Ocean Exploration and Research

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Project Instructions: EX-19-04, 2019 Technology Demonstration (Remotely Operated Vehicles & Mapping)

Date Submitted: July 11, 2019

Platform: NOAA Ship *Okeanos Explorer*

Project Number: EX-19-04

Project Title: 2019 Technology Demonstrations

Project Dates: July 18 - August 01, 2019

Prepared by:_____ **Dated:** _____
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Approved by:_____ **Dated:** _____
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I. Overview

> "America's future depends on understanding the ocean. We explore the ocean because its health and resilience are vital to our economy and to our lives. We depend on the ocean to regulate weather and climate; sustain a diversity of life; for maritime shipping and national defense; and for food, energy, medicine, and other essential services to humankind."
>
> *- NOAA Office of Ocean Exploration and Research Strategic Plan*

A. Brief Summary and Project Period

This document contains project instructions for EX-19-04. Operations for this cruise will be conducted 24 hours/day and consist of demonstrations of emerging technology and of existing technology integration into the Okeanos's Continuing Operations (CONOPS), remotely operated vehicle (ROV) dives to support technology demonstrations, mapping using the ship's suite of deepwater sonars, and limited shore participation via telepresence. The expedition will commence on July 18, 2019 in Norfolk, Virginia (Marine Operations Center-Atlantic) and conclude on August 1, 2019 in Davisville, Rhode Island. Operations will include the use of the ship's deep-water mapping systems (Kongsberg EM 302 multibeam sonar, EK split-beam fisheries sonars, Knudsen 3260 chirp sub-bottom profiler sonar, and Teledyne Acoustic Doppler Current Profilers), XBTs in support of multibeam sonar mapping operations, the two-body ROV system *Deep Discoverer* and *Seirios*, and the ship's high-bandwidth satellite connection for continuous real-time ship-to-shore communications. Technology demonstrations will include an integration/shakedown a REMUS 600 Autonomous Underwater Vehicle (AUV), deployment of a towed Kraken Robotics Katfish with Synthetic Aperture Sonar (SAS), integration of a Massachusetts Institute of Technology (MIT) 360 degree camera on *Deep Discoverer*, integration/testing of a Kraken Robotics SeaVision laser scanner on ROV *Deep Discoverer* and integration/testing of a One Way Travel Time Inverted Ultra Short Baseline (OWTTIUSBL) from the Woods Hole Oceanographic Institution (WHOI) on ROV *Deep Discoverer*. Operations are planned throughout the Northeast U.S. Continental Margin and on the Northeast U.S. continental shelf off of Virginia, Maryland, Delaware, New Jersey, New York, Rhode Island and Massachusetts.

The NOAA Office of Ocean Exploration and Research (OER) is the only federal program dedicated to exploring our deep ocean, closing the prominent gap in our understanding of U.S. deep waters to provide the valuable information needed to strengthen the economy, health, and security of our nation.

Using the latest tools and technology, OER explores previously unknown areas of our deep ocean, making discoveries of scientific, economic, and cultural value. Through live video streams, online coverage, training opportunities, and real-time events, OER allows

scientists, resource managers, students, members of the general public, and others to actively experience ocean exploration, expanding available expertise, cultivating the next generation of ocean explorers, and engaging the public in exploration activities. From this exploration, OER makes the collected data needed to understand our ocean publicly available, so we can maintain the health of our ocean, sustainably manage our marine resources, accelerate our national economy, and build a better appreciation of the value and importance of the ocean in our everyday lives.

NOAA Ship *Okeanos Explorer* is the only U.S. federal vessel dedicated to exploring our largely unknown ocean for the purpose of discovery and the advancement of knowledge. America's future depends on understanding the ocean. We explore the ocean to make valuable scientific, economic, and cultural discoveries; we explore because ocean health and resilience are vital to our economy and to our lives. Exploration supports NOAA mission priorities and national objectives by providing high-quality scientific information about the deep ocean to anyone who needs it.

In close collaboration with government agencies, academic institutions, and other partners, NOAA's Office of Ocean Exploration and Research (OER) conducts deep-ocean expeditions using advanced technologies on NOAA Ship *Okeanos Explorer (EX)*. From mapping and characterizing previously unseen seafloor to collecting and disseminating information about ocean depths, this work helps to establish a foundation of information and to fill data gaps. Data collected on the ship follow federal open-access data standards and are publicly available shortly after an expedition ends. This ensures the delivery of reliable scientific data needed to identify, understand, and manage key elements of the ocean environment.

The core objectives of this cruise will be to demonstrate, test, integrate and evaluate emerging and existing technology. Certain projects will be evaluated for their usefulness in meeting OER and partner data needs while others have the potential to benefit the larger oceanographic research community. NOAA will leverage internal, private and academic partnerships to meet cruise objectives.

The secondary objectives of this cruise will be to provide authoritative and actionable data to regional stakeholders. For example, certain sites have historical/archeological significance, certain targets are currently being evaluated by NOAA Emergency Response Division / Office of Response & Restoration as potentially polluting wrecks, ROV dives will attempt to target areas of known deep sea communities and

This expedition will contribute to NOAA's Atlantic Seafloor Partnership for Integrated Research and Exploration (ASPIRE), a major multi-year, multi-national collaborative field program focused on raising collective knowledge and understanding of the North Atlantic. This campaign provides timely, actionable information to support decision making based on reliable and authoritative science. It also serves as an opportunity for the nation to highlight the uniqueness and importance of these deepwater environments. ASPIRE builds on the momentum of past U.S. campaigns and international initiatives to support ecosystem-based management of marine resources.

A.1 Individual Summaries for Emerging Technology and Technology Demonstration Projects

1. **Remus 600**
    a. Evaluating the integration of AUVs into EX operations is an OER leadership priority. The NOAA Office of Coast Survey (OCS) owns a Remus 600 AUV equipped with an EM 3002. The testing of OCS' Remus 600 AUV will provide OER and EX experience and information of launching, recovery and the acquisition/processing of AUV data in order to inform how AUV operations might fit into current EX ROV/Mapping explorations. This cruise will also serve as a training opportunity for OCS to train additional operators. The Remus 600 has not been deployed in a year and therefore this cruise will be able to provide a platform for shakedown operations and objectives. OER has been working with regional partners to identify deployment locations that will provide valuable baseline data.
2. **Kraken Katfish**
    a. In 2018 NOAA OER and Kraken Underwater Systems developed a Cooperative Research and Development Agreement (CRADA) in order to jointly advance and collaborate on ocean exploration. Part of the Statement of Work within the CRADA is to test a Kraken towed Katfish with Synthetic Aperture Sonar (SAS) aboard an AUV or towed system on a NOAA vessel. This cruise will serve as an opportunity to deploy the Kraken Katfish and integrate towed operations into OER's existing operations. The Katfish system is comprised of an actively controlled smart towfish, SAS imaging, bathymetry and gap-filler sonars, launch and recovery system, operator console, and visualization software. There is strong interest from many in the oceanographic community in regards to SAS data and its application to object detection, site characterization and nautical charting. By the time of this cruise, the Katfish will have changed ownership to Thayer Mahan, who have also shown support for this opportunity. OER has been working with regional partners to identify targets of interest. In addition to providing valuable data, this project will serve as an example of how developing a public-private partnership can benefit the exploration community.
3. **One-Way Travel-Time Inverted Ultra-Short-Baseline (OWTTIUSBL) navigation system**
    a. The OWTTIUSBL is in development at Woods Hole Oceanogrpahic Instituion (WHOI) to support multi subsea vehicle navigation capability. This project supports the FY18 Federal Funding Opportunity (FFO) funded project, 'Exploration of the Deep Ocean with Teams of Long-Endurance Ocean RObots,' a technology effort to develop a low-power acoustic navigation system for application with an array of autonomous vehicles. The navigation system is for application on acoustically passive AUVs which can be used to

explore the deep ocean. The device would be mounted to ROV Deep Discoverer.

4. **Kraken SeaVision**
    a. In addition to testing of the Katfish, another objective in the SOW in the CRADA signed by NOAA and Kraken is the testing of the Kraken SeaVision 3D laser imaging system. This device is designed to operate in twin scanning configuration, with adjustable baseline and can generate high resolution 3D full color imagery. The goal is to image biological and archaeological targets using the SeaVision. There are many practical applications to collecting high-resolution spatial data via laser scanner technology. For instance, highly precise measurements of the size of benthic organisms are necessary in order to accurately estimate the age and growth rates of these organisms. While rough size estimates can be obtained from scaled video data, growth rates derived from such measurements have very large errors, and are thus not that useful. Additionally, percent benthic cover is one of the most frequently reported metrics in the marine ecological studies, however, estimating this metric is often times impossible from ROV video data. Laser scanning technology could help provide this metric. Furthermore, when visible impacts are seen on benthic organisms (e.g. tangled fishing nets, scars, diseases) their size is typically used as a proxy for health status, a measure that also requires accurate size measurements. In addition to ecological applications, laser scanner technologies are also of interest to the exploration of UCH sites. In fact, getting a 3D model of a maritime heritage site is frequently the main purpose of UCH dives conducted by OER. To date, this has been accomplished by mosaicing collected video data, a technique that requires spending considerable time transiting over the site with the ROV. With a 3D scanner, this could be accomplished much faster, more accurately, as well as reduce the chances of disturbing the UCH site.
5. **MIT 360 Camera, Maka'oi**
    a. The goal of this project is to create studio-caliber 360 degree video from the deep for VR/AR/Documentary/Planetarium work and more experimentally for real-time 360 visualization. Physically, the system is comprised of 6 compact 4k studio cameras housed within a spherical Al/Ti housing. The housing is currently rated to 4000m, but designed to go to 4500m plus with a healthy safety margin; The housing sports just two connectors, one copper for power and one fiber for data I/O. Each camera outputs its feed over SDI, which is then converted to optical and mixed into a single fiber out. On-ship the signals are demuxed and converted back into 4k SDI and recorded individually on high-quality recording monitors. The monitors provide a live view for the camera operator, who can adjust each camera individually or in groups (shutter, whitebalance, etc) from a simple control panel that lives in a pelican 1555 along with the monitors. The SDI control signal is converted to optical and sent down the same fiber to the camera, where it is converted to SDI and distributed to each camera for control. Moving forward, the goal is to live-stitch the video on-ship in real time to give the operator — and perhaps the ROV pilot — a real-time 360 view from the vehicle.

B. Days at Sea (DAS)

Of the 15 DAS scheduled for this project, 15 DAS have been allocated by OAR PFD. This project is estimated to exhibit a High Operational Tempo due to 24 hour operations consisting of ROV dives, AUV operations, towed system operations, integration of different technologies, and shore-side participation via telepresence.

C. Operating Area

EX-19-04 is a combined ROV, mapping and technology demonstration cruise that will focus operations in the maritime areas of the U.S. Northeast. Mapping, ROV, and technology demonstration operations will focus in depths generally between 20 and 3,500 meters.

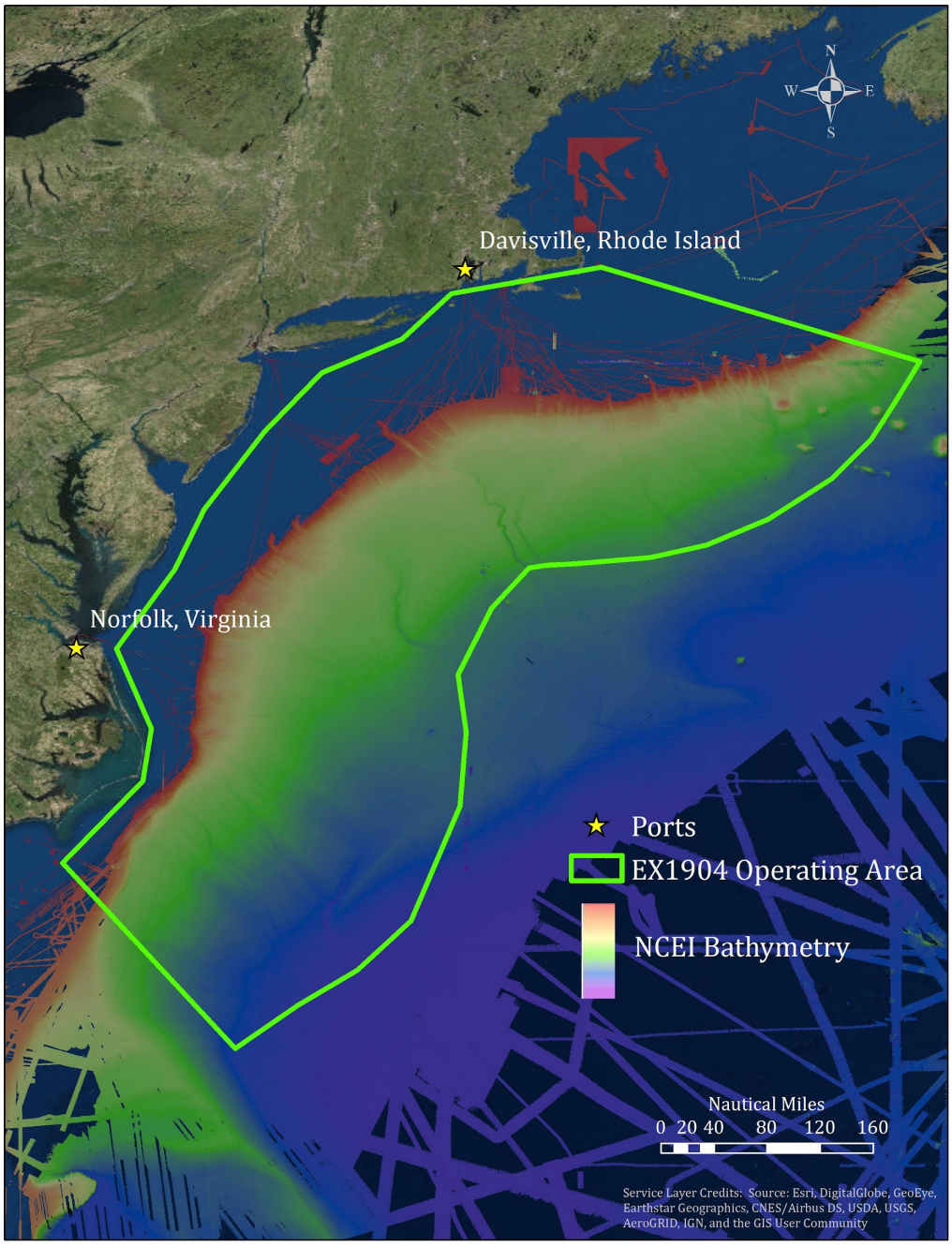

Figure 1: Map showing the general expedition operating area (green polygon) and current publicly available multibeam bathymetry.

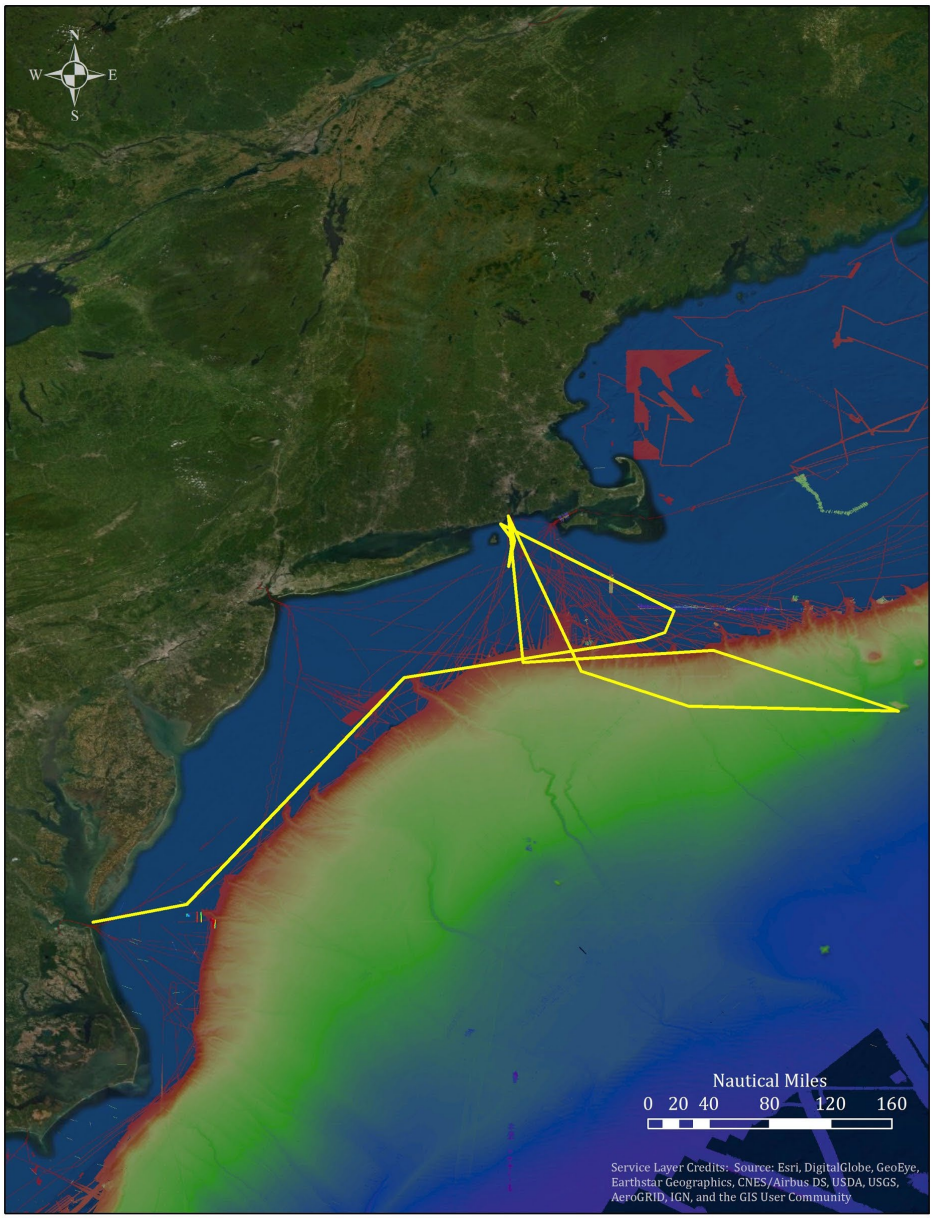

Figure 2: Map showing the general cruise trackline in yellow and current publicly available multibeam bathymetry.

