U.S. DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Pacific Islands Fisheries Science Center
2570 Dole St. • Honolulu, Hawaii 96822-2396
(808) 983-5300 • Fax: (808) 983-2902

30 April 2014

MEMORANDUM FOR: **CDR Robert A. Kamphaus**
Commanding Officer, MOC-PI

FROM: **Samuel G. Pooley**
Director, PIFSC

SUBJECT: **Change No. 3 - Amendment to *Hi'ialakai* Final Project Instructions, HA-14-01 MARAMP**

Please amend the subject HA-14-01 Project Instructions, dated 17 February 2014, to include the following comprehensive additions detailing the Leg IV (May 11 - 20) scientific surveys. The numbering scheme within the outline (as well as that of the Appendices) builds upon, and is continuous with, the original project instructions (Legs I – III). Also of note, *Hi'ialakai's* return transit is now termed and considered a separate Leg V.

I. Overview

A. Brief Summary and Project Period

Leg IV will focus on conducting preliminary explorations of the impact of natural acidification produced by the degassing of carbon dioxide from submarine volcanoes in the Northern Mariana Arc, specifically the island of Maug. These explorations are an extension of NOAA's Submarine Ring of Fire Expeditions that discovered multiple sites of natural acidification along the submarine Mariana Arc at depths ranging from 200m to 2,000m. Past explorations have been unable to examine shallow sites because research vessels do not typically operate in these relatively shallow waters. Conducting this investigation as part of MARAMP allows for the deployment of SCUBA divers, camera sleds, and survey instruments in these areas. Past surveys by Pacific Islands Fisheries Science Center Coral Reef Ecosystem Division (CRED) allowed for only limited time-on-station to investigate the water chemistry of the vent sites.

A primary goal is to establish Maug, a known hydrothermally active site, as a natural laboratory for the study of the impacts of ocean acidification on coral reefs. During Leg IV, the goal will be to gather sufficient data to evaluate Maug as a potential site for more detailed and long-term studies of the effects of ocean acidification on coral reef environments. A secondary goal is to collect multibeam data from *Hi'ialakai* during the transits between Saipan and Maug to fill gaps in existing bathymetry coverage.

Leg V is comprised solely of *Hi‘ialakai’s* return transit from Saipan, CNMI to Pearl Harbor, Hawai‘i. The scientific complement will not be aboard for Leg V.

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C. Operating Area

Leg IV: The operating area includes the Commonwealth of the Northern Marianas Islands (CNMI). Scientific surveys will be focused specifically at Maug, with multibeam surveys conducted on predefined routes between Saipan and Maug (*Appendix 11*). [If primary objectives at Maug are completed early, opportunistic investigations at nearby submarine volcanoes (Supply Reef and/or Ahyi and/or Sarigan) would be warranted, as transit time allows.]

Leg V: The operating area includes the return transit across the western and central Pacific Ocean, from Saipan, CNMI to Pearl Harbor, Hawai‘i (*Appendix 12*).

The Station/Waypoint List for Leg IV includes survey points at Maug, as well as the multibeam transit routes. It is presented in *Appendix 13* (attached file).

D. Summary of Objectives

… *(Objectives 1-8, MARAMP Legs I-III)*

9. Determine the spatial influence/gradient of the hydrothermal vent system gases and waters within the Maug caldera through the collection of water samples, CTD operations, and in-situ instrumentation.

10. Determine the water column chemistry of the hydrothermal vent waters and the circulation/residence time of the waters affected by the vent site, as well as forereef waters unaffected by the vent effluent through the collection of water samples, CTD operations, and in-situ instrumentation.

11. Deploy oceanographic instrumentation, by SCUBA divers, around the hydrothermal vent system and at forereef control sites.

12. Collect biological samples (calcifying organisms) under the approved collections permit.

13. Conduct photomosaic documentation of the hydrothermal vent system and forereef control sites.

14. Obtain footage for the Marianas Trench Marine National Monument footage library on behalf of NOAA Office of Exploration and Research (OER) and PIFSC Pacific Islands Regional Office (PIRO) Marine National Monuments Program.

15. Conduct multibeam survey transects between Saipan and Maug during both the northerly and southerly transits, as well as, opportunistic multibeam operations while on station at Maug.

16. If time permits, explore other nearby hydrothermal vent sites with the goal of finding new shallow vent systems, and characterize those as time allows.

E. Participating Institutions (Leg IV)

- NOAA Pacific Islands Fisheries Science Center Coral Reef Ecosystem Division (CRED)
- Joint Institute for Marine and Atmospheric Research (JIMAR)
- Pacific Marine Environmental Laboratory (PMEL)
- Atlantic Oceanographic and Meteorological Laboratory (AOML)
- National Institute of Standards and Technology (NIST)
- Scripps Institution of Oceanography (SIO)
- NOAA Diving Program (NDP)
- University of Guam (UOG)
- CNMI Bureau of Environmental & Coastal Quality (CNMI BECQ)
- Open Boat Films

F. Personnel / Science Party (Leg IV)

Name (Last, First)	Title	Embark	Disembark	Gender	Affiliation	Nationality
Barret, Pamela	Ocean Acidification Scientist	5/8/2014	5/20/2014	Female	PMEL	USA
Benavente, David	Ocean Acidification Scientist	5/8/2014	5/20/2014	Male	CNMI BECQ	USA
Bostick, James	Divemaster / Chamber Operator	5/7/2014	5/20/2014	Male	NDP	USA
Buck, Nathaniel	Ocean Acidification Scientist	5/8/2014	5/20/2014	Male	PMEL	USA
Butterfield, David	Ocean Acidification Scientist	5/8/2014	5/20/2014	Male	PMEL	USA
Clark, Jeanette	Instrumentation Diver	5/7/2014	5/20/2014	Female	CRED/JIMAR	USA
Day, Russell	Ocean Acidification Diver	5/8/2014	5/20/2014	Male	NIST	USA
Donham, Emily	Ocean Acidification Diver	5/8/2014	5/20/2014	Female	SIO	USA
Edwards, Clinton	Photo Mosaic Diver	5/8/2014	5/20/2014	Male	SIO	USA
Enochs, Ian	Ocean Acidification Diver	5/8/2014	5/20/2014	Male	AOML	USA
Fox, Michael	Photo Mosaic Diver	5/8/2014	5/20/2014	Male	SIO	USA
Gordon, Stephani	Filmmaker / Support Diver	5/8/2014	5/20/2014	Female	Open Boat Films	USA
Iguel, John	Ocean Acidification Scientist	5/8/2014	5/20/2014	Male	CNMI BECQ	USA
Kolodziej, Graham	Ocean Acidification Diver	5/8/2014	5/20/2014	Male	AOML	USA

