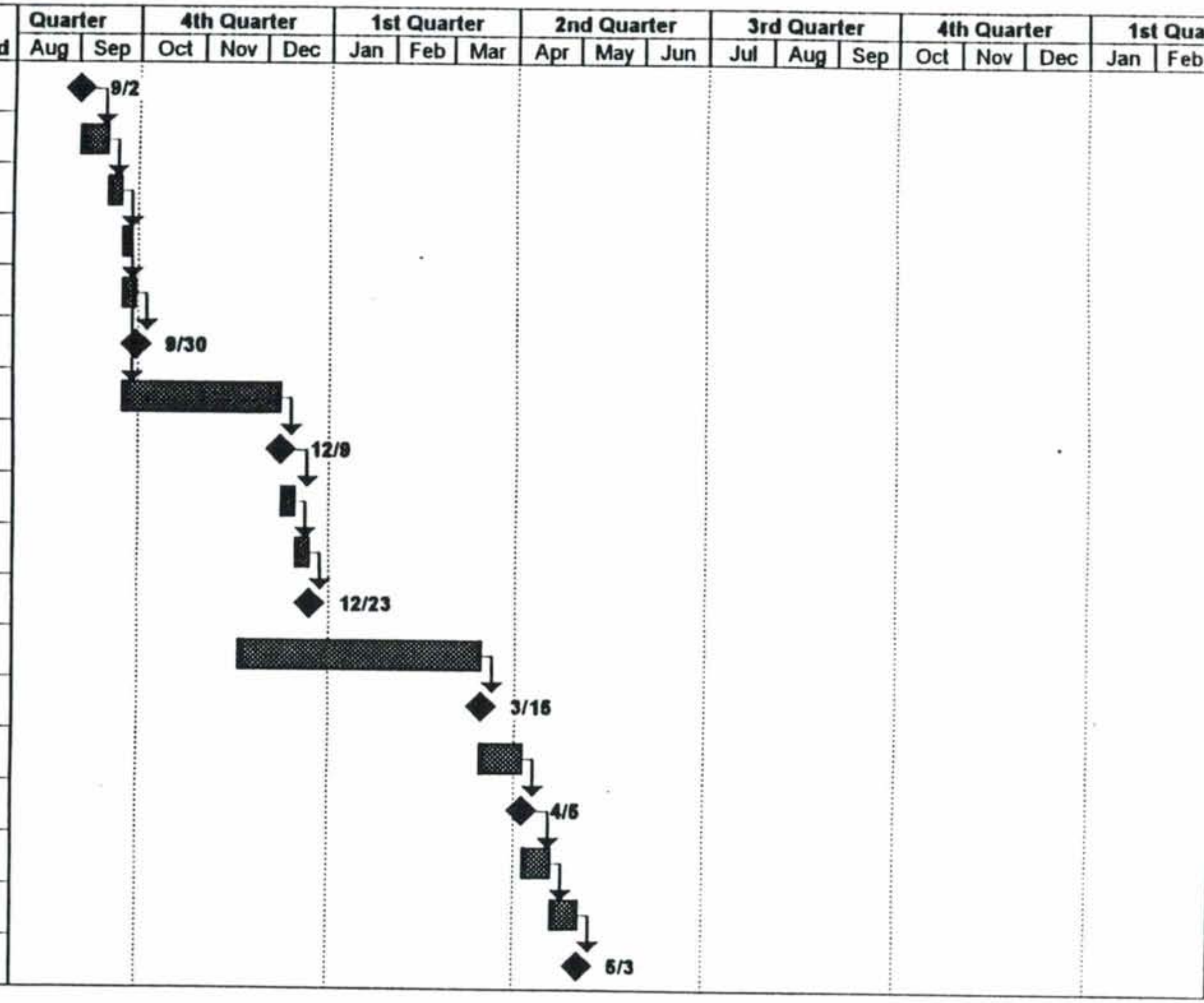


03 LEVEL



Schedule of Installation

ID	Task Name	Duration	Start	Finish	Pred
1	Atlantis II Arrival WHOI	0d	9/2/96	9/2/96	
2	Atlantis II Unload at WHOI	2ew	9/2/96	9/16/96	1
3	Atlantis II Transit to Caley	1ew	9/16/96	9/23/96	2
4	A-frame off load at Caley	0.5ew	9/23/96	9/26/96	3
5	Atlantis II GFE not A-frame	1ew	9/23/96	9/30/96	3
6	GFE at HMI	0d	9/30/96	9/30/96	5
7	A-Frame refurbishment	11ew	9/23/96	12/9/96	3
8	A-Frame at HMI	0d	12/9/96	12/9/96	7
9	A-Frame Installation (Calley e	7ed	12/9/96	12/16/96	8
10	A-Frame testing	7ed	12/16/96	12/23/96	9
11	A-Frame Completed	0d	12/23/96	12/23/96	10
12	Alvin Conversion Period	86d	11/18/96	3/15/97	
13	Atlantis Delivery	0d	3/15/97	3/15/97	12
14	Mission Demo	21ed	3/15/97	4/5/97	
15	Arrival WHOI	0d	4/5/97	4/5/97	14
16	Alvin Fit up @ WHOI	14ed	4/5/97	4/19/97	15
17	Alvin mission demo	2ew	4/19/97	5/3/97	16
18	Ready for Science	0d	5/3/97	5/3/97	17



Project: ATLANTIS/ALVIN CONVERS
Date: 11/17/95

Task — Progress — Milestone — Summary — Rolled Up Task — Rolled Up Milestone — Rolled Up Progress

APPENDIX IV

ALVIN BATTERY EVOLUTION

Presented to the
UNOLS Deep Submergence Science Committee
May, 1996
by Dudley Foster

Introduction

Since ALVIN was first launched 1964, lead-acid battery technology has provided a source of power that has been reliable, readily available, easily maintained, and cost effective. As in all electrical systems, there has been a continual increase in the need for more power as technology has provided new equipment for science instrumentation and imaging applications. The paramount factors in power consideration are safety and service reliability. The following report discusses several battery technologies considered for use in ALVIN. When factors of serviceability, reliability, cost, payload and space are considered, the higher capacity lead-acid cells still have an overall advantage compared to other relatively mature battery technologies.

Background

Appendix A is a summary of ALVIN's battery and power distribution evolution. The first design philosophy was to separate power for control (instrumentation, communication, life support, etc.), propulsion (thrusters and lights), and science applications. The design insured that if science equipment depleted its power, propulsion and control would still be available. Also, if propulsion power were depleted, control power was still available for critical surfacing, life support and communications functions. Since ALVIN was very much a prototype and development vehicle at that time, this conservative approach was prudent. The fundamental concern for safety as the primary design criteria has not been neglected in all subsequent design evolutions of the power system. However, experience has safely allowed changes resulting in equal power distribution throughout the submersibles systems.

By 1967, having three different battery systems was proving to be unreliable and a major maintenance problem. At this time a two-voltage system was implemented, essentially combining the science and control batteries into a single 30 volt system. The 60 volt propulsion batteries were retained as a separate power source. The resultant change allowed all batteries to be of the same type (six volts each), allowed design of a lower maintenance battery box, allowed simplification of the power distribution system, increased the battery power, but also decrease the payload due to heavier batteries.

In 1986 continued failures of the Hoover propulsion motors at increased operating depths necessitated conversion to brushless DC motors. The hydraulic propulsion system was replaced with individual electric thrusters. These motors required 120vdc and the combined 60/30 volt battery tanks were replaced with two 120-volt battery tanks and one 30-volt battery tank. In the previous configuration, both 30 volts and 60 volts were combined in each battery tank. Either battery tank could therefore provide all necessary submersible voltages in the event of a failure in the other tank. In order to retain the safety features of this power redundancy, the new 30 volt battery tank had three separate 30 volt strings. One string had lower capacity, lighter, batteries that went to an auxiliary 30 volt bus. In the event of a problem with the primary 30 volt bank the auxiliary 30 volt string could be brought on line to allow uneventful return to the surface. The disadvantage of this was that all the 30 volts were in one tank, and if that tank flooded or had to be dropped, only emergency batteries in the sphere were available for surfacing. At this time, the added batteries resulted in a 67% power increase but required filling almost all available space with a total of 1000 pounds of syntactic foam.

In 1988 the source of the 225ah Exide batteries became unreliable and they were replaced with 200ah KW batteries. Although these cells had less power, they were lighter, less expensive, and of better quality.

Even though the sub now had more power than pre-1986, many missions were still limited by the depletion of either the 120 or 30 volt batteries. Dive profiles requiring heavy lighting, hydraulics, or propulsion usage would deplete the 120 volts when the 30 volts still had power available. Conversely, missions with heavy instrumentation would deplete the 30 volt battery with power left in the 120 volt propulsion batteries.

The Current Battery System

In 1989, the 30 volt batteries were completely eliminated by installing 120vdc to 30vdc power converters inside the sphere. This had the advantage of allowing all the power available in the batteries to be consumed regardless of the mission profile. At this time the sub started to carry only two 120 volt battery tanks. This allowed 100% power redundancy because all systems could be run from either battery if one were flooded or dropped. Although there was space for a third 120-volt battery tank, there was insufficient payload to install one. A study was done in 1991 to determine how we could accommodate another battery and increase overall capacity. This was the motivation to develop the pressure tolerant motor controllers (PTC). By adding a large piece of syntactic under the stern, removing reserve steel ballast, and removing the motor controller pressure cases, there would be sufficient payload for a third tank. Appendix B shows the results of that design study. Since the pressure tolerant controller program was unsuccessful, we are still limited to two battery tanks using lead acid cells in the 190-260ah range.

Another factor limiting the use of the rated power of the batteries was the depletion of water in the cells over time. The normal loss of water in the cells during charging eventually exposed the battery plates to compensating oil and reduced the battery capacity until the battery could be removed for servicing. Due to operating demand, this service took place every six months, and experience showed that the last few cruises before a service period usually suffered from reduced battery capacity. To try and maintain battery capacity, and allow more operational days, a battery rotation program was implemented that replaced one of the two batteries every two months. As a result, each battery is serviced every four months and is less likely to suffer from water shortage and exposed plates. This method eliminated the need for a two-week maintenance stand-down every six months and allowed an additional 30 operational days per year. Installing three battery tanks with lighter and lower capacity batteries was evaluated. By using three tanks of 165ah cells, the total capacity could be increased by 24%. This would force us to go back to stretching the service period to six months, or to four months with a two-week stand down three times a year (six weeks out of service). Numerically we could replace one of the three batteries about every port stop, but this becomes logistically impossible. The final evaluation was that more sustained power was available with a two-tank rotation than would be available with a 24% larger battery capacity serviced every six months. Improvements in battery charger control also allowed us to customize the charging profiles to maximize charging and minimize water consumption.

It should be noted that during the battery evolution, the power demands have continually increased, payload demands have continually increased and the average dive time has remained about constant since 1986. The design tradeoffs and efficiency improvements have given more performance with less cost and have maintained the payload capacity. Appendix C illustrates the average dive time over the last three decades for each of the design change periods.

There are two areas which can improve dive duration. The most effective is to maximize the power available and to use it more efficiently. The second is to provide a raw increase in available power. Without doing the first, even the second would not provide satisfactory results. Power efficiency and capacity must consider the whole system, not just the battery. The system also includes personnel performance, battery maintenance and performance monitoring.

Appendix D is a comparison of recent dive statistics for four pilots. This is an average of 30 dives over a similar time period to minimize the effects of different mission profiles between each individual. The average difference between the shortest bottom time and the longest is about 40 minutes, or 15%. Without more data regarding the reason for completion of a dive, it is impossible to determine the reasons for the variability. It is possible that the work was generally completed which suggests the longer bottom time is due to slower work at reduced power, whereas the shorter time is due to faster work at a higher power rate. If the dives were terminated due to lack of power, it would indicate more emphasis should be placed on pilot training to improve their efficiency. In either case, the total health of the battery may have been an issue. To gather better data about pilot efficiency and battery performance, future pilot debrief sheets will include a comment about why the dive was terminated, whether it was lack of power, work completed, weather, equipment failure, etc. If the comment is lack of power, this should give the electrician daily feedback about the condition of the battery and the need for some corrective action.

Maximizing Available Power

Battery maintenance has a major affect on battery performance. Problems with battery chargers not delivering a full charge, insufficient battery equalization, battery age, and electrolyte levels all interact to establish how much power is available on a given dive. When a battery starts to loose capacity, the corrective action usually requires several battery discharge/charge cycles to regain the capacity. Even with the current 4-month battery rotation, a delicate balance must be maintained between slightly overcharging daily, periodic equalization and battery water consumption. Manufacturers recommend equalizing (periodic overcharging) batteries every 5-7 cycles to maintain their full capacity. These maintenance requirements are not unique to lead-acid batteries. All other vented aqueous type cells need similar care. This also results in the need to add water to the batteries every couple of weeks. Various automatic watering devices have been investigated by the ALVIN group to allow watering without removing the batteries. All the devices have a large risk involved in the event that one of the devices failed, resulting in an electrolyte overflow within the battery tank, subsequent short circuit, and possible fire or explosion.

To better monitor the battery condition and maintain maximum capacity, the electrician needs daily feedback about battery performance. By the time a pilot makes a comment about the battery performance, the battery has deteriorated to the level that mission performance is noticeably affected. Better instrumentation is required to monitor the daily and gradual change in the battery condition. WHOI is pursuing two courses of action to provide the necessary instrumentation. A prototype microprocessor based electronic circuit which resides within the battery tank has had some initial testing on the submersible. This circuit monitors volts and amps on charge and discharge, battery tank temperature, and electrolyte level in four cells. It has a SAIL data interface to log the battery data in real time. There have been several design refinements to the circuit based on the results of the field trials, and continued testing and evaluation is required to demonstrate reliability before the circuit can be considered operational. ALVIN does not presently have a SAIL system, and refinements to the logging system would be required as well as development of data evaluation software. Another device to be evaluated is a microprocessor based commercial product with an RS-232 interface that measures volts and amps during charging and discharging with respect to time. The data output includes volts, amps, number of cycles, deepest discharge, average depth of discharge, coulomb efficiency (power out/power in), etc. Testing and evaluation of this product will start in late July 1996. If it provides useful and accurate information, and a safety evaluation of the necessary wiring is satisfactory, the device may be incorporated in ALVIN during the next overhaul. In addition to potential use on the submersible, this device may also be used to log the performance of our Exide brand battery chargers which do not have a computer interface.

The overall performance of a system is also a function of the power usage efficiency. In addition to the pilot factors and battery maintenance already mentioned, the power efficiency of individual electrical and electronic equipment should be maximized. A design or selection criteria for any new equipment should include an evaluation of energy efficiency, especially for equipment that will be in continual use during a dive. Video cameras are an example of how of efficiency tradeoffs need to be evaluated. One way to get a better picture is to provide more light on the subject. This increases power requirements. An alternative way is to use a camera that needs less light to get a better picture which reduces the power requirements. Another power conservation method is to periodically assess the need for existing power consumers. This is constantly done on ALVIN and is a natural selection process. Those items that are not frequently used are removed from permanent installation. This helps control weight growth and reduces maintenance. Reducing obsolete or underutilized equipment means less power consumption. In designing the next generation of ALVIN data logger and display systems, an evaluation of what information is actually required in real time, and what is not necessary, will be considered. By reducing the complexity and demand for real time information, weight and energy savings may be possible.

