Ocean Wind
An Ørsted Initiative

Ocean Wind LLC

Ocean Wind Offshore Wind Farm Project

Site Assessment Plan

Submitted to the Bureau of Ocean Energy Management

September 15, Revised November 9, 2017, January 10, 2018, and February 23, 2018

Prepared by Tetra Tech, Inc.

Prepared	Scott Lundin, Janelle Lavallee (Tetra Tech ltd) 09 January 2018
Checked	Marcus Cross, Charles R Scott (Orsted) 09 January 2018
Accepted	Marcus Cross 10 January 2018 / 23 Feb 2018
Approved	Pernille Hermansen (Orsted) 10 January 2018 / 23 Feb 2018
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Acronyms and Abbreviations

AXYS	AXYS Technologies Inc.
BMPs	best management practices
BOEM	Bureau of Ocean Energy Management
CFR	Code of Federal Regulations
CMECS	Coastal and Marine Ecological Classification Standard
COP	Construction and Operations Plan
CVA	Certified Verification Agent
ESA	Endangered Species Act of 1973
FLIDAR	Floating Light Detection and Ranging
ft	feet
GHG	greenhouse gas
Ha	hectare
HAP	hazardous air pollutant
HRG	High Resolution Geophysical
HSE	health, safety, and environmental
kg	Kilogram
lb	Pound
Lease	Commercial Lease of Submerged Lands for Renewable Energy Development on the Outer Continental Shelf (OCS-A 0498)
m	meter

MID-ATLANTIC EA	*Revised Environmental Assessment of Commercial Lease Issuance and Site Assessment Activities on the Atlantic Outer Continental Shelf Offshore New Jersey, Delaware, Maryland, and Virginia*
Met Buoys	Two AXYS Technologies WindSentinel™ FLIDAR Buoys and one TRIAXYS Wave and Current Buoys, to serve as the proposed meteorological and metocean data collection technologies
MLLW	mean lower low water
MMPA	Marine Mammal Protection Act of 1972
MPDC	Mandatory Project Design Criteria
NAAQS	National Ambient Air Quality Standard
NHPA	National Historic Preservation Act of 1966
NMFS	National Oceanic and Atmospheric Administration, National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
NO_x	nitrogen oxides
NTL	Notice to Lessees
O_3	ozone
OCS	Outer Continental Shelf
OSRM	Oil Spill Response Measures
PATON	Private Aids to Navigation
PM_{10}	particulate matter less than 10 microns in diameter
$PM_{2.5}$	particulate matter less than 2.5 microns in diameter
SAP	Site Assessment Plan
SO_2	sulfur dioxide
TRIAXYS Buoy	TRIAXYS Wave and Current Buoy
U.S.C.	United States Code
USCG	United States Coast Guard
VOC	volatile organic compounds
WatchMan™	WatchMan™ 500 controller
WEA	Wind Energy Area

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1. Introduction

Ocean Wind LLC has prepared this Site Assessment Plan (SAP) in support of the installation and operation of two floating light and detection ranging buoys (FLIDARs) and one metocean/current buoy to be located within Official Protraction Diagram Wilmington NJ18-02, Blocks 7081 and 6986 (Installation Areas; see Figure 1-1). Ocean Wind LLC has selected the AXYS Technologies Inc. (AXYS) WindSentinel™ FLIDAR and TRIAXYS Wave and Current Buoy (TRIAXYS Buoy) (collectively referred to as the Met Buoys) as the proposed meteorological and metocean data collection technologies, respectively. The TRIAXYS buoy deployment is not currently anticipated, but included as a contingency. The Installation Areas are contained within the Ocean Wind Offshore Wind Farm Lease Area[1] as defined under the Commercial Lease of Submerged Lands for Renewable Energy Development on the Outer Continental Shelf (OCS-A 0498) (Lease). The Lease was issued to RES Americas Development Inc. on February 4, 2016, with an effective date of March 1, 2016. RES Americas Development Inc. subsequently assigned the lease to Ørsted on May 10, 2016. On February 14, 2017, Ørsted requested a 12-month extension of the Preliminary Term of the Lease from the Bureau of Ocean Energy Management (BOEM), which was approved on March 1, 2017 extending the Preliminary Term from March 1, 2017 to March 1, 2018 (see Appendix A).

This SAP has been prepared in accordance with 30 Code of Federal Regulations (CFR) §§ 585.606, 610, and 611 (see Table 1-1), the Guidelines for Information Requirements for a Renewable Energy SAP issued by BOEM on February 24, 2016, and in accordance with the stipulations of the Lease (see Table 2-2).

Prior to installation of the Met Buoys, Ocean Wind LLC will obtain all required permits and approvals from various jurisdictional agencies as identified in Table 1-2. Ocean Wind LLC will include copies of the final agency authorizations as part of the SAP (see Appendix A). Copies of agency authorizations will also be provided to BOEM prior to the initiation of SAP activities to begin no earlier than November 2017. All installation, operation, and decommissioning activities will be conducted in compliance with any additional requirements stipulated in the final permits to be issued by other regulatory agencies.

The Met Buoys described in this SAP will collect wind resource and metocean data to support development of the Lease Area.

1.1 Authorized Representative and Designated Operator

As the lease holder, Ocean Wind LLC, by default, is also the lease operator. Ocean Wind LLC proposes to have AXYS serve as the contracted operator for the met buoys. The contact information for AXYS's Authorized Representative is as follows:

Name of Authorized Representative	Devon Harris
Title	Project Manager
Phone Number	+12505075325
Email	dharris@axys.com
Address	2045 Mills Road, Sidney, BC V8L 5X2, Canada

[1] The Lease Area is defined by *Addendum A of BOEM Lease No. OCS-A 0498, Section II. Description of the Lease Area*. The total acreage of the Lease Area is approximately 160,480 acres. The Lease Area is depicted in its entirety on Figure 1-1 of this SAP.

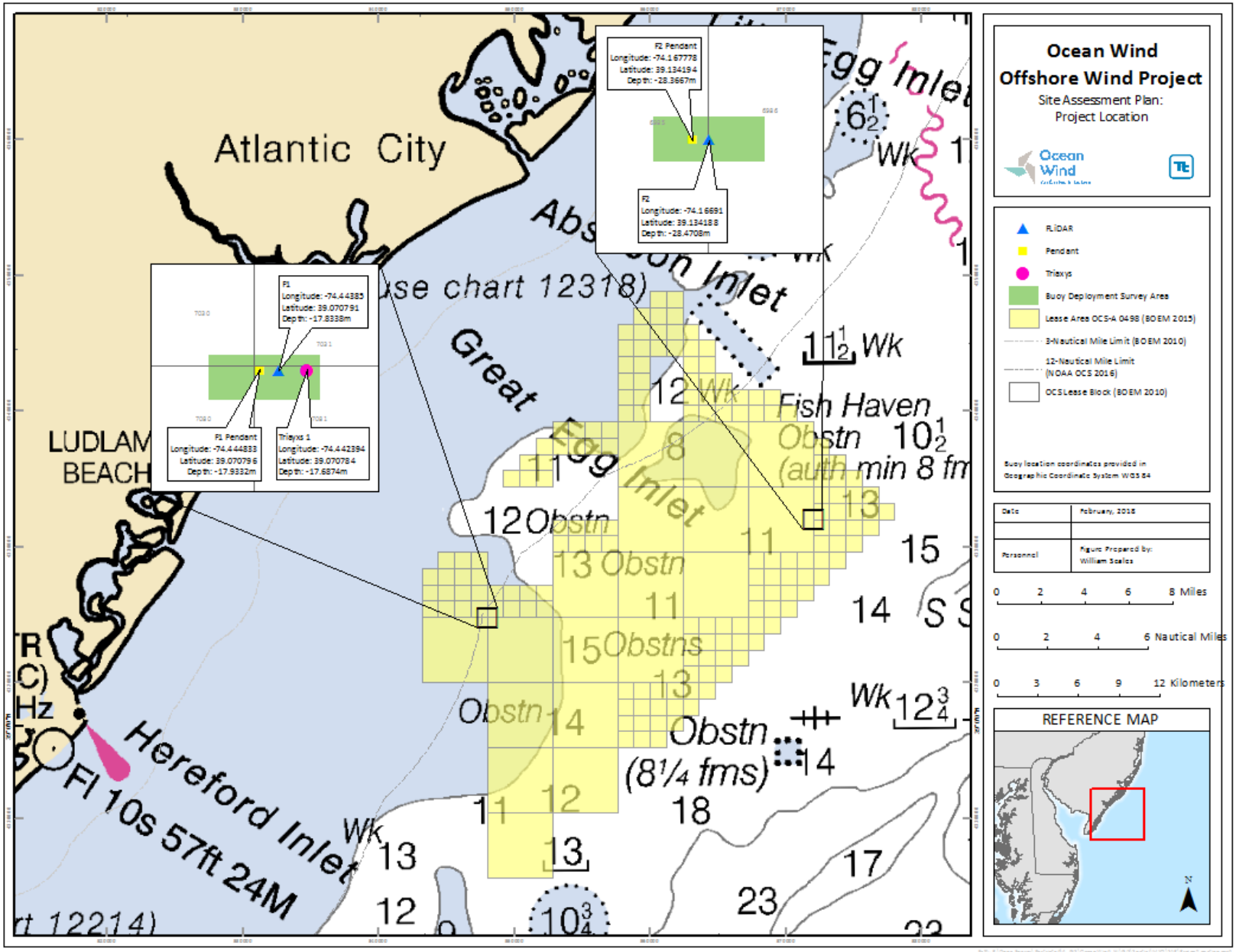

Figure 1-1 Site Assessment Plan Buoy Deployment Areas

Table 1-1 Site Assessment Plan Requirements for Commercial Leases Pursuant to §585.105(a), 606(a), 610(a) and (b), and 611(a) and (b)

Requirement	Compliance Statement
§ 585.105(a)	
1) The design of the environmental monitoring buoy and conduct of planned activities ensures safety and will not cause undue harm or damage to natural resources and will take measures to prevent unauthorized discharge of pollutants into the offshore environment.	Ocean Wind LLC will comply with this requirement, as evidenced in this SAP.
§ 585.606(a)	
1) The Project will conform to all applicable laws, regulations, and lease provisions.	Ocean Wind LLC will comply with this requirement. See Table 1-2, Table 1-3, Table 2-2, Table 2-2, and Appendix A.
2) The Project will be safe.	Ocean Wind LLC will comply with this requirement. Specifically, see Section 4.8.
3) The Project will not unreasonably interfere with other uses of the Outer Continental Shelf (OCS), including national security or defense.	Ocean Wind LLC will comply with this requirement. See Table 2-2 for specific activities to ensure compliance.
4) The Project will not cause undue harm or damage to natural resources; life; property; the marine, coastal, or human environment; or historical or archeological resources.	See Section 7 for an analysis of site characteristics and for avoidance and mitigation measures.
5) The Project will use best available and safest technology.	Ocean Wind LLC will comply with this requirement. See Section 3.1 and Appendix B for a description and technical specifications on the selected Met Buoys
6) The Project will use best management practices.	Ocean Wind LLC will comply with this requirement. Best management practices are described in Table 1-3, Sections 4, 5, 6, and 7.
7) The Project will use properly trained personnel.	Ocean Wind LLC will ensure that all personnel meet the company's standard technical as well as health, safety, and environmental (HSE) standards for the work being conducted.
§ 585.610(a)	
1) Contact Information	Julian Ralf Jensen Measurement Engineer +4599556187 julje@orsted.co.uk 5 Howick Place, Westminster, SW1P 1WG, London, United Kingdom
2) Site assessment concept	Meteorological, metocean, and biological data collection using two FLIDAR WindSentinels™ and one TRIAXYS Buoys.
3) Designation of operator	Not applicable. See Section 1.1
4) Commercial lease stipulations and compliance	See Table 2-2.
5) A location plat	See Figure 1-1.
6) General structural and project design, fabrication and installation information	See Sections 3, 4, and 5.
7) Deployment activities	See Section 4.
8) Measures for avoiding, minimizing, reducing, eliminating, and monitoring environmental impacts	This SAP has been prepared in accordance with the Commercial Wind Lease Issuance and Revised Environmental Assessment for Commercial Wind Lease Issuance and Site Assessment Activities on the Atlantic Outer Continental Shelf Offshore New Jersey, Delaware, Maryland, and Virginia (Mid-Atlantic EA), and Stipulations in the Commercial Lease. Specific efforts to avoid, minimize, reduce, eliminate, or monitor environmental impacts can be found in Sections 4 and 7. Conformance with the Mid Atlantic EA is detailed in Section 2
9) Certified Verification Agent nomination	Not applicable. See Section 1.2.
10) Reference information	See Section 8.
11) Decommissioning and site clearance procedures	See Section 6.

Table 1-1 Site Assessment Plan Requirements for Commercial Leases Pursuant to §585.105(a), 606(a), 610(a) and (b), and 611(a) and (b)

Requirement	Compliance Statement
12) Air quality information	See Section 7.7 and Appendix I.
13) A listing of all federal, state, and local authorizations or approvals required to conduct site assessment activities on your lease	See Table 1-2.
14) A list of agencies and persons with whom you have communicated, or with whom you will communicate, regarding potential impacts associated with your proposed activities	See Appendix A.
15) Financial assurance information	To be provided by Ocean Wind LLC prior to initiation of installation activities, if requested.
§585.610(b)	
Geotechnical	
(i) A description of all relevant seabed and engineering data and information to allow for the design of the foundation for that facility	Section 7.1, Appendix C
Shallow Hazards	
(i) Shallow faults;	Section 7.1
(ii) Gas seeps or shallow gas;	Section 7.1
(iii) Slump blocks or slump sediments;	Section 7.1
(iv) Hydrates; or	Section 7.1
(v) Ice scour of seabed sediments.	Section 7.1
Archaeological Resources	
(i) A description of the results and data from the archaeological survey;	Section 7.1, Appendix D
(ii) A description of the historic and prehistoric archaeological resources, as required by the National Historic Preservation Act of 1966 (NHPA), as amended.	Section 7.1, Appendix D
Geological Survey	
(i) Seismic activity at your proposed site;	Section 7.1
(ii) Fault zones;	Section 7.1
(iii) The possibility and effects of seabed subsidence; and	Section 7.1
(iv) The extent and geometry of faulting attenuation effects of geologic conditions near your site.	Section 7.1
Biological	
(i) Live bottoms	Sections 7.1 and 7.4
(ii) Hard bottoms	Sections 7.1 and 7.4
(iii) Topographic features; and	Sections 7.1 and 7.4
(iv) Surveys of other marine resources such as fish populations (including migratory populations), marine mammals, sea turtles, and sea birds.	Sections 7.1 and 7.4
§ 585.611(a) and (b) Requirements	
Hazard information	Section 7.1
Water quality	Section 7.7
Biological resources	
(i) Benthic communities	Section 7.2
(ii) Marine mammals	Section 7.4
(iii) Sea turtles	Section 7.4
(iv) Coastal and marine birds	Section 7.5
(v) Fish and shellfish	Sections 7.2 and 7.3
(vi) plankton and seagrasses, and	Sections 7.2

Table 1-1 Site Assessment Plan Requirements for Commercial Leases Pursuant to §585.105(a), 606(a), 610(a) and (b), and 611(a) and (b)

Requirement	Compliance Statement
(vii) plant life	Sections 7.2
Threatened or endangered species	Sections 7.4 and 7.5
Sensitive biological resources or habitats	Sections 7.2
Archaeological resources	Section 7.1, Appendix D
Socioeconomic resources	Section 7.9
Coastal and marine uses	Section 7.9
Consistency Certification	Table 1-2
Other Resources, conditions, and activities	Not Applicable.

Table 1-2 Permit Matrix

Permitting Agency	Applicable Permit or Approval	Statutory Basis	Regulations	Applicant Requirements
National Oceanic and Atmospheric Administration (NOAA), National Marine Fisheries Service (NMFS)	Endangered Species Act Section 7 Consultation	16 United States Code (U.S.C.) 1536	50 CFR 402	No Action Required. These consultations were completed prior to the issuance of the Lease.
	Magnuson-Stevens Fishery Conservation and Management Act Section 305(b) Consultation	16 U.S.C. 1801	50 CFR 600	No action required. These consultations were completed prior to the issuance of the Lease.
	Incidental Take Authorization	Marine Mammal Protection Act of 1972(MMPA)	16 U.S.C. §§ 1361 *et seq.*	No action required. As detailed in Sections 4, 5, and 6, installation, operation, and decommissioning of the Met Buoys will not result in the harassment of marine mammals protected under the MMPA.
U.S. Army Corps of Engineers, Philadelphia District	Nationwide Permit 5 – Scientific Measuring Devices	Clean Water Act 33 U.S.C.134	33 CFR 320 *et seq*.	Ocean Wind LLC filed form #4345 with the United States Army Corps of Engineers documenting eligibility under and conformance with the terms of the Nationwide Permit on September 12, 2017. See Appendix A for a copy of the application.
United States Coast Guard (USCG)	Approval for Private Aids to Navigation	14 U.S.C. 81	33 CFR Part 66	Ocean Wind LLC will submit an application to the USCG for a Private Aids to Navigation (PATON) prior to the installation of the Met Buoys. Ocean Wind LLC will submit a copy of the approved PATON to BOEM prior to buoy deployment.
U.S. Department of Interior, BOEM	NHPA Section 106 Consultation	NHPA 16 U.S.C. 470	36 CFR Part 60, Part 800	No action required. BOEM has executed a Programmatic Agreement that establishes procedures for consultations for site assessment activities in the New Jersey Wind Energy Area (WEA) and under NHPA Stipulations for the identification and protection of cultural resources are included in the Lease.
U.S. Fish and Wildlife Service	Endangered Species Act Section 7 Consultation	16 U.S.C. 1536	50 CFR 402	No action required. These consultations were completed prior to the issuance of the Lease.
U.S. Environmental Protection Agency (EPA) Region 2	Notice of Intent (NOI) Outer Continental Shelf (OCS) Air Permit	Clean Air Act of 1970 (CAA)	40 CFR 55	Ocean Wind LLC submitted a NOI to the U.S. EPA Region 2 office on December 21, 2017 for vessel emissions associated with the deployment of wind resource assessment buoys to be located off the coast of New Jersey. Ocean Wind LLC is currently incorporating responses to comments received from the EPA and intends to submit an updated NOI that includes the small diesel emergency generators located on the WindSentinel™ buoys in February 2018.

Table 1-2 Permit Matrix

Permitting Agency	Applicable Permit or Approval	Statutory Basis	Regulations	Applicant Requirements
New Jersey Department of Environmental Protection	Coastal Zone Program Consistency Certification	Coastal Zone Management Act	15 CFR 930 Subpart C	No action required. A final Coastal Zone Consistency Determination has been issued for SAP activities in the New Jersey WEA. See Appendix A for a copy of the concurrence letter from NJDEP.

1.2 Certified Verification Agent Waiver Request

Pursuant to 30 CFR § 585.610(a)(9), BOEM may require a Certified Verification Agent (CVA) to certify to BOEM that the Met Buoys are designed to withstand the environmental and functional load conditions for the intended life of the Met Buoys in the Installation Areas. Ocean Wind LLC requests a waiver of the CVA requirement per 30 CFR § 585.705(c) because the selected Met Buoys are a commercially available technology that has been deployed in similar conditions. Ocean Wind LLC will have a Measurements Engineer from AXYS perform the duties similar to those of a CVA. The Measurements Engineer will also inspect the equipment prior to installation, witness the installation, and prepare an installation report as described in Section 4.

1.3 Best Management Practices

Best management practices (BMPs) are described in Sections 1.3, 4, and 7. Ocean Wind LLC will use its standard internal project execution structure to manage activities described in the SAP. As stated in Section 4.8, SAP activities will be supported by a detailed HSE Plan, which is included as Appendix F.

In addition, Ocean Wind LLC will use many of the BMPs identified in the *Guidelines for Information Requirements for a Renewable Energy Site Assessment Plan* (BOEM 2016) and *Establishment of an OCS Alternative Energy and Alternate Use Program*, Record of Decision, December 2007 (BOEM 2007). See Table 1-3 for a summary of these BMPs (numbering in Table 1-3 corresponds to the format of the noted SAP Guidelines).

Table 1-3 Best Management Practices

Best Management Practices	Location in SAP Document
1. Minimize the area disturbed by installation	Section 3.4
2. Contact and consult with the appropriate affected Federal, state, and local agencies early in the planning process	Table 2-2 and Section 4.1
5. Conduct seafloor surveys to ensure that the project is sighted to avoid or minimize impacts associated with seafloor instability and other hazards	Section 3.4
7. Avoid known sensitive seafloor habitats	Section 7.1
8. Avoid anchoring on sensitive seafloor habitats	Section 7.1
10. Routine inspection of the buoys to monitor scouring and ensure structural integrity	Section 5.2
11. Avoid the use of explosives that may impact fish or benthic organisms	No explosives will be used for activities proposed in the SAP.
14, 15, 16, 17, and 21 related to minimizing/avoiding vessel impacts to marine mammals and sea turtles.	Section 4.4
18. Use existing data to identify important, sensitive, and unique marine habitats in the vicinity of the project and design the deployment to avoid adverse impacts to these habitats	Section 7
19. Minimize construction activities in areas containing anadromous fish during migration periods	Section 7.3
20. Minimize seafloor disturbance during installation of the buoys	Section 4.1
25. Minimize perching opportunities	Section 7.5

Table 1-3 Best Management Practices

Best Management Practices	Location in SAP Document
27. Comply with USCG lighting and marking requirements while using lighting technology that minimizes impacts to avian species	Table 1-2 and Section 7.5
31 and 32. Minimize potential conflicts with commercial and recreational fishing interests by working with commercial/recreational fishing entities and reviewing planned activities with potentially affected parties	Section 7.3
33. Use practices and operating procedures that reduce the likelihood of vessel accidents and fuel spills	Section 4
34. Avoid impacts to the commercial fishing industry by marking the buoy(s) with USCG-approved marking and lighting to ensure safe vessel operation	Table 1-2 and Section 7.8
36. Avoid hard-bottom habitats, including seagrass communities and kelp beds	Section 7.2
50. Prepare an oil spill response plan	Prior to commencing installation of the Met Buoys, Ocean Wind LLC will submit Oil Spill Response Measures for review and approval to the Oil Spill Response Division of the Bureau of Safety and Environmental Enforcement (BSEE). The measures will demonstrate compliance with the guidance provided by BOEM via email on October 26, 2017.

2. Conformity with Prior BOEM Actions Regarding SAP Activities

2.1 Mid-Atlantic Environmental Assessment

On January 20, 2012, BOEM issued a Finding of No Significant Impact based on a comprehensive Environmental Assessment (referred to herein as the "Mid-Atlantic EA") (BOEM 2012). The Mid-Atlantic EA analyzed the foreseeable consequences associated with issuing commercial leases within the New Jersey WEA, which is inclusive of the Lease Area (Figure 1-1), as well as the site assessment activities including the installation of Met Buoys. The Met Buoys and proposed activities described herein are consistent with Section 3.1.3.3 and 3.1.3.4 of the Mid-Atlantic EA. Table 2-1 below provides a comparison of the information assessed in the EA and the relevant detail being proposed by Ocean Wind LLC herein.

Table 2-1 Comparison of EA and SAP Elements

Project Component	Assessed in EA	Proposed in SAP	Summary
# of Buoys	max 2 buoys per lease area and an additional small tethered buoy	2 FLiDAR WindSentinel Buoys and 1 TRIAXYS Wave And Current Buoy	The number of buoys proposed in this SAP are consistent with what was assessed in the EA
Meteorological Buoy Specifications	100' long spar buoy, weighing 15 tons, just over 6' diameter	20.7' long, weighing 6.7 tons, 10.5' wide (FLiDAR)	The met buoys proposed in this SAP are smaller and weigh less that what was assessed in the EA
Meteorological Buoy Hull Type	NOMAD	NOMAD (FLiDAR)	Ocean Wind LLC is proposing to use the same hull type that was assessed in the EA
Meteorological Buoy Height above ocean surface	30-40'	13.5' (FLiDAR)	The met buoys proposed in this SAP are less than half the height that what was assessed in the EA
Meteorological Buoy Mooring Design	All chain mooring, 2.7-4.5 ton anchor, 36ft^2 resting on sea floor, anchor sweep 8.75 acres	All chain mooring, 5.5 and 2.5 ton clump weights, 42 ft^2 resting on seafloor, anchor sweep 2.6 acres (FLiDAR); All chain mooring, 0.8 ton clump weight, 10.2 ft^2	The weight and area of anchor resting on the sea floor is generally consistent with what was assessed in the EA. However, the anchor sweep of the mooring design proposed by Ocean

Table 2-1 Comparison of EA and SAP Elements

Project Component	Assessed in EA	Proposed in SAP	Summary
		resting on seafloor, anchor sweep 1.1 acres (TRIAXYS)	Wind LLC is less than half the size of what was assessed in the EA.
Small Tethered Buoy size	9.8’	3.6’ (TRIAXYS)	The proposed wave and current buoy is less than half the size of what was assessed in the EA.
Data Transmission	Transmit operational status and data to receiver on shore	Transmit operational status and data to shore via satellite or cellular telemetry or Bluetooth link	The data transmission protocols proposed by Ocean Wind LLC are consistent with what was assessed in the EA.
Maintenance	Monthly or quarterly	Every 3 to 6 months	The maintenance schedule proposed in this SAP is less frequent than what was proposed in the EA resulting in less vessel traffic during operation of the met buoys and minimize impacts.
Installation and decommissioning process	Carried or towed by vessel, lower or place buoy over final location, drop mooring anchor, decommissioning is reverse of installation	Carried or towed by vessel, deploy mooring system, lower or place buoy over final location, decommissioning is reverse of installation	The installation and decommissioning processes proposed by Ocean Wind LLC are consistent with what was assessed in the EA.
Installation and decommissioning timeframe	Installation 1 day per buoy, Decommissioning 1 day per buoy	Installation up to two days for both met buoys and the wave buoy, decommissioning up to two days for both met buoys and the wave buoy	The installation and decommissioning timeframes proposed by Ocean Wind LLC are consistent with what was assessed in the EA.
Power source	Solar, Wind, Backup Diesel Generator	Solar, Wind, Backup Diesel Generator	The power sources proposed by Ocean Wind LLC are consistent with what was assessed in the EA.
ADCP	300-600 kHz	600 kHz	The frequency of the ADCP is consistent with what was assessed in the EA.

2.2 Lease OCS-A 0498

BOEM identified mitigation measures or Mandatory Project Design Criteria (MPDC) in the Mid-Atlantic EA for buoy installation, operation, and decommissioning. The MPDCs were developed by BOEM in consultation with other federal and state agencies to reduce or eliminate the potential environmental risks to, or conflicts with, individual environmental and socioeconomic resources upon issuance of a commercial lease for site assessment and characterization activities. BOEM has issued the mitigation measures for Ocean Wind LLC’s lease-specific site characterization activities and site assessment activities in the Lease based upon these MPDCs. Ocean Wind LLC will implement these Lease specific measures as described in more detail in Table 2-2 and Section 7 of this SAP.

