# Cruise Plan for R/V *Kilo Moana* KM-21-07:
# ALOHA Cabled Observatory Service
# 29 May – 2 June 2021

23 May 2021

Version 3.0

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# 1. Introduction

The ALOHA Cabled Observatory 100 km north of Oahu at Station ALOHA is the deepest (4728 m) power and internet node on the planet, returning oceanographic data from the seafloor in realtime to shore. The ACO is coming up on its 10-year anniversary of operation with plug-and-play capability, on 6 June.

On this cruise, we will service the infrastructure and instrumentation and obtain biological samples. Specific objectives are:

- Deploy and connect a new Basic Sensor Package 5 (BSP5; $CTDO_2$ -conductivity, temperature, depth/pressure, oxygen) sensor to Observatory (OBS) port E3;
- Deploy and connect CAM2 (video camera, two lights, and hydrophone) on Secondary Node 1 (SN1) port J2; with the memorial plaque for Fred Duennebier in view;
- Housekeeping (clean sea electrode);
- Recover LIGHT1, LIGHT4 and 4 hose reels using the Elevator (ELEV) in two trips;
- Perform biological sampling of megafauna including holothurians and echionids;
- Perform housekeeping (clean sea electrode, video survey of all the bottom packages); and
- Provide mentoring and education opportunities for REU (Research Experiences for Undergraduates) students with real-time video interaction with shore

The first two objectives will replace failed instruments and/or provide needed redundancy (there is presently only 1 working CTD on the bottom, on BSP4). To connect between the instruments and OBS and SN1, we will use Port Extension Assemblies (PEAs) consisting of 53 m and 25 m hoses, respectively with ODI wet mate flying leads and pin-protecting dummy/parking position tripod at the instrument end (for future possible use).

The ROV *Lu'ukai* is the *sine qua non* for performing this service work.

The ship will depart the UH Marine Center at 1000 29 May and return 1700 2 June, HST. After the transit to Station ALOHA, a Casius survey (for acoustic tracking calibration) will be conducted. We will plan 2 dives to accomplish the objectives. The first dive will install BSP5 and CAM2 and recover LIGHT1. The second dive will perform biological sampling, housekeeping tasks and recover LIGHT4. Weather, of course, could impact these plans.

The science party will consist of Bruce Howe, Chief Scientist, Grant Blackinton, senior engineer, Elizabeth Miller, graduate student, and Samantha Hanson, REU student. Blue Eisen, ACO project engineer, is shared with the ROV team.

See Appendix F for social media links to the cruise including REU and ROV video, news stories, updated dive information, etc. A video documentary for the cruise is being produced by Voice of the Sea, to be available in July.

*Covid considerations.* Before and during the cruise COVID regulations and guidelines will be followed regarding the use of personal protective equipment (PPE, i.e., facemasks), social distancing, etc. Before the cruise, personal self-quarantine will be exercised.

Table 1-1 gives coordinates of relevant points See Figure 1-1 for a map with cruise lines.

| | Depth m | Latitude deg | N minutes | Longitude deg | W minutes |
|---|---|---|---|---|---|
| UHMC, Pier 35 | | 21° | 18.933 | 157° | 52.628 |
| Honolulu Buoy | | 21 | 16 | 157 | 54 |
| Test dive site | 430 | 21 | 14.915 | 157 | 58.558 |
| Barbers Point WP | | 21 | 16 | 158 | 09 |
| Ka'ena Ridge WP | | 21 | 33 | 158 | 20 |
| ACO Cable Termination Frame (CTF) | 4728 | 22 | 44.324 | 158 | 00.372 |
| Station ALOHA | | 22 | 45 | 158 | 00 |

*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. The ROV system is described, including the navigation system. The ship and deck configuration are described followed by a section on mobilization and responsibilities. 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 diagrams and connections, personnel/contacts, berthing, acronyms, and social media links.

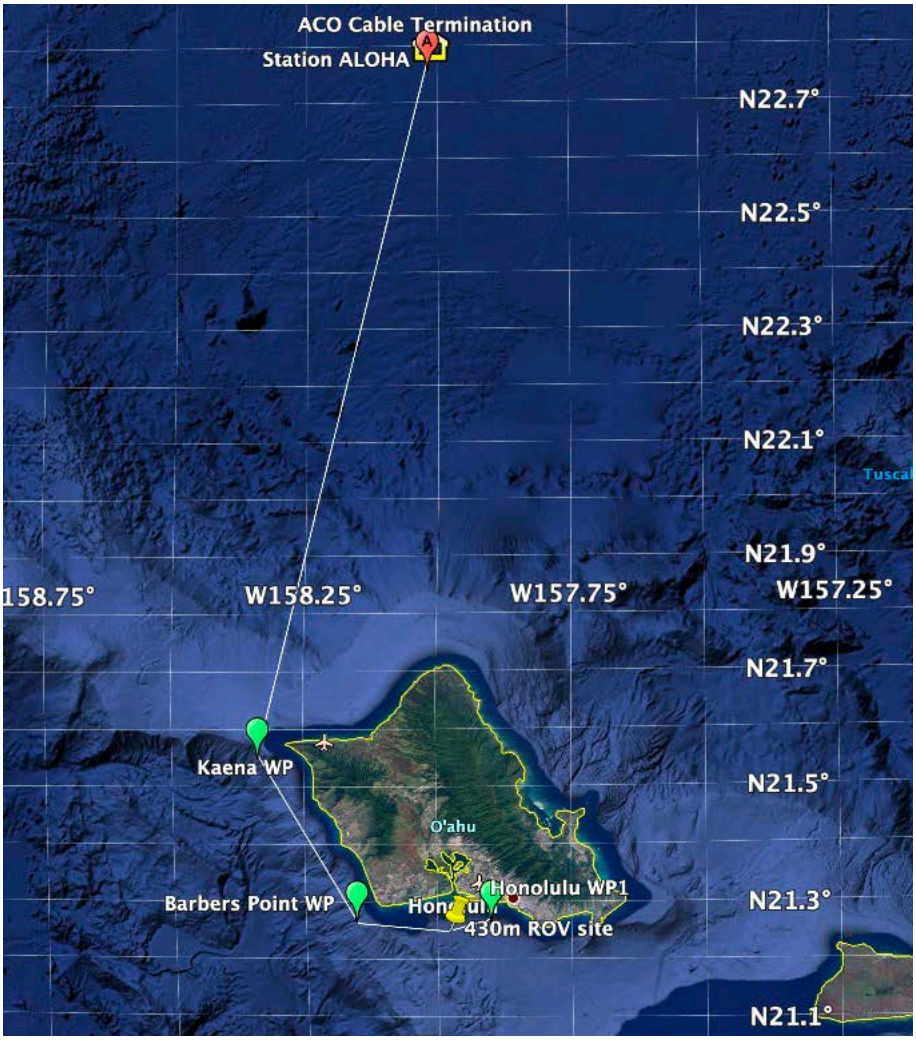



*Figure 1-1 Map of area and nominal cruise lines.*

# 2. ACO Description

Information on the previous service cruises (KM-19-13, KM-18-09, KM-17-07, KM-15-16 and KM-14-26) and installation cruise (KM-11-16) can be found in the respective cruise plans and reports, and the Oceans11 paper. See the list of references 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.

The ACO is an 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 were deployed in May-June 2011 with CAM1. A subsequent service cruise in November 2014 removed a failed secondary node and added CAM2, LIGHT1, and basic sensor package BSP1. All of these subsequently failed, with connectors known or suspected. In September 2015, BSP2 was plugged in, but the ROV failed and time ran out before we could connect LIGHT4, and before we could recover BSP1, CAM2 and LIGHT1. The KM-17-07 cruise was a failure from the ACO service point of view, as the main ship's winch failed at the start and in the process of recovering the cable, the fibers were broken at 4500 m. During the KM-18-09 cruise, BSP3 with hydrophone and secondary node 1 SN1 were deployed. BSP2 was damaged during repair. BSP1 was recovered. During the 2019 cruise, BSP2 was repaired and redeployed, BSP3 (icListen hydrophone) was recovered, and LIGHT4 connected for CAM1. LIGHT4 failed in December 2020 as did the CT sensor on the OBS, leaving only one operating CTD on BSP4.

Photographs of the system at various stages are shown below to familiarize the cruise participants and a brief description of various components is given. System block diagrams with the last interconnections are shown in Appendix A (along with the planned configuration). Section 3 addresses new components and an overview of tasks.

Figure 2-1 shows an image taken by *Jason* of the seafloor equipment in November 2014; from left to right, CAM2, CAM1, LIGHT1, OBS, and JBOX. The cable termination frame (CTF) is to the right (Figure 2-2). CAM1 is shown in Figure 2-3. A map showing all present-day and planned components is given in Figure 2-4.

The ELEVATOR is basically a package of deep-rated flotation with suitable mounting for beacons and recovery lines, dual acoustic releases, and then a weight below that can be acoustically released or by the ROVcutting the line to the drop weights.