Battery Technologies

In addition to striving for maximum performance and efficiency from the current power systems, the ALVIN Group is continuing to evaluate sources that might provide more power with less weight in the existing space available. Appendix E shows performance comparisons of four battery technologies considered for ALVIN. This data is based on production cell dimensional and weight information supplied by the manufacturers and should not be confused with specifications relating to laboratory test data. The total Kwh value is based on the possible installation configurations as discussed below. Three of these batteries represent technologies that are mature and are available in capacities suitable for electromotive applications such as ALVIN. The NiMH cells cannot be considered mature since they have not been broadly applied to electromotive applications but may have future applicability.

Nickel-Cadmium batteries are used in the Russian MIR submersibles to replace the Nickel-Iron batteries that were no longer available. The cells were made by SAFT-NIFE of France and are available in the US through their facility in Georgia. The Russians first started to evaluate these cells in 1989. There was a problem with the battery case material and a different cell was evaluated in 1992. In 1995 they replaced their nickel-iron batteries with the present NiCd's. This suggests they had a 5-year development and evaluation program before committing to this type of cell. Discussions with the MIR program manager and SAFT indicated the cells are performing well but require watering every 20 dives. In a full ALVIN diving schedule the battery would need to be removed and serviced every month, which would be operationally unacceptable. One of the Russian design requirements was for the cells to take a 30-degree roll without spilling the electrolyte. With an appropriate vent cap, it may be possible to increase the electrolyte volume and extend the watering interval. Presuming this shortcoming could be overcome, two new battery tanks containing 285ah cells (a 50% increase over Douglas) would fill the complete battery compartment and result in a 150-pound loss of payload. Alternatively, two tanks with 208ah cells (a 9% increase over Douglas) could be installed with a 700-pound increase in the payload. NiCd cells are not susceptible to damage by over discharging as opposed to lead-acid batteries which may be damaged if discharged below 80%. This suggests the NiCd cells could be discharged closer to their rated capacity as opposed to the 80% discharge limitation of Pd-acid cells. If one were to presume a 90% discharge for the 208ah NiCd, and a 70% discharge for the 190ah Pd-acid, the net useable power gain would be 41%, not the 9% suggested by just the amp-hr rating of the cells. For a 260ah Trojan lead acid cell, the above analysis results in only a 3% useable gain. Either of the NiCd battery packs would result in loss of the science space in the present 3rd battery position. The French source for these batteries might present a logistics problem. The only other source of high capacity NiCd batteries identified is VHB Industrial Batteries of Canada, a subsidiary of Varta. Their construction methods result in a cell with 47% fewer watt-hrs/liter and a weight 92% more than the SAFT cell. The SAFT battery cost for three tanks (including one rotating for service) would be approximately $210,000. New battery boxes and base plates would cost approximately $50,000. This is more than a 1000% increase in battery cost for a potential 41%, (or 3% with Trojan cells) increase in power.

A **Nickel-Metal-Hydride** battery in the 90 ah range is manufactured by Ovonic Battery Co. These batteries are being developed for use in electric cars and provide about 60% more power/weight than the best lead acid cells. The cell is proprietary and details about internal construction are not known. The standard cells are a sealed, no maintenance design which relies on recombining the hydrogen or oxygen generated during discharge/charge cycles. They use an aqueous potassium hydroxide electrolyte so there is a possibility that the cells could be applied to deep ocean applications. However, at the present time it is not known if the sealed nature of the cell is required to retain cell life or if the chemical reactions will effectively take place at 6,000 psi. The Ovonic cell life is only 600 cycles (compared to 1000+ for other types) and mass production quality has not been established since these cells are not yet generally available. General Motors expects to market vehicles with these cells in 1997. Because this technology is in its infancy, these cells are not appropriate for use in ALVIN at this time. With assistance from high level contacts at GM, WHOI plans to look more closely at the possible deep sea application of these cells. This will probably require a meeting with Ovonic engineers in Michigan to gather more information and start a pressure test evaluation program if appropriate. We have recently received word from VHB/Varta that they may have NiMH cells which are of high enough energy density to be of interest to us. We will be working with them to evaluate the potential for application of their product.

Silver-zinc batteries (Yardney) were investigated. Two sets of 750ah batteries (including one rotating spare) would cost approximately $336,000, could provide a 97% increase in power over Douglas, are light weight (a 1000 pound increase in the payload), have a short lifetime (only 70% capacity guaranteed after 12 months), have a poor reputation for reliability, and only one 120-volt battery could fit in ALVIN, eliminating the safety of having a redundant power source. Overall, these were not considered a viable alternative power source.

Lead acid Chloride Canada tubular plate cells have been a candidate for installation in past years. The most likely cell is a 180ah unit which is light enough that three tanks could be installed resulting in a net power increase of 42% over the present Douglas cells. There would be a 250-pound loss in the payload. This company also offers a 190ah cell that would require completely new battery boxes. With three tanks installed, there would be a 100-pound payload loss and a 50% increase in power. In both cases, the third battery space would not be available for science applications and would have all the disadvantages of the three-battery configuration discussed above (six month services, electrolyte depletion, etc.).

Exide has gone through some reorganization in recent years, and two of their current 225ah cells have been purchased for evaluation. Initial cycle testing indicates they do deliver the advertised capacity. Assuming that the Japanese purchase of the company has solved the previously experienced delivery and quality control problems, these are an option for installation in the coming overhaul that could provide a power increase of 18%. A major disadvantage is that they will reduce the payload by 200 pounds. With the increase in science payloads since these were last used, this could have a major impact on science capabilities. One possibility for offsetting the payload loss is to add syntactic to the third battery space. That space is being used frequently for science equipment such as altimeters, down looking cameras, lights, strobes, and down looking sonar systems. Syntactic in that area may impact those capabilities.

Testing of some Trojan Battery Co. lead acid cells rated at 260ah is currently in progress. Each of these cells is 0.5 pounds lighter than the existing 190ah cells and has a potential to increase power 37% while increasing payload 60 pounds. The manufacturer claims the cells require 40-50 cycles to achieve maximum power. However, after more than 40 cycles, they are delivering 83%-88% of their advertised capacity, or approximately 215-228ah. When sufficient cycle testing is complete, the test data will be discussed with the manufacturer. If these cells eventually deliver at least the capacity of the Exide cells (225ah), these would be an excellent candidate to replace the existing Douglas cells during the next overhaul. This company is the country's largest supplier of deep cycle industrial batteries for fork trucks, golf carts, commercial floor scrubbers, etc. Being a domestic company, there should be a reduced risk of supply problems in the future.

Summary

As can be seen in Appendix C, there has only been a 3% variation in average dive times since 1986, yet there has been a continual increase in power demand and the total power available has decreased 33%. This efficiency improvement can be attributed to improved power distribution, better battery maintenance through charging improvements and battery rotation, constant efforts to improve equipment efficiency, pilot training to improve efficiency of power utilization, and constant awareness of all involved in the operation and use of the facility to be conscious of power consumption. There is still room for improvement in power utilization and sustaining maximum output from the current lead acid battery technology. Daily charging records indicate the batteries are seldom delivering rated capacity. Additional work is needed to determine the threshold of heavier battery charging without prematurely depleting battery water. This effort requires better logging and record keeping over many operational months. Only incremental changes can be made to determine the point of diminishing returns and not adversely affect our primary mission of supporting science diving requirements. Our continued effort to install suitable instrumentation and adding daily commentary of battery performance should help us improve battery performance in the future.

Of the alternate battery technologies presented, the NiCd cells probably have the highest possibility of successful implementation in the future. Although many arguments based on the life cycle cost of the cells (including dollars/minute on the bottom) can be made, it is very difficult to justify the high initial expense to change to the NiCd cells for a theoretical 3% increase in power (@90% discharge) over the potential of the Trojan lead acid cells (@ 70% discharge). NiCd's are not widely used in the proposed application, and data for long term performance is not known. Contact with manufacturers of these cells indicates they know very little about deep sea applications of their products. For WHOI to commit to the usage of this cell, extensive evaluation and testing would need to be done to establish low temperature, high pressure performance, water consumption rates, reliability, quality, and extended service requirements as well as literature search of historical data, and possible direct consultation with manufacturers and MIR operators. This would be a labor intensive and time-consuming effort, require battery procurement, chargers, test instrumentation, and thus would need support from a funded proposal. There would be no guarantee that the study would result in positive recommendation for use of NiCd batteries.

In the immediate future, Trojan, Exide or Chloride Canada lead acid cells will likely be installed during the next overhaul. With the efficiency improvements since the last use of the Exide cells, an 18% increase in power might be achieved over the existing cells without the need to redesign the battery tanks. Part of the payload penalty may be compensated for by adding a partial block of syntactic in the third battery hole and still leave some room for science equipment installations in that area. If the Trojan test program is satisfactory (>225ah capacity), these cells would be an excellent choice for installation. They have the potential to increase power by 37% without redesigning the battery tank and there should be no need to add syntactic in the third battery bay. If the overhaul indicates there is a substantive loss in the payload due to either science equipment additions (HMI's, four cameras, two VCR's, etc) or gradual deterioration of syntactic foam, the lower capacity (180 ah), lighter, Chloride Canada cells may need to be seriously considered.

The power sources elaborated on in this report are not the only technologies that have been reviewed. Carbon pile hot air turbines, kinetic energy flywheel storage, and numerous specialized battery chemistries and laboratory curiosities have also been reviewed. When all factors of reliability, maintenance, payload, mass production quality, cost and implementation impacts are considered, most of these alternatives have been deemed impractical for current applications.

To better monitor the development of possible future power sources, WHOI will try to improve the dialog with Ovonic and VHB to determine the applicability of their NiMH cells for deep ocean applications. We also plan to attend the annual Power Source Symposium each June to closely monitor power technology developments.

Appendix A

ALVIN POWER EVOLUTION

Notes:

1. C/L is Cycle Life
2. WW is total Water Weight of battery tanks
3. Cost is for installed cells only, no spares for rotation

1964-1966

Tanks: 3
Cells: (75) 2v cells (Olympic)
(30) 12v cells (Exide)
Cap: 2v =105ah, 12v=60ah (37.35kwh total)
Volts: 30/30/60 (9.45kwh sci/6.3kwh cont./21.6kwh prop.)
C/L: <50 cycles
WW: 1600#
Cost: ?

Comments:

(1) as delivered design
(2) separate batteries for science, control and propulsion functions

1967-1985

Tanks: 3
Cells: (45) 6v batteries
Cap: 150 ah (40.5 kwh total)
Volts: 30/60 (13.5kwh cont./27.0kwh prop.)
C/L: >200 cycles
WW: 1740#
Cost: $3,760

Comments:

(1) greater capacity
(2) simplified circuitry (science/control combined and propulsion)
(3) better tank design (less ground potential)
(4) common battery throughout
(5) longer life
(6) heavier batteries

1986-1987

Tanks: 3
Cells: (150) 225ah 2v cells, (15) 150ah 2v cells (Exide tubular)

Cap: 450ah@120v propulsion/450ah@30v control/150ah@30v reserve (67.50kwh)
Volts: 120/30/30 (54kwh propulsion, 13.5kwh control, 4.5kwh reserve)
C/L: >200
WW: 3545#
Cost: $19,035

Comments:
(1) Heavier batteries
(2) Added ~1000# of foam flotation
(3) removed reserve steel ballast
(4) Increased propulsion power
(5) Changed propulsion to electric thrusters

1988

Tanks: 3
Cells: (150)200ah 2v cells (KW tubular plate), (15) 150ah 2v Exide tubular
Cap: 400ah @120, 400ah@30v, 150ah@30v, (60.0kwh useable)
Volts: 120/30/30 (48kwh propulsion/12kwh control/ 4.5kwh reserve)
C/L: >200
WW: 3145#
Cost: $8,721

Comments:
(1) Exide source unreliable, changed to KW tubular plate
(2) Increased payload
(3) Decreased cost
(4) Decreased propulsion power
(5) Still have control/propulsion imbalance

1989

Tanks: 2
Cells: (120) 200ah 2v cells (KW tubular)
Cap: 400ah @120v (48kwh useable)
Volts: 120 (all useable as mission demands)
C/L: >200
WW: 2500#
Cost: $5,670

Comments:
(1) Added 120vdc-24vdc converters to eliminate 30V battery requirement
(2) Reduced weight
(3) Reduced power
(4) All power available as required

1991-present

Tanks: 2
Cells: (120) 190ah 2v cells (Douglas flat plate)
Cap: 380ah@120v (45.6kwh useable}
Volts: 120
C/L: >200
WW: 2900#
Cost: $7,169

Comments:

(1) KW tubular plate stopped production (EPA), Douglas 190ah flat plate closest fit
(2) 1991 design study of battery configuration alternatives (appendix A)
(3) Unsuccessful pressure tolerant controller effort to reduce weight for 3rd battery
(4) Increased weight
(5) reduced power
(6) instituted battery rotation program (4mo in service, not 6mo) to maintain capacity.
(7) large equipment growth (cameras, HMI's, Mesotech, video equipment)

