UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NOAA Marine and Aviation Operations
Marine Operations Center
439 W. York Street
Norfolk, VA 23510-1114

APR 10, 2015

MEMORANDUM FOR: Captain Robert Kamphaus, NOAA
Commanding Officer, NOAA Ship *Ronald H. Brown*

FROM: Captain Anne K. Lynch, NOAA
Commanding Officer, NOAA Marine Operations Center-Atlantic

SUBJECT: Project Instruction for RB-15-03
P16N CLIVAR/CO2 Repeat Hydro

Attached is the final Project Instruction for RB-15-03, P16 CLIVAR/CO2 Repeat Hydro Survey, which is scheduled aboard NOAA Ship *Ronald H. Brown* during the period of April 10 – June 25, 2015. Of the 72 DAS scheduled for this project, 2 DAS are funded by an OMAO Allocation and 70 DAS are funded by a Line Office Allocation.

This project is estimated to exhibit a High Operational Tempo. Acknowledge receipt of these instructions via e-mail to **OpsMgr.MOA@noaa.gov** at Marine Operations Center-Atlantic.

cc:
Dr. Jessica Cross
Dr. Alison M. Macdonald
Dr. Kathy Tedesco
Dr. Christopher Sabine

U.S. DEPARTMENT OF COMMERCE

National Oceanic and Atmospheric Administration
Pacific Marine Environmental Laboratory
7600 Sand Point Way NE, Seattle, WA 98115

Project Instructions

Date Submitted: March 18, 2015

Platform: NOAA Ship *Ronald H. Brown*

Project Number: RB 15-03

Project Title: P16N CLIVAR/CO2 Repeat Hydro

Project Dates: April 10 – June 25, 2015

Prepared by: [signature] Dated: 19 Mar 2015
Dr. Jessica Cross
P16N Cruise co-coordinator
NOAA/OAR/PMEL

[signature] Dated: 3/18/2015
Dr. Alison M. Macdonald
P16N Cruise co-coordinator
WHOI

Approved by: Kathy Tedesco Dated: 3/20/2015
Dr. Kathy Tedesco
Program Manager
Climate Observation Division of the Climate Program Office
NOAA/OAR

[signature] Dated: 3/18/15
Dr. Christopher Sabine
Director, PMEL

[signature] CO/NOAA Dated: 4/9/15
CAPT Anne Lynch, NOAA
For: Commanding Officer
Marine Operations Center - Atlantic

I. Overview

A. Summary

This project will be a decadal reoccupation of repeat hydrography section P16N jointly funded by NOAA-COD/CPO (Climate Observation Division of the Climate Program Office) and NSF-OCE (National Science Foundation Division of Ocean Sciences) as part of the GO-SHIP (Global Ocean Ship-Based Hydrographic Investigation Program)/CO2/hydrography/tracer program.

Academic institutions and NOAA research laboratories will participate. GO-SHIP focuses on the need to monitor inventories of CO_2, heat and freshwater and their transports in the ocean. Earlier programs under CLIVAR, WOCE and JGOFS have provided a baseline observational field for these parameters. The new measurements will reveal much about the changing patterns on decadal scales. GO-SHIP will serve as a backbone to assess changes in the ocean's biogeochemical cycle in response to natural and/or man-induced activity. Global warming-induced changes in the ocean's transport of heat and freshwater, which could affect the circulation by decreasing or shutting down the thermohaline overturning, can be followed through long-term measurements. The Repeat Hydrography Program provides a robust observational framework to monitor these long-term trends. The goal of the effort is to occupy a set of hydrographic transects with full water column measurements over the global ocean to study physical and hydrographic changes over time. These measurements are in support of:

* Model calibration and validation
* Carbon system studies
* Heat and freshwater storage and flux studies
* Deep and shallow water mass and ventilation studies
* Calibration of autonomous sensors

GO-SHIP will follow the invasion of anthropogenic CO_2, CFCs and other tracers into intermediate and deep water on decadal timescales and determine the variability of the inorganic carbon system, and its relationship to biological and physical processes. More details on the program can be found at: http://ushydro.ucsd.edu/

Near surface seawater (temperature, salinity, pCO_2, ADCP, IOP, Fluorometry) and atmospheric measurements (CO_2, CFCs, aerosols) will be made along the cruise track

B. Days at Sea (DAS)

Of the 72 DAS scheduled for this project, 2 DAS are funded by an OMAO allocation, 70 DAS are funded by a Line Office Allocation (OAR), 0 DAS are Program Funded, and 0 DAS are Other Agency funded. The project is estimated to exhibit a High Operational Tempo.

The days are allocated as follows:

DEP: 4/10/15 Papeete, Tahiti Leg 1
ARR: 5/13/15 Honolulu, HI
DEP: 5/19/15 Honolulu, HI Leg 2
ARR: 6/25/15 Seattle, WA

C. Operating Area (including map)

The P16N cruise will focus on completing a long meridional section through the middle of the North Pacific, nominally along 152˚W from 16˚S to 55˚N. (see Figure 1). This section repeats the P16N section occupied during the World Ocean Circulation Experiment (WOCE) and CLIVAR periods, hence this cruise is designated P16N2015. This is a repeat of the NOAA led cruise in 1998 and 20 06, during which a full suite of inorganic carbon, hydrographic and CFC measurements were performed. Full water column CTD stations will be occupied at 30 nautical mile intervals (with increased resolution in some areas) and include a large variety of physical, chemical and biological parameters. The operating area is in the North Pacific Ocean with a schematics of the cruise track are shown in Figures 1 and 2.

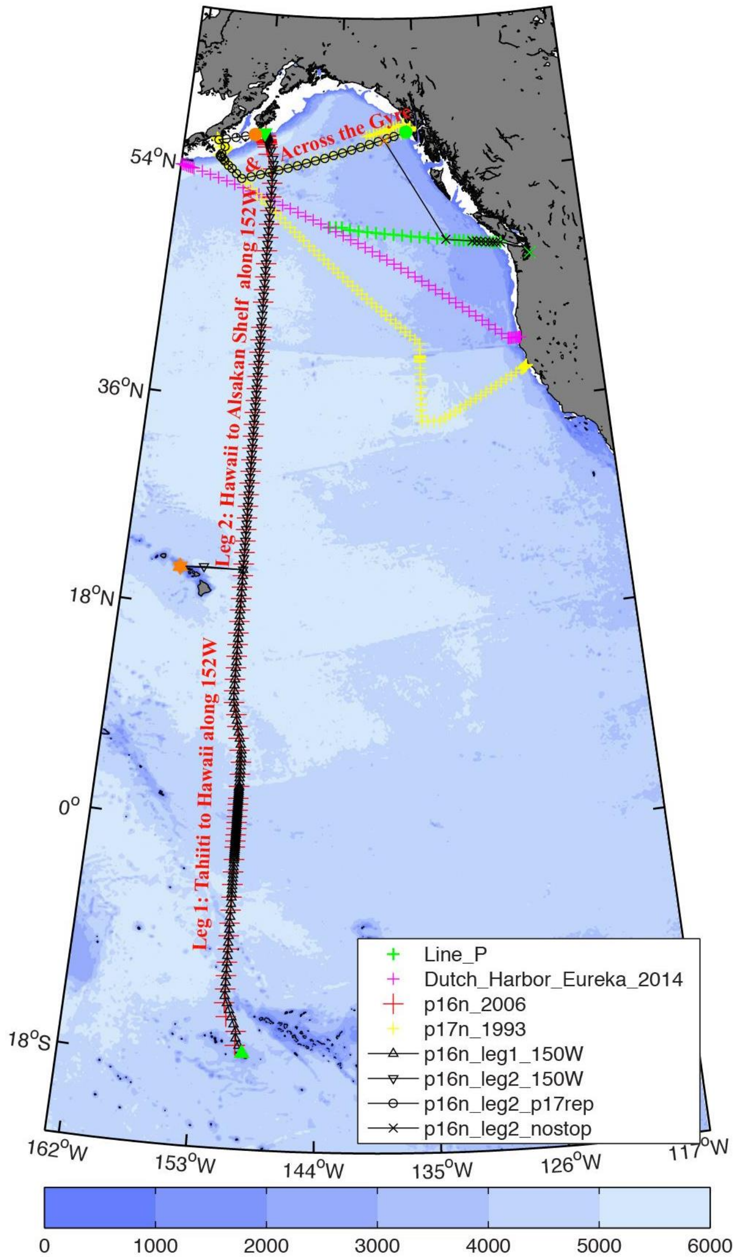

Figure 1: Location of expected stations along the 2015 P16N cruise track (black symbols) overlaid on previous occupations of associated lines including the 2006 CLIVAR P16N (red crosses), the 1993 WOCE P17N (yellow crosses), the multiply repeated Line-P occupied by Fisheries and Oceans Canada (green crosses), the 2014 Dutch Harbor - Eureka line occupied by R/V Point Sur out of Moss Landing Marine Laboratories.. The black line indicated as P16N-leg2-nostop shows the track approximately following the 3000 m isobath, along which underway cesium sampling will be performed. A preliminary cruise schedule is listed in Appendix A, Table 1.

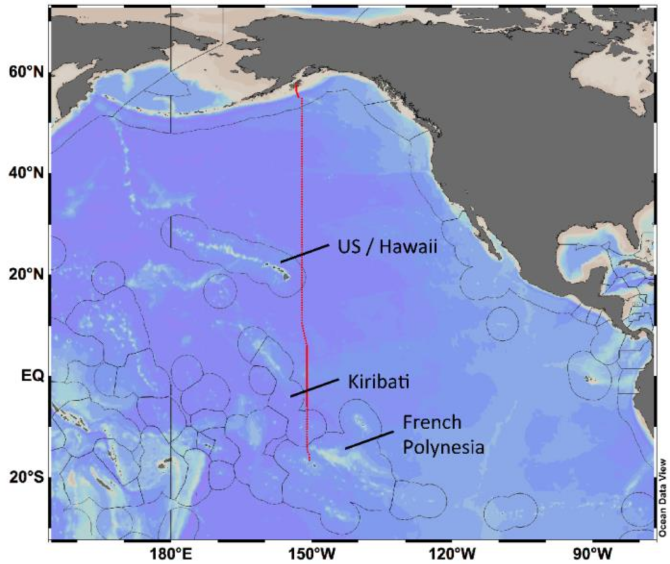

Figure 2: Schematic of the 150W portion of the 2015 P16N cruise track (red) with marine EEZ boundaries are shown in black. This cruise passes through French Polynesia, Kiribati, and US national waters. A preliminary cruise schedule is listed in Appendix A, Table 1.

D. Summary of Objectives

(see Section A)

E. Participating Institutions

a. *Primary:*
United States Department of Commerce
National Oceanic and Atmospheric Administration
Pacific Marine Environmental Laboratory (NOAA/PMEL)
7600 Sand Point Way NE
Seattle, WA 98115 USA
Telephone: 206-526-4314
Facsimile: 206-526-6744

b. *Additional (alphabetical)*

APL	Applied Physics Laboratory
AOML	Atlantic Ocean and Meteorological Laboratory
CCU	Coastal Carolina University
JISAO	Joint Institute for the Study of Atmosphere and Ocean
LDEO	Lamont-Doherty Earth Observatory, Columbia University
UM	University of Michigan
MIT	Massachusetts Institute of Technology
OSU	Oregon State University
Princeton	Princeton University
RSMAS	Rosenstiel School of Marine and Atmospheric Science/University of Miami
SIO	Scripps Institution of Oceanography/University of California at San Diego
SBU	Stony Brook University

WHOI	Woods Hole Oceanographic Institution
UAF	University of Alaska, Fairbanks
UCI	University of California, Irvine
UCSB	University of California, Santa Barbara
UCSD	University of California, San Diego
UM	University of Miami
URI	University of Rhode Island
UW(A)	University of Washington, Seattle
UW(I)	University of Wisconsin, Madison

F. Personnel/Science Party: duty, name (as appears on passport), affiliation, gender, and nationality (U.S. - United State, CA - Canada, MX - Mexico, CN - China, SI - Slovenia, U.K. - United Kingdom, USPR - United States Permanent Resident)

Table 1: LEG 1 Science Party Personnel

Duties	*Name*	*Affiliation*	*Gen.*	*Nationality*
Chief Scientist	*Jessica Cross*	*PMEL*	*F*	*U.S.*
Co-Chief Scientist	*Samantha Siedlecki*	*JISAO*	*F*	*U.S.*
Data Management	*Mary Johnson*	*SIO/ODF*	*F*	*U.S.*
CTD Processing	*Kristene McTaggart*	*PMEL*	*F*	*U.S.*
CTD/Salinity/LADCP/ET	*James Hooper*	*AOML*	*M*	*U.S.*
CTD/Salinity/LADCP/ET	*Andrew Stefanick*	*AOML*	*M*	*U.S.*
CTD Watchstander	*Annie Foppert*	*URI*	*F*	*U.S.*
CTD Watchstander	*Alejandra Sanchez-Franks*	*SBU*	*F*	***CA***
LADCP / SADCP	*Phil Mele*	*LDEO*	*M*	*U.S.*
Dissolved O_2	*Bryan Locher*	*UM*	*M*	*U.S.*
Dissolved O_2	*Samantha Ladewig*	*CCU*	*F*	*U.S.*
Nutrients	*Charles Fischer*	*AOML*	*M*	*U.S.*
Nutrients	*Eric Wisegarver*	*PMEL*	*M*	*U.S.*
DIC/underway pCO_2	*Charles Featherstone*	*AOML*	*M*	*U.S.*
DIC	*Dana Greeley*	*PMEL*	*M*	*U.S.*
CFCs/SF_6	*David Wisegarver*	*PMEL*	*M*	*U.S.*
CFCs/SF_6	*Xing Lu*	*RSMAS*	*F*	***CN***
TALK/pH	*David Cervantes*	*UCSD*	*M*	*U.S.*
TALK/pH	*Britain Richardson*	*UCSD*	*F*	*U.S.*

TALK/pH	*Michael Fong*	*UCSD*	*M*	*U.S.*
Helium/Tritium	*Zoe Sandwith*	*WHOI*	*F*	***CA***
CDOM	*Norm Nelson*	*UCSB*	*M*	*U.S.*
CDOM	*James Allen*	*UCSB*	*M*	*U.S.*
Chipod	*Miguel Jimenez Urias*	*UW*	*M*	***MX***
UVP	*Andrew McDonnell*	*UAF*	*M*	*U.S.*
$DO^{14}C$, black carbon	*Sheila Griffin*	*UCI*	*F*	*U.S.*
DOC/TON	*Anai Novoa*	*USD*	*F*	*U.S.*

Table 2: LEG 2 Science Party Personnel

Duties	*Name*	*Affiliation*	*Gen.*	*Nationality*
Chief Scientist	*Alison Macdonald*	*WHOI*	*F*	***U.K.^{USPR}***
Co-Chief Scientist	*Sabine Mecking*	*APL/UW*	*F*	*U.S.*
Data Management	*Mary Johnson*	*SIO/ODF*	*F*	*U.S.*
CTD Processing	*James Hooper*	*AOML*	*M*	*U.S.*
CTD/Salinity/LADCP/ET	*Ed Hunt*	*CIMAS*	*M*	*U.S.*
CTD/Salinity/LADCP/ET	*Andrew Stefanick*	*AOML*	*M*	*U.S.*
CTD Watchstander	*Andrew Shao*	*UW(A)*	*M*	*U.S.*
CTD Watchstander	*Amanda Fay*	*UW(I)*	*F*	*U.S.*
ADCP/LADCP	*Darren McKee*	*LDEO*	*M*	*U.S.*
Dissolved O_2	*Christopher Langdon*	*RSMAS*	*M*	*U.S.*
Dissolved O_2	*Maria Arroyo*	*UM*	*F*	*U.S.*
Nutrients	*Charles Fischer*	*AOML*	*M*	*U.S.*
Nutrients	*Eric Wisegarver*	*PMEL*	*M*	*U.S.*
DIC/underway pCO_2	*Robert Castle*	*AOML*	*M*	*U.S.*
DIC	*Brendan Carter*	*JISAO*	*M*	*U.S.*
CFCs/SF_6	*Dave Wisegarver*	*PMEL*	*M*	*U.S.*
CFCs/SF_6	*Sophia Wensman*	*UM*	*F*	*U.S.*

