Project Manager: Mark Brown

AUV Docking Station 2000+

Requested Incremental Budget:
Total Project Costs, Including Labor:
Duration of Project: 3 years
Date Submitted: 6/1/99
Lead Scientist: Jim Bellingham
Lead Engineer: Mark Brown
Project Team: Jim Bellingham, Mark Brown, Ed Mellinger, Rob McEwen
Summary of Resources Requested (Total No. of days per Division for 2000):

R&D Total: 38 for year 2000
TSD Total:
DMO Total:
ITD Total:

1) Abstract

The Monterey Bay Aquarium Research Institute has determined that part of its charter will be a autonomous ocean observing system. The concept of an ocean observing system has been outlined by the MOOS steering committee as follows: "*The system concept consists of a cabled mooring supporting a network of intelligent instrumentation nodes extending from the surface, through the water column, to the seafloor...*" The AUV effort being undertaken at MBARI supports the MOOS concept. Close coupled to the AUV effort is the requirement for a subsea AUV dock capable of data transfer and power regeneration for the vehicle. The dock would be an integral part of the cabled mooring providing a relay station for the transfer of data to shore as well as a communication link that would allow shore based operators the conduit for directions for mission specific tasks. The complexities involved with docking include homing the vehicle to the dock, data/power transfer, and charging vehicle batteries. A separate effort from the AUV project is required in order to form separate milestones and address critical design issues early in the concept and development phase while continuing to work in parallel with the AUV project. The ability to leverage the knowledge and years of experience from Jim Bellingham's lab at MIT is acknowledged to be a contributing factor for the success of this proposal.

2) Proposal

a) The problem addressed

- *Statement of the problem :*
  The AUV program at MBARI is in the initial stages of development. A critical subset of successful MBARI AUV operations includes docking the vehicle subsea for data and power transfer. A review of past efforts at MIT, WHOI, NRAD, FAU and other institutes and organizations world wide has revealed that successful docking of an AUV subsea is an intricate task that warrants a separate effort closely tied to the AUV vehicle program here at MBARI. The Docking Station is an integral part of the autonomous observing system. The complexity of the system requires precise acoustics between vehicle and docking station for positioning before engagement (e.g. Homing), and data transfer requiring precision alignment for inductive coupling. Finally power regeneration requiring an inductive couple for battery charging before the next mission.

- *Why it is important :*
  The Docking Station could become an integral part of the autonomous observing system proposed by MOOS. The station provides the necessary physical attachment point to download gathered science data to shore or archive, it allows the vehicle to power up to continue mission tasks.

- *Present state of art/understanding:*
  The Odyssey vehicle and its docking station from Jim Bellingham's lab at MIT represents the present state of the art in AUV and docking station technology. During Dr. Bellingham's tenure at the helm of the Sea Grant Lab at MIT giant strides have been made in AUV technology and MBARI is perfectly situated to leverage this knowledge and move the technology forward from a solid base.

- *How it relates/contributes to MBARI's mission and strategic plan*
  This proposal maintains a close connection to the mission of *MBARI "to achieve and maintain a position as a world center for advanced research and education in ocean science and technology, through the development of better instruments, systems, and methods for scientific research in the deep waters of the ocean."* The Docking Station as stated above would become an integral part of the autonomous observing system, which is the main objective of MOOS. The station would include the use and adaptation of existing technologies that combined would provide a unique contribution to the current developments in subsea engineering and oceanographic instruments.

b) Approach to the problem

- *Engineering/technology development:*
  Initial effort will be spent on learning the strengths and weaknesses of existing systems. Technology development will hinge primarily on what the team learns from observing the current MIT system. From the data gathered a more informed plan for design/development will be formed for the following year.

- *Field programs:*
  The Odyssey and its docking station will be here in August as part of a AOSN project. This will provide the proposal team with a unique opportunity to see the current state of the art for docking. This system will return here in April and will be deployed for a short time in the Monterey Bay where we will have access to observe the station functioning. During this time observations would made for review of the pro's and con's of the current system.

- *Proposed duration of project and approximate plan of action:*
  The proposed duration of this project is three years. Year one is characterized by research into the current state of the art technologies involved with docking subsea equipment not only AUV but also equipment used in the offshore oilfield. Year two is the design and development phase where the concept is developed from the research and a prototype is built for functionality testing. Year three is the delivery of a robust fully functioning AUV Docking Station, which would be integrated with the AUV project.

c) Specific deliverables

- *Products from research and development (tools, documentation, publications, presentations, etc.):*
  The specific deliverable would be an AUV Docking Station capable of data transfer, power regeneration for the batteries, and autonomous operation.