Table 2-2 Conformance with the Commercial Renewable Energy Lease Number OCS-A 0498 Stipulations

Addendum “C” Stipulation	Description	SAP Document
3 National Security and Military Operations		
3.2.4 Lessee Point-of-Contact for Evacuation/Suspension Notifications	The Lessee must inform the Lessor of the persons/offices to be notified to implement the terms of 3.2.2 and 3.2.3.	Marcus Cross Environmental Manager, USA (857) 310-8232 marcr@orsted.com 1 International Place Boston, MA 02110

Table 2-2 Conformance with the Commercial Renewable Energy Lease Number OCS-A 0498 Stipulations

Addendum "C" Stipulation	Description	SAP Document
3.2.5 Coordination with Command Headquarters	The Lessee must establish and maintain early contact and coordination with the appropriate command headquarters, in order to avoid or minimize the potential to conflict with and minimize the potential effects of conflicts with military operations.	Ocean Wind LLC will establish contact with Gregory Thomas at United States Fleet Forces (USFF) N46 at 1562 Mitscher Avenue, Suite 250, in Norfolk, Virginia ([757]836-6206), as provided in the Commercial Lease.
3.3 Electromagnetic Emissions	Prior to entry into any designated defense operating area, warning area, or water test area for the purpose of commencing survey activities undertaken to support SAP or Construction and Operations Plan (COP) submittal, the Lessee must enter into an agreement with the commander of the appropriate command to coordinate the electromagnetic emissions associated with such survey activities. The Lessee must ensure that all electromagnetic emissions associated with such survey activities are controlled as directed by the commander of the appropriate command headquarters.	Ocean Wind LLC will provide the frequencies the Met Facilities will use to transmit data to confirm electromagnetic emissions from the SAP activities will not conflict with military operations.
4 Standard Operating Conditions		
4.1.1 Briefing	Prior to the start of operations, the Lessee must hold a briefing to establish responsibilities of each involved party, define the chains of command, discuss communication procedures, provide an overview of monitoring procedures, and review operation al procedures. This briefing must include all relevant personnel, crew members, and protected species observers (PSO). New personnel must be briefed as they join the work in progress.	See Section 4.3, Pre-Installation Briefing.
4.1.2	The Lessee must ensure that all vessel operators and crew members, including PSO's, are familiar with, and understand, the requirements specified in Addendum C.	See Section 4.3, Pre-Installation Briefing.
4.1.3	The Lessee must ensure that a copy of the standard operating conditions (Addendum C) is made available on every project-related vessel.	See Section 4.3, Pre-Installation Briefing.
4.1.4 Marine Trash and Debris Prevention	The Lessee must ensure that vessel operators, employees and contractors actively engaged [in] site characterization activities performed in support of plan (i.e., SAP and/or COP) submittal are briefed on marine trash and debris awareness and elimination, as described in the Bureau of Safety and Environmental Enforcement Notice to Lessees (NTL) No. 2012-G01 ("Marine Trash and Debris Awareness and Elimination"), except that the Lessor will not require the Lessee, vessel operators, employees and contractors to undergo formal training or post placards. The Lessee must ensure that vessel operator employees, and contractors are made aware of the environmental and socioeconomic impacts associated with marine trash and debris and their responsibilities for ensuring that trash and debris are not intentionally or accidentally discharged into the marine environment. The above-referenced NTL provides information the Lessee may use for this awareness training.	Ocean Wind LLC will comply with this stipulation and NTL 2015-G03 which has superseded NTL 2012-G01, except that formal training will not be conducted and placards will not be posted. Vessel Operators, employees, and contractors will be briefed prior to boarding the vessel.
4.2.1 Vessel Strike Avoidance Measures	The Lessee must ensure that all vessels associated with activities performed in support of plan (i.e., SAP and/or COP) submittal comply with the vessel-strike avoidance measures specified in stipulations 4.2.1 through 4.2.9.1, except under extraordinary circumstances when complying with these requirements would put the safety of the vessel or crew at risk.	See Section 4.4, Protected Species Avoidance
4.3.6 No Impact without Approval	The Lessee must not knowingly impact a potential archaeological resource without the Lessor's prior approval.	See Section 7.9 Archaeological Resources and Appendix D. Marine Archaeological Resource Assessment Report

Table 2-2 Conformance with the Commercial Renewable Energy Lease Number OCS-A 0498 Stipulations

Addendum "C" Stipulation	Description	SAP Document
4.3.7 Post-Review Discovery Clauses	If the Lessee, while conducting site characterization activities in support of a plan submittal, discovers a potential archaeological resource, such as the presence of a shipwreck (e.g., a sonar image or visual confirmation of an iron, steel, or wooden hull, wooden timbers, anchors, concentrations of historic objects, piles of ballast rock), prehistoric artifacts, or relict landforms within the project area, the Lessee must:	Appendix D. Marine Archaeological Resource Assessment Report
4.3.7.1	Immediately halt seafloor/bottom-disturbing activities within the area of discovery;	Appendix D. Marine Archaeological Resource Assessment Report
4.3.7.2	Notify the Lessor within 24 hours of discovery;	Appendix D. Marine Archaeological Resource Assessment Report
4.3.7.3	Notify the Lessor in writing via report to the Lessor within 72 hours of its discovery;	Appendix D. Marine Archaeological Resource Assessment Report
4.3.7.4	Keep the location of the discovery confidential and take no action that may adversely affect the archaeological resource until the Lessor conducts an evaluation and instructs the applicant on how to proceed; and,	Appendix D. Marine Archaeological Resource Assessment Report
4.3.7.5	Conduct additional investigations as directed by the Lessor to determine if the resource is eligible for listing in the National Register of Historic Places (30 CFR 585.802(b)). The Lessor will direct the Lessee to conduct such investigations if: (1) the site has been impacted by the Lessee's project activities; or (2) impacts to the site or to the area of potential effect cannot be avoided. If investigations indicate that the resource is potentially eligible for listing in the National Register of Historic Places, the Lessor will tell the Lessee how to protect the resource or how to mitigate adverse effects to the site. If the Lessor incurs costs in protecting the resource, under Section 110(g) of the National Historic Preservation Act, the Lessor may charge the Lessee reasonable costs for carrying out preservation responsibilities under the OCS Lands Act (30 CFR 585.802(c-d)).	Appendix D. Marine Archaeological Resource Assessment Report
4.4.1 Reporting Injured or Dead Protected Species	The Lessee must ensure that sightings of any injured or dead protected species (e.g., marine mammals or sea turtles) are reported to the NMFS Northeast Region's Stranding Hotline (800-900-3622 or current) within 24 hours of sighting, regardless of whether the injury or death is caused by a vessel. In addition, if the injury or death was caused by a collision with a project-related vessel, the Lessee must ensure that the Lessor is notified of the strike within 24 hours. The Lessee must use the form provided in Appendix A to Addendum C of the Lease to report the sighting or incident. If the Lessee's activity is responsible for the injury or death, the Lessee must ensure that the vessel assist in any salvage effort as requested by NMFS.	See Section 4.4

3. Project Description and Objectives

3.1 Project Description and Objectives

Ocean Wind LLC will conduct meteorological and metocean evaluations as part of the site assessment activities of the Project within the Lease Area. Ocean Wind LLC will collect and analyze meteorological data, inclusive of wind speed and direction at multiple heights, and information on other meteorological and metocean conditions within the Lease Area. As stated previously, Ocean Wind LLC has proposed that the collection of this data will be performed using two AXYS WindSentinels™ and one TRIAXYS Buoy. The proposed Met Buoys represent state-of-the-art equipment that incorporates the best available technologies. Design drawings of the technology proposed are provided in Appendix B.

The WindSentinel™ will consist of instrumentation and supporting systems atop a floating moored buoy platform (Figure 3-1). The floating platform consists of the AXYS Navy Oceanographic Meteorological Automated Device hull, mooring chain, clump weight anchors and pendant marker buoy. The hull consists of marine-grade 5086 aluminum and measures 20.7 feet (ft) (6.3 meters [m]) long by 10.5 ft (3.2 m) wide and weighs 15,000 pounds (lbs) (6,818 kilograms [kg]) (bare hull weight). The vertical profile of the WindSentinel™, including instrumentation, will be approximately 13.5 ft (4.1 m) from the sea surface to the top of the hull mast. The submerged portion of the hull would measure approximately 8.5 ft (2.6 m) below the sea surface from the water line to the bottom of the mooring yoke. The outer hull is constructed of a corrosion resistant marine grade stainless steel. The hull has also been designed with consideration for avian species. Landing areas have been minimized and anti-perching devices will be installed on the lights and mast.

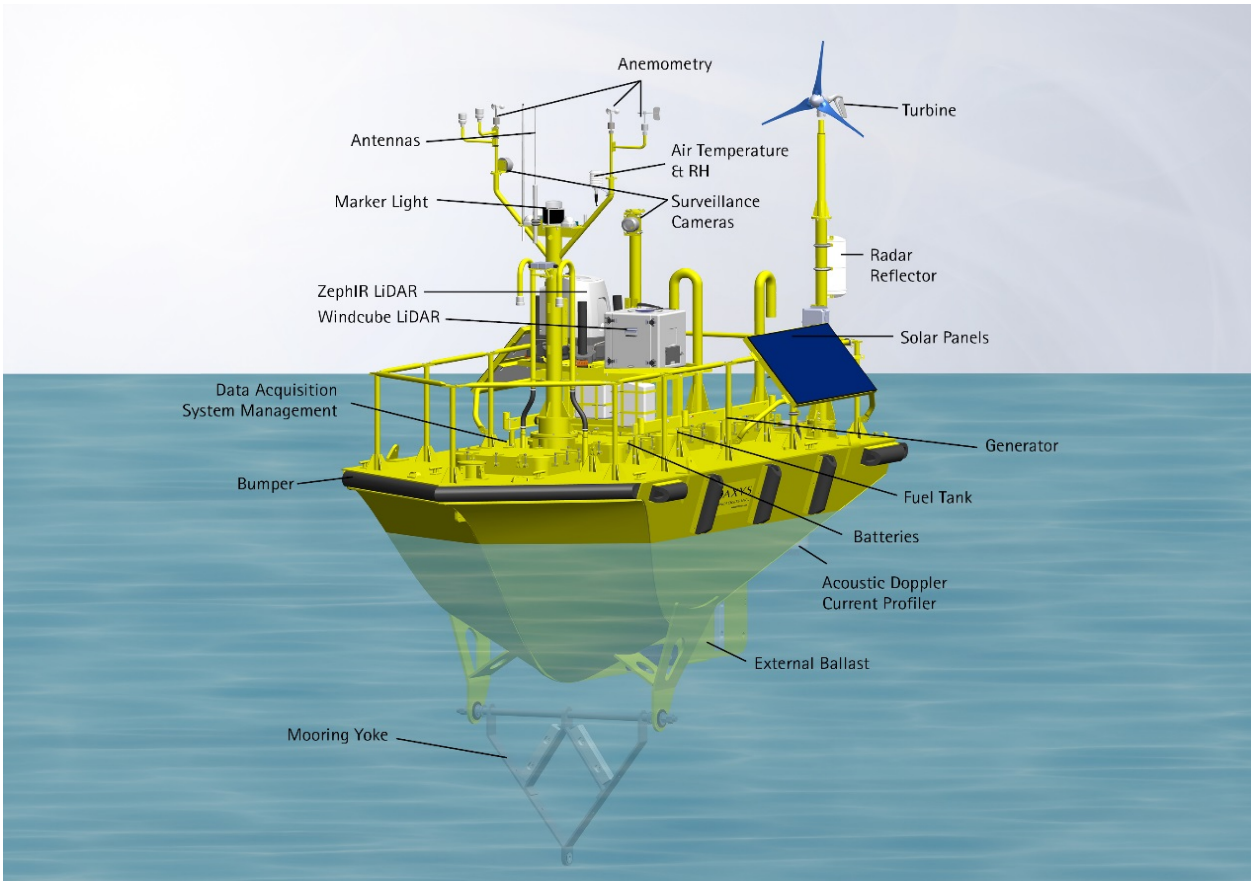

Figure 3-1 WindSentinel™ Buoy

The TRIAXYS Buoy is a 3.6 ft (1.1 m) round buoy that measures directional waves & currents as well as water temperature (Figure 3-2). The buoy hull and dome are constructed from stainless steel and impact resistant polycarbonate, respectively. The TRIAXYS Buoy is attached to the seabed using a floating collar and mooring design. The floating collar is made of Ionomer foam and adds buoyancy to the TRIAXYS to support the weight of the chain mooring.. The vertical profile of the TRIAXYS Buoy will be approximately 1.8 ft (0.55 m) from the sea surface to the top of the buoy. The submerged portion of the

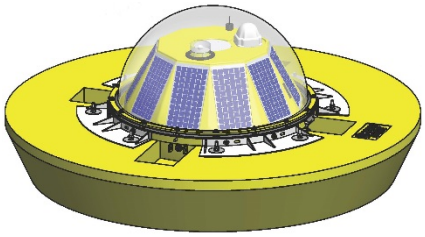

Figure 3-2 TRIAXYS Buoy

buoy hull would measure approximately 1.8 ft (0.55 m) below the sea surface from the waterline to the bottom of the buoy. The TRIAXYS Buoy weighs 507 lbs (230 kg).

Ocean Wind LLC plans to deploy the Met Buoys no earlier than March 2018. The operational lives of the WindSentinel™ and TRIAXYS Buoys are expected to be two and four years, respectively. The Met Buoys will be decommissioned at the end of the operational life as described in Section 6.

3.2 Site Location

The location of the proposed Met Buoys will fall within two sites that were surveyed and evaluated by Ocean Wind LLC in summer 2017 (see Figure 3-3, Section 7 and Appendices C, D, and E). These sites are collectively referred to the Installation Areas (Figure 1-1).

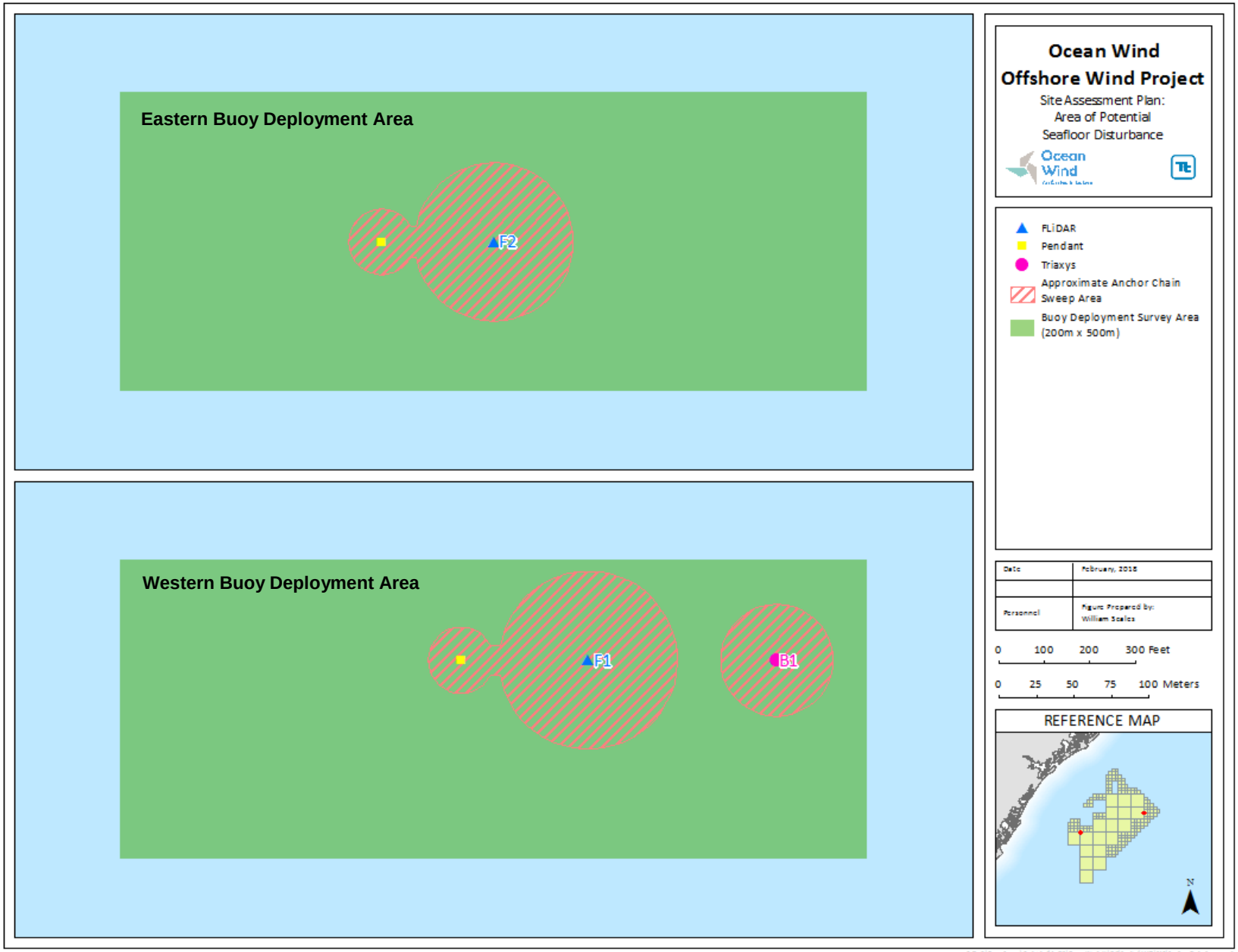

Figure 3-3 Area of Potential Seafloor Disturbance

For the purpose of the discussion in this SAP, the two Installation Areas where the Met Facilities are proposed to be located have been given unique identifiers. The Installation Area for the WindSentinel™ and TRIAXYS Buoys to be located in the western side of the Lease Area are referenced as F1 and B1, respectively. The Installation Area for the Met Buoy to be installed in the eastern side of the Lease Area is referenced as F2. The coordinates for these locations are provided in Table 3-1 and depicted on Figure 1-1.

The Met Buoys will be deployed within the proposed Installation Areas at the coordinates listed in Table 3-1.

Table 3-1 Location of the Met Buoys

Platform	ID	Northing (UTM 18N 2011 NAD83)	Easting (UTM 18N 2011 NAD83)	Mean Lower Low Water Depth	OCS Lease Block	Aliquot
WindSentinel™	F1	4324779	548110	17.8	7081	A
TRIAXYS Buoy	B1	4324779	548236	17.7	7081	A
WindSentinel™	F2	4331998	572002	28.5	6986	I

3.3 Mooring Designs, Power Equipment and Instrumentation

The location for the installation areas of the proposed Met Buoys as presented in Table 3-1 was based on a review of existing data, information collected during 2017 high resolution geophysical (HRG) surveys conducted within the Lease Area (See Appendix C) and the best available technologies. The following sections provide detailed descriptions of the proposed Met Buoys as well as their associated mooring designs, power equipment and instrumentation.

BOEM and the Department of Defense (DoD) will be notified in the event that Ocean Wind LLC elects to add any new sensors or instrumentation to the Met Buoys.

3.3.1 WindSentinel™

3.3.1.1 Mooring Design

The WindSentinels™ will be attached to the seafloor by means of a u-mooring design which is comprised of a chain that connects the WindSentinel™ to both a primary and secondary clump anchor on the sea floor as well as a pendant buoy on the surface of the water (Figure 3-4). The u-mooring design facilitates recovery of the WindSentinel™ in higher sea state conditions by allowing the mooring to be recovered and the WindSentinel™ to be towed without the need to transfer personnel at sea. The primary and secondary clump weights would weigh approximately 5.5 tons (5,000 kg) and 2.5 tons (2,500 kg), respectively and sit on the seabed for a total area of up to 42 ft^2 (3.9 m^2). The chain would be attached to the base of the hull via the steel mooring yoke. The area of the anchor chain sweep associated with the long-term operation of the WindSentinels™ are anticipated to be approximately 3.1 acres (1.3 ha) (based on anchor chain radii of approximately 195.2 ft [59.5 m], 72.2 ft [22 m].and 442.9 ft [135 m] of connector chain on the seafloor) for F1, and 2.6 acres (1.1 hectares [ha]) (based on anchor chain radii of approximately 173.9 ft [53 m], 72.2 ft [22 m], and 442.9 ft [135 m] connector chain on the sea floor) for F2 . Vertical penetration of the primary and secondary clump weights into the seabed is anticipated to be approximately 6.6 ft to 9.9 ft (2 m to 3 m) and 3.3 to 6.6 ft (1m to 2 m), respectively.

3.3.1.2 Power Equipment

The WindSentinel™ instrumentation will be powered by 40 100-amp hour lead-acid batteries, primarily charged by a hybrid wind-solar system, with a 3,200 watt diesel generator as a secondary backup battery charging source. Triple redundancy is provided through the use of a 2 by 240-watt solar panel array, which will be mounted on the superstructure to avoid damage by waves, and is available for instances where both wind and diesel generators are offline. The solar panel system will allow the WindSentinel™ to inform the operator that the main power systems are down and will continue to monitor and track the buoy. A regulator protects the batteries from being damaged by possible overcharging.

In the event of failure of the key power supply systems, the WindSentinel™ instrumentation would be capable of operating at full capacity on battery power alone for up to seven days.

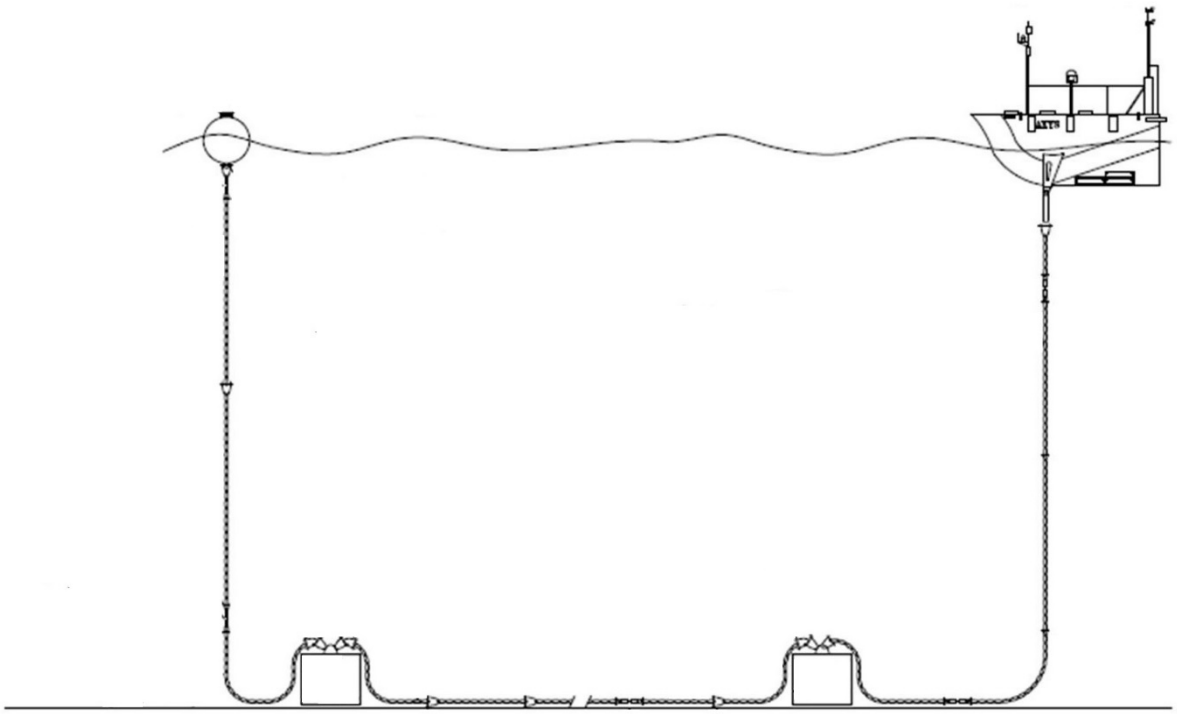

Figure 3-4 FLIDAR WindSentinel™ U-Mooring Design

3.3.1.3 Instrumentation Equipment

A dual light detection and ranging (LiDAR) instrumentation package, comprised of ZephIR300M and WINDCUBE® V2 Offshore LiDARs, will be installed atop the WindSentinel™. The ZephIR300M and WINDCUBE® units are wind profiling devices capable of remotely measuring and collecting wind speeds and directions up to 984 ft (300 m) and 656 ft (200 m) respectively. The WindSentinel™ would also contain the following equipment:

- A Gill WindSonic 1 wind sensor to measure wind speed and direction;
- a barometric pressure sensor to provide atmospheric pressure;
- a combined PT 100 RTD temperature sensor and Rotronic Hygromer C94 relative humidity sensor;

- a TRIAXYS™ g3 Wave Sensor that contains accelerometers that measure acceleration along each of the three orthogonal axes, three angular rate gyros that measure rotation about the yaw, pitch and roll axes and a magnetic compass. The TRIAXYS Sensor measures significant and maximum wave height, average wave direction, zero mean crossing period, peak period, and directional wave spectrum;
- A Nortek Acoustic Doppler Current Profiler (ADCP) to measure water current speed and direction; and,
- integrated wireless communication systems to provide data download and system remote operation via general packet radio service, satellite, or wireless radio or mobile phone connection to shore.

Table 3.2 provides a list of the parameters measured by the WindSentinel™, the associated instrumentation, as well as the range and accuracy of the measurements.

Table 3-2 Parameters Measured and Recorded by the WindSentinel™

Parameter	Instrumentation	Range	Accuracy
Wind Speed	ZephIR 300 LiDAR	<1 m/s to 70 m/s	<0.5%
Wind Direction	ZephIR 300 LiDAR	N/A	<0.5°
Wind Speed	WINDCUBE LiDAR	0 m/s to 60 m/s	0.1 m/s
Wind Direction	WINDCUBE LiDAR	N/A	2°
Wind Speed	Gill Windsonic 1 wind sensor,	0.1 m/s to over 60 m/s	2%
Wind Direction	Gill Windsonic 1 wind sensor	0 to 359 degrees	3 deg
Barometric Pressure	RM Young Model 61302 Barometric Pressure Sensor	500 – 1100 hPa	±0.2 hPa at 25°C
Air Temperature	Pt 100 RTD	-40°C to +60°C	±0.3°C at 20°C
Relative Humidity	Rotronic Hygromer C94	0 – 100% R.H.	±1.0%R.H. at 20°C
Wave Heave	TRIAXYS™ g3 Wave Sensor	±20 m	Better than 1%
Wave Period	TRIAXYS™ g3 Wave Sensor	1.5 to 33 seconds	Better than 1%
Wave Direction	TRIAXYS™ g3 Wave Sensor	0° to 360°	3°
Water Temperature	TRIAXYS™ g3 Wave Sensor	-5°C to 50°C	±0.5°C
Current velocity	Nortek Acoustic Doppler Current Profiler (ADCP)	0.1 m/s at bins through the water column	±0.1 m/s
Current direction	Nortek Acoustic Doppler Current Profiler (ADCP)	±5° at bins through the water column	±5°

The data acquisition system will acquire and store data using the WatchMan™ 500 controller (WatchMan™). The WatchMan™ has an intelligent, configurable sensor input/output platform with two-way communication, designed for long-term operations in harsh marine environments. The WatchMan™ manages the operation of each sensor in the system and the power equipment, allows for remote adjustments to system performance, and transfers data using a combination of, Iridium Short Burst Data and Inmarsat iSAT data pro satellite telemetry, HSPA/GPRS cellular telemetry, and Bluetooth for the WindSentinel™.

