PMEL

Pacific Marine Environmental Laboratory

DY17-04 Final Project Instructions

Date Submitted: **March 20, 2017**

Platform: NOAA Ship *Oscar Dyson*

Project Number: DY-17-04

Project Title: Eco-FOCI Spring Moorings

Project Dates: **April 22 – May 08, 2017**

Prepared by: ______________________ Dated: 3-20-2017
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NOAA-PMEL-Eco-FOCI/JISAO

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Commanding Officer
Marine Operations Center – Pacific

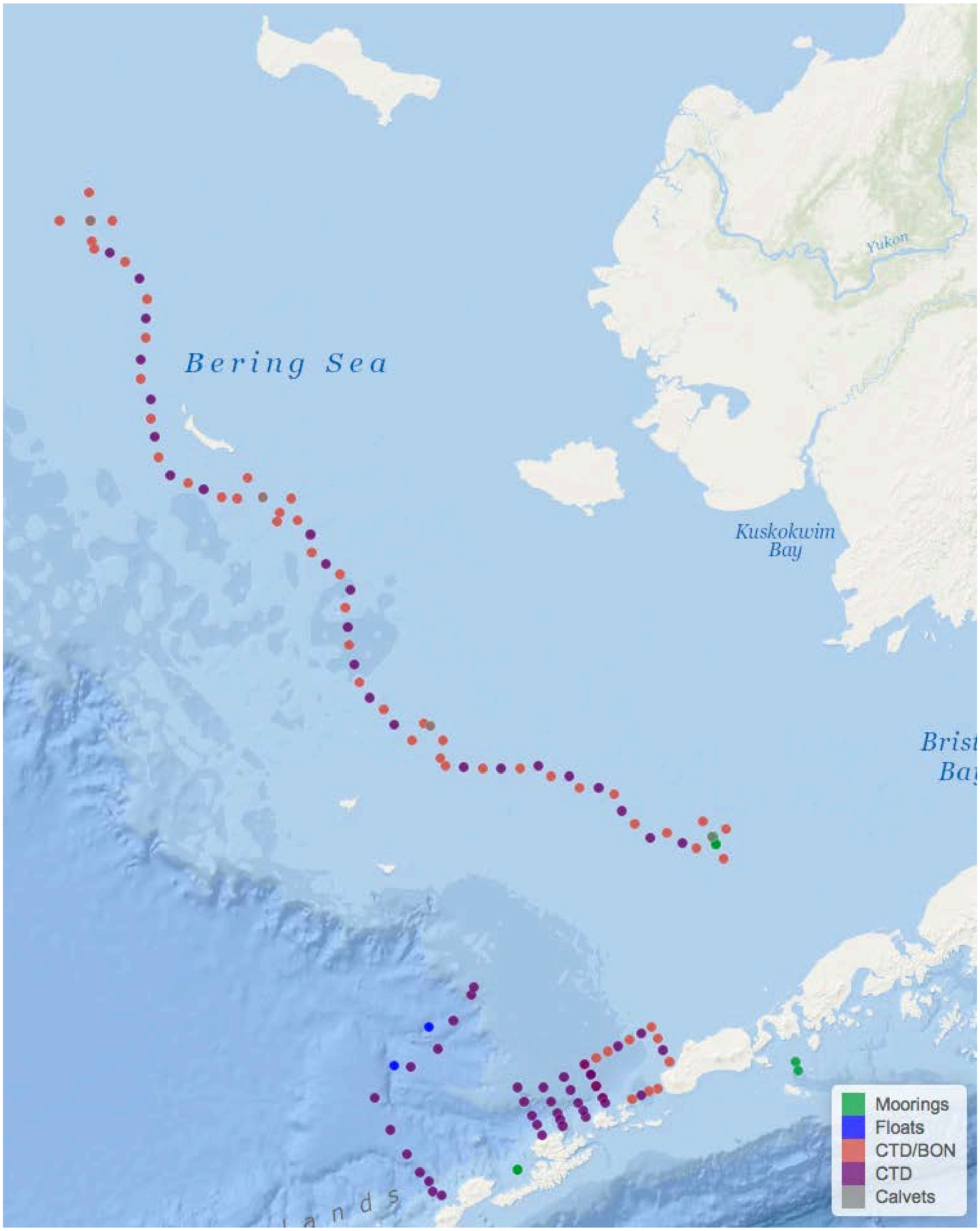
I. Overview

A. Brief Summary and Project Period: Eco-FOCI Spring 2017 Moorings; April 22, to May 08, 2017

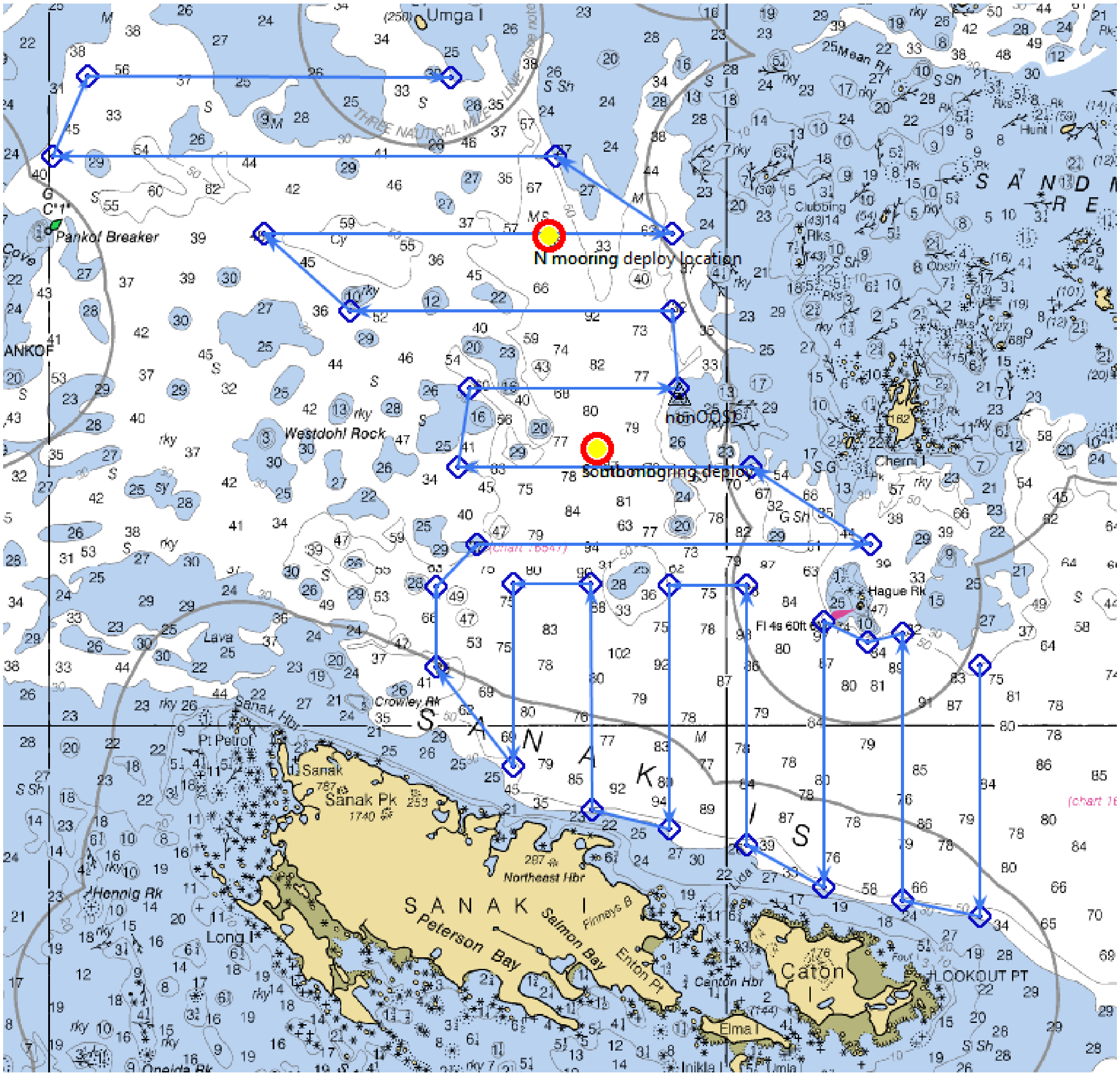
B. Days at Sea (DAS)

Of the 17 DAS scheduled for this project, 0 DAS are funded by an OMAO allocation, 17 DAS are funded by a Line Office Allocation, 0 DAS are Program Funded, and 0 DAS are Other Agency funded. This project is estimated to exhibit a High Operational Tempo.

C. Operating Area:



Area of operations in the Bering Sea including mooring sites, the Unimak Box, L-Line, Bering Canyon, and 70-meter isobath.



Area of operations for the Sanak Trough Mooring recovery. The track-line for the DY1701 survey, some parts of which may be repeated during this survey time permitting, are shown as well.

North Mooring: N 54° 42.606' W 162° 37. 872' (124 m)
South Mooring: N 54° 37.151' W 162° 35.695' (149 m)

D. Summary of Objectives

This project is intended to recover and deploy one (1) subsurface mooring in Chiniak Bay in the Gulf of Alaska; recover two (2) subsurface moorings at Sanak Trough in the Gulf of Alaska; recover two (2) subsurface moorings at Site M2 in the Bering Sea and deploy two (2) surface moorings and one (1) subsurface moorings at Site M2. Additionally, a oceanographic survey will be conducted in the Bering Sea consisting of conductivity, temperature and depth (CTD) profile casts, bongo net tows, California Vertical Egg Tow (CalVET) casts and use of the Acrobat Towed Vehicle. One (1) marine mammal subsurface mooring will be recovered and deployed off Umnak Island.

Additional projects may include:

1. Test of the Oculus Coastal Glider in the Bering Sea along the 70m isobath or other features of interest.
2. **R**apid **Z**ooplankton **A**ssessment (RZA), on select bongo tows, one net will be analyzed for a rapid assessment of the species and their abundance in the zooplankton community.
3. Search for a sunken crab fishing vessel (F/V Destination) using side-scan sonar, underwater camera and the ship's acoustic survey sonar.

The ship will depart Kodiak, AK and transit to Chiniak Bay to recover a subsurface mooring and deploy a subsurface mooring.

The ship will then proceed to the vicinity of Sanak Island to recover two subsurface moorings for AFSC. This operation may require small boat operations depending upon sea conditions.

The ship will then transit to Dutch Harbor, AK to disembark the two personnel from the Sanak Trough moorings project using the small boat (weather dependent).

After disembarking the personnel at Dutch Harbor, the ship will proceed to Unimak Pass and commence a CTD and bongo survey of the pass using the grid denoted as the Unimak Box.

Upon completion of the Unimak Box the ship will proceed to FOCI Site 2 (M2) to recover two subsurface moorings and deploy one subsurface and two surface moorings. A CTD will be conducted prior and subsequent to the mooring operations within ¼ mile of the moorings. Additionally, a series of CTDs, bongo tows and CalVETs will be conducted in a box around the mooring site. These may be accomplished before or after the mooring operations depending up on the weather and the time of arrival at Site 2.

While at the M2 mooring site, the Oculus Glider will be deployed; this will occur before the mooring operations at the site.

The ship will then proceed north along the 70m isobath, conducting CTDs, bongos and CalVETs per the attached list, going as far north as the ice conditions permit.

After completion of as much of the 70m line as may be safely accomplished, the ship will then proceed south to the beginning of 'L-line' set of stations. While the ship transits south the Acrobat Towed Vehicle may be deployed for further oceanographic surveys .

During the transit south to the L-line the ship will recover the Oculus glider if it has not already been recovered.
As time permits sampling will proceed along the L-line and the Bering Canyon transects.
While sampling along the L-line, two ARGO floats will be deployed in water over 2000 meters deep.
A Marine Mammal Mooring (M^3) will be recovered and deployed off Umnak Island.

