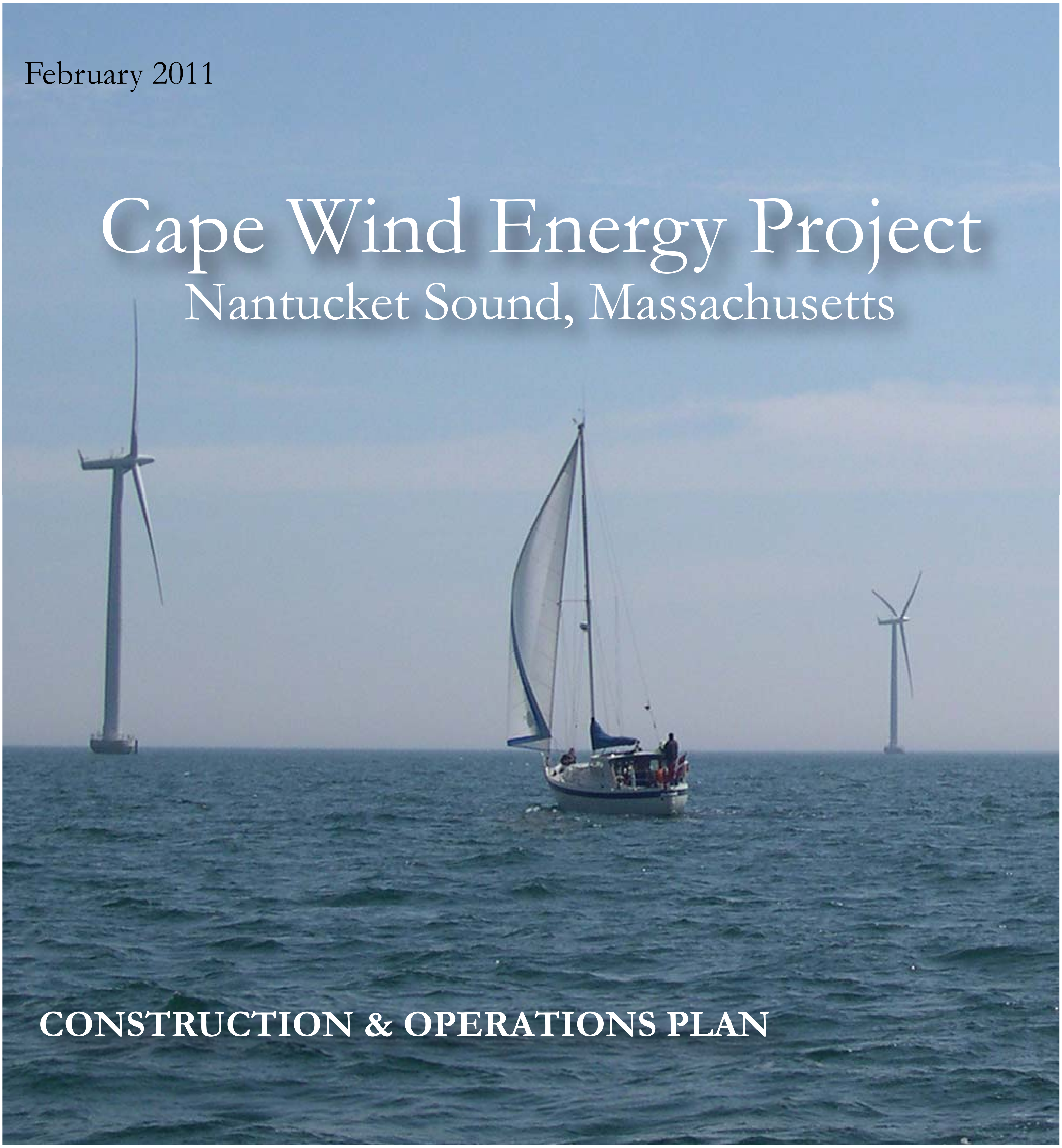
February 2011

Cape Wind Energy Project
Nantucket Sound, Massachusetts



CONSTRUCTION & OPERATIONS PLAN

Prepared for Submission to:

Bureau of Ocean Energy Management,
Regulation and Enforcement
381 Elden Street
Herndon, VA 20170

On Behalf of:

Cape Wind
Energy for Life.

Cape Wind Associates, LLC
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Prepared by:

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Construction & Operations Plan

CAPE WIND ENERGY PROJECT
NANTUCKET SOUND, MASSACHUSETTS

PREPARED FOR SUBMISSION TO

Bureau of Ocean Energy Management, Regulation and Enforcement
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Project No. E159-504.1

February 4, 2011

www.essgroup.com

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Nantucket Sound, Massachusetts

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ESS Group, Inc.

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ESS Group, Inc.

Acronyms

401 WQC	401 Water Quality Certification
ABMP	Avian and Bat Monitoring Plan
AC	Alternating Current
AHV	Anchor Handling Vessel
APE	Area of Potential Effect
API	American Petroleum Institute
APPE	Area of Potential Physical Effect
ATON	Aids to Navigation
AWOIS	Automated Wreck and Obstruction Information System
BMP	Best Management Practice
BOEMRE	Bureau of Ocean Energy Management, Regulation & Enforcement
Boomer	Boomer Subbottom Profiler
BoP	Balance of Plant
Cape Wind	The Cape Wind Project
CCC	Cape Cod Commission
CFR	Code of Federal Regulations
Chirp	Chirp Subbottom Profiler
COP	Construction and Operation Plan
CPT	Cone Penetrometer Test
Cu. ft	Cubic feet
CVA	Certified Verification Agency
CWA	Cape Wind Associates, LLC
CZM	Coastal Zone Management
DEIR	Draft Environmental Impact Report
DEIS	Draft Environmental Impact Statement
DGPS	Differential Global Positioning System
DEI&T	De-Energized Inspections and Tests
DOI	Department of Interior
DRI	Development of Regional Impact
EA	Environmental Assessment
EFSB	Energy Facilities Siting Board
EI	Energized Inspections
EIS	Environmental Impact Statement
EMF	Electrical and Magnetic Fields
EMI	Energy Management, Inc.
EPA	Environmental Protection Agency
ESA	Endangered Species Act
ESP	Electric Service Platform
ESS	ESS Group, Inc.
FAA	Federal Aviation Administration
FDR	Facilities Design Report
FEIR	Final Environmental Impact Report
FEIS	Final Environmental Impact Statement
FIR	Fabrication and Installation Report
FIS	Full Instrumentation Suite
FM	Frequency Modulated
FOIA	Freedom of Information Act
FONNSI	Finding of No New Significant Impact
fpm	flash per minute
ft	feet
G&G	Geological and Geotechnical
GPS	Global Positioning System
HAZOP	Hazard and Operability Study
HAZID	Hazard Identification

HDD	Horizontal Directional Drilling
HDPE	High Density Polyethylene
HF	High Frequency
HRG	High Resolution Geophysical
IALA	International Association of Marine Aids to Navigation and Lighthouse Authorities
IHA	Incidental Harassment Authorization
ISO-NE	Independent System Operator - New England
kcmil	Thousand Circular Mil (wire size)
km	kilometers
km2	Square kilometers
kV	Kilovolt
LGIA	Large Generator Interconnect Agreement
LTSA	Long Term Service Agreement
m	meters
MADEP	Massachusetts Department of Environmental Protection
MBUAR	Massachusetts Board of Underwater Archaeological Resources
MHC	Massachusetts Historical Commission
MLLW	Mean Low Lower Water
MMS	Minerals Management Service
MOC	Management of Change
mph	Miles per Hour
m/s	Meters/second
MV	Medium Voltage
MW	Megawatt
m3	Cubic meters
NDT	Non-destructive Testing
NEPA	National Environmental Policy Act
NHPA	National Historic Preservation Act
NTL	Notice to Lessee
NMFS	National Marine Fisheries Service
NOAA	National Oceanic And Atmospheric Administration
NSR	(Nonattainment) New Source Review
NSTAR	NSTAR Electric
O&M	Operations And Maintenance
OCS	Outer Continental Shelf
OSHA	Occupational Safety And Health Administration
OSI	Ocean Surveys, Inc.
OSRP	Oil Spill Response Plan
PAL	Public Archaeology Laboratory, Inc.
PATON	Private Aids to Navigation
PPE	Personal Protective Equipment
RIS	Reduced Instrumentation Suite
ROD	Record of Decision
ROW	Right-Of-Way
SAR	Search and Rescue
SAV	Submerged aquatic vegetation
SCADA	Supervisory control and data acquisition
SMDS	Scientific Measurement Devices Station
SMS	Safety Management Systems
SPCC	Spill Prevention, Control, and Countermeasure
SPT	Standard Penetration Test
SSA	Steam Ship Authority
SWPPP	Stormwater Pollution Prevention Plan
TI	Thermal Imaging
TP	Transition Piece

TSA	Turbine Supply Agreement
TVG	Time and Variable Gain
USACE	United States Army Corps of Engineers
USCG	United States Coast Guard
USFWS	United States Fish and Wildlife Service
USGS	United States Geological Survey
VHF	Very High Frequency
WAMS	Waterways Analysis and Management System
WFSS	Wind Farm SCADA System
WTG	Wind Turbine Generators
WTSS	Wind Turbine SCADA System
XLPE	Extruded Cross-Linked Polyethylene

1.0 INTRODUCTION

This Construction and Operation Plan (COP) presents, in an organized and synthesized manner, the extensive information and data that Cape Wind Associates, LLC (CWA) has developed over the past ten years to support the construction and operation of the Cape Wind Energy Project (Cape Wind or the Project). The Bureau of Ocean Energy Management, Regulation and Enforcement (BOEMRE) has already rigorously reviewed this information and relied upon it to prepare its extensive Final Environmental Impact Statement (FEIS) under the National Environmental Policy Act (NEPA) and its Section 106 Findings of Adverse Effects under the National Historic preservation Act for the Project. The information has also served as the basis for BOEMRE's consultations and coordination with state and federal agencies and the involved federally-recognized Tribal Nations.[1]

The only report presented in this COP that was not previously submitted is an analysis of the surface and subsurface geology data collected between 2001 and 2006 to identify potential shallow hazards (Appendix A). Please note that given the sensitive nature of the potential cultural resources identified in the report, this document should be considered and treated as confidential. This COP also attaches CWA's Avian and Bat Monitoring Plan (Appendix B), Oil Spill Response Plan (Appendix C), Materials Management and Disposal Plan (Appendix D), Safety Management System (Appendix E), Storm Water Pollution Prevention Plan (Appendix F). The Operations and Maintenance Plan (O&M Plan) is set forth in Section 5.0 of this COP.

1.1 Objective of the Construction and Operation Plan (COP):

The objective of this COP is to provide a description of all proposed activities and planned facilities for the Cape Wind Project.

The data, information, and written plans contained and described within this COP, or appended to it, are extensive and have been diligently collected, compiled and analyzed by both CWA and BOEMRE. This COP demonstrates that CWA's activities will:

- Conform to all applicable laws, implementing regulations, lease provisions, best management practices (BMPs) and environmental stipulations or conditions of its commercial lease;
- Not cause undue harm or damage to natural resources; life (including human and wildlife); property; the marine coastal or human environment; or sites, structures or objects of historical or archaeological significance;
- Be constructed and operated in a prudent and safe manner;

---

[1] On June 18, 2010 Secretary Ken Salazar issued Secretarial Order 3302 and renamed the Minerals Management Service the Bureau of Ocean Energy Management, Regulation and Enforcement. This COP is being filed subsequent to the agency's name change and, as such, this COP refers to this agency as Bureau of Ocean Energy Management, Regulation, and Enforcement (BOEMRE). In all instances, even when describing historical events prior to the agency name change this COP uses the current agency name, BOEMRE. In all instances, when this COP uses the term BOEMRE it means the agency now known as BOEMRE and formerly known as the Minerals Management Service (MMS). While the document has been edited for consistent use of this agency name, there may be some attachments, appendices, figures or references to this COP that include the term MMS because the compilation, preparation and/or production of those documents predate the agency name change.

- Not unreasonably interfere with other uses of the Outer Continental Shelf (OCS), including those involved with National security or defense;
- Use best available and safest technology;
- Use best management practices; and
- Use properly trained personnel.

The text that follows:

1. Describes all planned facilities that CWA will construct or use and describes all proposed construction activities and commercial operations for the Cape Wind facilities;
2. Presents an analysis of the surface and subsurface geology of the project area to provide information on potential shallow hazards; and
3. Describes the activities planned to implement the pre-construction cultural, geological, and geophysical studies set forth in Addendum C to the Lease.

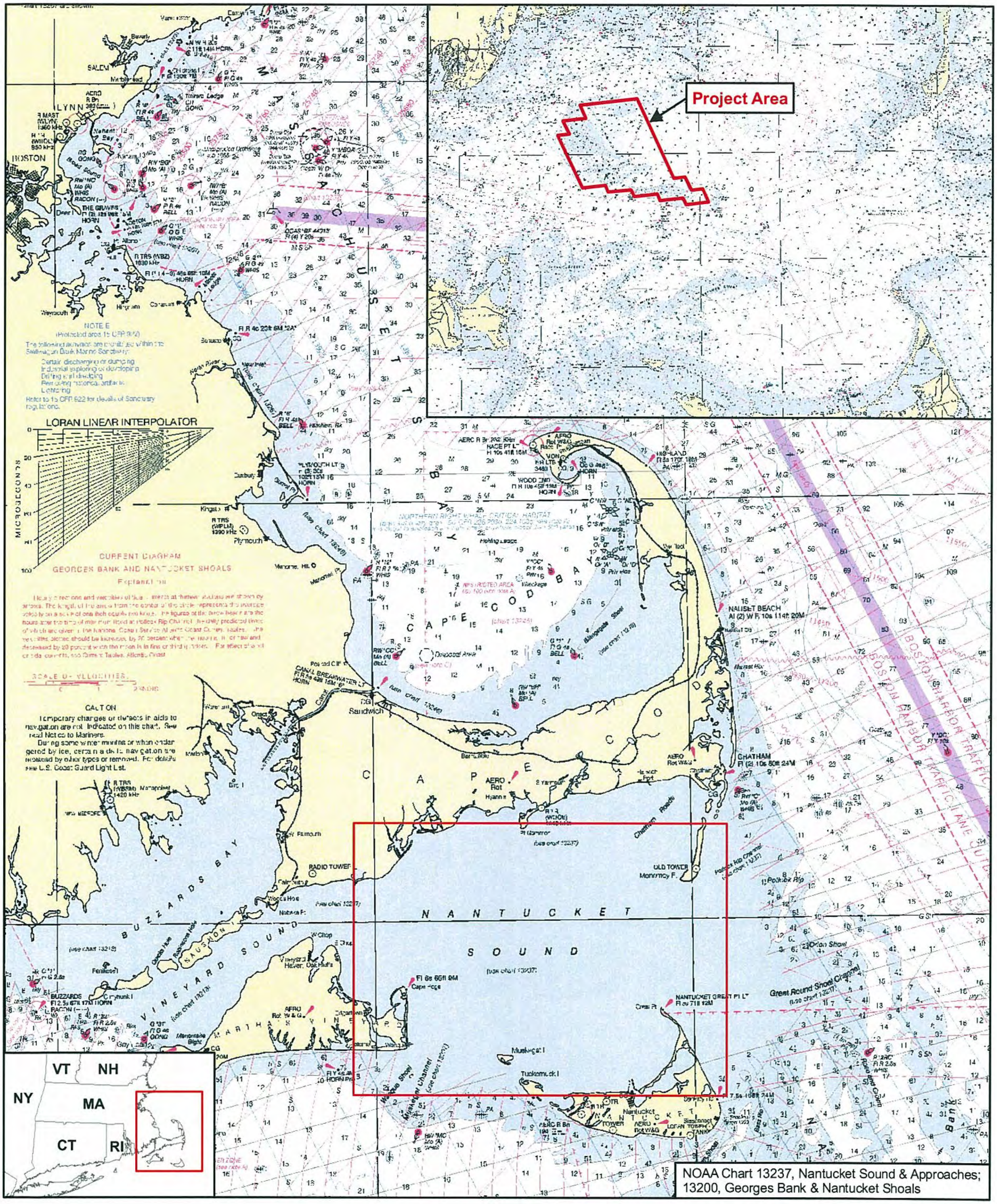
1.2 Project Overview:

The Cape Wind Project was the first offshore wind energy project to be proposed in the United States, and it will likely be the first utility-scale offshore wind energy project that will be constructed. As such it has undergone an unprecedented level of environmental and regulatory analysis over the course of its 10 year development history. The Project will be located in Nantucket Sound off the coast of Massachusetts and will consist of 130 Siemens 3.6 megawatt (MW) wind turbine generators capable of producing 468 MW of energy interconnected directly with Independent System Operator – New England (ISO-NE) at the Barnstable substation. The energy produced by the Project will be sufficient to supply approximately 75% of the annual requirements of Cape Cod and the nearby islands of Martha's Vineyard and Nantucket. In addition, Cape Wind will:

- Reduce the greenhouse gas emissions of otherwise required conventional generation, saving 733,000 tons of CO_2, 802 tons of SO_X, and 497 tons of NO_x annually;
- Create 600 – 1,000 direct, indirect and induced jobs in building and supplying the Project;
- Create 154 jobs in operation and administration;
- Provide consumers across the region a valuable hedge against increasing fossil fuel prices;
- Suppress market prices in ISO-NE, savings consumers approximately $4.6 billion over the life of the Project; and
- Catalyze the development of port facilities, offshore transmission technology, services and support capabilities and other infrastructure needed for future offshore wind and ocean energy projects.

The Project site is the nation's best location for offshore wind development. This site offers high wind energy potential, low wave heights and shallow depths. Unlike many other offshore and land-based projects, Cape Wind is close to large population centers, minimizing expensive transmission upgrades. Cape Wind is the only offshore wind project to have completed the lengthy NEPA review process at the Department of the Interior (DOI), to have received a Record of Decision from the DOI pursuant to section 388 of the Energy Policy Act of 2005, to have secured a lease on the Outer Continental Shelf for offshore energy production, and to have obtained all required state and local approvals.

The Project is fully described in Section 2 of the FEIS, but a brief overview is presented here. It entails the construction, operation and maintenance, and eventual decommissioning of an electric generating facility consisting of 130 wind turbine generators (WTGs) arranged in a grid pattern in the Horseshoe Shoal region of Nantucket Sound, Massachusetts (see Figure 1.2-1). Each of the 130 wind turbine generators would generate electricity independently of each other. For this area of Nantucket Sound, the wind power density analysis conducted by CWA determined that orientation of the array in a northwest to southeast alignment provides optimal wind energy potential for the operation of the WTGs. This alignment would position the WTGs perpendicular to prevailing winds, which are generally from the northwest in the winter and from the southwest in the summer for this geographic area in Nantucket Sound.



CAPE WIND ENERGY PROJECT
Project Locus Map

Figure 1.2-1

Solid dielectric submarine inner-array cables (33 kilovolt) from each wind turbine generator would interconnect within the WTG grid and terminate on an electrical service platform (ESP). The electric service platform would serve as the common interconnection point for all of the wind turbine generators. The proposed submarine transmission cable system (115 kilovolt) connecting the Project to Cape Cod is approximately 12.5 miles in length (7.6 miles within the Massachusetts 3 mile territorial line) from the electric service platform to the landfall location in Yarmouth. The submarine transmission cable system consists of two parallel cables that would travel north to northeast in Nantucket Sound into Lewis Bay past the westerly side of Egg Island, and then make landfall at New Hampshire Avenue.

The proposed onshore transmission cable system route from the landfall area to its intersection with the NSTAR Electric right-of-way (ROW) would be located entirely along existing paved right-of-ways where other underground utilities already exist. All of the roadways within Yarmouth and Barnstable in which the proposed transmission cable system would be placed are town owned and maintained roads with the exception of Routes 6 and 28, which are owned and maintained by the Massachusetts Highway Department. A portion of the onshore transmission cable system route would also be located underground within an existing maintained NSTAR Electric right-of-way.

Installation of the proposed action components would comprise five activities: (1) installation of the foundation monopiles and transition pieces; (2) erection of the wind turbine generators and electric service platform; (3) installation of the inner-array cables; (4) installation of the transmission cables from the electric service platform to the Barnstable Switching Station; and (5) installation of the scour protection around the monopiles and electric service platform piles. The electric service platform design is based on a piled jacket/template design with a superstructure mounting on top. The platform jacket and superstructure is expected to be fully fabricated on shore and delivered to the work site by barges, where it would be installed.

The installation of the submarine cables (both the inner array cables and the submarine transmission cables) would be accomplished by the Hydroplow embedment process, commonly referred to as jet plowing. This method involves the use of a positioned cable barge and a towed hydraulically-powered jet plow device that simultaneously lays and embeds the submarine cable in one continuous trench from wind turbine generator to wind turbine generator and then to the electric service platform, or from the electric service platform to the landfall area.

The transition of the submarine transmission cables from water to land would be accomplished through the use of Horizontal Directional Drilling (HDD). Construction of the onshore transmission cable is expected to occur in two phases. The first phase would consist of installing the ductbanks, conduits, and vaults. The second phase would consist of the installation of the onshore transmission cables, including splices and terminations. The main operation center for the project, housing the remote monitoring and command center will be located on Cape Cod. The service and maintenance vessels, supplies and personnel are expected to be stationed at two onshore locations: a New Bedford location for parts storage and larger maintenance supply vessels and Falmouth for crew transport, since it is closer to the site.

1.3 Construction and Operation Concept

The COP describes construction and operation activities for all planned Project facilities, including onshore and support facilities. Offshore construction activities, including Project components, installation methods, and safety for offshore construction workers, are described in Section 4.1, and include pre-construction offshore supplemental field surveys as specified in the Lease (Section 4.1.1), and safety management systems (SMS) (Section 4.1.2). The SMS (Appendix E) describes (a) how CWA will ensure the safety of personnel and others near the facilities, (b) remote monitoring, control, and shut down capabilities, (c) emergency response procedures, (d) fire suppression equipment, (e) testing of the SMS, and (f) personnel training. However, it is important to note that the SMS is a living document that will continue to evolve as CWA finalizes contracts for engineering, procurement, construction, and operation of the project. The SMS will also be updated as CWA contractors conduct engineering, construction and operations of the project. Detailed methods and procedures implementing the SMS will be developed in consultation with BOEMRE and the relevant health and safety regulatory agencies. Onshore construction activities, including Project components, installation methods, and safety for onshore construction workers, are described in Section 4.2.

The O&M Plan presented in Section 5 describes the approach to operations and maintenance for the Cape Wind Project and provides details regarding O&M elements of the Project that have previously been described and reviewed in the NEPA process. The purpose and objective of the O&M Plan is to maintain the plant in a safe and effective operating condition in order to maximize electricity output and plant reliability. The plan includes an explanation of specific practices and procedures that were more generally described in the FEIS and is based on practical experience from offshore wind projects in Europe, other pertinent offshore experience, and applicable regulatory requirements. [The O&M Plan specifically addresses the Lease stipulation requiring that an O&M Plan be developed to prevent potential impacts to water quality from spills and erosion/sedimentation. This requirement was established as a condition of the State FEIR Certificate and incorporated by BOEMRE as a Lease stipulation.]

1.4 Regulatory Status

The Project has undergone an unprecedented level of federal, state and local environmental review and public comment, from its initial application in November 2001 to then-lead federal agency the U.S. Army Corps of Engineers (USACE), culminating in the Record of Decision (ROD) and the signing of a Commercial Lease with BOEMRE.

The Cape Wind Project has received all state permits necessary to construct the project. All major federal reviews of the Project have also been completed. The BOEMRE issued a Record of Decision on April 28, 2010, and entered into a commercial lease with CWA on October 6, 2010. Additionally, the Federal Aviation Administration (FAA) has determined that the project is not a hazard to aviation, and other major federal permits necessary for construction (EPA and USACE) have been issued.

A comprehensive list of all required permits and the status of each is provided in Table 1.4-1, and attests to the extensive regulatory review and public comment that the Project has received over the last decade. Selected regulatory permits, approvals, and correspondence are included in Appendix H (see list in the Table of Contents). A detailed description of the Project's NEPA compliance and the permits and approvals obtained to date is provided in Section 8.0.

Table 1.4-1
Status of Permits and Approvals as of February 2011
Cape Wind Energy Project

Agency	Jurisdiction	Permit Description	ID Number	Date Applied	Date Approved
Federal					
Department of Interior - Minerals Management Service (BOEMRE)	Outer Continental Shelf	Lease, Easement or Right-of-way Under Renewable Energy and Alternate Uses of Existing Facilities on the OCS Regulatory Framework (30 CFR Part 285)	OCS-A 0478	9/14/05	ROD received; Lease Executed 10/6/10
Council on Environmental Quality, National Environmental Policy Act (NEPA)	NEPA jurisdiction is over the entire project	USACE Draft Environmental Impact Statement	(Formerly USACE NAE-2004-338-1)MMS FEIS 2-1-2-32, 2009	November 2004	
		BOEMRE Draft Environmental Impact Statement		Jan 2008	
		Final Environmental Impact Statement		Jan 2009	
		Record of Decision			4/28/2010
United States Army Corps of Engineers	Rivers and Harbors Act Section 10 jurisdiction is for work in navigable waters of the United States; Clean Water Act Section 404 jurisdiction is for work in waters of the United States and wetlands located within the 3-mile limit.	Individual Permit – Section 10/Section 404	USACE NAE-2004-338-1 (formerly 200102913)	11/22/01	Received 1/5/ 2011
United States Environmental Protection Agency (USEPA)	USEPA jurisdiction is on the upland component of the Project under the Clean Water Act and for NEPA (Section 309) review	National Pollutant Discharge Elimination System (NPDES) General Stormwater Permit		To be filed (Expected Q2 2011)	(Expected Q2 2011)
	Outer Continental Shelf	40 CFR Part 55 Air Permit for OCS Sources	OCS-R1-01	12/7/07	Received 1/7/2011
Federal Aviation Administration	Structures exceeding 200 feet into navigable airspace	Notice of Proposed Construction or Alteration Form (FAA Form 7460-1); Determination of No-Hazard	2009-WTE-332-OE through 461-OE	1/15/09	5/2010 (Petitions for discretionary review denied, determinations finalized 8/4/10)
US Coast Guard	Structures located in navigable waters of the U.S.	Permit to Establish and Operate a Private Aid-to-Navigation to a Fixed Structure		To be filed (Expected Q1 2011)	(Expected Q2 2011 or in the normal course)
National Marine Fisheries Service	Marine Mammal Protection Act (MMPA)	Incidental Harassment Authorization		To be filed (Expected Q1 2011)	(Expected Q2 2011 or in the normal course)

Agency	Jurisdiction	Permit Description	ID Number	Date Applied	Date Approved
U.S. Geological Survey (USGS)	Migratory Bird Treaty Act	Federal Bird Banding Permit		To be filed (Expected Q2 2011)	(Expected within 90 days of filing)
U.S. Fish & Wildlife Services (USFWS)	Migratory Bird Treaty Act	Federal Migratory Bird Scientific Collection Permit		To be filed (Expected Q2 2011)	(Expected within 60 days of filing)
National Park Service	National Parks & National Wildlife Refuges	Scientific Research and Collecting Permit		To be filed if necessary (Expected Q2 2011)	(Expected within 90 days of filing)
State					
Massachusetts Environmental Policy Act (MEPA)	Jurisdiction is within three-mile state territorial seas limit	Environmental Notification Form (ENF)	12643	11/15/01	4/22/02
		Draft Environmental Impact Report (DEIR)		11/15/04	3/3/05
		Notice of Project Change (NPC)		6/30/05	8/8/05
		Final Environmental Impact Report (FEIR)		2/15/07	
		Issuance of Certificate			3/29/07
Massachusetts Energy Facilities Siting Board (EFSB)	Jurisdiction is within three-mile state territorial seas limit	Petition to Construct Jurisdictional Facilities	EFSB 02-2	9/17/02	5/11/05
		Approval under G.L. c. 164, § 69J			
		Approval under G.L. c. 164 § 72	D.T.E. 02-53	11/19/07	5/2/08
		Project Change; Request for Extension	EFSB 02-2A	11/19/07	5/2/08
		Certificate of Environmental Impact and Public Interest (Approval under G.L. c. 164, §§ 69K-69O)	EFSB 07-08	5/27/09	5/27/09
Massachusetts Department of Environmental Protection (MADEP) – Wetlands and Waterways Regulation Program	Jurisdiction is within three-mile state territorial seas limit	Chapter 91 Waterways License	W08 -2480	10/6/08	12/22/08
		MADEP Water Quality Certification	W133633	11/2/07	8/15/08
Massachusetts Coastal Zone Management (MCZM)	State jurisdiction is within the three-mile limit under the Coastal Zone Management Act (CZMA). Federal Consistency Review jurisdiction is three mile limit and specific activities beyond three miles that may affect Massachusetts Coastal Zone	Concurrence with Federal Consistency Certification Statement		7/23/08	1/23/09

Agency	Jurisdiction	Permit Description	ID Number	Date Applied	Date Approved
Rhode Island Coastal Resources Management Council (CRMC)	State jurisdiction is within the three-mile limit under the Coastal Zone Management Act (CZMA). Federal Consistency Review jurisdiction is three mile limit and specific activities beyond three miles that may affect Rhode Island Coastal Zone	Concurrence with Federal Consistency Certification Statement		7/16/08	7/30/08
Massachusetts Highway Department (MHD)	Jurisdiction is within 3-mile limit	Permit to Access State Highway and Access Agreement	5-2008-0246	11/01/07	7/22/08; extension 7/21/09
Massachusetts Executive Office of Transportation (EOT)	Jurisdiction is within 3-mile limit	License/Permit Approval for Use and Occupancy of EOT property (RR bed)		11/05/07	9/17/08
Massachusetts Historical Commission (MHC): State Archaeologist	Jurisdiction is within three-mile state territorial seas limit	Permit for Upland Reconnaissance Archaeological Survey	2246	3/12/03	3/28/03
		Permit for Upland Intensive Archaeological Survey	2595	9/18/03	9/23/03
Massachusetts Division of Fisheries & Wildlife	Jurisdiction is within three-mile state territorial seas limit	Massachusetts State Scientific Collection permit		To be filed (Expected Q2 2011)	(Expected within 30 days of filing)
Massachusetts Division of Fisheries & Wildlife	Jurisdiction is within three-mile state territorial seas limit	Massachusetts Bird Banding permit		To be filed (Expected Q2 2011)	(Expected within 30 days of filing)
Regional					
Cape Cod Commission	Jurisdiction is within three-mile state territorial seas limit	Development of Regional Impact (DRI) Review	JR#20084	11/15/01	
					Procedural Denial 10/18/07;
		Issuance of DRI		EFSB Certificate of Environmental Impact and Public Interest (Approval under G.L. c. 164, §§ 69K-69O) 5/27/09	
Local					
Yarmouth Conservation Commission	Jurisdiction is within three-mile state territorial seas limit	Notice of Intent		11/15/07	EFSB Certificate of Environmental Impact and Public Interest (Approval under G.L. c. 164, §§ 69K-
		Issuance of Order of Conditions			
Barnstable Conservation Commission	Jurisdiction is within three-mile state territorial seas limit	Notice of Intent		11/15/07	
		Issuance of Order of Conditions			

Agency	Jurisdiction	Permit Description	ID Number	Date Applied	Date Approved
Yarmouth Department of Public Works (DPW)	Jurisdiction is within three-mile state territorial seas limit	Request for Transmission Line Location		11/13/07	69O) 5/27/09
Barnstable DPW	Jurisdiction is within three-mile state territorial seas limit	Request for Transmission Line Location		11/13/07	

2.0 PROJECT INFORMATION

2.1 Contact Information

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2.2 Financial Assurance

Per the terms of the lease, CWA must provide financial assurance in an amount based on the determination of BOEMRE to support payment of all accrued lease obligations.

On October 5, 2010, BOEMRE received and accepted financial assurance in the amount of $488,278 to cover (1) a $100,000 initial bond, (2) $300,000 to cover decommissioning for an existing structure, and (3) $88,278 to cover one year of advance rent. The $488,278 is an adequate amount to cover all lease obligations prior to the start of construction. CWA notes that Lease Addendum B, Section III (c) (pg B-11) notes that the Lessor reserves the right to adjust the amount of any financial assurance requirement (initial, supplemental or decommissioning) associated with the lease, and/or reassess Lessee's cumulative lease obligations, including decommissioning obligations, at any time.

Under separate cover, CWA will provide for review by BOEMRE an analysis of the amounts required to meet lease obligations during the life of the project and a proposed plan for providing financial assurance to meet the requirements under the lease.

2.3 Project Construction Schedule

2.3.1 Definitions of Terms:

The following terms are defined with respect to the construction schedule:

- **Available for Commercial Operations** means that the wind turbine generator (WTG), WTG array, or complete wind farm are ready to be operated in commercial dispatch as directed by ISO New England. This date is determined by CWA's acknowledgement of an Acceptance Certificate completed by the equipment manufacturer.

- The **Commercial Operations Date** ("COD") for this Construction and Operations Plan is the date on which the first WTG is Available for Commercial Operations.

FIGURE 2.3-1 REDACTED
Confidential business information.
Not for public disclosure.

2.3.2 Construction Activities – Offshore

Offshore construction will begin with the installation of the monopiles for the ESP foundation in the third quarter of 2011. [redacted]

2.3.3 Construction Activities – Onshore

Onshore construction work will begin with installation of the underground duct bank in the NSTAR right-of-way in the third quarter of 2011. Cable installation is expected to be completed by the fourth quarter of 2012.

2.3.4 Commissioning

Commissioning of the project includes all the activities required to make the fully-installed equipment ready for full operation. [redacted]

2.3.5 Operating Fee Payments during the Commissioning Period

[redacted]

[redacted]

On November 1 of each year, commencing on the effective date of the Lease (November 1, 2010) CWA will provide BOEMRE with an estimated commissioning schedule for the coming year. That schedule will show the estimated Commercial Operations Date for each turbine or group of turbines and will calculate the Operating Fee payment in accordance with the formula provided in Addendum B, Section III(b)(4) of the Lease. The calendar day for an individual turbine's COD will begin at 00:01 and end at 24:00 on the given day. No allowance will be made for the time if day when the final commissioning is complete.

On November 1, following actual commissioning of WTGs, CWA will provide BOEMRE with the actual commissioning schedule, and a calculation of the Operating Fee based on the actual commissioning schedule achieved during the prior year. The difference between the Operating Fee paid based on the estimated commissioning schedule and the Operating Fee calculated based on the actual commissioning schedule would be added to or subtracted from the fee calculated for the coming lease year. As described in the Lease, it is possible that not all the turbines will be commissioned in the same lease year. Further, there may be separation between the commencement of commissioning activities and full build-out of the project.

2.4 Certified Verification Agency (CVA) Nominations

The CVA requirements for an offshore renewable energy project are contained in 30 CFR Part 285 Subpart G – "Facility Design, Fabrication, and Installation," and in particular § 285.705 through § 285.712. On October 28, in a letter to BOEMRE, CWA nominated Det Norske Veritas (USA) Inc. (DNV) as its CVA for the Cape Wind Project. The following section describes in detail the qualifications of DNV and the activities they will undertake as CVA for Cape Wind.

2.4.1 CVA Qualification Statement (§ 285.706 (b))

2.4.1.1 Description of DNV (§ 285.706(b)(3))

DNV in Brief

DNV is a global provider of services for managing risk, helping customers to safely and responsibly improve their business performance. As companies today are operating in an increasingly more complex and demanding risk environment, DNV's core competence is to identify, assess, and advise on how to effectively manage risk, and to identify improvement opportunities. Our technology expertise and deep industry knowledge, combined with our risk management approach, have been used to manage the risks involved in numerous high-profile projects around the world.

Organized as an independent, autonomous foundation, DNV balances the needs of business and society, based on our independence and integrity. With the objective of safeguarding life, property and the environment, DNV serves a range of industries, with a special focus on the maritime and energy sectors. Established in 1864, the company has a global presence with a network of 300 offices in 100 countries, and is headquartered in Oslo, Norway. DNV's prime assets are the knowledge and expertise of our 9,000 employees.

DNV operates through four geographical divisions serving the maritime and energy industries: Norway, Finland and Russia; Asia, Pacific and Middle East; Europe and North Africa; and Americas and Sub-Saharan Africa. A division for Governance and Global Development supports the geographic divisions. In addition, DNV operates a global division for Sustainability and Innovation services. DNV also have three independent business units: DNV IT Global Services; DNV Software; and DNV Petroleum Services.

More information can be found at DNV's internet site: http://www.dnv.com.

DNV in the USA

DNV opened its first office in USA in New York in 1898. Today DNV has 700 employees in USA with Divisional office for Americas in Houston, and other offices in Atlanta, Chicago, Columbus, Cincinnati, Detroit, Jacksonville, Long Beach, Boston, Miami, Norfolk, New Orleans, New York, Portland, Seattle, San Francisco and La Porte.

DNV's main activities in USA are within the energy sector, both within wind energy and within oil & gas exploration, development and production. DNV is engaged in verification, classification and asset risk management offshore in the Gulf of Mexico and within risk management of onshore pipelines and refining. DNV has a Deepwater Technology Center in Houston and a leading Corrosion and Materials Technology Center in Ohio focusing on management of degradable structures.

DNV helps the maritime industry to manage risk in all phases of a ship's life through ship classification, statutory certification, fuel testing and a range of technical, business risk and competency-related services. DNV is among the top two classification societies for mobile offshore units. DNV is present in all maritime clusters in U.S. and our Global Cruise Center located in Miami supports our leading position in this sector.

DNV in the Wind Industry

DNV is the largest independent consultancy within wind energy in USA. DNV has 130+ professionals working primarily in Wind Energy, located in Seattle, Boston, Houston and San Roman offices.

A leader in providing technical services to the wind industry, DNV has conducted direct work on wind projects representing more than half of the new installed wind energy capacity in the United States. Additionally, DNV is the world's leading service provider in the field of offshore wind and has been involved in more than 60% of offshore wind projects worldwide. DNV has been leading the efforts of standardizing design practices through active participation in IEC (International Electro-technical Commission) and other international and national standards bodies.

DNV has been active in developing its own standards, specifications and guidelines for wind turbine structures and components since 2001. The standards integrate decades of experience from the offshore industry with DNV's in-depth wind turbine knowledge gained from the type certification of large megawatt turbines.

More information on DNV involvement and services within the Wind Energy industry can be found at DNV's internet site: www.dnv.com/focus/wind_energy/.

2.4.1.2 Previous Experience (§ 285.706(b)(1))

DNV's Recent Research Activities in the Wind Industry

2010 Projects

- HSE hazard management framework for the global wind industry
- Verification of complex foundation structures for the offshore wind industry
- Methods of correcting complex flow bias for remote sensing technologies
- An offshore standard for marine operations for installation of offshore wind
- Wind turbine gearbox durability analysis
- Offshore wind installation vessels advisory network
- Implementation of curtailment strategies to obtain production data for use in wake studies
- Development of new blade standard based on damage tolerant philosophy
- Probabilistic lifecycle model for strategic/management decision support for large investments in offshore wind (value chain analysis)
- Reliability database for large-scale wind turbines
- Best practices for design of floating wind turbines

2009 Projects

- Performance optimization methods for operating wind projects
- Guidelines for floating turbines
- Analysis of grouted connections for offshore wind turbines
- Development of real-time data loads analysis
- Development of offshore safety standard for transformer platforms
- WindMaster data management system – proprietary software for wind resource data analysis.
- Dynamics, load, and control system analysis of wind turbines mounted on catenary moored and TLP floating platforms

Extraordinary Innovation Projects

- Compressed air storage in pipelines and other options for energy storage for offshore wind.