The following supporting systems for navigational aids, position tracking, and remote monitoring will also be installed on the WindSentinel™:

- an Aid to Navigation AIS satellite transmitter for tracking the buoy location;
- a set of navigation light aids to protect the FLIDAR and act as a reference for mariners;

- a Carmanah Light Model M850 Solar LED Marine Lantern;
- a Skywave IDP-690 Inmrsat IsatData Pro satellite transceiver for Global Positioning System data, time synch, and back-up telemetry;
- a 3DM-GX3 miniature Attitude Heading Reference System to provide static and dynamic orientation and inertial measurements;
- a passive EchoMax RADAR Reflector to enhance the systems visibility to near-by vessels;
- a WatchCircle Alert System position verification; and
- two on-board web cameras to support operational performance and security.

Using the maintenance plan described in Section 5.2, equipment on the WindSentinel™ will have a minimum two-year operational lifespan.

3.3.2 TRIAXYS Buoy

3.3.2.1 Mooring Design

The TRIAXYS Buoy mooring design will consist of 4.9 ft (1.5 m) of open link chain which will run from the buoy to a 265.8 ft (81 m) mooring chain. The mooring chain will then be attached to a .8 ton (7,000 kg) clump weight that will rest on the seafloor for an area of approximately 10.2 ft^2 (1 m^2) (Figure 3-5). The area of the anchor chain sweep associated with the long-term operation of TRIAXYS Buoy B1 is anticipated to be approximately 1.1 acres (0.5 ha) (based on anchor chain radii of approximately 123 ft [37.5 m]. Vertical penetration of the anchor chain for the TRIAXYS Buoy into the seabed is anticipated to be approximately 0.5 ft to 1 ft (0.2 m to 0.3 m).

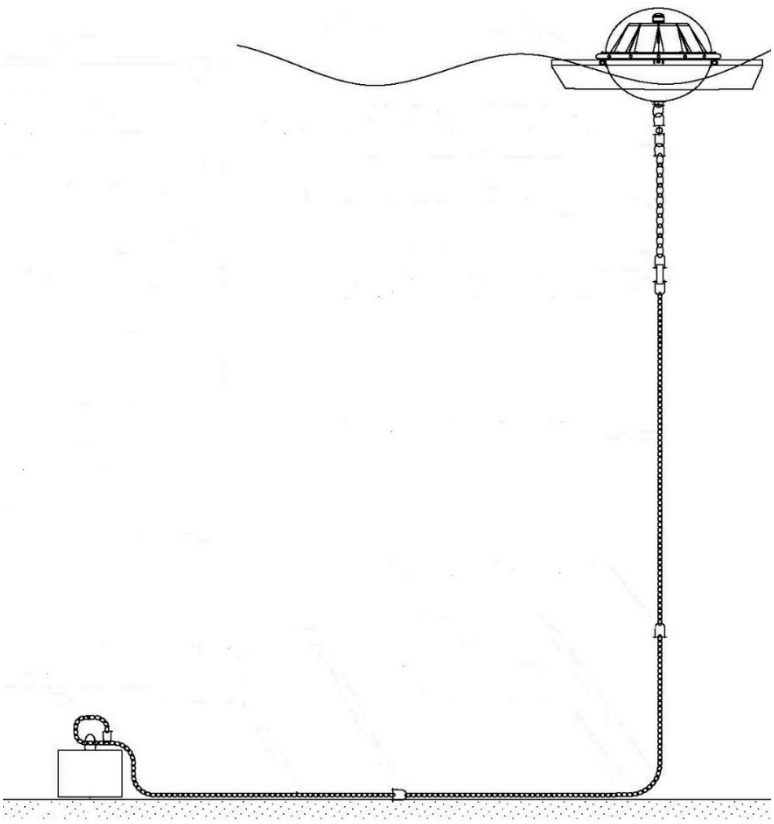

Figure 3-5 TRIAXYS Buoy Floating Mooring Design

3.3.2.2 Power Equipment

The TRIAXYS Buoy instrumentation will be powered by four 10-amp hour sealed lead-acid batteries, charged by a 2 by 240-watt solar panel array. The solar panels are mounted in an array under the protective polycarbonate dome to avoid damage by waves. Due to the surplus of solar power provided by the solar array, the batteries have enough reserve capacity to power the buoy in a standard sampling routine for up to 3 months without being charged. The Maximum Power Point Tracking solar charge controller protects batteries from being damaged by overcharging. The TRIAXYS Buoy also contains a Hydrogen Catalyst pack which will convert free hydrogen gas to water vapor. This system is paired with a large desiccant pack to absorb water in order to ensure safe operation of the buoy.

3.3.2.3 Instrumentation Equipment

The TRIAXYS Buoy is instrumented with the following sensors to provide in-situ monitoring and analysis of wave and current activity:

- a TRIAXYS g3 Directional Wave Sensor;
- a YSI Water Temperature Probe; and
- a Teledyne RDI 600 kilohertz Current Profiler.

Table 3.3 provides a list of the parameters measured by the TRIAXYS Buoy, as well as the resolution and accuracy of the measurements.

Table 3-3 Parameters Measured and Recorded by the TRIAXYS Buoy

Parameter	Definition	Resolution	Accuracy
Time	UTC	0.1 s	±0.1 s
Wave mean direction	The mean wave direction found by weighting the direction by the energy in the directional wave spectrum	1°	±5°
Significant wave height	Calculated as four times the standard deviation of the sea surface elevation in the time domain	0.1 m	Larges of ±0.1 m or 2%
Wave peak period	The period of waves at the peak of the wave energy spectrum	0.1 s	Larges of ±0.1 m or 2%
Wave zero crossing period	The mean period between successive zero crossings	0.1 s	Larges of ±0.1 m or 2%
Current velocity	The current velocities registered for bins up through the water column	0.1 m/s	±0.1 m/s
Current direction	The current direction registered for bins up through the water column with a bin size of one meter	±5°	±5°
Water surface temperature		1°C	±1°C
Measuring wave height	The buoy shall be able as a minimum to measure wave higher than 15 m		
Sea surface elevation	Instantaneous elevation of the sea surface	0.01 m	Larges of ±0.01 m or 2%

The data acquisition system will acquire and store data using the same WatchMan™ system as described for the WindSentinel™ (see Section 5.1).

The following supporting systems for navigational aids, position tracking, and remote monitoring will also be installed on the TRIAXYS Buoy:

- a SkyWave IDP-690 Inmarsat IsatData Pro satellite transceiver;

- a Fluxgate compass; and
- a WatchCircle Alert System position verification.

Using the maintenance plan described in Section 5.2, equipment on the TRIAXYS Buoy will have a minimum four-year operational lifespan.

4. Deployment/Installation

Installation of the Met Buoys may take up to two days, barring weather delays. It is anticipated that the deployment activities will be staged out of Avalon Marine Center in Avalon, New Jersey.

4.1 Overview of Installation and Deployment Activities

Ocean Wind LLC will notify BOEM, Fleet Forces Atlantic Exercise Coordination Center at Naval Air Station Oceana, the United States Army Corps of Engineers, and the United States Coast Guard (USCG) prior to mobilization to deploy the Met Buoys. Written notice via email will be provided to the appropriate contact at Fleet Forces Command prior to mobilization in order to avoid potential conflicts with military operations. Ocean Wind LLC will update Fleet Forces Command on the installation schedule following approval of the SAP and detailed planning.

Ocean Wind LLC will notify mariners, fisherman, and other users of the area by submitting a request to the USCG for publication of a Local Notice to Mariners two weeks prior to the start of the in-water work. This notice will include the contact names for the installation vessels, local fisheries liaison officer, channels of communication, and the duration of the work. Copies of all USCG communications will be provided to BOEM as required. Additionally, in accordance with standard maritime practices, the vessel captain(s) will broadcast via VHF radio on Marine Channel 16 notification to mariners of their position and limited mobility during installation activities and submit an application to the USCG for a PATON for the Met Buoys (see Table 1-2). Ocean Wind LLC will submit a copy of the approved PATON to BOEM prior to buoy deployment.

Within 30 days of completing the installation of the Met Buoys, Ocean Wind LLC will prepare an Installation Report and provide a copy to BOEM to fulfill the requirements of 30 CFR 585.615(a). This report will include a description of the equipment and the installation, including final coordinates of the installation site and photo documentation of the equipment deployed, the results of all commissioning tests, the plans and schedule for upcoming inspections and maintenance, and any noted problems or issues to be addressed.

Ocean Wind LLC will provide written notification to BOEM and the DoD of any proposal to add new sensors to the data collection buoy(s). Ocean Wind LLC will include the technical specifications (manufacturer, model, spectrum requirements, etc.) for any proposed new sensors, specifically seismometers and hydrophones, in the notification. The notification will be provided to the contacts listed in the Lease, or updated contact information as provided by BOEM.

4.1.1 WindSentinel™ and TRIAXYS Buoy Deployment

One workboat of approximately 92 ft (28 m) length and a smaller support vessel will be used for installation of the Met Buoys. The two WindSentinels™ will be towed behind the workboat one at a time to their deployment location. The TRIAXYS Buoy will be loaded onto the deck of a vessel and secured for transport to the Met Buoy Installation Area. The support vessel will be used to keep the WindSentinel™ away from the workboat during installation activities. The mooring systems will also be stored on the deck of a vessel

during transit. The mooring systems for the Met Buoys, inclusive of clump weights, chains, ropes and lines, will be deployed from the work vessel by a winch and A-Frame.

On arrival to the WindSentinel™ deployment location, The WindSentinel™ chain will be connected to the chain of the 5.5 ton (5,000 kg) clump weight. The winch will lower the chain into the water a decklength at a time until the 5.5 ton (5,000 kg) clump weight is reached. At this point, the A-Frame cable will be connected to the 5.5 ton (5,000 kg) clump weight, which is still secured on deck. The A-Frame will then pick up the 5.5 ton (5,000 kg) clump weight and move it out over the water away from the stern. At the same time, the deck winch will begin to lower the chain downline of the 5.5 ton (5,000 kg) clump weight so that it can be lowered into the water. Once the 5.5 ton (5,000 kg) clump weight has been lowered approximately 16 ft (5 m) below the water surface, the A-Frame will be disconnected from the 5.5 ton (5,000 kg) clump weight. The deck winch will continue to lower chain off the stern of the vessel a decklength at a time, until the water depth mark on the chain is about 33 ft (10 M), indicating that the clump weight is roughly 10 m from the bottom. At this point, the workboat will adjust its position so that it is directly above the 5.5 ton (5,000 kg) clump weight coordinates, then continue lowering the chain until the 5.5 ton (5,000 kg) clump weight is placed on the seafloor.

The workboat will then change its heading to move to the location of the 2.5 ton (2,500 kg) clump weight, continuing to let out chain in the same fashion previously described. The deck winch will continue to let out chain until the location of the 2.5 ton (2,500 kg) clump weight is reached. The same process described above will be used for connecting and lifting the chain and clump weight. The deck winch will continue to lower the chain and 2.5 ton (2,500 kg) clump weight until the water depth mark on the chain is about 33 ft (10 M), indicating that the clump weight is roughly 10 m from the bottom. The same process described above for lowering the 5.5 ton (5000 kg) clump weight will be used for placing the 2.5 ton (2,500 kg) clump weight on the bottom.

The deck winch will continue to lower the chain until the pennant buoy is near the stern. The deck winch cable will then be connected to the pendant buoy. The pendant buoy will then be lowered into the water by the A-Frame and released, completing the deployment. The second WindSentinel will be deployed in the same manner at the second deployment location.

At the TRIAXYS Buoy deployment location the mooring chain will be laid out on the deck of the vessel and in a manner that will prevent tangling or twisting while it is let out into the water. The TRIAXYS buoy will then be deployed into the water, the mooring will be streamed out, and the clump weight anchor will be released. (NOTE: Final deployment procedures may be modified depending on the deployment vessel configuration.). No vessel anchoring will take place during installation.

All personnel participating in the installation will attend a pre-installation briefing (See Section 4.3).

4.2 Vessels

Ocean Wind LLC will employ AXYS to transport and deploy the Met Buoys.

It is anticipated that the deployment of the Met Buoys will require the support of both a work boat and support vessel. Ocean Wind LLC is currently proposing to use the NorthStar Commander or a similar vessel as the work boat. The NorthStar Commander is a multi-purpose offshore utility vessel with a twin screw Volvo D125-E 450 horsepower engine. The vessel measures 92 ft (28 m) in length with a 26 ft (7.9 m) beam and 8.5 ft (2.6 m) draft. Ocean Wind LLC is currently proposing to use the Northstar Enterprise or a similar vessel as the support vessel. The Northstar Enterprise is a 41 ft (12.5 m) workboat with dual inboard

motors. Depending on vessel availability at the time of installation, Ocean Wind LLC may alternately elect to use a tug and barge with crane and one support vessel. See Appendix G for vessel specifications.

4.3 Pre-Installation Briefing

Prior to the installation of the Met Buoys, all personnel will attend a pre-installation briefing as required by Lease stipulation 4.1.1. The pre-installation briefing will include a Tool-Box Talk (Appendix E) as well as HSE and hazard identification presentations. The briefing will occur prior to commissioning. The purpose of this briefing will be to review the HSE requirements and associated emergency response requirements for the proposed work, identify the responsibilities of each person, define the chains of command, discuss communication procedures, and provide an overview of planned installation activities. Additional topics for the briefing will include protected species avoidance, marine trash and debris awareness, and oil spill response procedures.

The Ocean Wind LLC onsite representative will have the authority to stop or delay any of the installation activities, if deemed necessary. If change in personnel is required during installation activities, the new personnel will be briefed as they join the work in progress.

4.4 Protected Species Avoidance

All whales, dolphins, and porpoises in the northeast region are federally protected by the MMPA. In addition many large whales in the area, as well as sea turtles, are further protected under the Endangered Species Act of 1973 (ESA).

The Lease contains specific stipulations to minimize risk to marine species that must be followed. Installation of the Met Buoys will not require pile-driving; accordingly, mitigations to reduce adverse impacts on protected species from pile driving do not apply to this installation. The Lease stipulations summarized in Table 4-1 apply to activities associated with installation, operation and decommissioning of the Met Buoys and must be adhered to.

Table 4-1 Standard Operating Conditions in the Lease Area

Addendum "C" Stipulation	Vessel Operations Conditions
4.2 Vessel Strike Avoidance Measures	
4.2.1 Vessel Strike Avoidance Measures	The Lessee must ensure that vessels conducting activity in support of a plan (i.e., SAP and/or COP) submittal comply with the vessel-strike avoidance measures specified in stipulations 4.2.1 through 4.1.2.9.1, except under extraordinary circumstances where complying with these requirements would put the safety of the vessel or crew at risk.
4.2.2	The Lessee must ensure that vessel operators and crew maintain a vigilant watch for cetaceans, pinnipeds, and sea turtles and slow down or stop their vessels to avoid striking these protected species.
4.2.3	The Lessee must ensure that all vessel operators comply with 10 knot (<18. Km/hr) speed restrictions in any Dynamic Management Area[1].
4.2.4	The Lessee must ensure that vessels 65 feet in length or greater, operating from November 1 through July 31 will operate at speeds of 10 knots (<18.5 km/hr) or less.
4.2.5	The Lessee must ensure that all vessel operators reduce speed to 10 knots or less when mother/calf pairs, pods, or large assemblages of non-delphinoid cetaceans are observer near an underway vessel.
4.2.6 North Atlantic Right Whales	
4.2.6.1	The Lessee must ensure all survey vessels maintain a separation distance of 1,640 ft (500 m) or greater from any sighted North Atlantic right whale.
4.2.6.2	The Lessee must ensure that the following avoidance measures are taken if a vessel comes within 1,640 ft (500 m) of any North Atlantic right whale:

Table 4-1 Standard Operating Conditions in the Lease Area

Addendum "C" Stipulation	Vessel Operations Conditions
4.2.6.2.1	If underway, vessels must steer a course away from any sighted North Atlantic right whale at 10 knots (<18.5 km/h) or less until the 1,640 ft (500 m) minimum separation distance has been established (except as provided in stipulation 4.2.6.2.2).
4.2.6.2.2	If a North Atlantic right whale is sighted in a vessel's path, or within 328 ft (100 m) to an underway vessel, the underway vessel must reduce speed and shift the engine to neutral. The Lessee must not engage the engines until the North Atlantic right whale has moved outside of the vessel's path and beyond 328 ft (100 m), at which point the Lessee must comply with 4.2.6.2.1.
4.2.6.2.3	If a vessel is stationary, the vessel must not engage engines until the North Atlantic right whale has moved beyond 328 ft (100 m), at which point the Lessee must comply with stipulation 4.2.6.2.1.
4.2.7 Non-Delphinoid Cetaceans other than the North Atlantic Right Whale.	
4.2.7.1	The Lessee must ensure all vessels maintain a separation distance of 328 ft (100 m) or greater from any sighted non-delphinoid cetacean.
4.2.7.2	The Lessee must ensure that the following avoidance measures are taken if a vessel comes within 328 ft (100 m) of any non-delphinoid cetacean:
4.2.7.2.1	If any non-delphinoid cetacean is sighted, the vessel underway must reduce speed and shift. The engine to neutral, and must not engage the engines until the non-delphinoid cetacean has moved outside of the vessel's path and beyond 328 ft (100 m).
4.2.7.2.2	If a survey vessel is stationary, the vessel will not engage engines until the non-delphinoid cetacean has moved out of the vessel's path and beyond 328 ft (100 m).
4.2.8 Delphinoid Cetaceans and Pinnipeds	
4.2.8.1	The Lessee must ensure that all vessels underway do not divert to approach any delphinoid cetacean and/or pinniped.
4.2.8.2	The Lessee must ensure that if a delphinoid cetacean and/or pinniped approaches any vessel underway, the vessel underway must avoid excessive speed or abrupt changes in direction to avoid injury to the delphinoid cetacean and/or pinniped.
4.2.9 Sea Turtles	
4.1.1.6.1	The Lessee must ensure all vessels maintain a separation distance of 164 ft (50 m) or greater from any sighted sea turtle.
Note: 1. A Dynamic Management Area is defined in Section 1.2 of the Lease. Vessel operators may send a blank email to ne.rw.sightings@noaa.gov for an automatic response listing all current Dynamic Management Areas.	

In addition to the Lease stipulations, between November 1 and July 1, vessel operators will monitor National Marine Fisheries Service (NMFS) North Atlantic Right Whale reporting systems (e.g., the Early Warning System, Sighting Advisory System, and Mandatory Ship Reporting System) for the presence of North Atlantic Right Whales.

4.4.1 Reporting of Injured or Dead Protected Species

During all phases of marine activities, sightings of any injured or dead protected species (sea turtles and marine mammals) will be reported within 24 hours, regardless of whether the injury or death was caused by a vessel as specified in Stipulation 4.5.1 of the Lease. All marine activities will be suspended immediately and the circumstances reported as specified below if a dead or injured right whale is found in any of the Installation Areas. The Lease stipulations summarized in Table 4-2 below apply and must also be adhered to.

Table 4-2 Protected Species Reporting Requirements in the Lease Area

Addendum "C" Stipulation	Lease Requirement
4.5.1 Reporting Injured or Dead Protected Species	The Lessee must ensure that sightings of any injured or dead protected species (e.g., marine mammals, sea turtles or sturgeon) are reported to the Lessor, NMFS and the NMFS Northeast Region's Stranding Hotline (866-755-6622 or current) within 24 hours of sighting, regardless of whether the injury or death is caused by a vessel. In addition, if the injury or death was caused by a collision with a project-related vessel, the Lessee must notify the Lessor of the strike within 24 hours. The Lessee must use the form provided in Appendix A to Addendum "C" to report the sighting or incident. If the Lessee's activity is responsible for the injury or death, the Lessee must ensure that the vessel assist in any salvage effort as requested by NMFS.
4.5.2 Reporting Observed Impacts to Protected Species	
4.5.2.1	The Lessee must report any observed takes of listed marine mammals, sea turtles or sturgeon (as defined in 1.13) resulting in injury or mortality within 24 hours to the Lessor and NMFS.
4.5.2.2	The Lessee must report any observations concerning impacts to ESA-listed marine mammals, sea turtles, or sturgeon to the Lessor and NMFS Northeast Region's Stranding Hotline within 48 hours.
4.5.2.3	The Lessee must record injuries or mortalities using the form included as Appendix A to Addendum "C".
4.5.3 Protected Species Observer Reports	The Lessee must ensure that the protected-species observer record all observations of protected species using standard marine mammal observer data collection protocols. The list of required data elements for these reports is provided in Appendix B to Addendum "C."

4.5 Avian and Bat Protection

Ocean Wind LLC will provide an annual report to the to BOEM and U.S. Fish and Wildlife Service using the contact information listed in the Lease, or updated contact information as provided by BOEM, by January 31 of each year of the site assessment term. This report will document dead or injured birds or bats found on vessels and the meteorological buoy during construction, operations, and decommissioning of the meteorological buoy. Each report will contain the following information: the name of species, date found, location, a picture to confirm species identity (if possible) and any other relevant information. In addition to submitting the annual report, Ocean Wind LLC will report carcasses with Federal or research bands to the United States Geological Survey Bird Band Laboratory within 30 calendar days of discovery using the following website: https://www.pwrc.usgs.gov/bbl/, or updated contact information as provided by BOEM.

4.6 Marine Trash and Debris Awareness and Elimination

Ocean Wind LLC will comply with and ensure that all employees and contractors are briefed on marine trash and debris awareness elimination, as required in Addendum C, Section 4.1.2 of the Lease and as described in the Bureau of Safety and Environmental Enforcement NTL No. 2015-G03 or any NTL that supersedes NTL 2015-G03.

4.7 Oil Spill Response

Each WindSentinel™ will carry approximately 238 gallons (900 liters) of diesel to provide fuel for the backup generator. Prior to commencing installation of the Met Buoys, Ocean Wind LLC will submit Oil Spill Response Measures (OSRM) for review and approval to the Oil Spill Response Division of the Bureau of Safety and Environmental Enforcement (BSEE). The measures will demonstrate compliance with the guidance provided by BOEM via email on October 26, 2017. If any information in the OSRM changes, Ocean Wind LLC will update the OSRM and provide notice to BOEM within 30 days of the update. The OSRM will become an enforceable part of the SAP upon SAP approval.

4.8 Health and Safety

Ocean Wind LLC will implement a project-specific HSE Plan to ensure the health and safety of all personnel involved in the installation, operation, and maintenance, and decommissioning of the Met Buoys. The project-specific plan will be prepared in accordance with Ørsted's standard corporate HSE policies and procedures. The HSE Plan will also address emergency response and reporting requirements. The HSE plan is included as Appendix G to this SAP.

5. Operations and Maintenance

5.1 Data Collection and Operations for Wind and Metocean Data

As stated in Sections 3 and 4 the Met Buoys will remain moored in position and transmit wind data and metocean measurements autonomously via satellite or cellular telemetry, or a Bluetooth link via the WatchMan™. The WatchMan™ will manage the operation of each sensor and the power supply system according to pre-set operation parameters. The WatchMan™ stores up to 12 months of one-second wind data and ten-minute average data through a combination of on-board memory and compact flash memory. The data can be easily retrieved with above-deck access without opening a hatch and entering the buoy compartment during in-situ service trips should remote telemetries not be available. Using the DMS software suite the operation parameters can be modified remotely to achieve optimum system performance. Ten-minute average data will be updated at least once daily to a secure remote computer accessible to Ocean Wind LLC. Via AXYS-Analytics Portal Services.

5.2 Maintenance Activities

5.2.1 WindSentinel™

Annual inspection of the mooring systems will be carried out one year after deployment of the buoys. The operational life of the buoys will only be two years so no annual inspection will be conducted at the end of the second year; rather, the buoys and their moorings will be decommissioned. During the annual inspection, the entire mooring system will be recovered, and each buoy will be towed to shore for maintenance. Following completion of the annual inspection and maintenance, each buoy and mooring system will be redeployed at the original location. The process and vessels to be used for recovery and redeployment of the buoys and mooring systems will be identical to the processes and vessels used for installation and decommissioning of the buoys. Annual inspection activities will require two rounds trips per buoy.

Inspection of the mooring system will be performed on the deck of the workboat while the buoys are being towed back to port. Items requiring service or replacement will be flagged to be addressed prior to redeployment. Maintenance tasks to be performed on the buoys while at port include removal of biofouling and refilling of the diesel fuel tanks located on each buoy.

In addition to the annual inspection, quarterly maintenance visits will be scheduled every three months for the two year operational life of the buoys. Quarterly maintenance activities will be limited to above surface bouy components, including replacement of consumables, service of sensors, data retrieval, and cleaning of solar panels and wind turbines.

5.2.2 TRIAXYS Buoy

Planned on-site maintenance for the TRIAXYS Buoy is scheduled every 3 months for the first year of operation and will be completed by a vessel comparable to the support vessel used for installation (see Section 4.2). Planned maintenance activities at the first 3-month interval would include cleaning of the ADCP sensor and cleaning of the buoy dome and hull if necessary. The 6-month maintenance will include all three-month maintenance activities, as well as visual inspection of the mooring system. At 12 months the mooring will be recovered and carefully inspected. If required, it will be changed out during the 12-month maintenance period. Ocean Wind LLC will incorporate planned maintenance activities into a comprehensive annual Self-Inspection Plan pursuant to 30 CFR 585.824(a).

5.3 Reporting

Per Lease stipulation 2.2.1, Ocean Wind LLC will submit a semi-annual progress report to BOEM every six months for the duration of the site assessment term. The semi-annual progress report will provide a brief narrative of overall progress since the previous semi-annual progress report (or since the effective date for the first semi-annual progress report). The progress report will include updated survey plans to account for modifications in schedule, as necessary. In addition to the semi-annual progress reports, Ocean Wind LLC will prepare and submit a Self-Inspection Report, an Annual Report, and a Certification of Compliance to BOEM no later than November 1 of each year for the duration of the site assessment term. See Table 5-1 for a description of the content of each report and the associated regulatory citation.

Table 5-1 Reporting Requirements

Report Name	Content	Regulatory Citation
Self-Inspection Report	The Self-Inspection Report will based on the comprehensive Self-Inspection Plan that Ocean Wind LLC will develop pursuant to 30 CFR 585.824(a).	30 CFR 585.824(b)
Annual Report	The Annual Report will provide a summary of site assessment activities and the results of those activities.	30 CFR 585.615(b)
Certification of Compliance	Together with the certification, Ocean Wind LLC will submit: • Summary reports that demonstrate compliance with the terms and conditions that require certification; and • A statement identifying and describing any mitigation measures and monitoring methods that have been taken, as well as their effectiveness. If Ocean Wind LLC identifies measures that are not effective, we will make recommendations for substitute mitigations measures and monitoring methods, and explain why we believe they would be effective.	30 CFR 585.615(c)

5.4 Potential Faults or Failures

The Met Buoys will be remotely monitored for the duration of operations, this monitoring will include a range of key indicators such as power level, buoy location, and data quality to provide an insight to the 'health' of the buoy and payload. Unplanned maintenance activities may be required in the event of a power supply failure, hull leak, buoy drift outside of designated area, mooring component failure, or other such event. If any of these problems are suspected, a technical service crew would be promptly dispatched to investigate and repair the issue. The WindSentinels™ are capable of operating at full capacity without renewable power or backup generator supply to the batteries for up to seven days. The and TRIAXYS Buoy has enough reserve power to operate in a standard sampling routine for up to three months without being recharged.