Table 1: Bounding coordinates of the EX-19-04 operating area. All operations are planned within U.S. waters.

Generalized operating area coordinates		
ID	**Latitude**	**Longitude**
North	41° 17.524'N	71° 24.677'W
South	36° 43.631'N	74° 47.061'W
East	39° 16.375'N	66° 49.533'W
West	39° 40.852'N	72° 53.228'W

D. Summary of Objectives

July 18 to August 1, 2019 (Norfolk, Virginia to Davisville, Rhode Island) Emerging Technology, ROV and Mapping Operations. EX-19-04 operations will occur in the waters offshore the U.S. Mid-Atlantic to Northeast Coast. This cruise will focus on integrating emerging and existing technology projects into EX CONOPs.

Mission objectives for EX-19-04 include a combination of mapping/operational, science, education, outreach, and data management objectives:

1. REMUS 600 - The REMUS 600 AUV (R600), owned and operated by NOAA Office of Coast Survey (OCS) has been idle for over a year. Cruise objectives will focus on shakedown of the R600 and acquiring data over priority areas. Specifications can be found in Appendix I. Appendix J contains notes from the REMUS 600 ship visit and walkthrough from April 15, 2019.
    a. Integrate the REMUS 600 AUV on the Okeanos Explorer. This includes setting up a weather barrier and 220v, 30amp power for vehicle charging.
    b. Develop, implement and carry-out a Launch and Recovery Plan in coordination with ship's crew, OCS personnel and the scientific party.
    c. Collect EM3002 multibeam sonar data over targets and areas of interest in water depths between 20 and 400 meters, as directed by the scientific party.
    d. Process EM3002 multibeam sonar data from the R600 through NavLab and provide .ALL data to Chief Scientist.
    e. Provide exposure/training/experience to NRT1 team members in the operation and maintenance of the R600.
    f. Confirm the operational status of all R600 components and identify any equipment deficiencies.
    g. Demonstrate operational capabilities to any interested scientific and/or ships personnel.

2. Katfish: https://krakenrobotics.com/products/katfish/

a. Integrate the Katfish in existing EX operations
    i. Mount winch, cradle to fantail
    ii. Hang sheave
b. Develop a plan for LAR of Katfish system
c. Gather SAS data over regional priority targets
d. Gain operational experience with towed system on the EX
e. Develop a data pipeline for SAS data to be archived at NCEI
    i. Outline metadate, processing steps, acquisition parameters

3. SeaVision 3D Laser: https://krakenrobotics.com/products/seavision/
    a. Collect high resolution 3D scans in full color using the SeaVision laser scanner data over anthropogenic and biologic targets
    b. Process 3D data on the EX
    c. Integrate the SeaVision laser scanner on the ROV Deep Discoverer
4. One Way Travel Time Inverted Ultra Short Baseline
    a. Conduct three ROV dives in support of the OWTTIUSBL from WHOI
        i. First dive will be at 3000meters or greater in depth and will piggyback on normal ROV operations
        ii. Second dive will be to 3000 meters or greater in depth and will include completely square patterns with the ROVs at 500 meter increments
        iii. Third dive will be to 1000 meters in depth and will piggyback on normal ROV operations.
    b. During the dives while the ROVs are in the water and testing of the OWTTIUSBL is being conducted, hang a transducer over the side of the ship. Transducer weighs approximately 14 kg and is attached to 30 meters of cable.
5. Maka'oi 360 Camera System from MIT
    a. Collect 360 camera data during ROV dives
    b. Mount 360 camera to ROV Deep Discoverer

6. Science
    a. Explore U.S. maritime heritage by investigating sonar anomalies and characterizing shipwrecks.
    b. Collect high-resolution bathymetry in areas with no (or low quality) sonar data.
    c. Ground-truth acoustic data using video imagery and characterize associated habitat.
    d. Successfully conduct operations in conjunction with shore-based Exploration Command Centers (ECCs) and remote science team participants.
    e. Create and provide input into standard science products to provide a foundation of publicly accessible data and information products to spur further exploration, research, and management activities.
    f. Follow UCH SOPs as identified in Appendix H.
    g. Train and familiarize J. Dunn with the Expedition Coordinator role.

Remote Science/Exploration Command Centers (ECCs)

h. Provide operational support and training to scientists and managers to enable limited remote participation in at-sea operations.
i. Test and refine operating procedures and products.
j. Test and troubleshoot new methods of distributing video to shore.

2. ROV Engineering
   a. Daytime ROV dives on exploration targets.
   b. Complete engineering objectives during ROV dives.
   c. Ongoing training of engineers and pilots.
   d. Ongoing system maintenance, documentation, and training.
   e. Follow UCH SOPs as identified in Appendix H.
   f. Continue to develop and test ROV mosaic procedures for UCH and other sites.
   g. Formalize standard operating procedures for integrating and operating devices on the ROV's that are developed by outside groups.

3. Video Engineering (VSAT ~15 mb/sec ship-to-shore; 5 mb/sec shore-to-ship)
   a. Test terrestrial and high-speed satellite links.
   b. Support telepresence-enabled ROV operations.
   c. Collect/create all standard video products.
   d. Facilitate live outreach events between ship and shore.
   e. Follow UCH SOPs as identified in Appendix H.

4. Mapping operations will be opportunistic and a secondary objective relative to technology projects. Mapping operations will be completed as possible simultaneously during technology demonstrations in order to test CONOPs.
   a. Collect high-resolution mapping data from sonars in priority areas as dictated by operational needs, as well as science and management community input.
   b. Collect mapping data in support of Seabed 2030, SEDCI, NOAA's Southeast Regional Coordination Team (SECART), Monitor National Marine Sanctuary, and ongoing collaborations between NOAA, the Bureau of Ocean Energy Management, and the U.S. Geological Survey.
   c. Support ROV operations with mapping products and expertise.
   d. Conduct mapping operations during transit, with possible further development of exploration targets.
   e. Collect XBT casts as data quality requires during mapping operations.
   f. Create daily standard mapping products.
   g. Follow UCH SOPs as identified in Appendix H.
   h. Collect sun photometer measurements as part of surveys of opportunity (Section V, Appendix F).

5. Data Management
   a. Assist with network/data integration planning with our technology demonstration partners.

b. Appropriately integrate technology demonstration systems into existing ship's data management and network processes.
c. Provide data management and network support to help ensure demonstration success.
d. Provide a foundation of publicly accessible data and information products to spur further exploration, research, and management activities.
e. Receive training by our technology partners, train our partners on shipboard systems and practices.
f. Provide daily products to shore for operational decision making purposes.
g. Train new data management personnel.
h. Formalize Data Management SOPs.
i. Follow UCH SOPs as identified in Appendix H.
j. Continue to work on the GFOE network integration and develop SOPs.
k. Verify that GFOE data systems operate as expected.

6. Outreach
   a. Engage the general public in ocean exploration through live video and timely content (topical essays and web logs, imagery and mapping products) posted on the Ocean Explorer website.
   b. Host live events and interactions with shore. Only one live interaction is scheduled for this cruise. July 28 with CCOM.

7. Ship
   c. Conduct weekly and quarterly drills (man overboard, fire and emergency drills, abandon ship, spill drills, other maneuvering drills
   d. Review ROV Emergency Procedures. Continue training new deck department personnel in ROV launch and recovery.
   e. Develop and maintain proficiency with small boat operations for new and long term crew.
   f. Follow UCH SOPs as identified in Appendix H.
   g. SCUBA Dive operations (weather permitting).
   h. Conduct aft conn training.
   i. Additional safety training.

E. Participating Institutions

- National Oceanic and Atmospheric Administration (NOAA), Office of Ocean Exploration and Research (OER)–1315 East-West Hwy, Silver Spring, MD 20910 USA
- NOAA, National Oceanographic Data Center, National Coastal Data Development Center, Stennis Space Center MS, 39529 USA
- NOAA, Office of Coast Survey, 1315 East West Highway, Silver Spring, MD 20910

- University Corporation for Atmospheric Research Joint Office for Science Support (JOSS), PO Box 3000 Boulder, CO 80307 USA
- University of New Hampshire (UNH) Center for Coastal and Ocean Mapping (CCOM) Jere A. Chase Ocean Engineering Lab, 24 Colovos Rd, Durham, NH 03824 USA
- Global Foundation for Ocean Exploration, P.O. Box 417, Mystic, CT 06355
- University of Rhode Island Inner Space Center, 215 South Ferry Road Narragansett, RI 02882
- Kraken Robotics, 189 Glencoe Drive, Mount Pearl, NL A1N 4P6 Canada
- Woods Hole Oceanographic Institution, 266 Woods Hole Road, Woods Hole, MA 02543-1050 U.S.A.
- Massachusetts Institute of Technology, 77 Massachusetts Avenue, Cambridge, MA

F. Personnel (Mission Party)

Table 2: EX1904, Mission Party for Leg 01, Norfolk, VA to Davisville, RI. Full list of seagoing mission party members and their affiliations. Schedules below are tentative until final travel is booked. Any deviations from the schedule below will be coordinated through the OPS Officer.

#	Name (First, Last)	Title	Date Aboard	Date Disembark	Gender	Affiliation	Nationality
1	Michael White	Expedition Coordinator	7/16	8/3	M	OER/ CNSP	USA
2	Daniel Rogers	GFOE Team Lead	7/16	8/2	M	GFOE	USA
3	Anthony Lyons	Scientist	7/16	7/25	M	UNH/CCOM	USA
4	Daniel Freitas	Mapping Watch Lead	7/16	7/25 or 8/2 depending on 23rd bunk request	M	UCAR	USA
5	Neah Baechler	Mapping Watch lead	7/16	8/2	F	UCAR	USA
6	Rod Mather	Archaeologist	7/16	7/25	M	URI	USA
7	CDR Kurt Dreflak	OMAO UxS	7/16	8/2	M	OMAO	USA
8	Roland Brian	Engineering team	7/16	7/25	M	GFOE	USA
9	Bobby Mohr	Engineering team	7/16	8/2	M	GFOE	USA
10	Fernando Aragon	Engineering team	7/16	8/2	M	GFOE	USA
11	Dave Wright	Engineering team	7/16	8/2	M	GFOE	USA

12	Tara Smithee	Engineering Team	7/16	8/2	F	GFOE	USA
13	Barry Eakins	Data Manager	7/16	7/25	M	NCEI	USA
14	Michael Annis	REMUS 600	7/16	7/25	M	OCS	USA
15	Rob Downs	REMUS 600	7/16	7/25	M	OCS	USA
16	Alex Ligon	REMUS 600	7/16	7/25	M	OCS	USA
17	LT John Kidd	REMUS 600	7/16	7/25	M	OCS	USA
18	Tristan Strong	Katfish	7/16	7/25	M	Kraken Robotics	Canada
19	Brian Carroll	Katfish	7/16	7/25	M	Kraken Robotics	Canada
20	Steve Link	Katfish	7/16	7/25	M	Thayer Mahan	USA
21	Welles Sakmar	Katfish	7/16	7/25	M	Thayer Mahan	USA
22	Jon Mefford	Engineering Team	7/16	8/2	M	GFOE	USA

Table 3: EX1904, Mission Party for Leg 02, Davisville, RI to Davisville, RI. Full list of seagoing mission party members and their affiliations. Schedules below are tentative until final travel is booked. Any deviations from the schedule below will be coordinated through the OPS Officer.

#	Name (First, Last)	Title	Date Aboard	Date Disembark	Gender	Affiliation	Nationality
1	Michael White	Expedition Coordinator	7/16	8/2	M	OER/ CNSP	USA
2	Evan Denmark	360 Camera	7/25	8/2	M	MIT	USA
3	Charlene Xia	360 Camera	7/25	8/2	F	MIT	USA
4	Michael Jakuba	OWTTIUSBL	7/25	8/2	M	WHOI	USA
5	LCDR Christopher Dolan	OWTTIUSBL	7/25	8/2	M	WHOI	USA
6	Daniel Rogers	GFOE Team Lead	7/16	8/2	M	GFOE	USA
7	Chris Wright	Engineering Team	7/25	8/2	M	GFOE	USA
8	Bobby Mohr	Engineering Team	7/16	8/2	M	GFOE	USA
9	Sean Kennison	Engineering Team	7/25	8/2	M	GFOE	USA
10	Mark Durbin	Engineering Team	7/25	8/2	M	GFOE	USA

11	Lars Murphy	Engineering Team	7/25	8/2	M	GFOE	USA
12	Bob Knott	Engineering Team	7/25	8/2	M	GFOE	USA
13	Fernando Aragon	Engineering Team	7/25	8/2	M	GFOE	USA
14	Jim Meyers	Engineering Team	7/16	8/2	M	GFOE	USA
15	Jon Mefford	Engineering Team	7/16	8/2	M	GFOE	USA
16	Dave Wright	Engineering Team	7/16	8/2	M	GFOE	USA
17	Tara Smithee	Engineering Team	7/16	8/2	F	GFOE	USA
18	Caitlin Bailey	Engineering Team	7/25	8/2	F	GFOE	USA
19	Jan Albiez	SeaVision	7/25	8/2	M	Kraken	Germany
20	James Partan	OWTTIUSBL	7/25	8/2	M	WHOI	USA
21	Daniel Freitas	Mapping Watch Lead	7/16	7/25 or 8/2 depending on 23rd bunk request	M	UCAR	USA
22	CDR Kurt Dreflak	OMAO UxS	7/16	8/2	M	OMAO	USA
23	Neah Bachler	Mapping Watch Lead	7/16	8/2	F	UCAR	USA

G. Administrative

1. Points of Contact:

Ship Operations

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Mission Operations

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Alan Leonardi, Director
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Phone: 301-734-1016
Mobile: 202-631-1790
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Vessel Shipping Address

1. Shipments

Send an email to the *Okeanos Explorer* Operations Officer at OPS.Explorer@noaa.gov indicating the size and number of items being shipped.

NOAA Ship Okeanos Explorer
ATT: Name/Dept
439 W. York Street
Norfolk, VA 23510

2. Diplomatic Clearances

None required

3. Licenses and Permit

Pursuant to the National Environmental Policy Act (NEPA), NOAA OER is required to include in its planning and decision-making processes appropriate and careful consideration of the potential environmental consequences of actions it proposes to fund, authorize and/or conduct. NOAA's Administrative Order (NAO) 216-6A Companion Manual describes the agency's specific procedures for NEPA compliance. Among these is the need to review all proposed NOAA-supported field projects for their environmental effects. An Environmental Review Memorandum has been completed for this survey, in accordance with Section 4 of the Companion Manual. This evaluation document memorandum describes all activities that are part of the Southeast Deep Coral Initiative (SEDCI). (Appendix C).

Informal consultation was initiated under Section 7 of the Endangered Species Act (ESA), requesting NOAA Fisheries' Protected Resources Division concurrence with our biological evaluation determining that *Okeanos Explorer* operations conducted as part of SEDCI, may affect, but are not likely to adversely affect, ESA-listed marine species. The informal consultation was completed on July 13th 2017 when NOAA NCCOS received a signed letter from the Regional Administrator of South East Regional Office, stating that NMFS concurs with OER's determination that conducting proposed *SEDCI* cruises are not likely to adversely affect ESA-listed marine species (Appendix D).

NCCOS has completed consultation with NOAA's Habitat Conservation Division on potential SEDCI impacts of our operations to Essential Fish Habitat (EFH). They concurred that our operations would not adversely affect EFH provided adherence to our proposed procedures and their guidance stated in the letter (Appendix E).

Additionally, OER received a Letter of Acknowledgement (LOA) from NMFS for operations in the Southeast Deepwater MPAs and areas deemed as a Habitat Areas of Particular Concern (HAPCs). The LOA is attached in Appendix G.

II. Operations

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

A. Project Itinerary

All times and dates are subject to prevailing conditions and the discretion of the Commanding Officer. Locations are approximate. Final dive sites will be delivered to the bridge at night for the next day's dive. Notes from planning meeting can be found in Appendix J.

Additional items to be added to the schedule below as we are closer to sailing.

Currently, we are planning to have at least one Underwater Cultural Heritage ROV dive. These dates have not been determined yet, but once scheduled we anticipate following all UCH protocols established in Appendix H for data pertaining to these sites.

An hourly breakdown of the schedule can be found here: https://docs.google.com/spreadsheets/d/1_yOM_LNI_PGpkA6TNO80xQlpMT9FN3BGM8v7viD6tno/edit#gid=912414476

Table 4: Cruise Itinerary. This is an approximate itinerary and is subject to change based on community input, survey results, field conditions, and discretion of the CO. Please note- position information for each dive is tentative until the dive planning call approximately one day before the scheduled dive.