- *How success will be measured:*
  A successful project would be the deployment of an AUV Docking station somewhere in the Monterey Bay for an extended period of time without failure.

d) Project team

- Research Engineer: Jim Bellingham
  Jim provides guidance and leadership earned from years of leading the MIT Sea Grant lab.

- Mechanical Engineer: Mark Brown
  Mark provides mechanism and mechanical design skills.

- Electrical Engineer: Ed Mellinger
  Ed provides electrical design and power supply knowledge

- Software Engineer: Rob McEwen
  Rob provides software and controls experience to the team.

3) Budget

(SEE BUDGET)

4) Milestone and Resource Usage Forms

a) Project milestones form

- **YEAR ONE: Research & Development**

- Travel to the East Coast to visit the MIT Sea Grant Lab and see the AUV program.

- Attend AUV seminar.

- Travel to FAU (or appropriate destination) Visit and review AUV docking system.

- **YEAR TWO: Design Concept**

- *CONCEPT DEVELOPMENT*

  - DESIGN CONCEPT: Design requirements are evaluated from the statement of purpose and the design parameters are defined. A literature search is conducted to identify the current state of the art and identify experts in the field. Concepts are reviewed and the design intent is established.

  - PRELIMINARY DESIGN REVIEW: An expert panel review is conducted to determine if compliance with the design concept has been accomplished and the design intent is adhered to. Panel suggestions and recommendations may be implemented into the design.

  - MACHINE DRAWINGS: Mechanical Engineering drawings are generated and checked before release to manufacturing.

  - PROTOTYPE MANUFACTURE PHASE: When it is determined to be necessary a prototype is fabricated to examine and test concepts for validity.

  - CRITICAL DESIGN REVIEW: An expert panel reviews the Mechanical Engineering drawings with attention to detail. The critical review includes manufacturing feasibility, material selection and engineering calculations. All suggestions and revelations are addressed and applicable changes are made before the drawings are released.

  - MANUFACTURE: The prototype is manufactured using both in house resources and outside manufacturing as required to meet the project milestones.

    MATERIAL PROCUREMENT: Raw materials for fabrication are purchased. Long lead time items are identified and scheduled for delivery.

    PARTS PURCHASE: Vendor parts that will be purchased are identified and scheduled for delivery. Long lead items are identified and scheduled accordingly

    MACHINING: Machine shop supervisor works with P.M. to schedule part production and identify time conflicts.

    WELDING/FITTING: Welding is scheduled as required.

    QUALITY CONTROL/ASSURANCE: Parts are inspected as required. All assemblies are inspected and verified to comply with drawings and specifications.

- IN HOUSE TEST PHASE / (Prototype testing): The design as manufactured is tested in the test tank for compliance to specifications and general functionality. The results from testing are evaluated and necessary changes are implemented.

- FIELD TEST PHASE: The prototype is taken into the field for evaluation and testing. Test cruise using R/V Point Lobos/Western Flyer and vehicle Ventana/Tiburon as available.

- **YEAR THREE (SYSTEM EVALUATION)**

- EVALUATION (redesign/optimize): After the field-testing has been completed a review and evaluation is made by the project team to identify any significant areas that require immediate attention. The project as a whole is then revisited and evaluated to see if the original design objectives were met. A plan for improvement both in the long term and short term will be developed and presented to MBARI management.

The current supervisors are as follows:

(1) Information Applications – Mike McCann

(2) Machine Shop – Mike Parker

(3) Engineering
(a) Mechanical Engineering – Gene Massion
(b) Software Engineering – Duane Edgington
(c) Electrical Engineering – Ed Mellinger

(4) Technical Support – Carolyn Todd

(5) Observatory Support – Tom Tengdin

(6) Ship Support – Steve Etchemendy

(7) ROV Input and Support (for upgrades and/or modifications to vehicles such as mounting of new equipment) – Jim Barry

(8) Mooring Users Committee – Chris Scholin

(9) Data Users Committee – Dave Caress

(10) Video Laboratory – Nancy Jacobsen

(11) Computer Information Systems – Bill Brune

5) Project Plan/Timeline (For Final Proposals ONLY)

Once a proposal has been accepted for final selection, the Project Team may be required to revise their project to fit within certain budget and resource limitations. Parts 1-4 above must then be revised to reflect a new work plan, milestones, and resource requests consistent with those limits. In addition, since the resource supervisors now know the final selection of approved projects, the RSC will schedule the resources for year one of the project. Detailed timelines for the subsequent years of multi-year proposals will only be requested at proposal submission time the relevant years.