E. Participating Institutions:

NOAA – Pacific Marine Environmental Laboratory (PMEL)
7600 Sand Point Way NE, Seattle, WA 98115

Joint Institute for the Study of the Atmosphere and Oceans (JISAO)
University of Washington
3737 Brooklyn Ave. NE
Seattle, WA 98105-6715

NOAA – Alaska Fisheries Science Center (AFSC)
7600 Sand Point Way NE, Seattle WA 98115

University of Alaska (UAF)
505 South Chandalar Drive
Fairbanks, AK 99775

F. Personnel/Science Party: name, title, gender, affiliation, and nationality

Name (Last, First)	**Title**	**Date Aboard**	**Date Disembark**	**Gender**	**Affiliation**	**Nationality**
Proctor, Peter	CS	04/20/2017	05/09/2017	M	JISAO	USA
Lebon, Geoffrey	Sci.	04/20/2017	05/09/2017	M	JISAO	USA
Langis, Daniel	Sci.	04/20/2017	05/08/2017	M	NOAA Corps	USA
Tabisola, Heather	Sci.	04/21/2017	05/08/2017	F	JISAO	USA
Harpold, Colleen	Sci.	04/21/2017	05/08/2017	F	AFSC	USA
Busby, Morgan	Sci.	04/21/2017	05/08/2017	M	AFSC	USA
De Robertis, Alex	Sci.	04/21/2017	04/26/2017	M	AFSC	USA
Wilson, Chris	Sci.	04/21/2017	04/26/2017	M	AFSC	USA
Monacci, Natalie	Sci.	04/20/2017	05/08/2017	F	UAF	USA

G. Administrative

1. Points of Contact:

Dr. Peter Proctor (Chief Scientist); JISAO, 7600 Sand Point Way NE, Bldg. 3, Seattle, WA 98115; ph: (206) 526-6217; Peter.Proctor@NOAA.GOV

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Aras Zygas, LT (Operations Officer, NOAA Ship *Oscar Dyson*); NOAA Corps, 2002 SE Marine Science Dr., Newport, OR 97365; ph: (541) 867-8911 (Ship's VOIP), OPS.Oscar.Dyson@NOAA.GOV

2. Diplomatic Clearances

None Required.

3. Licenses and Permits

This project will be conducted under the Scientific Research Permit (U.S.) (SRP) #2017-B1 (U.S.); effective: February 1, 2017 to October 10, 2017. Issued to Douglas P. DeMaster, Science and Research Director – AFSC.

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:

Departure: Saturday, April 22, 2017; Kodiak, AK
Arrive: Monday, May 08, 2017; Dutch Harbor, AK

B. Staging and Destaging:

Two containers of equipment will be shipped from Seattle to Kodiak, AK and staged on the pier. Unloading of the containers and transfer of equipment to the ship will occur as appropriate prior to departure. Members of the scientific party will arrive at least two days prior to departure to assist in the loading of equipment and preparation of the moorings and setting up sampling gear in the labs and on deck. The science party will arrange their own vehicles for transporting personnel and equipment. At the end of the project, most equipment not needed later in the field season will remain on board to be off-loaded in Kodiak, AK for shipment back to Seattle. This will occur at the end of the subsequent project, DY17-05. To facilitate setting up the moorings, a crane operator will be needed during the normal work day hours on April 18 and 19.

Additional assistance will be needed from the engineering department and the deck force to mount the winch that will be used for the Acrobat Towed Vehicle on the port side of the after deck and install a block on the after A-frame for the towed vehicle.

Additional mooring equipment will be shipped from the University of Alaska, Fairbanks, to Kodiak for loading on the ship.

C. Operations to be Conducted:

Due to the time of year that this project occurs, the amount of mooring work accomplished and the sequence of operations will depend heavily upon ice conditions, weather and daylight. Decisions on which operations are to be conducted will be made on daily basis in consultation with the ship's command and the Chief Scientist and based upon conditions and priorities. A full list of Station IDs, including locations, is provided as Appendix I.

The ship is scheduled to depart Kodiak on Saturday, April 22, 2017 and transit to Chiniak Bay.

a) **Chiniak Bay moorings:** Upon arrival at Chiniak Bay, the subsurface mooring will be recovered and a new subsurface mooring deployed. At any time during the mooring ops, a calibration CTD will be conducted when it is convenient.
b) **Sanak Trough moorings:** At the Sanak Trough site, two subsurface moorings will be recovered. Due to the design of the moorings it may be necessary to launch a small boat (weather dependent) to retrieve the moorings as they do not have readily accessible attachment points (see photo in Appendix II). Additionally, some of the acoustic transects conducted during the Sanak AT survey (DY17-01) may be repeated

(See Appendix II). A small camera may be deployed using a fishing rod in an attempt to assess the presence or absence of fish in the area.

c) **Dutch Harbor debarkations of science party:** Upon arrival at Dutch Harbor, a small boat will be launched (weather dependent) to transport the disembarking personnel (DeRobertis and Wilson) ashore.

d) **Unimak Box CTDs:** CTDs will be taken at each of the 18 stations in the "box" around Unimak Pass. At each station within the pass and at every other station on the sides and across the top of the pass, a 20/60 cm bongo will be towed for the collection of zooplankton.

e) **Oculus Coastal Glider:** This project is still under development and subject to change; see Appendix III. However, it is proposed to launch the Oculus glider upon arrival at the M2 mooring site before commencement of mooring operations. This will give time for the glider to perform several dives and data transmissions and allow for evaluation of its operation. If it is performing as expected it will continue its deployment while the ship conducts the 70-meter isobath survey; the ship will then recover the glider while transiting to the beginning of the L-line. If the glider fails while the ship is in the vicinity of the mooring site, the glider will be recovered. Launching and recovery is preferred to be done by small boat operations (weather dependent).

f) **FOCI Bering Site 2:** Depending upon arrival time, the project will commence mooring operations or the CTD "box" will be conducted. Prior to commencement of mooring recovery operations, a calibration CTD will be conducted within ¼ mile of the mooring site. Due to sampling requirements, this may necessitate two CTDs to obtain all the water samples required. Two subsurface moorings will be recovered with the possibility that they may have been moved during the winter by the trawl fleet. Two surface moorings and one subsurface mooring will be deployed. Subsequent to the deployments another calibration CTD may be conducted. Additionally, a 20/60 cm bongo and triplicate CalVETs will be conducted at the calibration site. At four stations around Site 2 a CTD and 20/60 cm bongo tow will be completed; this is the "box" around Site 2.

g) **70-Meter Isobath Line:** A CTD cast with sampling for salinity, chlorophyll, nutrients and oxygen will be taken at each station along the 70-meter isobath. A 20/60 cm bongo tow will be conducted at every other station. Stations will commence at Site 2 and continue as far north as ice, weather and time permit. CTDs will be conducted to within 5 meters of the bottom unless it is deemed prudent to only go to within 10 meters. Winch speeds should be 30 meters/minute on both the downcast and upcast.

h) **FOCI Bering Sea Moorings, Sites 4, 5, & 8:** If weather and ice conditions permit access to these sites, using a sampling scenario similar to the one at Site 2, CTDs, bongos and CalVETs will be conducted at each mooring site.

i) **Acrobat Towed Vehicle:** Depending on time and weather conditions, the Acrobat Towed Vehicle will be towed while transiting south from the northern-most stations on the 70-meter line. If possible the vehicle will be towed through interesting hydrographic features identified from the CTD stations on the trip north. Appendix IV contains further information concerning the Acrobat Towed Vehicle.

j) **L-line:** Up to 11 CTD stations may be sampled if time permits, locations are in Appendix I. CTD casts will be to within 5 meters of the bottom or 1500 meters. At depths greater than 200 meters, winch speed may be increased to 40 meters per minute. After 1000 meters, or at the discretion of the scientists, winch speeds may be increased further to what the ship feels is operationally sound.

k) **Argo Float deployments:** Two Argo Floats will be deployed on the "Dog Leg Line" (L-Line) in water greater than 2000 meters (to prevent the floats from hitting the sea floor as they will dive to 2000 meters), and preferably in water more than 20 nm from water less than 2000 meters. The floats with their shipping boxes weigh 110 pounds, each float weighs 42 pounds and can be handled by two or three people; no lifting equipment will be required for deployment other than a line to lower the float to the water. Appendix I lists locations of previous deployments, these locations are not mandatory. Appendix VI contains further information about the floats and their deployment.

l) **Marine Mammal Mooring:** an acoustic sensor mooring for the detection of marine mammals – whales – will be recovered and a replacement mooring will be deployed off Umnak Island.

m) **Bering Canyon Transects:** A CTD station will be occupied at each of 15 stations across the Bering Canyon (5 stations/3 lines). A bongo tow will be conducted at 3 stations on each line for a total of nine tows.

n) **Unimak Box W Transect:** A second occupation of the Unimak Box W transect will be done as time permits. A CTD will be deployed at each of the 5 stations, a bongo tow will be conducted at 3 stations.

o) **The order of operations may change due to weather or the presence of sea ice.**

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

Conditions which preclude normal operations:

Conditions that preclude normal operations: poor weather, equipment failure, unforeseen conditions and ice coverage would all preclude normal operations. Poor weather would have to be waited out or the project track would have to be modified to provide the best weather conditions possible. A-frame and winch failures would need to be addressed immediately for the project to continue. Ice coverage would negate the ability to release mooring; these would have to be recovered later in the project (depending on the ice forecasts) or by another vessel. Similarly, the surface floats would not be deployed if there is a danger of ice at that location

III. Equipment

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

Hydrographic winch with slip rings and 3-conductor cable terminated for the CTD,

Sea-Bird Electronics' SBE 911plus CTD system with stand and dual Temperature and Conductivity sensors, each CTD system should include underwater CTD, weights, and altimeter, there should be a deck unit for the system,

5 or 10 liter Niskin sampling bottles for use with the CTD rosette (10 plus 4 spares); it is not necessary for these bottles to have silicon tubing vice springs for this project,

Hydrographic winch with slip rings and 3-conductor cable terminated for the SBE19plus for net tow operations (bongos),

12 KHz hull mounted Edgetech Acoustic release transducer,

Scientific Computer System (SCS),

For meteorological observations: 2 anemometers (one R.M. Young system interfaced to the SCS), calibrated air thermometer (wet- and dry-bulb) and a calibrated barometer and/or barograph,

Freezer space for storage of biological and chemical samples (blast and storage freezers, -20° C and -80° C), turned on and operating,

SIMRAD ES-60 and EK-60 echo sounders,

A minimum of 2 computer workstations in the acoustic lab with Internet, printer and email access,

Removable stern platform, in place,

Laboratory space with storage space,

Underway flow-through seawater system with TSG,

Seawater hoses and nozzles to wash nets,

Adequate deck lighting for nighttime operations,

Navigational equipment including GPS and radar,

Safety harnesses for working on side sample platform and fantail,

Ship's crane(s) used for loading and/or deploying

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

Sea-Bird Electronics SBE-19Plus SEACAT system,

Fluorometer, light meter (PAR), and dual oxygen sensors to be mounted on the CTD (backup),

60-cm bongo sampling arrays,

20-cm bongo arrays,

Manual wire angle indicator,

CalVET net sampling array,

Towed vehicle (Acrobat) and winch; winch to be mounted portside on the after deck,

Surface mooring, doughnut buoy and instruments and anchor,

ITAE (Innovative Technology for Arctic Exploration) mooring, buoy, instruments and anchor,

Two (2) subsurface moorings, floats, instruments and anchors,

Marine Mammal mooring, floats, instruments and anchor,

Dragging equipment as needed to drag for moorings that fail to release,

Miscellaneous scientific sampling and processing equipment,

Oceanic profiling floats – Argo (2),

Oculus glider and related launch and recovery equipment,

Winkler Oxygen Analysis system

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.

C. Inventory (itemized):

Oscar Dyson was loaded 1/19/2017 by FOCI and MACE personnel. All chemicals listed will be used for the entire 2017 Dyson Field Season. Chemical volumes will be reported to the Operations Officer and the designated contact for each survey will be required to report to the chemical owners. The name of the group responsible for each of the chemicals is designated after the chemical. MSDS, chemical hygiene plan and SOPs will be provided before loading of the vessel.