TALK/pH	*August Pereira*	*UCSD/SIO*	*M*	*U.S.*
TALK/pH	*David Cervantes*	*UCSD*	*M*	*U.S.*
TALK/pH	*Michael Fong*	*UCSD*	*M*	*U.S.*
Helium/Tritium	*Zoe Sandwith*	*WHOI*	*F*	***CA***
CDOM (Engineer)	*Erik Stassinos*	*UCSB*	*M*	*U.S.*
CDOM (grad stud)	*Kelsey Bisson*	*UCSB*	*F*	*U.S.*
UVP	*Jessica Turner*	*UAF*	*F*	*U.S.*
Chipod	*Bryan Kaiser*	*WHOI/MIT*	*M*	*U.S.*
DOC/TON	*Ben Granzow*	*UM*	*M*	*U.S.*
Cesium	*Steven Pike*	*WHOI*	*M*	*U.S.*
$DO^{14}C$, $DI^{14}C$,	*Brett Walker*	*UCI*	*M*	*U.S.*

G. Administrative

1. Points of Contact

Chief Scientist, Leg 1:

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Chief Scientist, Leg 2:

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amacdonald@whoi.edu

Co-Chief Scientist, Leg 1:

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Shipping agent Tahiti:	Mae Chu, Coordinator Global Logistics mae@globallogisticsshipping.com
Shipping agent Honolulu:	NOAA Marine Operations Center
Shipping agent Seattle:	NOAA Marine Operations Center

Project Operation Leads:

Data to be collected:	*Lead PI(s) :*
CTD:	Greg Johnson - PMEL; Molly Baringer - AOML
Salinity:	Molly Baringer - AOML
LADCP:	Andreas Thurnherr -LDEO
Dissolved Oxygen:	Chris Langdon - RSMAS
Nutrients:	Calvin Mordy - PMEL
CFCs/SF_6:	John Bullister – PMEL
Total CO_2(DIC):	Simone Alin - PMEL; Rik Wanninkhof - AOML
Total Alkalinity/pH:	Andrew Dickson - SIO
Inorganic Carbon Isotopes:	Ann McNichol-WHOI; Robert Key- Princeton
Organic Carbon Isotopes:	Ellen Druffel - UCI
DOM:	Craig Carlson, UCSB; Dennis Hansell, RSMAS
Helium/Tritium:	William Jenkins - WHOI
Oxygen Isotopes:	John Bullister - PMEL
Floats:	Greg Johnson - PMEL
Transmissometry:	Wilf Gardner - TAMU
Fluorometry/CDOM:	Norm Nelson - UCSB
Chipods:	Jonathan Nash – OSU
UVP:	Andrew McDonnell – UAF
Pterodpods:	Nina Bednarsek - UW
Bathymetry:	Ship personnel

Underway TSG:	Ship personnel
Dissolved Cesium:	Ken Buesseler – WHOI

2. Diplomatic Clearances

This project involves Marine Scientific Research in waters under the jurisdiction of French Polynesia, Kiribati, and the USA. Diplomatic clearance has been requested via the RATS system through Wendy Bradfield-Smith.

3. Licenses and Permits

None

II. Operations

The Chief Scientist is responsible for ensuring the scientific staff are trained in planned operations and are knowledgeable of project objectives and priorities. The Commanding Officer is responsible for ensuring all operations conform to the ship's accepted practices and procedures.

A. Project Itinerary

The P16N 2015 expedition is scheduled for 2 legs: RB-15-05 (Leg 1), and RB-15-05 (Leg 2) on RHB. Estimated transit times and station locations are provided in Table 1 of Appendix A.

Leg RB-15-05 (Leg 1): Papeete, Tahiti – Honolulu, Hawaii

After departing Papeete, the vessel will steam to the start of the P16N 2015 section (connecting with the northernmost occupation on the previous 2014 P16S transect) and begin a series of full water column stations. On most casts the CTD/rosette will be lowered to within 10 meters of the bottom. The first station will be at a depth of 200-500m. The vessel will move northward, occupying a series of closely spaced stations approximately 30 nautical miles apart. Approaching the equator (6°S to 3°S), 20 nautical mile station spacing will be used. Crossing the equator (3°S to 3°N), station spacing will be approximately 10 nm. Between 3°N and 6°N, station spacing will widen to 20 nautical miles and then the nominal 30 nautical will resume.

We anticipate ending Leg 1 at ~22.5°N 152°W to minimize the transit time from the line to Honolulu. If the cruise is ahead of schedule we will continue taking CTDs along the track proposed for P16N Leg 2 and then backtrack to Honolulu. Some scientific personnel will be exchanged in Honolulu (see personnel list). One group (cesium) will not send a participant for Leg 1, but will have a technician on board to collect water samples on Leg 2. Some scientific gear and spares will be on- and off-loaded by various groups.

Water samples will be collected with a 24 position, ten-liter CTD/rosette system from PMEL. Two backup rosette systems will also be available. These include a second 24 position, 10-liter rosette from PMEL and RHB's CTD/rosette package [12 position, 10 liter].

Leg RB-15-05 (Leg 2): Honolulu to Seattle

At the completion of the port stop, the ship will steam back to the section and continue the line northward as on the previous leg with nominal 30 nautical mile station spacing. On approach to the Alaska Shelf, closer station spacing will be used over the rising bathymetry and the track will be aligned perpendicular to the bathymetric gradient so that the first shelf station is observed at approximately 56.4°N 153.3°W. Once on the shelf, 20 nautical mile spacing will be used on the steam to the start of stations repeating those of the 1993 P17N survey (at ~158.5W). These shallow stations are particularly important to the observation of anthropogenic CO_2 accumulation. Closer spacing will be used coming off the shelf into deep water. Once the bathymetry levels out (~53.1°N 155.6°W), 40 nautical mile spacing will be used to cross the Alaska Gyre to ~ 136W with higher station resolution over the slope. On the final leg to Seattle, the ship will steam west to approximately 138.7W before steaming southward to 131.7W where it will follow the track of Line-P into the coast. No stations will be performed on this final section, however underway samples will be taken for the cesium group. If this leg is completed ahead of schedule, we plan to improve the station spacing across the Alaska Gyre to 30 nautical miles. At the completion of the section work, the ship will steam to port in Seattle. We anticipate that the vans and stowed scientific gear will be offloaded after RHB arrives in Seattle after P16N Leg 2.

As on Leg 1, water samples will be collected with a 24 position, ten-liter CTD/rosette system from PMEL. Two backup rosette systems will also be available. These include a second 24 position, 10-liter rosette from PMEL and RHB's CTD/rosette package [12 position, 10 liter].

B. Staging and Destaging

Staging of laboratory vans and ARGO floats for the cruise will be conducted in San Diego during a previous port call. We request access to the ship starting on February 20 for loading and equipment set-up. We plan to send four 20-foot lab containers to the ship: a 20-foot container for DIC analyses, a 20-foot container for CFC analyses containing some equipment for nutrient analyses and the secondary CTD package, a 20-ft storage container for He/Tr, and a 20-foot container containing the primary CTD/rosette package. They will be loaded with a shore-based crane. In conjunction with the previous cruise, the Argo program will be loading 24 floats in San Diego. 9 of these will be deployed during the transit from San Diego to Tahiti, with the remaining 15 to be deployed during the two legs of P16N. This can be loaded with the onboard crane. Scientific personnel will be present in Tahiti for these operations.

The DIC, CFC, and CTD vans will contain some hazardous materials and compressed gases. These will be packaged according to DOT and IATA regulations, and can be stored in the containers between San Diego and Tahiti. Some additional hazardous materials will be shipped directly to RHB for storage in the RHB Hazmat locker between San Diego and Tahiti.

In Tahiti, the vans stored during the transit between San Diego and Tahiti will be moved to workable laboratory spaces, requiring a shore-based crane. Additionally, we will load some palletized equipment, large deck boxes, and large freezers. These can be loaded with the on-board crane.

In Tahiti, we will require the assistance of the shipboard ET and Survey Technician for 8 hours on each of four-days prior to sailing and 8 hours the day before sailing to help install computer systems, terminations for the CTD and other science equipment. Laboratory vans for use during P16N should be repositioned on the ship as soon as practical after arrival into Tahiti and connected to power and remained powered for the duration of the cruise.

Limited staging and destaging will occur in Honolulu, requiring only the onboard crane. Loading will include at 2 freezers and 9 deck boxes (4x4x4) of empty plastic sampling container. Because of difficulties in shipping and storing scientific equipment from Hawaii, we anticipate most staging will occur in San Diego or Tahiti, and most destaging will occur in Seattle. All scientific equipment, vans, and hazardous materials used during Leg 2 or remaining from Leg 1 will be offloaded in Seattle. The vans will require a shore-based crane. Palletized scientific equipment will be offloaded with the onboard crane. The scientific party will prepare all documentation and shipping arrangements.

A list of all equipment to be brought aboard is shown in the FACILITIES section of the Project Instructions and in Appendix B.

C. Operations to be conducted

The preliminary personnel task assignments (ship's or scientific personnel) are indicated with each operation. The Chief Scientist and the Commanding Officer will determine final responsibilities. Note that in addition to these standard operations associated with CLIVAR, supplementary projects will also be conducted, including some operations not listed in this section (please is supplementary materials). This includes net tows for zooplankton speciation; and extra casts for cesium sampling along Leg 2. An abbreviated list of the core operations is given in Table 3 below, with extended descriptions following:

Table 3. Abbreviated list of core operations to be conducted.

a	Full water column CTD / Rosette Casts (Ship's and Scientific Personnel)		
	i	Profiling LADCP	Scientific Personnel
	ii	Transmissometer	Scientific Personnel
	iii	Altimeter	Ship's and scientific personnel
	iv	UVP	see supp. projects section
	v	Chipods	see supp. projects section
	vi	Fluorometer	see supp. projects section
b	Sampling of the rosette bottles		Scientific Personnel
	i	Salinity sampling and analysis	Scientific Personnel
	ii	Oxygen and nutrient sampling and analysis	Scientific Personnel

	iii	CFC, SF_6, sampling and analysis	Scientific Personnel
	iv	He / Tr sampling and analysis	Scientific Personnel
	v	DIC sampling and analysis	Scientific Personnel
	vi	TALK and pH sampling and analysis	Scientific Personnel
	vii	Inorganic carbon isotopes ($DI^{14}C$)	Scientific Personnel
	viii	Organic carbon isotopes ($DO^{14}C$) and black carbon	Scientific Personnel
	ix	DOC and TON	Scientific Personnel
	x	CDOM, POC, Chl	Scientific Personnel
c	Profiling Spectroradiometer		Ship's and scientific personnel
d	Float deployment		Ship's and scientific personnel
e	Navigation		Ship's personnel
f	Underway sampling operations		Scientific Personnel
	i	HPLC and AP	Scientific Personnel
	ii	Automated sea surface temperature and salinity	Ship's personnel
	iii	ADCP underway operations	Ship's and scientific personnel
	iv	Weather observations	Ship's personnel
	v	Seabeam and PDR	Ship's personnel
	vi	Underway air measurements	Scientific personnel

a. Full water column CTD/Rosette Casts (Ship's and scientific personnel)

It is of utmost importance to the success of the expedition that the ship be able to hold position at all times during the CTD casts, and that the CTD winch, meter wheel, hydraulic frame, conducting cable and backups function flawlessly during this expedition. Both primary and secondary winches must contain full lengths (10,000 m) of CTD conducting cable in good condition. Skilled ship personnel and adequate spare parts must be available on all legs to assure that this equipment is maintained in good working order. The ship's personnel must be skilled in CTD wire re-terminations, and adequate supplies of materials for CTD wire re-terminations must be available. Since typical steaming time between stations is less than 3 hours, re-terminations of the conducting cable (when required) must be completed within 2-3 hours.

The CTD/rosette system will be deployed off the starboard side. During recovery, the CTD/rosette package will be lowered onto a cart and rail system provided by the ship that will be tugged into the staging bay. The air winch used for tugging will be provided by PMEL. We request the ship's assistance to mount it up on a wall away from the rosette package to avoid water damage while sampling. A 24-position rosette system (AOML) with 10 liter bottles will be used for CTD/rosette casts. A secondary 24-position rosette with 10 liter water bottles will be available (PMEL system), with the RHB CTD system to be available as a tertiary system if necessary. The second package must be secured in a readily accessible area, and will be switched when required. A pinger and altimeter will be mounted on the rosette systems and used during casts to monitor distance from the bottom. We anticipate that during most casts, the CTD/rosette will be lowered within about 10 meters of the bottom. The ship's center beam of the SeaBeam system and/or the PDR must be working properly to aid this goal.

Two working winches with 7000+ meters 0.322" conducting cable in good shape (at least one new would be best) will be required for deployment of the CTD. The winch, wire and meter wheel for both winches must be capable of routinely making 6000 meter casts with these rosette systems. PMEL and AOML are sending CTD watch leaders on Legs 1 & 2 to perform CTD data collection, processing and quality control. CTD watch leaders will assign science party members to monitor CTD casts. During the casts, if needed and available, ship's personnel will assist the CTD operators monitoring of the bathymetric recorder and pinger signal and to properly assess the distance of the rosette package off the bottom. The ship's electronics technician will share responsibility with the scientific party for maintaining good electrical and mechanical connections between the CTD/rosette system, the conducting cable and winch slip-rings, and to the deck unit for the CTD/rosette system.

The ship's personnel will be responsible for the deployment and recovery of the CTD/rosette (both for regular casts and for cesium sampling) with assistance of scientific personnel during deployment and recovery (see Tables 1 & 2 above). A number of members of the scientific party have experience with CTD deployments and will be available to assist with these operations. Members of the scientific party will be responsible for collecting the water samples from the rosette. Members of the scientific party will also be responsible to collect oxygen, nutrient, salinity and isotope samples and recording sample ID's. Particular care must be taken in the collection and analysis of water samples to assure that all properties are measured with the greatest accuracy possible. The Chief/Co-Chief scientists and CTD data processor in collaboration with the individual science teams will monitor the preliminary data measurements to ensure the highest possible quality. Many of the chemical measurements are sensitive to contamination from smoke, soot, oils, solvents, spray cleaners, lubricants, paints, hydraulic fluid, ospho (rust treatment) and other substances. The Chief Scientist must be notified prior to the use of these substances. Care must be taken to avoid contamination of the rosette system with these substances. Smoking is prohibited in the area around the rosettes during sampling and at all times in the laboratories and in and near the staging bay. Please use caution with spray cans especially near the sampling area as these could contain halogenated compounds capable of contaminating the CFC measurements.

Discharges from holding tanks must be secured 20 minutes before arriving on station. The tanks may be pumped when the cast is at depth (>200 meters). Discharges must again be secured 20 minutes before the CTD/rosette returns to the surface layer. The bridge must inform the ship's engineers in advance when discharges are to be secured.

The collection of CTD data relies on using the ship's CTD workstation in the computer room, consisting of a desktop computer with a recent version of Sea-Bird acquisition and processing software installed, one (preferably two) monitors, and Sea-Bird V2 deck unit (and spare) with a NMEA data feed that allows position data to be merged with CTD data. The NMEA interface is designed to decode messages that are output from ship's navigation devices supporting NMEA protocol. The deck unit automatically decodes the messages and appends latitude and longitude to the CTD data stream that is passed to the computer for storage and real-time display with the CTD data. The NMEA interface is setup and maintained by the ship.

i. Profiling LADCP (Scientific personnel)

A lowered ADCP (LADCP) system will be used on the casts. It consists of a downward-looking 150kHz ADCP and an upward-looking 300kHz ADCP, a battery pressure case, a pressure case containing an incidental measurement package (IMP) to obtain better pitch/roll/heading data, as well as cables connecting the components, which should be mounted in the inner part of the rosette. The instrument system can be used to a depth of 6000 m. While on deck, the LADCP system is connected to a battery charger and a data acquisition computer, installed on a dry workbench; if at all possible, cable runs should be kept shorter than 50 feet.

Both the ADCPs and the IMP should be turned on a few (not longer than 15) minutes prior to the launch of the CTD/rosette package. The ADCPs are turned on using the data acquisitions computer and the IMP is powered on by connecting it to the rosette-mounted battery cable. After each CTD station, about 30 minutes are required to transfer the ADCP data from the instruments and to re-charge the batteries, before the system can be turned off. Data downloading from the IMP is done wirelessly using a tablet computer and takes just a few minutes. If Alkaline batteries are used, the battery pressure case must be opened to swap batteries approximately every 90 hours of operations (18 deep casts). Any of the hardware may have to be removed for diagnostics and/or repairs between casts.