Joint Industry Projects

- Updating methodology for grouted connections in offshore wind turbines.
- DNV Standards for Wind Energy

- DNV-OS-J101 Design of Offshore Wind Turbine Structures
- DNV-OS-J102 Design and Manufacture of Wind Turbine Blades
- DNV-OS-J201 Design of Offshore Substations
- Guideline Document for Offshore Floating Wind Turbine Structures

International Standards

- IEC 61400-1 "Wind Turbines – Part 1: Design Requirements", International Electrotechnical Commission, 2005
- IEC 61400-3 "Wind Turbines – Part 3: Design Requirements for Offshore Wind Turbines", International Electrotechnical Commission, 2008

Recent Industry Publications

- OMAE2010-20344 "Guideline for Offshore Floating Wind Turbine Structures" presented by DNV in ASME 29th International Conference on Ocean, Offshore and Arctic Engineering in 2010

- OTC-20674-PP "Qualification of a Semi-Submersible Floating Foundation for Multi-Megawatt Wind Turbines" jointly presented by Principal Power Inc and DNV in Offshore Technology Conference in 2010

A copy of the above mentioned publications can be provided upon request.

Other

- DNV has been actively participating in BOEM workshops and Industry discussion for CVA for Offshore Wind from the very beginning
- DNV has submitted an abstract on CVA for First Offshore Wind Turbine for US Waters for Windpower 2011

DNV's Latest (2010) CVA Experience

- CVA for BW Pioneer FPSO (the first FPSO in US waters) to ensure compliance for 30 CFR 250 Subpart I
- CVA for Macondo Riser intended for GOM oil spill containment operation

2.4.1.3 Technical Qualifications of DNV Team on Cape Wind CVA(§ 285.706(b)(2))

DNV proposes to staff this project with the following key team members. Specific assignments for some tasks may vary depending on timing of the work.

Santhosh Kumar Mony, Head of Project Certification (Project Sponsor)

Mr. Mony has 20 years of varied and extensive experience in offshore project and engineering management, as well as in EPC contract management and leadership. He is very knowledgeable in new build FPSOs and interface management (hull and topside), and also possesses knowledge in LNG value chain.

Mr. Mony is an experienced leader in people management, and is also very experienced in new service development and marketing of various services. He has been involved in the complete verification planning and execution of large and complex international offshore projects, and is well versed with the risk based verification approach and total project verification.

Mr. Mony has extensive experience in contract administration, bid management, product verification and consultancy services for offshore projects. He has been involved in SHEQ and training/competence development. Mr. Mony has a good understanding of the shipyard practices and practical knowledge of many aspects of working with the yards. He has early experience in structural/hull engineering, finite element analysis, welding technology, and knowledge in various topside, marine, control systems and safety studies.

ShashikantSarada, Senior Engineer (Project Manager)

Mr. Sarada has over eight years of experience in design, advanced analysis and construction of variety of civil/offshore steel and concrete structures. He is a Certified Project Manager Professional (PMP). He has been involved in Geotechnical / Foundation Investigation for installation of offshore wind turbines, structural approval and plan approval coordination for Class.

Mr. Sarada assisted in the development of Regulatory road map for performing plan approval and inspections on behalf of the United States Coast Guard for offshore installations in the outer continental shelf of Gulf of Mexico. He is Project Manager for CVA Project for BW Pioneer FPSO - Verification of hull, topsides, mooring, turret and piles.

Mr. Sarada has experience in detailed engineering design, analysis and installation of more than 30 fixed offshore platforms, caissons, guardians, decks and miscellaneous structures in Gulf of Mexico and in Black Sea. He has performed pile-soil-structure interaction analysis and pile design for a number of platforms, and has also prepared regulatory (MMS) permit and CVA documentation.

Morten Søgaard Andersen, Senior Engineer (Project Team Member)

Mr. Andersen has worked for seven years in DNV with wind turbine verification as project engineer for technical verification of support structures for wind turbines, and as project manager for wind project certification. He has high expertise in structural analysis of concrete and steel.

Prior to joining DNV, Mr. Andersen worked for five years as a consultant within structural design - mainly bridges and support structures for wind turbines. He has worked as research assistant, investigating concrete/reinforcement interface.

Jenny Yan Lu, Principle Engineer (Project Team Member)

Ms. Lu is a licensed PE with 15 years of experience in shipbuilding and offshore engineering, including design, analysis and verification of offshore structures including semi-submersibles, TLPs, Spars, FPSOs and jackups.

Ms. Lu is experienced in class systematics, verification and classification of offshore structures involving FEM analysis, structural dynamic analysis, hydrodynamic analysis, global and local strength evaluation (yield & buckling), fatigue analysis, blast analysis and risk based inspection analysis, etc. She is actively involved in business development, project management, and updates of DNV rules and other industry standards.

Jens Døssing, Senior Engineer (Project Team Member)

Since his graduation as a civil engineer, Mr. Doessing has been specializing in structural engineering. Mr. Doessing has been engaged in design and analysis of steel structures, including buildings, steel structures for process plants and also offshore structures, cranes, masts and towers.

Since 1990 Mr. Doessing has been responsible for larger structural projects including flue gas desulphurization plants, waste incineration plants and building design.

From 1993 to 2000 Mr. Doessing held the position as head of a steel structures design department, responsible for current planning, management and development of staff, sales and administration, project management, and maintenance of a general high professional standard, including introduction of new technology.

From 1982 to 1985 Mr. Doessing prepared his Ph.D. thesis on deck joints in offshore structures. The study comprised both theoretical and numerical analyses of circular cylindrical shells. For six months Mr. Doessing participated in an experimental research project on ultimate strength of tubular joints in offshore jacket structures in the United States.

AndrzejSerednicki, (Project Team Member)

Mr. Serednicki has 30 years of offshore industry-related experience, including:

- General structural plan approval of steel and concrete structures.
- Certification plan approval of materials and machinery components.
- Function, strength, fatigue, pressure and fire testing of structural and process equipment components.

- Assessment and qualify control of concrete materials, prestressing systems and construction methods.
- Assessment of platform installation methods and underbase grouting of gravity structures.
- Design of concrete weight coating for submarine pipelines and quality control of coating application.
- Assessment of design and construction of grouted connections for steel structures.
- Design, engineering and supervision of repairs to pipelines, steel and concrete structures.
- Design and execution of high integrity bolted joints. Bolt specifications.
- Design, engineering and supervision of elastomeric and PTFE structural bearings.

Mr. Serednicki also has eight years of experience in structural design of precast concrete industrial structures and office buildings.

Steven Kelsey, Principle Surveyor (Project Team Member)

Mr. Kelsey is responsible for performing vendor surveillance for the certification of production and drilling-related equipment, as well as marine propulsion, controls and automation and associated components. He is responsible for performing various types of third party inspections and surveillances on behalf of oil production and drilling-related clients, as well as acting as oil production company representative contractor facilities to assure contractual requirements, schedules and qualification activities are fulfilled (e.g. - Statoil).

Mr. Kelsey is involved in daily activities such as monitoring welding, hydrostatic/functional testing, dimensional inspections, performance testing, and various NDE testing (as a minimum) for production, downhole, drilling, offshore, onshore and subsea equipment as well as ships. He performs project monitoring and various activities for oil production and drilling-related clients. He has been involved in witnessing of various types of inspections related to land-based, offshore and subsea equipment. He has also been involved in the development of overview documents for monitoring of manufacturing activities, as well as development of quality procedures geared towards improvement and consistency in implementation of inspection activities and reporting methods within the assigned department.

Ed Groff, Senior Surveyor (Project Team Member)

Mr. Groff possesses extensive experience in ensuring conformance to requirements in accordance with DNV Management Policies and Procedures, customer requirements, national standards and specifications, and international standards and specifications and their application to the equipment reviewed. He is knowledgeable in the review of welding process specifications and supporting process specification records, as well as in the review of non-destructive examination (NDE) requirements for both application and qualification of NDE technicians.

LivHamre, Principal Specialist (Project Team Member)

Ms. Hamre has extensive experience in foundation design of gravity base and piled structures. She is responsible for the development of best practice for geotechnical verification of wind turbine foundations in DNV. She is knowledgeable in soil modeling for computer applications, and is involved in supervision of offshore soil investigation, together with planning and reporting of soil parameters for design. Ms. Hamre is well experienced in the interpretation of soil parameters from in situ and laboratory testing.

2.4.1.4 Software (§ 285.706(b)(4))

DNV has access to several computer programs, which are part of SESAM suite, for undertaking any complex independent analysis. The figure on the next page summarizes SESAM suite of programs that are currently available. Abstracts are not presented for these programs, however in the event they are required to be applied, abstracts will be presented with the verification reports.

REDACTED
Confidential business information.
Not for public disclosure.

Figure 2.4-1 [redacted]

2.4.1.5 Resource Availability (§ 285.706(b)(5))

The nominated resources described in this section are based on DNV's current work schedule. Should project personnel availability change at the time of contract award, DNV will discuss and agree to changes in resources with the customer. DNV will identify alternative resources with the same level of competence as the resources listed.

2.4.1.6 CVA Previous Experience with BOEMRE Procedures (§ 285.706(b)(6))

The Cape Wind Project is the first offshore wind facility to enter into a lease agreement with BOEMRE. As such, there is no existing experience with offshore wind-specific BOEMRE requirements and procedures. However, DNV has extensive experience in the offshore wind industry in Europe, including participation in development of the relevant standards used industry-wide. Further, DNV also has experience with BOEMRE requirements for offshore mineral extraction projects. This experience is described in Section 2.4.1.2.

2.4.1.7 Conflict of Interest (§ 285.706(c))

§ 285.706(b)(6) states:

Individuals or organizations acting as CVAs must not function in any capacity that will create a conflict of interest, or the appearance of a conflict of interest.

Outside of the contract to provide CVA services, DNV or any of its employees and or family members not affiliated with CWA in any capacity. CWA is not aware of any function performed by DNV that would create a conflict of interest or the appearance of a conflict of interest. DNV has successfully met this requirement on all of the past CVA projects executed under 30 CFR 250.

2.4.1.8 Professional Engineer Supervision (§ 285.706(d))

The USCG recognizes certification by DNV employee as equivalent to Certification by PE under the NVIC 10-92 dated June 19, 1998.

DNV has met this requirement on all of the past CVA projects executed under 30 CFR 250. The proposed CVA team includes DNV employees who are also registered PE's.

DNV has own quality system with strict requirement to assign only people with required competence to oversee and/or execute the project activities.

2.4.2 CVA Level of Work (§ 285.706(b)(7))

DNV has developed a systematic approach to ensure verification with respect to 30 CFR 285 Subpart G requirements. DNV's systematic approach to CVA for oil and gas facilities (with respect to 30 CFR 250) in the Gulf of Mexico has been appreciated and accepted by BOEMRE.

In line with BOEMRE requirements, DNV as a CVA will, through verification activities and using sound engineering judgment and practices, verify that the Cape Wind Project is designed, fabricated and installed to withstand the environmental and functional load conditions appropriate for the intended service life and site specific conditions.

DNV has developed a scope of work consistent with the BOEMRE requirements and based on DNV's experience in working as CVA on other energy production facilities. Since there are some uncertainties regarding exactly what BOEMRE will require for wind turbine projects, the scope may have to be adjusted at a later stage. It is anticipated that there will be a CVA nomination meeting which will give DNV opportunity to explain the scheme of execution and level of involvement to BOEMRE for this first offshore wind project in US waters.

2.4.2.1 List of Activities

Table 2.4-1 shows the four project phases and the appurtenant tasks.

Table 2.4-1 – Overview of Project Phases

Phase	Task	Task Description
Phase 1: WTG Structure Design Verification	Task 1	Project Kickoff Meeting
	Task 2	Site Conditions Verification
	Task 3	Site Suitability Verification
	Task 4	WTG Load Cases
	Task 5	Statement of Compliance
	Task 6	WTG Foundation Design Verification
	Task 7	WTG Structure Design Verification Report
Phase 2: ESP Structure Design Verification	Task 1	ESP Load Cases
	Task 2	ESP Foundation Design
	Task 3	ESP Structure Design Verification Report
Phase 3: ESP and WTG Foundation Structure Fabrication Verification	Task 1	On-site inspection of monopile and transition piece fabrication
	Task 2	Fabrication Verification Report
Phase 4: Installation Verification	Task 1	WTG and ESP Pile Installation
	Task 2	Transition Piece Installation
	Task 3	Offshore Cable Installation
	Task 4	ESP Topsides Installation
	Task 5	Installation Verification Report

2.4.2.2 Execution

Phase 1: WTG Structure Design Verification

The CVA work scope and duties for the design phase, and more specifically Phase 1 of this project, are as stipulated in 30 CFR §285.707. DNV as CVA will use good engineering judgment and practices in conducting an independent assessment of the design of the facility.

[redacted]

The CVA design phase scope of work for the WTG structure is verification through independent assessment of the following elements:

1. Planning criteria
2. Operational requirements
3. Environmental loading data

4. Load determinations
5. Stress Analysis
6. Material designations
7. Soil and foundations conditions
8. Safety factors
9. Foundations

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

Phase 2: ESP Structure Design Verification

The CVA work scope and duties for Phase 2 are also as stipulated in 30 CFR §285.707.

The CVA design phase scope of work for the ESP structure is verification of the following elements through independent assessment:

1. Environmental loading data

2. Load determinations
3. Stress Analysis
4. Material designations
5. Safety factors
6. Foundations

[redacted]

[redacted]

[redacted]

Phase 3: ESP and WTG Foundation Structure Fabrication Verification

The CVA work scope including responsibilities and duties for the fabrication phase (Phase 3) is stipulated in §285.708 and §285.709, and include the following:

[redacted] Use good engineering judgment and practice in conducting independent assessments of fabrication activities associated with monopile and transition piece fabrication. [redacted]

2. Verify quality control aspects of the construction program at various stages of the fabrication phase by conducting periodic onsite inspections and verifications of the following:
   a. Fabrication contractor's quality control plans
   b. Material quality and identification methods
   c. Adherence to sound fabrication procedures specified in the Fabrication and Installation Report
   d. Welder and welding procedure qualification and identification
   e. NDE requirements and results

f. Destructive testing requirements and results

g. Dimensional check, erection and alignment procedures

h. Submit interim fabrication verification report to establish status of quality-control records at various stages of fabrication

[redacted]

Phase 4: Installation Verification

The CVA work scope including responsibilities and duties for the installation phase (Phase 4) is stipulated in §285.708 and §285.710, and include the following:

1. Independently assess the adequacy of the overall installation plan and observe that installation sequences and activities per design assumptions are being followed. [redacted]

2. Independent analyses of Soil Resistance to Driving (SRD), and pile drivability.

[redacted] Observe installation activities, spot check equipment, procedures and record keeping as necessary to verify compliance with design parameters such as environmental data, design loads, platform structural aspects, and foundation design. [redacted]

4. Submit installation verification reports interim and final for all installation activities to establish status of quality-control records at various stages of installation.

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

2.4.2.4 Deliverables

Verification Activities

A Statement of Compliance for the WTG load cases and the site investigation with respect to API RP-2A WSD, IEC 61400-01 and 61400-03, will be issued upon completion of related verification activities/review.

Independent Analysis

A technical report summarizing FE models, analysis methodology and comparison of results will be prepared where independent analysis has been performed by DNV as part of verification activities.

CVA Reports

DNV deliverables shall include intermediate and final report.

The intermediate report will be provided at agreed milestones.

[redacted]

[redacted]

[redacted]

The final report shall be submitted as per the requirements in 30 CFR §285.712 and shall be submitted to the BOEMRE Regional Supervisor with a copy to Cape Wind Associates.

2.4.3 Required Documents(§ 285.706(b))

2.4.3.1 Design Verification Plan

The following documents will be provided to the CVA for the Design Verification Plan (Phases 1 and 2 of the list of activities described in Section 2.4.2.):

Document	Developed By
Wave Report (includes tides and currents)	SgurrEnergy
Wind Report (includes wake effects and temperature)	AWS Truepower
Accessibility Report (includes snow, ice and marine growth effects)	SgurrEnergy
Location Coordinates (includes water depths)	Cape Wind/ESS Group
Geophysical Studies	OSI, Inc.
Geotechnical Studies	GZA
WTG elevations and interface levels	Cape Wind
Design Basis (codes and standards to be used for design, including IEC 61400-03)	Siemens
Allowable structure frequencies	Siemens
Functional specifications, including design life, fatigue life, natural frequencies, etc.	Siemens
Project specific design load case table	Siemens
Selection of turbine position to be considered for design loads	Siemens
Wind turbine data, including masses, loads, etc.	Siemens
Input for Component Certification for rotor/nacelle assembly	Siemens
WTG tower structural design requirements	Siemens
Corrosion protection design basis	Foundation Designer
Material data and specifications for monopiles and transition pieces	Foundation Designer
Design plan for grouted connection, including all relevant back-up documentation	Foundation Designer
Design procedure for load generation, soil pile interaction, scour, design load iterations and computer programs	Foundation Designer
Monopile structural design requirements	Foundation Designer
Transition piece structural design requirements	Foundation Designer
Transition piece operational and interface design requirements	Siemens
ESP foundation design basis	ESP Contractor
ESP structural design requirements	ESP Contractor
ESP foundation design procedure (including software)	ESP Contractor

2.4.3.2 Fabrication Verification Plan

The following documents will be provided to the CVA for the Fabrication Verification Plan (Phase 3 of the list of activities described in Section 2.4.2.):

Document	Developed By
Inspection and test plan for WTG tower manufacturing	Siemens
WTG tower manufacturing locations	Siemens
WTG tower manufacturing procedures	Siemens
WTG tower inspection and NDT procedures	Siemens
Inspection and test plan for monopile and transition piece	EPC Contractor
Monopile and transition piece manufacturing locations	EPC Contractor
Monopile and transition piece manufacturing procedures	EPC Contractor
Monopile and transition piece inspection and NDT procedures	EPC Contractor
Inspection and test plan for ESP	ESP Contractor
ESP manufacturing locations	ESP Contractor
ESP manufacturing procedures	ESP Contractor
ESP inspection and NDT procedures	ESP Contractor

2.4.3.3 Installation Verification Plan

The following documents will be provided to the CVA for the Installation Verification Plan (Phase 4 of the list of activities described in Section 2.4.2.):

Document	Developed By
WTG tower and nacelle assembly procedures	Siemens
WTG tower and nacelle assembly QA/QC plan	Siemens
Monopile driveability study	Foundation Designer
Monopile installation procedures	EPC Contractor
Monopile installation QA/QC plan	EPC Contractor
Transition piece installation procedures	EPC Contractor
Transition piece installation QA/QC plan	EPC Contractor
ESP foundation installation procedures	EPC Contractor
ESP foundation installation QA/QC plan	EPC Contractor

3.0 SITE INVESTIGATIONS COMPLETED TO DATE

The following section describes in detail the geological, geophysical, geotechnical and cultural investigations performed at the project site. As per the request of BOEMRE, a sequential description of the investigations, interpretations, and mitigations for geological and cultural purposes is laid out below. Additional site investigations including meteorological, oceanographic and biological (including but not limited to fish, marine mammals, sea turtles, and sea birds) are described in the FEIS and are not repeated herein.

A shallow hazard report for the Project Area is provided in Appendix A. The intention of this shallow hazards report is to identify the presence of natural and man-made hazards in the Project Area. The report was prepared in accordance with applicable requirements and discussions with the BOEMRE.

3.1 Introduction

Over the ten year development of the Project, CWA has conducted detailed investigations of all relevant environmental conditions, to characterize and evaluate the existing physical, archaeological, oceanographic, biological conditions and shallow hazards to assist in the siting and design of the Project. Section 10 of the FEIS includes a comprehensive list of 60 technical reports that have been prepared by the CWA technical team on behalf of the Project, as part of the extensive environmental analysis. Field studies and analyses conducted to date not only CWA with a complete understanding of the proposed Project site to satisfy the required regulatory reviews. Studies and analyses include:

- Geophysical surveys in 2001, 2002, 2003 and 2005 that covered approximately 635 nautical miles of tracklines encompassing the project site on Horseshoe Shoal, as well as the proposed cable route and nearshore landfall area.
- Geological/geotechnical surveys in 2001, 2002, 2003, 2004 and 2005 that obtained 86 sediment vibracores and 22 deep borings at representative turbine locations and along proposed cabling corridors.
- Terrestrial and marine archeological surveys.
- Avian surveys covering all seasons and times of day that were conducted from 2002 through 2006 and involved several methodologies including land and barge based radar, as well as direct observations from land, boats and planes.
- Shellfish and benthic surveys conducted in 2001, 2002, 2003, and 2005 to gather benthic macroinvertebrate community information at turbine sites and along the cable routes. Samples were also gathered from the foundation piles of the met tower.
- Gathering of metocean data on wind, waves and currents from the met tower constructed in 2002.
- Survey of submerged aquatic vegetation (SAV) including dive and underwater video surveys.
- Wetland delineation and environmental survey along the upland cable route.
- Noise analyses to obtain ambient background levels both above and below water and to model anticipated impacts to humans and marine mammals.
- Visual simulations from representative cultural resources within the project viewshed.
- Recreational and Commercial Fisheries data analyses, including user surveys.

- Navigational Risk Assessment that included vessel counts, analysis of Search and Rescue (SAR) data, and analyses of oil spill and vessel collision probabilities.

- Dive survey analysis of the effectiveness of proposed Scour Control methods on the Met tower foundation.

Descriptions of the methodology and findings of these investigations have been reported in previous filings. The sections below provide the information relevant to the COP requirements, and also provide the locations of the specific reports for more detailed information. Planned pre-construction field programs, as required by the ROD and the Lease terms, are described in Section 4.0.

3.2 Geophysical and Geological/Geotechnical (G&G) Investigations Completed

Integrated marine geophysical/hydrographic surveys and geological/geotechnical investigations were conducted for the Project in 2001, 2002, 2003, 2004, and 2005 on Horseshoe Shoal and along the proposed submarine transmission cable route from the ESP to the proposed landfall location in Yarmouth. This survey coverage has provided characterization of surficial and subsurface geology in and around Horseshoe Shoal. As indicated in the table below, approximately 635 nautical miles of marine geophysical trackline data was collected and 22 borings and 86 vibracores advanced in multiple field surveys conducted for the Project since 2001.

Survey	Approx Trackline nautical miles	# of Vibracores	# of Borings
OSI 2001	180	47	
GZA 2002	--		3
GZA 2003	--		19
OSI 2003	370	23	
SI 2004	--	4	
OSI 2005	85	12	
TOTAL	**635**	**86**	**22**

The studies yielded site-specific information about water depths, surface and sub-surface sediment types, seafloor morphology, sub-seafloor stratigraphy, natural or man-made obstructions, and other conditions that may affect installation, operation, and decommissioning of the proposed facilities.

The methodologies and results of the G&G surveys were described in the following regulatory filings and technical reports. In addition, a comprehensive description of the equipment, data acquisition settings, and data analysis conducted during these investigations is provided in Appendix A of the COP. A summary of equipment Reports pertaining to oceanographic processes, including sediment scour and mitigation measures, are listed and summarized in Section 3.4 of the COP.

USACE Draft Environmental Impact Statement (DEIS) (11/2004)

- See Sections 5.1 and 5.2, and cited figures, tables and appendices.

Application for Lease (7/11/2006)

- See Section C1 (page 1-6).

Final Environmental Impact Report (FEIR) (2/2007)

- See Section 3.20 and Section 2.2.1.3.3, and cited figures, tables and appendices.

MMS DEIS (1/2008)

- See Section 4.1.1. and cited figures, tables and appendices.

MMS FEIS (1/2009)

- See Section 4.1. and Section 2.7, and cited figures, tables and appendices.

In addition, hard copies of the following confidential commercial technical data and reports (which were not included in the filings above) have previously been provided to BOEMRE (via CWA transmittal to Dr. Rodney Cluck dated August 28, 2006), as confidential commercial or financial information protected from disclosure under Exemption 4 to the Freedom of Information Act (FOIA). This data was voluntarily submitted by CWA to assist BOEMRE in its preparation of the Environmental Impact Statement (EIS), to assist in compliance with the NEPA.

Geophysical survey reports:

- Ocean Surveys, Inc. (OSI). 2002. Marine geophysical survey and sediment sampling program: Cape Wind Energy Project, Nantucket Sound, Massachusetts. Prepared for Cape Wind L.L.C., Boston, Mass., Old Saybrook, Conn.
- Ocean Surveys, Inc. (OSI). 2003. Final report: Supplemental Marine Geophysical Survey: Cape Wind Energy Project, Nantucket Sound, Massachusetts. Prepared for Cape Wind L.L.C., Boston, Mass., Old Saybrook, Conn.
- Ocean Surveys, Inc. (OSI). 2005. Final report: Marine geophysical survey investigation, Nantucket Sound, Massachusetts. Prepared for Cape Wind L.L.C., Boston, Mass., Old Saybrook, Conn.

Boring logs and geotechnical analyses were included in the following reports:

- GZA GeoEnvironmental, Inc. (GZA). 2002. Geotechnical Data Report Cape Wind Met Tower Foundations, Hyannis/Nantucket, Massachusetts. Prepared for Cape Wind Associates, Boston, Massachusetts. Old Saybrook, Conn.
- GZA GeoEnvironmental, Inc. (GZA). September 2003. 2003 Geotechnical Data Report Cape Wind Energy Project, Nantucket Sound, Massachusetts. Prepared for Cape Wind Associates, Boston, Massachusetts.
- GZA GeoEnvironmental, Inc. (GZA). October 2003. October 2003 Geotechnical Data Report Cape Wind Energy Project, Nantucket Sound, Massachusetts. Prepared for Cape Wind Associates, Boston, Massachusetts.

Responses to Individual BOEMRE Data Requests:

- See correspondence to BOEMRE dated April 20, 2006, August 28, 2006, November 27, 2006, July 13, 2007 and February 28, 2007.
- Geochemical and bulk testing data submitted 8/28/2006.
- Supplemental information to be provided prior to construction, per FEIS Section 2.7

Vibracore logs:

- ESS Group, Inc. Logs of 86 vibracores advanced for the Project in 2001, 2003, 2004 and 2005.

Analytical bulk physical testing results of marine sediments:

- GeoTesting Express Inc. laboratory reports from 2001; November 12, 2003; January 3, 2005; and January 6, 2006 (latter carried in Attachment C of ESS Geotechnical/Benthic Field Evaluations Report dated March 22, 2006)/

Analytical bulk chemical testing results of marine sediments:

- Woods Hole Group Analytical Reports dated August 31, 2001; September 19, 2001; November 7, 2003; January 14, 2005; February 2, 2005; and December 30, 2005.

Thermal resistivity and ambient temperatures of marine sediments:

- Geotherm, Inc/. dated October 14, 2003

The following sections rely on the above filings and source documents and the Shallow Hazards Survey report included in Appendix A of the COP

3.2.1 Geophysical Surveys

Three Project-specific marine geophysical/hydrographic surveys were designed and conducted to collect remote sensing data to evaluate WTG foundation installation feasibility, gather data to support the foundation design process, and to support the analysis of the surface and subsurface sediments on Horseshoe Shoal and the proposed submarine transmission and inner-array cable routes. Surveys included:

- Hydrographic measurements with a fathometer to determine water depths;
- Side-scan sonar to evaluate surface sediments, seafloor morphology and potential surface obstructions;
- Seismic profiling with high frequency (HF) (high resolution; limited penetration below the seafloor) and low frequency (low resolutions; deeper penetration beneath the seafloor) acoustic sources; and
- Magnetometer surveys to identify ferrous objects at the surface or shallow subsurface areas; combined with a differential Global Positioning System (GPS) to document the precise location of anomalies.

Figure 4.1.1-8 of the FEIS illustrates the locations of the 2001, 2003, and 2005 marine geophysical and hydrographic vessel tracklines, as they relate to the proposed action facilities. Following completion of the field survey, the digital data files were processed at the surveyor’s mainland facility, then reviewed and interpreted by staff and a marine archaeologist (for potential cultural resources). Digital hydrographic files were corrected for tidal fluctuations to report water depths at mean low lower water (MLLW). Side scan sonar and magnetic intensity data were interpreted to delineate acoustic targets and magnetic anomalies. Details of each geophysical field survey are provided below.

June to August 2001 Geophysical/Hydrographic Survey

From June to August 2001, a marine geophysical/hydrographic survey was conducted by Ocean Surveys, Inc. (OSI) within the Proposed Horseshoe Shoal Alternative site in Nantucket Sound and along alternative submarine cable routes. Survey tracklines are shown in green on Figure 5.1-1 of the DEIS. The survey included use of side-scan sonar to evaluate surface sediments, seafloor morphology and potential surface obstructions; high frequency transducer receiver ("chirp" or "shallow") and low frequency transducer receiver ("boomer" or "intermediate") sub-bottom profilers to evaluate subsurface sediment conditions; magnetometer to identify ferrous objects at the surface or shallow subsurface areas; and a precision fathometer to measure water depths. Locations of survey anomalies were precisely identified using a Differential Global Positioning System (DGPS) accurate to +/- 3.3 feet (ft) (1 meter (m)). Specifications of the instrumentation used during the survey are listed in Table 5.1-1 of the DEIS.

The turbine array and scientific measurement devices station (SMDS) areas were encompassed by a total of 14 tracklines oriented north-south and spaced 2,743 feet (836 meters) apart; five east-west oriented lines spaced 5,236 feet (1,596 meters) apart; and two additional east-west lines spaced 2,000 feet (610 meters) apart. Three tracklines, spaced 500 feet (152.4 meters) apart, provided subsurface data between the ESP and the proposed landfall location in Yarmouth. Additional tracklines were run to enable avoidance of areas where review of the data suggested hard bottom conditions existed. OSI survey coverage of the bottom during this survey is described below (Nowak, 2002):

- **Side-Scan Sonar:** Sweep range was up to 328 feet (100 meters) on either side of the underwater transducer (towfish), depending on water depth. The normal convention is to tow the side scan instrument 26 feet (8 meters) to 66 feet (20 meters) above the bottom for optimum coverage at this sweep range. In shallow water, where tow height is limited by water depth, the effective sweep coverage is approximately 12.5 times the towed transducer height above the seafloor. In shallow water, the transducer is generally towed within 5 feet (1.5 meters) of the water surface, so the towed transducer height is equal to the water depth minus 5 feet (1.5 meters). The main beam coverage of each channel of the side scan sonar is between 20 and 70 degrees below the horizontal plane.

- **Cesium Magnetometer:** This magnetometer senses the ambient magnetic field and localized anomalies. Each individual run of the magnetometer used in the survey can be considered to have coverage of approximately 50 to 75 feet (15.2 to 22.9 meters) in width. An anomaly peripherally detected by a single magnetometer run would not provide an accurate indication of size or location of that magnetic anomaly off the trackline. Additional magnetometer information was collected at anomalies as necessary, based upon field interpretation of the data.

- **Sub-Bottom Profiler:** The coverage of the instrumentation is generally narrow, and considered to be the area directly below the instrument.

August 2002 Supplemental Geophysical Survey of SMDS Area

A supplemental August 2002 marine geophysical survey of the SMDS site was conducted in a 630-foot x 810-foot (192-meter x 246.9-meter) area centered on the SMDS site, approximately 11 nautical miles (20.4 kilometers) south-southwest of Hyannis Harbor. A total of 25 transects, generally at 50-foot (15.2-meter) intervals, were surveyed to identify potentially significant submerged prehistoric archaeological resources (see Section 5.10 of the DEIS). The equipment listed on Table 5.1-1 of the DEIS was used for this survey as well, with the exception of the "boomer" intermediate sub-bottom profiler.

June to July 2003 Supplemental Geophysical Survey of Horseshoe Shoal and Proposed Submarine Cable Route

Because the planned array was reduced from 170 to 130 turbines and the layout reconfigured following the 2001 survey, a geophysical program was conducted in June-July 2003 to help evaluate seafloor and subsurface conditions directly over the new turbine and inner-array cable locations proposed. The geophysical survey was followed by a geotechnical boring program (see August and October 2003 field program descriptions in Section 5.1.2.2 of the DEIS) in order to correlate seismic data with geologic conditions. This geophysical program was also planned to support a marine archaeological reconnaissance survey within the Project area, as described in Section 5.10.2.3 of the DEIS. The subsequent October 2003 vibracore program provided both shallow sediment samples for geotechnical analysis for foundation design and information used in the archaeological survey (see Sections 5.10.3.1.1 and 5.10.3.2.1 of the DEIS).

Field operations for this supplemental geophysical program in deeper waters were conducted in June and July 2003, with shallow waters near the Lewis Bay landfall area surveyed in September 2003. Survey vessels were equipped similarly to the 2001 Geophysical Program, with remote sensing and vessel positioning equipment, as listed on Table 5.1-1 of the DEIS.

Survey tracklines were chosen prior to commencement of survey operations, and are shown in blue on Figure 5.10-1 of the DEIS. In the area of the proposed WTG array on Horseshoe Shoal, survey lines were run northwest-southeast and east-west to connect proposed WTG locations. Northwest-southeast survey lines consisted of a centerline crossing proposed WTG locations and two survey lines each offset 50 feet (15.2 meters) east and west of the centerline.

The centerline was run with a full instrument suite (FIS), including "boomer" and "chirp" subbottom profilers, side-scan sonar, magnetometer, and fathometer. The offset lines were run with a reduced instrument suite (RIS), including "chirp" subbottom profiler, side-scan sonar, magnetometer, and fathometer. East-west lines connecting WTGs and portions of proposed inner-array cable routes were surveyed as two RIS survey lines offset from the cable centerline by 25 feet (7.6 meters) on each side.

In the ESP survey area, which is approximately 8,300 feet long and 3,275 feet wide, survey lines were run with the RIS generally northwest-southeast at a 50-foot (15.2 meter) line spacing.

Hydrographic, magnetometer and "chirp" subbottom data were collected on all lines. Side-scan sonar data were collected on nearly every line. The submarine cable route between the proposed ESP and landfall was surveyed as two RIS survey lines offset from the proposed submarine cable route centerline by 25 feet (7.6 meters) on each side.

June to July 2005 Supplemental Geophysical Survey of Project Area

Between 2003 and 2004, a number of project issues came to light that resulted in modifications to the WTG array layout. The purpose of the 2005 geophysical field program was to extend the survey coverage to the new WTG locations and associated interconnect cable routes. Identical equipment, trackline orientation, and trackline spacing were used in order to maintain consistency with previous surveys as indicated in Section 4.1.1.1 of the FEIS. Results of the 2005 studies were incorporated into Section 4.1.1 of the FEIS. A technical description of the 2005 survey is provided in the Shallow Hazards Report (Appendix A).

3.2.2 Geological/Geotechnical Surveys

Three marine sediment sampling methods, surface grab sampling, vibracoring and sediment borings, were used to advance sediment sampling devices below the seafloor surface to collect representative samples for analysis from the site of the proposed action. The information gathered during these studies was used to correlate the geophysical data collected to actual sediment characteristics where WTG foundations are proposed in deep sediment (85 ft [26 m] below the seafloor) and along shallow electrical inner-array cable routes in shallow sediment depths (targeted for 6 ft [1.8 m] below the seafloor). Benthic grab samples of the seafloor were also collected at some of the vibracore locations, to collect biological information (see Section 3.5 of the COP). Figures 4.1.1-8 and 4.1.1-9 of the FEIS illustrate the offshore locations of the marine vibracores, the geotechnical/sediment sampling, and the wind turbine locations.

In addition, soil borings and test pits were completed along the onshore transmission cable route to confirm the surficial materials expected to be encountered during transmission cable installation. Figure 4.1.1-10 of the FEIS illustrates the geotechnical boring and test pit locations along the onshore cable route.

3.2.2.1 Marine Sediment Borings

A total of 22 sediment marine borings were advanced, to a maximum depth below the seafloor of 150 ft (45.7 m), to collect geotechnical information as it relates to the below seafloor depths of the proposed wind turbine foundations. Sediment borings were advanced from a ship. Sampling devices, split spoons, were driven ahead of drilling tools to collect representative sediment samples. Standard penetration test blow counts were recorded. Sediment recovered in the split spoons was characterized, and at various applicable locations, field tests included pocket penetrometer and torvane tests to estimate the un-drained shear strength of the cohesive soils encountered. Grain size and Atterberg Limits analyses were performed on sediment samples and pressure meter tests were performed at select locations to measure the in situ strength and deformation characteristics of the sediment. The pressure meter tests can be used to assess the bearing capacity and settlement of foundations.

Details of each boring program are provided below.

April 2002 Marine Borings

Three borings (GZA-SB-01 through GZA-SB-03) were advanced on Horseshoe Shoal in April 2002 at locations shown on Figure 5.1-1 of the DEIS. The borings were advanced to a maximum-drilled depth of 98.5 feet (30 meters) below the seafloor (127.5 feet (38.9 meters) below MLLW) to characterize geologic conditions to the maximum expected depths of the WTG foundations. Split-spoon sediment samples were obtained at approximately 5-foot (1.5 meter) intervals, and visually classified.

August 2003 Marine Borings

In August 2003, 10 borings were advanced across Horseshoe Shoal for geotechnical purposes. These borings were designated SB-01 to SB-07 and SB-11 to SB-13, and were advanced to depths between 98.4 and 150.3 feet (30 and 45.81 meters) below the seafloor. Locations are shown on Figure 5.1-1 of the DEIS. Sediment field tests were performed including pocket penetrometer and torvane tests to estimate the undrained shear strength of the cohesive soils. Grain size and Atterberg Limits analyses were performed on sediment samples collected via split-spoon. Pressuremeter tests were performed at select depths in Borings SB-05 and SB-13.

October 2003 Marine Borings

Also for geotechnical purposes, nine borings were advanced in October 2003 to depths between 100 and 102 feet (30.5 to 31.09 meters) below the seafloor at proposed wind turbine locations on Horseshoe Shoal. These borings were designated according to their WTG grid number: SB-A10, SB-B12, SB-C9, SB-D4, SB-D11, SB-G2, SB-G11, SB-J5, and SB-J13. Locations are shown on Figure 5.1-1 of the DEIS. In Boring SB-B12, where organic silt was encountered, an undisturbed sample was obtained by pushing a Shelby Tube mechanically into the soft sediments. Field tests included pocket penetrometer and torvane tests, to estimate the undrained shear strength of cohesive soils (GZA, 2003).

Data obtained from these field studies was integrated with published reports and information on Nantucket Sound to characterize existing conditions in the vicinity of the Project area, as described in Section 5.1.3 of the DEIS.

3.2.2.2 Marine Vibracore Sampling

A total of 86 vibracores were advanced to confirm geophysical survey interpretations, to visually characterize the sediment, and to collect representative samples for physical property and chemical constituent analysis. Three of the vibracores collected were used to support the marine archaeological investigation as a result of the geophysical review. Benthic grab samples of the seafloor were also collected adjacent to some vibracore locations as part of the benthic monitoring program and provided information about surficial sediment types.

Vibracores were advanced and collected from a marine vessel. The cores were labeled and capped on the ship and transported to shore for analysis. Cores were advanced up to 30 ft (9.1 m) below the seafloor in the wind turbine field grid and typically to 10 ft (3 m) below the seafloor along the transmission cable route. Onshore, cores were opened, photographed, and were described in accordance with the Unified Soil Classification System. Summaries of each vibracore program are presented below. The vibracore and benthic grab field programs are summarized below.

Summer 2001 Vibracore and Benthic Grab Program

The Summer 2001 sediment sampling and geotechnical program was performed after the 2001 geophysical survey results were reviewed. The program was conducted in accordance with procedures outlined in ESS, Inc.'s *Geotechnical Sampling and Analysis Protocol* (2001), which was provided to the Massachusetts Department of Environmental Protection (MADEP) and USACE for review and comment prior to the fieldwork. No modifications to the protocol were requested by MADEP (MADEP, 2001).