Larson, Benjamin	Ocean Acidification Scientist	5/8/2014	5/20/2014	Male	PMEL	USA
Michael, Susanna	Ocean Acidification Scientist	5/8/2014	5/20/2014	Male	PMEL	USA
Pomeroy, Noah	Instrumentation Diver	5/7/2014	5/20/2014	Male	CRED/JIMAR	USA
Reardon, Kerry	Instrumentation Diver	5/7/2014	5/20/2014	Female	CRED/JIMAR	USA
Reardon, Russell	Operations Lead / Instrumentation Diver	5/7/2014	5/20/2014	Male	CRED/JIMAR	USA
Roe, Kevin	Ocean Acidification Scientist	5/8/2014	5/20/2014	Male	PMEL	USA
Schils, Tom	Ocean Acidification Diver	5/8/2014	5/20/2014	Male	UOG	BEL
Young, Charles	Chief Scientist / Instrumentation Diver	5/7/2014	5/20/2014	Male	CRED/JIMAR	USA

G. Administrative

1. Points of Contact

Chief Scientist:

Charles Young (Leg IV)
Charles.Young@noaa.gov
NMFS / PIFSC / CRED
1845 Wasp Blvd., Bldg. #176
Honolulu, HI 96818
808-725-5408

Operations Lead:

Russell Reardon (Leg IV)
Russell.Reardon@noaa.gov
NMFS / PIFSC / CRED
1845 Wasp Blvd., Bldg. #176
Honolulu, HI 96818
808-725-5404

Ship Operations Officer:

LT Faith Knighton
OPS.Hiialakai@noaa.gov
NOAA Ship *Hi'ialakai*
1897 Ranger Loop, Bldg. #184
Honolulu, HI 96818
808-721-9957

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II. Operations

A. Project Itinerary

Weather, equipment failures, and scheduling problems are unpredictable. As such, the following intended itinerary should be considered as only a guide for survey progression. Transit estimates have been calculated based on a ship's speed of 9.5 knots westbound, 9.0 knots north and southbound, and 8.4 eastbound, unless otherwise indicated (*e.g*. reduced speed for multibeam operations).

Leg IV:

May 8 - 10	**Saipan Harbor, Saipan in-port period:** Resupply small boat fuel, if necessary. Incoming scientists (16) will embark and ready lab spaces and equipment. Conduct CTD rosette modifications (i.e. wiring of additional oceanographic instruments regularly used by, and provided by, PMEL specifically for this cruise). The instruments seamlessly connect with the shipboard SBE 9+ CTD. Additions to the standard *Hi'ialakai* CTD package include a SBE18 pH sensor and a Miniature Autonomous Plume Recorder (MAPR), both used to detect hydrothermal anomalies. (http://www.pmel.noaa.gov/eoi/PlumeStudies/mapr/)
May 11	**Depart Saipan Harbor / Multibeam Surveys in Transit to Maug:** Conduct davit hook checkouts with new scientific personnel and ship's crew, while at the pier and/or in the vicinity of Saipan Harbor, as time allows. Depart Saipan between 1000-1200h, but no later than 1200h, in order to begin transit to Maug. One consideration that requires on-site input from PMEL scientists is conducting one shipboard CTD hydrocast (typically 800-1200m depth) off the coast of Saipan to achieve a sound velocity profile of the water column in order to calibrate *Hi'ialakai's* multibeam system prior to beginning the multibeam surveys en route to Maug via the pre-designated 335nm 'south to north' route *(Appendix 11 & 13)*. Once PMEL scientists are onboard *Hi'ialakai* (May 9), the SST will have the opportunity to meet with PMEL scientists familiar with multibeam operations and together they will be able to advise the Chief Scientist and Commanding Officer on what is required (regarding time and hydrocast depth) for successful multibeam operations prior to beginning the transit to Maug. These discussions may result in a suggested earlier departure from Saipan harbor than 1200h. Maximum transit speed will be determined by the data quality achieved and likely not to exceed 8 knots (335nm @ 8kt, 1d 18h).
May 12	**Transit to Maug / Multibeam Surveys:** Continue transit to Maug while conducting multibeam surveys. If transit speed for multibeam data collection is too slow to achieve an on-time arrival at Maug, then multibeam surveys will be conducted only up to the point at which a direct route to Maug at maximum cruising speed must be realized.

May 13

Maug: Arrive Maug cauldera NLT 0800h. Conduct familiarization dives with scientific personnel, as well as a hydrothermal vent system orientation dives. Reconvene science party for operational planning based on orientation dives. As time allows, conduct SCUBA dives and small boat instrument deployments to investigate the hydrothermal vent system and surrounding reefs, using up to 5 small boats launched from *Hi'ialakai*. Priority investigations for the initial days on station are detailed immediately below. (Scientific operations to be conducted during the Project are fully outlined in Section II.C.)

Choosing sites for instrument deployments and coral growth experiments depends on knowing the pH gradients. The first two days of operations will focus on collecting pH data and understanding the pH gradients within and around Maug by several means:

1) in-situ pH collection along the eastern island and throughout the caldera with SeaFET pH sensors mounted on SCUBA diver towboards;

2) in-situ pH measurements at discrete locations around the caldera by SCUBA divers with SeaFET sensors;

3) in-situ pH measurements made by a SeaFET sensor(s) mounted on hand-held SBE 19plus CTD(s) and deployed from small boat(s);

4) ship-board analysis of pH from SCUBA diver-collected water samples collected from around the active hydrothermal vent site.

In addition to measuring pH gradients, the patterns of pH signal dispersal, due to water currents, must be determined prior to establishing a scientific plan for the balance of the time on station, as the results of measuring water movement within the caldera may influence sampling design. Seven (7) Nortek Aquadopp current profilers will be deployed in strategic locations across the caldera. The goal of identifying the currents within the caldera should be achieved within the first 72 hrs of being on station at Maug. (This will be done by deploying current profilers on Day 1 and recovering the instruments on Day 3.) The current profilers will be re-deployed later in Leg IV operations for a long-term study, and recovered on a separate AOML research mission to Maug in August 2014.)

Gases and vent fluids will be collected directly from the vent systems within the caldera, by SCUBA divers, on Day 1 or

Day 2. CRED and PMEL conducted similar investigative operations in 2007 at Maug, and this new data will help determine the source water concentrations of potential tracers, as well as help identify the dispersal patterns of gases and dissolved components in/around the vent system.

May 14-17 — **Maug:** Continue to conduct SCUBA dives, small boat and ship-based scientific operations within the caldera and on the forereef.