6) Curriculum Vitae

Please be sure that your Division Administrator has a current 2-page electronic copy of all CV's for each MBARI and non-MBARI person that is involved in your project, whether participating as a collaborator, contractor, student, volunteer, etc. This requirement can be relaxed in the case of non-MBARI personnel that will be funded on external proposals. The Division Administrators will create a file of all applicable CV's on CD-ROM to accompany project proposals.

Definition of Roles

PCO Committee – A decision making body that selects final proposals and reviews progress.

RSC – A decision making body that resolves conflicts and determines the reasonability of requested resources.

Resource Supervisor – Responsible for scheduling resources for approved projects to the level approved. Resource Supervisors have authority to schedule the allocated contingency assigned to each project if they deem it necessary. Any request for resources beyond the level approved plus contingency will trigger a PCO review of project with possible outcomes of: 1) cancel, 2) descope, or 3) additional resource provided (if available).

Division Administrators – Responsible for aiding Project Managers/Teams in the development of project documentation and schedules to ensure consistency; having direct access to all up-to-date project documentation for projects in their respective divisions; aiding Project Managers and Resource Supervisors to communicate any requests/changes in writing to all parties (i.e. PCO, RSC, Resource Supervisors, etc.)

All proposals are strongly encouraged to have the following:

Project Manager – Responsible for developing and adhering to project schedule, budget, and milestones.

Lead Scientist – Responsible for science requirements, science direction, data collection, processing, interpretation, and publication.

Lead Engineer – Responsible for converting science requirements into engineering solutions, oversees engineering design, development, review, fabrication, testing, documentation and debugging.

Proposers may also include "Lead"s from DMO, ITD, TSD, when appropriate.

AUV Docking – Brown
This project is approved for 2000 as a one-year design study only. Future years' resources and milestones should be centrally coordinated under MOOS.

This project is part of the MOOS Implementation Program. Although the resources and funds below are approved for the year 2000, the scope of the project may be modified, milestones may be adjusted, and the resources and funds may be redistributed between the MOOS projects, at the discretion of the MOOS project management.

The PCO assumes that the resources will be as follows:

Personnel time:	Days
Research Engineer	4days
Electrical Engineer	11
Software Engineer	7
Mechanical Engineer	16
Ship time:	
Point Lobos/Ventana	3
Internal Funding:	
All other expenses	$ 8,650.00

PROJECT SUMMARY

Notes: Labor, Fringe and Ship Costs will automatically be updated after data input phase.
Total project costs will be calculated at that time
If multi-year project - submit separate file for each year (name yr1, name yr2, etc)

PROJECT TITLE: AUV-Docking Station

EXISTING PROJECT?: YES ☐ NO ☑

PROJECT NUMBER:

LEAD SCIENTIST: Jim Bellingham

LEAD ENGINEER: Mark Brown

PROJECT MANAGER: Mark Brown

☑ Multi-Year? **YEAR:** 2000

DATE LAST UPDATED:

PROJECT COST SUMMARY

Revenue

Revenue / Reimbursement Total	$	-

Expense

DIRECT LABOR			$	12,923.12
LABOR FRINGE			$	5,556.94
INTERNAL SHIP	$	23,214.00		
CAPITAL	$	-		
ALL OTHER EXPENSE	$	8,650.00		
PROJECT TOTAL			**$**	**50,344.06**

FORM UPDATE
5/18/1999 4:32 p.m.

AUV-Docking Station

NOTE: ENTER STAFFING DATA AS DAYS - NOT HOURS!

10/18/99 3:47 PM

MILESTONE NAME	*Travel to MIT*	*AUV Observation*	*AUV Conference*	*Travel to FAU*					TOTAL DAYS	Total Days
DATE OF COMPLETION										
RESEARCH										
Scientist									0.00	
Research Specialist									0.00	
Research Technician									0.00	
Post Doc - Science									0.00	
Lab Assistant									0.00	0.00
DEVELOPMENT										
Engineer-Research			4.00						4.00	
Engineer-Electrical	3.00		4.00	4.00					11.00	
Engineer-Software	3.00		4.00						7.00	
Engineer-Mechanical	5.00	3.00	4.00	4.00					16.00	
Post Doc - Engineer									0.00	38.00
IAG										
S/W Applications Developer									0.00	
Software Engineer/IAG									0.00	0.00
ITD										
Research Tech/Video Analyst									0.00	
Editorial Assist/WEB									0.00	
Techwriter/Documentation									0.00	
CTD Data Tech									0.00	
Licensing Associate									0.00	
Research Tech/Samples									0.00	
AV Technician									0.00	0.00
DMO										
Director/Associate									0.00	
ROV Pilot/Ventana									0.00	
ROV Pilot/Tiburon									0.00	
Technician/Marine Ops									0.00	
CTD Tech/Ops									0.00	
Diver									0.00	0.00
TSD										
Technician - EE									0.00	
Technician - ME									0.00	
Machinist/Machine Shop									0.00	
Technician - Ocean Obs									0.00	
I.S. Administrator									0.00	0.00

