Pacific Northwest
NATIONAL LABORATORY

Proudly Operated by Battelle *Since 1965*

Wind-Profiling Lidar Buoy Deployment Plan

Virginia Beach, Virginia

December 2014 – November 2015

U.S. DEPARTMENT OF ENERGY

Prepared for the U.S. Department of Energy
under Contract DE-AC05-76RL01830

Preface

This deployment plan was prepared under Annual Operating Plan project 2.7.0.602 A2e, “Measurement, Testing, and Verification”, CPS Agreement Number 28544 with the U.S. Department of Energy Wind and Water Power Technologies Office.

Contents

Preface 2
1.0 Overview 5
1.1. Background 5
1.2. Deployment Location 6
1.3. WindSentinel buoys 7
1.4. Dominion Project Description 9
1.5. Personnel, Organizations, Roles, and Contact Information 9
2.0 Primary Project Components 11
2.1. Mooring Description 11
2.2. Environmental Permitting 12
2.3. WindSentinel Buoy Communication Systems 13
2.4. Data and Buoy Alert Notifications, Monitoring and Management 13
2.4.1. Implementation Schedule 13
2.4.2. Classification of Monitoring Parameters 14
2.4.3. DMS Notification Programming 14
2.4.4. Data Flow and Automated Processing 14
2.4.5. Key Monitoring and Reporting Roles and Responsibilities 15
2.4.6. Action Plan 16
3.0 Deployment Summary 16
3.1. Storage and Transportation 18
3.2. Deployment Overview 18
3.3. Environmental Health and Safety 18
3.4. Contingency Planning 18
3.5. Maintenance or Repairs 19
3.6. WindSentinel Buoy Retrieval and Storage 19
Attachment 1: Environmental Permitting Conditions, Requirements, and Notifications 20
Attachment 2: Data and Buoy Alert Notifications, Monitoring, and Management 22
Attachment 3: Environment Safety and Health Plan 26

Figures

Figure 1. Dominion's Lease Area for Offshore Wind Energy Development 6
Figure 2. Approximate Buoy Deployment Location (Red Marker)..... 7
Figure 3. Wind Sentinel Buoy 8
Figure 4. Virginia Mooring Design..... 11
Figure 5. Flow Diagram for Data Collected at the Buoy. 15
Figure 6. Deployment timeline. 17

Tables

Table 1. Personnel, Organizations, Roles, and Contact Information. * = Staff member receives e-mail alerts from the buoy 10
Table 2. Permits, Authorizations and Consultations Obtained and Completed for the Virginia LiDAR Buoy Deployment. 12

1.0 Overview

1.1. Background

There is currently a nearly complete lack of long-term observations above the ocean surface of winds at rotor plane heights for wind turbines in U.S. offshore waters. Most observations are either episodic (e.g., several-week-long scientific field studies) or not publicly available (e.g., measurements from offshore wind plant developers such as Cape Wind and Fishermen's Energy). There have been long-term measurements from European facilities such as the FINO towers in Germany, but those data are not readily available and are not fully representative of conditions encountered in U.S. waters.

This lack of long-term data is a barrier to the development of offshore wind energy in the U.S. In particular, it has not been established how well assumptions about scaling winds to hub height from buoy observations at the surface actually work. This scaling is typically performed using either a power law or logarithmic profile. In the customary application of these relations, effects of atmospheric thermodynamic stability are not considered. Ongoing research in the atmospheric boundary layer (ABL), including the marine ABL (MABL), shows that stability dramatically affects the shape of the wind profile. Other research indicates that the wind profile shape can deviate substantially from the conventional functional forms depending on the orientation of wind direction relative to ocean swell and whether a low-level jet, which is common in coast areas, is present. Additionally, there is virtually no information about turbulence at hub heights or the behavior of winds and turbulence during extreme weather conditions. Finally, the lack of data has precluded the comprehensive evaluation of the performance of regional weather forecast models used for wind predictions and for developing resource assessment maps for offshore wind energy.

To begin to remedy this lack of information offshore, the US Department of Energy's Office of Energy Efficiency and Renewable Energy (DOE-EERE) procured two AXYS Technologies, Inc. Wind Sentinel oceanographic buoys equipped with advanced scientific instruments. These buoys will provide data to better understand air-sea interactions and their impact on how much wind energy a turbine could capture at particular offshore sites, for a variety of research and development activities that are intended to accelerate the development of offshore wind plants in the U.S. The Pacific Northwest National Laboratory (PNNL)[1] is managing the buoys for DOE and will deploy one of the buoys off the coast of Virginia next to an area leased by Dominion from the Bureau of Ocean Energy Management (BOEM) for large-scale commercial offshore wind generation (**Figure 1**).

[1] This is a collaborative effort of PNNL's Fundamental and Computational Sciences Directorate, Richland, Washington and Energy and the Environment Directorate, Coastal Sciences Division, Marine Sciences Laboratory, Sequim, Washington

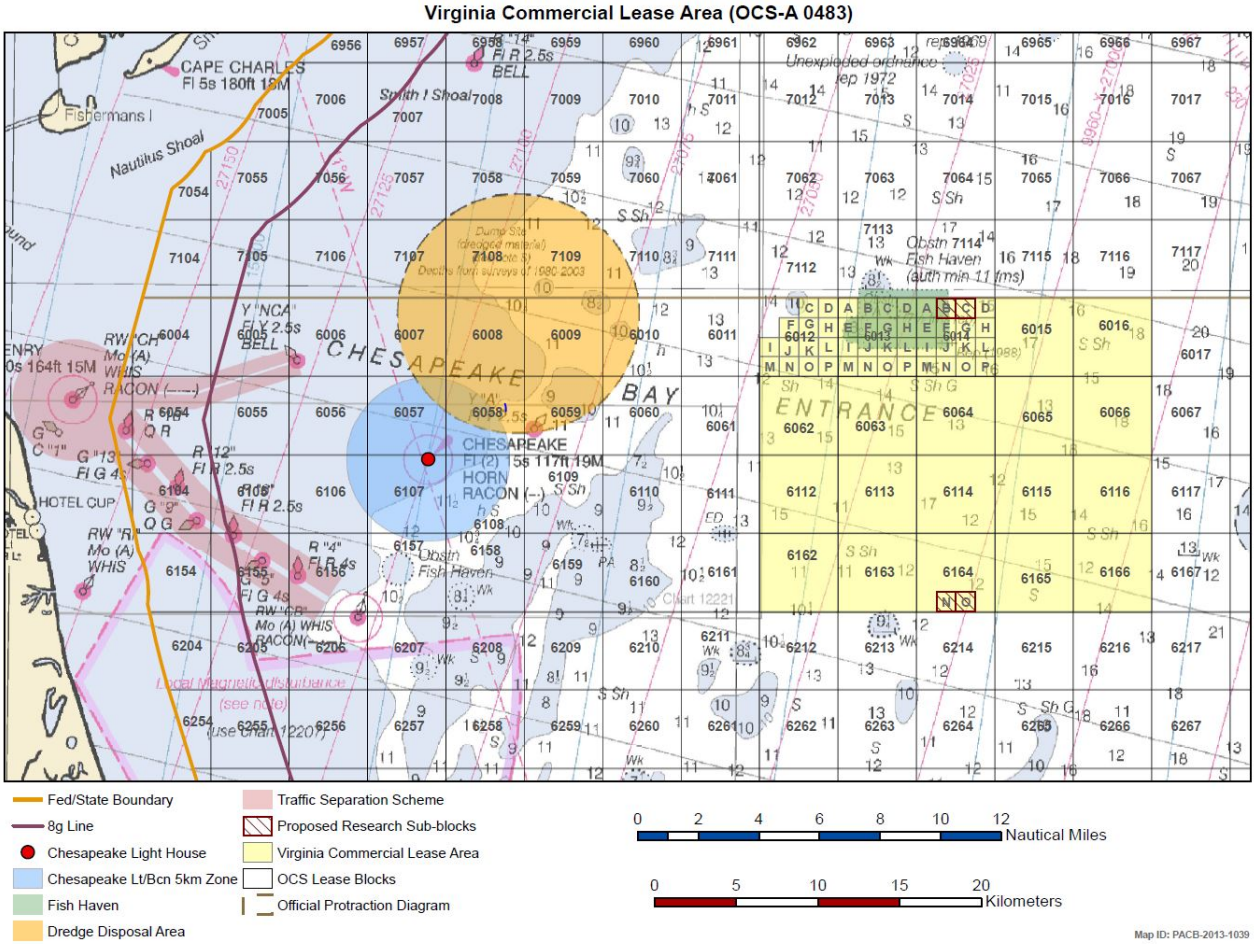


Figure 1. Dominion's Lease Area for Offshore Wind Energy Development

1.2. Deployment Location

The deployment location is approximately 52 km (28 nm) offshore from Virginia Beach, VA in less than 30 meters (m) of water (**Figure 2**). This is west of Dominion's lease block. The deployment location for the Wind Sentinel mooring anchor will be near 36° 52.008' N, 75° 29.532' W.