1997-Future options

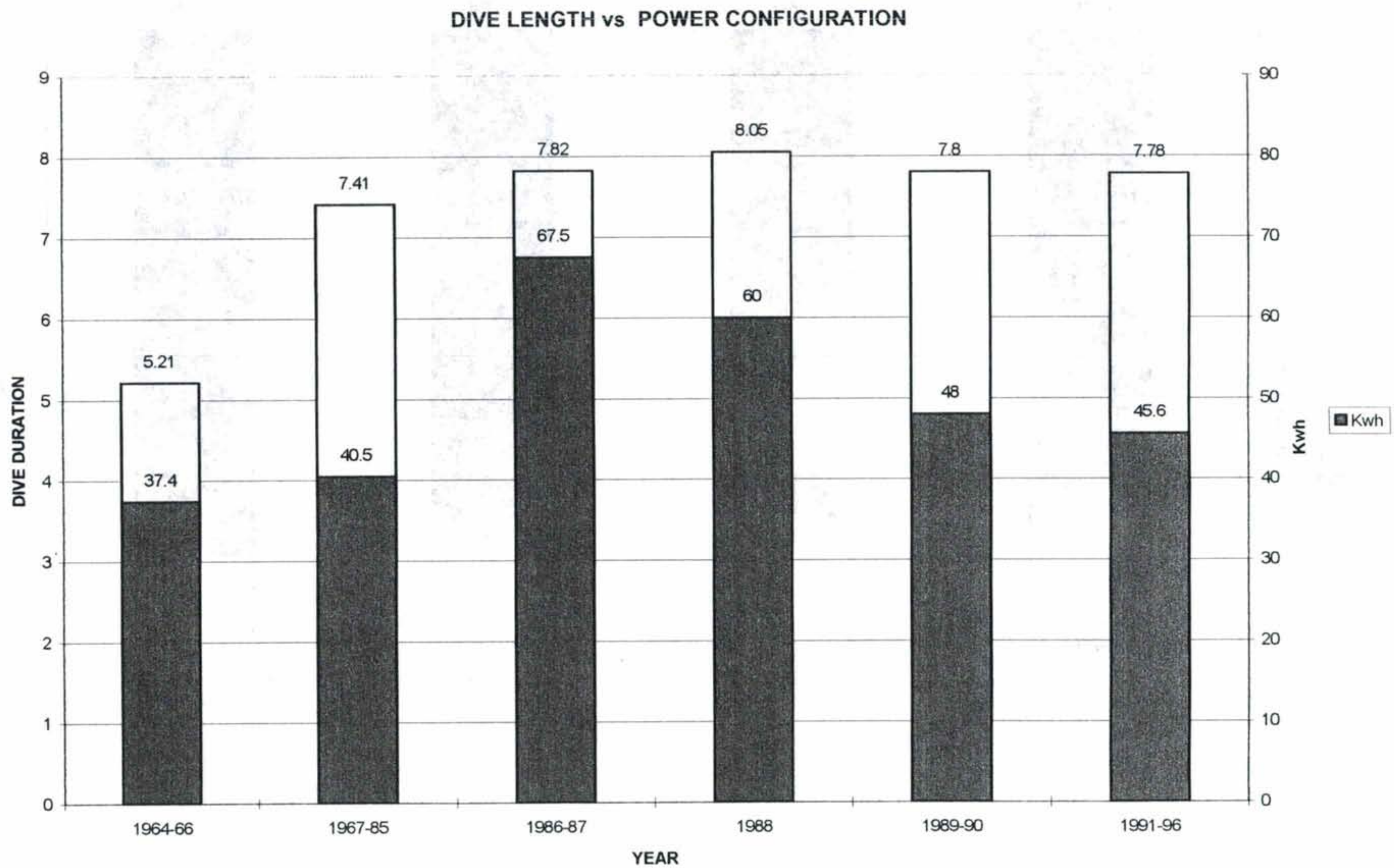
	Trojan Pb	Cl Can. Pb	Saft NiCd	Ovonic NiMH
Tanks:	2	2	2	3
Cells:	(120) 2v	(120)2v	(200)1.2v	(60)12v
AH/cell	260	180	208	90
Cap:	62.4kwh	43.2kwh	49.9kwh	64.8kwh
Volts:	120	120	120	120
C/L:	>1000	>1000	>1000	>600
WW:	2600	1950	2000	1400
Cost:	$9,168	$11,213	$140,000	$42,000
Risk:	low	low	high	very high

Appendix B

1991 BATTERY EVALUATION

w/wo PTC	Vendor	# Tanks	Model	AH	Water Wt.	Total AH
wo	CI Canada	2	3ET205	190	1800	380
wo	CI Canada	3	3ET205	190	2700	570
wo	CI Canada	3	XILF7	180	2900	540
wo	GNB	2	65C-7	195	2665	390
w	GNB	3	55C-7	165	3440	495
wo	Douglas	2	65-7	195	2650	390
wo	Exide	2	E75-7	225	2845	450
wo	Exide	3	E55-7	165	2900	495
wo	KW	2	50T-200	200	2495	400

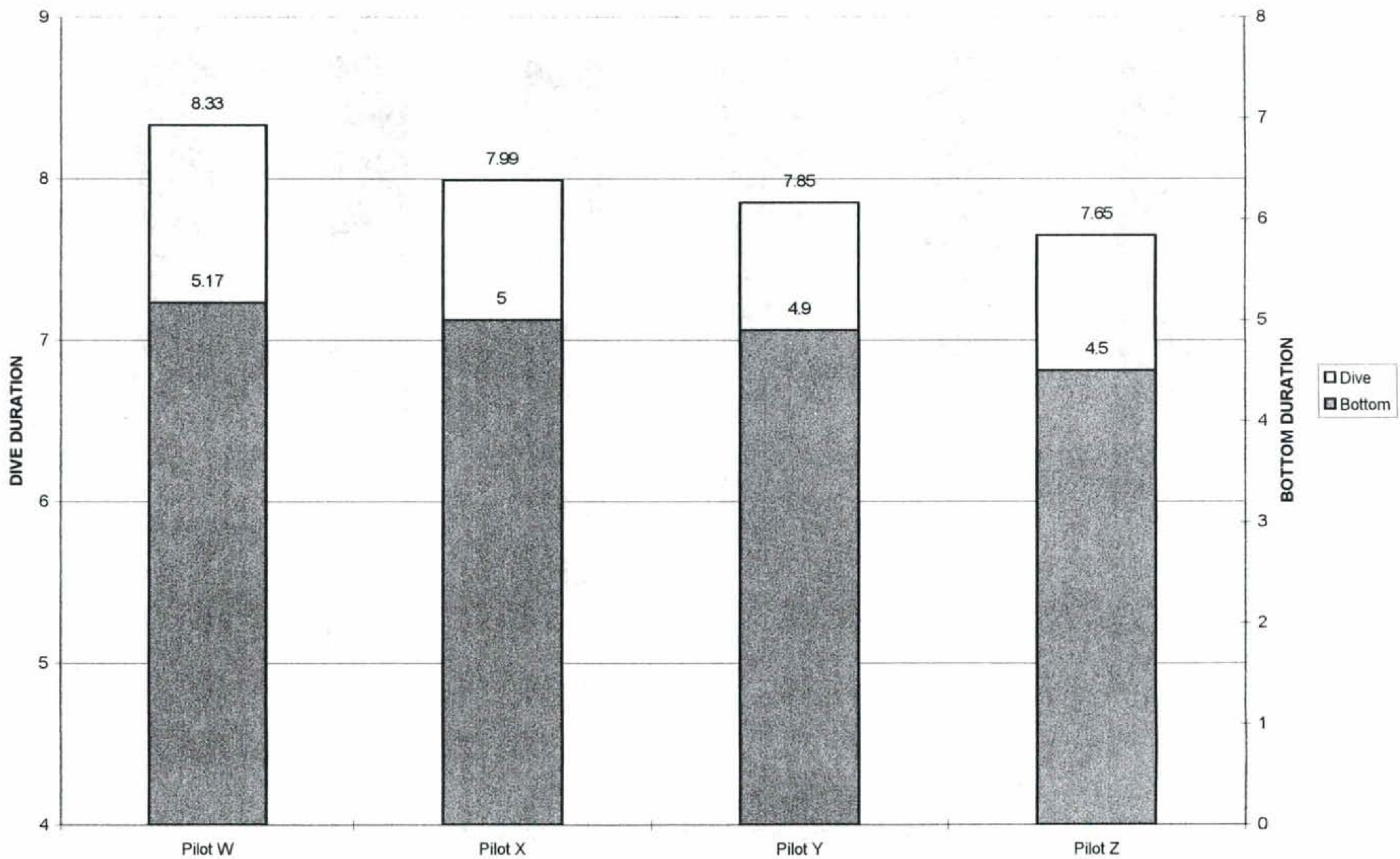
Appendix C



DIVE LENGTH vs POWER CONFIGURATION
DIVE DURATION
Kwh
Kwh
YEAR
1964-66
1967-85
1986-87
1988
1989-90
1991-96
5.21
7.41
7.82
8.05
7.8
7.78
37.4
40.5
67.5
60
48
45.6
0
1
2
3
4
5
6
7
8
9
10
20
30
40
50
60
70
80
90

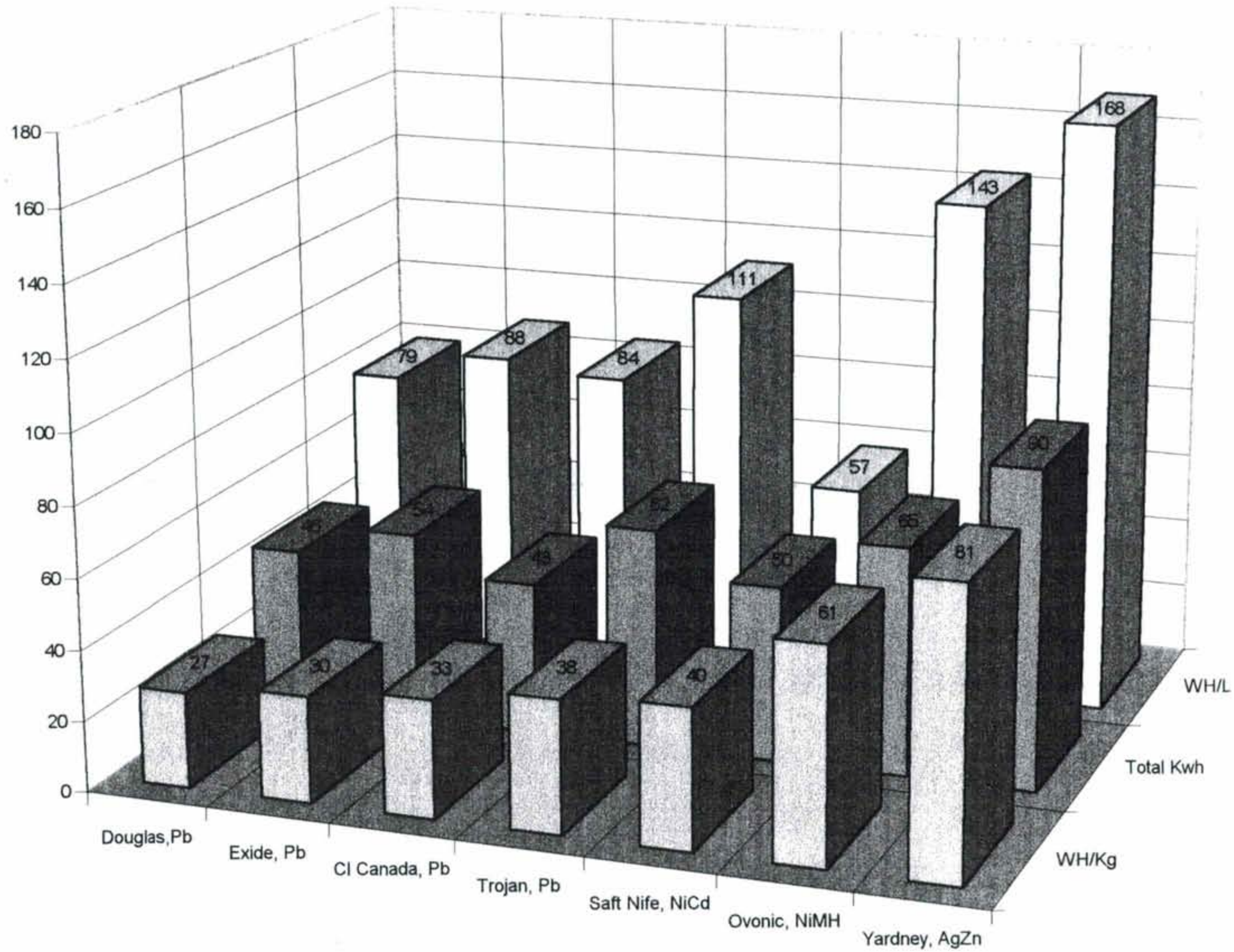
Appendix D

PILOT VARIABILITY



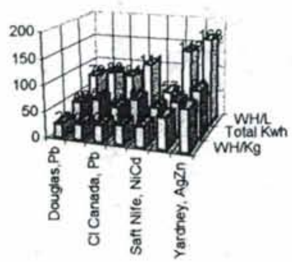
Appendix E

CELL COMPARISONS



Manuf	Model	WH/Kg	Total Kwh	WH/L	Volts	AmpHr	Pounds	Kg	Length	Width	Height	Liters	$/cell	$/AH	$/WH	# required	$/set+1
Douglas,Pb	65-7	27	46	79	2.0	190	31.00	14.06	2.75	6.19	17.25	4.81	60	0.32	0.16	180	10800
Exide, Pb	E75L-7	30	54	88	2.0	225	33.00	14.97	2.75	6.19	18.42	5.14	175	0.78	0.39	180	31500
CI Canada, Pb	XILF7	33	43	84	2.0	180	23.80	10.80	2.42	6.22	17.3	4.27	93	0.52	0.26	180	16740
Trojan, Pb	CEB-269	38	62	111	2.0	260	30.50	13.83	2.75	6.19	16.75	4.67	76	0.29	0.15	180	13680
Saft Nife, NiCd	SEH 200	40	50	57	1.2	208	13.89	6.30	3.07	6.54	13.23	4.35	700	3.37	2.80	300	210000
Ovonic, NiMH	Production90	61	65	143	12.0	90	39.24	17.80	4.02	7.05	16.22	7.53	700	7.78	0.65	80	56000
Yardney, AgZn	LR750DS-5	81	90	168	1.5	750	30.80	13.97	3.78	5.52	19.53	6.68	2100	2.80	1.87	160	336000

Appendix E



APPENDIX V

DSOG Unmanned Vehicle Status

Jason/Medea

- Addition of Auxiliary Hydraulic System - completed
- Installation of Benthos DSC - underway
- Documentation/Training - underway
- Revision of Manipulator Gripper - underway
- Revise design of lower payload Skid/Basket - complete
- Test HiDef Video - underway
- Install Zoom Color Video Camera - underway
-

Argo II

- Improved Obstacle Avoidance Forward Looking Sonar - complete, not tested
- Thrusters for Heading Control - complete
- Resolve Noise on LBL Transducer - complete
- Install Benthos DSC - complete
- Test HiDef Video - underway
- Documentation/Training - underway

DSL 120

- Replace Depressor - complete
- Refine Low Speed Tow Dynamics - underway
- Addition of Auxiliary Data Channels - complete
- Determine suitable Upgrade Path for Surface Processing - proposal pending
- Documentation/Training - underway
- Addition of audio uplink for LBL Nav. - complete

Jason Manipulator Test Program

Objectives/Status

- Improve reliability
  conducted approx. 150 hours of operations during
  pressure tests and dock trials

- Test at maximum rated pressure
  Tested to 6,800 meters

- Develop techniques for handling and triggering "double major" hydrothermal vent fluid samplers
  installed auxiliary hydraulic system and
  associated triggering mechanism

- Design and test new elevator system
  Mid water design/docking transfer

- Redesign gripper
  Improve gripping force and address pressure related failure

- Improve spares and documentation

- Demonstrate ability to work with temperature probes and "bio. boxes"
  Underway

DSOG Navigation Upgrade Status

- Three copies of Winphrog software and associated hardware purchased

- Initial interface to Benthos 455 ASP completed

- Field trials during Alvin engineering dives:
    1. Winphrog functioned in parallel to ACNAV
    2. In hull test completed

- Interface to ROV system underway and will be tested during upcoming field programs

- Presently determining suitable upgrade path for Alvin in hull system

- Preparing phase two proposal to address Alvin in hull system and advanced capabilities (ie. doppler/USBL, replacement of portable LBL system for ROVs)

APPENDIX VI

ROV Letters of Interest - Summary 1997 and Beyond

		1997 Prop.	1997 Funded	1998 + Prop.	1998 + Funded
ATLANTIC					
3	Sempere	37			
4	Smith	24			
6	Fornari	8			
9	Smith (use of UK TOBI Veh.)	33			
	Total	**102**	**0**	**0**	**0**

		1997 Prop.	1997 Funded	1998 + Prop.	1998 + Funded
MEDITERRANEAN					
12	Ballard, Yoerger/, indell	21	0		
	Total	**21**	**0**	**0**	**0**