Decommissioning

BOEM requires decommissioning of facilities described in the SAP in accordance with § 585.901. Ocean Wind LLC will submit a decommissioning application to BOEM as required by § 585.902(b) prior to

decommissioning of the Met Buoys. Following BOEM approval of the decommissioning application, Ocean Wind LLC will notify BOEM at least 60 days prior to vessel deployment.

5.5 Overview of Decommissioning Activities

Upon completion of SAP activities, the Met Buoys will be decommissioned. The decommissioning process will be similar to the installation process but in reverse. Similar types and numbers of vessels used for the installation of the Met Buoys would be used for decommissioning. Mooring recovery will begin with the connection and lift of the pendant buoy to the deck using the vessel crane. The pendant buoy will be disconnected from the mooring and moved away from the work area using the vessel crane and secured to the deck. The mooring chain will then be connected to the winch and wound onto the main deck winch until the 2.5 ton (2,500 kg) clump weight reaches the surface. The 2.5 ton (2,500 kg) clump weight will be lifted to deck, disconnected from the winch, moved away from the work area and secured to the deck. The mooring chain will then be wound onto the main deck winch until the 5.5 ton (5,000 kg) clump weight reaches the surface. The 5.5 ton (5,000 kg) clump weight will be lifted to deck, disconnected from the winch, moved away from the work area and secured to the deck. The Met Buoys will then be towed back to port.

5.6 Site Clearance

The operation of the Met Buoys is not expected to result in any trash or bottom debris. However, Ocean Wind LLC will ensure that the seafloor has been cleared of all obstructions created by activities on the Lease as required in § 585.902(a)(2). This will be accomplished via photo documentation of all deployed and retrieved equipment. As stated in Section 4.1, Ocean Wind LLC will provide an Installation Report that will contain the final coordinates and photo documentation of the equipment that was deployed. At the completion of decommissioning, similar documentation will be provided to BOEM to confirm that all equipment was retrieved from the site.

5.7 Reporting

As specified in the Lease, Addendum C, Section 2.2, Ocean Wind LLC will submit semi-annual progress reports to BOEM throughout the duration of activities covered by the SAP. At the conclusion of the site assessment activities a Decommissioning Report will be prepared in accordance with §§ 585.900-913 and provided to BOEM with the semi-annual progress reports, or upon request. This report will include a description of the process and equipment used for decommissioning the Met Buoys and confirmation of site clearance.

6. Affected Environment, Potential Impacts, and Mitigation Measures

The following sections describe the affected environment, impacts and proposed mitigation measures for benthic resources, archaeological resources, and geophysical conditions which have been developed through site surveys and analysis that were conducted in June through July 2017 in support of the SAP. Surveys at each Buoy Deployment Area covered approximately 69.2 acres (28 ha) (Figure 1-1). Site surveys and analysis followed a detailed SAP Survey Plan which included protocols, methods, and/or used data that represented the state of industry techniques and knowledge at the time of the study. The SAP Survey Plan, detailing the SAP survey approach, timing, identified surveys, and reporting, was accepted by BOEM on June 15, 2017.

The analysis focuses on the maximum area of potential disturbance associated with the installation, operation, and decommissioning of the Met Buoys (site assessment activities): approximately 3.2 acres

(1.8 ha) for the Western Buoy Deployment Area and 2.6 acres (1.1 ha) for the Eastern Buoy Deployment Area.

As stated in Section 3.3, the two Deployment Areas where the Met Buoys are proposed to be located have been given unique identifiers. The Western Buoy Deployment Area will have a WindSentinel™ and TRIAXYS, located at positions F1 and B1 as indicated in Table 3-1. The Eastern Buoy Deployment Area will have a WindSentinel™ at location F2, per Table 3-1. The coordinates for these locations are provided in Table 3-1 and depicted on Figure 1-1.

6.1 Geological Conditions

The following section summarizes results of the high-resolution geophysical (HRG) survey that was conducted in June-July 2017. The survey was conducted in accordance with the plan, approved by BOEM on June 15, 2017. The full site characterization report is provided in Appendix C.

The HRG survey and sampling program involved acquisition of the following data:

- **Multibeam echosounder bathymetry**– to determine water depths and topographic features on the seabed and initial review of surficial sediment;
- **Sidescan sonar imagery** – acoustic seabed imagery used to map surficial sediment distributions and bedforms, as well as detect possible natural and anthropogenic hazards on the seabed such as boulders, debris, and shipwrecks;
- **Sub-bottom profiler** – a subsurface investigation using a pinger shallow-penetration sub-bottom profiler to investigate shallow (up to 66 ft / 20 m) sediment stratigraphy;
- **Magnetometer** – fluctuations in the magnetic field were measured to detect ferrous items on the seabed that could be potential hazards or cultural deposits, included debris and shipwrecks;
- **Sediment grab samples** – to ground-truth interpretation of the geophysical data; and
- **Underwater video imagery** – collected using a remotely operated camera to identify natural and human-caused obstructions, as well as aid in benthic habitat assessment.

Data from the HRG and sampling program, along with information from publically-available databases were compiled and reviewed to describe the surface and subsurface geologic conditions in the Buoy Deployment Areas. Table 7-1 summarizes the water depth, surficial seafloor sediment, and side scan or magnetometer within the Buoy Deployment Areas.

6.1.1 Western Buoy Deployment Area

Water depths across Western Buoy Deployment Area range between 16.2m and 23.3m MLLW. Water depth at the proposed Pendant 1, F1 and B1 Locations is 22.3m MLLW, 21.8m MLLW and 20.2m MLLW respectively. The seafloor is generally flat in the east of the area, displaying gradients of less than 0.5°. This is exceeded only on the edges of a shallow trough orientated northwest / southeast with gradients up to 3°. In the Western Buoy Deployment Area the seafloor is characterized by a series of shallow troughs orientated northwest / southeast, the edges of which display gradients up to 3°. Bathymetry contours for the Western Buoy Deployment Area are presented as Chart 10969.02 in Appendix C.

Seabed features and side-scan sonar data indicate that the Western Buoy Deployment Area is located in an area of medium to coarse sand with occasional gravel, with ripples and megaripples as confirmed by environmental camera and grab samples. Seabed Features and the side scan sonar mosaic for the Western

Buoy Deployment Area are presented as Chart 10969.03 and Chart 10969.04 respectively in Appendix C. Two geologic features are identified in the side scan sonar data and classified as boulders. One of these features (SSS_014) is located within the Anchor Chain Sweep Area.

Total magnetic field contours for the Western Buoy Deployment Area are presented as Chart 10969.05 in Appendix C. Two magnetic anomalies occur within the Western Buoy Deployment Area, see Appendix C. None of the anomalies are located within the Anchor Chain Sweep Area, and none of the anomalies are associated with side scan sonar targets.

Acoustic penetration with the shallow seismic pinger system was good with seismic reflections present to greater than 20m below seabed. There is a good correlation between the shallow seismic pinger data and the medium penetration seismic data though the resolution of the pinger data is considerably better. From these combined datasets, the base of the Holocene transgressive sediments has been mapped, presented on Chart 10969.06 in Appendix C. The base of these sediments at the Pendant 1, F1 and B1 location is 1.5m, 1.7m and 2.8m below seabed respectively, and is present across the Western Buoy Deployment Area, deepening to the east. Below Holocene transgressive sediments lie the interpreted late-Pleistocene sediments, which contain a number of unconformities. An assumed seismic velocity of 1700m/s was used for time to depth conversion throughout.

6.1.2 Eastern Buoy Deployment Area

Water depths across Eastern Buoy Deployment Area range between 26.2m and 29.5m MLLW. Water depth at the proposed Pendant 2 and F2 locations is 26.6m MLLW and 26.8m MLLW, respectively. The seafloor is characterized by a series of shallow troughs orientated WNW / ENE, these being more pronounced towards the west of the area. The seabed generally displays a gradient <0.5° and locally up to 3° on the slopes of the shallow troughs. Bathymetry contours for the Eastern Buoy Deployment Area are presented as Chart 10969.08 in Appendix C.

Seabed features and the side-scan sonar data indicate that Eastern Buoy Deployment Area is located in a region of medium to coarse sand with shallow troughs containing gravelly coarse sand (Laboratory grain size analysis results pending). Seabed Features and a side scan sonar mosaic for the Eastern Buoy Deployment Area are presented as Chart 10969.09 and Chart 10969.10 in Appendix C respectively. No objects are present in the side scan sonar data within the Eastern Buoy Deployment Area.

Total magnetic field contours for the Eastern Buoy Deployment Area are presented as Chart 10969.11 in Appendix C. Two magnetic anomalies occur within the Eastern Buoy Deployment Area, and none of the anomalies are located within the smaller Anchor Chain Sweep Area, see Appendix C.

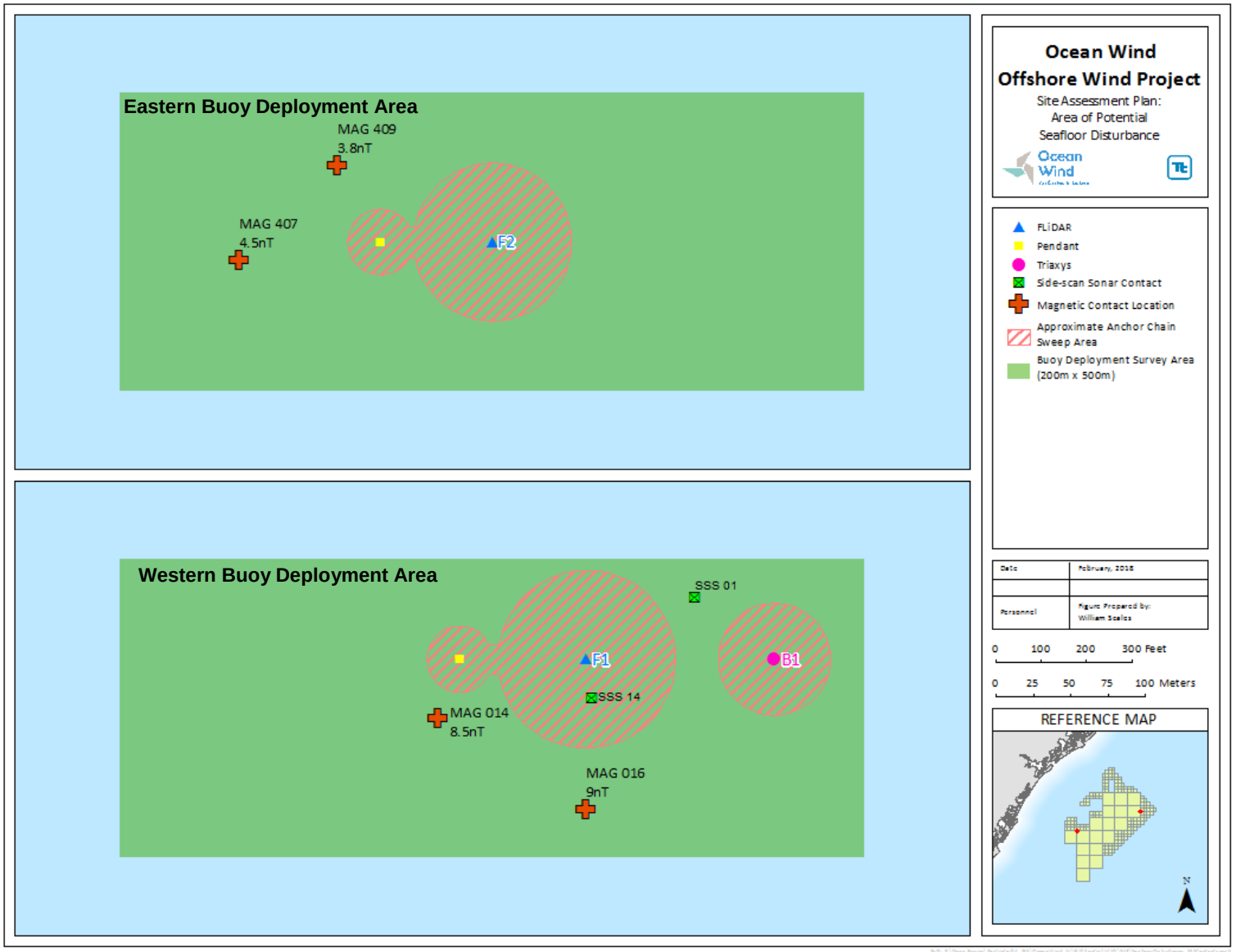

Figure 7-1 Area of Potential Seafloor Disturbance with Surveyed Magnetic Anomalies and Side Scan Targets

None of these anomalies are associated with side scan sonar targets. All four of the magnetic anomalies fall outside of the Approximate Anchor Chain Sweep Area (Figure 7-1).

Acoustic penetration with the shallow seismic pinger system was good with seismic reflections present to greater than 20m below seabed. There is a good correlation between the shallow seismic pinger data and the medium penetration seismic data though the resolution of the pinger data is considerably better. From these combined datasets, the base of the Holocene transgressive sediments has been mapped, presented on Chart 10969.12 in Appendix C. The base of these sediments at the Pendant 2 and F2 location is 11.2m and 10.8m below seabed respectively, and is present across the Eastern Buoy Deployment Area deepening to the west. Below the Holocene transgressive sediments lie the interpreted late-Pleistocene sediments, which contain a number of unconformities. An assumed seismic velocity of 1700m/s was used for time to depth conversion throughout.

6.1.3 Natural Seafloor and Sub-Seafloor Hazards

The HRG datasets were analyzed for seafloor and sub-seafloor hazards, which could pose a potential risk to the installation, operation, and maintenance of the FLIDAR and Metocean/current buoys. The side scan and multibeam bathymetry datasets were interpreted and found to contain no evidence of the surficial expression of shallow faults, and the sub-bottom profiler data showed no significant offsets of sedimentary bedding indicative of shallow faults. No areas of acoustic whiteouts or other amplitude anomalies were observed in the sub-bottom profiler data, as would be anticipated for any significant accumulation of shallow gas. The sub-bottom profiler records do not contain any bottom simulating reflectors, which are a typical indication of the presence of hydrates. The generally low relief of the two Deployment Areas, along with the lack of observed buried failure planes, slump blocks, or other evidence of mass wasting in the sub-bottom profiler records indicate that slump blocks and slump sediment are not found within the study area. The interpretation of the side-scan sonar, multibeam bathymetry, and sub-bottom profile datasets provide no evidence of ice scour, such as seabed gouging by either icebergs or sea ice pressure ridges. Additionally, no craters or other seabed evidence of strudel scours were noted in any of the datasets.

The HRG datasets were used to determine the presence or absence of additional geological hazards (see Table 7-1). The side scan sonar, multibeam bathymetry, and sub-bottom profiler datasets were reviewed and do not provide any evidence of seismic activity, such as extensive or regional faulting or slump and mass wasting features. Additionally, no fault zones, nor any other faulting activity, are identified either from seabed data or from the sub-bottom profiler records, as would typically be indicated by offset sedimentary bedding planes in the sub-bottom profiles or linear fault-related features on the seabed. No faults or other sedimentary features indicative of differential compaction or localized seabed subsidence have been identified. As there has been no faulting identified, there has also been no evidence of faulting attenuation effects observed in the geophysical datasets. These results are consistent with the expected nature of the passive continental margin off of New Jersey.

Table 7-1 Seafloor and Sub-Seafloor Hazards

Hazard	Definition	Identified and Description
Seafloor		
Scarp	An exposed face of soil above the head of a landslide.	None identified on bathymetry data.
Channels	The deepest portion of a body of water through which the main volume or current of water flows.	None identified on bathymetry data.
Ridges	A relatively narrow elevation which is prominent on account of steep angle at which it rises.	None identified on bathymetry data.

Table 7-1 Seafloor and Sub-Seafloor Hazards

Hazard	Definition	Identified and Description
Bedforms	Features that develop due to the movement of sediment by the interaction of flowing water; critical angle and forces required for movement are dependent upon many factors.	Shallow troughs up to 0.5m deep with gradients of up to 3° in both Buoy Deployment areas. Additionally, Sand ripples and megaripples occur in the Western Buoy Deployment Area.
Exposed Rocky Area	Surface expression of bedrock outcropping on seafloor.	None identified on bathymetry, side scan sonar or pinger data.
Boulders	Glacial erratics (boulders) greater than 12 inches in diameter; outcropping coarse till/drift or lag deposit.	In the Western Buoy Deployment Area, two SSS contacts are identified as boulders. The height above the seafloor for each is approximately 4 inches (0.1 m). No contacts are identified in the bathymetry or SSS data in the Eastern Buoy Deployment Area.
Buried Boulders	Glacial erratics (boulders) greater than 12 inches in diameter; subsurface coarse till/drift or lag deposits.	In the Western Buoy Deployment Area, two SSS contacts are identified as boulders. The height above the seafloor for each is approximately 4 inches (0.1 m). No contacts are identified in the bathymetry or SSS data in the Eastern Buoy Deployment Area.
Pock Marks / Depressions	Craters in the seabed caused by fluids (gas and liquids) erupting /streaming through the seabed sediments.	None identified on bathymetry data.
Seabed Scars / Ice Scour / Drag Marks	Incisions or cuts into the seafloor may be associated with glacial advances/retreats or bottom fishing activity.	None identified on bathymetry data or side scan sonar data.
Buried Channels	Former fluvial drainage pathways during sea level low stands, usually only deepest portion of the waterway in-filled and preserved. Mark ancestral patterns of glacier meltwater runoff.	None identified in the sub-bottom data.
Submarine Canyons	Steep-sided valley cut into the seafloor of the continental slope, sometimes extending well onto the continental shelf.	None identified on bathymetry data.
River Channel	Outline of a path of relatively shallow and narrow body of fluid	None identified on bathymetry data.
Exposed Hardbottom Surfaces	Any semi-lithified to solid rock strata exposed at the seafloor; in this area, may include bedrock or a nearly continuous pavement of fragmented rock or boulders.	None identified on bathymetry, side scan sonar or pinger data.
Shallow Gas	Subsurface concentration of material in gaseous form that has accumulated by the process of decomposition of carbon-based materials (former living organisms).	None identified on bathymetry, side scan sonar or seismic data.
Gas Hydrates	Subsurface gas deposits that were formed at or near the seafloor in association with hydrocarbon seeps.	None identified on sub-bottom data.
Gas/Fluid Expulsion Features	Upward movement of gas/fluid via low resistance pathways through sediments onto the seafloor; may be related to other hazards diapirs, faults, shallow water flows).	None identified on bathymetry, side scan sonar or sub-bottom data.
Diapiric Structure Expressions	The extrusion of more mobile and ductily-deformable material forced onto the seafloor from pressure below.	None identified on sub-bottom data.
Karst Areas	Landscape formed from the dissolution of soluble rocks.	None identified in the sub-bottom data.
Faults, Faulting Expression, Fault Activity	Physiographic feature (surface expression) related to a fracture, fault, or fracture zone along which there has been displacement of the sides relative to one another.	None identified on sub-bottom data.
Slumping, Sliding Seafloor Features	Large scale structures that result from the downslope movement of sediments due to instability and gravity. In the submarine environment these structures are often found in slope environments along coastal margins.	None identified on bathymetry, side scan sonar or sub-bottom c data.
Steep/Unstable Seafloor Slopes	Large scale feature/stretch of ground forming a natural or artificial incline, with a slope that approaches the angle of repose (maximum angle at which the material remains stable).	None identified on bathymetry, side scan sonar or sub-bottom data.
Scour/Erosion Features	Erosion of material due to water flow. Often associated with erosion adjacent to larger natural and man-made structures.	None identified on bathymetry, side scan sonar or sub-bottom data.
Sensitive Benthic Habitats	Shallow water habitats of submerged aquatic vegetation including macroalgae and sea grasses	None identified on bathymetry, side scan sonar or sub-bottom data.

Table 7-1 Seafloor and Sub-Seafloor Hazards

Hazard	Definition	Identified and Description
(chemosynthetic communities, submerged aquatic vegetation)		

Based on the Ocean Wind Geophysical Site Investigation Site Characterization Report for Site Acquisition Plan (Appendix C), the site conditions are suitable for the installation of the Metocean Buoys and associated mooring equipment in each of the two Buoy Deployment Areas. No notable hazards have been identified which would preclude installation at these locations. The rippled seabed may indicate minor seabed currents, but no larger scour-related features, such as deep moats, nor evidence of large-scale migrating bedforms are present in the seabed and shallow subsurface datasets. Due to the absence of these more significant features, seabed currents are inferred to be modest and seabed scour due to bottom currents is not anticipated to be a significant issue for the mooring systems.

6.2 Archaeological Resources

The following section summarizes the analysis and findings described in the Marine Archaeological Resource Assessment Report (Appendix D).

6.2.1 Affected Environment

Installation of the Met Buoys has the potential to affect submerged archaeological resources. Background research indicates that the Eastern buoy deployment location was inundated by approximately 10,000-10,500 ya when sea level was 30-32 m lower, while the Western buoy deployment location was inundated by approximately 7,700-8,000 ya when the water elevation was 20-22 m lower than present. The Western buoy deployment location was sub-aerially exposed and available for human occupation for +/-2,000-2,500 years longer than the Eastern buoy deployment location.

There are a number of reasons to suggest that the Holocene transgression likely removed any evidence of pre-contact settlements in this portion of the now submerged coastal plain (Schmidt et al. 2017). The relatively straight coastline did not provide any areas of protection from assault by the open ocean since there was only minimal shoreline geomorphology and topography. The character of this area at the end of the Pleistocene and in the early Holocene was quite different in terms of overall climate, topography and the nature of the fluvial/drainage systems that flowed into the Atlantic. There is no obvious fluvial drainage today that might suggest similar sediment input in the past. The drainage systems that existed during periods of lower sea levels were characterized by more extensive down cutting of channels due to steeper gradients, producing a far different landscape than the embayed estuaries and drowned stream valleys that mark drainages entering the Mid-Atlantic coast today. Patterns of deposition in such stream valleys, and thus the potential for preservation (or lack thereof) of archaeological deposits in stratified contexts, also differed from those prevailing under the current gradient conditions tied to today's much higher sea levels. Low sedimentation rates means habitation sites were not buried significantly and thus were more exposed to the effects of transgression. Burial is considered by many as a prerequisite for preservation. Inferred slows of sea level rise would have eroded more material and further reduced the possibility of preservation. Thus, the Lease Area has a low to moderate potential for preservation of in-situ pre-contact archaeological sites.

Historic period archaeological sites that may exist within offshore portions of the survey area are predominantly related to marine activity, such as historic shipwrecks from the 17th to 20th centuries (BOEM 2013). Background research indicates that there have been numerous vessel wrecks in the Lease Area but none are located within or in close proximity to the proposed Buoy Deployment Areas (see Appendix D).

R. Christopher Goodwin & Associates, Inc. conducted an archaeological assessment of the HRG survey data acquired in 2017 for the Project (described in Section 7.1). The HRG survey and archaeological assessment were performed in accordance with the Ocean Wind Offshore Wind Farm HRG and Geotechnical Survey Plan, which was reviewed and approved by BOEM on June 15, 2017.

The HRG survey utilized numerous remote survey methods including: marine magnetometer, side scan sonar, subbottom profiler, and multibeam echosounder. Archaeological review of the survey data focused on the entire Buoy Deployment Areas, although bottom disturbing activity will be limited to the anchor sweep area (Figure 3-3). The qualified marine archaeologist (QMA) from Goodwin, identified no magnetic anomalies and no side scan sonar contacts representing submerged cultural resources within the two Buoy Deployment Areas. Sub-bottom profiler data was collected and analyzed to identify paleolandscape features. This data indicated that no prominent seismic reflectors indicative of paleo-landforms are present that may preserve inundated archaeological sites.

6.2.2 Potential Impacts and Proposed Mitigation Measures

Based upon the results of the 2017 marine archaeological assessment (Appendix D), no potential submerged cultural or archaeological resources were identified within Buoy Deployment Areas as such the installation and operation of the proposed Met Buoys would result in no impacts to marine archaeological resources. Due to the height of the FLiDAR buoys (13.5 ft [4.1 m] from the sea surface to the top of the hull mast) and the distance from shore (approximately 12 nautical miles southeast of Strathmere, New Jersey, and 18 nautical miles south of Atlantic City, New Jersey), the installation and operation of the met facilities will not result in any visual impacts.

6.3 Benthic Resources

The following section summarizes results of the benthic habitat assessment that was conducted in June-July 2017. The survey was conducted in accordance with the plan, approved by BOEM on June 15, 2017. The full benthic habitat assessment report is provided in Appendix E.

Benthic sampling and visual investigations were carried out using a stainless-steel 0.1 m^2 Day grab. The grab carried extra weights where appropriate to induce better penetration on impact and an extended bucket lip to reduce sediment washout. Storm feet and elastic straps were used to reduce the likelihood of the instrument pre-triggering in the water column during deployment. An attached, protective enclosure held a SubSea 1Cam HD digital camera with a dedicated video lamp.

6.3.1 Western Buoy Deployment Area

Western Buoy Deployment Area was characterized with side sonar imagery by large bands of different reflectivity, with a distinct border between a lower reflectivity, rippled area and a high reflectivity, mega rippled area not far from the proposed buoy location.. Two grab sample stations were sampled to ground truth both the sediment types noted on the side scan data.

The high reflectivity mega rippled area consisted of gravelly sand with shells, shell fragments and occasional cobbles. The lower reflectivity area consisted of medium sand with occasional shell fragments

and sand ripples were also observed. Fauna observed included: Annelida (Polychaeta, tube worms), Arthropoda (Amphipoda, *Paguroidea, Brachyura*), Cnidaria (Ceriantharia), Mollusca (*Nucella lapillus*), and Pisces (*Urophycis regia*). Coastal and Marine Ecological Classification Standard (CMECS) Biotic classification of stations was limited due to the lack of macrofauna data. Both Stations at Western Buoy Deployment Area were categorized up to Biotic Subclass as 'Soft Sediment Fauna'.

There was no evidence from the seabed imagery or sampling of any protected or unique habitats within Western Buoy Deployment Area. No benthic species are listed under the ESA and no protected fish species were observed.

6.3.2 Eastern Buoy Deployment Area

Eastern Buoy Deployment Area was characterized as uniformly flat with low reflectivity seabed and sparse, poorly-defined possible sandwaves. One station was sampled to ground truth the sediment in this area.

