Cruise Plan
for
R/V *Kilo Moana* KM-14-23:
ALOHA Cabled Observatory Service
29 October – 3 November 2014

26 October 2014

Version 3.0

Bruce Howe, Chief Scientist

Department of Ocean and Resources Engineering
School of Ocean and Earth Science and Technology
University of Hawaii
Department Office: 2540 Dole Street, Holmes Hall 402
Office: 1680 East-West Road, POST 105G
Honolulu, HI 96822

Tel: 808-956-0466 Mobile: 808-469-0553 bhowe@hawaii.edu

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1. Introduction

The purpose of this NSF-funded cruise on the R/V *Kilo Moana* is to service infrastructure and instrumentation on the ALOHA Cabled Observatory (ACO). ACO is the deepest operating cabled observatory on the planet. Specifically a new camera and light system and a basic sensor package will be installed, and the AMM secondary node will be recovered. The remotely operated vehicle ROV *Jason* is essential to performing the required tasks.

During the cruise, an Argo float will be deployed for Joel Reiter, Seabird.

The cruise is 5 days long, from 1200 Wednesday 29 October – 1200 Monday 3 November 2014. The ship will depart Honolulu and proceed directly to Station ALOHA, 100 km north, to perform the ACO work. If all goes according to this current plan, the work can be done during one ROV dive. See Figure 1-1 for a map with nominal cruise lines. Table 1-1 gives coordinates of relevant points.

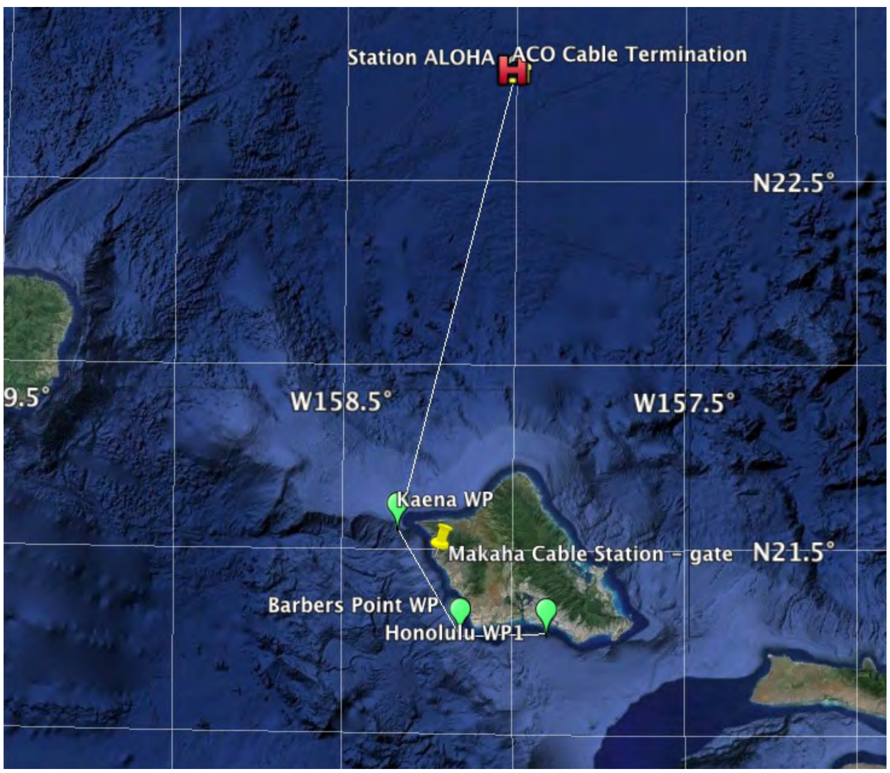


Figure 1-1 Map of area and nominal cruise lines.

	Latitude deg	N minutes	Longitude deg	W minutes	Incremental distance (nmi)
UHMC, Snug Harbor	21	18.937	157	53.186	
Honolulu WP1	21	16	157	54	
Barbers Point WP	21	16	158	09	14
Ka‘ena Ridge WP	21	33	158	20	21
ACO Cable Termination Frame (TF)	22	44.324	158	00.372	75
Station ALOHA	22	45	158	00	1

Table 1-1 Coordinates of waypoints and stations

In this Plan, we first describe the ACO system as it is now installed followed by a description of the new instrumentation to be installed. Two port test tools will be described; they will be used by the ROV to test observatory port functionality. The ROV system is described, including the navigation system. The ship and deck configuration is described followed by a section on responsibilities. Finally, the operations are described with a timeline (some readers may wish to skip some of the preceding material). An even more detailed step-by-step plan is given in Appendix B. Other appendices have system block diagrams and connections, personnel/contacts, berthing, and acronyms.

Information on the last cruise and installation can be found in the KM-11-16 cruise plan, the cruise report, and the Oceans11 paper. See the list of references below and the ACO web site for this and other information including photographs and video, http://aco-ssds.soest.hawaii.edu/index.html. Because the ROV operations are so important for this cruise, this plan is written to emphasize those aspects.

All cruises such as this have some level of risk associated with completing the desired tasks. The most obvious two factors affecting risk here are weather and technical problems. In this case the cruise is taking place when weather is often not good. An advantage of using elevators and free-falling packages is we can work in rougher weather and get the work done with a single ROV dive – as long as we can get the ROV in the water to start with.

2. ACO Description

The ACO is a prototypical example of a deep ocean observatory system that uses a retired cable. The ACO uses a highly reliable existing transoceanic cable system to provide power and communications bandwidth to a "node" on the seafloor. In the simplest terms, we provide power and communications ports for users to plug into on the seafloor for arbitrary instrumentation. Here we include core instrumentation for scientific measurements of water properties (pressure, temperature, salinity, velocity, optics), video and acoustics, and acoustic communications.

The ACO node and instrumentation was deployed in May-June 2011 (see the KM-11-16 Cruise plan and report, and the Oceans11 article, Howe, et al., 2011). A composite photograph of the system deployed then is shown in Figure 2-1, a plan view photo mosaic is shown in Figure 2-2, and a line drawing to scale in Figure 2-3. The first figure indicates what instruments and sensors are and are not working currently.

Photographs of the equipment from the 2011 cruise are shown in Figures 2-4 – 2-9. System block diagrams with interconnections are shown in Appendix A (along with the planned configuration). Note the TAAM mooring (with thermistors and acoustic modem) was recovered in December 2012, leaving one cable plugged into OBS port E3. Also, at the last minute, after photographs were taken on the bottom, the camera connection was transferred from the AMM to OBS port E4.

Additional photographs and other system documentation can be found on the project wiki web site http://www.soest.hawaii.edu/acowiki/index.php/Main_Page and on the anonymous ftp server ftp.soest.hawaii.edu/bhowe/ACO. Also see the ROV *Jason* Virtual Control Van videos from the June 2011 cruise. http://4dgeo.whoi.edu/webdata/virtualvan/html/VV-km1116/index.html

Figure 2-1 shows an image taken by *Jason* of the seafloor equipment. The cable termination frame (TF) and the TAAM mooring and anchor are pasted in; all other items are true to scale, as shown in the mosaic in the following Figure 2-2. The current camera (CAM1) is working but the lights have failed, so we will be leaving it in place (though we may move it a little). The AMM secondary node is not working; we suspect a ground fault in the cable connecting to the Observatory (OBS). It will be recovered as an intermediate step of this operation.

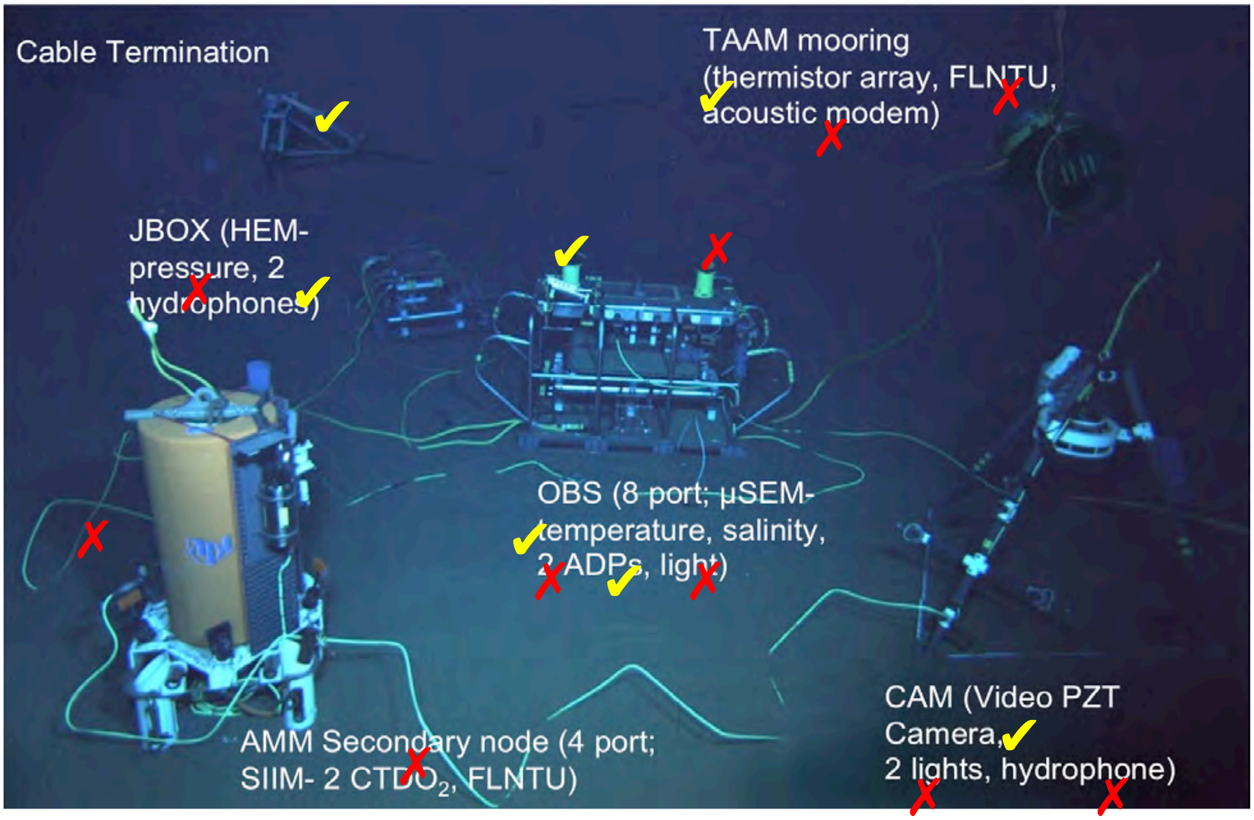


Figure 2-1 Image of present system showing working (yellow) and non-working (red) items.

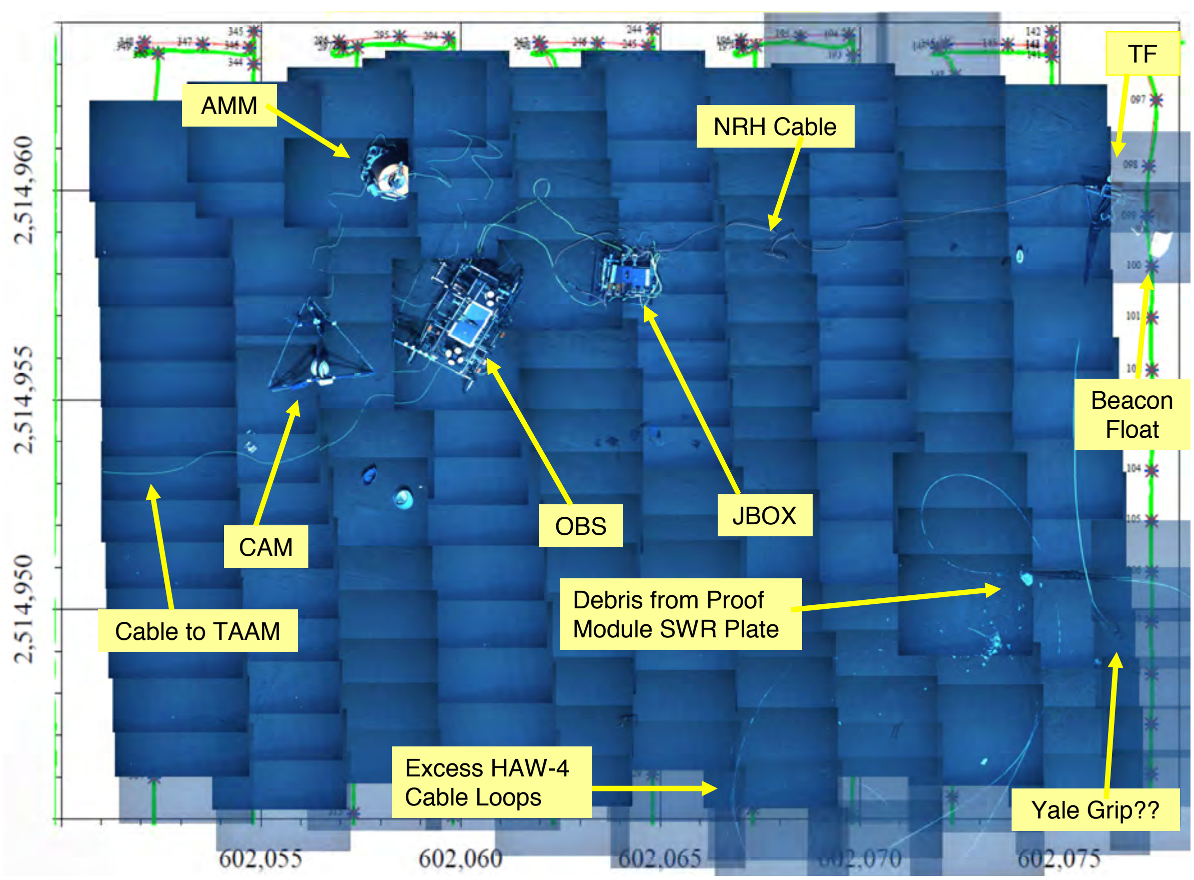


Figure 2-2 Mosaic of present system

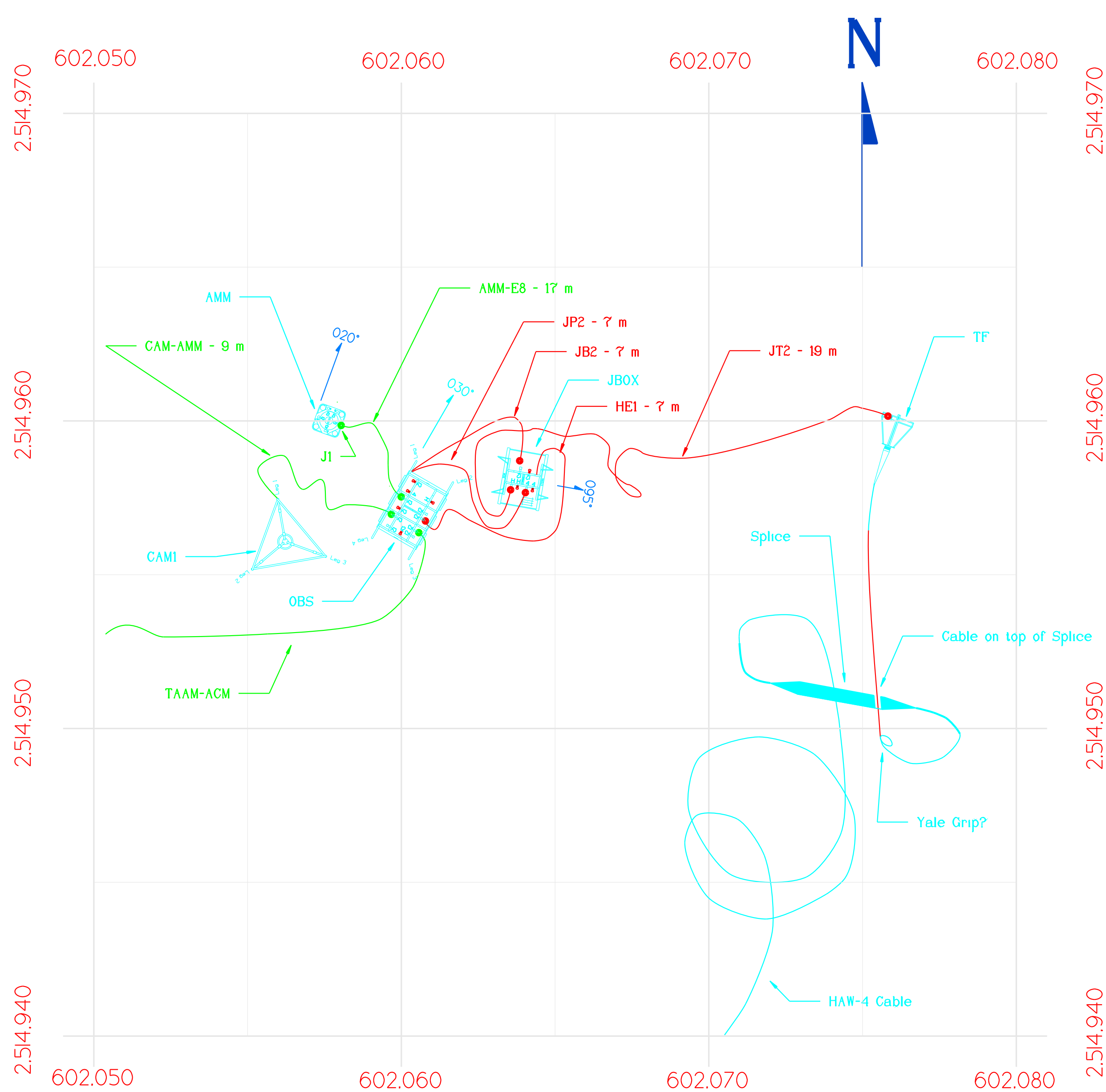


Figure 2-3 Present ACO seafloor configuration

The ACO cable termination as it was left in June 2011 is shown in Figure 2-4. An acoustic "homer" beacon is secured to the float on the neighboring short mooring. The junction box (JBOX) converts the telecom communications protocols to standard 100 Mb/s Ethernet and generates a precise pulse-per-second referenced to GPS on shore using IEEE-1588v2-PTP precise time protocol. On the JBOX frame is the hydrophone experiment module (HEM) with two hydrophones and a pressure sensor, Figure 2-5. Note the lowering bridle (this version has a mooring snubber).