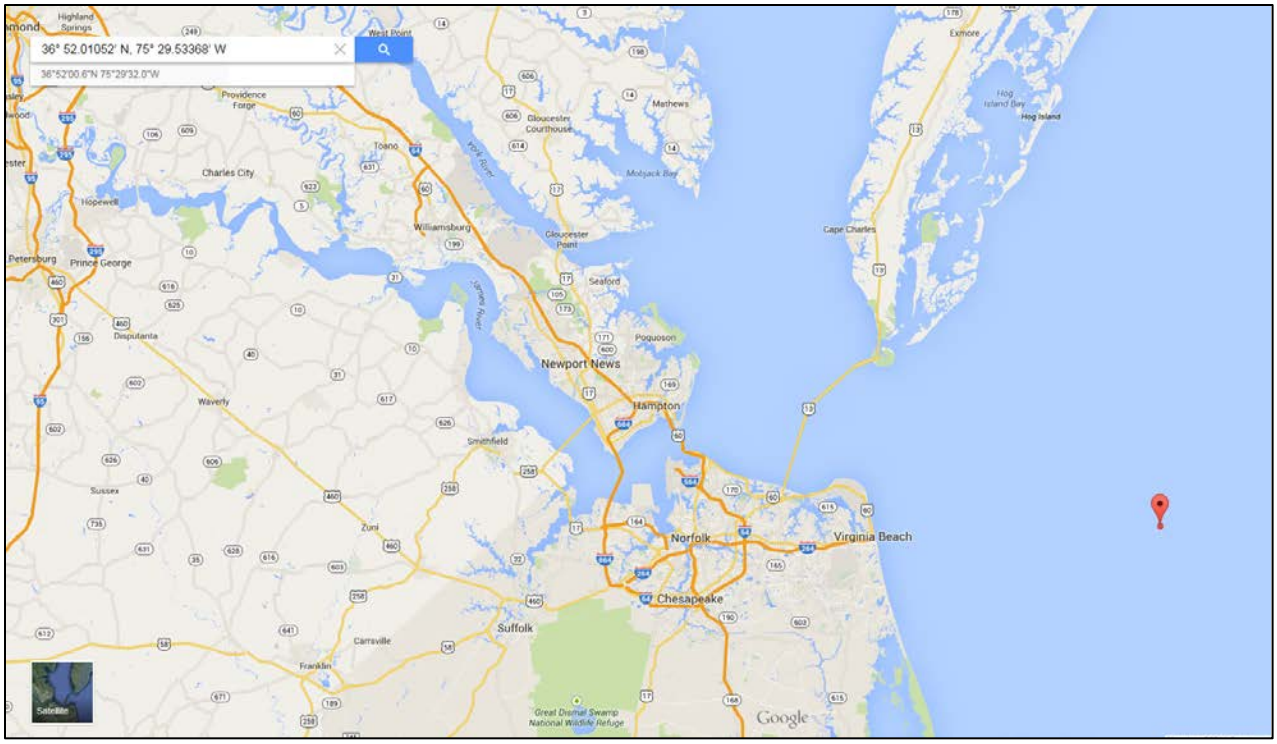


Figure 2. Approximate Buoy Deployment Location (Red Marker)

1.3. WindSentinel buoys

The WindSentinel buoys were manufactured by AXYS Technologies, Inc. in Sidney, British Columbia (**Figure 3**). The buoys utilize onboard meteorological instruments to measure wind speed and direction at multiple heights above the ocean, air and sea surface temperature, barometric pressure, relative humidity, wave height and period, water conductivity, and subsurface ocean currents. The buoys are disassembled (i.e., masts, railings, instruments and cabling are removed from the buoy) for long-distance transport and re-assembled at the deployment location by a team of trained PNNL researchers.

Figure 3. Wind Sentinel Buoy

The WindSentinel buoys incorporate a comprehensive set of atmospheric and oceanographic measurements needed for offshore wind resource characterization. The system provides flexibility for user definition and control of averaging intervals for all instrumentation. In general, observations will be recorded at the highest rate available for each instrument to allow maximum flexibility in subsequent analysis, though data transmitted will be less frequent than data stored on the buoy. In most cases, this is a sampling rate of at least once per second. The primary observational capabilities of the WindSentinel buoys are summarized as follows:

- Wind profile (six user-selectable altitudes to 200 m)
- Near-surface wind speed and direction
- Near-surface air temperature, humidity, and pressure
- Solar radiation
- Waves: Significant and maximum wave height, peak period, directional wave spectrum
- Surface water temperature
- Water velocity profile
- Water temperature and conductivity profile.

The above observations are recorded by the WindSentinel's data acquisition system and transmitted via satellite (low bandwidth) to the WindSentinel data archive at PNNL in near-real time. High-bandwidth data, such as the raw LiDAR data, may be retrieved during maintenance visits to the buoys because the distance from shore requires the use of satellite instead of cellular communications to communicate with the buoy.

1.4. Dominion Project Description

On September 4, 2013, Dominion obtained a lease from the federal government, through the Bureau of Ocean Energy Management (BOEM), to develop wind energy resources in a 456.5 km^2 region (**Figure 1**). In the coming decade, Dominion's intent is to install a 2,000 megawatt wind farm in this area. In support of this project, DOE has directed PNNL to deploy one WindSentinel buoy just west of Dominion's lease block and just south of Virginia Tech's Waverider buoy approximately 28 miles offshore of Virginia Beach, Virginia. The WindSentinel buoy will be placed approximately 600 meters away from the Waverider buoy so as to eliminate the potential for entanglement of the buoys' moorings while still providing the desired proximal location for collaborative data collection.

1.5. Personnel, Organizations, Roles, and Contact Information

All contact information for personnel at the PNNL, Axys Technologies, Cape Henry Launch Service, and Landstar Ranger trucking company, and the relevant organizational points of contact has been collated (**Table 1)**.

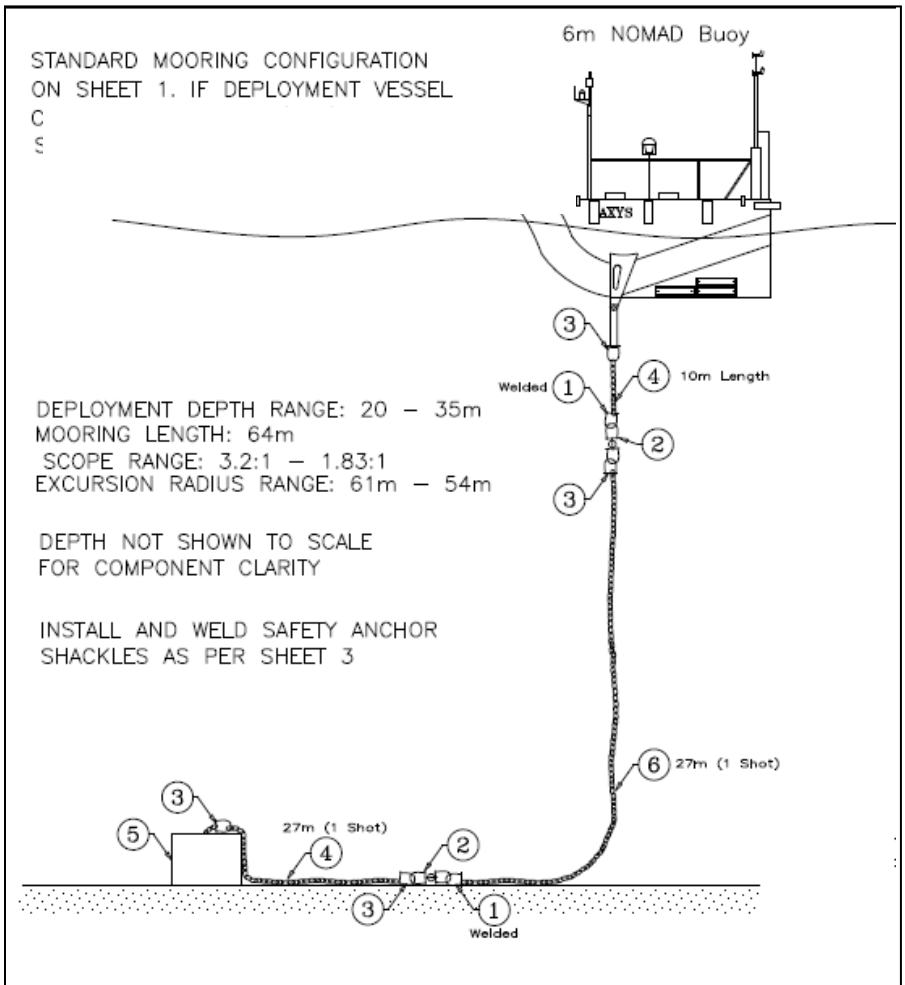
Table 1. Personnel, Organizations, Roles, and Contact Information. * = Staff member receives e-mail alerts from the buoy