Seabed imagery indicated that the low reflectivity seabed consisted of medium sand with occasional shell fragments. Fauna observed included: Annelida (Polychaeta, tube worms), Arthropoda (Amphipoda), Echinodermata (Clypeasteroida, *Echinarachnius parma*), Mollusca (*Nucella lapillus*), and Pisces (*Prionotus carolinus*). CMECS Biotic classification was possible due to aggregations of the common sand dollar *Echinarachnius parma*. The Biotic Community is categorized as '*Echinarachnius parma* Bed'.

There was no evidence from the seabed imagery or sampling of any protected or unique habitats within Eastern Buoy Deployment Area. No benthic species are listed under the ESA and no protected fish species were observed.

6.4 Fisheries

As demonstrated in Section 2, the equipment and methodologies proposed herein by Ocean Wind LLC are consistent with the activity considered by BOEM in the Mid-Atlantic EA (BOEM, 2012). Section 4.1.2.7 of the EA provide details on the affected environment and potential impacts to fisheries that may be present during the proposed site assessment activity and is incorporated by reference and not repeated.

Ocean Wind LLC has reviewed currently available literature and data (see Section 8.2) regarding fisheries in the Mid-Atlantic off the coast of New Jersey and has determined that there is no substantive new information that would change BOEM's analysis. While stock assessments for the Mid-Atlantic have been updated since 2012, species assemblages as described in the Mid-Atlantic EA remain relevant. In addition, at the time of publication of the Mid-Atlantic EA, the Atlantic sturgeon was under review for listing under the ESA. Since publication of the Mid-Atlantic EA, NMFS has designated critical habitat for Atlantic Sturgeon. However, the designated critical habitat does not fall within the Lease Area. This species was listed endangered in 4 out of 5 Distinct Population Segments (DPS's), including the New York Bight, and threatened in the Gulf of Maine DPS (77 FR 5880; 77 FR 5913). However, the actual listing of the Atlantic sturgeon does not change the results of the EA and BOEM's analysis and conclusion that the proposed activity is not anticipated to result in any significant or population-level effects to fisheries is applicable.

While no specific stipulations concerning interactions with commercial and recreational fishing are provided in the Lease, as recommended in BOEM's October 20, 2015 Fisheries Social and Economic Conditions guidance document (BOEM 2015), Ocean Wind LLC will develop a Fisheries Communication Plan and has hired a Fisheries Liaison Officer, Mr. John Williamson, and Fisheries Industry Representative, Mr. Art Unkefer, who was on board the HRG survey vessel during the SAP survey activities. As necessary, Mr.

Williamson will conduct outreach with the surrounding commercial and recreational fishing communities prior to buoy deployment. Outreach with commercial and recreational fishermen will continue throughout the site assessment term. In addition, Ocean Wind LLC will notify commercial and recreational fishermen, as well as other users of the area about the proposed activities via a LNM and broadcasts on Marine Channel 16 prior to installation and decommissioning. Ocean Wind LLC will also submit an application to the USCG for a PATON for the Met Buoys (see also Section 4 and Table 1-2).

In addition, Ocean Wind LLC has committed to implementing BMPs for the installation, operation, and decommissioning of the met buoys in order to further reduce the potential for interactions with or impacts on fisheries. Ocean Wind LLC will comply with any additional stipulations as set forth in permits or approvals in support of the proposed site assessment activity.

6.5 Marine Mammals and Sea Turtles

As demonstrated in Section 2, the equipment and methodologies proposed herein by Ocean Wind LLC are consistent with the activity considered by BOEM in the Mid-Atlantic EA (BOEM, 2012). Sections 4.1.2.3 and 4.1.2.4 of the EA provide details on the species and seasonal occurrence of marine mammals and sea turtles that may be present during the proposed site assessment activity and is incorporated by reference and not repeated.

Ocean Wind LLC has reviewed publically available literature and data published since the Mid-Atlantic EA and Finding of No Significant Impact were issued (see Section 8.3). There is no substantive new information that would change BOEM's analysis and conclusion that the proposed activity is not anticipated to result in any significant or population-level effects to marine mammals.

Ocean Wind LLC has committed to implementing all applicable lease conditions, which include BMPs for the installation, operation, and decommissioning of the met buoys in order to further reduce the potential for interactions with or impacts on marine wildlife. Ocean Wind LLC will comply with any additional stipulations as set forth in permits or approvals in support of the proposed site assessment activity.

Pile driving activity is not required for met buoy installation and therefore design criteria established in Appendix B.1.3 associated with acoustic harassment and mitigation measures are not applicable.

6.6 Avian and Bat Resources

As demonstrated in Section 2, the equipment and methodologies proposed herein by Ocean Wind LLC are consistent with the activity considered by BOEM in the Mid-Atlantic EA (BOEM, 2012). Sections 4.1.2.5 and 4.1.2.6 of the EA provide details on the species and seasonal occurrence of avian and bat resources that may be present during the proposed site assessment activity and is incorporated by reference and not repeated.

Ocean Wind LLC has reviewed currently available literature and data (see Section 8.4) regarding avian and bat resources in the Mid-Atlantic off the coast of New Jersey and has determined that there is no substantive new information that would change BOEM's analysis. The results of the EA and BOEM's analysis and conclusion that the proposed activity is not anticipated to result in any significant or population-level effects to avian and bat resources is applicable.

Ocean Wind LLC has committed to implementing all applicable lease conditions, which include BMPs for the installation, operation, and decommissioning of the met buoys in order to further reduce the potential

for interactions with or impacts on avian and bat resources. Ocean Wind LLC will comply with any additional stipulations as set forth in permits or approvals in support of the proposed site assessment activity.

6.7 Water Quality

As demonstrated in Section 2, the equipment and methodologies proposed herein by Ocean Wind LLC are consistent with the activity considered by BOEM in the Mid-Atlantic EA (BOEM, 2012). Section 4.1.1.2 of the EA provide details on the potential impacts to water quality that result from the proposed site assessment activity and is incorporated by reference and not repeated.

Ocean Wind LLC has reviewed currently available literature and data (see Section 8.5) regarding water quality in the Mid-Atlantic off the coast of New Jersey and has determined that there is no substantive new information that would change BOEM's analysis. The results of the EA and BOEM's analysis and conclusion that the proposed activity is not anticipated to result in any significant impact to water quality is applicable.

Ocean Wind LLC has committed to implementing all applicable lease conditions, which include BMPs for the installation, operation, and decommissioning of the met buoys in order to further reduce the potential for impacts on water quality. Ocean Wind LLC will comply with any additional stipulations as set forth in permits or approvals in support of the proposed site assessment activity.

6.8 Air Quality

The closest points of land to the proposed site assessment activity are located in Atlantic County and Cape May County, New Jersey. Each of these counties has been designated as moderate nonattainment with respect to the 1997 8-hour ozone (O_3) standard in the revised National Ambient Air Quality Standards (NAAQS), and as marginal nonattainment with respect to the 2008 8-hour O_3 standard. In addition, the Environmental Protection Agency (EPA) has designated New Jersey as an unclassifiable/attainment area for the new one-hour NO_2 NAAQS, which was promulgated in 2010, pending the collection of additional monitoring data. A similar designation is expected for the one-hour sulfur dioxide (SO_2) NAAQS. New Jersey is designated as unclassifiable or attainment for all other NAAQS. Finally, all of New Jersey is within the Northeast Ozone Transport Region as designated by the Clean Air Act.

A notice of intent (NOI) was prepared in accordance with the EPA's Outer Continental Shelf (OCS) air regulations (40 CFR 55) for the two FLIDAR buoys, each of which will be equipped with a small backup diesel generator engine and will therefore be considered OCS sources. It is believed that the marine vessels proposed to be used for installation, maintenance, and decommissioning of the FLIDAR buoys will not themselves be OCS sources, as defined in 40 CFR 55.2, because they will never be permanently or temporarily attached to the seabed, and because they will not have any "stationary source aspects" during any times they may be physically attached to an OCS facility. This NOI was submitted to the EPA regional office and to the New Jersey Department of Environmental Protection Air Quality Permitting Program.

6.8.1 Potential Impacts and Proposed Mitigation Measures

The proposed site assessment activity has the potential to impact local air quality. Potential emission sources would however be limited to a work boat and a support vessel. Vessels associated with these activities would emit criteria air pollutants (NO_x, carbon monoxide [CO], sulfur dioxide [SO_2], particulate matter less than 10 microns in diameter [PM_{10}], particulate matter less than 2.5 microns in diameter [$PM_{2.5}$]), and VOCs), hazardous air pollutants (HAPs) and greenhouse gasses [GHGs]). Vessels would emit pollutants both in state and federal waters while traveling to and from the Installation Areas throughout the operational lifecycle of the proposed buoys. Impacts from pollutant emissions associated with these vessels

would likely be localized within the immediate vicinity of the site assessment activity. Equipment and fuel suppliers will be required to provide equipment and fuels for the Project that have been certified to be in compliance with the applicable EPA standards or equivalent.

It is anticipated each FliDAR buoy will require one working day for installation, as well as one working day for decommissioning. A one-time annual inspection is anticipated to require two working days per buoy, bringing the total to 8 work boat days for installation, annual inspection, and decommissioning. Ocean Wind has also assumed a support vessel will accompany the work boat for all tasks, as well as conducting three round trips per year for quarterly maintenance during the two-year operational period, for a total of 14 support vessel round trips during all phases of the Project. A summary of the air emission estimates is presented in Table 7-2, and the detailed emission calculations and assumptions (including distances and durations for each marine vessel task) are presented in Appendix G.

Table 7-2 Ocean Wind Met Facilities Air Emissions Summary

Met Facilities Activity	VOC tons	NO_X tons	CO tons	PM/PM_{10} tons	$PM_{2.5}$ tons	SO_2 tons	HAPs tons	GHG tons CO2e
Installation Activities	0.009	0.23	0.13	0.008	0.008	4.23E-05	0.001	16.2
Quarterly Maintenance Activities	0.004	0.14	0.07	0.004	0.004	1.84E-05	0.001	9.9
FLiDAR Backup Generators	0.005	0.04	0.01	0.001	0.001	3.47E-05	9.15E-05	3.8
Annual Inspection	0.017	0.45	0.26	0.016	0.015	8.46E-05	0.002	32.5
Decommissioning Activities	0.009	0.23	0.13	0.008	0.008	4.23E-05	0.001	16.2
Maximum Annual Emissions [1]	**0.035**	**0.86**	**0.47**	**0.028**	**0.027**	**1.80E-04**	**0.004**	**62.5**
Total Project Lifetime Emissions	**0.053**	**1.26**	**0.69**	**0.040**	**0.039**	**2.75E-04**	**0.007**	**92.4**

Note:
1. The maximum annual emissions assumes that the quarterly and annual maintenance activities, the annual inspection, and either the installation or decommissioning activities occur in the same year.

Emissions associated with the site assessment activity would be minor based on the estimate of less than 50 tons per year of NO_X and VOCs, 100 tons per year of the other criteria air pollutants, and 25 tons per year of HAPs or 10 tons per year of any individual HAP. The majority of these emissions would occur within Installation Areas and therefore would not affect local onshore air quality in New Jersey.

6.9 Socioeconomic Resources

As demonstrated in Section 2, the equipment and methodologies proposed herein by Ocean Wind LLC are consistent with the activity considered by BOEM in the Mid-Atlantic EA (BOEM, 2012). Section 4.1.3 of the EA provide details on the affected environment and potential impacts to socioeconomic resources that may result from the proposed site assessment activity and is incorporated by reference and not repeated.

Ocean Wind LLC has reviewed currently available literature and data (see Section 8.7) regarding socioeconomic resources in the Mid-Atlantic off the coast of New Jersey and has determined that there is no substantive new information that would change BOEM's analysis. The results of the EA and BOEM's analysis and conclusion that the proposed activity is not anticipated to result in any significant impact to socioeconomic resources is applicable.

Ocean Wind LLC has committed to implementing all applicable lease conditions, which include BMPs for the installation, operation, and decommissioning of the met buoys in order to further reduce the potential

for impacts on social and economic resources. Ocean Wind LLC will comply with any additional stipulations as set forth in permits or approvals in support of the proposed site assessment activity.

6.10 Meteorological and Oceanographic Hazards

As demonstrated in Section 2, the equipment and methodologies proposed herein by Ocean Wind LLC are consistent with the activity considered by BOEM in the Mid-Atlantic EA (BOEM, 2012). Section 3.2.1 of the EA provide details on the affected environment and potential impacts to meteorological and oceanographic conditions by the proposed site assessment activity and is incorporated by reference and not repeated.

Ocean Wind LLC has reviewed currently available literature and data (see Section 8.8) regarding meteorological and oceanographic conditions in the Mid-Atlantic off the coast of New Jersey and has determined that there is no substantive new information that would change BOEM's analysis. The results of the EA and BOEM's analysis and conclusion that the proposed activity is not anticipated to result in any significant impact to meteorological or oceanographic conditions is applicable.

Ocean Wind LLC has committed to implementing all applicable lease conditions, which include BMPs for the installation, operation, and decommissioning of the met buoys in order to further reduce the potential for impacts on meteorological or oceanographic conditions. Ocean Wind LLC will comply with any additional stipulations as set forth in permits or approvals in support of the proposed site assessment activity.

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Appendix A
Permits and Consultations

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From:	Pernille Hermansen
To:	James Bennett
Cc:	Waskes, Will; Rina Stender Sapru
Subject:	Contains Privileged or Confidential Information: Preliminary Term Extension Request for Ocean Wind Lease OCS-A 0498
Attachments:	image002.jpg
Sensitivity:	Confidential

Dear Mr Bennett,
Please see attached a Request for Extension of the Preliminary Term for the Ocean Wind Project lease OCS-A 0498 including a file containing confidential information relating to the extension request.

Please don't hesitate to contact me if you have any questions or require any further information.

Many thanks,
Pernille

Best regards
Pernille Hermansen
Project Manager
Permitting Project Management
Wind Power

Kraftværksvej 53
7000 Fredericia
Denmark
Tel. +45 99 55 67 86

peher@dongenergy.dk
www.dongenergy.com

United States Department of the Interior

BUREAU OF OCEAN ENERGY MANAGEMENT
WASHINGTON, DC 20240-0001

Mr. Thomas Brostrøm
Ocean Wind LLC
c/o DONG Energy Wind Power (U.S.) Inc
One International Place
100 Oliver Street, Suite 1400
Boston, Massachusetts 02110

Dear Mr. Brostrøm:

The Bureau of Ocean Energy Management (BOEM) acknowledges receipt of Ocean Wind LLC's Outer Continental Shelf (OCS) Renewable Energy Lessee's, Grantee's, and Operator's Bond No. 800014999 in the amount of $100,000, conditioned to cover lease OCS-A 0498. The bond was executed by Atlantic Specialty Insurance Company, as the surety, on March 1, 2016, and Ocean Wind LLC, as principal, on March 3, 2016.

The bond conforms to the requirements of the leasing and operating regulations for submerged lands on the OCS. It is effective as of the date filed, April 14, 2016, and has been placed in lease file OCS-A 0498 maintained in BOEM's Office of Renewable Energy Programs.

Please do not hesitate to contact Ms. Gina Best at (703) 787-1341 if you have any questions.

Sincerely,

Annette G Moore

acting for James F. Bennett
Program Manager
Office of Renewable Energy Programs

Enclosure
Surety Bond No. 800014999

cc: Atlantic Specialty Insurance Company
Attn: Tara W. Mealer, Attorney-in-Fact
Marsh USA Inc.
1111 Northshore Drive, Suite. N-550
Knoxville, Tennessee 37919

United States Department of the Interior

BUREAU OF OCEAN ENERGY MANAGEMENT
WASHINGTON, DC 20240-0001

Mr. Thomas Brostrøm
DONG Energy Wind Power (U.S.) Inc
One International Place
100 Oliver Street, Suite 1400
Boston, Massachusetts 02110

Dear Mr. Brostrøm:

The Bureau of Ocean Energy Management has received your March 15, 2016, letter providing documentation to establish Ocean Wind LLC's (BOEM Company Number: 15057) technical and financial qualifications to hold a commercial wind energy lease on the Outer Continental Shelf (OCS) offshore New Jersey.

In accordance with 30 C.F.R. §§585.106-107, we evaluated the information submitted to determine whether the filing demonstrates the necessary technical and financial ability to construct, operate, maintain, and decommission the type and scope of project for which you are requesting authorization. After review, we have determined that Ocean Wind LLC is technically and financially qualified to hold a commercial wind energy lease on the OCS offshore New Jersey.

If you have questions about financial and technical qualifications, you may contact Mr. William Waskes at 703-787-1287.

Sincerely,

Arnette B. Moore

acting for James F. Bennett
Program Manager
Office of Renewable Energy Programs

United States Department of the Interior

BUREAU OF OCEAN ENERGY MANAGEMENT
WASHINGTON, DC 20240-0001

MAY 10 2016

NOTICE

Assignor:
RES America Developments Inc.
11101 W. 120th Avenue, Suite 400
Broomfield, Colorado 80021

Assignee:
Ocean Wind LLC
c/o DONG Energy Wind Power (U.S.) Inc
One International Place
100 Oliver Street, Suite 1400
Boston, Massachusetts 02110

Lease Number: OCS-A 0498
Assignment Filed: April 14, 2016
Assignment Effective Date: May 10, 2016

Assignment of Lease Approved

Please find enclosed a copy of the above-referenced Outer Continental Shelf (OCS) Renewable Energy Assignment of Interest in Lease affecting lease OCS-A 0498. The Assignee must comply with all terms and conditions of the lease and the regulations in 30 C.F.R. Part 585.

Bureau of Ocean Energy Management records reflect the following ownership, including all right, title and interest, of the subject lease:

Ocean Wind LLC – 100%

Ocean Wind LLC has designated the representatives identified below to update the Lessee Contact Information included in Addendum "A" of lease OCS-A 0498.

	Lease Representative	**Operations Representative**
Name	Thomas Brostrøm	Same as Lease Representative
Title	President	
Address	One International Place 100 Oliver Street, Suite 1400 Boston, MA 02110	
Phone	(857) 800-2900	
Fax	+44 207 822 5298	
Email	THBRO@dongenergy.co.uk	

For further information regarding this notice, please contact Ms. Gina Best at (703) 787-1341 or gina.best@boem.gov.

Annette B. Moore
acting for James F. Bennett
Program Manager
Office of Renewable Energy Programs

Enclosure

U.S. Department of the Interior
Bureau of Ocean Energy Management

OMB Control No.: 1010-0176
Expiration Date: 4/30/16

OCS-A 0498
Lease No.

OUTER CONTINENTAL SHELF (OCS) RENEWABLE ENERGY ASSIGNMENT OF INTEREST IN LEASE

RECEIVED
APR 14 2016
Office of Renewable Energy Programs

March 1, 2016
Lease Effective Date

New Lease No. (BOEM Use Only)

Sterling, VA
BOEM Regional Office

Part A: Assignment

This assignment is made with respect to the block(s) and/or aliquot part(s) described in Exhibit "A" attached hereto and made a part hereof.

Assignor(s) does hereby sell, assign, transfer and convey unto Assignee(s) the following undivided right, title and interest:

Insert name and Company number of each Assignor and Assignee.

Assignor(s):

Percentage Interest Conveyed
100%

Company Number: 15021
Company Name: RES America Developments Inc.

Assignee(s):

Percentage Interest Received
100%

Company Number: 15057
Company Name: Ocean Wind LLC

☐ Exhibit "B," which sets forth other provisions between Assignor(s) and Assignee(s), is attached to and made a part of this assignment.

For BOEM Use only – Do Not Type Below This Line

This Assignment of Record Title Interest has been filed as of the date stamped on this document and hereby approved by the Bureau of Ocean Energy Management on the date below.

By Annette B. Moore — Acting, Program Manager — MAY 10 2016
Authorized Official for BOEM — Title — Approval Date

Date

Part B – Certification and Acceptance

1. Assignor(s) certifies it is the owner of the interest in the above-described lease that is hereby assigned to the Assignee(s) specified above.

2. **DEBARMENT COMPLIANCE:** Assignee shall comply with the Department of the Interior's nonprocurement debarment and suspension regulations as required by Subpart B of 2 CFR Part 1400 and shall communicate the requirement to comply with these regulations to persons with whom it does business related to this interest assignment by including this term in its contracts and transactions.

3. **EQUAL OPPORTUNITY AND AFFIRMATIVE ACTION COMPLIANCE CERTIFICATION**: Assignor(s) and Assignee(s) certify that they are in full compliance with Equal Opportunity Executive Order 11246, as amended, and the implementing regulations at 41 CFR 60-01 – Obligations of Contractors and Subcontractors; and 41 CFR 60-2 – Affirmative Action Programs. These requirements are for the purpose of preventing discrimination against persons on the basis of race, color, religion, sex, or national origin. These regulations have specific performance requirements.

4. Assignee's execution of this assignment constitutes acceptance of all applicable terms, conditions, stipulations and restrictions pertaining to the lease described herein. Applicable terms and conditions include, but are not limited to, an obligation to conduct all operations on the leasehold in accordance with the terms and conditions of the lease, to restore the leased lands upon completion of any operations as described in the lease, and to furnish and maintain bond(s) pursuant to regulations at 30 CFR Part 585. This assignment is subject to the Outer Continental Shelf Lands Act of August 7, 1953, 43 U.S.C. 1331 et seq., as amended (the "Act"), and Assignee(s) is subject to, and shall fully comply with, all applicable regulations now or to be issued under the Act. Notwithstanding any agreement between the Assignor(s) and Assignee(s), the parties' liability to the Bureau of Ocean Energy Management is governed by 30 CFR Part 585.

This Assignment of Interest will be made effective between the parties hereto as of _____, upon approval by the Bureau of Ocean Energy Management, United States Department of the Interior.

This instrument may be executed in any number of counterparts, each of which will be deemed an original instrument, but all of which together shall constitute but one and the same instrument provided, however, this instrument and any other counterpart hereof, will not be binding unless and until executed by all of the parties, and will not be accepted by the Bureau of Ocean Energy Management unless all counterparts are filed simultaneously.

I certify that the statements made herein by the undersigned are true, complete and correct to the best of my knowledge and belief and are made in good faith.

Title 18 U.S.C. 1001 makes it a crime for any person knowingly and willfully to make to any Department or agency of the United States any false, fictitious or fraudulent statements or representations as to any matter within its jurisdiction.

ASSIGNOR

By: _____
Name: Brian Evans
Title: President
Company Name: RES America Developments Inc.

April 13, 2016
Execution Date

ASSIGNOR

By: _____
Name:
Title:
Company Name:

_____
Execution Date

ASSIGNEE

By: _____
Name: Thomas Brostrøm
Title: Director
Company Name: Ocean Wind LLC (by its sole member, DONG Energy Wind Power (U.S.) Inc)

April 13, 2016
Execution Date

ASSIGNEE

By: _____
Name:
Title:
Company Name:

_____
Execution Date

Attach Notary Acknowledgement (not mandatory)

EXHIBIT "A"

OUTER CONTINENTAL SHELF (OCS)
RENEWABLE ENERGY LEASE
ASSIGNMENT OF INTEREST

The Assignment is made with respect to the following described block(s) and/or aliquot parts of the lease:

Area Name or Protraction Diagram	Block	Subdivision or Aliquot Part (If entire block, enter "All")
Wilmington NJ18-02	6833	E1/2, SE1/4 of NW1/4, SW1/4
Wilmington NJ18-02	6834	NW1/4 of SW1/4, S1/2 of SW1/4
Wilmington NJ18-02	6883	W1/2
Wilmington NJ18-02	6884	SW1/4 of NE1/4, NW1/4, S1/2
Wilmington NJ18-02	6885	SW1/4, SW1/4 of SE1/4
Wilmington NJ18-02	6931	SE1/4 of NE1/4, SE1/4 of SW1/4, SE1/4
Wilmington NJ18-02	6932	N1/2
Wilmington NJ18-02	6933	All
Wilmington NJ18-02	6934	All
Wilmington NJ18-02	6935	All
Wilmington NJ18-02	6936	SW1/4 of NW1/4, SW1/4, SW1/4 of SE1/4
Wilmington NJ18-02	6982	S1/2
Wilmington NJ18-02	6983	All
Wilmington NJ18-02	6984	All
Wilmington NJ18-02	6985	All
Wilmington NJ18-02	6986	N1/2, SW1/4, N1/2 of SE1/4, SW1/4 of SE1/4
Wilmington NJ18-02	6987	SW1/4 of NW1/4
Wilmington NJ18-02	7030	E1/2, NE1/4 of NW1/4, S1/2 of NW1/4, SW1/4
Wilmington NJ18-02	7031	S1/2
Wilmington NJ18-02	7032	All
Wilmington NJ18-02	7033	All
Wilmington NJ18-02	7034	All
Wilmington NJ18-02	7035	N1/2, SW1/4, N1/2 of SE1/4, SW1/4 of SE1/4
Wilmington NJ18-02	7036	N1/2 of NW1/4, SW1/4 of NW1/4
Wilmington NJ18-02	7080	All
Wilmington NJ18-02	7081	All
Wilmington NJ18-02	7082	All
Wilmington NJ18-02	7083	All
Wilmington NJ18-02	7084	N1/2, SW1/4, N1/2 of SE1/4, SW1/4 of SE1/4
Wilmington NJ18-02	7085	N1/2 of NW1/4, SW1/4 of NW1/4
Wilmington NJ18-02	7131	All
Wilmington NJ18-02	7132	All
Wilmington NJ18-02	7133	N1/2, SW1/4, N1/2 of SE1/4, SW1/4 of SE1/4
Wilmington NJ18-02	7134	N1/2 of NW1/4, SW1/4 of NW1/4
Salisbury NJ18-05	6031	All
Salisbury NJ18-05	6032	All
Salisbury NJ18-05	6081	All

James F. Bennett, Program Manager
Office of Renewable Energy Programs, BOEM
MS VAM-OREP
45600 Woodland Road
Sterling, VA 20166

[submitted via email to: *James.Bennett*@boem.gov]

One International Place
100 Oliver Street, Suite 1400
Boston, MA 02110
USA

www.dongenergy.com

OCW01_Ocean Wind Request to extend the preliminary term

14 February 2017

Our ref. SOPBA/PEHER

Doc. no. 2695622
(ver. no. 2695622A)
Case no. 200-16-2791

Dear Mr Bennett,

We are writing in relation to the Commercial Lease of Submerged Lands for Renewable Energy Development on the Outer Continental Shelf, Lease No. OCS-A 0498 between Ocean Wind LLC and the Bureau of Ocean Energy Management (BOEM), hereinafter referred to as the Lease.

Words and expressions used in this letter have the same meaning as in the Lease unless otherwise defined in this letter.

The Effective Date of the Lease is 1 March 2016 and as such the Preliminary Term currently ends on 1 March 2017.

In accordance with the Lease, Ocean Wind LLC is required to submit a Site Assessment Plan (SAP) by the end of the Preliminary Term. While the project has made significant progress to date on the Ocean Wind offshore wind farm, due to the timing of the lease award on 1 March 2016 to RES America Developments, Inc. (RESA), and the subsequent assignment of the commercial lease from RESA to Ocean Wind LLC on 10 May 2016, seasonal considerations in relation to undertaking site characterization work and continued uncertainty in terms of the policy for the project in New Jersey, Ocean Wind LLC is requesting an extension of the Preliminary Term period of 12 months until 1 March 2018, in accordance with 30 C.F.R. § 585.235(b).

