List of Suggested Reviewers or Reviewers Not To Include (optional)

SUGGESTED REVIEWERS:
Not Listed

REVIEWERS NOT TO INCLUDE:
Not Listed

COVER SHEET FOR PROPOSAL TO THE NATIONAL SCIENCE FOUNDATION

PROGRAM ANNOUNCEMENT/SOLICITATION NO./CLOSING DATE if not in response to a program announcement/solicitation enter NSF 14-1

PD 98-1680 **02/15/15**

FOR CONSIDERATION BY NSF ORGANIZATION UNIT(S) (Indicate the most specific unit known, i.e. program, division, etc.)

OCE - OCEAN TECH & INTERDISC COORDIN

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NSF PROPOSAL NUMBER

~~1514756~~

DATE RECEIVED	NUMBER OF COPIES	DIVISION ASSIGNED	FUND CODE	DUNS# (Data Universal Numbering System)	FILE LOCATION
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EMPLOYER IDENTIFICATION NUMBER (EIN) OR TAXPAYER IDENTIFICATION NUMBER (TIN)

770150580

SHOW PREVIOUS AWARD NO. IF THIS IS
☒ A RENEWAL
☐ AN ACCOMPLISHMENT-BASED RENEWAL

1114794

IS THIS PROPOSAL BEING SUBMITTED TO ANOTHER FEDERAL AGENCY? YES ☐ NO ☒ IF YES, LIST ACRONYM(S)

NAME OF ORGANIZATION TO WHICH AWARD SHOULD BE MADE

Monterey Bay Aquarium Research Institute

A WARDEE ORGANIZATION CODE (IF KNOWN)

4000069000

ADDRESS OF AWARDEE ORGANIZATION, INCLUDING 9 DIGIT ZIP CODE

Monterey Bay Aquarium Research Institute
7700 Sandholdt Rd
Moss Landing, CA. 950399644

NAME OF PRIMARY PLACE OF PERF

Monterey Bay Aquarium Research Institute

ADDRESS OF PRIMARY PLACE OF PERF, INCLUDING 9 DIGIT ZIP CODE

Monterey Bay Aquarium Research Institute

CA ,950399644 ,US.

IS AWARDEE ORGANIZATION (Check All That Apply) (See GPG II.C For Definitions)
☐ SMALL BUSINESS ☐ MINORITY BUSINESS ☐ FOR-PROFIT ORGANIZATION ☐ WOMAN-OWNED BUSINESS

☐ IF THIS IS A PRELIMINARY PROPOSAL THEN CHECK HERE

TITLE OF PROPOSED PROJECT **MARS Operations and Maintenance**

REQUESTED AMOUNT	PROPOSED DURATION (1-60 MONTHS)	REQUESTED STARTING DATE	SHOW RELATED PRELIMINARY PROPOSAL NO. IF APPLICABLE
$ ~~2,144,419~~	60 months	~~03/01/15~~03/01/2021	

THIS PROPOSAL INCLUDES ANY OF THE ITEMS LISTED BELOW

☐ BEGINNING INVESTIGATOR (GPG I.G.2)
☐ DISCLOSURE OF LOBBYING ACTIVITIES (GPG II.C.1.e)
☐ PROPRIETARY & PRIVILEGED INFORMATION (GPG I.D, II.C.1.d)
☐ HISTORIC PLACES (GPG II.C.2.j)
☐ VERTEBRATE ANIMALS (GPG II.D.6) IACUC App. Date _____
PHS Animal Welfare Assurance Number _____
☒ FUNDING MECHANISM **Equipment/Instrumentation**

☐ HUMAN SUBJECTS (GPG II.D.7) Human Subjects Assurance Number _____
Exemption Subsection _____ or IRB App. Date _____
☐ INTERNATIONAL ACTIVITIES: COUNTRY/COUNTRIES INVOLVED (GPG II.C.2.j)

☒ COLLABORATIVE STATUS
Not a collaborative proposal

PI/PD DEPARTMENT
Marine Operations

PI/PD FAX NUMBER
831-775-1620

PI/PD POSTAL ADDRESS
7700 Sandholdt Road

Moss Landing, CA 950399644
United States

NAMES (TYPED)	High Degree	Yr of Degree	Telephone Number	Email Address
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CO-PI/PD ~~Craig Dawe~~	~~BS~~	~~2002~~	~~831-775-1910~~	~~dacr@mbari.org~~
CO-PI/PD				
CO-PI/PD				
CO-PI/PD				

CERTIFICATION PAGE

Certification for Authorized Organizational Representative (or Equivalent) or Individual Applicant

By electronically signing and submitting this proposal, the Authorized Organizational Representative (AOR) or Individual Applicant is: (1) certifying that statements made herein are true and complete to the best of his/her knowledge; and (2) agreeing to accept the obligation to comply with NSF award terms and conditions if an award is made as a result of this application. Further, the applicant is hereby providing certifications regarding conflict of interest (when applicable), drug-free workplace, debarment and suspension, lobbying activities (see below), nondiscrimination, flood hazard insurance (when applicable), responsible conduct of research, organizational support, Federal tax obligations, unpaid Federal tax liability, and criminal convictions as set forth in the NSF Proposal & Award Policies & Procedures Guide,Part I: the Grant Proposal Guide (GPG). Willful provision of false information in this application and its supporting documents or in reports required under an ensuing award is a criminal offense (U.S. Code, Title 18, Section 1001).

Certification Regarding Conflict of Interest

The AOR is required to complete certifications stating that the organization has implemented and is enforcing a written policy on conflicts of interest (COI), consistent with the provisions of AAG Chapter IV.A.; that, to the best of his/her knowledge, all financial disclosures required by the conflict of interest policy were made; and that conflicts of interest, if any, were, or prior to the organization's expenditure of any funds under the award, will be, satisfactorily managed, reduced or eliminated in accordance with the organization's conflict of interest policy. Conflicts that cannot be satisfactorily managed, reduced or eliminated and research that proceeds without the imposition of conditions or restrictions when a conflict of interest exists, must be disclosed to NSF via use of the Notifications and Requests Module in FastLane.

Drug Free Work Place Certification

By electronically signing the Certification Pages, the Authorized Organizational Representative (or equivalent), is providing the Drug Free Work Place Certification contained in Exhibit II-3 of the Grant Proposal Guide.

Debarment and Suspension Certification

(If answer "yes", please provide explanation.)

Is the organization or its principals presently debarred, suspended, proposed for debarment, declared ineligible, or voluntarily excluded from covered transactions by any Federal department or agency? Yes ☐ No ☒

By electronically signing the Certification Pages, the Authorized Organizational Representative (or equivalent) or Individual Applicant is providing the Debarment and Suspension Certification contained in Exhibit II-4 of the Grant Proposal Guide.

Certification Regarding Lobbying

This certification is required for an award of a Federal contract, grant, or cooperative agreement exceeding $100,000 and for an award of a Federal loan or a commitment providing for the United States to insure or guarantee a loan exceeding $150,000.

Certification for Contracts, Grants, Loans and Cooperative Agreements

The undersigned certifies, to the best of his or her knowledge and belief, that:
(1) No Federal appropriated funds have been paid or will be paid, by or on behalf of the undersigned, to any person for influencing or attempting to influence an officer or employee of any agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress in connection with the awarding of any Federal contract, the making of any Federal grant, the making of any Federal loan, the entering into of any cooperative agreement, and the extension, continuation, renewal, amendment, or modification of any Federal contract, grant, loan, or cooperative agreement.
(2) If any funds other than Federal appropriated funds have been paid or will be paid to any person for influencing or attempting to influence an officer or employee of any agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress in connection with this Federal contract, grant, loan, or cooperative agreement, the undersigned shall complete and submit Standard Form-LLL, ''Disclosure of Lobbying Activities,'' in accordance with its instructions.
(3) The undersigned shall require that the language of this certification be included in the award documents for all subawards at all tiers including subcontracts, subgrants, and contracts under grants, loans, and cooperative agreements and that all subrecipients shall certify and disclose accordingly.

This certification is a material representation of fact upon which reliance was placed when this transaction was made or entered into. Submission of this certification is a prerequisite for making or entering into this transaction imposed by section 1352, Title 31, U.S. Code. Any person who fails to file the required certification shall be subject to a civil penalty of not less than $10,000 and not more than $100,000 for each such failure.

Certification Regarding Nondiscrimination

By electronically signing the Certification Pages, the Authorized Organizational Representative (or equivalent) is providing the Certification Regarding Nondiscrimination contained in Exhibit II-6 of the Grant Proposal Guide.

Certification Regarding Flood Hazard Insurance

Two sections of the National Flood Insurance Act of 1968 (42 USC §4012a and §4106) bar Federal agencies from giving financial assistance for acquisition or construction purposes in any area identified by the Federal Emergency Management Agency (FEMA) as having special flood hazards unless the:
(1) community in which that area is located participates in the national flood insurance program; and
(2) building (and any related equipment) is covered by adequate flood insurance.

By electronically signing the Certification Pages, the Authorized Organizational Representative (or equivalent) or Individual Applicant located in FEMA-designated special flood hazard areas is certifying that adequate flood insurance has been or will be obtained in the following situations:
(1) for NSF grants for the construction of a building or facility, regardless of the dollar amount of the grant; and
(2) for other NSF grants when more than $25,000 has been budgeted in the proposal for repair, alteration or improvement (construction) of a building or facility.

Certification Regarding Responsible Conduct of Research (RCR)
(This certification is not applicable to proposals for conferences, symposia, and workshops.)

By electronically signing the Certification Pages, the Authorized Organizational Representative is certifying that, in accordance with the NSF Proposal & Award Policies & Procedures Guide, Part II, Award & Administration Guide (AAG) Chapter IV.B., the institution has a plan in place to provide appropriate training and oversight in the responsible and ethical conduct of research to undergraduates, graduate students and postdoctoral researchers who will be supported by NSF to conduct research. The AOR shall require that the language of this certification be included in any award documents for all subawards at all tiers.

CERTIFICATION PAGE - CONTINUED

Certification Regarding Organizational Support

By electronically signing the Certification Pages, the Authorized Organizational Representative (or equivalent) is certifying that there is organizational support for the proposal as required by Section 526 of the America COMPETES Reauthorization Act of 2010. This support extends to the portion of the proposal developed to satisfy the Broader Impacts Review Criterion as well as the Intellectual Merit Review Criterion, and any additional review criteria specified in the solicitation. Organizational support will be made available, as described in the proposal, in order to address the broader impacts and intellectual merit activities to be undertaken.