Date	Activities
7/12	EX arrives Norfolk, VA. ROV Seirios is moved from the back deck to the 02 deck. ROV sheave is disconnected from the A-frame and stored securely. ROV D2 is moved as far forward in the ROV Hangar as possible. Katfish is loaded onto the EX. Katfish is secured to deck, power is connected and Katfish sheave is hung.
7/13	Crew Rest. Science party continues to mobilize. Crane support may be available if needed.
7/14	Crew Rest. Science party continues to mobilize.
7/15	Crew Rest. Science party continues to mobilize.
7/16	Mobilize the REMUS 600. CTD Rosette is moved to the 02 deck. REMUS 600 is craned onboard and lashed to the CTD Deck. Setup top-side electronics for REMUS 600. GFOE team will arrive later in the day. OCSteam will move onboard.
7/17	Staging and Mobilization continues. Will plan to complete practice Launch and Recovery with the Katfish and the REMUS 600.
7/18	Depart Norfolk. Transit to head of Norfolk Canyon. Deploy Katfish, begin Katfish operations over Billy Mitchell fleet and other archaeology targets. Will include UCH work.
7/19	Recover Katfish, deploy REMUS 600. Deploy REMUS 600 operations over Billy Mitchell fleet and other archaeology targets. Recover REMUS 600, begin transit to USS Murphy
7/20	Arrive USS Murphy. Deploy Katfish and commence operations over USS Murphy. Recover Katfish, deploy REMUS 600, begin overnight REMUS operations on USS Murphy/Head of Hudson Canyon.
7/21	Recover REMUS 600 in the morning. Transit to Wreck 1478. Arrive Wreck 1487 in the evening. Deploy Katfish. Commence overnight Katfish operations.

7/22	Continue Katfish operations on wreck 1487. Transit to U-550. Commence Katfish operations on U-550. Recover Katfish in the morning, deploy REMUS 600. Commence REMUS 600 operations on Wreck 1487/-U-550. Recover REMUS 600, transit to Pan Pennsylvania. Deploy Katfish over Pan Pennsylvania.
7/23	Recover Katfish in the morning. Deploy REMUS 600 over Pan Pennsylvania. Recover REMUS 600 late afternoon, begin transit to Point Judith, RI.
7/24	Katfish Operations on USS Bass. Recover Katfish, begin transit to Narragansett sea buoy. Passage into Davisville pier. Arriving Davisville, offload Katfish and move Seirios back into place. Will include UCH work.
7/25	Crane operations to offload REMUS 600. Hang ROV sheave and .68 cable. Reterminate .68 cable and ROV umbilical. Testing may include high voltage operations. Onboard MIT 360 camera, WHOI OWTTIUSBL and Kraken SeaVision personnel. Begin integration of topside electronics. Late afternoon/evening passage to depart Davisville, RI. Transit to Dive 01.
7/26	Overnight mapping operations near Dive 00, Engineering Dive. Dive 00 will be scheduled for a 1300 deployment. Dive will ensure the topside electronics are operational and will verify the re-connection of the .68 and the tether for the ROVs.
7/27	Dive 01. Dive on UCH target. Target may be the USS Baltimore. Will test Kraken SeaVision Laser scanner. Extended ROV dive requested.
7/28	Dive 02. Dive on biology with SeaVision, target deep sea corals and sponges.
7/29	Dive 03. Dive on Mytilus Seamount. Extended ROV dive requested. Dive will include MIT 360 camera and WHO OWTTIUSBL
7/30	Dive 04. Dive Location still TBD. Dive will include MIT 360 camera and WHO OWTTIUSBL
7/31	Dive 05. Dive location TBD. Dive will include MIT 360 camera and WHO OWTTIUSBL.
8/1	**Arrive Davisville, RI. Demobilization.**

B. Staging and De-staging

Staging is detailed above. Staging will begin on July 12th with crew support, will proceed through July 15th without crew support and will resume on July 16th with crew support.

Demobilization will occur in two stages. The first will begin the evening of the 24th after completing Katfish and REMUS 600 operations. This demobilization will complete the morning of July 25 with ship supported crane operations. Demobilization after the ROV portion of the cruise is expected to include normal ROV demobilization operations. Notes from planning meeting can be found in Appendix J.

C. Operations to be Conducted

1. **Telepresence / Outreach Events**

a. Three live video feeds will be used throughout the cruise to provide situational awareness for onshore personnel.
b. Additional live events are likely but TBD.

2. **In-Port Events**
    a. No major in port events are planned for this cruise, but smaller tours with partners and VIPS are likely in both ports.

D. SCUBA Dive Plan

All dives are to be conducted in accordance with the requirements and regulations of the NOAA Diving Program and require the approval of the ship's Commanding Officer. No science dives are planned during EX-19-03 leg 2, but the ship may plan training, safety drill, or maintenance dives.

E. Applicable Restrictions

Sonar Operations

EM 302, EK 60, ADCP, and sub-bottom profiler data acquisition is planned for this cruise. All data acquisition will be conducted in accordance with established standard operating procedures under the direction of the mapping team lead. These operating procedures will include protection measures when operating in the vicinity of marine mammals, sea turtles or Endangered Species Act-listed species as described in the appendices of this document. The final decision to operate and collect 24-hour sub-bottom profiler data will be at the discretion of the Commanding Officer.

III. Equipment

A. Equipment and capabilities provided by the ship

- Kongsberg Simrad EM 302 Multibeam Echosounder (MBES)
- Kongsberg Simrad EK 60 Deepwater Echosounders and GPTs (18, 70, 120, 200 kHz)
- Knudsen Chirp 3260 Sub-bottom profiler (SBP)
- Teledyne RDI Workhorse Mariner (300 kHz) ADCP
- Teledyne RDI Ocean Surveyor (38 kHz) ADCP
- Teledyne Underway CTD
- LHM Sippican XBT Mark21 System(Deep Blue probes)
- AOML Automated XBT Launcher (Deep Blue probes)
- Seabird SBE 911Plus CTD
- Seabird SBE 32 Carousel and 12 10L Niskin Bottles
- Seapoint Turbidity / Light Scattering Sensor (LSS)
- PMEL Oxidation Reduction Potential (ORP)
- Seabird SBE-43 (DO) sensor

- Altimeter Sensor and battery pack
- POS/MV
- Seabird SBE-45 (Micro TSG)
- Kongsberg Dynamic Positioning-1 System
- Scientific Computing System (SCS)
- ECDIS
- Met/Wx Sensor Package
- 1 functioning and seaworthy SOLAS approved fast rescue boat
- 1 functioning and seaworthy work boat to support ROV operations and personnel transfers

B. Equipment and capabilities provided by OER and Partners

- Microtops II Ozone Monitor Sun photometer and handheld GPS required for NASA Marine Aerosols Network supplementary project.
- NOAA OER 6000 m *Deep Discoverer* ROV NOAA *Seirios* Camera Platform
- IVS Fledermaus Software suite
- SIS Software and Kongsberg acquisition computer
- EK 60 acquisition computer
- Sub bottom profiler acquisition computer
- CTD acquisition computer
- Hypack Software
- GFOE provided VSAT High-Speed link (15 Mbps ship to shore; 5 Mbps shore to ship)
- Backscatter Mosaic computer
- GFOE exploration operations networking infrastructure
- Scientific Computing System (SCS)
- Telepresence System
- NCEI Cruise Information Management System (CIMS)
- GFOE VOIP system
- GFOE provided data storage
- MarineStar GPS with corrections

IV. Hazardous Materials

A. Policy and Compliance

The Expedition Coordinator 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). The Expedition Coordinator and Science Team Lead will be responsible for transporting all samples and HAZMAT on and off the ship. 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

Item	Use	Approx. locations
95% Denatured Ethanol (60 gallons)** This is currently being heavily used on EX1903L2	Sample preservation	Wetlab, under the chemical hood
10% Buffered Formalin (2 gallons) This is currently being heavily used onEX1903L2	Sample preservation	Wetlab, under the chemical hood
Aqua Shield (7 bottles, 8 oz each)	Underwater Lubricant	ROV Workshop Fire Cabinet, Pit

Dow Corning 4 (10 bottles, 5.3 oz each)	Electrical insulating compound	ROV Workshop Fire Cabinet, Pit
Fluid Film Spray (2 bottles, 11.75 oz each)	Silicone Lubricant	ROV Workshop Fire Cabinet
Isopropanol Alcohol (35 gallons)	Solvent	ROV Workshop Fire cabinet
Scotchkote (7 bottles, 4 oz each)	Electrical insulating compound	ROV Workshop Fire cabinet
3M Silicone Spray (5 bottles, 13.74 oz each)	Silicone Lubricant	ROV Workshop Fire cabinet
Synthetic AW Hydraulic Oil, ISO-22 (35 gallons)	Amsoil (AWG-05)	Hanger, Pit, Vehicles
Tap Magic Cutting Fluid (1 bottle, 16 oz each)	Cutting/Machining Lubricant	ROV Workshop Fire cabinet
Tap Magic Heavyweight Cutting Fluid (2 bottles, 16 oz each)	Cutting/Machining Lubricant	ROV Workshop Fire cabinet
Tuff Coat M (20 gal)	Marine Lubricant	Winch room
Dow Corning Molykote 111 (7 bottles, 5.3 oz each)	Valve Lubricant and Sealant	ROV Workshop Fire cabinet, Pit
WD40 (3 bottles, 12 oz each)	Lubricant	ROV Workshop Fire cabinet
Locktite (2 bottles, 1.69 oz each)	Bolt adhesive	ROV Workshop Fire cabinet
Shell Diala S2 (55gallons)	Vitrea	Hanger, Vehicles
Por-15 (1 bottle, 8 oz each)	Paint Kit	ROV Workshop Fire cabinet
Aeroshell 41 (80 gal)	Hydraulic Fluid	Hanger, ROV *D2*
Ultratane (2 bottles, 5.13 oz each)	Butane fuel	ROV Workshop fire cabinet
Rust-oleum (2 bottles, 15 oz each)	Protective Enamel	ROV Workshop fire cabinet
Flux-Off (1 bottle, 12 oz each)	Soldering Flux remover	ROV Workshop fire cabinet
Propane (2 bottles, 14.1 oz each)	Torch Fuel	ROV Workshop fire cabinet
Adhesive Pliobond 25 (0 bottles, 3 oz each)	General adhesive	Tool room
AP 120 Metal Prep (1 bottle, 20 oz each)	Degreaser/cleaner for metal surfaces	Pit
Butane Fuel (1 can, 5 oz)	Torch refill	Tool Room
PVC cement (1 bottle, 8 oz each)	Adhesive for PFV plastic piping	Tool Room
Phosphoric Acid (1 bottle, 6 oz each)	Ferrous metal rust removal	Tool room
Pipetite Paste (1 bottle, 8 oz each)	Plumbing sealant	Tool room/pit
Spindle Oil 10, ROS PT (14 bottles, 12 oz each)	Lubricant/compensation oil	Tool room
DC557 (1 bottle, 11 oz each)	Silicon grease	Tool room/pit
Tether Potting Catalyst (8 bottles, 5.2 g each)	Two part epoxy catalyst	Pit
Tether Potting Compound (8 bottles, 490 g each)	Two part epoxy ingredient	Pit

ThermaPlex Bearing Grease (1 bottle, 14.1 oz each)	Lubricant	Pit
Tritech Seaking (1 bottle, 32 oz each)	Compensator oil for sonar head	Pit

C. Chemical safety and spill response procedures

All safety and spill response procedures will be handled according to OMAO guidelines and following the manufacturer's MSDS which has been provided to the ship's ECO.

D. Radioactive Materials

NOT APPLICABLE TO THIS CRUISE

V. Additional Projects

A. Supplementary Projects

NASA Maritime Aerosol Network

During the cruise the marine aerosol layer observations will be collected for the NASA Maritime Aerosol Network (MAN). Observations will be made by mission personnel (as time allows) with a sun photometer instrument provided by the NASA MAN program. Resulting data will be delivered to the NASA MAN primary investigator Alexander Smirnov by the expedition coordinator. All collected data will be archived and publically available at: http://aeronet.gsfc.nasa.gov/new_web/maritime_aerosol_network.html
Equipment resides on the ship and is stewarded by the Expedition Coordinator.
See Appendix G for full Survey of Opportunity Form.

B. NOAA Fleet Ancillary Projects

No NOAA Fleet Ancillary Projects are planned.

VI. Disposition of Data and Reports

A. Data Responsibilities

All data acquired on *Okeanos Explorer* will be provided to the public archives without proprietary rights. All data management activities shall be executed in accordance with NAO 212-15, Management of Environmental and Geospatial Data and Information

Ship Responsibilities

The Commanding Officer is responsible for all data collected for missions until those data have been transferred to mission party designees. Data transfers will be documented on

NOAA Form 61-29. Reporting and sending copies of project data to NESDIS (ROSCOP form) is the responsibility of OER.

NOAA OER Responsibilities

The Expedition Coordinator will work with the *Okeanos Explorer* Operations Officer to ensure data pipeline protocols are followed for final archive of all data acquired on *Okeanos Explorer* without proprietary rights. See Appendix B for detailed data management plans.

Deliverables

1. At sea
   a. Daily plans of the Day (POD)
   b. Daily situation reports (SITREPS)
   c. Summary forms for each ROV dive
   d. Summary forms for each CTD rosette cast
   e. Daily summary bathymetry data files
   f. Raw sonar files (EM 302, EK 60, Subbottom, ADCP)
2. Post cruise
   a. Refined SOPs for all pertinent operational activities
   b. Assessments of all activities
3. Science
   a. Multibeam raw and processed data (see appendix B for the formal cruise data management plan)
   b. XBT raw and processed data
   c. EK 60 raw data
   d. Knudsen 3260 sub-bottom profiler raw data
   e. ADCP raw data
   f. Mapping data report
   g. Cruise report

Archive

OER and ship will work together to ensure documentation and stewardship of acquired data sets in accordance with NAO 212-15. The Cruise Information Management System is the primary tool used to accomplish this activity.

VII. Meetings, Vessel Familiarization, and Project Evaluations

A. Shipboard Meetings

A safety brief and overview of POD will occur on the Bridge each morning. Daily Operations Briefing meetings will be held at a time and location determined by Operations Officer based on watch schedule, to review the current day, and define operations, associated requirements, and staffing needs for the following day. A Plan of the Day (POD) will be posted each evening for the next day in specified locations throughout the ship. Daily

Situation Reports (SITREPS) will be produced by onboard Expedition Coordinator (EC). OMAO related information in SITREPS will be discussed during either safety or operations meetings. Additionally, EC and OPS will be meet as needed to discuss OMAO related information in SITREPS. The OPS Officer will be cc'd on SITREPS sent to shore to provide additional clarification as needed.

1. Pre-Project Meeting:
The Expedition Coordinator 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 Expedition Coordinator in arranging this meeting.

2. 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.

3. Post-Project Meeting:
The Commanding Officer is responsible for conducting a meeting no earlier than 24 hours before or seven days after the completion of a project to discuss the overall success, challenges, and shortcomings 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 applicable ship's officers, applicable crew, the Expedition Coordinator, and members of the scientific party and is normally arranged by the Operations Officer and Expedition Coordinator.

4. Project Evaluation Report:
Within seven days of the completion of the project, a Customer Satisfaction Survey is to be completed by the Expedition Coordinator. The form is available at https://docs.google.com/a/noaa.gov/forms/d/1a5hCCkgIwaSII4DmrHPudAehQ9HqhRqY3J_FXqbJp9g/viewform 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 ship, 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 twenty-one days prior to the survey (e.g., Expedition Coordinator is allergic to fin fish).

Berthing requirements, including number and gender of the scientific party, will be provided to the ship by the Expedition Coordinator. The Expedition Coordinator and Operations Officer will work together on a detailed berthing plan to accommodate the gender mix of the scientific party taking into consideration the current makeup of the ship's complement. The Expedition Coordinator 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 Expedition Coordinator is also responsible for the cleanliness of the laboratory spaces and the storage areas utilized by the scientific party, both during the cruise and at its conclusion prior to departing the ship.

All NOAA scientists will have proper travel orders when assigned to any NOAA ship. The Expedition Coordinator will ensure that all non-NOAA or non-Federal scientists aboard also have proper orders. It is the responsibility of the Expedition Coordinator 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 7, 1999 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 30 days in advance by each participating scientist. The NHSQ can be obtained from the Expedition Coordinator or the NOAA website http://www.corporateservices.noaa.gov/noaaforms/eforms/nf57-10-01.pdf.
All NHSQs submitted 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 four 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 Kiteworks 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.

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
E-mail: MOA.Health.Services@noaa.gov
Please make sure the medical.explorer@noaa.gov email address is cc'd on all medical correspondence.

Prior to departure, the Expedition Coordinator must provide a listing of emergency contacts to the Operations Officer for all members of the scientific party, with the following information: name, address, relationship to member, and telephone number.
Emergency contact form is included as Appendix A.

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. Steel-toed shoes are required to participate in any work dealing with suspended loads, including CTD deployments and recovery. The ship does not provide steel-toed boots. Hard hats are also

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.

Operational Risk Management: For every operation to be conducted aboard the ship (NOAA-wide initiative), risk management procedures will be followed. For each operation, risks will be identified and assessed for probability and severity. Risk mitigation strategies/measures will be investigated and implemented where possible. After mitigation, the residual risk will have to be assessed to make Go-No Go decisions for the operations. Particularly with new operations, risk assessment will be ongoing and updated as necessary. This does not only apply to over-the-side operations, but to everyday tasks aboard the vessel that pose risk to personnel and property.