The program consisted of the following activities:

- Advancement of a total of 47 vibracores at selected locations in the Wind Park and along alternative submarine cable routes to confirm geophysical survey interpretations of subsurface sedimentary conditions;
- Visual characterization and photography of the cores, to identify sediment types; and
- Selection of representative sediment samples from similar and varied acoustic/geologic types for subsequent laboratory analysis of bulk physical properties and chemical parameters.

Benthic grab samples (BG series) were also collected from surface sediments at the vibracore locations, prior to coring for benthic species analysis. Locations of the vibracores (VC01 series) are shown on Figure 5.1-1 of the DEIS; a summary of vibracore information is presented on Table 5.1-2 of the DEIS.

October 2003 Vibracore Program

A total of 23 vibracores were collected along the proposed submarine cable route and in the eastern portion of Horseshoe Shoal during this field program. Vibracore locations were selected after review of the 2003 geophysical data.

During this program, nine vibracores were advanced in areas of possible archaeological sensitivity throughout the WTG array, as part of the marine cultural resources investigation (see Section 5.10 of the FEIS). These cores were located to determine the presence/absence of organic sediments intermittently encountered in previous studies in order to assess the origin (terrestrial or marine) of the organic material, if found.

An additional 14 vibracores were advanced for geotechnical and chemical analysis along the proposed submarine cable route to characterize the sediment at and above the proposed cable burial depth. Samples from Cores VC03-10 through VC03-24 were analyzed for bulk physical parameters. Samples from Cores VC03-13, VC03-16, VC03-19 and VC03-20 were analyzed for bulk physical and chemical parameters. The results of these analyses are discussed in Sections 5.1.3.2 and 5.1.3.3, and are shown on Tables 5.1-2 through 5.1-6 of the DEIS.

Because an area of fine-grained material was encountered along the proposed submarine cable route in Lewis Bay, a series of test cores were advanced to identify the horizontal and vertical extent of this fine material. This process included advancing vibracores and immediately splitting them on the deck to photograph and visually describe the sediment. The Lewis Bay cable route was delineated to avoid these fine sediments, to the extent feasible. Sediments from cores along the selected Lewis Bay route were then submitted for bulk physical analyses.

November 2005 Vibracore Program

A total of 12 vibracores were collected throughout the Project Area to ground truth results of the 2005 geophysical survey. Vibracore sampling methodology was conducted consistently with the procedures implemented in 2001 and 2003 and in accordance with the ESS Group, Inc. (ESS) *Geotechnical Sampling and Analysis Protocol* (2001), which was provided to the MADEP and USACE for review and comment prior to the initiating the 2001 studies.

Laboratory Analysis

Composite sediment samples from representative vibracores were submitted for analysis of physical properties and chemical constituents following the completion of each vibracore program. Analytical results were provided to BOEMRE for review and are addressed in the FEIS. Results from the 2001 and 2003 sampling program are presented in Sections 5.1.3.2 and 5.1.3.3, and on Tables 5.1-3 through 5.1-6 of the DEIS.

All samples submitted for chemical analysis were composited from the 0- to 5-foot (0- to 1.5-meter) depth range because shallow sediments are more likely to be affected by potential modern contamination than the deeper sediments. Sample locations were selected to assess the chemical conditions of shallow marine sediments throughout the Project area, as well as shallow sediments that were observed to contain greater than 50 percent fines during field classification. Samples were selected based upon depth and location within the Project area, using the following locational categories and parameters:

- **Cable route cores:** Sediments were composited from the 0- to 5-foot (0 to 1.5 meter) and 5- to 10-foot (1.5 to 3 meter) depth intervals, with a minimum of one physical sample submitted for bulk analysis from each depth interval in this category. If the sample from these depths contained more than 50 percent fines based on visual observations, then a sample of that interval was also collected and submitted for chemical analysis.

- **Nearshore and select cable route cores:** Sediments were composited from the 0- to 5-foot (0 to 1.5 meter) and 5- to 10-foot (1.5 to 3 meter) depth intervals. A minimum of one sample was collected and submitted for bulk physical analysis from each interval, and a minimum of one sample from the 0- to 5-foot (0 to 1.5 meter) depth range was collected and submitted for chemical analysis in this category.

- **Cable route cores within the WTG array:** Sediments were composited from the 0- to 5-, 5- to 10- and 10- to 30-foot (0- to 1.5-, 1.5- to 3-, and 3- to 9.1-meter) depth intervals, with a minimum of one sample submitted for bulk physical analysis from each interval within this category. If the composite sample for the 0- to 5- or 5- to 10-foot (0 to 1.5 or 1.5 to 3 meter) interval contained more than 50 percent fines based upon visual observations, then a sample of that interval was also submitted for chemical analysis.

- **WTG Cores**: Sediments were composited from the 0- to 10- and the 10- to 20-foot (the 0- to 3- and the 3- to 6.1 meter) depth intervals. A minimum of one sample was submitted from each interval for bulk physical analysis. If the composite of the 0- to 10-foot (0- to 3-meter) depth interval contained more than 50 percent fines based on visual observation, then a sample from that depth interval was also submitted for chemical analysis.

- **Select WTG cores**: Sediments were composited from the 0- to 10-foot (0- to 3-meter) and 10- to 20-foot (3- to 6.1-meter) depth intervals. A minimum of one sample from each interval was submitted for bulk physical analysis; a minimum of one sample from the 0- to 10-foot (0- to 3-meter) interval was submitted for chemical analysis.

The results of chemical analyses were compared to marine sediment guidelines published by Long et al., 1995, which are used to assess effects to the benthic community. Results are presented on DEIS Tables 5.1-4 though 5.1-6 and discussed in Sections 5.1.3.2 and 5.1.3.3 of the DEIS.

3.2.3 Offshore Geology

The offshore area of the proposed action is located in Nantucket Sound, a broad passage of water that separates the south shore of the Cape Cod mainland and the islands of Nantucket and Martha's Vineyard, and in Lewis Bay, a coastal embayment along the south coastline of Cape Cod. In general, the bathymetry in Nantucket Sound is irregular, with a large number of shoals present in various locations throughout this basin. The foundations for the WTGs and the ESP are proposed for installation on Horseshoe Shoal, located in the central region of Nantucket Sound, with the transmission cables extending northward into Lewis Bay and the southern shoreline of Cape Cod. As its name suggests, Horseshoe Shoal is shaped like a horseshoe opening to the east, with a northern leg and a southern leg surrounded by deeper water.

A combination of National Oceanic and Atmospheric Administration (NOAA) nautical charts and project-specific hydrographic surveys were used to assess existing bathymetric conditions. On Horseshoe Shoal where the WTGs and the ESP are proposed, hydrographic surveys indicate water depths are as shallow as 0.5 ft (0.15 m) (MLLW), with depths of up to 60 ft (18.3 m) (MLLW) occurring between the northern and southern legs of the shoal. The WTGs and ESP would be located in water with depths between 12 and 50 ft (3.7 and 15.2 m) (MLLW).

Water depths between Horseshoe Shoal and the Cape Cod shoreline have an average depth of approximately 15 to 20 ft (4.6 to 6.1 m) (MLLW). Along the proposed transmission cable system route, water depths range from 16 to 40 ft (4.9 to 12.2 m) (MLLW), with an average depth of approximately 30 ft (9.1 m) (MLLW).

In Lewis Bay, water depths range from 8 to 16 ft (2.4 to 4.9 m) (MLLW) in the center of the bay to less than 5 ft (1.5 m) (MLLW) along the perimeter. Water depths along the proposed transmission route in Lewis Bay range from 2 to 16 ft (0.61 to 2.4 m) (MLLW).

Results of marine geophysical surveys indicate a seafloor in the Project Area that ranges from flat and barren to rolling with areas of sand waves of varying heights. Localized areas of glacial erratics (pebble to boulder size rock fragments) were observed. This possible till deposit has been avoided during the selection of the final proposed transmission cable alignments. In addition, the side scan geophysical imagery was indicative of coarse glacial material (gravel, cobbles, and boulders) and intermingled with man-made debris (generally from 1 to 5 ft [0.3 to 1.5 m] in size) on the seafloor in the west central part of the proposed action area.

Sand Waves and Sediment Transport

The sand waves observed during the geophysical surveys are wave-like seabed features, with elongated, more or less parallel crests. Typically, sand waves are not static, rather they are migrating bedforms and evidence of active sediment transport along the seabed. Sand waves in this shoal environment are morphologically dynamic, with sand waves moving, appearing, disappearing, and changing shape over time as a result of tidal and storm influences. This sand wave process is not unique to Nantucket Sound, but rather occurs in coastal settings wherever the appropriate hydrodynamic conditions exist along with a predominance of sandy, non-cohesive sediments.

Sand waves of varying heights characterize the areas of active sediment transport, generally in the center of the Horseshoe Shoal. However, a large field of sand waves extends across the southern half of the shoal, and several smaller fields are located to the north within the area of the proposed action. Figure 4.1.1-11 of the FEIS presents the location and maximum observed heights of sand waves identified during geophysical surveys completed in 2003 and 2005, and includes the locations of the proposed WTGs and the electrical transmission cable routes.

The sand wave crests are oriented generally in a north-south direction, with long period wavelengths ranging from 100 to 600 ft (30.5 to 182.9 m). Short period sand waves are located between the larger crests. The average sand wave height observed was 4 to 5 ft (1.2 to 1.5 m), but waves as high as 12 ft (3.7 m) were present. Smaller wave heights from 1 to 2 ft (0.3 to 0.61 m) were often observed between the larger wave crests.

Tidal currents flow east and west across the Nantucket Sound, with the eastward-flowing flood tide more dominant than the westward-flowing ebb tide. The symmetry of the sand waves indicates migration to the east or west, depending on where they formed on the Horseshoe Shoal. Sand waves forming on the west flank of the shoal tend to migrate easterly. Sand waves forming on the east flanks of the shoal tend to migrate to the west. Sand waves across the crest of the shoal have a symmetrical profile, suggesting an equal force in both the ebb and flood tidal phases. Not all bed forms exhibit a clear migration direction, indicative of multiple processes impacting sediment transport in Nantucket Sound, including storm events.

Analytical sediment transport modeling was completed to determine the extent to which existing wave and current conditions are likely to lift and move sand at the site of the proposed action. A two-dimensional sediment transport model was developed to simulate 26 current and wave conditions across the site of the proposed action. The model inputs included a grid of wave heights and ambient currents for the site of the proposed action. The model then calculated near bottom velocities and shear stresses associated with waves and ambient currents. The model results represent whether and where sediment transport is likely to occur and potential rates of bed load and suspended load sediment transport (FEIS Report No. 4.1.1-9).

Ten tidal and wind driven current scenarios were run for Horseshoe Shoal. The conditions were selected to represent a range of tidal currents, locally-generated wind waves within Nantucket Sound, ocean waves, and wind-generated currents in the sound. Extreme conditions, such as storms, were not modeled. The results of the model runs are useful in understanding the dynamics of sediment transport in Nantucket Sound under different conditions. However, qualitative sediment transport rates and net sediment flux within Horseshoe Shoal are not possible without field measurements for model verification (FEIS Report No. 4.1.1-9).

The results of the modeling indicate that active sediment transport occurs at Horseshoe Shoal under typical wave and tidal current conditions. The highest sediment transport rates are focused locally on the shallowest portions of the shoal, and there is relatively little sediment transport in the deeper regions of the shoal (particularly the east side) under typical conditions. Bed load transport is typically an order of magnitude greater than suspended load transport. The range of sediment transport volume from the energy flux calculation for mean flood tide conditions and commonly occurring waves (height = 1.3 ft [0.4 m], period = 2.3 seconds) is 0 to 32.3 cubic feet (cu. ft)/feet-day (0 to 3.0 cubic meters (m3)/meters-day), though the authors recognize that the model cannot account for erosion and equilibration of the seafloor and likely the rates predicted are overstated (FEIS Report No. 4.1.1-9).

Spring tidal currents and typical wind-driven currents (wind speeds ranging from 15 to 20 miles per hour (mph) [6.7 -8.9 meters/second (m/s)]) initiate approximately 20 percent more transport than mean tidal currents. The greatest impact on sediment transport initiation is wave action. Larger locally generated waves within Nantucket Sound can result in a significant increase in sediment transport. Storm generated ocean swells reaching the sound can greatly increase sediment transport rates, as much as one-hundred fold (FEIS Report No. 4.1.1-9).

Subsurface Geology

The sediment below the seafloor was characterized by completing geophysical surveys at all of the WTG locations and along electrical transmission cable runs, and the collection, characterization, and analysis of samples collected from 86 vibracores (not including three archeological cores) and 22 deep borings on Horseshoe Shoal. On Horseshoe Shoal, vibracores were advanced up to 20 ft (6.1 m) below the seafloor. Geotechnical borings were advanced below the anticipated depth of the WTG foundations (85 ft [26 m]). At the proposed location of the ESP, one boring extended to 150 ft (47.5 m) below the seabed which corresponds to the anticipated ESP pile depth. Geophysical surveys characterized shallow and deep sediments, with bottom profiler gathering data to 200 ft (61 m) below the seafloor at some locations. In general, geotechnical surveys indicate that subsurface soil conditions within the WTG array on Horseshoe Shoal consist primarily of sands and glacial deposits to greater than 100 ft (30.5 m) below the seafloor, and provide an appropriate physical location and seabed structure for Project design and construction.

Shallow sediment samples collected from vibracores (extended up to 20 ft [6.1 m] below the seafloor) between the WTGs indicates the shallow surficial sediments are primarily medium sand in shallow water and fine sand in deeper water. Characterization via bulk physical analysis was completed on composite samples collected from the upper 4 to 5 ft (1.2 to 1.5 m) of sediment collected from the vibracores. The samples collected from shallow water indicated the presence of well sorted sands with less than 5 percent fines. In the deeper waters, well sorted sand to silty sand was present. Detailed cross sections across Horseshoe Shoal A″-A‴ and B″-B‴ are presented as FEIS Figures 4.1.1-12 and 4.1.1-13, respectively; the plan view for cross section locations are presented in Figure 4.1.1-5 of the FEIS.

Along the proposed transmission cable route in Nantucket Sound, sediment characterization samples were collected and analyzed and were found to be very similar to those in the WTG array area. Within Lewis Bay, a higher percentage of silt and clay were identified with the sands. In addition, thin layers of organic material, including thin (0.5 ft [0.15 m] thick) layers of peat, were observed. The geophysical sub-bottom profiles approaching Lewis Bay contain inconsistent (continuous, discontinuous) acoustic subsurface reflectors, which may be evidence of the fluvial erosion (during sea-level fall) and then wave erosion (during sea-level rise) that has occurred on the Cape Cod southern coastline (OSI, 2002 and 2003).

These shallow sediments are representative of the material to be disturbed (suspended during jet plow embedment) during the WTG inner-array cable installation, which is targeted for a depth of 6 ft (1.8 m). Figure 4.1.1-9 of the FEIS presents vibracore sample locations and a plan view of a geologic cross section location along the 115 kilovolt (kV) Cable Route from the WTG array to landfall. The cross section is presented in Figure 4.1.1-14 of the FEIS.

Deeper sediments were characterized as re-worked fine to medium sands. Locally, intermittent beds of organics are located within and below this re-worked sediment. This is presented on the cross section presented in FEIS Figure 4.1.1-12 with boring SB-01-2002. This intermittent zone of organics may be a soil horizon marking land surface exposed during the sea level low-stand prior to the marine transgression and sea-level rise that continues today. The lack of a broad soil horizon is likely related to the erosion and reworking of the sediment during this marine transgression.

In addition, limited areas of Horseshoe Shoal contained near-surface gaseous sediments derived from organic material which was identified by acoustical penetration restrictions during the geotechnical seismic profiling. This is a common occurrence in shallow near-shore sediments, yet is not considered a geologic hazard. Signs of high biogenic gas content, such as sea-bed pockmarks, were not identified during the geophysical surveys.

In addition to the organic soil horizon, a thin but distinct sedimentary facies of interbedded clay was locally observed at the same location and others, but at a greater depth. Though not widespread, this may be evidence of a former glacial lake. Analysis of the sub-bottom geophysical results and the deep boring data indicates this intermittent clay horizon has been eroded, a geologic unconformity. This is best illustrated on the cross section presented in Figure 4.1.1-13 of the FEIS comparing the silty-clay horizon of SB-03 and the fine sand and clay horizon of SB-02-2002, with the sandy sediment in SB-01.

A correlation between the geophysical and geotechnical soil boring results indicates the subsurface sediment is dominated by fine to coarse-grained sand interbedded with deposits of clay, silt, gravel and/or cobbles. An example of this geologic setting is illustrated on the geophysical trackline profile G-13, correlated to marine boring GZA-SB-02 in Figure 4.1.1-15 of the FEIS.

The potential for diapirism, a fairly common type of soft sediment deformation in continental shelf sediments, was assessed for the area of the proposed action. Diapirs can be composed of salt or mud depending on the source sediments. Sediments undergo compaction as younger sediments are deposited over them, leading to increasing pressure on fluids within the sediments. The pressurized fluids can start to flow, mobilizing the sediments to zones of lower pressure at or near the seafloor. This process may also be associated with methane-producing organic content in the sediments (Kennett and Fackler-Adams, 2000).

In the process of flowing upward, the diapirs deform the overlying sediments in a doming or piercing fashion. Diapirs are discrete features that can be identified on geophysical subbottom profiler data and can be avoided. They can be active or inactive, exhibit a range of sizes, and may or may not intersect the seafloor. They can cause pockmarked depressions in the seafloor, and slumping and landslides of fine-grained marine sediments in areas of steep unstable slopes (such as on continental slopes in deep water). As indicated in the Shallow Hazards Report (Appendix A) no evidence of diapirism is found throughout the Project Area, based upon a review of the geophysical data collected for the Project.

Bedrock was not encountered during the geophysical investigation. The depth to bedrock beneath the seafloor is estimated at greater than 300 to 900 ft (91.5 to 274.4 m) below the seafloor across the area of the proposed action, sloping to the southeast. The estimated depth to bedrock is below the deepest foundation proposed (USGS, 1983; USGS, 1990; USGS, 2006d).

Faults

A fault is a fracture plane within the Earth's lithosphere along which displacement has occurred. No active shallow or deep faults have been identified within the area of the proposed action based upon geologic literature review. Results of the Shallow Hazards Analysis (provided in Appendix A) indicate that there is no indication of disruption or internal deformation of lithologic units within overlying Quaternary sediments throughout the Project Area.

Seismic Setting

In general, Cape Cod and Nantucket Sound are considered a relatively stable tectonic setting, distantly located from a tectonic plate boundary, where frequent high energy earthquakes are typically more common. This intraplate setting is not a seismic-free location. The seismic activity here is less frequent than at plate boundaries, but low intensity earthquakes are common in New England, with an average of 30 to 40 occurring each year, but most are never felt by residents. In Massachusetts, 316 earthquakes were recorded between 1627 and 1989. In Rhode Island, only 32 earthquakes were recorded between 1766 and 1989 (NESEC, 2006).

Compared to the mainland of New England, it is recognized that Nantucket Sound is relatively less seismically active. However, on October 24, 1965, the residents of Nantucket Island felt a moderate earthquake. Very slight damage was recorded, mostly to ornaments and doors. Windows and dishes rattled, and house timbers creaked (USGS, 2006b). This recent example indicates that the area of the proposed action is not earthquake free but that seismic activity is typically low energy.

Occasionally, higher energy earthquakes could occur in Massachusetts, such as the largest earthquake recorded in Massachusetts, the Cape Ann earthquake of 1755. With an intensity value of VIII on the Modified Mercalli scale (magnitude 6+ on the Richter Scale), very strong shaking and moderate structural damage were recorded in Boston and the North Shore (USGS, 2006b).

Seismic waves travel out from an earthquake epicenter through the surrounding rock. Ground motion is higher closer to the location of the event. In general, ground motion decreases away from the epicenter, though the amount of ground motion at the surface is related to more than just distance from the epicenter. Some natural materials can amplify ground motion, for instance ground motion is generally less on solid bedrock and greater on thick deposits of clay, sand, or artificial fill.

Seismic hazards defined in building codes are typically based on peak ground acceleration. During an earthquake, a particle attached to the earth would move back and forth irregularly. The horizontal force a structure must withstand during an earthquake is related to ground acceleration. Peak ground acceleration is the maximum acceleration experienced by a particle during an earthquake.

The United States Geologic Survey (USGS) produces probabilistic Seismic Hazard Maps for the United States with peak ground acceleration values represented as a factor of "g." One g is equal to the force on an object at the surface of the earth due to gravity. Engineers utilize these probabilistic ground motion values, representing hard rock beneath site soils, when designing earthquake resistant structures.

The USGS Seismic Hazard Maps were reviewed for the area of the proposed action. The maps show a 10 percent probability of a 2-3 percent g exceedence in 50 years (see Figure 4.1.1-19 of the FEIS). In addition, there is a 2 percent probability of a 6 to 10 percent g exceedence in 50 years (see FEIS Figure 4.1.1-20) (USGS, 2002a). This information will be utilized by project engineers during final design to ensure foundation stability during times of seismic stress.

Liquefaction

Liquefaction is a process whereby the strength and stiffness of a soil and/or sediment is reduced by earthquake shaking or other rapid loading. The result is a transformation of soil and/or sediment to a liquid state. Typically, three general factors are necessary for liquefaction to occur. They are (USGS, 2006c):

- Young (Pleistocene) sands and silts with very low or no clay, naturally deposited (beach, river deposits, windblown deposits) or man-made land (hydraulic fill, backfill).
- Soils and sediments must be saturated. The space between individual particles is completely filled with water. This water exerts a pressure on the soil and sediment particles that influences how tightly the particles themselves are pressed together. This is most commonly observed at or near bodies of water such as rivers, lakes, bays, and oceans, and associated wetlands.
- Severe shaking. This is most commonly caused by a large earthquake. Prior to an earthquake, the water pressure is relatively low. However, earthquake shaking can cause the water pressure to increase to the point where the soil particles can readily move with respect to each other. This factor is limited by the distance from the large earthquake epicenter. That is, liquefaction potential decreases as distance increases from the epicenter of a large earthquake.

Based on the USGS Seismic Hazard Maps for the area of the proposed action, the risk of a large earthquake resulting in severe shaking of the young, saturated sand deposits of Horseshoe Shoal is low.

Based on results of the geotechnical sampling and analysis program, as described above, the sediment conditions across the site consist of fine to medium sand. Intervals of silty clay, organic silt, fine sand and coarse sand/gravel were encountered at most boring locations. The Standard Penetration Test (SPT) values in the sand deposits generally indicate a relative density of dense to very dense. The organic silt has a loose to medium dense relative density. The SPT N-values obtained in the silt indicate it had a relative density of very dense.

Based on these factors the bearing strata (not organic soil) of sediment in the Project Area presents no risk of liquefaction because the relative density is dense to very dense. There may have been a risk of liquefaction in the organic silt deposits caused by cyclic loading because the relative density is loose to medium dense. Since the organic silt deposits are not a bearing strata for the Project, the possibility of liquefaction in the Project Area is considered negligible.

3.3 Archaeological Investigations Completed

Offshore pre-European Contact Period (prehistoric) and post-Contact Period (historic) archaeological resources with the potential to be impacted by the construction and operation of the proposed project have been thoroughly evaluated over the course of the 9 year regulatory review process. The following section provides references to the extensive body of source documents that have been prepared as part of that review, and then provides a brief summary of the archaeological surveys and studies completed.

Project Lease Application (7/11/2006)

- See Section C10 (page 31-33).

FEIR (2/2007)

- See Section 3.11.

DEIS

- See Section 4.3.5

FEIS (1/2009)

- See Section 4.3.5. and the reports highlighted in bold below, which were contained in the FEIS.

Reports

- Public Archaeological Laboratories (PAL). 2004. Preliminary archaeological sensitivity assessment. Cape Wind Energy Project Alternatives: Horseshoe Shoal; Combination New Bedford/Buzzards Bay and Reduced Horseshoe Shoal; Monomoy and Handkerchief Shoals; Tuckernuck Shoal; and South of Tuckernuck Island, Massachusetts. PAL Project No. 1485.02. Submitted to Cape Wind Associates, L.L.C. Boston, Mass. Pawtucket, R.I.
- **FEIS Report No. 4.3.5-1.** Graves, A. K., and H. Herbster. 2004. Terrestrial Archaeological Reconnaissance Survey, Terrestrial Route Alternatives #1 and #2, Barnstable, Mashpee, and Yarmouth, Massachusetts and Intensive (Locational)

Archaeological Survey, Terrestrial Route Alternative #1, Cape Wind Energy Project, Barnstable and Yarmouth, Massachusetts. Submitted by Public Archeological Laboratory. PAL Report No. 1485.01. Submitted to Cape Wind Associates, L.L.C., Boston, Mass. Pawtucket, R.I.

- **FEIS Report No. 4.3.5-2.** Robinson, D. S., B. Ford, H. Herbster, and J. N. Waller, Jr. 2003. Marine Archaeological Sensitivity Assessment, Cape Wind Energy Project, Nantucket Sound, Massachusetts. Submitted by Public Archeological Laboratory. PAL Report No. 1485. Submitted to Cape Wind Associates, L.L.C., Boston, Mass. Pawtucket, R.I.
- **FEIS Report No. 4.3.5-3.** Robinson, D. S., B. Ford, H. Herbster, and J. N. Waller, Jr. 2004. Marine Archaeological Reconnaissance Survey Cape Wind Energy Project, Nantucket Sound, Massachusetts. Submitted by Public Archeological Laboratory. PAL Report No. 1485. Submitted to Cape Wind Associates, L.L.C., Boston, Mass. Pawtucket, R.I.
- **FEIS Report No. 4.3.5-4.** Public Archeological Laboratory (PAL), 2006. Supplement Report, Cape Wind Energy Project Nantucket Sound Massachusetts, Supplemental Marine Archaeological Reconnaissance Survey of Revised Layout Offshore Project Area. PAL Report No. 1485.06. Prepared for Cape Wind Associates, L.L.C., Boston, Mass. Pawtucket, R.I.

3.3.1 Offshore Area of Potential Effect for Archaeological Resources

The Area of Potential Effect (APE) for offshore archaeological resources includes the direct impact areas associated with the footprints of the WTG structures on the sea bottom;; the jet plowed trenches for installation of the inner-array cables connecting the WTGs to the ESP; the jet plowed trenches for the transmission cable system from the ESP to the landfall, as well as the indirect impact areas associated marine work areas around each WTG, the ESP, inner array cable, and the transmission cable system where marine sediments may be disturbed, such as spud and anchor drop zones and anchor cable sweep areas.

A marine sensitivity assessment of approximately 15,360 acres (62.15 square kilometers (km2)) of Nantucket Sound seafloor comprising the proposed action study area, as well as along the 115 kV transmission cable system route to the Yarmouth landfall, was conducted in 2003 (FEIS Report No. 4.3.5-2). Based on this assessment, a marine archaeological reconnaissance survey was conducted in the offshore study area in 2003 (FEIS Report No. 4.3.5-3). A supplemental marine archaeological reconnaissance survey was performed in 2005 after the WTG array was revised to avoid potential archaeologically sensitive areas (FEIS Report No. 4.3.5-4).

A pre-construction archaeological investigation will be conducted of the offshore APE, including anchor impact areas, prior to construction, as described in Section 4.0. Project compliance with NEPA and Section 106 of the National Historic Preservation Act of 1966, as amended (the NHPA), is addressed in Section 8.0.

3.3.2 Marine Archaeological Sensitivity Assessment

The Marine Archaeological Sensitivity Assessment conducted for the proposed action by Public Archaeology Laboratory, Inc (PAL) (FEIS Report No. 4.3.5-2) indicated that there were 45 ships reported lost within the general vicinity of the project area and that the project area had a moderate probability for containing submerged historic resources (i.e., shipwrecks). The dates of the vessels lost ranged from 1841 to 1963; however, 19 of the vessels had no date of loss given in the source databases used by PAL. The primary sources of shipwreck data used in the PAL analysis were the Massachusetts Board of Underwater Archaeological Research (MBUAR), the Northern Shipwreck Database, and the NOAA Automated Wreck and Obstruction Information

System (AWOIS) database. A listing of these reported shipwrecks is found in Appendix A of PAL's report (FEIS Report No. 4.3.5-2).

The marine archaeological sensitivity assessment conducted for the Project also indicated that except for a crescent-shaped area on the eastern flank of Horseshoe Shoal in the eastern portion of the offshore study area where former natural soil strata (paleosols) could have been present, a majority of the offshore study area had a low probability for containing submerged prehistoric archaeological resources. Some of this sensitive area was located within the proposed project area. The archaeological sensitivity of the proposed project area was further evaluated in subsequent studies, as described below.

3.3.3 Marine Archaeological Reconnaissance Survey in 2003

Based upon the results of the marine archaeological sensitivity assessment and subsequent consultation with state, federal and tribal agencies, and because the preliminary turbine array layout was revised after the original geophysical field surveys in 2001, additional marine geophysical field survey was conducted in June, July and September 2003, to assess seafloor and subsurface conditions and to determine the presence or absence of submerged cultural resources within the direct impacts portion of the Project's marine APE.

The scope of this marine archaeological reconnaissance survey was developed following consultation with Massachusetts Board of Underwater MBUAR and Massachusetts Historical Commission (MHC). The field portion of the marine geophysical survey was conducted by OSI in two separate field deployments during the summer and fall of 2003. The survey collected over 300 linear miles (483 kilometers (km)) of geophysical information within the Wind Park and along the proposed 115 kV transmission cable route into Lewis Bay. In addition to OSI personnel and other scientists, a marine archaeologist from PAL was on board the geophysical survey boat during each field day, to identify targets and note other areas of interest for potential submerged cultural resources.

The geophysical survey was performed using differential GPS, side scan sonar, sub-bottom profiler, a marine magnetometer and a recording fathometer. A survey trackline interval of 50 feet (15.2 meters) was utilized for those portions of the Project area in which sub-surface impacts during construction are anticipated, such as where installations of the WTGs, ESP, inner-array and submarine cable transmission lines are proposed. The geophysical survey program collected data to be used for geotechnical assessment and engineering design purposes, as well as for archaeological assessment purposes.

The 2003 geophysical survey recorded 154 magnetic anomalies and 109 side-scan sonar contacts. Of the 154 magnetic anomalies, and 109 side-scan sonar contacts all but 29 were determined by the marine archaeologist to have a source that was non-cultural in nature or was interpreted as isolated debris, and, therefore, were eliminated from further consideration.

Additional analysis of post-processed data collected in June, July and September 2003, focusing particularly on the 29 anomalies of interest, was completed. Analyses of the post-processed 2003 data produced three target areas consisting of one side-scan anomaly associated with a cluster of five magnetic anomalies (PAL Target 03-01), and two clusters of three magnetic anomalies associated with observed changes in the bathymetry (PAL Targets 03-02 and 03-03), all of which were assessed as having a moderate probability of representing potential submerged cultural resources (i.e., shipwrecks). All three target areas are located in the vicinity of Horseshoe Shoal. Locations for these areas were reported to MHC and the MBUAR; Project components were re-located to avoid these areas. PAL Target 03-01 is located over 4,000 feet away from the ESP structure, in an area surveyed using tight geophysical spacing referred to as the ESP area. Therefore, the area will be clearly avoided.

A map showing the delineation of the three targets, the 100-foot buffer zones around each, and the Project components, is being provided to BOEMRE by OSI on an ArcGIS shape file. The potential for impact to these targets is not problematic. In addition, the target delineations and the 100-foot radial buffer zones will be marked as No Seafloor Disturbance Zones on maps provided to the construction contractors. The contractors will also be informed in Project construction documents, which will include navigational coordinates around the targets, annotated to avoid all seafloor disturbance in these zones. Avoidance of seafloor disturbance in the zones around the three targets will also be overseen by the Environmental Inspector(s) working in the field during construction.

Please note that the target locations should not be publicly disseminated to protect the integrity of these possible archaeological sites.

In addition, based on the results of the geophysical survey, PAL recommended additional vibracores be taken to determine the source of sub-bottom profiler anomalies (i.e., reflectors) and better characterize the origin, nature and extent of organic sediments observed in three vibratory coring samples previously recovered from the eastern edge of the marine Project area. The purpose of the archaeological vibracore program was to assess whether intact shallow submerged terrestrial paleosols (formerly subaerially exposed soil surfaces) were present within the offshore Project area. Identification of such a paleosol deposit would indicate a potential for these areas to contain submerged prehistoric resources. Twenty-three vibracores (including the additional eight recommended by PAL and one by ESS) as having high probability for paleosols based upon subbottom geophysical reflectors were collected during the 2003 field program for archaeological and geotechnical assessment and engineering design purposes. The entire suite of data was reviewed by PAL.

As a result of the 2003 marine archaeological survey, organic material interpreted as paleosols (ancient land surfaces) was identified in limited areas within the easternmost portion of the WTG array. The extent of the paleosols and associated seismic signature on shallow geophysical data are discontinuous and intermittent, which is consistent with the widespread destruction of former land surfaces that geophysical and geotechnical data collected to date for the project indicates occurred during the Holocene marine transgression. Avoidance of ground disturbing activities was recommended in these limited areas where sub-bottom profiler reflectors correlating to the intermittent paleosols encountered in the vibracores were identified within the direct impact areas of the current APE. The Project APE for the inner array cables extends to a maximum depth of 8 feet (2.4 meters) below the seafloor. The APE for the WTGs and ESP pilings extends to depths well below the 12–foot (3.7 meter) depth considered the technologically/logistically viable maximum depth for performing systematic sub-surface archaeological testing (see USACE DEIS Report in Appendix 5.10-C).

Avoidance of areas along seismic reflectors with specific characteristics which appear to correlate with the paleosols required adjustment of locations for WTGs G3, G4, H9, I4, I5, and L4 and seven limited portions of the inner array cable grid (see Figure 6-1 in USACE DEIS Appendix 5.10-C). If avoidance was deemed not possible, then additional survey was recommended, in consultation with SHPO (MHC and MBUAR). However, those WTG and portions of inner array cables recommended for location adjustments were moved out of the potential paleosol area. A supplemental geophysical/geotechnical survey of the newly adjusted WTG and inner array locations was conducted in 2005. MBUAR and MHC concurred with the project archaeologist's recommendations by letters dated February 27, 2006 and March 8, 2006, respectively.

3.3.4 Supplemental Marine Archaeological Reconnaissance Survey in 2005

The direct impact areas associated with the revised locations of the WTGs and interconnect cable routes adjusted for the current layout in federal waters were subjected to a supplemental survey integrating geophysical, geotechnical and hydrographic data acquisition programs designed to meet both engineering and archaeological data needs. The supplemental survey was performed in June, July and November 2005, the results from which are detailed in FEIS Report 4.3.5-4.

Geophysical survey methods and instrumentation employed in 2005 were essentially the same as those used during the 2003 survey. The geophysical survey data were acquired along a series of parallel survey track lines spaced 50 feet (15 m) apart; data sets were monitored as they were acquired on the vessel by the marine archaeologist. These were subsequently correlated with post-processed data to provide a final inventory of anomalies and locations for review, in conjunction with the results of the 2003 marine archaeological reconnaissance survey information.

Three shallow sub-bottom profiler reflectors on the flanks of Horseshoe Shoal were vibracored at the recommendation of the marine archaeologist, to assess the presence/absence of potential paleosols. No visible evidence indicating the presence of contextually intact, stratified paleosol deposits were found in any of the three vibracores upon examination by a marine archaeologist and a marine geologist/limnologist. None of the relatively low density of small side-scan sonar and magnetometer anomalies detected in the 2005 survey possessed characteristics associated with historic archaeological deposits such as shipwrecks.

The marine archaeologist recommended no further archaeological investigation of the direct impact area associated with the revised locations of the WTGs and interconnect cable routes (see FEIS Report 4.3.5-4); MBUAR and MHC concurred with the project archaeologist's recommendations by letters dated February 27, 2006 and March 8, 2006, respectively.

Summary of Anomalies:

The sidescan sonar and magnetic anomalies detected during the Project's three geophysical surveys conducted in 2001, 2003 and 2005 and individually reported in previous reports cannot be summed to obtain an accurate total of anomalies identified to date within the final layout of the Wind Park. As reported in previous filings, the layout has been revised since 2001 for various reasons that include avoidance of certain anomalies, reduction of visual impacts to southern Cape Cod and the Kennedy Compound National Historic Landmark, siting to remain in federal waters after a state boundary line change, and to reduce potential navigational impacts along the southern Project Area. Anomaly totals in previous reports often included proposed and alternative cable routes, as well as anomalies detected on tracklines now outside the final layout. For example, Figures 2 and 3 in the Shallow Hazards Report show 2001 and 2003 survey tracklines that extend beyond the final layout.

Only those sonar and magnetic anomalies identified within the surveyed final layout of the Wind Park were included in the Shallow Hazards Report and associated figures and drawings in Appendix A of the COP. A total of 161 sidescan sonar and 225 magnetic anomalies have been identified during the three surveys run to date within the final layout of the Wind Park.

The specifications for the magnetometer and sidescan sonar instruments run during the geophysical surveys in 2001, 2003 and 2005 are reported in Tables 2 through 4 of the Shallow Hazards Report, respectively. Additional specifications were provided with the geophysical datasets sent to BOEMRE by OSI in November and December 2010. The location of all tracklines surveyed to date in the Wind Park are shown on the Navigation Post-Plot provided as Drawing 1 in the Shallow Hazards Report.

4.0 CONSTRUCTION PLAN

This section of the COP describes construction for all planned Project facilities, including onshore and support facilities. The anticipated construction schedule is presented in Figure 2.3-1.

Offshore construction activities, including Project components, installation methods, and safety for offshore construction workers, are described in Section 4.1, and include pre-construction offshore supplemental field surveys (Section 4.1.1).

Onshore construction activities, including Project components, installation methods, and safety for onshore construction workers, are described in Section 4.2.

4.1 Offshore Construction Plan

The offshore components of the Project include 130 monopile foundations, transition pieces and WTGs; the inner array 33 kV cables; the ESP; the submarine 115 kV transmission cable system to shore; and the components of the offshore cable system as it transitions to upland cable at the landfall.

The construction plan for the offshore components incorporates the construction descriptions set forth in the FEIS. The Project's construction activities will adhere to the stipulations set forth in the Lease, to the extent they are technically feasible and necessary, in consultation with BOEMRE.

Safety management systems to ensure the appropriate training and safety of offshore construction personnel are summarized in Section 4.1.3. Offshore Project facilities, including design and fabrication, and installation methods for each component and support facilities are described in Sections 4.1.4 through 4.1.9.

4.1.1 Pre-Construction Offshore Field Surveys

While an extensive amount of data has been gathered during the past 10 years providing CWA with the information necessary to ensure successful development of the Project, supplemental offshore field surveys will be conducted prior to the start of construction to comply with pre-construction requirements in the ROD and the Lease. These supplemental pre-construction field surveys will include high resolution geophysical (HRG) surveys, geological and geotechnical (G&G) surveys, and archaeological investigations. The scopes of the planned surveys are presented below.

Pre-construction field surveys within the Project's offshore lAPE for construction and operation will be conducted prior to the start of seafloor-disturbing construction activities, and will provide data supplemental to prior project-specific field investigations conducted since 2001. The field surveys will include G&G investigations as well as marine archaeological, investigations. The investigations will be planned and conducted to comply with federal and state permit requirements for supplemental investigations post-lease and prior to the start of construction.

In accordance with the Lease, CWA will meet with representatives of BOEMRE for a pre-survey planning meeting prior to the start of any offshore G&G investigation activities. CWA will be prepared to further review and finalize the specifications of data acquisition systems, field techniques, data to be acquired, processing and analysis to be performed, data and information to be submitted.