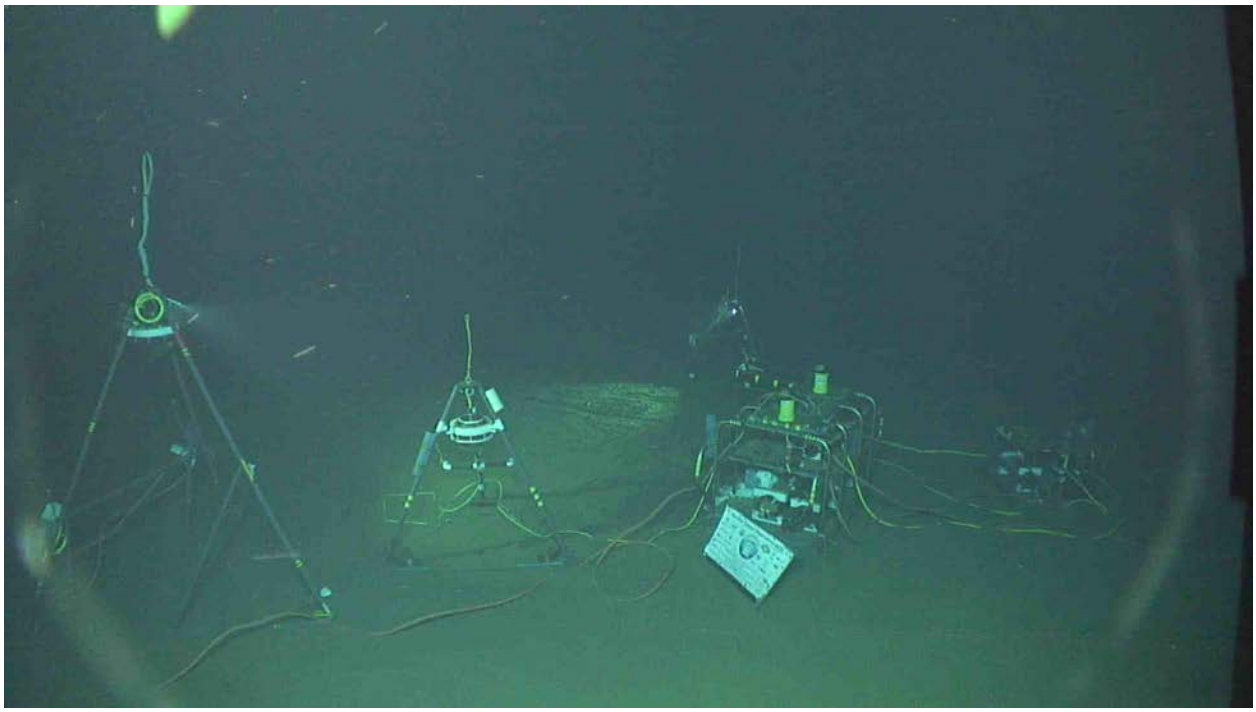


*Figure 2-1 Image of system at the end of the November 2014 cruise.*

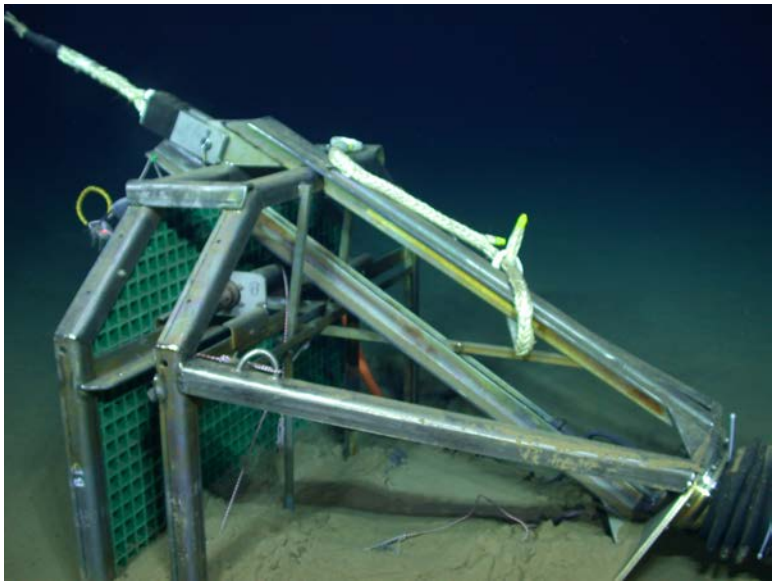


*Figure 2-2 The cable termination frame, 2011*

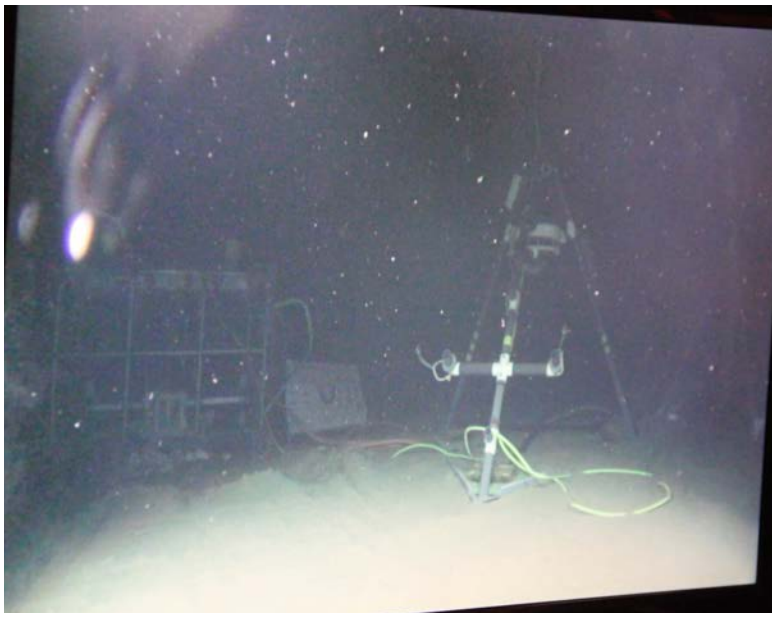


*Figure 2-3 From Lu'ukai, OBS, sponsor poster, and CAM1*

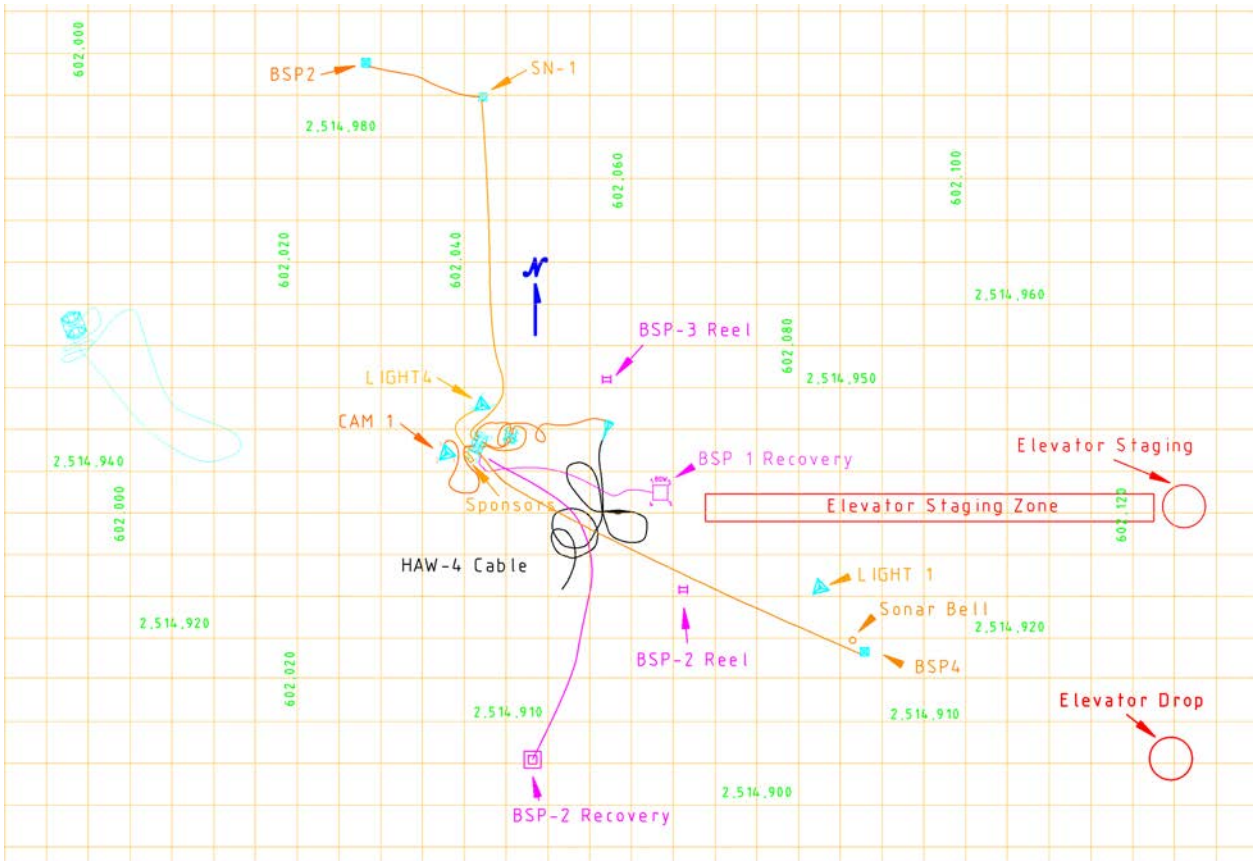



*Figure 2-4 Present ACO seafloor configuration.*

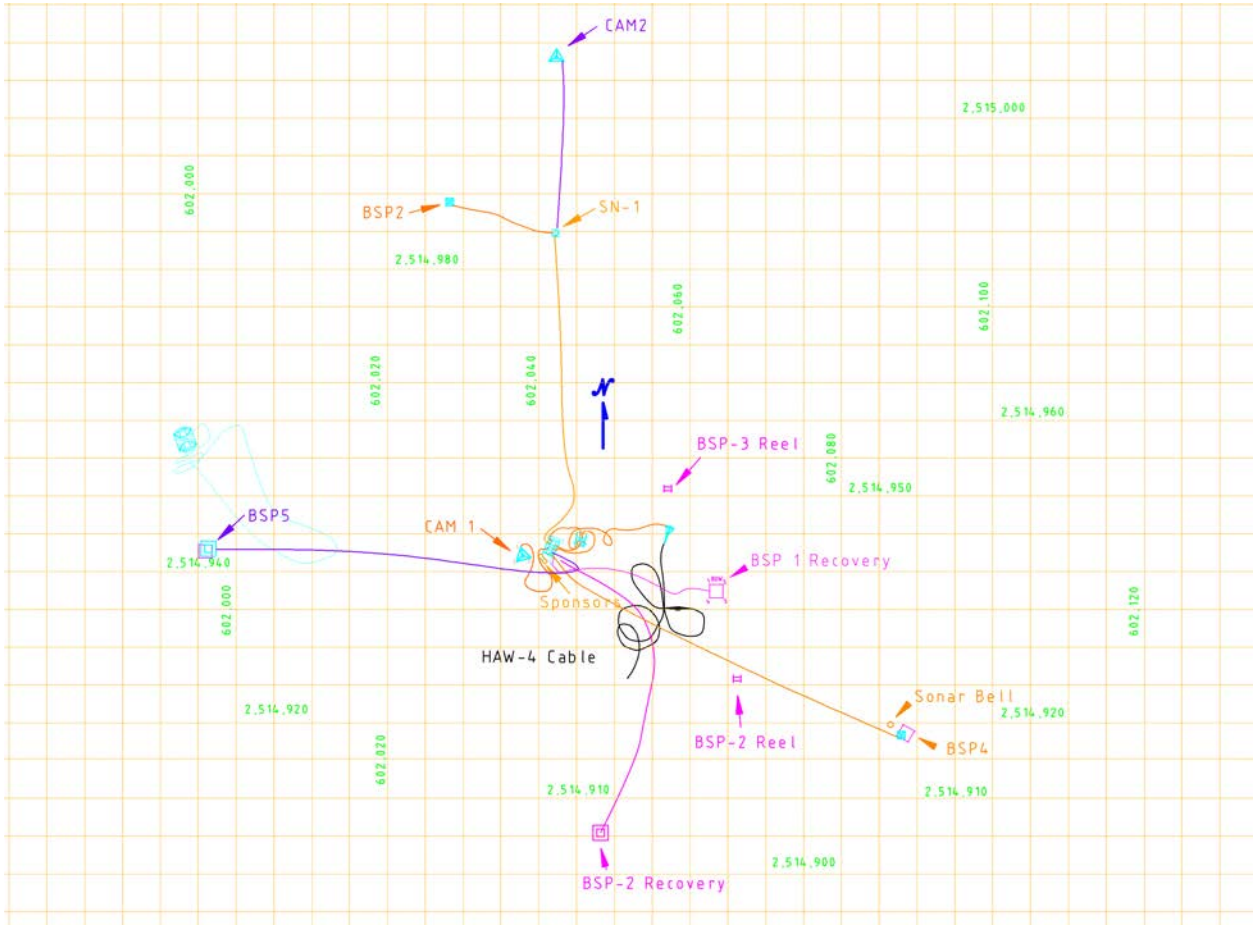
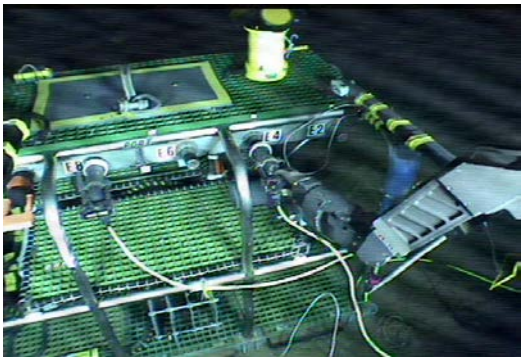
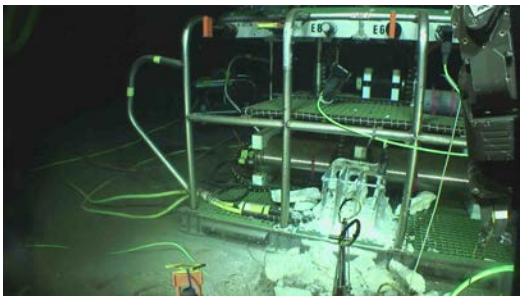


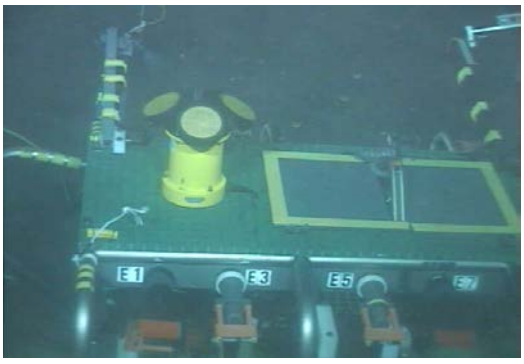

*Figure 2-5 Desired post-cruise layout*\.

The ACO cable termination is connected to the junction box (JBOX) with an ODI hybrid optical-fiber/electrical hose assembly. The JBOX provides the fiber-to-electrical 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), now with one working hydrophone.