- CTD, ROV (and other pertinent) ORM documents will be followed by all personnel working onboard *Okeanos Explorer*.
- All personnel onboard are in the position of calling a halt to operations/activities in the event of a safety concern.

D. Communications

A daily situation report (SITREP) on operations prepared by the Expedition Coordinator will be relayed to the program office. Sometimes it is necessary for the Expedition Coordinator to communicate with another vessel, aircraft, or shore facility. Through various modes of communication, the ship is able to maintain contact with the Marine Operations Center on an as needed basis. These methods will be made available to the Expedition Coordinator upon request, in order to conduct official business. The ship's primary means of communication with the Marine Operations Center is via e-mail and the Very Small Aperture Terminal (VSAT) link. VSAT bandwidth at 15Mbps will be paid by OER and provided by OMAO.

Specific information on how to contact NOAA Ship *Okeanos Explorer* and all other fleet vessels can be found at http://www.moc.noaa.gov/MOC/phone.html#EX

Important Telephone and Facsimile Numbers and E-mail Addresses

Ocean Exploration and Research (OER):
OER Program Administration
Phone: (301) 734-1010
Fax: (301) 713-4252
E-mail: Firstname.Lastname@noaa.gov

University of New Hampshire, Center for Coastal and Ocean Mapping
Phone: (603) 862-3438
Fax: (603) 862-0839

NOAA Ship *Okeanos Explorer* - Telephone methods listed in order of increasing expense:
Okeanos Explorer Cellular: (401) 713-4114
Okeanos Explorer Iridium:(808) 659-9179
OER Mission Iridium (dry lab): (808) 851-3827

EX INMARSAT B
Line 1: 011-870-764-852-328
Line 2: 011-870-764-852-329
Voice Over IP (VoIP) Phone:
(541) 867-8932
(541) 867-8933
(541) 867-8934
E-mail: Ops.Explorer@noaa.gov- (mention the person's name in SUBJECT field)
E-mail: expeditioncoordinator.explorer@noaa.gov for dissemination of all hands emails by Expedition Coordinator while onboard. See ET for password.

E. IT Security

1. 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: 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 three days of embarking.

F. Foreign National Guests Access to OMAO Facilities and Platforms

In total 3 FNGs will be participating on EX1904. Mr. Tristin James Strong and Mr. Brian Richard Carroll of Kraken Robotics in Canada will be sailing on the NOAA Ship Okeanos Explorer during leg 1 of the EX1904 cruise. They will be onboard July 16th and will depart July 25. Dr. Jan Albiez of Kraken Robotics Germany will be sailing on the EX during leg 2 of the cruise and will be onboard from July 25 to August 2. CDR Kurt Dreflak will serve as the site sponsor for all three FNGs.

IX. References

Appendix A

EMERGENCY CONTACT DATA SHEET–NOAA SHIP *OKEANOS EXPLORER*
Scientists sailing aboard *Okeanos Explorer* shall fill out the form found at the following link location: https://docs.google.com/forms/d/1xbmRNHbLhyc68QiY_R-km9f7ynRSCpUPsFdk9dnc1W4/viewform?edit_requested=true#start=invite with their emergency contact information

Appendix B: Data Management Plan

Data Management Plan
Okeanos Explorer (EX1904): 2019 Technology Demonstrations

OER Data Management Objectives
Provide a foundation of publicly accessible data and information products to spur further exploration, research, and management activities.

27-Jun-19

1.1 **Name and Purpose of the Data Collection Project**
Okeanos Explorer (EX1904): 2019 Technology Demonstrations

1.2 **Summary description of the data to be collected.**
Operations will include the use of the ship's deep-water mapping systems (Kongsberg EM 302 multibeam sonar, EK split-beam fisheries sonars, Knudsen 3260 chirp sub-bottom profiler sonar, and Teledyne Acoustic Doppler Current Profilers), XBTs in support of multibeam sonar mapping operations, the two-body ROV system Deep Discoverer and Seirios, and the ship's high-bandwidth satellite connection for continuous real-time ship-to-shore communications. Technology demonstrations will include an integration/shakedown a REMUS 600 Autonomous Underwater Vehicle (AUV), deployment of a towed Kraken Robotics Katfish with Synthetic Aperture Sonar (SAS), integration of a Massachusetts Institute of Technology (MIT) 360 degree camera on Deep Discoverer, integration/testing of a Kraken Robotics SeaVision laser scanner on ROV Deep Discoverer and integration/testing of a One Way Travel Time Inverted Ultra Short Baseline (OWTTIUSBL) from the Woods Hole Oceanographic Institution (WHOI) on ROV Deep Discoverer.Keywords or phrases that could be used to enable users to find the data.

1.3 **Keywords or phrases that could be used to enable users to find the data.**
expedition, exploration, explorer, marine education, noaa, ocean, ocean discovery, ocean education, ocean exploration, ocean exploration and research, ocean literacy, ocean research, OER, science, scientific mission, scientific research, sea, stewardship, systematic exploration, technology, transformational research, undersea, underwater, Davisville, mapping survey, multibeam, multibeam backscatter, multibeam sonar, multi-beam sonar, noaa fleet, okeanos, okeanos explorer, R337, Rhode Island, scientific computing system, SCS, single beam sonar, singlebeam sonar, single-beam sonar, sub-bottom profile, water column backscatter, oceans, telepresence, REMUS 600, Kraken Robotics, Katfish, SeaVision, Synthetic Aperture Sonar, SAS, MIT 360 degree camera, WHOI, One Way Travel Time Inverted USBL, Northeast US Continental Shelf, Northeast US Continental Margin, Virginia, Maryland, Delaware, New Jersey, New York, Massachusetts, ASPIRE, NOAA's Atlantic Seafloor Partnership for Integrated Research and Exploration, EM3002, EM302

1.4 **If this mission is part of a series of missions, what is the series name?**
Okeanos ROV Cruises

1.5 **Planned or actual temporal coverage of the data.**
Dates: 7/18/2019 to 8/1/2019

1.6 **Planned or actual geographic coverage of the data.**
Latitude Boundaries: 36.72 to 41.3
Longitude Boundaries: -74.79 to -66.82

1.7 **What data types will you be creating or capturing and submitting for archive?**
Project Instructions, Highlight Images, ADCP, Bottom Backscatter, CTD (processed), CTD (product), CTD (raw), Dive Summaries, EK60 Singlebeam Data, Expedition Cruise Report, Multibeam (image), Multibeam (processed), Multibeam (product), Multibeam (raw), Raw Video (digital), Raw video inventory logs, SAS Images, SCS Output (compressed), SCS Output (native), Sub-Bottom Profile data, Temperature data, Water Column Backscatter, XBT (raw)

1.8 **What platforms will be employed during this mission?**
NOAA Ship Okeanos Explorer, Deep Discoverer ROV, SEIRIOS Camera Sled

Overall POC: Michael White
Title: Expedition Coordinator
Affiliation/Dept: NOAA Office of Ocean Exploration and Research E-Mail: michael.white@noaa.gov
Phone: (301) 938-8460

Data POC Name: Barry Eakins, Andrew O'Brien
Title: Stewardship Data Manager, Onboard/Shoreside Data Manager
E-Mail: barry.eakins@noaa.gov, andrew.obrien@tgfoe.org

4.1 **Have resources for management of these data been identified?** True

4.2 **Approximate percentage of the budget devoted to data management. (specify % or "unknown")**
unknown

5.1 **What is the processing workflow from collection to public release?**
SCS data shall be delivered in its native format as well as an archive-ready, documented, and compressed NetCDF3 format to NCEI-MD; multibeam data and metadata will be compressed and delivered in a bagit format to NCEI-CO

5.2 **What quality control procedures will be employed?**
Quality control procedures for the data from the Kongsberg EM302 is handled at UNH CCOM/JHC. Raw (level-0) bathymetry files are cleaned/edited into new data files (level-1) and converted to a variety of products (level-2). Data from sensors monitored through the SCS are archived in their native format and are not quality controlled. Data from CTD casts and XBT firings are archived in their native format. CTDs are post-processed by the data management

team as a quality control measure and customized CTD profiles are generated for display on the Okeanos Atlas.

6.1 **Does the metadata comply with the Data Documentation Directive?**
Yes

6.1.1 **If metadata are non-existent or non-compliant, please explain:**
not applicable

6.2 **Where will the metadata be hosted?**
Organization: An ISO format collection-level metadata record will be generated during pre-cruise planning and published in the NOAA OneStop catalog and an OER Web Accessible Folder (WAF) hosted at NCEI-MS for public discovery and access.
URL: https://www.ncddc.noaa.gov/oer-waf/ISO/Resolved/2019/
Meta Std: ISO 19115-2 Geographic Information with Extensions for Imagery and Gridded Data will be the metadata standard employed.

6.3 **Process for producing and maintaining metadata:**
Metadata will be generated via xml editors or metadata generation tools.

7.1 **Do the data comply with the Data Access Directive?**
Yes

7.1.1 **If the data will not be available to the public, or with limitations, provide a valid reason.**
Not Applicable

7.1.2 **If there are limitations, describe how data are protected from unauthorized access**.
Account access to mission systems are maintained and controlled by the Program. Data access prior to public accessibility is documented through the use of Data Request forms and standard operating procedures.

7.2 **Name and URL of organization or facility providing data access.**

Org: NOAA National Centers for Environmental Information (NCEI)
URL: https://www.ncei.noaa.gov

7.3 **Approximate delay between data collection and dissemination. By what authority?**
Hold Time: Data are considered immediately publicly accessible as soon as possible after the mission, unless there are documented restrictions.

7.4 **Prepare a Data Access Statement**
No data access constraints, unless data are protected under the National Historic Preservation Act of 1966.

8.1 **Actual or planned long-term data archive location:**
Data from this mission will be preserved and stewarded through the NOAA National Centers for Environmental Information. Refer to the Okeanos Explorer Data Management Plan at NOAA's EDMC DMP Repository for detailed descriptions of the processes, procedures, and partners involved in this collaborative effort.

8.2 **If no archive planned, why?**
Not applicable

8.3 **If any delay between data collection and submission to an archive facility, please explain.**
Data will be available for public consumption within 90-120 days

8.4 **How will data be protected from accidental or malicious modification or deletion?**
Data management standard operating procedures minimizing accidental or malicious modification or deletion are in place aboard the Okeanos Explorer and will be enforced.

8.5 **Prepare a Data Use Statement**
Data use shall be credited to NOAA Office of Ocean Exploration and Research.

Appendix C: Categorical Exclusion

Categorical Exclusion (CE) Evaluation Worksheet

Project Identifier: EX19-04 Tech Demo

Date Review Completed: 6/17/2019

Completed by: Paula Keener

OAR Functional Area: OER

Worksheet File Name: 2019-05-OER-E3-EX1904

Step 1. CE applicability

1. **Is this federal financial assistance, including via grants, cooperative agreements, loans, loan guarantees, interest subsidies, insurance, food commodities, direct appropriations, and transfers of property in place of money?**

   no

2. **What is the proposed federal action?**

   OER's EX19-04 Technology Demonstration cruise operations will be conducted 24 hours/day and consist of demonstrations of emerging technology and of existing technology integration into the NOAA Ship Okeanos Explorer's Continuing Operations (CONOPS), remotely operated vehicle (ROV) dives, mapping using the ship's suite of deepwater sonars, and limited shore participation via telepresence. The expedition will commence on July 18, 2019 in Norfolk, Virginia (Marine Operations Center-Atlantic) and conclude on August 1, 2019 in North Kingstown, Rhode Island. Operations will include the use of the ship's deep-water mapping systems (Kongsberg EM 302 multibeam sonar, EK split-beam fisheries sonars, Knudsen 3260 chirp sub-bottom profiler sonar, and Teledyne Acoustic Doppler Current Profilers), XBTs in support of multibeam sonar mapping operations, the two-body ROV Deep Discoverer and Seirios, and the ship's high-bandwidth satellite connection for continuous real-time ship-to-shore communications.

   Technology demonstrations will include an integration/shakedown of a REMUS 600 Autonomous Underwater Vehicle (AUV), deployment of a towed Kraken Robotics Katfish with Synthetic Aperature Sonar (SAS), integration of a Massachusetts Institute of Technology (MIT) 260 degree camera on the ROV Deep Discoverer, integration/testing

of a Kraken Robotics SeaVision laser scanner on ROV Deep Discoverer and integration/testing of a One Way Travel Time Inverted Ultra Short Baseline (OWTTIUSBL) from the Woods Hole Oceanographic Institution (WHOI) on ROV Deep Discoverer. Each of these technology demonstrations is described below. For more detail, see the EX-19-04 Project Instructions.

Remus 600

The NOAA Office of Coast Survey (OCS) owns and operates the Remus 600 AUV. The integration of OCS' Remus 600 AUV onboard the Okeanos Explorer will provide OER and the ship's crew the experience and information of launching, recovery and the acquisition/processing of AUV data to effectively assess how AUV operations will be able to most effectively become integrated into the Okeanos Explorer's ROV/Mapping explorations. This cruise will also serve as a training opportunity for OCS to train additional operators on this NOAA-owned and operated asset. In 2012, the AUV Sentry was deployed from the Okeanos Explorer using Best Management Practices (BMPs) for this type of instrument deployment, operation and recovery. BMPs will be employed by Remus operators during this mission.

Kraken Katfish

In 2018 NOAA OER and Kraken Underwater Systems developed a Cooperative Research and Development Agreement (CRADA) to jointly advance and collaborate on ocean exploration. Part of the Statement of Work within the CRADA is to test a Kraken towed Katfish with Synthetic Aperture Sonar (SAS) mounted on an AUV or towed system on a NOAA vessel. The Katfish system is comprised of an actively controlled smart towfish, SAS imaging, bathymetry and gap-filler sonars, launch and recovery system, operator console, and visualization software. The Katfish was tested on a non-NOAA vessel in Narragansett Bay in 2018 in partnership with the University of Rhode Island's Applied History Lab as part of the NOAA/Kraken CRADA. This cruise will serve as an opportunity to deploy the Kraken Katfish and integrate towed operations into OER's existing operations on a NOAA vessel. The Okeanos Explorer tows an Underwater CTD, and has towed a Continuous Plankton Recorder and other instruments on previous expeditions. The Kraken Katfish system will be conducted using BMPs for deployment, operation and recovery.

Massachusetts Institute of Technology (MIT) 260-Degree Camera

EX-19-04 will test the integration of a Massachusetts Institute of Technology (MIT) 260-degree camera on the ROV Deep Discoverer. The goal of this project is to create studio-caliber 360-degree video from the deep for VR/AR/Documentary/Planetarium work and more experimentally for real-time 360-visualization. Physically, the system is

comprised of six compact 4k studio cameras housed within a spherical Al/Ti housing with no external moving parts. The passive video recording system will be mounted on the ROV Deep Discoverer, and will have no negative environmental effects.

Kraken Robotics SeaVision Laser Scanner

EX-19-04 will demonstrate the integration of a Kraken Robotics SeaVision laser scanner on the ROV Deep Discoverer. Another objective in the Scope of Work in the CRADA signed by NOAA and Kraken is the testing of the Kraken SeaVision 3D laser imaging system. This device is designed to operate in twin scanning configuration, with adjustable baseline and can generate high resolution 3D full color imagery. The goal is to image biological and archaeological targets using the SeaVision. Highly precise measurements of the size of benthic organisms are necessary in order to accurately estimate the age and growth rates of these organisms. While rough size estimates can be obtained from scaled video data, growth rates derived from such measurements have very large errors, and are thus not very useful. Additionally, percent benthic cover is one of the most frequently reported metrics in the marine ecological studies; however, estimating this metric is often times impossible from ROV video data. Laser scanning technology helps provide this metric. In addition to ecological applications, laser scanner technologies are also of interest to the exploration of UCH sites. In fact, getting a 3D model of a maritime heritage site is frequently the main purpose of UCH dives conducted by OER. This system has been used regularly by the international science community in Canadian waters, and in the Baltic and North Seas with no known negative environmental effects noted by the science community or by the manufacturer.

Integration/Testing of a One Way Travel Time Inverted Ultra Short Baseline

EX-19-04 will demonstrate the integration of a One Way Travel Time Inverted Ultra Short Baseline (OWTTIUSBL) developed by the Woods Hole Oceanographic Institution (WHOI) on the ROV Deep Discoverer. The OWTTIUSBL is in development at Woods Hole Oceanographic Institution (WHOI) to support multi-subsea vehicle navigation capability. This project supports the FY18 Federal Funding Opportunity funded project, 'Exploration of the Deep Ocean with Teams of Long-Endurance Ocean Robots,' a technology effort to develop a low-power acoustic navigation system for application with an array of autonomous vehicles. The navigation system is for application on acoustically-passive AUVs which can be used to explore the deep ocean. The device was used in 2016 on the NOAA Ship Pisces when it was mounted on the AUV Sentry to conduct work supported by OER to explore deep-sea canyons off North Carolina. For EX-19-04, the device will be mounted on the ROV Deep Discoverer and is a passive, one-way acoustic system with no negative environmental effects. A transducer lowered from the ship to excite the OWTTIUSBL operates within the range of existing systems of

the Okeanos Explorer.

Operations are planned throughout the Northeast U.S. Continental Margin and on the Northeast U.S. continental shelf off Virginia, Maryland, Delaware, New Jersey, New York, Rhode Island and Massachusetts.