Certification Regarding Federal Tax Obligations

When the proposal exceeds $5,000,000, the Authorized Organizational Representative (or equivalent) is required to complete the following certification regarding Federal tax obligations. By electronically signing the Certification pages, the Authorized Organizational Representative is certifying that, to the best of their knowledge and belief, the proposing organization:
(1) has filed all Federal tax returns required during the three years preceding this certification;
(2) has not been convicted of a criminal offense under the Internal Revenue Code of 1986; and
(3) has not, more than 90 days prior to this certification, been notified of any unpaid Federal tax assessment for which the liability remains unsatisfied, unless the assessment is the subject of an installment agreement or offer in compromise that has been approved by the Internal Revenue Service and is not in default, or the assessment is the subject of a non-frivolous administrative or judicial proceeding.

Certification Regarding Unpaid Federal Tax Liability

When the proposing organization is a corporation, the Authorized Organizational Representative (or equivalent) is required to complete the following certification regarding Federal Tax Liability:

By electronically signing the Certification Pages, the Authorized Organizational Representative (or equivalent) is certifying that the corporation has no unpaid Federal tax liability that has been assessed, for which all judicial and administrative remedies have been exhausted or lapsed, and that is not being paid in a timely manner pursuant to an agreement with the authority responsible for collecting the tax liability.

Certification Regarding Criminal Convictions

When the proposing organization is a corporation, the Authorized Organizational Representative (or equivalent) is required to complete the following certification regarding Criminal Convictions:

By electronically signing the Certification Pages, the Authorized Organizational Representative (or equivalent) is certifying that the corporation has not been convicted of a felony criminal violation under any Federal law within the 24 months preceding the date on which the certification is signed.

AUTHORIZED ORGANIZATIONAL REPRESENTATIVE	SIGNATURE	DATE
NAME **Danielle Haddock**	**Electronic Signature**	**~~Nov 12 2014 1:33PM~~**

TELEPHONE NUMBER	EMAIL ADDRESS	FAX NUMBER
831-775-1803	**grants@mbari.org**	**831-775-1620**

PROJECT SUMMARY

Overview:

MARS (Monterey Accelerated Research System) O&M (Operation and Maintenance)

MARS (Monterey Accelerated Research System) is a facility that provides both a test bed for sensor development, and a sensor system providing real time data to CeNCOOS and the Northern California Seismic Network.

This proposal seeks to continue what has been a very successful program of testing and development of sensors by researchers from across the country and around the world. In addition, MARS is an observatory in its own right providing real time data to the Northern California Seismic Network through MOBB (Monterey Ocean Bottom Broadband Seismometer) and physical oceanography data available through CeNCOOS (Central and Northern California Ocean Observing System) data portal (Dec 2013). Additionally, high definition video from MARS is displayed at the Monterey Bay Aquarium for public outreach. Negotiations to route this video the Smithsonian Institute are in process.

MARS, an operational deep water cabled observatory, was built to support the U.S. ocean science community. Operating with just 1.25 FTEs (Full Time Equivalents), MARS provides an important service to the science community at a very cost effective rate. Ship and ROV services are minimized due to the proximity of the MARS observatory to the MBARI facility in Moss Landing, California (two hours sail). MARS users have the advantage of access to skilled operational personnel, technicians, and engineers on a very cost effective hourly basis. Additionally, MBARI/MARS facilities, a 10m deep test tank and the MARS Wet Node Simulator are available on a day rate basis.

Intellectual Merit :

MARS is a Facility that supports the intellectual merit of scientists and research engineers funded to develop sensors for ocean science or to access data from sensors connected to the MARS system.

Broader Impacts :

The development of reliable ocean science sensors is the key to expanding Man's knowledge of the world ocean. Three examples are: MARS supported the D-ESP (Deep Environmental Sample Processor) testing. This is a devise that identifies microorganisms using DNA analysis. Additionally, we also tested Dr. Kang Din's Calibrator Linked In-situ Timed Observatory (CALLISTO). This pH Calibrator is an instrument for in situ calibration and measurement of chemical species (pH) in aqueous fluids at elevated pressure. Finally, Dr. William Chadwick's Bottom Pressure Recorder (BPR), designed to monitor inflation or deflation in submarine volcanic areas caused by magma movements underground, was tested on MARS and is now one of the first instruments providing data from the RSN. The point is that MARS is a facility that enables technically savvy scientists and engineers to economically test their instruments avoiding expensive lessons learned at sea. The broader impact of using MARS as a test bed is becoming very obvious.

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For font size and page formatting specifications, see PAPPG section II.B.2.

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Biographical Sketches (Not to exceed 2 pages each)	3	
Budget (Plus up to 3 pages of budget justification)	9	
Current and Pending Support	2	
Facilities, Equipment and Other Resources	1	
Special Information/Supplementary Documents (Data Management Plan, Mentoring Plan and Other Supplementary Documents)	1	
Appendix (List below.) **(Include only if allowed by a specific program announcement/ solicitation or if approved in advance by the appropriate NSF Assistant Director or designee)**		
Appendix Items:		

*Proposers may select any numbering mechanism for the proposal. The entire proposal however, must be paginated. Complete both columns only if the proposal is numbered consecutively.

Project Description: MARS (Monterey Accelerated Research System) O&M (Operations and Maintenance)

Results from Prior NSF support

NSF Award Number: OCE- 1114794

Amount: $1,112,257; Project Period: 6/1/2011 – 5/31/2015

Title: MARS (Monterey Accelerated Research System) O&M (Operations and Maintenance)

Steve Etchemendy, Director of Marine Operations, MBARI, is the PI on the current MARS (Monterey Accelerated Research System) O&M (Operations and Maintenance) grant (NSF OCE- 1114794, Award total $1,112,257) for performance period 06/1/2011- 05/31/2014. A no cost extension was granted and calculations forecast we have sufficient funds to operate until February 29th, 2015. The second three years of operations have demonstrated a cost effective, reliable, service oriented facility, which has supported science and engineering development effectively. Etchemendy was the PI on the first MARS Operations and Maintenance grant (NSF OCE-0739828: $1,462,983 Total Award Funds). Craig Dawe has been the MARS Operations Manager during NSF OCE-1114794 and NSF OCE-0732983 and will assume the role of PI for the renewal.

Summary of Results:

Broader Impacts
MBARI has integrated the MARS Observatory into the Monterey Bay Aquarium 'Discovering Monterey Canyon' auditorium program as well as in the new MBARI exhibit. The Monterey Bay Aquarium has over one million visitors a year, thereby providing wide exposure for MARS and OOI to the public. The EARTH Project, a science teacher outreach effort, has used MARS as a tool at over 20 presentations to high school educators. See http://www.mbari.org/earth/default.htm for details. The MBARI sponsored PHOBOS data set is available on request from the MBARI Shore Side Data System (SSDS) archive and via the CeNCOOS data portal http://www.cencoos.org.

Intellectual Merit
MARS O&M is a facility built to support scientists and ocean engineers developing and testing new sensors, systems, and operational methods to further ocean science capabilities. Therefore, the intellectual merit of MARS is the sum of the progress made by the MARS users. Listed below are the MARS users for performance period 06/1/2011- 10/1/2014.

Dr. John Orcutt/ SIO UCSD
Dr. John Orcutt of Scripps Institute of Oceanography deployed an Ocean Bottom Seismograph (OBS) on April 7th, 2010 as part of the Ocean Observatory Initiative Cyber-infrastructure effort and the Laboratory for the Ocean Observatory Knowledge INtegration Grid (LOOKING) project. The recovery was extended till October 26th, 2011. (NSF Cooperative Agreement Number: OCE 04-27974) so this spanned both the first and second MARS O&M NSF awards.

Dr. Peter Brewer/MBARI

Dr. Peter Brewer of the Monterey Bay Aquarium Research Institute (MBARI) has deployed the Free Ocean Carbon Dioxide Enrichment Experiment (FOCE) numerous times using the MARS facility. FOCE is designed to study the effects of an increasingly acidic ocean on deep-sea biology. Each deployment refines the processes and the engineering design. The most recent deployment was May 4th 2011 with the subsequent recovery October 8th 2012. The FOCE system development conducted on MARS has contributed to the production of several systems deployed and being deployed around the world, Villefranche surMer, France (http://efoce.eu/), Heron Island, Great Barrier Reef, Austrailia (David Kline), and currently at Casey Station, Antarctica (Antarctica).

MARS/MBARI has deployed the PHOtographic Benthic Observing System (PHOBOS) to the MARS node on three separate occasions. PHOBOS was originally deployed as a tool to aid in operations at the MARS node from October 2010 to September 2011. It was recovered for repairs and enhancements (new lighting platform) and redeployed in November 2011 until October 2012. During the following maintenance period a new platform was built to accommodate additional sensors and a High Definition (HD) underwater imaging system. It has morphed into an outreach device providing real time HD images to the Monterey Bay Aquarium's Live from the Deep exhibit and provides data (Acoustic Doppler Current Profiler (ADCP), Conductivity Temperature Depth (CTD), Oxygen, and Fluorescence) to the CeNCOOS data portal http://www.cencoos.org. It was redeployed in July 2013. Data collected from the site are also being archived in the MBARI Shore Side Data System (SSDS). SSDS is not currently public. However, access to the data can be granted via MBARI's ftp site on request.

Dr. Huaiyang Zhou/Tongji University

In April 2011 Dr. Huaiyang Zhou of Tongji University deployed the Chinese Observatory on MARS for an initial six week trial. Three separate packages were placed near MARS in a two ship operation using the RV Western Flyer to lower and release each package while the ROV Ventana provided guidance to the RV Western Flyer to position each package with meter level precision near MARS. The packages were a junction box (distribution center) with a video camera, a chemical monitoring system measuring in-situ anion concentrations, methane, chlorophyll, oxygen, nitrate, as well as pH, and a Dynamics Environment Monitoring System providing CTD and bottom current velocity. The deployment was extended to October 2012.

Dr. Barbara Romanowicz/UC Berkeley

Dr. Barbara Romanowicz operates Monterey Ocean Bottom Broadband seismometer (MOBB) originally funded under NSF/*OCE grant* OCE-0648302 (now expired) but currently funded by UC (Berkeley). MOBB is a three component, broadband seismometer and the only permanent underwater seismometer west of the San Andreas Fault system. MOBB is connected to MARS via a 3.5 Km cable laid by the MBARI ROV Ventana on February 26, 2009. www.berkeley.edu. During the initial deployment period MOBB was struck by fishing trawls three times, the last breaking the cable and disabling the system. To mitigate these incidents, MBARI developed a plow that works in conjunction with the cable lay tool-sled to bury the cable up to 12 inches in soft seafloor material. MOBB continues operation to date

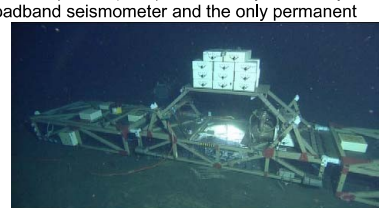

Figure 1 FOCE Free Ocean Carbon Dioxide Enrichment Experiment

under funding from the Berkeley Seismological Laboratory. Fishing activities continue in the area with no further incidents detected.