Further, before conducting offshore survey operations employing towed geophysical gear, CWA will notify commercial fishers and other OCS users through a Notice to Mariners. The notice will be provided at least two weeks before the start of operations and approximately 72 hours prior to mobilization (30 CFR 285.606(3), 285.621(c), 285.641(c)).

The scopes of the anticipated studies are described below, and have been designed to comply with the Lease and other applicable permit requirements. The results of the surveys are expected to be reported in the Facilities and Design Report, which will be submitted to BOEMRE for acceptance prior to the start of construction.

4.1.1.1 Plan for Pre-Construction High-Resolution Geophysical (HRG) Survey

A pre-construction HRG Survey will be conducted in the offshore Project area to satisfy the mitigation and monitoring requirements for Cultural Resources and Geology in the Environmental Stipulations in Addendum C of the Lease. The pre-construction survey will be conducted to collect data to supplement the three previous site-specific geophysical surveys (described in Section 3.0 above and in Section 4.1.1.1 of the FEIS). The three HRG surveys conducted to date provide information about seafloor and subsurface conditions pertinent to the design, construction, operation and removal of Project structures and foundations.

HRG Survey Area

In accordance with Addendum C1.II.a of the Lease, the pre-construction HRG survey will be conducted within an area extending 1,000 feet beyond the Area of Potential Effect for offshore archaeological resources defined Section 2.1 of the *Documentation of Section 106 Finding of Adverse Effect (Revised)*, issued by BOEMRE in 2010 and available at

http://www.boemre.gov/offshore/RenewableEnergy/PDFs/CapeWind/Tripathi/Revised_Findings_Main.pdf

As stated in that document:

> *…The APE for offshore archaeological resources includes the footprints of the WTG structures on the sea floor; the work area around each WTG where marine sediments may be disturbed; the jet plowed trenches for installation of the inner-array cables connecting the WTGs to the ESP; the jet plowed trenches for the transmission cable system from the ESP to the landfall site; and associated marine work areas such as anchor drop areas.*

The marine work areas associated with WTG and submarine cable installation will be finalized by the marine construction contractor (once selected), based upon specific vessel and anchoring requirements.

HRG Survey Design

The HRG survey will be conducted along tracklines oriented in a NNW/SSE and E/W pattern within the WTG array, and parallel to the 115kV submarine cable between the ESP and landfall in Lewis Bay. The orientation of the survey tracklines is designed to be consistent with previous geophysical data collected throughout the Project area and is generally consistent with the geomorphology and bathymetry of Horseshoe Shoals. Tracklines oriented in these directions also intersect the maximum number of WTGs, which were sited to optimize the power derived from the prevailing winds.

Tracklines will be spaced 30 meters apart to comply with the Cultural Resource stipulations in Addendum C.1.II.c.i. of the Lease. The following instrumentation will be deployed on every trackline: depth sounder for bathymetry, magnetometer, side scan sonar, and Chirp subbottom profiler (Chirp). Side scan sonar will provide the full coverage of the seafloor bottom and suitable resolution of targets required at Addendum C.1.II.c.iii of the Lease. Although multibeam equipment is also stipulated in that clause to collect bathymetry data, use of the single beam echo sounder equipment is appropriate, given the site's shallow water depths and because the necessary bottom coverage and target resolution will be provided by the side scan sonar. Single beam equipment will adequately provide all the bathymetric data needed, given the close required line spacing. The collection of medium penetration sub-bottom profiler data would be collected on tracklines at 150 meter spacing. The selection of survey equipment will be finalized during pre-survey discussions between BOEMRE and the Project's geophysical contractor. As stated in Addendum C.1.II of the Lease, the stipulations for the HRG Survey "may be modified if BOEMRE determines that the criteria are not technically feasible or necessary to implement at the Project site".

It should be noted that additional processing of the medium penetration seismic profiling (boomer) data, as discussed in the Shallow Hazards Report in Appendix A, has been conducted to further evaluate shallow subsurface hazards to maximum depths of interest to BOEMRE (150 to 300 feet below the seafloor, as site conditions allow). These depths are well below the approximately 85 foot maximum depths of the monopiles. The subbottom penetration and data resolution of the existing boomer data adequately characterizes the subsurface geology within the Project Area, which is typical for a coastal embayment in a tidal environment dominated by unconsolidated glaciated and re-worked sediments on and below the seafloor. No faulting, diapirs, gas hydrates or unexpected features have been identified from the field investigations completed to date, and neither of the two types of subsurface hazards identified (boulders and buried channels) are expected to pose any adverse impact to the Project. It is unlikely that future acquisition of boomer data will identify any additional types of geologic features or hazards.

The HRG survey will likely be conducted prior to the G&G survey (described below), so that data from the HRG survey can be used to plan the sampling locations for the G&G survey. The majority of the HRG survey program is expected to be conducted using a 40- to 45-foot-long diesel-powered vessel, outfitted with the survey equipment. In shallow waters, the survey will be conducted using a smaller vessel, likely a 25- to 30-foot gasoline-powered boat.

The survey vessels will operate approximately 10 hours per day during relatively calm sea conditions. The vessel will travel at approximately 15 knots when transiting to the survey area (approximately 1 hour each way), and at approximately 3 knots per hour during the 8 hours of actual survey time per day. The vessel will continuously transect the area, obtaining an estimated 30 linear miles of data each day, before returning to port each night before dark.

In accordance with the requirements of the Lease, a "ramp up" (depending on the technical limitations of the equipment used) will be required at the beginning of each seismic survey in order to allow marine mammals, sea turtles and fish to vacate the area prior to the commencement of activities. Seismic surveys may not commence (i.e., ramp up) at night time or when the exclusion zone cannot be effectively monitored (i.e., reduced visibility). For more detail refer to Section 9-29 of the FEIS.

Instrumentation

The following navigation, hydrographic, and geophysical equipment systems (or equivalent) are proposed for use on the HRG surveys:

Trimble Differential Global Positioning System

A Trimble differential satellite positioning system provides reliable, high-precision positioning and navigation for a wide variety of operations and environments. The system consists of a GPS receiver, a GPS volute antenna and cable, RS232 output data cables, and a Coast Guard beacon receiver. The beacon receiver consists of a small control unit, a volute antenna and cable, and RS232 interface to the Trimble GPS unit. In this system configuration a position accuracy of ± 1 meter is quoted by the manufacturer.

Fully automated, the Trimble receivers provide a means for 9 channel simultaneous satellite tracking with real time display of geodetic position, time, date, and boat track if desired. The Trimble unit is mounted on the survey vessel with the beacon receiver which continuously receives differential satellite correction factors via radio link from one of the DGPS United States Coast Guard reference beacons. The Trimble GPS accepts the correction factors and applies the differential corrections to obtain continuous, high accuracy, real time position updates. A standard NMEA string including geographic coordinates is output from the Trimble DGPS and interfaced to the navigation system running HYPACK software for trackline control.

HYPACK Navigation Software

Survey vessel trackline control and position fixing will be obtained by utilizing a computer-based data-logging package running HYPACK navigation software. The computer is interfaced with the Trimble DGPS onboard the survey vessel. Vessel position data were updated at one second intervals and input to the HYPACK navigation system which processes the geographic position data into State Plane coordinates used to guide the survey vessel accurately along preselected tracklines. The incoming data are logged on disk and processed in real time allowing the vessel position to be displayed on a video monitor and compared to each preplotted trackline as the survey progresses. Digitized shoreline, NOAA charts, and the locations of existing structures, buoys, and control points can also be displayed on the monitor in relation to the vessel position. The computer logging system, combined with the HYPACK software, thus provide an accurate visual representation of survey vessel location in real time, combined with highly efficient data logging capability and post-survey data processing and plotting routines.

The HYPACK survey software digitally records the position data for each sensor, depth sounding data, motion sensor readings (heave, pitch, roll), and magnetic intensity measurements, as well as exports sensor position data (adjusted for offset and layback values) to external devices for recording with digital imagery (side scan sonar, subbottom profiles).

Innerspace Model 448 Single Beam Depth Sounder

Precision single beam water depth measurements will be recorded by employing an Innerspace Model 448 digital depth sounder with a 200 kilohertz, 3-8° beam width transducer. The Model 448 recorder provides precise, high-resolution depth records using a solid state thermal printer as well as digital data output which allows integration with the computer-based HYPACK navigation system. Depth sounding points were collected at the maximum rate of the system, 13 samples per second. The Model 448 also incorporates both tide and draft corrections plus a calibration capability for local water mass sound speed.

Sound speed calibrations are accomplished by performing "bar checks" in shallow water sites. The bar check procedure consists of lowering an acoustic target, typically a 20 pound lead disk, on a measured sounding line, to the specified Project depth. The speed of sound control is adjusted such that the reflection from the disk is printed on the recorder precisely at this known depth. The acoustic target is then raised to successively shallower depths and calibration readings at these depths are recorded. Variations which exist in the indicated depth at these calibration points are incorporated in the sounding data processing to produce maximum accuracy in the resulting depth measurements. Bar checks were performed at the beginning of each day to check the surface water mass sound speed in comparison with the CTD profiler.

Bar checks are used for calibration when surveying in shallow water areas of generally less than 60-80 feet. For depth sounder calibration in the deeper water a Sea-Bird SBE19 CTD Profiler is utilized to measure the temperature, salinity, and density of the entire water column from which sound velocity can be calculated and input to the 448 echosounder. Both checks were performed during this field investigation for quality control and comparison.

SeaBird Electronics SBE19 SEACAT Profiler

Water column velocity measurements will be logged at multiple locations daily using SeaBird Electronics 19 SEACAT Profiler. The SBE 19 is the next generation personal CTD, bringing numerous improvements in accuracy, resolution, reliability and ease-of-use. The SBE 19 samples at 4 Hz, has a 0.005 accuracy and has 8 Mbytes of memory. Data are recorded in non-volatile FLASH memory and can be transferred and processed on a PC. The SBE 19 has a fast sampling and pump controlled TC-ducted flow configuration, significantly reducing salinity spiking caused by ship heave.

The sound velocity profiles collected using the Sea-Bird are important for adjusting the single beam depth soundings for velocity changes in the water column to attain the highest level depth accuracy possible. Sound velocity is also input to other geophysical systems that provide the option for applying sound corrections for distance plotting on imagery (side scan sonar, subbottom profilers).

TSS DMS-05 Motion Sensor

Vessel heave, pitch and roll information will be measured and logged utilizing TSS's DMS-05 Dynamic Motion Sensor. Incorporating an enhanced external velocity and heading aiding algorithm for improved accuracy during dynamic maneuvers, the solid state angular sensor offers reliability and the highest performance of any TSS produced vertical reference unit. The DMS-05 motion sensor was designed for use with single and multibeam echosounders and incorporates advanced processing techniques and high grade inertial sensing elements to attain heave, pitch, and roll measurements with high dynamic accuracy and immunity to vessel turns and speed changes. The DMS-05 allows full utilization of all echosounder beams and survey capabilities to IHO standards. The DMS-05 has a dynamic roll and pitch accuracy to 0.05° over a 30° range and dynamic heave accuracy to 5 centimeters or 5% (whichever is greater). The unit can output digital data at a rate up to 200 hertz and accepts a standard NMEA 0183 message string. Digital data are logged by the HYPACK navigation computer. The DMS-05 permits survey operations to continue through degrading weather conditions, increasing project productivity and efficiency.

Klein Model 3900 Dual Frequency Side Scan Sonar

Side scan sonar images of the bottom will be acquired using a Klein 3900 dual frequency, high-resolution sonar system operating at frequencies of 445 and 900 kilohertz. The system consists of a topside computer, monitor, keyboard, mouse, tow cable, and sonar towfish. All system components are interfaced via a local network hub and cable connections. The system contains an integrated navigational plotter which accepts standard NMEA 0183 input from a GPS system. This allows vessel position to be displayed on the monitor and speed information to be used for controlling sonar ping rate. Sonar sweep can also be plotted in the navigation window for monitoring bottom coverage in the survey area.

The hardware is interfaced to the Klein SonarPro data acquisition and playback software package which runs on the topside computer. All sonar images are stored digitally and can be enhanced real-time or post-survey by numerous mathematical filters available in the program software. Imagery is displayed in a waterfall window in either normal or ground range (water column removed) formats. Other software functions that are available during data acquisition include; changing range scale and delay, display color, automatic or manual TVG (time variable gain), speed over bottom, multiple enlargement zoom, target length, height, and area measurements, logging and saving of target images, and annotation frequency and content. The power of this system is its real-time processing capability for determining precise dimensions of targets and areas on the bottom.

As with many other marine geophysical instruments, the side scan sonar derives its information from reflected acoustic energy. A set of transducers mounted in a compact towfish generate the short duration acoustic pulses required for extremely high resolution. The pulses are emitted in a thin, fan-shaped pattern that spreads downward to either side of the fish in a plane perpendicular to its path. As the fish progresses along the trackline this acoustic beam sequentially scans the bottom from a point directly beneath the fish outward to each side of the survey trackline.

Acoustic energy reflected from any bottom discontinuities is received by the set of transducers in the towfish, amplified and transmitted to the survey vessel via the tow cable where it is further amplified, processed, and converted to a graphic record by the side scan recorder. The sequence of reflections from the series of pulses is displayed on a video monitor and/or dual-channel graphic recorder on which paper is incrementally advanced prior to printing each acoustic pulse. The resulting output is essentially analogous to a high angle oblique "photograph" providing detailed representation of bottom features and characteristics. This system allows display of positive relief (features extending above the bottom) and negative relief (such as depressions) in either light or dark opposing contrast modes on the video monitor. Examination of the images thus allows a determination of significant features and objects present on the bottom within the survey area.

Geometrics G882 Cesium Marine Magnetometer

Total magnetic field intensity measurements at a 10 hertz sampling rate will be acquired along the survey tracklines using a Geometrics G882 cesium magnetometer that has an instrument sensitivity of 0.1 gamma. The G882 magnetometer system includes the sensor head with a coil and optical component tube, a sensor electronics package which houses the AC signal generator and mini-counter that converts the Larmor signal into a magnetic anomaly value in gammas, and a RS-232 data cable for transmitting digital measurements to a data logging system. The cesium-based method of magnetic detection allows a center or nose tow configuration off the survey vessel, simultaneously with other remote sensing equipment, while maintaining high quality, quiet magnetic data with ambient fluctuations of less than 1 gamma. The Geometrics G882 features an altimeter which outputs sensor height above the seafloor. Data are recorded on the data-logging computer by the HYPACK software.

The G882 magnetometer acquires information on the ambient magnetic field strength by measuring the variation in cesium electron energy level states. The presence of only one electron in the atom's outermost electron shell (known as an alkali metal) makes cesium ideal for optical pumping and magentometry.

In operation, a beam of infrared light is passed through a cesium vapor chamber producing a Larmor frequency output in the form of a continuous sine wave. This radio frequency field is generated by an H1 coil wound around a tube containing the optical components (lamp oscillator, optical filters and lenses, split-circular polarizer, and infrared photo detector). The Larmor frequency is directly proportional to the ambient magnetic intensity, and is exactly 3.49872 times the ambient magnetic field measured in gammas or nano-Teslas. Changes in the ambient magnetic field cause different degrees of atomic excitation in the cesium vapor which in turn allows variable amounts of infrared light to pass, resulting in fluctuations in the Larmor frequency.

Although the earth's magnetic field does change with both time and distance, over short periods and distances the earth's field can be viewed as relatively constant. The presence of magnetic material and/or magnetic minerals, however, can add to or subtract from the earth's magnetic field creating a magnetic anomaly. Rapid changes in total magnetic field intensity, which are not associated with normal background fluctuations, mark the locations of these anomalies.

EdgeTech "Chirp" Shallow Subbottom Profiler

High-resolution subbottom profiling will be accomplished utilizing an EdgeTech Full Spectrum "Chirp" Subbottom Profiler system operating with frequencies of 2-16 kHz. The subbottom profiler consists of three components: the deck or topside unit (desktop computer processor, amplifier, monitor, keyboard, and trackball), an underwater cable, and a Model 216 towed vehicle housing the transducers. Data are displayed on a color monitor while saved in a DAT/JSF type proprietary digital format on the topside computer.

The EdgeTech Chirp sonar is a versatile subbottom profiler that generates cross-sectional images and collects normal incidence reflection data over many frequency ranges. The system transmits and receives a frequency modulated (FM) pulse signal generated via a streamlined towed vehicle (subsurface transducer array). The outgoing FM pulse is linearly swept over a full spectrum range of 2-16 kHz for a period of approximately 20 milliseconds. The acoustic return received at the hydrophone array is cross-correlated with the outgoing FM pulse and sent to the deck unit for display and archiving, generating a high-resolution image of the subbottom stratigraphy. Because the FM pulse is generated by a converter with a wide dynamic range and a transmitter with linear components, the energy, amplitude, and phase characteristics of the acoustic pulse can be precisely controlled and enhanced.

The "chirp" subbottom profiler is designed for acquiring high-resolution subsurface data from the upper portions of the stratigraphic column (20-50 feet depending on site conditions). The higher end frequencies allow good resolution of subbottom layering while the lower end acoustic frequencies provide significant penetration. This particular system is capable of providing excellent acoustic imagery of the nearsurface in a wide variety of marine environments.

Medium Penetration Seismic Profiler/Applied Acoustics 300J Boomer Subbottom Profiling System

Medium penetration seismic subbottom profiler data will be collected using an Applied Acoustics 300 Joule boomer subbottom seismic reflection system. The "boomer" system consists of an Applied Acoustics AA-200 sound source ("boomer" plate), a 10 element hydrophone array or receiver, and an Octopus Model 760 Shallow Seismic Processor which includes a universal amplifier and TVG (time varied gain) filter with bottom tracking, automatic gain control, and a swell compensator. This system will interface with a graphic recorder for displaying the seismic profiles.

Operationally, the "boomer" employs a sound source that utilizes electrical energy discharged from a capacitor bank to rapidly move a metal plate in the transducer housing. The motion of the metal plate creates an intense, short duration (330 ms) acoustic pulse or signal in the water column with broad band frequencies (0.5 - 8 kHz) capable of penetrating up to 250 feet or more of marine sediments with optimum layer resolution of 1-3 feet. The maximum anticipated depth of WTG foundations is approximately 95 feet below the seafloor. Based on the lease agreement, which specifies the required penetration capability for the system, the "boomer" seismic profiler will be capable of penetrating a minimum of 61 meters below the seafloor for the existing geologic conditions. The lease requires boomer data penetration of at least 50 feet below the anticipated depth of WTG foundations. Therefore the boomer meets the equipment specifications required by BOEMRE.

Data Processing & Analysis

The HRG survey data will be processed and analyzed in accordance with terms of the Lease and applicable sections of BOEMRE guidelines for the shallow hazards program (Notice to Lessee (NTL) No. 2006-P01) and archaeological resource surveys and reports (NTL No. 2005-G07). The following requirements are specified in the Lease and will be addressed:

- Magnetometer data will be contoured for the entire survey area (Addendum C.1.II.g.iv of the Lease); and
- A side scan sonar mosaic will be produced (Addendum C.1.II.H.iv of the Lease).

Results of the HRG survey will be provided in the Facility Design Report.

4.1.1.2 Plan for Pre-Construction Archaeological Review

The pre-construction archaeological review will supplement the information already obtained during the Project's previous marine archaeological investigations (see Section 3.0 above).

The APE for the pre-construction archaeological investigation will coincide with the APE for the HRG survey defined above in Section 4.1.1.1 and in Addendum C1.II.a of the Lease. The study area of the archaeological investigation will extend 1,000 feet beyond the APE for offshore archaeological resources defined Section 2.1 of the *Documentation of Section 106 Finding of Adverse Effect (Revised)*, issued by BOEMRE in 2010:

…The APE for offshore archaeological resources includes the footprints of the WTG structures on the sea floor; the work area around each WTG where marine sediments may be disturbed; the jet plowed trenches for installation of the inner-array cables connecting the WTGs to the ESP; the jet plowed trenches for the transmission cable system from the ESP to the landfall site; and associated marine work areas such as anchor drop areas.

The marine work areas associated with WTG and submarine cable installation will be finalized by the marine construction contractor (once selected), based upon specific vessel and anchoring requirements.

Marine archaeologist(s) will participate in the geophysical survey described in Section 4.1.1.1, which will be designed and conducted to comply with Environmental Stipulations for Cultural Resources and Geology in Addendum C of the Lease. The marine archaeologist(s) will observe and preliminarily analyze geophysical data as it is acquired on the vessel and to identify remote sensing anomalies in the data with potential to be submerged cultural resources. The geophysical data will be collected, processed and mapped to comply, as feasible, with assessment and reporting requirements for underwater archeological resources BOEMRE's NTL No. 2005-G07 and its Appendices 1 & 2, entitled *Archaeological Resource Surveys and Reports*. Parallel trackline spacing for archaeological data acquisition purposes will be set at a 30 m (100 foot) interval. Instrumentation will consist of the equipment suite described above.

Vibracores will be advanced at every WTG location. The vibracores will likely be advanced from a small gasoline-powered vessel less than 25 feet in length. Up to 6 vibracores can be collected in a field day with favorable bottom conditions and calm seas.

In accordance with the cultural resource requirements for mitigation and monitoring in the Lease, the sediments will be visually examined by a marine archaeologist for evidence of paleosols. If evidence of paleosols is visible, the following analyses (listed in Addendum C.1.III.b of the Lease) may be conducted:

- Sediment grain size analysis
- Point count analysis
- Geochemical analysis
- Palynological analysis
- Radiometric data (C14, Pb210, and possibly Cs137) of strata or organic material

- Sediment shear strength

The analytical suite applied to specific sediment samples to assess the presence/absence of cultural resources will be determined by the marine archaeologist based upon field conditions, in consultation with BOEMRE.

Measures to protect submerged cultural resources during Project construction are described in Section 7.0. Tribal monitors will be invited to monitor bottom disturbing activities, in accordance with Addendum C.V.c. of the Lease. CWA will comply with the *Procedures for the Unanticipated Discovery ("Chance Finds") of Cultural Resources and Human Remains* in Addendum C VI. of the Lease during construction.

4.1.1.3 Plan for Pre-Construction Geological & Geotechnical (G&G) Surveys

In accordance with Addendum C of the Lease, a pre-construction G&G Survey will be conducted in the offshore APE to satisfy the mitigation and monitoring requirements for Cultural Resources and Geology. Note that the APE, as defined in Section 4.1.1.1 above and the Cultural Resources stipulations at Addendum C.1.II.a of the Lease, is considered the same as the Area of Potential Physical Effect (APPE) used in the Geology stipulations at Addendum C.2.e.ii of the Lease.

The following geotechnical sampling/testing protocols for cone penetrometer tests and soil borings are established in the Lease. These will be followed during the pre-construction G&G survey, unless field or equipment conditions warrant modification, in consultation with BOEMRE.

i. In situ cone CPTs and soil borings must be taken at all platform and turbine locations except as provided below. In some cases, CPT data may substitute for soil borings, provided that the Lessor, and the Lessee's CVA if available, determine that there is adequate continuity of soil and rock strata, evidenced by soil properties and engineering performance parameters. All CPTs and soil borings must extend at least 10m below the tip of the foundation location. If soil conditions do not allow CPTs to be pushed using a seabed frame to routinely penetrate to the prescribed total depth, the Lessor shall, in consultation with Lessee's CVA, if available, determine whether borings are needed below the refusal depth at specific locations to support the engineering design of the Project. Where full depth CPT data can be obtained with a seabed CPT frame at all structures, soil borings can be limited to (1) a portion of the structure locations depending on subsurface complexity (based on the results of the geophysical survey), and (2) the ESP site. The Lessor, in consultation with the CVA, if available, may approve departures from the above requirements if it determines that doing so will not in any way jeopardize the engineering integrity of the Project, or pose a significant adverse risk to safety or environmental and cultural resources.

In accordance with the geology requirements for mitigation and monitoring in the Lease, the following geotechnical sampling/testing activities will also be conducted, if deemed necessary by Project engineers with the agreement of the designated CVA:

- In situ and laboratory soil test data must be analyzed to estimate foundation soil response to maximum anticipated static and dynamic loads.
- Determine embedment depth and predict susceptibility of the foundation to liquefaction and scour protection.

The Lease includes the following stipulations that have already been addressed through review of existing data:

- Potential for seafloor erosion and scour in the context of empirically derived current velocity data has been evaluated (see Report No. 4.1.1-5 in the FEIS).
- The liquefaction potential of the Project Area has already been characterized as negligible in the context of regional seismicity in Section 3.2.2.

4.1.1.4 Plan for Pre-Construction Biological Investigations

Permit conditions associated with certain federal and state approvals of the Project require the following biological investigations to be conducted prior to the initiation of construction. The purpose of the pre-construction environmental study program is to further document the pre-existing conditions of certain resources in order to monitor and evaluate the impacts of the Project during construction and operation, as well as to evaluate monitoring methods and techniques to be used in post-construction monitoring.

CWA will conduct the following biological investigations post-lease and prior to construction:

Avian and Bat Monitoring Program

Pursuant to the Biological Opinion issued by the U.S. Fish and Wildlife Service (USFWS) as part of the Endangered Species Act Section 7 consultation and the ROD issued by BOEMRE, portions of an ABMP will be initiated prior to construction. The scope of the program was developed by the BOEMRE and CWA (September 19, 2008) to gather data to assess potential impacts to bird and bat populations as a result of the Project. The monitoring program will focus on bats, migratory birds and federally and state endangered birds including the Roseate Tern and Piping Plover, which are known to occur in and near Nantucket Sound. The ABMP also includes specific study objectives and research questions that will be addressed through pre-construction and post-construction monitoring techniques. The monitoring efforts described in the ABMP will apply to migratory birds.

The monitoring plan was developed in coordination with the BOEMRE and USFWS and includes several monitoring requirements as a result of previous regulatory review. As a requirement of the USFWS Biological Opinion and the BOEMRE Record of Decision (BOEMRE 4/28/10), the monitoring protocols are being peer-reviewed prior to implementation. CWA submitted draft protocols to BOEMRE in July 2010 (see Appendix B) and is currently in discussions with BOEMRE and USFWS as to the details of the monitoring plan. The pre-construction avian work is anticipated to take approximately one year before the installation of WTGs.

Seafloor Habitat and Benthic Community Video Survey and Aerial Photography

Video surveillance is proposed for 3 pre-selected cable embedment segments within the 3-mile limit and 3 segments on the OCS, each up to 0.5-mile in length with the intent being to collect all video data within a couple of days. A video camera with GPS linkage will be towed along each of the routes, tracking the centerline. (see Attachment E of the 401 WQC).

Once collected, videotapes of the selected segments of the route will be reviewed by a marine biologist.

The following observations will be made:

- Presence and general characterization of the substrate (three dimensional features and regularity).
- Presence and general characterization of epibenthic invertebrates (especially lobster and crabs).
- Presence and general characteristics of shellfish (especially scallops).
- Evidence of lobster burrows, if visible.
- Presence and general characterization of fish and habitat.
- Organisms that have been identified to the lowest practicable taxonomic level.
- Location of features.

CWA will also conduct aerial photography of the inshore cable route from the entrance to Lewis Bay during the month of July (high growth time period for eel grass) prior to the commencement of cable installation.

CWA will monitor benthic community recovery in state waters and the OCS pursuant to the Seafloor Habitat/Benthic Community Monitoring Plan contained in the MEPA FEIR and cited in MEPA Certificate. CWA will include three additional paired monitoring sites on the OCS in addition to those outlined in the Seafloor Benthic Community Monitoring Plan. The Seafloor Habitat/Benthic Community Monitoring Plan is included in the MassDEP Water Quality Certificate (Appendix H-6, Attachment E). BOEMRE will be copied on the submission on the summary reports.

Shellfish Monitoring Program

Prior to construction in Lewis Bay a shellfish monitoring program will be implemented. A plan will be submitted to the state agencies and samples will be extracted from within the footprint of anticipated project construction impact areas of Lewis Bay in order to characterize existing shellfish resources. Preconstruction shellfish monitoring will take approximately 1- 2 days. In accordance with the ROD and the MEPA FEIR, CWA will coordinate with the Town of Yarmouth shellfish constable to appropriately avoid or minimize impacts to designated shellfish areas from installation of the submarine cable. CWA will provide the Town of Yarmouth with funds to mitigate for the direct area of impact within the Town's designated shellfish bed.

Eelgrass Survey

Pursuant to the Massachusetts Department of Environmental Protection 401 Water Quality Certification (see Appendix H), in accordance with Section 401 of the Federal Clean Water Act, an eelgrass survey will be conducted within 60 days prior to initiating submarine cable installation.

A dive survey will be conducted to confirm the limits of the eelgrass bed near Egg Island no more than 60 days prior to the commencement of cable installation. Should aerial photography, conducted during the seafloor habitat/benthic community monitoring program, identify other eelgrass beds in the vicinity of the cable route, additional diver surveys may be required. The survey shall document the edge of any eelgrass beds close to the work area and mark the edge using a buoy system. Additionally, transects through the eelgrass beds will be performed in order to determine the extent and health of the bed. The eelgrass survey is expected to take about a week.

In addition to the survey within State waters, CWA will comply with the environmental Lease stipulations for Coastal and Intertidal Vegetation (pg C-18 Addendum C of the Lease) including pre-construction dive survey of the anticipated work area for WTG B4, where previous survey has indicated the presence of SAV, and avoiding any identified eelgrass beds where practicable. CWA will conduct eelgrass monitoring for two years following the commencement of commercial operations of WTG B4, and will replant eelgrass at a ratio of 3:1 if the results of surveying indicate that eelgrass was lost as a result of project activities. It is not practicable to relocate WTG B4 due to resulting wind resource wake losses and decreases in power production.

Marine Mammal Monitoring

During pre-construction HRG Survey activities, CWA will monitor the Project area for marine mammals and sea turtles. A 500 meter-radius exclusion zone will be established around any seismic-survey vessel and an on-board NMFS approved observer will monitor the zone for marine mammals and sea turtles for 60 minutes prior to commencing or restarting surveys, during surveys, and for 60 minutes after surveys end. The seismic sound source will be shut down immediately should a marine mammal or sea turtle enter the zone during surveying, and not restarted until the area has been clear for 60 minutes. Observations will be reported to NMFS within 90 days of the completion of the surveys.

4.1.2 Summary of Safety Management System

The Project's Safety Management System (SMS) is provided in Appendix E, and details specific safety practices and procedures to be adopted during offshore construction, based on good practice on offshore wind projects in Europe, and other pertinent offshore experience and regulatory requirements in the USA. The SMS describes overall safety policies and objectives, organization and responsibilities, methods to identify, assess, control and mitigate hazards, training and emergency response procedures, and compliance monitoring. For additional information, see Appendix E.

4.1.3 Monopile Foundations, Transition Pieces and Wind Turbine Generators (WTGs)

4.1.3.1 Foundation System Design Criteria

Based on the results of the site specific geophysical and geological surveys and geotechnical subsurface soil conditions at Horseshoe Shoal, the use of a driven monopile was chosen as the preferred foundation design system for the WTG.

In addition, the selected pile foundation system was analyzed for the following structural loadings, which are both steady state and dynamic in nature.

- Wind loads from WTG operation including wind shear and turbulence;
- Hydrodynamic loads from prevailing and extreme sea-state conditions;
- Impact loads from pile-driving installation;
- Earthquake loads; and
- Lateral loading from sea ice.

In order to demonstrate the structural adequacy and design lifetime of the Foundations the Contractors shall in the FDR design documentation describe the models used and the essential design parameters. The design documentation supplied by the Contractors will contain not only the list of information provided in Appendix A of the IEC 61400-3 but also the following minimum parameters:

Information Provided by Cape Wind to Contractors for Design Basis

- Units, Datums and Coordinate Systems including vertical and horizontal datums, conversion factors and units to be used
- Site layout includes coordinates of the wind turbines, substation(s) (incl. electrical layout), meteorological mast and metocean report
- Support structure levels including the interface level and hub height level

- Site conditions including bathymetry, ground conditions, wind data, wake effects (including methodology), metocean data (including wave conditions and wind wave misalignment probabilities), salinity, air and sea temperatures, marine growth, global sea level rise and ice loads
- Foundation Design Basis
- Foundation design basis including design codes and standards, design philosophy, design life, reference level, interface level, corrosion protection, secondary structures
- Geotechnical data including design methodology, sources of information, principles for establishing characteristic soil profiles, principles for assessing driveability of piles, geography and geology, determination of engineering profiles, density, strength, vertical capacity, vertical and lateral load responses, parameters for driveability
- Environmental data including water depths, wind climate, wave climate (including wind wave misalignment and windspeed-wave height correlation), tidal elevation and currents extreme sea state and extreme wave height, severe sea state and severe wave height, normal sea state, wave breaking, additional parameters, ice, seismic conditions, ship impact and wave run up
- Material data including structural steel specification for monopiles and transition pieces
- Design procedure including grouted connection, load generation, soil pile interaction, scour, design load iterations and computer programmes
- Terminology and principles of limit state design including limit states, design format, design situations and load combinations (including a load case table compatible with part B) and fatigue
- Wind turbine data including masses and operational requirements supplied by SWP
- Generic turbine positions to be considered and interpolation of loads to other turbine positions
- Overall logarithmic damping factor (incl. soil, hydrodynamic, structural contribution)
- Special requirements including installation and testing of monopiles and transition pieces.

Geophysical and geotechnical surveys indicate that subsurface sediment conditions within the WTG array on Horseshoe Shoal consist primarily of sands and glacial sedimentary deposits to greater than 100 feet (30.5 meters) below the present bottom. The pile foundation system will be installed by mechanical hammer driving, thereby minimizing seabed disturbance and turbidity associated with foundation installation.

The significant wave height and period for various water depths was calculated and utilized in the foundation design evaluation. This analysis showed that the dominating loading criterion for monopiles is the fatigue loading. For structural analysis the fatigue loading from the wind is combined with a representative fatigue wave. A design tidal current of 1 meter per second (m/sec) was applied to the design analysis based on data obtained by baseline studies performed by Woods Hole Group (see Report 4.1.1-9 in the FEIS).

Although foundation loading by drifting sea ice is not a frequent occurrence for this area of Nantucket Sound, a conservative ice loading design factor of a 6-inch (0.15 m) ice cap was applied in the analysis. In addition, a 1.18-inch (30 mm) ice cover over the tower and nacelle was included.

The Massachusetts State Building Code describes Nantucket Sound as a low seismic activity area. Therefore, while seismic loading was considered in the design, it was not a determining factor in the foundation design analysis.

The monopile and transition piece foundation will likely have a three-part system to protect it from corrosion. This will consist of the following:

- Corrosion allowance – a liberal corrosion allowance will be added to the design criteria;
- Coating - A coating system will be applied to surfaces that come in contact with both the atmosphere and the splash zone; and
- Cathodic protection utilizing sacrificial anodes (pure aluminum).

Length of monopile, insertion distance and finished elevation will vary by individual location due to water depth and structural and geotechnical parameters and will be further described in the Fabrication and Installation Report and/or the Facilities Design Report. Monopiles are anticipated to be installed to a depth of approximately 85 feet below the seafloor..

Fabrication and Installation

Monopiles and transition pieces are expected to be fabricated in the Northeast United States and possibly at an additional facility in Europe. The monopiles and transition pieces will likely be delivered to the Project Area via barge from the location in the US and via transport vessel from Europe. Ideally, the monopiles and transition pieces will be installed directly from the barge or transport vessel and not require an intermediate unload/load at the staging area.

During pile driving activities, it is estimated that approximately 4-6 vessels would be present in the general vicinity of the pile installation. Most of these vessels will be stationary or slow moving barges and tugs conducting or supporting the installation. Other project vessels will be delivering construction materials or crew to the site and will be transiting from the various points on the mainland to the Project site and back. Barges, tugs and vessels delivering construction materials will travel at 10 knots (19 kilometers per hour) or below and may range in size from 90 to 400 feet (27.4 to 122 meters). The only vessels that are anticipated to be traveling at greater speeds are crew boats that will deliver and return crew to the Project site twice per day. Crew boats are anticipated to be approximately 50 feet (15.2 meters) in length and may travel at speeds up to 21 knots (39 kilometers per hour). These crew boats are similar to typical vessel traffic occurring in Nantucket Sound already on a regular basis.

The vessel drafts for equipment currently used for installation of similar projects are approximately 10 feet (3.0 meters). Based upon site specific bathymetric survey there are no proposed turbine locations in water depths less than approximately 12 feet (3.7 meters) relative to mean lower low water. All monopile sites are constructible at the proposed locations. Construction vessel access to each of the sites is available from at least one direction.

As a contingency, CWA's normal construction sequence may be altered to accommodate water depths. For those few sites where the water depth approaches the 12 feet (3.7 meters) relative to mean lower low water it may require careful coordination with tides, construction sequencing and vessel loading. Once the vessel is in place and jacked up (which can occur at high tide), it will be unaffected by water depths.

A specialized jack-up barge with a large crane and pile driving equipment will be utilized for the actual installation of the monopiles. This specialized barge is the first of three barges that will be involved in the construction of each of the WTGs. The jack-up barge (Barge #1) is anticipated to have four legs with pads of about four meters square (approximately 172 square feet [16 square meters]). The crane will lift the monopiles from a transport barge that is held in place with an attendant tug and place them into position. The monopiles will be installed into the seabed by means of pile driving ram or vibratory hammer and to an approximate depth of 85 feet (26 meters) into the seabed. This will be repeated at all WTG locations. CWA anticipates that two monopiles may be installed simultaneously. However, hammering of the piles will occur one at a time. As a result, two specialized pile driving barges will likely be present within the Project area at any one time. The anticipated duration of installing all of the monopiles from start to finish is expected to be approximately ten months including delays due to weather.

Pile Driving and Marine Mammal Mitigation

CWA will conduct required sound measurements to verify the established exclusion zone that will be maintained during pile driving to protect marine mammals and sea turtles. A preliminary 2,461 ft (750 m) radius exclusion zone for listed whales and sea turtles will be established around each pile driving site in order to reduce the potential for serious injury or mortality of these species. Field verification of the exclusion zone will take during pile driving of the first three piles. The results of the measurements from the first three piles can then be used to establish a new exclusion zone which is greater than or less than the 2460 ft (750 m) depending on the results of the field tests. For additional detail regarding noise measurements and maintenance of the exclusion zone, refer to FEIS 9-26 through 9-27.

A "soft start" will be used at the beginning of each pile installation in order to provide additional protection to listed whales and sea turtles and for juvenile and adult fish allowing them to vacate the area at the commencement of pile driving activities. The soft start requires an initial set of 3 strikes from the impact hammer at 40 percent energy with a one minute waiting period between subsequent 3-strike sets. If listed whales or sea turtles are sighted within the exclusion zone prior to pile driving, or during the soft start, the Resident Engineer (or other authorized individual) will delay pile-driving until the animal has moved outside the exclusion zone. For additional detail refer to 9-29 of the FEIS.

Pile driving will not be started during night hours or when the safety radius can not be adequately monitored (i.e., obscured by fog, inclement weather, poor lighting conditions) unless the applicant implements an alternative monitoring method that is agreed to by MMS and NMFS. However, if a soft start has been initiated before dark or the onset of inclement weather, the pile driving of that segment may continue through these periods. Once that pile has been driven, the pile driving of the next segment will not begin until the exclusion zone can be visually or otherwise monitored.