PROJECT NAME AUV-Docking Station
LEAD SCIENTIST Jim Bellingham
LEAD ENGINEER Mark Brown
PROJECT MANAGER Mark Brown

	POINT LOBOS ONLY	POINT LOBOS/ VENTANA	WESTERN FLYER ONLY	WESTERN FLYER/ TIBURON	OUTSIDE SHIPTIME *	OUTSIDE SHIPTIME *
SEA DAYS (insert # of days)	0	3	0	0	0	0
DOCKSIDE / MOBILIZATION DAYS (insert # of days)	0	0	0	0	0	0
TRANSIT TIME : extended cruise time charged to project (insert # of hours)	0	0	0	0	0	0
Preferred Usage: **Examples: a)** 10 consecutive days (Santa Barbara) requiring 2 days each mob/demob; **b)** (2) 3-day groupings in March & September (time series); 1/2 day mob needed in March for software installation; **c)** Outside shiptime: 7 days JOHN MARTIN throughout year for mooring work		3 CONSECUTIVE DAYS FOR FILMING OF AUV ODYSSEY DURING THE MONTH OF APRIL.				
Special Requests (night dives, extended days, etc.)						
PCO/RSC use only: Actual At-sea Days Allocated:						

OUTSIDE SHIP TIME *: All Project Managers are required to secure their own outside ship time, though DMO will assist as applicable.
Outside ship time expense must be budgeted in expense sheet. (See DMO for rates)

Extended Costs		**Rate**	**Extension**
Point Lobos only	$	4,828	$0
Point Lobos/Ventana	$	7,738	$23,214
Dockside / Mobilization	$	3,869	$0
Western Flyer only	$	11,056	$0
Western Flyer/Tiburon	$	16,499	$0
Extended Hours	$	-	$0

SHIP COST TOTAL (internal) $ 23,214.00

Project: 0

Please mark all dates for which shiptime **WILL NOT** be feasible for your project with a bold **"X"** and comment as needed.

Please mark specific dates or time periods for which shiptime is **MANDATORY** for meeting your project milestones with a bold **"M"** and comment as needed.

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
EXAMPLE 1				<	<	**M**	>	>								<	<	X	X	X	X	X	X	X	X	X	>	>			
comments				testing new eqpmt first week of month															tentative cruise on New Horizon												
JANUARY																															
comments																															
FEBRUARY																															
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MARCH																															
comments																															
APRIL			M	M	M																										
comments			THE REQUEST IS FOR THREE CONSECUTIVE DAYS IN APRIL, THE ACTUAL DATES HAVE NOT BEEN DETERMINED.																												
MAY																															
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Project-No	Acct-No	Account Name	Line-Item Description	Amount
PROJECT NUMBER:	410	Travel - Domestic - Lodging	Hotel for two people AUV Conference	$1,500
PROJECT NUMBER:	410	Travel - Domestic - Lodging	Hotel for S.E. & E.E one week	$1,500
PROJECT NUMBER:	410	Travel - Domestic - Lodging	Hotel for MIT visit	$750
		Travel - Domestic - Lodging Total		$3,750
PROJECT NUMBER:	411	Travel - Domestic - Meals/Incidentals	Meals for two people AUV Conference	$300
PROJECT NUMBER:	411	Travel - Domestic - Meals/Incidentals	Meals estimate for S.E. & E.E one week	$400
PROJECT NUMBER:	411	Travel - Domestic - Meals/Incidentals	Meals estimated for one week	$200
		Travel - Domestic - Meals/Incidentals Total		$900
PROJECT NUMBER:	412	Travel - Domestic - Transportation	Tickets for two people for AUV Conference	$1,600
PROJECT NUMBER:	412	Travel - Domestic - Transportation	Expense for S.E. & E.E travel to MIT	$1,600
PROJECT NUMBER:	412	Travel - Domestic - Transportation	VISIT MIT SEA GRANT LAB	$800
		Travel - Domestic - Transportation Total		$4,000
		Grand Total		$8,650