Ocean Wind LLC is planning to undertake site investigations, with geophysical surveys scheduled in 2017 and to be followed by a small geotechnical investigations campaign. In preparation for this, significant progress has been made preparing for the surveys including engagement with BOEM about the SAP survey plan, as well as with both BOEM and the National Marine Fisheries Services (NMFS) in relation to the required Incidental Harassment Authorizations to be issued by NMFS.

In addition, several contractor services in support of the site characterization surveys have been procured or are in the process of being procured via a competitive tender process.

During the requested preliminary term extension following BOEM's approval of the SAP Survey Plan, the project intends to undertake the geophysical survey and the geotechnical investigations campaign. The data collected from the geophysical survey relevant to the Flidar and buoy locations (the Flidar survey) will be included in the SAP. Immediately following the Flidar surveys, Ocean Wind LCC may decide to undertake further geophysical surveys across the whole lease area. Once the Plan is approved by BOEM, the project is planning to deploy the Flidar(s) and wave buoys at the lease area.

Despite the above progress and owing to the factors noted earlier, Ocean Wind LLC is not in a position to complete a SAP by 1 March 2017, and considers it prudent to request an extension of the deadline for submitting the SAP rather than attempting to complete a SAP prematurely to the potential detriment of the project.

I hope the information as described above provides the necessary level of detail to allow BOEM to accept Ocean Wind LLC's request for a 12-month extension of the Preliminary Lease Term. If you have any questions or comments, please contact me at thbro@dongenergy.com or at +1 617 535 7554.

Yours sincerely,

Thomas Brostrøm
Lease Representative
Ocean Wind LLC

cc Will Waskes, Project Coordinator

Enclosed: Confidential Information

United States Department of the Interior

BUREAU OF OCEAN ENERGY MANAGEMENT
WASHINGTON, DC 20240-0001

MAR 1 2017

Mr. Thomas Brostrøm
Ocean Wind LLC
One International Place
100 Oliver Street, Suite 1400
Boston, Massachusetts 02110

Dear Mr. Brostrøm:

The Bureau of Ocean Energy Management (BOEM) has received Ocean Wind LLC's (Ocean Wind) February 14, 2017, letter requesting a 12-month extension of the preliminary term for commercial lease OCS-A 0498, from March 1, 2017, to March 1, 2018, pursuant to 30 C.F.R. § 585.235(b). BOEM is approving your request for the reasons described below.

Your letter states that while Ocean Wind has made significant progress to date, it is not in a position to complete a Site Assessment Plan (SAP) by March 1, 2017, as required by lease OCS-A 0498 in light of the following considerations:

1. Timing of the lease award on February 4, 2016, to RES America Developments, Inc., and the subsequent assignment of the lease (OCS-A 0498) to Ocean Wind on May 10, 2016 reduced the time available for Ocean Wind to complete its SAP.
2. Seasonal considerations in relation to undertaking offshore site characterization work; and
3. Continued uncertainty in New Jersey's Offshore Renewable Energy Certificate Program.

Your letter indicates that Ocean Wind has already undertaken the planning for site investigations in support of a SAP and a small geotechnical investigation in support of activities on lease OCS-A 0498. These activities include:

1. Engagement with BOEM regarding the SAP survey plan in January 2017.
2. Submission of an Incidental Harassment Authorization application to the National Marine Fisheries Service (NMFS) in December 2016 in support of Ocean Wind's site characterization surveys.
3. Procurement, or the in-process procurement, of contractor services in support of site characterization surveys via a competitive tender process.

Your letter provides a plan for conducting geophysical and geotechnical surveys during the requested preliminary extension term. The results from these surveys will be included in the SAP planned for filing in March 2018. Assuming the SAP is approved by BOEM; Ocean Wind would deploy the Flidar(s) and wave buoy(s) in the lease area in July 2018.

BOEM has reviewed your request and has determined an extension of the preliminary term is justified. We base our decision on the fact Ocean Wind has identified their previous and planned

activities over the next year to support SAP submission and development of commercial lease OCS-A 0498. Specifically, BOEM has received Ocean Wind's SAP survey plan dated February 21, 2017, pursuant to OCS-A 0498, Addendum C, Section 2.1.1. The SAP survey plan indicates that the geophysical and geotechnical surveys needed to support a SAP submission per 30 C.F.R. § 585.610-611 in March 2018 are planned for June 2017 and October 2017 respectively.

Therefore, pursuant to 30 C.F.R. § 585.235(b) and in consideration of the information provided in your February 14, 2017 letter, your request to extend the preliminary term of commercial lease OCS-A 0498 to March 1, 2018 is approved.

If you have any questions please contact Mr. William Waskes at 703-787-1287 or will.waskes@boem.gov.

Sincerely,

Daryl K. Francois

Acting for

James F. Bennett
Program Manager
Office of Renewable Energy Programs

FW FW CZMA federal consistency letter

From: Thurston, Jean
Sent: Thursday, October 06, 2011 9:00 AM
To: Byrum, Algene D
Cc: Morin, Michelle
Subject: FW: FW: CZMA federal consistency letter

Algene,

Please include this email as part of our administrative record for NJ CZMA concurrence.

Thanks!
Jean

-----Original Message-----
From: Tom Micai [mailto:Tom.Micai@dep.state.nj.us]
Sent: Wednesday, October 05, 2011 2:52 PM
To: Thurston, Jean
Cc: Morin, Michelle; Marilyn Lennon; Michele Siekerka
Subject: Re: FW: CZMA federal consistency letter

Afternoon Jean: There was additional internal discussion today here at the NJDEP, and I can now affirm via this e-mail that the Commissioner's 8/11 letter sent to you should be construed as a determination of Concurrence from New Jersey. If you have further, questions, please call me.

Thomas Micai, Director
NJDEP Office of Land Use Planning
609-984-0058

>>> "Thurston, Jean" <Jean.Thurston@boem.gov> 10/4/2011 5:49 PM >>>
Tom,

Can you provide us an email that states whether or not the letter sent to BOEMRE in August (with the mis-date) reflects that the State of New Jersey has completed its review of the Regional Federal Consistency Determination (RFCD) and that, in accordance with 15 CFR 930.41, this letter supports the position that the State of New Jersey concurs (or
not) with the RFCD for the project under the enforceable policies of the New Jersey's Coastal Management Program?

Thanks!
Jean

-----Original Message-----
From: Thurston, Jean
Sent: Tuesday, October 04, 2011 11:08 AM
To: 'Tom Micai'
Subject: RE: CZMA federal consistency letter

Thanks Tom!

-----Original Message-----
From: Tom Micai [mailto:Tom.Micai@dep.state.nj.us]
Sent: Tuesday, October 04, 2011 11:05 AM
To: Thurston, Jean
Cc: Kilanski, Jennifer; Morin, Michelle; Marilyn Lennon
Subject: RE: CZMA federal consistency letter

I agree, we normally do that in our consistency reviews and determinations, however in this case, a different office drafted the response for the Commissioner's signature. We are in discussion mode internally to clarify the Commisioner's response to you. I hope to hear the response today, and communicate that to you

shortly.

>>> "Thurston, Jean" <Jean.Thurston@boem.gov> 10/4/2011 10:54 AM >>>
Hello Tom,

Thanks for looking into this further. A state's response to a federal consistency determination should clearly state whether it concurs with or objects to the Federal agency activity. Unfortunately, the letter you sent does not seem to provide BOEM with the level of certainty required to meet our CZMA federal consistency responsibilities. If you could please provide a letter that clearly states New Jersey's response in regard to CZMA we would appreciate it. Would it be possible for your office to provide this to us by the end of the week?

Thanks again for your time and consideration!

Thanks,
Jean

-----Original Message-----
From: Tom Micai [mailto:Tom.Micai@dep.state.nj.us]
Sent: Monday, October 03, 2011 2:27 PM
To: Thurston, Jean
Cc: Marilyn Lennon
Subject: Re: CZMA federal consistency letter

Jean: The attached letter was sent as NJ's comments from Commissioner Martin. Note, the letter is mis-dated, its a 2011 letter, not a 2010 letter. I am trying to decypher whetther the conclusion is concurrence or not, and will get back to you shortly with that reply.

>>> "Thurston, Jean" <Jean.Thurston@boem.gov> 10/3/2011 11:45 AM >>>
Hi Tom,

We are completing our environmental analysis of the Commercial Wind Lease Issuance and Site Characterization Activities on the Atlantic Outer Continental Shelf Offshore New Jersey, Delaware, Maryland and Virginia. We would like to have a letter from your agency regarding the status of the State of New Jersey's review of the Regional Federal Consistency document we sent to you in July for our records. Please feel free to call me if you have any questions!

Thank you,

Jean

Nina (Jean) Thurston

_____

U.S. Department of Interior

Bureau of Ocean Energy Managment

Office of Offshore Renewable Energy Programs

381 Elden St, MS 1328

Herndon, VA 20170

Office: 703.787.1768

Jean.Thurston@boemre.gov

U.S. ARMY CORPS OF ENGINEERS

APPLICATION FOR DEPARTMENT OF THE ARMY PERMIT

33 CFR 325. The proponent agency is CECW-CO-R.

OMB APPROVAL NO. 0710-0003
EXPIRES: 28 FEBRUARY 2013

Public reporting for this collection of information is estimated to average 11 hours per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of the collection of information, including suggestions for reducing this burden, to Department of Defense, Washington Headquarters, Executive Services and Communications Directorate, Information Management Division and to the Office of Management and Budget, Paperwork Reduction Project (0710-0003). Respondents should be aware that notwithstanding any other provision of law, no person shall be subject to any penalty for failing to comply with a collection of information if it does not display a currently valid OMB control number. Please DO NOT RETURN your form to either of those addresses. Completed applications must be submitted to the District Engineer having jurisdiction over the location of the proposed activity.

PRIVACY ACT STATEMENT

Authorities: Rivers and Harbors Act, Section 10, 33 USC 403; Clean Water Act, Section 404, 33 USC 1344; Marine Protection, Research, and Sanctuaries Act, Section 103, 33 USC 1413; Regulatory Programs of the Corps of Engineers; Final Rule 33 CFR 320-332. Principal Purpose: Information provided on this form will be used in evaluating the application for a permit. Routine Uses: This information may be shared with the Department of Justice and other federal, state, and local government agencies, and the public and may be made available as part of a public notice as required by Federal law. Submission of requested information is voluntary, however, if information is not provided the permit application cannot be evaluated nor can a permit be issued. One set of original drawings or good reproducible copies which show the location and character of the proposed activity must be attached to this application (see sample drawings and/or instructions) and be submitted to the District Engineer having jurisdiction over the location of the proposed activity. An application that is not completed in full will be returned.

(ITEMS 1 THRU 4 TO BE FILLED BY THE CORPS)

1. APPLICATION NO.	2. FIELD OFFICE CODE	3. DATE RECEIVED	4. DATE APPLICATION COMPLETE

(ITEMS BELOW TO BE FILLED BY APPLICANT)

5. APPLICANT'S NAME	8. AUTHORIZED AGENT'S NAME AND TITLE (agent is not required)
First - See Attached Middle - Last -	First - Scott Middle - N/A Last - Lundin
Company - See Attachment	Company - Tetra Tech
E-mail Address - See Attachment	E-mail Address - scott.lundin@tetratech.com
6. APPLICANT'S ADDRESS:	**9. AGENT'S ADDRESS:**
Address- One International Place, 100 Oliver Street, Suite 2610	Address- 160 Federal Street, 3rd Floor
City - Boston State - MA Zip - 02110 Country - U.S.	City - Boston State - MA Zip - 02110 Country - U.K.
7. APPLICANT'S PHONE NOs. w/AREA CODE	**10. AGENTS PHONE NOs. w/AREA CODE**
a. Residence b. Business c. Fax	a. Residence b. Business c. Fax
N/A 857-284-1430 N/A	N/A 617-443-7512 N/A

STATEMENT OF AUTHORIZATION

11. I hereby authorize, Tetra Tech, Inc. to act in my behalf as my agent in the processing of this application and to furnish, upon request, supplemental information in support of this permit application.

Marcus Cross Digitally signed by Marcus Cross Date: 2017.09.13 14:09:29 -04'00'

SIGNATURE OF APPLICANT DATE

NAME, LOCATION, AND DESCRIPTION OF PROJECT OR ACTIVITY

12. PROJECT NAME OR TITLE (see instructions)

Ocean Wind

13. NAME OF WATERBODY, IF KNOWN (if applicable)	14. PROJECT STREET ADDRESS (if applicable)
Atlantic Ocean	Address N/A
15. LOCATION OF PROJECT Latitude: °N Please see Table 1 of Longitude: °W the Attachment	City - N/A State- N/A Zip- N/A

16. OTHER LOCATION DESCRIPTIONS, IF KNOWN (see instructions)

State Tax Parcel ID N/A Municipality N/A

Section - N/A Township - N/A Range - N/A

17. DIRECTIONS TO THE SITE

The Project site is located in federal waters of the Atlantic Ocean within the Commercial Lease of Submerged Lands for Renewable Energy Development on the Outer Continental Shelf OCS-A 0498 (Lease Area). The Lease Area is located approximately 9 nautical miles southeast of Atlantic City, New Jersey. Please see Attachment for additional detail.

18. Nature of Activity (Description of project, include all features)

Ocean Wind, LLC intends to deploy two AXYS WindSentinel FLiDAR units and one TRIAXYS Wave and Current Buoy within the Lease Area. Please see Attachment for additional detail.

19. Project Purpose (Describe the reason or purpose of the project, see instructions)

Ocean Wind LLC will conduct scientific measurements in the Lease Area to evaluate meteorological and oceanographic conditions. Please see Attachment for additional detail.

USE BLOCKS 20-23 IF DREDGED AND/OR FILL MATERIAL IS TO BE DISCHARGED

20. Reason(s) for Discharge

N/A

21. Type(s) of Material Being Discharged and the Amount of Each Type in Cubic Yards:

Type Amount in Cubic Yards	Type Amount in Cubic Yards	Type Amount in Cubic Yards
N/A	N/A	N/A

22. Surface Area in Acres of Wetlands or Other Waters Filled (see instructions)

Acres N/A

or

Linear Feet N/A

23. Description of Avoidance, Minimization, and Compensation (see instructions)

N/A

24. Is Any Portion of the Work Already Complete? ☐ Yes ☒ No IF YES, DESCRIBE THE COMPLETED WORK

N/A

25. Addresses of Adjoining Property Owners, Lessees, Etc., Whose Property Adjoins the Waterbody (if more than can be entered here, please attach a supplemental list)

a. Address- N/A

City - N/A State - N/A Zip - N/A

b. Address- N/A

City - N/A State - N/A Zip - N/A

c. Address- N/A

City - N/A State - N/A Zip - N/A

d. Address- N/A

City - N/A State - N/A Zip - N/A

e. Address- N/A

City - N/A State - N/A Zip - N/A

26. List of Other Certificates or Approvals/Denials received from other Federal, State, or Local Agencies for Work Described in This Application.

AGENCY	TYPE APPROVAL*	IDENTIFICATION NUMBER	DATE APPLIED	DATE APPROVED	DATE DENIED
BOEM	SAP Approval	N/A	TBD	TBD	N/A
USCG	PATON	TBD	TBD	TBD	N/A
USCG	LNM	TBD	TBD	TBD	N/A

* Would include but is not restricted to zoning, building, and flood plain permits

27. Application is hereby made for permit or permits to authorize the work described in this application. I certify that this information in this application is complete and accurate. I further certify that I possess the authority to undertake the work described herein or am acting as the duly authorized agent of the applicant.

Marcus Cross Digitally signed by Marcus Cross Date: 2017.09.13 14:09:45 -04'00' _____

SIGNATURE OF APPLICANT DATE

SCOTT LUNDIN Digitally signed by SCOTT LUNDIN DN: CN = SCOTT LUNDIN Date: 2017.09.12 09:23:23 -05'00' _____

SIGNATURE OF AGENT DATE

The Application must be signed by the person who desires to undertake the proposed activity (applicant) or it may be signed by a duly authorized agent if the statement in block 11 has been filled out and signed.

18 U.S.C. Section 1001 provides that: Whoever, in any manner within the jurisdiction of any department or agency of the United States knowingly and willfully falsifies, conceals, or covers up any trick, scheme, or disguises a material fact or makes any false, fictitious or fraudulent statements or representations or makes or uses any false writing or document knowing same to contain any false, fictitious or fraudulent statements or entry, shall be fined not more than $10,000 or imprisoned not more than five years or both.

U.S. Army Corps of Engineers
Application for Department of the Army Permit
Ocean Wind, LLC
Scientific Measurement Device Deployment
Attachment

Applicant's Name (Box 5)

Responsible Party:
Ocean Wind LLC
One International Place
100 Oliver Street, Suite 2610
Boston, MA 02110
Tel: (857)284-1430

Point of Contact:
Marcus Cross
One International Place
100 Oliver Street, Suite 2610
Boston, MA 02110
Email: marcr@dongenergy.com
Tel: (857)310-8232

Project Description and Objectives

Ocean Wind LLC will deploy scientific measurements devices to record meteorological and oceanographic conditions in the Lease Area (OCS-A 0498) including wind speed and direction at multiple heights above the sea surface. Ocean Wind LLC has proposed that the collection of this data will be performed using two AXYS WindSentinels™ and one TRIAXYS Buoy. The proposed Met Buoys represent state-of-the-art equipment that incorporates the best available technologies.

Ocean Wind LLC plans to deploy the Met Buoys no earlier than November 2017. The operational lives of the WindSentinel™ and TRIAXYS Buoy are expected to be two and four years, respectively.

Site Location

The location of the proposed scientific measurement devices will fall within two Buoy Deployment Areas that were surveyed and evaluated by Ocean Wind LLC in summer 2017 (see Figure 1). Survey results were evaluated by a qualified marine archaeologist and a benthic marine ecologist who verify that no culturally significant material or biologically unique habitat would be disturbed.

The two Buoy Deployment Areas where the met buoys are proposed to be located have been given unique identifiers. The Buoy Deployment Area for the WindSentinel™ and TRIAXYS Buoys located in the western side of the Lease Area are referenced as F1 and B1, respectively. The Buoy Deployment Area for the WindSentinel™ to be installed in the eastern side of the Lease Area is referenced as F2. The coordinates for these locations are provided in Table 1 and depicted on Figure 1.

Table 1 Location of the Met Buoys

Platform	ID	Northing (UTM 18N 2011 NAD83)	Easting (UTM 18N 2011 NAD83)	Mean Lower Low Water Depth	OCS Lease Block	Aliquot
WindSentinel™	F1	4324779	548110	17.8 m	7081	A
TRIAXYS Buoy	B1	4324779	548236	17.7 m	7081	A
WindSentinel™	F2	4331998	572002	28.5 m	6986	I

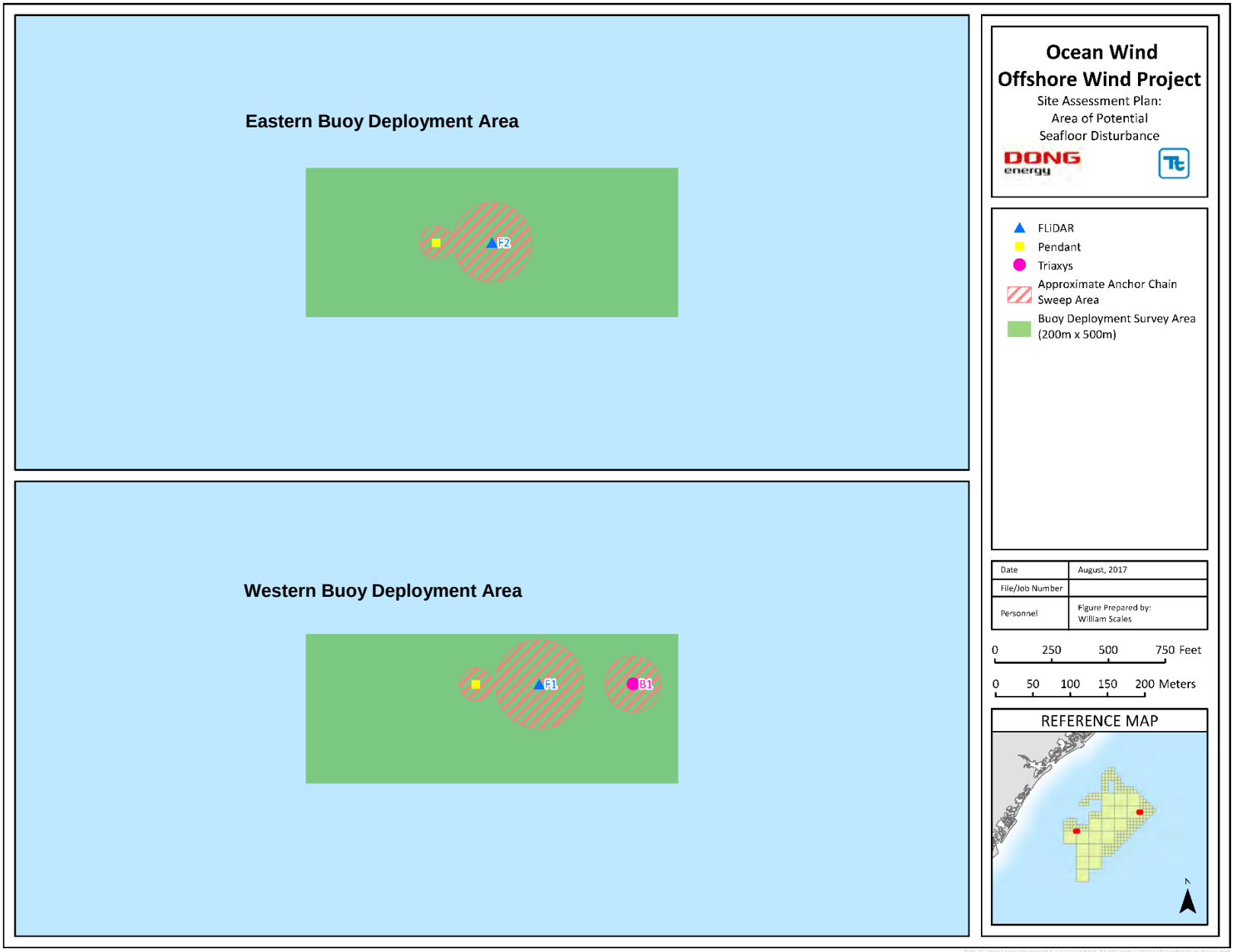

Figure 1 Area of Potential Seafloor Disturbance

WindSentinel™

The WindSentinel™ will consist of instrumentation and supporting systems atop a floating moored buoy platform (Figure 2). The floating platform consists of the AXYS Navy Oceanographic Meteorological Automated Device hull, mooring chain, clump weight anchor and pendant marker buoy. The hull consists of marine-grade 5086 aluminum and measures 20.7 feet (ft) (6.3 meters [m]) long by 10.5 ft (3.2 m) wide and weighs 15,000 pounds (lbs) (6,818 kilograms [kg]) (bare hull weight). The vertical profile of the WindSentinel™, including instrumentation, will be approximately 13.5 ft (4.1 m) from the sea surface to the top of the hull mast. The submerged portion of the hull would measure approximately 8.5 ft (2.6 m) below the sea surface from the water line to the bottom of the mooring yoke. The outer hull is constructed of a corrosion resistant marine grade stainless steel. The hull has also been designed with consideration for avian species. Landing areas have been minimized and anti-perching devices will be installed on the lights and mast.

The WindSentinels™ will be attached to the seafloor by means of a u-mooring design which is comprised of a chain that connects the WindSentinel™ to both a primary and secondary clump anchor on the sea floor as well as a pendant buoy on the surface of the water (Figure 3). The u-mooring design facilitates recovery of the WindSentinel™ in higher sea state conditions by allowing the mooring to be recovered and the WindSentinel™ to be towed without the need to transfer personnel at sea. The primary and secondary clump weights would weigh approximately 5.5 tons (5,000 kg) and 3.3 tons (3,000 kg), respectively and sit on the seabed for a total area of up to 42 ft^2 (3.9 m^2). The chain would be attached to the base of the hull via the steel mooring yoke. The area of the anchor chain sweep associated with the long-term operation of the WindSentinels™ are anticipated to be approximately 3.1 acres (1.3 ha) (based on anchor chain radii of approximately 195.2 ft [59.5 m], 72.2 ft [22 m].and 442.9 ft [135 m] of connector chain on the seafloor) for F1, and 2.6 acres (1.1 hectares [ha]) (based on anchor chain radii of approximately 173.9 ft [53 m], 72.2 ft [22 m], and 442.9 ft [135 m] connector chain on the sea floor) for F2 . Vertical penetration of the primary and secondary clump weights into the seabed is anticipated to be approximately 6.6 ft to 9.9 ft (2 m to 3 m) and 3.3 to 6.6 ft (1m to 2 m), respectively.