Chris Lovera/Barry Lab /MBARI

Echinoderms are thought to be highly sensitive to ocean acidification driven by increased atmospheric CO_2. The deepFOCE system was used to evaluate the effects of high CO_2 conditions on the behavior of the deep-sea urchin *Strongylocentrotus fragilis*. We exposed batches of urchins (~30 per treatment) to high (-0.45 pH units) or low CO_2 levels (background seawater pH = 7.62) in FOCE chambers from Sept 19 to Oct 22, 2011 at a depth of 890 m on the continental slope off Monterey, CA. Four trials (days 5, 26, 30, 35) were completed by resetting the experiment with *S. fragilis* from holding cages in each FOCE chamber. Video and still image recordings of urchin movements enclosed in a 'raceway' were made to examine behavioral changes in response to CO_2 levels. The time taken for urchins to travel ~ 0.75m to a food source (giant kelp) in controls ranged from 20 min. to 27 hrs. Urchins exposed to high CO_2 took from 50 min. to greater than 8 days. Total distance and speed will also be used to compare urchin performance between high CO_2 and control treatments. Several reports for shallow-living taxa have noted impacts of high CO_2 levels on urchins ranging from reduced growth, survival, and calcification of larvae, to reduced growth and higher mortality in adults. The goal of this FOCE experiment was to examine long term, less-studied sub-lethal effects that may display as changes in normal movement, posture and feeding rates.

Dr. William Chadwick/PMEL

Dr. William Chadwick deployed a Bottom Pressure Recorder (BPR) coupled with a high resolution tilt meter June 30th, 2010. (NSF OCE-0826490) The instrument package is designed to monitor inflation or deflation in submarine volcanic areas caused by magma movements underground. Originally scheduled for recovery in June 2011 the BPR was extended to November 28th, 2011. The BPR's final destination is Axial Seamount, a tectonically active area on the margin of the Juan de Fuca plate. http://www.pmel.noaa.gov/vents/geology/mars/

Dr. Ken Smith/MBARI

Dr. Ken Smith deployed the Sedimentation Event Sensor (SES) on three occasions, September, October and November 2011. SES is a sediment trap mounted on a rotating plate, allowing the collected sediment to be imaged for composition and size, and measured for chlorophyll content. One of the challenges of this development is creating robust software to control the system both autonomously and for test deployments on MARS. The software framework developed for the Rover is ideally suited to this task, given the similarities of their sensors and actuators (i.e. cameras, lights, motors). To increase the likelihood of success, of the autonomous version of SES was deployed onto MARS. Without these trials on MARS the system would in all likelihood be still under development due to the location of Station M (Latitude N35 9.5150 Longitude W122 59.0024) where it is currently deployed to monitor episodic sedimentation events in support of the MBARI Biodiversity Initiative.

Dr. Clare Reimers/OSU and Dr. Peter Girgus/Harvard

Dr. Clare Reimers (OSU) and Dr. Peter Girgus (Harvard) deployed the Benthic Microbial Fuel Cell Project (BMFC) in October of 2011. The BMFC developed an alternative approach to remote seafloor instrumentation deployments by harvesting power from the environment and then relay data acoustically to the MARS cabled observatory. The primary accomplishment of

this project was the demonstration of this kind of underwater sensing/acoustic communications-based infrastructure. BMFC was recovered in January 2012.

Dr. Kang Ding/University of Minnesota

In November 2012 Dr. Kang Ding from the Earth Science Department of the University of Minnesota deployed the Calibrator Linked In-situ Timed Observatory (CALLISTO) in Monterey Bay. The pH Calibrator is an instrument for *in situ* calibration and measurement of chemical species (pH) in aqueous fluids at elevated pressure. It has been transformed from a battery-powered instrument for short-term application into a unit that can be used to take full advantage of cabled-powered observatories that are now online at a number of locations in marine environment. The MARS deployment was the initial steps in this conversion. This work is supported by US NSF grant 0927615, China National High Technology Research and Development Program funding 2010AA09Z202 and the Knowledge Innovation Project SIDSSE-201204 from Sanya Institute of Deep-sea Science and Engineering. CALLISTO was recovered in January of 2013. Dr. Kang Ding has been funded again by NSF and we expect to install the new version of CALLISTO on MARS in 2016.

Dr. Chris Scholin/MBARI

Deep Environmental Sample Processor (D-ESP) was funded by NASA and NSF OCE-0314222. The D-ESP is a microbiology laboratory capable of autonomously running sandwich hybridization and quantitative PCR assays *in situ*. The D-ESP collects particulates from a water sample (typically 1 liter), lyses these particulates, and washes the lysate over a 35-target probe array. It also can extract nucleic acid from that lysate and perform a single-plex qPCR assay on up to five targets. The D-ESP has just completed a NASA-sponsored 34 week run on the MARS cable. During that time, 24 samples were collected, performed both sandwich hybridization and qPCR on each sample, and collected and preserved a second sample near that same time-point for later analysis in the laboratory.

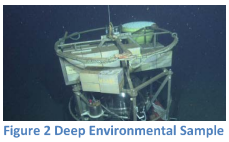

Figure 2 Deep Environmental Sample Processor

D-ESP had three deployments on the MARS cable in the last three years:
Dec 14, 2009 to Jan 7, 2010
Nov 30, 2010 to Jan 4, 2011
Apr 18, 2013 to Dec 11, 2013
Each deployment provided constant communication with the instrument, and in some cases allowed us to fix instrument issues that normally would cause the mission to abort. The third run on the cable was the longest on record for a microbial laboratory, and allowed us to view not only changes in microbial populations resulting from deep-water changes in the currents, but also microbial changes in the detrital 'snow' raining down from the surface through the winter/summer and summer/winter transition periods.

Publications and products resulting from prior support:

The American Geophysical Union (AGU) meeting in December 2012, OOI's Cyberinfrastructure: An Opening, Contributed poster presented by John Graybeal; Tim Ampe; Matthew Arrott; Alan D. Chave; Rod Cressey; Susanne Jul; Tim McPhail; Michael Meisinger; John A. Orcutt; Cheryl L. Peach; Oscar Schofield; Karen Stocks; Julie Thomas; Frank Vernon.

MTS/IEEE OCEANS '11 Kona, Hawai'i, September 19-22, 2011: Contributed talk
C.D. Kecy, E.T. Peltzer, P.M. Walz, K. Headley, B. Herlien, W. Kirkwood, T. O' Reilly, K.A. Salamy, F. Shane, J. Schofield, and P.G. Brewer. Design and Development of the CO_2 Enriched Seawater Distribution System.

Fall 2011 AGU Meeting, San Francisco, CA. December 5-9, 2011: Contributed talk
Kirkwood, W.J., Peltzer, E.T., Walz, P.M., Shane, F., Kecy, C., Headley, K.L., Herlien, B., Maughan, T., Scholfield, J., Salamy, K.A., O'Reilly, T. & Brewer, P.G. Enriched Seawater Delivery System to Support In Situ Ocean Acidification Experiments using Carbon Dioxide for pH Adjustment of Seawater.

AGU Fall Meeting, San Francisco, CA, Dec 3-7, 2012: Contributed poster
Long-term, High Frequency, High Precision pH Measurements on the MBARI deep-water FOCE Experiment at the MARS Cabled Observatory in Monterey Bay, CA. E.T. Peltzer; T. Maughan; J.P. Barry; P.G. Brewer; K.L. Headley; R. Herlien; W.J. Kirkwood; G.I. Matsumoto; T.C. O'Reilly; K.A. Salamy; J. Scholfield; F.F. Shane; P.M. Walz.

Oceans 2012 MTS/IEEE, Yeosu, Korea, 21–24 May 2012
Nano-resolution technology demonstrates promise for improved local tsunami warnings on the MARS project. Paros, J., C. Meinig, M. Spillane, P. Migliacio, L. Tang, W. Chadwick, T. Schaad, and S. Stalin. In (2012)

AGU Fall Meeting, San Francisco, CA, Dec 3-7, 2012: Contributed poster
A remotely operated time-series sampler for collecting gas-tight hydrothermal fluids. Shijun Wu [1, 2], Canjun Yang [1], Kang Ding [2], Chunyang Tan 1. Key Laboratory of Fluid Power Transmission and Control, Zhejiang University, Hangzhou, China 2. Earth Science Department, University of Minnesota, Minneapolis, MN, United States3. Tongji University, Shanghai, China

IEEE/ASME TRANSACTIONS ON MECHATRONICS, VOL. 17, NO. 1, FEBRUARY 2012
Development of an *In Situ* pH Calibrator in Deep Sea Environments. Chunyang Tan, Kang Ding, Bo Jin, William E. Seyfried Jr., and Ying Chen

IEEE Oceans 2011 Development of an Undersea Science Node for Cabled Ocean Observatories. Feng Lu, Huaiyang Zhou, Xiaotong Peng, Jiguang Yue, Bin He, Bangchun Wu. Tongji University, Shanghai, China

Sedimentation Event Sensor: new ocean instrument for in-situ imaging and fluorometry of sinking particulate organic carbon. IEEE Journal of Oceanic Engineering. Ken Smith et. al.

On the Systematic Long Period Noise Reduction on Ocean Floor Broadband Seismic Sensors Collocated with Differential Pressure Gauges. Taka'aki Taira, Zhao Zheng and Barbara Romanowicz, Berkeley Seismological Laboratory, University of California, Berkeley. *Under review.*

Project Description

Background

The MARS observatory was originally conceived as a test-bed for equipment and instrumentation destined for the Ocean Observing Initiative's (OOI) Regional Scale Networks (RSN) and other observatory efforts nationally and internationally. As these installations mature and begin to be operational, the need for pre-deployment testing and qualification becomes paramount. Over the past six years of operation MARS has proven its value. The cost and risks associated with deploying untested and unverified equipment is greatly reduced by using the MARS observatory. As an example, Dr. Bill Chadwick's BPR tilt meter was tested on MARS and is the first instrument providing reliable data from the RSN.

MARS became operational November 10, 2008 after an eight month commissioning delay. MARS has been operating with just a few minor interruptions in service for maintenance and repair since. As of October 2014 MARS completed a full year of faultless service with no interruptions at all.

There is relatively inexpensive and readily available access through MBARI research vessels and ROV systems. The cost of using these assets is greatly reduced by proximity and availability.