CWA will provide the following reports to BOEMRE and NMFS during pile driving activities:

(1) Weekly status reports during pile driving activities, including a summary of the previous week's monitoring activities and an estimate of the number of marine mammals and sea turtles that may have been taken as a result of pile driving activities;

(2) Any observed injury or mortality to marine mammals or sea turtles from pile driving within 24 hours of such observation;

(3) Any observations concerning other impacts on marine mammals and sea turtles within 48 hours of such observation; and

(4) A final report within 120 days after completion of the pile driving and construction activities, which summarizes monitoring activities, observed impacts to marine mammals and sea turtles, an assessment of the effectiveness and feasibility of the mitigation measures employed.

4.1.3.2 Transition Pieces

Each WTG foundation and substructure unit will include a transition piece. Each transition piece will be a prefabricated large diameter steel structure largely standardized for each WTG. The transition pieces will include decks, ladders, corrosion protection, a turbine tower flange, I/J-tubes and supports for cable connections, a maintenance crane, a boat landing, and other hardware. The transition pieces will also include an external work platform for use during turbine installation, routine operation and maintenance activities. The work platforms will be designed to accommodate access to the WTG during installation and for ongoing equipment inspections.

The transition piece will be placed onto the monopile, leveled, set at the precise elevation of the tower, and grouted into place to the foundation monopile using a product such as Ducorit® D4 by Densit. Following the grouting of the transition piece the installation barge will move to the next available installed monopile to repeat the transition piece installation process.

CWA and its design team continue to conduct exhaustive research on the state of the art and stay abreast of the experiences of the European offshore installations, and expect to make modifications to the traditional monopile / transition piece cylindrical connections. As a result of horizontal grout failures being experienced with the cylindrical connections at some European installations, CWA will be utilizing either a conical interface in order to provide additional compression for grout adhesion, shear keys to transfer the axial load, an elastomeric bearing to take the vertical load or other solution developed during design development. Any of these solutions should effectively eliminate the problem. CWA and its consultants are investigating to determine which solution is most reliable and cost-effective. The final design solution will be reviewed and approved by the CVA and included in the FDR and/or FIR.

4.1.3.3 Scour Control

After installation of the pile foundation, some localized scour around the monopile foundation may occur depending on the location of the WTG on Horseshoe Shoal and local sediment transport conditions. Scour protection will be designed and installed using scour mats and/or rock armoring. (see Report 4.1.1-5 in the FEIS, Revised Scour Analysis and Report 4.1.1-6 in the FEIS – Rock Armoring). Scour mats are synthetic fronds designed to mimic seafloor vegetation that would afford the necessary scour protection while minimizing potential alterations to the benthic and fish communities typically associated with Horseshoe Shoal. This is because the synthetic fronds (scour control mats), when secured to the bottom as a network, trap sediments and become buried. In the event that scour mats are found to be less effective than anticipated, more traditional scour protection methods (such as rock armor) are available as an alternative and may be utilized upon written request and permission from BOEMRE as provided for in the Lease. The rock armor scour control design requires the use of filter layer material and rock armor stones. The rock armor and filter material would be placed so that the final elevations approximate pre-installation bottom contours to the extent practicable such that mounds of material would not be created. The rock armor stones would be placed on top of this filter layer material which is used to fill the majority of the scour hole that is predicted to develop after installation of each WTG and the ESP. The filter layer would also minimize the potential for the underlying natural sediment material to be removed by the wave action and would also minimize the potential for the rock armor to settle into the underlying sediment material. The armor stones will be sized so that they are large enough not to be removed by the effects of the waves and current conditions, while being small enough to prevent the stone fill material placed underneath it from being removed.

As the monopiles and transition pieces are completed, the submarine inner-array cables will be laid in order to connect the string of wind turbines (up to 10 WTGs), and then the seabed scour control system will be installed on the seabed around each monopile. The scour control system will help to prevent underwater currents from eroding the substrate adjacent to the WTG foundation. The scour control system will consist of either a set of six scour-control mats arranged to surround the monopile or rock armor.

Each scour control mat is 16.5 feet by 8.2 feet (5 meters by 2.5 meters) with eight anchors which securely tie to the seabed. Figure 2.3.2.3 of the FEIS illustrates the typical arrangement of the mats. For a complete installation procedure, see Report 4.1.1-5 in the FEIS. It is anticipated that the process of completing one string of WTGs (10 WTGs with associated inner-array cable and scour mats) will take up to approximately one month. The installation of the scour mats will overlap with monopile, transition piece, and array cabling installations. The scour mats are placed on the seabed by a crane or davit onboard the support vessel. Final positioning is performed with the assistance of divers. After the mat is placed on the bottom, divers use a hydraulic spigot gun fitted with an anchor drive spigot to drive the anchors into the seabed.

It is anticipated that at 24 WTG locations rock armor scour protection may be necessary as an alternative approach to scour control. Figure 2.3.2.4 of the FEIS shows the turbines for which it is anticipated that rock armor could be used. The rock armor and filter material will be placed on the seabed using a clamshell bucket or chute. For a complete installation procedure for the rock armor scour protection see Report 4.1.1-6 in the FEIS.

4.1.3.4 Wind Turbine Generators (WTGs)

The Project will utilize pitch-regulated upwind WTGs with active yaw and a three-blade rotor (see 2.1.1-1 of the FEIS). The WTG nacelle hub height will be approximately 264.1 feet (80.5 meters) from the MLLW datum (0.0 feet = MLLW). The total height of the wind turbine is 440 feet. The main components of the WTG are the rotor, the transmission system, the generator, the yaw system, and the control and electrical systems, which are located within the WTG's nacelle. The WTG's nacelle will be mounted on a manufactured steel tower supported by a monopile foundation system (described above). The monopile is simply a large diameter pile generally 14.75 to 19.75 feet (4.5 to 6.0 meters) driven approximately 85 feet (26 meters) into the seabed depending on the local load bearing characteristics of subsurface marine sediments. The base of the tower, a pre-fabricated access platform and service vessel landing (approximately 32 feet (9.6 meters) from MLLW) will be provided. The WTG and all its components described in this section will be designed to IEC standard 61400-1 or 61400-3 as applicable. The design will also be verified by an independent CVA. Design criteria for the turbine and foundation system will also include the hurricane criteria as indicated in the API-RP 2A WSD considering a 100-year storm occurrence and will also be designed to the loads specified in the controlling design standards. A step-up transformer for each wind turbine generator will be located in the base of the tower. It will be a liquid filled transformer with the insulating liquid being a biodegradable ester oil. Installation and maintenance will be conducted in accordance with NFPA 70E, "Standard for Electrical Safety in the Workplace." Installation will also conform to IEC 61400-1 on Wind Turbine Safety and Design. Ongoing maintenance will generally follow the International Electrical Testing Association's "Maintenance Testing Specifications for Electrical Power Distribution Equipment and Systems" and the manufacturer's recommendations. The steel tower and nacelle will be mounted on a transition piece which is attached through a grouted connection to a welded steel monopile foundation as described in more detail above.

In order to demonstrate the structural adequacy and design lifetime of the WTGs, the Contractors shall in the FDR design documentation describe the models used and the essential design parameters. The design documentation supplied by the Contractors will contain not only the list of information provided in Appendix A of the IEC 61400-3 but also the following minimum parameters:

Information Provided by Cape Wind to Contractors for Design Basis

- Units, Datums and Coordinate Systems including vertical and horizontal datums, conversion factors and units to be used
- Site layout includes coordinates of the wind turbines, substation(s) (incl. electrical layout), meteorological mast and metocean report
- Support structure levels including the interface level and hub height level
- Site conditions including bathymetry, ground conditions, wind data, wake effects (including methodology), metocean data (including wave conditions and wind wave misalignment probabilities), salinity, air and sea temperatures, marine growth, global sea level rise and ice loads

WTG Design Basis

- References including standards, rules and guidelines and project specific documents
- Units and Coordinate System including the system of units, reference sea level, definition of directions and wind turbine coordinate system (to be compatible with Part A)
- Site description including wind turbine locations and water depth variation over the park (to be compatible with Part A)
- Environmental conditions including wind climate (PCC), wave climate, wind wave joint directional probabilities, site turbulence, wake effects and soil conditions (from Foundation Designer)

- Allowable interval for first system frequency
- Description of the wind turbine including general properties, mass properties, preliminary tower structure and first eigen frequency
- Sloshing dampers contribution to overall damping
- Functional specifications and requirements including foundation type and preliminary layout, service life and fatigue life, eigen (natural) frequencies, structural misalignments and installation and O&M
- Load exchange format
- Project specific design load case table in accordance with IEC 61400-3/-1 for all cases except the extreme storm event which shall be based on a 100 year return period using API RP 2A WSD and the applicable API standard for the additional IEC 61400-1 design load case (DLC) 6.1 and DLC 6.2.
- Generic turbine position to be considered

In addition the WTG tower shall be provided with a lift (elevator). The safe working capacity shall be 250kg minimum. The lift shall be suitable for carrying at least two persons as well as tools and equipment simultaneously. The lift shall be installed inside the tower within reach of the ladder. The lift shall meet the requirements laid down in the relevant OSHA, ANSI, applicable Coast Guard regulations and international standards. The lift is to have a cage which must fully close during operation. It shall not be possible for the lift to start moving, with goods, persons or extremities protruding from the cage. The lift shall also not be able to move if the cage is not closed and locked. Provision shall be made to ensure other persons working in the tower, during movement or operation of the lift, are safe. To achieve this, sensors shall be present in the lift system to stop the lift in the event that a person or piece of equipment is blocking its movement. It shall be possible to operate the lift cage remotely from both the nacelle and also tower base, as well as from inside the lift itself. The lift shall have the capacity to descend safely the entire tower height in the event of power loss. Prior to first use the lift will be inspected and certified by a qualified sub-contractor.

WTG Installation

The WTGs will be manufactured in Denmark by Siemens and delivered to the onshore staging area on freighter vessels. Delivery vessels will likely transport 6 turbines per trip. The turbines will be offloaded and stored at the staging area until WTG installation is initiated. Prior to installation, the pitch mechanism will be installed in the turbines and they will be pre-assembled by the manufacturer.

Installation of the WTGs will likely be from specialized vessels configured or converted specifically for this purpose (see Figure 2.3.2-2 of the FEIS). Work vessels for the Project will comply with applicable mandatory ballast water management practices established by the U.S. Coast Guard in order to avoid the inadvertent transport of invasive species.

The vessels will be loaded at the onshore staging area with the necessary components to erect six to eight WTGs. Components include the towers, nacelles, hubs and blades. Two teams of installation crews will likely be established with one jack-up installation barge with a crane and two transport barges without cranes per team. The two jack-up barges will likely remain deployed at the Project Site throughout the duration of the installation program, while the transport barges will transit between the staging area and Project Site.

The vessels will transit from the onshore staging area to the work site as described above and locate adjacent to one of the previously installed monopiles. A jack-up system will then stabilize the vessel in the correct location. Depending on the actual circumstance, four or six jacking legs will raise the vessel to a suitable working elevation.

The crane located on the installation barge will then place the first tower section onto the deck of the transition piece. Once this piece is secured, the upper tower section is raised and bolted to the lower section. In order, the nacelle, hub and blades are raised to the top of the tower and secured. Several of these components may be pre-assembled prior to final installation. This process is anticipated to take approximately 24 hours to cycle through one complete WTG and would be repeated for each of the 130 WTG locations. Including the twenty or so trips from the onshore staging area to Horseshoe Shoal, this process will take approximately nine months including delays due to weather. The installation of the WTGs will overlap with the installation of the monopile foundations and transition pieces.

4.1.4 Inner-Array 33 kV Cables

Each of the 130 WTGs within the Wind Park will generate electricity independently of each other and will be connected in arrays of 8 to 10 turbines each. Within the nacelle of each turbine, a wind-driven generator will produce low voltage electricity, which will be "stepped up" by an adjacent transformer (see section 4.1.3.4) to produce the 33 kV electric transmission capacity of the WTG. Solid dielectric submarine cables from each WTG will interconnect within the grid and terminate at their spread junctions on the ESP. General testing of the submarine cables for integrity (i.e. thermal aging, tests for resistance to cracking, corona) will be conducted in compliance with:

- Association of Edison Illuminating Companies: AEIC CS7, AEIC CS8
- International Electrotechnical Commission: IEC 60811 series, IEC 60840
- Insulated Cable Engineers Association: ICEA S-93-639, ICEA S-97-682
- CIGRE Electra No. 189

The submarine cable system interconnecting the WTGs with the ESP will be of solid dielectric AC construction, using a three-conductor cable with all phases under a common jacket. The cables will be arranged in strings, each of which will connect up to approximately 10 WTGs to a 33 kV circuit breaker on the ESP (see Figure 2-6 of the FEIR). All submarine cables will receive a DC proof test prior to terminating. The 33 kV cables will also be meggered. Terminals will be metric. There will be a total of approximately 66.7 miles (107 km) of inner-array cabling throughout the Wind Park. The electrical current in the cable segments within each string will vary depending on WTGs location within the string. Cable segments closer to the ESP will provide greater transmission capacity compared to cables further away from the ESP. It is anticipated that three different cable sizes will be used to accommodate this variation in transmission capacity related to the distance of the WTG from the ESP. The conductor cross sections are 3x150 mm2, 3x400 mm2, and 3x630 mm2 and the overall diameter of the cable is 132 mm (5.19 inches), 146 mm (5.75 inches), and 164 mm (6.45 inches) respectively (see Figure 4-9 of the DEIS).

Inner Array 33 kV Cable Installation

The 33 kilovolt cable will likely be transported to the onshore staging area at Quonset Point Rhode Island (see Section 4.1.8.2) from the cable manufacturer in a special cable transport vessel. Specified lengths of inner array cable will be transferred onto a cable holding barge and transported to a location proximate to the immediate work area. A cable installation barge will offload specific lengths of cable from the holding barge. The linear cable machines on-board the installation barge will pull the cables from coils on the holding barge onto the installation barge, and into prefabricated tubs.

The method of installation of the submarine cable is by the jet plow embedment process, commonly referred to as jet plowing (see Figure 2.1.3-3 of the FEIS). This method involves the use of a positioned cable barge and a towed hydraulically-powered jet plow device that simultaneously lays and embeds the submarine cable in one continuous trench from WTG to WTG and then to the ESP. The cable will be embedded approximately 6 feet (1.8 m) below the seabed by the fluidized sediments from the jet plow and will not require supplemental anchoring. The barge will propel itself along the route with the forward winches, and the other moorings holding the alignment during the installation. For installation of the inner array cables, a four point mooring system which will also include the use of mid-line buoys, will allow the support tug to move anchors while the installation and burial proceeds uninterrupted on a 24-hour basis. Additionally, jet-plowing is expected to be suspended during extreme storm events. For additional detail on submarine cable installation please refer to Section 4.1.6 below.

When the barge nears the ESP, the barge spuds will be lowered to secure the barge in place for the final end float and pull-in operation. The cable will be pulled into the J-tube and terminated at the switchgear.

CWA will contact NMFS and BOEMRE within 24-hours of the commencement of jet plowing activities and again within 24-hours of the completion of the activity.

4.1.5 Electrical Service Platform (ESP)

The ESP will be installed and maintained within the approximate center of the WTG array. The ESP will serve as the common interconnection point for all of the WTGs within the array. Each WTG will interconnect with the ESP via a 33 kV submarine cable system. These cable systems will interconnect with circuit breakers and transformers located on the ESP in order to increase the voltage level and transmit wind-generated power through the 115 kV shore-connected submarine cable system. The two 115 kV submarine circuits will then ultimately connect to the existing land-based NSTAR Electric transmission system on Cape Cod.

The ESP will provide electrical protection and inner-array cable sectionalizing capability in the form of circuit breakers. It will also include voltage step-up transformers to step the 33 kV inner-array transmission voltage up to the 115 kV voltage level for the submarine cable connection to the land-based system. The service platform will also function as a helipad and as a maintenance area during periods of servicing the Wind Park equipment.

(The ESP is expected to be a fixed template type platform consisting of a jacket frame with six approximately 42-inch (106.7 centimeters) driven piles to anchor the platform to the ocean floor. The platform will likely consist of a steel superstructure of approximately 100 feet by 200 feet (30.5 meters by 61 meters). The platform will be placed approximately 39 feet (12 meters) above the MLLW datum plane in 28 feet (8.5 meters) of water.

In order to demonstrate the structural adequacy and design lifetime of the ESP, the Contractors shall in the FDR design documentation describe the models used and the essential design parameters. The design documentation supplied by the Contractors will contain not only the list of information provided in Appendix A of the IEC 61400-3 but also the following minimum parameters:

<u>Information Provided by Cape Wind to Contractors for Design Basis</u>

- Units, Datums and Coordinate Systems including vertical and horizontal datums, conversion factors and units to be used
- Site layout includes coordinates of the wind turbines, substation(s) (incl. electrical layout), meteorological mast and metocean report
- Support structure levels including the interface level and hub height level
- Site conditions including bathymetry, ground conditions, wind data, wake effects (including methodology), metocean data (including wave conditions and wind wave misalignment probabilities), salinity, air and sea temperatures, marine growth, global sea level rise and ice loads

<u>ESP Design Basis</u>

- Foundation design basis including design codes and standards, design philosophy, design life, reference level, interface level, corrosion protection, secondary structures

- Geotechnical data including design methodology, sources of information, principles for establishing characteristic soil profiles, principles for assessing driveability of piles, geography and geology, determination of engineering profiles, density, strength, vertical capacity, vertical and lateral load responses, parameters for driveability
- Environmental data including water depths, wind climate, wave climate (including wind wave misalignment and windspeed-wave height correlation), tidal elevation and currents extreme sea state and extreme wave height, severe sea state and severe wave height, normal sea state, wave breaking, additional parameters, ice, seismic conditions, ship impact and wave run up
- Material data including structural steel specification for monopiles and transition pieces
- Design procedure including grouted connection, load generation, soil pile interaction, scour, design load iterations and computer programs
- Terminology and principles of limit state design including limit states, design format, design situations and load combinations (including a load case table compatible with part B) and fatigue
- Special requirements including installation, fire detection and protection (separation and suppression systems, helicopter landing area, emergency survival area, oil containment, and grid interconnection parameters.

The ESP will follow the recommended practices and standards as follows:

- Electrical Equipment – Electrical equipment will be installed following recommended practices of the National Electric Code (NEC) (also known as NFPA 70). Generally ANSI and IEEE standards will be followed with UL listed equipment specified. Use of alternate IEC equipment standards may be considered on a case by case basis where ANSI/IEEE standards do not apply or when IEC codes are deemed superior. For high voltage equipment, the above US electric power industry standards, the grid operator requirements, and requirements of the project specific Large Generator Interconnection Agreement will be followed.

Interior Spaces – NEC and OSHA requirements will be the recommended standards followed internal to the ESP topsides and around electrical equipment as these standards are deemed to be more applicable to the electrical high voltage substation environment.

ESP Lightning Protection - Lightning protection shall be provided where necessary in accordance with NFPA No. 780, UL96, UL96A and Lightning Protection Institute Standards 175, 176 and 177 and per manufacturers' recommendations. Air terminals, conductors and other related accessories shall be UL listed and labeled and suitable for installation in a marine environment.

Fire Detection and Suppression Systems for the ESP will follow NFPA recommended practices, including but not limited to:

- No. 10 Portable Fire Extinguishers.
- No. 11 & 11A Foam Extinguishing System.
- No. 12 Carbon Dioxide Extinguishing Systems.
- No. 70 National Electric Code.

- No. 72 National Fire Alarm Code

It is envisioned that a fire risk evaluation will be conducted with the contractor and insurance underwriter as the ESP design is progressed and addressed in the FDR. Areas with oils, flammable liquids, storage locker and areas, electrical equipment rooms, and cable spreading rooms will be considered for fixed fire suppression systems (most probably CO2 fixed suppression system). Egress, separation, fire barriers, emergency power system, etc. will be also considered within the fire risk evaluation.

Fire detection and manual alarm pull stations will be installed throughout the ESP. The Fire System Alarm Panel will provide indication at the onshore control room. Since the ESP is normally unmanned and primarily contains electrical equipment, a conventional fire main with hose stations is not proposed. Portable Fire extinguishers will be USCG approved type. The exterior platforms, ladders, water craft provisions and life safety equipment (including PPE, PFD's and life rafts) will met USCG requirements and be approved by local USCG jurisdiction.

ESP Installation

The ESP design is based on a piled jacket/template design with a superstructure mounting on top. The platform jacket and superstructure will be fully fabricated on shore and delivered to the work site by barges. It is anticipated that the ESP will be fabricated in either Europe or the Gulf of Mexico and delivered directly to the Project Site on a floating barge.

The jacket will be transported to the site on a jack up transport barge. Once on site, the jacket is expected to be lifted from the transport barge by a crane mounted on a separate jack up barge (similar to Barge #1 described above). The jacket assembly will then likely be sunk and leveled in preparation for piling. The six piles will then be driven through the pile sleeves to the design tip elevation of approximately 150 feet (46 meters) below the surface of the sea bottom. The piles will be vibrated and hammered as required. An alternate installation method is to install the piles first without the jacket and then float the jacket over the piles on a barge. The barge decreases draft by taking on ballast thus lowering the jacket onto the piles.

The superstructure will be loaded onto a transport barge and floated over the jacket as described in the alternate method above. The superstructure will be lowered onto the jacket and then will be connected to the jacket in accordance with the detail design requirements. The installation of the ESP is anticipated to take approximately 10 days to complete plus any delays due to weather (See Figure 2.3.3-1 of the FEIS).

After the ESP is fully constructed, the inner-array cables and the high voltage transmission cables will be terminated at the ESP. These cables will be routed through J-tubes located on the outside of the support jackets. Once the inner-array cables are connected to the ESP, the scour control mats will be installed around the ESP piles utilizing a similar design as the WTG foundations.

4.1.6 Submarine 115kV Transmission Cable System to Shore

The submarine cable system consists of the two 115 kV solid dielectric AC submarine transmission circuits (two (2) three-conductor cable systems per trench equals one circuit, for a total of 4 cables), (See Figure 2.1.3-1 of the FEIS). The conductor cross section is expected to be approximately 3x800 mm2 (approximately 3x1,600 kcmil) and the overall diameter of the cable is 197 mm (7.75 inches). The following table shows the rating of the 115 kV (and the 33 kV) submarine cables under normal operations and for short circuit conditions:

Table 4.1-1 – Rating for 115 kV and 33 kV Submarine Cable

Cable type	Normal Rating (A)	Overload Rating (A) (Note 2)	Short Circuit Rating (kA)
115 kV 800 mm^2	631 A (note 1)	850 A (Note 1)	40 kA
33 kV 150 mm^2	400 A	540 A	31.7 kA
33 kV 400 mm^2	610 A	820 A	40 kA
33 kV 630 mm^2	725 A	975 A	40 kA

Notes:
1. Ratings are per cable. There are two cables per 115 kV circuit and two circuits total.
2. Emergency overload rating depends on duration of overload. Values indicated are based on 12 hour duration of overload. Values are approximate and depend also on amount of pre-load current in the cable prior to the occurrence of the overload

All submarine cables will receive a DC proof test prior to terminating. Terminals will be metric. The European RoHS does not apply to electrical equipment designed for use at AC voltages exceeding 1000 V. As such the 35 kV and 115 kV submarine cables are not governed by RoHS and their manufacturers do not participate in the UL RSCS, which is designed to demonstrate compliance with RoHS. The cable manufacturing process will be monitored by the owner or owner's engineer, the EPC contractor, and the lender's engineer.

The two circuits of interconnecting transmission lines linking the ESP to the landfall location will be embedded by jet plow approximately 6 feet (1.8 m) below the sea floor, with approximately 20 feet (6.1 meters) of horizontal separation between circuits. As discussed previously in Section 4.1.4, the burial depth of 6 feet will insure protection of the submarine cables' mechanical integrity from inadvertent anchor drop or fishing gear interaction. Cable ampacity calculations performed by Prysmian (formerly Pirelli), a potential cable supplier, were based on a native soil thermal resistivity of 0.5°K-m/W at burial depth, as determined by the marine geophysical and geotechnical survey. This thermal resistivity is adequate to permit transfer of heat away from the affected cables (including for the two 115 kV cable per trench configuration).

Jet plow equipment uses pressurized sea water from water pump systems on board the cable vessel to fluidize sediments. The jet plow device is typically fitted with hydraulic pressure nozzles that create a direct downward and backward "swept flow" force inside the trench. This provides a down and back flow of re-suspended sediments within the trench, thereby "fluidizing" the in situ sediment column as it progresses along the predetermined submarine cable route such that the submarine cable settles into the trench under its own weight to the planned depth of burial. The jet plow's hydrodynamic forces do not work to produce an upward movement of sediment into the water column since the objective of this method is to maximize gravitational replacement of re-suspended sediments within the trench to bury or "embed" the cable system as it progresses along its route. The pre-determined deployment depth of the jetting blade controls the cable burial depth. Available tidal and current data indicates that scouring is not a significant concern. Therefore, CWA is not planning to anchor the submarine cable.

Due to the relatively shallow water depths in Nantucket Sound, shallow draft vessels/barges which typically use anchors for positioning are necessary for installation. Deeper draft vessels equipped with dynamic positioning thrusters therefore cannot be used.

The cable-laying barge is specifically designed for installations of submarine cable. It is used for both transport and installation. The submarine cable is installed in continuous lengths delivered from the cable factory and loaded directly onto a revolving turntable on the vessel. The cable system location and burial depth will be recorded during installation for use in the preparation of as built location plans. The jet plow device is equipped with horizontal and vertical positioning equipment that records the laying and burial conditions, position, and burial depth. This information is monitored continually on the installation vessel; therefore the use of an ROV is not required. This information will be forwarded to appropriate agencies and organizations as required for inclusion on future navigation charts.

A skid/pontoon-mounted jet plow, towed by the cable-laying barge, is proposed for the Project's submarine installation. This jet plow has no propulsion system of its own. Instead, it depends on the cable vessel for propulsion. For burial, the cable barge tows the jet plow device at a safe distance as the laying/burial operation progresses. The cable system is deployed from the vessel to the funnel of the jet plow device. The jet plow blade is lowered onto the seabed, pump systems are initiated, and the jet plow progresses along the pre-selected submarine cable route with the simultaneous lay and burial operation. It is anticipated that, to install each transmission line circuit to the required depth providing a minimum of six feet (1.8 meters) of cover in the sediments that are generally found along the proposed submarine transmission line route into Lewis Bay, the jet plow tool will fluidize a pathway approximately four to six feet (1.2 to 1.8 meters) wide at the seabed and eight feet (2.4 meters) deep into which the cable system settles through its own weight. As mentioned above, the jet plow device is equipped with horizontal and vertical positioning equipment that records the laying and burial conditions, position, and burial depth. The pontoons can be made buoyant to serve different installation needs.

The geometry of the trench is typically described as trapezoidal with the trench width gradually narrowing with depth. Temporarily re-suspended in situ sediments are largely contained within the limits of the trench wall, with only a minor percentage of the re-suspended sediment traveling outside of the trench. Any re-suspended sediments that leave the trench tend to settle out quickly in areas immediately flanking the trench depending upon the sediment grain-size, composition, and hydraulic jetting forces imposed on the sediment column necessary to achieve desired burial depths. Jet-plowing operations would not be scheduled during or prior to any predicted extreme storm events. Additionally, jet-plowing would be suspended during any unanticipated extreme storm events.

This interconnection to the mainland will involve the installation of approximately 12.5 circuit miles (20.1 kilometers) of which 7.6 miles (12.2 kilometers) are within Massachusetts' waters of transmission cable for each of the two circuits. The installation of the submarine transmission line via jet plow embedment is anticipated to take approximately two to four weeks to complete. As the jet plow progresses along the route, the water pressure at the jet plow nozzles will be adjusted as sediment types and/or densities change to achieve the required minimum burial depth. In the unlikely event that the minimum burial depth is not met during jet plow embedment, additional passes with the jet plow device or the use of diver-assisted water jet probes will be utilized to achieve the required depth.

Prior to pulling the cable ashore and to the sea-land transition vault, the jet plow will be set up in the pre-excavation pit located at the offshore end of the drilled conduit. The cable will then be floated from the barge with assistance of small support vessels. The cable end will be securely anchored in place after being pulled through the jet plow and into the high density polyethylene conduit installed during the HDD and secured beyond the transition vault.

From the HDD exit point, the cable is embedded across the shallows by means of towing the jet plow along the cable route from the smaller barge's winch. The cable and jet hose will be supported by cable floats to maintain control of cable slack and the amount of hose out. The cables between the jet plow start point and the transition vault will be inside the high density polyethylene conduit.

When the cable embedment has proceeded into deeper water and nears the barge, the jet plow setback will be secured approximately 20-30 feet (6.1-9.1 meters) behind the stern chute, the barge will lift its spuds and begin winching along the cable route, with the six-point mooring system (which will utilize mid-line buoys) towing the jet plow and feeding cable off the barge and into the plow funnel as it moves along the route at a rate equal to the barge movement. This will be repeated for the second circuit.

The barge will propel itself along the route with the forward winches, and the other moorings holding the alignment of the route. The six-point mooring system allows the support tug to move anchors while the installation and burial proceeds uninterrupted on a 24-hour basis.

When the barge nears the ESP the transmission cable will be pulled into the J-tube and terminated at the switchgear.

CWA will contact NMFS and BOEMRE within 24-hours of the commencement of jet plowing activities and again within 24-hours of the completion of the activity.

4.1.7 Transition to Landfall

The transition of the interconnecting 115 kilovolt submarine transmission lines from water to land will be accomplished through the use of HDD methodology in order to minimize disturbance within the intertidal zone and near shore area. The HDD will be staged at the upland landfall area and involve the drilling of the boreholes from land toward the offshore exit point. Conduits will then be installed the length of the boreholes in order for the transmission lines to be pulled through the conduits from the seaward end toward the land. Two parallel transition manhole/transmission line splicing vaults will be installed using conventional excavation equipment (backhoe) at the upland transition point where the submarine and land transmission lines would be connected (see Figure 4-21 of the DEIS).

There will be four 18-inch (0.46 m) High Density Polyethylene (HDPE) conduit pipes (one for each three-conductor 115 kV cable and fiber optic cable set) installed to reach from the onshore transition vaults to beyond the mean low water level. The offshore end will terminate in a pre-excavated pit where the jet plow cable burial machine will start. The four conduits will have an approximately 10 foot (3 meters) separation within the pre-excavation area. The four boreholes will be approximately 200 feet (61 meters) long (borehole diameters will be slightly larger than the conduit diameter to allow the conduit to be inserted in the borehole) (see Figure 4-21 of the DEIS).

A drill rig will be set up onshore behind a bentonite pit where a 40-foot (12.1 meter) length of drill pipe with a pilot-hole drill bit will be set in place to begin the horizontal drilling. A bentonite and freshwater slurry will then be pumped into the hole. The HDD construction process involves the use of the bentonite and freshwater slurry in order to transport drill cuttings to the surface for recycling, aid in stabilization of the in situ sediment drilling formation, and to provide lubrication for the HDD drill string and down-hole assemblies. This drilling fluid is composed of a carrier fluid (freshwater) and solids (bentonite clay). The ratio of the drilling fluid is expected to be ninety-five percent water and five percent inorganic bentonite clay, which is a naturally occurring hydrated aluminosilicate composed of sodium, calcium, magnesium, and iron.

After each 40 feet (12.1 meters) of drill pipe installation, an additional length of drill pipe is added, until the final drill length is achieved. To minimize the release of the bentonite drilling fluid into Lewis Bay, freshwater will be used as a drilling fluid to the extent practicable for the final section of drilling just prior to the drill bit emerging in the pre-excavated pit. This will be accomplished by pumping the bentonite slurry out of the hole, and replacing it with freshwater as the drill bit nears the pre-excavated pit. When the drill bit emerges in the pre-excavated pit, the bit is replaced with a series of hole-opening tools called reamers that are designed to widen the borehole. Once the desired hole diameter is achieved, a pulling head is attached to the end of the pipe and the drill pipe is used to pull back the eighteen inch (457 millimeter) diameter conduit into the bored hole from the offshore end. As with the pilot hole drilling process, freshwater will be utilized to the maximum extent practicable as the reaming process nears the pre-excavated pit.

After the borehole has been constructed, 18-inch (45.7 centimeter) diameter HDPE pipe will be installed in each borehole to serve as protection for the submarine cable system. Smaller conduits with pulling wires will be placed inside the 18-inch (45.7 centimeter) diameter HDPE pipe to house the submarine cable system. Once the internal cable conduits have been inserted into the 18-inch (45.7 centimeter) HDPE conduit, a clay/bentonite medium will be injected into the conduit system to fill the void between the cable conduits and the 18-inch (45.7 centimeter) pipe. The conduits will be sealed at both ends until the submarine cable system is ready to be pulled through the conduit. After submarine cable system installation, the conduits will then be permanently sealed at each end to complete the installation process.

The HDD operation will include an upland based HDD drilling rig system, drilling fluid recirculation systems, residuals management systems, and associated support equipment. HDD drilling material handling equipment will be located on New Hampshire Avenue. Drilling will take place from the upland to Lewis Bay. Excavated soils will be temporarily stored near the HDD drill rig during construction, and will then be reused onsite or removed and disposed of as required.

To further facilitate the HDD operation, a temporary cofferdam will be constructed at the end of the boreholes in Lewis Bay. The cofferdam will be approximately 65 feet (19.8 meters) wide and 45 feet (13.7 meters) long and will be open at the seaward end to allow for manipulation of the HDD conduits. The area enclosed by the cofferdam will be approximately 2,925 square feet (271.7 square meters). The cofferdam will be constructed using steel sheet piles driven from a barge-mounted crane. The top of the sheet piles will be cut off approximately 2 feet (0.61 meters) above mean high water. This will serve to contain any turbidity associated with the dredging and subsequent jet plow embedment operations and to provide a visual reference to its location for mariners. While the cofferdam will be located outside of areas normally subject to vessel traffic, the location of the cofferdam will be appropriately marked to warn vessels of the temporary cofferdam's presence.

The area inside the cofferdam will be excavated to expose the seaward end of the borehole. Sediment inside the cofferdam will be excavated to expose the area where the HDD borehole will end at an elevation of approximately -10 feet (-3 meters) relative to mean lower low water, with a 1 foot (0.3 meter) allowable over dredge. A 20 foot (6.1 meters) long level area will be created at the closed end of the cofferdam at this elevation. From that point, the bottom of the excavated area will be sloped at 4 horizontal:1 vertical until it meets the existing seafloor bottom contour. Approximately 840 cubic yards (642.2 cubic meters) of sediment will be excavated from the cofferdam. At the end of the cable installation, the cofferdam excavation will be backfilled, rather than allowed to in-fill over time. The dredged material will be temporarily placed on a barge for storage, and then the dredged area of the cofferdam will be backfilled with the dredged material. If necessary, the dredged material backfill material will be supplemented with imported clean sandy backfill material to restore the seafloor to preconstruction grade. No removal of sediment outside of the cofferdam will be required.

The cofferdam will help to facilitate threading of the submarine cable system through the 18-inch (45.7 cm) diameter HDPE pipes placed in the horizontal directional drilled boreholes. This temporary cofferdam will be installed prior to the beginning of the HDD borehole construction, and will remain in place until jet plow embedment installation of the submarine cable system is complete.

The HDD operations will be conducted to minimize or avoid impacts to water quality in Lewis Bay. The upland HDD operation will be a self-contained system combined with a drilling fluid re-circulation system. This re-circulation system will recycle drilling fluids and contain and process drilling returns for offsite disposal to minimize excess fluids disposal and residual returns. None of these materials will be directly discharged or released to marine or tidal waters in Lewis Bay.

Each of the two landfall transition vaults will be approximately 8 feet (2.4 meters) wide by 35 feet (10.7 meters) long (outside dimensions) (see Figures 2.3.7-1 of the FEIS and Figure 4-21 of the DEIS). The submarine transmission lines will be spliced to the upland transmission lines within these transition vaults. Each transition vault will contain two 38-inch (96.5 centimeters) manholes for access and be installed approximately with its bottom ten feet (2.4 meters) below grade. The submarine transmission lines will enter through the four 18-inch (45.7 centimeter) HDPE conduits and the upland transmission lines will exit the landfall transition vault to the ductbank system through 6-inch (15.3 centimeter) diameter PVC conduits. There will be a total of 16 PVC conduits encased within concrete: 12 transmission line conduits, two conduits for 96-fiber fiber optic cables for telecommunications, supervisory control and data acquisition (SCADA) and protective relaying, and two spare conduits for the upland transmission line, as shown in Figures 2.1.3-4 and 2.1.3-5 of the FEIS.

It is anticipated that the installation of the borehole and conduit by HDD techniques will take approximately two to four weeks.

Upon completion of the installation of the conduit pipes and submarine cable system, the HDD equipment will be removed and New Hampshire Avenue will be restored to its pre-construction grades and conditions. Standard stormwater erosion and sedimentation controls will be installed on the site prior to the initiation of construction activities, and will be inspected and maintained throughout construction operations per the SWPPP (Appendix F)[2]. Once construction is completed, all equipment and construction materials will be removed from the site and the area will be returned to its original condition.

4.1.8 Vessels, Equipment, Staging and Transportation Routes

Overland transportation corridors are described in Section 4.4.1 of the FEIS. Airport facilities are described in Section 4.4.2 of the FEIS. Port facilities are described in Section 4.4.3 of the FEIS.

[2] While CWA is submitting its SWPPP in compliance with the Lease, CWA notes that the SWPPP is applicable to upland activities only which are outside of BOEMRE's jurisdiction. CWA further notes that the Part 285 regulations do not require that a SWPPP be submitted as part of a COP. CWA will submit its SWPPP to the EPA for substantive review, which has permitting authority for general stormwater permits under the National Pollutant Discharge Elimination System (NPDES).

Other infrastructure, such as communication infrastructure, is described in Section 4.4.4 of the FEIS.

4.1.8.1 Vessels and Equipment

This section provides a list of the primary equipment that will likely be required to complete all phases of construction. This primary equipment will be supplemented by hand tools and power tools such as impact drivers and wrenches, drills, hammers, grinders, sanders, saws, torches, welders, etc. that are typically used by construction work crews. Construction of the Project will generally consist of the following phases:

- Onshore Staging
- Monopile and Transition Piece Installation
- Wind Turbine Generator Installation
- Electric Service Platform Installation
- 33 kV Inner-array Submarine Transmission Cable System Installation
- 115 kV Submarine Transmission Cable System Installation
- Landfall Transition Installation
- Upland Transmission Line Installation

A summary of each construction phase, and detailed descriptions of each key component of the Project are provided above. For simplicity, several construction phases have been combined in the discussion that follows either because the installation methods are similar (e.g. submarine cables) or the phases are closely related in sequence (e.g. monopile and wind turbine generator installation).