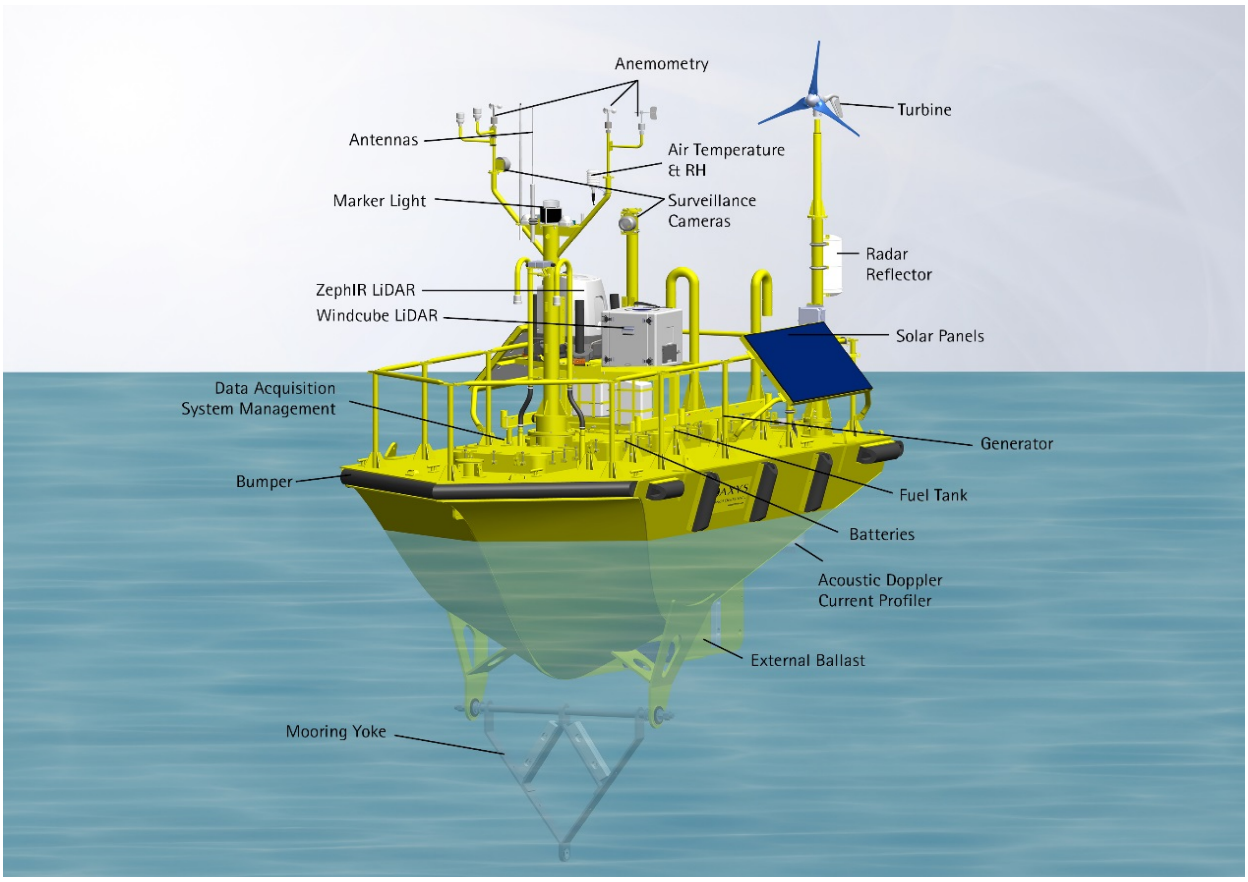

Figure 2 WindSentinel™ Buoy

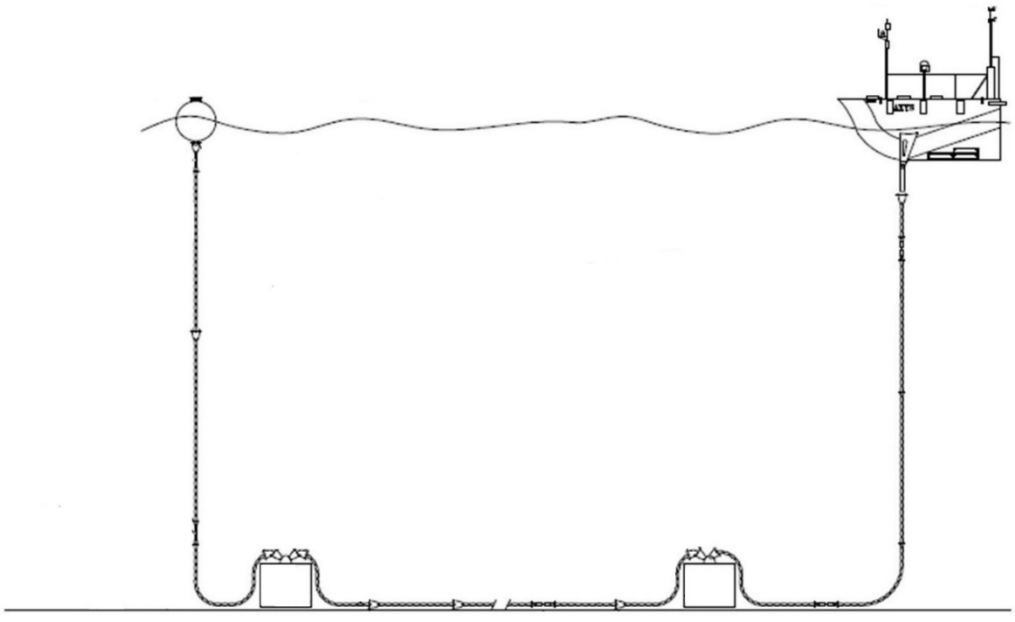

Figure 3 FLIDAR WindSentinel™ U-Mooring Design

TRIAXYS Buoy

The TRIAXYS Buoy is a 3.6 ft (1.1 m) round buoy that measures directional waves & currents as well as water temperature (Figure 4). The buoy hull and dome are constructed from stainless steel and impact resistant polycarbonate, respectively. The TRIAXYS Buoy is attached to the seabed using a floating collar and mooring design. The floating collar is made of Ionomer foam and adds buoyancy to the TRIAXYS to support the weight of the chain mooring. The vertical profile of the TRIAXYS Buoy will be approximately 1.8 ft (0.55 m) from the sea surface to the top of the buoy. The submerged portion of the buoy hull would measure approximately 1.8 ft (0.55 m) below the sea surface from the waterline to the bottom of the buoy. The TRIAXYS Buoy weighs 507 lbs (230 kg).

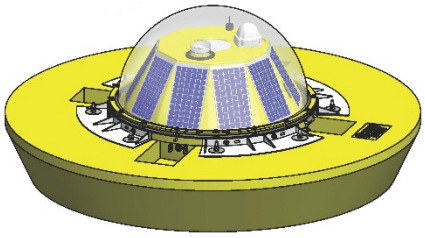

Figure 4 TRIAXYS Buoy

The TRIAXYS Buoy mooring design will consist of 4.9 ft (1.5 m) of open link chain which will run from the buoy to a 265.8 ft (81 m) mooring chain. The mooring chain will then be attached to a .8 ton (7,000 kg) clump weight that will rest on the seafloor for an area of approximately 10.2 ft^2 (1 m^2) (Figure 5). The area of the anchor chain sweep associated with the long-term operation of TRIAXYS Buoy B1 is anticipated to be approximately 1.1 acres (0.5 ha) (based on anchor chain radii of approximately 123 ft [37.5 m]. Vertical penetration of the anchor chain for the TRIAXYS Buoy into the seabed is anticipated to be approximately 0.5 ft to 1 ft (0.2 m to 0.3 m).

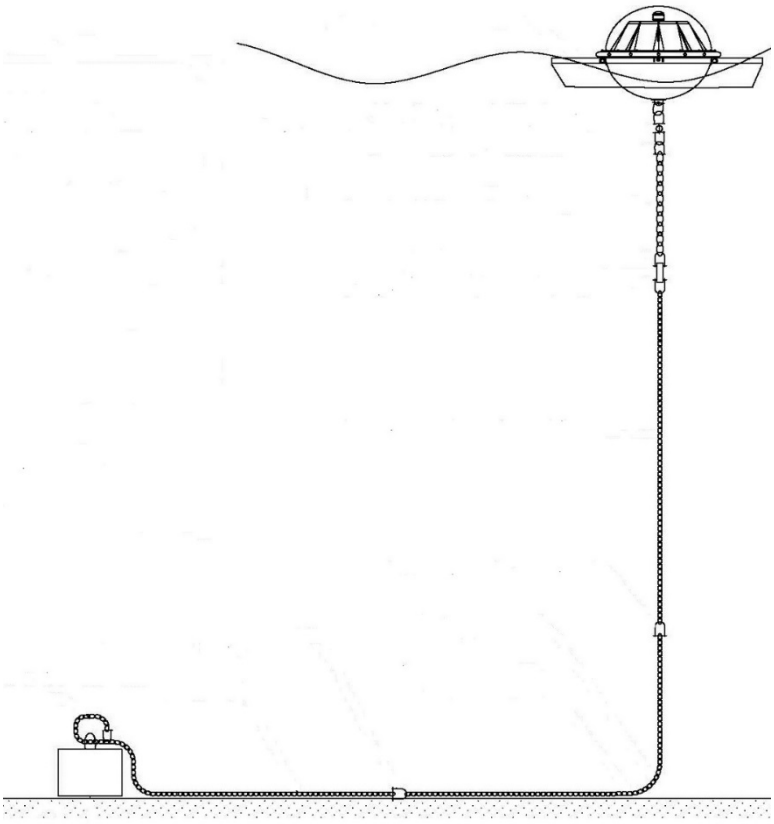

Figure 5 TRIAXYS Buoy Floating Mooring Design

Appendix B

Equipment Specifications and Modelling Results

Contains Privileged or Confidential Information - Provided Under Separate Cover

Appendix C

Site Characterization Report

Contains Privileged or Confidential Information - Provided Under Separate Cover

Appendix D

Marine Archaeological Resource Assessment Report in Support of the Ocean Wind Offshore Wind Farm

Contains Privileged or Confidential Information - Provided Under Separate Cover

Appendix E

Benthic Assessment

Contains Privileged or Confidential Information - Provided Under Separate Cover

Appendix F

Health And Safety Plan

Contains Privileged or Confidential Information - Provided Under Separate Cover

Appendix G
Vessel Specifications

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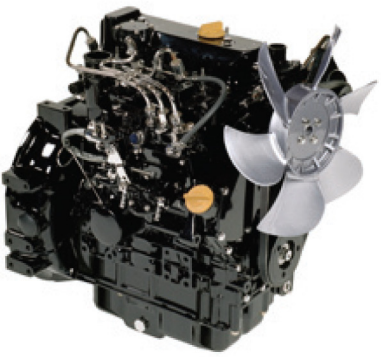
2TNV70-HGE



Dimensions, Performance Data & Quick Specs

NET INTERMITTENT POWER (kW/hp) Potencia Neta Intermitente	13.4/10
RATED SPEED (RPM) Velocidad de Regimen	3600
LENGTH (in/mm) Longitud	16.4/417
WIDTH (in/mm) Ancho	16.1/410
HEIGHT (in/mm) Altura	19.8/504

SPECIFICATION Especificacion	HGE
CYLINDERS Cilindros	2
BORE X STROKE Diametro x Carrera	70 X 74 (mm) 2.75 X 2.91 (in)
DISPLACEMENT Cilindrada	570 (cc) 34.8(ci)

COMBUSTION TYPE
Tipo de Combustion

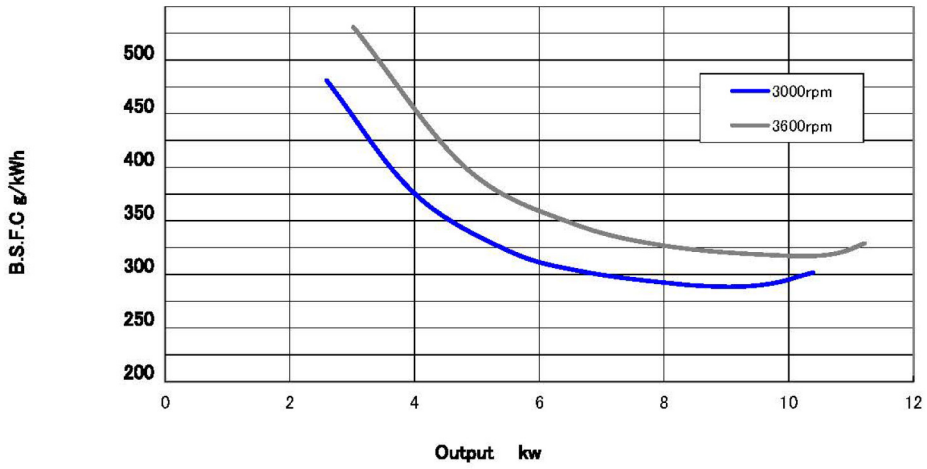
Indirect Injection
Inyección Indirecta

ASPIRATION
Aspiracion

Naturally Aspirated
Aspiracion Natural

GOVERNOR TYPE
Tipo de Gobernador

Mechanical
Mecánico



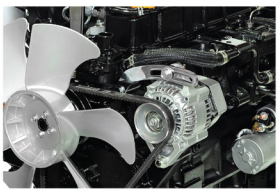
Lubrication System
2.2LL Capacity Deep Oil Pan

Electrical System
12V, 40A Alternator

Fuel System
In-line ML Fuel Injection Pump

Cooling System
Water Pump, Belt-driven

Power Take Off
FWH: SAE #6 t=80
FW: SAE 6.5" CMP



Reliable and Durable

The TNV engines now proudly take up the running as Yanmar's premium small industrial diesel. They offer even more enhanced durability due to better block cooling, a stiffer crank and pistons, finer tolerance in the journal and more. CAE analysis has brought lower vibrations and higher strength to the mounting structure for even better reliability in heavy-duty jobs.

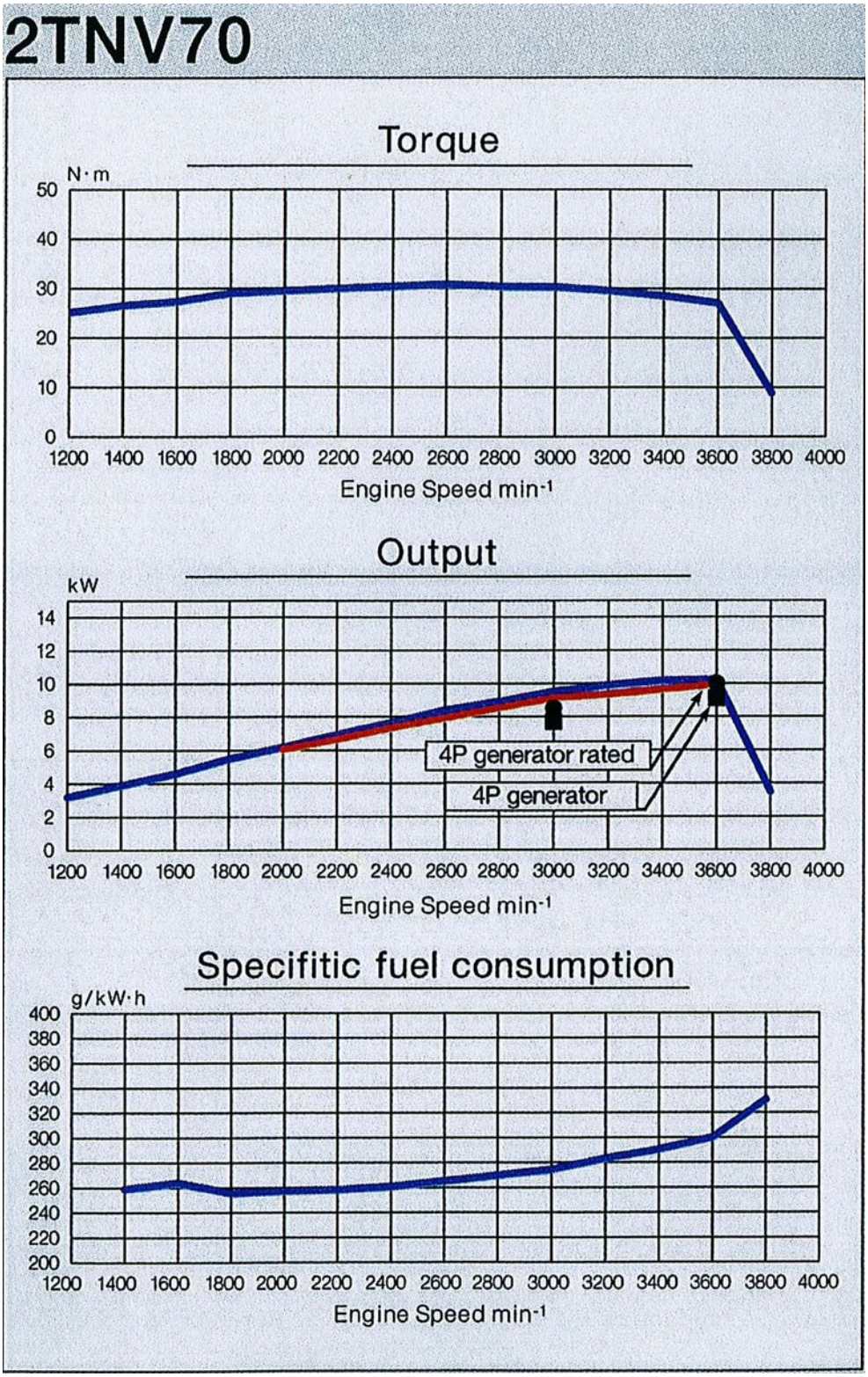
Clean Emissions

Building off the proven TNE design, Yanmar has achieved superior exhaust emissions by improving the combustion chamber and fuel injection equipment design. Engines are compliant with 2008 EPA Tier 4.

Fuel Delivery and Economy

A newly designed, in-line ML fuel injection pump is utilized to assure more precise fuel delivery and control. The result is reduced emissions, improved performance over a wide range of applications and increased fuel economy which assures that Yanmar's reputation for superior starting characteristics continues.

2TNV70



Note : Intermittant Rating

Red Line – Variable Speed
Blue Line – Fixed Speed

California Environmental Protection Agency AIR RESOURCES BOARD	YANMAR CO., LTD.	EXECUTIVE ORDER U-R-028-0506 New Off-Road Compression-Ignition Engines

Pursuant to the authority vested in the Air Resources Board by Sections 43013, 43018, 43101, 43102, 43104 and 43105 of the Health and Safety Code; and

Pursuant to the authority vested in the undersigned by Sections 39515 and 39516 of the Health and Safety Code and Executive Order G-02-003;

IT IS ORDERED AND RESOLVED: That the following compression-ignition engines and emission control systems produced by the manufacturer are certified as described below for use in off-road equipment. Production engines shall be in all material respects the same as those for which certification is granted.

MODEL YEAR	ENGINE FAMILY	DISPLACEMENT (liters)	FUEL TYPE	USEFUL LIFE (hours)
2011	BYDXL0.57U2N	0.57	Diesel	3,000

SPECIAL FEATURES & EMISSION CONTROL SYSTEMS	TYPICAL EQUIPMENT APPLICATION
Indirect Diesel Injection	Generator Set

The engine models and codes are attached.

The following are the exhaust certification standards (STD) and certification levels (CERT) for hydrocarbon (HC), oxides of nitrogen (NOx), or non-methane hydrocarbon plus oxides of nitrogen (NMHC+NOx), carbon monoxide (CO), and particulate matter (PM) in grams per kilowatt-hour (g/kW-hr), and the opacity-of-smoke certification standards and certification levels in percent (%) during acceleration (Accel), lugging (Lug), and the peak value from either mode (Peak) for this engine family (Title 13, California Code of Regulations, (13 CCR) Section 2423):

RATED POWER CLASS	EMISSION STANDARD CATEGORY		EXHAUST (g/kW-hr)					OPACITY (%)		
			HC	NOx	NMHC+NOx	CO	PM	ACCEL	LUG	PEAK
8 ≤ kW < 19	Tier 4	STD	N/A	N/A	7.5	6.6	0.40	N/A	N/A	N/A
		CERT	--	--	6.0	1.3	0.15	--	--	--

BE IT FURTHER RESOLVED: That for the listed engine models, the manufacturer has submitted the information and materials to demonstrate certification compliance with 13 CCR Section 2424 (emission control labels), and 13 CCR Sections 2425 and 2426 (emission control system warranty).

Engines certified under this Executive Order must conform to all applicable California emission regulations.

This Executive Order is only granted to the engine family and model-year listed above. Engines in this family that are produced for any other model-year are not covered by this Executive Order.

Executed at El Monte, California on this 20 day of October 2010.

Annette Hebert, Chief
Mobile Source Operations Division

Engine Model Summary Template

U-R-028-0506

9/30/10

ATTACHMENT

Engine Family	1.Engine Code	2.Engine Model	3.BHP@RPM (SAE Gross)	4.Fuel Rate: mm/stroke @ peak HP (for diesel only)	5.Fuel Rate: (lbs/hr) @ peak HP (for diesels only)	6.Torque @ RPM (SEA Gross)	7.Fuel Rate: mm/stroke@peak torque	8.Fuel Rate: (lbs/hr)@peak torque	9.Emission Control Device Per SAE J1930
BYDXL0.57U2N	N/A	2TNV70-CHCL	15.2/3600	18.7	7.4	N/A	N/A	N/A	EM IFI
BYDXL0.57U2N	N/A	2TNV70-H	14.2/3600	17.5	6.9	N/A	N/A	N/A	EM IFI
BYDXL0.57U2N	N/A	2CA1-H	14.2/3600	17.5	6.9	N/A	N/A	N/A	EM IFI

NORTHSTAR
ENVIRONMENTAL & MARINE SERVICES
Est. 1990

NORTHSTAR COMMANDER

The Northstar Commander is a multi-purpose offshore utility vessel (work-boat), capable of performing a wide variety of duties such as towing, salvage, marine construction, oil-spill response work, in-shore supply work and supporting a wide array of scientific and research projects.

SPECIFICATIONS

Vessel Type	R/V / Commercial Utility Vessel
Length, overall	92ft
Beam	26ft
Draft	8.5ft
Engine	Twin screw Volvo D125-E 450hp each (new 2011)
Accommodations	12 births in 3 cabins
Navigation	2x Furuno Radars, Furuno Nav Net Chart Plotter, AIS & DGPS, Raytheon Thermal Imaging Camera
Fuel Capacity	10,000 gallons
Water Capacity	2,900 gallons with additional options available for extended cruises
Other Equipment	75 ton Tow Winch
	Generators: 1x 65KW John Deere (new 2015) 1X 65KW Caterpillar (reconditioned 2010)
	3.75 ton Palfinger PK 18080MD-S25 Marine Knuckleboom Crane
	Push Knee, Towing Winch, Capstan & Windlass
	Heavy A-frame ready, 16ft A-frame available
	Deck Office Container available
	Auxiliary Hydraulics and additional Pull Master Winches available
	Full USGS safety requirements met

(http://www.northstarmarineinc.com)

SPECIFICATIONS

Vessel Type	: Workboat
Documentation	: CG # 41406
Tonnage	: 28,500 lbs (Displ.)
Length, overall	: 41 ft
Beam	: 13 ft 5 in.
Draft	: 4 ft 1 in
Main Engines	: 2 x Cummins – 560 HP
Generator	: 24v – Battery System
Fuel capacity	: 480 g
Electronics	:Furuno Chart Plotter, VHF, Exceeds USCG Safety reqs.
Special features	:

Appendix H
Air Quality Emissions Calculations

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OCEAN WIND OFFSHORE WIND FARM
Air Emission Calculations
Emission Summary - FLiDAR Buoy Deployment

Met Facilities Activity	VOC tpy	NO_X tpy	CO tpy	PM/PM_{10} tpy	$PM_{2.5}$ tpy	SO_2 tpy	HAPs tpy	GHG tpy CO_2e
Deployment Activities (yr. 1)	0.009	0.23	0.13	0.008	0.008	4.23E-05	0.001	16.2
Quarterly Maintenance Activities (yrs. 1-2)	0.004	0.14	0.07	0.004	0.004	1.84E-05	0.001	9.9
FLiDAR Backup Generators (yrs. 1-2)	0.005	0.0365	0.01	0.001	0.001	3.47E-05	9.15E-05	3.8
Annual Inspection (end of yr. 1)	0.017	0.45	0.26	0.016	0.015	8.46E-05	0.002	32.5
Decommissioning Activities (End of Yr. 2)	0.009	0.23	0.13	0.008	0.008	4.23E-05	0.001	16.2
Maximum Annual Emissions [1]	0.035	0.86	0.47	0.028	0.027	1.80E-04	0.004	62.5
Total Project Lifetime Emissions (tons)	**0.053**	**1.26**	**0.69**	**0.040**	**0.039**	**2.75E-04**	**0.007**	**92.4**

Note:
1. The maximum annual emissions assume that the quarterly and annual maintenance activities, the annual inspection, and either the installation or decommissioning activities occur in the same year.

OCEAN WIND OFFSHORE WIND FARM - AIR EMISSION CALCULATIONS
FLIDAR Buoy Backup Generators

Generator Engine Data

Manufacturer	Yanmar	
Model	2TNV70	
Engine Type	4 cycle, 2 cy diesel	
Original rated power output	kW	10
Original rated power output	bhp	13.4
Derated power output	kW	3.5
Derated power output	bhp	4.7
Total displacement	L	0.57
Number of cylinders	cy	2
Displacement per cylinder	L/cy	0.29
Engine speed	rpm	3600

Fuel Use Assumptions

Fuel consumption at 100% load	gal/hr	0.33
Heat input rate	MMBtu/hr (HHV)	0.047
Number of generators (total both buoys)	engines	2
Annual operating hours per generator	hr/yr	500
Annual fuel usage per generator	gal/yr	163

Fuel Data

Fuel type	Ultra low sulfur diesel	
Fuel heat content	Btu/lb (LHV)	19,300
Fuel heat content	Btu/lb (HHV)	20,316
Fuel density	lb/gal	7.1
Fuel sulfur content	% weight	0.0015
Conversion factor	LHV/HHV	0.95

Engine Emission Factors

NOx	g/hp-hr	7.05
CO	g/hp-hr	1.74
HC (VOC)	g/hp-hr	1.00
PM/PM10	g/hp-hr	0.20
PM2.5	g/hp-hr	0.20
SO2	lb/MMBtu (HHV)	0.0015
HAP	lb/MMBtu (HHV)	0.0039
CO2	lb/MMBtu (HHV)	163.1
CH4	lb/MMBtu (HHV)	0.007
N2O	lb/MMBtu (HHV)	0.001

Engine Emission Estimates

				Annual Emissions Per Engine (tons/yr)	Annual Emissions for Both Engines (tons/yr)
NOx	lb/hr (per engine)	0.07	NOx	0.018	0.036
CO	lb/hr (per engine)	0.02	CO	0.005	0.009
VOC	lb/hr (per engine)	0.010	VOC	0.0026	0.005
PM10	lb/hr (per engine)	0.002	PM10	0.0005	0.001
PM2.5	lb/hr (per engine)	0.002	PM2.5	0.0005	0.001
SO2	lb/hr (per engine)	6.94E-05	SO2	1.74E-05	3.47E-05
HAP	lb/hr (per engine)	1.83E-04	HAP	4.57E-05	9.15E-05
CO2	lb/hr (per engine)	7.7	CO2	1.92	3.83
CH4	lb/hr (per engine)	3.11E-04	CH4	7.78E-05	1.56E-04
N2O	lb/hr (per engine)	6.22E-05	N2O	1.56E-05	3.11E-05
CO2e	lb/hr (per engine)	7.7	CO2e	1.92	3.85

Notes:
1. Engine power rating and displacement are based on manufacturer specification sheet.
2. Fuel consumption is based on manufacturer estimated fuel use of 300 g/kWh at 3600 rpm.
3. It is assumed these engines will be limited to no more than 500 hours per year, including maintenance and testing.
4. Emission factors for NOx, CO, VOC, and PM are based on actual vendor data, and are compliant with EPA 2008 Tier 4 standards for engines 25 hp (5.6 g/hp-hr NOx+HC; 4.9 g/hp-hr CO; 0.3 g/hp-hr PM). The vendor-provided NOx+HC rate was apportioned into NOx and VOC rates bas of Tier 1 limits (9.2 g/kWh NOx and 1.3 g/kWh HC).
5. All particulate (PM) is assumed to be ≤ to 10 µm (PM10) and 97% of the PM is assumed to be smaller than 2.5 µm (PM2.5) based on US EPA and Crankcase Emission Factors for Nonroad Engine Modeling - Compression-Ignition, No. NR-0009d, July 2010.
6. SO2 emission factor calculated from mass balance for 0.0015% by weight ULSD, assuming 100% conversion of fuel sulfur to SO2.
7. Emission factors used to calculate emission rates for CO2 (73.96 kg/MMBtu), CH4 (0.003 kg/MMBtu) and N2O (0.0006 kg/MMBtu) were ba and C-2 of 40 CFR Part 98 - Mandatory Greenhouse Gas Reporting, Subpart C - General Stationary Fuel Combustion Sources.
8. CO2e emission rates use the following carbon equivalence factors: 25 for CH4, and 298 for N2O.