For processing LADCP profiles, 5Hz (0.2s interval) CTD files with the following information are required: scan number, pressure, temperature (in situ), salinity or conductivity, latitude and longitude. If it is not possible to co-record GPS with the CTD data (via a GPS feed to the CTD deck box), operators must ensure that the CTD and ADCP clocks are kept accurate to within 1s throughout the cruise. (Note: 5Hz, rather than the more usual 1Hz CTD time-series files are required for calculating vertical velocity from LADCP data.)

ii. Transmissometer (Scientific personnel)
iii. Altimeter (Ship's and scientific personnel)
iv. UVP (see supplementary projects section)
v. Chipods (see supplementary projects section)
vi. Fluorometer (see supplementary projects section)

b. Sampling of the rosette bottles (Scientific personnel)

The usual order for drawing seawater samples on deck will be: CFCs, Helium, oxygen, DIC, pH, TALK, $DI^{14}C$, DOC, TON, $DO^{14}C$, CDOM, POC, Chl, nutrients, salinity, Tritium, Cs, black carbon.

i . Salinity sampling and analysis (Scientific personnel):

Scientific personnel will analyze salinity samples. Two salinity samples will be drawn from the deepest bottle at each station to monitor the precision of the sampling/analysis procedures. Salinity samples will be run using RHB's Guild line 8600B Autosal instrument that is calibrated in coordination with AOML, complete with computer interface and laptop computer. A backup salinometer must be provided by the ship. The salinometers must be checked for accuracy and precision during the import before the start of the expedition and the tests will determine which unit will be the primary one. Salinity samples will be analyzed in the salinity lab off the main oceanographic laboratory, and variations in laboratory temperature must not exceed 1°C during a 24 hour period. The salinity samples will also be stored in this temperature controlled area for at least 8 hours to allow them to come to ambient temperature. The Autosal will be standardized at least once each run with new vials of standard seawater. Standard seawater will be provided by the scientific personnel for use on this cruise, and one vial will be analyzed per day. To maintain the required accuracy, it is advisable to have one person run all salinity samples. We anticipate ~140-160 samples/day. An accuracy of 0.003 PSS-78 or better is required, and will be monitored by scientific personnel by comparison with CTD and historical data. To assure timely detection of any problems with the CTD system or Autosal, salinity analyses should be completed within 36 hours of sampling and submitted to the CTD operators. Any problems with the Autosal should be reported immediately to the Chief Scientist.

ii. Oxygen and nutrient sampling and analysis (Scientific personnel)

Samples will be collected for oxygen and nutrient analysis from each sample bottle at all stations. Nutrients will be run on board ship by members of the scientific party. Refrigerator space will be required near the bio-analytical lab for nutrient sample storage prior to analysis. Nutrient measurements will be made using a Seal AA3 system. Dissolved oxygen samples will be run in the hydro lab or the main lab by members of the scientific party.

iii. *CFC ('Freon'), SF_6 and ^{18}O sampling and analysis (Scientific personnel)*

Water samples will be drawn for CFC and SF_6 analyses at most stations. CFC/SF_6 samples must be drawn first, ahead of the helium and oxygen samples. The chief scientist should be notified prior to any service or maintenance of the air-conditioning system and of any discharge or leakage of CFCs or solvents on the ship. Atmospheric sampling for CFCs will be conducted while underway and on station only when the wind is forward of the beam. Air inlet cups will be mounted on the foredeck mast for collecting uncontaminated marine air. Air sampling lines (3/8" plastic tubing) will run from these inlets into the laboratory and laboratory vans.

iv. *Helium/Tritium sampling and analysis (Scientific Personnel)*

Helium samples will be drawn at selected stations into cold welded copper tubing and stored. Due to the risk of contamination, no luminous dial watches (that is, watches dials that glow in the dark and generally contain tritiated compounds) may be used on board the ship during this expedition. The chief scientist, Bill Jenkins (WHOI) and the representative for this group must be notified of any proposed use of helium gas on board ship during this expedition.

Tritium samples will be drawn at selected stations and stored separately.

v. *Dissolved inorganic carbon (DIC) sampling and analysis, (Scientific personnel)*

The chemistry groups from PMEL and AOML will make the DIC measurements at the hydrocast stations. DIC samples will be collected from the 10-L Niskin bottles into 300 ml glass-stoppered bottles containing 0.12 mL of a 50% saturated solution of $HgCl_2$ to retard bacterial oxidation of organic matter prior to analysis. DIC samples will be measured by the coulometric titration method and will be done in a laboratory van.

vi. *Total Alkalinity (TALK) and pH sampling and analysis (Scientific personnel)*

The CO_2 chemistry group from SIO will make the pH and TALK measurements at the hydrocast stations. TALK samples will be measured by an acidimetric titration method; pH will be measured at constant temperature (25 °C) using a pH indicator dye (m-cresol purple) in a spectrophotometer. The expected water budget for these samples (including rinsing, etc.) is: TALK ~400 mL; pH ~ 600 mL, *i.e.* 1 L in all.

vii. Inorganic Carbon Isotopes (Scientific Personnel)

The radiocarbon content of seawater dissolved inorganic carbon ($DI^{14}C$) is measured by extracting the inorganic carbon as CO_2 gas, converting the gas to graphite, and counting the number of ^{14}C atoms in the sample directly using an accelerator mass spectrometer. Samples will be drawn from the CTD, processed, and stored in a climate controlled space. Due to concerns about sample contamination, laboratory spaces will be tested for previous spills or existing contaminants prior to the cruise dates, likely in San Diego.

viii. Organic carbon isotopes and black carbon sampling and analysis (Scientific personnel)

Samples will be collected from 3 stations on each leg for two sample types ($DO^{14}C$ and BC). Samples are drawn directly from Niskin bottles and filtered through GF/F filters held inside a filter holder.

For $DO^{14}C$, samples will be collected from 14 Niskin bottles at each station; 1.3 L per Niskin (including rinses). For BC, samples will be collected from 2 depths (~20 m and ~2000 m) at each station (or within 4 nearby stations and combine water); 13 L (including rinses) for ~20 m depth and 25 L (including rinses) for ~2000 m depth.

Sampling will be conducted in conjunction with $DI^{14}C$ (McNichol/Key, as in (*vii*) above), DOC (Carlson/Hansell, as in (*ix*) below) and DIC and TA samples are collected (as in (*v*) and (*vi*) above, respectively).

Due to concern about sampling contamination with ^{14}C and tritium, several precautions will be taken. In order to detect potential pre-existing contamination problems, laboratory spaces will need to be tested prior to the cruise dates, likely in San Diego. During the cruise, the work areas designated for this sampling (~5 linear ft of bench space) will be thoroughly cleaned and covered with ^{14}C free plastic. After processing, samples will be stored in clean -20 °C chest freezers provided by the scientists.

ix. Dissolved organic carbon (DOC) and Total Dissolved Nitrogen (TON) (Scientific personnel)

DOC and TON will be sampled from each Niskin on approximately every other station, in conjunction with full profiles of DIC as in (*v*) above. Samples are drawn directly from Niskin bottle through an inline filter holding a GF/F filter and the filtrate is collected into 60 ml sample bottles. The water budget for these samples is ~100 ml including rinses. DOC sampling occurs directly after gas sampling to avoid organic contamination from spigot handling.

Samples will be stored in a -20 °C Freezer. Note that these samples cannot be stored in conjunction with any chlorophyll samples taken by Nelson as in (*x*) below. Leg 1 Samples will be offloaded in HI.

x. *CDOM, HPLC, AP, POC, Chl sampling and analysis (Scientific personnel):*

Our stocks and characterization observations need to be made over the full depth range sampled, achieving fair resolution over the euphotic zone. This corresponds to 24-36 samples on a given cast. The water needs for routine DOM and CDOM profiling are small. Other measurements described below are aimed at characterizing the DOM pools and providing support for ocean color work that NASA is interested in.

CDOM (CDOM absorption and fluorescence spectra): 1 profile per day, up to 36 samples per profile, 100 ml per sample, one sample per bottle. This is similar to our collection on A16N. Will be analyzed at sea using Barnstead NanoPure UV water standard (we'll bring our system). Profile should one which arrives on deck between 1000 and 1400 hours to match with satellite overpasses.

Chl (fluorometric chlorophyll concentration): 1 profile per day, 8 – 10 depths in upper 200m, 300 ml per sample. Need fume hood for extractions and -20 °C freezer for extracted samples (must be separate from DOM storage for Carlson as in (*ix*) above.) Same cast as CDOM.

POC (particulate organic carbon): One limited profile (4 depths, 2L each depth) on non-Carbon casts for POC analysis to calibrate Wilf Gardner transmissometer. Stored in liquid N_2, analyzed on land.

We will require 15-30 min per day while sun is high to conduct a profiling spectroradiometer cast as in (c) below.

c. Profiling spectroradiometer (Ship's and scientific personnel)

Profiling spectroradiometer (Biospherical C-OPS): Deployment by hand once per day during high-sun hours (between 0900 and 1600 local works). Can perform when CTD arrives on deck while gas sampling is underway.

- < 30 minutes start to finish
- Surface to ~100 m free fall, kited away from ship to avoid ship shadow
- Will need access to fantail from main lab
- Need communication means for computer/cable handlers and to bridge (handheld preferred)
- Need to place reference radiometer somewhere unobstructed by the ship's superstructure and preferably near the stern

d. Float deployment (Ship and scientific personnel):

Argo floats will be released during this expedition. The Chief Scientist will coordinate this program. These floats may need to be unpacked prior to deployment, preferably while the CTD is in the water. Floats will be deployed at designated stations immediately following completion of the final cast at each designated station, just before the ship gets well underway. Deployment involves lowering the ~20 kg float by hand into the water from the stern of the ship, with the ship slowly steaming ahead at about 1 to 2 kts. One or two persons from the ship and scientific party will be required for preparation and deployment. Shortly after deployments the following information should be e-mailed to PMEL_Floats@noaa.gov:

Float serial number
Deployment date and time (GMT)
Deployment latitude and longitude
Ship name
Deployer name(s)
Station number for the closest CTD
Any comments (problems with deployment, etc)

e. Navigation (Ship's personnel)

Navigation shall be based on the best available information including GPS, radar and visual. When GPS control is available, it is the preferred navigation method. It is important that accurate speed and course information be used in satellite position computation. At least one GPS P-code receiver and one Seapath 3DF GPS unit must be functional and integrated with the ship's SCS system for ADCP and LADCP measurements.

The station locations listed in Appendix A are nominal positions and some drift during CTD/rosette casts is acceptable to maintain wire angle. In most cases, starting station positions along the section should be within 1-2 nautical miles of the listed position. Navigation information will be recorded on the MOA form. In addition to satellite fixes and other events as they occur, MOA entries shall be made at least once every four hours, and at the time of each course and speed change when the ship is en route between stations (including slowdowns on arrival at the station and speedups on departure).

The numerical MOA entries will suffice for scientific purposes; a cruise plot is not required in the cruise data package. Since copies of the MOA forms will be made and used by various cruise participants, it is important that the entries be checked and made clearly and dark enough for reproduction.

f. Underway Sampling operations

Underway measurements will be made along the entire cruise track. The ship's seawater line including all branches of the lines to laboratories should be flushed with fresh water and cleaned with bleach prior to departure from Papeete for Leg 1 and Honolulu for Leg 2.

i. Phytoplankton pigments and particulate absorption:

HPLC (phytoplankton pigments): 1 surface sample per day (1 – 4L depending on chlorophyll levels). Stored in liquid N_2, analyzed on land. We will use 'clean' underway seawater system to collect samples concurrently with CTD cast.

AP (particulate absorption spectra): 1 surface sample per day (4L). Stored in liquid N_2, analyzed on land. We will use 'clean' underway seawater system to collect samples concurrently with CTD cast.

ii. *Automated Sea surface temperature and salinity (Ship's personnel):*

Sea surface temperature and salinity will be recorded continuously with a system accurate to within 0.02°C and 0.1 PSS-78. A copy of the calibration data will be provided to the Chief Scientist. The thermosalinograph should be calibrated no more than 3 months before the start of the cruise.

iii. *ADCP underway operations (Ship's and scientific personnel):*

Data from the ship's ADCP system will be logged continuously while underway.

iv. *Weather observations (Ship's personnel):*

Observations must be done at each station, and at regular intervals while underway.

v. *Seabeam and PDR (Ship's personnel):*

While underway, in place of annotation of the bathymetric (PDR) chart record, Sea Beam (center beam) will be operated to obtain a continuous record of time, position and bottom depth. During CTD stations, the PDR will be required for bottom detection.

vi. *Underway air measurements (*Scientific personnel):
Atmospheric sampling for CFCs will be conducted while underway and on station only when the wind is forward of the beam. Air inlet cups will be mounted on the foredeck mast for collecting uncontaminated marine air. Air sampling lines (3/8" plastic tubing) will run from these inlets into the laboratory and laboratory vans.

D. Dive Plan

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.

Dives are not planned for this project.

E. Applicable Restrictions

See Appendix A for mitigation strategies to deal with delays.

III. Equipment

A. Equipment and Capabilities provided by the ship (itemized)

The following communications devices are currently on board RHB and are expected to be in working order. The chief scientist should be apprised at earliest possibility of malfunction of equipment.

a. High Frequency SSB (SEA 330): SEA Inc. 300-watt high frequency transceiver. The transceiver covers a frequency range from 1.6 to 29.9 MHz
b. Furuno Global Maritime Distress and Safety System (GMDSS)
c. Satellite communication system (INMARSAT -A, -B, -M)
d. Five fixed VHF radios with eight channels pre programmed with a selection of marine band and NOAA frequencies.
e. Cell phones

The electronic instrumentation used for navigation includes:

f. Furuno Navigator GP-150 GPS
g. Applanix POSMV GPS
h. Furuno GP-90 GPS
i. Meridian Commercial Gyro Compass SG Brown
j. Two Furuno FAR 2xx7 Series Marine RADAR(S-band (10 cm) 30 kW radar and an X-band (3 cm) 25 kW radar)
k. Kongsberg K-POS Dynamic Positioning System
l. Raytheon model DSN-450 Doppler Speed/distance log
m. NAVTEX receiving and printing the international automated medium frequency (518 KHz) weather warnings
n. Weather maps: Medium frequency/high frequency

Ship's scientific equipment:

o. Echo Sounder (Ocean Data Equipment Corporation (ODEC) Bathy 2000 or the Knudsen system) used in 12 kHz mode to be used while on CTD station. This will be resolved with CST and ETs prior to cruise
p. Continuous EM122 multibeam swath bathymetric sonar system sampling while underway between stations.
q. Barometer
r. WOCE IMET sensors
s. Hydrographic Winch system and readouts (using 10 km of 0.322 conducting capable for CTD operations).
t. One backup hydrographic winch system for CTD operations with 10 km of 0.322 conducting cable.
u. Hull mounted acoustic Doppler current profiler (RD Instruments (RDI), 75 kHz Ocean Surveyor acoustic Doppler current profiler) with gyro input.
v. MAHRS gyro system for acquisition of heading data used by acoustic Doppler current profiler.
w. Seapath GPS system for acquisition of heading data for testing the new MAHRS system.

B. Equipment and Capabilities provided by the scientists (itemized)

Four container vans will be loaded aboard RHB for this cruise. Three of these containers will act as laboratory vans, and must be accessible at all times throughout the expedition. Compressed gas (non-flammable) cylinders will be used in ship's laboratories and laboratory vans.

Extensive instrumentation to measure a variety of biogeochemical parameters in ocean water and atmosphere will be deployed during the cruise as detailed in Appendix B. In addition to the suite of oceanographic and meteorological instruments on board RHB, the science party will bring the following instruments and materials on board (in addition see Appendix B for full specifications):

a. Two 24 position rosette sampling with 10 liter water sampling bottles and spare parts.
b. Complete CTD recording and processing system including 2 Sea-Bird CTDs, 2 deck units (to be used only as spares), connectors, spare parts and consumables.
c. Chemical analysis instrumentation including gas chromatographs, equilibrators, oxygen titration system, autoanalyzer, coulometer, alkalinity titrator, and spectrophotometers.
d. Chemical reagents, compressed gases (approximately 30 cylinders). A listing of chemicals is given in Appendix B and will be updated prior to departure for Leg 1.
e. Alitimeter and spares.
f. Strain gage
g. Milli-Q system, and replacement parts
h. 1-m Bongo nets
i. Three chest freezers for storing $DO^{14}C$ and black carbon samples

IV. Hazardous Materials

A. Policy and Compliance

The Chief Scientist is responsible for complying with FEC 07 Hazardous Materials and Hazardous Waste Management Requirements for Visiting Scientific Parties (or the OMAO procedure that supersedes it). By Federal regulations and NOAA Marine and Aviation Operations policy, the ship may not sail without a complete inventory of all hazardous materials by name and quantity, MSDS, appropriate spill cleanup materials (neutralizing agents, buffers, or absorbents) in amounts adequate to address spills of a size equal to the amount of chemical brought aboard, and chemical safety and spill response procedures. . Documentation regarding those requirements will be provided by the Chief of Operations, Marine Operations Center, upon request.
Per OMAO procedure, the scientific party will include with their project instructions and provide to the CO of the respective ship 30 days before departure:

- List of chemicals by name with anticipated quantity
- List of spill response materials, including neutralizing agents, buffers, and absorbents
- Chemical safety and spill response procedures, such as excerpts of the program's Chemical Hygiene Plan or SOPs relevant for shipboard laboratories
- For bulk quantities of chemicals in excess of 50 gallons total or in containers larger than 10 gallons each, notify ship's Operations Officer regarding quantity, packaging and chemical to verify safe stowage is available as soon as chemical quantities are known.