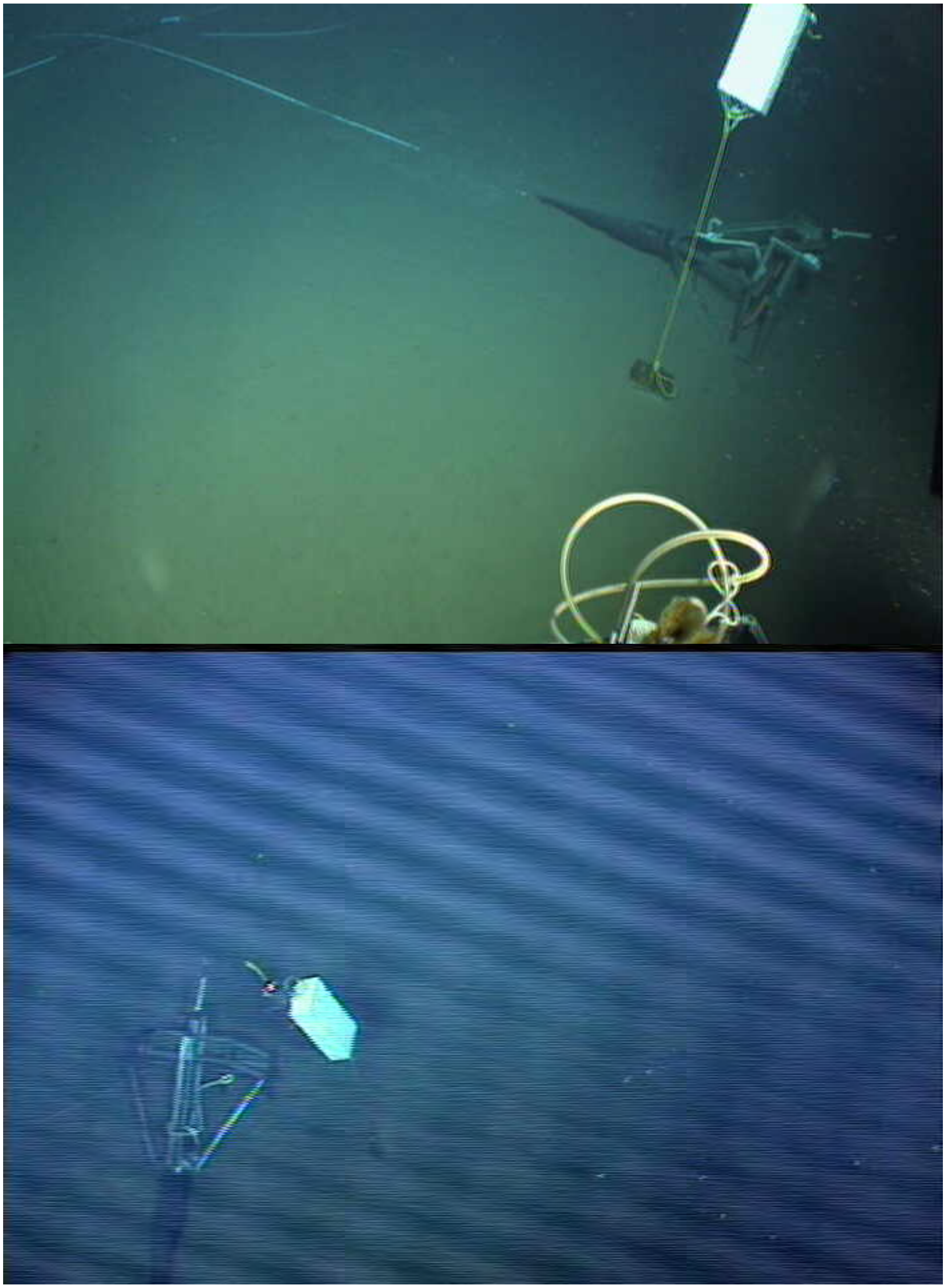


Figure 2-4 The cable termination frame on 24 May (top) and 6 June 2011 (bottom).

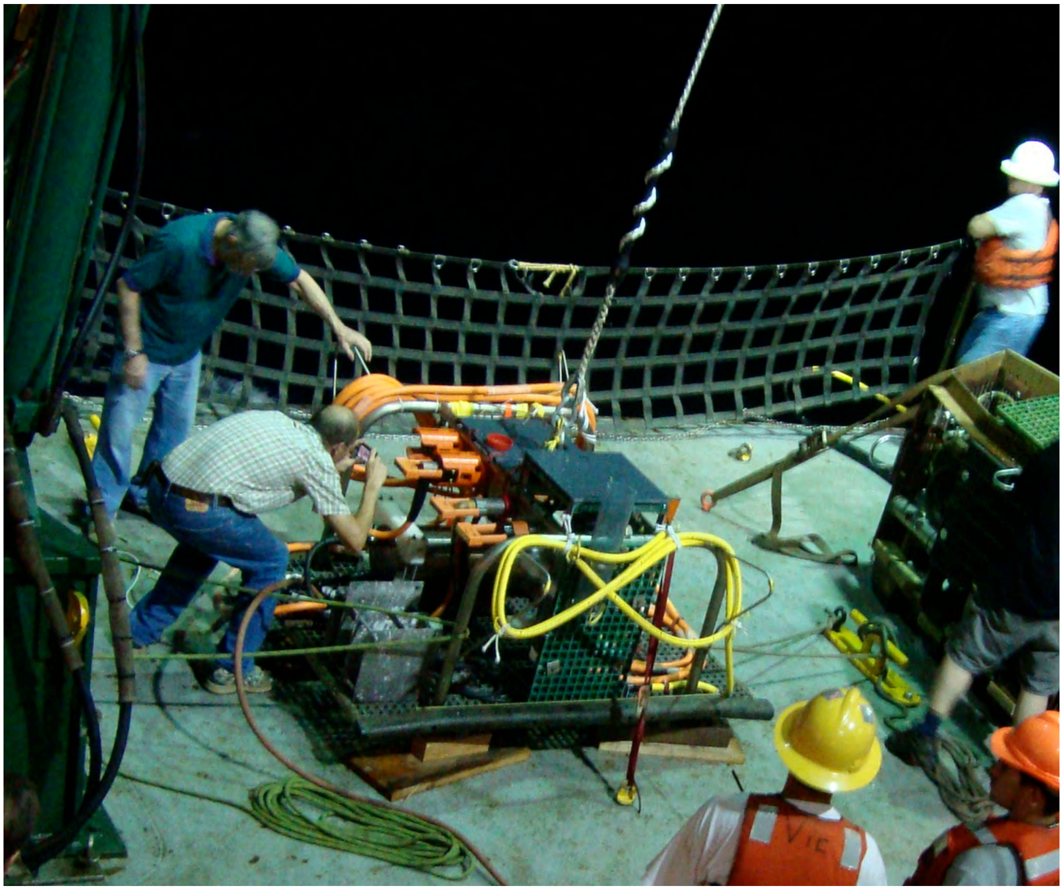
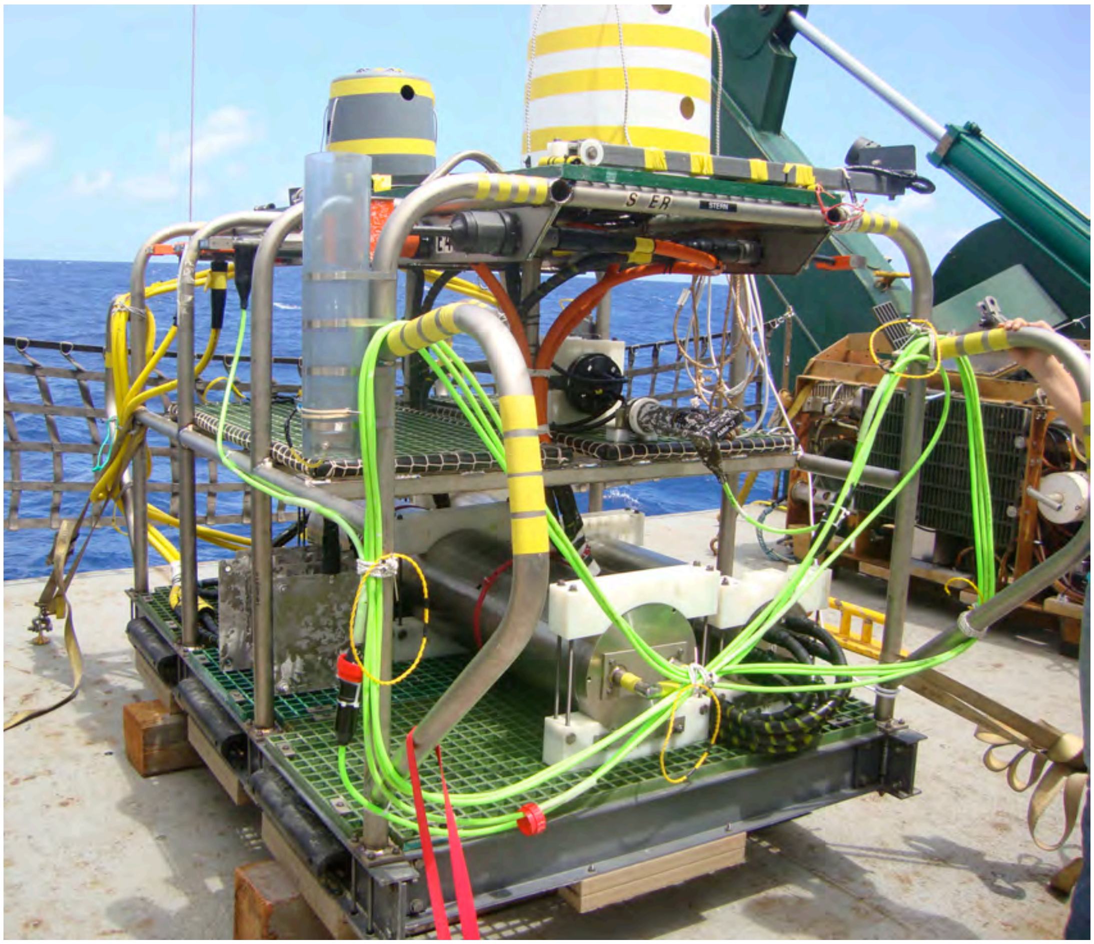
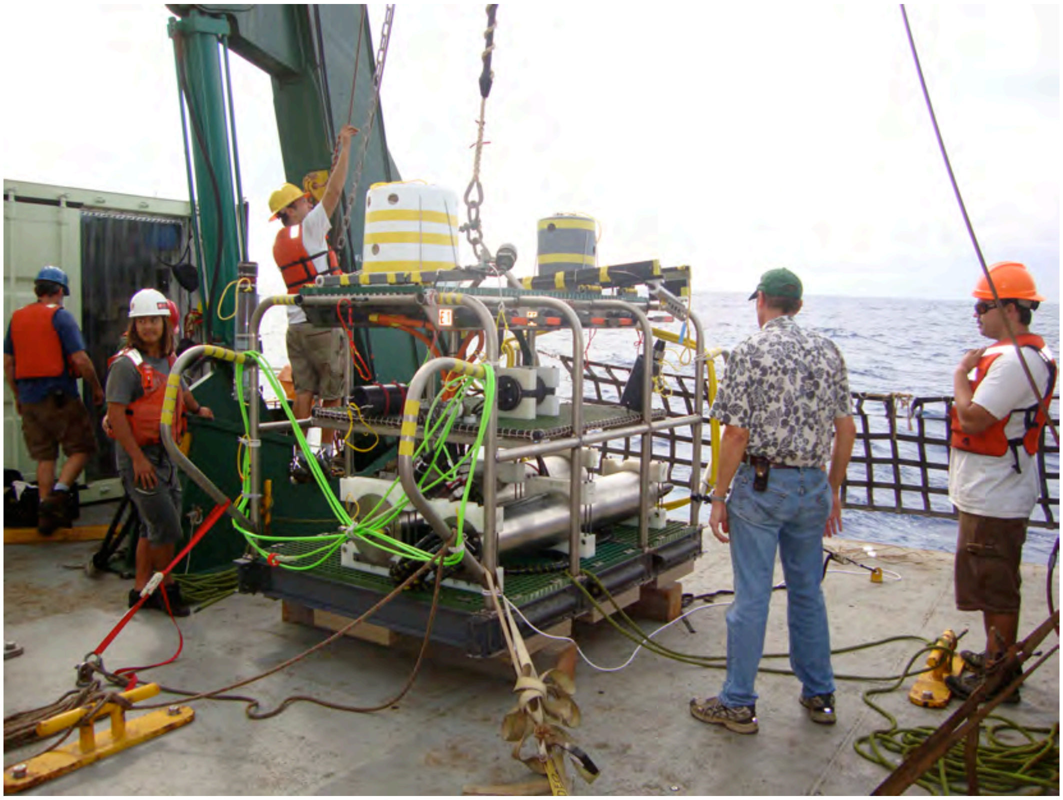


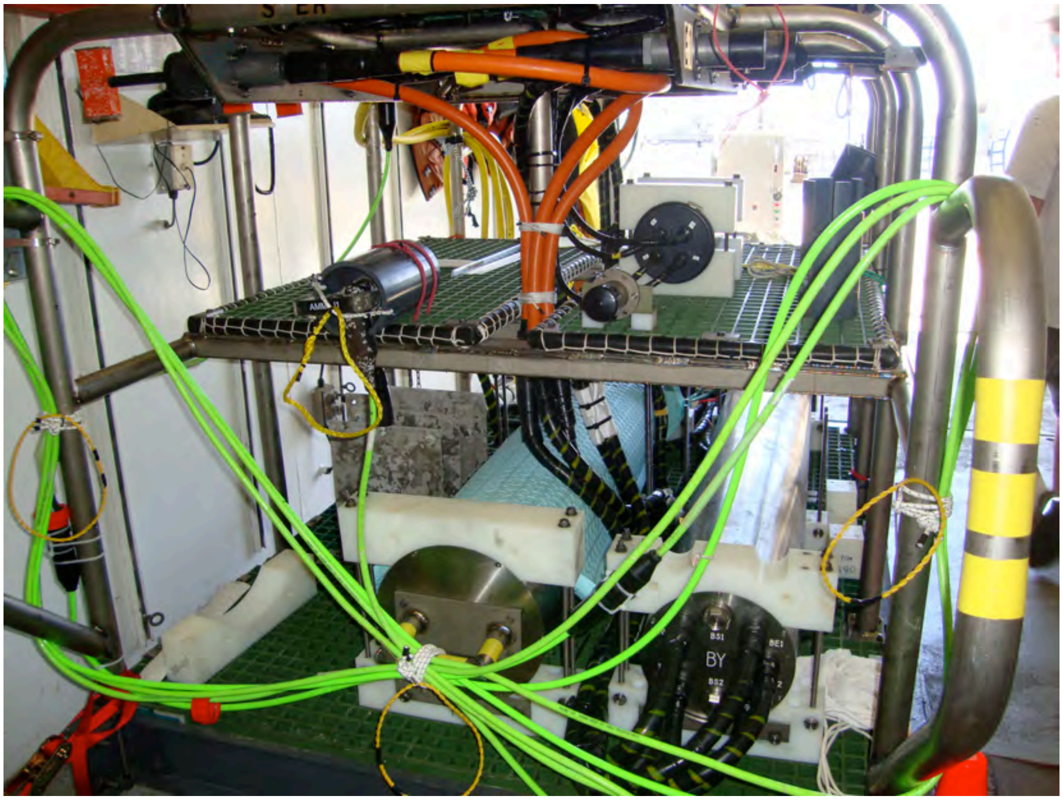
Figure 2-5 ACO JBOX (on deck and seafloor)

The observatory (OBS) is connected to the JBOX, Figure 2-6. The OBS converts the dc current on the cable to 48 V and 400 V, and distributes this, the Ethernet, and timing signals to eight user ports. On the observatory are two acoustic Doppler profilers (ADPs), a temperature/conductivity instrument (CT), and a light, that are connected to one “micro science experiment module” (μSEM) that is in turn connect to one OBS port, E6. Note the orientation guides: yellow tape on corners (1-4; 1 is port bow, 2 is starboard bow, …), and port numbers; see also Appendix A for a schematic of this including instrument port assignments. Deck pictures show the CTD and light in stowed positions; on the seafloor they have been rotated 180 degrees, so as to hang outboard of the OBS. Note the seawater return/ground plates on the bottom of the Observatory, port side. Alos note the pin-protecting dummy at the stern on the middle deck; there is also one in the E6 position on the port quarter.






PORT
JB2 PARK
JP2 PARK
E6
JB2
JP2
AMM-OBS
JP2
We Came In Peace For All Fish 'Kine.


BY


ACO deployed 2011-06-07 00:03:46

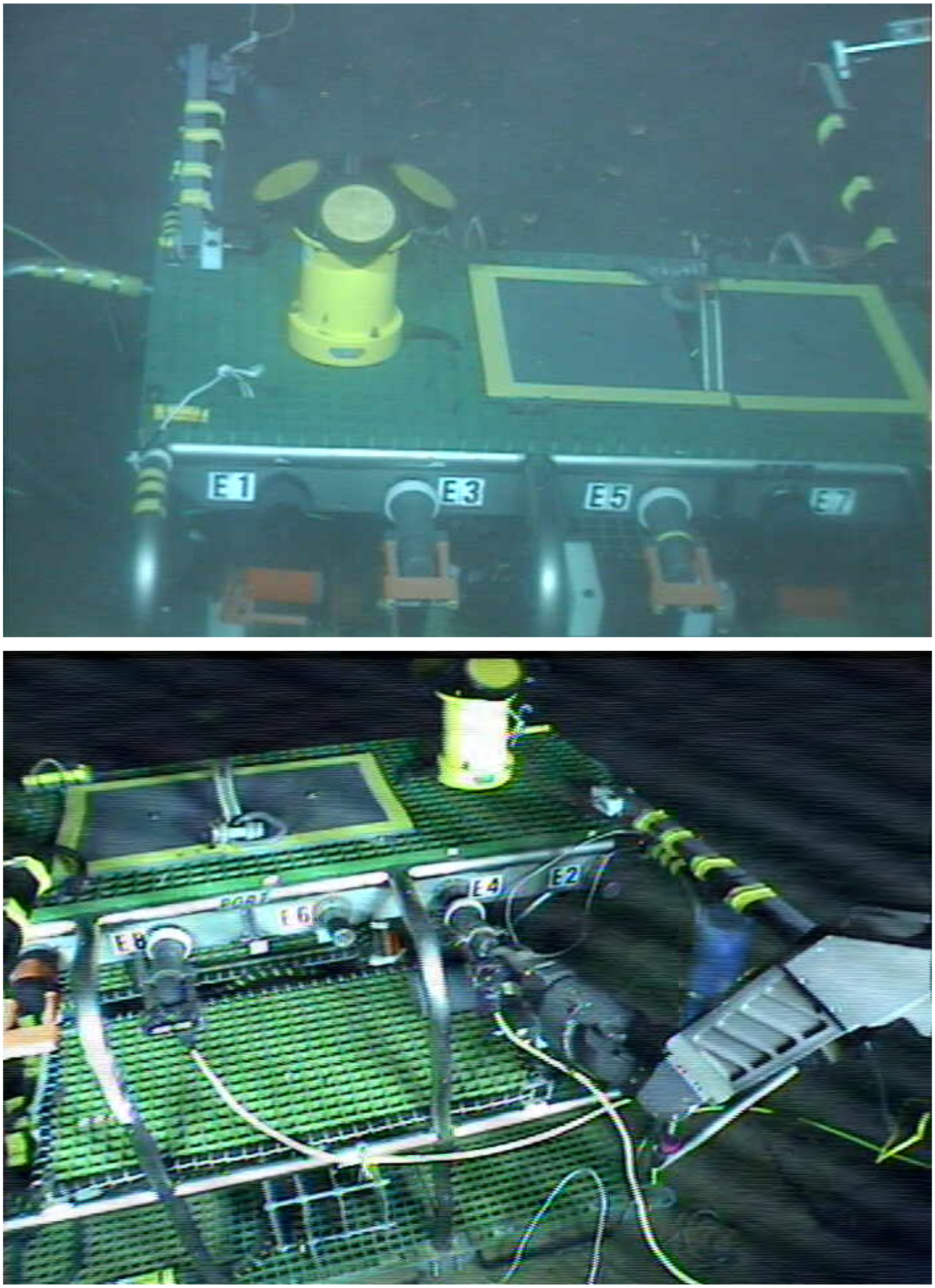
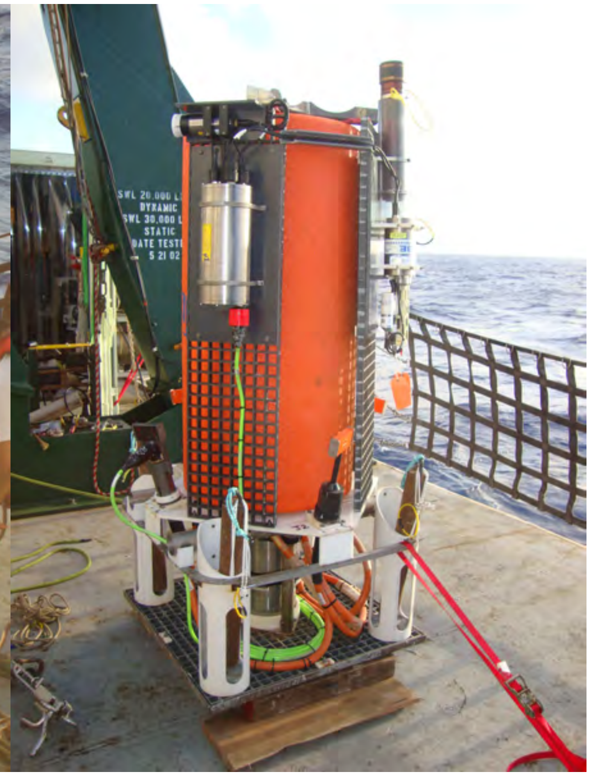


Figure 2-6 OBS frame (on deck and seafloor)

The AMM (ALOHA-MARS Mooring) seafloor secondary node and the camera are connected to the OBS, Figures 2-7 and 2-8. The AMM node provides four additional user ports and has two $CTDO_2$'s and a fluorometer. It is currently non-functional; we suspect the connecting cable has failed. Note the ballast weights, one in each corner when on deck (Figure 2-7 top right) and two after installation on the seafloor (one under the SIIM between ports 2 and 3, and opposite between ports 1 and 5, Figure 2-7 bottom).