Fish/Zooplankton sampling chemicals:

Common Name /Responsibility	**Concentration**	**Amount**	**Spill Response**	**Notes**
DNA Away/FOCI	100%	1 – 250 ml	Gloves, Paper Towels,	Not a regulated chemical

Common Name /Responsibility	**Concentration**	**Amount**	**Spill Response**	**Notes**
			Plastic bags	
Ethanol/FOCI	100%	4 – 1-gallon plastic jugs	Spill Control E, Gloves, 3M Sorbent Pads, Plastic bags	Store in Chem. Lab, yellow flammables locker
Ethylene Glycol /FOCI	100%	1 – 500 ml	Gloves, Paper Towels, Plastic bags	Not a regulated chemical. Store in Spill Kit
Formaldehyde /FOCI	37%	8 – 2.5 gallon barrels	Spill Control F, Gloves, eye protection, Fan-Pads, Formalex, PolyForm-F, Plastic bags	Store in Fish Lab flammable cabinets. Will need to place 4 in each cabinet
Sodium Borate Solution/FOCI	5-6%	1 – 5-gallon carboy	Gloves, Paper towels, Plastic bags	Not a regulated chemical. Working container will be secured on Fish Lab bench.
Sodium Borate Powder/FOCI	100%	1 – 500 g	Gloves, Wet paper towels, Plastic bags	Not a regulated chemical. Stored in Spill Kit.
Glycerol/Thymol Solution/MACE	50%	2 – 5 gallon buckets	Gloves, Paper Towels, Kitty litter	Not a regulated chemical/solution Store in Fish Lab, under sink

Lithium Batteries, property of PMEL:

Size		Number	Spill Response	Notes
9V		45	NA	In SeaBird and WET Labs instruments
AA		100	NA	In SeaBird instruments and MicroCATs Saft LS14500
D		59	NA	In RCM9 & Peggy Mooring
DD		2 x 12 each	NA	In Argo Floats, stored on after deck, outside
Battery Packs		2 x 3 2x1	NA	In Oculus Glider, 3 packs per glider, store in the glider on the after deck. Second group in WBATT's

SONA buoys, property of National Marine Mammal Laboratory (NMML)
(transport only; will not be deployed during the cruise)

CO_2 cartridges:

Common Name	Concentration	Amount	Spill Response	Notes
5 cases of Sona buoys, 48 buoys per case	1 CO_2 cartridge/buoy	16 gm CO_2/cartridge 768 gm/case 3840gm total		Stored on deck in wooden case

CO_2 cartridges and Lithium batteries:

Common Name	Concentration	Amount	Spill Response	Notes
3 cases of Sona buoys, 48 buoys per case	1 CO_2 cartridge/buoy	16 gm CO_2/cartridge 768 gm/case 2304gm total CO_2	NA	Contained within buoy. Stored on deck in wooden case
3 cases of Sona buoys, 48 buoys per case	1 Lithium battery/buoy	0.3 gm Li per battery 14.4gm Li/case 43.2 gm Li total	NA	Contained within buoy. Stored on deck in wooden case

NOTE: There are a total of 8 cases of Sona buoys, 5 cases have only CO_2 cartridges in them. 3 cases of Sona buoys have CO_2 cartridges and Lithium batteries.

Oxygen Analysis Chemicals, property of PMEL

Common Name	Concentration	Amount	Spill Response	Notes
Manganese Chloride	3 M	1 liter	Gloves, Paper Towels, Kitty litter, Plastic bags	Not a regulated chemical /solution.
Potassium Iodate	0.00167 M	1 liter	Spill Control PI, Gloves, Kitty litter, Plastic bags	Store in Acid Locker in Chem. Lab.
Sodium Iodide/NaOH Solution	4 M NaI, 8 M NaOH	1 liter	Spill Control B	Store in Acid Locker in Chem. Lab.
Sodium Thiosulfate	0.11 M	1 liter	Spill Control ST	Store in Acid Locker in Chem. Lab.

Common Name	Concentration	Amount	Spill Response	Notes
Sulfuric Acid	5 M	1 liter	Spill Control A	Store in Acid Locker in Chem. Lab.

Acrobat Towed Vehicle

Common Name	Concentration	Amount	Spill Response	Notes
Gasoline	100%	2-5 gallon	Spill Control E, Gloves, 3M Sorbent Pads, Plastic bags	Store in Paint Locker
Hydraulic oil	100%	5-gallons	Spill Control E, Gloves, 3M Sorbent Pads, Plastic bags	Stored in power pack hydraulic oil tank.

UAF Chemicals and Lithium batteries:

Common Name	Concentration	Amount	Spill Response	Notes
Compressed Air	Calibration gas used in the CO_2 system on Peggy Buoy	2 tanks (roughly the size of dive tanks)	NA	
Sodium Hydroxide	10 M	1 liter	Spill Control B	
Mercuric Chloride	Saturated Solution	0.25 liter	Spill Control M	
Lithium D Cell Batteries		18	NA	In SEACAT instruments for Peggy Buoy

FOCI Spill Kit Contents:

Common Name	Amount	Use	Total Spill Volume Controllable	Notes
Formalex	1 – 5 gallons	Formaldehyde	1:1 control	Formalex will

Common Name	Amount	Use	Total Spill Volume Controllable	Notes
	2 – 1 gallon	cleanup, (all concentrations)		be used in conjunction with Fan-Pads to reduce spill volumes.
Fan-Pads	2 rolls (50 sheets per roll)	Formaldehyde cleanup, (all concentrations)	50 sheets = 50 – 150 ml spills	Formalex will be used in conjunction with Fan-Pads to reduce spill volumes.
PolyForm-F	1 – 5-gallon bucket	Formaldehyde cleanup, (all concentrations)	1:1 control	Pour onto large spill immediately to deactivate formaldehyde.
3 M Pads	10 pads	Ethanol cleanup	10 pads = 10 – 250 ml spills	Pads may be reused if dried out under fume hood.
Nitrile Gloves	8 pairs each: S,M,L,XL	For all cleanup procedures	NA	Gloves will be restocked by each survey group.
Eye protection	4 pairs goggles,1 face shield	Formaldehyde cleanup	NA	Eye protection will be cleaned before reuse
Tyvex Lab Coats	2 coats	Formaldehyde cleanup	NA	Coats will be cleaned with Fan-Pads and Formalex before reuse.
Plastic Bags	2	Formaldehyde cleanup/Fan-Pads	NA	Bags may be packed full and sealed.

PMEL Acid-Base Spill Kit Contents:

Common Name	Amount	Use	Total Spill Volume Controllable	Notes

Common Name	Amount	Use	Total Spill Volume Controllable	Notes
Spilfyter Acid Neutralizer	1 Box	Clean up acid spill – H_2SO_4	1.5 liters of 5M Sulfuric Acid	
Spilfyter Base Neutralizer	1 Box	Clean up base spill – NaOH	2.0 liters of NaOH	
Vinyl Gloves	1 box each M, L and XL	Protect hands during all cleanups	NA	
Foxtail/Dust pan	1 each	Pick up absorbed neutralizer	NA	
Rubber Apron	1 each	Protect personnel during cleanup	NA	
Paper Towels	1 roll	Absorb small amounts of liquids	NA	
Goggles	2 pair	Protect eyes during cleanups	NA	
Chemical Absorbent (kitty litter)	1 liter	Absorb liquids	0.5 liters	
Plastic Bags	2 each	Contain used absorbents/waste	NA	

C. Chemical safety and spill response procedures

A: ACID

- 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.

B: BASE

- 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 dilute acid such as 10% HCl if possible. Collect in a non-combustible container for prompt disposal.

E: Ethanol

- 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.

F: Formalin/Formaldehyde

- 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.

M: Mercury

- 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.

PI: Potassium Iodate

- Wear appropriate personal protective equipment.
- Avoid contact with combustibles (wood, paper, clothing, etc.)
- Absorb with kitty litter or vermiculite.
- Do not use combustible materials, such as saw dust.
- Keep substance damp with water spray.
- Vacuum or sweep up material and place into suitable disposable container (plastic bags).

ST: Sodium Thiosulfate

- Ventilate area of leak or spill.
- Wear appropriate personal protective equipment.
- Use chemical safety goggles. Maintain eye wash fountain and quick-drench facilities in work area.
- Avoid contact with combustibles (wood, paper, clothing, etc.)
- Absorb with kitty litter or vermiculite.
- Do not use combustible materials, such as saw dust.
- Recover liquid or particulate in 5-gallon bucket.

D. Radioactive Materials

No Radioactive Isotopes are planned for this project.

V. Additional Projects

A. Supplementary ("Piggyback") Projects

No Supplementary Projects are planned.

B. NOAA Fleet Ancillary Projects

No NOAA Fleet Ancillary 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
At the end of the project, the Chief Survey Technician will provide the Chief Scientist with copies of the data from the ship's SCS, barometer measurements, log sheets, TSG data, rain sensor data, wind speed and direction data, ship's navigation log data, speed logs, winch system, Fluorometer data, and any other logged scientific data. The number of copies of each data set will be worked out between the Chief Scientist and the Chief Survey Technician.

B. Responsibilities: Chief Scientist will distribute data to Program Principal Investigators as appropriate.

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 https://sites.google.com/a/noaa.gov/omao-intranet-dev/operations/marine/customer-satisfaction-survey and provides a “Submit” button at the end of the form. It is also located at https://docs.google.com/a/noaa.gov/forms/d/1a5hCCkgIwaSII4DmrHPudAehQ9HqhRqY3J_FXqbJp9g/viewform. 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 – Pacific
2002 SE Marine Science Dr.
Newport, OR 97365
Telephone 541-867-8822
Fax 541-867-8856
Email MOP.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

D.

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 email 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 and it must be arranged through the ship's Commanding Officer at least 30 days in advance.

E. IT Security

Any computer that will be hooked into the ship's network must comply with the *OMAO 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 the above 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

Foreign National access to the NOAA ship or Federal Facilities is not required for this project.

VIII. Appendices

Appendix I: Station List
Appendix II: Sanak Trough Moorings
Appendix III: Oculus
Appendix IV: Sea Sciences Acrobat Standard Operating Procedure
Appendix V: Argo Floats
Appendix VI: Chemical Hygiene Plan
Appendix VII: Mooring Diagrams

Appendix I: Station List

Note: the locations for the CalVETs and CTD/BON on the locations of the moorings are the actual locations of the moorings; CalVETs and CTDs should be approximately 0.25 nm from the location of the moorings, Bongos adjusted accordingly.

CTD casts will be to 5 meters from the bottom or 1500 meters max.

	Sta. Name	Activity	Water Depth (m)	Lat.dd	Lon.dd
	Depart Kodiak	DEPART		57.784	152.426
Chiniak Bay					
	16CB-1A	CTD	190	57.722	152.290
	16CB-1A	Recover subsurface mooring	190	57.722	152.290
	17CB-1A	Deploy subsurface mooring	190	57.722	152.290
	17CB-1A	CTD	190	57.722	152.290
Sanak Trough					
	16ST-N	Recover Subsurface Mooring	124	54.710	162.631
	16ST-S	Recover Subsurface Mooring	149	54.619	162.595
Dutch Harbor		Disembark members of Science Party		53.900	166.545
Unimak Box					
	UBS1	CTD/BON	42	54.441	164.985
	UBS2	CTD/BON	110	54.419	165.141

	UBS3	**CTD**	**203**	**54.375**	**165.277**
	UBS4	**CTD/BON**	**91**	**54.342**	**165.429**
	UBW1	**CTD/BON**	**91**	**54.358**	**165.929**
	UBW2	**CTD/BON**	**511**	**54.472**	**166.039**
	UBW3	**CTD**	**402**	**54.583**	**166.129**
	UBW4	**CTD/BON**	**329**	**54.688**	**166.237**
	UBN1	**CTD/BON**	**183**	**54.751**	**166.051**
	UBN2	**CTD/BON**	**168**	**54.813**	**165.858**
	UBN3	**CTD**	**153**	**54.868**	**165.671**
	UBN4	**CTD/BON**	**139**	**54.930**	**165.480**
	UBN5	**CTD**	**124**	**54.987**	**165.287**
	UBN6	**CTD/BON**	**110**	**55.049**	**165.107**
	UBE1	**CTD/BON**	**88**	**54.937**	**164.996**
	UBE2	**CTD**	**67**	**54.827**	**164.894**
	UBE3	**CTD/BON**	**46**	**54.716**	**164.784**
BS Site 2					
	16BS-2	**CTD**	**70**	**56.87**	**164.05**
	16BS-2C	**Recover Subsurface Mooring**	**70**	**56.87**	**164.051**
	16BSP-2B	**Recover Subsurface Mooring**	**70**	**56.878**	**164.066**
	16BSV-2A	**Recover Subsurface Mooring**	**70**	**56.866**	**164.056**
	17BSM-2A	**Deploy Surface Mooring**	**70**	**56.8**	**164.0**
	17BS-ITAE	**Deploy Surface Mooring**	**70**	**56.8**	**164.0**
	17BSP-2A	**Deploy Subsurface Mooring**	**70**	**56.8**	**164.0**
	70M2/M2	**3 CalVETs**	**72**	**56.871**	**164.066**
	70M2/M2	**CTD/BON**	**72**	**56.871**	**164.066**
	CTD -M2N	**CTD/BON**	**69**	**57.017**	**164.217**
	CTD - M2E	**CTD/BON**	**69**	**56.942**	**163.834**
	CTD -M2S	**CTD/BON**	**72**	**56.667**	**163.867**
	CTD - M2W	**CTD/BON**	**75**	**56.767**	**164.333**
70 m isobath					
	70M3	**CTD**	**73**	**56.808**	**164.583**