3. **Which class of CE in Appendix E of the NAO 216-6A Companion Manual is applicable to this action and why?**
   a. E3: Activities to collect aquatic, terrestrial, and atmospheric data in a non-destructive manner.
   b. The topical scope of this action is consistent with CE number E3 in Appendix E of the Companion Manual to NOAA Administrative Order (NAO) 216-6A: activities to collect aquatic, terrestrial, and atmospheric data in a non-destructive manner. The expedition will use remote sensing, video, and imagery to collect baseline information on unexplored shallow and deep-water (20 - 3500 m) on the Northeast U.S. continental shelf off of Virginia, Maryland, Delaware, New Jersey, New York, Rhode Island and Massachusetts.

Step 2. Extraordinary Circumstances Consideration

4. **Would the action result in adverse effects on human health or safety that are not negligible?**

No. NOAA Ship Okeanos Explorer will be operating exclusively in areas of 20 – 3500 m during EX1904 during this expedition which seeks to address integrating of emerging and existing technology projects into EX CONOPs. The technology demonstrations described in question 2 above will be evaluated for their usefulness in meeting OER and partner data needs while others have the potential to benefit the larger oceanographic research community. This action does not involve any procedures or outcomes known to result in impacts on human health and safety more than would be negligible.

5. **Would the action result in adverse effects on an area with unique environmental characteristics that are not negligible?**

This cruise will collect baseline data and information to support priority NOAA science and management needs. Furthermore, any effects caused by sonar and AUV/ROV operations during this expedition will be negligible on the seabed and water column. The expedition is being planning in partnership with NOAA's National Oceanographic Data Center, National Coastal Data Development Center, the University Corporation for Atmospheric Research Joint Office for

Science Support (JOSS), the University of New Hampshire (UNH) Center for Coastal and Ocean Mapping (CCOM), the Global Foundation for Ocean Exploration, and the University of Rhode Island Inner Space Center. OER will use input from these partners and other management authorities that are familiar with these areas to ensure no more than negligible effects on these areas with potentially unique environmental characteristics.

6. Would the action result in adverse effects on species or habitats protected by the ESA, MMPA, MSA, NMSA, or MBTA that are not negligible?

OER has taken measures to ensure that any effects on species or habitats protected by the ESA, MMPA, MSA or NMSA meet the definition of negligible. In 2018, an informal consultation was initiated under Section 7 of the Endangered Species Act (ESA), requesting NOAA Fisheries' Protected Resources Division concurrence with our Biological Evaluation determining that NOAA Ship Okeanos Explorer operations conducted during the 2018-2019 field seasons, including those to be undertaken during the EX1904 expedition, are not likely to adversely affect ESA-listed marine species. The informal consultation was completed on August 8, 2018 when OER received a signed letter from the Chief ESA Interagency Cooperation Division in the NOAA Office of Protected Species, stating that NMFS concurs with OER's determination that operations conducted during NOAA Ship Okeanos Explorer 2018-2019 field seasons are not likely to adversely affect ESA-listed marine species. The ESA Section 7 Letter of Concurrence is provided as an Appendix in the EX-19-04 project instructions.

Given the primary offshore focus of most of our proposed work, it is improbable that we will encounter marine mammals protected under the MMPA, or sea birds protected under the MBTA. If we did encounter any such protected animals, our impacts would be negligible because of the best management practices to which we adhere to avoid or minimize environmental impacts. These best management practices are outlined in the appendices of the EX-19-04 project instructions.

OER also initiated a request for an abbreviated Essential Fish Habitat (EFH) consultation for expeditions by NOAA Ship Okeanos Explorer in 2018-2020 to the Greater Atlantic Region, including EX1904. On July 19, 2018, OER received a letter from the Assistant Regional Administrator for the NOAA Office of Habitat Conservation stating that these expeditions will not adversely impact EFH. This letter is provided in appendices of the EX-19-04 project instructions.

Additionally, OER also initiated a request for a Letter of Acknowledgement (LOA) from the NOAA Greater Atlantic Regional Office (GARFO) covering all activities to be conducted as part of this expedition. On April 24, 2019, OER received a signed LOA from the GARFO Assistant Regional Administrator for Sustainable Fisheries stating that expedition activities are all in accordance with NMFS regulations. This letter is provided in appendices of the EX-19-04 project instructions.

7. **Would the action result in the potential to generate, use, store, transport, or dispose of hazardous or toxic substances, in a manner that may have a significant effect on the environment?**

No. The operations of the expedition will be in compliance with FEC 07 Hazardous Materials and Hazardous Waste Management Requirements for Visiting Scientific Parties (or the OMAO procedure that supersedes it) to ensure generation, use, storage, transport, and disposal of such substances will not result in significant impacts.

8. **Would the action result in adverse effects on properties listed or eligible for listing on the National Register of Historic Places authorized by the National Historic Preservation Act of 1966, National Historic Landmarks designated by the Secretary of the Interior, or National Monuments designated through the Antiquities Act of 1906; Federally recognized Tribal and Native Alaskan lands, cultural or natural resources, or religious or cultural sites that cannot be resolved through applicable regulatory processes?**

During the expedition, we will conduct some mapping operations in areas believed to contain shipwrecks or other underwater cultural heritage (UCH) sites. Should any potential UCH targets be discovered during mapping operations, an ROV dive may be conducted on the area to determine whether this is indeed an UCH. If any such areas are confirmed to be shipwrecks via ROV visual surveys, they can potentially be eligible for listing on the National Register of Historic Places. OER conducts non-invasive surveys on archaeology targets and has specific protocols for protecting sensitive location information of such UCH sites. These protocols and procedures are outlined in detail in the appendices of the EX-19-04 project instructions.

9. **Would the action result in a disproportionately high and adverse effect on the health or the environment of minority or low-income communities, compared to the impacts on other communities (EO 12898)?**

No. NOAA Ship Okeanos Explorer will be operating in offshore areas of the North Atlantic during the expedition (see EX-19-04 project instructions). There are no communities within or near the geographic scope of the expedition, and the mission does not involve actions known or likely to result in adverse impacts on human health. The Kraken SeaVision Laser Safety Guide Document 9070102 Version 1 (April 2019) will be adhered to at all times while the system is being deployed.

10. **Would the action contribute to the introduction, continued existence, or spread of noxious weeds or nonnative invasive species known to occur in the area or actions**

that may promote the introduction, growth, or expansion of the range of the species?

No. During EX-19-04, NOAA Ship Okeanos Explorer will not make landfall in areas other than commercial ports in Norfolk, Virginia and ship's home port of North Kingstown, Rhode Island. The ship and OER mission team will comply with all applicable local and federal regulations regarding the preventing or spread of invasive species. At the completion of every AUV/ROV dive or CTD cast, the equipment will be thoroughly rinsed with freshwater and completely dried to prevent spreading organisms from one site to another. Also, the Engineering Department aboard the NOAA Ship Okeanos Explorer attends yearly Ballast Management Training in accordance with NOAA Form 57-07-13 NPDES VGP Annual Inspection and Report to prevent the introduction of invasive species.

11. Would the action result in a potential violation of Federal, State, or local law or requirements imposed for protection of the environment?

The proposed action will not result in a potential violation of Federal, State, or local law or requirements imposed for protection of the environment. Authorizations for this field season were obtained via several consultations on ESA Section-7 and EFH outlined in questions 4-7 above.

12. Would the action result in highly controversial environmental effects?

No. The exploration activities will be localized and of short duration in any particular area at any given time. Given the project's scope and breath, no notable or lasting changes or highly controversial effects to the environment will result.

13. Does the action have the potential to establish a precedent for future action or an action that represents a decision in principle about future actions with potentially significant environmental effects?

No. While each cruise contributes to the overarching goal of exploring, mapping, and sampling the ocean, every cruise is independently useful and not connected to subsequent cruises.

14. Would the action result in environmental effects that are uncertain, unique, or unknown?

No. The techniques and equipment used have been used in other locations and on other platforms for similar types of field study.

15. Does the action have the potential for significant cumulative impacts when the proposed action is combined with other past, present and reasonably foreseeable future actions, even though the impacts of the proposed action may not be significant by themselves?

By definition, actions that a federal agency classifies as a categorical exclusion have no potential, individually or cumulatively, to significantly affect the environment. This cruise is consistent with a class of CE established by NOAA and there are no extraordinary circumstances for this action that may otherwise result in potentially significant impacts.

CE Determination

☑I have determined that a Categorical Exclusion is the appropriate level of NEPA analysis for this action and that no extraordinary circumstances exist that would require preparation of an environmental assessment or environmental impact statement.

☐I have determined that an environmental assessment or environmental impact statement is required for this action.

Signature: CANTELAS.FRANK.J.1365855087 Digitally signed by CANTELAS.FRANK.J.1365855087 Date: 2019.06.18 08:52:32 -04'00'

Signed by: Frank Cantelas, Acting Deputy Director, Office of Ocean Exploration and Research

Date Signed: June 17, 2019

Appendix D: ESA Section Letter of Concurrence

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Silver Spring, MD 20910

JUN 18 2019

Refer to NMFS No: OPR-2019-01058

Frank Cantelas
Acting Deputy Director
Office of Ocean Exploration and Research
1315 East West Highway
Silver Spring, Maryland 20910

RE: Concurrence Letter for the National Oceanic and Atmospheric Administration's Office of Ocean Exploration and Research's Reinitiation of Section 7 Consultation Pursuant to the Endangered Species Act for Marine Operation Activities on the National Oceanic and Atmospheric Administration Ship *Okeanos Explorer* for the 2018 through 2019 Field Seasons

Dear Mr. Cantelas:

On June 13, 2019, the National Marine Fisheries Service (NMFS) received your reinitiated request for a written concurrence that the National Oceanic and Atmospheric Administration (NOAA) Office of Ocean Exploration and Research's marine operations activities on the NOAA Ship *Okeanos Explorer* for the 2018 through 2019 field seasons under the Endangered Species Act of 1973, as amended (ESA; 16 U.S.C. 1531 et seq.) is not likely to adversely affect species listed as threatened or endangered or critical habitats designated under the ESA. Reinitiation was necessary to add survey areas and sonar technologies that will be used starting in July 2019. The added survey areas are six sites in the North Atlantic in water depths ranging from 50-118 meters off the coast of Virginia, Maryland, Delaware, New Jersey, New York, Rhode Island and Massachusetts. In addition to new survey areas, NOAA's Office of Ocean Exploration and Research plans to use additional sonar technologies that will operate in shallow water survey areas. These additional technologies are a Remus 600 Autonomous Underwater Vehicle and a Kraken Katfish sonar system. These technologies will be the only sonar devices that will operate in shallow waters during the surveys. This response was prepared by NMFS pursuant to section 7(a)(2) of the ESA, implementing regulations at (50 C.F.R. §402), and agency guidance for preparation of letters of concurrence.

We reviewed the correspondence for the reinitiated consultation and related materials submitted by your office. In addition, we requested and received more information related to the frequency and source levels of the newly proposed sonar devices. This assisted NMFS' ESA Interagency Cooperation Division to determine that the 400 meter shutdown zone will mitigate risks of ESA harassment from the use of the Remus 600 Autonomous Underwater Vehicle and Kraken Katfish sonar system in shallow water survey areas. As a result, the proposed activities are not likely to adversely affect ESA listed species or critical habitat within the action area during the 2018 through 2019 field season on the NOAA Ship *Okeanos Explorer*. Based on our knowledge, expertise, and the materials submitted in your reinitiated request for informal consultation, we

concur with the Office of Ocean Exploration and Research's conclusions that the proposed action is not likely to adversely affect ESA-listed species and/or designated critical habitat.

This concludes consultation under the ESA for species and/or designated critical habitat under NMFS's purview on the NOAA Office of Ocean Exploration and Research's reinitiation of Section 7 Consultation for marine operation activities on the NOAA Ship *Okeanos Explorer* for the 2018 through 2019 field seasons.

Reinitiation of consultation is required and shall be requested by the NOAA Office of Ocean Exploration and Research or by NMFS where discretionary Federal involvement or control over the action has been retained or is authorized by law and: (a) take occurs; (b) new information reveals effects of the action that may affect listed species or critical habitat in a manner or to an extent not previously considered in this consultation; (c) the action is subsequently modified in a manner that causes an effect to the listed species or critical habitat not previously considered in this consultation; or (d) if a new species is listed or critical habitat designated that may be affected by the action (50 C.F.R. §402.16).

We look forward to further cooperation with you on other projects to ensure the conservation of our threatened and endangered marine species and designated critical habitat. If you have any questions on this consultation, please contact me at (301) 427-8495 or by email at cathy.totorici@noaa.gov or Jonathan Molineaux at (301) 427-8440 or by email at jonathan.molineaux@noaa.gov.

Sincerely,

Cathryn E. Tortorici
Chief, ESA Interagency Cooperation Division
Office of Protected Resources

Appendix E: EFH Consultation Letter

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
GREATER ATLANTIC REGIONAL FISHERIES OFFICE
55 Great Republic Drive
Gloucester, MA 01930-2276

JUL 19 2018

MEMORANDUM FOR: Daniel Wagner, Ph.D.
Expedition Coordinator, Cherokee Nation Strategic Programs
NOAA Office for Ocean Exploration and Research

FROM: Louis A. Chiarella
Assistant Regional Administrator, Habitat Conservation Division

SUBJECT: Essential Fish Habitat (EFH) Consultation for Deep-Sea Exploration Activities occurring within the Greater Atlantic Region aboard NOAA Ship *Okeanos Explorer* in 2018-2020

This responds to your request for an abbreviated EFH consultation for the field activities to be conducted aboard the NOAA Ship *Okeanos Explorer* in the Greater Atlantic Region between July 2018 and December 2020. During this time, up to 33 different research expeditions will be undertaken to collect critical baseline information in unknown or poorly known areas of the region at depths of 250 m or deeper through telepresence-based exploration. Specific activities to be undertaken include the use of deep-water mapping systems such as multi-beam, single beam, sub-bottom profiler and acoustic Doppler current profiler (ACDP) sonar systems, and the use of remotely operated vehicles (ROV), the ship's conductivity-temperature-depth (CTD) rosette, underway CDT, and high-bandwidth satellite connection for real-time ship to shore communications. New technologies and novel applications may be tested during the research expeditions. These technology demonstration projects are still under development at this time and will be evaluated individually for environmental impact. Your consultation request supplements a previously completed EFH consultation between NOAA's National Centers of Coastal Ocean Science (NCCOS) and NOAA Fisheries Southeast Regional Office (SERO) for research activities to be conducted in U.S. federal waters of the Gulf of Mexico, South Atlantic Bight and Caribbean in 2017-2019 using NOAA ships *Okeanos Explorer* and *Nancy Foster*.

As specified in the Magnuson Stevens Fishery Conservation and Management Act (MSA), EFH consultation is required for federal actions that may adversely affect EFH. We have reviewed information provided on the proposed activities as well as the protective measures and best management practices incorporated into the action and have determined that adverse impacts have been minimized to the extent practicable. As such, we have no EFH conservation recommendations to provide pursuant to Section 305(b)(2) of the MSA. Further EFH consultation on this action is not necessary unless future modifications are proposed that would change the basis of our determination.

cc: GAR/HCD- K.Greene
SERO/HCD-V. Fay, D. Dale

Appendix F: NASA Maritime Aerosols Network Survey of Opportunity

Survey or Project Name

Maritime Aerosol Network

Lead POC or Principle Investigator (PI & Affiliation)

POC: Dr. Alexander Smirnov

Supporting Team Members Ashore

Supporting Team Members Aboard (if required)

Activities Description(s)(Include goals, objectives and tasks)

The Maritime Aerosol Network (MAN) component of AERONET provides ship-borne aerosol optical depth measurements from the Microtops II sun photometers. These data provide an alternative to observations from islands as well as establish validation points for satellite and aerosol transport models. Since 2004, these instruments have been deployed periodically on ships of opportunity and research vessels to monitor aerosol properties over the World Oceans.

Appendix G: NMFS Letter of Acknowledgement (LOA) for operations in the Southeast

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Southeast Regional Office
263 13th Avenue South
St. Petersburg, Florida 33701-5505
http://sero.nmfs.noaa.gov

MAY 14 2018 F/SER25:FH

Mr. Craig Russell
NOAA Office of Ocean Exploration and Research (OER)
Seattle, WA 98115

Dear Mr. Russell:

This letter of acknowledgement (LOA) recognizes the activities outlined in your May 9, 2018, request as scientific research in accordance with the definitions and guidance at 50 CFR 600.10 and 600.745(a). As such, the proposed activities are not subject to fishing regulations at 50 CFR 622 developed in accordance with the Magnuson-Stevens Fishery Conservation and Management Act. This LOA is effective from date of issuance through December 31, 2019.

NOAA Fisheries understands primary operations aboard the NOAA Ship *Okeanos Explorer* will take place throughout federal waters of the South Atlantic and U.S. Caribbean in areas deeper than 250 m. OER anticipates supporting up to seven cruises between 2018 and 2019 that will be some combination of mapping and remote operating vehicle (ROV) operations. Specifically, these efforts will (1) survey deep-sea coral ecosystems using ROV, (2) map deep-water habitats using multi-beam echosounders, and (3) sample the physical and chemical properties of the water column. From May 22 through June 6, 2018, NOAA OER will conduct a seafloor and water column mapping cruise (EX-18-05) to collect data to help improve fundamental understanding in this region and to facilitate ROV dive planning. During the second leg of this expedition (EX-18-06), ROV and mapping operations will be conducted during the expedition's second cruise (EX-18-06) from June 11 to July 2, 2018, at depths ranging from 250 m to approximately 4,000 m. Mapping and ROV targets for operations in the Southeast include, but are not limited to unexplored areas of the Blake Plateau, Blake Ridge, Blake Escarpment, submarine canyons offshore North Carolina, submerged cultural heritage sites in the region, areas predicted to be suitable habitat for deep sea corals and sponges, inter-canyon areas, and gas seeps. The combined dives will enable scientists and managers to have a better understanding of the diversity and distribution of deep water habitats in this region, and enable informed resource management decisions.