Upon embarkation and prior to loading hazardous materials aboard the vessel, the scientific party will provide to the CO or their designee:

- An inventory list showing actual amount of hazardous material brought aboard
- An MSDS for each material
- Confirmation that neutralizing agents and spill equipment were brought aboard sufficient to contain and cleanup all of the hazardous material brought aboard by the program
- Confirmation that chemical safety and spill response procedures were brought aboard

Upon departure from the ship, scientific parties will provide the CO or their designee an inventory showing that all chemicals were removed from the vessel. The CO's designee will maintain a log to track scientific party hazardous materials. MSDS will be made available to the ship's complement, in compliance with Hazard Communication Laws.

Scientific parties are expected to manage and respond to spills of scientific hazardous materials. Overboard discharge of hazardous materials is not permitted aboard NOAA ships.

B. Inventory (itemized)

Appendix A provides the inventory according to scientific analysis

C. Chemical safety and spill response procedures

a. Acid (A)

- Wear appropriate protective equipment 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 far ahead of spill for later disposal. 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 in original containers for re-use.
- Neutralize spill area and washings with soda ash or lime. Collect in a non-combustible container for prompt disposal.
- J. T. Baker NEUTRASORB® acid neutralizers are recommended for spills of this product.

b. Mercury (M)

- Spills: Pick up and place in a suitable container for reclamation or disposal in a method that does not generate dust. Sprinkle area with sulfur or calcium polysulfide to suppress mercury. Use Mercury Spill Kit if need be.

c. Formalin/Formaldehyde (F)

- Ventilate area of leak or spill. Remove all sources of ignition.
- Wear appropriate personal protective equipment.

- 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, dry sand, earth), and place in a chemical waste container.
- Do not use combustible materials, such as saw dust.

d. Inventory of spill kit supplies
An inventory of spill kit materials is included in Appendix C.

D. Radioactive Materials (R)

No radioactive isotopes are planned for this project.

V. Additional Projects

A. Supplementary ("Piggyback") Projects

a. Measurements of Marine Particle Distributions using the Underwater Vision Profiler (UVP)

The Underwater Vision Profiler 5 (UVP) is an in situ camera system that will be integrated into the CTD rosette to map out the distributions of marine particles and zooplankton >100μm in size. The instrument is battery powered, and can be charged with a deck cable that is hooked up while the CTD is on deck. The UVP is self-contained in terms of battery power and onboard memory, but can also be connected up to one of the CTD911 data channels to provide the CTD and UVP operator with real-time information on the function of the instrument. The instrument is activated by its onboard pressure sensor during the pre-profile CTD soaking phase. There is a small deck box and laptop with that will require a 2'x2' dry bench spot within a 25 m cable run of the CTD. Depending on station spacing and depth, the battery capacity and charging rate may only allow for data collection on every 2nd or 3rd cast, but even if it is not collecting data, the instrument can remain attached to the CTD rosette. The instrument can be used to a depth of 6000m.

The instrument is installed on the rosette and all work is performed on a not-to-interfere basis and does not introduce any added logistical requirements. The chief scientist assumes responsibility of the hazardous materials aboard RHB for this project. A list of the HAZMAT associated with this project is provided in Appendix C.

b. Micro-structure Measurements using a CTD-Chipod

Chipods are self-contained instruments that use fast response thermistors and precision accelerometers to measure microscale temperature gradients, from which we compute the dissipation rate of temperature variance (chi) and the eddy diffusivity of heat and other tracers. Unlike traditional microstructure measurements based on shear probes, chi is not sensitive to platform vibration but does require that our sensors see undisturbed, "clean" fluid on both down and upcasts. We will install 3 small pressure cases and 3 cabled sensors that will be attached to rods that either protrude above the rosette or position the sensor in a void near the LADCP head. Instruments record data autonomously, are rated to 6000-m and data will be monitored and downloaded periodically via USB cable, and monitored by a student or research tech during the cruise.

The instrument is installed on the rosette and all work is performed on a not-to-interfere basis and does not introduce any added logistical requirements. The chief scientist assumes responsibility of the hazardous materials aboard RHB for this project. A list of the HAZMAT associated with this project is provided in Appendix C.

c. Measurement of Ocean Cesium Concentration

The goal of this project is to investigate the pathways, mixing and transport of water in the North Pacific Ocean. In particular, we are seeking to understand the timescales associated with the gyre transport of water mixed down by winter storms in the western Pacific, as well as mixing and dispersion along the transport pathways as observed using the radionuclide tracers ^{137}Cs (~30 year half-life) and ^{134}Cs (2 year half-life). The proposed work includes surface or near sampling on both legs where possible (that is where it does not interfere with the core measurements) and twenty stations at which secondary casts using the regular rosette and CTD will be used to obtain profile samples to 1000 m. Each sample will require 20L (two Niskin bottles) of sea water. 260 x 20L samples are expected to be obtained. Sampling for this project will be performed on board, while all analyses will occur back in the lab at WHOI under NSF funding.

Sampling is straightforward: filling 20-L cubitainers with unfiltered seawater (<0.1% of Cs is particulate) and adding a stable Cs carrier for yield determination. As part of sample collection, some samples will be pumped slowly through a 5-ml volume KNiFC-AMP resin column to minimize sample volume. Analyses for cesium isotopes begins back at the shore-based WHOI lab, where the samples are processed and transferred to a counting vial for cesium detection in one of several high purity germanium well detectors at WHOI. A single technician can collect and process 10-12 samples per day on average over a cruise. Both ^{134}Cs and ^{137}Cs can be detected down to levels of 1.0 Bq m^{-3} using counting times of 24-48 hours. An aliquot is taken before and after the column for later analyses of stable Cs by ICP mass spectrometry to determine the extraction yields, which average 93.5%. On leg 1, all samples will be stored and shipped back to WHOI from Hawaii. On leg 2, a technician will process the samples to reduce the volume of water shipped back to the lab. All analysis will occur at the shore-based lab.

Occasional underway samples will be taken on legs 1 and 2 for later measurement of cesium. These will be 20L samples, collected from the underway seawater system, and stored in cubitainers. After the last hydro station, if and only if time permits, while underway, pumping of seawater or integrated surface water sampling of cesium will be performed. Slowing to the speed recommended by ship's personnel for efficient pumping will occur. Sample size will be a 20L minimum, but may be larger if containers are available.

On leg 2, the ship will be required to stay on station to allow for the cesium profile casts, otherwise all work is performed on a not-to-interfere basis and does not introduce any added ship logistic requirements. Two days of ship time have been allotted for the profile casts on Leg 2. The chief scientist assumes responsibility of the hazardous materials aboard RHB for this project. A list of the HAZMAT associated with this project is provided in Appendix C.

d. Measurement of Pteropod Distribution and Calcification Adaption: Net Tows

The purpose of this project is to measure calcification, dissolution and metabolic rates in conjunction with changes along the carbonate saturation state gradients. Net tows will be used to collect pteropods from 100 m to the surface once per evening. Tows should be conducted several hours after nightfall, preferably between 12 AM - 3AM (note the preferred time frame will change as the ship proceeds northward). We will use 0.5 m diameter zooplankton nets (Bongo; 30 lbs) with 60-80 lbs weight attached, which will be obliquely towed at 1-2 knots on the starboard side of the ship from the forward (backup) winch. The net will remain at 100 m for 10 minutes, then will be brought to the surface at ~10 m per minute. The net will be in the water for a total of about 20 minutes after which a member of the science party will rinse the net with seawater, and collect and store the net contents for later identification of different species.

The assistance of ship's personnel is requested for the deployment and recovery of nets. The scientific party will collect samples and wash the nets with salt water for the next use.

All net tows will be performed after the regular CTD casts, and a detailed operating procedure will be provided to the Brown. All work is to be performed on a not-to-interfere basis and does not introduce any additional ship logistical requirements other than those stated above. One day of ship time has been allotted for net deployments on each of the two legs (a total of two days of ship time). The chief scientist assumes responsibility of the hazardous materials aboard RHB for this project. A list of the HAZMAT associated with this project is provided in Appendix A.

B. NOAA Fleet Ancillary Projects

No supplementary projects are planned.

VI. Disposition of Data and Reports

Disposition of data gathered aboard NOAA ships will conform to NAO 216-101 *Ocean Data Acquisitions* and NAO 212-15 *Management of Environmental Data and Information.* To guide the implementation of these NAOs, NOAA's Environmental Data Management Committee (EDMC) provides the *NOAA Data Documentation Procedural Directive* (data documentation) and *NOAA Data Management Planning Procedural Directive* (preparation of Data Management Plans). OMAO is developing procedures and allocating resources to manage OMAO data and Programs are encouraged to do the same for their Project data.

A. Data Classifications: *Under Development*

a. OMAO Data

b. Program Data

We will be using the automated underway sea surface temperature and salinity data in conjunction with several projects, and request this data to be provided to the chief scientist within 3 months of the cruise completion.

B. Responsibilities

The Chief Scientist will be responsible for the disposition, feedback on data quality, and archiving of data and specimens collected on board the ship for the primary project. As representative of the program manager (Director, AOML), the Chief Scientist will also be responsible for the dissemination of copies of these data to participants in the cruise, to any other requesters, and to NESDIS in accordance with NDM 16-11 (ROSCOP within 3 months of cruise completion). The ship may assist in copying data and reports insofar as facilities allow.

The Chief Scientist will receive all original data gathered by the ship for the primary project, and this data transfer will be documented on NOAA Form 61-29 "Letter Transmitting Data". The Chief Scientist in turn will furnish the ship with a complete inventory listing all data gathered by the scientific party detailing types and quantities of data.

Individuals in charge of piggyback projects conducted during the cruise have the same responsibilities for their project's data as the Chief Scientist has for primary project data. All requests for data should be made through the Chief Scientist.

VII. Meetings, Vessel Familiarization, and Project Evaluations

A. Pre-Project Meeting:

The Chief Scientist and Commanding Officer will conduct a meeting of pertinent members of the scientific party and ship's crew to discuss required equipment, planned operations, concerns, and establish mitigation strategies for all concerns. This meeting shall be conducted before the beginning of the project with sufficient time to allow for preparation of the ship and project personnel. The ship's Operations Officer usually is delegated to assist the Chief Scientist in arranging this meeting.

B. Vessel Familiarization Meeting:

The Commanding Officer is responsible for ensuring scientific personnel are familiarized with applicable sections of the standing orders and vessel protocols, e.g., meals, watches, etiquette, drills, etc. A vessel familiarization meeting shall be conducted in the first 24 hours of the project's start and is normally presented by the ship's Operations Officer.

C. Post-Project Meeting:

The Commanding Officer is responsible for conducted a meeting no earlier than 24 hrs before or 7 days after the completion of a project to discuss the overall success and short comings of the project. Concerns regarding safety, efficiency, and suggestions for future improvements shall be discussed and mitigations for future projects will be documented for future use. This meeting shall be attended by the ship's officers, applicable crew, the Chief Scientist, and members of the scientific party and is normally arranged by the Operations Officer and Chief Scientist.

D. Project Evaluation Report

Within seven days of the completion of the project, a Customer Satisfaction Survey is to be completed by the Chief Scientist. The form is available at http://www.omao.noaa.gov/fleeteval.html and provides a "Submit" button at the end of the form. Submitted form data is deposited into a spreadsheet used by OMAO management to analyze the information. Though the complete form is not shared with the ships', specific concerns and praises are followed up on while not divulging the identity of the evaluator.

VIII. Miscellaneous

A. Meals and Berthing

The ship will provide meals for the scientists listed above. Meals will be served 3 times daily beginning one hour before scheduled departure, extending throughout the project, and ending two hours after the termination of the project. Since the watch schedule is split between day and night, the night watch may often miss daytime meals and will require adequate food and beverages (for example a variety of sandwich items, cheeses, fruit, milk, juices) during what are not typically meal hours. Special dietary requirements for scientific participants will be made available to the ship's command at least seven days prior to the project.

Berthing requirements, including number and gender of the scientific party, will be provided to the ship by the Chief Scientist. The Chief Scientist and Commanding Officer will work together on a detailed berthing plan to accommodate the gender mix of the scientific party taking into consideration the current make-up of the ship's complement. The Chief Scientist is responsible for ensuring the scientific berthing spaces are left in the condition in which they were received; for stripping bedding and linen return; and for the return of any room keys which were issued. The Chief Scientist is also responsible for the cleanliness of the laboratory spaces and the storage areas utilized by the scientific party, both during the project and at its conclusion prior to departing the ship.

All NOAA scientists will have proper travel orders when assigned to any NOAA ship. The Chief Scientist will ensure that all non NOAA or non Federal scientists aboard also have proper orders. It is the responsibility of the Chief Scientist to ensure that the entire scientific party has a mechanism in place to provide lodging and food and to be reimbursed for these costs in the event that the ship becomes uninhabitable and/or the galley is closed during any part of the scheduled project.

All persons boarding NOAA vessels give implied consent to comply with all safety and security policies and regulations which are administered by the Commanding Officer. All spaces and equipment on the vessel are subject to inspection or search at any time. All personnel must comply with OMAO's Drug and Alcohol Policy dated May 17, 2000 which forbids the possession and/or use of illegal drugs and alcohol aboard NOAA Vessels.

B. Medical Forms and Emergency Contacts

The NOAA Health Services Questionnaire (NHSQ, NF 57-10-01 (3-14)) must be completed in advance by each participating scientist. The NHSQ can be obtained from the Chief Scientist or the NOAA website:
http://www.corporateservices.noaa.gov/noaaforms/eforms/nf57-10-01.pdf.
All NHSQs submitted after March 1, 2014 must be accompanied by NOAA Form (NF) 57-10-02 - Tuberculosis Screening Document in compliance with OMAO Policy 1008 (Tuberculosis Protection Program).

The completed forms should be sent to the Regional Director of Health Services at the applicable Marine Operations Center. The NHSQ and Tuberculosis Screening Document should reach the Health Services Office no later than 4 weeks prior to the start of the project to allow time for the participant to obtain and submit additional information should health services require it, before clearance to sail can be granted. Please contact MOC Health Services with any questions regarding eligibility or completion of either form. Ensure to fully complete each form and indicate the ship or ships the participant will be sailing on. The participant will receive an email notice when medically cleared to sail if a legible email address is provided on the NHSQ.

The participant can mail, fax, or email the forms to the contact information below. Participants should take precautions to protect their Personally Identifiable Information (PII) and medical information and ensure all correspondence adheres to DOC guidance (http://ocio.os.doc.gov/ITPolicyandPrograms/IT_Privacy/PROD01_008240).

The only secure email process approved by NOAA is Accellion Secure File Transfer which requires the sender to setup an account. Accellion's Web Users Guide is a valuable aid in using this service, however to reduce cost the DOC contract doesn't provide for automatically issuing full functioning accounts. To receive access to a "Send Tab", after your Accellion account has been established send an email from the associated email account to accellionAlerts@doc.gov requesting access to the "Send Tab" function. They will notify you via email usually within 1 business day of your approval. The 'Send Tab" function will be accessible for 30 days.

Contact information:

Regional Director of Health Services
Marine Operations Center – Atlantic
439 W. York Street
Norfolk, VA 23510
Telephone 757-441-6320
Fax 757-441-3760
Email MOA.Health.Services@noaa.gov

Prior to departure, the Chief Scientist must provide an electronic listing of emergency contacts to the Executive Officer for all members of the scientific party, with the following information: contact name, address, relationship to member, and telephone number.

C. Shipboard Safety

Hard hats are required when working with suspended loads. Work vests are required when working near open railings and during small boat launch and recovery operations. Hard hats and work vests will be provided by the ship when required.