May 18 — Conduct a full day of scientific operations at Maug. Depart Maug NLT 1800h. Conduct one shipboard CTD hydrocasts to a minimum of 800m depth to achieve a sound velocity profile prior to initiating multibeam surveys en route to Saipan via the pre-designated 308nm 'north to south' route *(Appendix 11 & 13)*. Maximum transit speed will be determined by the data quality achieved and likely not to exceed 8 knots (308nm @ 8kt, 1d 14.5h).

May 19 — **Transit to Saipan / Multibeam Surveys:** Continue transit / multibeam surveys.

May 20 — **Transit to Saipan / Multibeam Surveys / Arrive vicinity of Saipan Harbor / Transfer Scientists Ashore:** Continue multibeam surveys while transiting to Saipan. Arrive in the vicinity of Saipan Harbor no later than 1400h for transfer of all 22 scientific personnel ashore via small boat. All scientific personnel shuttled ashore and small boats secured back aboard *Hiʻialakai* NLT 1700h. End of Leg IV.

<u>Leg V</u>: — 1700h: Begin Leg V return transit from Saipan Harbor, CNMI to Pearl Harbor, Hawaiʻi (3,235 nmi @ 8.4 kt, 16d 2h; adjusted to 15d 6h due to dateline and time zones).

May 22 - June 4 — **Transit:** Continue transit to Pearl Harbor, Hawaiʻi.

June 5 — **End of Project:** Arrive Pearl Harbor, Hawaiʻi.

B. Staging and Destaging, Leg IV

<u>Staging:</u> Much of the equipment for Leg IV was loaded in Seattle and Honolulu prior to the departure of HA-14-01. However, additional hand carried items and personal gear will be loaded in Saipan during the in-port period, May 8-10, 2014. Additional small boat gasoline may be necessary. (The need will be determined prior to the end of Leg III.)

<u>De-staging:</u> All 22 scientists will be transferred ashore in Saipan on May 20 via small boat. Limited scientific samples as well as personal gear are anticipated to be transported ashore. Multiple small boat trips are expected in order to complete

the transfer of the scientific party. The bulk of scientific dive/personal gear, equipment and scientific samples will remain aboard *Hi'iakalai* for return to Honolulu. Scientific samples will either be room stable and stored in an air conditioned space or will require freezing. Samples being frozen in the Wet Lab scientific freezer and in the CRED provided chest freezer on the O-2 deck should remain frozen throughout the transit from Saipan to Pearl Harbor. Upon completion of Leg IV, participating scientists will inventory and report on the HAZMAT remaining onboard to the Chief Scientist, *Hi'ialakai* SST and Operations Officer, so that the proper protocols for care and transport can be followed. The full off-load of scientific samples, program-provided equipment/materials, and small boats will occur, in coordination with the Command, once *Hi'ialakai* returns to Pearl Harbor on June 5.

C. Operations to be Conducted

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<u>Scientific Operations, Leg IV</u>

Scientific operations on Leg IV will require diving, small boat, and ship based surveys. Up to five small boats may operate simultaneously during daylight hours to maximize productivity. The following list details the scientific operations that will be conducted on Leg IV:

1. Sample known sources of CO_2 venting into the coral reef ecosystems of the Maug caldera.

a. SCUBA divers will collect gas samples at each vent site where CO_2 bubbling occurs.

b. SCUBA divers will collect water samples from each warm water/gas vent site to:

i. Analyze water samples (shipboard) for pH, alkalinity, hydrogen sulfide (H_2S), dissolved silica, methane (CH_4), and hydrogen (H_2) using gas chromatography (GC) techniques.

ii. Preserve samples for later elemental analyses, trace metals, dissolved inorganic nutrients, and nitrogen (N) isotopes on nitrate, nitrite, ammonia, dissolved organic carbon (DOC), dissolved inorganic carbon (DIC) and total alkalinity (TA).

c. Deploy custom-built pCO_2/pH mapping apparatus from a small boat, focusing on the hydrothermal vent system.

2. Document the vent's impact on local coralline ecosystems

a. SCUBA divers will collect carbonate material grab samples of surface layer sand/sediments along transects originating from the vent site and analyzed onboard by micro-computed tomography (microCT).

i. Analyze sediment samples (shipboard) for metal content (Fe, Mn, heavy metals).

ii. Preserve/freeze a subsample or separate sediment sample for later DNA analysis.

b. SCUBA divers will conduct targeted benthic surveys along CO_2 gradients across the vent site.

3. Deploy reef monitoring instruments

a. SCUBA divers will deploy up to seven Acoustic Doppler Current Profilers (ADCPs) throughout the caldera.

b. SCUBA divers will deploy Calcification Accretion Units (CAUs) from within the hydrothermal vent site, extending into the surrounding reef habitat.

c. SCUBA divers will deploy up to three seaFET pH loggers throughout the caldera.

d. SCUBA divers will deploy a Pro-Oceanus pCO_2 logger within the vent site.

e. SCUBA divers will deploy up to three EcoPAR sensors throughout the caldera.

4. Explore for new sites within the shallow waters of the caldera

Leg IV exploratory dives within the caldera will rely on observations from previous MARAMP expeditions. Previously sighted areas of gas bubbles, unusual sediment accumulation, or bacterial mats are of particular interest and will be explored further. Leg IV participants will be also be searching for new sites of gas or warm water venting.

5. Characterize the hydrography and chemistry of the water column within and around the caldera

a. Collect water samples in Niskin bottles, deployed via SCUBA diver or shipboard CTD cast, throughout the caldera and outside the caldera, with the goal of creating a detailed map of water column calcite/aragonite saturation states. Water samples will be analyzed on board for dissolved methane and hydrogen and dissolved silica, and preserved on board for shore-based analysis of DIC, alkalinity, nutrients (nitrate/nitrite/ammonia/silica/phosphate), total dissolvable trace metals, with a subset of samples collected for helium and nitrogen isotope studies.

b. Conduct pH sensor (seaFET) surveys around the caldera in upper surface layers (<50m depth), via CRED tow-boarding, in-situ instrumentation, or CTD casts.

c. Collect crustose coralline algae, *Halimeda*, coral biopsy/nubbin, and sponges along the pH gradient transect and prepare collections for later analysis for boron isotopes by multicollector - inductively coupled plasma - mass spectrometry (MC-ICP-MS).

d. Conduct CTD casts from small boats and *Hi'ialakai*. Up to 16 shipboard CTD casts are possible during the Maug operations.

i. CTD cast locations:

(a) In the caldera from surface to deepest parts (~200m) on opposite sides of the central caldera dome.

(b) Directly centered over the central dome (~60m).