The U.S. Ocean Observing Initiative is currently on the cusp of being fully operational. MARS has been used as a test bed to develop instruments and sensors for the RSN (Regional Scale Nodes) including Dr. Freitag's Acoustic Comms Base Station (ACCOMS), Dr. Chadwick's Bottom Pressure Tilt meter (BPR), Dr. Kang Ding's Calibrator Linked In-situ Timed Observatory (CALLISTO), Drs. Reimers and Girguis' Benthic Microbial Fuel Cell (BMFC). Additionally MARS has been used to test potential candidates for either OOI or IOOS observatories; Dr. Horne's EK 60 and Dr. Scholin's Deep Environmental Sample Processor (DESP). MARS has also been used to host an assortment research and engineering efforts including Dr. Barbara Romanowitz's Monterey Ocean Bottom Seismometer (MOBB), Dr. Peter Brewer's Free Ocean Carbon Dioxide Enrichment Experiment (FOCE), the Photographic Benthic Observing System (PhoBOS) Dr. Matsumoto, Dr. Edie Widder's Eye in the Sea (EITS), Dr. Ken Smith's Benthic Rover, and the Sediment Event Sensor (SES) and the Tongji University's Chinese Observatory on MARS. Additionally, MARS is supporting the development of an inductive power and data connector prototype which has successfully transferred power (150 watts) and data (100 Mbps) underwater. Next year, if funded, we will replace one ODI connector with an inductive connector strip that will have four power and data outputs. This will effectively replace the need to plug and unplug the ODI connectors providing increased reliability for all the cabled observatories and quadruple the MARS science port availability.

MARS Description

Located on a sediment-covered site on Smooth Ridge, approximately 37 km from Moss Landing, California, MARS is a single node cabled observatory with eight ODI (Ocean Design Inc.) underwater mate-able science connectors. Connected to the shore station via 52 km of

submarine telecom cable, the node lies at 890 m depth. The shore station provides 7.5 kW of power and telemetry via eight single mode fibers. Power is distributed as needed across the eight science ports at both 375 and 48 VDC (Volts, Direct Current). Each science port provides a 100-Mbit per second full duplex Ethernet communication channel. Time distribution is provide by NTP (Network Time Protocol) for accuracies of 10 milliseconds and a 1 PPS (Pulse Per Second) signal providing accuracy on the order of 10 microseconds.

MARS users can plug instrument clusters into the science ports via "extension" cables. Both of MBARI's ROVs have been equipped with cable-laying tool sleds capable of laying four Km of 3/8 inch cable from the MARS node. Longer distances can be achieved by "daisy chaining" extension cables. In addition to surfaced laid cable these tool-sleds can be equipped with a plow that will bury cables up to 0.3 meters in soft substrate. Power delivery at the end of the extension cables is a function of the extension cable length and conductor size.

The primary electronics module is exchangeable by ROV without recovery of the main telecom cable or its termination assembly. This makes maintenance of the sea floor electronics affordable because it requires only one dive to unplug the electronics and recover it for shore side repair and one dive to reconnect it.

Data Management Plan

MARS O&M is a facility built to support scientists and ocean engineers developing and testing new sensors, systems, and operational methods to further ocean science capabilities. As such MARS O&M does not have its own DMAS (Data Management and Storage) but rather directs MARS users control and data directly to the MARS users IP address.

MARS is connected to the internet via CENIC, a 100 Gigabit/sec (Gb/s) circuit, which is shared by MBARI and Moss Landing Marine Labs (MLML). Therefore, there is no choke point between the 1 gigabit MARS output to the users' IP destinations.
http://sanctuarysimon.org/projects/project_info.php?projectID=100391&site=true

Permits

As part of the permit and reporting requirements, the MARS facility is required to complete an environmental impact survey every five years. The most recent report can be found at http://sanctuarysimon.org/projects/project_info.php?projectID=100391&site=true. We have started the second environmental impact survey and will complete the second survey next year (2015).

Service-Oriented Facility

The MARS facility is designed to provide service to the ocean science community in a cost effective manner. It requires only one full-time position (the MARS Facility Support Technician), providing only essential operations and maintenance services limiting fixed costs. Keeping these costs low results in a cost effective program for NSF because resources are not wasted when the MARS user load is low or self-sufficient users are using the MARS test bed. As a result, MARS users need to request funding for special technical services required by their project in their proposals. During proposal preparation, potential MARS users are provided technical, budget and deployment/recovery advice by the MARS Operations Manager (less than

half time position). Once the MARS users are funded, MBARI's Operations Administrator provides permit support, and Information Services provides the necessary IT support to insure connectivity from the users instrument to the users IP addresses at no cost to NSF or the MARS user. MARS does not provide DMAS (Data Management and Support). MARS does provide facilities to locate user RAID arrays, computers or routers as needed. MARS users usually need a single test tank day to verify that their instruments are correctly configured to operate on MARS via the wet node simulator. Ship and ROV deployment and recovery is available using either of MBARI's two ROV-equipped ships, or UNOLS ships. Ocean science users are charged "at cost" rates for MBARI ship/ROV services. MARS is available to several different funding organizations, including but not limited to: NSF, ONR, NOAA, NASA, DOE, and DOD. Each of these organizations will benefit from the availability of MARS as an ocean science and technology test site. Upon inception of the MARS facility, NSF and MARS agreed that the MARS O&M costs should be distributed fairly to the actual users and NSF should not bear the full burden of the ongoing operations and maintenance costs. To achieve this objective, MARS charges a minimal fee for each project funded either by NSF or to those whose objective is to develop technology for OOI observatories using one of the eight MARS ports. The intent of this fee is help pay for maintenance and other costs. MARS also requires a fee equaling a fair share of the operational costs from other U.S. government funding agencies to use MARS, as these agencies may have objectives not directly linked to NSF or OOI. The current MBARI/NSF rate is $1000.00 per month. All other organizations using MARS will be charged $5000.00 per month. This charge begins the day the instrument receives power from MARS and ends on the day MARS power is turned off to the instrument. Partial months are prorated.

Operations Philosophy
The MARS operations team is committed to enabling MARS users, engineers and scientists, to be successful developing and testing their systems on the MARS cabled test bed observatory. Although the NSF-funded MARS team is small, MBARI's Marine Operations and Engineering Divisions are dedicated to developing operational capabilities for ocean observing that have common uses. For example, the NSF-sponsored MARS and many MBARI-sponsored projects both benefit from developments like the inductive power and data connector, the cable laying tool sleds, extension cable developments, SIIMs (Science Instrument Interface Modules), PUCK (Programmable Underwater Connector with Knowledge) and SIAM (Software Infrastructure and Applications for MOOS). Developments to enhance ocean-observing capabilities benefit our common objectives. The SIIM design is available at no charge to users. MARS O&M also takes pride in MARS users' successes. As indicated above the projects over these past years are a testament to the success of MARS and its value to the Ocean Science community.

What does MARS O&M cost?
Ship/ROV days for maintaining the infrastructure are included in this proposal. Parts and supplies costs are requested. Labor equaling 1.25 FTE (Full Time Equivalents) is requested for the duration of the project. Costs associated with fishermen's association coordination are requested. Costs derived from the permit process include reoccurring benthic biology survey requirements and a minimal fee for right of way through Moss Landing Harbor District property. This proposal is based on guidance from NSF to provide the minimum operations and maintenance costs consistent with a no frills support operation. Extra services can be provided when supported by the user's project funding.

Permit mitigation, insurance and "right-of-way use" lease
The installation of the MARS Cabled Observatory required approval from 13 State and Federal Agencies. Mitigation for issues ranging from seafloor disturbance to right-of-way through California State lands have resulted in the following on-going costs:

Cable route inspections:

- Ongoing ROV surveys of the cable route preformed are included.
- "Actual Impacts Assessment" surveys (biologic sampling and assay) were required 18 – 24 months after installation now extended to every five years for the duration. Costs included in this proposal.

Fisherman Agreement:

- A 24-hour fishermen's hotline has been established at MBARI's expense.
- In the unlikely event that fishing gear gets tangled in the MARS cable/node, costs for fishing gear lost are **not** provided for in this proposal. A supplemental proposal will be submitted to NSF in the event that this becomes necessary.

Insurance:

• Liability insurance costs are paid for by MBARI.
• Property and D.I.C. (earthquake) coverage estimates are cost prohibitive; MBARI has received a waiver from NSF to exclude property and D.I.C. (earthquake) insurance for the facility.

Right of way:

• A portion of the MARS cable route transverses Moss Landing Harbor District property, costs are included in this proposal.

The MARS staff

The MARS Operations Manager (two months a year) is responsible for maximizing the success of the MARS users' community. Additionally, the MARS Operations Manager is the primary resource to assess deployment "readiness" of science experiments as well as any infrastructure component of MARS. The MARS Operations Manager will function as the MBARI Marine Operations Technical Manager during the unfunded portion of the year. The logic here is to integrate MARS maintenance and operations requirements with the primary service vessels for MARS as much as possible.

This Position:
• Works with MARS users at the proposal stage to refine experiment designs
• Advises on the development of new equipment such as extension cables, SIIM's (Science Instrument Interface Modules) and connectors
• Provides oversight and maintenance plans for all components of system
• Maintains records for all operational issues and assists in reporting this information
• Develops deployment plans for each science and/or engineering mission for MARS
• Coordinates deployment schedules with MBARI's Division of Marine Operations (DMO)
• Manages MARS finances and cost reporting
• Assists with troubleshooting electronics and communications problems

The MARS Facility Support Technician (full time position) is responsible for the day-to-day operation of the MARS system.
This Position:
• Monitors data streams and adjusts power levels using PMACS (Power Management and Control System).
• Monitors system functional parameters and provides watchdog functions to ensure smooth operations.

• Insures the data store and forward functions are working.
• Maintains the system and manages the day-to-day needs of the MARS computer network.
• Assists with the test tank experiment installations and supports users.

The MARS PIs
Steve Etchemendy, Director of Marine Operations at MBARI, will function as Co PI for MARS until his retirement in December 2015. He deals with policy issues, permitting, insurance, staffing, and reporting obligations with NSF. Additionally, Steve will represent MARS O&M for UNOLS ship scheduling functions when required. (**At no cost to NSF**)
Craig Dawe, MBARI Marine Operations Technical Manager and MARS Operations Manager will act as Co PI with Steve Etchemendy, providing technical oversight to the project as well as meeting the other obligations of PI.

MARS user costs (not covered by MARS O&M)
A MARS user proposal may request technical support and ship/ROV support from MBARI or may use UNOLS vessels/submersibles or other resources. An example of services available "at cost" from MBARI are provided at the following URL: http://www.mbari.org/mars/new/rates.html
Note: Labor is based on average wage for that group plus fringe and overhead. Ship/ROV costs are operating costs divided by days/year so they vary each year.