Wearing open-toed footwear or shoes that do not completely enclose the foot (such as sandals or clogs) outside of private berthing areas is not permitted. At the discretion of the ship CO, safety shoes (i.e. steel or composite toe protection) may be required to participate in any work dealing with suspended loads, including CTD deployment and recovery. The ship does not provide safety-toed shoes/boots. The ship's Operations Officer should be consulted by the Chief Scientist to ensure members of the scientific party report aboard with the proper attire.

D. *Communications*

A progress report on operations prepared by the Chief Scientist may be relayed to the program office. Sometimes it is necessary for the Chief Scientist to communicate with another vessel, aircraft, or shore facility. Through various means of communications, the ship can usually accommodate the Chief Scientist. Special radio voice communications requirements should be listed in the project instructions. The ship's primary means of communication with the Marine Operations Center is via e-mail and the Very Small Aperture Terminal (VSAT) link. Standard VSAT bandwidth at 128kbs is shared by all vessels staff and the science team at no charge. Increased bandwidth in 30-day increments is available on the VSAT systems at increased cost to the scientific party. If increased bandwidth is being considered, program accounting is required it must be arranged at least 30 days in advance.

E. *IT Security*

Any computer that will be hooked into the ship's network must comply with the *NMAO Fleet IT Security Policy* 1.1 (November 4, 2005) prior to establishing a direct connection to the NOAA WAN. Requirements include, but are not limited to:

(1) Installation of the latest virus definition (.DAT) file on all systems and performance of a virus scan on each system.
(2) Installation of the latest critical operating system security patches.
(3) No external public Internet Service Provider (ISP) connections.

Completion of these requirements prior to boarding the ship is required.

Non-NOAA personnel using the ship's computers or connecting their own computers to the ship's network must complete NOAA's IT Security Awareness Course within 3 days of embarking.

F. *Foreign National Guests Access to OMAO Facilities and Platforms*

All foreign national access to the vessel shall be in accordance with NAO 207-12 and RADM De Bow's March 16, 2006 memo (http://deemedexports.noaa.gov). National Marine Fisheries Service personnel will use the Foreign National Registration System (FNRS) to submit requests for access to NOAA facilities and ships. The Departmental Sponsor/NOAA (DSN) is responsible for obtaining clearances and export licenses and for providing escorts required by the NAO. DSNs should consult with their designated Line Office Deemed Export point of contact to assist with the process.

Foreign National access must be sought not only for access to the ship involved in the project but also for any Federal Facility access (NOAA Marine Operations Centers, NOAA port offices, USCG Bases) that foreign nationals might have to traverse to gain access to and from the ship. The following are basic requirements.

Full compliance with NAO 207-12 is required.

Responsibilities of the Chief Scientist:

1. Provide the Commanding Officer with the e-mail generated by the FRNS granting approval for the foreign national guest's visit. This e-mail will identify the guest's DSN and will serve as evidence that the requirements of NAO 207-12 have been complied with.
2. Escorts – The Chief Scientist is responsible for providing escorts to comply with NAO 207-12 Section 5.10, or as required by the vessel's DOC/OSY Regional Security Officer.
3. Ensure all non-foreign national members of the scientific party receive the briefing on Espionage Indicators (NAO 207-12 Appendix D) at least annually or as required by the servicing Regional Security Officer.
4. Export Control - Ensure that approved controls are in place for any technologies that are subject to Export Administration Regulations (EAR).

The Commanding Officer and the Chief Scientist will work together to implement any access controls necessary to ensure no unlicensed export occurs of any controlled technology onboard regardless of ownership.

Responsibilities of the Commanding Officer:

1. Ensure only those foreign nationals with DOC/OSY clearance are granted access.
2. Deny access to OMAO platforms and facilities by foreign nationals from countries controlled for anti-terrorism (AT) reasons and individuals from Cuba or Iran without written NMAO approval and compliance with export and sanction regulations.
3. Ensure foreign national access is permitted only if unlicensed deemed export is not likely to occur.
4. Ensure receipt from the Chief Scientist or the DSN of the FRNS e-mail granting approval for the foreign national guest's visit.
5. Ensure Foreign Port Officials, e.g., Pilots, immigration officials, receive escorted access in accordance with maritime custom to facilitate the vessel's visit to foreign ports.
6. Export Control - 8 weeks in advance of the project, provide the Chief Scientist with a current inventory of OMAO controlled technology onboard the vessel and a copy of the vessel Technology Access Control Plan (TACP). Also notify the Chief Scientist of any OMAO-sponsored foreign nationals that will be onboard while program equipment is aboard so that the Chief Scientist can take steps to prevent unlicensed export of Program controlled technology. The Commanding Officer and the Chief Scientist will work together to implement any access controls necessary to ensure no unlicensed export occurs of any controlled technology onboard regardless of ownership.
7. Ensure all OMAO personnel onboard receive the briefing on Espionage Indicators (NAO 207-12 Appendix A) at least annually or as required by the servicing Regional Security Officer.

Responsibilities of the Foreign National Sponsor:

1. Export Control - The foreign national's sponsor is responsible for obtaining any required export licenses and complying with any conditions of those licenses prior to the foreign national being provided access to the controlled technology onboard regardless of the technology's ownership.
2. The DSN of the foreign national shall assign an on-board Program individual, who will be responsible for the foreign national while on board. The identified individual must be a U.S. citizen, NOAA (or DOC) employee. According to DOC/OSY, this requirement cannot be altered.
3. Ensure completion and submission of Appendix E (Certification of Conditions and Responsibilities for a Foreign National

APPENDICES

Appendix A

Station Operations

CTD Operations: CTD casts will include the CTD/O2 unit, a LADCP with battery pack, a fluorometer, a transmissometer, Chi-pod, a UVP, an altimeter and a Rosette sampler with 24, 10-L bottles on the Rosette frame. Approximately 225 casts will be conducted to full water column depth, maximum estimated at 6000 meters. We will require a package tracking system and display for the CTD operations (Knudsen/Bathy2000). We request that the ship carries a back-up CTD conducting cable for this cruise and a functioning spare winch. Approximate station locations are listed in Table 1. The primary goal for this cruise to complete sampling along the 150W line. from 17.S to 56.44N using a nominal 30 nm spacing in the open ocean, closer across the equator and over steep topography. The secondary goals are obtain 20 nm spacing between 6S-3S and 3N-6N, 10 nm spacing between 3S-3N, sampling across the Alaskan Shelf and across the Alaska Gyre. Lastly, should time permit, another dozen stations are planned on the Alaskan Shelf and closer station spacing of steep bathymetry.

Strategies for dealing with delays:

Leg 1: Early delays can be offset by slightly wider station spacing across the equator.
Later delays can be offset by ending the leg further south (Leg 2 will take up the slack)
Leg 1 should seek to conclude no further south than 14N
Widening of nominal (30 nm) spacing is the last resort
Leg 2: Delays can be offset by removal of the offshore track for underway pumping of Cs samples near the US west coast - i.e. we take the shortest route to Seattle
Second - removal of last hydrographic stations (near the N. American coast)
Third - removal of the outer Alaska Gyre (P17N) stations
Fourth - wider spacing on the Alaska Gyre stations
Fifth - removal of all the Alaska Gyre stations
Sixth - removal of the some or all of the P17N shelf stations northeast of the original P16N line.
Widening of nominal (30 nm) spacing is the last resort

Table 1. **(**a) Leg 1. (b) Leg 2. (c) supplemental. Planned station locations (positive degrees N & E) and distance between stations, along with estimated depths, on station, draw, steam and cumulative elapsed times, the date and time of station departure and arrival time at next station. The column labeled 'Stag' indicates the set of bottle depths to be used at the station. STA=-999 indicate track only, not station positions. Extra time is included equivalent to about 1.5 weather days per leg. Time is also included for

net tows and spectroradiometer casts once pers day, and on leg 2 20 extra casts to obtain cesium samples. This is considered a best possible scenario. Contingency plans for further delays due to weather or technical difficulties are described above. Should Leg 1 finish ahead of schedule it will continue with first Leg 2 stations. Leg 2 will begin with a repeat of the last Leg 1 station. Should Leg 2 look to be finishing ahead of schedule, the stations in Table 1c will be occupied, and/or closer spacing will be used across the Alaska Gyre and/or hydrographic stations will be obtained along the Line-P repeat coming into Seattle.

Table 1a

Leg 1 Start Date and Time: 04-10-15 10:00 (Tahiti time) = UTC – 10

(assumed ship speed: 10.5 knots between stations, 11.5 knots to/from ports)

Leg 1 STA	LAT	LONG	DIST (nm)	DEPTH (m)	STAG	ONSTA (hrs)	DRAW (hrs)	STEAM tonext	ELPSD days	DATE leave	LVTIME (GMT)	DATE nxtsta	ARTIME (GMT)
PORT	-17.530	-149.470	35.4	0	-	0.00	0.00	3.08	0.13	04-10-2015	20:00	04-10-2015	23:05
Test 1	-17.000	-149.743	33.4	500	I	2.00	1.03	3.18	0.30	04-11-2015	01:05	04-11-2015	03:10
2	-16.500	-150.000	30.0	4207	I	3.60	1.45	2.86	0.57	04-11-2015	06:46	04-11-2015	09:37
3	-16.000	-150.000	32.1	4226	II	3.61	1.45	3.06	0.85	04-11-2015	13:14	04-11-2015	16:17
4	-15.500	-150.200	32.2	4279	III	3.90	1.45	3.06	1.12	04-11-2015	20:11	04-11-2015	23:00
5	-15.000	-150.400	32.2	4501	I	3.80	1.45	3.06	1.41	04-12-2015	02:48	04-12-2015	05:52
6	-14.500	-150.600	32.2	4441	II	3.76	1.45	3.06	1.70	04-12-2015	09:38	04-12-2015	12:42
7	-14.000	-150.800	32.2	4314	III	3.67	1.45	3.06	1.99	04-12-2015	16:22	04-12-2015	19:46
8	-13.500	-150.999	30.0	4632	I	3.90	1.45	2.86	2.30	04-12-2015	23:40	04-13-2015	03:11
9	-13.000	-150.999	30.0	4596	II	3.87	1.45	2.86	2.58	04-13-2015	07:03	04-13-2015	09:55
10	-12.500	-150.999	30.0	4799	III	4.01	1.45	2.86	2.88	04-13-2015	13:55	04-13-2015	17:07
11	-12.000	-150.999	30.0	4852	I	4.05	1.45	2.86	3.17	04-13-2015	21:10	04-14-2015	00:01
12	-11.500	-150.999	30.0	5012	II	4.16	1.45	2.86	3.49	04-14-2015	04:11	04-14-2015	07:43
13	-11.000	-150.999	30.0	5056	III	4.19	1.45	2.86	3.80	04-14-2015	11:54	04-14-2015	15:06
14	-10.500	-150.999	30.0	4929	I	4.36	1.45	2.86	4.09	04-14-2015	19:27	04-14-2015	22:03
15	-10.000	-151.000	30.0	4664	II	3.92	1.45	2.86	4.40	04-15-2015	01:59	04-15-2015	05:30
16	-9.500	-151.000	30.0	4929	III	4.11	1.45	2.86	4.69	04-15-2015	09:36	04-15-2015	12:28
17	-9.000	-151.000	30.0	3837	I	3.34	1.45	2.86	4.96	04-15-2015	15:48	04-15-2015	18:59
18	-8.500	-151.000	30.0	4051	II	3.49	1.45	2.86	5.22	04-15-2015	22:29	04-16-2015	01:20
19	-8.000	-151.000	30.0	4996	III	4.15	1.45	2.86	5.54	04-16-2015	05:29	04-16-2015	09:01
20	-7.500	-151.000	30.0	5238	I	4.32	1.45	2.86	5.86	04-16-2015	13:20	04-16-2015	16:31
21	-7.000	-151.000	30.0	5209	II	4.30	1.45	2.86	6.15	04-16-2015	20:50	04-16-2015	23:41
22	-6.500	-151.000	30.0	4916	III	4.10	1.45	2.86	6.47	04-17-2015	03:47	04-17-2015	07:18
23	-6.000	-151.001	18.0	5031	I	4.18	1.45	1.71	6.75	04-17-2015	11:29	04-17-2015	14:04
24	-5.700	-151.001	18.0	5001	II	4.16	1.45	1.71	7.02	04-17-2015	18:13	04-17-2015	20:28
25	-5.400	-151.001	18.0	5154	III	4.51	1.45	1.71	7.32	04-18-2015	00:59	04-18-2015	03:39
26	-5.100	-151.001	18.0	5103	I	4.23	1.45	1.71	7.59	04-18-2015	07:53	04-18-2015	10:08
27	-4.800	-151.001	18.0	4923	II	4.10	1.45	1.71	7.87	04-18-2015	14:14	04-18-2015	16:49
28	-4.500	-151.001	18.0	4664	III	3.92	1.45	1.71	8.12	04-18-2015	20:44	04-18-2015	22:59
29	-4.200	-151.001	18.0	4646	I	3.91	1.45	1.71	8.41	04-19-2015	02:53	04-19-2015	05:48
30	-3.900	-151.000	18.0	4681	II	3.93	1.45	1.71	8.67	04-19-2015	09:44	04-19-2015	11:59
31	-3.600	-151.000	18.0	4750	III	3.98	1.45	1.71	8.94	04-19-2015	15:58	04-19-2015	18:33
32	-3.300	-151.000	15.6	4746	I	3.98	0.50	1.49	9.23	04-19-2015	22:31	04-20-2015	01:26
33	**-3.040**	**-151.000**	**9.6**	**4777**	**II**	**4.00**	**1.45**	**0.91**	**9.49**	**04-20-2015**	**05:26**	**04-20-2015**	**07:41**
34	-2.880	-151.000	10.2	4715	III	3.95	0.50	0.97	9.76	04-20-2015	11:39	04-20-2015	14:14
35	**-2.710**	**-151.000**	**9.6**	**4809**	**I**	**4.02**	**1.45**	**0.91**	**10.02**	**04-20-2015**	**18:15**	**04-20-2015**	**20:30**
36	-2.550	-151.000	10.2	4819	II	4.03	0.50	0.97	10.31	04-21-2015	00:31	04-21-2015	03:26
37	**-2.380**	**-151.000**	**9.6**	**4926**	**III**	**4.10**	**1.45**	**0.91**	**10.57**	**04-21-2015**	**07:33**	**04-21-2015**	**09:48**
38	-2.220	-151.000	10.2	4849	I	4.30	0.50	0.97	10.84	04-21-2015	14:06	04-21-2015	16:06
39	**-2.050**	**-151.000**	**9.6**	**4715**	**II**	**3.95**	**1.45**	**0.91**	**11.10**	**04-21-2015**	**20:03**	**04-21-2015**	**22:18**

Table 1a continued

Leg 1 STA	LAT	LONG	DIST (nm)	DEPTH (m)	STAG	ONSTA (hrs)	DRAW (hrs)	STEAM tonext	ELPSD days	DATE leave	LVTIME (GMT)	DATE nxtsta	ARTIME (GMT)