	70M4	CTD/BON	72	56.909	164.828
	70M5	CTD	73	56.859	165.123
	70M6	CTD/BON	72	56.994	165.378
	70M7	CTD	70	57.107	165.613
	70M8	CTD/BON	70	57.262	165.747
	70M9	CTD	70	57.321	166.011
	70M10	CTD/BON	70	57.322	166.326
	70M11	CTD	70	57.438	166.513
	70M12	CTD/BON	70	57.429	166.812
	70M13	CTD	70	57.522	167.038
	70M14	CTD/BON	71	57.499	167.344
	70M15	CTD	72	57.501	167.665
	70M16	CTD/BON	71	57.501	167.986
	70M17	CTD	79	57.520	168.304
	70M18	CTD/BON	78	57.524	168.614
	70m19-M4S	CTD/BON	75	57.600	168.700
	CTD - M4E	CTD/BON	74	57.767	168.667
	70M21/M4	3 CalVETs	73	57.890	168.872
	70M21/M4	CTD/BON	73	57.890	168.872
	70M22 - M4W	CTD/BON	71	57.767	169.200
	CTD - M4N	CTD/BON	71	57.917	169.000
	70M23	CTD	70	57.907	169.500
	70M24	CTD/BON	69	58.042	169.673
	70M25	CTD	71	58.147	169.918
	70M26	CTD/BON	72	58.282	170.095
	70M27	CTD	73	58.446	170.186
	70M28	CTD/BON	72	58.617	170.276
	70M29	CTD	71	58.774	170.294
	70M30	CTD/BON	72	58.948	170.327
	70M31	CTD	69	59.107	170.247
	70M32	CTD/BON	68	59.247	170.412
	70M33	CTD	70	59.335	170.656
	70M34	CTD/BON	81	59.436	170.906
	70M35	CTD	80	59.595	170.923
	70M36	CTD/BON	79	59.716	171.140
	70M37	CTD/BON	78	59.777	171.450
	M5E	CTD/BON	81	59.898	171.258
	CTD - M5S	CTD/BON	80	59.700	171.500

	70m38/ M5	3 CalVETs	79	59.911	171.735
	70m38/ M5	CTD/BON	79	59.911	171.735
	70M38 - M5N	CTD/BON	77	60.075	172.000
	70M39 M5W	CTD/BON	76	59.898	172.167
	70M40	CTD/BON	74	59.912	172.435
	70M41	CTD	68	59.978	172.746
	70M42	CTD/BON	70	60.037	173.007
	70M43	CTD	70	60.101	173.317
	70M44	CTD/BON	70	60.252	173.522
	70M45	CTD	60	60.425	173.592
	70M46	CTD/BON	68	60.572	173.640
	70M47	CTD	72	60.739	173.648
	70M48	CTD/BON	83	60.907	173.825
	70M49	CTD	79	61.066	173.829
	70M50	CTD/BON	75	61.250	173.741
	70M51	CTD	75	61.411	173.736
	70M52	CTD/BON	72	61.560	173.712
	70M53	CTD	71	61.727	173.855
	70M54	CTD/BON	71	61.862	174.094
	70M55	CTD	73	61.943	174.364
	70M56	CTD/BON	74	62.027	174.659
	CTD-M8S	CTD/BON	70	61.975	174.617
	M8	CTD/BON	70	62.195	174.684
	M8	CALVETS	70	62.195	174.684
	CTD-M8N	CTD/BON	80	62.422	174.700
	CTD-M8W	CTD/BON	80	62.200	175.200
	CTD-M8E	CTD/BON	70	62.200	174.300
L-Line					
L-Line	LL3	CTD	500	55.372	168.187
L-Line	LL4	CTD	200	55.441	168.141
L-Line	LL5	CTD	1500	55.115	168.483
L-Line	LL6	CTD	1500	54.837	168.745
L-Line	LL7	CTD	1500	54.667	169.203
L-Line	DL7/LL8	CTD	1500	54.350	169.833

L-Line	**DL6/LL9**	**CTD**	**1500**	**54.037**	**169.560**
L-Line	**DL5/LL10**	**CTD**	**1575**	**53.783**	**169.267**
L-Line	**DL4/LL11**	**CTD**	**1500**	**53.603**	**169.062**
L-Line	**DL3/LL12**	**CTD**	**1500**	**53.520**	**168.903**
L-Line	**DL2/LL13**	**CTD**	**1000**	**53.410**	**168.835**
L-Line	**DL1/LL15**	**CTD**	**1500**	**53.368**	**168.692**
Argo Floats					
A-Float	**A1**	**Deploy Float**	**2366**	**55.047**	**168.913**
A-Float	**A2**	**Deploy Float**	**2895**	**54.668**	**169.506**
Umnak Island					
	16M^3-1	**Recover Marine Mammal Mooring**	**100**	**53.632**	**167.393**
	17M^3-1	**Deploy Marine Mammal Mooring**	**100**	**53.632**	**167.393**
Bering Canyon Transects					
Bering Canyon Transects	**UT5**	**CTD**	**100**	**53.978**	**166.976**
	UT4	**CTD**	**1300**	**54.085**	**167.067**
	UT3	**CTD**	**1700**	**54.175**	**167.150**
	UT2	**CTD**	**1100**	**54.322**	**167.267**
	UT1	**CTD**	**650**	**54.452**	**167.380**
	AW5	**CTD**	**550**	**54.458**	**166.938**
	AW4	**CTD**	**750**	**54.320**	**166.818**
	AW3	**CTD**	**1350**	**54.205**	**166.710**
	AW2	**CTD**	**900**	**54.140**	**166.652**
	AW1	**CTD**	**100**	**54.072**	**166.620**

	AE1	**CTD**	**90**	**54.168**	**166.233**
	AE2	**CTD**	**700**	**54.233**	**166.263**
	AE3	**CTD**	**900**	**54.305**	**166.350**
	AE4	**CTD**	**550**	**54.437**	**166.480**
	AE5	**CTD**	**450**	**54.562**	**166.593**
	UBW4	**CTD**	**300**	**54.688**	**166.237**
	UBW3	**CTD**	**400**	**54.583**	**166.129**
	UBW2	**CTD**	**500**	**54.472**	**166.039**
	UBW1	**CTD**	**460**	**54.358**	**165.929**
	UBW0	**CTD**	**110**	**54.310**	**165.883**
	Arrive Dutch Harbor	**ARRIVE!**	**650**	**53.900**	**166.545**

Appendix II: Sanak Trough Moorings

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Two trawl-resistant bottom-mounted moorings (4 feet wide by 6 feet long by 2 feet high, 300 lb.) in Sanak trough will be recovered. The moorings will be triggered with an acoustic release and will rise to the surface within ~ 3 minutes; about half of the mooring floats above the surface when it is at the surface. The mooring is equipped with a radio beacon, and a handheld radio direction finder will be used to locate it if needed. The mooring is designed to be trawl-resistant and it may be challenging to recover this mooring from *Oscar Dyson*, and a small boat may be required for recovery. This mooring has been recovered several times from vessels with lower freeboard and recovery methods will be adapted to the Dyson in consultation with the *Dyson's* Commanding Officer and Chief Boatswain prior to the beginning of the project during the MACE winter field season.

Appendix III: Oculus

The Oculus Coastal Glider in its cradle

The Oculus coastal glider is an autonomous underwater vehicle (AUV) catered to the shallow depths of the Arctic. By using a rapid buoyancy system this glider can change buoyancy states 20 times faster and achieve speeds 3 times faster than legacy gliders - allowing for a more efficient and adaptive Arctic survey, but transferable to a variety of markets. We anticipate the Oculus to be field tested in the spring of 2017 on NOAA Ship *Oscar Dyson*.

The vehicle moves through the water in a saw-tooth like pattern and surfaces often to determine its position. Navigation is accomplished using a combination of GPS fixes while on the surface and internal sensors that monitor the vehicle heading, depth and attitude during dives. External sensors are constantly scanning the ocean to determine environmental properties.

Technical Specifications:
Weight and Dimensions

- Length: 2.1 meters
- Diameter: 11.675 inches
- Weight: 70 kg

Shipping and Storage

- 2-4 boxes of 92x24x24
- Weight: ~200 lbs

Battery

- **1** - 4.4 MJ
- **2** - 'science batteries' at 3.9 MJ each
- **1** - main 24-volt battery at 12.2 MJ

Deployment:

The Oculus coastal glider will be deployed similarly to legacy gliders. Small boat operations are the preferred method by which to do this, not only for vehicle but personnel safety. Each glider will be packaged in a stretcher/cradle for ease of deployment, mobility to and from deployment/recovery point, and safety. Though not preferred, the Oculus glider, like legacy gliders, can be deployed and recovered from the R/V using standard lifting procedures and an additional 'lasso' to ensure safety of the glider and crew. The lifting point is under two black 'wings' in the tail section. Please see photos below as an example from a test mission in Lake Washington.

Appendix IV: Sea Sciences Acrobat Standard Operating Procedure

SEA SCIENCES ACROBAT STANDARD OPERATING PROCEDURE

ACROBAT TOWED VEHICLE SPECIFICATIONS:

Tow-body size: 5.5 x 2.3 x 2.6 ft. with wings and payload
Tow-body weight: <40 kg with payload
Tow cable length: 50-300 m
Towing speed: 2-12 knots
Mode of operation: Towed behind ship
Depth controlled by shipboard operator from deck box in the Acoustic Lab.

ACROBAT TOWED VEHICLE WINCH SPECIFICATIONS:

Winch size: 48x24x36 inches; Length x Width x Height
Weight of winch, hydraulic power pack and baseplate: ~1500 pounds
Power requirements: This is a hydraulic winch that will be powered by a Honda hydraulic power pack.
The winch and the associated power pack will be mounted on a custom made base plate which will be bolted to the ship's deck, port side, aft, by use of specially made Baxter bolts. The winch is controlled by means of a controller/joystick that can be remotely positioned by means of an attached cable.

OBJECTIVE:

Tow the Acrobat behind the ship to make high-resolution hydrographic surveys as it undulates from the surface to 100 m maximum depth.

GENERAL GUIDELINES:

The Acrobat will be towed 150-300 m behind the ship from a supplied winch on deck following a predetermined course.

The tow cable length will be static when towing. Maximum tension while towing at speed will be ~1000 lbs.

As it is towed, the Acrobat will undulate or "fly" between the surface down to 100 m and is operated from the shipboard deck box on the ship.

Towing speeds will range from 5-9 knots when towing, 1-4 knots when recovering.

Operations will occur during the day and night.

STANDARD OPERATING PROCEDURES:

Before the start of the project, the survey area and waypoints will be provided to the *Dyson*. This may be altered during the survey to sample hydrographic features of interest.

Before deploying the Acrobat, the Acrobat operator will communicate with the Operations officer to establish and confirm a protocol for deployment, towing and recovery.

After approval from the Operations officer, the Acrobat will be deployed from the working deck using the A-frame and Acrobat winch. When the Acrobat is in the water and 10-15 from the back deck, the operator will turn the power on.

While towing, the Acrobat operator will monitor the depth of the instrument. Once deployed, the tow cable position only needs to be monitored during turns. Before executing a turn, towing speed will be reduced and the operator will bring the Acrobat to the surface. During the turn, the bridge and either a member of the crew or scientific party will monitor the angle of the tow cable to prevent fouling. After the turn is complete, the bridge will communicate with operator and sampling will continue.

Upon recovery, the ship will slow down to about 3 knots. The Acrobat operator will bring the vehicle to the surface and turn the power to the Acrobat off. The winch will be use to spool the two cable in and, in conjunction with the ship's A-frame, be used to bring the Acrobat onboard.

EMERGENCY RECOVERY:

There are several scenarios that will require emergency recovery:

Complete power failure

In the case of complete power failure, which will result in the loss of control of the Acrobat, the wings will automatically reset to a neutral position bringing the Acrobat to the surface. The Acrobat can then be recovered as per the standard procedure with the A-frame and the winch.

Winch malfunction

If the Acrobat cannot be recovered using the supplied winch, the tow cable can be spooled in using appropriate shipboard equipment (e.g. winch, capstan). Before recovery, the operator will shut off power to the Acrobat to reset the wings to the neutral position, causing the Acrobat to come to the surface and reduce tension on the tow cable.

Catastrophic cable failure

Catastrophic failure will occur if the tow cable is severed; in this case the Acrobat will sink. The remaining tow cable is to be recovered. If deemed possible, an attempt to recover the Acrobat should be made.

Appendix V: Argo Floats

SEA·BIRD SCIENTIFIC

sea-birdscientific.com
info@sea-birdscientific.com

Navis
Autonomous Profiling Float

The Navis float has a traditional layout, with the sensor head at the top, and the buoyancy bladders at the bottom. The Navis buoyancy engine uses a positive displacement piston pump to transfer silicon oil from internal to external reservoirs to increase the float volume and cause it to rise. This system provides improved energy efficiency, better parking stability, and increased depth range over existing floats.

The Navis buoyancy engine is augmented at the sea surface by inflation of an air reservoir. This surface-following function provides excess buoyancy to improve surface communications. The open-loop air buoyancy system uses a seamless, natural-rubber, external bladder and oil-augmented bladder crush prevention.