The observatory (OBS) is connected to the JBOX. 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, one working), a temperature/conductivity instrument (CT, failed December 2020), and a light (failed), that are connected to one "micro science experiment module" (μSEM) that is in turn (hard) connected 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 (the white aragonite material needs to be periodically removed). Also note the pin-protecting dummy at the stern on the middle deck; there is also one in the E6 position on the port quarter.







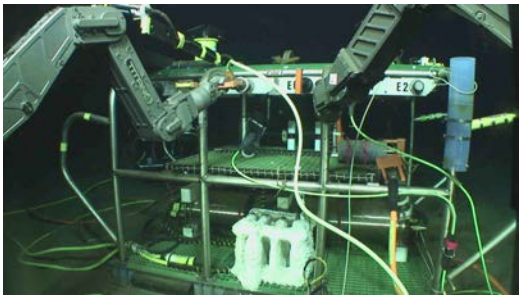


*Figure 2-6 OBS frame (on deck and seafloor).*

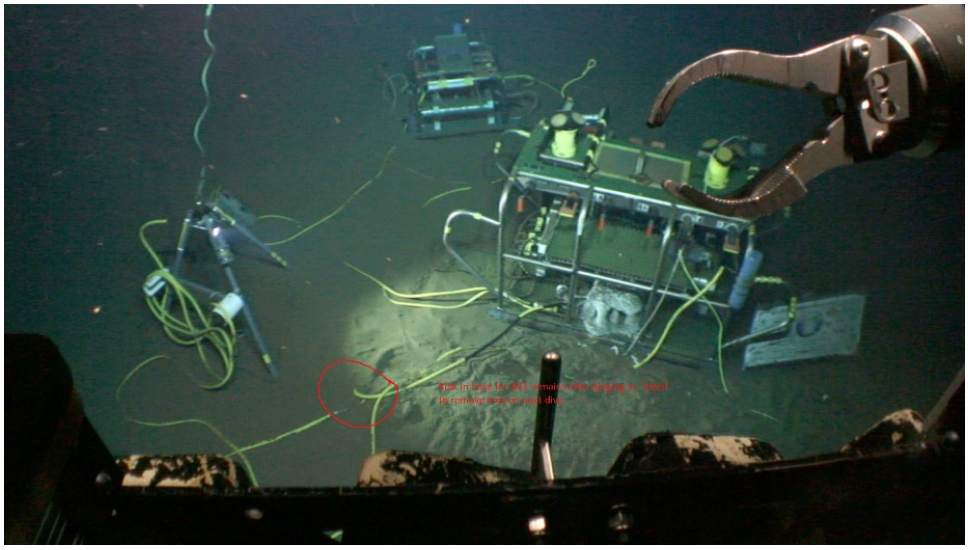


*Figure 2-7 One view at end of June 2018.*

The (failed) LIGHT1 is shown in Figure 2-8; it is in the "boneyard" now. The stand-alone LIGHT4 is a copy of LIGHT1. LIGHT4 is presently still connected to the OBS and was illuminating CAM1 until it failed in December 2020.

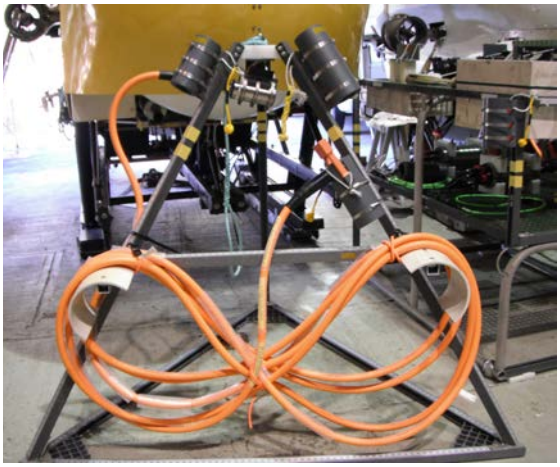


*Figure 2-8 LIGHT1 – stand alone (with holsters)*

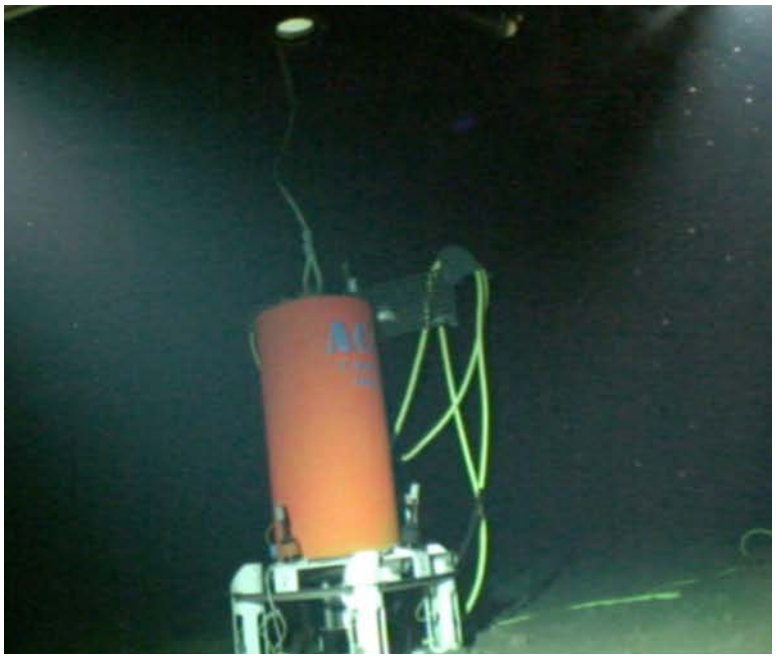


*Figure 2-9 SN1 looking SE, prior to BSP2 being connected.*

The BSP2 (Figure 2-10) 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. The BSP2 is connected to the OBS via a 50 m pressure balanced oil-filled (PBOF) hose with a 12-pin flying connector, and a corresponding dry mate connector to the SIIM. This SIIM has been modified so it can plug into a 400 V port if necessary. The SIIM aggregates multiple instruments so that only one standard 12-pin connect or is required to connect to the Observatory (OBS) or similar. The SIIM brings together the following sensors: Seabird conductivity, temperature, depth (pressure) and oxygen pumped (CTDO2), SBE-52/43MP; Paroscientific nano-resolution pressure sensor; and WetLabs fluorometer/turbidity optical sensor (FLNTU). BSP2 is now deployed connected to SN1 and deployed west of SN1 50 m.

On BSP4 (Figure 2-11), the SIIM brings together the following sensors: Seabird conductivity, temperature, depth (pressure) and oxygen pumped (CTDO2), SBE- 37 SMP ODO; RBR bottom pressure recorder (BPR); WetLabs fluorometer/turbidity optical sensor, FLNTU; Woods Hole Oceanographic Institution (WHOI) acoustic micro-modem. Only the CTDO2 is working now. The corners of the BSP4 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. BSP4 is now deployed about 40 m SE of the OBS.

A 200-mm diameter SonarBell is moored nearby 2 m off the bottom, attached to the parking position tripod, as a passive beacon (325 kHz) that will show on the sonar display (hard to see in Figure 2-11 as it is black).

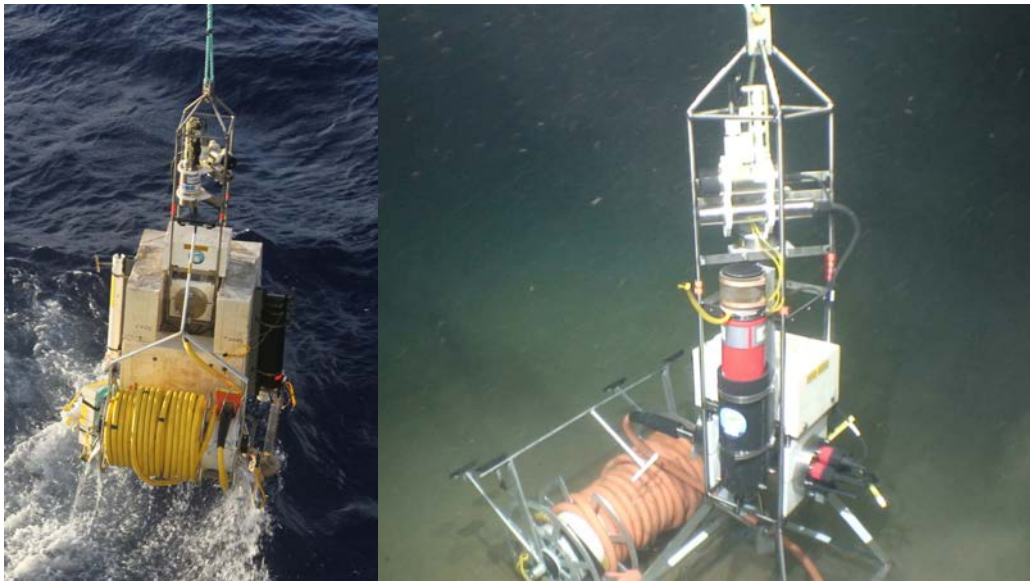


*Figure 2-10 BSP2 with cable reel (2018, 2019 after repair).*

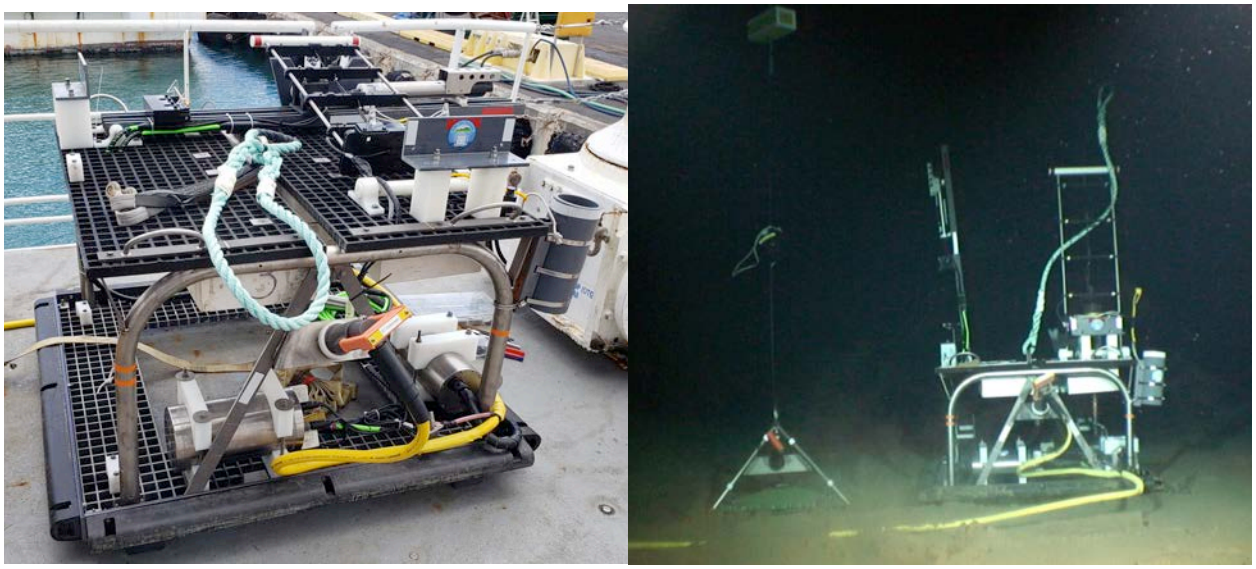


*Figure 2-11 BSP4 at Makai pier for testing (left) and on the seafloor (right).*


*Figure 2-12 ELEVATOR*

## 3. New ACO Equipment and Overview

Some equipment (LIGHT1 and LIGHT4) will be recovered and new equipment installed (BSP5 and CAM2) so that we end with a system layout as shown in Figure 3-1. A preview of tasks is useful here (more detail in Section 10 below). If all goes according to plan, one ROV dive and 2 ELEV trips are required.