Project participants covered under this LOA include: Kasey Cantwell, Eric Johnson, Elizabeth Lobecker, Rosemary Abbitt, Craig Russell, and Alan Leonardi. Copies of this LOA and the scientific research plan for the project should be onboard the vessel during all sampling activities. This LOA is separate and distinct from any permit or consultation required by the Marine Mammal Protection Act, Endangered Species Act, or any other applicable law.

Please send a copy of any cruise report or other publications resulting from the scientific research activity to me and to the Director, Southeast Fisheries Science Center, 75 Virginia Beach Drive, Miami, Florida 33 149-1003.

Sincerely,

For Roy E. Crabtree, Ph.D.
Regional Administrator

Enclosure

cc: F/SEFSC, F/EN3

Appendix H: UCH Standard Operating Procedures

NOAA Office of Ocean Exploration and Research
Operational Policy and Procedures for Underwater Cultural Heritage Missions Conducted onboard the NOAA Ship *Okeanos Explorer*

IV. Purpose

The purpose of this document is to provide guidance for OER mission activities conducted aboard the NOAA Ship Okeanos Explorer, when such mission activities involve either unexpected discovery or targeted exploration of potential Underwater Cultural Heritage sites.

II. Background

Since the inception of NOAA's ocean exploration program in 2000, OER data management practices have been guided by the 2000 President's Panel Report recommendations, which prioritized rapid and unrestricted data sharing as one of five critical exploration program components. More recently Public law 111-11 [Section XII Subtitle A Part 1 Exploration] reinforced and expanded OER data management objectives, continuing to stress the importance of sharing unique exploration data and information to improve public understanding of the oceans, and for research and management purposes.

OER missions conducted aboard the NOAA Ship Okeanos Explorer offer a 'best-case' scenario for meeting Program mission objectives related to data sharing:

- Dedicated shipboard and shore-side teams work in tandem to ensure near-real time data product generation from shipboard and ROV sensors;
- Telepresence is used to share data products and information in real-time with shore-side participants and the public;
- Mission information is publicly communicated in real time via Internet access to streamed video and related resources; and
- Data are managed throughout the lifecycle in accordance with all applicable policy directives and community best practices.

The nature of exploration defines the possibility of discovery, including unexpectedly exposing the location of underwater cultural resources; on some occasions, exploration targets are specifically focused on the exploration of suspected underwater cultural heritage (UCH) sites.

The need to protect the location of suspected UCH sites until they are fully understood, whether purposefully explored or fortuitously discovered, is an important statutory responsibility. In the case of OER expeditions aboard the Okeanos Explorer, a range of operational procedures must be modified to ensure this protection occurs to the fullest extent possible. The following sections of this document define the methods for ensuring protection of these sensitive data throughout the data lifecycle.

III. Authority

a. ***Marine Archaeology:*** This document is informed by: the Federal archaeology program; U.S. legislation on the treatment of cultural remains; and the UNESCO Convention for the Protection of the Underwater Cultural Heritage.

   The NOAA Office of Ocean Exploration and Research (OER) supports the standards for conducting marine archaeological activities enumerated in the Annex Rules of the UNESCO Convention on the Protection of the Underwater Cultural Heritage. Preservation and protection of prehistoric and historic cultural resources is the policy of the Federal government and OER has a responsibility to consider the effects of its activities on these resources. If data is found to be sensitive because it reveals the location of a historically significant cultural resource, Section 304 of the National Historic Preservation Act provides that the head of a Federal agency or other public official shall withhold from public disclosure information about the location, character, or ownership of a historic property when disclosure may: cause a significant invasion of privacy; risk harm to the historic property; or impede the use of a traditional religious site by practitioners. This document will use the term Underwater Cultural Heritage, or UCH, to refer to historic and prehistoric traces of human existence that are totally or partially underwater.

b. ***Data Management:*** Geospatial data are considered a national capital asset. National policy and international standards guide data management best practices to ensure timely and broad public accessibility to these data. Within NOAA, data management practices are informed by NOAA Administrative Order (NAO) 212-15 Management of Environmental Data and Information, which states in part:

   Environmental data will be visible, accessible and independently understandable to users, except where limited by law, regulation, policy (such as those applicable to personally identifiable information or protected critical infrastructure information or proprietary trade information) or by security requirements.

   Sensitive UCH data collections require special handling while determinations are made as to whether each location will be nominated and will qualify for protection under the NHPA Section 304. OER considers these data to fall within the scope of the NAO 212-15 exceptions during this period.

IV. Roles and Responsibilities

Particular to the NOAA Ship *Okeanos Explorer*, there are many methods employed to ensure rapid and broad data access. When the goal is to restrict access to precise positional information, several operational scenarios must be considered. Alternate operating procedures are then developed for:

- Real time operations:
  - Routine data transmissions and events that broadcast the ship position
  - Seafloor mapping operations and data production
  - Telepresence-enabled ROV operations
  - Video annotations and production
  - Public broadcast operations via website and maps
- Post-cruise data management

This table summarizes the roles and responsibilities of each Team Lead in implementing the policy through the management approaches described herein and the SOPs as defined in the Appendices.

MISSION PERSONNEL (Coordinated by: Expedition Coordinator)	
Responsible Team	**Accountable for these (primary) actions**
Expedition Coordinator	Notification of NDA to Mission Personnel ID , communicate and enforce UCH buffer zone Coordinate with Team leads and key personnel / ensure SOP compliance
Seafloor Mapping Team	Segregate raw and processed data into marked files so that restricted data are held separately and are clearly marked
Telepresence Team	Ensure broadcast data is free of any positional information
Video Team	Ensure UCH Dives and dive products are annotated as such; ensure all raw data and products are not geo-referenced
Data Management Team	Ensure all UCH data are appropriately segregated and documented. Follow post cruise and archive procedures as specified.
Communications Team	Ensure all communications are controlled through one primary POC; ensure communications are not geo-referenced.
***Okeanos Explorer* Operations (Coordinated by: CO or Designee)**	
OMAO Operations	Notification to crew of NDA responsibilities Stop SCS events (email notifications) upon entering buffer zone; Start SCS events (email notifications) upon exiting buffer zone

V. Appendices: Standard Operating Procedures

Appendix A: MAPPING OPERATIONS

The following outlines the process for pre-cruise planning, mapping field operations, post-cruise follow up, and data archival procedures for the following scenarios:

- When UCH is unexpectedly discovered on a standard, non-UCH targeted mapping cruise
- When a cruise is specifically targeted at UCH.
- When an Isolated UCH survey is conducted as part of a broader cruise
- Large survey over UCH area with potential to contain multiple instances of UCH

A. Pre-Cruise Planning

1. Standard Mapping Pre-Cruise Planning

a. This section does not affect normal pre-cruise or data management processes for standard mapping cruises that are not conducting targeted UCH mapping. During pre-cruise planning the EX Cruise Coordinator is advised to consult with the OER Marine Archaeologist to discuss possible UCH targets in the mission area. The mapping team may be requested to optimize line planning as necessary to detect UCH and to process data, when possible, to a smaller non-standard grid size to create higher resolution mapping products to provide better images of potential UCH. If so, follow guidance in the UCH Mapping Pre-Cruise Planning section below.

2. UCH Mapping Pre-Cruise Planning

a. Background information - The EX mapping team should be supplied with information about targets in the survey area that will help in their detection and identification. This information will be supplied by OER's marine archaeologist and collaborating archaeologists.

b. Data processing and data products - Archaeologists involved with the survey will consult with the mapping team to discuss data processing and data products that will increase the potential to discover UCH. The cruise coordinator and mapping team lead will work with OER's marine archaeologist to coordinate this activity.

c. Consultation and data sensitivities - Cruise planning must also include a discussion on data sensitivity and data management/archiving. It is the appropriate time to collaborate with other Federal and state agencies that may have a legal or management interest in potential UCH in the survey area. The risks to the resources should be weighed to inform a post-cruise decision on whether or not UCH with potential historical or cultural significance should have information about their location restricted from public release. This should be a collaborative discussion that includes OER's marine archaeologist, cruise coordinator and cruise data manager along with cultural resource managers and archaeologists from other agencies with an interest in the UCH. Agencies that may have an interest include the

Office of National Marine Sanctuaries (ONMS) Maritime Heritage Program, Bureau of Ocean Energy Management, Bureau of Safety and Environmental Enforcement, U.S. Navy History and Heritage Command, National Park Service, State Historic Preservation Officers, and others. While planning expeditions in any foreign country the host government should be made aware of the potential to discover UCH.

d. In survey areas where an agency has responsibility for UCH, the data management team should carry out a consultation process with the agency to identify any special protocols that should be put in place to conform with the policies of the agency and these should be incorporated into the data management plan. The expedition coordinator is responsible for the overall execution of the data management plan.

e. On mapping missions within the National Marine Sanctuary System, pre-cruise discussions between the EX Cruise Coordinator and ONMS should include the ONMS Director of the Maritime Heritage Program (MHP) and the maritime heritage coordinator at the sanctuary site. They will help determine the sensitivity of data and data products.

B. Mapping Field Operations

1. Standard Mapping Field Operations

a. While standard mapping field operations are not affected by the marine archaeology SOP, any features which appear to be of cultural or historical significance, and appear anthropogenic in origin, do require special consideration. Cultural features include wrecks of ships or aircraft, the recognizable debris from wrecks, evidence of previous human settlements, or other items which may appear anthropogenic in origin and have some associated cultural or historical significance.

b. The EX Cruise Coordinator will consult with OER's marine archaeologist immediately on the discovery of UCH in the field. The Cruise Coordinator should provide an image and location information by email. The OER marine archaeologist may request special data products that have higher resolutions than standard data products to aid in characterizing UCH.

c. If UCH is determined not to be historically or culturally significant or it is determined that no harm will result by disclosing position information, no change to standard mapping field procedures is required.

d. If UCH is historically significant or potential to be historically significant, data and data products should be held from public release until reviewed for sensitivity as applicable under the National Historic Preservation Act and other pertinent legislation and regulations, prior to releasing data to a public archive.

e. The expedition coordinator is responsible for the overall execution of the data management plan.

f. When appropriate, OER's marine archaeologist will contact relevant entities to notify them of the discovery and consult with them regarding the significance of the UCH.

2. *UCH Targeted Mapping Field Operations*

a. No informal information about UCH should be released to the general public by the ship or personnel. This includes posting information and images on social networking sites like Facebook, Twitter or personal blogs. Mapping data will be released to the public following the normal process and announcement of discoveries will be made through the appropriate offices and public affairs officials.

b. A five-mile buffer zone shall be created around the UCH isolated survey box. The following steps will be taken just prior to entering the buffer zone in order to stop broadcasting the ship's location while the survey is conducted:

i. NOAA Shiptracker: Disable the SCS feed from the ship going to Shiptracker

ii. Automated Information System (AIS): NOAA requires that the AIS feed which broadcasts information about the ship, including position, course and speed, must remain on at all times for collision avoidance and other safety reasons. Although the International Maritime Organization's (IMO) Maritime Safety Committee condemns the Internet publication of AIS data, it is easily available for viewing. During the cruise planning phase the Expedition Coordinator will provide the AIS broadcast range on the EX to the chief scientist and science team. The Chief scientist, the science team, or other parties involved in a UCH mapping cruise should be made aware of this and decide whether the value of the operation merits acceptance of the potential issues/outcomes imposed.

iii. Telepresence Video Feeds: Do not stream any feeds that include a visible ship location, for example the multi-beam acquisition screen does not high enough resolution over the video feed to see ship position. Streams include but not limited to the SCS data screen, or any active mapping data acquisition screens, or video feeds. It is acceptable to stream video feeds that do not include the ship's location.

iv. The Cruise Coordinator will ensure the survey department takes steps to distinguish and separate UCH mapping data from non-UCH mapping data as appropriate.

v. Raw Multibeam Data Acquisition: Raw data will be logged in the standard folder structure on the multibeam acquisition computer. Raw data will be copied into a "Restricted" folder in the RAW data network folder structure. Data acquisition and processing logs will clearly state which files are restricted.

vi. Multibeam Data Field Processing: Restricted files will be processed and gridded separately from other non-restricted data and will be clearly labeled as such in projects and filenames. The products will be created according to normal field quality-control procedures, but will not be sent to shore with the daily products, in order to not become publicly available via normal channels (FTP / Digital Atlas).

vii. Raw EK 60 and Subbottom Data Acquisition: Raw data will be logged in the standard folder structure on the acquisition computers. Raw data will be copied into a 'Restricted' folder on the RAW and CRUISE DATA data network folder structure. Data acquisition and processing logs will clearly state which files are restricted.

viii. Cruise Data Transfer (EX to UNH) Package: In the Cruise Data Package carried from the ship by the Mapping Team Lead, a "Restricted" top-level directory will be added in the cruise data folder. Within the "Restricted" folder the same directory structure as the unrestricted folder will be repeated (i.e. SCS, CTD, Multibeam, Imagery, etc).

ix. CTD and XBT operations conducted within the buffer zone do not need to be isolated from non-UCH data, or repressed from the *Okeanos* Atlas. CTD and XBT files should follow the normal unrestricted processing procedures and archiving.

x. Daily updates are normally linked to the location of the ship at the time the update is posted. If daily updates are made during UCH surveys, no position shall be provided. If a position is required, the position should be posted as it makes sense, 5 miles outside of the extent of the survey area.

c. Normal transmissions from the ship shall resume after the EX finishes UCH survey operations and exits the 5-mile buffer zone. Exiting the buffer zone should occur at approximately the same location as entry to prevent obvious data location gaps pointing to UCH location.

C. Post-Cruise Follow Up

1. Information Release

a. No informal information about UCH should be released to the general public by the ship or personnel. This includes posting information and images on social networking sites like Facebook or personal blogs. Mapping data will be released to the public following the normal process and announcement of discoveries will be made through the appropriate offices and public affairs officials.

2. Standard Mapping Cruise follow-up where UCH is discovered

a. The mapping team will provide a brief summary of the survey and target that includes a description of the survey, water depth, site location, site dimensions, bottom type, and images of the target at the best available resolution.

b. The EX Cruise Coordinator and the OER Marine Archaeologist have an initial consultation to discuss the nature of the UCH and its potential significance. This consultation may include other agencies or entities.

c. If UCH is determined not to be historically significant no change to standard data management procedures is required.

d. If UCH has the potential for historical significance but it is determined that no harm will result by disclosing position information, such as UCH in deep water, no change to standard data management procedures is required.

e. If UCH has potential historically significance and disclosing information about the site poses a threat, further discussions will be held on how to minimize potential harmful impacts, including data management decisions outlined in Data Archiving section of this document. The EX cruise Coordinator, a representative from the data management team, OER's marine archaeologist, a representative from the ONMS Maritime Heritage Program, and any parties with jurisdiction, management or other legal ties to the resource shall meet to determine what measures are needed to protect the UCH while minimizing impacts on the distribution of data and data products.

3. UCH Targeted Mapping Cruise Follow-Up

a. The mapping team will create a survey report that provides technical details on the survey, data processing and data products. It should contain a list of targets that includes site location, water depth, site dimensions, bottom type/topography, and images of the target at the best available resolution. Other helpful products include SD and kmz files.

b. The EX cruise coordinator, OER's marine archaeologist, a representative from the ONMS Maritime Heritage Program, archaeologists involved in the survey, and any parties with jurisdiction, management or other legal ties to the resource shall meet to discuss the potential historical significance of the UCH and the sensitivities of releasing data to the public that can be protected under Section 304 of the National Historic Preservation Act.

c. The outcome of this meeting will determine if it is necessary to protect site location information from public release.

d. When data can be released

- ***i.*** If the findings determine that releasing information and data on UCH is not a threat, development of products and data management should follow the guidelines for a standard mapping cruise.

e. When data should be protected

- ***i.*** If it is determined that a site is or has potential to be historically significant and eligible for nomination to the National Register of Historic Places, the location and data containing the location should not be released to the public.
- ***ii.*** Data products that contain position information will be forwarded to the EX data management team where data and products will be stored in an archive with restricted access.
- ***iii.*** Cruise plans, cruise reports, situation reports, mapping summary reports and other documents that are publically available outside NOAA or freely accessible within NOAA shall not provide location information for UCH or survey areas. In certain circumstances the

lead archaeologist for the cruise may request that certain UCH sites are not mentioned in the public reports.

4. ***UCH mapping follow-up for National Marine Sanctuaries***
   a. When the EX conducts UCH work inside a National Marine Sanctuary the EX Cruise Coordinator shall inform the OER Marine Archaeologist, ONMS Maritime Heritage Program Director, Sanctuary Superintendent and Sanctuary Maritime Heritage Coordinator on the availability of data products and initial results of the survey. ONMS shall determine the sensitivity of the data and whether or not it can be disclosed to the public. Published metadata shall indicate the point of contact to access UCH data within the NMS system is the Director of the Office of National Marine Sanctuaries.