Concept of Operations
• ***Operations Philosophy*** **-** The primary mission of MARS is to provide a facility to test and develop equipment for the ocean science community. In many cases MARS will provide the first long duration sea trials of ocean sensors under development. MARS will enable ocean engineers not only to directly monitor their instrumentation on the sea floor but also to modify their software based on real world sensor inputs. Although primarily a test bed, MARS can be used as an ocean science platform. MOBB, UC Berkley's broadband seismometer feeds directly into the Northern California Seismic Network. Where it is appropriate, NSF, NOAA or other funding agencies may decide to install science sensors on MARS that are not in the development phase. If recovery of equipment is necessary, it is only two hours away by ship from Moss Landing. To be cost effective MARS staff will operate on a normal (40 hr.) work week schedule. This will minimize personnel costs and is appropriate for a test bed facility.

• ***Customer support, pre-proposal stage*** **-** The overall purpose of the MARS O&M is to provide the platforms and services necessary to test and support prospective technologies destined for use on ocean observatories. MARS O&M will provide prospective users with support to estimate ship/ROV time to deploy and recover their experiments as well as the shore-side technician time that is necessary to test equipment prior to pre-qualification deployments in MBARI's test tank. MBARI does not have sufficient engineering resources to support all potential MARS users but we have assembled a list of **recommended engineering resources** that can be tailored to a potential user's needs. This list includes freelance engineers as well as medium sized companies like Ocean Design and Ocean Works (Vancouver, B.C.). Even large companies like SAIC are on the MARS engineering support list. MARS O&M will assist potential users by providing a list of engineering resources that could fit their needs.

• ***Customer support permits*** **-** MARS is located in the Monterey Bay National Marine Sanctuary. As such, some instrumentation will require permits and others may qualify under the MARS general permit. Federal regulations require NSF to assess whether a project meets applicable federal and state permits prior to awarding a proposal grant. NSF will use the standard proposal process to review MARS user proposals. If a proposal is judged acceptable but requires a permit, NSF may fund resources necessary for the permit process prior to

granting the proposal. This may range from minor resources to prepare permit documentation to resources sufficient to submit an EIS (Environmental Impact Survey). NSF will submit proposals not covered by the MARS general permit through interagency channels for approval.

• ***Customer support during operations*** - A MARS user's instruments deployed on MARS are the sole responsibility of the user. MARS does not have any DMAS (Data Management and Archiving) capability. Instead, MARS will direct data connectivity to a user-supplied IP address. If a MARS user needs power adjustments, instrument recovery, or other support over the course of a deployment, we expect an e-mail message that will be acted on during normal working hours to schedule necessary adjustments.

Communications
MARS O&M provides a list server to keep interested parties informed about MARS issues. The MARS technical/schedule discussion list reports on system down time, technical and schedule issues.

Not Applicable. There are no references cited for this project.

Steve Etchemendy
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Moss Landing, CA 95039
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(a) Professional Preparation
University of Washington, B.S., Natural Science, DMG 1972
Air/Mixed Gas/Saturation Diver, Commercial Diving Center, Wilmington, CA. 1979
Atmospheric Diving Systems Certification (*Jim/Wasp*), Alton, England 1982
Advanced Diving Systems, Supervisor Certification, Aberdeen, Scotland 1984
Department of the Navy, Deep Submergence Operator Certificate 1989
U.S. Coast Guard, U. S. Merchant Marine: Master, Master 100 GT 1996

(b) Appointments
MBARI, Director of Marine Operations, 1989 - present
WHOI, Alvin Pilot/Electrical Section Lead 1987 - 1989
Deep Ocean Engineering, Vice President 1982 - 1986
Oceaneering International, Diving Supervisor 1979 - 1982

(c) Selected Publications
Etchemendy, S. and D. Davis (1991) Designing an ROV for oceanographic research: Monterey Bay Aquarium Research Institute converted an oil-field ROV into a scientifically usable tool. Sea Technology 32 (2): 21.

Dawe, T.C., D.S. Stakes, P.R. McGill, J.P. Barry and **S. Etchemendy** (1998) Subsea instrument deployments: methodology and techniques using a work class Remotely Operated Vehicle (ROV). Oceans '98, Nice, France, IEEE/OES: 1589-1593. Stakes, D.S., G.L. Holloway, P. Tucker,

T.C. Dawe, D. Burton, J.A.R. McFarlane and **S. Etchemendy** (1997). Diamond rotary coring from an ROV or submersible for hardrock sample recovery and instrument deployment: The MBARI multiple-barrel rock coring system. Marine Technology Society Journal 31 (3): 11-20

Romanowicz, B., D. Stakes, J.P. Montagner, P. Tarits, R. Uhrhammer, M. Begnaud, E. Stutzmann, M. Pasyanos, J.-F. Karczewski, **S. Etchemendy** and D. Neuhauser (1998). MOISE; a pilot experiment towards long-term sea-floor geophysical observatories. *Earth, Planets and Space* 50 (11-12): 927-937.

Stutzmann, E., J.P. Montagner, A. Sebai, W.C. Crawford, J.L. Thirot, P. Tarits, D. Stakes, B.Romanowicz, J.F. Karczewski, J.C. Koening, J. Savary, D. Neuhauser and **S. Etchemendy** (2001). MOISE: A prototype multiparameter ocean-bottom station. *Bulletin of the Seismological Society of America* 91 (4): 885-892. (ii)

Stakes, D.S., B. Romanowicz, J.-P. Montagner, P. Tarits, J.-F. Karczewski, S. **Etchemendy,** T.C. Dawe, D. Neuhauser, P.R. McGill, J.C. Koening, J. Savary, M. Begnaud and M. Pasyanos (1998). Seismic experiment paves way for long-term seafloor observatories. *EOS, Transactions* 79 (26): 301, 308-309.

(d) Synergistic Activities

The MBARI Director of Marine Operations manages a facility that provides the services of three vessels, three ROV's, and three AUVs (http://www.mbari.org/dmo/vessels.htm) and an Observatory (mooring) Group that develops and maintains a technologically advanced oceanographic mooring (http://www.mbari.org/dmo/observatory/oo.htm)There are many similarities in the requirements necessary to operate a facility like MARS and the requirements of a diverse Marine Operations Division. Operational techniques for ROV deployed scientific instrumentation and in-situ maintenance has been developed and can be reviewed in the listed publications or online at (http://www.mbari.org/mars/). Reviewers may find data products from MBARI moorings by viewing quick look plots at (http://www.mbari.org/oasis/qc/index.html).

(e) Collaborators and Co-Editors

Dr. Peter Brewer (MBARI), Dr. J.P. Barry (MBARI),Dr. William Chadwick (OSU), Dr. Kang Ding (U. Minnesota), Dr. Lee Freitag (WHOI), Dr. Peter Girguis (Harvard), Dr. John Horne (UW), Dr. Clair Reimers (OSU), Dr. Barbara Romanowitz (UC, Berkley), Dr. Chris Meinig (NOAA), Dr. John Orcutt (SIO), Dr. Chris Scholin (MBARI), Dr. Ken Smith's (MBARI), Dr. Edie Widder (ORCA), Dr. Huaiyang Zhou (Tongji University), Dr. Bruce Hutchison (Glosten Assoc.)

Craig Dawe
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(a) Professional Preparation
British Columbia Institute of Technology, *National Diploma of Technology Electrical & Electronics Program* 1984
University of Phoenix, B.S., Information Technologies, 2002

(b) Appointments
MBARI, Technical Support Manager, Nov 2009 - present
MARS Operations Manager Oct 2007 - present
Chief ROV Pilot Ventana Jan 1995 – present
Seaway Technology PCL, Senior ROV Pilot/ technician 1990-1991
Oceaneering A/S, ROV Senior Supervisor 1989- 1990

(c) Selected Publications
Dawe T. Craig, Bird, Larry, Talkovic, Mark, Brekke, Knute, Osborne, Denver J., Etchemendy, Stephen, Operational Support of Regional Cabled Observatories, The MARS Facility, Proceedings OCEANS 2005, Washington DC.

Dawe T. Craig, and Stakes, Debra S., McGill, P., Barry, J.P., Etchemendy, S.E SubSea Instrument Deployments: Methodology and Techniques Using a Work Class Remotely Operated Vehicle. (ROV) Proceedings OCEANS 1998., Nice, France

Stakes, D.S., B. Romanowicz, J-P. Montagner, P. Taris, J-F. Karczewski, S. Etchemendy, **C. Dawe**,D. Neuhauser, P. McGill, J.C. Koenig, J. Savary, and M. Pasyanos, MOISE: Monterey Bay Ocean Bottom International Seismic Experiment, EOS, Tans. Amer. Geophys. Un., June 24, 1998.

Stakes, D.S., Holloway, G.L., Tucker, P., **Dawe C.**, Diamond Rotary Coring from an ROV or Submersible for Hardrock Sample Recovery and Instrument Deployment: The MBARI Multiple-Barrel Rock Coring System, Marine Tech. Soc. Jour., 31, 11-20,1997.

(d) Synergistic Activities
The Chief ROV pilot is responsible for operations involving the deployment of research equipment and experiments with the ROV or to the seafloor. This is similar to the tasks required to ensure that researchers are properly advised when deploying equipment on the MARS observatory and that it will interface correctly with the ROV systems at MBARI.

(e) Collaborators and Co-Editors

Dr. Peter Brewer (MBARI), Dr. J.P. Barry (MBARI),Dr. William Chadwick (OSU), Dr. Kang Ding (U. Minnesota), Dr. Lee Freitag (WHOI), Dr. Peter Girguis (Harvard), Dr. John Horne (UW), Dr. Clair Reimers (OSU), Dr. Barbara Romanowitz (UC, Berkley), Dr. Chris Meinig (NOAA), Dr. John Orcutt (SIO), Dr. Chris Scholin (MBARI), Dr. Ken Smith's (MBARI), Dr. Edie Widder (ORCA), Dr. Huaiyang Zhou (Tongji University)

SUMMARY PROPOSAL BUDGET

YEAR 1

ORGANIZATION	PROPOSAL NO.	DURATION (months)	
Monterey Bay Aquarium Research Institute		Proposed	Granted
PRINCIPAL INVESTIGATOR / PROJECT DIRECTOR	AWARD NO.		
Steve Etchemendy			