DYNAMIC
STATIC

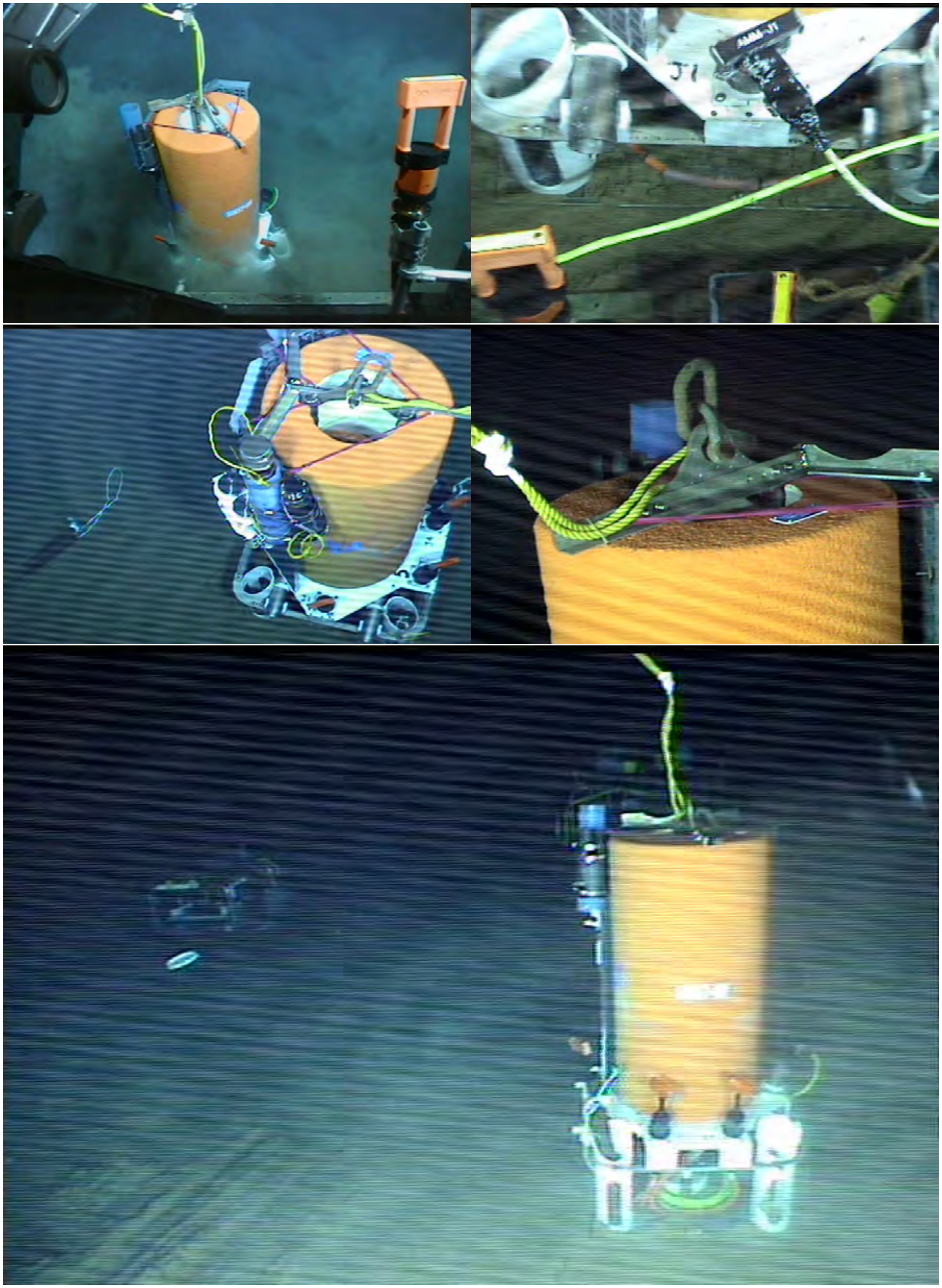
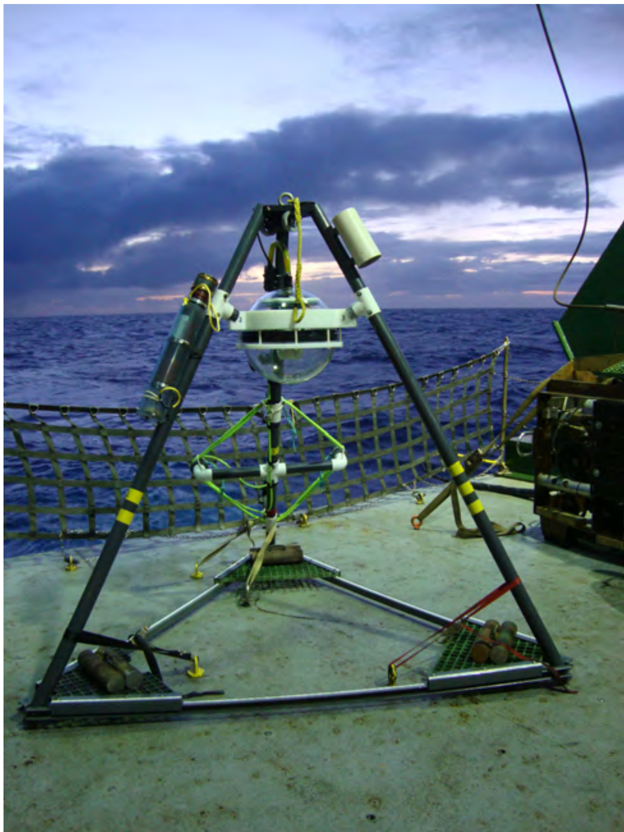


Figure 2-7 AMM seafloor secondary seafloor node (on deck and seafloor)

The camera with two lights and a hydrophone (CAM1) is connected to the OBS node port E4, Figure 2-8; the hydrophone does not work and the lights failed after about 6 weeks (our circuitry suspected). But the camera is still working.



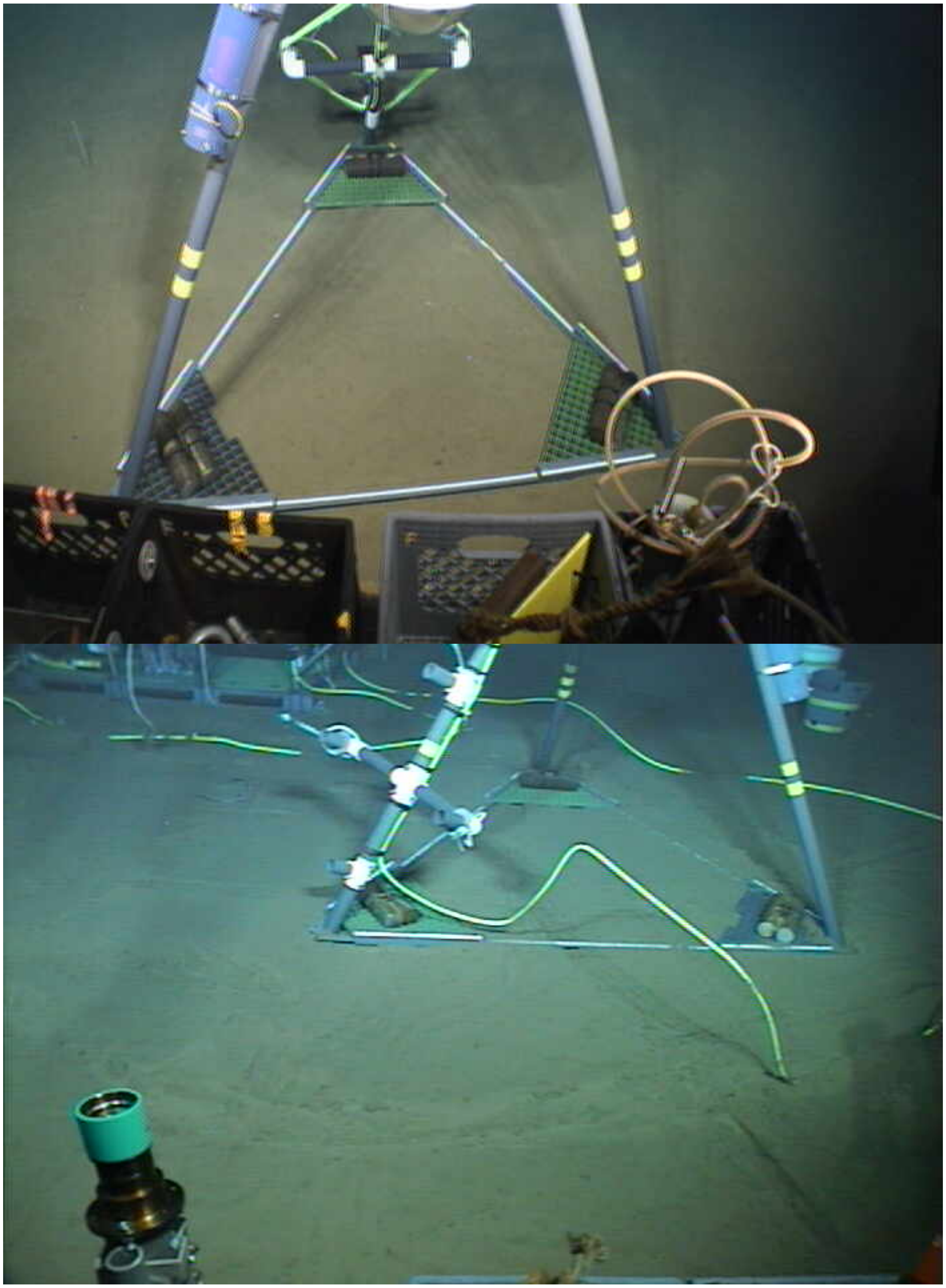


Figure 2-8 Camera (on deck and seafloor)

The TAAM anchor sits 50 m off to the west, still connected with one cable to OBS port E3. The mooring was recovered in December 2011. One of the lengths of cable was never deployed and the ODI flying connector is still connected to a pin-protecting dummy on the anchor frame. There is a remaining (now) unused dummy on the frame. We will use the TAAM anchor as a location for leftover weights, and other miscellaneous items being left on the bottom.

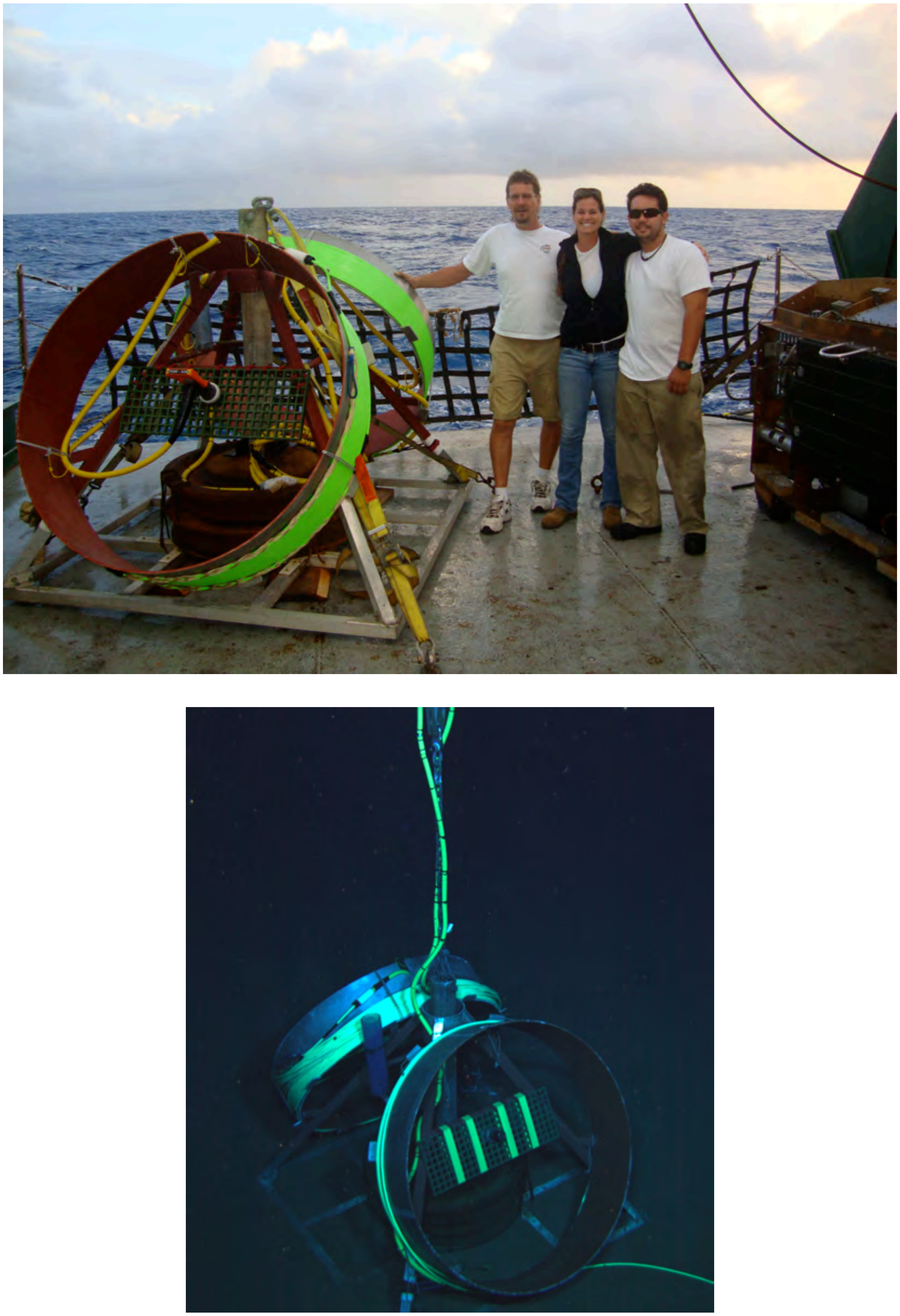


Figure 2-9 TAAM anchor (on deck and seafloor)

3. New ACO Equipment

Some equipment will be recovered and new equipment installed so that we end with a system layout as shown in Figure 8-1. A preview of tasks is useful here (more detail in Section 10 below). If all goes according to plan, only one ROV dive is required.

The camera (CAM2) and a WHOI elevator will be free-falled. They will carry USBL and homer beacons. The stand-alone LIGHT1 will be carried down secured on CAM2. These will be moved into position near the OBS. The LIGHT1 will be positioned and plugged in and then the CAM2 will be positioned and plugged in. We will recover the AMM secondary node using the elevator. With the ROV remaining on the bottom, the ship will recover the AMM secondary node, and a CTD will be transferred to the BSP1. The latter will be free-falled. The ROV will then move it into location and plug it in. Various housekeeping tasks will be done, including testing all OBS ports and recovering several flying connectors and dummies.

In Figure 3-1, the BSP1 is shown 18 m from the OBS with the bow (with ADCP) at 20° T. This orientation corresponds to the major axis of the tidal ellipse, so the main tidal flow is perpendicular to the line connecting the BSP and the rest of the bottom instrumentation to the west, i.e., the JBOX, OBS and the cameras and lights that generate heat and flow disturbance. The CAM2 and lights are to the west of the OBS with the goal to maximize areal coverage using the two cameras and three available lights (LIGHT1 standalone, and LIGHT2 and LIGHT3 on the CAM2 frame), with some overlap, and keeping a view of the OBS and seawater return (SWR). We should strive to get the new equipment where shown, and then fine tune based on feedback from shore, using *Jason*. (Note, the TAAM cable and the AMM will be gone.)