(c) Outside of the caldera in four transects extending in each of the cardinal directions.

ii. CTD sampling interval should capture the variation in the surface mixed layer with sampling at: 1m, 5m, 10m, 20m, 30m, 40m, 50m, 75m, 100m, 125m, 150m, and 175m.

iii. CTD sensors:

(a) Shipboard CTD and Rosette:

(1) SBE 9+ with standard pressure sensor and dual temperature and conductivity sensors provided by *Hi'ialakai*.

(2) Dual fluorimeter/backscatter (FLNTU) and SBE43 Oxygen sensor provided by CRED.

(3) Light scattering, SBE18 pH sensor, MAPRs, and ORP sensors (analog voltage) provided by PMEL. **These sensors are requested to be cabled into the shipboard SBE9+.** PMEL will provide a CTD survey technician to aid in rosette modifications and CTD operations.

(b) Small boat hand-held hydrocasts will be conducted with two SBE19+ CTDs. One is equipped with an additional FLNTU, turbidity sensor and SBE43 O2 sensor.

6. **Conduct vent fluid sampling for gas**

SCUBA divers will deploy stainless steel 150 ml volume cylinders to collect vent gas and deliver samples to the small boats for later analysis. Excess gas pressure will be relieved by expansion and expulsion of seawater out of the backside of the piston.

7. **Conduct vent fluid sampling for dissolved chemistry**

SCUBA divers will deploy Teflon tubing intake nozzles with pistons into the vents where warm water is exiting the seafloor. The divers will fill the samplers by drawing up the piston handle with the intake in the vent. Samplers are returned to the small boat such that the samples can be processed back onboard *Hi'ialakai*.

8) **Conduct photomosaic documentation of the hydrothermal vent system and forereef control sites.**

a. SCUBA divers will use a large format system (towed surface frame) to conduct a single large standard mosaic or conduct several standard (100 m^2) mosaics along regular distance intervals from the vent. (Method chosen will depend on the size of the vent area required to be in the mosaic.)

b. SCUBA divers will target as many as eight forereef locations to establish photomosaic plots (100 m^2) using a dual camera mosaic frame. Mosaic plots are ideally paired with existing monitoring sites and/or in 10m water depth.

9. **Obtain footage for the Marianas Trench Marine National Monument footage library on behalf of NOAA Office of Exploration and Research (OER) and PIFSC Pacific Islands Regional Office (PIRO) Marine National Monuments Program.**

Open Boat Films will collect professional quality high-definition footage and stills of the underwater and topside environment of the Islands Unit of the Marianas Trench MNM for use with NOAA OER and PIRO Marine National Monuments Program science, education, and outreach materials.

In addition to documenting the ongoing field research and the diversity of underwater habitats, five priority filming sites are: the vent within the caldera; the (inside) reef slope of West Island; the northeast (outside) corner of North Island; the recent shipwreck on the northwest (inside) corner of East Island (PIRO request); and the bubble coral topped reef in the center of the caldera.

10. **Conduct multibeam survey transects between Saipan and Maug during both the northerly and southerly transits, as well as, multibeam operations while on station at Maug.**

During transits between Saipan and Maug, *Hi'ialakai* will operate its multibeam sonar on pre-designated routes to opportunistically fill gaps in existing bathymetry coverage. One shipboard CTD hydrocast will be conducted to a minimum of 800m depth to update the sound velocity profile prior to initiating multibeam surveys on each transect (i.e. once at Saipan; once at Maug).

11. Locate new sources of CO2 venting at Supply Reef and/or Ahyi and/or Sarigan submarine volcanoes as time allows.

a. Characterize the chemistry of these sources, including their pH, DIC, and TA.

b. Determine the saturation state of waters in and around the volcanoes, especially those proximal to sites of venting.

c. Make preliminary assessment of the health, abundance, and community structure of corals and other carbonate secreting organisms at these sites.

d. Sample gas and warm seawater from any new vents found.

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D. Dive Plan, Leg IV

All dives are to be conducted in accordance with the requirements and regulations of the NOAA Diving Program (http://www.ndc.noaa.gov/dr.html) and require the approval of the ship's Commanding Officer.

The Dive Plans for Leg IV of HA-14-01 are presented in *Appendix 15* (attached files).

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III. Equipment

A. Equipment and Capabilities Provided by the Ship

1. **Equipment:** In addition to the comprehensive list of items detailed in the subject Project Instructions, dated 17 February 2014, the Leg IV science plan requires the multibeam SONAR (30 kHz EM300) system to be brought on line.

2. **Capabilities:** It is requested that the Senior Survey Technician, assisted by PMEL scientists, facilitate multibeam data collection on northbound and southbound transits between Saipan and Maug.

B. **Equipment and Capabilities Provided by the Scientists, Leg IV**

1. **Equipment**: The program's full equipment list detailing what was previously loaded aboard (Legs I – III) was presented with the initial Project Instructions (*Appendix 8*). A Leg IV Supplement is presented in *Appendix 16*.

2. **Capabilities**: In addition to scientific expertise, the program will provide the following capabilities:

    a. Coxswains and routine maintenance for program-provided 19' SAFE Boats and 17' Avon (if required).

    b. A scientist to assist in rosette modifications (cabling in of light scattering, SBE18 pH sensor, MAPRs, and ORP sensors) and CTD operations.

    c. A scientist to assist in multibeam surveys, including updating the sound velocity profile in the EM300 system prior to data collection and monitoring data quality during mapping operations.

IV. Hazardous Materials

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B. Inventory of Hazardous Materials

See *Appendix 17* (Leg IV Supplement).

Since Leg V will be conducted without the scientific complement aboard, *Hi'ialakai's* HAZMAT Custodian Plan will be followed. The Chief Scientist will provide the Senior Survey Technician an updated inventory of hazmat and spill response equipment remaining onboard before the ship takes custody of the materials for the return transit to Pearl Harbor, Hawai'i.

C. Chemical Safety and Spill Response Procedures

See *Appendix 18*.

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VIII. Miscellaneous

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F. Foreign National Guests Access to OMAO Facilities and Platforms

The foreign national participants for project HA-14-01 Leg 4 are Tom Schils and no others. Chamber Operator James Bostick will serve as the onboard foreign national sponsor for this participant.