FOR NSF USE ONLY

A. SENIOR PERSONNEL: PI/PD, Co-PI's, Faculty and Other Senior Associates (List each separately with title, A.7. show number in brackets)	NSF Funded Person-months CAL	ACAD	SUMR	Funds Requested By proposer	Funds granted by NSF (if different)
1. **Craig Dawe - Co-PI**	2.00	0.00	0.00	**25,990**	
2.					
3.					
4.					
5.					
6. (**0**) OTHERS (LIST INDIVIDUALLY ON BUDGET JUSTIFICATION PAGE)	0.00	0.00	0.00	**0**	
7. (**1**) TOTAL SENIOR PERSONNEL (1 - 6)	2.00	0.00	0.00	**25,990**	
B. OTHER PERSONNEL (SHOW NUMBERS IN BRACKETS)					
1. (**0**) POST DOCTORAL SCHOLARS	0.00	0.00	0.00	**0**	
2. (**4**) OTHER PROFESSIONALS (TECHNICIAN, PROGRAMMER, ETC.)	17.00	0.00	0.00	**120,702**	
3. (**0**) GRADUATE STUDENTS				**0**	
4. (**0**) UNDERGRADUATE STUDENTS				**0**	
5. (**0**) SECRETARIAL - CLERICAL (IF CHARGED DIRECTLY)				**0**	
6. (**0**) OTHER				**0**	
TOTAL SALARIES AND WAGES (A + B)				**146,692**	
C. FRINGE BENEFITS (IF CHARGED AS DIRECT COSTS)				**82,148**	
TOTAL SALARIES, WAGES AND FRINGE BENEFITS (A + B + C)				**228,840**	
D. EQUIPMENT (LIST ITEM AND DOLLAR AMOUNT FOR EACH ITEM EXCEEDING $5,000.)					
computer hardware (routers) **$ 16,000**					
TOTAL EQUIPMENT				**16,000**	
E. TRAVEL 1. DOMESTIC (INCL. CANADA, MEXICO AND U.S. POSSESSIONS)				**1,000**	
2. INTERNATIONAL				**0**	
F. PARTICIPANT SUPPORT COSTS					
1. STIPENDS $ **0**					
2. TRAVEL **0**					
3. SUBSISTENCE **0**					
4. OTHER **0**					
TOTAL NUMBER OF PARTICIPANTS (**0**) TOTAL PARTICIPANT COSTS				**0**	
G. OTHER DIRECT COSTS					
1. MATERIALS AND SUPPLIES				**10,450**	
2. PUBLICATION COSTS/DOCUMENTATION/DISSEMINATION				**0**	
3. CONSULTANT SERVICES				**0**	
4. COMPUTER SERVICES				**0**	
5. SUBAWARDS				**0**	
6. OTHER				**128,460**	
TOTAL OTHER DIRECT COSTS				**138,910**	
H. TOTAL DIRECT COSTS (A THROUGH G)				**384,750**	
I. INDIRECT COSTS (F&A)(SPECIFY RATE AND BASE)					
Modified Total Direct Costs (Rate: 51.0000, Base: 269750)					
TOTAL INDIRECT COSTS (F&A)				**137,573**	
J. TOTAL DIRECT AND INDIRECT COSTS (H + I)				**522,323**	
K. RESIDUAL FUNDS				**0**	
L. AMOUNT OF THIS REQUEST (J) OR (J MINUS K)				**522,323**	

M. COST SHARING PROPOSED LEVEL $ **0** AGREED LEVEL IF DIFFERENT $

PI/PD NAME	FOR NSF USE ONLY		
Steve Etchemendy	INDIRECT COST RATE VERIFICATION		
ORG. REP. NAME*	Date Checked	Date Of Rate Sheet	Initials - ORG
Danielle Haddock			

1 ***ELECTRONIC SIGNATURES REQUIRED FOR REVISED BUDGET**

SUMMARY PROPOSAL BUDGET

YEAR 2

ORGANIZATION	PROPOSAL NO.	DURATION (months)	
Monterey Bay Aquarium Research Institute		Proposed	Granted
PRINCIPAL INVESTIGATOR / PROJECT DIRECTOR	AWARD NO.		
Steve Etchemendy			

FOR NSF USE ONLY

A. SENIOR PERSONNEL: PI/PD, Co-PI's, Faculty and Other Senior Associates (List each separately with title, A.7. show number in brackets)	NSF Funded Person-months CAL	ACAD	SUMR	Funds Requested By proposer	Funds granted by NSF (if different)
1. **Craig Dawe - Co-PI**	2.00	0.00	0.00	**26,770**	
2.					
3.					
4.					
5.					
6. (**0**) OTHERS (LIST INDIVIDUALLY ON BUDGET JUSTIFICATION PAGE)	0.00	0.00	0.00	**0**	
7. (**1**) TOTAL SENIOR PERSONNEL (1 - 6)	2.00	0.00	0.00	**26,770**	
B. OTHER PERSONNEL (SHOW NUMBERS IN BRACKETS)					
1. (**0**) POST DOCTORAL SCHOLARS	0.00	0.00	0.00	**0**	
2. (**1**) OTHER PROFESSIONALS (TECHNICIAN, PROGRAMMER, ETC.)	13.00	0.00	0.00	**75,405**	
3. (**0**) GRADUATE STUDENTS				**0**	
4. (**0**) UNDERGRADUATE STUDENTS				**0**	
5. (**0**) SECRETARIAL - CLERICAL (IF CHARGED DIRECTLY)				**0**	
6. (**0**) OTHER				**0**	
TOTAL SALARIES AND WAGES (A + B)				**102,175**	
C. FRINGE BENEFITS (IF CHARGED AS DIRECT COSTS)				**57,217**	
TOTAL SALARIES, WAGES AND FRINGE BENEFITS (A + B + C)				**159,392**	
D. EQUIPMENT (LIST ITEM AND DOLLAR AMOUNT FOR EACH ITEM EXCEEDING $5,000.)					
ODI connectors $ **18,000**					
TOTAL EQUIPMENT				**18,000**	
E. TRAVEL 1. DOMESTIC (INCL. CANADA, MEXICO AND U.S. POSSESSIONS)				**1,000**	
2. INTERNATIONAL				**0**	
F. PARTICIPANT SUPPORT COSTS					
1. STIPENDS $ **0**					
2. TRAVEL **0**					
3. SUBSISTENCE **0**					
4. OTHER **0**					
TOTAL NUMBER OF PARTICIPANTS (**0**) TOTAL PARTICIPANT COSTS				**0**	
G. OTHER DIRECT COSTS					
1. MATERIALS AND SUPPLIES				**7,450**	
2. PUBLICATION COSTS/DOCUMENTATION/DISSEMINATION				**0**	
3. CONSULTANT SERVICES				**0**	
4. COMPUTER SERVICES				**0**	
5. SUBAWARDS				**0**	
6. OTHER				**40,658**	
TOTAL OTHER DIRECT COSTS				**48,108**	
H. TOTAL DIRECT COSTS (A THROUGH G)				**226,500**	
I. INDIRECT COSTS (F&A)(SPECIFY RATE AND BASE)					
Modified Total Direct Costs (Rate: 51.0000, Base: 174510)					
TOTAL INDIRECT COSTS (F&A)				**89,000**	
J. TOTAL DIRECT AND INDIRECT COSTS (H + I)				**315,500**	
K. RESIDUAL FUNDS				**0**	
L. AMOUNT OF THIS REQUEST (J) OR (J MINUS K)				**315,500**	

M. COST SHARING PROPOSED LEVEL $ **0** AGREED LEVEL IF DIFFERENT $

PI/PD NAME	FOR NSF USE ONLY		
Steve Etchemendy	INDIRECT COST RATE VERIFICATION		
ORG. REP. NAME*	Date Checked	Date Of Rate Sheet	Initials - ORG
Danielle Haddock			

 ***ELECTRONIC SIGNATURES REQUIRED FOR REVISED BUDGET**

SUMMARY PROPOSAL BUDGET

YEAR 3

ORGANIZATION **Monterey Bay Aquarium Research Institute**				FOR NSF USE ONLY PROPOSAL NO.	DURATION (months) Proposed / Granted
PRINCIPAL INVESTIGATOR / PROJECT DIRECTOR **Steve Etchemendy**				AWARD NO.	
A. SENIOR PERSONNEL: PI/PD, Co-PI's, Faculty and Other Senior Associates (List each separately with title, A.7. show number in brackets)	NSF Funded Person-months CAL	ACAD	SUMR	Funds Requested By proposer	Funds granted by NSF (if different)
1. **Craig Dawe - Co-PI**	2.00	0.00	0.00	**27,573**	
2.					
3.					
4.					
5.					
6. (**0**) OTHERS (LIST INDIVIDUALLY ON BUDGET JUSTIFICATION PAGE)	0.00	0.00	0.00	**0**	
7. (**1**) TOTAL SENIOR PERSONNEL (1 - 6)	2.00	0.00	0.00	**27,573**	
B. OTHER PERSONNEL (SHOW NUMBERS IN BRACKETS)					
1. (**0**) POST DOCTORAL SCHOLARS	0.00	0.00	0.00	**0**	
2. (**2**) OTHER PROFESSIONALS (TECHNICIAN, PROGRAMMER, ETC.)	13.00	0.00	0.00	**77,667**	
3. (**0**) GRADUATE STUDENTS				**0**	
4. (**0**) UNDERGRADUATE STUDENTS				**0**	
5. (**0**) SECRETARIAL - CLERICAL (IF CHARGED DIRECTLY)				**0**	
6. (**0**) OTHER				**0**	
TOTAL SALARIES AND WAGES (A + B)				**105,240**	
C. FRINGE BENEFITS (IF CHARGED AS DIRECT COSTS)				**58,935**	
TOTAL SALARIES, WAGES AND FRINGE BENEFITS (A + B + C)				**164,175**	
D. EQUIPMENT (LIST ITEM AND DOLLAR AMOUNT FOR EACH ITEM EXCEEDING $5,000.) **computer hardware (routers)** **$ 16,000**					
TOTAL EQUIPMENT				**16,000**	
E. TRAVEL 1. DOMESTIC (INCL. CANADA, MEXICO AND U.S. POSSESSIONS)				**1,000**	
2. INTERNATIONAL				**0**	
F. PARTICIPANT SUPPORT COSTS 1. STIPENDS $ **0** 2. TRAVEL **0** 3. SUBSISTENCE **0** 4. OTHER **0**					
TOTAL NUMBER OF PARTICIPANTS (**0**) TOTAL PARTICIPANT COSTS				**0**	
G. OTHER DIRECT COSTS					
1. MATERIALS AND SUPPLIES				**22,450**	
2. PUBLICATION COSTS/DOCUMENTATION/DISSEMINATION				**0**	
3. CONSULTANT SERVICES				**0**	
4. COMPUTER SERVICES				**0**	
5. SUBAWARDS				**0**	
6. OTHER				**76,823**	
TOTAL OTHER DIRECT COSTS				**99,273**	
H. TOTAL DIRECT COSTS (A THROUGH G)				**280,448**	
I. INDIRECT COSTS (F&A)(SPECIFY RATE AND BASE) **Modified Total Direct Costs (Rate: 51.0000, Base: 194488)**					
TOTAL INDIRECT COSTS (F&A)				**99,189**	
J. TOTAL DIRECT AND INDIRECT COSTS (H + I)				**379,637**	
K. RESIDUAL FUNDS				**0**	
L. AMOUNT OF THIS REQUEST (J) OR (J MINUS K)				**379,637**	
M. COST SHARING PROPOSED LEVEL $ **0**	AGREED LEVEL IF DIFFERENT $				