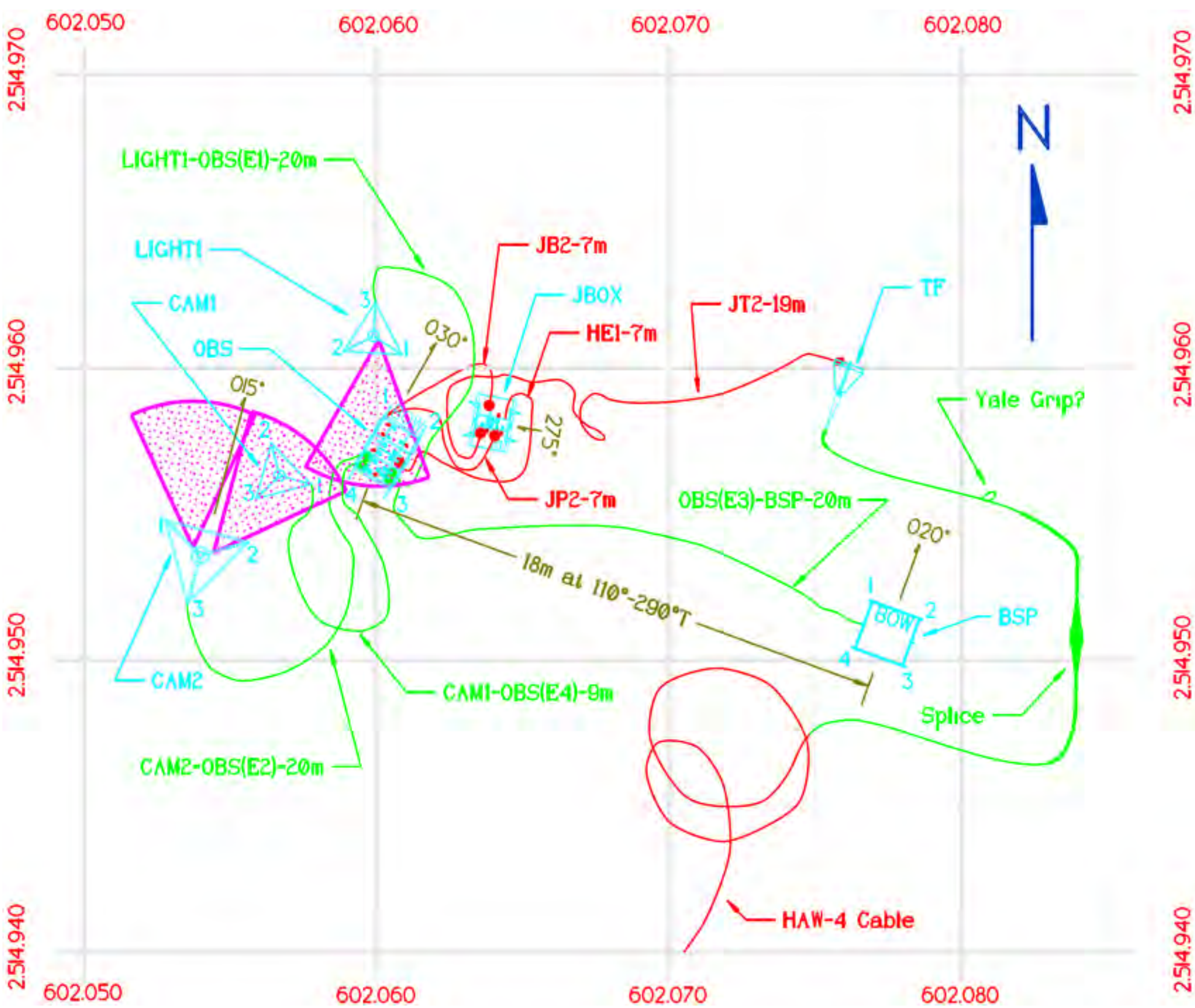


Figure 3-1 ACO planned bottom configuration

It is important to know the various in-air and in-water weights of the components, Table 3-1.

Weight, lb	Base in-air	Base in-water	Fixed added weight	Removable weight on frame	Weight on line hanging below for deploy	Total in-air deployment weight	Total in-water deployment weight	Total in-water weight final, on seafloor
CAM1	290	110	0?	0 (120?)				110
AMM	1110	88	0	70				88
BSP1*	1152	161	0	0	100	1252	261	161
CAM2	272	56	0	0	100	372	156	56
LIGHT1	116	40	0	0	0	116	40	40
CAM2+LIGHT1	388	96	0	0	100	488	196	96

*Includes ADCP protective grating, 13 lb in air, 5 lb in water.

Table 3-1 ACO instrument package weights

3.1 Basic sensor package (BSP)

The BSP1 is made up of a Science Instrument Interface Module (SIIM, from APL-UW), several science instruments, and a frame with syntactic foam buoyancy and ballast weights and provision for carrying navigation beacons (Figures 3-2 – 3-5). The BSP1 is connected to the OBS via a 20 m ODI pressure balanced oil-filled (PBOF) hose with a 12-pin flying connector, and a corresponding dry mate connector to the SIIM.

The SIIM aggregates multiple instruments so that only one standard 12-pin connect or is required to connect to the Observatory (OBS) or similar. Inside the SIIM 8-inch OD by 12-inch long titanium pressure case is an 8-port managed Ethernet switch and power supply. One of the Ethernet ports is connected to the 12-pin connector. The other ports are connected to Digiconnect-ME port servers that provide RS-232 for individual user instruments. Either 48 V or 12 V is provided to each user instrument port (hardwire selected before deployment). The pulse-per-second (PPS) from the OBS is propagated to user ports as needed (also selected before deployment).

The SIIM brings together the following sensors:

- Seabird conductivity, temperature, depth (pressure) and oxygen pumped (CTDO2), SBE-52MP/43P, TTL level, 12 V. The particular unit that will be used on the BSP is currently one of two on the AMM; after recovery of the AMM, we will transfer it to the BSP. Contributed by Tim McGinnis at APL-UW.
- Seabird conductivity, temperature, depth (pressure) and oxygen pumped (CTDO2), SBE-37 SMP ODO, RS-232, 12 V. The oxygen sensor is an optical dissolved oxygen (ODO) sensor. The unit has no pressure sensor (or rather, its 2000 m sensor is isolated with a dummy plug). Seabird is contributing the particular unit that will be used on the BSP.
- RBRduo bottom pressure recorder (BPR), RS-232, 12 V, using a Paroscientific Digiquartz pressure sensor. Contributed by Jerome Aucan.
- WetLabs fluorometer/turbidity optical sensor, FLNTU, RS232, 12 V.
- Woods Hole Oceanographic Institution (WHOI) acoustic micro-modem, 7.5-12.5 kHz, 4 element receiving array, RS232, 48 V, 1 PPS. Lee Freitag at WHOI has provided this unit (it is the same unit that was on the TAAM mooring, connected to OBS port E3, with an undiagnosed shunt fault).
- Teledyne RDI broadband 150 kHz acoustic Doppler current profiler (ADCP), RS232, 48 V. This is an “old” ~1997 4 beam unit used as a lowered ADCP with many, many

depth cycles. The estimated measurement range is 100-200 m. Eric Firing at has donated it UH.

The BSP frame is roughly 4 x 4 x 6 ft (1.2 x 1.2 x 1.8 m). It is made from a combination of stainless steel tube (sandblast finish) and fiberglass unistrut and grating. The main frame will have zinc anodes. Stainless steel brackets and fasteners are used where necessary. Syntactic foam buoyancy blocks totaling 10 ft^3 are used (salvaged from retired deep tow mapping vehicles; 45 lb/ft^3 in air; –19.6 lb/ft^3 in seawater, using 64.4 lb/ft^3 for seawater).

The corners of the BSP are numbered and marked with yellow tape (ADCP is at the bow): port bow, 1 tape; starboard bow 2 tapes; starboard stern 3 tapes; port stern 4 tapes. This is the same convention as with the OBS.

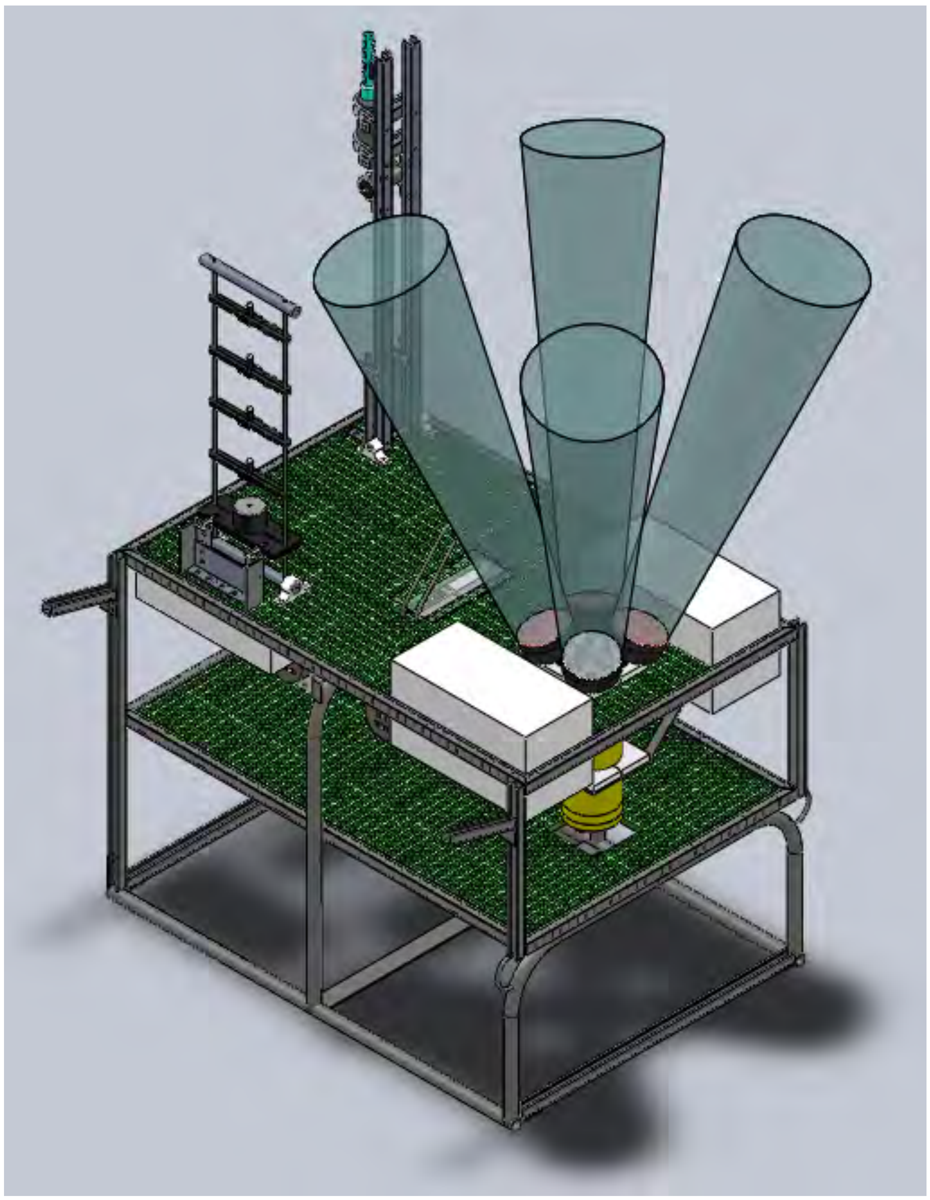


Figure 3-2 Basic Sensor Package (BSP; masts fold for deployment)

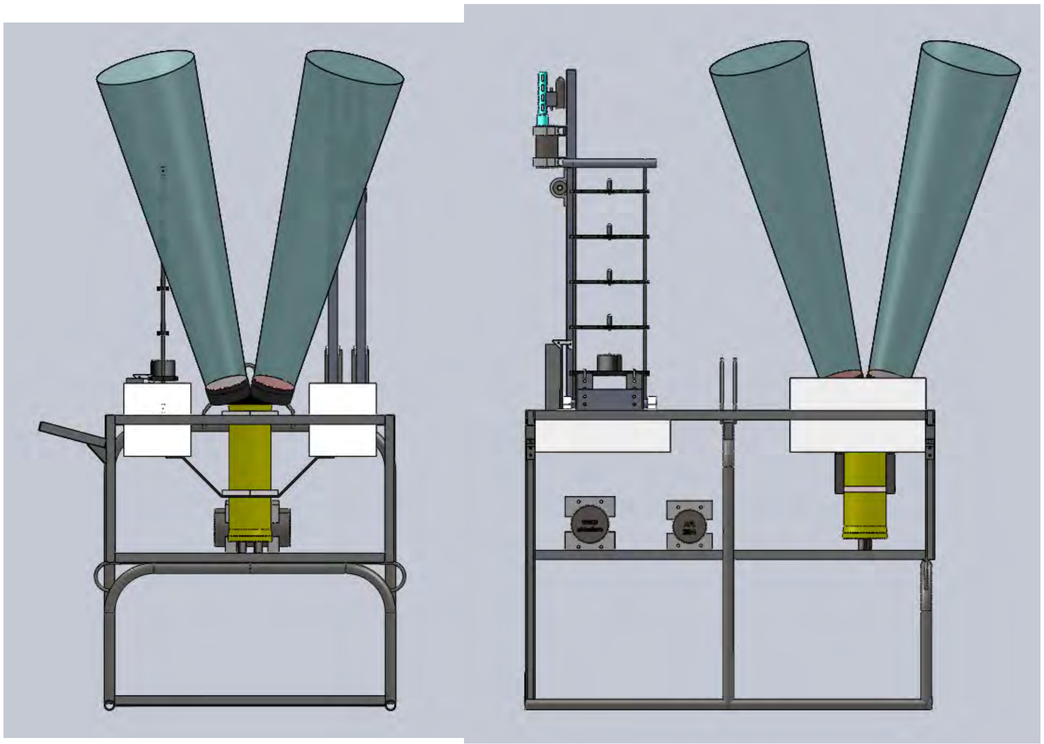


Figure 3-3 BSP – (hose will go on port side)

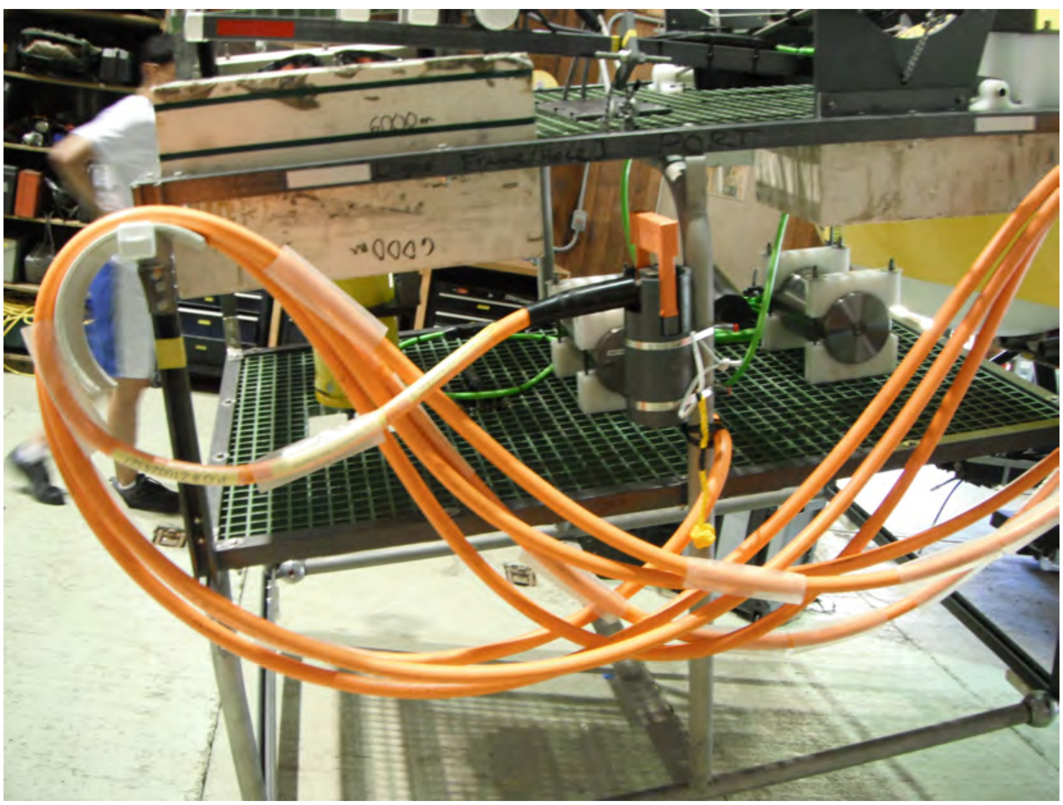


Figure 3-4 BSP at Makai Pier (more foam added since photo)

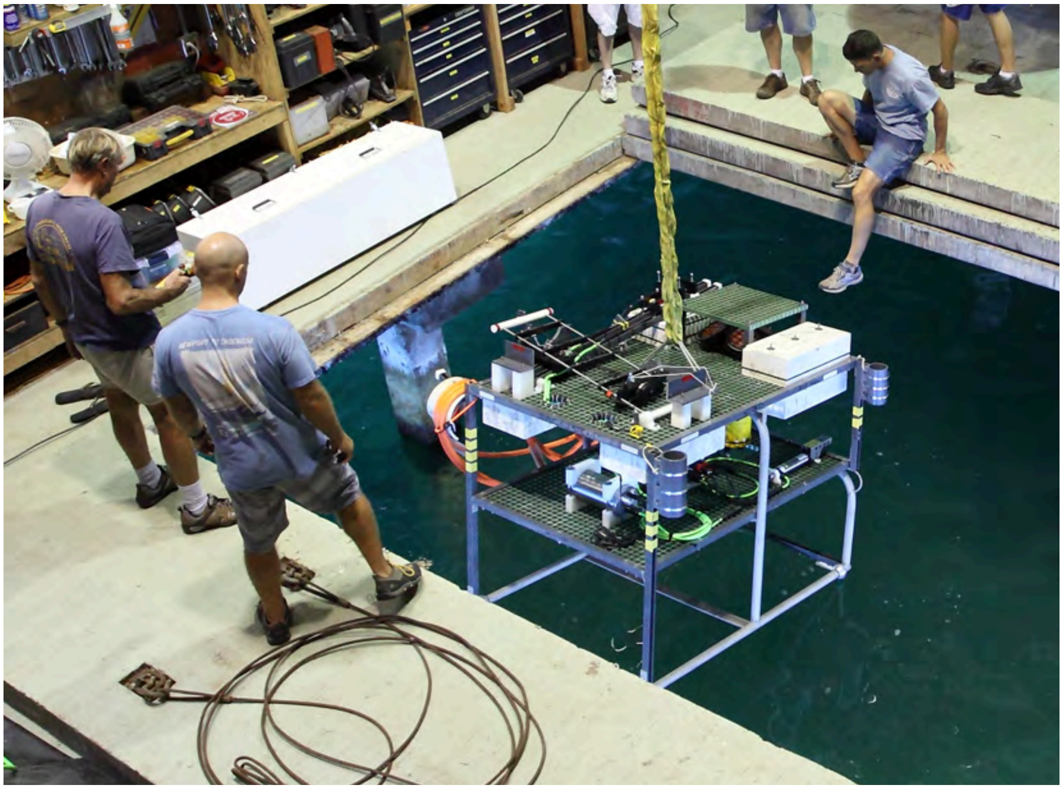


Figure 3-5 BSP1 at Makai Pier (more foam added since photo)

3.2 Camera (CAM2) and LIGHT1

The CAM2 has a similar configuration as the current CAM1, i.e., an AXIS Internet surveillance camera inside a Nautilus polished glass sphere with two lights and a hydrophone, Figures 3-6, 3-7, and 3-9.

Inside the glass sphere, an Opengear ACM5004-2-I-SDC device server acts as a remote interactive management (RIM) gateway providing:

- Ethernet to a HPoE injector going to the camera
- RS485 to the lights
- Serial (RS232) to engineering sensors (temperature, humidity)
- 5 V power for the hydrophone pre-amplifier

The 48 V coming into the sphere from the OBS directly powers the lights, a 48 V – 12 V converter to run the device server, and the HPoE injector (high power over Ethernet). Opengear contributed this device to the project.

The camera is an Axis Q6035 PTZ (pan, tilt, zoom) high definition surveillance camera with video streaming H.264 and motion jpeg. Axis contributed this camera to the project.

The LED lights are made by Cathx Ocean, Aphos Series 4, 48 V, 135 W, 7000 Lumen, 6500 m rated, fully controllable for output level and duty cycle, and they also report light temperature and current. The pressure case is Series 4L Corrbio™ titanium with a protective, high heat transfer coating. Two of these lights are on CAM2 (LIGHT2 on CAM2 port bow and LIGHT3 on CAM 2 starboard bow), and are software controlled. Initial software settings will be such that CAM2 could be plugged into a low power port if necessary. LIGHT2 maximum power is set to 125 W, but will come on at 3% intensity using 0.17 A (3.8 W). LIGHT3 maximum power is set to 125 W. It will come on at 60% intensity using 1.55 A (75 W). After deployment, the intensity levels can be changed with software commands, up to the maximum. In this state, with the camera drawing 0.35 A, the total current is 2.07 A or 102 W. (The observatory typically outputs ~49.3 V.) If both lights are subsequently turned to maximum power, the total draw will be 270 W.