40	-1.890	-151.000	9.6	4839	III	4.04	0.50	0.91	11.39	04-22-2015	02:20	04-22-2015	05:15
41	**-1.730**	**-151.000**	**10.2**	**4889**	**I**	**4.08**	**1.45**	**0.97**	**11.65**	**04-22-2015**	**09:20**	**04-22-2015**	**11:35**
42	-1.560	-151.000	9.6	4873	II	4.07	0.50	0.91	11.93	04-22-2015	15:39	04-22-2015	18:14
43	**-1.400**	**-151.000**	**10.2**	**4853**	**III**	**4.05**	**1.45**	**0.97**	**12.19**	**04-22-2015**	**22:17**	**04-23-2015**	**00:32**
44	-1.230	-151.000	9.6	4854	I	4.05	0.50	0.91	12.48	04-23-2015	04:35	04-23-2015	07:30
45	**-1.070**	**-151.000**	**10.2**	**4731**	**II**	**3.97**	**1.45**	**0.97**	**12.75**	**04-23-2015**	**11:28**	**04-23-2015**	**14:03**
46	-0.900	-151.000	9.6	4250	III	3.63	0.50	0.91	13.00	04-23-2015	17:41	04-23-2015	19:56
47	**-0.740**	**-151.000**	**9.6**	**4459**	**I**	**3.77**	**1.45**	**0.91**	**13.28**	**04-23-2015**	**23:42**	**04-24-2015**	**02:37**
48	-0.580	-151.000	10.2	4344	II	3.69	0.50	0.97	13.52	04-24-2015	06:19	04-24-2015	08:34
49	**-0.410**	**-151.000**	**9.6**	**4388**	**III**	**3.72**	**1.45**	**0.91**	**13.79**	**04-24-2015**	**12:17**	**04-24-2015**	**14:52**
50	-0.250	-151.000	10.2	4108	I	3.78	0.50	0.97	14.03	04-24-2015	18:39	04-24-2015	20:39
51	**-0.080**	**-151.000**	**9.6**	**4342**	**II**	**3.69**	**1.45**	**0.91**	**14.30**	**04-25-2015**	**00:21**	**04-25-2015**	**03:16**
52	0.080	-151.000	10.2	3773	III	3.29	0.50	0.97	14.53	04-25-2015	06:33	04-25-2015	08:48
53	**0.250**	**-151.000**	**9.6**	**3773**	**I**	**3.29**	**1.45**	**0.91**	**14.78**	**04-25-2015**	**12:06**	**04-25-2015**	**14:41**
54	0.410	-151.000	10.2	4742	II	3.97	0.50	0.97	15.04	04-25-2015	18:39	04-25-2015	20:54
55	**0.580**	**-151.000**	**9.6**	**3238**	**III**	**2.91**	**1.41**	**0.91**	**15.28**	**04-25-2015**	**23:48**	**04-26-2015**	**02:43**
56	0.740	-151.000	9.6	4199	I	3.59	0.50	0.91	15.52	04-26-2015	06:19	04-26-2015	08:34
57	**0.900**	**-151.000**	**10.2**	**4235**	**II**	**3.62**	**1.45**	**0.97**	**15.78**	**04-26-2015**	**12:11**	**04-26-2015**	**14:46**
58	1.070	-151.000	9.6	3763	III	3.28	0.50	0.91	16.01	04-26-2015	18:03	04-26-2015	20:18
59	**1.230**	**-151.000**	**10.2**	**4277**	**I**	**3.65**	**1.45**	**0.97**	**16.29**	**04-26-2015**	**23:57**	**04-27-2015**	**02:52**
60	1.400	-151.000	9.6	3117	II	2.82	0.50	0.91	16.50	04-27-2015	05:41	04-27-2015	07:56
61	**1.560**	**-151.000**	**10.2**	**4118**	**III**	**3.53**	**1.45**	**0.97**	**16.75**	**04-27-2015**	**11:28**	**04-27-2015**	**14:03**
62	1.730	-151.000	9.6	4214	I	3.60	0.50	0.91	17.00	04-27-2015	17:39	04-27-2015	19:54
63	**1.890**	**-151.000**	**9.6**	**4118**	**II**	**3.53**	**1.45**	**0.91**	**17.26**	**04-27-2015**	**23:26**	**04-28-2015**	**02:21**
64	2.050	-151.000	10.2	4412	III	3.74	0.50	0.97	17.51	04-28-2015	06:06	04-28-2015	08:21
65	**2.220**	**-151.000**	**9.6**	**4508**	**I**	**3.81**	**1.45**	**0.91**	**17.78**	**04-28-2015**	**12:09**	**04-28-2015**	**14:44**
66	2.380	-151.000	10.2	4736	II	3.97	0.50	0.97	18.04	04-28-2015	18:42	04-28-2015	20:57
67	**2.550**	**-151.000**	**9.6**	**4725**	**III**	**3.96**	**1.45**	**0.91**	**18.33**	**04-29-2015**	**00:55**	**04-29-2015**	**03:50**
68	2.710	-151.000	10.2	4623	I	3.89	0.50	0.97	18.58	04-29-2015	07:43	04-29-2015	09:58
69	**2.880**	**-151.000**	**7.2**	**4792**	**II**	**4.01**	**1.45**	**0.69**	**18.86**	**04-29-2015**	**13:59**	**04-29-2015**	**16:34**
70	3.000	-151.000	19.8	5090	III	4.22	1.45	1.89	19.13	04-29-2015	20:47	04-29-2015	23:02
71	3.330	-151.000	20.4	4848	I	4.05	1.45	1.94	19.42	04-30-2015	03:05	04-30-2015	06:00
72	3.670	-151.000	19.8	4980	II	4.14	1.45	1.89	19.70	04-30-2015	10:08	04-30-2015	12:43
73	4.000	-151.000	19.8	5048	III	4.19	1.45	1.89	19.97	04-30-2015	16:55	04-30-2015	19:10
74	4.330	-151.000	20.4	5214	I	4.31	1.45	1.94	20.27	04-30-2015	23:28	05-01-2015	02:23
75	4.670	-151.000	19.8	5101	II	4.48	1.45	1.89	20.54	05-01-2015	06:52	05-01-2015	08:52
76	5.000	-151.000	19.8	5080	III	4.21	1.45	1.89	20.82	05-01-2015	13:04	05-01-2015	15:39
77	5.330	-151.000	20.4	5024	I	4.17	1.45	1.94	21.09	05-01-2015	19:50	05-01-2015	22:05
78	5.670	-151.000	19.8	5273	II	4.35	1.45	1.89	21.39	05-02-2015	02:26	05-02-2015	05:21
79	6.000	-151.000	30.6	5086	III	4.22	1.45	2.91	21.69	05-02-2015	09:34	05-02-2015	12:28
80	6.500	-151.100	30.8	5097	I	4.22	1.45	2.94	22.00	05-02-2015	16:42	05-02-2015	19:58
81	7.000	-151.220	30.8	5393	II	4.43	1.45	2.94	22.33	05-03-2015	00:24	05-03-2015	04:00
82	7.500	-151.340	30.8	5306	III	4.37	1.45	2.94	22.64	05-03-2015	08:22	05-03-2015	11:19
83	8.000	-151.460	30.8	5104	I	4.23	1.45	2.94	22.95	05-03-2015	15:32	05-03-2015	18:48
84	8.500	-151.580	30.8	5147	II	4.26	1.45	2.94	23.28	05-03-2015	23:04	05-04-2015	02:40
85	9.000	-151.700	30.8	5168	III	4.27	1.45	2.94	23.58	05-04-2015	06:57	05-04-2015	09:53
86	9.500	-151.820	30.8	5214	I	4.56	1.45	2.94	23.88	05-04-2015	14:26	05-04-2015	17:07
87	10.000	-151.940	30.2	5204	II	4.30	1.45	2.88	24.18	05-04-2015	21:25	05-05-2015	00:18
88	10.500	-152.000	30.0	5168	III	4.27	1.45	2.86	24.50	05-05-2015	04:34	05-05-2015	08:06
89	11.000	-152.000	30.0	5578	I	4.56	1.45	2.86	24.83	05-05-2015	12:39	05-05-2015	15:51
90	11.500	-152.000	30.0	5235	II	4.32	1.45	2.86	25.13	05-05-2015	20:10	05-05-2015	23:01
91	12.000	-152.000	30.0	5438	III	4.46	1.45	2.86	25.46	05-06-2015	03:29	05-06-2015	07:01
92	12.500	-152.000	30.0	5048	I	4.19	1.45	2.86	25.77	05-06-2015	11:12	05-06-2015	14:23
93	13.000	-152.000	30.0	5623	II	4.59	1.45	2.86	26.08	05-06-2015	18:59	05-06-2015	21:50
94	13.500	-152.000	30.0	5643	III	4.61	1.45	2.86	26.42	05-07-2015	02:27	05-07-2015	05:58
95	14.000	-152.000	30.0	5645	I	4.61	1.45	2.86	26.74	05-07-2015	10:35	05-07-2015	13:46
96	14.500	-152.000	30.0	5597	II	4.58	1.45	2.86	27.05	05-07-2015	18:21	05-07-2015	21:12
97	15.000	-152.000	30.0	5643	III	4.86	1.45	2.86	27.39	05-08-2015	02:04	05-08-2015	05:20

Table 1a continued

Leg 1 STA	LAT	LONG	DIST (nm)	DEPTH (m)	STAG	ONSTA (hrs)	DRAW (hrs)	STEAM tonext	ELPSD days	DATE leave	LVTIME (GMT)	DATE nxtsta	ARTIME (GMT)
98	15.500	-152.000	30.0	5595	I	4.57	1.45	2.86	27.70	05-08-2015	09:55	05-08-2015	12:46
99	16.000	-152.000	30.0	5469	II	4.49	1.45	2.86	28.02	05-08-2015	17:15	05-08-2015	20:27
100	16.500	-152.000	30.0	5387	III	4.43	1.45	2.86	28.35	05-09-2015	00:52	05-09-2015	04:24
101	17.000	-152.000	30.0	5312	I	4.37	1.45	2.86	28.65	05-09-2015	08:46	05-09-2015	11:38
102	17.500	-152.000	30.0	5338	II	4.39	1.45	2.86	28.97	05-09-2015	16:01	05-09-2015	19:13
103	18.000	-152.000	30.0	5082	III	4.21	1.45	2.86	29.29	05-09-2015	23:25	05-10-2015	02:57
104	18.500	-152.000	30.0	5277	I	4.35	1.45	2.86	29.59	05-10-2015	07:18	05-10-2015	10:09
105	19.000	-152.000	30.0	5084	II	4.21	1.45	2.86	29.90	05-10-2015	14:22	05-10-2015	17:33
106	19.500	-152.000	30.0	5236	III	4.32	1.45	2.86	30.20	05-10-2015	21:53	05-11-2015	00:44
107	20.000	-152.000	30.0	5094	I	4.47	1.45	2.86	30.52	05-11-2015	05:12	05-11-2015	08:29
108	20.500	-152.000	30.0	5194	II	4.29	1.45	2.86	30.83	05-11-2015	12:46	05-11-2015	15:58
109	21.000	-152.000	30.0	5193	III	4.29	1.45	2.86	31.13	05-11-2015	20:15	05-11-2015	23:07
110	21.500	-152.000	327.5	5336	I	4.39	1.45	28.48	32.53	05-12-2015	03:30	05-13-2015	08:39
PORT	21.310	-157.860	0.0	0	-	0.00	0.00	0.00	32.53	05-13-2015	08:39	05-13-2015	08:39

Leg 1 Final Date and Time: 05-13-15 08:39 (UTC) = 5-12-15 22:39 (Hawaii) = GMT - 10

(Bold-face) Between 3S - 3N, every other cast will be a CTD-only cast. For calibration purposes Salt & Oxygen samples will be drawn, but no other regular samples will be drawn.

Table 1b

Leg 2 Start Date and Time: 04-10-15 10:00 (Tahiti time) = UTC – 10

(assumed ship speed: 10.5 knots between stations, 11.5 knots to/from ports)

Leg 2 STA	LAT	LONG	DIST (nm)	DEPTH (m)	STAG	ONSTA (hrs)	DRAW (hrs)	STEAM tonext	ELPSD days	DATE leave	LVTIME (GMT)	DATE nxtsta	ARTIME (GMT)
PORT	21.310	-157.860	123.6	0	-	0.00	0.00	10.75	0.45	05-19-2015	20:00	05-20-2015	06:45
-111	21.500	-155.657	204.2	500	I	2.00	1.03	17.75	1.22	05-20-2015	08:45	05-21-2015	01:24
112	21.500	-152.000	30.0	5336	III	4.39	1.45	2.86	1.55	05-21-2015	05:47	05-21-2015	09:19
113	22.000	-152.000	30.0	5167	I	4.27	1.45	2.86	1.87	05-21-2015	13:35	05-21-2015	16:46
114	22.500	-152.000	30.0	5274	II	4.35	1.45	2.86	2.17	05-21-2015	21:07	05-21-2015	23:59
115	23.000	-152.000	30.0	5397	III	4.43	1.45	2.86	2.50	05-22-2015	04:25	05-22-2015	07:56
116	23.500	-152.000	30.0	5482	I	4.49	1.45	2.86	2.82	05-22-2015	12:26	05-22-2015	15:37
117	24.000	-152.000	30.0	5617	II	4.59	1.45	2.86	3.13	05-22-2015	20:13	05-22-2015	23:04
118	24.500	-152.000	30.0	5415	III	4.70	1.45	2.86	3.46	05-23-2015	03:46	05-23-2015	07:02
119	25.000	-152.000	30.0	5385	I	4.43	1.45	2.86	3.78	05-23-2015	11:28	05-23-2015	14:39
120	25.500	-152.000	30.0	5455	II	4.48	1.45	2.86	4.08	05-23-2015	19:08	05-23-2015	21:59
121	26.000	-152.000	30.0	5373	III	4.42	1.45	2.86	4.41	05-24-2015	02:24	05-24-2015	05:56
122	26.500	-152.000	30.0	5399	I	4.44	1.45	2.86	4.73	05-24-2015	10:22	05-24-2015	13:33
123	27.000	-152.000	30.0	5347	II	4.40	1.45	2.86	5.03	05-24-2015	17:57	05-24-2015	20:49
124	27.500	-152.000	30.0	5476	III	4.49	1.45	2.86	5.37	05-25-2015	01:18	05-25-2015	04:50
125	28.000	-152.000	30.0	5467	I	4.48	1.45	2.86	5.67	05-25-2015	09:19	05-25-2015	12:10
126	28.500	-152.000	30.0	5254	II	4.33	1.45	2.86	5.99	05-25-2015	16:30	05-25-2015	19:42
127	29.000	-152.000	30.0	5585	III	4.57	1.45	2.86	6.32	05-26-2015	00:16	05-26-2015	03:47
128	29.500	-152.000	30.0	5398	I	4.69	1.45	2.86	6.63	05-26-2015	08:28	05-26-2015	11:05
129	30.000	-152.000	30.0	5544	II	4.54	1.45	2.86	6.95	05-26-2015	15:37	05-26-2015	18:48
130	30.500	-152.000	30.0	5289	III	4.36	1.45	2.86	7.28	05-26-2015	23:10	05-27-2015	02:41
131	31.000	-152.000	30.0	5314	I	4.38	1.45	2.86	7.58	05-27-2015	07:04	05-27-2015	09:55
132	31.500	-152.000	30.0	5431	II	4.46	1.45	2.86	7.88	05-27-2015	14:23	05-27-2015	17:14
133	32.000	-152.000	30.0	5222	III	4.31	1.45	2.86	8.18	05-27-2015	21:33	05-28-2015	00:24
134	32.500	-152.000	30.0	5209	I	4.30	1.45	2.86	8.51	05-28-2015	04:42	05-28-2015	08:14