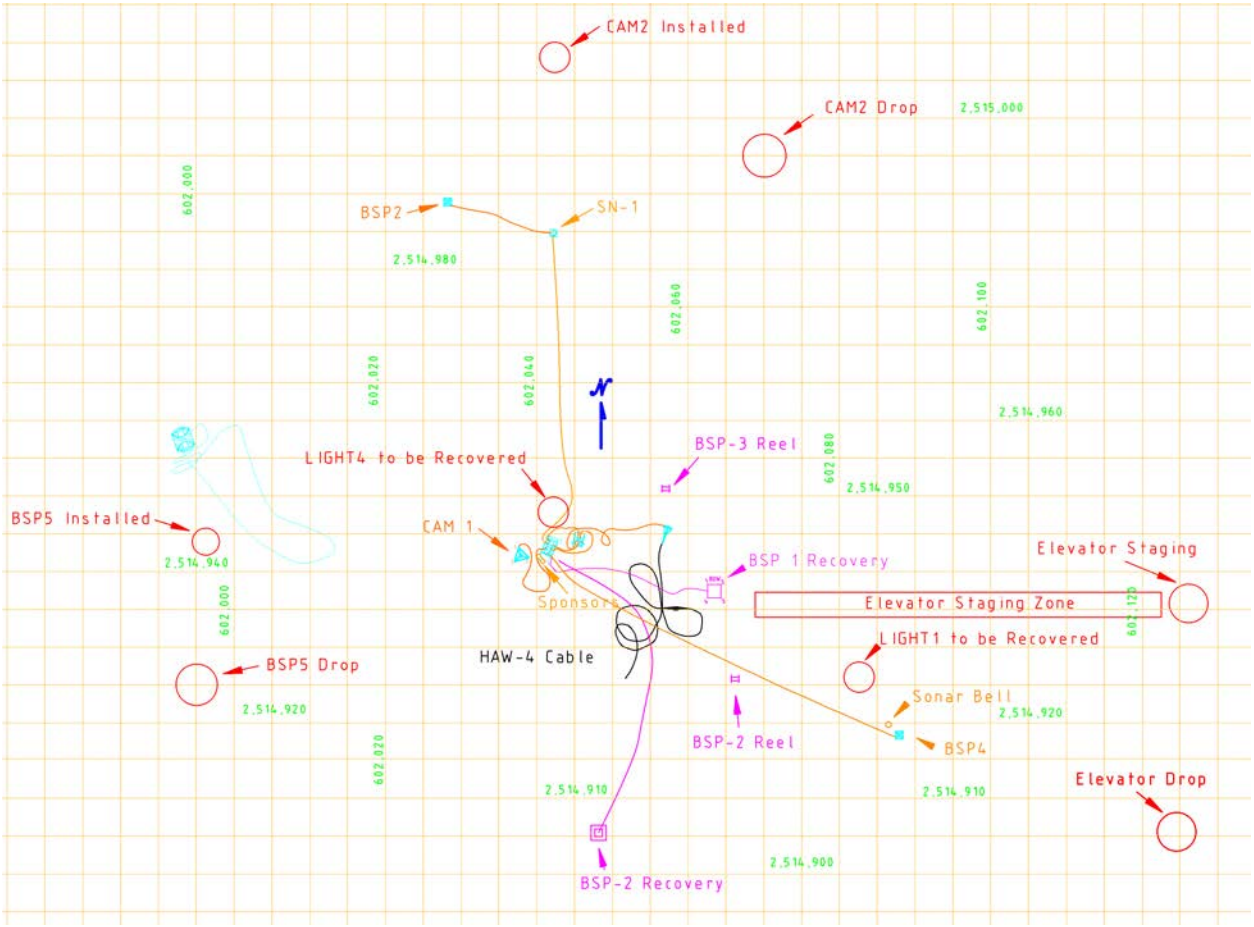



Figure 3-1 ACO Layout, including before and after 2021 elements.

BSP5 (Figure 3-2) will be the single new instrument package deployed. It has a single SBE-37 SMP ODO with conductivity, temperature, depth/pressure, and oxygen, with a pump. It has been modified. Inside the unit, a diode was placed in the TX line to accommodate the OBS RS422. In the PBOF hose, a small container with a (pressure tested) 48V-12V dc-dc converter is in-line.

CAM2 (Figure 3-3) is a greatly modified version of the previous CAM2. The camera is the same Axis surveillance camera, as is the hydrophone (now feeding into Line-in on the camera). However, there is a new microprocessor to independently control the two DSP&L LED lights. These are isolated from one another and system ground. To accommodate these changes, and to remove the faulty, culprit, connector from the earlier version, a second hole was cut on the glass and two Seacon XLS connectors, identical to those used successfully on the OBS, are used to accommodate the various connections. The camera lens is 1 m off bottom.

Figure 3-2 BSP5 with CTDO2 in Lab

Figure 3-3 CAM2 in Lab with reel and parking position tripod

For the biological sampling part of the cruise. we will search the seafloor for deposit-feeding megafauna, including holothurians (sea cucumbers) and echionids (sea urchins). If found, megafauna will be collected using the ROV manipulator arm and placed in the bio box for retrieval and processing once the ROV is aboard.

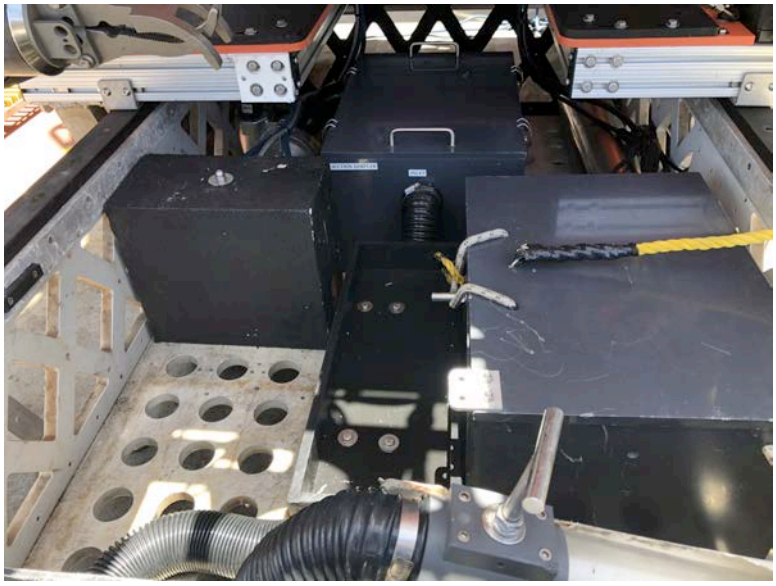


Figure 3-4 Bio box (gray, right) for samples, in the ROV basket

# 4. ROV and TMS

ROV *Lu`ukai* is a two-body ROV system (Figure 5-1). A 0.681-inch electro-optic-mechanical (EOM) cable delivers electrical power and commands from the ship through the TMS and then to the ROV; both return data and live video imagery. The TMS serves as a dock for the ROV facilitating launch and recovery. When the ROV is swimming free of the TMS loosely tethered, the ROV is then decoupled from the movements (heave primarily) of the ship. While the tether is 100 m long, operationally, making effective use of this length requires further testing/practice. The TMS provides 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 TMS.

*Figure 4-1 TMS and ROV.*

# 5. Navigation

*Lu'ukai* will navigate in several ways. In addition to video, a scanning sonar will be used to detect targets/packages to a range of ~50 m. 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 stem on the port side that can lower the sensor head 6-ft below the bottom of the hull. It will measure range and solid angle to beacons on the TMS and ROV, and our packages. The azimuthal orientation will be calibrated as the first step at Station ALOHA, using the beacons deployed on BSP5 and ELEV.

The ultra-short baseline transducer is a Sonardyne Marksman LUSBL Model 8023 with a 50° wide downward looking beam. 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. The two beacons on the TMS and ROV will be configured as responders (triggered with an electrical signal from the deck unit). Absolute geographical position is provided by the ship's POS-MV system using Fugro GPS with decimeter accuracy.


*Figure 5-1 USBL Wideband Mini Transponder (WMT) – 7000 m*

# 6. Deck Layout

When on deck, *Lu`ukai* will sit on the centerline under the A-frame. The tool van and the ROV control van will sit on the O1 level, port side. The motor-motor generator will be placed on the

O1 level, starboard side. The Connector Test Frame will be on the starboard quarter for use in the harbor. The ship's crane will be used to deploy this. The STU will be put in line between the traction winch and the A-frame, immediately adjacent to the bulkhead of the winch room. The STU weights 13,000 lb and the base plate 3,500 lb. The ELEV+BSP5 will be placed on the aft port quarter for deployment with the crane, along with CAM2.

Interior space is allocated as follows: The PI and the ROV crew share Lab2. ROV supplies will be in HydroLab. Hydraulic oil supplies will be in the WetLab. Personnel are free to use the rest of the lab space for personal computers, etc.

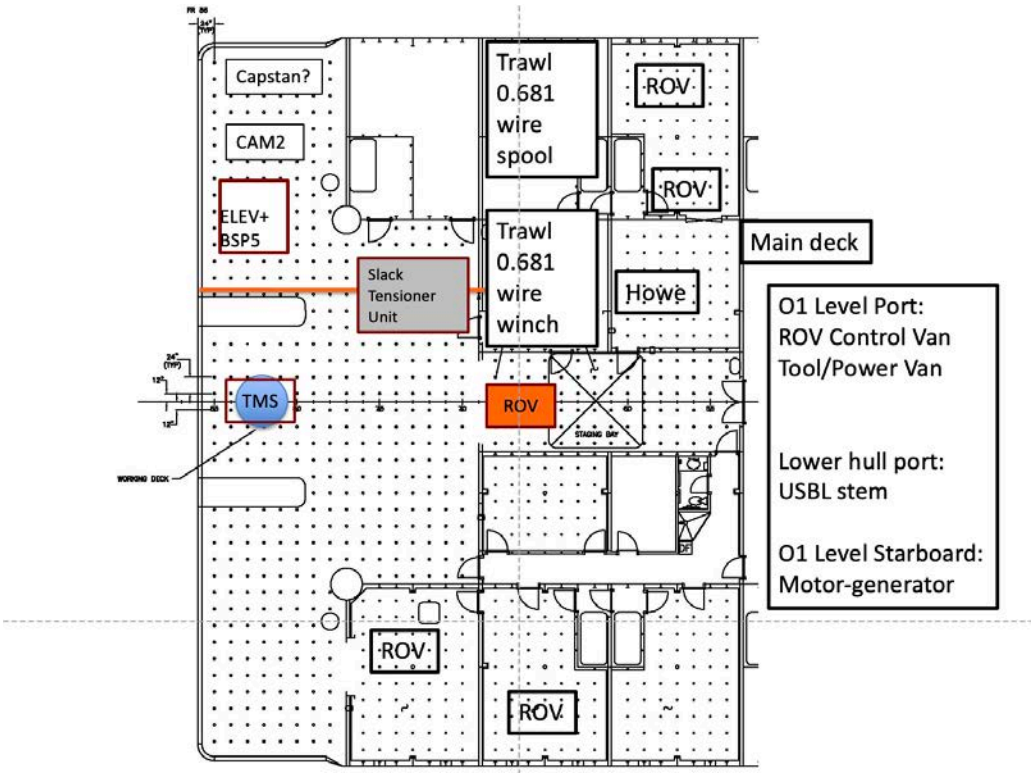



*Figure 6-1 Main deck layout*

# 7. Mobilization and Responsibilities

The ROV will be mobilized 20-23 May. The ACO gear will be loaded on the ship including: BSP5, ELEVATOR, CAM2, bench node for OBS, extra weights, and tools.

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. The ship/OTG will provide a dedicated satellite Internet connection in the ROV 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 ELEVATOR, BSP5, CAM2 and recovering the ELEVATOR with LIGHT1 and LIGHT4.

ACO will supply pin-protecting dummies for ODI connectors, with ROV mating provision (i.e., T-Handle, in-basket jig). ACO will provide a cable/hose "guide" tool.

ACO will provide snap hooks/carabiners and line for ELEV use.

ROV will provide cutting tools, i.e., sharp knives and garden shears for line, bungies, tie wraps, in the “tool box” in the basket. One cutting tool with protected blade inside a “c”.

ROV will provide necessary USBL beacons.

ROV will provide bio-sample box.

ACO will provide cleaning/scraping/brushing tools for cleaning the precipitate crust 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 acoustic Doppler current profiler data/plots (using 38 kHz and 300 kHz instruments), two air tuggers, and pallet jack. ADCP data processed in near-real time to determine currents affecting free fall instruments.