D. Data Archiving – See Appendix C

Appendix B: TELEPRESENCE-ENABLED ROV OPERATIONS

The following outlines the process for pre-cruise planning, field operations, post-cruise follow up, and data archival procedures for the following scenarios:

- When a cruise conducts ROV operations specifically targeted at UCH.
- When UCH is unexpectedly discovered on non-archaeological operation

A. Unexpected UCH Discovery

- During the Cruise: If UCH is unexpectedly discovered during an ROV dive, the onboard Expedition Coordinator should immediately contact OER's Lead Maritime Archaeologist, and the Archaeology Doctors-on-Call identified for that expedition. Those archaeologists should be engaged in the site investigation as soon as possible to provide information to help assess the site discovered. No changes to the data, video or onboard data acquisition processes should be made. A post-dive and post-cruise discussion will be held with the OER archaeologist to determine whether any datasets should be withheld from archive. (Section 2.D.II).
- **Follow-up when UCH is unexpectedly discovered**
  - ***a.*** The EX Cruise Coordinator and the OER Marine Archaeologist will have an initial consultation to discuss the nature of the UCH and its potential significance. This consultation may include other agencies or entities.
  - ***b.*** If UCH is determined not to be historically significant no change to standard data management procedures is required.
  - ***c.*** If UCH has the potential for historical significance but it is determined that no harm will result by disclosing position information, such as UCH in deep water, no change to standard data management procedures is required.
  - ***d.*** If UCH is or has potential historical significance and disclosing location information about the site poses a threat, further discussions will be held on how to minimize potential harmful impacts, including data management decisions outlined in the Data Archiving section of this document. The EX cruise Coordinator, a representative from the data management team, OER's marine archaeologist, a representative from the ONMS Maritime Heritage Program, and any parties with jurisdiction, management or other legal ties to the resource shall meet to determine what measures are needed to protect the UCH while minimizing impacts on the distribution of data and data products.

B. Cruises conducted with ROV operations specifically targeted at UCH.

1. **Pre-Cruise Planning: ROV Exploration**
   a. Notifying the Team of their Responsibility to Protect Sensitive UCH Resources
   Expedition members and OER personnel to have a legal responsibility to protect sensitive archaeological information (primarily location information) from untimely release.

For a planned UCH cruise, the EC shall notify the CO and each shall have responsibility for ensuring personnel are aware of this responsibility. The EC shall provide an archaeology background document to familiarize personnel with the particular mission and requirements.

Appendix D details the range of existing accountability mechanisms already in place.

2. **Pre-dive planning**
   a. Archaeologists will develop a dive plan based on the best available knowledge of the site that will maximize data recovery and minimize any potential impact to the site. The archaeology team will work closely with the cruise coordinator and deep submergence vehicle manager to develop and implement the plan. The plan should include:
      I. Objectives (cultural/interdisciplinary science)
      II. The types of sensors needed and data to be generated
   b. As a rule ROV dives will not disturb or touch the shipwreck or cultural feature. Exceptions to this rule must discuss the rationale behind such a decision and incorporate it into the dive plan (collection of diagnostic artifacts or samples is sometimes conducted if the activity leads to better baseline characterization).
   c. Prior to the cruise any permitting requirements should be identified and if required, permits must be procured.
   d. Automated Information System (AIS): NOAA requires that the AIS feed which broadcasts information about the ship, including position, course and speed, must remain on at all times for collision avoidance and other safety reasons. Although the International Maritime Organization's (IMO) Maritime Safety Committee condemns the Internet publication of AIS data, it is easily available for viewing. During the cruise planning phase the Expedition Coordinator will provide the AIS broadcast range on the EX to the chief scientist and science team. The science team, chief scientist, or other parties involved in a UCH mapping cruise should be made aware of this and decide whether the value of the operation merits acceptance of the potential issues/outcomes imposed. A Go/No-Go decision will be made based on this information.

C. *Field Operations*

1. Exploration dives by ROV should be planned to collect optical and acoustic images without causing physical disturbance to the UCH. Representatives and leads from operational groups including the ROV, data/video, and telepresence teams, and ship operations should meet to discuss ROV operations and data collection.
   a. The guidelines for mapping operations should be followed to ensure site locations are not disclosed during field operations. SOPs with full operational details are available on the ship.
   b. A three-mile buffer zone shall be created around the UCH target or isolated survey box. The time at which the ship enters, and departs the three-mile buffer

zone needs to be recorded and provided to the Data Team Lead for post-processing use. Following work at the site, the ship will return to the site where it first entered the three-mile buffer zone to continue operations.

c. The following steps will be taken just prior to entering the five-mile buffer zone in order to stop broadcasting the ship's location while the survey is conducted:

I. NOAA email events will be stopped (OMAO/ET)

- NOAA Shiptracker: Disable/stop the e-mail updates from the ship going to OMAO / Shiptracker
- *Okeanos* Atlas: Disable/stop the e-mail updates to NCDDC
- SAMOS: Disable/stop the e-mail update to FSU containing METOC and flow-through data, etc.

II. Telepresence Video Feeds (OER Telepresence team lead): Do not stream any feeds that include the ship's location, including but not limited to the SCS data screen, or any active mapping data acquisition screens, or video feeds. It is acceptable to stream video feeds that do not include the ship's location.

III. Redirect Live Feed as needed (OER EC or CO): If highly sensitive features (human remains, evidence of human remain such as shoes or other accoutrements, highly valuable items, etc.) are going to be investigated or are unexpectedly encountered during the course of our seafloor investigation, the lead archaeologist, ROV Team Leader, Expedition Coordinator or Commanding Officer has authority to immediately switch the live feed from the ROV and Seirios camera sled to another camera on the ship.

d. Daily updates on the *Okeanos* Atlas are normally linked to the location of the ship at the time the update is posted. If daily updates are made during UCH surveys, no position shall be provided. If a position is required, the position should be posted as it makes sense, 3 miles outside of the extent of the site or survey area.

e. Normal transmissions from the ship shall resume after the EX finishes UCH survey operations and exits the 3-mile buffer zone. The point of exit should be as near to the point of entry as is feasible to minimize location data gaps pointing to the location of the UCH.

f. No informal information about UCH should be released to the general public by the ship or personnel. This includes posting information and images on social networking sites like Facebook, Twitter or personal blogs. Images, video and information on UCH will be released to the public following the normal process and announcement of discoveries will be made through the appropriate offices and public affairs officials.

g. In addition to the items listed, the ship sends out automated weather (autoIMET) observations every hour and manual weather observations every 6 hours with positions as a voluntary ship observer. These observations are pulled onto public sites by several different websites and Google Map apps. One example is sailwx.info. This is only accurate to the nearest decimal degree (6 nm). This level

of accuracy is not of concern.

D. Post-Cruise Data Management – Appendix C for detail

Following completion of the expedition, the Expedition Coordinator should have a follow-up call with the Data Management Team & OER lead archaeologist to review the datasets collected, confirm those that need to be withheld from public archive, and provide information to the data management team for associated metadata records.

E. Post-Cruise Follow-Up

1. Information Release

a. No informal information about UCH should be released to the general public by the ship or personnel. This includes posting information and images on social networking sites like Facebook or personal blogs. Images, video, and mapping data will be released to the public following the normal process and announcement of discoveries will be made through the appropriate offices and public affairs officials.

b. Determination of whether UCH is potentially eligible for nomination to the National Register of Historic Places, or eligible for protection under other legislation such as the Sunken Military Craft Act or National Marine Sanctuary Act, will take some time following completion of the cruise. Sensitive or potentially sensitive information about the UCH is to remain restricted until determination is complete. Following completion of the cruise, the lead Archaeologist will work with others to analyze the UCH data and conduct historical research to determine whether the UCH is eligible for nomination to the National Register of Historic Places.

I. If the UCH is determined to be eligible, the lead Archaeologist will prepare the nomination for the NRHP process.

II. If the UCH is determined to NOT be eligible, and protection of the site does not fall under other legislation, the Lead archaeologist will notify the data management team that site information can be made publicly available.

2. UCH Targeted Cruise Follow-Up

a. The EX cruise coordinator, OER's marine archaeologist, a representative from the ONMS Maritime Heritage Program, archaeologists involved in the survey, and any parties with jurisdiction, management or other legal ties to the resource shall meet to discuss the potential historical significance of the UCH and the sensitivities of releasing data to the public that can be protected under Section 304 of the National Historic Preservation Act. The outcome of this meeting will determine if it is necessary to protect site location information from public release.

I. When location data can be released:

a. If the findings determine that releasing information and data on UCH is not a threat, development of products and data management should

follow the guidelines for a standard ROV cruise.

II. When location data should be protected:

- ***a.*** If it is determined that a site is or has potential to be historically significant and eligible for nomination to the National Register of Historic Places, the location and data containing the location should not be released to the public.

III. Data products that contain position information will be forwarded to the EX data management team where data and products will be stored in an archive with restricted access.

IV. Cruise plans, cruise reports, situation reports, mapping summary reports and other documents that are publically available outside NOAA or freely accessible within NOAA shall not provide location information for UCH or survey areas. In certain circumstances the lead archaeologist for the cruise may request that certain UCH sites are not mentioned in the public reports.

Appendix C: Post-Cruise Data Management

Data collected by OER that is considered sensitive will be protected from direct public release until such time as a final determination can be made as to permanent protection. Data in this state will be:

- Fully documented, so as to be independently understandable to users;
- Visible through publication of metadata records by OER;
- Accessible upon request to OER (controlled access by permission);
- Preserved in NOAA archives as 'restricted' (not available for direct public access).

These data will not be available for direct public access unless and until they are eliminated from consideration for nomination to the National Register of Historic Places (NHPA Section 304), or for protection under other legislation such as the Sunken Military Craft Act or National Marine Sanctuary Act.

If data are nominated and accepted for any official protection, then the exceptional status will be made permanent, and all documentation updated and finalized as such.

Data generated by the *Okeanos Explorer* is archived under a data management agreement with NCEI. Only data that has potential to reveal the nature and location of UCH shall be restricted from public access. In accordance with the data management agreement, sensitive data from the EX will have restricted access at NCEI. To assist researchers in discovering sensitive data NGDC will publish a metadata record (but not the data) that identifies a point of contact for access. Requests to access the data will be made to the Director of OER who may delegate to the OER marine archaeologist. In lieu of the OER marine archaeologist, the OER Director may delegate to the Director of the ONMS Maritime Heritage Program.

If data is found to be sensitive because it reveals the location of a historically significant cultural resource, Section 304 of the National Historic Preservation Act provides that the head of a Federal agency or other public official shall withhold from public disclosure information about the location, character, or ownership of a historic property when disclosure may cause a significant invasion of privacy; risk harm to the historic property; or impede the use of a traditional religious site by

practitioners. Data collected by the EX that is considered sensitive will be archived in a location where it can be withheld from public disclosure.

Data sets and associated products are housed in the appropriate NOAA archive; National Oceanographic Data Center, National Geophysical Data Center, National Coastal Data Development Center, National Climate Data Center, and the NOAA Central Library.

- Digital Atlas: NCEI will develop appropriate metadata records to post on the digital atlas.
- CTD and XBT data collected during mapping operations conducted within the buffer zone will not be repressed from the *Okeanos Atlas* and will be held in a public archive.
- Cruise reports, cruise plans, mapping summary reports and other documents that are publically available outside NOAA or freely accessible within NOAA should not provide location information for UCH or survey areas.

Start and end times for the 3-mile buffer zone surrounding a UCH site need to be provided to the data management team. Datasets containing sensitive location information will be restricted in their entirety, unless other parsing arrangements have been made. The following datasets may contain sensitive UCH location information and need to be reviewed, post-processed as appropriate, made restricted and pertinent metadata records created and made available.

- Multibeam, sub-bottom and single beam sonar data
- SCS Data Logs are to be restricted
- All ROV dive products (including associated sensor data) need to be restricted
- CTD rosette and *in situ* sensor datasets collected in relation to the UCH, and within the 3 nm buffer zone, need to be restricted.
- All imagery needs to be reviewed and geospatial imagery removed before being made public. Imagery with geospatial information should be restricted.
- Ship track and other datasets within the buffer zone

Appendix D: NDA References

Expedition members and OER personnel to have a legal responsibility to protect sensitive archaeological information (primarily location information) from untimely release. The following summarizes the types of personnel who might be engaged in an *Okeanos Explorer* Expedition, where their responsibility to protect sensitive location information about UCH lies, and whether this responsibility has already been addressed or signature of a Non-Disclosure Agreement (NDA) is required to allow their participation in an expedition with planned UCH operations.

- If they are federally-employed scientists, they agreed not to disclose sensitive information and to adhere to federal laws as part of the terms of their employment with the federal government.
- The crew onboard the ship are under the CO's purview. On *Okeanos Explorer*, all crew are federal employees, and thus agreed not to disclose sensitive information and to adhere to federal laws as part of the terms of their employment with the federal government.
- All other members of the Mission team who are not federal employees and are engaged at-sea or ashore (including technicians, vehicle operators, students, etc.) are required to sign a non-disclosure agreement to protect sensitive cultural heritage information as part of their contract agreement.
- Other OER personnel who have access to data and information on the FTP site are either federal employees or contractors and need to be similarly reminded of their

responsibilities. OER contractors signed an NDA as condition of employment with the federal government (this should be confirmed annually).

At the beginning of the expedition, all personnel need to be notified of their responsibilities:

MISSION PERSONNEL (Notified by: Expedition Coordinator)		
Employee	**Accountability Mechanism for With-holding Sensitive Data**	**Action**
NOAA Federal Employees	NOAA and Federal Contract	Reminder of contract, and provide archaeology background document.
Mission Contractors (UCAR, ERT Inc., 2020 Company LLC)	Non-Disclosure Agreement	Confirm all contractors signed NDA. Send reminder of contract and provide archaeology background document.
NOAA/Federal Scientists	NOAA and Federal Contract	Reminder of Contract, and provide Archaeology background document
Other Federal Scientists (BOEM, Navy, NPS, etc.)	Federal Contract	Reminder of Contract, and provide Archaeology background document
Other Mission Personnel and Scientists	Non-Disclosure Agreement	Get NDA Signed
Okeanos Explorer Crew (Notified by: CO or Desingnee)		
NOAA Federal Employees	Subject to NOAA and the ship's communications plans and protocols for sensitive data	CO sends out reminder of contract to ship via All Hands, and provides Archaeology background document
Other Federal Employees (e.g. Public Health Service)	Subject to NOAA and the ship's communications plans and protocols for sensitive data	CO sends out reminder of contract to ship via All Hands, and provides Archaeology background document
Wage Mariners	Subject to NOAA and the ship's communications plans and protocols for sensitive data	CO sends out reminder of contract to ship via All Hands, and provides Archaeology background document

Appendix I: REMUS 600 Technical

NOAA Hydroid REMUS-600 AUV Technical Configuration & Specifications
February 2013

AUV
Physical Characteristics
• Length Overall (LOA) – 140 inches
• Diameter – 12.75 inches
• Weight in Air – 670 lbs
• Transport Cart – 2' x 4' x 1.5' (L x W x H)

Operational Limits
• Endurance: Approximately 24 Hours @ 4 Knots
• Max Depth: 450M (Limited by EM3002 Transducers)

Primary Sensor
• Kongsberg EM3002 Multibeam Echosounder

Secondary Sensors (Used for Navigation)
• Conductivity-Temperature: Neil Brown Ocean Sensor (NBOSI) G-CTD o Conductivity: 0-90 mS/cm2 ±0.002mS/cm
o Temperature: 0-30°C ±0.001°C

• Pressure: Paroscientific, Inc Model 9000-1-k-101 o 0-1000psia (0.01% full scall or ±6.85cm of seawater)

• Terrain Avoidance Sonar: Imagenex 852 (675KHz)

Navigation
• Primary GPS: Novatel OEMV-3-HP L1/L2 Receiver
• Emergency Board GPS: Garmin 15HX L1 Reciever
• IMU – Honeywell HG9900
• DVL – Teledyne RDI Workhorse 600KHz
• INS- Kongsberg Hugin Navigation Processing Suite (NavP)

Communications
• Acoustic Modem: WHOI Micro-Modem (20-30 kHz, 80-1200 bps) o Range: Up to 1.5 km

• Ethernet: Wired and Wireless (802.11g)

• Iridium Satellite Modem

NOAA Hydroid REMUS-600 AUV Physical Characteristics & Host Vessel Requirements
February 2013

AUV
Physical Characteristics
• Length Overall (LOA) – 140 inches
• Diameter – 12.75 inches
• Weight in Air – 670 lbs
• Transport Cart – 2' x 4' x 1.5' (L x W x H)

Notes: The AUV can be stored on the weather deck, but requires protection from sea spray and precipitation during high-speed data transfer and battery charging. Mission planning and low-speed data transfer can be performed over wireless Ethernet with the AUV on deck in any weather.

The Transport Cart has locking wheels, but the cart and AUV must be secured while on deck.

Topside Equipment
Lab Space Equipment
• Mission Planning Laptop – Ruggedized Windows Laptop requires 120VAC outlet.
• Shipboard Console – Provides communication between the AUV and Mission Planning Laptop. o Dimensions: 16" x 22" x 30"
o Power Requirements: Two 120VAC outlets
o Cable connections: § Antenna Cable – 75 Ft (To Mast Box described below)
§ High-Speed Data Cable – 50 Ft (To AUV)
§ Acoustic Comms Cable – 75 Ft (To Ranger Tow Fish described below)

• Shipboard Power Console – Provides AUV battery charging and conditioning. o Dimensions – 11" x 22" x 30"
o Power Requirements: One 240VAC/30A NEMA L6-30R receptacle and one 120VAC outlet.
o Cable Connection: 45 Ft charging cable to AUV

• Tools & Spares Kit – One 42" x 25" x 20" shipping case.
• Additional Equipment – Two data processing laptops.