Onshore Staging

- 800 HP Cranes
- Heavy-Duty Trucks
- Pick-up Trucks

Wind Turbine Generator Installation

- Monopile Installation Jack-Up/Spud Barge
  - 800 HP Crane
  - Pile Driving Hammer Equipment
  - Tool Room
  - Deck Lighting

  - Emergency Spill Response Kit
  - Porta-John
  - Office Trailer
  - Lunch Room
- Transition Piece Installation Jack-Up Barge
  - 800 HP Crane
  - Tool Room
  - Deck Lighting
  - Emergency Spill Response Kit
  - Porta-John
  - Office Trailer
  - Lunch Room
- WTG Component Installation Jack-Up Barge (towers, nacelles, hubs, and blades)
  - 800 HP Crane
  - Tool Room
  - Deck Lighting
  - Emergency Spill Response Kit
  - Porta-John
  - Office Trailer
  - Lunch Room
- Pre-Installed Component Transport Spud Barges
  - Monopiles
  - Transition Pieces
  - Hub
  - Nacelle
  - Blades

Auxiliary Support Vessels

- Scow Barges
- Tug Boats

- 3,000 HP Attendant Tugs
- 6,000 HP Tow Tugs
- Work Skiffs

Electric Service Platform Installation

- Foundation Transport Barge
- Foundation Installation Jack-Up Barge
    - 3,000 HP Crane
    - Pile Driving Hammer Equipment
    - Tool Room
    - Deck Lighting
    - Emergency Spill Response Kit
    - Porta-John
    - Office Trailer
    - Lunch Room
- Service Platform Superstructure Transport and Lift Jack-Up Barge
    - 800 HP Crane
    - Tool Room
    - Deck Lighting
    - Emergency Spill Response Kit
    - Porta-John
    - Office Trailer
    - Lunch Room
- Auxiliary Support Vessels
- Scow Barges
- Tug Boats
- 3,000 HP Attendant Tugs
- 6,000 HP Tow Tugs
- Work Skiffs

Submarine Cable Installation (including 33kV and 115kV cables)

- Purpose-built Cable Laying Vessel (deep water)
- Cable Holding Barge
- Cable Installation Barge (shallow water)
- Skid/Pontoon Mounted Jet Plow
- Jet Plow support systems (including pumps and accessories)
- Cable laying support systems (including cable machines, chute, tubs and complete diving operations center to support divers)
- 1,500 HP Tow Tug Boats (for handling anchors)
- Six-point mooring system with two 60-inch spuds. The mooring system will consist of 3 double winches, plus another double drum winch for controlling the two spuds. Each winch drum will contain approximately 2,000 feet (610 meters) of 1 1/8" (28.6 millimeter) mooring cable and have an anchor attached. Mid-line buoys will be attached to minimize anchor cable scour. Pendant wire with 58-inch (1.5 m) steel ball buoys will be attached to anchors for deployment and quick recovery
- Auxiliary trencher pulling barge - a small barge of 40 x 100 feet (12.2 x 30.5 meters) outfitted with spuds
- Auxiliary Vessels
- Crew Boat
- Inflatable Boats
- Work Skiffs.

Landfall Transition

- Marine Support Equipment:
    - Porta-John
    - Deck Barge with Spuds
    - 150-200 Ton Crane
    - Vibratory Driver / Excavator
    - Environmental Clamshell Bucket
    - Tool Room
    - Dive Spread
    - Diesel Welder

- o Deck Lighting
- o Emergency Spill Response Kit
- o Office Trailer
- o Lunch Room
- o Materials Deck Barge – as required
- o Scow Barge – as required
- o Tug Boat – as required
- o Work Skiffs
- o Land Support Equipment
- o Horizontal Directional Drilling Rig
- o Bore/Drill Rigs
- o High Density Polyethylene Fusion Machine
- o Excavator
- o Cement Mixer
- o Front End Loader
- o Graders
- o Rough Terrain Crane
- o Vibratory Driver / Extractor
- o Dump Truck
- o Heavy-Duty Trucks
- o Pick-up Trucks

Upland Cable Installation

- Heavy-Duty Trucks
- Winch
- Bore/Drill Rigs
- Crane
- Backhoe
- Excavator
- Trenchers
- Compressor

- Dump Trucks

The Project is subject to the U.S. EPA's General Conformity Regulation (40 CFR 93) for the air emissions from all vessels and equipment associated with the Project during its construction, while located outside of 25 miles from the site and within state jurisdictional boundaries. The MMS (now BOEMRE) issued a Final General Conformity Determination for the Project in December 2009.

The Project is also subject to the U.S. EPA's Outer Continental Shelf (OCS) Air Regulations (40 CFR 55) for the air emissions from all vessels and equipment associated with the Project during both construction and operation, while located within 25 miles from the site. The U.S. EPA issued the Final OCS Air Permit for the Project on January 7, 2011 (see Appendix H).

Both the General Conformity Determination and the OCS Air Permit for the Project contained emission limitations, emissions offset requirements, and mitigation, monitoring, recordkeeping, and reporting requirements for the Project related to its emissions and potential impacts to air quality. Additional requirements for the Project related to the mitigation and monitoring of impacts to air quality are contained in the Lease issued by BOEMRE. These requirements include the following:

- CWA will purchase Emission Reduction Credits. Massachusetts and Rhode Island are both designated as non-attainment areas for ozone by the U.S. EPA. Therefore, the nitrogen oxides (NO_X) emissions from any source whose emissions exceed the minimum thresholds must offset its NO_X emissions, so as to not contribute to any further degradation of air quality in a non-attainment area. The NO_X emissions from vessels and equipment associated with the Project during its construction exceed the minimum thresholds; therefore as a condition of both the General Conformity Determination and the OCS Air Permit, CWA must offset its NO_X emissions during construction. CWA will acquire Emission Reduction Credits (ERC) in a sufficient quantity to satisfy the Project's offset requirements during its construction. In accordance with the Conformity Determination, Cape Wind will provide MMS documentation of the purchase of offsets prior to commencement of construction activities.

- CWA will provide BOEMRE with descriptions of any emission control technologies, quantification of the emission reductions that would be achieved, etc.. The Project's emissions offset requirement described above can be achieved by either the purchase of ERCs, the reduction of emissions through reduced equipment usage or additional emissions controls, or by a combination of each. If Project emissions during construction are offset by utilizing additional emissions controls, CWA will provide BOEMRE with a description of any emission control technologies used, and a quantification of the resulting emission reductions achieved by their use.

- CWA will provide BOEMRE with data on horsepower rating of all propulsion and auxiliary engines, duration of time operating in State waters, load factor, and fuel consumption, for each vessel, including vessels delivering materials and supplies to the staging site, going to and from Quonset Point. CWA provided MMS (now BOEMRE) with estimated specifications for all of the vessels to be used during the Project's construction phase in State waters for the General Conformity Determination. This information was used to estimate the Project's potential emissions from such vessels and to estimate the quantity of emissions offsets required to satisfy General Conformity. CWA will provide the requested specifications for such vessels to BOEMRE as required by the Lease during its construction in order to determine the actual emissions from the vessels so that it can be confirmed that sufficient emissions offsets have been acquired for their use.

- In accordance with the EPA Air Permit, CWA will provide the engine information and emissions control equipment no later than 30 days before the start of Phase 1 (as defined in the EPA air permit).
- CWA will comply with any requirements specified by the BOEMRE in order to meet the general conformity requirements applicable at the time of decommissioning of any facility or structure.
- CWA will ensure that contractors operating diesel-powered equipment at the Quonset Point staging site use ultra low sulfur diesel fuel, if requested to do so by the Rhode Island Department of Environmental Management (RIDEM). 40 CFR 80.510(b) requires that, beginning June 1, 2010, all non-road diesel fuel is subject to a 15 parts per million (ppm) sulfur content limit, which is defined in practice as ultra low sulfur diesel (ULSD) fuel. CWA will ensure that the fuel used for all diesel-powered equipment associated with the Project meets its respective EPA sulfur content limit, which will include the use of ULSD fuel for all non-road diesel-powered equipment operated at the construction staging site.
- CWA will ensure that contractors operating vehicles, diesel engines, or non-road diesel engines at the Quonset Point staging site limit unnecessary idling. RIDEM Air Pollution Control Regulation No. 45 prohibits the unnecessary idling of diesel motor vehicles and non-road diesel engines. The Code of Massachusetts Regulations (310 CMR 7.11) prohibits the unnecessary idling of the engine of a motor vehicle in excess of five minutes. CWA will ensure that contractors operating vehicles, diesel engines, or non-road diesel engines at the construction staging site limit unnecessary idling.

4.1.8.2 Staging and Construction Management

CWA has been kept aware of the proposal by the Commonwealth of Massachusetts and the City of New Bedford to construct a Multi-Purpose Marine Commerce Terminal that could, among other purposes, serve as a staging area for construction of offshore wind projects, including the Project. At this time, however, it is unclear whether such Terminal would be both developed and available on a timeline that would meet the construction schedule for CWA set forth in this COP. Therefore, this COP is submitted with Quonset Point serving as the Project's staging area, and BOEMRE should review this filing on that basis. In the event, however, that the New Bedford Terminal does becomes available and CWA proposes its utilization for all or a substantial portion of the Project's staging requirements, CWA would submit a notice of project change and seek an appropriate and corresponding COP modification at that time.

The COP proposes that major construction activities will be supported by onshore facilities, located in Quonset, Rhode. The most probable scenario is that the majority of material and equipment will be staged onshore and then loaded onto various vessels for transportation to the offshore site, and ultimately installation. Construction personnel will be ferried by boat and/or helicopter depending upon weather conditions and other factors. Once loaded, vessels traveling from Quonset would pass through Narragansett Bay to Rhode Island Sound to Vineyard Sound, North of Martha's Vineyard to the Main Channel, a distance of about 55 nautical miles (102 kilometers).

Quonset, Rhode Island

CWA has identified an existing, underutilized, industrial port facility in Quonset, Rhode Island, as having the attributes required for staging an offshore construction project of the magnitude of the Project. The Quonset Business Park is located on Narragansett Bay in the town of North Kingstown, Rhode Island and is owned and controlled by the Quonset Development Corporation, a quasi-state agency that operates the 3,160-acre industrial park. This site is a portion of what once was a much larger government facility known as the U.S. Naval Reservation–Quonset Point, part of which is still actively utilized as a civilian airport and base for an Air National Guard Reserve squadron.

The Quonset Business Park is an active marine industrial site that houses several industrial businesses such as General Dynamics (shipbuilding) and Senesco (marine construction). Following the downsizing of the US Naval Reservation–Quonset Point, the park was created in order to develop prime industrial sites, create job opportunities and to improve the economic conditions throughout the region. The proposed staging of the Project from the Quonset Business Park is consistent with the park's stated purpose.

The entire park consists of approximately 3,150 acres (12.75 square kilometers), of which 817 acres (3.3 square kilometers) have been sold for such uses as industrial, offices, and transportation/utility (railroad and highways). Another 463 acres (1.9 square kilometers) have current leases, 605 acres (2.45 square kilometers) are used for a civilian airport (Quonset State Airport - OQU) operated by the State of Rhode Island, approximately 600 acres (2.43 square kilometers) are designated open space, about 200 acres are utilized for recreation including a golf course, and the remaining 465 acres (1.9 square kilometers) are vacant, open land available for industrial and commercial activities.

The site has deep-water capacity (30 feet [9 meters] depth) and two piers that are 1,200 feet (366 meters) in length and capable of servicing the largest of ships. One of the piers

(Pier 1) is currently leased by a company as an automobile unloading and transfer operation. The other pier (Pier 2) has intermittent use as a staging area for the Rhode Island Department of Transportation bridgework. Pier 2 would become available in the near future; however, based on timing, either pier may be available for lease.

CWA plans the use of Pier 2 because it has a load bearing capacity of over 1,000 pounds per square feet (4890 kilograms per square meters) and is 1,200 feet (365.9 meters) long by 650 feet (198.2 meters) wide. This pier would be used for the receiving, storing and assembly of the large turbine parts such as the monopiles, towers, nacelles, transition pieces, hubs, and blades. CWA and the Rhode Island Economic Development Corporation have discussed leasing all or part of Pier 2 and the land contiguous to it, which consists of approximately 33.5 acres (0.14 square kilometers) zoned for industrial or commercial activity. Additional land is also available within the park, approximately 3,000 feet (914.6 meters) away, which is accessible by a public road approximately 40 feet (12.2 meters) in width. These satellite parcels consist of approximately 25 plus acres (0.1 square kilometers) that could be used for other components of the wind turbines and associated infrastructure if needed. One of the parcels has two large buildings, which were utilized by the U.S. Navy Construction Battalion (Seabees) during the 1940's, 1950's, and 1960's, which may be capable of handling certain requirements of the Project for covered storage and enclosed workspace. Some modifications to the buildings and roadways may be required to accommodate the specialized equipment and wind turbine components. The deep-water piers are adequate to accommodate anticipated construction vessels and are not expected to require any additional dredging or modification.

New Bedford, Massachusetts

Regardless of the site for staging of construction, CWA expects that post-construction parts storage and larger maintenance supply vessels will be based out of New Bedford once the Project is operational. New Bedford Harbor is at the mouth of the Acushnet River. The Port of New Bedford is a deep-water port with depths of 30 feet (9 meters). The harbor features a hurricane barrier that stretches across the water from the south end of New Bedford to the Town of Fairhaven. The barrier's 150-foot (46 meter) opening is closed during hurricane conditions and coastal storms, making New Bedford one of the safest harbors on the eastern seaboard.

Across the harbor, shipyards line the Fairhaven waterfront. Marine service and vessel repair industries in Fairhaven have established reputations along the East Coast. Two major shipyards, D.N. Kelley & Son and Fairhaven Shipyard, are known internationally for quality repair on all types of boats.

Falmouth, Massachusetts

Falmouth Harbor located in the town of Falmouth, Massachusetts is the primary target to be utilized as a personnel staging area for the daily transport of crews to the construction site.

Falmouth Harbor is a relatively narrow well protected harbor located on the southwestern tip of Cape Cod. The harbor is approximately 10-12 miles from the wind farm site with less than 10 minutes of travel time from dockside to harbor entrance. This short distance to open water results in reduced time transporting to and from work site. Falmouth Harbor is mainly a recreational boating destination with several ferry vessels serving Martha's Vineyard Island. Falmouth is located within one hour of major cities Boston and Providence.

Falmouth Harbor has several marine service companies that are capable of supporting crew transport type vessel repairs. It is one of the facilities that will be utilized as a crew staging area and future operations and management (O&M) center for the Project. The facility has underutilized building and bulkhead area and is easily accessible from the main roadways leading to Falmouth. There is sufficient dockage for several crew vessels with bulkhead access for loading of vessels. There is also sufficient offsite parking that can be utilized throughout the tourist months and for the duration of construction. Converting the construction staging area into the O&M staging area and control center would result in cost savings and logistic synergies by allowing commissioning personnel and O&M personnel to work together during the transition phase.

4.1.8.3 Navigation And Transportation Routes

Information regarding Navigation and Transportation Routes is provided in the FEIS.

- Overland transportation corridors: Section 4.4.1 of the FEIS.
- Airport facilities: Section 4.4.2 of the FEIS.
- Port facilities: Section 4.4.3 of the FEIS.

4.1.9 Anchoring

Installation vessels will be stationed in the Project Area using a combination of jack-up spud emplacement and anchor deployment. The installation vessel anchors are emplaced by anchor handling vessels (AHV) that are specifically designated for anchor handling support operations. More specific details about the anchoring, including the size and anticipated scope associated with anchors, will be determined once a contractor has been selected. A more detailed description of anchoring will be provided in the Fabrication and Installation Report (FIR), which will be provided following COP approval. The following discussion is provided as an overview of the potential anchoring activities that will take place throughout the offshore construction process.

4.1.9.1 Equipment

The specification of the mooring winches, wires and anchors will be determined once a contractor is selected. A representative example of anchor tackle to be used is provided below.

Wire anchor configuration:

- Nominal pull of winch: 4 x 30 Metric tons (Mt)
- Stalling pull: 4 x 45 Mt
- Wire specification: 48 mm
- Spooling capacity winch: 4 x 900m wire
- Anchors: 4 x 4 Tons Flipper Delta

Chain anchor configuration:

- Nominal pull of chain anchor winch: 10 Mt
- Chain length: 235 meter 56 mm
- Anchor: 5 Tons Spec Anchor

Mid-line buoys will be attached to all anchors in order to minimize anchor cable scour and bottom impacts. In addition, pendant wire with steel ball buoys will be attached to anchors for deployment and quick recovery.

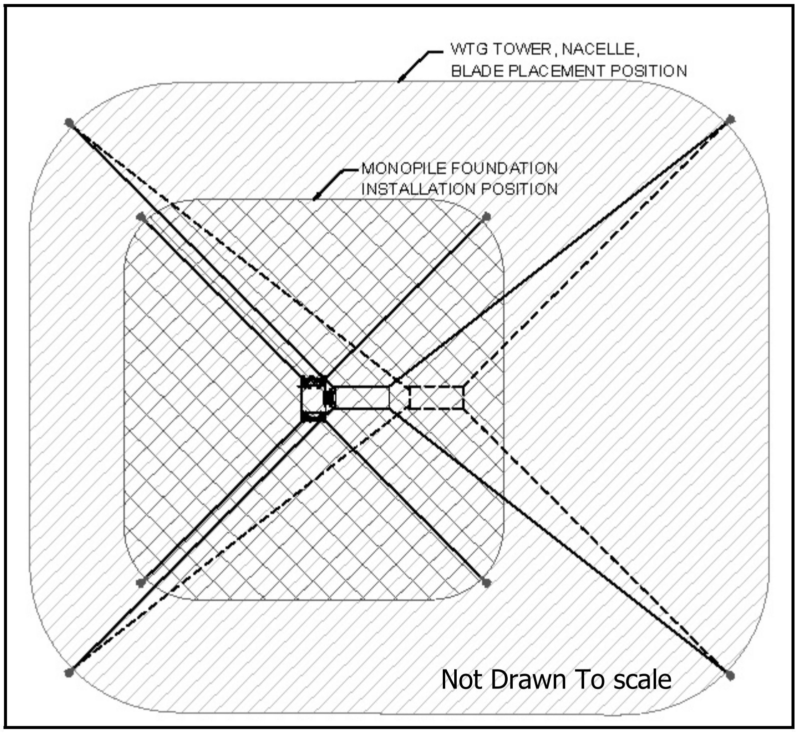
4.1.9.2 Anchor Configuration

As noted in the FEIS, anchors for installation will be configured in a four point configuration (Section 2.3.4 and 2.3.5). CWA anticipates that two additional spuds may be used to secure the vessel position during installation of the 115 kV submarine cable as described in Section 2.3.5 of the FEIS.

A representative anchor configuration for WTG and monopile installation is illustrated in figure 4.1-1. Two separate vessel deployments are shown below illustrating the monopile foundation installation and WTG installation phase and the anticipated anchor configuration. During the installation of the monopile foundation, the installation vessel is positioned adjacent to the installation location and two anchors are positioned forward and two anchors are positioned aft of the installation vessel. During the placement of the WTG tower, nacelle, and blades, the installation vessel moves away from the monopile and repositions the four anchors in the same configuration, although the length of anchor scope is greater for the second phase of this installation. The approximate overall area of temporary impact around each WTG is approximately 1500 feet in each direction. Due to overlapping coverage between WTGs, the temporary impacts related to the cabling are included in the entire anchor impact area as shown on Drawing 1 Sheet 1. The total permanent impacts related to the Project (monopiles, cables and rock armoring) as presented in FEIS Section 2.2 are 54.38 acres

Figure 4.1-1

Potential WTG Installation Anchor Configuration



The representative extent of the potential total temporary anchor impact area is provided on the Location Plat, as denoted by a red line (Drawing 1, Sheet 1).

4.1.9.3 Placement of Anchors

The anchor deployment sequence will depend on the prevailing tide, current, waves and wind direction during anchor operations. The installation vessels and AHVs will be equipped with appropriate surface positioning systems for accurate positioning of the anchors. The surface positioning systems will include survey equipment consisting of a GPS and Gyro compass systems.

Once all anchors have been deployed, the anchors will be pre-tensioned (test load) to ensure the anchors have adequate holding capacity. If an anchor does not hold it will be recovered and redeployed and the procedure will be repeated.

4.1.9.4 Operational Contingency

Vessels motions resulting from weather will restrict anchor handling work. Certain anchor handling activities are more weather sensitive than others, and the amplitude of motions depends on the heading of the installation vessels relative to wind, waves and current.

During anchor handling, the weather restriction that applies is also in relation to the motions of the AHV and its ability to handle and place anchors. The decision to proceed with anchor handling will depend on weather forecasts and the outlook for the construction activity period.

Throughout the anchor handling phase of the work, the following environmental conditions of the offshore work site will be monitored:

- Wind speed and direction
- Wave length, period and direction (visually)
- Current speed and direction (visually)
- Water-depth

4.2 Onshore Construction Plan

This section describes onshore Project facilities, including design and fabrication, and installation methods for each component and support facilities. Safety management systems to ensure the appropriate training and safety of onshore construction personnel are summarized below and detailed in Appendix E.

4.2.1 Summary of Safety Management System

The Project's SMS is provided in Appendix E, and details specific safety practices and procedures to be adopted during onshore construction The SMS describes overall safety policies and objectives, organization and responsibilities, methods to identify, assess, control and mitigate hazards, training and emergency response procedures, and compliance monitoring. For additional information, see Appendix E.

4.2.2 Upland 115 kV Transmission Cable System

Once the 115 kV submarine transmission lines make landfall at New Hampshire Avenue (as described in section 4.1.9), the submarine transmission lines will be interconnected with a 115 kV upland transmission line system within two parallel below-grade landfall transition vaults that will have interior dimensions of approximately 7'0" (2.13 m) W x 34'0" (10.36 m) L x 7'6" (2.29 m) H, containing one circuit each. (see Figure 2.3.7-1 of the FEIS) The upland transmission line system will utilize 12 single-conductor 115 kV cables each with copper conductor, Extruded Cross-linked Polyethylene (XLPE) insulation, copper wire metallic shielding, aluminum/polymer laminate moisture barrier and an outer polyethylene sheath. The metallic shields of the cables will be cross-bonded to minimize the cable losses and to limit induced voltages in the shields (see Figure 4-11 of the DEIS). The conductor cross section would be approximately 1.24 square inches (800 mm2). The 12 cables would be segregated into two circuits, each composed of two cables per phase. The balance of the upland cable route will be installed in buried concrete ductbank as described below.

Upon making landfall, the proposed transmission cable route would then follow New Hampshire Avenue north, merging with Berry Avenue. The route continues north on Berry Avenue, crossing Route 28 and continuing north on Higgins Crowell Road to Willow Street. Proceeding north on Willow Street, the route passes under Route 6 to the proposed intersection point with the existing NSTAR Electric 115 kV transmission cable ROW, approximately 500 ft (152.4 m) north of Summer Street. The route then turns westerly within the NSTAR Electric's existing ROW to the Barnstable Switching Station, crossing under Route 6. The proposed onshore transmission cable would be located within the existing public roadways for a length of approximately 4 miles (6.4 km) from landfall to NSTAR Electric transmission cable ROW located on the west side of Willow Street. The onshore transmission cable would then continue underground approximately 1.9 miles (3.1 km) along existing NSTAR Electric ROW and running from Willow Street to the Barnstable Switching Station. A new 115 kV bus at the Barnstable Switching Station will be the point of sale and change in ownership for the power being delivered to ISO New England.

Installation of the proposed onshore transmission cable includes constructing a utility easement within and along four roadways: New Hampshire Avenue, Berry Avenue, Higgins Crowell Road, and Willow Street. The easement would also include the crossing of Route 28 and Route 6. The onshore transmission cable would affect several intersections.

New Hampshire Avenue: New Hampshire Avenue is a two-lane residential road allowing vehicle access in a north-south direction. The roadway is a dead-end with a concrete retaining wall at its southern end. There are no sidewalks on either side of the roadway. In addition, there is no on-street parking. The transmission cable would be installed within the east side of the roadway.

Berry Avenue: Berry Avenue is a two-lane residential road allowing vehicle access in a north-south direction. There are sidewalks on both sides of the roadway. The transmission cable would cross to the west side of Berry Avenue off of New Hampshire Avenue.

Intersection 1 - Route 28 between Berry Avenue and Higgins Crowell Road: At the intersection with Berry Avenue and Higgins Crowell Road, Route 28 is a two-lane roadway with a painted divider. Vehicles on Route 28 travel in an east-west direction. The intersection of Route 28 with Berry Avenue and Higgins Crowell Road is signalized. There are sidewalks on both sides of Route 28. The transmission cable would be installed underneath Route 28 using trenchless technologies.

Higgins Crowell Road: Higgins Crowell Road is a two-lane road with a painted divider and vehicle travel is in a north-south direction. There are no sidewalks on either side of the roadway; however, there are unpaved shoulders along either side. The transmission cable would be placed on the east side of Higgins Crowell Road.

Intersection 2 - Buck Island Road: At the intersection with Higgins Crowell Road is a two-lane roadway with a painted divider. Vehicle on Buck Island Road travels in an east-west direction. The intersection of Buck Island Road with Higgins Crowell Road is signalized. The transmission cable would be installed beneath Buck Island Road using trenchless technologies.

Willow Street: Willow Street is a two-lane road with a painted divider. Vehicle travel is in a north-south direction. There are no sidewalks on either side of the roadway; however, there are unpaved shoulders along either side. The transmission cable would be placed on the west side of Willow Street.

Route 6 Crossings: The transmission cable would be installed using trenchless techniques as it passes underneath the Route 6 overpass. Approximately 0.5 mile (0.8 km) past the Route 6 overpass, the transmission cable would enter the NSTAR Electric ROW. The transmission cable would also cross under Route 6 from the NSTAR Electric ROW from north to south to connect with the Barnstable Switching Station. This crossing would also be accomplished using trenchless techniques.

The upland transmission line will enter the NSTAR Electric ROW and make the physical connection to the Barnstable Switching Station by continuing with two new underground transmission lines in the existing NSTAR Electric ROW approximately 1.9 miles (3.1 km) in length and running from the point where the new upland transmission line intersects the existing ROW in Yarmouth to the Barnstable Switching Station. The two transmission lines together would be comprised of 12 (2 circuits x 2 conductor/phase x 3 phases) cables of approximately 800 mm^2 (approximately 1,600 kcmil) in a cross sectional area. A third bay would be added at the Barnstable Switching Station to allow for the installation of three new circuit breakers and two banks of shunt reactors. (see Figure 2.1.3-2 of the FEIS).

4.2.3 Ancillary Structures

The duct system will consist of a single ductbank, approximately 5'8" (1.73 m) W by 2' (0.61 m) H in size with a total of sixteen (16) 6-inch (0.15 m) PVC ducts encased within a concrete envelope. The ductbank will be constructed within a trench beneath existing roadway corridors along the majority of the route. Twelve (12) of the 16 ducts will be occupied with the upland transmission lines, two ducts will contain fiber optic lines for protective relaying and communications, and two vacant ducts will be reserved for future use as spares. Figure 2.1.3-4 of the FEIS shows typical cross section of the transmission line "eight over eight" ductbank, which will also be utilized within the NSTAR Electric ROW. Figure 2.1.3-5 shows a typical cross section of the transmission line "four over four" ductbank, which will be utilized to transition from underground vaults to the "eight over eight" ductbank.

In addition to the landfall transition vault at the New Hampshire Avenue landfall site, the proposed transmission facility will include approximately 15 underground vaults along the public roadway layout portion of the proposed route and approximately nine underground vaults within NSTAR Electric's ROW. The vaults will include upland transition vaults which are required at locations utilizing trenchless techniques and typical splice vaults. All vault locations will include two parallel vaults constructed of reinforced concrete, approximately 8 inches thick. The interior dimensions of the upland transition vaults and the splice vaults will be 7'0" (2.13 m) W x 33'6" (10.21 m) L x 7'6" (2.29 m) H. The underground vaults will be located along the route as required based on cable reel capacities and to keep cable pulling tensions within manufacturer's specifications, generally at intervals between 500 to 1,700 feet (152.4 to 518 meters). The underground vaults will accommodate cable splicing and cross-bonding of cable metallic sheaths. (see Figures 2.3.7-1 of the FEIS, 4-16 and 4-17 of the DEIS).

5.0 OPERATIONS & MAINTENANCE PLAN

5.1 Introduction

This Operations and Maintenance (O&M) Plan describes the approach to operations and maintenance for the CWA project and provides details regarding O&M elements of the project that have previously been described and reviewed in the NEPA process. This plan includes an explanation of specific practices and procedures that were more generally described in the FEIS and is based on practical experience from offshore wind projects in Europe, other pertinent offshore experience, and applicable regulatory requirements in the US. Abbreviations are used liberally throughout this section as a means of streamlining the text. Please refer to the acronym list at the beginning of the document.

It is recognized that this O&M Plan will be enhanced with further project-specific details as EPC and O&M contracts are executed with CWA's selected vendors and suppliers. Further detail about O&M activities will be added as Hazard and Operability Study (HAZOP) and risk assessment reviews are completed during SMS implementation.

5.1.1 Purpose and Objectives

The purpose and objectives of this O&M Plan is to maintain the plant in a safe and effective operating condition in order to maximize electricity output and plant reliability, protect water quality and minimize potential environmental impacts by:

- Effective operational management and scheduling of maintenance tasks.
- Timely completion of scheduled and unscheduled maintenance tasks using safe systems of work as described by the SMS.
- Development and implementation of control measures to ensure the equipment is maintained in a safe and effective operating condition.
- Regular inspection of all elements of the Project according to an inspection program and applicable regulatory requirements.
- Maintenance of a safe place of work as described by the SMS.

5.1.2 Overview of Offshore Wind Farm O&M

Wind turbine operations are highly automated and wind farms are designed to operate remotely without on-site attendance at the WTGs. Monitoring sensors within the WTG gather and transmit data via the SCADA system on meteorological conditions, controls status, power generation, condition monitoring and system alarms and any other critical active safety functions. Monitoring is conducted over a SCADA system from shore base stations, which can be local to the project or centralized for monitoring of many wind farms.

The chosen WTG for the CWA project, the Siemens SWT-3.6-107, is a well-proven offshore wind turbine model. This will limit maintenance and operation risks because it reduces the likelihood of problems related to new, untried technology and serial defects, and ensures that the appropriate maintenance procedures have already been developed.

Wind farms are designed in accordance with safe life design principles for passive elements such as the structures, and fail-safe design principles for active elements such as drives and controls. This eliminates the need for continuous on-site attendance. The main reasons for intermittent on-site personnel attendance are:

- Perform as-needed maintenance to ensure high availability of power generation and transmission equipment.
- Perform scheduled inspections and maintenance to maintain good condition and operating life of the plant.
- Perform scheduled maintenance to ensure safety systems and equipment are always fully functional.
- Reviews to satisfy applicable permit conditions or regulatory requirements.

The CWA facility will be designed to be remotely operated continuously in its specific off-shore environment. The project equipment will be designed to have a useful life that meets or exceeds the life of the lease. The project will be operated and maintained in accordance with the Lease.

5.2 O&M Plan Elements

The O&M strategy for the CWA project will focus on reliable operation and continuous availability of the plant in a safe condition while fulfilling the requirements of the SMS (Appendix E). The SMS will include HAZOP/ Hazard Identification (HAZID) and risk assessment to support the safe operation and maintenance of the CWA project.

The O&M Plan elements comprise:

- Overall purpose and objectives.
- Organization, responsibilities.
- Operational management of the wind farm.
- Scheduled maintenance of the plant for safe operation.

- Scheduled maintenance of the plant for effective operation.
- Schedule inspections of the project to meet regulatory requirements.
- Unscheduled maintenance.
- Reference to the SMS to identify and assess hazards.
- Reference to the SMS to control and mitigate hazards through defined procedures and method statements.
- Reference to the SMS for monitoring and auditing of compliance of safety aspects.
- Continuous improvement interfacing with the SMS.
- Reference to the OSRP and the SMS for emergency response procedures.

The O&M Plan elements address the following key aspects of the project:

- All permanently installed offshore structures and equipment which will usually be unmanned, including the WTGs and ESP, and their foundations and substructures.
- Offshore array and export electrical cables for interconnection to the onshore electric grid.
- Operation of onshore facilities including the permanent onshore control room; permanent onshore service or staging area; permanent onshore warehouse area; shore termination of electrical cable and onshore route for grid connection.
- Grid connection at the Barnstable Switching Station operated by NSTAR.

The following is covered in the SMS:

- Operation of remote monitoring and control systems.
- Operation of all access and service vessels used during the operational phase.
- Emergency evacuation procedures.
- Onshore transportation and marshalling activities for large replacement components
- Lists of all offshore and onshore equipment and facilities, and all vessels or helicopters to be used for the project will be included in the SMS Safety File (see SMS, Appendix E).

5.2.1 O&M Plan Development

Detailed level maintenance schedules will be developed as the project progresses through the following stages:

- Selection of contractors for the engineering, procurement, construction and operation of the project, and the CVA.
- Detailed engineering design and specification.
- HAZOP and risk assessment stages.
- Lessons learned from the construction phase will be applied to the operations.
- Pre-operational planning including preparation and approval of detailed method statements and procedures for specific activities.

5.3 Cape Wind and O&M Contractor Responsibilities and Resources

5.3.1 Areas of Control

This O&M Plan covers the project equipment and activities in several geographical locations which make up the Project Site. Overall the geographical sphere of management control related to the operational phase has been defined as follows:

- "Offshore Wind Farm Site" area located on Horseshoe Shoal within Nantucket Sound off of Cape Cod, MA, USA.
- "O&M Staging Area" The facility is anticipated to be located in the town of Falmouth, MA with approximately 550 feet of quay within the harbor, and docking facilities on site for two approximately 50' service vessels. This site may also include the "O&M Warehouse Area" and "Onshore Control Center". When heavy lifting or repair activities are needed during the O&M phase, these will likely be staged out of New Bedford, MA.
- "O&M Warehouse Area" is the location where the operational spare parts and supplies will be stored. The facility is anticipated to be located in Falmouth, MA.
- "Onshore Control Center" means the CWA onshore control center which is anticipated to be located in Cape Cod, MA.
- "Cable Installation Zone" meaning the zone in which the interconnecting export cable has been installed stretching from the "Offshore Wind Farm Site" to the termination at the Barnstable Switching Station.

5.3.2 Cape Wind Organization

The CWA management team has a long track record of successful construction and operation of ambitious energy projects. The team's significant technical, financial and project management expertise is critical to the operating success of the Project.

The Project team is organized to ensure that there is a clear chain of command and responsibility between CWA, its contractors and their subcontractors. This chain of command is essential to ensuring the safe construction and operation of the wind farm. The main contractors for the project during the operational phase are planned to be:

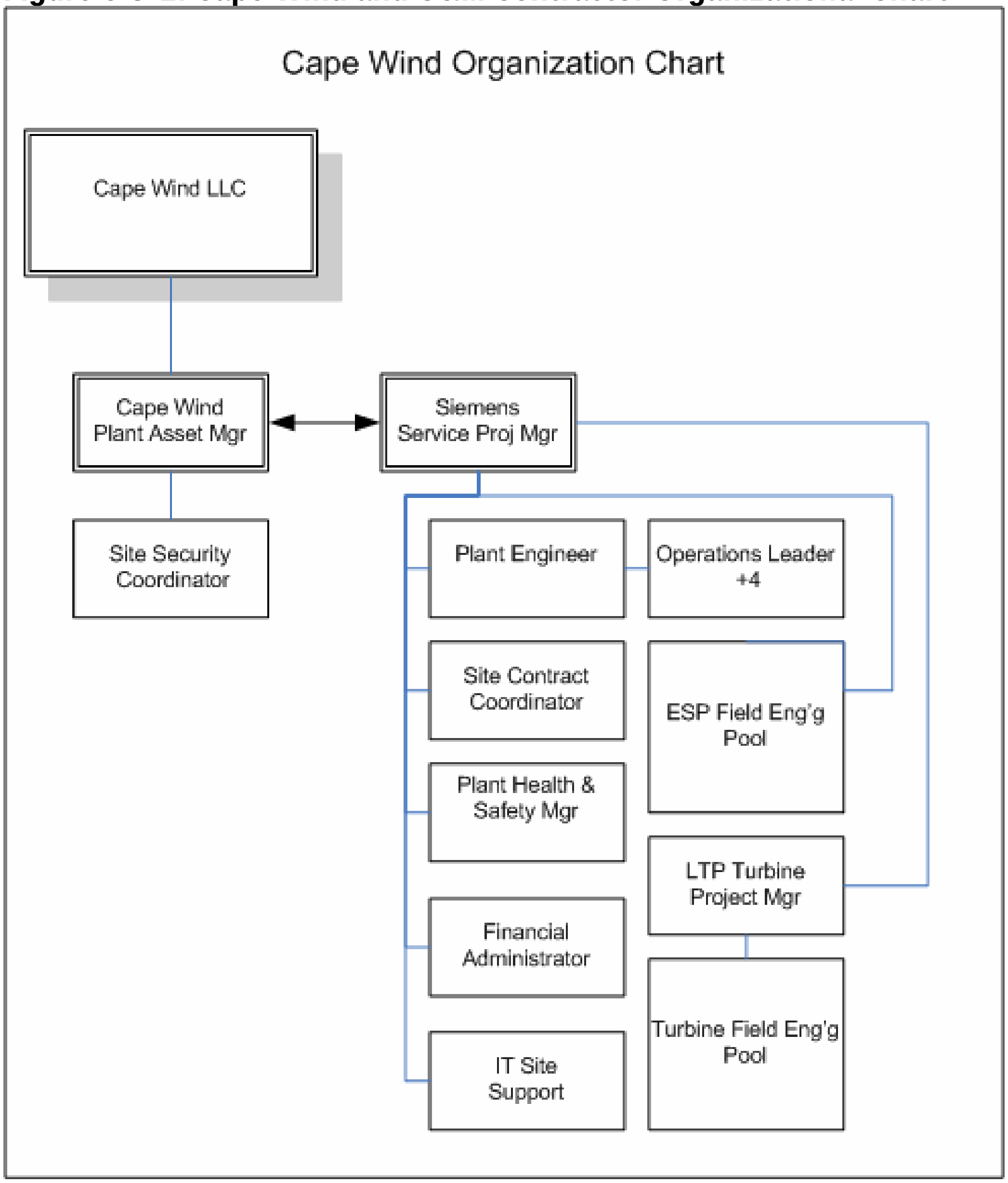
- O&M Contractor will undertake operation and maintenance of the WTGs and the ESP during the operational phase, including provision of access vessels, replacement parts and spares.

Further contractors, subcontractors or other third parties may include:

- Service or maintenance vessels providers either contracted to the Owner or the O&M Contractor.
- Subcontractors to the O&M Contractor for specialized maintenance procedures.
- The Owner's technical advisors.
- The Owner's environmental advisors.
- The Owner's safety advisors.

The CWA and O&M Contractor organizational chart is provided in Figure 5.3-1.

Figure 5.3-1: Cape Wind and O&M Contractor Organizational Chart



5.3.3 Responsibilities

5.3.3.1 Cape Wind Management Responsibilities

CWA is responsible for asset management and overall supervision of operational management of the Project.

The asset management team will handle the commercial aspects of the wind farm over the lifetime of the Project, and ensure that all safety and regulatory requirements are met in the operational management of the Project. CWA management team will:

- Oversee the activities of the O&M Contractor.
- Make decisions regarding Project dispatch and the scheduling of maintenance activities.
- Make decisions with respect to those items not within the scope of the O&M Contract.
- Monitor and inspect operations and maintenance activities.
- Conduct periodic reviews of operations and maintenance.
- Review health and safety, security and environmental programs.
- Review the spare parts and major maintenance strategy.
- Coordinate with regulatory agencies.

In particular, CWA will ensure that necessary preventive and corrective actions are performed. This includes remedial work and repairs and replacements, including provision of necessary access, maintenance, and safety vessels.