		1997 Prop.	1997 Funded	1998 + Prop.	1998 + Funded
JUAN DE FUCA					
13	Becker		6		6
14	Chadwick	4		9	
15	Delaney	33		27	
17	Lilley/Mottl	21			
	Total	**58**	**6**	**36**	**6**

		1997 Prop.	1997 Funded	1998 + Prop.	1998 + Funded
PRINCE WILLIAM SOUND					
20	Cowan (ROV Not identfied)	28			
	Total	**28**	**0**	**0**	**0**

		1997 Prop.	1997 Funded	1998 + Prop.	1998 + Funded
NORTH EAST PACIFIC RISE					
26	Carbotte, Ryan, Fornari	32			
27	Lutz		23		46
	Total	**32**	**23**	**0**	**46**

		1997 Prop.	1997 Funded	1998 + Prop.	1998 + Funded
EQUATORIAL PACIFIC					
33	Karson, Klein, Hurst, et al	15			
34	Detrick (Canadian ROBOS)	16			
	Total	**31**	**0**	**0**	**0**

		1997 Prop.	1997 Funded	1998 + Prop.	1998 + Funded
SOUTH EAST PACIFIC RISE					
36	Hey/Baker/Lupton	29			
41	Sinton	2.5			
	Total	**32**	**0**	**0**	**0**

		1997 Prop.	1997 Funded	1998 + Prop.	1998 + Funded
Hawaii					
43	Chave, Butler, et al				10
44	J.R. Smith	7			
45	Smith, Long, Parfitt, Gregg	26			
	Total	**33**	**0**	**0**	**10**

		1997 Prop.	1997 Funded	1998 + Prop.	1998 + Funded
WESTERN PACIFIC					
50	Fryer		27		
	Total	**0**	**27**	**0**	**0**

		1997 Prop.	1997 Funded	1998 + Prop.	1998 + Funded
INDIAN OCEAN					
51	Dick (Canadian ROBOS)	22			
	Total	**22**	**0**	**0**	**0**

SUMMARY	1997 Prop.	1997 Funded	1998 + Prop.	1998 + Funded
Total	**359**	**56**	**36**	**62**

ALVIN Letters of Interest - Summary 1997 and Beyond

		1997 Prop.	1997 Funded	1998 + Prop.	1998 + Funded
ATLANTIC					
1	Calder			2	
2A	Chave, Van Dover,Tyson		6		
22ALT	Lutz, Delaney, Humphris			12	
5	Rona, Kleinrock, Tivey	10			
6	Fornari	4			
7	Johnson, Tivey, Honnorez	21			
8	Vrijenhoek, Lutz	14			
10	Becker				2
52	Martin		12		
	Total	**49**	**18**	**14**	**2**

		1997 Prop.	1997 Funded	1998 + Prop.	1998 + Funded
ROMANCHE TRENCH					
11	Bonarti	16			
	Total	**16**	**0**	**0**	**0**

		1997 Prop.	1997 Funded	1998 + Prop.	1998 + Funded
JUAN DE FUCA					
2B	Chave, Van Dover,Tyson		6		6
13	Becker, Davis, Pettigrew		8		8
16	Karsten	10			
18	Tivey, Bradley	5			
19	Seyfreid, Tivey	3		3	
	Total	**18**	**14**	**3**	**14**

		1997 Prop.	1997 Funded	1998 + Prop.	1998 + Funded
S. CAL/SAN DIEGO TROUGH					
21	Smith, DeMaster		3		
	Total	**0**	**3**	**0**	**0**

		1997 Prop.	1997 Funded	1998 + Prop.	1998 + Funded
NORTH EAST PACIFIC RISE					
22	Lutz,Delaney, Humphris			12	
23	Mullineaux, Peterson, Fisher	14		10	
24	Manahan, Mullineaux, Young	10		20	
25	Mann, Manahan, Mullineau, Yo	28		63	
28	Tolstoy, Orcutt, Fornari	8		4	
29	Childress	6		6	
30	Taylor, Wirsen	5			
31	Felbeck,Childress, Fisher, Lutz	10			
32	Cary, Epifanio, Dittel	4		8	
	Total	**85**	**0**	**123**	**0**

		1997 Prop.	1997 Funded	1998 + Prop.	1998 + Funded
EQUATORIAL PACIFIC					
33	Karson, Klein, Hurst, Gillis, Ma	15			
	Total	**15**	**0**	**0**	**0**

		1997 Prop.	1997 Funded	1998 + Prop.	1998 + Funded
SOUTH EAST PACIFIC RISE					
2B ALT	Chave, Van Dover, Tyson				4
32 ALT	Cary, Epifanio, Dittel	4		8	
35	Edmond			30	
37	Lilley, VonDamm		27		
38	Lupton	25			
39	Lutz,Vrijenhoek			14	
40	Mullineaux, France			8	
41	Sinton	21			
42	Childress			6	
	Total	**50**	**27**	**66**	**4**

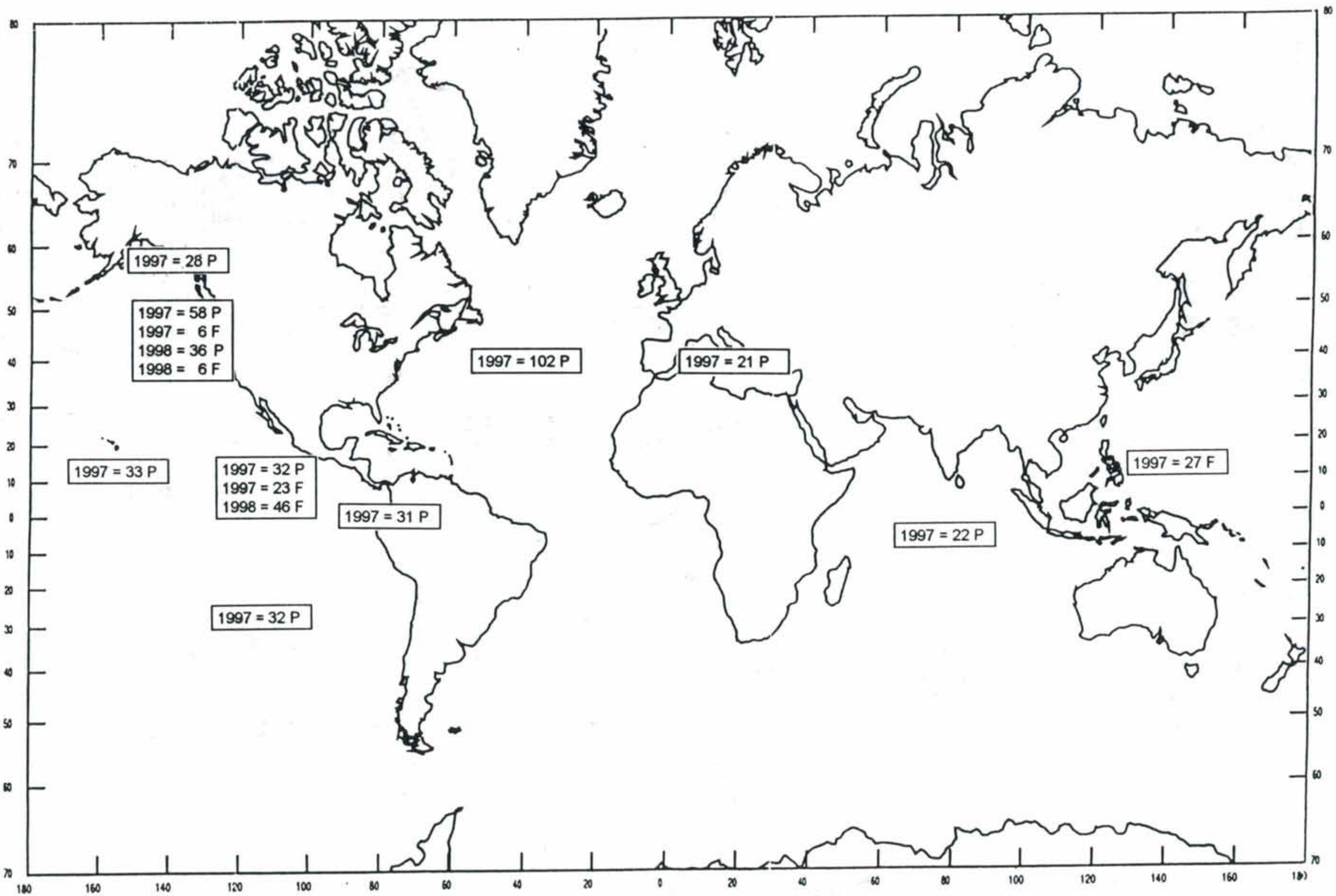
ALVIN Letters of Interest - Summary 1997 and Beyond (Cont'd.)

		1997 Prop.	1997 Funded	1998 + Prop.	1998 + Funded
HAWAII					
46	Garcia, Rhodes, Kurz	10			
	Total	**10**	**0**	**0**	**0**

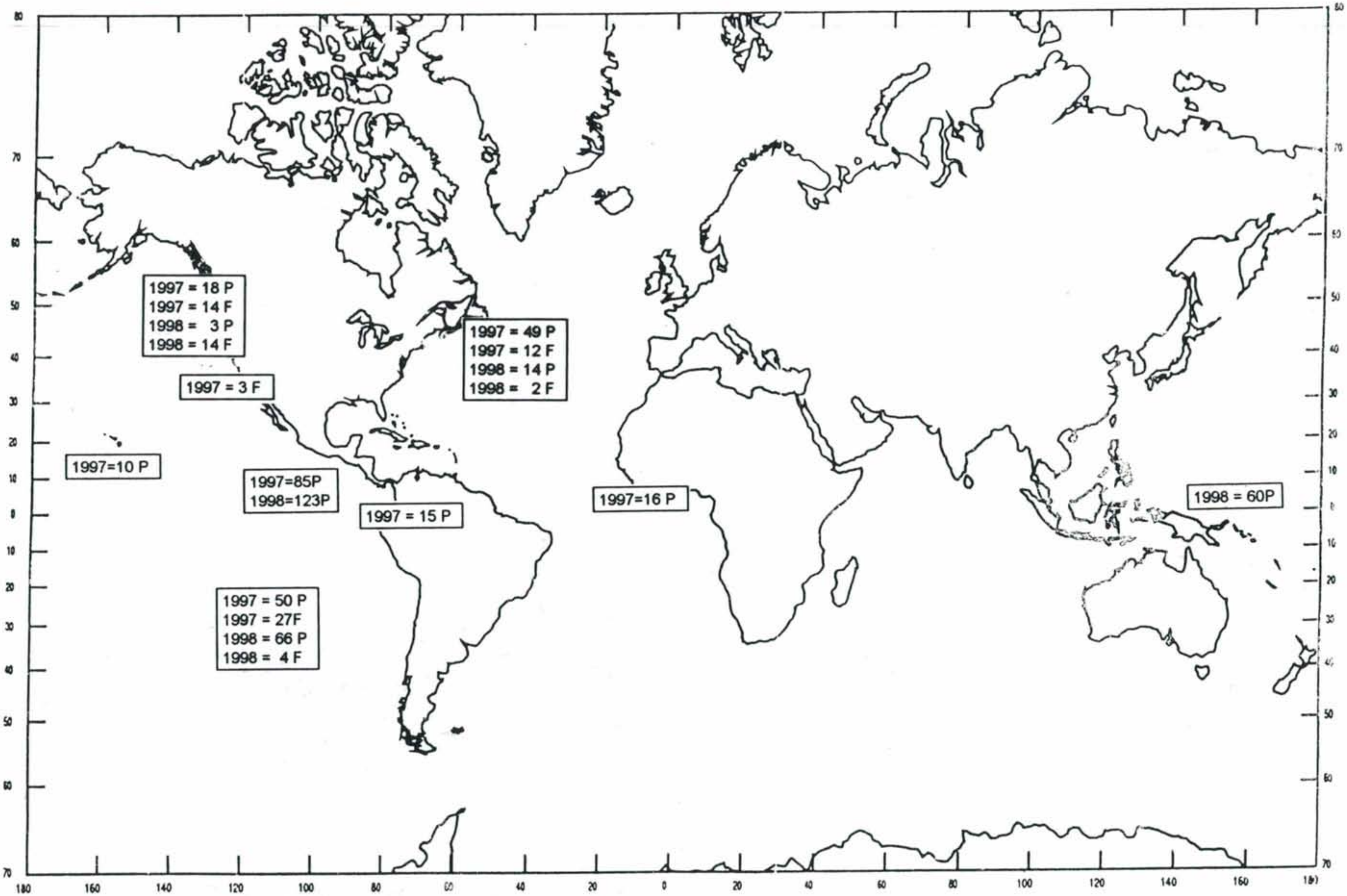
		1997 Prop.	1997 Funded	1998 + Prop.	1998 + Funded
WESTERN PACIFIC					
47	Perfit et al.			20	
48	Stern			20	
49	Stern, Cleft			20	
	Total	**0**	**0**	**60**	**0**

SUMMARY	1997 Prop.	1997 Funded	1998 + Prop.	1998 + Funded
	243	**62**	**266**	**20**

ROV AREAS OF INTEREST - 1997 AND BEYOND



ALVIN AREAS OF INTEREST - 1997 AND BEYOND



ALVIN/ROV Letters of Interest - Summary 1997 - 1999

#	Source	Investigator	Area	Title	Sponsor	Date	Alternate	Dives	Platform/Remarks	Disc.
ATLANTIC:										
1	reconfirm	D. Calder, ROM	Bermuda Pedestal 32 35'N, 64 55' W	Bathymetric zonation of hydroids, from shallow-waters to deep-sea, at Bermuda	Canada Sub 10/15/95	Jul-Aug 1997/8		2	ALVIN	Biol.
2A (move to NEPR)	831 7/21/95	A. Chave, WHOI C. Van Dover, U.Alask J. A. Tyson, AT&T	MAR TAG/Snakepit hydrothermal areas	ALISS: Ambient light Imaging and Spectral System	NSF FUNDED OCE 9407774	Oct-Nov 1997	Jan-Feb 1998	6	ALVIN	Biol.
3	831 8/8/95	J.-C. Sempere, UW	MAR, 29 N	Fine-scale segmentation and structural variability within a slow-spreading segment	NSF RIDGE	1997		37	DSL-120 AGOR II	G&G
4	831 8/11/95	D. K. Smith, WHOI S. Humphris, WHOI W. Bryan, Whoi M. Tivey, WHOI	25 35'N, 45 05'W, 24 50'N, 45 30' W, 25 55 N, 45 05'W, 25 15 N, 45 25 W	Linking Morphology, Petrology and Geochemistry to understand crustal construction at the Mid-Atlantic Ridge	NSF RIDGE	Feb - Jul 1997		24	AMS 120 & ARGO II	G&G
22 Alt	No 831	R. Lutz, Rutgers J. Delaney, UW S. Humphris, WHOI	TAG - MAR or 9-10 NEPR	Research and Educational Opportunities Associated with Production of an IMAX documentary on Deep-Sea Hydrothermal Vents	NSF Sub 11/95	Feb-Jun 1998		12	ALVIN	Biol
5	831 5/14/96	P. Rona, Rutgers Kleinrock, Vanderbilt M.A. Tivey, WHOI	TAG 26N, 45 W	TAG Relict Hydrothermal Zones: Role in Evolution of the TAG field	NSF sub 2/15/96	1997		10	ALVIN	G&G
6	831 2/14/96 NEW	D.J. Fornari, WHOI	32 N, 64 30'W 36-38 N, 30-31 W	Science Testing of UNOLS Integrated Deep Science on R/V ATLANTIS: Sequential use of vehicle systems for data acquisition	NSF	Jun 1997	JUL 1997	4 5 days 3 days	ALVIN, MEDEA-JASON 120 kHz Sonar	other
7	831 2/8/96 NEW	H.P. Johnson, U Wash M Tivey, WHOI J Honnorez, Strasbourg	10-12 N, 43 W	A geophysical study of a vertical section of ocean crust: the southern transverse ridge of the Vema Fracture Zone	NSF			21	ALVIN	G&G
8	NEW No 831	R.C. Vrijenhoek, Rutge R.A. Lutz, Rutgers	14 46'N 37 36'W	Gene Flow and Species Diversity in Deep-Sea Hydrothermal Vent Communities	NSF	1997	1998	14 Dives	ALVIN	Biol.
9	831 2/12/96 NEW	D.K. Smith, WHOI S. Humphris, WHOI M. Tivey, Whoi L. Parson, SOC W. Bryan, WHOI	MAR 35 N	Geological and Geophysical Investigation of Two Constrating Segments at the Mid-Atlantic Ridge, 35 Degrees N	NSF	Feb-Jul 97		33 Days	UK Tobi Vehicle	G&G
10	NEW MSG 1/22/96	K. Becker, RSMAS	MAR	Instrumented Borehole 395A Seals	NSF FUNDED	1998	1999	2	ALVIN	Other
52	831 10/20/94	W. Martin, WHOI	NW Atlantic	Benthic Fluxes and Sediment Irrigation on the Continental Margin, NW Atlantic	NSF FUNDED	Jul-97	Jun, Aug 97	12	ALVIN	Chem.