At the surface, Navis uses a Garmin 15xL-W GPS to acquire positional information. It then transmits the acquired data via an Iridium Transceiver 9523. The Iridium antenna is mounted on the CTD end cap, and is supported by the CTD cell guard.

The Navis aluminum hull has a smaller diameter and length than existing floats, providing a lightweight and cost-effective package that requires less energy to operate. The float is powered by twelve lithium DD batteries in a Sea-Bird battery pack. The battery pack provides sufficient power for 300 CTD profile cycles to 2000 dbars.

Features

- Sufficient power for 300 CTD profile cycles to 2000 dbars.
- SBE 41CP CTD; Argo standard
  - Pump-controlled, T-C ducted flow minimizes salinity spiking
  - Anti-foulant devices provide effective bio-fouling protection
- Iridium continuous circuit switched, 2-way communications for low-cost download of large amounts of data
- Self-ballasting, 1 day to equilibrate; ballasting and setup done at Sea-Bird prior to shipment
- Easy-to-use interface for mission programming, and for reprogramming while deployed
- Firmware based on field-proven Argo firmware
- Lightweight and easy to deploy (< 18.5 kg)
- Expandable and scalable design for future missions, such as biogeochemical floats, deep floats
- Warranty — 100 profiles at 100% of purchase price, pro-rated thereafter

www.seabird.com sales@seabird.com 425-643-9866

SBE Sea-Bird Electronics

CTD Operation

The SBE 41CP CTD measures temperature, conductivity, and pressure continuously at 1 Hz through ascent and provides high accuracy, resolution, and stability. The pump-controlled, T-C ducted flow configuration minimizes salinity spiking caused by mismatch of temperature and conductivity measurements. The carefully engineered anti-foul protection includes anti-foulant devices, a U-shaped flow path, and an integral pump. On the float's ascent, as it approaches 10 to 5 dbars beneath the ocean surface, the pump turns off. The U-shaped flow path prevents sea surface oils and contaminants from being ingested while proceeding through the ocean surface skin and sitting at the surface during data transmittal. Between profiles, the pump is off. The U-shaped flow path prevents water flow through the system caused by waves or currents; minute amounts of anti-foulant concentrate inside the conductivity cell to minimize bio-fouling.

Science Data (SBE 41CP CTD)

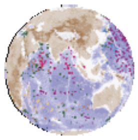
Temperature	Initial accuracy ± 0.002 °C; Stability 0.0002 °C/year
Salinity	Initial accuracy ± 0.002 PSS-78; Stability 0.001 PSS-78/year
Pressure	Initial accuracy ± 2 decibars; Stability 0.8 decibars/year

Float Operation

Depth Rating	2000 decibars
Communications	Iridium Transceiver 9523 — RUDICS, circuit switched
Position	GPS, Garmin 15xL-W
Park Interval	1 - 15 days
Materials	Aluminum hull, seamless natural-rubber external bladders
Ballasting	Self-ballasting, 1 day to equilibrate
Weight in air	Less than 18.5 kg
Self-Activation	Starts operating automatically on deployment, when pressure reaches user-programmable setpoint
Internal batteries	4 packs of 3 DD lithium sulfuryl chloride cells (cannot ship in passenger aircraft; Class 9 Dangerous Goods).
Power Endurance	10 years or 300 2000-dbar cycles
Memory	CTD stores one 2000-dbar CTD profile; Navis stores 64 2000-dbar CTD profiles
Dimensions	Hull diameter 14 cm, Ring diameter 24 cm, Total length 159 cm

SEA·BIRD SCIENTIFIC

Sea-Bird Electronics
+1 425-643-9866
sales@seabird.com



Argo

How Argo floats work

part of the integrated global observation strategy

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About Argo

Argo data

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Media Center

Documents

Argo Steering Team

Meetings

Links

Google Earth layer

FAQ

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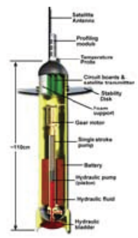
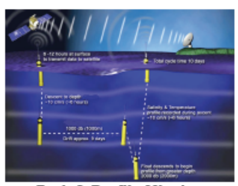
Contact

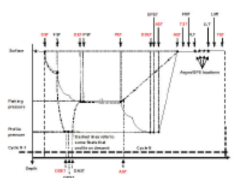
Site Map



Float Design



Park & Profile Mission Operation



Argo Cycle Timing Variables

Argo Floats

Argo is an international collaboration that collects high-quality temperature and salinity profiles from the upper 2000m of the ice-free global ocean and currents from intermediate depths. The data come from battery-powered autonomous **floats** that spend most of their life drifting at depth where they are stabilised by being neutrally buoyant at the "parking depth" pressure by having a density equal to the ambient pressure and a compressibility that is less than that of sea water. At present there are several models of profiling float used in Argo. All work in a similar fashion but differ somewhat in their design characteristics. At typically 10-day intervals, the floats pump fluid into an external bladder and rise to the surface over about 6 hours while measuring temperature and salinity. Satellites or GPS determine the position of the floats when they surface, and the floats transmit their data to the satellites. The bladder then deflates and the float returns to its original density and sinks to drift until the cycle is repeated. Floats are designed to make about 150 such cycles.

Argo Mission

The standard Argo mission is a **park and profile mission** where the float descends to a target depth of 1000m to drift and then descends again to 2000m to start the temperature and salinity profile. In 2015, 80% of floats profile to depths greater than 1500m. Another 12% profile to between 1000 and 1500m.

Argo Cycle Timing Variables

Each Argo float cycle is composed of programmed events. Depending on float type, some of these events can be dated and sent back by the float to aid in the calculation of velocities. The Argo Program has highlighted several cycle timing variables that it would prefer that floats send back timing information. This **cycle timing document** explains the variables and how they fit into the trajectory file.

Argo Float Models

The Argo array is currently comprised of several float models:

- the **PROVOR** and the new generation PROVOR, the **ARVOR** built by NKE-INSTRUMENTATION in France in close collaboration with IFREMER
- the **APEX** float produced by Teledyne Webb Research
- the **SOLO** and the new generation SOLO, the **SOLO-II** float designed and built by Scripps Institution of Oceanography
- the **S2A** float is produced by MRV Systems in the USA who bought the rights to the SOLO-II and manufactures it under the rebranded name of the S2A float
- the **NAVIS** built by Sea-Bird in the USA

The **SBE** temperature/salinity sensor suites is now used almost exclusively. In the beginning, the **FSI** sensor was also used. The temperature data are accurate to a few millidegrees over the float lifetime. For discussion of salinity data accuracy please see the **Data FAQ**.

Argo Data Transmission

As the float ascends, a series of about 200 pressure, temperature, salinity measurements are made and stored on board the float. These are transmitted to satellites when the float reaches the surface. For floats using high speed communications with more bandwidth capabilities, measurements are taken more frequently, often up to every 2db, resulting in several hundred measurements per profile.

For 60% of floats in the Argo array the data are transmitted from the ocean surface via the **Système Argos** location and data transmission system. The data transmission rates are such that to guarantee error free data reception and location in all weather conditions the float must spend between 6 and 12 hrs at the surface. Positions are accurate to ~100m depending on the number of satellites within range and the geometry of their distribution.

An alternative system to Argos using positions from the Global Positioning System (GPS) and data communication using the **Iridium** satellites now comprises 40% of the Argo array. Iridium is becoming a more attractive option as it allows more detailed profiles to be transmitted with a shorter period at the surface and two-way communication with the float. In 2014, 55% of floats were been deployed with Iridium antennas and 45% with Argos antennas.

As noted above, an Argo float weighs less than 40 pounds in air. Launching is relatively straight forward with two persons handling a line fed through a hole in the collar of the float. Once the ship has come to about 1-2 knots the float is lowered over the side and the line retrieved. Position of the release is marked on the ships SCS system, usually via a button on the CTD computer. The float will self-actuate when it reaches its programmed depth.

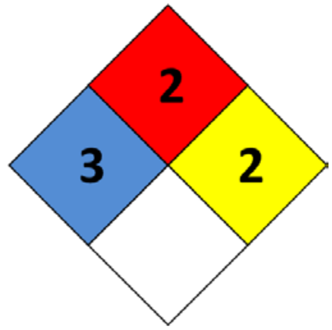
Appendix VI – Chemical Hygiene Plan

Previous sections of the Project Instructions include a list of hazardous materials by name and anticipated quantity. Chemicals will be transported, stored and used in a manner that will avoid any spills and adequate containment, absorbents and cleanup materials will be available in the event of a chemical spill.

The scientific chemicals to be used for this project are: (1) ethyl alcohol (100%) and (2) formaldehyde (37%) and reagent chemicals for the preservation and analysis of oxygen samples. Other chemicals brought aboard are consumer products in consumer quantities. Dilutions of the scientific chemicals will be used to preserve *in faunal* organisms collected with towed zooplankton nets (bongos and CalVETs) as described in the Operations section of these Project Instructions and for the pickling and analysis of oxygen samples for calibration of the oxygen sensors on the CTD. Use of these chemicals and the specified dilutions will only occur in exterior locations on the ship away from air intakes. Scientific chemicals shall not be disposed over the side.

Standard Operating Procedures and Information Sheets are provided here for the scientific chemicals. Included are details concerning personal protective equipment, work area precautions, special handling and storage requirements, spill and accident procedures/first aid, waste disposal and other pertinent information. Both small and large spills are of particular concern; in both cases, the spill response is intended to first contain the spill and then neutralize it. This may be easily accomplished for small spills depending on the degree of vessel motion and the prevailing environmental conditions. In all cases, the first responder should quickly evaluate the risks of personal exposure versus the potential impacts of a delayed response to the spill and act accordingly. For example, if the spill is small and it is safe to do so, a neutralizing agent should be rapidly applied to encircle/contain the spill and then cover it. However, a large formaldehyde spill (> 1 L) is extremely hazardous and individuals at risk of exposure should immediately leave the area. The CO or OOD should be notified immediately so that a response team with self-contained breathing apparatus (SCBA) can be deployed to complete the cleanup operation or dispense the hazard with a fire hose directed overboard. The vessel's course should be adjusted to minimize exposure of personnel to wind-driven vapors and to limit spread of the spill due to vessel motion. The reportable quantity (RQ) of formaldehyde is 1,000 pounds and the RQ for ethyl alcohol is 5,000 pounds which greatly exceed the quantities brought aboard for this project.

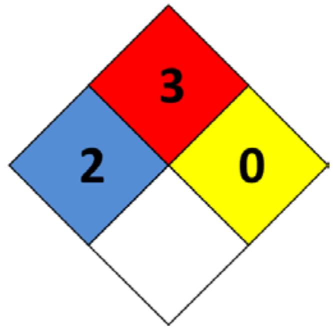
Standard Operating Procedures – Formaldehyde At-Sea



Chemical Name: 37% Formaldehyde
UN Number: 1198
<u>Hazard Ratings: (on a scale of 0 to 4)</u>
Health (blue): 3 Flammability (red): 2
Reactivity (yellow): 2 Special (white):
<u>Personal Protection Gear Needed</u>
*gloves
*goggles or face shield
<u>Special Handling Instructions</u>
* If a ventilation hood is not available, then pouring of chemical must be done outside. At least two people should be involved with large chemical transfers in case of an emergency.
* Chemical must be stored at temperatures above 15^{o} c to prevent polymerization of paraformaldehyde.
<u>First Aid</u>
* If swallowed, give large amounts of drinking water and induce vomiting.
*If vapors inhaled, get out into fresh air immediately. Give oxygen if breathing is difficult.
* If spilled on skin or splashed in eyes, flush with water for at least 15 minutes.
<u>Spill Cleanup Procedures</u>
For small spills (500-1000 ml):
Cover spill quickly with a Fan Pad and spray on Formalex to deactivate and absorb chemical. Let material sit for 10 - 15 minutes. Dispose of materials in plastic bag.
For large spills (>1000 ml):
Use a combination of Fan Pads and Formalex as quickly as possible to contain spill and deactivate it. Vacate area and try to ventilate room, if possible. Call Bridge immediately (x101).
<u>Deactivation/Disposal Procedures at Sea</u>
*Formalex is a greenish liquid that is to be used to insure proper chemical deactivation. Formalex should also be used in conjunction with Fan Pads. Place used Fan Pad in plastic bag, seal, and put in bottom of Spill Kit.
*Fan Pads may be used to absorb small spills alone but these pads work best when used with Formalex to immediately control the vapor layer.
<u>Shipping Procedures and Restrictions</u>
37% formaldehyde cannot be ship by air due to its flammability rating.
All quantities should be over-packed with absorbency material in case the original container is damaged. When shipping by barge or land, labels are not required for quantities under 110 gallons by D.O.T. but the container should have MSDSs and the UN number readily available.