5.3.3.2 Safety Critical Roles

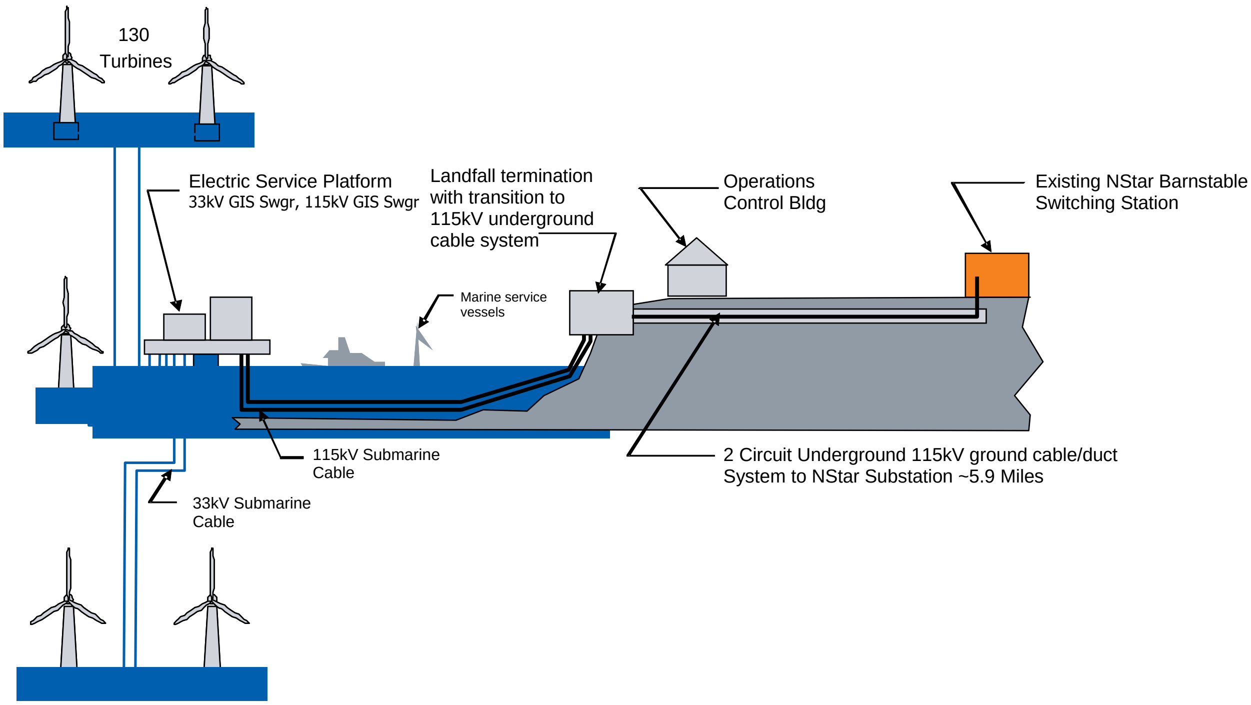
CWA's commitment to safety and safety critical roles on this project is described in the SMS. The SMS (Appendix E) describes (a) how CWA will ensure the safety of personnel and others near the facilities, (b) remote monitoring, control, and shut down capabilities, (c) emergency response procedures, (d) fire suppression equipment, (e) testing of the SMS, and (f) personnel training. However, it is important to note that the SMS is a living document that will continue to evolve as CWA finalizes contracts for engineering, procurement, construction, and operation of the project. The SMS will also be updated as CWA contractors conduct engineering, construction and operations of the project. Detailed methods and procedures implementing the SMS will be developed in consultation with BOEMRE and the relevant health and safety regulatory agencies.

5.3.3.3 O&M Contractor Responsibilities

Under the O&M with CWA it is planned that the O&M Contractor will provide all planned maintenance, unplanned maintenance and spare parts for the Project. Vessels and equipment needed for service or maintenance will also be provided by The O&M Contractor.

Figure 5.3-2: Scope of Equipment for O&M Activities

The figure below illustrates the equipment and plant systems that will be subject to O&M activities:



5.3.4 Resources

5.3.4.1 Cape Wind Capabilities

The CWA management team has direct experience managing the development, construction and operations of innovative power projects. The team is employed by the project manager, Energy Management Inc (EMI). While at EMI, the same individuals developed, financed and managed the construction of a number of new and noteworthy electric generating facilities, including cogeneration projects, the first merchant power project in the United States, early air cooled power projects in New England, the first inlet chilled power project in New England and the largest biomass power project in the United States.

CWA has assembled an interdisciplinary team to manage the construction and operations of the Project. The team draws upon the more than 100 years of experience of the core personnel as well as the more than 35 years of experience of EMI as a business entity in the field of energy development.

5.3.4.2 O&M Contractor Capabilities

The selected O&M Contractor will be highly qualified and experienced in the operation and maintenance of offshore WTGs including transmission and distribution systems. It is anticipated that CWA's selected O&M Contractor will be capable of augmenting traditional O&M services through direct support during the installation and commissioning phases. These value-added services with combined with traditional O&M contracted services will support further O&M planning.

5.3.4.3 Plant Spares and Special Tools

A list of typical spare parts and special tools that are anticipated to be supplied by the O&M Contractor and stored at the O&M staging area will be included upon submittal of the FIR. Special tools will be engineered and provided by the WTG manufacturer.

5.3.4.4 Site Resources

All operation and maintenance activities will be staged from the shore on a daily basis for all scheduled activities. The site resources for the operational phase of the project will comprise:

- Operational control center.
- Operational service base or onshore staging area.
- Onshore warehouse area.

Operations of the CWA Project will be conducted from an onshore operations control center located on Cape Cod. The operations control center will be staffed by the O&M Contractor. The CWA asset management team will likely also be based at the operations control center in order to have direct oversight of O&M activities. All commands, instructions or requests from ISO-NE, transmission owner-NSTAR, and regulatory and safety agencies, will be handled by the operations control center.

It is anticipated that Falmouth Harbor will be utilized as a personnel staging area for the daily transport of crews to the project site. Falmouth Harbor is a relatively narrow, well protected harbor located on the southwestern tip of Cape Cod. The harbor is approximately 10-12 miles from the wind farm site with less than 10 minutes of travel time from dockside to harbor entrance. The short distance to open water results in reduced time for transportation to and from the work site.

Falmouth Harbor has several marine service companies that are capable of supporting crew transport type vessel repairs. The facility has underutilized building and bulkhead area and is easily accessible from the main roadways leading to Falmouth. There is sufficient dockage for several crew vessels with bulkhead access for loading of vessels.

5.3.4.5 Access and Service Vessels

Access vessels will be provided to deploy work crews to perform scheduled maintenance or unscheduled maintenance.

From the anticipated onshore staging area in Falmouth Harbor work crews will be deployed to the WTGs and/or the ESP in approximately 50 ft (15 m) long crew boats manned by professional mariners. The O&M Contractor will supply, maintain and captain the crew boats.

5.3.4.6 Supporting Resources

Technical Advisory Support

In addition to the in-house technical expertise of CWA in power generation asset management, and Siemens expertise in WTGs, ESPs and electrical power plants, CWA will retain independent technical advisors on the following aspects when necessary:

- Offshore wind farm asset management including for example performance assessment, condition monitoring, inspection.
- Offshore structures including foundations, subsea and topsides structures, and subsea cables.
- Marine and offshore logistics including accessibility studies and evaluation of provision and use of vessels.
- Safety and environmental advisors as described in the SMS.

Helicopters

The ESP will be equipped with a helipad to allow the use of helicopters should emergency deployment or recovery of personnel become necessary.

To meet the conditions of the lease, the helipad on the ESP shall be maintained so that it can be used by USCG HH-60 Jayhawk and HH-65 Dolphin helicopters if requested to do so by the USCG. Helicopter navigational lights will be remotely activated on the helipad as needed.

Maintenance Vessels

In addition to the access and service vessels (crew boats) described above, occasionally it may be necessary to access and utilize the following vessels:

- Transfer vessels for replacement of equipment.
- Jack-up barges or heavy lift vessels for replacement of major items of equipment or refurbishment.
- Safety vessels.

These vessels, their crews and management will be provided by qualified vessel operators, whether contracted direct to the Owner or to the O&M Contractor.

Emergency Services

Emergency response services may be called upon to perform essential functions in the event of incidents, and in undertaking safety and emergency response drills and exercises. The primary first responder is the USCG. Consultation, pre-planning and coordination with emergency services is essential and is described in the SMS.

Potential emergency services which may be called upon are identified in the HAZOP and the SMS. These will include but not be limited to:

- Paramedics operating onshore, offshore, and/or in the air.
- USCG

The OSRP (Appendix C) identifies responders and response procedures in the event of an oil spill.

5.3.5 Planning and Risk Management

In order to manage risk, maximize reliable operations and minimize accidents and injuries, CWA and its contractors will be applying a systematic approach to implementing the O&M plan which includes:

- Operational management systems.
- Plant design for reliability, safe-life and fail-safe operation.
- Provision of adequate O&M resources, both personnel and equipment.
- Monitoring and recording of equipment condition, performance and trends.
- Preventive maintenance through maintenance schedules.
- Control of corrective maintenance activities.
- Management of Change control through design, build, and operational phases.

HAZOP/ HAZID, risk management and planning of how specific activities are performed safely in order to minimize risk of accident or injury, are described in the SMS.

It is planned that the O&M resources shall be fully trained and mobilized in place at least 3 months before completion of construction to allow for transition from the construction phase. Progress of the wind farm array construction will enable a progressive transition to O&M activities.

5.3.6 Documentation

O&M Plan supporting documents include, but are not limited to:

- Wind farm operating procedures.
- Operational reports.
- Self Inspection procedures.
- Maintenance schedules.
- O&M manuals.
- Service vessels specifications.
- Mobilization and logistics management.
- Training documents.
- Maintenance procedures and method statements.
- Registers of safety equipment and equipment testing procedures.
- Service and maintenance records.
- Inspection and test records.
- Management of Change control procedures.
- Safety documentation including risk assessments, risk registers, method statements, and work procedures included in SMS.

5.3.7 Communications

The Communications for the operation of the project will be compliant with the requirements of the applicable regulatory agencies, primarily the USCG and FAA. CWA's lease requires that its control center have full capability to communicate with the USCG and mariners within and in the vicinity of the Project. Communications capability will at a minimum include VHF marine radio and landline and wireless for voice and data and must include the ability to communicate with private vessels, USCG vessels and aircraft while underway, and Coast Guard Sector Southeastern New England. CWA will continue its ongoing coordination with the USGC prior to the start of construction. The coordination discussions will include but not be limited to:

- Routine operation communications as outlined below in Section 5.8.3.
- Communications with ISO–NE and NSTAR.
- Communication with the public.
- Liaison with regulatory authorities and safety notifications as described in the SMS.

- Planning and coordination of emergency response as described in the SMS.
- Procedures will be implemented for vessel and personnel tracking as described in the SMS.
- Incident reporting and emergency procedures as described in the SMS.

CWA is responsible for normal communications with Regulatory Authorities, but its communications procedures will allow and encourage immediate contacts from field construction and operations staff with authorities to report emergency conditions.

Lease conditions that will be met include the following:

- To ensure sufficient opportunity for the public to receive information directly from the owners/operators of the Project, CWA will attend quarterly meetings of the South-Eastern Massachusetts Port Safety Forum and brief the forum on the status of construction and operations, and on any problems or issues encountered with respect to navigation safety.
- The Project construction and operation, including the control center and its operators, and all plans and policies related thereto, will be subject to regular review and examination by the USCG on at least an annual basis, or more frequently if circumstances dictate.

5.3.8 Inspections and Tests

Inspections and tests will be undertaken over the operational phase of the project including during pre-operation planning and through refurbishment or decommissioning. During routine operation the entire CWA facility will typically be inspected annually, with more frequent inspections following commencement of operation, during and following major repairs or refurbishments, and after extreme storm events.

5.3.9 Management Review and Continuous Improvement

Management review will follow from inspections and will address failures to follow defined operating procedures or other matters of concern. Periodic reviews will be undertaken of both this O&M Plan and the SMS to ensure that both project performance and safety aspects are properly addressed.

CWA will employ principles of continuous improvement.

5.3.10 Management of Change

CWA has established that its contractors and subcontractors shall follow a procedure for managing the implementation of change to the facility and documentation. The procedure requires all contractors involved in any aspect of the project to have implemented a robust Management of Change (MOC) policy. This policy establishes minimum procedures for tracking, evaluating, implementing and documenting all changes from original design documents. Further detail regarding MOC can be found in the SMS (Appendix E).

5.4 Contractor Responsibilities

Area of responsibilities for contractors will be defined by an interface matrix.

The interface matrix is being developed during contract negotiations and will be included in the FIR.

5.4.1 General Contractor Responsibilities

All contractors are responsible for planning and execution of the work they undertake including:

- Appointment of person to act as point of contact with the Owner.
- Timely provision of risk assessments and method statements.
- Hours of work within regulatory requirements.
- Provision of suitably qualified and experienced personnel for the work they or their subcontractors undertake, following procedures for selection and control of subcontractors.
- Contractors' supervision and coordination of their work.
- Implementation and control of temporary works.
- Responsibility for safety and the environment.

5.5 Vessel Operations and Management

Two access vessels for operations and maintenance will be provided by the O&M Contractor. The FEIS describes the current state of knowledge related to vessel types and anticipated vessel trips. Based on the above analysis the normal activity would include two vessel trips per working day (252 days/year), which would include one crew boat from Falmouth and possibly the maintenance support vessel from New Bedford. Maintenance vessel(s), which may include a jack-up barge, will be available on an as-needed basis. In addition, an occasional second round trip from Falmouth could take place in times of fair weather or for emergency service. Vessel contractors are to be responsible for operation and maintenance of vessels in a safe condition, and to prevent damage to the environment.

All vessels for the proposed action would comply with applicable mandatory ballast water management practices established by the USCG in order to minimize the inadvertent transport of invasive species as well as the potential for adversely impacting water quality. Discharge of blackwater would not occur into the harbor while vessels are berthed. Instead, wastewater would either be held until offshore disposal can occur or would be pumped onshore for proper disposal. All vessel waste would be offloaded, stored and disposed of in accordance with all applicable local, state and federal regulations.

5.6 Competence and Training

CWA and all contractors are responsible for provision of suitably qualified and experienced personnel for the work they undertake, including assessment of qualifications, skills, experience, competence, and training requirements; and following procedures for selection and control of subcontractors as described in the SMS.

In addition to the specific requirements of the SMS, all personnel will be technically competent and possess the required regulatory license for the work they are expected to undertake.

5.7 Control Center

5.7.1 Standard Operating Procedures

Standard operating procedures for the control center shall define the methods for establishing and testing WTG rotor shutdown; method(s) for notifying the USCG of mariners in distress or potential/actual SAR incidents; method(s) for notifying the USCG of any events or incidents that may impact maritime safety or security.

5.7.2 Staffing

The control center will be staffed at all times. The number of personnel to staff the control center will be sufficient to ensure continuous monitoring of WTG operations, communications and surveillance systems; hours of operation; levels of supervision, job qualification requirements; initial, on-the-job, and refresher training requirements to ensure all plant operators maintain satisfactory levels of proficiency at all times.

5.7.3 Communications

Capabilities will be maintained by the control center to communicate with the USCG and mariners within and in the vicinity of the Project. Communications capability will at a minimum include VHF marine radio and landline and wireless for voice and data and will include the ability to communicate with private vessels, USCG vessels and aircraft while underway, and Coast Guard Sector Southeastern New England.

5.7.4 Monitoring:

Capabilities will be maintained by the control center to monitor, in real time, marine traffic within and in the vicinity of the Project and to monitor the status of all private aids to navigation.

5.8 Operational Management Tasks

Operations management includes plant monitoring, maintenance planning, and monthly reporting. The plant will be monitored consistent with the information available through both the wind turbine supplier and wind farm SCADA systems.

In addition to regular reporting and progress meetings, monitoring of the execution of maintenance work on site will be the subject of direct surveillance by CWA and/or its nominated agent.

5.8.1 Operation Management Services by O&M Contractor

The O&M Contractor will support the Owner in the operational management of the Project through provision of the following services:

- Management of interfaces.
- Reporting.
- 24 hour monitoring and site work instruction.
- Downtime / alarm analysis and performance recommendations.
- Planning and management of planned and unplanned O&M.
- Spares management including ordering, storage and managing of spares and consumables required for delivery of the O&M services.

5.8.1.1 Scheduling and Managing Planned Maintenance and Unplanned Maintenance

The O&M Contractor shall be responsible for planning all maintenance activities. This includes coordinating with other 3rd parties that deliver services to the wind farm. Where possible activities will be planned to be undertaken in parallel with other works or operational occurrences at the wind farm (e.g. grid outages) allowing the output of the wind farm to be optimized. This may require planning and coordination with 3rd parties and a collaborative approach must be adopted.

5.8.1.2 24 Hr Monitoring and Site Work Instruction

The O&M Contractor will:

- Monitor the Site via the remote facility continuously on a daily basis.
- Undertake any reset or other work relating to the operation of the wind farm where such work has been identified as necessary by the Contractor or by the Owner via remote monitoring.
- Provide a regular report summarizing both scheduled and unscheduled O&M activities, including environmental, health and safety matters that may have arisen during the report period.

5.8.2 Wind Farm Operational Procedures

The wind farm operating procedures will include the following:

- Remote monitoring and control.
- Start Up.

- Normal Operation.
- Shut Down.
- Emergency Operation.

Remote Monitoring and Control

The control room operator will have monitoring capability of critical operational parameters of the individual turbines and ESP. Critical mechanical, electrical and fault status including meteorological data can be archived for future analysis.

The control room operator will have the ability to remotely control and monitor the wind farm at all times with the exception of when start-up is disabled for personnel working on site.

SCADA systems will monitor the project WTGs and all other wind farm infrastructure. The WTG SCADA will be capable of fully interfacing with the wind farm SCADA system. The systems will be capable of providing real-time information on all WTG and wind farm data and communications. This shall include monitoring of:

- Meteorological conditions.
- Plant controls status.
- Power generation.
- Plant condition.
- System alarms.
- Any other critical active safety functions.

The SCADA systems will also be capable of remotely controlling and shutting down the WTGs and the wind farm, as and when required, including for health, safety and environmental purposes. The SCADA operations will incorporate emergency shutdown procedures, and all relevant personnel will be fully trained in this practice. Radio and telephone coverage will be available on the project site, and all site personnel fully trained in emergency procedures and communication.

A detailed description of a SCADA system is provided in Appendix G-1.

Start Up

Start-up of WTGs will generally be automated unless this is disabled by remote supervisory control, or for personnel attendance on site. This is in accordance with established wind farm operating practice.

Normal Operation

Under normal operation the individual wind turbines operate automatically. It is self-starting when the wind speed reaches an average of about 3 to 5 *m/s* (about 10 mph). The output increases approximately linearly with the wind speed until the wind speed reaches 13 to 14 *m/s* (about 30 mph). At this point, the power is regulated at rated output. If the average wind speed exceeds the maximum operational limit of 25 *m/s* (about 56 mph), the wind turbine is shut down by feathering the blades. When the average wind speed drops back below the restart average wind speed, the systems reset automatically

Hence frequent start up and shut down is part of the automated function of the wind farm.

Shut Down

The turbine is able to shut down safely from any operating situation, even in case of total breakdown of either the pitch system or the mechanical brake.

In accordance with the Lease:

- The WTGs have the capability to shut down automatically when icing conditions are present or the operator can initiate a manual shutdown of the WTG(s) should the WTGs be experiencing icing conditions.
- The Lessee will immediately shut down all or a portion of the WTGs upon notification from the USCG that search and rescue aircraft have been ordered to respond to an incident within or immediately adjacent to the Wind Park.

Emergency Operation

The operations center will have the capability to shutdown all wind turbines within a 2-minute period as required by the USCG. Emergency stops will be provided locally at each WTG and ESP and via the control center.

In the event of an emergency involving mechanical damage to the submarine cables (such as an unlikely anchor snag) ground fault protective relaying will be provided for 33 kV cables. High speed sensitive differential protection, capable of detecting ground faults, will be provided for the 115 kV cables.

Ground faults on the 33 kV array cables will be detected by digital protection relays with directional ground overcurrent elements supervising the 33 kV feeder circuit breakers on the ESP. Detected faults will result in rapid tripping of the ESP feeder breaker connected to the faulted cable. Ground faults on 33 kV array cables will also be detected by the ground overcurrent element in the Woodward WIP1 protective relay located at the 33 kV switchgear in the base of each WTG. The Woodward relay will trip its associated 33 kV circuit breaker. Ground faults in the 115 kV export submarine cables will be detected by redundant high speed differential protection relays located on the ESP and at Barnstable Substation. Those relays will result in rapid tripping of the 115 kV circuit breakers at both ends of the faulted cable.

No field splices of the submarine cable are planned, however repair slices, if necessary, will be conducted using the following process. After the cable has been brought up to the deck of the repair vessel, the damaged section is cut out and cut back sufficiently to assure an undamaged end. This end and one end of the spare cable are moved into a clean working area (tent or other enclosure) on deck. Then the various cable layers are removed and the remaining surfaces are carefully cleaned. The copper conductors of each phase are mechanically jointed by compression in a power core conductor ferrule. Each joint is then wrapped in semi-conducting tape and the insulation layers are built up. The metallic screen is reconstituted – in the case of the 33 kV cable by tinned copper mesh tape — and then protected with water barrier mastic. Each of the three power core joints is housed in a split brass joint sleeve, sealed with foam tape at each end. The joint sleeve is filled with polyurethane resin.

Each fiber of the fiber optic bundle is spliced using a fusion splicer. All of the fiber splices are contained within a dedicated fiber optic jointing box.

The three power core joints and the fiber optic jointing box are then housed in a dual set of armor bodies with appropriate sealing arrangements. The armor bodies are filled with a water repellent gel compound. Bend strain relievers are mounted on the rear of the armor bodies to provide a smooth transition from the metal work to the steel wire cable armor.

The entire splicing procedure is then repeated to join the other end of the spare cable with the other end of the damaged cable.

Emergency response procedures and drills are addressed in the SMS.

5.8.3 Communications

Vessels will have GPS tracking from control center in addition to VHF marine radio and private radio frequency communication. Due to the wind farms proximity to land wireless telephone communication will also be utilized.

The control center will have the capabilities at all times to communicate with the USCG and mariners within the vicinity of the project. Communications capability will at a minimum include VHF marine radio, landline and wireless for voice and data and must include the ability to communicate with private vessels, USCG vessels and aircraft while underway, and Coast Guard Sector South-Eastern New England.

During the operation phase capabilities will also be maintained by the control center to monitor in real time on a 24/7 basis the marine traffic within the vicinity of the Wind Farm and to monitor the status of all private aids to navigation (PATONs). The project will report any issues pertaining to PATONs to the USCG. Also the project will provide monthly reports to the USCG describing any navigational safety issues, complaints from mariners and correspondence from any other regulatory agencies regarding navigational safety issues. CWA will also communicate to the public by reporting at the quarterly South-Eastern Massachusetts Port Safety Forums.

The Control Room will on a 24/7 basis have communication capabilities with local first responders, and all required regulatory agencies. Per the LGIA the control center will also have a dedicated Ring Down line with ISO-NE in order to respond to all transmission system directives and emergencies.

5.8.4 Emergency Response

Emergency response plans, including evacuation and rescue, shall be as detailed in the OSRP and the SMS and are to be drilled on a regular basis.

A schedule of emergency response exercises will be prepared and implemented which will cover key hazard events identified from the HAZOP/HAZID as far as is practicable without entailing disproportionate risks in the exercises themselves. Risk assessments, method statements and procedures for such exercises are to be prepared and recorded in accordance with the SMS.

5.9 Maintenance Tasks

Unplanned maintenance on any part of the WTG is carried out in response to a breakdown or failure. This activity may be simple and require only hand tools, in which case the normal crew vessels would suffice. If there is a requirement to exchange larger items, the use of the larger maintenance vessel may be required to transport and lift the particular items. Such items of equipment could be an electrical control cabinet, and 33 kV voltage transformer, generator, gearbox parts, etc. The ability to conduct such operations would depend heavily on the prevailing weather conditions. Accurate weather forecasting is an essential ingredient in the planning of such offshore operations where a weather window of one to two days is required to complete the task.

5.9.1 General Requirements for Effective Operation

Maintenance shall be undertaken to ensure the following over the operating life of the project:

- Good condition of the plant and its facilities in accordance with good practice as established in the wind and offshore sectors.
- Power generation performance of the wind farms consistent with the WTGs power curve.
- Function of electrical power systems complying with ISO-NE and the Large Generator Interconnect Agreement (LGIA) and local transmission operator (NSTAR) requirements.
- Good reliability of all monitoring, control, and communication systems in accordance with good practice as established in the wind and offshore sectors.
- Good reliability of all ancillary systems in accordance with good practice as established in the wind and offshore sectors.

Maintenance activities shall be undertaken as follows:

- In accordance with suppliers' maintenance schedules and operation and maintenance manuals, including all tasks specified therein unless agreed otherwise.
- Additional maintenance tasks shall be defined and performed if required to comply with good practice as established in the wind and offshore sectors.
- Additional maintenance tasks shall be defined and performed if required to meet risk management or mitigation requirements arising from HAZOP/HAZID or risk assessment.
- Additional maintenance tasks shall be defined and performed to comply with all applicable regulatory requirements.
- Additional maintenance tasks shall be defined and performed if indicated by experience during construction or operation.
- Additional remedial or refurbishment activities shall be undertaken if necessary to meet the requirements for continued good condition, functionality, performance, reliability and availability as stated above.
- In accordance with the SMS and supporting documentation.

5.9.2 General Requirements for Safe Operation and Structural Integrity

To assure the safe operation and the structural integrity of the wind farm, the O&M Contractor will monitor and maintain the condition and/or test the function of the following:

- Structural integrity of primary structures including but not limited to foundations, substructures, and topside structures (monopiles, TPs, WTG towers, ESP topsides).
- Condition and security of secondary structures (including access walkways, safety barriers, netting, etc.).
- Foundations scour protection and electrical cables scour.
- Corrosion protection (surface finishes and cathodic protection systems).
- Condition of electrical insulation and security of electrical connections.
- Electrical isolation, protection and safety systems functional checks.
- Lighting protection systems (resistance checks).
- Automated WTG load, speed, power limiting and shut down systems (blade pitch actuation and control; hub braking and locks; yaw drive, control, braking and locks).
- Back-up power systems.

- Icing mitigation measures.
- Aids to Navigation (ATON) and aviation hazard warning.
- Ventilation, dehumidification, and temperature control (including air monitoring equipment).
- Fire protection systems (fire barriers, fire doors, fire shutters, grilles, and fire suppression systems).
- Personnel day rest facilities and refuge areas.
- Emergency lighting.
- Access and egress routes (kept clear).
- Material handling and lifting equipment.
- Elevators for personnel.
- Ladders, safety harness attachment points and fall arrest systems including security and load capacity of all anchorages.
- Emergency escape apparatus.
- Emergency stops and interlocks,
- Remote monitoring and fail-safe control of safety-critical functions.
- Any other safety systems included in the approved design or equipment registers.
- Life-saving and survival equipment registered and held on site.
- All Personal Protective Equipment (PPE) registered and held on site.

5.9.3 Self Inspection Program

Regular inspections of all elements of the Project will be conducted according to an inspection program.

A comprehensive annual self-inspection program will cover all facilities. Annual inspection will tie-in with scheduled annual service and maintenance of the equipment, particularly the service and maintenance schedules provided by the equipment suppliers, and any further service and maintenance which is specific to the project, for example that identified by HAZOP.

The inspection program, accompanying service and maintenance schedules, and records of all inspections, tests, service and maintenance carried out will be included in the Project Safety File as specified in the SMS.

The Self Inspection Program will specify:

- The type, extent, and frequency of in-place inspections that will be conducted for both the above-water and the below-water structures of all facilities.
- How corrosion protection for both the above-water and below-water structures will be monitored.
- How and when scour protection systems will be monitored. (see Section 5.9.4.4 below).
- When a structural assessment is required under API RP 2A WSD.

Details of reports that will be prepared, presenting:

- A list of facilities inspected.
- The type of inspection employed, (i.e., visual, magnetic particle, ultrasonic testing).
- A summary of the inspection indicating what repairs, if any, were needed and the overall structural condition of the facility.

Requirements for inspections of equipment will include but not be limited to:

- Ensure the procedure for all inspections and tests is in accordance with the Conditions of Contract and Owner's Requirements including the Technical Specifications where applicable.
- Include for the inspection and testing necessary confirmation that the services are in accordance with the specification and any relevant National or International Standards, Electricity Supply Industry Technical Specifications, relevant wind energy association standards or guidance.
- Provide all measuring equipment or special apparatus required for Site tests. All instruments shall be calibrated before and after tests.
- Comply with the requirements of ISO 9001/2/3 (as appropriate) in full.
- Where non-destructive testing (NDT) is required this shall be carried out to recognized standards referenced in the design codes.

The Self Inspection program will include scheduled inspections derived from the HAZOP/HAZID and specific equipment maintenance schedules. Further details of foundation structure inspections can be found in Section 5.9.4.3 below.

5.9.4 Scheduled or Preventive Maintenance Arrangements

As previously presented in the FEIS scheduled maintenance activities will be required to ensure continued reliable operations. Based on both offshore and onshore WTG operational experience, five days per year per turbine has been established as the anticipated maintenance requirement.

These visits cover two days of planned or preventative maintenance, and three days of unplanned or forced outage emergency maintenance. The WTG design is based on a twenty year operating life and all components have been analyzed to meet this design criterion. Based on 5 maintenance days per year for each of the 130 WTGs, the total is equivalent to 650 maintenance days. Based on 252 workdays per year (which adjusts for weather days and holidays) this results in 2.5 work teams or conservatively three teams being deployed. During these deployments, maintenance on the ESP would be included. Experience has shown that wind speeds must be less than 17.9 mph (8 m/s) to gain safe access to the WTGs, although safe access with winds up to 26.8 mph (12 m/s) is possible depending on direction and sea state. Based on these weather related concerns, the number of trips per day could be altered to take advantage of good weather.

The submarine cables will be inspected periodically to ensure adequate coverage is maintained. If problem areas are discovered, the submarine cables will be re-buried. Depending upon the extent of reburial required, either hand jetting or re-deployment of a jet plow would be used.

Based on the above analysis the normal activity would include two vessel trips per working day (252 days/year), which would include one crew boat from Falmouth and the, if needed, the maintenance support vessel from New Bedford. In addition, an occasional second round trip from Falmouth could take place in times of fair weather or for emergency service.

5.9.4.1 WTG Maintenance Schedules

The scheduled service and maintenance of each WTG will generally be undertaken annually and will include, but not be limited to, the items indicated in the following representative maintenance summary (Table 5.9-1).

Table 5.9-1: WTG Service and Maintenance Summary

Maintenance Task	Annual Service	Other
Visual inspection of equipment condition	*	
Inspection of blades for signs of damage or cracking	*	
Torque of bolts at tower, hub, nacelle bedplate, transmission, and check of generator alignment	*	
Recharge grease in main bearing, yaw bearing, blade bearings, generator bearings	*	
Check hydraulic pressure and pumping systems operation and sensors for brake, pitch, and yaw	*	
Blade pitch hydraulic accumulators: check charge pressure	*	
Hydraulic pumping systems for brake, pitch, and yaw: change oil filter	*	
Hydraulic pumping systems for brake, pitch, and yaw: sample oil	*	

Maintenance Task	Annual Service	Other
Hydraulic pumping systems for brake, pitch, and yaw: change oil		2-5 years
Replace flexible hoses		7-10 years
Main gearbox check oil level, pressure switch, vibration sensor	*	
Main gearbox change oil filter	*	
Main gearbox sample oil	*	
Main gearbox change oil		2-5 years
Check heating elements in main gearbox and generator	*	
Generator brushes: clean and check resistance		
Check frequency converter coolant	*	
Change frequency converter coolant		7 years
Lightning protection system inspection including grounding brushes	*	
Replace slip rings		10 years
Replace UPS batteries		3 years
Check dehumidifiers	*	
Check emergency lighting	*	
Check fire detection equipment and extinguishers	*	
Check emergency evacuation equipment	*	
Check first-aid equipment	*	
Check survival equipment	*	
Check condition and operation of lifting equipment	*	
Check condition and operation of personnel lifts	*	

Table 5.9-1 summarizes the service and maintenance tasks as specified in the standard Siemens service and maintenance manual for the SWT-3.6-107 off-shore WTG, the maintenance schedule from this manual being included in Appendix G-2.

In compliance with the lease conditions, for each existing WTG, and not later than 30 days prior to January 1, April 1, July 1, and October 1 each year, the Lessee will provide BOEMRE and the USCG with its planned WTG maintenance schedule for each respective quarter. Appropriate Notice to Mariners submissions will accompany each maintenance schedule.

5.9.4.2 ESP Topsides Maintenance Schedules

Electrical equipment will be inspected, tested and maintained in accordance with applicable standards and practices of the following organizations:

- American National Standards Institute (ANSI)
- Institute of Electrical and Electronics Engineers (IEEE)
- International Electrotechnical Commission (IEC)
- National Electrical Manufacturers Association (NEMA)
- National Fire Protection Association (NFPA)
- Underwriters Laboratories (UL)

Components that are UL listed and labeled will be provided where available. Acceptance testing of electrical equipment on the ESP will be performed in accordance with equipment manufacturer's recommendations and generally with the International Electrical Testing Association's "Acceptance Testing Specification for Electrical Power Distribution Equipment and Systems." Ongoing maintenance will generally follow the International Electrical Testing Association's "Maintenance Testing Specifications for Electrical Power Distribution Equipment and Systems" and the manufacturer's recommendation.

ESP Topside maintenance schedules include:

- Scheduled maintenance activities as usually included by the ESP supplier, as required for the design of the ESP, component manufacturers' recommendations, and as established by previous experience and good practice.
- Scheduled maintenance activities to meet project-specific requirements pertaining to the ESP Topsides scope of supply.

It is anticipated that scheduled service and maintenance of the ESP will generally be undertaken annually, with the addition of:

- 3-5 year major ESP plant and equipment service.
- 5 year inspection of 33kV and 115kV switchgear and associated protection.

Descriptions of some of the maintenance approaches and techniques which it is anticipated to use for the ESP (and other electrical or energized equipment) are given in the following paragraphs.

Preventive Maintenance Energized Inspections (EI)

The objective of preventive maintenance inspections is to ascertain the condition of the equipment with respect to the ingress of environmental contamination, visible wear and tear due to operation, vibration or other external factors that may impact the mechanical integrity of the equipment or may be a precursor to poor electrical performance. These inspections involve the physical inspection of all accessible areas of the equipment during energized operation as permitted by applicable safety standards in effect. Where possible the field engineer or technician will be looking for deterioration of painted surfaces, excessive dust and debris accumulation, evidence of extreme condensation or moisture accumulation, which may impact operational behavior or length of uninterrupted service of the equipment. Inspections would also cover outdoor insulators and lightning arresters for evidence of flash over or corona discharge. During inspections the service personnel will further listen for unnecessary or excessive vibration of housings, assemblies, components mounted on equipment. Finally the inspection will look for leaking of lubricant or insulation oil. Additionally and depending upon the asset type being visually inspected and functionality of SCADA system, inspection would also include the capturing of equipment operational data such as temperatures, pressures of dielectric mediums etc., if this data is not being captured through remote monitoring. All of these typical findings will be noted by the technician or field engineer in the field report with comments on potential corrective maintenance activity to be performed or additional inspections to be performed during the next de-energized testing and inspection interval depending upon severity.

Thermal Imaging Inspections and Tests (TI)

The intent of thermal imaging inspection and tests is to provide additional information regarding relative condition of equipment without the need for de-energized inspection and tests. Thermal imaging has proven to be a relatively inexpensive method to measure temperature gradients relative to ambient that can indicate loss of cooling of efficiency, deteriorating connectivity or other forms of excessive thermal conditions prevalent in components of the electrical substation. Thermal imaging would be done during energized inspections or at some interval between energized and de-energized inspections. The field engineer performing the thermal imaging will perform comparative analysis to previous images to gauge relativistic changes in condition and performance of the substation components.

Preventative Maintenance De-Energized Inspections and Tests (DEI&T)

All de-energized inspections and tests will be carried out pursuant to OSHA and NFPA guidelines and requirements, as appropriate. Prior to initiating de-energized inspections or testing, Lockout/Tagout safety practices will be undertaken. All personnel prior to performing tasks will be involved in a safety review meeting outlining site safety practices to be adhered to and be observed prior to and during tasks to be performed.

The objective of de-energized inspections and tests is to review both mechanical integrity and verify electrical characteristics and functionality of the equipment involved. De-energized inspections are performed similar to that outlined for energized inspections except in areas normally prohibited during equipment operation. In addition to the general mechanical integrity issues already outlined de-energized inspections also look for discoloration of terminations wires, power connections and the like. Such change in color are often leading indicators of loose or deteriorating connectivity that could result in eventual failure. Cleaning activities such as vacuuming of debris and dirt accumulated in inspected compartments will also be included in the work performed as needed by visual inspection or as recommended during energized visual inspection reports. In general continuity, grounding and insulation power factor testing will also be performed during this service. Additionally testing with respect to protection and control devices will take place during this stage of preventative maintenance using signal generation test equipment to verify set points, calibration and functional integrity of control and protective devices. Additional tests pursuant to O&M Service program will also be administered as required which are either asset specific or are deemed required due to criticality of the asset to substation availability. All testing performed will have either test data explicitly measured or test pass/fail/investigate classification in reports provided from the work performed. It should be noted that de-energized tests performed on assets become more pervasive with time as the equipment ages or accumulates more operations. Additionally, depending upon the classification of the protection and control assets within the substation by FERC/NERC regulatory agencies, the frequency at which protective relays are tested to verify functional performance and calibration may become less or more frequent. In general most protective relays will require functional testing and calibration after three to five years in service and repeated every three to five years thereafter.

A representative ESP maintenance schedule is provided in Appendix G-3.

5.9.4.3 Foundations and Substructures Maintenance

The O&M Contractor, together with the foundations designer, is to prepare a maintenance schedule that will include but not be limited to:

- An in-service inspection procedure.
- Methods to monitor, inspect, and/or test structural integrity.
- Methods to monitor or inspect scour protection.
- Methods to monitor, inspect, test, and/or maintain corrosion protection.
- Other requirements as necessary.

Further guidance and regulations may include the following:

- Likely structural inspection requirements will correspond to at least API RP2 A.
- BOEMRE requirements may be met with USCG review of an in-service inspection program.
- Applicable regulations include 33 CFR Subchapter N.
- Diving operations and equipment should comply with 46 CFR 197 Subpart B.

Routine Inspection of Foundations and Substructures

It is anticipated that routine inspections from above water will be required including:

- Inspection of corrosion protection paintwork applied to transition pieces and secondary steel (including ladders, j-tubes, platforms, boat landings, etc.).
- Inspection and testing of Cathodic Protection systems applied to monopiles/ transition pieces.
- Inspection, maintenance (and testing where appropriate) of boat landings, ladders, fall-arrest and other access systems.
- Inspection, maintenance, testing and certification of davit cranes, hoists and other lifting devices.
- Maintenance of navigation lights, fog horns and other external lighting and marking.

In addition it is anticipated the following will be required:

- Regular surveys of scour protection around the foundations.

Detailed Inspection of Foundations and Substructures

It is anticipated that detailed inspections, for example by divers, of the foundation and substructures will be required on a suitable sampling basis including:

- Internal and external inspection of the transition pieces for the WTGs.
- Inspection of the grout seals between the monopiles and the transition pieces, and the transition pieces and the WTG towers.
- Inspection of the scour protection and monopile foundation at the seabed.

Marine Growth

Contractors shall undertake cleaning of marine growth as appropriate from access ladders and the monopiles.

Cathode Replacement

Specialist contractors shall, based upon the findings of scheduled inspections of the cathodic protection, advise the Owner of any maintenance or replacement of cathodic protection necessary. Where the replacement of the cathodic protection is necessary the contractor will undertake the maintenance or replacement in a timely manner to allow replacement of the cathodes in advance of their corrosion protection being made redundant or less effective.

As stated above specialist technical advice is to be sought from the Balance of Plant (BoP) Contractor and Foundations Designer, in parallel with the design of the foundations, subsea, and topsides structures, to determine the inspection and maintenance schedule, including scour and corrosion protection.