OCEAN WIND OFFSHORE WIND FARM
Air Emission Calculations
Marine Vessel Emissions - FLiDAR Buoy Deployment

Vessels/Equipment	No. of Engines per vessel	Dimensions (ft) length x breadth x draft	Emission Factor Used (see EFs worksheet)	Activity	Engine Rating (hp)	Fuel Type	Trips	Hrs/trip	Operating Days	Operating Hours (hrs/day)	Total Vessel Operating Hours (hrs)	Average load (%)	Fuel Usage Gallons	Total Emissions									
														VOC tons	NO_X tons	CO tons	PM_{10} tons	$PM_{2.5}$ tons	SO_2 tons	HAPs tons	CO_2 tons	CH_4 tons	N_2O tons	CO_2e tons
Work boat (Northstar Commander or similar)		92' x 26' x 8.5'		Deploying FLIDAR 1																			
- main engines	2		2		450	Diesel	1	3	1	12	15	43%	292.7	1.29E-03	0.05	0.02	1.23E-03	1.19E-03	6.21E-06	2.65E-04	3.29	4.30E-04	9.55E-05	3.33
- aux. generator	1		2		87	Diesel	1	3	1	12	15	43%	28.3	1.25E-04	4.52E-03	2.31E-03	1.19E-04	1.15E-04	6.00E-07	2.56E-05	0.32	4.15E-05	9.23E-06	0.32
- aux. engine	1		205		120	Diesel	0	0	1	12	12	100%	72.0	1.54E-03	1.09E-02	1.35E-02	1.18E-03	1.15E-03	7.56E-06	1.96E-05	0.82	3.33E-05	6.67E-06	0.82
Support vessel (Northstar Enterprise or similar)		41' x 13.5' x 4'		Deploying FLIDAR 1																			
- main engines	2		2		425	Diesel	1	3	1	12	15	45%	289.3	1.27E-03	0.05	0.02	1.22E-03	1.18E-03	6.13E-06	2.62E-04	3.26	4.25E-04	9.44E-05	3.29
Work boat (Northstar Commander or similar)		92' x 26' x 8.5'		Deploying FLIDAR 2																			
- main engines	2		2		450	Diesel	1	4.5	1	12	16.5	43%	321.9	1.42E-03	0.05	0.03	1.35E-03	1.31E-03	6.83E-06	2.92E-04	3.62	4.73E-04	1.05E-04	3.67
- aux. generator	1		2		87	Diesel	1	4.5	1	12	16.5	43%	31.1	1.37E-04	4.97E-03	2.54E-03	1.31E-04	1.27E-04	6.60E-07	2.82E-05	0.35	4.57E-05	1.02E-05	0.35
- aux. engine	1		205		120	Diesel	0	0	1	12	12	100%	72.0	1.54E-03	1.09E-02	1.35E-02	1.18E-03	1.15E-03	7.56E-06	1.96E-05	0.82	3.33E-05	6.67E-06	0.82
Support vessel (Northstar Enterprise or similar)		41' x 13.5' x 4'		Deploying FLIDAR 2																			
- main engines	2		2		425	Diesel	1	4.5	1	12	16.5	45%	318.2	1.40E-03	0.05	0.03	1.34E-03	1.30E-03	6.75E-06	2.88E-04	3.58	4.67E-04	1.04E-04	3.62
Support vessel (Northstar Enterprise or similar)		41' x 13.5' x 4'		Quarterly maintenance (year 1)																			
- main engines	2		2		425	Diesel	3	5	3	10	45	45%	867.8	3.82E-03	0.14	0.07	3.65E-03	3.54E-03	1.84E-05	7.86E-04	9.77	1.27E-03	2.83E-04	9.88
Support vessel (Northstar Enterprise or similar)		41' x 13.5' x 4'		Quarterly maintenance (year 2)																			
- main engines	2		2		425	Diesel	3	5	3	10	45	45%	867.8	3.82E-03	0.14	0.07	3.65E-03	3.54E-03	1.84E-05	7.86E-04	9.77	1.27E-03	2.83E-04	9.88
Work boat (Northstar Commander or similar)		92' x 26' x 8.5'		Annual maintenance FLIDAR 1																			
- main engines	2		2		450	Diesel	2	3	2	12	30	43%	585.3	2.58E-03	0.09	0.05	2.46E-03	2.39E-03	1.24E-05	5.30E-04	6.59	8.59E-04	1.91E-04	6.67
- aux. generator	1		2		87	Diesel	2	3	2	12	30	43%	56.6	2.49E-04	0.01	4.61E-03	2.38E-04	2.31E-04	1.20E-06	5.13E-05	0.64	8.31E-05	1.85E-05	0.64
- aux. engine	1		205		120	Diesel	0	0	2	12	24	100%	144.0	3.08E-03	2.18E-02	2.70E-02	2.37E-03	2.30E-03	1.51E-05	3.92E-05	1.64	6.67E-05	1.33E-05	1.65
Support vessel (Northstar Enterprise or similar)		41' x 13.5' x 4'		Annual maintenance FLIDAR 1																			
- main engines	2		2		425	Diesel	2	3	2	12	30	45%	578.5	2.55E-03	0.09	0.05	2.43E-03	2.36E-03	1.23E-05	5.24E-04	6.51	8.49E-04	1.89E-04	6.59
Work boat (Northstar Commander or similar)		92' x 26' x 8.5'		Annual maintenance FLIDAR 2																			
- main engines	2		2		450	Diesel	2	4.5	2	12	33.0	43%	643.9	2.84E-03	0.10	0.05	2.71E-03	2.63E-03	1.37E-05	5.83E-04	7.25	9.45E-04	2.10E-04	7.33
- aux. generator	1		2		87	Diesel	2	4.5	2	12	33	43%	62.2	2.74E-04	9.95E-03	5.08E-03	2.62E-04	2.54E-04	1.32E-06	5.64E-05	0.70	9.14E-05	2.03E-05	0.71
- aux. engine	1		205		120	Diesel	0	0	2	12	24	100%	144.0	3.08E-03	2.18E-02	2.70E-02	2.37E-03	2.30E-03	1.51E-05	3.92E-05	1.64	6.67E-05	1.33E-05	1.65
Support vessel (Northstar Enterprise or similar)		41' x 13.5' x 4'		Annual maintenance FLIDAR 2																			
- main engines	2		2		425	Diesel	2	4.5	2	12	33	45%	636.4	2.80E-03	0.10	0.05	2.68E-03	2.60E-03	1.35E-05	5.76E-04	7.16	9.34E-04	2.08E-04	7.25
Work boat (Northstar Commander or similar)		92' x 26' x 8.5'		Decommissioning FLIDAR 1																			
- main engines	2		2		450	Diesel	1	3	1	12	15	43%	292.7	1.29E-03	0.05	0.02	1.23E-03	1.19E-03	6.21E-06	2.65E-04	3.29	4.30E-04	9.55E-05	3.33
- aux. generator	1		2		87	Diesel	1	3	1	12	15	43%	28.3	1.25E-04	4.52E-03	2.31E-03	1.19E-04	1.15E-04	6.00E-07	2.56E-05	0.32	4.15E-05	9.23E-06	0.32
- aux. engine	1		205		120	Diesel	0	0	1	12	12	100%	72.0	1.54E-03	1.09E-02	1.35E-02	1.18E-03	1.15E-03	7.56E-06	1.96E-05	0.82	3.33E-05	6.67E-06	0.82
Support vessel (Northstar Enterprise or similar)		41' x 13.5' x 4'		Decommissioning FLIDAR 1																			
- main engines	2		2		425	Diesel	1	3	1	12	15	45%	289.3	1.27E-03	0.05	0.02	1.22E-03	1.18E-03	6.13E-06	2.62E-04	3.26	4.25E-04	9.44E-05	3.29
Work boat (Northstar Commander or similar)		92' x 26' x 8.5'		Decommissioning FLIDAR 2																			
- main engines	2		2		450	Diesel	1	4.5	1	12	16.5	43%	321.9	1.42E-03	0.05	2.63E-02	1.35E-03	1.31E-03	6.83E-06	2.92E-04	3.62	4.73E-04	1.05E-04	3.67
- aux. generator	1		2		87	Diesel	1	4.5	1	12	16.5	43%	31.1	1.37E-04	4.97E-03	2.54E-03	1.31E-04	1.27E-04	6.60E-07	2.82E-05	0.35	4.57E-05	1.02E-05	0.35
- aux. engine	1		205		120	Diesel	0	0	1	12	12	100%	72.0	1.54E-03	1.09E-02	1.35E-02	1.18E-03	1.15E-03	7.56E-06	1.96E-05	0.82	3.33E-05	6.67E-06	0.82
Support vessel (Northstar Enterprise or similar)		41' x 13.5' x 4'		Decommissioning FLIDAR 2																			
- main engines	2		2		425	Diesel	1	4.5	1	12	16.5	45%	318.2	1.40E-03	0.05	0.03	1.34E-03	1.30E-03	6.75E-06	2.88E-04	3.58	4.67E-04	1.04E-04	3.62
													7,437.3	**0.04**	**1.18**	**0.67**	**0.04**	**0.04**	**2.06E-04**	**6.37E-03**	**83.8**	**1.03E-02**	**2.29E-03**	**84.7**

Notes:
1. One separate round trip per vessel will be required to install each FLIDAR buoy.
2. Two separate round trips per vessel will be required for annual maintenance on each FLIDAR buoy.
3. One separate round trip per vessel will be required to decommission each FLIDAR buoy.
4. Quarterly maintenance activities will be performed in three out of four calendar quarters. The fourth quarter trip will be either annual maintenance (year 1) or decommissioning (year 2).
5. Trip time constitutes the round trip transit time to and from the project site. The number of hours per trip were estimated based on an assumed transit speed of 10 knots, and additional time required for maneuvering and berthing. Round trip distances are estimated to be: 28 nm for FLIDAR 1 deployment/ maintenance/ decommissioning; 45nm for FLIDAR 2 deployment/ maintenance/ decommissioning; and 49.5 nm for quarterly maintenance (3-leg trip from port to FLIDAR 1, then FLIDAR 2, then back to port.)
6. Operating days/hours is the estimated time each vessel is at the deployment site performing its associated activities.
7. The auxiliary engine on the work boat powers the winch, crane, and A-frame, and will only operate in the immediate vicinity of each deployment site.
8. Emission calculations based on vessels traveling from Avalon Marine Center.
9. The engines utilized on each of the vessels are assumed to be Category 1 engines based on engine horsepower rating (<1,000 kW) and cylinder displacement (1-5 liters per cylinder).
10. Emission factors for marine vessel engines are from Table 3-8 in the ICF International report to the US EPA "Current Methodologies in Preparing Mobile Source Port-Related Emissions Inventories", April 2009. (See emission factors summary page) Assumed all engines to be used are certified to meet EPA Tier 1 engine standards; therefore, the Tier 1 emission factors in Table 3-8 from the ICF International report was used to provide conservative estimate.
11. HAP emission factors for commercial marine vessels were determined using the methodology identified by US EPA for the 2011 National Emissions Inventory (NEI); i.e., they are calculated as percentages of the PM_{10}, $PM_{2.5}$, or VOC emissions from the CMVs. The HAP emisson for nonroad engines were based on EPA's AP-42 Volume 1, Chapters 3.3 and 3.4 for small and large diesel engines. (see HAP emission factor summary pages)
12. Average load factors were estimated based on load factors presented in Table 3-4 of the ICF International report.
13. CO_2e emission rates use the following carbon equivalence factors: 25 for CH_4, and 298 for N_2O.

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Emission Factor Summary

Commercial Marine Vessels (CMVs)

		Commercial Marine Vessel Emission Factors (g/hp-hr) /a									Fuel Cons.
	Engine Type	VOC	NO_x	CO	PM/ PM_{10} /b, /c	$PM_{2.5}$ /b	SO_2 /c	CO_2	CH_4	N_2O	(gal/hp-hr) /d
1	Category 2 engines	0.37	7.3	3.73	0.46	0.45	0.0010	515	0.067	0.015	0.050
2	Category 1 engines ≤ 1000 kW	0.20	7.3	3.73	0.19	0.19	0.0010	515	0.067	0.015	0.050
3	Category 3 engines (MSD using MDO) (>30L/cyl.)	0.37	9.8	0.82	0.14	0.13	0.296	482	0.003	0.023	0.046
4	All Categories aux. engines (MSD using MDO)	0.30	10.4	0.82	0.14	0.13	0.316	515	0.003	0.023	0.049

/a Emission factors for Category 1 and 2 engines are from Table 3-8 from ICF International report to the US EPA "Current Methodologies in Preparing Mobile Source Port-Related Emissions Inventories", April 2009 (converted from g/kW-hr to g/hp-hr by multiplying by 0.746 kW/hp). Assumed all Category 1 and 2 engines to be used are certified to meet EPA Tier 1 and 2 marine engine standards respectively (providing conservative estimate for Category 1 engines); therefore the Tier 1 and 2 emission factors in Table 3-8 from the ICF International report was used. Note, the CO emission factor for Category 1 Tier 2 engines is higher than what is provided for Tier 1 engines, thus the Tier 2 emission factor for CO was used to provide a conservative estimate.

/b All PM is assumed to less than 10 µm in diameter; therefore, PM emission factor is equivalent to PM_{10} emission factor. $PM_{2.5}$ is estimated to be 97 % of PM_{10} per EPA guidance in "Exhaust and Crankcase Emission Factors for Nonroad Engine Modeling - Compression-Ignition," EPA420-R-10-018/NR-009d, July 2010.

/c Emission factors for Category 1 and 2 engines for SO_2 and PM_{10} presented in Table 3-8 of the ICF report (ICF International 2009) are based on a fuel sulfur content of 1.5 percent. These factors were adjusted for the 15 ppmw sulfur content in ultra-low sulfur diesel fuel, by multiplying the emission factors by 0.001 and 0.86 for SO_2 and PM_{10}, respectively, following the approach used in Section 3.4.2 of the ICF Report.

/d Fuel consuption rate for Category 1 and 2 marine engines was estimated based on CO_2 emission factor (g/hp-hr) and the emission factor for the mass of CO_2 generated per gallon of fuel (10.21 kg CO_2/gal fuel) as presented in the Table 13.1 of the "2014 Climate Registry Default Emission Factors." Fuel consumption for Category 3 marine engines was based on the BSFC (g/kW-hr) in the ICF International report.

Land-Based Stationary Diesel Engines, Excluding Fire Pumps (<= 2,237 kW and Displacement < 10 L/cylinder)

			Subpart IIII standards (g/kWh) /a				(g/kWh) /b	Other Emission Factors (lb/MMBtu) /c, /d				Fuel Cons.
	Stationary Source Category	Engine Size (kW)	VOC	NO_x	CO	PM/ PM_{10}	$PM_{2.5}$	SO_2	CO_2	CH_4	N_2O	(gal/hp-hr) /e
200	Non-Emergency Engines (pre-2007)	kW < 8	1.3	9.2	8.0	1.0	0.97	0.0015	163.1	0.007	0.001	0.050
201		8 <= kW < 19	1.18	8.32	6.6	0.80	0.78	0.0015	163.1	0.007	0.001	0.050
202		19 <= kW < 37	1.18	8.32	5.5	0.80	0.78	0.0015	163.1	0.007	0.001	0.050
203		37 <= kW < 56	1.3	9.2	11.4	1.0	0.97	0.0015	163.1	0.007	0.001	0.050
204		56 <= kW < 75	1.3	9.2	11.4	1.0	0.97	0.0015	163.1	0.007	0.001	0.050
205		75 <= kW < 130	1.3	9.2	11.4	1.0	0.97	0.0015	163.1	0.007	0.001	0.050
206		130 <= kW < 225	1.3	9.2	11.4	0.54	0.52	0.0015	163.1	0.007	0.001	0.050
207		225 <= kW < 450	1.3	9.2	11.4	0.54	0.52	0.0015	163.1	0.007	0.001	0.050
208		450 <= kW < 560	1.3	9.2	11.4	0.54	0.52	0.0015	163.1	0.007	0.001	0.050
209		kW > 560	1.3	9.2	11.4	0.54	0.52	0.0015	163.1	0.007	0.001	0.050

/a Values are from Table 1 to 40 CFR 60 Subpart IIII, except as follows:
For highlighted cells, either a combined standard was provided (NMHC+NOx) or no standard was provided (CO and PM, and VOC in three cases).
Values for NMHC+NOx were apportioned into NOx and VOC rates based on the ratio of Tier 1 limits (9.2 g/kWh NOx and 1.3 g/kWh HC).
Substitute values for CO and PM (and VOC, when only a NOx standard was provided) were based on the worst-case rate provided for non-emergency pre-2007 engines.

/b All PM is assumed to less than 10 µm in diameter; therefore, PM emission factor is equivalent to PM_{10} emission factor. $PM_{2.5}$ is estimated to be 97 % of PM_{10} per EPA guidance in "Exhaust and Crankcase Emission Factors for Nonroad Engine Modeling - Compression-Ignition," EPA420-R-10-018/NR-009d, July 2010.

/c SO2 emission factor based on typical mass balance for 0.0015% by weight ULSD, assuming 100% conversion of fuel sulfur to SO2.

/d Emission factors used to calculate emission rates for CO2 (73.96 kg/MMBtu), CH4 (0.003 kg/MMBtu) and N2O (0.0006 kg/MMBtu) were based on Tables C-1 and C-2 of 40 CFR Part 98 - Mandatory Greenhouse Gas Reporting, Subpart C - General Stationary Fuel Combustion Sources.

/e Fuel consumption rate is on a higher heating value (HHV) basis per unit of engine output, assuming the AP-42 specific consumption rate of 7,000 Btu/hp-hr, and a fuel heat content of 140,000 Btu/gal.

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EPA NEI HAP emission factors for Commercial Marine Vessels

HAP emission factors for commercial marine vessels were determined using the methodology identified by US EPA for the 2011 National Emissions Inventory (NEI); i.e., they are calculated as percentages of the PM10, PM2.5, or VOC emissions from the CMVs.

CMV fuel type			Diesel (distillate)		Residual			
Operating description			In Port	Underway	In Port		Underway	
SCC code			2280002100	2280002200	2280003100		2280003200	
Type			Maneuvering	Cruising	Manuevering	Hotelling	Cruising	Reduced Speed Zone
Type Code			M	C	M	H	C	Z
Pollutant	HAP?*	Fraction of						
Ammonia	No	PM10	0.01	0.02	0.00238	0.0108	0.00477	0.00477
Arsenic	Yes	PM10	0.0000175	0.00003	8.74126E-05	0.0004	0.000174825	0.000174825
Benzo[a]Pyrene	Yes	PM10	0.0000025	0.000005	4.37063E-07	0.000002	8.74126E-07	8.74126E-07
Benzo[b]Fluoranthene	Yes	PM10	0.000005	0.00001	8.74126E-07	0.000004	1.74825E-06	1.74825E-06
Benzo[k]Fluoranthene	Yes	PM10	0.0000025	0.000005	4.37063E-07	0.000002	8.74126E-07	8.74126E-07
Beryllium	Yes	PM10			0.000000546	0.000000546	0.000000546	0.000000546
Cadmium	Yes	PM10	0.00000283	0.00000515	0.0000226	0.0000059	0.0000226	0.0000226
Chromium (VI)	Yes	PM10	0.0000085	0.000017	0.00006528	0.000204	0.00006528	0.00006528
Chromium III	Yes	PM10	0.0000165	0.000033	0.00012672	0.000396	0.00012672	0.00012672
Cobalt	Yes	PM10			5.94406E-05	0.000292	0.000153846	0.000153846
Hexachlorobenzene	Yes	PM10	0.00000002	0.00000004	3.4965E-09	0.000000016	6.99301E-09	6.99301E-09
Indeno[1,2,3-c,d]Pyrene	Yes	PM10	0.000005	0.00001	8.74126E-07	0.000004	1.74825E-06	1.74825E-06
Lead	Yes	PM10	0.000075	0.00015	1.39642E-05	0.00006	0.0000262	0.0000262
Manganese	Yes	PM10	0.00000153	0.000001275	0.0000573	0.0000573	0.0000573	0.0000573
Mercury	Yes	PM10	0.000000025	0.00000005	2.7076E-07	0.0000014	5.24476E-07	5.24476E-07
Nickel	Yes	PM10	0.0005	0.001	0.003250219	0.0154	0.00589	0.00589
Phosphorus	Yes**	PM10			0.001787587	0.00438	0.005734266	0.005734266
Polychlorinated Biphenyls	Yes	PM10	0.00000025	0.0000005	4.37063E-08	0.0000002	8.74126E-08	8.74126E-08
Selenium	Yes	PM10	2.83E-08	5.15E-08	1.9125E-06	0.00000908	0.00000348	0.00000348
Total HAP (ratioed to PM10)			**0.0006**	**0.0013**	**0.0055**	**0.0212**	**0.0123**	**0.0123**
Acenaphthene	Yes	PM2.5	0.000018	0.000015	0.00000034	0.00000034	0.00000034	0.00000034
Acenaphthylene	Yes	PM2.5	0.00002775	0.000023125	0.000000525	0.000000525	0.000000525	0.000000525
Anthracene	Yes	PM2.5	0.00002775	0.000023125	0.000000525	0.000000525	0.000000525	0.000000525
Benz[a]Anthracene	Yes	PM2.5	0.00003	0.000025	0.000000567	0.000000567	0.000000567	0.000000567
Benzo[g,h,i,]Perylene	Yes	PM2.5	0.00000675	0.000005625	0.000000128	0.000000128	0.000000128	0.000000128
Chrysene	Yes	PM2.5	0.00000525	0.000004375	9.93E-08	9.93E-08	9.93E-08	9.93E-08
Fluoranthene	Yes	PM2.5	0.0000165	0.00001375	0.000000312	0.000000312	0.000000312	0.000000312
Fluorene	Yes	PM2.5	0.00003675	0.000030625	0.000000695	0.000000695	0.000000695	0.000000695
Naphthalene	Yes	PM2.5	0.00105075	0.000875625	0.0000199	0.0000199	0.0000199	0.0000199
Phenanthrene	Yes	PM2.5	0.000042	0.000035	0.000000794	0.000000794	0.000000794	0.000000794
Pyrene	Yes	PM2.5	0.00002925	0.000024375	0.000000553	0.000000553	0.000000553	0.000000553
Total HAP (ratioed to PM2.5)			**0.0013**	**0.0011**	**0.000024**	**0.000024**	**0.000024**	**0.000024**
2,2,4-Trimethylpentane	Yes	VOC	0.0003	0.00025	NA	NA	NA	NA
Acetaldehyde	Yes	VOC	0.0557235	0.04643625	0.000229	0.000229	0.000229	0.000229
Acrolein	Yes	VOC	0.002625	0.0021875	NA	NA	NA	NA
Benzene	Yes	VOC	0.015258	0.012715	0.0000098	0.0000098	0.0000098	0.0000098
Ethyl Benzene	Yes	VOC	0.0015	0.00125	NA	NA	NA	NA
Formaldehyde	Yes	VOC	0.1122	0.0935	0.00157	0.00157	0.00157	0.00157
Hexane	Yes	VOC	0.004125	0.0034375	NA	NA	NA	NA
Propionaldehyde	Yes	VOC	0.004575	0.0038125	NA	NA	NA	NA
Styrene	Yes	VOC	0.001575	0.0013125	NA	NA	NA	NA
Toluene	Yes	VOC	0.0024	0.002	NA	NA	NA	NA
Xylenes (Mixed Isomers)	Yes	VOC	0.0036	0.003	NA	NA	NA	NA
Total HAP (ratioed to VOC)			**0.2039**	**0.1699**	**0.0018**	**0.0018**	**0.0018**	**0.0018**

*For completeness, all of the pollutants in EPA's database are shown, but not all are HAP as defined in Section 112 of the Clean Air Act and as updated in 40 CFR 63 Subpart C.

**Only elemental phosphorus (CAS #7723140) is a HAP; phosphorus-containing compounds in general are not.

Reference: US EPA, "2011 National Emissions Inventory, version 1, Technical Support Document", draft, November 2013, available from http://www.epa.gov/ttn/chief/net/2011nei/2011_neiv1_tsd_draft.pdf; Table 104 on pp. 178-179 refers to the dataset "2011EPA_HAP-Augmentation" for HAP emissions, which is available from ftp://ftp.epa.gov/EmisInventory/2011/doc; the factors above are from that

OCEAN WIND OFFSHORE WIND FARM
HAP Emission Factor Calculation Sheet
Small Diesel Engines

Pollutant	Emission Factor (lb/MMBtu)[a]	Emission Factor Rating	Source (AP-42 Table)	
Organic Compounds				
Benzene[b]	9.33E-04	E	3.3-2	
Toluene[b]	4.09E-04	E	3.3-2	
Xylene[b]	2.85E-04	E	3.3-2	
1,3 Butadiene	< 3.91E-05	E	3.3-2	
Propylene	2.58E-03	E	3.3-2	
Formaldehyde[b]	1.18E-03	E	3.3-2	
Acetaldehyde[b]	7.67E-04	E	3.3-2	
Acrolein[b]	< 9.25E-05	E	3.3-2	
PAH				
Naphthalene[b]	8.48E-05	E	3.3-2	
Acenaphthylene[b]	< 5.06E-05	E	3.3-2	
Acenaphthene[b]	< 1.42E-06	E	3.3-2	
Fluorene[b]	2.92E-05	E	3.3-2	
Phenanthrene[b]	2.94E-05	E	3.3-2	
Anthracene[b]	1.87E-06	E	3.3-2	
Fluoranthene[b]	7.61E-06	E	3.3-2	
Pyrene[b]	4.78E-06	E	3.3-2	
Benzo(a)anthracene[b]	1.68E-06	E	3.3-2	
Chrysene[b]	3.53E-07	E	3.3-2	
Benzo(b)fluoranthene[b]	< 9.91E-08	E	3.3-2	
Benzo(k)fluoranthene[b]	< 1.55E-07	E	3.3-2	
Benzo(a)pyrene[b]	< 1.88E-07	E	3.3-2	
Indeno(1,2,3-cd)pyrene[b]	< 3.75E-07	E	3.3-2	
Dibenz(a,h)anthracene[b]	< 5.83E-07	E	3.3-2	
Benzo(g,h,i)perylene[b]	< 4.89E-07	E	3.3-2	
TOTAL PAH	1.68E-04	E	3.3-2	
Metals and inorganics[c]				
Arsenic[b]	4.62E-08			Based on ppb by weight in fuel detection limit in Rising et al. 2004
Cadmium[b]	5.13E-09			Based on ppb by weight in fuel detection limit in Rising et al. 2004
Chromium[b]	1.24E-05			Based on average ppb by weight in fuel in Rising et al. 2004
Chromium VI[b]	2.24E-06			18% of value for chromium
Lead[b]	7.69E-07			Based on average ppb by weight in fuel in Rising et al. 2004
Mercury[b]	1.03E-08			Based on ppb by weight in fuel detection limit in Rising et al. 2004
Nickel[b]	1.48E-06			Based on average ppb by weight in fuel in Rising et al. 2004
Selenium[b]	2.56E-07			Based on ppb by weight in fuel detection limit in Rising et al. 2004

Total for substances identified as HAP[e]	< 3.89E-03