On-Deck Equipment
• Mast Box – GPS, Iridium, Wireless Ethernet antennas for AUV comms. o Dimensions: 10" x 15" x 5"

o Cable Connection: 75 Ft to Shipboard Console
o *Note*: The Mast Box may be strapped to the host vessel's mast, rail, or superstructure. The location should be unobstructed and maximize the height off the water given available cable length (75 ft) and location of the Shipboard Console.

• Acoustic Communications o Ranger – Handheld topside unit and small tow body for acoustic communications with the AUV while it is in the water up to 1.8KM away. § Tow Body – Approximately 1 Ft LOA on 25 Ft cable connected to the handheld unit or Acomms Bottle.
§ The tow body may be connected to the Shipboard Console via the Acoustic Comms Cable and small Acomms Bottle to allow acoustic comms from the Mission Planning Laptop.
§ Note: The Acoustic Comms are necessary during launch and recovery and when a situation arises to intervene during the AUV's mission, such as aborting the mission due to hazardous weather conditions. To maximize range and reliability of acoustic comms the host vessel must not be underway and the tow fish deployed where it has an unobstructed acoustic path to the AUV. During routine AUV survey operations the tow body is not deployed and AUV status is monitored via Iridium satellite comms.

Appendix J: Notes from planning meeting June 2, 2019

In attendance: Incoming CO Manning, CB Hozendorf, CO Johnson, Ops, XO Knighton, Andy O'Brien, Roland Brian, CET Peperato, Mike White

Ship Arrives on Friday July 12th after EX1903 Leg 02, ROV and Mapping

- Plan is to have the ROVs de-mob and ready to move when the ship touches pier
    - Includes moving Seirios and taking down the ROV sheave
    - CB Requested D2 be moved as far forward as possible in the hangar
- Still unclear if the ship will go to shore power, if so, will add 1 hour of crane operations
- Katfish will be at MOC-A ready to bring onboard
    - Ship will plan to bring Katfish onboard, secure winch and cradle, hook-up power, and hang sheave on the 12th.
    - Once the Katfish is onboard, scientists can access as needed
        - Unclear when scientists will be able to move on board prior to the 15th/16th, but meals will not be served
        - Noted that stewards will to turn rooms over, increased importance on good room inspection
- CET Peperato requested that an ET support for Kraken Katfish begin on Friday the 12th
- In general, it was noted that any topside equipment that is to be set-up in the Wetlab or the Dry Lab use a barrier between it and the counters as to not damage the surfaces.
- We would request the Katfish/REMUS groups not enter the front row

Saturday, July 13th

- Plan is to accomplish ROV de-mob on the 12th of June and to have crew rest (three days after a 23 day cruise) begin on the 13th.
- CB Hozendorf communicated he will be available on the morning of the 13th if additional crane support is needed

Sunday July 14, Monday, 15

- Continue crew rest
- Science part will be able to continue to work on integration without crew support
- Ops' birthday is the 15th

- GFOE and Mission personnel plan to arrive 15th, or earlier as possible
- From Dan Rogers, "The GFOE team will probably plan to arrive at the ship by end of day on the 16th, unless there is a reason to show up earlier. There will be no ROV mobilization during these days."

Tuesday 16th,

- Mobilize the OCS REMUS 600
    - Bring OCS REMUS onboard, lash to the baxter bolts on the CTD deck (launch with J frame)
        - Crane support needed [TBD hours]
    - Setup the topside electronics
- Science Party arrives

Wednesday 17th

- Practice launch and recovery of the Katfish
- We also discussed practicing launching and recovering the REMUS 600
- Stores will arrive either the 16th or 17th

Ship will depart 18th

- Till the morning of the 24th, operations will alternate between REMUS 600 and Katfish. Our objectives are to test the technology and so we may have to be flexible. Launch and recovery are planned during working hours.
- Ship noted GAR/ORM will be completed for every over the side operation

July 24th

- Planned pick-up of VIPs via small boat at Point Judith, RI
    - EX small boat safely and comfortably fit 3 persons
        - For more people, EX small boat will have to make additional runs
    - Ship commented that we should consider if VIP staffers/attendants should attend, since it may lead to additional small boat runs, at least weigh the options
- After small boat transfer, ship will head south to complete Katfish operations.
- Ship will then complete an afternoon/evening passage in the daylight to Davisville pier
- We will begin demobilization of topside electronics and other equipment

July 25th

- Morning crane operations to de-mob the REMUS 600 and Katfish.
- After de-mob, we will move the ROVs back into place

- It was noted this will be a tight turn around for the stewards, mission will plan to assist
- Afternoon/evening departure in the daylight

July 26th

- Overnight July 25 into July 26th will include transit mapping operations
- We will plan to dive after lunch on July 26th, Dive 00
    - GFOE has communicated that it will be difficult to mobilize the vehicles in time and integrate the Kraken SeaVision laser scanner
    - If we dive after lunch then we would request an extended dive into the evening
    - XO noted that an extended dive might be a lot on the crew and so would have to make a determination closer to the date

Appendix K: Notes from EX and REMUS 600 Walkthrough, April 15, 2019

Okeanos Explorer, at VT Halter Shipyard

Purpose of Visit: Scoping OCS REMUS 600 AUV operations on the EX

Attendees: GFOE Daniel Rogers, CO Eric Johnson, CB Jerrod Hozendorf, BGL Mike Collins, CET Dave Blessing, SST Charlie Wilkins, CME Vinny Palazzo, OCS Rob Downs, OCS Mike Annis, OER Mike White

Key Takeaways:

1) We discussed having the REMUS on the fantail. Fan tail would not provide adequate weather protection and may interfere with simultaneous towed operations
2) CB suggested CTD Deck. The ship's CTD rosette would be stored on the O2 Deck, making it non-operational for the duration of the cruise
a. REMUS would be stored perpendicular to the long axis of the ship on the CTD deck
b. The J-frame would be used for launch, the starboard crane would be used for recovery
i. All agreed on an outline of the launch and recovery operations, with special attention paid to the lack of a sway arrest and size of vehicle
1. Upon recovery, Deck with used tag the REMUS from the grated deck.
2. CB noted that the J-frame will place the unit about 10 feet away from ship hull for launch
3) As a result of the Launch and Recovery outline, there will be a limited weather window during with the REMUS can be in use. There was no set threshold, but we anticipated that seas over 3-4 feet would incompatible with launch and recovery
a. If the weather is building, we should anticipate an early recovery.
4) Day vs Night Operations
a. OCS noted that the vehicle is much more visible at night while at the surface due to a strobe light, a consideration if we are operating in high traffic areas
b. However, it was also noted that charging the REMUS is limited by the temperature of the vehicle and that charging at night would provide cooler ambient temperatures
c. If the vehicle were to surface at night, it would require a crew callout during non-working hours.
5) Charging the REMUS

a. Fast charging the vehicle in a non-environmentally controlled area will elevate the internal temperature to the point where charging would have to be ceased

i. There is no environmentally controlled space on the EX that is large enough or has the access to store the unit

b. Deck Department can rig material to provide shade on the CTD deck which may help mitigate vehicle heating. OER will scope the possibility of providing a shaded area on the CTD deck for some protection

c. Charging will require a step-down transformer to convert the ship's power to the appropriate voltage. Additional investigation is needed regarding acquisition

6) Opening the Vehicle on Deck

a. OSC communicated that if the vehicle has an internal issue they could not operate on the vehicle on an open ship's deck

i. If the vehicle suffers an internal malfunction it has the potential to stop operations for the duration of the cruise.

7) OSC personnel will provide OER position corrected multibeam data in Kongsberg raw .all formats for the production of standard OER mapping products.

a. OER will follow up with NCEI regarding data archival.

8) OSC personnel were to travel to Stennis in the afternoon to determine the health of the vehicle since it has been idle for a year

a. Vehicle will go through a shakedown on as USN ship sometime in April/May 2019

Conclusions:

The launch and recovery is limited by weather and sea state. If the weather is forecast to build, we will have to recover early. The vehicle cannot be opened on deck, therefore an internal issue has the potential to cease operations. Charging will be limited due to lack of an environmentally controlled space. However, if these operational parameters are to be accepted, all present agreed that it was feasible to operate the REMUS 600 on the EX. We do not anticipate any major issues with data management.

Appendix L: Katfish Technical Specifications

Specifications can also be found here:http://krakenrobotics.com/wp-content/uploads/2017/11/Katfish-Brochure-17.11.27.pdf

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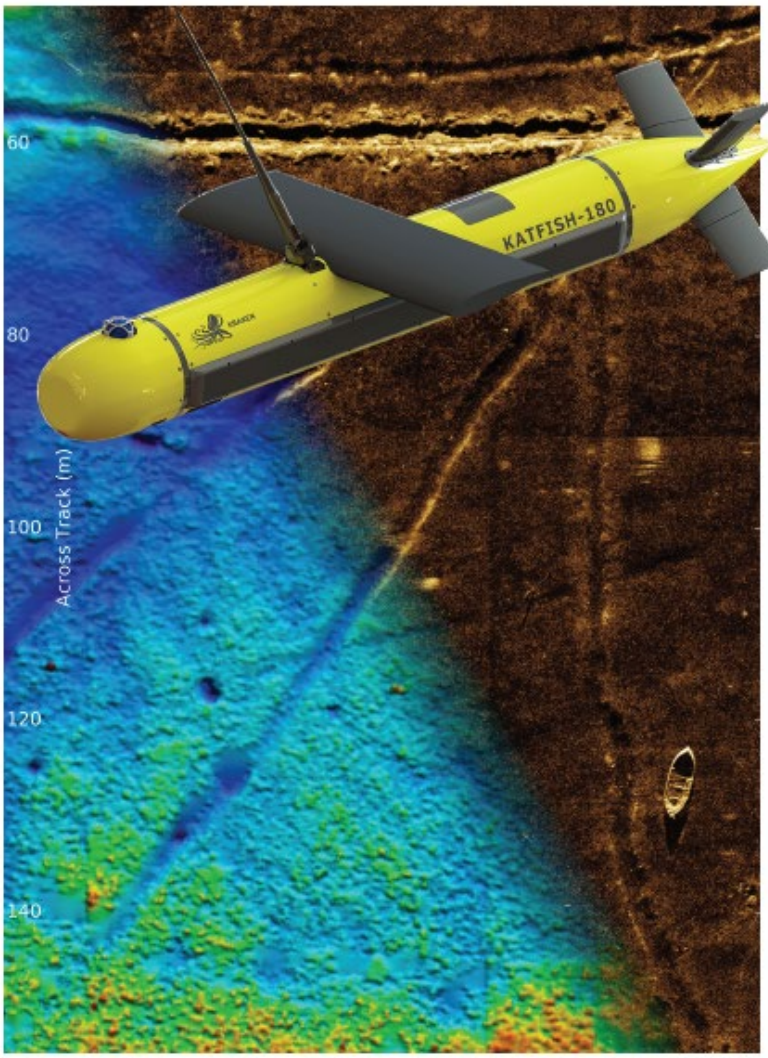
SEEING WITH SOUND



Anchor scars in Bedford Basin - Halifax Harbor, Nova Scotia

The Kraken Active Towfish (KATFISH) is based on our proven next-generation Miniature Interferometric Synthetic Aperture Sonar (MINSAS) to provide the industry's best area coverage rates combined with ultra high resolution seabed imagery and 3D bathymetry.

The KATFISH system is comprised of an actively controlled smart towfish, SAS imaging, bathymetry and gap-filler sonars, launch and recovery system, operator console, and visualization software. The towfish may be deployed from either Manned or Unmanned Surface Vessels (USV). The entire system is designed to be quickly installed and removed from vessels of opportunity.

A 180 cm AquaPix MINSAS sensor array is the heart of KATFISH, which provides remarkably sharp 3 cm x 3 cm constant resolution across ranges up to 220 meters per side. With tow speeds up to 8 kts and an integral Gap Filler, KATFISH provides unprecedented high resolution Area Coverage Rates (ACR) of 3.9 km² / Hr.

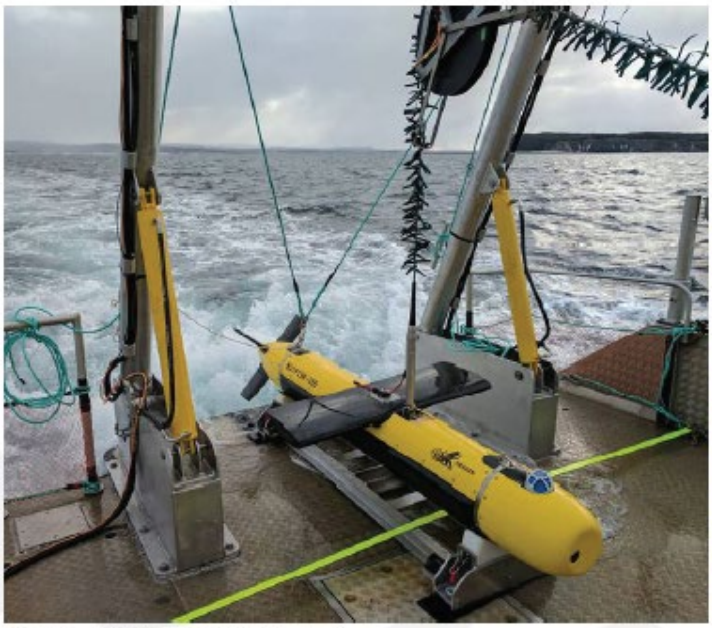
KATFISH incorporates Kraken's latest generation real-time SAS Processor, the RTSAS GPU. RTSAS enables real-time processing of SAS imagery and bathymetry, and allows operators to leverage Kraken's suite of post-processing tools, including the newly developed SASView 3D visualization and control software.

From the beginning, the engineers at KRAKEN set out to design a towfish with unparalleled resolution and coverage rates to make the industry rethink how hydrographic, pipeline, and MCM surveys are conduct ed. Providing SAS capability and performance at an affordable cost has truly elevated KATFISH into a league of its own.

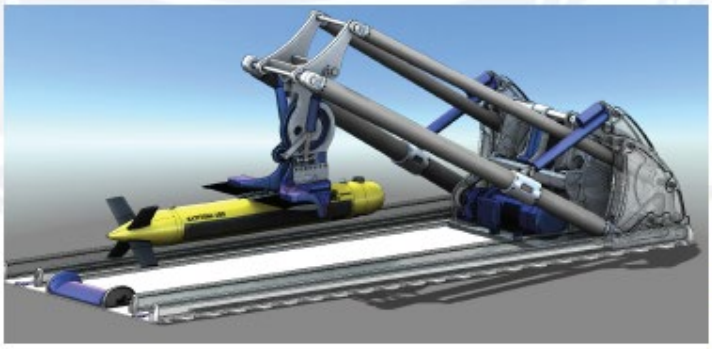
www.krakenrobotics.com

KATFISH™

KRAKEN



KATFISH sea trials in St. John's, Newfoundland

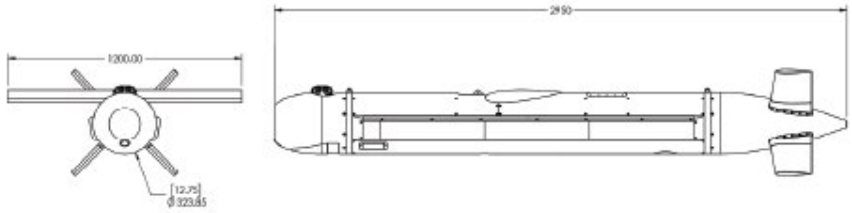


KATFISH Autonomous Launch and Recovery System (ALARS) for USV platforms.

KATFISH 180 - Performance Characteristics	
Ground speed	2 - 8 kts
Dual sided max swath	>250 m at 8 kts (>480 m at 4 kts)
Single sided max plan range	>125 m at 8 kts (220 m at 4 kts)
Dual sided area coverage rate	3.9 km^2 / hr (with gap fill)
Survey altitude	13 m (min 5 m, max 30 m)
Along track SAS image resolution	3 cm
Across track SAS image resolution	3 cm
SAS image grating lobe level	-40 dB
SAS bathymetry resolution - Real Time	25 cm (configurable up to 6 cm)
SAS bathymetry resolution - Post Proc.	25 cm (configurable up to 6 cm)
SAS bathymetry vertical accuracy	10 cm
Pulse length	5 ms (configurable 1 ms -> 16 ms)
Pulse bandwidth	40 kHz
Pulse type	Linear FM (CHIRP)
Pulse center Frequency	337 kHz
SAS robustness against yaw	±10° over 50 m track length
SAS robustness against sway	±0.2 m/s
Max crab angle	20°

KATFISH 180 - System Physical Characteristics	
Towfish dimensions	3.5 m length x 0.25 m ext. diameter
Towfish wingspan	1.0 m width
Towfish weight in air	< 250 kg
Array dimensions	180 cm x 3 cm x 7 cm
Depth rating	300 m (cable length limited)

KATFISH 180 - System Topside Components	
Rackmount case size	Standard 12U
HDD capacity	2 Tbyte standard, solid state (Ruggedized 4TB RAID NAS Optional)
Data format	Kraken .TIL, .XTF, GeoTIFF, XYZ
Dual sided data rate, 192 channels total	36 MByte/sec
Towfish data connection	Dual fully-redundant fiber Single Mode
Topside Data connection	Gigabit Ethernet
Total system power	300 W
SAS processing	Real-time on GPU
Power supply	120/240 VAC, 50-60 Hz, 600 W peak (not including winch)



KATFISH Physical dimensions in millimeters

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