ALVIN/ROV Letters of Interest - Summary 1997 - 1999

#	Source	Investigator	Area	Title	Sponsor	Date	Alternate	Dives	Platform/Remarks	Disc.
ROMANCHE TRENCH										
11	831 8/30/95 NEW	E. Bonarti	Start 1N 15 W End 0 30'S 17 30"	A Submersible Study of Exposed Mantle Mesozoic Crust and Drowned Reefs of the Eastern Romanche RTI	NSF	1996	1997	16 Days	ALVIN	G&G
MEDITERRANEAN										
12	No 831	R.D. Ballard, Inst. for E D. Yoerger, WHOI D. Mindell, MIT	Straits of Sicily north of Skerki Bank	Exploration of the Straits of Sicily	ONR	Jun/Jul 1997		21	MEDEA-JASON	Other
JUAN DE FUCA										
28	831 7/21/95	A. Chave, WHOI C. Van Dover, U.Alask J. A. Tyson, AT&T	Juan De Fuca Ridge	ALISS: Ambient light Imaging and Spectral System	NSF FUNDED OCE 9407774	Jun-Jul 1998	Jul-Aug 1998	6	ALVIN	Biol.
13	831 8/15/95	K. Becker, UM E. Davis, PGC T. Pettigrew, ODP	JDF Ridge - ODP 48 n, 129 W	Instrumented borehole seals for 1996 ODP drilling on the Juan de Fuca Ridge.	NSF ODP FUNDED	1) Sum 97 2) Sum 98		1) 8 Days 2) 8 Days	1) JASON 2) ALVIN	G&G
14	831 5/21/95	W. Chadwick, OSU	JDF Ridge, Cleft Segment	Acoustic Extensometer: A seafloor Observatory Experiment	NSF RIDGE sub 8/15/95	1) Sum 1996 2) Sum 1997 3) Sum 1998 4) Sum 1999 5) Sum 2000		1) 12 2) 4 3) 3 3) 3 3) 3	MEDEA-JASON (Could be added on to P. Johnson 1996 Cruise)	G&G
15	831 3/1/96	J.R. Delaney, UW	ROBE sites 44 N 130 W 44 N 129 W	Spatial Control for Temporal Variability Studies: 3-D Multiscalar Mapping of seafloor features and Water Column Plumes within the RIDGE observatory (ROBE) sites.	NSF	ul 15-Aug 1 1997 1998	Jul 15-Sep 15 1997 1998	 33 27	JASON, DSL 120	G&G
16	831 2/20/96	J. Karsten, UH J. Head, Brown et al	Endeavor Seg. JDF 48 N, 129 W	Submersible and petrologic study of the recent magmatic history of the Endeavour Segment, Juan de Fuca Ridge: Establishing a time-series of ridge axis volcanism.	NSF Sub 2/15/96	Summer 1997		10	ALVIN	G&G
17	831 3/19/95	M.D. Lilley, UW M. Mottl, UH et al.	1) JDF, 48 N Middle Valley) Escanaba Trough Gorda Ridge, 41 N	Temporal variations in sedimented-ridge hydrothermal systems at Middle Valley and Escanaba Trough: an ROV study	NSF - MGG proposal ODP	late spring early sum '96 and Summer 97		1996 1) 14 2) 7 1997 1) 14 2) 7	JASON	G&G
18	831 2/14/95	M.A. Tivey, WHOI A. Bradley, WHOI	Juan de Fuca: 48N, 129W	Development of Flow Sensors for Active High and Low Temperature Seafloor Vents	NSF RIDGE	Jun-Sep 1997		5	ALVIN any active site would be acceptable if ALVIN	G&G
19	NEW No 831	W.E. Seyfreid, U of Mi M.K. Tivey, WHOI	Endeavour Main Field 47 58'N 129W	In-situ Measurement and Monitoring of Disolve H2, H2S, and pH in Mid-Ocean Ridge Hydrothermal Fluids	NSF	1997 1998		3 Dives 3 Dives	ALVIN ALVIN	G&G

ALVIN/ROV Letters of Interest - Summary 1997 - 1999

#	Source	Investigator	Area	Title	Sponsor	Date	Alternate	Dives	Platform/Remarks	Disc.
PRINCE WILLIAM SOUND										
20	831. 8/3/95 NEW	E. Cowan, Applachian R. Powell, No. Ill Univ	rince William Soun 60 15'N 147 44" 59 58' N 139 35'	Collaborative Research: Sedimentary Forcing of Temperata Marine Glacier Behavior During Climate Change	NSF	May 15-30 97 Jul 15-30 97	 Aug 1-15 97	14 Days 14 Days	Some ROV-not identified	G&G
SOUTHERN CALIFORNIA/SAN DIEGO TROUGH/MONTEREY CANYON										
21	No 831	C. R. Smith, U.H. D. DeMaster, NCSU	S. California 32d 12'N, 118d 30' W	Age dependent bioturbation of deep-sea sediments: tests at three bathyal sites.	NSF FUNDED OCE 9022116	Jul-Dec 1997	Jan - Mar 1998	4	ALVIN (MEDEA-JASON if ALVIN not available)	Biol
NORTH EAST PACIFIC RISE										
22	No 831	R. Lutz, Rutgers J. Delaney, UW S. Humphris, WHOI	9-10 NEPR or D168TAG - MAR	Research and Educational Opportunities Associated with Production of an IMAX documentary on Deep-Sea Hydrothermal Vents	NSF Sub 11/95	Feb-Jun 1998		12	ALVIN	Biol
23	831 2/9/96 Reconfirm 5/20/96	L. Mullineaux, WHOI C.H. Peterson, UNC C.R. Fisher, Penn S	9-10 N, EPR	Role of Larve Settlement, Species Interactions and Physiological Adaptations in colonization and Community Development of Hydrothermal Vents	NSF sub 2/96	Oct-97 Oct-98		14 10	ALVIN	Biol
24	831 2/15/95	D. Manahan, USCal L. Mullineaux, WHOI C. Young, HBOI	9-10 N, EPR	Dispersal Potential Hydrothermal Vent Animals: Larval Energetics, Depth regulation and Field Distribution	NSF RIDGE Sub 2/96	1) late 1997 2) 1998 3) 1999		1) 10 2) 10 3) 10	ALVIN	Biol.
25	831 2/14/96 NEW	R. Mann, VIMS D. Manahan, USC L. Millineau, WHOI C. Young, WHOI S.C. Cary, U Del	9-10 N, EPR	Quantitative studies of temporal and spatial variability in reproduction of communities associated with hydrothermal vents	NSF	1) Oct 97 2) Mar 98 3) Oct 98 4) Oct 99		28 21 21 21	ALVIN	Biol.
26	831 2/19/96 NEW	S. Carbotte, LDEO W.B.F. Ryan, LDEO D. Fornari, WHOI	9 30'N 104 30'W	Collaborative research: Exploiting high resolution Digital elevation models and imagary to study deformation and volcanic processes at a fast spreading ridge	NSF	Oct-Dec 97	Jan-May 98	32 Days	dsg-120kHz sonar	G&G
27	NEW No 831	R.A. Lutz, Rutger	9 50'N EPR	Temporal Chasnges in Biological Community Structure and Associated Geologoical Features at Newly-Formed Hydrothermal Vents on the EPR	NSF FUNDED	1) 1997 2) 1998 3(1999		23 23 23	JASON/MEDIA	Biol
28	831 2/19/96 NEW	M. Tolstoy, SIO J. Orcutt, SIO D.Fornari, WHOI	9 51' N 104 17' W	An experiment ot measureground ddrformation at a fast fpreading Mid-Oceanridge	NSF RIDGE	1)Oct-Dec97 2)Oct-Dec98	Jan-May 98 Jan-May 99	8 Dives 4 Dives	ALVIN ALVIN	G&G G&G
29	NEW No 831	JJ. Childress UCSB	9 & 13 N EPR	Studies on the Ecological Physiology of Hydrothermal Vent chemoautrotrophic	NSF RIDGE	1997 1998		6 Dives 6 Dives	ALVIN ALVIN	 Ecog.

ALVIN/ROV Letters of Interest - Summary 1997 - 1999

#	Source	Investigator	Area	Title	Sponsor	Date	Alternate	Dives	Platform/Remarks	Disc.
30	831 12/19/95 NEW	C. D. Taylor, WHOI C.O. Wirsen, WHOI	9 51'N 104 17.5" NEPR	Microbiology and Ecology of filamentous sulphur formations	NSF RIDGE	?	?	5 Dives	ALVIN	Biol.
31	831 2/9/95 NEW	H. Felbeck, SIO Childress, UCSB Fisher, Penn State Lutz, Rutgers	N EPR	Metabolic Charactertyization of a Symbiotic System, the Hydrothermal Vent Tubeworm Riftia Pachyptlle	NSF	1997		10 Dives	ALVIN	Biol
32	831. 2/14/96 NEW	S. Cary, U Del C. Epifanio, U Del S. Dittel, U Del	9 50'N 104 17'W	Reproduction, DIspersal, and Recruitment of Hydrothern\mal Vent Crabs: a Tractable System	NSF	Nov-97 May-98 Nov-98	Oct-97 Jun-98 Oct-98	4 4 4	ALVIN ALVIN ALVIN	Bio
EQUATORIAL PACIFIC										
33	831 2/21/96 NEW	J.A. Karson, Duke E. Klein, Duke S. Hurst, Duke K. Gillis, U Vic. (Canada) C. Macleod, IOS (UK) J-L. Cheminee, U Vic (Canada)	Hess Deep 2 22' N, 101 17W	Jason/Media and ALVIN Investigation of the Uppermost Oceanic Crust of Hess Deep	NSF	May-97	Jun-97	15 15	ALVIN Jason/Media	G&G
34	831. 8/6/95 NEW	R. Detrick, WHOI M. Tivey, WHOI G. Christenson, UTIG M. Sen, UTIG K. Gillis, U of Victoria	Hess Deep 2 20'N 101 30'W	Orgin of the Seismic Layer 2A/2B Boundry: Correlation of Geophysical Structure and Outcrop Geology in the Walls of Hess Deep	NSF	Feb-97	Jan-May 97	16 Days	Candian Robos System	G&G
SOUTHERN EAST PACIFIC RISE:										
28 ALT	831 7/28/95	A. Chave, WHOI C. Van Dover, U.Alaska J. A. Tyson, AT&T	SEPR - 17 S	ALISS: Ambient light Imaging and Spectral System (This is alternative to Item 2B)	NSF FUNDED OCE 9407774	Jan-Feb 1998	Mar-Apr 1998	4	ALVIN - Alternate for 9 N EPR site	Biol.
35	on file	J.M. Edmond, MIT	Southern EPR Easter Island and vicinity	Hydrothermal Studies on the Easter Microplate.	NSF 9312950	Austral Summer 1997/8		30	ALVIN	Chem
36	No 831	R. Hey, UH E. Baker, PMEL, NOAA J. Lupton, PMEL	S. EPR between Easter $ Juan rnandex microplate 28-32 S, 112-113 W	Hydrothermal and structural investigations along the fastest spreading center: The 28-32 S EPR reorganizing plate boundary.	NSF FUNDED	southern summer 1996/1997		29	120 KhZ side-looking Sonar	G&G
37	831 5/10/94	M.D. Lilley, UW K.L. Von Damm, UNH L.E. Lupton, NOAA	17 S, 113 W 21 30 S, 113 W	Gas and fluid chemistry of hydrothermal systems on a superfast spreading center: Southern East Pacific Rise	NSF RIDGE FUNDED	1997		27	ALVIN	Chem