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APPENDICES

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Appendix 11 Operating Area for HA-14-01 Leg IV

Appendix 12 Operating Area for HA-14-01 Leg V

Appendix 13 Station/Waypoint List for HA-14-01 Leg IV (attached file)

Appendix 14: Survey Area Map: Maug

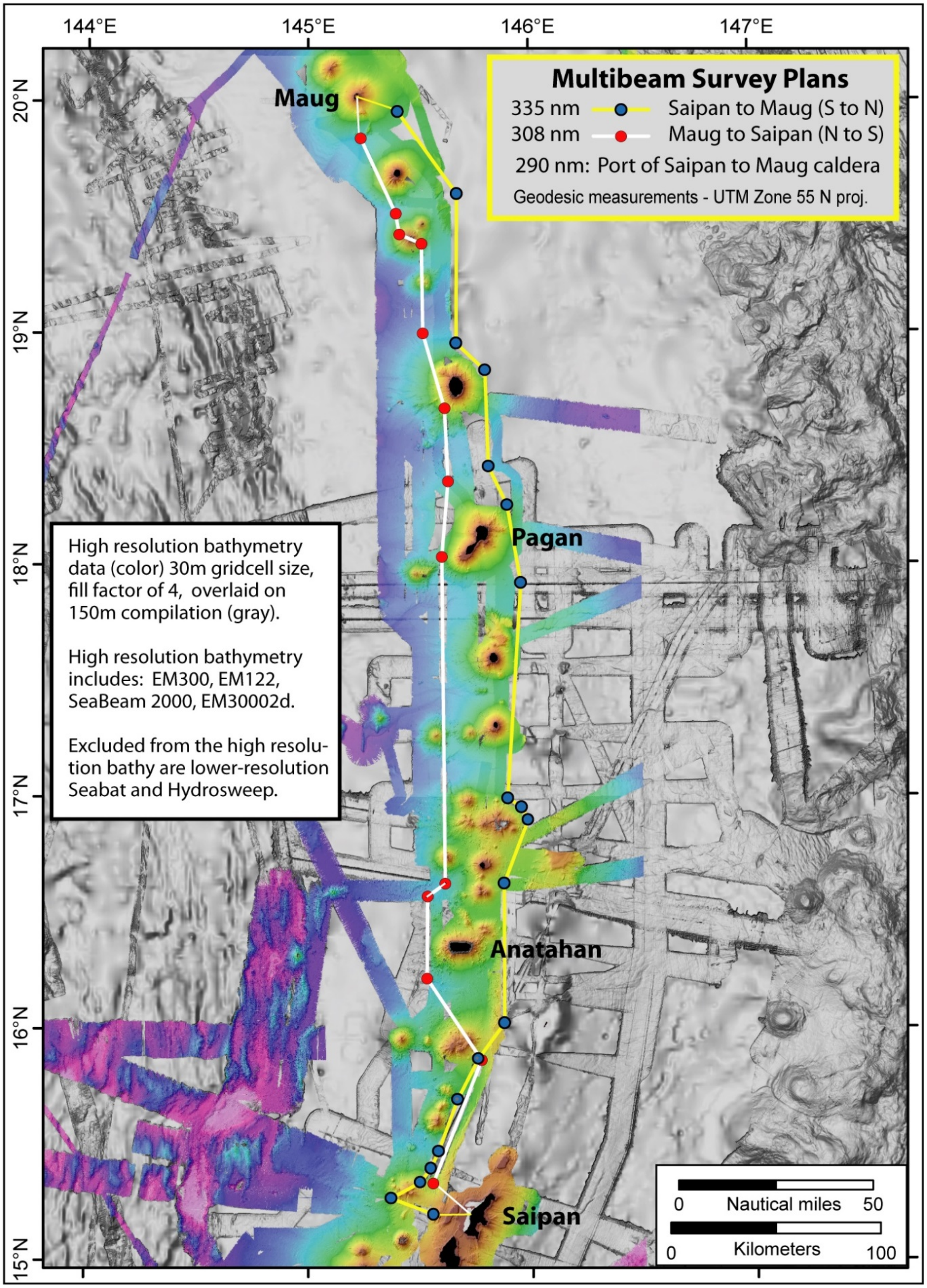
Appendix 15: Dive Plan for HA-14-01 Leg IV (attached file)

Appendix 16: Program Provided Equipment List (Leg IV Supplement)

Appendix 17: Section Section IV.B. Hazardous Materials Inventory (Leg IV Supplement)

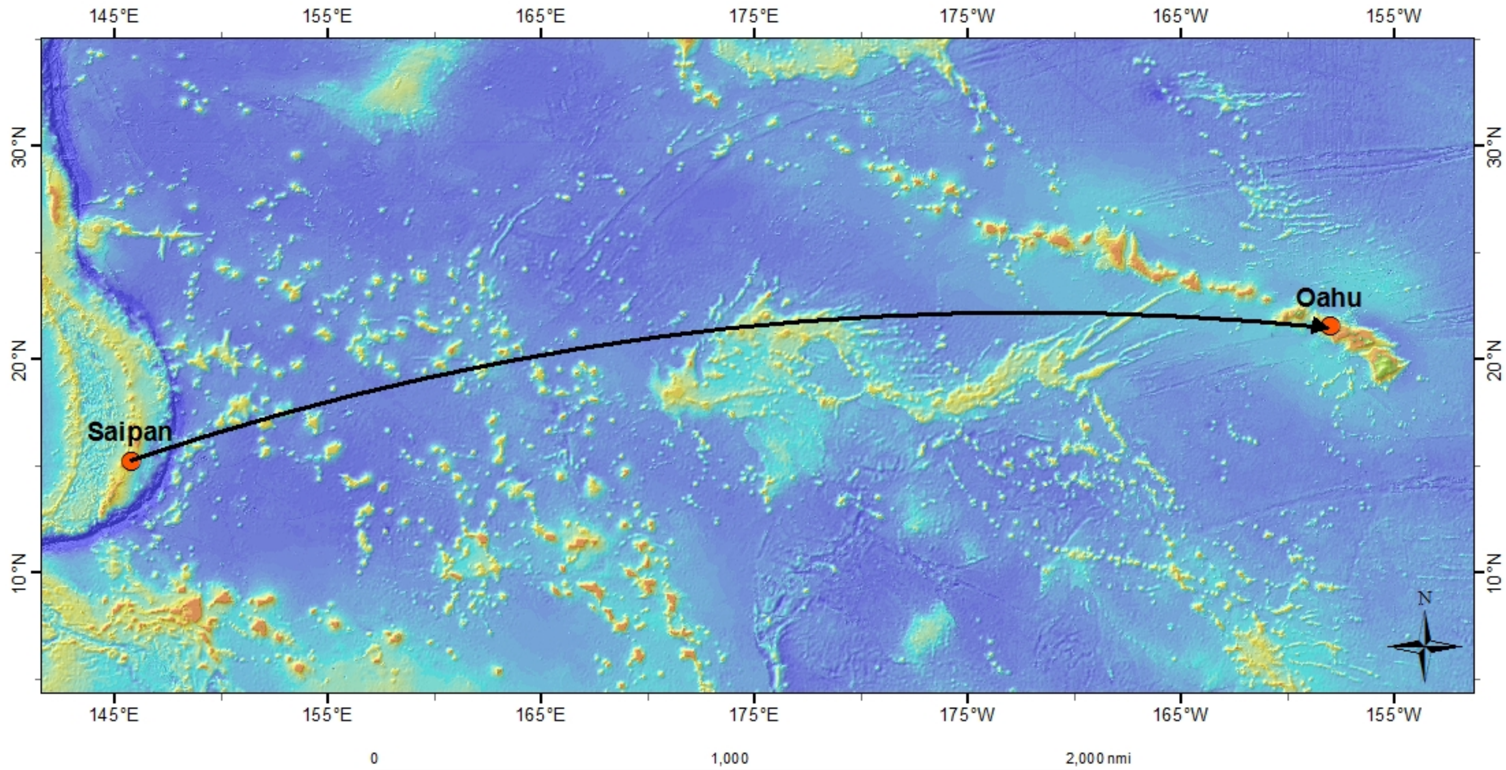
Appendix 18: Section Section IV.C. Chemical Safety and Spill Response Procedure