# 8. Operations and timeline

See Table 10.1 for a summary of tasks and times, and Appendix D for a detailed version.

BSP5 and ELEV will be deployed first together as one package. Using the beacons (one a backup), a “Casius” procedure will be used to survey in the position, and the ship ultra-short baseline transducer attitude (especially the azimuth). Then, after the ROV is deployed and is on the bottom, BSP5 will be moved and plugged into OBS port E3. ELEV will be moved next to LIGHT1 in the “boneyard”. CAM2 will be deployed free fall from the ship and then connected to SN1 port J2 by the ROV. At this point the ROV will work on removing the aragonite on the sea water electrode on the OBS. Then LIGHT1 (with several reels) will be recovered with the ELEV. The ROV will also be recovered. The ELEV is refurbished and deployed again to pick up LIGHT4 and reels. The ROV is reconfigured for bio-sampling and then deployed. A complete video survey will be done in this time frame, of all packages and cables on the seafloor. During the survey, and for several more hours, bio-sampling will take place. Weather and waves, of course, may impact this schedule.

During the free fall of packages, we want to monitor drop and landing positions and ADCP near surface and bottom (from ACO) velocities to better estimate currents and so that we can better estimate drop locations and have the packaged land where desired.

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 (All shore personnel should have updated AT&T documents). Good communications are essential.

| | Task | Start | Elapsed | End |
|---|---|---|---|---|
| 1 | Transit to Station ALOHA | 05/29 10:00 | 11:25 | 05/29 21:25 |
| 2 | Deploy and Survey ELEV+BSP5 | 05/29 21:25 | 12:33 | 05/30 09:58 |
| 3 | ROV ACO Dive 1 (LK-xx1), Find ELEV+BSP5 | 05/30 09:58 | 5:14 | 05/30 15:12 |
| 4 | Move ELEV+BSP5, connect BSP5 | 05/30 15:12 | 6:35 | 05/30 21:47 |
| 5 | Deploy and connect CAM2 | 05/30 21:47 | 4:40 | 05/31 02:27 |
| 6 | Disconnect LIGHT4 and take to boneyard | 05/31 02:27 | 2:20 | 05/31 04:47 |
| 7 | Clean Electrode | 05/31 04:47 | 2:30 | 05/31 07:17 |
| 8 | Connect LIGHT1 to ELEV, recover ELEV+ROV | 05/31 07:17 | 6:35 | 05/31 13:52 |
| 9 | Turn around the ROV and ELEV and deploy both | 05/31 13:52 | 11:01 | 06/01 00:53 |
| 10 | Rig LIGHT4 | 06/01 00:53 | 3:05 | 06/01 03:58 |
| 11 | Remaining Housekeeping, Video, Bio Sampling | 06/01 03:58 | 15:50 | 06/01 19:48 |
| 12 | Recover ELEV+LIGHT4 and ROV | 06/01 19:48 | 6:39 | 06/02 02:27 |
| 13 | Contingency | 06/02 02:27 | 1:33 | 06/02 04:00 |
| 14 | Transit from ACO to Honolulu | 06/02 04:00 | 13:00 | 06/02 17:00 |
| | | | 103:00 | |

*Table 8-1 Summary cruise tasks and times (local HST time)*

# 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
2014 cruise plan
http://aco-ssds.soest.hawaii.edu/ACO/docs/ACO_3_Cruise_Plan_2014.pdf
2014 cruise report
http://aco-ssds.soest.hawaii.edu/ACO/docs/ACO_3_Cruise_Report_2014.pdf
2015 cruise plan
http://aco-ssds.soest.hawaii.edu/ACO/docs/Cruise_Plan_KM-15-16_Howe_20150914_lo-res.pdf
2015 cruise report
http://aco-ssds.soest.hawaii.edu/ACO/docs/Cruise_Report_KM-15-16_Howe_20160909.pdf
2017 cruise plan
http://aco-ssds.soest.hawaii.edu/ACO/docs/Cruise_Plan_KM-17-07_Howe_20170605.pdf
2017 cruise report
http://aco-ssds.soest.hawaii.edu/ACO/docs/Cruise_Report_KM-17-07_Howe_20170614_r1.pdf
2018 cruise plan
http://aco-ssds.soest.hawaii.edu/ACO/docs/Cruise_Plan_KM-18-09_Howe_20180616_lo-res.pdf
2018 cruise report
http://aco-ssds.soest.hawaii.edu/ACO/docs/Cruise_Report_KM-18-09_ACO_Howe_20181013.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 web site http://aco-ssds.soest.hawaii.edu/index.html. Also see the ROV *Jason* Virtual Control Van videos from the KM-11-16 June 2011 cruise and the KM-14-26 November 2014 cruise, http://4dgeo.whoi.edu/jason/.

# Appendix A – ACO Diagrams

The following diagrams show the OBS port assignments, current and planned.

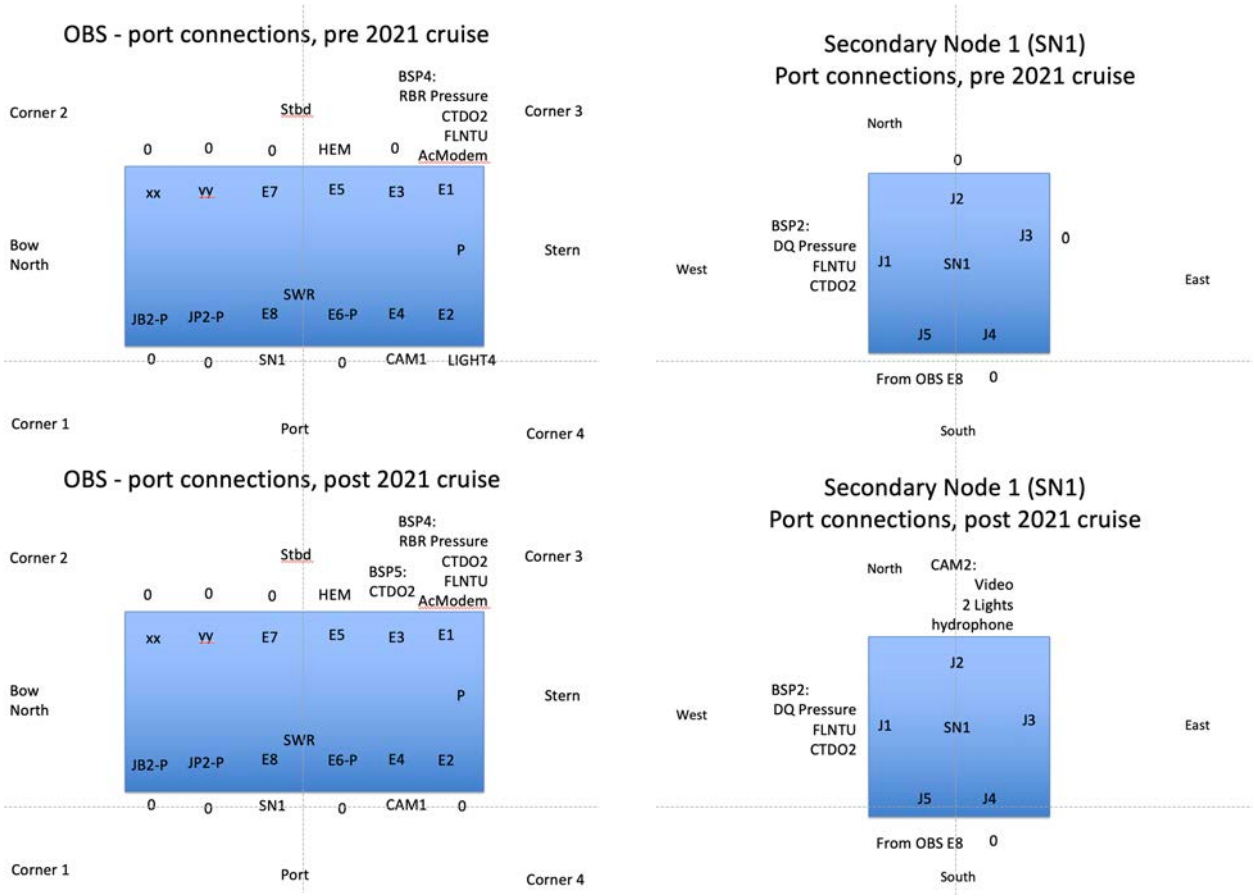



*Figure A-0-1 ACO Observatory port connections – present and new (P = parking)*

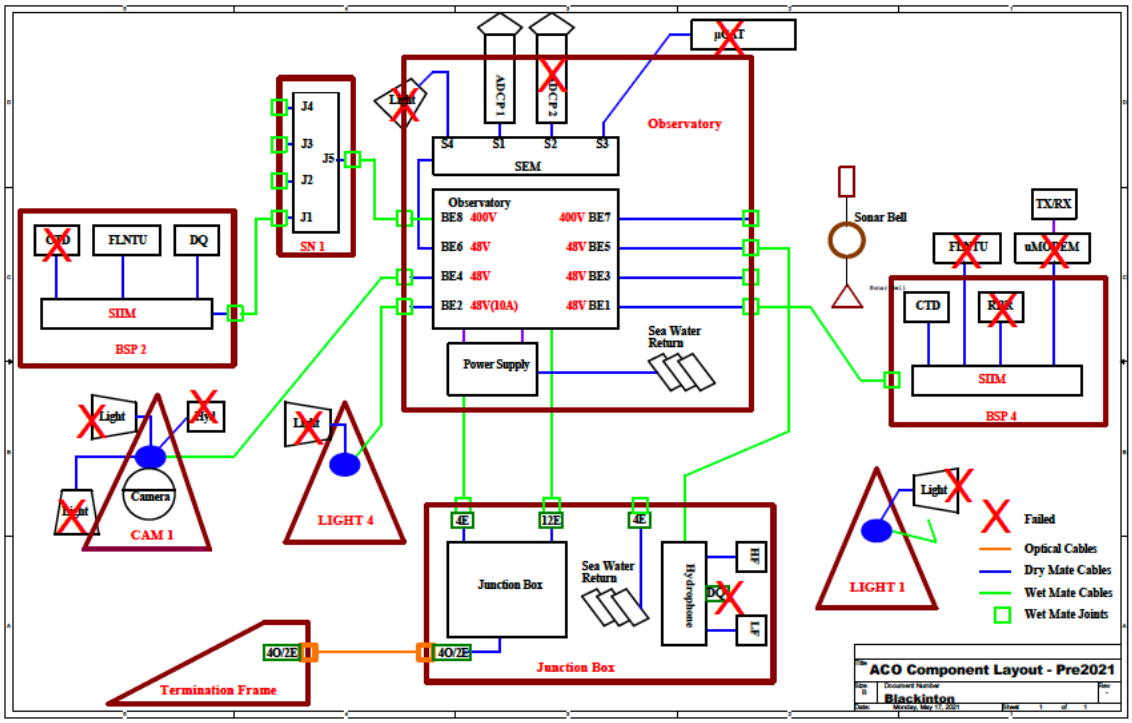



*Figure A-0-2 ACO connections – pre-May 2021; x = failed*

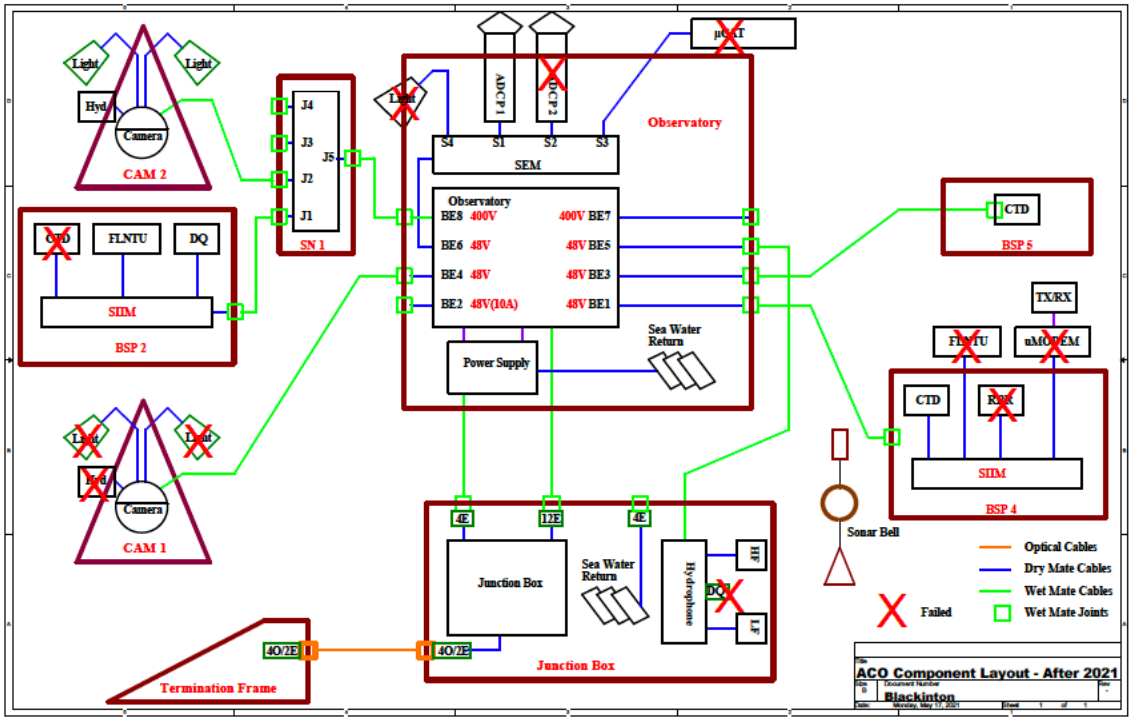



*Figure A-0-3 Planned ACO connections – post May 2021; x = failed*

# Appendix B – ACO Operations

The following table gives the detailed ACO tasks associated with deploying and recovering the instrumentation. Time is local HST.