Table 1b continued

Leg 2 STA	LAT	LONG	DIST (nm)	DEPTH (m)	STAG	ONSTA (hrs)	DRAW (hrs)	STEAM tonext	ELPSD days	DATE leave	LVTIME (GMT)	DATE nxtsta	ARTIME (GMT)
135	33.000	-152.000	30.0	5374	II	4.42	1.45	2.86	8.83	05-28-2015	12:39	05-28-2015	15:50
136	33.500	-152.000	30.0	5434	III	4.46	1.45	2.86	9.13	05-28-2015	20:18	05-28-2015	23:09
137	34.000	-152.000	30.0	5559	I	4.55	1.45	2.86	9.47	05-29-2015	03:42	05-29-2015	07:14
138	34.500	-152.000	30.0	5601	II	4.83	1.45	2.86	9.79	05-29-2015	12:03	05-29-2015	15:00
139	35.000	-152.000	30.0	5653	III	4.61	1.45	2.86	10.10	05-29-2015	19:37	05-29-2015	22:28
140	35.500	-152.000	30.0	5646	I	4.61	1.45	2.86	10.41	05-30-2015	03:05	05-30-2015	05:56
141	36.000	-152.000	30.0	5512	II	4.52	1.45	2.86	10.74	05-30-2015	10:27	05-30-2015	13:39
142	36.500	-152.000	30.0	5732	III	4.67	1.45	2.86	11.05	05-30-2015	18:19	05-30-2015	21:10
143	37.000	-152.000	30.0	5532	I	4.53	1.45	2.86	11.38	05-31-2015	01:42	05-31-2015	05:13
144	37.500	-152.000	30.0	5539	II	4.53	1.45	2.86	11.69	05-31-2015	09:46	05-31-2015	12:37
145	38.000	-152.000	30.0	4973	III	4.14	1.45	2.86	12.00	05-31-2015	16:45	05-31-2015	19:57
146	38.500	-152.000	30.0	5239	I	4.32	1.45	2.86	12.32	06-01-2015	00:16	06-01-2015	03:47
147	39.000	-152.000	30.0	5784	II	4.71	1.45	2.86	12.64	06-01-2015	08:30	06-01-2015	11:21
148	39.500	-152.000	30.0	5144	III	4.51	1.45	2.86	12.95	06-01-2015	15:52	06-01-2015	18:48
149	40.000	-152.000	30.0	5253	I	4.33	1.45	2.86	13.28	06-01-2015	23:08	06-02-2015	02:39
150	40.500	-152.000	30.0	4973	II	4.14	1.45	2.86	13.57	06-02-2015	06:48	06-02-2015	09:39
151	41.000	-152.000	30.0	4998	III	4.15	1.45	2.86	13.87	06-02-2015	13:48	06-02-2015	17:00
152	41.500	-152.000	30.0	5404	I	4.44	1.45	2.86	14.18	06-02-2015	21:26	06-03-2015	00:18
153	42.000	-152.000	30.0	5139	II	4.25	1.45	2.86	14.50	06-03-2015	04:33	06-03-2015	08:04
154	42.500	-152.000	30.0	5099	III	4.22	1.45	2.86	14.81	06-03-2015	12:18	06-03-2015	15:29
155	43.000	-152.000	30.0	5141	I	4.25	1.45	2.86	15.11	06-03-2015	19:44	06-03-2015	22:36
156	43.500	-152.000	30.0	4621	II	3.89	1.45	2.86	15.42	06-04-2015	02:29	06-04-2015	06:00
157	44.000	-152.000	30.0	5530	III	4.53	1.45	2.86	15.74	06-04-2015	10:32	06-04-2015	13:44
158	44.500	-152.000	30.0	5201	I	4.55	1.45	2.86	16.04	06-04-2015	18:16	06-04-2015	20:53
159	45.000	-152.000	30.0	5222	II	4.31	1.45	2.86	16.36	06-05-2015	01:11	06-05-2015	04:43
160	45.500	-152.000	30.0	5235	III	4.32	1.45	2.86	16.66	06-05-2015	09:02	06-05-2015	11:54
161	46.000	-152.000	30.0	5286	I	4.36	1.45	2.86	16.98	06-05-2015	16:15	06-05-2015	19:26
162	46.500	-152.000	30.0	4854	II	4.05	1.45	2.86	17.29	06-05-2015	23:30	06-06-2015	03:01
163	47.000	-152.000	30.0	5167	III	4.27	1.45	2.86	17.59	06-06-2015	07:17	06-06-2015	10:09
164	47.500	-152.000	30.0	5010	I	4.16	1.45	2.86	17.90	06 06-2015	14:18	06-06-2015	17:30
165	48.000	-152.000	30.0	4896	II	4.08	1.45	2.86	18.18	06-06-2015	21:35	06-07-2015	00:26
166	48.500	-152.000	30.0	5019	III	4.17	1.45	2.86	18.51	06-07-2015	04:36	06-07-2015	08:08
167	49.000	-152.000	30.0	4980	I	4.14	1.45	2.86	18.81	06-07-2015	12:16	06-07-2015	15:28
168	49.500	-152.000	30.0	4994	II	4.40	1.45	2.86	19.10	06-07-2015	19:52	06-07-2015	22:28
169	50.000	-152.000	30.0	4943	III	4.12	1.45	2.86	19.42	06-08-2015	02:35	06-08-2015	06:07
170	50.500	-152.000	30.0	5005	I	4.16	1.45	2.86	19.73	06-08-2015	10:16	06-08-2015	13:27
171	51.000	-152.000	30.0	4977	II	4.14	1.45	2.86	20.02	06-08-2015	17:36	06-08-2015	20:27
172	51.500	-152.000	30.0	4744	III	3.98	1.45	2.86	20.33	06-09-2015	00:26	06-09-2015	03:57
173	52.000	-152.000	30.0	5087	I	4.22	1.45	2.86	20.63	06-09-2015	08:10	06-09-2015	11:02
174	52.500	-152.000	30.0	4403	II	3.74	1.45	2.86	20.91	06-09-2015	14:46	06-09-2015	17:57
175	53.000	-152.000	30.0	4477	III	3.79	1.45	2.86	21.19	06-09-2015	21:44	06-10-2015	00:36
176	53.500	-152.000	30.0	4704	I	3.95	1.45	2.86	21.50	06-10-2015	04:33	06-10-2015	08:04
177	54.000	-152.000	19.8	4584	II	3.86	1.45	1.89	21.77	06-10-2015	11:56	06-10-2015	14:31
178	54.330	-152.000	22.6	4176	III	3.58	1.45	2.15	22.01	06-10-2015	18:05	06-10-2015	20:20
179	54.700	-152.115	35.5	4333	I	3.69	1.45	3.08	22.32	06-11-2015	00:01	06-11-2015	03:46
180	55.260	-152.445	12.4	4465	II	3.78	1.45	1.18	22.58	06-11-2015	07:33	06-11-2015	09:48
181	55.450	-152.590	18.2	5159	III	4.27	1.45	1.74	22.85	06-11-2015	14:04	06-11-2015	16:19
182	55.730	-152.798	9.1	4420	I	3.75	1.45	0.87	23.10	06-11-2015	20:04	06-11-2015	22:19
183	55.870	-152.903	5.4	4051	II	3.49	1.45	0.51	23.36	06-12-2015	01:48	06-12-2015	04:43
184	55.950	-152.976	5.4	2697	III	2.51	1.32	0.51	23.56	06-12-2015	07:14	06-12-2015	09:29
185	56.030	-153.049	7.0	1977	I	1.97	1.20	0.67	23.75	06-12-2015	11:27	06-12-2015	14:02
186	56.140	-153.118	6.4	1364	II	1.51	1.07	0.61	23.91	06-12-2015	15:33	06-12-2015	17:48
187	56.240	-153.187	3.4	964	III	1.21	0.95	0.32	24.05	06-12-2015	19:00	06-12-2015	21:15

188	56.290	-153.233	9.7	272	I	0.69	0.82	0.92	24.17	06-12-2015	21:57	06-13-2015	00:12
189	56.440	-153.342	40.0	47	II	0.49	0.62	3.48	24.37	06-13-2015	00:41	06-13-2015	04:50
190	56.280	-154.511	40.0	79	III	0.52	0.66	3.48	24.53	06-13-2015	05:21	06-13-2015	08:49

Table 1b continued

Leg 2 STA	LAT	LONG	DIST (nm)	DEPTH (m)	STAG	ONSTA (hrs)	DRAW (hrs)	STEAM tonext	ELPSD days	DATE leave	LVTIME (GMT)	DATE nxtsta	ARTIME (GMT)
191	56.120	-155.674	39.9	64	I	0.50	0.62	3.47	24.70	06-13-2015	09:19	06-13-2015	12:48
192	55.960	-156.831	40.0	28	II	0.46	0.57	3.48	24.88	06-13-2015	13:16	06-13-2015	17:04
193	55.800	-157.986	31.1	117	III	0.55	0.70	2.96	25.02	06-13-2015	17:38	06-13-2015	20:35
194	55.680	-158.881	39.2	155	I	0.59	0.74	3.41	25.19	06-13-2015	21:11	06-14-2015	00:35
195	55.250	-158.015	32.3	88	II	0.53	0.70	3.08	25.37	06-14-2015	01:07	06-14-2015	04:52
196	54.750	-158.365	10.2	210	III	0.64	0.78	0.97	25.49	06-14-2015	05:30	06-14-2015	07:45
197	54.600	-158.502	6.4	565	I	0.94	1.03	0.60	25.62	06-14-2015	08:42	06-14-2015	10:57
198	54.530	-158.365	3.6	1410	II	1.55	1.07	0.35	25.79	06-14-2015	12:29	06-14-2015	15:04
199	54.490	-158.287	11.6	1908	III	1.92	1.16	1.11	25.97	06-14-2015	16:59	06-14-2015	19:14
200	54.360	-158.040	7.8	3022	I	2.75	1.41	0.74	26.18	06-14-2015	21:59	06-15-2015	00:14
201	54.270	-157.880	24.7	4075	II	3.50	1.45	2.35	26.45	06-15-2015	03:45	06-15-2015	06:46
202	53.990	-157.364	20.3	5519	III	4.52	1.45	1.93	26.74	06-15-2015	11:17	06-15-2015	13:52
203	53.790	-156.902	29.4	4860	I	4.06	1.45	2.80	27.03	06-15-2015	17:56	06-15-2015	20:44
204	53.450	-156.307	30.8	4659	II	3.92	1.45	2.93	27.34	06-16-2015	00:39	06-16-2015	04:15
205	53.130	-155.635	40.7	4499	III	3.80	1.45	3.54	27.65	06-16-2015	08:03	06-16-2015	11:35
206	53.330	-154.552	40.7	4356	I	3.70	1.45	3.54	27.96	06-16-2015	15:17	06-16-2015	19:10
207	53.540	-153.470	40.3	4630	II	3.89	1.45	3.51	28.30	06-16-2015	23:03	06-17-2015	03:14
208	53.740	-152.388	40.2	4720	III	3.96	1.45	3.49	28.61	06-17-2015	07:11	06-17-2015	10:41
209	53.940	-151.305	40.0	4096	I	3.52	1.45	3.48	28.92	06-17-2015	14:12	06-17-2015	18:00
210	54.140	-150.223	40.0	3916	II	3.39	1.45	3.48	29.20	06-17-2015	21:24	06-18-2015	00:53
211	54.350	-149.140	39.6	3502	III	3.10	1.45	3.44	29.50	06-18-2015	03:59	06-18-2015	08:05
212	54.550	-148.058	39.4	4041	I	3.48	1.45	3.43	29.81	06-18-2015	11:34	06-18-2015	15:20
213	54.750	-146.976	39.3	4206	II	3.60	1.45	3.42	30.10	06-18-2015	18:56	06-18-2015	22:21
214	54.950	-145.893	39.3	4127	III	3.54	1.45	3.41	30.42	06-19-2015	01:53	06-19-2015	05:58
215	55.160	-144.811	38.9	4017	I	3.46	1.45	3.38	30.70	06-19-2015	09:26	06-19-2015	12:49
216	55.360	-143.728	38.7	3850	II	3.35	1.45	3.37	30.99	06-19-2015	16:10	06-19-2015	19:52
217	55.560	-142.646	38.6	3686	III	3.23	1.45	3.35	31.30	06-19-2015	23:05	06-20-2015	03:07
218	55.760	-141.563	38.5	3315	I	2.97	1.45	3.35	31.56	06-20-2015	06:05	06-20-2015	09:26
219	55.970	-140.481	38.2	3476	II	3.08	1.45	3.32	31.84	06-20-2015	12:31	06-20-2015	16:10
220	56.170	-139.399	38.0	3312	III	2.97	1.45	3.31	32.10	06-20-2015	19:08	06-20-2015	22:26
221	56.370	-138.316	29.2	3127	I	2.83	1.41	2.78	32.36	06-21-2015	01:16	06-21-2015	04:43
222	56.520	-137.478	44.1	2649	II	2.47	1.32	3.83	32.63	06-21-2015	07:11	06-21-2015	11:01
223	56.750	-136.210	7.4	1535	III	1.63	1.07	0.70	32.80	06-21-2015	12:39	06-21-2015	15:14
224	56.780	-135.993	94.7	564	I	0.94	1.03	8.24	33.18	06-21-2015	16:11	06-22-2015	00:25
-999	56.220	-138.667	500.6	0	-	0.00	0.00	43.53	35.00	06-22-2015	00:25	06-23-2015	19:57
-999	49.040	-131.667	119.0	0	-	0.00	0.00	10.35	35.43	06-23-2015	19:57	06-24-2015	06:18
-999	48.820	-128.667	19.9	0	-	0.00	0.00	1.73	35.52	06-24-2015	06:18	06-24-2015	08:33
-999	48.780	-128.167	19.9	0	-	0.00	0.00	1.73	35.62	06-24-2015	08:33	06-24-2015	10:48
-999	48.740	-127.667	20.0	0	-	0.00	0.00	1.74	35.71	06-24-2015	10:48	06-24-2015	13:03
-999	48.690	-127.167	20.0	0	-	0.00	0.00	1.74	35.80	06-24-2015	13:03	06-24-2015	15:18
-999	48.650	-126.667	13.4	0	-	0.00	0.00	1.16	35.90	06-24-2015	15:18	06-24-2015	17:33
-999	48.620	-126.333	13.3	0	-	0.00	0.00	1.15	35.99	06-24-2015	17:33	06-24-2015	19:48
-999	48.600	-126.000	19.9	0	-	0.00	0.00	1.73	36.09	06-24-2015	19:48	06-24-2015	22:03
-999	48.580	-125.500	117.1	0	-	0.00	0.00	10.18	36.51	06-24-2015	22:03	06-25-2015	08:13
-999	48.000	-122.700	28.9	0	-	0.00	0.00	2.51	36.61	06-25-2015	08:13	06-25-2015	10:44
PORT	47.600	-122.300	0.0	0	-	0.00	0.00	0.00	36.61	06-25-2015	10:44	06-25-2015	10:44

Leg 2 Final Date and Time: 06-25-15 10:44 (GMT) =02:44 (Seattle) = GMT - 8

Table 1c
Stations to be included in Leg 2 if time permits.

BETWEEN STA	STA	LAT	LONG	DEPTH (m)
189	190	56.360	-153.926	76
191	192	56.200	-155.092	33
192	193	56.040	-156.252	164
195	196	55.470	-158.447	151
196	197	55.000	-157.992	89
198	199	54.570	-158.443	1063
200	201	54.380	-158.085	2566
202	203	54.190	-157.729	5059
224	225	56.680	-136.594	2091
224	225	56.780	-136.038	1097
225	end	56.790	-135.951	230

Appendix B. Equipment list including Hazmat for P16N Cruises

1. AOML/RSMAS VAN:

- CTD: Greg Johnson - PMEL / Molly Baringer – AOML
  - CTD rosette and instruments will be packed in container
    - Transmissometer: Wilf Gardner - TAMU
    - UVP: Andrew McDonnell – UAF
    - Fluorometer: Norm Nelson (UCSB)
    - Chipods: Jonathan Nash
  - Extra LADCP battery packs (but not the instrument)
- Salinity: Molly Baringer - AOML
  - Salinometer will be packed in container

2. CFC VAN:

- CFC van contains its own laboratory space and instrumentation.
- Equipment for nutrient and oxygen analysis is also packaged in this van.
- The hazmat listed below will be packed according to DOT regulations and can be stored in the van during the transit from San Diego.

Group	Common Name	Quantity	Notes	Trained Individual		Spill Control	Where stored during TAO?
				Leg 1	Leg 2		

AOML-Nutrients	Ammonium molybdate	45x 7.1g	Granular Solid	Charles Fischer	Charles Fischer		PMEL CFC Van
AOML-Nutrients	Ammonium molybdate	45x 10.8g	Granular Solid	Charles Fischer	Charles Fischer		PMEL CFC Van
AOML-Nutrients	Ascorbic Acid	45x 17.6g	Granular Solid	Charles Fischer	Charles Fischer		PMEL CFC Van
AOML-Nutrients	Brij-35, 21%	2x 125 mL	Liquid	Charles Fischer	Charles Fischer		PMEL CFC Van
AOML-Nutrients	Cadmium metal granular	2x 25g	Granular Solid	Charles Fischer	Charles Fischer		PMEL CFC Van
AOML-Nutrients	Culpric Sufate (Copper Sulfate)	5x 20g	Granular Solid	Charles Fischer	Charles Fischer		PMEL CFC Van
AOML-Nutrients	Dodecyl sodium salt, 15%	2x 500 mL	Liquid	Charles Fischer	Charles Fischer		PMEL CFC Van
AOML-Nutrients	Hydrazine Sulfate	30x 10g	Granular Solid	Charles Fischer	Charles Fischer		PMEL CFC Van
AOML-Nutrients	Hydrochloric Acid 32-38%	24x 500 mL	Liquid	Charles Fischer	Charles Fischer	A	PMEL CFC Van
AOML-Nutrients	Imidazole	30 x 13.6g	Granular Solid	Charles Fischer	Charles Fischer		PMEL CFC Van
AOML-Nutrients	NEDA	30x 1g	Granular Solid	Charles Fischer	Charles Fischer		PMEL CFC Van
AOML-Nutrients	Oxalic Acid	45x 50g	Granular Solid	Charles Fischer	Charles Fischer		PMEL CFC Van
AOML-Nutrients	Potassium Nitrate	8x 4g	Granular solid	Charles Fischer	Charles Fischer		PMEL CFC Van
AOML-Nutrients	Potassium phosphate monobasic	8x 0.5g	Granular solid	Charles Fischer	Charles Fischer		PMEL CFC Van
AOML-Nutrients	Sodium hexafluorosilicate	16x 0.9 g	Granular solid	Charles Fischer	Charles Fischer		PMEL CFC Van