An ITC 1072B hydrophone is connected to a custom preamplifier made by BHcircuits that is in turn connected to the audio input of the camera. The preamplifier is powered by the 5 V from the device server. Peter Worcester, SIO, provided this hydrophone.

The engineering sensors (temperature, humidity) obtain power from the Opengear device server. At this time, one accesses the data only through an Opengear web interface.

A “spider” breakout Y-Mold is used to bring all the various cables together in one potted block, so there can be one connector to the OBS (same ODI 12-pin assembly as for the BSP) and just one penetration in the glass sphere (in addition to a vacuum port). As we are concerned about the performance of this assembly, both the potted block and the cable going to the camera sphere, as contingency, a spare oil-filled unit that could replace the potted block and shorten the cable in question will be available.

The camera is ~8-ft (2.4 m) off the bottom. The length of a side on the bottom is 10 ft (3.0 m) and the length of the slant leg is 12 ft (3.6 m). The top of the frame is 11 ft 8 inches (3.6 m) high. The frame is made from the same fiberglass unistrut and grating as the BSP. Stainless steel brackets and fasteners are used where necessary.

The stand-alone light is the same model as above, but the maximum power draw is set to a maximum of 2.7 A at 48.0 V (130 W electrical) so that it could plug into any 48 V OBS port. It will be plugged into OBS 48 V port E1 that can deliver up to 3 A, ~150 W. There is no communication with the standalone light (incompatible communications wiring) so the OBS will just serve to turn power on and off. It stands approximately 6 ft (1.8 m) high on a tripod of similar construction as the camera (Figure 3-8). It will be carried down on the CAM2 tripod.

Two hinge brackets connect the bases of CAM2 and LIGHT1 during the stowed, deployment configuration, Figure 3-10. Once a titanium pin is pulled, which allows the top sections of the tripods to separate (not shown), LIGHT1 can be lifted vertically ~0.5 ft to separate from CAM2. The reverse is in principle possible, using both ROV arms.

Figure 3-6 Initial CAM2 solidworks

Figure 3-7 CAM2+LIGHT1 at Makai Pier

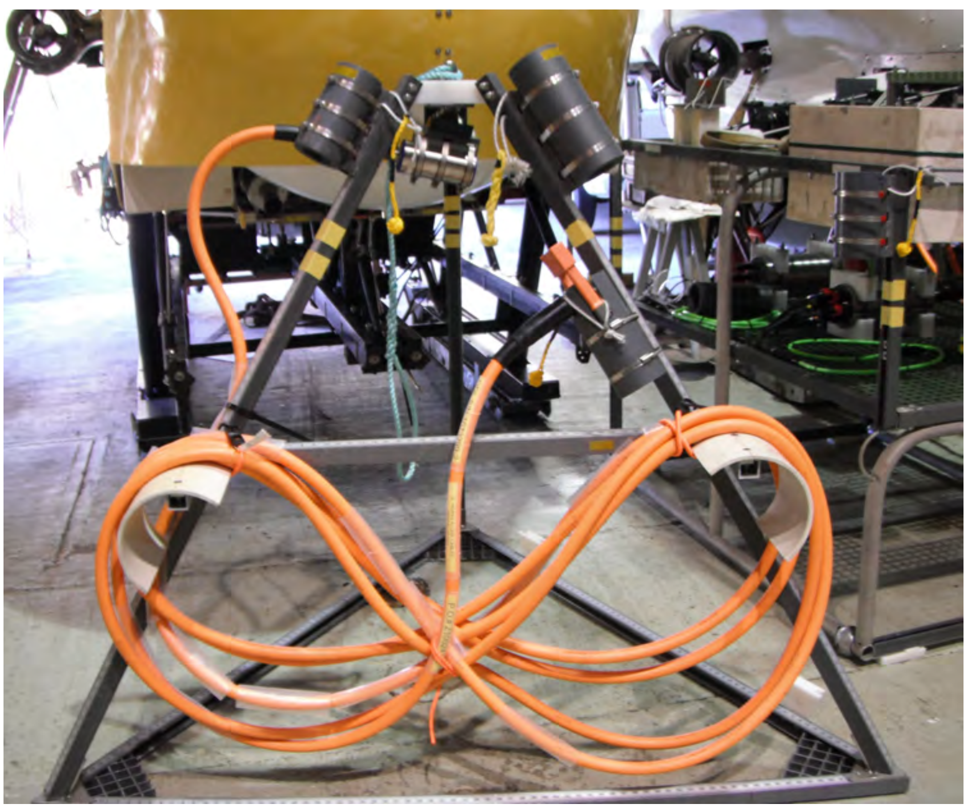


Figure 3-8 LIGHT1 – stand alone (BSP to right)

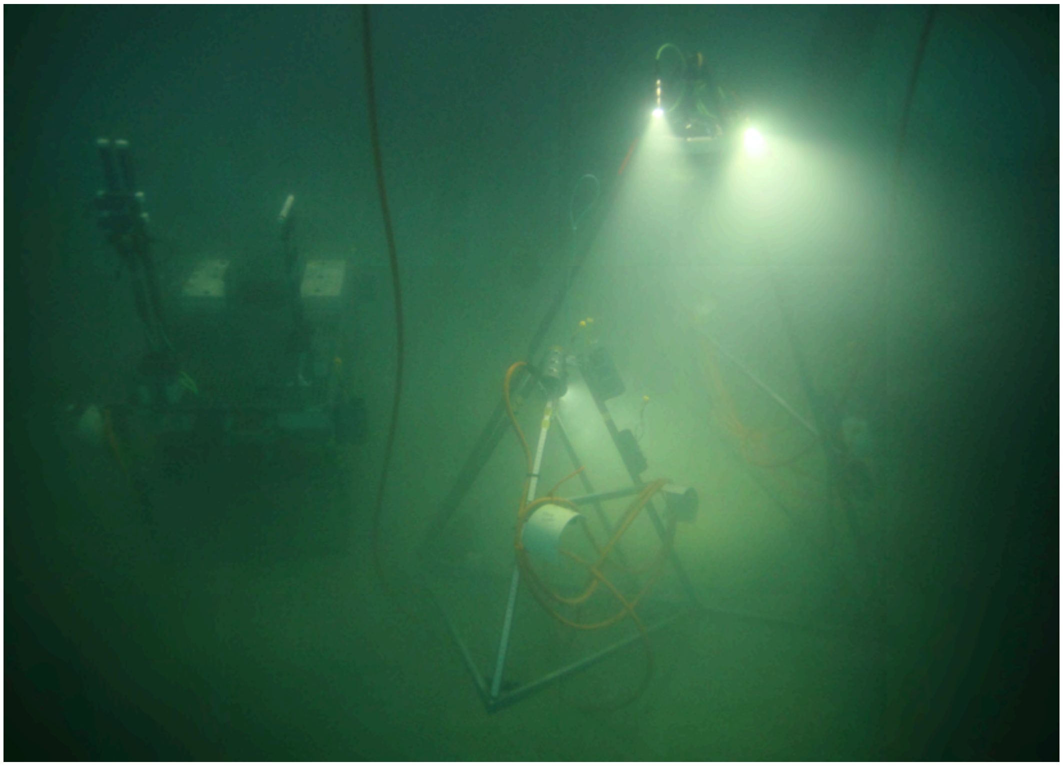


Figure 3-9 BSP, LIGHT1 and CAM2 on seafloor at Makai Pier

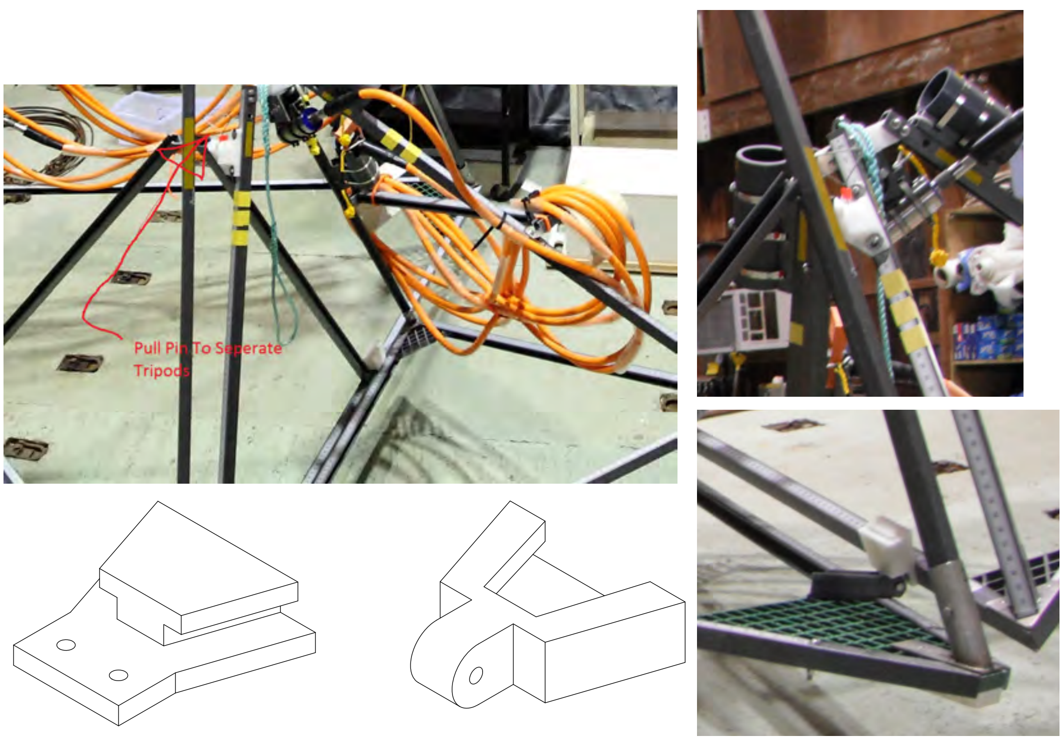


Figure 3-10 Hinge and pin connecting CAM2 and LIGHT1

3.3 Port test tools

Two port test tools (PTT) will be available for testing the ACO observatory ports. One PTT will be an active device provided by MBARI, developed for MARS but applicable here and for other "standard" observatory ports. It can test power (400 V and 48 V), communications (Ethernet), and (possibly) timing (1 PPS). It can operate either connected just to the observatory, or connected to the ROV. MBARI has worked with *Jason* in regard to the latter, and will provide support on the ship for this purpose. This PTT has one pressure case (about 9-inch diameter by 12 inch long) with one cable going to the ROV and another to the OBS, with an ODI 12-pin flying lead. When connected to the OBS it provides a transparent Ethernet communications link from the ship to the OBS and the ACO shore network.

The second port test tool is quite simple and can test only power. It has two dummy load resistors in an oil-filled hose, see Table 3-2 and Figure 3-12.

OBS Ports	Voltage V	Resistance Ω	Current A	Power W	ODI flying lead pins
E7-E8*	5	49.5	0.10	0.5	11,12
E1-E5	48	49.5	0.97	46.5	11,12
E7-E8	390	1950	0.20	78	9,10

*ACO E8 5 V disconnected internally

Table 3-2 ACO Port Test Tool (PTT)

Figure 3-11 ACO port test tool

3.4 Other

ODI pin-protecting dummy connectors will be used to protect the pins on flying connectors. The two we have will be used initially for CAM2 and LIGHT1. Figure 3-12 shows one with a T-handle for the ROV.

Figure 3-12 ODI 12-pin-protecting dummy with ROV T-handle

An ACO Banner, Figure 3-13, will be carried down on the Elevator and positioned in the field of view of the cameras. It is a 2 ft x 4 ft x ¼-inch white PVC sheet with a vinyl poster.

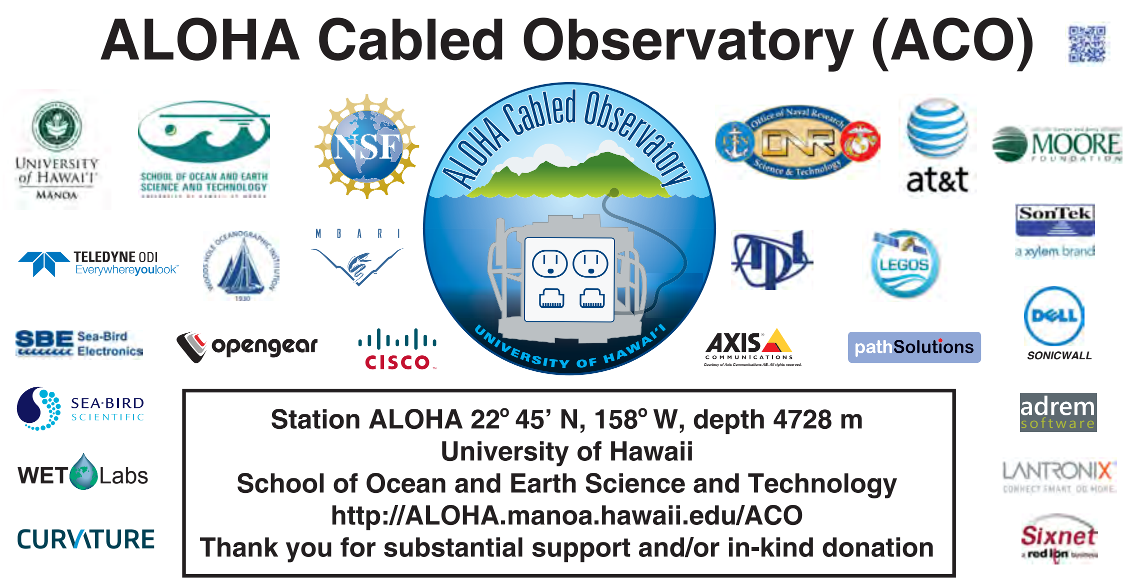


Figure 3-13 ACO Banner

Completely independent from the ACO activities, an Argo float equipped with a pH sensor will be deployed in the later part of the cruise.

4. Jason/Medea and Elevator

Jason is a two-body ROV system (Figures 4-1 and 4-2). A fiber-optic tether delivers electrical power and commands from the ship through Medea and down to Jason, which then returns data and live video imagery. Medea serves as a shock absorber, buffering Jason from the movements of the ship, while providing lighting and a bird's eye view of the ROV during seafloor operations. On this cruise, the ship's 0.681-inch electro-optical-mechanical cable is used as the main umbilical to Medea. Navigation is discussed in the next section.

Figure 4-1 Jason

Figure 4-2 Medea

The elevator is basically a vertical strength member with flotation at the top end and a ROV pin release at the other end. Figure 4-3 shows one version with glass balls with a base carrying packages; in our case, it will have no base, and it will likely use a disk of syntactic foam for buoyancy. It can be directly connected to a bottom package (the AMM secondary node in this case) to provide the necessary buoyancy to bring it to the surface, after Jason releases a weight. For recovery aids it has a flasher and a radio. Various combinations of the various flotation options can be used to obtain the requisite buoyancy for the bottom package(es) to be recovered. As another backup, *Medea* will also carry a recovery bridle (below).

Figure 4-3 Elevator (one of several options)

5. Navigation

Jason will navigate in several ways. First and simplest Jason uses a Doppler velocity log that gives, when integrated from a starting location to obtain position, good relative positioning within 100 m of the seafloor.

Second, some of the bottom packages will have Sonardyne Deep Marker Transponder Type 7835-000-05 "homer" beacons (35–55 kHz; Figure 4-3) and Jason can navigate relative to these up to about 100 m, using measured roundtrip travel times. The cable termination frame has a homer beacon (code 61).

Figure 5-1 Sonardyne homer beacon

Third, a scanning sonar will be used to detect targets/packages to a range of ~50 m.

Lastly, for large area coverage, the UH Sonardyne ultra-short-baseline (USBL) system will be used. The USBL transducer head will be installed on the retractable mast in the starboard instrument well that can lower the sensor head 6-ft below the bottom of the hull (as was done for the ACO installation cruise in June 2011). It will measure range and solid angle to beacons on Medea, Jason, and our packages. The azimuthal orientation will have already been calibrated on the preceding cruise.

The ultra-short baseline transducer is a Sonardyne Marksman LUSBL Model 8023 with a 50° wide downward looking beam (Figure 5-2). The accuracy specification is 0.27 percent 1 Drms Slant Range, i.e., 63 per cent of fixes lie within 13.5-meter radius in 5,000 meters water depth. The transponder beacon is shown in Figure 5-3. Absolute geographical position is provided by the ship using CNav GPS with decimeter accuracy.

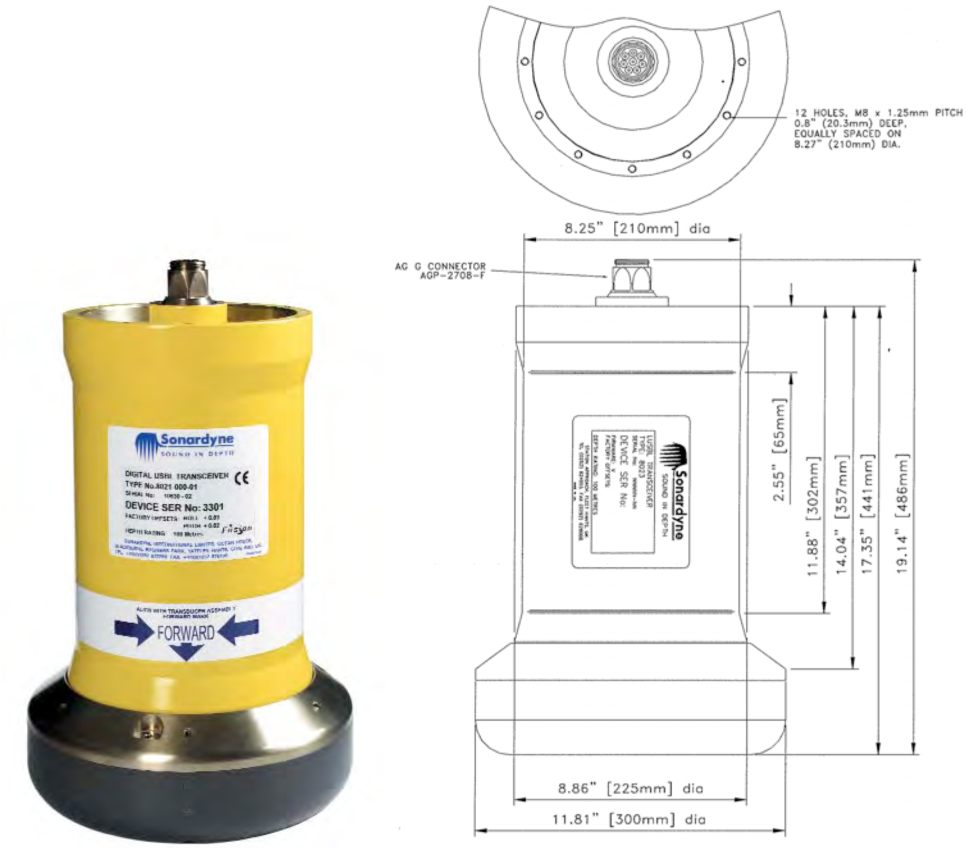


Figure 5-2 USBL transducer head

Figure 5-3 USBL Wideband Mini Transponder (WMT) – 7000

6. Deck Layout

When on deck, *Jason* will sit in the port quarter, and *Medea* on the centerline under the A-frame. The tool van is midships directly behind *Medea* (it should have been on aft starboard quarter). The ROV control van will sit on the O1 level, port side, and the rigging van on the starboard side. The BSP1 will be in the staging bay, and the CAM2 with LIGHT1 will sit just outside and slightly port by the tool van doors prior to deployment. Upon loading they will be connected to electronics in Lab 2 via a 20-m ODI orange hose (as well as when one CTD is transferred from the AMM to the BSP). The ship's crane will be used to deploy both of these units.