Appendix 11 **Operating Area for HA-14-01 Leg IV**



Operating area for Leg IV showing the designated multibeam survey routes between Saipan and Maug (waypoint coordinates found in *Appendix 13*).

Appendix 12 **Operating Area for HA-14-01 Leg V**

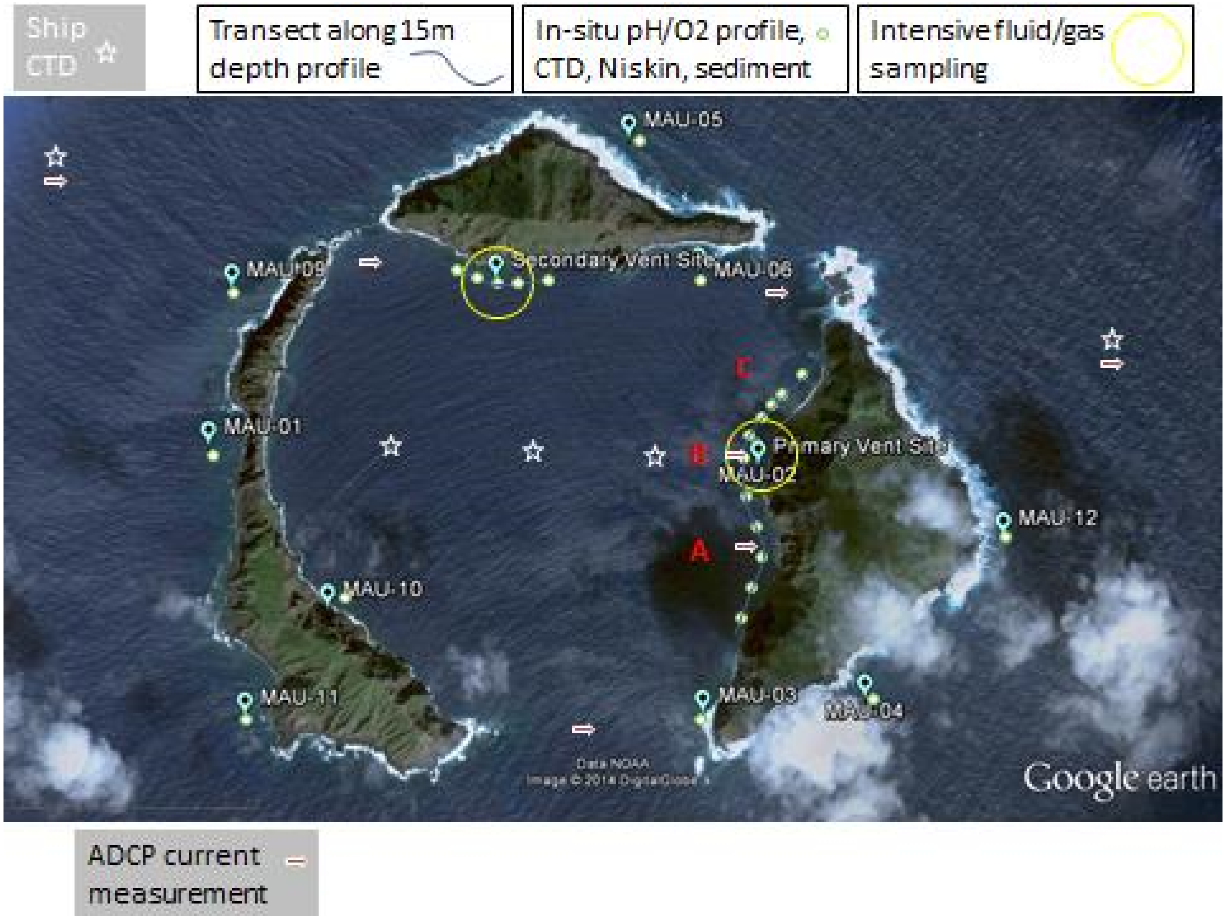


Operating Area for Leg V showing the return transit from Saipan, CNMI to Pearl Harbor, Hawai'i.

Appendix 13 Station/Waypoint List for HA-14-01 Leg IV

(Attached file)

***Appendix 14:* Survey Area Map: Maug**



Proposed Leg IV survey areas at Maug. Note: The CRED MARAMP permanent sites (MAU-XX) are shown for reference only.

Appendix 15: **Dive Plan for HA-14-01 Leg IV**

(*Attached file*)

Appendix 16: Program Provided Equipment List (Leg IV Supplement)

Qty	Description	Dim, inches	Unit Weight (lbs)	Total Weight (lbs)	Special Consideratoins / Preferred Storage / Notes / Etc.	Contact Name	Location Loaded: Seattle, Honolulu, Saipan.
4	K-size gas tanks		200	800	Wet Lab in gas tank rack	D. Butterfield	Seattle
3	Shipping crates	48x45x36	375	1125	On upper deck, covered w/ tarps under lids, keep lashed down	D. Butterfield	Seattle
1	Shipping crate	48x45x48	400	400	On upper deck, covered w/ tarps under lids, keep lashed down	D. Butterfield	Seattle
2	Boxes, spectrophoto-meter and gas chromatograph	24x30x15	50	100	In Dry Lab under corner desk, keep in air conditioned space if possible. Must be in dry space.	D. Butterfield	Seattle
1	Blue Tote	24x18x30	20	20	On shelf in Dry Lab, keep in A/C space if possible, must be in dry space	D. Butterfield	Seattle
1	Cardboard Box, Titrator	16x16x24	20	20	On shelf in Dry Lab, keep in A/C space if possible, must be in dry space	D. Butterfield	Seattle
1	Cardboard Box, Spectrophoto-meter	15x15x24	25	25	In cabinet in Dry Lab, keep in A/C space if possible, must be in dry space	D. Butterfield	Seattle
1	Plastic tote, pH meter setup	24x18x30	30	30	In Dry Lab, keep in A/C space if possible, must be in dry space	N. Buck	Seattle
1	20 L carboy (millepore water)	16x16x24	44	44	Wet Lab	R. Day	Honolulu
1	Plastic tote, field supplies	36x20x20	100	100	Wet Lab	R. Day	Honolulu
1	Cooler (120 qt) for samples	39x19x19	15	15	Scientific freezer	R. Day	Honolulu