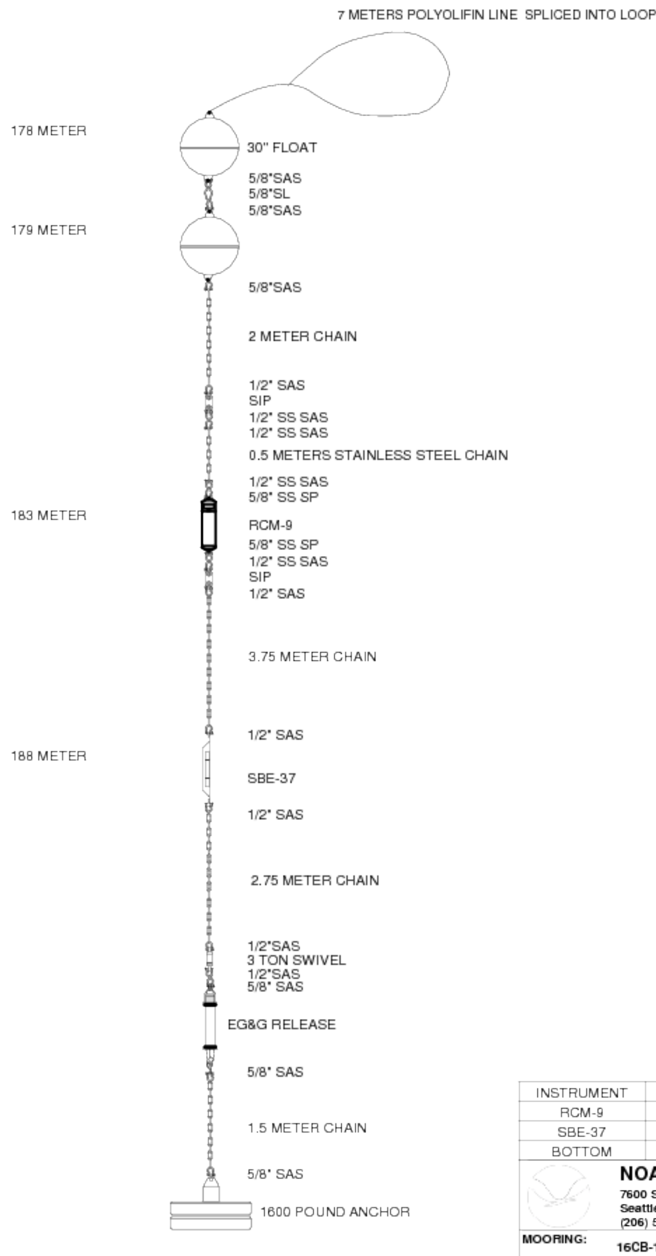
Standard Operating Procedures – Ethanol At-Sea

Chemical Name: 100% Alcohol
UN Number: 1170
<u>Hazard Ratings: (on a scale of 0 to 4)</u>
Health (blue): 2 Flammability (red): 3
Reactivity (yellow): 1 Special (white):



<u>Personal Protection Gear Needed</u>
*gloves
*goggles or face shield when pouring
<u>Special Handling Instructions</u>
* Keep away from heat, flame, and other potential ignition sources.
* Store in a well ventilated area or in a flammable cabinet.
<u>First Aid</u>
* If swallowed, give large amounts of drinking water and induce vomiting.
* If vapors inhaled, get out into fresh air immediately. Give oxygen if breathing is difficult.
* If spilled on skin or splashed in eyes, flush with water for at least 15 minutes.
<u>Spill Cleanup Procedures</u>
Absorb ethanol with 3M Sorbent Pads and allow to dry in a well ventilated area away from ignition source.
<u>Deactivation/Disposal Procedures at Sea</u>
Use 3M Sorbent Pads to absorb the ethanol. Put used pads outside to dry (secure from blowing overboard and exposure to flame). Once dry, the pads may be reused or burned.
<u>Shipping Procedures and Restrictions</u>
Due to the flammability rating of 95% ethanol, this chemical cannot be shipped by air. Transportation by barge or land vehicle will require the ethanol container to be over-packed with absorbent materials such as clumping kitty litter or shredded paper. Include MSDS and the UN number with the shipment for reference in the event of a spill.

Appendix VII – Mooring Diagrams



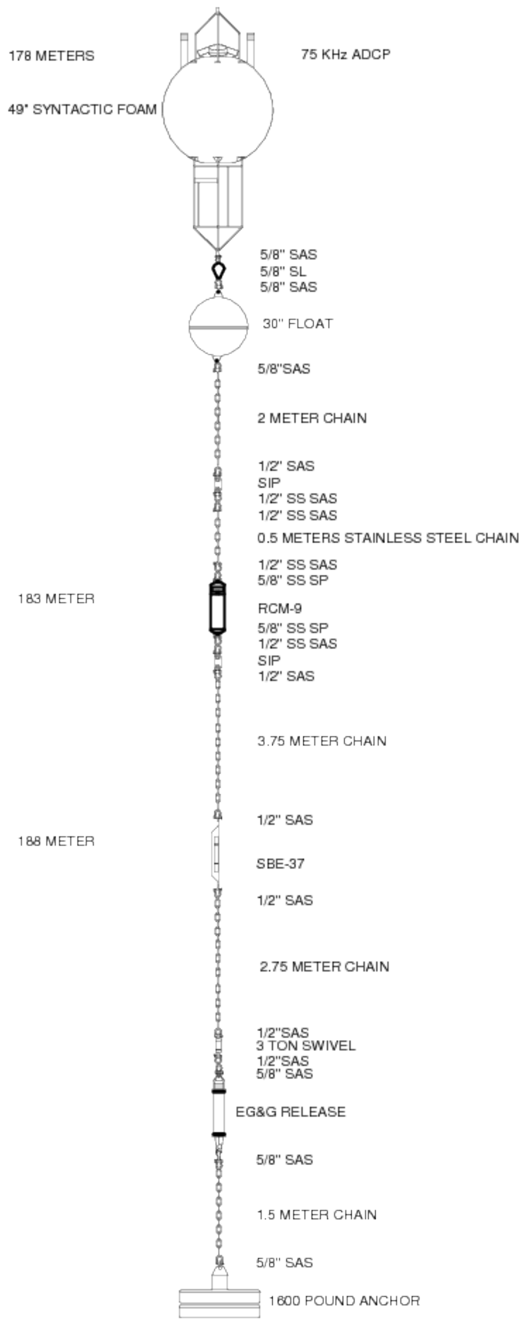
INSTRUMENT	DEPTH	SN
RCM-9	183	
SBE-37	188	
BOTTOM	194	

NOAA-PMEL-FOCI
7600 Sandpoint Way NE
Seattle, Wa. 98115
(206) 526-6175

MOORING: 16CB-1A

LOCATION: CHINIAK BAY, KODIAK ISL.

DRAWN BY: MIKE CRAIG
DATE: 2 NOVEMBER 2015
APPROVED BY:
DATE:



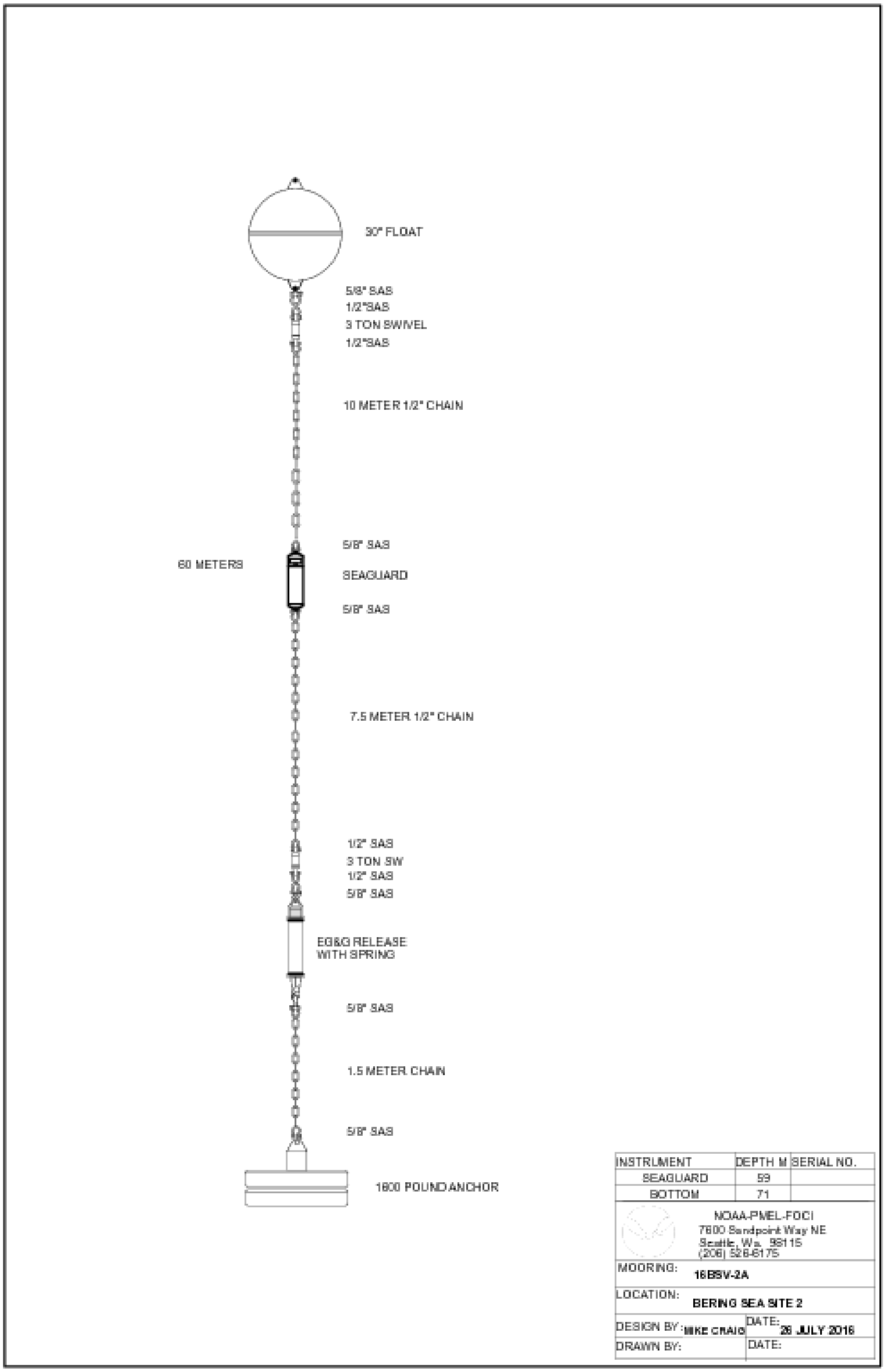
INSTRUMENT	DEPTH	SN
75 KHZ ADCP	179	
RCM-9	183	
SBE-37	188	
BOTTOM	194	