Interior space is allocated as follows: ACO will use two thirds of Lab 2 for electronics and sensor preparation and monitoring. The ROV crew will use Lab 1, the Science office, the Chem lab, and part of Lab 2 as needed. One technician from the previous HUMMA cruise will be working in the wet and hydro labs.

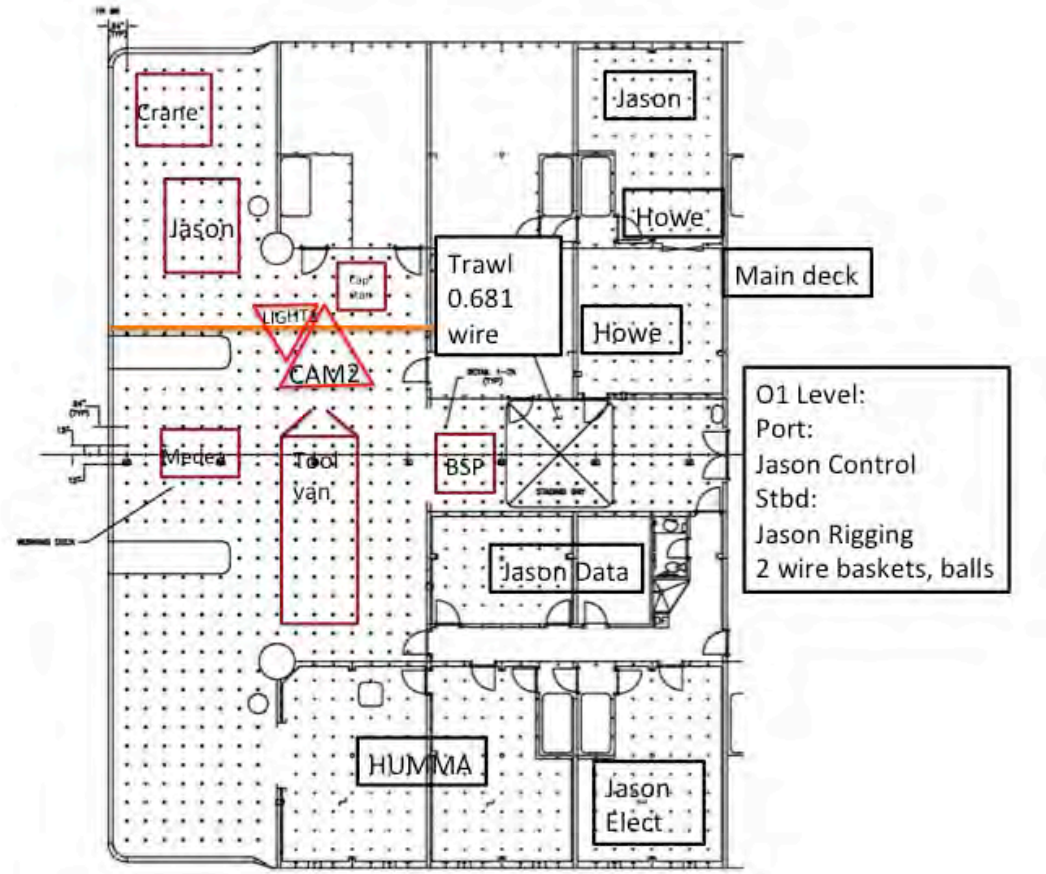


Figure 6-1 Main deck layout

7. Mobilization

We will be using the ship immediately after it comes back from Margo Edwards' HUMMA ROV cruise, at 0800 29 October, so that the ROV will have already been mob'ed and used. That party will leave most gear on board (and two technicians for sample curation). We will load our gear immediately on arrival and depart when secure, at ~1200.

All ACO equipment will already be staged at Snug Harbor before the Edwards cruise, so the *Jason* crew can see it first hand and suggest improvements from the ROV perspective, and to be ready for loading.

The ACO lab and spare equipment and supplies will be loaded first, then BSP, and finally CAM2+LIGHT1. The bench-top test node will be installed immediately on a shelf to be installed immediately to the right of the Lab 2 door, so as to be close to the bulkhead access port for deck cables. GPS and Iridium antenna cables (100 ft) will be run from the lab up to the O1 level above, stern rail. An Iridium cable (50 ft) will be run from the *Jason* control van roof to the interior for real time comms to shore during operations. CAM2, LIGHT1, and BSP will be connected with their orange 20-m umbilicals to the bench node in Lab2 and tested. The acoustic modem transducer will be rigged for easy deployment off the stern.

In parallel, the MBARI port test tool will be integrated on *Jason* and tested, also connected to the bench node. For the cables to reach in this testing, the pressure vessel and cable will have to be strung out over the deck toward the lab.

The Argo float will be loaded and stowed.

8. Responsibilities

The ACO science team is responsible for all the ACO packages, testing and preparing these for deployment, and providing science direction to the ROV crew during operations.

Good communications with the shore party will be essential. ACO will bring one Iridium phone (from Seaglider Lab). Two external antennas will be available. The ship will provide a second Iridium phone as a backup, as well as Satcom. Brian Chee will set up a Delome Iridium chat unit in the ROV van. In addition to HiSeasNet Internat, the ship/OTG will provide a dedicated Fleet Broadband satellite Internet connection in the Jason van for real time email and chat with the ACO shore party. ACO will have a laptop in the control van for this purpose.

The ROV team will operate the ROV, and be in charge of the deck during all operations that involve their equipment.

ACO/OTG will be responsible for deploying the free-falling CAM2+LIGHT1, BSP, and Elevator, and recovering the Elevator/AMM secondary node.

ROV will supply all bridles and lines associated with packages under *Medea* (for backup/contingency), as well as for the Elevator.

ACO will supply pin-protecting dummies for ODI connectors (2 available), with ROV mating provision (i.e., T-Handle). MBARI will bring one additional pin protecting dummy.

ACO will provide a WHOI micromodem deck set (electronics and fish) for testing the ACO BSP modem.

ACO will provide a "dumb" dummy/resistive load port test tool.

MBARI will provide a "smart" port test tool, interfaced to Jason with 48 V and Ethernet. Its shipboard computer will be set up in the Jason control van.

ROV will provide a cutting tool, i.e., sharp heavy knife and garden shears for line, bungies, tie wraps, in the "tool box" on the sled. Also a hydraulically driven cable cutter module (for ~1/2-inch "green" Falmat cable).

ACO will provide a tool suitable to cutting/crushing the standard green fiberglass grating (to extract bolted-on ODI 12-pin-protecting dummies). This is just a 1-inch square steel bar with a triangular, sharpened tip that can be put into the grating to cut/crush one cell at a time.

ROV will provide two homer beacons that can be deployed on ACO packages, as well as the Elevator. Holsters will be provided by ACO. The two identified for use are: 1) SN=275748-001, ID:/4-8(80); 2) SN=292137-001, ID:/5-5(51)

ACO provides one homer beacon, already mounted on the cable termination frame: code 61.

UH will provide two USBL navigation beacons for use on packages CAM2 and BSP1. ACO will provide holsters. 1) Config: 7212, Transducer: MF-DIR, Housing Rating: 7000 m, Address: 2710, Unit ID: 3BB7; 2) only identifying number is 3004 (Address?).

ROV will provide spare steel weights (20 lb pieces). ACO will have 4 "spelter sockets" – old wire rope towing terminations each ~80 lb with chain and shackles (2 to be used for free-falling CAM2 and BSP).

ROV will provide three elevators with different buoyancy capability from ~100 lb to ~400 lb. One will be used to recover the AMM secondary node. It may also be used to recover the BSP and/or CAM2 if necessary. It will be rigged with the ACO banner on the initial deployment.

ACO will provide cleaning/scraping/brushing tools for cleaning the precipitate on the seawater return (SWR) on the OBS.

The ship will operate much of the time in dynamic positioning. This entire system must be checked out before this cruise and it must be fully operational with all backup and redundant systems tested and operational.

The ship and OTG will provide sub-bottom echosounders (3.5 kHz and 12 kHz), acoustic Doppler current profiler data/plots (using 38 kHz and 300 kHz instruments), two air tuggers, and pallet jack.

9. Operations and timeline

Some equipment will be recovered and the new equipment installed so that we end with a system layout as shown in Figure 3-1. One ROV dive is required. As mentioned above, the camera (CAM2) will be free-falled first with LIGHT1 and the Elevator. We will recover the AMM secondary node by attaching it to the Elevator and free-floating it to the surface. Lastly we will free fall the BSP and connect it.

A backup to the elevator retrieval of the AMM secondary node (or any of the other packages as needed) is the Medea bridle shown in Figures 10-1 and 10-2. Double braid nylon rope used for the bridle has a specific gravity of 1.14 so it will naturally sink. This will be put on Medea for backup, stowed so as not to interfere with normal operations.

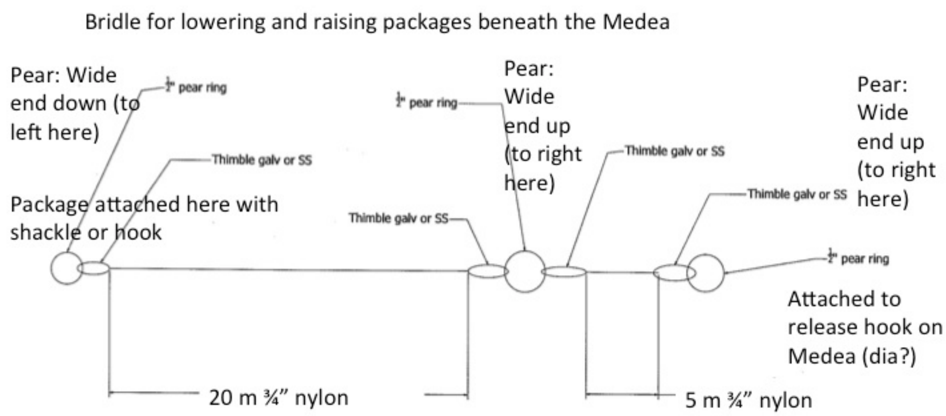


Figure 9-1 Package Medea bridle

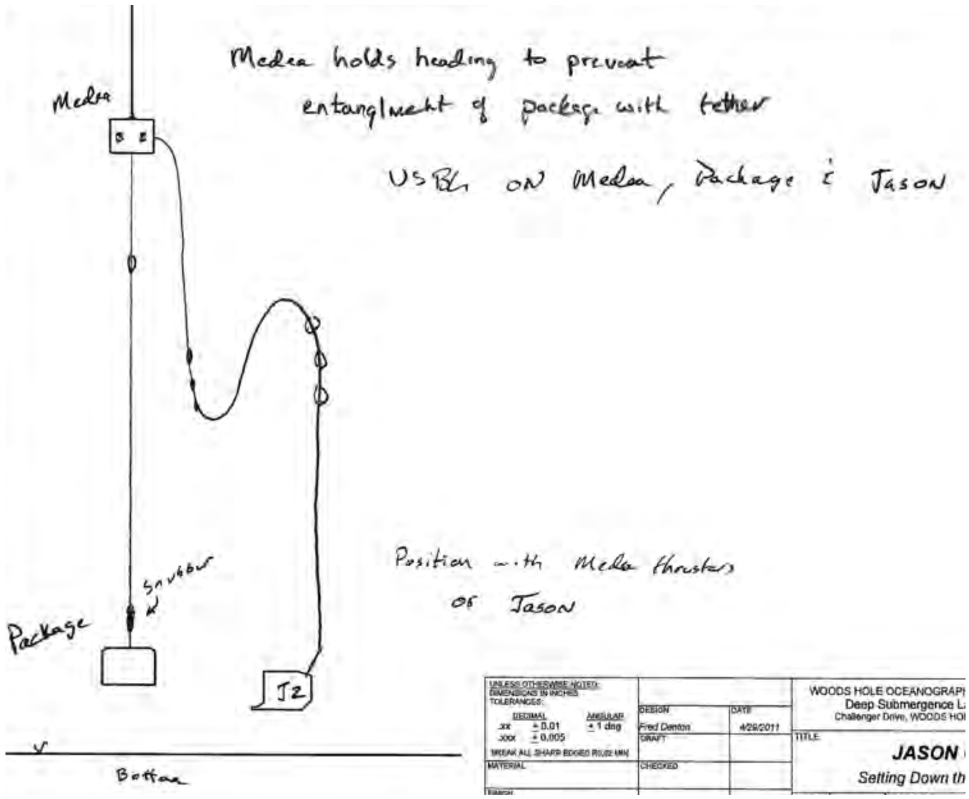


Figure 9-2 Medea, Jason and a package on the bridle

The two packages BSP1 and CAM2+LIGHT1 are 161 lb and 96 lb negative in seawater, respectively. While the BSP1 is somewhat heavy, *Jason* will be able to lift both and move them as necessary. An additional 80 lb weight ("spelter socket") on a ~10 m nylon line will be added (per Table 3-1, releasable by the ROV when on bottom) to somewhat speed descent (so it does not wander so much horizontally while falling) but also for deceleration of the package before it hits bottom. With weight attached to one corner, there will be less symmetry that could induce kiting. The weight+line will be attached to Corner 1 for CAM2 and the port center bottom tube for BSP. The line will be cut near or off the frame before moving. The line will be negatively buoyant.

During operations UH ACO shore personnel will be available to turn instrument power on and off to individual ports, control the overall system, and test components as we add them. This command and control will be done at UH. The AT&T Makaha Cable Station will be notified of our activity, in case there is some need (not expected at this point) for the shore personnel to operate from there. Good communications is essential. A detailed checkout procedure for each package will be followed and results therefrom reported.

Most testing of the components will involve people on shore. They will report results to the ship in a timely manner. Two-way acoustic modem testing will use the shipboard transducer, as well as from shore.

If all goes according to the plan laid out in detail in Appendix B and in the schedule in Table 10-1, the entire operation should be completed in the allotted time, with ~31 hours of contingency in Task 10.

The following table gives the major tasks and associated times.

Table 9-1 Cruise tasks and times (local HST time)

ACO Cruise with Jason, 29 Oct - 3 Nov 2014
Bruce Howe
2014 October 22

	Task	Start	hh:mm	End
1	Transit to Station ALOHA and ACO	10/29 12:00	13:00	10/30 01:00
2	Free-Fall CAM2+LIGHT1, and Elevator	10/30 01:00	3:10	10/30 04:10
3	Dive; connect LIGHT1	10/30 04:10	14:40	10/30 18:50
4	Connect CAM2	10/30 18:50	3:55	10/30 22:45
5	Recover AMM	10/30 22:45	10:00	10/31 08:45
6	Deck work	10/31 08:45	5:10	10/31 13:55
7	Free-Fall BSP	10/31 13:55	2:25	10/31 16:20
8	Find, move, and connect BSP	10/31 16:20	3:30	10/31 19:50
9	Clean up TAAM and finalize BSP	10/31 19:50	4:25	11/01 00:15
10	Photos, Mosaic, Housekeeping, and Contingency	11/01 00:15	45:45	11/02 22:00
11	Transit to Honolulu	11/02 22:00	14:00	11/03 12:00
		10/29 12:00	120.0	11/03 12:00

References

2011 cruise plan
http://aco-ssds.soest.hawaii.edu/ACO/docs/20110515_KM1116_Cruise_Plan_Howe_lo-res.pdf

2011 cruise report
http://aco-ssds.soest.hawaii.edu/ACO/docs/20110617_KM1116_Cruise_Report_Howe_lo-res.pdf

Oceans 11 paper
Howe, B. M., R. Lukas, F. Duennebier, and D. Karl, ALOHA cabled observatory installation, *OCEANS 2011*, 19-22 Sept. 2011, URL:
http://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=6107301&isnumber=6106891
or
http://aco-ssds.soest.hawaii.edu/Howe_et_al_ACO_Oceans11.pdf

Additional photographs and other system documentation can be found on the project wiki web site http://aco.wikispot.org/ and on the anonymous ftp server ftp.soest.hawaii.edu/bhowe/ACO. Also see the ROV *Jason* Virtual Control Van videos from the June 2011 cruise. http://4dgeo.whoi.edu/webdata/virtualvan/html/VV-km1116/index.html

Appendix A – ACO Diagrams

The following diagrams show components of ACO in a schematic form, naming frames, connectors and cables, pressure cases and endcaps, sensors, control screen, etc.