AOML-Nutrients	Sodium Hydroxide	20g	Granular Solid	Charles Fischer	Charles Fischer		PMEL CFC Van
AOML-Nutrients	Sodium Hydroxide 10N	15x 30mL	Liquid	Charles Fischer	Charles Fischer		PMEL CFC Van
AOML-Nutrients	Sodium nitrate	20x 0.3g	Granular solid	Charles Fischer	Charles Fischer		PMEL CFC Van
AOML-Nutrients	Sulfanilamide	3 x 10g	Granular Solid	Charles Fischer	Charles Fischer		PMEL CFC Van
AOML-Nutrients	Sulfuric Acid 90-98%	18x 500 mL	Acid	Charles Fischer	Charles Fischer	A	PMEL CFC Van
AOML-Oxygen	Manganese Chloride (1M)	9x 1L	Liquid	Brian Locher	Chris Langdon		PMEL CFC Van
AOML-Oxygen	Potassium Hydroxide	9x 1L	Liquid	Brian Locher	Chris Langdon		PMEL CFC Van
AOML-Oxygen	Potassium Iodate	9x 0.5L	Liquid	Brian Locher	Chris Langdon		PMEL CFC Van
AOML-Oxygen	Sodium thiosulfate	20x 1g	Granular Solid	Brian Locher	Chris Langdon		PMEL CFC Van
AOML-Oxygen	Sulfuric Acid	9x 1L	Acid	Brian Locher	Chris Langdon	A	PMEL CFC Van
PMEL-CFC	5% Methane in Argon	1 cylinder	Compressed Gas	D. Wisegarver	D. Wisegarver		PMEL CFC Van
PMEL-CFC	Ascarite	1 kg	Granular solid	D. Wisegarver	D. Wisegarver		PMEL CFC Van
PMEL-CFC	Ethanol	20 pints	Solvent	D. Wisegarver	D. Wisegarver		PMEL CFC Van
PMEL-CFC	Magnesium perchlorate	2 kg	Granular solid	D. Wisegarver	D. Wisegarver		PMEL CFC Van
PMEL-CFC	N2 (normal cylinder)	8 cylinders	Compressed gas	D. Wisegarver	D. Wisegarver		PMEL CFC Van

PMEL-CFC	N2 (small cyllinder)	5 cylinders	Compress ed gas	D. Wisegarve r	D. Wisegarve r		PMEL CFC Van

3. DIC VAN:

- Total CO_2(DIC): Simone Alin – PMEL / Rik Wanninkhof - AOML
- DIC Van contains its own laboratory space and instruments.
- Supplies for the analysis of Total Alkalinity will also be packed in this container.
- The hazmat listed below will be packed according to DOT regulations and can be stored in the van during the transit from San Diego.
- The non-hazardous reference materials listed below are temperature sensitive. In conjunction with TAO, we loaded these cases for storage in the wet lab during the transit from San Diego, and will move them to a more appropriate space during P16N.

Group	**Common Name**	**Quantity**	**Notes**	**Trained Individual**		**Spill Control**	**Where stored during TAO?**
				Leg 1	**Leg 2**		
Scripps-Alkalinity	Certified reference	200 x 0.5 L in 10 cases	Liquid	D. Cervantes	D. Cervantes	NR	Wet Lab
PMEL-DIC	Certified reference	240x 500 mL bottles in 12 cases	Seawater standard	D. Greeley	B. Carter	NR	Wet Lab
Scripps-Alkalinity	Mercuric Chloride	2x 25g	Granular salt	D. Cervantes	D. Cervantes	M	PMEL DIC Van
Scripps-Alkalinity	Meta-cresol purple	1g	Solid	D. Cervantes	D. Cervantes		PMEL DIC Van
Scripps-Alkalinity	sodium chloride	54 g	Solid	D. Cervantes	D. Cervantes	NR	PMEL DIC Van
Scripps-Alkalinity	Sodium hydroxide	1.5 g	Solid	D. Cervantes	D. Cervantes		PMEL DIC Van
Scripps-Alkalinity	Tris buffer reference	15 x 0.25 L	Liquid	D. Cervantes	D. Cervantes	NR	PMEL DIC Van
PMEL-DIC	Acetone	6x 1L	Solvent	D. Greeley	B. Carter		PMEL DIC Van
PMEL-DIC	CO2 + N2	1 cyllinder	Compress ed Gas	D. Greeley	B. Carter		PMEL DIC Van

PMEL-DIC	Coulometer solution (anode)	12x 0.5L	Liquid	D. Greeley	B. Carter	NR	PMEL DIC Van
PMEL-DIC	Coulometer solution (cathode)	9 gallons	Liquid	D. Greeley	B. Carter	NR	PMEL DIC Van
PMEL-DIC	Magnesium perchlorate	2x 500 g	Granular Salt	D. Greeley	B. Carter		PMEL DIC Van
PMEL-DIC	Mercuric Chloride	6 x 5g	Granular salt	D. Greeley	B. Carter	M	PMEL DIC Van
PMEL-DIC	Nitrogen	1 cylinder	Compressed gas	D. Greeley	B. Carter		PMEL DIC Van
PMEL-DIC	Phosphoric Acid	3x 0.5L bottles	Acid	D. Greeley	B. Carter	A	PMEL DIC Van
PMEL-DIC	Potassium Iodide	20x 50 g	Granular Salt	D. Greeley	B. Carter	NR	PMEL DIC Van
PMEL-DIC	Pure CO2	6 cylinders (0.5L each)	Compressed Gas	D. Greeley	B. Carter		PMEL DIC Van
PMEL-DIC	Soda Lime	2x 500g	Granular Salt	D. Greeley	B. Carter	NR	PMEL DIC Van
UW-Chipods	Lithium-Ion batteries	16x 4.5g Li /cell, 72g Li total	Battery	M. Jimenez Urias	Bryan Kaiser		PMEL DIC Van

4. **<u>Helium/Tritium Van: William Jenkins – WHOI</u>**

- 580 copper tube samples, 1L each
- 580 tritium samples, 1.25L each
- Cold welding (air compression) sealer
- Empty cubitainers for cesium sampling sent in this van
- Empty containers for collection of 14DIC

5. <u>Pteropods: Nina Bednarsek – UW</u>

- 1x 4x4x4 pallet of scientific equipment, including a bongo net
- The hazmat listed below will be packaged according to DOT regulations and is being sent to Tahiti.

Group	Common Name	Quantity	Notes	Trained Individual		Spill Control	Where stored during TAO?
				Leg 1	Leg 2		
Pteropods	90% Ethanol	8 x 1L bottles	Solvent	A. McDonnell	N. Bednarsek		n/a

7. CDOM: Norm Nelson – UCSB

- 2x 4x4x4 pallets, total 580 kg
- Hazmat listed below was packaged according to DOT regulations and was loaded into RHB's hazmat locker in San Diego:

Group	Common Name	Quantity	Notes	Trained Individual		Spill Control	Where stored during TAO?
				Leg 1	Leg 2		
UCSB-CDOM	Acetone	6x 1L	Solvent	Norm Nelson	Erik Stassinos		Hazmat locker
UCSB-CDOM	Contrad NF alkaline detergent	3.8L	Non-hazardous detergent	Norm Nelson	Erik Stassinos		Hazmat locker
UCSB-CDOM	Hydrochloric Acid	2.5L	Acid	Norm Nelson	Erik Stassinos	A	Hazmat locker
UCSB-CDOM	Isopropyl Alcohol 70%	500 mL	Solvent	Norm Nelson	Erik Stassinos		Hazmat locker
UCSB-CDOM	Methanol	4L	Solvent	Norm Nelson	Erik Stassinos		Hazmat locker

8. ^{14}C / carbon isotopes: Ellen Druffel – UCI

- 2x 2Lx30Wx32H crates, ~14 cu ft. each
- 4x 26Lx19Wx16H totes, ~7 cu ft. each
- No Hazmat

9. LADCP: Andreas Thurnherr –LDEO

- Battery / gyro

10. Floats: Greg Johnson – PMEL

- 25 Floats will be loaded in San Diego, with 9 to be deployed during TAO and 14 to be deployed during P16N. These floats will be stored on an expanded rack in the main lab during both the TAO transit from San Diego and during the P16N cruise (both legs).

Appendix C. List of Chemicals

A listing of hazardous materials is given below, including the responsible group, trained individuals, storage spaces, and name, quantity, and description of materials, as well as the trained individual and spill control response. As in section IV-C listed above, spill control abbreviations indicate Acid (A), Mercury (M), Formalin (F). Non-regulated materials are indicated by NR.

Group	Common Name	Quantity	Notes	Trained Individual		Spill Control	Where stored during TAO?
				Leg 1	Leg 2		
UCSB-CDOM	Acetone	6x 1L	Solvent	Norm Nelson	Erik Stassinos		Hazmat locker
UCSB-CDOM	Contrad NF alkaline detergent	3.8L	Non-hazardous detergent	Norm Nelson	Erik Stassinos		Hazmat locker
UCSB-CDOM	Hydrochloric Acid	2.5L	Acid	Norm Nelson	Erik Stassinos	A	Hazmat locker
UCSB-CDOM	Isopropyl Alcohol 70%	500 mL	Solvent	Norm Nelson	Erik Stassinos		Hazmat locker
UCSB-CDOM	Methanol	4L	Solvent	Norm Nelson	Erik Stassinos		Hazmat locker
Scripps-Alkalinity	Certified reference	200 x 0.5 L in 10 cases	Liquid	D. Cervantes	D. Cervantes	NR	Wet Lab
PMEL-DIC	Certified reference	240x 500 mL bottles in 12 cases	Seawater standard	D. Greeley	B. Carter	NR	Wet Lab
Scripps-Alkalinity	Mercuric Chloride	2x 25g	Granular salt	D. Cervantes	D. Cervantes	M	PMEL DIC Van
Scripps-Alkalinity	Meta-cresol purple	1g	Solid	D. Cervantes	D. Cervantes		PMEL DIC Van
Scripps-Alkalinity	sodium chloride	54 g	Solid	D. Cervantes	D. Cervantes	NR	PMEL DIC Van
Scripps-Alkalinity	Sodium hydroxide	1.5 g	Solid	D. Cervantes	D. Cervantes		PMEL DIC Van
Scripps-Alkalinity	Tris buffer reference	15 x 0.25 L	Liquid	D. Cervantes	D. Cervantes	NR	PMEL DIC Van

PMEL-DIC	Acetone	6x 1L	Solvent	D. Greeley	B. Carter		PMEL DIC Van
PMEL-DIC	CO2 + N2	1 cyllinder	Compressed Gas	D. Greeley	B. Carter		PMEL DIC Van
PMEL-DIC	Coulometer solution (anode)	12x 0.5L	Liquid	D. Greeley	B. Carter	NR	PMEL DIC Van
PMEL-DIC	Coulometer solution (cathode)	9 gallons	Liquid	D. Greeley	B. Carter	NR	PMEL DIC Van
PMEL-DIC	Magnesium perchlorate	2x 500 g	Granular Salt	D. Greeley	B. Carter		PMEL DIC Van
PMEL-DIC	Mercuric Chloride	6 x 5g	Granular salt	D. Greeley	B. Carter	M	PMEL DIC Van
PMEL-DIC	Nitrogen	1 cylinder	Compressed gas	D. Greeley	B. Carter		PMEL DIC Van
PMEL-DIC	Phosphoric Acid	3x 0.5L bottles	Acid	D. Greeley	B. Carter	A	PMEL DIC Van
PMEL-DIC	Potassium Iodide	20x 50 g	Granular Salt	D. Greeley	B. Carter	NR	PMEL DIC Van
PMEL-DIC	Pure CO2	6 cylinders (0.5L each)	Compressed Gas	D. Greeley	B. Carter		PMEL DIC Van
PMEL-DIC	Soda Lime	2x 500g	Granular Salt	D. Greeley	B. Carter	NR	PMEL DIC Van
UW-Chipods	Lithium-Ion batteries	16x 4.5g Li /cell, 72g Li total	Battery	M. Jimenez Urias	Bryan Kaiser		PMEL DIC Van
AOML-Nutrients	Ammonium molybdate	45x 7.1g	Granular Solid	Charles Fischer	Charles Fischer		PMEL CFC Van
AOML-Nutrients	Ammonium molybdate	45x 10.8g	Granular Solid	Charles Fischer	Charles Fischer		PMEL CFC Van
AOML-	Ascorbic	45x 17.6g	Granular	Charles	Charles		PMEL

Nutrients	Acid		Solid	Fischer	Fischer		CFC Van
AOML-Nutrients	Brij-35, 21%	2x 125 mL	Liquid	Charles Fischer	Charles Fischer		PMEL CFC Van
AOML-Nutrients	Cadmium metal granular	2x 25g	Granular Solid	Charles Fischer	Charles Fischer		PMEL CFC Van
AOML-Nutrients	Culpric Sufate (Copper Sulfate)	5x 20g	Granular Solid	Charles Fischer	Charles Fischer		PMEL CFC Van
AOML-Nutrients	Dodecyl sodium salt, 15%	2x 500 mL	Liquid	Charles Fischer	Charles Fischer		PMEL CFC Van
AOML-Nutrients	Hydrazine Sulfate	30x 10g	Granular Solid	Charles Fischer	Charles Fischer		PMEL CFC Van
AOML-Nutrients	Hydrochlo ric Acid 32-38%	24x 500 mL	Liquid	Charles Fischer	Charles Fischer	A	PMEL CFC Van
AOML-Nutrients	Imidazole	30 x 13.6g	Granular Solid	Charles Fischer	Charles Fischer		PMEL CFC Van
AOML-Nutrients	NEDA	30x 1g	Granular Solid	Charles Fischer	Charles Fischer		PMEL CFC Van
AOML-Nutrients	Oxalic Acid	45x 50g	Granular Solid	Charles Fischer	Charles Fischer		PMEL CFC Van
AOML-Nutrients	Potassium Nitrate	8x 4g	Granular solid	Charles Fischer	Charles Fischer		PMEL CFC Van
AOML-Nutrients	Potassium phosphate monobasic	8x 0.5g	Granular solid	Charles Fischer	Charles Fischer		PMEL CFC Van
AOML-Nutrients	Sodium hexafluoro silicate	16x 0.9 g	Granular solid	Charles Fischer	Charles Fischer		PMEL CFC Van
AOML-Nutrients	Sodium Hydroxide	20g	Granular Solid	Charles Fischer	Charles Fischer		PMEL CFC Van
AOML-Nutrients	Sodium Hydroxide 10N	15x 30mL	Liquid	Charles Fischer	Charles Fischer		PMEL CFC Van
AOML-Nutrients	Sodium nitrate	20x 0.3g	Granular solid	Charles Fischer	Charles Fischer		PMEL CFC Van

AOML-Nutrients	Sulfanilamide	3 x 10g	Granular Solid	Charles Fischer	Charles Fischer		PMEL CFC Van
AOML-Nutrients	Sulfuric Acid 90-98%	18x 500 mL	Acid	Charles Fischer	Charles Fischer	A	PMEL CFC Van
AOML-Oxygen	Manganese Chloride (1M)	9x 1L	Liquid	Brian Locher	Chris Langdon		PMEL CFC Van
AOML-Oxygen	Potassium Hydroxide	9x 1L	Liquid	Brian Locher	Chris Langdon		PMEL CFC Van
AOML-Oxygen	Potassium Iodate	9x 0.5L	Liquid	Brian Locher	Chris Langdon		PMEL CFC Van
AOML-Oxygen	Sodium thiosulfate	20x 1g	Granular Solid	Brian Locher	Chris Langdon		PMEL CFC Van
AOML-Oxygen	Sulfuric Acid	9x 1L	Acid	Brian Locher	Chris Langdon	A	PMEL CFC Van
PMEL-CFC	5% Methane in Argon	1 cylinder	Compressed Gas	D. Wisegarver	D. Wisegarver		PMEL CFC Van
PMEL-CFC	Ascarite	1 kg	Granular solid	D. Wisegarver	D. Wisegarver		PMEL CFC Van
PMEL-CFC	Ethanol	20 pints	Solvent	D. Wisegarver	D. Wisegarver		PMEL CFC Van
PMEL-CFC	Magnesium perchlorate	2 kg	Granular solid	D. Wisegarver	D. Wisegarver		PMEL CFC Van
PMEL-CFC	N2 (normal cylinder)	8 cylinders	Compressed gas	D. Wisegarver	D. Wisegarver		PMEL CFC Van
PMEL-CFC	N2 (small cyllinder)	5 cylinders	Compressed gas	D. Wisegarver	D. Wisegarver		PMEL CFC Van
PMEL-DIC	90% Ethanol	8 x 1L bottles	Solvent	A. McDonnell	N. Bednarsek		n/a