| | | | | HST (UTC-10) | | |
|---|---|---|---|---|---|---|
| | | | **Fred = Fred's Memorial Plaque** | 05/29 10:00 | | **06/02 17:00** |
| | | | **Task** | **Start** | **Elapsed** | **End** |
| **1** | | | **Transit to Station ALOHA** | | | |
| 1 | | 1 | Transit from UHMC Honolulu to Station ALOHA | 05/29 10:00 | 11:00 | 05/29 21:00 |
| 1 | | 2 | Establish DP position (A-frame of ship) 70_m SW of the Cable Termination Frame (CTF) | 05/29 21:00 | 0:25 | 05/29 21:25 |
| **2** | | | **Deploy and Survey ELEV+BSP5** | | | |
| 2 | | 1 | Test package - USBL acoustic beacons over fantail; test radio beacon, light; check releases | 05/29 21:25 | 0:10 | 05/29 21:35 |
| 2 | | 2 | Deploy ELEV+BSP5 70 m SW of CTF. ELEV with USBL beacon, flasher, radio, dual acoustic releases. BSP5 with reel and parking position tripod. Log USBL data (surface/bottom) for drop/current analysis | 05/29 21:35 | 0:28 | 05/29 22:03 |
| 2 | | 3 | Track package to bottom. Note packages and depth averaged current. Package reached bottom x m | 05/29 22:03 | 1:20 | 05/29 23:23 |
| 2 | | 4 | XBT cast | 05/29 23:23 | 0:10 | 05/29 23:33 |
| 2 | | 5 | Perform USBL survey per Casius plan (first point over ELEV) | 05/29 23:33 | 9:00 | 05/30 08:33 |
| 2 | | 6 | Prep ROV, go into DP over ELEV | 05/30 08:33 | 1:25 | 05/30 09:58 |
| **3** | | | **ROV ACO Dive 1 (LK-xx1), Find ELEV+BSP5** | | | |
| 3 | LK xx1 | 1 | **Deploy ROV (hose hook, knives, chisels/etc for chipping electrode deposits, dummy plugs, dust covers) Dive LK-137** | 05/30 09:58 | 0:03 | 05/30 10:01 |
| 3 | LK xx1 | 2 | In water, lines clear | 05/30 10:01 | 0:41 | 05/30 10:42 |
| 3 | LK xx1 | 3 | continue | 05/30 10:42 | 0:00 | 05/30 10:42 |
| 3 | LK xx1 | 4 | Stop at 400 m | 05/30 10:42 | 0:38 | 05/30 11:20 |
| 3 | LK xx1 | 5 | Passing 1000 m | 05/30 11:20 | 0:40 | 05/30 12:00 |

| | | | | | | |
|---|---|---|---|---|---|---|
| 3 | LK xx1 | 6 | Passing 2000 m | 05/30 12:00 | 0:51 | 05/30 12:51 |
| 3 | LK xx1 | 7 | Passing 3000 m | 05/30 12:51 | 0:51 | 05/30 13:42 |
| 3 | LK xx1 | 8 | Passing 4000 m | 05/30 13:42 | 0:35 | 05/30 14:17 |
| 3 | LK xx1 | 9 | At 4700 m moving to ELEV+BSP5 | 05/30 14:17 | 0:04 | 05/30 14:21 |
| 3 | LK xx1 | 10 | Undock and rotate ROV to scan sonar | 05/30 14:21 | 0:12 | 05/30 14:33 |
| 3 | LK xx1 | 11 | Check ROV trim | 05/30 14:33 | 0:24 | 05/30 14:57 |
| 3 | LK xx1 | 12 | continue | 05/30 14:57 | 0:03 | 05/30 15:00 |
| 3 | LK xx1 | 13 | Visual on ELEV+BSP5 | 05/30 15:00 | 0:12 | 05/30 15:12 |
| **4** | **Move ELEV+BSP5, connect BSP5** | | | | | |
| 4 | LK xx1 | 1 | Go to ELEV+BSP5 | 05/30 15:12 | 0:05 | 05/30 15:17 |
| 4 | LK xx1 | 2 | continue | 05/30 15:17 | 0:05 | 05/30 15:22 |
| 4 | LK xx1 | 3 | Put ELEV+BSP5 loop on horn | 05/30 15:22 | 0:08 | 05/30 15:30 |
| 4 | LK xx1 | 4 | Dock ROV | 05/30 15:30 | 0:05 | 05/30 15:35 |
| 4 | LK xx1 | 5 | Move ELEV+BSP5 to desired BSP5 position 45 m W and 5 m S of OBS Port E3 | 05/30 15:35 | 1:00 | 05/30 16:35 |
| 4 | LK xx1 | 6 | Undock | 05/30 16:35 | 0:03 | 05/30 16:38 |
| 4 | LK xx1 | 7 | Set ELEV+BSP5 on bottom with BSP5 base facing E to OBS | 05/30 16:38 | 0:15 | 05/30 16:53 |
| 4 | LK xx1 | 8 | continue | 05/30 16:53 | 0:00 | 05/30 16:53 |
| 4 | LK xx1 | 9 | Remove reel from ELEV | 05/30 16:53 | 0:35 | 05/30 17:28 |
| 4 | LK xx1 | 10 | Put reel on bottom to left of ELEV, facing ELEV | 05/30 17:28 | 0:10 | 05/30 17:38 |
| 4 | LK xx1 | 11 | Remove BSP5 (leave parking position tripod for later) | 05/30 17:38 | 0:15 | 05/30 17:53 |
| 4 | LK xx1 | 12 | Set BSP5 down with connector toward E, OBS | 05/30 17:53 | 0:05 | 05/30 17:58 |
| 4 | LK xx1 | 13 | Put reel on ROV basket. Outer ODI flying lead connector already attached to BSP5, mechanically and electrically. | 05/30 17:58 | 0:07 | 05/30 18:05 |
| 4 | LK xx1 | 14 | Lift off and start unreeling cable as moving toward OBS (likely do a 180), to E past CAM1 on S side, until inner ODI comes off, to E of OBS | 05/30 18:05 | 0:05 | 05/30 18:10 |
| 4 | LK xx1 | 15 | continue | 05/30 18:10 | 0:05 | 05/30 18:15 |

| | | | | | | |
|---|---|---|---|---|---|---|
| 4 | LK xx1 | 16 | Unspool reel until all cable and connector come off | 05/30 18:15 | 0:05 | 05/30 18:20 |
| 4 | LK xx1 | 17 | Connector with pin protecting dummy free. | 05/30 18:20 | 0:05 | 05/30 18:25 |
| 4 | LK xx1 | 18 | Hose Yale thimble on basket horn. Connector held by Orion. | 05/30 18:25 | 0:05 | 05/30 18:30 |
| 4 | LK xx1 | 19 | Sit on bottom. Nav reference check. Range and bearings to bottom packages. Apply map offset | 05/30 18:30 | 0:10 | 05/30 18:40 |
| 4 | LK xx1 | 20 | Lift up to OBS port E3 to check length of hose | 05/30 18:40 | 0:05 | 05/30 18:45 |
| 4 | LK xx1 | 21 | Thimble back on horn. | 05/30 18:45 | 0:05 | 05/30 18:50 |
| 4 | LK xx1 | 22 | Remove Environmental Cover from E3; stow in basket | 05/30 18:50 | 0:05 | 05/30 18:55 |
| 4 | LK xx1 | 23 | Removing pin-protecting dummy from ODI flying lead (using tool in basket) | 05/30 18:55 | 0:10 | 05/30 19:05 |
| 4 | LK xx1 | 24 | Connect flying lead to OBS Port E3 | 05/30 19:05 | 0:30 | 05/30 19:35 |
| 4 | LK xx1 | 25 | Continue | 05/30 19:35 | 0:00 | 05/30 19:35 |
| 4 | LK xx1 | 26 | Connector in E3 and latched. Shore notified. | 05/30 19:35 | 0:05 | 05/30 19:40 |
| 4 | LK xx1 | 27 | Sit on bottom. Nav ref check again | 05/30 19:40 | 0:05 | 05/30 19:45 |
| 4 | LK xx1 | 28 | Shore reports xx mA current into BSP5 | 05/30 19:45 | 0:05 | 05/30 19:50 |
| 4 | LK xx1 | 29 | Moving back to BSP5, dress hose with hose hook tool | 05/30 19:50 | 0:10 | 05/30 20:00 |
| 4 | LK xx1 | 30 | Verify data from BSP5 | 05/30 20:00 | 0:02 | 05/30 20:02 |
| 4 | LK xx1 | 31 | Move BSP5 if necessary | 05/30 20:02 | 0:15 | 05/30 20:17 |
| 4 | LK xx1 | 32 | Remove parking position tripod from ELEV and set by BSP5 | 05/30 20:17 | 0:10 | 05/30 20:27 |
| 4 | LK xx1 | 33 | Dress cable and parking position tripod near BSP5 | 05/30 20:27 | 0:15 | 05/30 20:42 |
| 4 | LK xx1 | 34 | continue | 05/30 20:42 | 0:00 | 05/30 20:42 |
| 4 | LK xx1 | 35 | Retrieve ELEV and reel and place next to LIGHT1 in boneyard | 05/30 20:42 | 0:30 | 05/30 21:12 |
| 4 | LK xx1 | 36 | Dock ROV, raise to 4000 m | 05/30 21:12 | 0:10 | 05/30 21:22 |
| 4 | LK xx1 | 37 | continue | 05/30 21:22 | 0:05 | 05/30 21:27 |
| 4 | LK xx1 | 38 | Move ship to CAM2 deployment location, 25 m N of SN1 and 70 m W (exact position determined from earlier current estimate) | 05/30 21:27 | 0:20 | 05/30 21:47 |