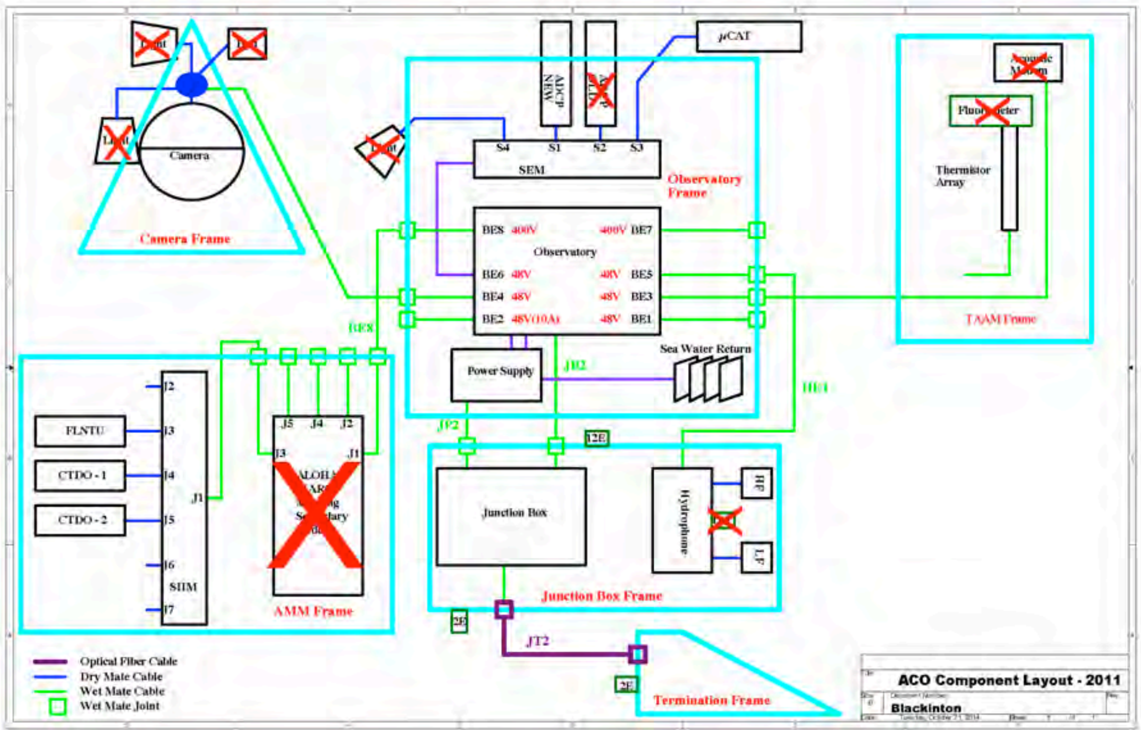


Figure A-1 ACO bottom interconnection diagram – present

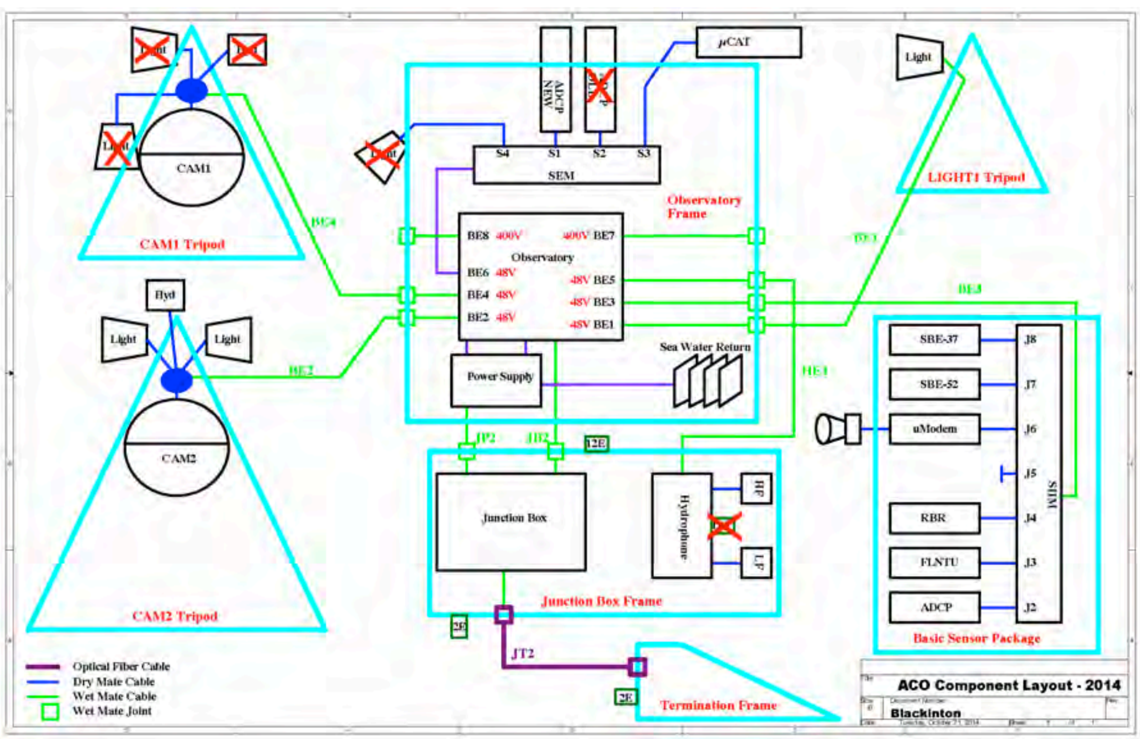


Figure A-2 ACO bottom interconnection diagram – planned

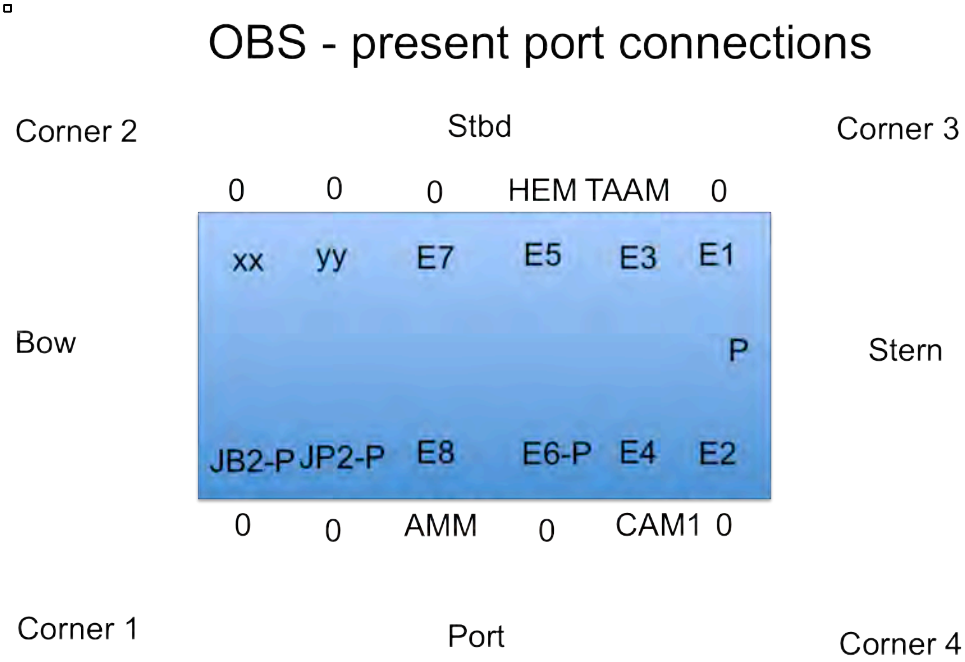


Figure A-3 ACO Observatory port connections – present (P = parking)

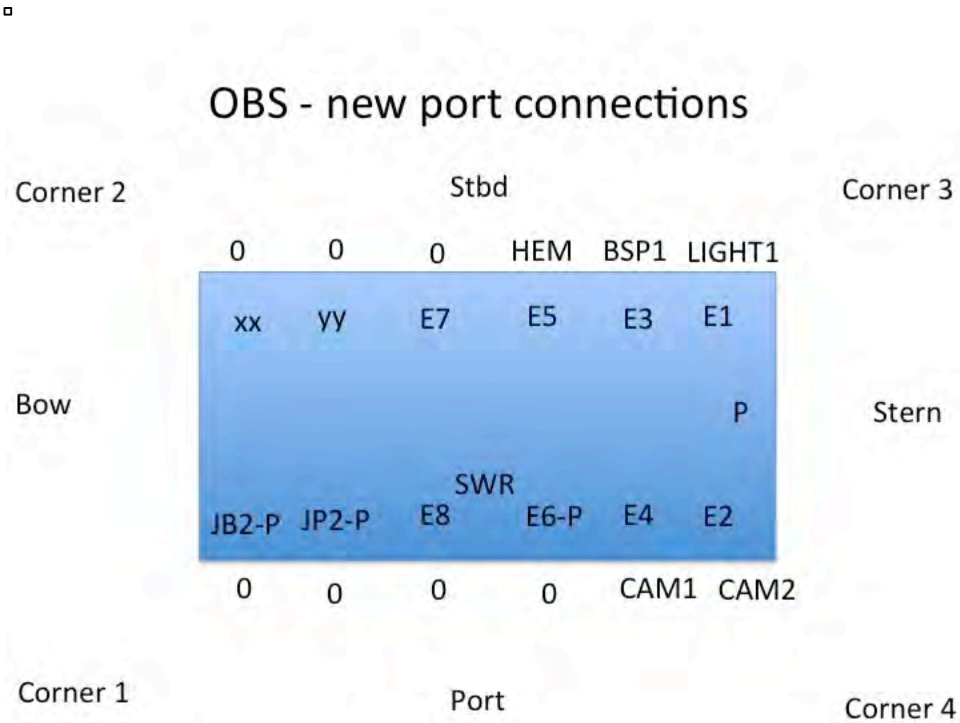


Figure A-4 ACO Observatory port connections – new (P = parking)

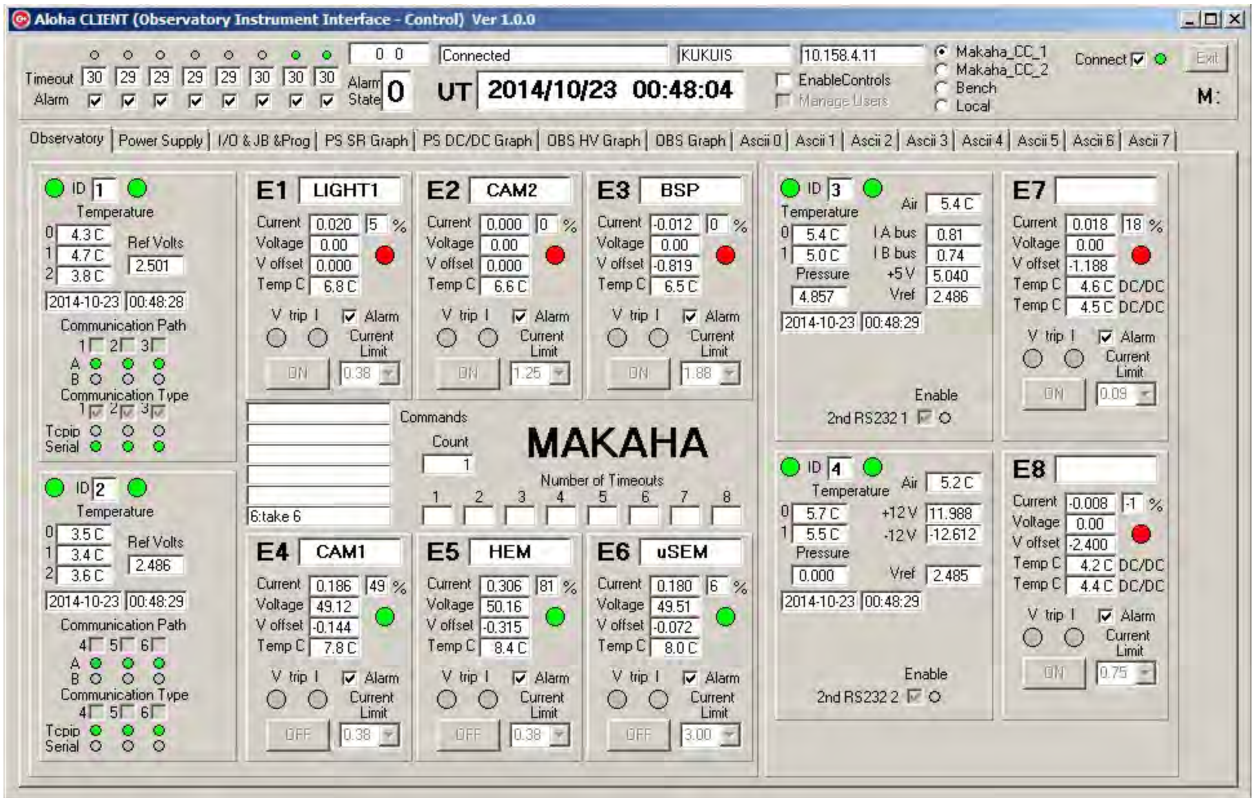


Figure A-5 ACO Client screen showing the various instruments and ports

Appendix B – ACO Operations

The following table gives the detailed ACO tasks associated with deploying and recovering the instrumentation.

Table B-1 ACO tasks for deployment

		Task	Start	hh:mm	End
1		**Transit to Station ALOHA and ACO**	**10/29 12:00**		
	1	Transit	10/29 12:00	12:00	10/30 00:00
	2	Load ROV tool sled with tools: knife, Port Test Tool (PTT; 2 ea, MBARI connected to ROV, ACO stand alone), hydraulic cable cutter, cleaning brushes, bungie cords with hooks. Put 25 m bridle on Medea (to recover AMM).Test MBARI Port Test Tool (PTT). Continue to monitor CAM2_LIGHT1 and BSP.	10/30 00:00	0:00	10/30 00:00
	3	Establish ship in DP mode 100 m due east of Cable Termination site. Bottom depth 4728 m.	10/30 00:00	1:00	10/30 01:00
				13:00	**10/30 01:00**
2		**Free-Fall CAM2+LIGHT1, and Elevator**	**10/30 01:00**		
	1	Final prep of CAM2+LIGHT1 and Elevator on deck; Elevator has ACO banner	10/30 01:00	1:00	10/30 02:00
	2	Elevator USBL beacon code xx, homer beacon code yy	10/30 02:00	0:00	10/30 02:00
	3	CAM2 USBL beacon code xx, homer beacon code yy	10/30 02:00	0:00	10/30 02:00
	4	Elevator: total deployment weight xxx lbs in air, yyy lbs in water; z1 removeable weight added to frame and z2 removable weight added on line/chain below (these include USBL beacon). Total Package weights.	10/30 02:00	0:00	10/30 02:00
	5	CAM2+LIGHT1: total deployment weight xxx lbs in air, yyy lbs in water; z2 removable weight added on line below (theseweights include USBL beacon). LIGHT1 weights xx lb. Total Package weights yy lb.	10/30 02:00	0:00	10/30 02:00
	6	Position ship stern at desired CAM2 deployment position (if any reliable current data, modify accordingly).	10/30 02:00	0:30	10/30 02:30
	7	**Deploy Elevator using crane, in free fall**	10/30 02:30	0:20	10/30 02:50
	8	**Deploy CAM2+LIGHT1 using crane, in free fall**	10/30 02:50	0:20	10/30 03:10
	9	Track Elevator and CAM2+LIGHT1 as they fall.	10/30 03:10	0:30	10/30 03:40
	10	Move ship to 100 m south of cable termination frame (TF)	10/30 03:40	0:30	10/30 04:10
				3:10	**10/30 04:10**

3	**Dive; connect LIGHT1**		**10/30 04:10**		
	1	**Start Dive 1.** Deploy ROV.	10/30 04:10	0:30	10/30 04:40
	2	Continually check navigation and cable tension	10/30 04:40	2:30	10/30 07:10
	3	Stop with Medea 30 m off bottom, ROV in sight of bottom. Inform shore, use CAM1 to look for ROV light, and listen	10/30 07:10	0:10	10/30 07:20
	4	Check bearings, navigation, sonar, nav and homer beacons	10/30 07:20	0:10	10/30 07:30
	5	Move ROV north to find sea cable.	10/30 07:30	0:05	10/30 07:35
	6	Find cable termination	10/30 07:35	0:30	10/30 08:05
	7	Inspect TF and homer beacon/float.	10/30 08:05	0:05	10/30 08:10
	8	Zero Doppler log next to TF; check navigation.	10/30 08:10	0:10	10/30 08:20
	9	Check CAM1 functionality from shore (using ROV lights)	10/30 08:20	0:15	10/30 08:35
	10	Find CAM2+LIGHT1. Move ship/Medea if necessary. Look for Elevator at same time.	10/30 08:35	1:30	10/30 10:05
	11	Inspect CAM2+LIGHT1.	10/30 10:05	0:10	10/30 10:15
	12	Remove/cut line with weight from CAM2+LIGHT1.	10/30 10:15	0:10	10/30 10:25
	13	**Lift and move CAM2+LIGHT1** to desired location with desired orientation (CAM2 bow at heading 15°T). Move ship/Medea if necessary.	10/30 10:25	1:00	10/30 11:25
	14	Remove LIGHT1 with hose from CAM2 frame.	10/30 11:25	0:20	10/30 11:45
	15	**Move LIGHT1 to desired location**, set tripod at 180°T, and prep hose/connector for removal.	10/30 11:45	0:30	10/30 12:15
	16	Move ROV to OBS port E1, OBS starboard side toward stern quarter, corner 3.	10/30 12:15	0:10	10/30 12:25
	17	**Remove TAAM connector from E3**.	10/30 12:25	0:10	10/30 12:35
	18	Set connector aside on the stern OBS mid-deck temporarily.	10/30 12:35	0:10	10/30 12:45
	19	Remove EC from port E1.	10/30 12:45	0:05	10/30 12:50
	20	Plug PTT into OBS port E1.	10/30 12:50	0:10	10/30 13:00
	21	Test port E1 (from shore, and on ship through ROV).	10/30 13:00	0:45	10/30 13:45
	22	Unplug PTT from E1	10/30 13:45	0:05	10/30 13:50
	23	Plug PTT into OBS port E3.	10/30 13:50	0:10	10/30 14:00
	24	Test port E3 (from shore, and on ship through ROV).	10/30 14:00	0:35	10/30 14:35
	25	Unplug PTT from E3.	10/30 14:35	0:05	10/30 14:40
	26	Put EC on E3.	10/30 14:40	0:05	10/30 14:45
	27	Move ROV back to LIGHT1.	10/30 14:45	0:10	10/30 14:55
	28	Remove bungies holding hose.	10/30 14:55	0:10	10/30 15:05
	29	Take LIGHT1 flying connector to OBS port E1.	10/30 15:05	0:20	10/30 15:25
	30	Remove pin-protecting dummy from flying connector.	10/30 15:25	0:10	10/30 15:35
	31	**Plug LIGHT1 into E1.**	10/30 15:35	0:05	10/30 15:40
	32	Turn on LIGHT1.	10/30 15:40	0:10	10/30 15:50

	33	Test light (from shore).	10/30 15:50	0:20	10/30 16:10
	34	Dress HE1 hose between E5 and JBOX	10/30 16:10	0:15	10/30 16:25
	35	Remove EC from port E7.	10/30 16:25	0:10	10/30 16:35
	36	Plug PTT into OBS port E7.	10/30 16:35	0:10	10/30 16:45
	37	Test port E7 (from shore, and on ship through ROV).	10/30 16:45	0:35	10/30 17:20
	38	Unplug PTT from E7	10/30 17:20	0:05	10/30 17:25
	39	Put EC on E7.	10/30 17:25	0:05	10/30 17:30
	40	Flip non-working light on OBS over so the light is above E1 (in preparation to working on E2).	10/30 17:30	0:10	10/30 17:40
	41	Clear any interference between the TAAM connector/cable and the LIGHT1 cable. Put pin-protecting dummy on TAAM connector; set connector on seafloor 4 meters south.	10/30 17:40	0:20	10/30 18:00
	42	Dress LIGHT1 hose and CAM1 cable (in E4) and fine tune tripod/LIGHT1 position and direction. (There will be other opportunities to tune cameras and lights.)	10/30 18:00	0:20	10/30 18:20
	43	Test LIGHT1 and CAM1.	10/30 18:20	0:30	10/30 18:50
	44			**14:40**	**10/30 18:50**
4	**Connect CAM2**		**10/30 18:50**		
	1	Move ROV to CAM2.	10/30 18:50	0:05	10/30 18:55
	2	Adjust CAM2 position and azimuth if necessary (more opportunity later too).	10/30 18:55	0:10	10/30 19:05
	3	Remove bungies securing hose and connector.	10/30 19:05	0:10	10/30 19:15
	4	Remove connector and umbilical hose.	10/30 19:15	0:10	10/30 19:25
	5	Carry connector to OBS port E2 (OBS port stern, SW corner, corner 4).	10/30 19:25	0:10	10/30 19:35
	6	Remove EC from port E2, stow in tool basket.	10/30 19:35	0:05	10/30 19:40
	7	Plug PTT into port E2.	10/30 19:40	0:10	10/30 19:50
	8	Test port E2.	10/30 19:50	0:35	10/30 20:25
	9	Unplug PTT from E2.	10/30 20:25	0:05	10/30 20:30
	10	Unplug pin-protecting dummy from CAM2 flying lead; stow on ROV.	10/30 20:30	0:05	10/30 20:35
	11	**Plug CAM2 into E2**.	10/30 20:35	0:05	10/30 20:40
	12	Shore turns on port E2.	10/30 20:40	0:15	10/30 20:55
	13	Shore tests CAM2.	10/30 20:55	0:30	10/30 21:25
	14	Remove CAM2 USBL beacon and homer beacon; stow on ROV.	10/30 21:25	0:20	10/30 21:45
	15	Adjust positions of CAM1, CAM2, LIGHT1	10/30 21:45	1:00	10/30 22:45
				3:55	**10/30 22:45**
5	**Recover AMM**		**10/30 22:45**		
	1	Return to OBS, port side.	10/30 22:45	0:15	10/30 23:00
	2	Inspect and clean sea water return (SWR).	10/30 23:00	0:30	10/30 23:30
	3	Position ROV by E8 – CAUTION – CTD just to left.	10/30 23:30	0:15	10/30 23:45