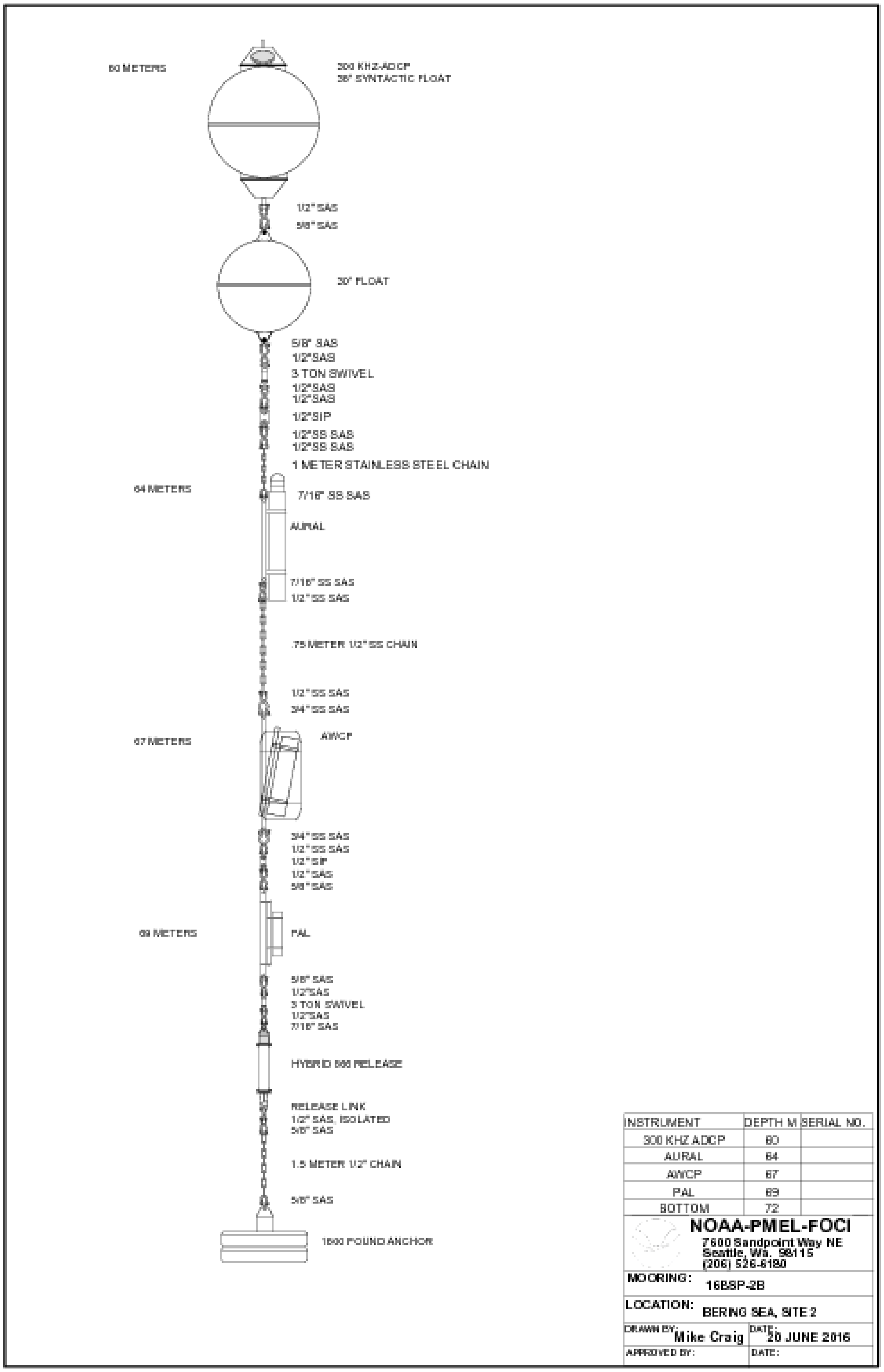
NOAA-PMEL-FOCI
7600 Sandpoint Way NE
Seattle, Wa. 98115
(206) 526-6175

MOORING: 17CB-1A

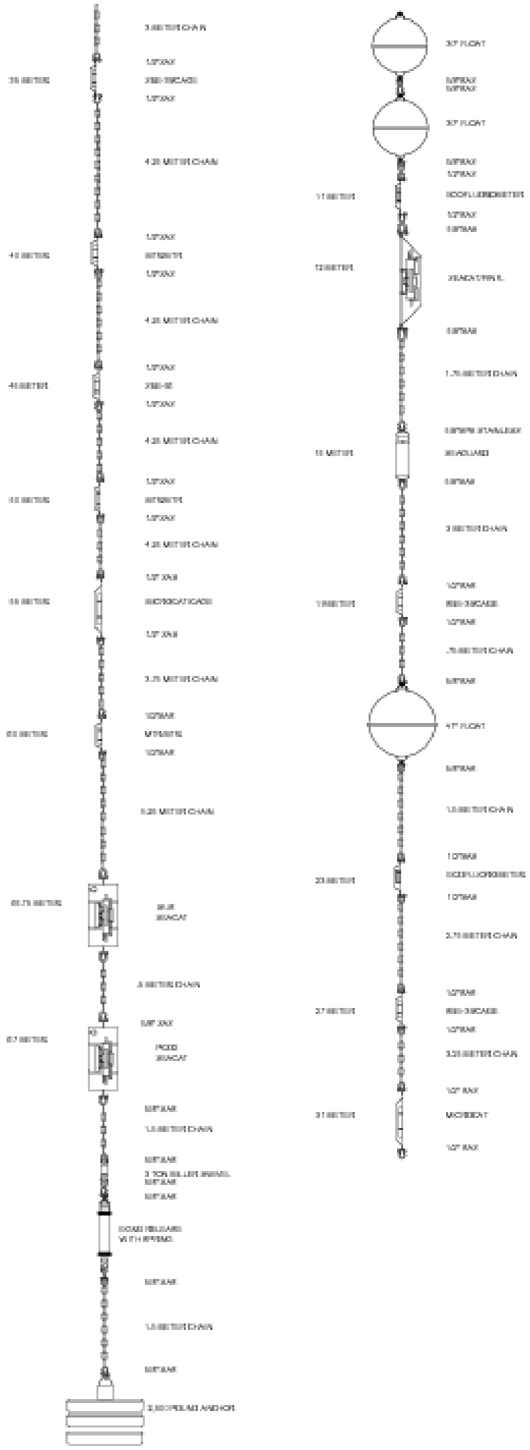
LOCATION: CHINIAK BAY, KODIAK ISL.

DRAWN BY:	DATE:
MIKE CRAIG	8 FEBRUARY 2017
APPROVED BY:	DATE:


30" FLOAT
5/8" SAS
1/2"SAS
3 TON SWIVEL
1/2"SAS
10 METER 1/2" CHAIN
5/8" SAS
60 METERS
SEAGUARD
5/8" SAS
7.5 METER 1/2" CHAIN
1/2" SAS
3 TON SW
1/2" SAS
5/8" SAS
EG&G RELEASE
WITH SPRING
5/8" SAS
1.5 METER CHAIN
5/8" SAS
1600 POUND ANCHOR
INSTRUMENT
DEPTH M
SERIAL NO.
SEAGUARD
59
BOTTOM
71
NOAA-PMEL-FOCI
7600 Sandpoint Way NE
Seattle, Wa. 98115
(206) 526-6175
MOORING: 16BSV-2A
LOCATION: BERING SEA SITE 2
DESIGN BY: MIKE CRAIG
DATE: 26 JULY 2016
DRAWN BY:
DATE:



NOTE: this mooring was dragged up by a fishing vessel and is currently located in Dutch Harbor.



INSTRUMENTS		
DEPTH (M)	INST.	SER #
11	ECO-FLUOR	
12	SEACAT/NP/NFL	
15	RCM-9	
19	SBE-39	
23	ECO-FLUOR	
27	SBE-39	
31	MICROCAT	
35	SBE-39	
40	MTR/MTR	
45	SBE-56	
50	MTR/MTR	
55	MICROCAT	
60	MTR/MTR	
65.75	ISUS/SEACAT	
67	PCO2/SEACAT	
72	BOTTOM	

NOAA-PMEL-FOCI

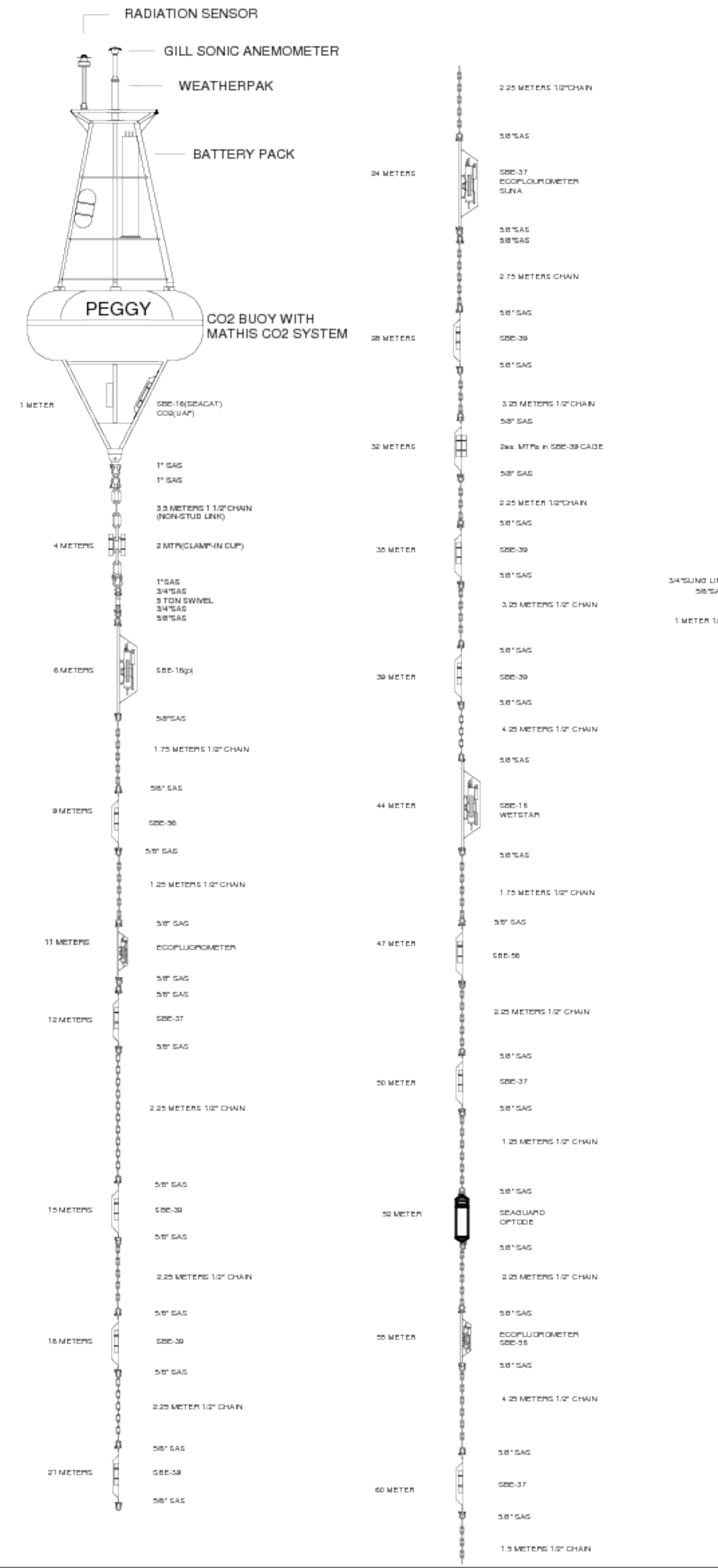
7600 Sandpoint Way NE
Seattle, Wa. 98115
(206) 526-6023

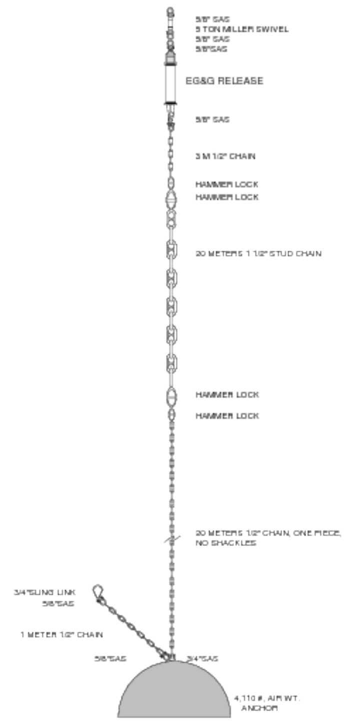
MOORING: 16BS-2C

LOCATION: BERING SEA, SITE 2

DRAWN BY: MIKE CRAIG | DATE: 24 JUNE 2016

approved by: | DATE:





NO LOOSE OR UNSUPPORTED CHAIN OR HARDWARE ON THIS MOORING. SUBSURFACE AURAL NEARBY. ANCHOR DEPLOY CHAIN OK

SCOPE 1.5:1

SUBSURFACE INSTRUMENTS		
DEPTH (M)	INST.	SER #
1	SBE-16	
1	CO2	
4	MTR	
4	MTR	
6	SBE-16(P)	
9	SBE-56	
11	ECOFLOUR	
12	SBE-37	
15	SBE-39	
18	SBE-39	
21	SBE-39	
24	SBE-37	
24	ECOFLUOR	
24	SUNA	
28	SBE-39	
32	MTR	
32	MTR	
35	SBE-39	
39	SBE-39	
44	SBE-16	
44	WETSTAR	
47	SBE-56	
50	SBE-37	
52	SEAGUARD	
52	OPTODE	
55	ECOFLUOR	
55	SBE-56	
60	SBE-37	
	AC.REL.	
72	BOTTOM	