| | | | | | | |
|---|---|---|---|---|---|---|
| 4 | LK xx1 | 39 | continue | 05/30 21:47 | 0:00 | 05/30 21:47 |
| **5** | **Deploy and connect CAM2** | | | | | |
| 5 | LK xx1 | 1 | Deploy CAM2 (with reel, parking postion tripod, Fred's plaque) | 05/30 21:47 | 0:15 | 05/30 22:02 |
| 5 | LK xx1 | 2 | In water, lines clear, move ship 100 m W, then move ship to track CAM2, meet at bottom | 05/30 22:02 | 0:10 | 05/30 22:12 |
| 5 | LK xx1 | 3 | CAM2 at 4000 m | 05/30 22:12 | 1:20 | 05/30 23:32 |
| 5 | LK xx1 | 4 | CAM2 on bottom at 47xx m | 05/30 23:32 | 0:15 | 05/30 23:47 |
| 5 | LK xx1 | 5 | Move ROV to CAM2; Undock | 05/30 23:47 | 0:10 | 05/30 23:57 |
| 5 | LK xx1 | 6 | Adjust ROV trim | 05/30 23:57 | 0:05 | 05/31 00:02 |
| 5 | LK xx1 | 7 | Pick up CAM2 and move to desired location, 20 m north of SN1, connector facing S, to SN1 | 05/31 00:02 | 0:30 | 05/31 00:32 |
| 5 | LK xx1 | 6 | Disconnect reel and parking position tripod, setting each on bottom | 05/31 00:32 | 0:15 | 05/31 00:47 |
| 5 | LK xx1 | 7 | Mount reel on ROV | 05/31 00:47 | 0:10 | 05/31 00:57 |
| 5 | LK xx1 | 7 | Move ROV S toward SN1, unspooling, to E of SN1, until ODI Flying lead free | 05/31 00:57 | 0:05 | 05/31 01:02 |
| 5 | LK xx1 | 7 | Remove reel and set down. | 05/31 01:02 | 0:05 | 05/31 01:07 |
| 5 | LK xx1 | 6 | Put connector on horn | 05/31 01:07 | 0:05 | 05/31 01:12 |
| 5 | LK xx1 | 6 | Remove Environmental Cover from J2 | 05/31 01:12 | 0:05 | 05/31 01:17 |
| 5 | LK xx1 | 7 | Connect CAM2 ODI flying lead to J2 on SN1 | 05/31 01:17 | 0:10 | 05/31 01:27 |
| 5 | LK xx1 | 7 | Inform shore when connection made | 05/31 01:27 | 0:05 | 05/31 01:32 |
| 5 | LK xx1 | 7 | Shore informs current draw | 05/31 01:32 | 0:05 | 05/31 01:37 |
| 5 | LK xx1 | 7 | Shore informs CAM2 functional | 05/31 01:37 | 0:05 | 05/31 01:42 |
| 5 | LK xx1 | 7 | ROV moves back to CAM2, dress hose with hose hook tool | 05/31 01:42 | 0:10 | 05/31 01:52 |
| 5 | LK xx1 | 7 | ROV lifts CAM2 and moves slightly N to take up slack; positions CAM2 pointing due N | 05/31 01:52 | 0:05 | 05/31 01:57 |
| 5 | LK xx1 | 8 | Re-position parking position tripod with Fred in view of CAM2 | 05/31 01:57 | 0:05 | 05/31 02:02 |
| 5 | LK xx1 | 6 | Pick up reel (near SN1) | 05/31 02:02 | 0:05 | 05/31 02:07 |
| 5 | LK xx1 | 7 | Move to boneyard, set reel down next to LIGHT1 | 05/31 02:07 | 0:15 | 05/31 02:22 |

| | | | | | | |
|---|---|---|---|---|---|---|
| 5 | LK xx1 | 8 | CAM2 finished | 05/31 02:22 | 0:05 | 05/31 02:27 |
| **6** | **Disconnect LIGHT4 and take to boneyard** | | | | | |
| 6 | LK xx1 | 1 | Move to Port E8 on OBS (NW corner, #1), with CTD arm | 05/31 02:27 | 0:10 | 05/31 02:37 |
| 6 | LK xx1 | 2 | Flip CTD (not working) on top of OBS | 05/31 02:37 | 0:15 | 05/31 02:52 |
| 6 | LK xx1 | 3 | Move to Port E2 on OBS (SW corner, #3, with CAM1 on right) | 05/31 02:52 | 0:20 | 05/31 03:12 |
| 6 | LK xx1 | 4 | Confirm with shore no power | 05/31 03:12 | 0:15 | 05/31 03:27 |
| 6 | LK xx1 | 5 | Unplug ODI flying lead from E2, pur on horn | 05/31 03:27 | 0:20 | 05/31 03:47 |
| 6 | LK xx1 | 6 | Put environmental cover on E2 | 05/31 03:47 | 0:15 | 05/31 04:02 |
| 6 | LK xx1 | 7 | Take flying lead to LIGHT4 just off port bow (NW corner) of OBS | 05/31 04:02 | 0:05 | 05/31 04:07 |
| 6 | LK xx1 | 8 | Attache pin protecting dummy. Then put flying lead into holser on LIGHT4, secure with bungie | 05/31 04:07 | 0:15 | 05/31 04:22 |
| 6 | LK xx1 | 9 | Pick up LIGHT4 and take to boneyard, 60 m E of OBS | 05/31 04:22 | 0:20 | 05/31 04:42 |
| 6 | LK xx1 | 10 | Set down LIGHT4 | 05/31 04:42 | 0:05 | 05/31 04:47 |
| 6 | LK xx1 | 11 | continue | 05/31 04:47 | 0:00 | 05/31 04:47 |
| **7** | **Clean Electrode** | | | | | |
| 7 | LK xx1 | 1 | Move to portside of OBS (west side) | 05/31 04:47 | 0:10 | 05/31 04:57 |
| 7 | LK xx1 | 2 | Set ROV on bottom by OBS (? Or hold on to frame with Mantis) | 05/31 04:57 | 0:05 | 05/31 05:02 |
| 7 | LK xx1 | 3 | Chip away at white aragonite deposit on electrode | 05/31 05:02 | 2:00 | 05/31 07:02 |
| 7 | LK xx1 | 4 | Collect 1 reel and take to boneyard by LIGHT1 | 05/31 07:02 | 0:15 | 05/31 07:17 |
| 7 | LK xx1 | 5 | continue | 05/31 07:17 | 0:00 | 05/31 07:17 |
| **8** | **Connect LIGHT1 to ELEV, recover ELEV+ROV** | | | | | |
| 8 | LK xx1 | 1 | Connect LIGHT1 to ELEV | 05/31 07:17 | 0:25 | 05/31 07:42 |
| 8 | LK xx1 | 2 | Dress hose | 05/31 07:42 | 0:10 | 05/31 07:52 |
| 8 | LK xx1 | 3 | Attach 1st reel to ELEV/LIGHT1 | 05/31 07:52 | 0:20 | 05/31 08:12 |
| 8 | LK xx1 | 4 | Attach 2nd reel to ELEV/LIGHT1 | 05/31 08:12 | 0:20 | 05/31 08:32 |

| | | | | | | |
|---|---|---|---|---|---|---|
| 8 | LK xx1 | 5 | Move ROV off to side | 05/31 08:32 | 0:10 | 05/31 08:42 |
| 8 | LK xx1 | 6 | Send acoustic release command | 05/31 08:42 | 0:15 | 05/31 08:57 |
| 8 | LK xx1 | 7 | Try again send acoustic release command | 05/31 08:57 | 0:15 | 05/31 09:12 |
| 8 | LK xx1 | 8 | if Release does not work, cut line | 05/31 09:12 | 0:20 | 05/31 09:32 |
| 8 | LK xx1 | 9 | ROV and ELEV+LIGHT1 ascends | 05/31 09:32 | 1:20 | 05/31 10:52 |
| 8 | LK xx1 | 10 | ELEV+LIGHT1 at surface, snag line | 05/31 10:52 | 1:00 | 05/31 11:52 |
| 8 | LK xx1 | 11 | Recover ELEV+LIGHT1 while ROV still ascending (if possible) | 05/31 11:52 | 1:00 | 05/31 12:52 |
| 8 | LK xx1 | 12 | Recover ROV. End of Dive LK-xx1 | 05/31 12:52 | 1:00 | 05/31 13:52 |
| **9** | **Turn around the ROV and ELEV and deploy both** | | | | | |
| 9 | | 1 | Refurb ELEV | 05/31 13:52 | 1:00 | 05/31 14:52 |
| 9 | | 2 | Refurb ROV, rig basket for biological sampling | 05/31 14:52 | 4:00 | 05/31 18:52 |
| 9 | LK xx2 | **3** | **Deploy ROV, hold at 50 m** | 05/31 18:52 | 0:15 | 05/31 19:07 |
| 9 | LK xx2 | 4 | Deploy ELEV | 05/31 19:07 | 0:30 | 05/31 19:37 |
| 9 | LK xx2 | 5 | ROV starts down, head for ELEV | 05/31 19:37 | 0:00 | 05/31 19:37 |
| 9 | LK xx2 | 6 | ROV Stop at 400 m | 05/31 19:37 | 0:38 | 05/31 20:15 |
| 9 | LK xx2 | 7 | Passing 1000 m | 05/31 20:15 | 0:40 | 05/31 20:55 |
| 9 | LK xx2 | 7 | ELEV at bottom | 05/31 20:55 | 0:51 | 05/31 21:46 |
| 9 | LK xx2 | 8 | Passing 2000 m | 05/31 21:46 | 0:51 | 05/31 22:37 |
| 9 | LK xx2 | 9 | Passing 3000 m | 05/31 22:37 | 0:51 | 05/31 23:28 |
| 9 | LK xx2 | 10 | Passing 4000 m | 05/31 23:28 | 0:35 | 06/01 00:03 |
| 9 | LK xx2 | 11 | At 4700 m moving to ELEV | 06/01 00:03 | 0:04 | 06/01 00:07 |
| 9 | LK xx2 | 12 | Undock and rotate ROV to scan sonar | 06/01 00:07 | 0:12 | 06/01 00:19 |
| 9 | LK xx2 | 13 | Check ROV trim | 06/01 00:19 | 0:24 | 06/01 00:43 |
| 9 | LK xx2 | 14 | continue | 06/01 00:43 | 0:10 | 06/01 00:53 |
| **10** | **Rig LIGHT4** | | | | | |
| 10 | LK xx2 | 1 | ROV to ELEV | 06/01 00:53 | 0:10 | 06/01 01:03 |
| 10 | LK xx2 | 2 | ROV picks up elevator | 06/01 01:03 | 0:10 | 06/01 01:13 |

| | | | | | | |
|---|---|---|---|---|---|---|
| 10 | LK xx2 | 3 | ROV moves ELEV to LIGHT4 | 06/01 01:13 | 1:00 | 06/01 02:13 |
| 10 | LK xx2 | 4 | ROV at LIGHT4, attach LIGHT4 to ELEV | 06/01 02:13 | 0:45 | 06/01 02:58 |
| 10 | LK xx2 | 5 | ROV picks up nearby reel | 06/01 02:58 | 0:15 | 06/01 03:13 |
| 10 | LK xx2 | 6 | ROV attaches reel to LIGHT4 | 06/01 03:13 | 0:15 | 06/01 03:28 |
| 10 | LK xx2 | 7 | ROV picks up second reel | 06/01 03:28 | 0:15 | 06/01 03:43 |
| 10 | LK xx2 | 8 | ROV attaches reel to LIGHT4 | 06/01 03:43 | 0:15 | 06/01 03:58 |
| **11** | **Remaining Housekeeping, Video, Bio Sampling** | | | | | |
| 11 | LK xx2 | 1 | ROV to OBS to complete electrode cleaning | 06/01 03:58 | 1:00 | 06/01 04:58 |
| 11 | LK xx2 | 2 | Set up sponsor poster | 06/01 04:58 | 0:20 | 06/01 05:18 |
| 11 | LK xx2 | 3 | Video, bio samples, dress cables, OBS | 06/01 05:18 | 0:45 | 06/01 06:03 |
| 11 | LK xx2 | 4 | Video, bio samples, dress cables, CTF | 06/01 06:03 | 0:45 | 06/01 06:48 |
| 11 | LK xx2 | 5 | Video, bio samples, dress cables, JBOX | 06/01 06:48 | 0:45 | 06/01 07:33 |
| 11 | LK xx2 | 6 | Video, bio samples, dress cables, CAM1 | 06/01 07:33 | 0:45 | 06/01 08:18 |
| 11 | LK xx2 | 7 | Video, bio samples, dress cables, BSP5 | 06/01 08:18 | 0:45 | 06/01 09:03 |
| 11 | LK xx2 | 8 | Video, bio samples, dress cables, BSP4 | 06/01 09:03 | 0:45 | 06/01 09:48 |
| 11 | LK xx2 | 9 | Video, bio samples, dress cables, sea cable south | 06/01 09:48 | 0:45 | 06/01 10:33 |
| 11 | LK xx2 | 10 | Video, bio samples, dress cables, SN1 | 06/01 10:33 | 0:45 | 06/01 11:18 |
| 11 | LK xx2 | 11 | Video, bio samples, dress cables, BSP2 | 06/01 11:18 | 0:45 | 06/01 12:03 |
| 11 | LK xx2 | 12 | Video, bio samples, dress cables, CAM2 | 06/01 12:03 | 0:45 | 06/01 12:48 |
| 11 | LK xx2 | 13 | Video, bio samples, dress cables, TAMM achor | 06/01 12:48 | 0:45 | 06/01 13:33 |
| 11 | LK xx2 | 14 | Video, bio samples, dress cables, xxx | 06/01 13:33 | 4:15 | 06/01 17:48 |
| 11 | LK xx2 | 15 | Collect Jason weights to boneyard | 06/01 17:48 | 1:00 | 06/01 18:48 |
| 11 | LK xx2 | 16 | Final housekeeping | 06/01 18:48 | 1:00 | 06/01 19:48 |
| 11 | LK xx2 | 17 | Bio Sample surveys | 06/01 19:48 | 0:00 | 06/01 19:48 |
| 11 | LK xx2 | 18 | continue | 06/01 19:48 | 0:00 | 06/01 19:48 |
| **12** | **Recover ELEV+LIGHT4 and ROV** | | | | | |
| 12 | LK xx2 | 1 | Go to ELEV+LIGHT4 | 06/01 19:48 | 0:15 | 06/01 20:03 |
| 12 | LK xx2 | 2 | Release ELEV with acoustic release | 06/01 20:03 | 0:30 | 06/01 20:33 |