PI/PD NAME **Steve Etchemendy**	FOR NSF USE ONLY INDIRECT COST RATE VERIFICATION		
ORG. REP. NAME* **Danielle Haddock**	Date Checked	Date Of Rate Sheet	Initials - ORG

 *ELECTRONIC SIGNATURES REQUIRED FOR REVISED BUDGET

SUMMARY PROPOSAL BUDGET

YEAR 4

ORGANIZATION	PROPOSAL NO.	DURATION (months)	
Monterey Bay Aquarium Research Institute		Proposed	Granted
PRINCIPAL INVESTIGATOR / PROJECT DIRECTOR	AWARD NO.		
Steve Etchemendy			

FOR NSF USE ONLY

A. SENIOR PERSONNEL: PI/PD, Co-PI's, Faculty and Other Senior Associates (List each separately with title, A.7. show number in brackets)	NSF Funded Person-months CAL	ACAD	SUMR	Funds Requested By proposer	Funds granted by NSF (if different)
1. **Craig Dawe - Co-PI**	2.00	0.00	0.00	**28,400**	
2.					
3.					
4.					
5.					
6. (**0**) OTHERS (LIST INDIVIDUALLY ON BUDGET JUSTIFICATION PAGE)	0.00	0.00	0.00	**0**	
7. (**1**) TOTAL SENIOR PERSONNEL (1 - 6)	2.00	0.00	0.00	**28,400**	
B. OTHER PERSONNEL (SHOW NUMBERS IN BRACKETS)					
1. (**0**) POST DOCTORAL SCHOLARS	0.00	0.00	0.00	**0**	
2. (**2**) OTHER PROFESSIONALS (TECHNICIAN, PROGRAMMER, ETC.)	13.00	0.00	0.00	**79,997**	
3. (**0**) GRADUATE STUDENTS				**0**	
4. (**0**) UNDERGRADUATE STUDENTS				**0**	
5. (**0**) SECRETARIAL - CLERICAL (IF CHARGED DIRECTLY)				**0**	
6. (**0**) OTHER				**0**	
TOTAL SALARIES AND WAGES (A + B)				**108,397**	
C. FRINGE BENEFITS (IF CHARGED AS DIRECT COSTS)				**60,703**	
TOTAL SALARIES, WAGES AND FRINGE BENEFITS (A + B + C)				**169,100**	
D. EQUIPMENT (LIST ITEM AND DOLLAR AMOUNT FOR EACH ITEM EXCEEDING $5,000.)					
computer hardware (routers) $ **8,000**					
ODI connectors **9,000**					
TOTAL EQUIPMENT				**17,000**	
E. TRAVEL 1. DOMESTIC (INCL. CANADA, MEXICO AND U.S. POSSESSIONS)				**1,000**	
2. INTERNATIONAL				**0**	
F. PARTICIPANT SUPPORT COSTS					
1. STIPENDS $ **0**					
2. TRAVEL **0**					
3. SUBSISTENCE **0**					
4. OTHER **0**					
TOTAL NUMBER OF PARTICIPANTS (**0**) TOTAL PARTICIPANT COSTS				**0**	
G. OTHER DIRECT COSTS					
1. MATERIALS AND SUPPLIES				**7,450**	
2. PUBLICATION COSTS/DOCUMENTATION/DISSEMINATION				**0**	
3. CONSULTANT SERVICES				**0**	
4. COMPUTER SERVICES				**0**	
5. SUBAWARDS				**0**	
6. OTHER				**43,341**	
TOTAL OTHER DIRECT COSTS				**50,791**	
H. TOTAL DIRECT COSTS (A THROUGH G)				**237,891**	
I. INDIRECT COSTS (F&A)(SPECIFY RATE AND BASE)					
Modified Total Direct Costs (Rate: 51.0000, Base: 184920)					
TOTAL INDIRECT COSTS (F&A)				**94,309**	
J. TOTAL DIRECT AND INDIRECT COSTS (H + I)				**332,200**	
K. RESIDUAL FUNDS				**0**	
L. AMOUNT OF THIS REQUEST (J) OR (J MINUS K)				**332,200**	

M. COST SHARING PROPOSED LEVEL $ **0** AGREED LEVEL IF DIFFERENT $

PI/PD NAME	FOR NSF USE ONLY		
Steve Etchemendy	INDIRECT COST RATE VERIFICATION		
ORG. REP. NAME*	Date Checked	Date Of Rate Sheet	Initials - ORG
Danielle Haddock			

 ***ELECTRONIC SIGNATURES REQUIRED FOR REVISED BUDGET**

SUMMARY PROPOSAL BUDGET

YEAR 5

ORGANIZATION	PROPOSAL NO.	DURATION (months)	
Monterey Bay Aquarium Research Institute		Proposed	Granted
PRINCIPAL INVESTIGATOR / PROJECT DIRECTOR	AWARD NO.		
Steve Etchemendy			

FOR NSF USE ONLY

A. SENIOR PERSONNEL: PI/PD, Co-PI's, Faculty and Other Senior Associates (List each separately with title, A.7. show number in brackets)	NSF Funded Person-months CAL	ACAD	SUMR	Funds Requested By proposer	Funds granted by NSF (if different)
1. **Craig Dawe - Co-PI**	2.00	0.00	0.00	**29,252**	
2.					
3.					
4.					
5.					
6. (**0**) OTHERS (LIST INDIVIDUALLY ON BUDGET JUSTIFICATION PAGE)	0.00	0.00	0.00	**0**	
7. (**1**) TOTAL SENIOR PERSONNEL (1 - 6)	2.00	0.00	0.00	**29,252**	
B. OTHER PERSONNEL (SHOW NUMBERS IN BRACKETS)					
1. (**0**) POST DOCTORAL SCHOLARS	0.00	0.00	0.00	**0**	
2. (**3**) OTHER PROFESSIONALS (TECHNICIAN, PROGRAMMER, ETC.)	15.00	0.00	0.00	**97,850**	
3. (**0**) GRADUATE STUDENTS				**0**	
4. (**0**) UNDERGRADUATE STUDENTS				**0**	
5. (**0**) SECRETARIAL - CLERICAL (IF CHARGED DIRECTLY)				**0**	
6. (**0**) OTHER				**0**	
TOTAL SALARIES AND WAGES (A + B)				**127,102**	
C. FRINGE BENEFITS (IF CHARGED AS DIRECT COSTS)				**71,177**	
TOTAL SALARIES, WAGES AND FRINGE BENEFITS (A + B + C)				**198,279**	
D. EQUIPMENT (LIST ITEM AND DOLLAR AMOUNT FOR EACH ITEM EXCEEDING $5,000.)					
TOTAL EQUIPMENT				**0**	
E. TRAVEL 1. DOMESTIC (INCL. CANADA, MEXICO AND U.S. POSSESSIONS)				**1,000**	
2. INTERNATIONAL				**0**	
F. PARTICIPANT SUPPORT COSTS					
1. STIPENDS $ **0**					
2. TRAVEL **0**					
3. SUBSISTENCE **0**					
4. OTHER **0**					
TOTAL NUMBER OF PARTICIPANTS (**0**) TOTAL PARTICIPANT COSTS				**0**	
G. OTHER DIRECT COSTS					
1. MATERIALS AND SUPPLIES				**7,450**	
2. PUBLICATION COSTS/DOCUMENTATION/DISSEMINATION				**0**	
3. CONSULTANT SERVICES				**0**	
4. COMPUTER SERVICES				**0**	
5. SUBAWARDS				**0**	
6. OTHER				**267,119**	
TOTAL OTHER DIRECT COSTS				**274,569**	
H. TOTAL DIRECT COSTS (A THROUGH G)				**473,848**	
I. INDIRECT COSTS (F&A)(SPECIFY RATE AND BASE) **Modified Total Direct Costs (Rate: 51.0000, Base: 237080)**					
TOTAL INDIRECT COSTS (F&A)				**120,911**	
J. TOTAL DIRECT AND INDIRECT COSTS (H + I)				**594,759**	
K. RESIDUAL FUNDS				**0**	
L. AMOUNT OF THIS REQUEST (J) OR (J MINUS K)				**594,759**	

M. COST SHARING PROPOSED LEVEL $ **0** AGREED LEVEL IF DIFFERENT $

PI/PD NAME	FOR NSF USE ONLY		
Steve Etchemendy	INDIRECT COST RATE VERIFICATION		
ORG. REP. NAME*	Date Checked	Date Of Rate Sheet	Initials - ORG
Danielle Haddock			

 ***ELECTRONIC SIGNATURES REQUIRED FOR REVISED BUDGET**

SUMMARY PROPOSAL BUDGET

Cumulative

ORGANIZATION **Monterey Bay Aquarium Research Institute**				FOR NSF USE ONLY PROPOSAL NO.	DURATION (months) Proposed / Granted
PRINCIPAL INVESTIGATOR / PROJECT DIRECTOR **Steve Etchemendy**				AWARD NO.	
A. SENIOR PERSONNEL: PI/PD, Co-PI's, Faculty and Other Senior Associates (List each separately with title, A.7. show number in brackets)	NSF Funded Person-months CAL	ACAD	SUMR	Funds Requested By proposer	Funds granted by NSF (if different)
1. **Craig Dawe - Co-PI**	10.00	0.00	0.00	**137,985**	
2.					
3.					
4.					
5.					
6. ( ) OTHERS (LIST INDIVIDUALLY ON BUDGET JUSTIFICATION PAGE)	0.00	0.00	0.00	**0**	
7. (**1**) TOTAL SENIOR PERSONNEL (1 - 6)	10.00	0.00	0.00	**137,985**	
B. OTHER PERSONNEL (SHOW NUMBERS IN BRACKETS)					
1. (**0**) POST DOCTORAL SCHOLARS	0.00	0.00	0.00	**0**	
2. (**12**) OTHER PROFESSIONALS (TECHNICIAN, PROGRAMMER, ETC.)	71.00	0.00	0.00	**451,621**	
3. (**0**) GRADUATE STUDENTS				**0**	
4. (**0**) UNDERGRADUATE STUDENTS				**0**	
5. (**0**) SECRETARIAL - CLERICAL (IF CHARGED DIRECTLY)				**0**	
6. (**0**) OTHER				**0**	
TOTAL SALARIES AND WAGES (A + B)				**589,606**	
C. FRINGE BENEFITS (IF CHARGED AS DIRECT COSTS)				**330,180**	
TOTAL SALARIES, WAGES AND FRINGE BENEFITS (A + B + C)				**919,786**	
D. EQUIPMENT (LIST ITEM AND DOLLAR AMOUNT FOR EACH ITEM EXCEEDING $5,000.) $ **67,000**					
TOTAL EQUIPMENT				**67,000**	
E. TRAVEL 1. DOMESTIC (INCL. CANADA, MEXICO AND U.S. POSSESSIONS)				**5,000**	
2. INTERNATIONAL				**0**	
F. PARTICIPANT SUPPORT COSTS					
1. STIPENDS $ **0**					
2. TRAVEL **0**					
3. SUBSISTENCE **0**					
4. OTHER **0**					
TOTAL NUMBER OF PARTICIPANTS (**0**) TOTAL PARTICIPANT COSTS				**0**	
G. OTHER DIRECT COSTS					
1. MATERIALS AND SUPPLIES				**55,250**	
2. PUBLICATION COSTS/DOCUMENTATION/DISSEMINATION				**0**	
3. CONSULTANT SERVICES				**0**	
4. COMPUTER SERVICES				**0**	
5. SUBAWARDS				**0**	
6. OTHER				**556,401**	
TOTAL OTHER DIRECT COSTS				**611,651**	
H. TOTAL DIRECT COSTS (A THROUGH G)				**1,603,437**	
I. INDIRECT COSTS (F&A)(SPECIFY RATE AND BASE)					
TOTAL INDIRECT COSTS (F&A)				**540,982**	
J. TOTAL DIRECT AND INDIRECT COSTS (H + I)				**2,144,419**	
K. RESIDUAL FUNDS				**0**	
L. AMOUNT OF THIS REQUEST (J) OR (J MINUS K)				**2,144,419**	
M. COST SHARING PROPOSED LEVEL $ **0**	AGREED LEVEL IF DIFFERENT $				