Last	First	Organization	Role	Office	Cell	E-mail or Address (or Notes)
REDACTED		AXYS Technologies	Satellite Service Provider	*REDACTED*		
		AT&T Cellular	Cellular Service Provider			
		US Coast Guard	Local USCG response			
		US Coast Guard	Regional Rescue Coordination Center			
		Divers Unlimited	Dive Shop (compressed air, fills, visual inspections)			
		PNNL	Contracts			
		Cape Henry	Storage Location, Deployment, Retrieval (Marine Contractor)			
		PNNL	Safety & Health Representative			
		PNNL	Task Management			
		AXYS Technologies	Electronics Technologist			
		PNNL	Logistics			
		AXYS Technologies	Technical Services Lead			
		Platypus Marine	Point of Contact			
		PNNL	Data Management			
		PNNL	Data Management			
		NOAA	National Data Buoy Center			
		PNNL	Data Analysis			
		PNNL	Data Analysis/ Management			
		Landstar Ranger	Trucking Company			
		PNNL	Logistics, Buoy Maintenance			
		PNNL	Environmental Permitting			
		PNNL	Principal Investigator, Project Manager			
		PNNL	Logistics Team Lead			
		PNNL	Environmental Permitting Team Lead			
		PNNL	PNNL Data Management Facility Point of Contact			

2.0 Primary Project Components

2.1. Mooring Description

The mooring will be a standard, all-chain mooring with a concrete anchor, as shown in **Figure 4**. PNNL is providing a 58" diameter steel float marked with a U.S. Coast Guard approved yellow light to attach to the mooring should the LiDAR buoy need to be temporarily removed from its mooring mid-deployment (for scheduled maintenance or in the event of a hurricane or other contingency). Cape Henry Launch Service, the deployment contractor, will fabricate the mooring using components provided by PNNL from a previous deployment.



ITEM	PART No.	PART NAME	QTY
6	51708016	Material, Chain, 1–1/2", Stud Link Chain, Grade 2, Black	27m
5	7031	MET, Mooring, 4 Ton (Wet Weight), Concrete	1
4	51708003	Material, Chain, 1–1/2", Open Link Chain, Grade 2, Black/Galvanized	37m
3	51308052	Hardware, Shackle, USCG Spec, 1–1/2", Split Key Shackle, 3rd Class	4
2	51308026	Hardware, Shackle, Crosby, 1–1/2", Eye & Eye Swivel, Welded Nut	2
1	51308017	Hardware, Shackle, Crosby, 1–1/2", SCS, G2150	2

PARTS LIST

Figure 4. Virginia Mooring Design

2.2. Environmental Permitting

A number of environmental permits/authorizations/consultations are required to deploy the LiDAR buoy and mooring system. Each has its own conditions and requirements that must be met, including permitting agency notification at particular times throughout the project. *REDACTED* is PNNL's environmental primary permitting contact, and will work closely with the PNNL deployment team before, during, and after buoy deployment to ensure that permit conditions are met and permitting agency notifications are made (**Table 1** for contact information). **Table 2** provides a list of the permits/authorizations/consultations that have been obtained and completed for this project and the respective permitting agencies. A brief explanation of each permit/authorization/consultation follows. Permit compliance information, e.g., conditions, requirements, and notifications are provided in **Attachment 1**.

Permitting documents require a relatively specific location, not a general area. While the general location for deployment (Virginia) was selected in July, the actual location (e.g., coordinates) was not selected until September. Once the actual location was chosen, the timeframe for permitting was less than 3 months.

Table 2. Permits, Authorizations and Consultations Obtained and Completed for the Virginia LiDAR Buoy Deployment.

Permit / Authorization / Consultation	Agency
National Environmental Policy Act (NEPA) Project-Specific Categorical Exclusion	U.S. Department of Energy Pacific Northwest Site Office, NEPA Compliance Officer
Rivers and Harbors Act - Section 10 – Nationwide Permit 5 (NAO-2014-1957)	U.S. Army Corps of Engineers
Endangered Species Act – Section 7	NOAA Fisheries
Endangered Species Act – Section 7	U.S. Fish and Wildlife Service
Magnuson-Stevens Act – Section 305(b)(2)	NOAA Fisheries
Marine Mammal Protection Act	NOAA Fisheries
Private Aids to Navigation (PATON)	U.S. Coast Guard
National Historic Preservation Act – Section 106	Virginia State Historic Preservation Office

The Rivers and Harbors Act – Section 10 requires acquisition of a permit from the U.S. Army Corps of Engineers before building wharfs, piers, jetties, or other structures, or placing excavation or fill within navigable waters of the United States.

The Endangered Species Act – Section 7 requires that federal agencies evaluate the potential impacts of any action that they perform, fund, or permit on wildlife, fish, plant, and invertebrate species listed as endangered or threatened or any designated critical habitat for such species. Consultation with NOAA Fisheries and/or U.S. Fish and Wildlife Service is required if the action may affect listed species and/or designated critical habitat within the respective jurisdictions of these agencies. Note that authorizations from both agencies were obtained for the LiDAR buoy project.

The Magnuson-Stevens Fisheries Conservation and Management Act – Section 305(b)(2) requires that federal agencies consult with NOAA Fisheries on any action that may adversely affect essential fish habitat, which includes waters and substrate necessary for spawning, breeding, feeding, or growth to maturity.

The Marine Mammal Protection Act protects all marine mammals in U.S. waters. Consultation with NOAA Fisheries and/or U.S. Fish and Wildlife Service is required if an action may affect marine

mammal species within the respective jurisdictions of these agencies. Note that only an authorization from NOAA Fisheries was obtained for the LiDAR buoy project because only marine mammal species within its jurisdiction could be affected.

A Private Aid to Navigation (PATON) is a permit issued by the U.S. Coast Guard that requires individuals or organizations to mark privately owned marine obstructions in order to minimize hazards to marine navigation.

The National Historic Preservation Act – Section 106 requires federal agencies to evaluate the impact of federally funded or permitted projects on historic properties (buildings, archaeological sites, etc.) in consultation with State Historic Preservation Offices.

2.3. WindSentinel Buoy Communication Systems

The WindSentinel buoy is equipped with three communication options for transmitting status information and data to shore. One option is via a cellular network, i.e. that used by a cell phone. This is the preferred option, if service is available, because it is the cheapest, most reliable, and has the greatest bandwidth. This option will be used while the buoy is on land or close to shore prior to deployment at the planned location offshore. It will not be available at offshore positions. The other two options are via satellite: Inmarsat DataPro and Irridium. The primary satellite link is through Inmarsat DataPro service, the secondary link is Iridium. Both of these services are provided through AXYS. Of these satellite options, the iSatDataPro option is preferred because it supports more data transmission. Both satellite options are activated through a service agreement with AXYS. All three options remain active throughout the deployment and the onboard system uses whichever service is available to transmit status and data. The onboard system is configured to send certain messages over each of the communication links, in order to minimize the data usage of the satellite links while still providing sufficient status information.

2.4. Data and Buoy Alert Notifications, Monitoring and Management

The PNNL Data Management Facility point of contact is *REDACTED*, and Data Analysis points of contact are *REDACTED* and *REDACTED* (Table 1). The Logistics Team Lead is *REDACTED* and the Permits Team Lead is *REDACTED*. The notifications, monitoring and management are summarized in **Attachment 2**.