1	Helium sampling supplies	18x18x52	150	150	In dry space, not temperature sensitive	D. Butterfield	Honolulu
1	Gas sample bottles and supplies	18x24x24	50	50	In dry space, contains vacuum pump	D. Butterfield	Honolulu
3	ECO-PAR loggers	7.5x14.5x17	9.5	28.5	No extreme heat, electronics. Preferred space in air conditioned storage room.	I. Enochs / C. Young	Honolulu
3	SeaFET	9x19x23	30.5	91.5	No extreme heat, electronics. Preferred space in air conditioned storage room.	I. Enochs / C. Young	Honolulu
1	NCRMP Water Sampling Kit	7.5x14.5x17	11.5	11.5	Preferred space in air conditioned storage room.	I. Enochs / C. Young	Honolulu
2	Bottle Crate (24 glass bottles)	15x20.5x27.5	32	64	Preferred space in air conditioned storage room.	I. Enochs / C. Young	Honolulu
1	CO2-PRO CV battery pack in wood crate	14x10x38.5	123	123	No extreme heat, electronics. Preferred space in air conditioned storage room.	I. Enochs / C. Young	Honolulu
1	CO2-PRO CV logger unit	10.5x17x22	25.5	25.5	No extreme heat, electronics. Preferred space in air conditioned storage room.	I. Enochs / C. Young	Honolulu
1	Box of stainless steel stakes	40.5x3.5 diam., cylindrical	22	22	Stainless steel locker on deck.	I. Enochs / C. Young	Honolulu
1	Tissue processing equipment	5.5x18x9.5	6	6	Wet Lab	I. Enochs / C. Young	Honolulu
1	Plastic tote, field supplies	36x20x20	100	100	Wet Lab	R. Day	Saipan
1	Green rolling dive bag	36x16x18	50	50	Dive locker	R. Day	Saipan
1	Cylinder of inert nitrogen gas for instrument calibration	~12x12x12	10	10	No extreme heat. Preferred space in air conditioned storage room.	I. Enochs / C. Young	Saipan

1	Cylinder of CO2 calibration gas	~12x12x12	10	10	No extreme heat. Preferred space in air conditioned storage room.	I. Enochs / C. Young	Saipan
2	Dive bags	36x18x18	40	80	Dive locker	I. Enochs	Saipan
2	Coolers of mosaic equipment	30x17x17	50	100	Anywhere accessible	C. Edwards	Saipan
1	Action packer	35x21x17	50	50	Anywhere accessible	C. Edwards	Saipan
3	Coolers of field supplies	40x18x22	70	210	Wet Lab	R. Day / E. Donham	Saipan
1	Cooler (& misc bags) camera equipment	26x15x16	120	120	Dry storage	S. Gordon	Saipan

Appendix 17: **Section IV.B. Hazardous Materials Inventory (Leg IV Supplement)**

Inventory of Hazardous Materials

Common Name	**Qty.**	**Notes**	**Trained Individual Aboard Ship and Agency**	**Spill Control***
Ethanol	8 L	For cleaning instrument	Rusty Day NIST	AL
Ferric Chloride	60g	Reagent for H2S	Kevin Roe PMEL	P
Oxalic Acid	200g	Reagent for silica	Kevin Roe PMEL	A
Sodium Sulfide	4g	For H2S standard	Kevin Roe PMEL	SULF
Hydrochloric Acid, 12M	2.5L	Acidification of trace metal samples; for reagents and cleaning	Kevin Roe PMEL	A
Hydrochloric Acid, 0.1M	1 L	Titrant for alkalinity	Kevin Roe PMEL	A
Sulfuric Acid	2L	Silica reagent	Kevin Roe PMEL	A
Potassium Iodate	0.7g	Reagent	Kevin Roe PMEL	NT
sodium flourosilicate, dissolved	6L	Standards for silica	Kevin Roe PMEL	NT
4-methylaminophenol sulfate (metol)	30g	Reagent for silica	Kevin Roe PMEL	PO
NN-dimethyl-1-4-phenylenediamine dihydrochloride	36g	Reagent for sulfide	Kevin Roe PMEL	PO
Mercuric Chloride, sat'd solution	60 mL	Preservative for DIC/Alk	Kevin Roe PMEL	M
Nitrogen, compressed	1 tank	For purging samples prior to analysis	PMEL, D Butterfield	G

Hydrogen, compressed	1 tank	For gas chromatography	PMEL, D Butterfield	G
Air, compressed	1 tank	For gas chromatography	PMEL, D Butterfield	G
Helium, compressed	1 tank	For gas chromatography	PMEL, D Butterfield	G
Mercuric Chloride solution	50 mL	Preservative for DIC/Alk	AOML, Ian Enochs	M
Nitrogen, compressed	1 tank	For equipment calibration	AOML, Ian Enochs	G
CO2, compressed	1 tank	For equipment calibration	AOML, Ian Enochs	G
Sodium dodecyl sulfate, 1% SDS in 0.5M NaCl sol’n	~25mL	DNA preservative buffer	AOML, Ian Enochs	NT

Appendix 18: **Section IV.C. Chemical Safety and Spill Response Procedure**

***Spill Control Key**

A: Acids

- Wear appropriate personal protective equipment (PPE) and clothing during clean-up.
- Keep upwind. Keep out of low areas.
- Ventilate closed spaces before entering them.
- Stop the flow of material, if this is without risk. Dike the spilled material, where this is possible.
- **Large Spills**: Dike ahead of spill for containment. Use a non-combustible material like vermiculite, sand or earth to soak up the product and place into a container for later disposal.
- **Small Spills**: Wipe up with absorbent material (e.g. cloth, fleece). Clean surface thoroughly to remove residual contamination.
- Never return spills to original containers for re-use.
- Neutralize spill area and washings with soda ash or lime. Collect in a non-combustible container for disposal.
- J. T. Baker NEUTRASORB® acid neutralizers are recommended for spills of this type.