ALVIN/ROV Letters of Interest - Summary 1997 - 1999

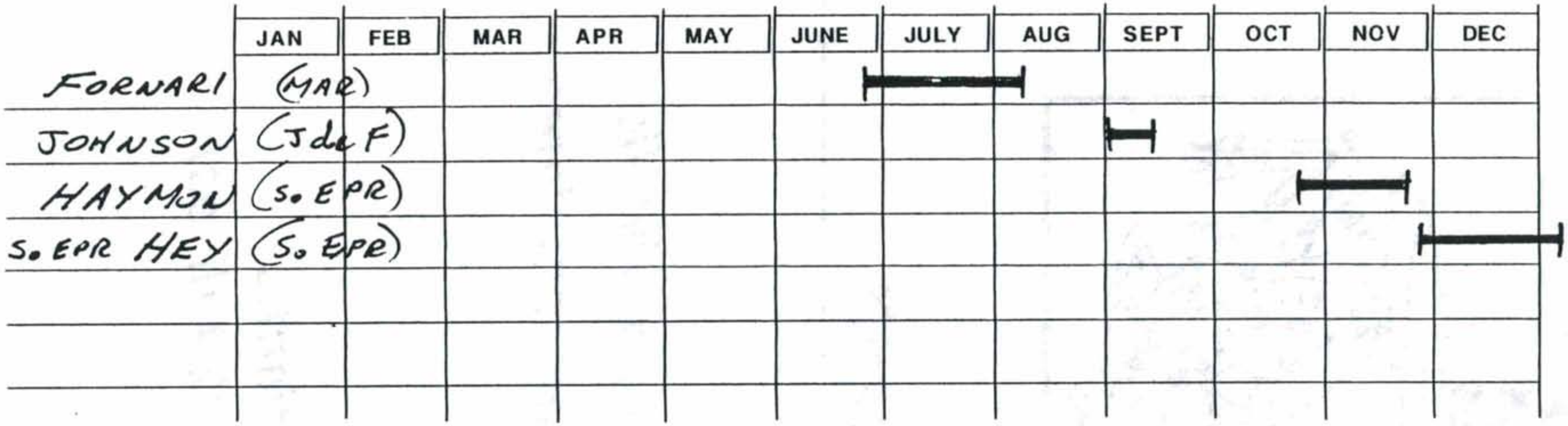
#	Source	Investigator	Area	Title	Sponsor	Date	Alternate	Dives	Platform/Remarks	Disc.
38	Letter 4/20/95	J. Lupton, NOAA	S. EPR 13.5 -20 S, 112-113	Investigation of hydrothermal systems This is in collaboration with the Japanese Ridge Flux Project.	NOAA NURP	Austral Summer 1997-1998		25	ALVIN	G&G
39	No 831	R. Lutz, Rutgers R. C. Vrijenhoek, Rutg	17 22 S EPR	Gene Flow, Dispersal, and Systematics of Deep-Sea Hydrothermal Vent Organisms	NSF FUNDED will submit renewal 2/96	1996, 1997, 1998		14	ALVIN (may be able to use JASON)	Biol
40	No 831	L. Mullineaux, WHOI S. France, UNH	Sala y Gomez Ridge 22 S - East of Easter Is.	Genetic diversity and gend flow among populations of deep-seamount invertebrates	NSF	1998		8	ALVIN	Biol
41	Upated No 831	J. Sinton, U of Hawaii	18 40'S 113 24' W 17 25'S 113 13"W SEPR	Volcanological investigation of a superfast spreading ridge	NSF	Oct-97	Early 1998	21 Dives 2.5 Days	ALVIN DSL 120	G&G
42	No 831 NEW	JJ. Childress UCSB	18 & 20 S SEPR	Studies on the Ecological Physiology of Hydrothermal Vent chemoautrotrophic	NSF RIDGE	1998		6 Dives	ALVIN	Ecog.
32ALT	831. 2/14/96 NEW	S. Cary, U Del C. Eoifanio, U Del S. Dittel, U Del	S EPR	Reproduction, Dispersal, and Recruitment of Hydrothern\mal Vent Crabs: a Tractable System	NSF	Nov-97 May-98 Nov-98	Oct-97 Jun-98 Oct-98	4 4 4	ALVIN ALVIN ALVIN	Bio
HAWAII										
43	831 2/10/95	A. Chave, WHOI R. Butler, IRIS Duennebeir, U Hawaii D. Yoerger, WHOI J Catiporic	awaii 2 Observator 28 N, 140 W	Hawaii 2 Observatory - install a junction box and sensor on a submarine cable between Hawaii and California	NSF ARI FUNDED	Sep-98	Aug-98	10	JASON	EGR
44	No 831	J.R .Smith, U of Hawai	Hawaii Hot spot 19 20N 155-157 W	High-resolution magneto-stratigraphic and U-series dating of giant submarine landslides and their correlation with explosive volcanism on the Hawaiian Hot Spot	NSF	Jan-Feb 97	Aug-Sep 97		ARGO II	G&G
45	831 2/12/96	D.K. Smith, U of Hawa L.Long, U of Hawaii E. Parfitt, U of Leeds (UK) T. Greeg, WHOI	Puna Ridge 19 50' N 154 10'W	Understanding Volancanic Processes at the Submarine Puna Ridge	NSF	97/98		18 Days 8 Days	DSL-120 AGRO-II	G&G
46	No 831 NEW	M. Garcia, U of Hawaii M. Rhodes, U of Mass M. Kurz, WHOI	Mauna Loa	Geology Evolution of Mauna Loa	NSF	Summer 199	Fall 1997	10 Dives	ALVIN	G&G

Funded? Ams 120 3 days

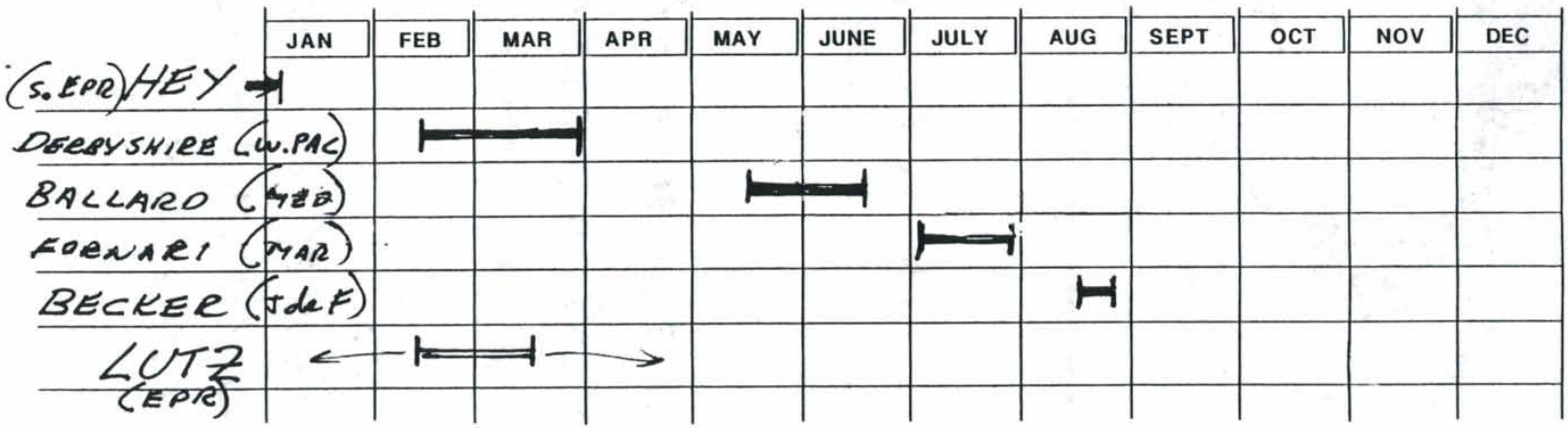
ALVIN/ROV Letters of Interest - Summary 1997 - 1999

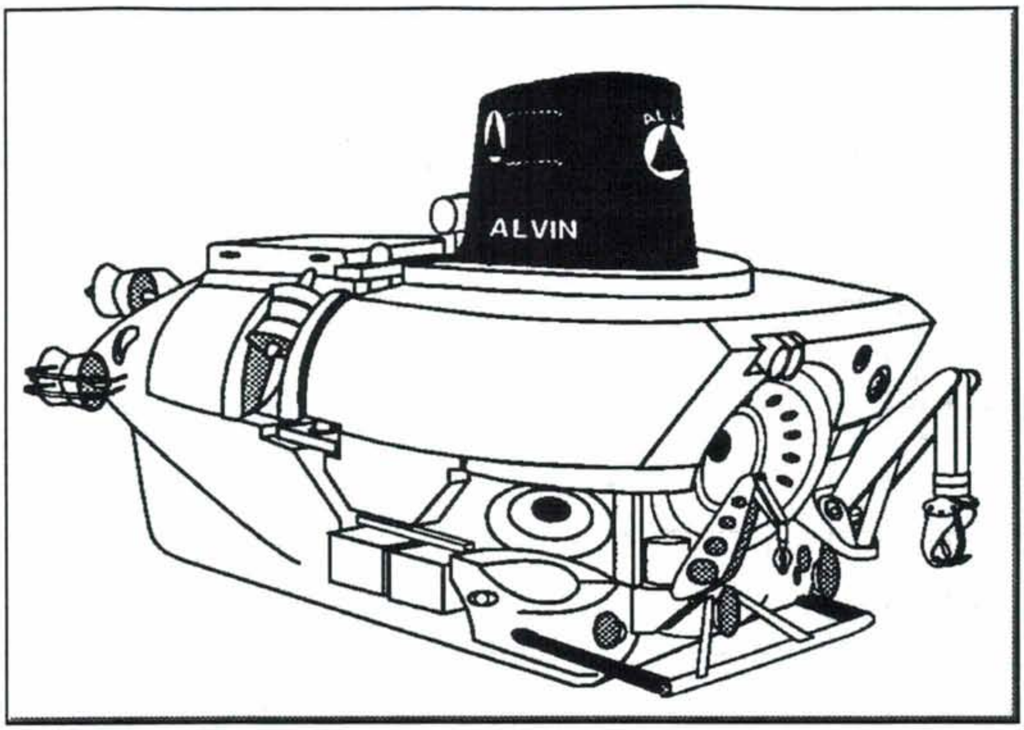
#	Source	Investigator	Area	Title	Sponsor	Date	Alternate	Dives	Platform/Remarks	Disc.
WESTERN PACIFIC										
47	831 2/15/95	M/R. Perfit, U. Fla K. Farley, Cal Tech B. McInnes, CSIRO D. Colodner, LDEO V. Tunnicliffe, U. Vic.	Solomon Is., Papua New Guinea S.W. Pacific	ALVIN Investigation of Hydrothermally Active Submarine Volcanoes in the New Ireland and Soloman Island Fore-arcs, S.W. Pacific	NSF (maybe ARC) ReSub 1996	Fall 1998	Early 1999	20	ALVIN (possibly MEDEA-JASON & 120 KhZ Sonar)	G&G
48	No 831	R.J. Stern	13 15'N, 144 30 E 16 N, 145 40 E	Submarine Volcanism in the Southern Seamount Province of the Mariana Arc	NSF sub 2/15/96	TBA 1998?		20	ALVIN	G&G
49	No 831	R.J. Stern P. Cleft, WHOI	Mariana Trough 24 N, 141 E 22 n, 142E 22N, 143 E	Volcanic and Tectonic Activity in the Northern Mariana Trough - ODP Site Survey	NSF sub 2/15/96	TBA 1998?		20	ALVIN, ROV one site avoid Typhoon season	G&G
50	No 831	P. Fryer,	Mariana Arc	Survey of Mariana Arc	NSF FUNDED	1997	1998	27 Days		G&G
INDIAN OCEAN										
51	831 2/21/96 NEW	H. Dick, WHOI J. Natland, RSMAS J. Hirth, WHOI J. Robinson, Dalhouse et al	32 40'S 57 E	The Plutonic Foundation of a Very Slow-Spreadong Ridge	NSF OPD	Jan-Feb 97	Prior Oct 97	22 Days	Canadian ROBOS	G&G