2.4.1. Implementation Schedule

Upon deployment of each LiDAR buoy, status monitoring systems will be implemented in three stages. First, the configuration of the Data Management System (DMS) notification system (AXYS software running on a PNNL server) will be developed through selection of pre-set options to meet the needs of the project, a relatively straightforward task. During the Virginia Beach pre-deployment testing in November-December 2014, both satellite and cell messages containing wind profile data and buoy status data are being transmitted to PNNL for the first time. Fewer data/messages are available over satellite link than over the cell connection. If necessary, the contents of messages transmitted via satellite link(s) may be adjusted to accommodate critical parameters. The DMS notification system will be configured to send out e-mails and/or SMSs when a critical parameter drifts beyond its normal operation range.

Second, the data and meta-data describing transmission of data will be examined via a set of scripts that will automatically plot most of the data that are collected, on a daily basis (5-10 day length-of-record plots). The summary statistics on data transmission (number of messages, measurements, etc.) can be examined for consistency with expectations for the performance of the instruments and of the overall system (e.g., the frequency of measurement, the quantity of data transmitted, etc.).

Third, once a substantial length of record (LOR) has been obtained (e.g., 1-2 mo), we plan to develop and implement another set of scripts to automatically monitor significant deviations from expected ranges in the data of interest for the program (e.g., wind speed, consistency of parameters within the dataset). However, some combinations of parameters require judgment to determine whether there is a problem requiring action, e.g., it is not as simple as a critical threshold that may be exceeded. Downloads from the DMS server intended for archiving and public release will be used once these are automated.

2.4.2. Classification of Monitoring Parameters

A set of warning-indicator monitoring parameters has been identified that includes the critical buoy status and function indicators (5), essential buoy and power generation functions (8), and important instrument/data function (3) (**Attachment 2**). The set of 22 parameters is separated into 3 categories based on the urgency of response, as follows:

1) Critical (potentially dangerous, i.e. complete buoy loss and/or navigation hazard): to be monitored automatically via DMS notification system; confirmed critical alarm condition most probably will require emergency or as-soon-as-possible (ASAP) buoy visit;
2) Essential (affect buoy performance and/or multiple data streams): to be periodically examined (each working day) using a set of automatically generated plots; confirmed essential alarm condition may require a special buoy visit;
3) Important (affect single data stream, potential loss or compromise of the data): to be periodically (each working day) examined using a set of automatically generated plots; important alarm condition may not require a special buoy visit, but may require a sensor replacement during next buoy visit.

It should be noted that we are designing the monitoring system in parallel with this communication, and so updates should be expected. This preliminary plan is based on experience with testing during the pilot deployment off Dungeness Spit, Washington and onshore pre-deployment at Virginia Beach, Virginia.

2.4.3. DMS Notification Programming

The DMS system provides flexible environment for notification management. A notification is defined via a notification profile, which specifies a set of conditions upon which an alert is generated, a list of recipients, and means of communication. Assessments of the conditions are based on the data parameters received from the buoy in the data messages. Specific sets of monitoring conditions and corresponding parameters requiring different levels of response have been compiled (**Attachment 2, Table 1A**.)

2.4.4. Data Flow and Automated Processing

The buoy and the DMS system maintain two-way communications via available telecommunication channels (cell modem, Iridium, and Inmarsat). The data collected are locally stored on the buoy (three CF cards for subsets of the data). Only a subset of the stored data (low temporal-resolution buoy status and data statistics) is transmitted to the DMS system using National Marine Electronics Association (NMEA) data messaging, an industry standard of communication for marine electronics. For example, all “CF errors” and “Free space” parameters are not available in the satellite data subset. The DMS system stores the received data in a database (controlled by a MS SQL server) and in local log files. We plan to implement automatic service that will extract the data via pre-defined data queries to the database server and store the data in a simplified format (ASCII) on a local server. The data stored on the local server will be accessed for automated processing and plotting to generate daily status reports (DSR). After every visit to the buoy, the DMS database is to be updated with the high-resolution data from the retrieved CF cards

and a copy of the data in a simplified format is to be created on the local server. Initially, the data from the local server will be accessible to local users; in the future, we plan to submit the meteorological and oceanographic data to a publically accessible archive provided by the EERE Atmosphere to electrons (A2e) Data Archive and Portal (DAP).

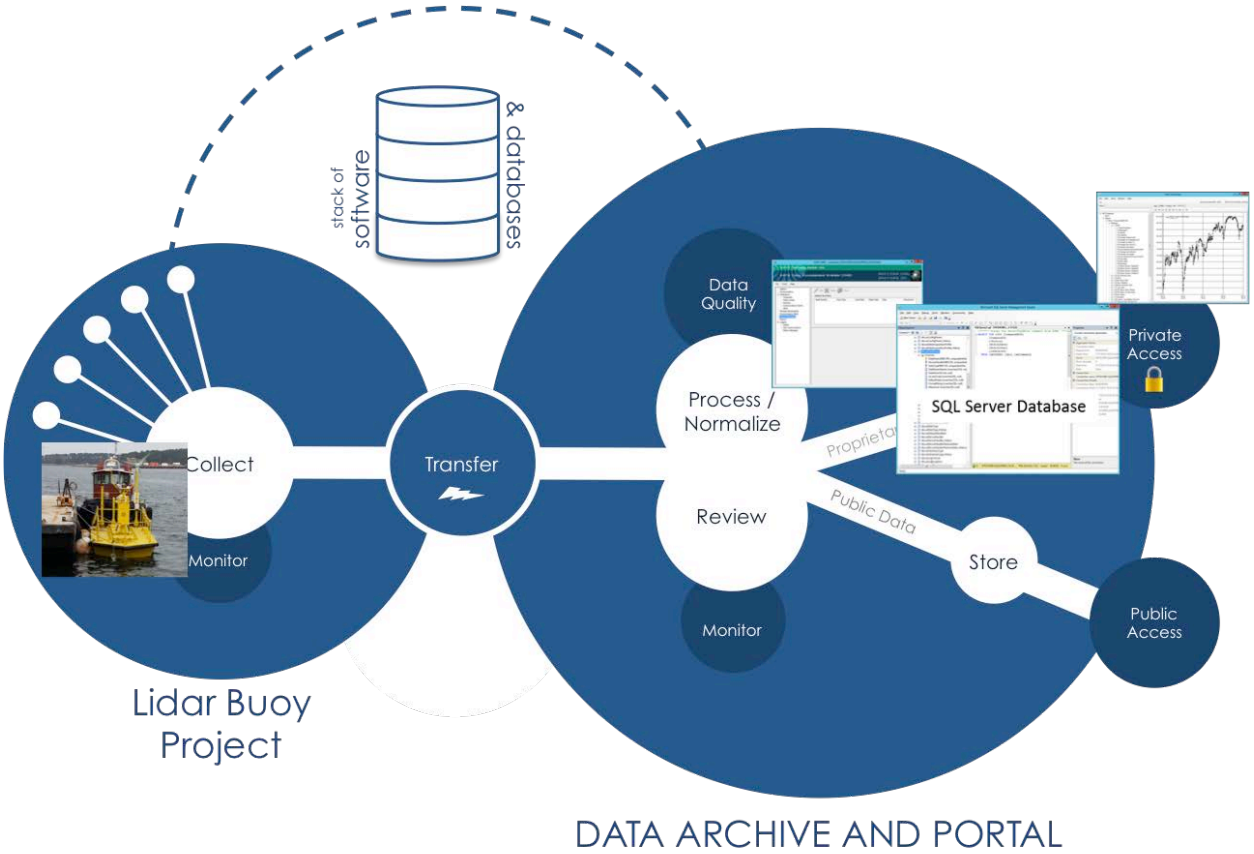


Figure 5. Flow Diagram for Data Collected at the Buoy. Data are transmitted to the A2e DAP, processed and archived

2.4.5. Key Monitoring and Reporting Roles and Responsibilities

Monitoring buoys for one year is a substantial undertaking requiring teamwork and relief for those on call. The lead scientists for first line of defense monitoring are *REDACTED*. *REDACTED* is responsible for development and daily review of the Daily Summary Report (DSR), and daily review of the DMS notifications. *REDACTED* is his delegate, responsible when *REDACTED* has pre-arranged relief. On weekends, *REDACTED* monitors DMS notifications by email and alerts *REDACTED*'s cell phone of out-of-range activity. Other scientists with significant subject matter expertise are part of the monitoring team: *REDACTED*. *REDACTED* is *REDACTED* delegate. The wind data summary will be reviewed weekly by *REDACTED*. When out-of-range activity occurs, all available members of the team will review data and determine the initial path forward. The problem, decisions and steps taken to resolve it will all be documented on the PNNL Confluence LiDAR Buoy collaboration site.

2.4.6. Action Plan

All notifications will be reported at the weekly team lead meeting. If a notification indicates an emergency response is needed, it will be reported within 24 hours to the following people: *REDACTED*.