PI/PD NAME **Steve Etchemendy**	FOR NSF USE ONLY INDIRECT COST RATE VERIFICATION		
ORG. REP. NAME* **Danielle Haddock**	Date Checked	Date Of Rate Sheet	Initials - ORG

C *ELECTRONIC SIGNATURES REQUIRED FOR REVISED BUDGET

BUDGET JUSTIFICATION – MBARI
Salaries/Wages
A. Senior personnel:

Steve Etchemendy (PI, 2 months at no cost to NSF), Director of Marine Operations at MBARI will function as to the PI for MARS until retirement (Dec. 2015). He deals with policy issues, permitting, insurance, staffing, and reporting obligations with NSF. Additionally, Steve will represent MARS O&M for UNOLS ship scheduling functions.

Craig Dawe (Co-PI, 2 person months) deals with policy issues, permitting, insurance, staffing, and reporting obligations with NSF. In addition to duties as PI, Craig will continue as the MARS Operations Manager and will be responsible for maximizing the success of the MARS users' community. Additionally, the MARS Operations Manager is the primary resource to assess deployment “readiness” of science experiments as well as any infrastructure component of MARS. The MARS Operations Manager will function as the MBARI Marine Operations Technical Manager and Ventana Chief Pilot during the unfunded portion of the year. The logic here is to integrate MARS maintenance and operations requirements with the primary service vessels for MARS as much as possible.

B. Other personnel:
B. 2. Other Professionals:

Funds are requested for three months of time split between an MBARI Electrical Engineer and MBARI Software Engineer in year 1 (2015) to complete the inductive power and data transfer strip and test it on MARS.

Funds are requested for one month/year for MBARI Engineering support. In year 1 the mechanical design of the inductive power and data transfer strip will require this engineering time. In subsequent years we have needed engineering support for the maintenance of the MARS facility. These funds will cover the “as needed engineering support” to maintain MARS.

The MARS Facility Support Technician (12 person months/year) is responsible for the day-to-day control of the MARS system. This position monitors data streams and adjusts power levels using PMACS (Power Management and Control System) and monitors system functional parameters and provides watchdog functions to ensure smooth operations. The MARS technician insures the data store and forward functions are working and maintains the system and manages the day-to-day needs of the MARS computer network. The MARS technician also assists with the test tank experiment installations and supports users.

C. Fringe Benefits:
Rates are set by MBARI annually. The base is labor dollars and the pool costs consist of payroll taxes, health benefits, retirement benefits, workers compensation, and leave. The rate for full-time regular and part-time (30-39hrs/wk) employees is 56%.

D. Equipment
MARS will require replacement of five Cisco routers (all are now 10 years old) over the five-year term of this proposal. Currently, we have two Cisco Routers immersed in fluorinert in the subsea node and the survivability of these routers is in question (year 3). The three shore based routers (also 10 years old) will need to be replaced (years 1 and 4).

Two ODI (Ocean Design Inc.) connecters have partially failed on the subsea node. Funds are requested to purchase these connectors in year 2 and replace these connectors when we replace the Cisco routers in the subsea node (year 3). A spare connector will be purchased in year 4.

E. Travel
E.1. Domestic:
Over the years of MARS O&M, travel has been necessary to coordinate technical issues with vendors, meet with NSF to discuss policy issues, participate in OOI workshops and go to a national scientific meeting (American Geophysical Union). 1,000/year

E.2. Foreign: None

G. Other Direct Costs:
G.1. Materials and Supplies:
Maintenance of the MARS system over the last 6 years has averaged:
Supplies computer hardware: $750/year
Computer software: $200/year
Non-Cap Equipment: $4,500/year
Supplies General: $2,000/ year but we need $3,000 for the inductive power and data transfer strip in year 1 (2015) and $15,000 is budgeted for fluorinert (Year 3).

G.2 Publication Costs: none.

G.6
Other:
Internal ship time
Year 1 (2015): We are budgeting for six ship/ROV days (R/V Rachel Carson/ROV Ventana at the 12 hour daily rate of $16,500/day). Four of these days will be to complete the "Actual Impacts Assessment" surveys required every five years by the California State Lands Commission and the other two will be to maintain the MARS subsea node. We already completed four Western Flyer days and three Rachel Carson days in 2014 starting the Actual Impacts Survey in 2014. Periodic maintenance includes servicing the actual site to clear up old cables, and to recover anchors and periodic testing of ports with the Port Test Tool.

Year 2: (2016): We are budgeting two ship/ROV days (R/V Rachel Carson/ROV Ventana at the 12 hour daily rate) for routine maintenance.

Year 3 (2017): We are budgeting six ship/ROV days. (R/V Rachel Carson/ROV Ventana at the 12 hour daily rate). Four of these days will be for the recovery of the MARS electronics node and redeployment after servicing. The other two days will be for routine maintenance.

Year 4 (2018): We are budgeting two ship/ROV days (R/V Rachel Carson/ROV Ventana at the 12 hour daily rate) for routine maintenance.

Year 5 (2019) We will budget four days of the R/V Western Flyer and six days (R/V Rachel Carson/ROV Ventana at the 12 hour daily rate) to complete the "Actual Impacts Assessment" environmental impact survey required by California State Lands Commission every five years. It is more cost effective to use the R/V Western Flyer for the deeper parts of the survey than the R/V Rachel Carson.

Ship rates have a 3% inflation rate built into the cost for outlying years.

Outside Services
CISCO router maintenance license are only prudent to maintain MARS routers for the three shore based routers. CISCO will not provide service for the subsea routers. We would like to buy two new routers in year 1, and one more in year 4. This will require a maintenance contract, $300/year/router.

The three servers HP DL360s will require service contracts for all 5 years of the award $292/yr/server = $4380.

Actual Impacts Assessment: Year 1 and year 5 we need $22,980 for laboratory analysis of the samples for the California State Lands required Actual Impacts survey.

Right of way: A portion of the MARS cable route transverses Moss Landing Harbor District (MLHD) property, costs are $1,300 each year raised by the CPI for the year.

Shipping/Postage
Nominal amounts are requested (200/year for shipping) for activities directly assignable to MARS O&M.

I. Indirect Cost - The institutional IDC rate is 53% MTDC. The base excludes capital items, participant support costs, internal ship time and subcontract costs exceeding the first 25K of each subcontract.

Current and Pending Support

Steve Etchemendy, Director, Marine Operations - MBARI

Agency	Project Title	Award	Project Period	Effort Cal. Mos.
NSF *Pending* (this proposal)	MARS (Monterey Accelerated Research System) O&M (Operations and Maintenance)	$2,144,419	03/01/2015 - 02/28/2020	2
NSF *Active*	MARS (Monterey Accelerated Research System) O&M (Operations and Maintenance)	$1,112,257	06/01/2011 – 05/31/2015	2
UC Berkeley *Active*	MARS Port Fees	$12,000	01/01/2014- 12/31/2014	.10

Current and Pending Support

Craig Dawe, MARS Manager, Marine Operations - MBARI

Agency	Project Title	Award	Project Period	Effort Cal. Mos.
NSF *Pending* (this proposal)	MARS (Monterey Accelerated Research System) O&M (Operations and Maintenance)	$2,144,419	03/01/2015 - 02/28/2020	2
NSF *Active*	MARS (Monterey Accelerated Research System) O&M (Operations and Maintenance)	$1,112,257	06/01/2011 – 05/31/2015	2*

*effort spent on project as MARS Manager not as MARS Co-PI.

MARS Facilities and Resources

MBARI institutional resources and facilities provide the backbone for at sea capabilities and operations. MBARI's Engineering department consists of 40 highly skilled software, electrical, and mechanical engineers with extensive experience in development of oceanographic vehicles, instruments, and observatories. MBARI's 40-person Division of Marine Operations (DMO) is responsible for deployment, operation, and maintenance of the MOOS, OASIS, and MARS observatories, and thus provides a wealth of practical experience from the standpoint of operational users and divers. Physical access to the ocean is provided by MBARI's research vessels and Remotely Operated Vehicles (ROVs). MBARI's dock is just across the street from the main campus, and thus complex equipment can be easily staged directly from laboratory facilities to at-sea operations. MBARI's nine-person Information Systems group provides technical support in planning, deployment, and maintenance of computing facilities and networks. Other relevant MBARI assets include a 10-meter saltwater test tank, high-pressure test facility, electronics fabrication shop, and extensive machine shop facilities.

The ROV Ventana in the test tank

The MARS node

Facilities

MARS control room (850 ft.^{2}) and maintenance areas (850 ft.^{2}) are provided by MBARI. The MARS Cabled observatory is in itself the "Facility". The actual MARS subsea node is shown above and the hut that houses the high voltage transformers is shown below.

MARS high voltage cable termination hut

The MARS control room

Data Management Plan

The MARS facility connects the MARS users' instrumentation directly to the users' IP address. Data management and storage is the responsibility of the individual user therefore MARS itself does not have a Data Management Plan. MARS is a facility for testing sensors and that data and control belong directly to the developer. Additionally, the oceanographic data accumulated at MARS is sent to the CeNCOOS portal which is sponsored by NOAA IOOS. The Northern California Seismic Network is directly connected to the broadband seismometer attached to MARS.