AL: Alcohols (daily use quantities)

- Extinguish smoking lamp. Remove all sources of ignition.
- Wear appropriate PPE and clothing during clean-up.
- Ventilate closed spaces before entering them.
- Use absorbent socks to surround spills or to divert fluid flow.
- Use vermiculite or kitty litter to soak up and absorb fluid.
- Do not use combustible materials, such as saw dust.
- Use absorbent pads/diapers to wipe up the spill or a dust pan to sweep up vermiculite/kitty litter.
- Place used absorbents in plastic bag or pail.
- Clean surface thoroughly to remove residual contamination.
- Bags containing used absorbents will be properly disposed of once the ship returns to port.

B: Bases

- Wear appropriate PPE and clothing during clean-up.
- Keep upwind. Keep out of low areas.
- Ventilate closed spaces before entering them.
- Stop the flow of material, if this is without risk. Dike the spilled material, where this is possible.
- **Large Spills**: Dike ahead of spill for containment. Use a non-combustible material like vermiculite, sand or earth to soak up the product and place into a container for later disposal.
- **Small Spills**: Wipe up with absorbent material (e.g. cloth, fleece). Clean surface thoroughly to remove residual contamination.

- Never return spills to original containers for re-use.
- Neutralize spill area and washings with product such as Grainger Base Eater Spill Kit. Collect in a non-combustible container for prompt disposal.

F: Fixatives/Formalin/Formaldehyde

- Wear appropriate PPE (gloves, goggles, breathing mask).
- Ventilate area of leak or spill. Remove all sources of ignition.
- Isolate hazard area. Keep unnecessary and unprotected personnel from entering.
- Contain and recover liquid when possible.
- Use non-sparking tools and equipment. Collect liquid in an appropriate container or absorb with an inert material (e.g., vermiculite, kitty litter, absorbent pads), and place in a chemical waste container. A dust pan and plastic bags are available to aid in cleanup and disposal.
- Do not use combustible materials, such as saw dust.

G: Compressed Gases

- Wear appropriate PPE (gloves, goggles, breathing mask).
- Turn off the source of the gas at the regulator if possible.
- Ventilate area of leak. Remove all sources of ignition.
- Isolate hazard area. Keep unnecessary and unprotected personnel from entering.

LN: Liquid Nitrogen

- Wear appropriate PPE (close-toed shoes, cryogloves, goggles, long-sleeved and long-legged clothes are of particular importance).
- Ventilate area.
- Contain spill where safe to do so.
- Nitrogen is more harmful in its liquid state than in its gaseous state, in a well-ventilated area. Minimally handle or interfere with the spilled LN, and allow it to sublimate off after restricting personnel access to the contained spill area under well maintained ventilation.

M: Mercury

- Wear appropriate PPE and clothing during clean-up (a minimum of nitrile gloves and eyewear).
- Stop the flow of fluid by using absorbent material (e.g. cloth, fleece, paper) to dike and soak up the spilled solution.
- Use Mercury Spill Kit if need be.
- Sprinkle area with sulfur or calcium polysulfide to suppress mercury.
- Contaminated area should be wiped with water dampened absorbent material, until one feels the area is sufficiently clean.
- Pick up used absorbents and place in a suitable container for reclamation or disposal in a method that does not generate dust
- If all the $HgCl_2$ solution from a spill is not wiped up, then potential exists for the $HgCl_2$ to come out of solution, and $HgCl_2$ crystals are more problematic (from a health perspective) than $HgCl_2$ in solution.
- All PPE and absorbent material contaminated with $HgCl_2$ should be contained in a zip-top bag labeled “$HgCl_2$ Waste,” kept within the ship’s HAZMAT locker, and properly disposed of once the ship returns to port.

- The concentration of $HgCl_2$ in solution, once mixed with copious amounts of fresh/salt water, will rapidly dilute the concentration of $HgCl_2$ relieving concern for further contamination by effluent, as concentrations will be below environmental toxicity, see MSDS for toxicological information.
- Areas of skin contact should be thoroughly rinsed under fresh/salt water for a minimum of 15 minutes.
- $HgCl_2$ solution contact with eyes/ingestion should be immediately addressed by the ship's doctor, rinse eyes for a minimum of 15 minutes.

NT: Non-toxic

- Wear appropriate PPE and clothing during clean-up.
- Ventilate area.
- Contain spill where safe to do so.
- Absorb liquid with paper towel while wearing gloves; place waste in sealed plastic container until processed on land.

P: Powdered Chlorine Salts

- Wear appropriate PPE (gloves, eyewear, dust mask, etc.) and clothing during clean-up.
- Ventilate area.
- Keep upwind. Avoid inhalation of salts, granules or dust.
- **Large Spills**: Sweep or scoop all spilled material, contaminated soil or other materials and place into clean, dry containers for disposal. Do not close containers containing wet or damp material. If wet or damp, container should be left open in a well-ventilated area to disperse any hazardous gases that may form. Once cleaned, neutralize/flood the spill area with large amounts of water as appropriate.
- **Small Spills**: Sweep or scoop up spilled material and add it to dive gear "disinfectant" rinse tote if available and full of water. If dive gear "disinfectant" rinse tote is not available, dispose of collected material into a clean, dry container. Once cleaned, neutralize/flood spill area with large amounts of water as appropriate.
- Never return spills to original containers for re-use.

PO: Poison

- Wear appropriate PPE (gloves, eyewear, dust mask, etc.) and clothing during clean-up.
- Ventilate area.
- Keep upwind. Avoid inhalation of salts, granules or dust.
- **Small Spills**: Sweep or scoop up spilled material and place in a wide-mouth plastic bottle for disposal on shore. Neutralize/flood spill area with large amounts of water as appropriate.
- Never return spills to original containers for re-use.

SULF: Sodium Sulfide Solution

- Wear appropriate PPE (gloves, eyewear, dust mask, etc.) and clothing during clean-up.
- Ventilate area.

- Keep upwind. Avoid inhalation of vapors.
- **Small Spills**: Neutralize liquid with sodium bicarbonate or acid spill kit. Absorb, sweep or scoop up neutralized material and place in a plastic bag for disposal on shore.
- Clean the area of the spill with water.
- Never return spills to original containers for re-use.

Inventory of Spill Kit Supplies

Product Name	Amount	Chemicals useful against	Amount of clean up possible
Absorbent pads	20	A, AL, F, PO	~4 L
Base Eater	Large Kit	B	~19 L
Dust pan	1 set	A, F, P, PO	n/a
Goggles	1 pair	A, F, G, PO	n/a
Kitty litter	5.4 kg	A, AL,F	~4 L
Nitrile gloves	6 pairs	A, F, PO, SULF	n/a
NEUTRASORB®	3.2 kg	A, SULF	Varies with acid concentration
Plastic bags	5	A, AL, F, P, PO, SULF	~4 L (each)
Vermiculite	2.5 kg	AL, F, NT	~6 L of chemical spilled
Vinyl gloves	20 pairs	A, F, PO, SULF	n/a