Off-Position and/or significant Water Intrusion – 509-375-2400-PNNL 24 hour emergency line calls *REDACTED*. Conference call to discuss factors in emergency retrieval (e.g. weather and the direction and speed of buoy drift) and make a plan. Engagement of the National Data Buoy Center and the Coast Guard (contact information in **Table 1**) if circumstances make immediate effective response difficult.

Critical and Essential Buoy Functions, Status, Parameters - Evaluate impact and cross-check with other relevant information; if warranted, conference call to discuss possibility of service visit.

Essential Power Generation Parameters - Evaluate impact and cross-check with other relevant information; confirm and/or localize hardware failure; if warranted, conference call to discuss next step and/or service buoy visit.

Important Instrument/Data Functions - Evaluate possibility of hardware failure; if warranted, conference call to discuss next step; contingency plan to perform sensor replacement during next buoy visit.

3.0 Deployment Summary

Five months of advance preparation specific to the selected site were necessary to support the deployment of the buoy off Virginia Beach (**Figure 5**).

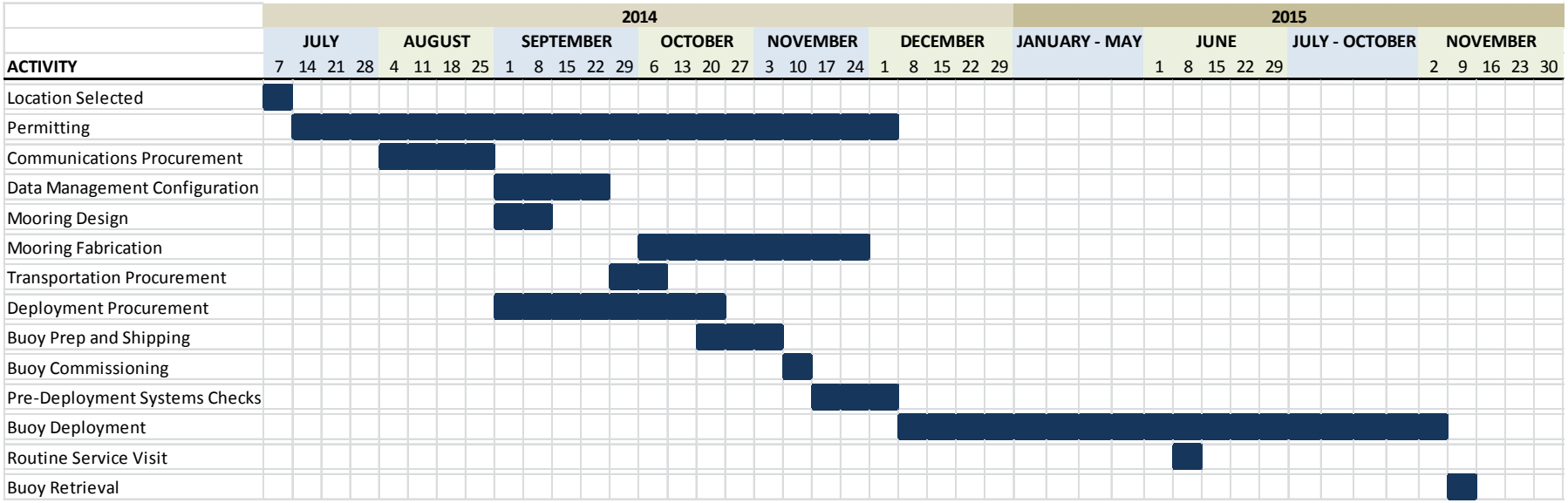


Figure 6. Deployment timeline.

3.1. Storage and Transportation

Platypus Marine, in Port Angeles, Washington, is the site at which the buoy was stored following the Dungeness Spit deployment and prior to the Virginia Beach deployment. In October 2014, the buoy was disassembled in Port Angeles, WA. Platypus Marine provided crane service to load the buoy onto a flatbed truck operated by Landstar Ranger trucking company (contact information in **Table 1**) for its transport to Virginia. All accessory materials were also placed on a truck for transport to Virginia Beach, VA (see schedule, **Figure 5**). The trucking company provided chain binders to secure the buoy to the truck. PNNL provided hardwood dunnage and aluminum plates for the buoy to sit upon. A tarp to cover the buoy during transport was not necessary. The shipment arrived in VA November 7, 2014.

3.2. Deployment Overview

Cape Henry Launch Services, Inc. (Cape Henry) was under contract to receive the buoy, mooring anchor, and accessories and set them up in secure storage in an industrial yard. They are also manufacturing the mooring system (**Figure 4**). Two days after buoy delivery to Virginia a team of three PNNL staff and one AXYS technician traveled to Virginia Beach and unpacked and reassembled the buoy (November 9-14, 2014). The instruments were powered on and began collecting data which is collected remotely. The instruments are being allowed to operate for several weeks on shore. Environmental permits were finalized by November 21, 2014. Once researchers are satisfied the buoy instruments are working properly, a smaller team will return to Virginia for deployment of the buoy offshore. This is expected to occur in early December 2014. Cape Henry will transfer the buoy to the water for at least 48 hours of in-water testing of the power system before towing it to the deployment location. The mooring will be deployed within the environmentally permitted area and the buoy will be attached to the mooring line. Final GPS coordinates for the mooring anchor will be captured at the time of deployment. PNNL staff will observe the deployment from the Cape Henry contracted vessel to document that it is performed according to plan.

Cape Henry will retrieve the buoy and mooring around November 2015. PNNL staff will travel to Virginia to disassemble the buoy and prepare it for transport to its next location.

3.3. Environmental Health and Safety

An Environmental Safety and Health Plan has also been developed for this task (**Attachment 3**).

3.4. Contingency Planning

We have developed cost estimates for the five possible contingencies that we can anticipate, and requested a contingency fund be made available in the event that any of them should occur and require immediate response.

1) System malfunction during deployment (to be fixed remotely)
2) System malfunction and/or eyes-on maintenance visit on the water
3) Emergency retrieval and repairs at shore
4) If mooring or other changes, reevaluate permits
5) Parts/Instrument Replacements

In the event that findings during the routine monitoring (See **Section 2.4**) leads to the possibility that one of these contingencies may occur, the following individuals will be immediately notified by the monitoring leads: *REDACTED*. See **Attachment 2** for further description of communications related to contingencies.

In case of any mid-year retrieval being required, contingency 3 will be implemented. In the case of an extreme weather event, PNNL staff will likely receive a call from Cape Henry saying a weather event is predicted that could affect the buoy. PNNL staff will make a decision to leave the buoy in place or have Cape Henry tow it to shore to prevent damage. PNNL staff is not expected to travel to the site.

3.5. Maintenance or Repairs

In the event the buoy requires unscheduled interim maintenance or repairs (based on notifications that critical or essential functions of the buoy have been compromised, see **Attachment 2**), the impacts to project costs, schedule, buoy integrity and staff safety will be considered in making a determination whether to visit the buoy at sea or bring it back to shore. At least two staff will travel to Virginia if maintenance or repairs must be performed on the buoy. Visits to the buoy at sea would use a Cape Henry small vessel during favorable weather conditions, to perform visual inspections of the buoy and to perform simple preventive maintenance activities and change out data storage devices (three CF cards). If necessary to perform unscheduled interim maintenance or repairs on shore, Cape Henry will be responsible for retrieving the buoy. PNNL staff will perform the maintenance and/or repairs on shore, and if time allows will accompany the Cape Henry boat to the deployment site again to ensure that the buoy is re-deployed properly.

3.6. WindSentinel Buoy Retrieval and Storage

Cape Henry will store materials at their secure industrial yard in a Conex container throughout the deployment period (e.g., marine float, ladder, tools that will be required for retrieval and disassembly). At time of buoy retrieval (estimated November 2015), staff will travel to Virginia Beach, Virginia. Cape Henry will tow the buoy to shore and set it on land at their secure industrial yard. The mooring system will also be retrieved by Cape Henry, although this may be performed separately. A team of four people will disassemble the buoy in Virginia Beach and prepare it for transport to its next destination. Cape Henry will provide crane service to lift the buoy and other heavy materials onto a transport vehicle (vehicle contracted separately).

Attachment 1: Environmental Permitting Conditions, Requirements, and Notifications

Vessel operators and crews must be briefed on the following requirements prior to deployment. The on-board PNNL representative shall assure that the crew is briefed on these requirements and shall have all crew members sign a roster indicating that they received the briefing.