	4	Remove AMM connector from OBS port E8; set on ROV tool sled.	10/30 23:45	0:10	10/30 23:55
	5	Plug PTT connector in E8.	10/30 23:55	0:10	10/31 00:05
	6	Shore tests E8.	10/31 00:05	0:35	10/31 00:40
	7	Remove PTT connector from E8.	10/31 00:40	0:10	10/31 00:50
	8	Place environmental cover (EC) on E8.	10/31 00:50	0:05	10/31 00:55
	9	Carry connector back to AMM.	10/31 00:55	0:15	10/31 01:10
	10	Remove EC from free port (suggest J5).	10/31 01:10	0:05	10/31 01:15
	11	Plug connector into free port.	10/31 01:15	0:05	10/31 01:20
	12	Move ROV back toward previous position, to end loop of cable.	10/31 01:20	0:10	10/31 01:30
	13	Secure/loop this 17 m cable to AMM frame. (Or wrap cable around AMM before plugging connector into J5 or other.)	10/31 01:30	0:20	10/31 01:50
	14	Move ROV to find Elevator.	10/31 01:50	1:00	10/31 02:50
	13	ROV disconnects fall weight from Elevator	10/31 02:50	0:15	10/31 03:05
	14	ROV picks up Elevator.	10/31 03:05	0:05	10/31 03:10
	15	ROV carries Elevator next to AMM and parks it.	10/31 03:10	0:45	10/31 03:55
	16	ROV removes ACO Banner from Elevator.	10/31 03:55	0:20	10/31 04:15
	17	Set up ACO Banner leaning on port stern corner of the OBS in the CAM1 view	10/31 04:15	0:20	10/31 04:35
	18	Add USBL and homer beacons to AMM (ones used on CAM2). Use holsters already on AMM. Secure with bungies.	10/31 04:35	0:20	10/31 04:55
	19	Install homer and USBL beacons in holsters on AMM	10/31 04:55	0:30	10/31 05:25
	20	Test homer beacon. Test USBL beacon.	10/31 05:25	0:10	10/31 05:35
	21	Move Elevator next to AMM.	10/31 05:35	0:10	10/31 05:45
	22	Connect Elevator line to AMM.	10/31 05:45	0:10	10/31 05:55
	23	Clear all lines around AMM.	10/31 05:55	0:15	10/31 06:10
	24	ROV pulls Elevator release pin	10/31 06:10	0:20	10/31 06:30
	25	ROV observes AMM rising - estimate speed.	10/31 06:30	0:15	10/31 06:45
	26	**Recover AMM using the ship.**	10/31 06:45	2:00	10/31 08:45
	27	After AMM recovery during subsequent deck work, ROV repositions sea cable between splice and termination frame, to make a cable free spot for the BSP. After this, perform housekeeping tasks per below if time available.	10/31 08:45	0:00	10/31 08:45
				10:00	**10/31 08:45**
6	**Deck work**		**10/31 08:45**		
	1	Unmount nav and homer beacons from AMM.	10/31 08:45	0:20	10/31 09:05
	2	Unmount CTDs from AMM.	10/31 09:05	0:30	10/31 09:35
	3	Move ship to desired BSP drop location.	10/31 09:35	0:10	10/31 09:45
	4	Test one CTD on BSP (tub of salt water with cleaner)	10/31 09:45	2:00	10/31 11:45
	5	Mount CTD on BSP.	10/31 11:45	0:30	10/31 12:15

	6	Mount nav and homer beacons from AMM to BSP.	10/31 12:15	0:10	10/31 12:25
	7	Test BSP with CTD.	10/31 12:25	1:00	10/31 13:25
	8	Final check of BSP.	10/31 13:25	0:30	10/31 13:55
				5:10	**10/31 13:55**
7	**Free-Fall BSP**		**10/31 13:55**		
	1	Final prep of BSP on deck with hose secured on side.	10/31 13:55	0:30	10/31 14:25
	2	BSP USBL beacon code xx, homer beacon code yy	10/31 14:25	0:00	10/31 14:25
	3	BSP: total deployment weight xxx lbs in air, yyy lbs in water; z2 lb removable weight added on line below (these weights include USBL beacon, weight).	10/31 14:25	0:00	10/31 14:25
	4	Position ship stern at desired BSP position (if any reliable current data, modify accordingly).	10/31 14:25	0:10	10/31 14:35
	5	**Deploy BSP using crane, in free fall**	10/31 14:35	0:15	10/31 14:50
	6	Track BSP as it falls.	10/31 14:50	1:00	10/31 15:50
	7	Move ship and ROV to intercept on bottom.	10/31 15:50	0:30	10/31 16:20
				2:25	**10/31 16:20**
8	**Find, move, and connect BSP**		**10/31 16:20**		
	1	ROV Find BSP.	10/31 16:20	0:30	10/31 16:50
	2	Remove line and weight.	10/31 16:50	0:10	10/31 17:00
	3	**Lift and move BSP** to desired location with desired orientation with port side facing the OBS; bow (with ADCP) heading 20 °T. Move ship/Medea if necessary.	10/31 17:00	1:00	10/31 18:00
	4	Position ROV opposite ODI umbilical on BSP, port side.	10/31 18:00	0:10	10/31 18:10
	5	Remove securing bungies from umbilical.	10/31 18:10	0:10	10/31 18:20
	6	With flying connector fly slightly up and away to pull all umbilical off frame, then turn toward OBS.	10/31 18:20	0:10	10/31 18:30
	7	Carry umbilical/connector to OBS.	10/31 18:30	0:05	10/31 18:35
	8	Position ROV to plug into E3.	10/31 18:35	0:05	10/31 18:40
	9	Remove EC from E3.	10/31 18:40	0:05	10/31 18:45
	10	**Plug into E3.**	10/31 18:45	0:05	10/31 18:50
	11	**Shore party tests BSP1**. Ship deploys acoustic modem transducer for testing acoustic communications and ranging	10/31 18:50	1:00	10/31 19:50
				3:30	**10/31 19:50**
9	**Clean up TAAM and finalize BSP**		**10/31 19:50**		
	1	**Pick up TAAM connector** and cable (left on the bottom 4 m S of the OBS, above).	10/31 19:50	0:10	10/31 20:00
	2	Pull up and away and fly to TAAM anchor (follow cable back on itself, roughly 50 m west, at 270 °T, see Figure 2-3). Avoid camera vicinity.	10/31 20:00	0:10	10/31 20:10

			Start	Duration	End
	3	Fly farther to west to clear TAAM cable from observatory area.	10/31 20:10	0:10	10/31 20:20
	4	Loop back to TAAM anchor, set ROV down by TAAM anchor (facing 2 strip side, with connector still plugged into dummy)	10/31 20:20	0:10	10/31 20:30
	5	Cut off flying connector on end of cable and put in basket.	10/31 20:30	0:10	10/31 20:40
	6	Cut cable to flying connector currently plugged into pin-protecting dummy on TAAM anchor	10/31 20:40	0:10	10/31 20:50
	7	Remove connector and put in ROV basket	10/31 20:50	0:10	10/31 21:00
	8	**Return to BSP1**	10/31 21:00	0:10	10/31 21:10
	9	Assume testing ok.	10/31 21:10	0:10	10/31 21:20
	10	Raise acoustic modem mast and confirm lock in place.	10/31 21:20	0:10	10/31 21:30
	11	Raise CTD mast and confirm lock in place.	10/31 21:30	0:10	10/31 21:40
	12	Remove ADCP protective grating. Stow on mid-deck (or put on ROV tool sled for recovery)	10/31 21:40	0:20	10/31 22:00
	13	**Shore and continue testing BSF1.**	10/31 22:00	1:00	10/31 23:00
	14	Remove USBL and homer beacons; stow on ROV.	10/31 23:00	0:15	10/31 23:15
	15	Adjust positions of CAM1, CAM2, LIGHT1	10/31 23:15	1:00	11/01 00:15
				4:25	**11/01 00:15**
10	**Photos, Mosaic, Housekeeping, and Contingency**		**11/01 00:15**		
	1	If not already, clean sea-water return.	11/01 00:15	0:50	11/01 01:05
	2	On TAAM anchor, cut/rip out pin-protecting dummies from grating on both sides of anchor frame, using triangular breaker bar	11/01 01:05	1:20	11/01 02:25
	3	Cleanup (cables, weights, buoyancy).	11/01 02:25	1:45	11/01 04:10
	4	Photo op – ROV, CAMs interaction.	11/01 04:10	1:50	11/01 06:00
	5	Mosaic.	11/01 06:00	6:00	11/01 12:00
	6	Contingency	11/01 12:00	31:00	11/02 19:00
	7	Ascend and recover.	11/02 19:00	2:30	11/02 21:30
	8	**End Dive 1.**	11/02 21:30	0:30	11/02 22:00
				45:45	**11/02 22:00**
11	**Transit to Honolulu**		**11/02 22:00**		
	1	Begin transit	11/02 22:00	0:00	11/02 22:00
	2	Transit	11/02 22:00	14:00	11/03 12:00
	3	Arrive	11/03 12:00	0:00	11/03 12:00
				14:00	**11/03 12:00**
			10/29 12:00	**120.0**	**11/03 12:00**

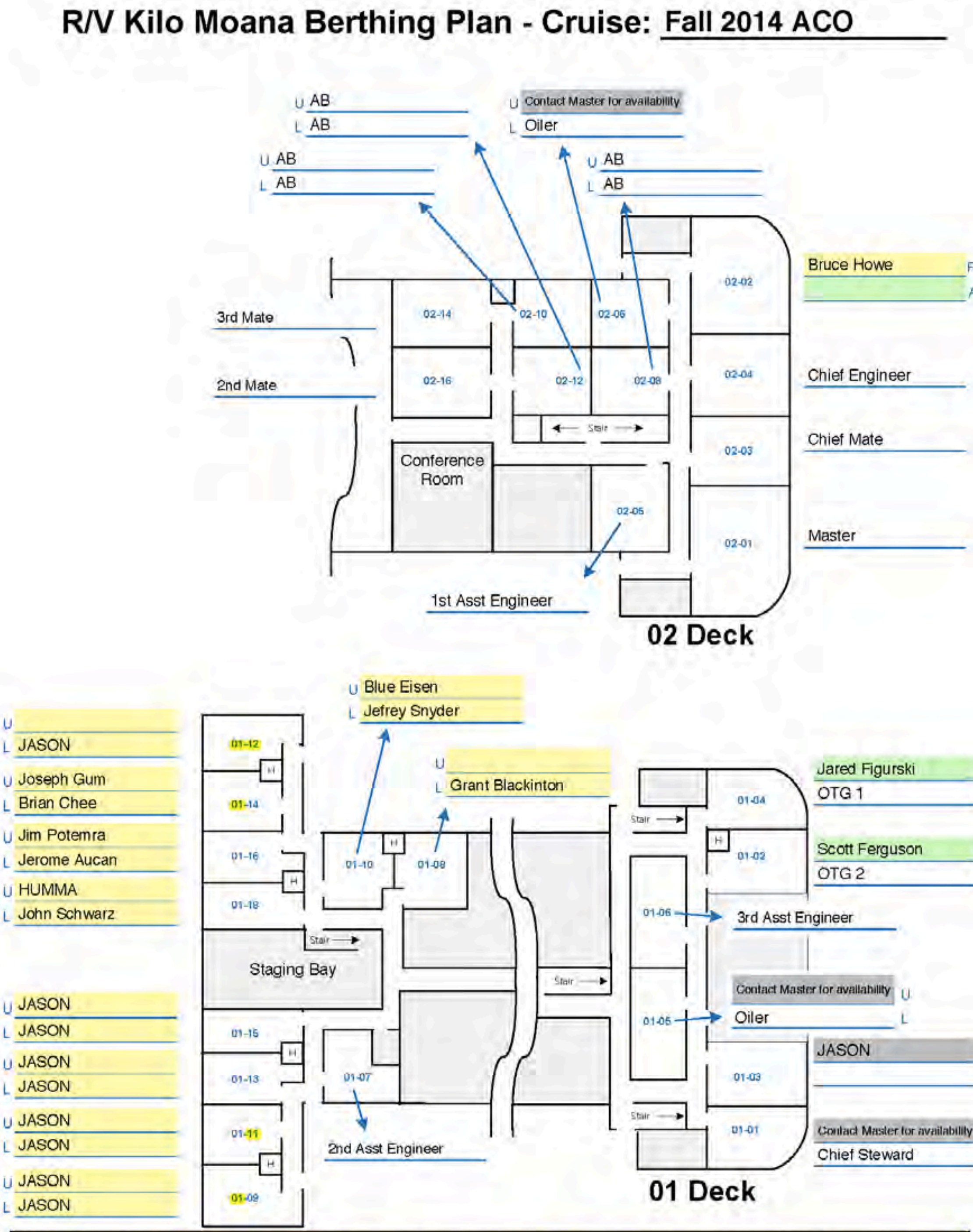
Appendix C – Cruise Participants and Contacts List

	Name	Position	Email	Phone
	Cruise Participants			
	UH/ACO			
1	Bruce Howe	Chief Scientist	bhowe@hawaii.edu	Cell: 808-469-0553 Off: 808-956-0466 Hm: 808-888-0665 Iridium: 011-8816-22426745
2	Blue Eisen	Engineer	bdeisen@hawaii.edu	Off: 808-956-0385 Cell: 808-226-9357
3	Jefrey Snyder	Engineer	jefrey@hawaii.edu	Lab: 808-956-7931
4	Brian Chee	Network Specialist	chee@hawaii.edu	Off: 808-956-5797 Cell: 808-372-7426
5	Grant Blackinton	Engineer	grant@blackinton.org	Cell: 206-579-7738
6	Joseph Gum	Engineer	jgum@hawaii.edu	Cell: 808-645-0441
7	Jim Potemra	Scientist	jimp@hawaii.edu	Off: 808-956-2737 Cell: 808-393-3693
8	Jerome Aucan	Scientist	jerome.aucan@ird.fr	Cell: 626 840 3719
9	Jared Figurski	MBARI Ocean Observatory Technician	jared@mbari.org	Off:: 831-775-1967 Cell: 831-818-2769
10	John Schwarz	HUMMA, Chemist	john.l.schwarz@us.army.mil	
11	HUMMA	HUMMA		
12	TBD			
	ROV *Jason* - WHOI			
13	Casey Agee	Navigator		
14	Scott Hansen	Pilot		
15	Tito Collasius	Expedition Leader, Navigator	tito@whoi.edu	
16	Hugh Popence	Engineer		
17	Korey Verhein	Pilot	kverhein@whoi.edu	508-289-2273
18	Lisa Borden	Engineer		508-289-2273
19	Jim Varnum	Pilot		
20	Scott McCue	Engineer/Data		508-289-3885
21	James Pelowski	Engineer		
22	Mario Fernandez	Engineer		
	OTG			
23	Trevor Young	Technician	tnyoung@hawaii.edu otg@soest.hawaii.edu	
24	OTG	Technician		
	UH/Other			
25	Scott Ferguson	Director, Marine Technical	jscottf@hawaii.edu	Cell: 808-349-2750 Off: 808-832-3081

		Services		
	Contacts			
	UH/ACO			
	Roger Lukas	Scientist	rlukas@hawaii.edu	Off: 808-956-7896
	Fernando Santiago-Mandujano	Scientist	mandujan@soest.hawaii.edu santiago@hawaii.edu	Off: 808-956-7000
	Fred Duennebier	Scientist	fred@soest.hawaii.edu	Cell: 808-398-4628 Hm: 808-373-3669
	Jim Jolly	Engineer	jjolly@hawaii.edu	Lab: 808-956-2488 Cell: 808-392-4784
	Jim Babinec	Technician	babinec@hawaii.edu	Lab: 808-956-2876
	Mark Tremblay	Engineer	mdtremblay@optonline.net	Hm: 732-681-4748
	Mario Williamson	Machinist	mariow@hawaii.edu	Shop: 808-956-7304
	Karynne Morgan	Project Asst	karynnem@hawaii.edu	808-956-6036
	Kellie Terada	Project Asst	kterada@hawaii.edu	808-956-4101
	AT&T Makaha Cable Station			
	Makaha Cable Station – ACO			808-696-1904
	Makaha Cable Station – AT&T		GCSO_Makaha@att.com	808-696-4224
	Daniel Donigian	Manager	dd2575@att.com	808-696-2777
	UH/Marine Center			
	Alan Hilton	Marine Superintendent	marsup@soest.hawaii.edu	Off: 808-842-9814 Cell: 808-818-5178
	Gray Drewry	Master R/V *Kilo Moana*	gray@soest.hawaii.edu master@km.soest.hawaii.edu	Cell: 864-0122 Cell: 808-348-4469
	Ross Barnes	Port Operations Manager	pom@soest.hawaii.edu	Off: 808-842-9815 Cell: 808-864-0122 Cell: 808-294-6915
	WHOI *Jason*			
	Matt Heintz		mheintz@whoi.edu	508-289-3426
	Catherine Offinger		coffinger@whoi.edu	508-289-2411
	Eric Benway		ebenway@whoi.edu	508-289-3770

Kilo Moana:
In Port Ship Numbers: (808) 842-9817 | (808) 842-9834
Voice: 011-870-773-234249
Fax: 011-870-783207825
IRIDIUM: 1-480-768-2500 THEN, 881631830418
Cell: (808) 864-0065

Appendix D – Berthing Plan



All 21 science berths in yellow must be filled first. The next three are in green. There are two additional bunks available through the Master. No members of the opposite sex, excepting a married couple, may be berthed together. (UHMC SQ COQP-1.0-25)

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Appendix E – Acronyms and abbreviations

12E	Electrical connector with 12 electrical circuits
2E	ODI NRH Connector with 2 electrical circuits and 4 optical circuits
4E	Electrical connector with 4 electrical circuits
ACO	ALOHA Cabled Observatory
ACP	Acoustic current profiler
ADCP	Acoustic Doppler current profiler
AMM	Aloha Mars Mooring Secondary Node
BSP	Basic Sensor Package
CAM	Camera Tripod
$CTDO_2$	Conductivity, temperature, depth, oxygen sensor package
DMAS	Data Management and Archiving System
DP	Dynamic positioning
EC	Environmental Cover – protective cap for unconnected ODI bulkheads
EM	Electrical-Mechanical
EO	Electrical-Optical
EOM	Electrical-Optical-Mechanical
HEM	Hydrophone Experiment module, resides on JBOX
HOT	Hawaii Ocean Timeseries
μSEM	micro Science Experiment Module
JBOX	Frame with junction box and HEM with cables and connectors
MARS	Monterey Accelerated Research System
MBARI	Monterey Bay Aquarium Research Institute
NRH	Nautilus Rolling Hybrid – optical and electrical ODI connector
NTP	Network Time Protocol
OBS	Observatory package
ODI	Ocean Design, Inc. wet mateable connector
PBOF	Pressure balanced, oil filled
PMACS	Power Management and Control System
PPS	Pulse Per Second (GPS-derived precise timing signal)
PTP	Precise Time Protocol
PTT	Port Test Tool
ROV	Remotely Operated Vehicle
SIIM	Science Instrument Interface Module
SMF	Single mode fiber
TF	Termination Frame