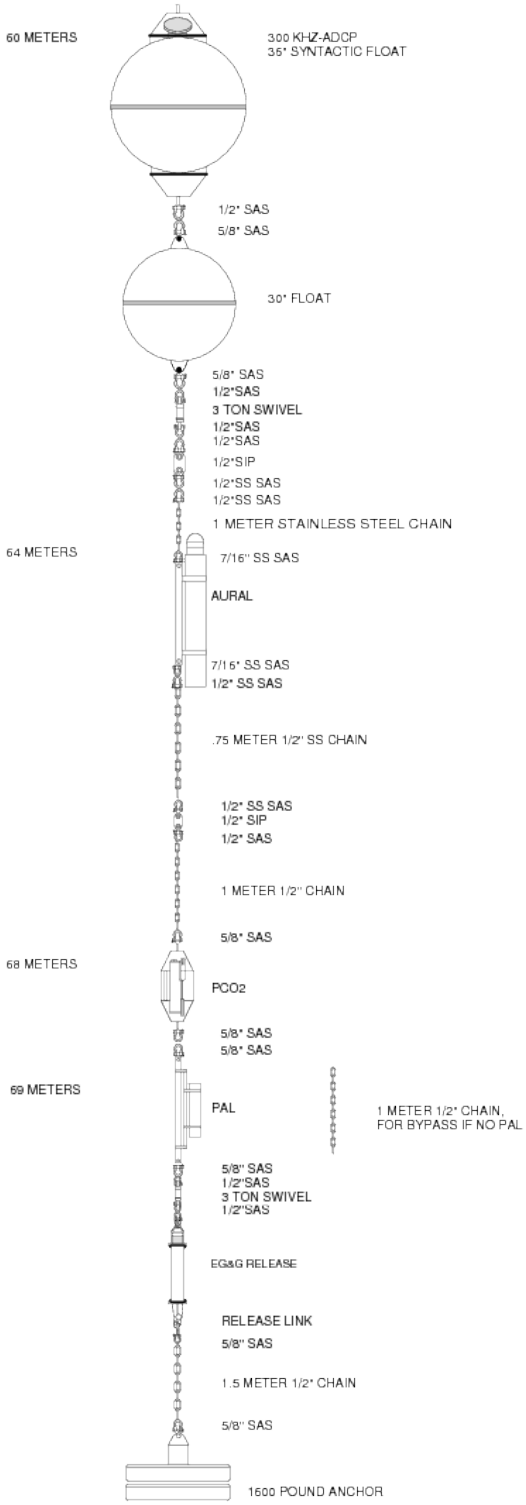
NOA-PMEL-FOCI
7600 Sandpoint Way NE
Seattle, Wa. 98115
(206) 526-6180

MOORING: 17BSM-2A

LOCATION: BERING SEA SITE 2

DRAWN BY: MIKE CRAIG | DATE: 9 FEBRUARY 2017

APPROVED BY: | DATE:



INSTRUMENT	DEPTH M	SERIAL NO.
300 KHZ ADCP	60	
AURAL	64	
PCO2	68	
PAL	69	
BOTTOM	72	

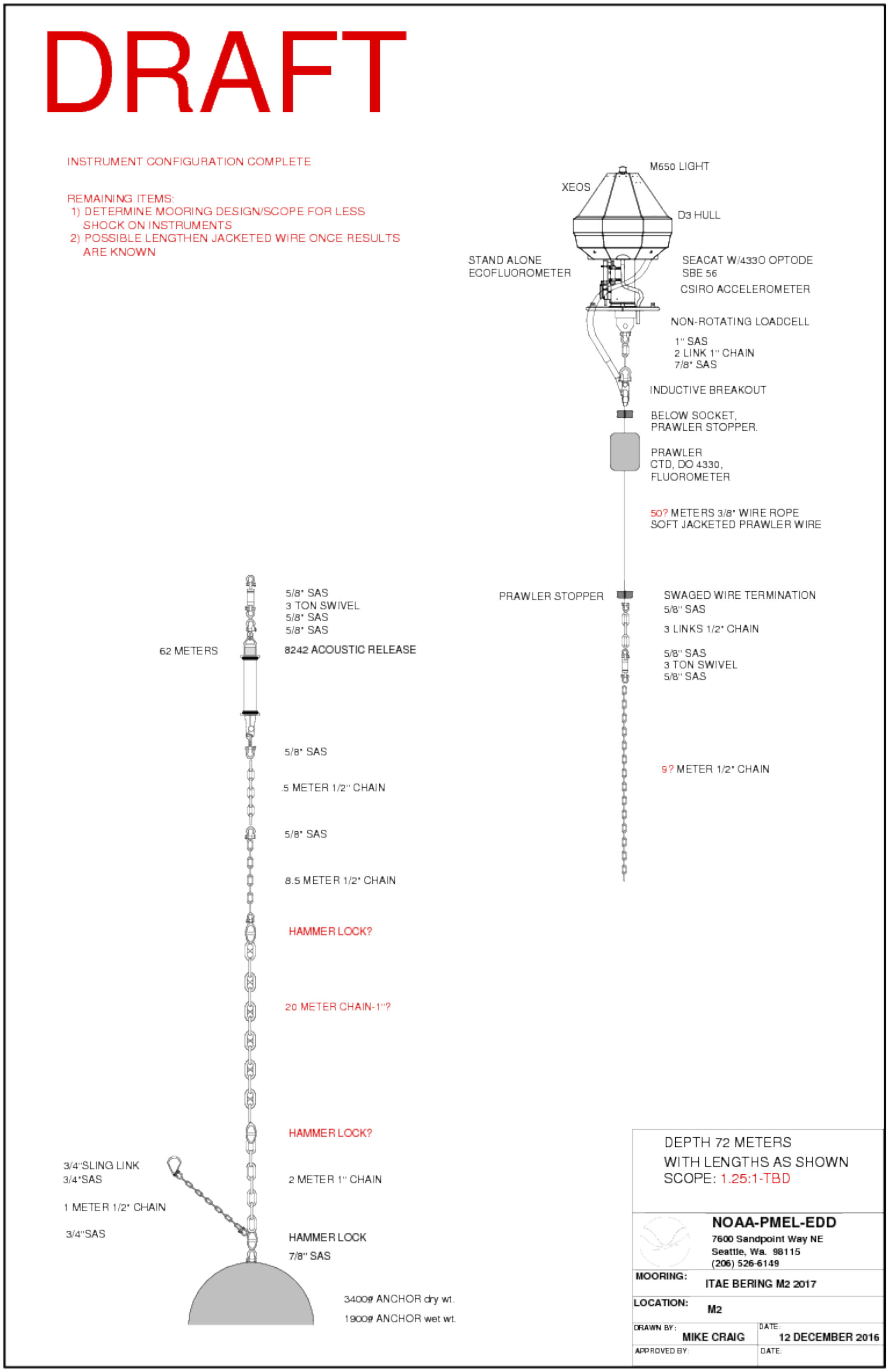
NOAA-PMEL-FOCI
7600 Sandpoint Way NE
Seattle, Wa. 98115
(206) 526-6180

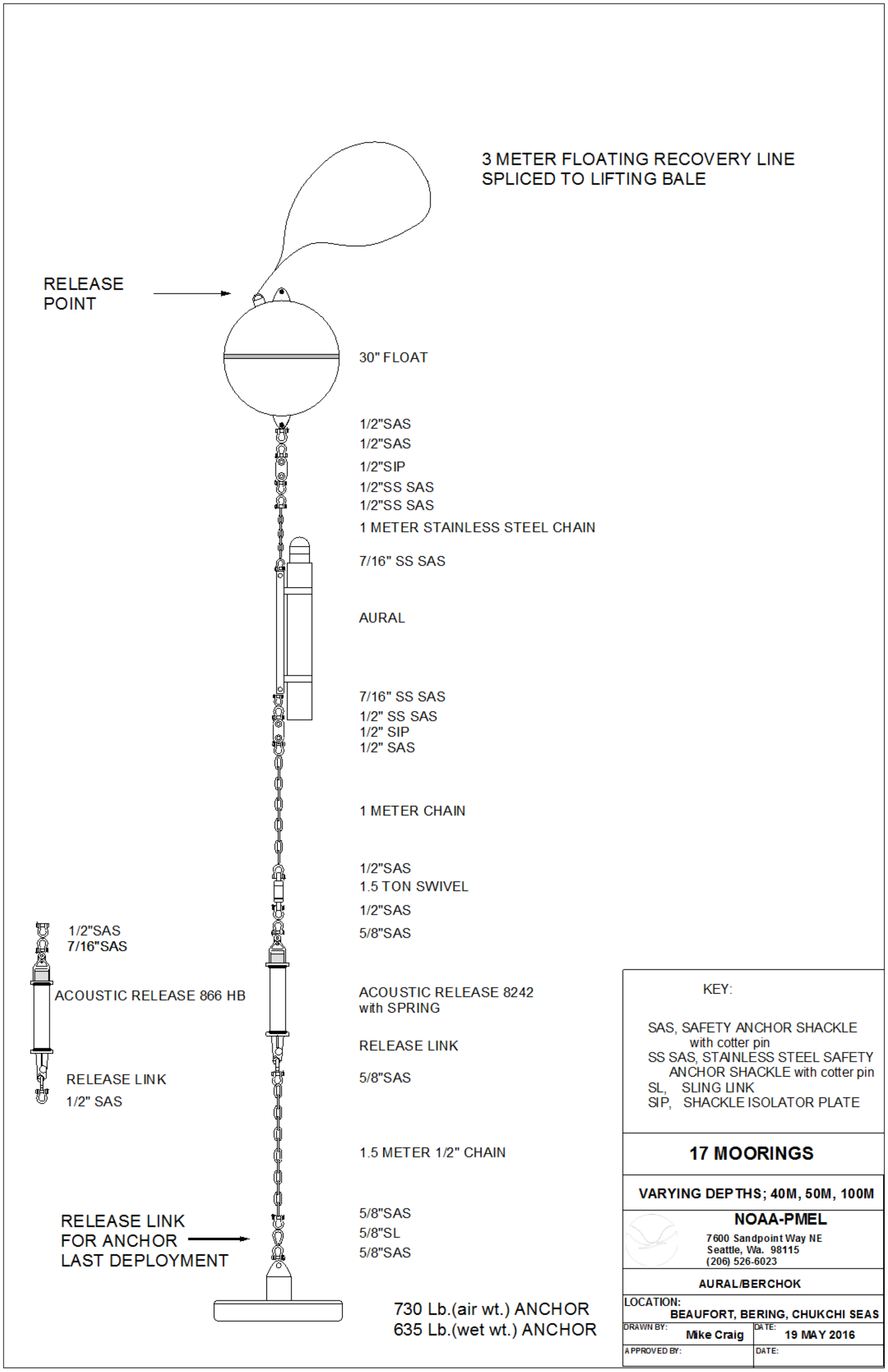
MOORING: 17BSP-2A

LOCATION: BERING SEA, SITE 2

DRAWN BY: Mike Craig | DATE: 19 DECEMBER 2016

APPROVED BY: | DATE:


DRAFT
INSTRUMENT CONFIGURATION COMPLETE
REMAINING ITEMS:
1) DETERMINE MOORING DESIGN/SCOPE FOR LESS SHOCK ON INSTRUMENTS
2) POSSIBLE LENGTHEN JACKETED WIRE ONCE RESULTS ARE KNOWN
M650 LIGHT
XEOS
D3 HULL
STAND ALONE ECOFLUOROMETER
SEACAT W/4330 OPTODE
SBE 56
CSIRO ACCELEROMETER
NON-ROTATING LOADCELL
1" SAS
2 LINK 1" CHAIN
7/8" SAS
INDUCTIVE BREAKOUT
BELOW SOCKET, PRAWLER STOPPER.
PRAWLER
CTD, DO 4330,
FLUOROMETER
50? METERS 3/8" WIRE ROPE
SOFT JACKETED PRAWLER WIRE
PRAWLER STOPPER
SWAGED WIRE TERMINATION
5/8" SAS
3 LINKS 1/2" CHAIN
5/8" SAS
3 TON SWIVEL
5/8" SAS
9? METER 1/2" CHAIN
5/8" SAS
3 TON SWIVEL
5/8" SAS
5/8" SAS
62 METERS
8242 ACOUSTIC RELEASE
5/8" SAS
.5 METER 1/2" CHAIN
5/8" SAS
8.5 METER 1/2" CHAIN
HAMMER LOCK?
20 METER CHAIN-1"?
HAMMER LOCK?
3/4"SLING LINK
3/4"SAS
1 METER 1/2" CHAIN
3/4"SAS
2 METER 1" CHAIN
HAMMER LOCK
7/8" SAS
3400# ANCHOR dry wt.
1900# ANCHOR wet wt.
DEPTH 72 METERS
WITH LENGTHS AS SHOWN
SCOPE: 1.25:1-TBD
NOAA-PMEL-EDD
7600 Sandpoint Way NE
Seattle, Wa. 98115
(206) 526-6149
MOORING:
ITAE BERING M2 2017
LOCATION:
M2
DRAWN BY:
MIKE CRAIG
DATE:
12 DECEMBER 2016
APPROVED BY:
DATE:



NOTE: The Aural/Berchok recovery and deployment moorings are identical.