Rivers and Harbors Act - Section 10 – Nationwide Permit 5 – US Army Corps of Engineers

Requirements from General Conditions applicable to all nationwide permits:

Discovery of previously unknown remains or artifacts – if cultural, historic, or archeological remains or artifacts are observed, avoid activities that may affect the resources and immediately notify *REDACTED* who will coordinate with the USACE District Engineer. (General Condition 21)

Compliance Certification - The corps must be provided with a signed certification documenting completion of the authorized activity – including removal of the anchor and mooring at the end of the deployment. Upon deployment the PNNL representative on board will document the buoy location coordinates. *REDACTED* will notify the ACE when the buoy is deployed with the final coordinates and will coordinate preparation of the compliance certification at the end of deployment. (General Condition 30)

National Historic Preservation Act Section 106 Compliance

Either the buoy deployment vessel or a support vessel will use its depth finder to scan the selected deployment site. The area should have a relatively flat sandy bottom. If depth anomalies are noted that could indicate the presence of a sunken vessel, the team shall move approximately 100 m from the anomaly to assure that the object is not damaged by the anchor or chain scour.

Endangered Species Act – Section 7 – NOAA Fisheries

Vessel Strike Avoidance

Operators and crews must maintain vigilant watch for cetaceans (whales and dolphins), pinnipeds (seals), and sea turtles and slow down or stop to avoid striking protected species.

Vessels ≥65 feet in length must operate at speeds of 10 knots or less November 1 through July 31, or at any time of the year within Seasonal or Dynamic Management Areas. Send a blank email to ne.rw.sightings@noaa.gov for an automatic response listing current SMAs and DMAs.

If cetaceans or sea turtles are observed, maintain the following separation distances:

Northern Right Whale -	500m (1640 ft)
Other whales	100 m (328 ft)
Dolphins	50 m (164 ft)
Sea Turtles	50 m (164 ft)

If one of these animals is sighted within the above limits the vessel must reduce speed and put engine in neutral until the animal has moved at least the listed stand-off distances and is not in the vessel's path. If

a whale is sighted and cannot be positively identified, the crew shall assume it is a right whale and maneuver to provide the 500 m buffer.

All sightings of ESA-listed species must be reported to NOAA – listed species most likely to be seen include the North Atlantic right whale, humpback whale, fin whale, and all species of sea turtles (green, Kemp's ridley, leatherback, and loggerhead). The PNNL representative on the boat will be responsible for noting the location and species (if possible to identify) and providing the information to *REDACTED*.

Vessel crews must report sightings of injured or dead marine mammals, sea turtles, or sturgeon within 24 hours, regardless of whether the injury or death is cause by the deployment vessel, use the NOAA Fisheries Hotline – 1-866-755-6622.

If injury or death was the result of a strike with the deployment vessel, the PNNL representative will notify, as soon as possible but within 24 hours, the NOAA Fisheries hotline – 1-866-755-6622, *REDACTED*, as well as 509-375-2400, the PNNL representative should be prepared to provide a photograph of the animal, the location (lat/long), name of vessel, and the species identification (if known) or description of animal.

Trash and Debris Awareness

All vessel operators, employees, and contractors must be briefed on marine trash and debris awareness and elimination, and all must be made aware of the environmental and socioeconomic impacts associated with marine trash and debris, and their responsibilities for assuring that none are intentionally or accidently discharged to the marine environment. NTL No. 2012-G01 (http://www.bsee.gov/Regulations-and-Guidance/Notices-to-Lessees/2012/2012-BSEE-G01-pdf/) may be used as guidelines for this awareness training.

Marine Mammal Protection Act (NOAA)

The ADCP is assumed to operate at 400 kHz. If it operates at a lower frequency, notify *REDACTED* as we may need to reconsider potential impacts to marine mammals.

Follow the avoidance measures listed under Endangered Species Act section to protect marine mammals.

Private Aids to Navigation (PATON) – U.S. Coast Guard

The PNNL on-board representative will record actual latitude / longitude of the buoy deployment and the date deployed. He/she will provide information to *REDACTED* who will transmit to USCG. *REDACTED* also will notify USCG at the end of deployment that the buoy has been removed.

Attachment 2: Data and Buoy Alert Notifications, Monitoring, and Management

Table A1. The monitoring schedule and reporting and maintenance plan for regular and unexpected LiDAR buoy requirements. Note: A daily summary report (DSR) of the buoy-generated monitoring data will be produced by an algorithm once daily and reviewed daily by the responsible scientists.

Instrument/ Equipment/ Function Name	**Monitoring Method (data source)**	**Monitoring Frequency/ Notification method**	**Indicator (Metric) of Maintenance Requirement** *(unit of measure)*	**All Direct Recipients of First-Stage Alerts or Reports (see list of initials below)***	**Consequences if Function is Lost or Reduced**	**Possible Repair or Replace at Sea?** (Y/N) M=maybe	**Required Response and Potential Outcome**
Critical Buoy Functions/Status/Parameters (potentially dangerous (hazard to navigation, loss of the buoy), requires emergency response)							
Off-Position	DMS Notification (WatchCircle Status in Message 10, Field 5 and/or Message 19, Field 5)	10 min Auto e-mail (SMS)	Current buoy position is outside of the Watchcircle Radius of 350 m	2400 number; Initials in this column *REDACTED*	Complete loss of the buoy. Hazard to navigation.	M	Critical. Immediate/emergency response required. Note: current discussions with Operations Ctr and Help Desk to determine viability of call to 2400
Water intrusion #1	DMS Notification (Water intrusion voltage (compartment 1), Message 8, Field 11 and/or Message 10, Field 7)	60 min Auto e-mail (SMS)	Water intrusion sensor voltage below the threshold (V)		Damage to the buoy electronics housed in the compartment 1; worst case scenario – complete loss of the buoy (sinking)	M	Critical, requires emergency response but may require buoy service visit
Water intrusion #2	DMS Notification (Water intrusion voltage (compartment 2), Message 8, Field 12 and/or Message 10, Field 8)	60 min Auto e-mail (SMS)	Water intrusion sensor voltage below the threshold (V)		Damage to the buoy power system and battery banks housed in the compartment 2; worst case scenario – complete loss of the buoy (sinking)	M	Critical, requires emergency response but may require buoy service visit

Instrument/ Equipment/ Function Name	Monitoring Method (data source)	Monitoring Frequency/ Notification method	Indicator (Metric) of Maintenance Requirement *(unit of measure)*	All Direct Recipients of First-Stage Alerts or Reports (see list of initials below)*	Consequences if Function is Lost or Reduced	Possible Repair or Replace at Sea? (Y/N) M=maybe	Required Response and Potential Outcome
Water intrusion #3	DMS Notification (Water intrusion voltage (compartment 2), Message 8, Field 13 and/or Message 10, Field 9)	60 min Auto e-mail (SMS)	Water intrusion sensor voltage below the threshold (V)		May be indication on damaged fuel tanks, housed in the compartment 3; worst case scenario – complete loss of the buoy (sinking)	M	Critical, requires emergency response but may require buoy service visit
Water intrusion #4	DMS Notification (Water intrusion voltage (compartment 4), Message 8, Field 14 and/or Message 10, Field 10)	60 min Auto e-mail (SMS)	Water intrusion sensor voltage below the threshold (V)		Damage to the diesel generator and/or starter battery, housed in the compartment 4; worst case scenario – complete loss of the buoy (sinking)	M	Critical, requires emergency response but may require buoy service visit
Essential Buoy Function and Power Generation Status/Parameters (critical to the buoy performance, affecting most of the measurements)							
Vindicator Sample Statistics	DMS Notification (Number of valid samples from range gate #1, Message TBD); Review DSR	10 min or 60 min Auto e-mail (SMS)	Number of valid wind measurement from Vindicator Range Gate #1 is below the threshold		Vindicator wind data could be compromised or lost	M	Critical, does not require emergency response but may require buoy service visit
Average Battery Voltage	DMS Notification (Average battery voltage, Message 20, Field 3 and/or Message 10, Field 6)	10 min or 60 min Auto e-mail (SMS)	Minimum and or average voltage of the battery system is below the threshold (V)		The buoy may stop normal operation, including data collection and communication	M	Critical, does not require emergency response but may require buoy service visit
Solar power generation	Review DSR	Daily on 5 business days/wk Manual e-mail	Average solar power consistent with measured solar radiation (Whr)		Diminished buoy power generation	M	Essential. No emergency response required; further monitoring/analysis of relevant data; plan for next buoy visit