1996 — ROV — 1996



1997 — ROV — 1997





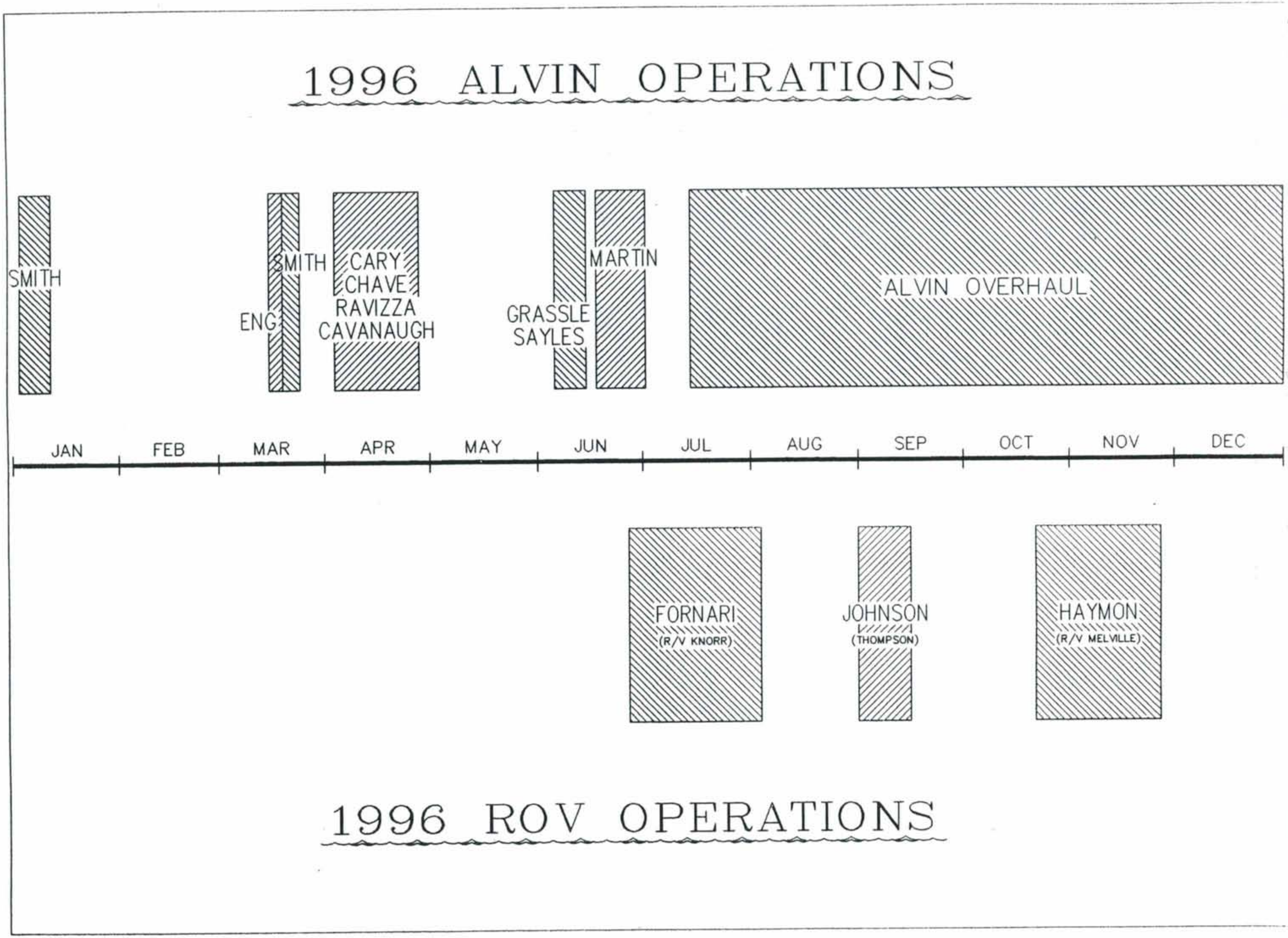
1996 Highlights

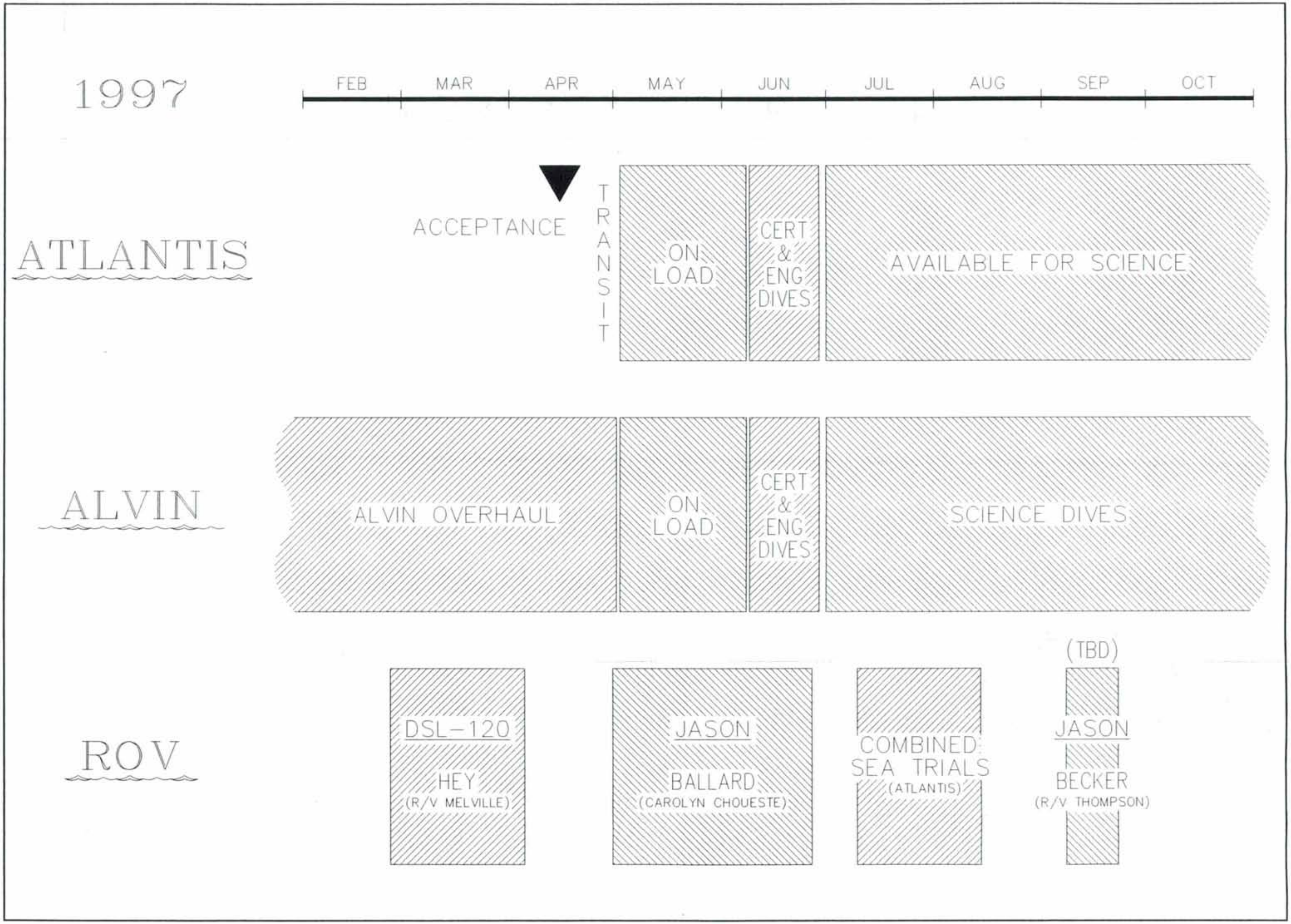
So Far:

- ✓ *4 cruises, January-April, in Pacific*
- ✓ *27 of 28 proposed dives completed*
- ✓ *4 engineering dives*

Coming Up:

- ✓ *2 cruises to the NW Atlantic Continental Margin (24 dives)*
- ✓ *Major overhaul*


1996 ALVIN OPERATIONS
SMITH
ENG
SMITH
CARY
CHAVE
RAVIZZA
CAVANAUGH
GRASSLE
SAYLES
MARTIN
ALVIN OVERHAUL
JAN
FEB
MAR
APR
MAY
JUN
JUL
AUG
SEP
OCT
NOV
DEC
FORNARI
(R/V KNORR)
JOHNSON
(THOMPSON)
HAYMON
(R/V MELVILLE)
1996 ROV OPERATIONS


1997
FEB
MAR
APR
MAY
JUN
JUL
AUG
SEP
OCT
ATLANTIS
ACCEPTANCE
TRANSIT
ON LOAD
CERT & ENG DIVES
AVAILABLE FOR SCIENCE
ALVIN
ALVIN OVERHAUL
ON LOAD
CERT & ENG DIVES
SCIENCE DIVES
ROV
DSL-120
HEY
(R/V MELVILLE)
JASON
BALLARD
(CAROLYN CHOUESTE)
COMBINED SEA TRIALS
(ATLANTIS)
(TBD)
JASON
BECKER
(R/V THOMPSON)

APPENDIX VII

US Deep Submergence Community Request for *Alvin* Upgrades
(prioritized by DESSC) 5/23/96

Priority Rank: 1 = highest

Rank	System	Proposed Action	Cost Estimate	Comments
1	VB/ Hydraulics	Purchase new VB pump.	2@ $10K	Replace one-of-a-kind pump. Failure of existing pump could result in lost dives.
1	Power	Upgrade battery system to increase bottom time.	?	Alvin engineers are continuing to research battery options. A new vendor of lead-acid batteries with advertised greater capacity has been identified and several cells are being tested at WHOI. Alvin Group is preparing a detailed assessment of power management and potential modifications for DESSC.
1	Power	Continue training sessions on power management during dives. Provide scientists with a shipboard orientation session on power consumption by various Alvin systems and suggestions on how to optimize bottom time.	N.C.	Initiate and continue efforts to maximize science time.
1	Navigation	Replace existing gyro	2@ $30K ea.	Purchase ring-laser gyro. This would replace the existing gyro, saving space and power. COst includes interface development.
1.5	Payload	Increase the general payload.		Alvin Group is working toward this with modifications in Motor Controller Cans (miniaturization of electronics to eliminate one or more cans) and improvements of VB system monitoring. Additional syntactic foam can be added.
1.5	Systems Integration	Make sure Alvin upgrades are integrated as a whole		Insure power/data management will support new systems that will result in an integrated, user-friendly platform

US Deep Submergence Community Request for *Alvin* Upgrades
(prioritized by DESSC) 5/23/96

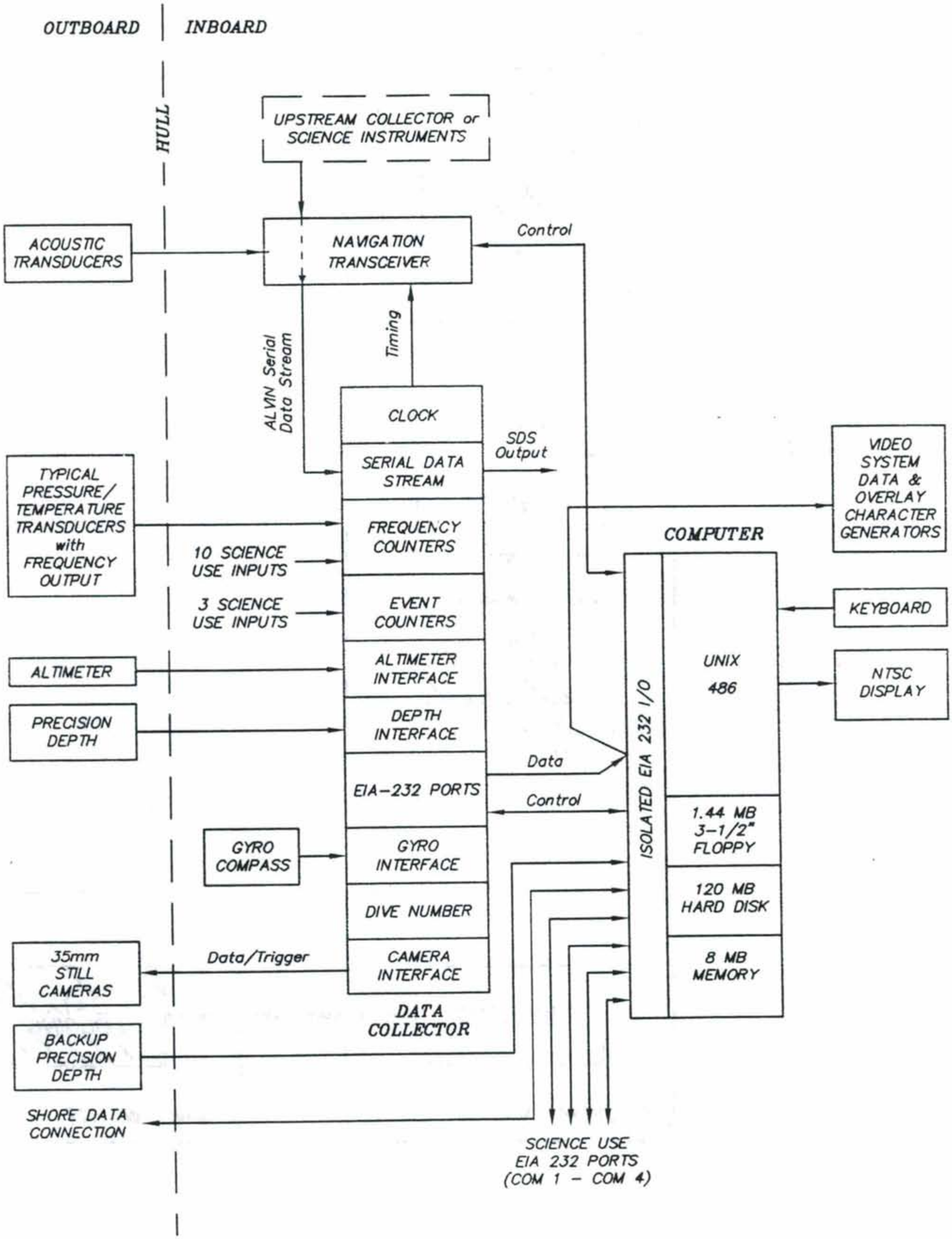
Rank	System	Proposed Action	Cost Estimate	Comments
2	Imaging	Add overlay displays of time, depth, alt, hdg, dive number, date, etc. to all camera feeds.		Part of complete datalogger/video display upgrade issue.
2		Place camera(s) on pan and tilt mechanisms with controls (including zoom, focus, iris) conveniently placed for operation by scientists.	paid for	A prototype pan and tilt has been funded for Alvin and is currently under development/evaluation. Consider adding position sensors and scaling device.
2		Replace b&w video monitors in-hull with color monitors for observer viewing.		This is related to navigation upgrades and improvements to video switching capabilities. Cable upgrade required? Possible use of LCD displays.
2	Navigation	Use an in-hull nav program that uses travel times from all available transponders to calculate a position.		Navigation upgrade with WINFROG will accommodate this.
2		Replace in-hull navigation receiver with an off-the-shelf item.	4@$5,000 ea.	More reliable, improved capabilities.
2		Provide in-hull graphic display with bathymetry (and side-scan) and target overlays with tracking that differentiates current, recent, and old fixes.		Phase 2 of Navigation Upgrade. Potentially part of WINFROG capability.
2		Provide as standard a re-crunch of the transponder net and navigation data based on in-hull travel times.		WINFROG will accommodate this.
2		Implement standard inductively-coupled modem transceiver unit on Alvin with published design so anyone can build equipment that can communicate to laptops inside without needing through-hull connections.		Still in development/conceptual evaluation stage. This approach is being taken in development of a remote temperature sensor for Ti water samplers.
2	Sonar	Replace CTFM.	2@125K ea	Straza digital unit is the only suitable replacement with equivalent capability. Important to have distance capability

US Deep Submergence Community Request for *Alvin* Upgrades
(prioritized by DESSC) 5/23/96

2	Sampling	Purchase a pump to increase usefulness of Alvin CTD and develop a good mounting position on the sub for routine CTD profiling.		Science needs to define "good" mounting positions for quality data by all users. Upgrades include position sensors, pump and data management protocols, moveable sensors
3	Imaging	Add a digital ccd camera to the array of external imaging devices routinely carried on Alvin, with hardware and software for post-processing on board the ship.		Fornari is experimenting with this technology. Perhaps appropriate when resolved.
3		Obtain two pencil cameras (DSPL or equivalent) for view-finding or other monitoring requirements and long cables for mounting in various locations on Alvin.		
3		Ensure internal/external wiring/switching capabilities are adequate for imaging requirements.		Part of complete rework of existing datalogger/display problem.
3	Sampling	Provide push cores with core catchers.	$200 ea	
3		Improve Paroscientific depth gauge up to spec. This should be just a programming issue. Sample at 4 Hz.		Requires upgrade of datalogging system to sample at 4 Hz.
3		Develop a remote temperature sensor for Ti water samplers.		In progress. To be tested in April 1996.
3		Develop slup-gun for general use		Muliple chamber system (SEALINK)
3		Develop a micro-water sampler (ml volumes rather than liter volumes).	~$4K ea	

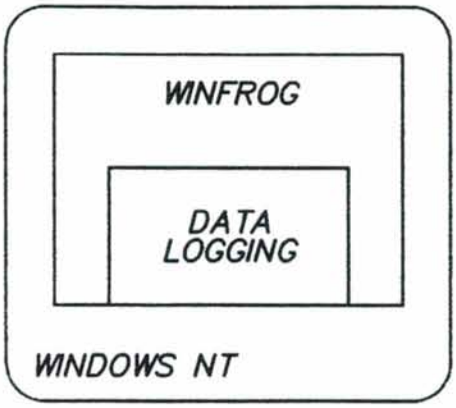
APPENDIX VIII

CURRENT DATA SYSTEM

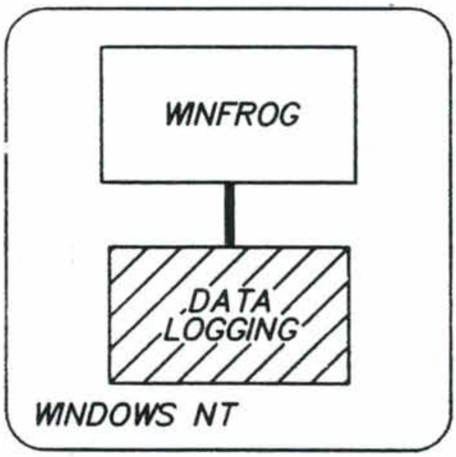


DATA SYSTEM OPTIONS

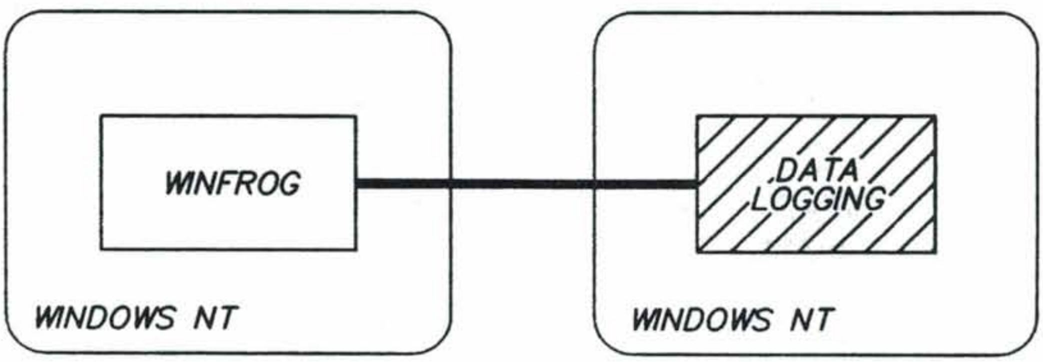
(1)