| | | | | | |
|---|---|---|---|---|---|
| 12 | LK xx2 | 3 | if Release does not work, cut line | 06/01 20:33 | 0:20 | 06/01 20:53 |
| 12 | LK xx2 | 4 | ELEV ascends | 06/01 20:53 | 1:30 | 06/01 22:23 |
| 12 | LK xx2 | 5 | ROV ascends | 06/01 22:23 | 3:00 | 06/02 01:23 |
| 12 | LK xx2 | 6 | Recover ELEV+LIGHT4 | 06/02 01:23 | 0:30 | 06/02 01:53 |
| 12 | LK xx2 | 7 | recover ROV, on deck, end Dive LK-139 | 06/02 01:53 | 0:30 | 06/02 02:23 |
| 12 | | 8 | continue | 06/02 02:23 | 0:04 | 06/02 02:27 |
| **13** | **Contingency** | | | | | |
| 13 | | 1 | continue | 06/02 02:27 | 1:00 | 06/02 03:27 |
| 13 | | 2 | continue | 06/02 03:27 | 0:33 | 06/02 04:00 |
| 13 | | 3 | continue | 06/02 04:00 | 0:00 | 06/02 04:00 |
| **14** | **Transit from ACO to Honolulu** | | | | | |
| 14 | | 1 | Transit | 06/02 04:00 | 11:00 | 06/02 15:00 |
| 14 | | 2 | continue | 06/02 15:00 | 1:00 | 06/02 16:00 |
| 14 | | 2 | At Honolulu buoy | 06/02 16:00 | 1:00 | 06/02 17:00 |
| 14 | | 3 | Arrive | 06/02 17:00 | 0:00 | 06/02 17:00 |
| | | | | **05/29 10:00** | **103:00** | **06/02 17:00** |

| Dives | Start | Duration (hrs) | End |
|---|---|---|---|
| **LK xx1** | **05/30 09:58** | 27:54 | **05/31 13:52** |
| **LK xx2** | **05/31 18:52** | 31:31 | **06/02 02:23** |
| | | **59:25** | |

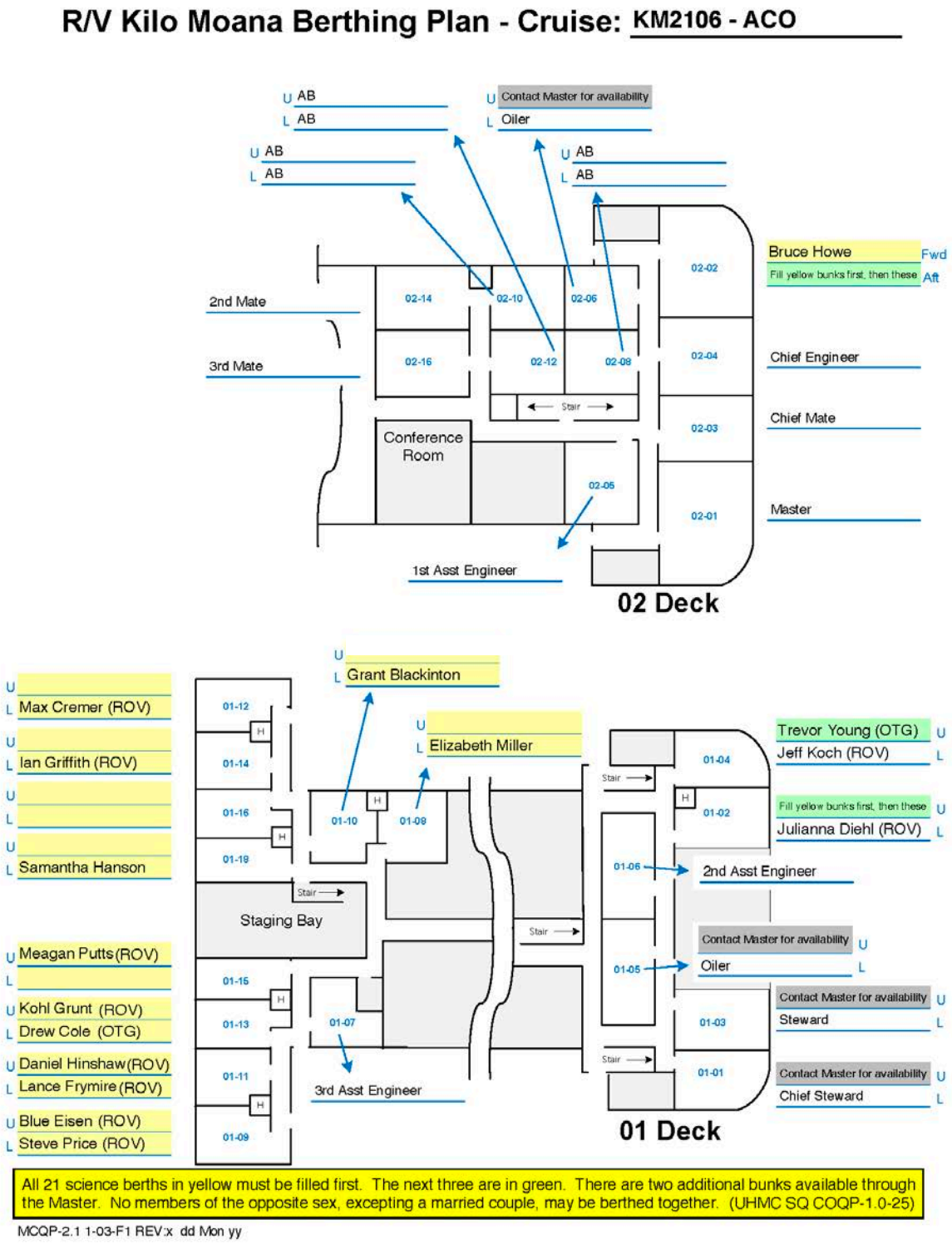
*Table B-1 ACO tasks for deployment*

# Appendix C – Cruise Participants and Contacts List

Voice: 011-870-773-234249 Fax: 011-870-783207825
IRIDIUM: 1-480-768-2500 THEN, 881631830418 Cell: (808) 864-0065
Kilo Moana: In Port Ship Numbers: (808) 587-8566 | (808) 587-8567

| | Name | Position | Email | Phone |
|---|---|---|---|---|
| | **UH/ACO, Science** | | | |
| 1 | Bruce Howe | Chief Scientist | bhowe@hawaii.edu | Cell: 808-469-0553<br>Off: 808-956-0466<br>Hm: 808-888-0665 |
| 2 | Grant Blackinton | Engineer | grant@blackinton.org | Cell: 206-579-7738 |
| 3 | Elizabeth Miller | Research Assistant | ecmiller@hawaii.edu | Cell: 206-919-4934 |
| 4 | Samantha Hanson | Student | 8lifflefoot@go.byuh.edu | Cell: 850-714-2288 |
| | **ROV *Lu'ukai*** | | | |
| 5 | Max Cremer | Dive Supervisor/<br>Manip ops | mcremer@hawaii.edu | Cell: 808-222-9588 |
| 6 | Steve Price | Navigator/Manip ops | stevenpr@hawaii.edu | Cell: 808-888-6248 |
| 7 | Blue Eisen | Engineer | bdeisen@hawaii.edu | Off: 808-956-0385<br>Cell: 808-226-9357 |
| 8 | Lance Frymire | Manip Ops/OTG | | |
| 9 | Meagan Putts | ROV data/video | meagan.putts@noaa.gov | |
| 10 | Julianna Diehl | Navigator | | Off: 808-956-0693 |
| 11 | Daniel Hinshaw | Machinist | dhinshaw@hawaii.edu | Off: 808-956-7304 |
| | **DOER** | | | |
| 12 | Ian Griffith | Engineer/DOER | ian@doermarine.com | Cell: 209-481-1943 |
| 13 | Kohl Grunt | Engineer/DOER | | |
| | **OTG** | | | |
| 14 | Trevor Young | Marine Tech | tnyoung@hawaii.edu | Cell: 808-200-9727 |
| 15 | Drew Cole | Marine Tech | | |
| | **Contacts on Land** | | | |
| | **UH/ACO** | | | |
| | Jim Potemra | Scientist | jimp@hawaii.edu | Off: 808-956-2737<br>Cell: 808-393-3693 |
| | Fernando Santiago-Mandujano | Scientist | mandujan@soest.hawaii.edu<br>santiago@hawaii.edu | Off: 808-956-7000 |
| | Brian Chee | Network Specialist | chee@hawaii.edu | Cell: 808-372-7426 |
| | Kellen Rosburg | Engineer | krosburg@hawaii.edu | Off: 808-956-7000<br>Cell: 206-799-5626 |
| | Jim Jolly | Engineer | jjolly@hawaii.edu | Lab: 808-956-2488<br>Cell: 808-392-4784 |
| | Mark Tremblay | Engineer | mdtremblay@optonline.net | Hm: 732-681-4748 |
| | 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 David | Manager | DD332H@att.com | 808.220.9041 |
| | **UH/Marine Center** | | | |
| | Anita Lopez | Director Research Vessel Operations | drvo@soest.hawaii.edu | Off: 808-956-0686 |
| | David Martin | Master<br>R/V *Kilo Moana* | master@km.soest.hawaii.edu | |
| | Scott Ferguson | Dir, Marine Tech Services | jscottf@hawaii.edu | Off: 808-956-0694<br>Cell: 808-349-2750 |

# Appendix D – Berthing Plan



# 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 |
| CTF | Cable Termination Frame |
| $CTDO_2$ | 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 |
| SN | Secondary Node |
| TF | Termination Frame (also CTF) |

# Appendix F – ACO REU Cruise Comms Plan

**Useful links:**

Real-time/ live feed from Lu'ukai: https://vimeo.com/event/974861

Teaser video created by Meagan: https://vimeo.com/547055160

SOEST News story: (same story submitted to UH News, post coming soon on www.hawaii.edu/news):
https://www.soest.hawaii.edu/soestwp/announce/news/uh-to-livestream-dives-to-the-deepest-ocean-cabled-observatory/

SOEST Announcement where updates on dive times will be posted:
https://www.soest.hawaii.edu/soestwp/announce/announcements/join-live-streaming-dives-to-the-deepest-ocean-cabled-observatory/

SOEST Facebook page where updates dive times will be posted:
https://www.facebook.com/SOEST/

Lu'ukai Social Media also for updates:
FaceBook Instagram Twitter

Other Links:

ACO, REU program, Lu'ukai Info page, Lu'ukai YouTube, REU Facebook Page