Instrument/ Equipment/ Function Name	**Monitoring Method (data source)**	**Monitoring Frequency/ Notification method**	**Indicator (Metric) of Maintenance Requirement** *(unit of measure)*	**All Direct Recipients of First-Stage Alerts or Reports (see list of initials below)***	**Consequences if Function is Lost or Reduced**	**Possible Repair or Replace at Sea?** (Y/N) M=maybe	**Required Response and Potential Outcome**
Wind power generation	Review DSR	Daily on 5 business days/wk Manual e-mail	Average wind power consistent with measured wind speed (Whr)		Diminished buoy power generation	M	Essential. No emergency response required; further monitoring/analysis of relevant data; contingency plan for next buoy visit
Diesel Generator Error Code	Review DSR	Daily on 5 business days/wk Manual e-mail	Engine Failure Code not equal to 0		With no diesel generator buoy operation could be limited to several days; complete data outage, but no additional damage to the buoy hardware	M	Essential. No emergency response required; further monitoring/analysis of relevant data; contingency plan for next buoy visit. Buoy visit may be required in a few days.
Diesel Generator Engine Oil level	Review DSR	Daily on 5 business days/wk Manual e-mail	Engine Oil Level below the threshold or unexpected drop (%)		Diesel generator failure -- buoy operation could be limited to several days; complete data outage, but no additional damage to the buoy hardware	M	Essential. No emergency response required; further monitoring/analysis of relevant data; contingency plan for next buoy visit. Buoy visit may be required in a few days.
Diesel Generator Engine Fuel Level	Review DSR	Daily on 5 business days/wk Manual e-mail	Engine Fuel Level below the threshold or unexpected drop (%)		Diesel generator failure -- buoy operation could be limited to several days; complete data outage, but no additional damage to the buoy hardware Complications of possible diesel fuel spill in the compartment/outside.	M	Essential. No emergency response required; further monitoring/analysis of relevant data; contingency plan for next buoy visit. Buoy visit may be required in a few days.

Instrument/ Equipment/ Function Name	Monitoring Method (data source)	Monitoring Frequency/ Notification method	Indicator (Metric) of Maintenance Requirement *(unit of measure)*	All Direct Recipients of First-Stage Alerts or Reports (see list of initials below)*	Consequences if Function is Lost or Reduced	Possible Repair or Replace at Sea? (Y/N) M=maybe	Required Response and Potential Outcome
Diesel Generator Starter Battery Voltage	Review DSR	Daily on 5 business days/wk Manual e-mail	Engine starter battery voltage below the threshold (V)		Diesel generator failure -- buoy operation could be limited to several days; complete data outage, but no additional damage to the buoy hardware. Complications of possible gas by-products in the compartment	M	Essential. No emergency response required; further monitoring/analysis of relevant data; contingency plan for next buoy visit. Buoy visit may be required in a few days.
Important Instrument/Data Functions (affect one type of measurement, with potential compromise or loss of the data)							
Wind Speed	Review DSR	Daily on 5 business days/wk Manual e-mail	Wind speeds measured by different sensors are not consistent		Partial loss or compromise of wind speed data; worst case scenario – Vindicator failure	M	Important No emergency response required; cup anemometer replacement during next buoy visit or (worst case) Vindicator replacement
Wind Direction	Review DSR	Daily on 5 business days/wk Manual e-mail	Wind directions measured by different sensors are not consistent		Partial loss or compromise of wind direction data	M	Important No emergency response required; wind vane replacement during next buoy visit or (worst case) Vindicator replacement
Air Temperature	Review DSR	Daily on 5 business days/wk Manual e-mail	Air temperature are not consistent with temperatures measured by other sensors		Partial loss or compromise of air and dew point temperature data		Important No emergency response required; replacement of air temperature sensor during next buoy visit

* Names *REDACTED*

Attachment 3: Environment Safety and Health Plan

Date: 11/4/2014	**Author:** *REDACTED*
Project #: 65381	**Project Title**: Lidar Buoy 120 VA Mobilization & Deployment, Eyes-on Checks, De-mobilization

Describe Activities: *(Describe the work and general activities to be performed. It is allowed to reference or attach other detailed descriptions. Use sufficient detail to fully assess risk sources [hazards])*

Three PNNL staff members and one AXYS Technician will unpack and put together LiDAR Buoy 120 at Cape Henry Launch Services, Inc. in Virginia Beach, Virginia prior to deployment. Current plans: staff will travel to Virginia on Sunday November 9, 2014; work Monday through Thursday; and travel home on Friday November 14, 2014. The buoy will be left in operational mode at Cape Henry Launch Services for several weeks to make sure that the instruments are collecting data, that it is realistic, and that PNNL staff are able to access buoy data and functions remotely. Once environmental permits are in place following the Thanksgiving holiday, two PNNL staff will return to Virginia Beach for the actual deployment of the mooring and buoy. They will be aboard a contracted vessel to answer questions, to ensure the mooring is deployed in the correct geographical area, and to perform any last-minute adjustments at sea following the deployment. Depending on the configuration of the tow, PNNL staff may need to board the buoy after the deployment is complete (assuming the sea state makes it safe to do so) to turn on the wind turbine and/or adjust the solar panels to the proper angles. PNNL staff will follow all safety protocols and wear appropriate personal protective equipment (e.g., PFDs) and will not work beyond their own level of training.

During the deployment, staff may visit the buoy using a chartered vessel contracted through Cape Henry Launch Service to check on the buoy, perform basic maintenance or repairs, and change out CF cards, etc. There is a contingency plan to tow the buoy to shore for repairs or to weather a severe storm if needed. PNNL staff will not be involved with the on-water work in that case, but could have to work on the buoy on land or while it is moored at a marina.

At the end of the deployment period, Cape Henry will tow the buoy to shore and bring back the mooring anchor as well. PNNL staff will be on hand to disassemble the buoy and pack up instruments, etc., getting it ready to place on a truck for transport to its next destination. Any hoisting and rigging will be performed by a contractor.

Work Location(s): 1) Cape Henry Launch Services, Inc. 2377 Ferry Road, Virginia Beach, Virginia 23451. contact information *REDACTED*

Risk Sources:			
	☒ Electrical hazards	☒ Vehicles / trailers	☐ Excavation / drilling
☐ Basic lab work	☐ Tools / machines	☐ Off-road vehicles	☐ Fatigue / physical stress
☒ Basic field work	☒ Manual lifting	☒ Boats / water hazards	☒ Weather or temperature extremes (thermal stress)
☐ Chemical	☒ Hoisting and rigging	☐ Diving underwater	☐ Hazardous activities nearby
☐ Special chem (Be, PCBs, Pb, asbestos,	☐ Work at heights		

nanoscale) ☐ Biological ☐ Radiological ☒ Lasers/ magnetic field / NIR (RF) ☒ Pressure, vacuum or compressed gas system ☐ Other risk sources:	☒ Confined space ☒ Industrial site ☒ Noise ☐ Erecting structures ☐ Hot work (welding) ☐ Working alone ☐ Firearms / weapons	☐ Aviation ☐ Human subjects ☐ Research animals ☐ Hazardous plants / animals ☐ Air emissions	☐ Travel security concerns ☐ Security (physical, info) ☐ Transport hazardous mat'ls ☐ Solid or liquid waste generation / treatment / disposal

Risk Analysis:

The level of risk is moderate, but all hazards can be mitigated to acceptable levels. Tailgate safety briefings will be held to go over safety concerns each day and people working on field aspects of the project will read this document and sign off that they understand it and will follow these guidelines.

The PNNL staff and AXYS Technician who will assemble the buoy are familiar with them and have performed most of the tasks before, either in training at AXYS, while the buoys were at John Wayne Marina and were deployed at Dungeness Spit, WA, or at Platypus Marine where two buoys were retrieved from the water and disassembled.

Risks are associated with working at the Cape Henry Launch Services site in an industrial area and accessing equipment inside the buoy's four hatches. There may be hoisting and rigging activities or heavy machinery working nearby on the industrial site. PNNL staff will obtain an on-site safety briefing from Cape Henry staff before beginning work at their site.

During deployment there are risks associated working near water, on the contracted vessel, and boarding the buoy at sea. A float plan will be filed according to HDI and PNNL staff will check in with a shore contact upon their return to shore. PFD's will be worn at all times when on the water. Weather forecasts (marine forecast) will be checked prior to heading offshore and the trip will be postponed if the captain or PNNL staff feels conditions are too questionable and would put the crew or buoy deployment at risk.

Staff will not work outside their training or comfort zone. All staff have the ability to stop work at any time if they feel what is happening – or about to happen – is unsafe.