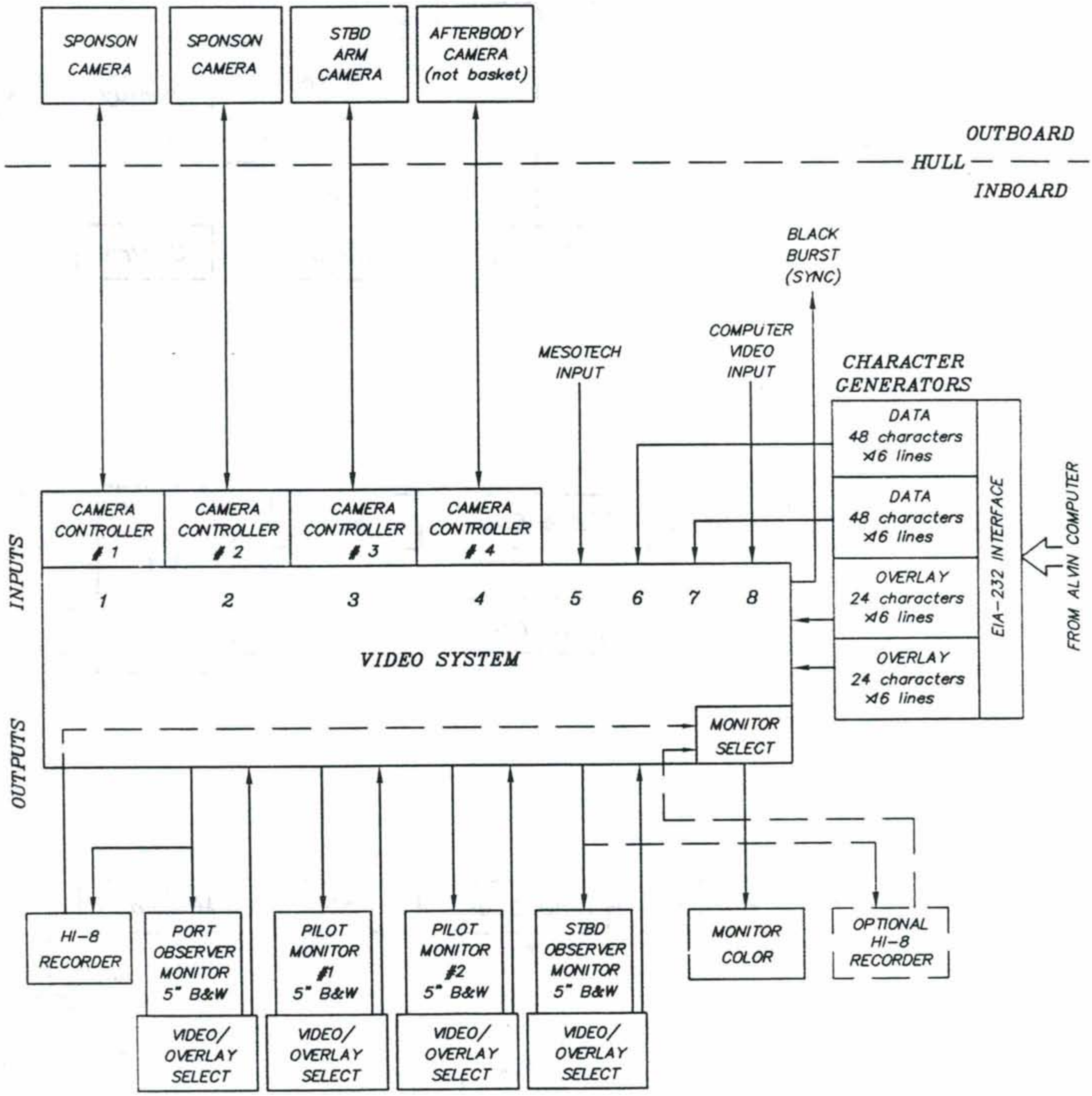
(2)



(3)

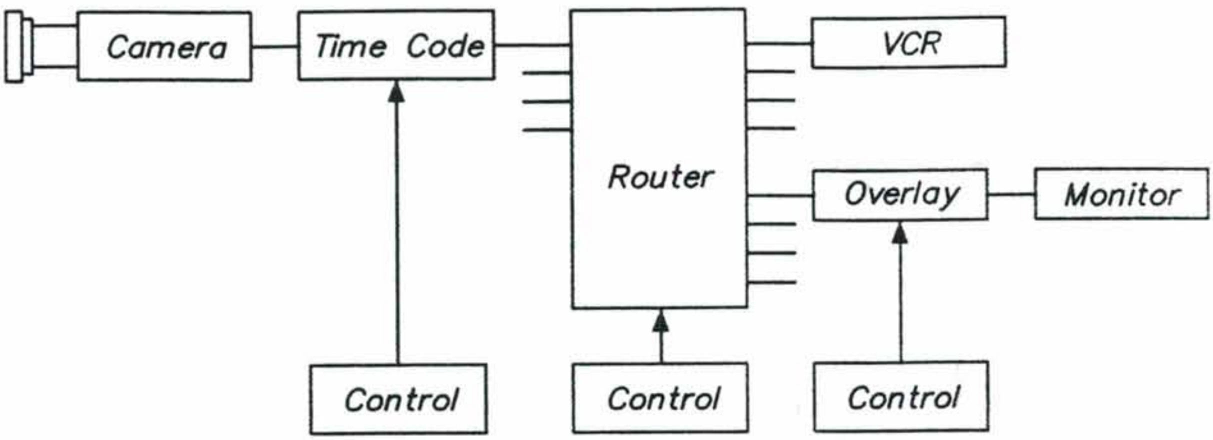


CURRENT VIDEO SYSTEM

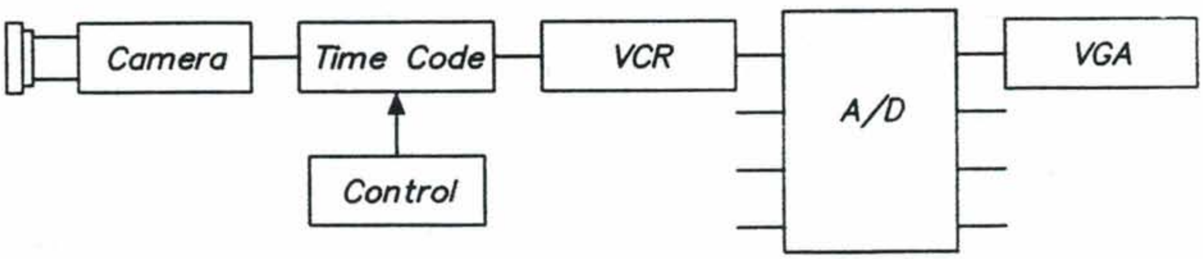


VIDEO SYSTEM OPTIONS

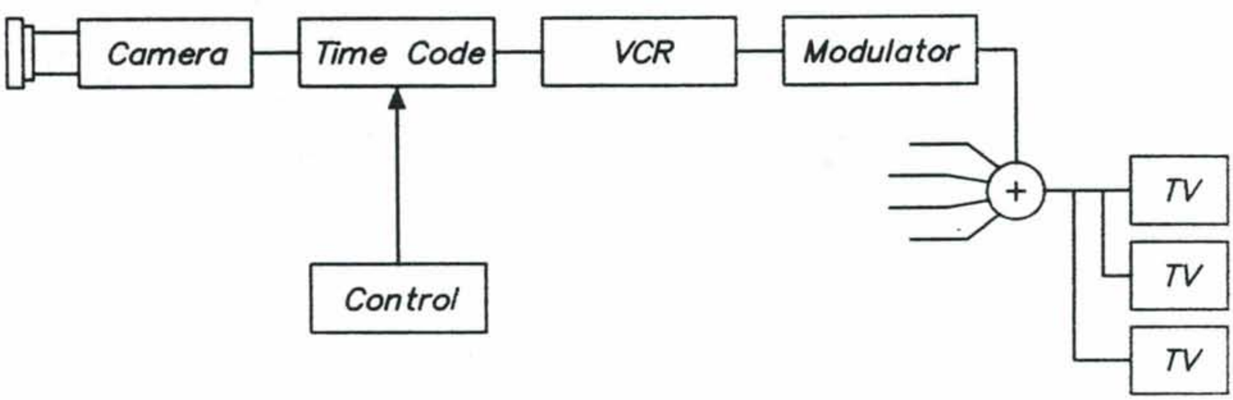
(1)



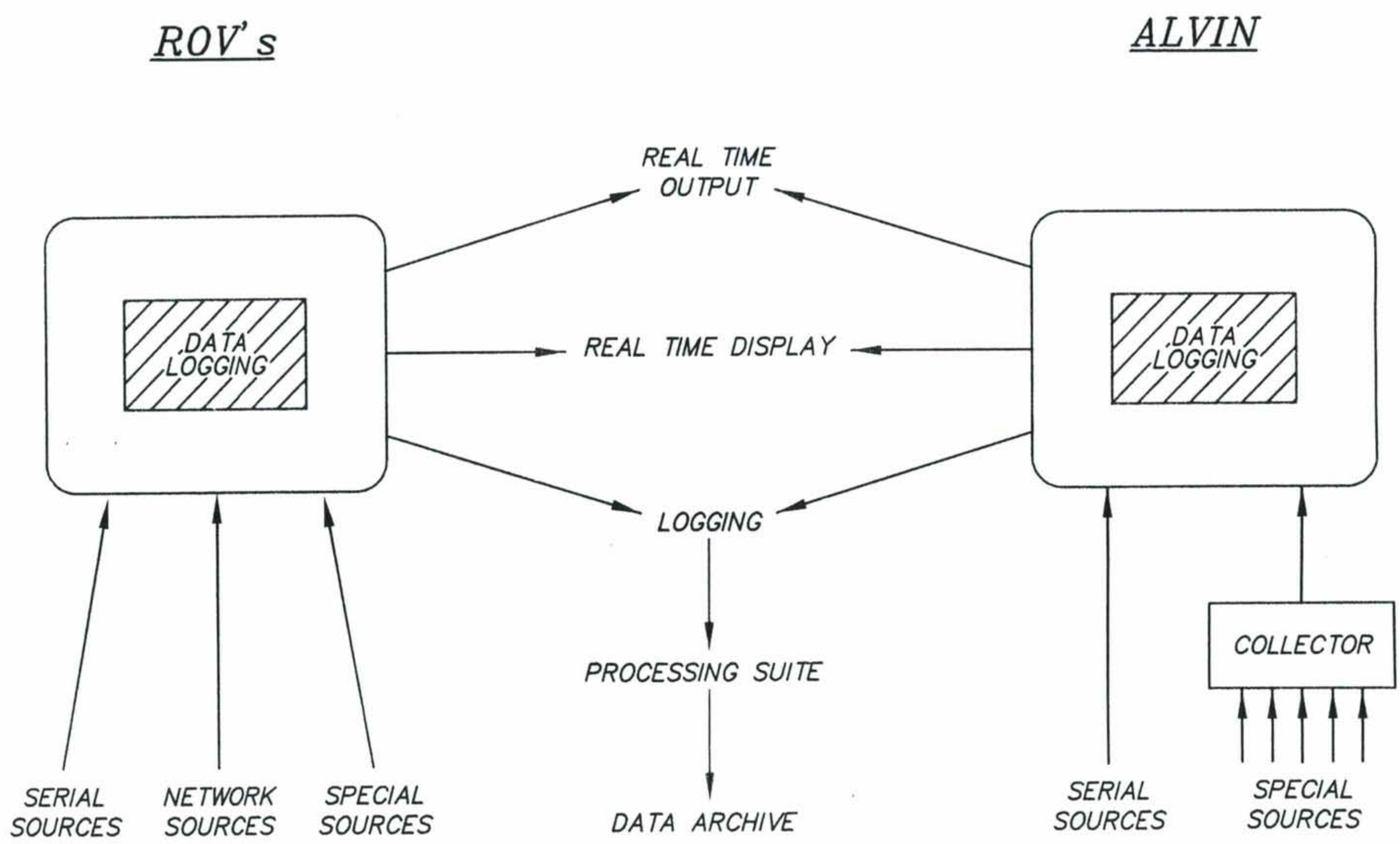
(2)



(3)



MANNED/UNMANNED DATA SYSTEM CONSOLIDATION



APPENDIX IX

OCEANOGRAPHIC CENTERS & FACILITIES

- Staff Change
  * Lisa Rom, Instrumentation and Technical Services (ITS)
    - one year leave. August 1996-August 1997
  * Sandy Shor, ITS Program Director
    - IPA, University of Hawaii, August 1996-August 1997

- Program Addition
  * Interamerican Institute (IAI)
  * Line budget in OCFS ($1.6M)
  * OCE "center" management
  * Global Change Program

- UNOLS Liaisons

  Unols Council - Don Heinrichs
  RVOC, Ship scheduling, DESSC - Dolly Dieter
  RVTEC - Lisa Rom/Sandy Shor
  FIC - Richard West

NSF Ocean Sciences Division

Ocean Sciences

- Budget estimate is $193.7 Million
- Increase of $0.9 Million or 0.5%

	FY 1994	FY 1995	FY 1996
Ocean Sciences Research	$100.0 M	$102.6M	104.9M
Oceanographic Centers & Facilities	50.3M	50.4M	48.9M
Ocean Drilling Program	38.7M	39.8M	39.9M
	$189.0M	$192.8M	193.7M

- Major Research Initiatives

	FY 1994	FY 1995	FY 1996
Global Change Programs	$53.7M	$57.7M	57.6M
Biotechnology	4.0M	3.6M	3.0M
High Performance Computing	0.4M	0.8M	0.8M
Environmental Research	7.3M	7.7M	7.3M
SMETE (EHR)	2.1M	2.9M	3.1M
	$67.5M	$72.7M	$71.8M
Other Research Activities	$121.5M	$120.6M	$121.9M

(May 1996)

APPENDIX X

West Coast NURC
Gulf of Alaska Initiative

Tectonics

Seeps

Habitats, Fisheries and Community Structure

1996: Workshop and development of science plan (March)
Peer-reviewed RFP (1 June)
Proposal submissions (31 August)

1997	FIELD SEASON 1	$300K (20 dos)
1998	FIELD SEASON 2	$300K (20 dos)
1999	FIELD SEASON 3	$300K (20 dos)

West Coast NURC
1996 Deep Submergence Field Programs

- **Rona** -

  Hydrothermal plume and diffuse flow imaging sonar system: Test and application *(Navy) yr 1 of 2*

- **Fisher** -

  Growth and productivity of *Ridgeia piscesae* and trophic interactions within the vestimentiferan communities in different vent environments *(ROPOS) yr 1 of 2*

- **Nelson** -

  Ecology and physiology of *Beggiatoa* sp. at Monterey Canyon seeps: A model of novel, sulfide-driven bacterial denitrification *(VENTANA) yr 1 of 1*

West Coast NURC
1996 Deep Submergence Field Programs

- **Dayton & Vetter -**

  Elevated invertebrate and fish production in submarine canyons: effects of macrophyte detritus (*Navy and Delta) yr 2 of 2*

- **Smith -**

  Structure, succession and phylogenetic affinities of deep-sea whale-fall communities on the northeast Pacific slope *(Navy and Delta) yr 2 of 2*

- **Embley -**

  New lessons on the relationships between magmatic processes, the subsurface biosphere and the ocean intra-transform extensional basin: Blanco Fracture Zone, Northeast Pacific *(Navy) yr 1 of 1*