Risk Source Management: *(For each activity list specific risk sources of concern and mitigation methods. Please reference HDI and project-specific controls in the Risk Controls/Mitigation column.)*

Specific Activity	Risk Source(s)	Risk Controls / Mitigation
Working at Cape Henry Launch Services, Inc.	Basic field work	Staff will hold a safety briefing before work begins at Cape Henry. Staff will be briefed on PPE required for the work ahead. Staff will remain vigilant and watch out for one another's safety. Anyone can call "stop" if they feel an activity is unsafe or outside their comfort zone.

Operating the Vindicator LiDAR	Lasers/ magnetic field / NIR (RF)	The Vindicator LiDAR is a Class 1M laser product. It is labeled, “Avoid Exposure. Invisible laser radiation is emitted from apertures. Do not view directly with optical instruments (binoculars or telescopes).” The lasers are installed above eye-height on the buoy and point skyward. Staff will not look directly into the apertures while the unit is powered on.
Changing compressed air tanks	Pressure, vacuum or compressed gas	Two empty SCUBA tanks were shipped to Virginia. These will be taken to a local dive shop where a visual inspection of the interior will be performed prior to filling them with air. The tanks will be installed on the buoy. This action does not require lock and tag according to HDI (changing tanks). They will be secured in the vehicle during transport to/from the dive shop. They are Aluminum 80 cu ft tanks rated for 3000 psi (standard off-the-shelf SCUBA tanks with DIN valves).
Accessing the electrical panel and battery banks inside Hatch 2	Electrical hazards	Hatch 2 on the buoys contains 40 Sunlyte 12-5000x sealed, rechargeable lead acid batteries. AXYS does use a solid-state battery charger / regulator to optimize power and prevent over-charging. The entire battery/charging system is limited to 24 volts DC. Inspection showed no arc-flash hazard. Physical guards will be installed by a qualified electrical worker as soon as those details are worked out (currently working with Electrical Safety SMEs in Richland). Until the guards are in place, only qualified electrical workers (e.g., *REDACTED*) will be allowed in that hatch at this time.
Lifting and carrying heavy scientific instruments or other objects.	Manual lifting	To prevent back injury, in general, individuals should not attempt to lift loads of 50 pounds or more without the assistance or appropriate lifting equipment. The following recommendations should be considered when lifting or preparing to lift a heavy load: • Split heavy loads into smaller loads, and reduce the size of individual loads • Bring the load close to the body. • Remove any horizontal barriers. • Avoid lifts near the floor or ground surface. • If loads near the floor or ground surface cannot be avoided, the load should fit easily between the legs. • Raise/lower the origin/destination of the lift. • Reduce trunk rotation by rotating the feet.

		• Reduce the lifting frequency and duration. • Provide longer recovery periods. • Use mechanical lifting aids whenever possible. • Have someone assist with the lift, especially for heavy or awkward loads. • Make sure the path of travel is clear prior to the lift. • • Use carts or other methods of transporting heavy objects when possible.
Accessing the four hatches on top of the buoy	Confined Space	The Lidar buoys have four hatches on top that contain instrumentation (Hatch 1), 40 Sunlyte 12-5000x sealed, rechargeable lead acid batteries (Hatch 2), diesel fuel tanks (Hatch 3), and an onboard generator (Hatch 4). The staff traveling to Cape Henry have received training on confined space access and proper buoy air testing, monitoring, and purging procedures during the Acceptance Testing at John Wayne Marina in Sequim (from AXYS and Mike Fullmer- ES&H at PNNL). Special note: batteries in confined spaces can be hazardous under certain circumstances (e.g., http://maritimeaccident.org/2013/02/beware-the-buoy-bomb-bird-droppings/). Staff will read the accident report (URL above) as a lessons-learned.
Working at Cape Henry; Moving buoy from dry land to the water and back again.	Hoisting and rigging Example above of how this buoy should be lifted.	All hoisting and rigging (and blocking) activities will be performed by Cape Henry and PNNL staff will only observe and provide advice. Proper PPE for the activities will be worn when additional protection from mechanical or physical hazards is necessary (e.g., hard hats and impact resistant safety shoes meeting the requirements of ANSI Z41 standards would be worn.) PNNL staff should inspect blocking before boarding the buoy on land for the first time (each time it is relocated on land).
Generator operation	Noise	Noise levels have not been measured, but because it is possible that the generator, while operational, could be above threshholds for working without ear protection, hearing protection will be available to those working on the buoy.

Working at the Cape Henry site around open hatches and other equipment on top of the Lidar buoy	Trip / fall	There are 4 hatches on each buoy that are typically 36 x 37 inches. When open, they create a trip/fall hazard as well. Railings are installed along the outside of the buoy to prevent falls into the water or onto the ground, but there are no barriers present to prevent falls into an open hatch other than the raised lids and a raised (~4-inch) lip around each hatch opening. When not being accessed, covers will be closed. The deck is non-skid material. Staff will be aware of their surroundings and be cognizant of trip/fall hazards if they perform work on top of the buoy.
Operating, maintaining, or trouble-shooting onboard equipment.	Tools / machines	PNNL staff will follow all standard safety procedures and wear appropriate PPE when using tools or machinery at the Cape Henry site.
Staff will drive personal vehicles to airports and rental vehicles in Virginia.	Vehicle Use	• Perform operator check before driving (to include; brakes, tires, horn, lights, wipers, defrost, turn signals, mirrors, etc.). • Correct if not operating properly. • Follow principles of defensive driving at all times. • Obey all posted speed limit and directional signs. • Obey State and Federal Vehicle Operating Rules and Regulations. • Report incidents to 509-375-2400
Working on a Contracted Vessel	Boats / Water Hazards	• Follow the instructions of the captain and crew. Get a safety tour before getting underway (include man-overboard, and access to survival suits [if the right time of year]). • File a float plan per HDI requirements • Wear PFDs while on the water. • Stay alert to weather bulletins and changing environmental conditions. • Be aware of CO emissions when the boat is idling for any length of time to avoid over-exposure • Be prepared for offshore conditions (take seasickness medication BEFORE leaving shore, if it may be needed) • NOTES – the captain reports the vessel does have an EPIRB and satellite phone.
Field Work	Fatigue / physical stress	Often when working offsite, long hours are spent performing physical labor out-of-doors. PNNL staff will watch one another to help prevent inattentiveness, distraction, fatigue, or lack of communication or coordination that can be a precursor to physical injury. Some specifics include:

		• Conduct pre-work meetings at the job site. Take breaks as needed. • Ensure proper safety equipment is available. • Discuss questionable situations with supervisor and/or co-workers. • Remove yourself or others from hazardous areas as appropriate. • Understand heat stress symptoms and be aware of your own and co-workers' physical/emotional state. • Stretch or rest before and during strenuous activities.
Working outside	Weather or temperature extremes (thermal stress)	The buoy will be on land for assembly but will be outside where staff working on them will be exposed to outside air temperatures and possibly rain and wind (though a tent or carport-like shelter may be utilized). Staff may be on an open deck at sea depending on the vessel utilized. Staff will dress appropriately for the weather (e.g., layers, warm hats, gloves, rain gear, ettc.) and will be able to find shelter in one of the Cape Henry buildings or in a vehicle if necessary to warm up or dry off. It is also possible it could be warm outside. Again, staff will dress appropriately and will carry food and water to the site to stay fed and hydrated.
Emergency Response: *(Identify general and site-specific requirements.)*		• In Virginia dial 9-1-1 for emergency service (fire, medical, law enforcement) • There are currently 20 urgent care centers in Virginia Beach. One of the closest to Cape Henry is: I&O Medical Center, 1290 Diamond Springs Rd, Virginia Beach, VA 23455, (757) 460-0700. iandomedical.com • The nearest hospital is Sentara Virginia Beach General Hospital, 1060 Colonial Rd, Virginia Beach, VA 23454 (757) 395-8000 (Emergency Department = (757) 395-8890). • An alternate emergency contact at PNNL would be the Building Emergency Director at the MSL, *REDACTED*.

Approval: *(Consult with the project management office director to identify the required approvers.)*

Role	Name	Signature	Date
Task Manager	*REDACTED*		
S&H Rep			
ECR			
Operations Manager			

Principal Investigator/ Project Manager			
Program Management Office Director			

Authorized Workers

I have read the Off-Site Risk Management Plan, understand the risk sources (hazards) and controls associated with this work, and will implement the controls as indicated. I will inform the activity lead if there are changes to the risk source or if the controls appear to be inadequate.

Print Name	Signature	Date
REDACTED		