A representative maintenance schedule is provided as part of Appendix G-2.

5.9.4.4 Electrical Cables and Scour Protection Maintenance

Other than the 115 kV splice to upland cable at landfall, there will be no submarine cable splices performed in the field. After each fiber optic cable -- including the interstitial fiber optic units in the submarine power cables -- has been completely installed, the attenuation in each fiber will be measured using an OTDR in accordance with ANSI/EIA/TIA-445-61.

The following discussion summarizes presents steps that CWA and its contractors will take to ensure that the inner-array and 115 kV submarine transmission cables are adequately covered, will not negatively affect water quality and will not interfere with fishing gear/activity or with the safe operation of the cables. CWA will ensure that the submarine transmission cables are initially buried to or below the approved and required depth of six feet below the seafloor. To ensure this initial burial depth, CWA will require that the selected cable vendor utilize real-time monitoring of the cable installation, to ensure optimal performance of the cable embedment technology and to maximize cable burial depth. Additionally, the cable installer will be required to conduct an as-built survey of the cable system shortly after installation, providing detailed latitudes, longitudes and depths of the emplaced cables.

CWA will use scour mats to provide protection at the base of the installed monopiles and the ESP. Rock armor will be used if it is believed that scour protection mats will not be adequate in a given area.

After the first year of installation, CWA will visually inspect the seabed footing of each monopile and ESP, and will visually inspect the seafloor along the reaches of all buried cables. If no initial deterioration is observed at the first year inspection, CWA will visually inspect the seabed footing of each monopile and ESP, and representative reaches of buried cables in areas of migrating sand waves and other selected reaches on a biennial (every two years) basis. This inspection will include the monitoring of scour mats and any approved rock armor. CWA will immediately inform BOEMRE if scour mats or approved rock armor become dislodged and/or significant scouring is occurring.

CWA will conduct biennial visual inspections, which may be aided or unaided by optical devices, of the inner array cable routes in areas of migrating sand waves. Should the visual inspection indicate that cable burial depth is compromised, CWA may utilize technical survey methodologies such as using Pulse Induction Technology (such as, but not limited, to a TSS

350) to determine the vertical range of the buried cable. CWA shall also conduct sample surveys of cables after any significant storm activity.

The O&M Contractor's maintenance for the WTG array and export cables shall include but not be limited to:

- In-service inspection procedures.
- Methods to monitor or inspect scour protection.
- Regular surveys of scour protection around the foundations.
- Regular surveys to check cable burial is maintained.

A representative electric cable maintenance schedule is provided in Appendix G-2.

5.9.4.5 Aids to Navigation and Aviation Hazard

The Project, including the ATON and aviation hazard warning equipment function and operation shall be maintained to meet regulatory requirements and the lease conditions:

- Each individual WTG will be marked with private aids to navigation in accordance with guidelines established by the International Association of Marine Aids to Navigation and Lighthouse Authorities (IALA), subject to the approval of the Commander, First Coast Guard District.
- Each individual WTG will be clearly marked with a unique alphanumeric designation on the tower, and the USCG, other local, states, and Federal agencies will be provided with a plan showing designations for each WTG.
- WTGs will be painted an off-white (5 percent grey) color.
- There will be no daytime FAA white lighting.
- The Project will abide by the terms and conditions of the FAA's Determination of No Hazard to Air Navigation, issued on May 17, 2010.
- 50 perimeter WTG nacelles and the 8 WTGs located adjacent to the ESP will be lighted at night:
    - Each perimeter WTG nacelle will be lighted with one red flashing FAA light fixture equipped with automatic lamp changers.
    - Every other perimeter WTG will be lit by a single, medium intensity red light at night, with each alternating perimeter WTG lit by a single, low intensity red light.

- o Medium intensity lanterns (FAA L-864) will be used at corners/points of direction change with intervals of no more than 1.5 miles (2.4 km) between similar intensity fixtures.
- o The balance of perimeter WTGs will be marked with low intensity lanterns (similar in intensity to the FAA L-810 with visibility to approximately 1.15 miles).
- o The eight turbines adjacent to the ESP will each have one L-810 flashing red fixture.
- o The red lights on the perimeter WTGs and other FAA lighting [on WTGs adjacent to ESP] will be synchronized to flash in unison. The red lighting will flash on for one second, followed by no flashes for two seconds to give a rate of 20 flashes per minute (fpm).

- The balance of the interior turbines will not have FAA lighting.

5.9.4.6 Access and Egress Arrangements

Access and egress arrangements, including those for emergency evacuation and rescue, will be installed and maintained to meet the requirements of the SMS.

The Owner and all contractors will cooperate to ensure that the following requirements are fully incorporated in the design, build, and operation and maintenance of the wind farm equipment (primarily the WTGs with their transition piece (TP), and the ESP). Particularly, this will require incorporation in the maintenance schedules, and checks that this maintenance is performed, including checks on the following:

- Condition and security of access walkways, safety barriers, netting, etc.
- Access and egress routes kept clear of obstructions, hazardous materials or wastes.
- Fire protection systems do not unduly hinder egress, and any fire suppression systems do not present undue hazard to personnel (zoning, selection of fire suppression type, disabled when personnel might require access).
- Emergency lighting.
- Elevators for personnel.
- Ladders, safety harness attachment points and fall arrest systems including security and load capacity of all anchorages.
- Emergency escape apparatus.
- Emergency stops and interlocks.

Inspection and tests will generally be undertaken annually or as required by regulatory authority.

5.9.4.7 SCADA Systems Maintenance

SCADA functions will be monitored remotely on a continuous basis. Should any faults occur, a decision will be made as to whether immediate repair is necessary or whether attendance at the offshore site can await the next scheduled service or maintenance visit, in accordance with established protocols for wind farm management.

Inspection, testing, and preventive maintenance will generally be undertaken annually as indicated in the maintenance schedules for the WTGs / WTG SCADA, ESP or BoP / Wind Farm SCADA.

5.9.4.8 Communications Systems Maintenance

Communications systems will be monitored remotely on a continuous basis. Should any faults occur with critical primary or secondary / back-up communication systems, immediate repair will be scheduled in order that the status of the plant can be continuously monitored, or emergency remote supervisor controls implemented whenever required.

Inspection, testing, and preventive maintenance will generally be undertaken annually as indicated in the maintenance schedules for the BoP.

5.9.5 Unscheduled or Corrective Maintenance Arrangements

The O&M Contractor will provide Corrective Maintenance, either directly or through the application of subcontracting services, on equipment where the vendor has Preventative and Corrective Maintenance responsibility. The O&M Contractor has full responsibility for all corrective maintenance on the WTGs. Whenever possible Corrective Maintenance will be planned through a scheduled outage, in the event Corrective Maintenance is required due to a forced outage, The O&M Contractor will dispatch personnel to site to perform Corrective Maintenance tests and repairs. Services provided associated with the delivery of Corrective Maintenance incorporates the following:

1) Timely dispatch of manpower with appropriate skill levels consistent with the tasks anticipated.
2) Timely dispatch of testing equipment and other resources to site to perform diagnostic testing and perform repairs and/or replacement based upon tasks anticipated.
3) Delivery of a Corrective Maintenance field report to Owner regarding dispatch performance, test results and service activities performed. This field report will typically include:
    a. Test results for both diagnostic and verification of successful repair.
    b. List of Spare Parts consumed in the performance of Corrective Maintenance.

c. Recommendation with respect to equipment, follow up maintenance activity, testing or inspections to be scheduled in the future.

d. If appropriate, recommendation on equipment replacement or refurbishment, or reduced utilization as consequence of condition or residual damage sustained.

4) Provide listing of Spare Parts consumed in the performance of Corrective Maintenance Services.

5.9.6 Special Maintenance Arrangements

Special maintenance arrangements will be implemented for the following:

- Additional preventive maintenance (e.g. maintenance thought to be beneficial in improving reliability or operating life additional to that already scheduled.
- Complex repairs.
- Refurbishment.

Technical support, provision of spares or replacement parts, and undertaking of such maintenance works on the WTGs or ESP shall be provided by the O&M Contractor.

Maintenance of the sub-sea array and export cables, onshore termination, onshore cables and grid connection interface shall be arranged by the Owner unless the O&M Contract is extended to cover special maintenance of these aspects.

5.9.6.1 WTG Complex Repairs

Complex repairs 'will include all ancillary spare parts, lubricants, consumables and labor (including a works supervisor and any labor associated with managing the lifting of major components). The Owner shall provide the necessary specialist lifting vessels unless otherwise stated in the contracts.

Complex Repairs are categorized as follows:

Complex Repair (typically requiring a specialist vessel)

- Gearbox replacement.
- Generator replacement.
- Blade replacement.
- Blade pitch bearing or replacement.
- Yaw ring replacement.
- Main shaft (including temporary hub removal and bearing replacement).

- 33kV transformer replacement.

Complex Repair (typically not requiring a specialist vessel)

- Generator drive end bearing replacement.
- Generator non-drive end bearing replacement.
- Generator slip ring replacement.
- Yaw motor replacement.
- Yaw gearbox replacement.
- Pitch cylinder replacement.
- Pitch accumulator replacement.
- Gearbox high speed bearing replacement.
- Gearbox intermediate shaft replacement.
- Control system.
- Brake caliper replacement.
- Main hydraulic pump unit replacement.
- Rotating union replacement.
- UPS replacement.
- Local blade inspection and repairs (including exposed fiberglass components including nacelle, nose cone).
- 33kV switchgear replacement.
- WTG SCADA system WTG remote station.
- WTG SCADA system base station.
- Lifting equipment repair.

5.9.6.2 ESP Complex Repairs

Complex repairs 'will include all ancillary spare parts, lubricants, consumables and labor (including a works supervisor and any labor associated with managing the lifting of major components). The Owner shall provide the necessary specialist lifting vessels unless otherwise stated in the contracts.

Complex Repairs are anticipated to be categorized as follows:

Complex Repair (typically requiring a specialist vessel)

- 115kV transformer replacement.

Complex Repair (typically not requiring a specialist vessel)

- 33kV switchgear and associated protection replacement.
- 115kV switchgear and associated protection replacement.
- 115kV transformers repair.
- Fire protection system repair.
- UPS replacement.
- WTG SCADA system WTG remote station repair.
- WTG SCADA system base station repair.
- Lifting equipment repair.
- ESP standby diesel engine generators replacement (if installed).

5.9.6.3 Cable Complex Repairs

The potential for a fault occurring during the operational lifetime of a buried cable system is minimal, based on industry experience (see Section 5.8.2 above). However, a cable repair procedure would be formulated by the O&M Contractor to cover the remote possibility of a fault occurring in the offshore submarine cable system. The focus would be to repair the cable quickly, while minimizing or eliminating environmental and community impacts. Should a cable failure occur, a cable repair procedure would be implemented. Once the location of the fault is identified, should the cable fault occur in the onshore sections of the project, then typical trench, repair and backfill methods would be used and no formal fault plan required. Communication with the appropriate people would take place at least 48 hours prior to repair and would specify the location, method, and date of work. Along the submarine cable, the procedures listed below are one way of repairing a cable fault.

- Mobilize the splice boat and fine tune the location of the fault.
- The splice boat would likely be a barge, equipped with water pumps, jetting devices, hoisting equipment and other tools typically used in repairs of cables.
- Expose the cable with hand-operated jet tools and cut the cable in the middle of the damaged area.

- Position the repair vessel above the cut cable, and raise one end.
- Cut off the damaged portion of the cable
- Perform a cable splice between the retrieved cable and one end of the spare cable onboard.
- Pay out cable and move to the other end of the spare cable, keeping a portion of the spare cable onboard.
- Retrieve the other damaged cable end.
- Cut off the damaged portion of the cable.
- Perform a cable splice between the retrieved cable and the remaining end of the spare cable onboard.
- Lower the second joint and position it on the sea bottom.
- Hand jet the repaired and exposed sections into the sea bottom.
- Demobilize the repair vessel.

6.0 CONCEPTUAL DECOMMISSIONING PLAN

This section discusses the general concepts and methodologies involved in the decommissioning of the Project.

6.1 Decommissioning Plan Requirements

As stated in the BOEMRE lease (Section 13: Removal of Property and Restoration of the Leased Area on Termination of Lease), CWA is required to "remove or decommission all facilities, projects, cables, pipelines, and obstructions and clear the seafloor of all obstructions created by activities on the leased area, including any project easements(s) within two years following lease termination, whether by expiration, cancellation, contraction, or relinquishment, in accordance with the Addenda and applicable regulations."

Prior to commencing decommissioning activities, CWA will submit a Decommissioning Application to BOEMRE for their approval.

As required in the BOEMRE Lease (Addendum B. III (b) Additional Financial Assurance) CWA is required to provide "a decommissioning bond or other approved means of meeting the Lessee's decommissioning obligations." (See Section 2.0 for further information on financial assurance)

In the event that the Project permanently ceases operation, a decommissioning plan will be implemented to remove and recycle, to the greatest degree possible, equipment and associated materials, thereby returning the area essentially to pre-existing conditions.

It bears noting that due to the relative newness of the offshore wind industry, none of the facilities in operation around the world have been decommissioned. The discussion below presents procedures and methods that would be most appropriate given today's technology, however it is probable that technological advancements will take place over the next two decades that would be more appropriate at the time of the Project's decommissioning.

6.2 Decommissioning Plan

Any decision by CWA to cease operation of individual WTGs or the entire Project and to decommission and remove the Project components will require consultation with BOEMRE. CWA is required to submit a decommissioning plan to BOEMRE for approval which must comply with BOEMRE's structural removal standards. Upon decommissioning of the facility, CWA must implement the decommissioning plan to remove and recycle equipment and associated materials, thereby returning the area to pre-existing conditions.

Decommissioning the Project is largely the reverse of the installation process. Decommissioning of the wind farm is broken down into several steps, closely related to the major components of the Project:

- Submarine transmission cables.
- Turbine generators and towers.
- Monopile foundations and scour system.
- Electric Service Platform.
- Upland transmission cables.

It is anticipated that equipment and vessels similar to those used during installation will be utilized during decommissioning. For offshore work this would likely include a jet plow, crane barges, jack-up barges, tugs, crew boats and specialty vessels such as cable laying vessels or possibly a vessel specifically built for erecting WTG structures. For upland work, general construction equipment such as backhoes and cable trucks would be utilized. The environmental impacts from the use of this equipment during decommissioning activities would be similar to impacts experienced during construction. However it is reasonable to expect that by the end of the Lease term, technological advances in methods and equipment servicing the offshore industry will result in some increased level of efficiencies as well as a reduced level of environmental impacts.

6.3 Decommissioning Process

The decommissioning of the offshore facilities would necessitate the involvement of an onshore disposal and recycling facility with the capacity and capabilities of handling the large quantities of steel, fiberglass and other materials from the Project. Acknowledging the fact that other potential onshore disposal and recycling facilities may exist at the end of the Lease term that may prove to be more desirable, facilities do currently exist that are capable of handling the materials. Prolerized New

England Inc. operates several facilities, two of which are located in Everett Massachusetts, and Johnston Rhode Island. Prolerized staff has indicated that they have the capabilities and capacity to handle the disposal and recycling of the materials from the proposed action, if it were to take place today. The Everett facility has deep water access, allowing for the steel towers and monopiles to be directly offloaded from the barges, cut into manageable sections, sheared into smaller pieces and then shipped to end-users as scrap metal.

For this reason, the Everett facility would be the proposed location for the onshore disposal and recycling of project materials. Currently there is no commercial scrap value for the fiberglass in the rotor blades. The fiberglass from the blades would be cut into manageable pieces and then disposed of as solid waste at an approved onshore facility. The initial step in the decommissioning process would involve the disconnection of the inner- array 33kV cables from the WTGs. The cables would then be pulled out of the J-tubes, and removed from their embedded position in the seabed. Where necessary the cable trench will be jet plowed to fluidize the sandy sediments covering the cables, and the cables will then be reeled up onto barges. The cable reels will then be transported to the port area for further handling and recycling.

The WTGs would be prepared for dismantling by properly draining all lubricating fluids according to the established operations and maintenance procedures and Materials Management and Disposal Plan (Appendix D), and removing the fluids to the port area for proper disposal and / or recycling. This would be followed by the WTGs being deconstructed (down to the transition piece at the base of the tower) in much the same way as they were installed. Utilizing the same or similar types of cranes and vessels as during their construction, the blades, rotor, nacelle and tower would be sequentially disassembled and removed to port for recycling. It is anticipated that (with the possible exception of the fiberglass) virtually the entire WTG will be recyclable.

Once the wind turbines and towers have been removed, the foundation components (transition piece, monopile and, scour mats / rock armor) would be decommissioned. Sediments inside the monopile will be suctioned out and stored on a barge to allow access for cutting and, in accordance with the BOEMRE's removal standards (30 CFR 250.913) , the monopile and transition piece assembly will be cut approximately 15 feet (5 meters) below the seabed, with the portion of the pile below the cut remaining in place. Depending upon the capacity of the available crane, the assembly above the cut may be further cut into more manageable sections in order to facilitate handling, and then placed on a barge for transport to the port area for recycling. Cutting of the pile would likely be done using one or a combination of: underwater acetylene cutting torches, mechanical cutting, or high pressure water jet. The sediments previously removed from the inner space of the monopile would be returned to the depression left when the monopile is removed, using the vacuum pump and diver assisted hoses in order to minimize sediment disturbance and turbidity. All scour mats will be recovered, brought to the surface by crane, placed on a barge and brought to port for recycling or disposal. In those locations where rock armoring has been used for scour protection, it would be excavated with a clamshell dredge, placed on a barge, and disposed of at an upland location.

The ESP will be dismantled in a similar manner as the WTGs, using similar vessels. The ESP would be prepared for dismantling by properly draining all oils, lubricating fluids, and transformer oil according to the established operations and maintenance procedures and OSRP, and removing the fluids to the port area for proper disposal and / or recycling. The inner-array 33kV cables from the WTGs and the 115 kV transmission cables to shore would be disconnected from the ESP and removed as discussed above. The heliport, ladders and boat platform will be removed from the ESP by cutting, and placed on a barge for removal to the mainland and recycling. The balance of the jacketed superstructure will be cut from the piles and lifted out of the water, placed onto barges, and removed to port for recycling. The ESP foundation piles and scour protection will be removed according to the same procedures used in the removal of the WTG foundations described above.

Decommissioning of the landfall transition and upland transmission line components will consist of pulling the cables out of the underground concrete ductbank, loading it onto truck mounted reels and transporting them offsite for reuse or salvage. The underground vaults, conduits and ductbanks will be left in place, available for reuse if the need should arise, in order to avoid disruption to the streets.

The FEIS discusses the potential impacts associated with these decommissioning activities.

7.0 ENVIRONMENTAL SAFEGUARDS

CWA has committed to implementing extensive resource safeguards to avoid, minimize or mitigate potential impacts due to construction, operation and decommissioning of the Project. These safeguards are categorized as 1) BMPs; 2) mitigation measures; 3) monitoring programs and compliance plans; and 4) reporting requirements.

All Project activities undertaken pursuant to the Lease will comply to the maximum extent practicable with the extensive BMPs identified in Section 5 of the ROD. These BMPs will not be repeated herein.

Mitigation, monitoring and reporting requirements will be the responsibility of an Environmental Coordinator, as described in section 4.0 of this COP. The Environmental Coordinator will report to the Project Director and will ensure that all local, state and federal permitting requirements and laws relating to environmental protection and reporting are adhered to. The Project's Environmental Coordinator will be responsible for verifying compliance with environmental protection programs and protocols for environmental incident response, and ensuring that any and all reporting requirements that are part of the mitigation and monitoring stipulations are completed and filed in a timely manner.

This section incorporates by reference all the environmental safeguards that have been agreed upon with BOEMRE in the executed Lease, as well as with state and local agencies. How CWA will comply with the terms, conditions, and environmental stipulations of the lease is presented and discussed throughout this COP, and its appendices. Table 7.0-1 references the relevant sections of the COP where the implementation of the mitigation, monitoring, and reporting requirements can be found.

Table 7.0-1

Mitigation and Monitoring			
Environmental Resource	**Source Document(s) Initiating**	**Details**	**Implementation Discussed in COP Section**
Cultural Resources	Lease; ROD and FEIS	Per Section 106 review process and source documents' stipulations, the Environmental Coordinator will ensure that CWA will: ▪ Conduct a pre-survey meeting with BOEMRE to finalize survey details. ▪ Conduct High Resolution Geophysical (HRG) and Geotechnical (G&G) Surveys according to the Lease ▪ Protect Cultural Resources utilizing pre-determined buffer zones in consultation with BOEMRE and Marine Archaeologist ▪ Follow procedures for Unanticipated Discovery ("Chance Finds") of Cultural Resources and/or Human Remains. ▪ Bottom disturbing activities to be monitored by qualified archaeologist and tribal members.	▪ Section 4.1.1 ▪ Section 4.1.1.2
Geology	Lease; ROD and FEIS	Per the source documents' stipulations, the Environmental Coordinator will ensure that CWA will: ▪ Conduct a pre-survey meeting with BOEMRE to finalize survey details. ▪ Conduct High Resolution Geophysical (HRG) and Geotechnical (G&G) Surveys according to the Lease ▪ Follow geotechnical sampling / testing protocols for CPTs, vibracores and soil borings ▪ Install and monitor scour protection mats and/or rock armor at the base of all monopiles and ESP ▪ Install and monitor submarine cables to ensure proper burial depth.	▪ Section 4.1.1 ▪ Section 4.1.1.3 and Appendix A ▪ Section 4.1.3.3 ▪ Sections 4.1.4 and 4.1.6 ▪ Section 5.9.4.4

Mitigation and Monitoring			
Environmental Resource	**Source Document(s) Initiating**	**Details**	**Implementation Discussed in COP Section**
Air Quality	Lease; ROD; FEIS and BOEMRE Conformity Analysis	Per the source documents' stipulations, the Environmental Coordinator will ensure that CWA will: ▪ Purchase appropriate Emission Reduction Credits ▪ Comply with all emission control and equipment requirements ▪ Comply with all reporting requirements ▪ Contractors operating diesel-powered equipment at the Quonset Point staging site use ultra low sulfur diesel fuel	▪ Section 4.1.8.1 and Appendix H (EPA Air Permit)
Water Quality	Lease; ROD; FEIS and 401 Water Quality Certificate	Per the source documents' stipulations, the Environmental Coordinator will ensure that CWA will: ▪ Comply with Operations and Maintenance Plan ▪ Comply with the OSRP ▪ Comply with the SWPPP	▪ Section 5.9.4.4 ▪ Appendix C ▪ Appendix F
Electrical and Magnetic Fields	Lease; ROD; FEIS	Per the source documents' stipulations, the Environmental Coordinator will ensure that CWA will: ▪ Install shielded three conductor cables as configured, in one trench to the specified depth of at least 6 feet in order to minimize any Electrical and Magnetic Fields (EMF)	▪ Sections 4.1.4 and 4.1.6

Mitigation and Monitoring			
Environmental Resource	**Source Document(s) Initiating**	**Details**	**Implementation Discussed in COP Section**
Coastal and Intertidal Vegetation	Lease; ROD; FEIS and 401 Water Quality Certificate	Per the source documents' stipulations, the Environmental Coordinator will ensure that CWA will: ▪ Conduct pre and post construction eel grass surveys until two years following commencement of commercial operations ▪ Aerial photography ▪ Monitor cable installation activities near Egg Island (including diver assisted anchor placements to avoid eel grass) ▪ Replant eel grass if the results of post construction surveys indicate that eelgrass was lost as the result of the project ▪ Comply with all reporting requirements	▪ Section 4.1.1.4 ▪ Appendix H-6, MassDEP Water Quality Certificate, Attachment E
Subtidal Offshore Resources	Lease; ROD; FEIS; FEIR and 401 Water Quality Certificate	Per the source documents' stipulations, the Environmental Coordinator will ensure that CWA will: ▪ Monitor benthic community recovery along the transmission line route (both on the OCS, including three additional paired monitoring sites, and within state waters) according to the Seafloor Habitat/Benthic Community Monitoring Plan ▪ Utilize proper scour control methods ▪ Comply with all monitoring and reporting requirements	▪ Section 4.1.1.4 ▪ Appendix H-6, MassDEP Water Quality Certificate, Attachment E ▪ Section 4.1.3.3

Mitigation and Monitoring			
Environmental Resource	**Source Document(s) Initiating**	**Details**	**Implementation Discussed in COP Section**
Fisheries and Essential Fish Habitat	Lease; ROD; FEIS; FEIR and 401 Water Quality Certificate	Per the source documents' stipulations, the Environmental Coordinator will ensure that CWA will: ▪ Abide by time of year in-water work restrictions to protect winter flounder spawning ▪ Install and monitor scour control to ensure proper function ▪ Install and monitor submarine cables to ensure proper burial depth ▪ Properly notice all construction activities ▪ Monitor benthic community recovery along the transmission line route (both on the OCS, including three additional paired monitoring sites and within state waters) according to the Seafloor Habitat/Benthic Community Monitoring Plan	▪ Section 2 and Appendix H (401 WQC) ▪ Section 4.1.1 ▪ Section 4.1.3.3 ▪ Sections 4.1.4 and 4.1.6 ▪ Section 4.1.1.4 ▪ Section 5.9.4.4

Mitigation and Monitoring			
Environmental Resource	**Source Document(s) Initiating**	**Details**	**Implementation Discussed in COP Section**
Marine Mammals and Sea Turtles	Lease; ROD; FEIS	Per the source documents' stipulations, the Environmental Coordinator will ensure that CWA will: ▪ Obtain Incidental Harassment Authorization (IHA) prior to construction ▪ Comply with all NMFS mitigation measures resulting from the Endangered Species Section 7 consultation ▪ Abide by NOAA Fisheries Northeast Regional Viewing Guidelines and MMS Gulf of Mexico Region's Notice to Lessee (NTL) No. 2007-G04, ▪ Limit start of pile-driving to daylight hours ▪ Seismic surveying equipment will comply as much as possible with applicable equipment noise standards of the U.S. ▪ Ensure a "soft start" at the beginning of each pile installation in order to allow marine mammals and sea turtles to vacate the project area ▪ Employ NMFS approved Marine mammal observers on survey and pile driving vessels ▪ Establish and maintain appropriate exclusion zones ▪ Conduct required sound measurements ▪ Comply with all reporting requirements	▪ Section 4.1.1.4 ▪ FEIS pg 9-24 ▪ FEIS Appendix G ▪ Biological Opinion Appendix J of the FEIS ▪ Section 4.1.3.1

Mitigation and Monitoring			
Environmental Resource	**Source Document(s) Initiating**	**Details**	**Implementation Discussed in COP Section**
Avifauna and Terrestrial and Coastal Fauna	Lease; ROD; FEIS	Per the source documents' stipulations, the Environmental Coordinator will ensure that CWA will: ▪ Comply with all United States Fish and Wildlife Service (USFWS) mitigation measures resulting from the Endangered Species Section 7 consultation ▪ Comply with all requirements of the ABMP once it has been finalized. The current draft version of the ABMP has been submitted to BOEMRE and USFWS and is currently under review and discussion. CWA will continue to consult with BOEMRE and USFWS to finalize the ABMP. ▪ Comply with all reporting requirements	▪ Biological Opinion Appendix J of the FEIS ▪ Section 4.1.1.4 ▪ Appendix B
Visual Resources	Lease; ROD; FEIS; FAA Determination of No Hazard	Per the source documents' stipulations, the Environmental Coordinator will ensure that CWA will: ▪ Mark and light the facilities according to approved FAA plan (off-white 5% grey tone paint and no day-time lighting).	▪ Section 5.9.4.5 and Appendix H (FAA Determination of No Hazard)
Airport Facilities and Air Traffic	Lease; ROD; FEIS; FAA Determination of No Hazard; FAA Affirmation of Determination	Per the source documents' stipulations, the Environmental Coordinator will ensure that CWA will: ▪ Implement the marking, flash sequence and lighting provisions per the Lease ▪ Implement the terms and conditions related to radar mitigation in the FAA Determination of No Hazard	▪ Section 5.9.4.5 and Appendix H (FAA Determination of No Hazard)

Mitigation and Monitoring			
Environmental Resource	**Source Document(s) Initiating**	**Details**	**Implementation Discussed in COP Section**
Marine Activities and Port Facilities	Lease; ROD; FEIS	Per the source documents' stipulations, the Environmental Coordinator will ensure that CWA will: ▪ Implement all terms and conditions identified by the USCG in Appendix B of the FEIS to insure maritime safety ▪ Continue to consult and coordinate closely with USCG ▪ Ensure that all WTGs and ESP are properly marked with Private Aids to Navigation (PATONS) ▪ Ensure that communication protocols are in place with USCG to enable remote shutdown and assist with SAR if requested ▪ Mark each individual WTG with clearly visible, unique, alpha-numeric identification characters ▪ Comply with all reporting requirements	▪ Section 4.1 ▪ Section 5.7.4 ▪ Section 5.8.3 ▪ Section 5.9.4.5 ▪ Appendix E ▪ FEIS Page 5-258
Communications	Lease; ROD; FEIS	Per the source documents' stipulations, the Environmental Coordinator will ensure that CWA will: ▪ Avoid use of specified radio frequencies as necessary and ensure that VHF radios utilized by the project do not interfere with other mariners and maritime safety	▪ Appendix E, Section 6

Through compliance with the extensive stipulations in the Lease, the ROD, the FEIS, FEIR and other regulatory documents as outlined above, the oversight of the Environmental Coordinator will ensure that CWA minimizes, through avoidance, monitoring and mitigation of impacts from the Project.

8.0 NEPA AND REGULATORY COMPLIANCE

8.1 NEPA Compliance

The information contained in a COP is intended to provide BOEMRE with information necessary to allow BOEMRE to comply with NEPA and other relevant laws. However, CWA has already submitted – and BOEMRE has extensively reviewed – the information that would otherwise be submitted in a COP. Therefore, CWA incorporates by reference into this COP, the Final Environmental Impact Statement issued by BOEMRE in January 2009, as well as the Environmental Assessment and Finding of No New Significant Information (FONNSI) issued by BOEMRE on April 28, 2010. Specific environmental resources that could be affected by construction and operation of the Project have been fully assessed in prior filings; locations of the resource assessments are reported in the FEIS. The information contained in this COP further details the procedures that will be followed to construct, operate, and maintain the project in accordance with the project description contained in Section 2.0 of the FEIS.

The status of all permits and approvals is summarized in Table 1.4-1.

New information relevant for NEPA purposes since BOEMRE's April 28, 2010 FONNSI is limited to:

1. The Shallow Hazards Report (Appendix A) that shows that existing site conditions are typical for site area and that no unexpected features exist that would alter the construction and operation of the project as detailed in the FEIS.

2. The FAA's Finding of No Hazard On May 17, 2010, (Appendix H) approving construction of the turbines and stating that the aeronautical studies "revealed that the structure would have no substantial adverse effect on the safe and efficient utilization of the navigable airspace by aircraft or on the operation of air navigation facilities." Following the May 17, 2010 Determinations of No Hazard, the FAA received several petitions for discretionary review, in effect appealing its decision based on impacts to visual flight rules and radar. The FAA conducted a review of the aeronautical study and Determination process and upheld its decision, issuing its affirmation of Determination of No Hazard on August 5, 2010 (Appendix H).

3. BOEMRE's reinitiation of formal ESA consultation with National Marine Fisheries Service (NMFS) on July 13, 2010 in response to the sighting of a number of Right whales outside of Nantucket Sound in April 2010. NMFS issued it's revised Biological Opinion (12/30/10) which concluded that consistent with the previous Opinion would not jeopardize the existence of the Right whale.

4. EPA Region I issued an OCS Air Permit for the project on January 7, 2011, requiring the project to comply with the applicable provisions of the Massachusetts air pollution control regulations, including New Source Review (NSR) and the applicable provisions of 40 CFR 60, Standards of Performance for New Stationary Sources. (Appendix H)

5. USACE issued an Individual Permit – Section 10 Rivers and Harbors Act / Section 404 Clean Waters Act on January 5, 2011 authorizing the placement of the WTG structures in navigable waters, and the discharge of dredge or fill material related to the landfall transition cofferdam. .

8.2 Permits and Approvals

CWA has received all state permits necessary to construct the project. All major federal reviews of the Project have also been completed. The BOEMRE has issued a Record of Decision, and has entered into a commercial lease with CWA on October 6, 2010. Additionally, the Federal Aviation Administration has determined that the project is not a hazard to aviation, and other major federal permits necessary for construction (EPA and USACE) have been issued. The federal and state permits and approvals are summarized in Table 1.4-1.

Coastal Zone Management (clarification):

On January 23, 2009, the Massachusetts Office of Coastal Zone Management (MCZM) issued its concurrence with the consistency certification submitted by CWA on July 23, 2008, finding that all aspects of the CWA Project, including Project components located in federal waters, were consistent with the MCZM enforceable program policies. MCZM's concurrence letter is attached (see Appendix H-4). There have been no changes made to the project that would trigger a need for any further federal consistency review by the MCZM. Indeed, even if changes were made to the project, the only requirement is for CWA to notify MCZM and to submit an explanation of the nature of the change, as required by 15 CFR Part 930. Resubmission of the consistency certification and supporting data is not required.[3]

Since concurrence has already been received, it makes little sense for CWA to submit to BOEMRE a consistency certification and data supporting. Both BOEMRE and MCZM have conducted a comprehensive review of all the necessary data.

For your convenience, the review process engaged in by MCZM, is further described below.

MCZM Consistency Review

On January 23, 2009, the Massachusetts Office of Coastal Management (MCZM), implementing its federally-approved coastal zone management program in accordance with the requirements of 15 CFR Part 930, Subpart D (Consistency for Activities Requiring a Federal License or Permit) and the requirements of 15 CFR Part 930, Subpart E (Consistency for Outer Continental Shelf (OCS) Exploration, Development and Production Activities), notified CWA, BOEMRE, and the United States Army Corps of Engineers (USACE) of its concurrence with the CWA certification that the Project would be consistent with the CZM enforceable program policies.

The MCZM consistency review encompassed all of the information prescribed to be submitted by CWA in order to satisfy the federal consistency requirements set forth at 15 CFR § 930.58(a)(2)[4] and 15 CFR § 930.58(a)(3)[5] as well as the MCZM program requirements set forth at BOTH 301 CMR

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[3] As with approvals issued by BOEMRE, MCZM provided that, should the Project be modified from that which was reviewed by MCZM, CWA would be required to notify MCZM and to submit an explanation of the nature of the change, as required by 15 CFR Part 930. The Project has not undergone modification as contemplated by MCZM and, in the event that the Project is so modified in the future, CWA will provide the requisite notification and explanation to MCZM and MCZM will determine the need for any further federal consistency review

[4] 15 CFR § 930.58(a)(2) provides, in relevant part:

Information specifically identified in the management program as required necessary data and information for an applicant's consistency certification. The management program as originally approved or amended may describe data and information necessary to assess the consistency of federal license or permit activities. Necessary data and information may include completed State or local government permit applications which are required for the proposed activity, but shall not include the issued State or local permits. NEPA documents shall not be considered necessary data and information when a Federal statute requires a Federal agency to initiate the CZMA federal consistency review prior to its completion of NEPA compliance.

[5] 15 CFR § 930.58(a)(3) provides, in relevant part:

21.07(3) (Review Procedures – Federal License or Permit In or Affecting the Coastal Zone; Federal Consistency Review)[6] and 301 CMR 21.08(3) (Review Procedures – Outer Continental Shelf (OCS) Exploration, Development and Production Activities; Federal Consistency Review)[7].

Scope and Extent of MCZM Federal Consistency Review

The MCZM federal consistency review process, which commenced in July 2008, included submission by CWA and review and consideration of information and documentation NOT required to be reviewed and considered under the federal regulations and in excess of the requirements of both 301 CMR 21.07 and 301 CMR 21.08. Because of the scope and extent of the CWA NEPA review; initial application triggering federal action to the USACE (which commenced the first NEPA review process prior to the enactment of the Energy Policy Act of 2005); and the development and promulgation of 30 CFR Part 285 (which commenced the second NEPA review process); MCZM determined that its federal consistency review would include all aspects of the CWA Project as would be submitted to and considered by MMS (subsequently BOEMRE) in its review of the CWA Construction and Operations Plan (COP)[8].

While not required under the federal program, MCZM did, in fact, participate in the NEPA public comment process and reviewed and considered federal NEPA documents as well as Massachusetts Environmental Policy Act documents:

To inform our federal consistency review, CZM reviewed the [State] Environmental Notification Form (ENF), Notice of Project Change (NPC), Draft Environmental Impact Report (DEIR), and Final Environmental Impact Report (FEIR) developed pursuant to the Massachusetts Environmental Policy Act, two [Federal] Draft Environmental Impact Statements (DEIS) and a Final Environmental Impact Statement developed pursuant to the National Environmental Policy Act; and, pursuant to the Coastal Zone Management Act, your federal consistency certification, applicable to state permits/licenses, and lease/easement/right-of-way application to the Minerals Management Service under the Outer Continental Shelf Lands Act. Over the course of the state and federal review process, CZM has received all of the data and information necessary to make a consistency determination [emphasis added].

An evaluation that includes a set of findings relating the coastal effects of the proposal and its associated facilities to the relevant enforceable policies of the management program. Applicants shall demonstrate adequate consideration of policies which are in the nature of recommendations. Applicants need not make findings with respect to coastal effects for which the management program does not contain enforceable or recommended policies.

[6] This section of the Massachusetts regulations corresponds to 15 CFR Part 930 Subpart D (Consistency for Activities Requiring a federal license or Permit).

[7] This section of the Massachusetts regulations corresponds to 15 CFR Part 930 Subpart E (Consistency for Outer Continental Shelf (OCS) Exploration, Development and Production Activities).

[8] The approach taken by MCZM, analogous to the approach taken by BOEMRE, acknowledged the need to review and consider all of the information necessary to support BOEMRE approval of both a Site Assessment Plan and a Construction and Operations Plan, even though BOEMRE ultimately determined that CWA would not be required to submit a Site Assessment Plan.

Based on our review, all aspects of the project, including those project elements located in federal waters and the project's effects on resources and uses in the Massachusetts coastal zone [emphasis added], we concur with your certification that the activity as proposed is consistent with the CZM enforceable program policies.

January 23, 2009 CZM Federal Consistency Review of Cape Wind Energy Project – Minerals Management Service Action; Nantucket.

9.0 REFERENCES AND AGENCY CONTACTS

Over the past decade of environmental studies and preparation of multiple permitting documents for the Project, hundreds of reference documents have been studied, dozens of regulatory agencies and technical experts have been contacted by the CWA team, and numerous opportunities for public comment have been provided. The individual references have been cited in the previous permit applications listed below that are in the public domain, and will not be repeated herein. The agencies contacted are identified below, in addition permitting documents available in the public domain which are relevant to this COP are provided in Appendix H. Details about the issues addressed with the agencies are available in the relevant permitting documents.

9.1 References

The following previously submitted documents contain bibliographies of references used in preparation of this COP:

- BOEMRE FEIS
- EFSB Final Decision
- BOEMRE DEIS
- MEPA FEIR
- USACE DEIS/MEPA DEIR/CCC DRI
- MEPA ENF

9.2 Agencies Contacted and Consultations

The following documents, with the most recent first, contain lists of agencies contacted and consultations conducted:

- BOEMRE Record of Decision: Sections 7.0 and 8.0 lists public involvement, agency consultations and coordination. Agencies and Tribal Governments consulted include:
  - Wampanoag Tribe of Gay Head (Aquinnah)
  - Mashpee Wampanoag Tribe

- NOAA Fisheries Service, also known as National Marine Fisheries Service
- US Army Corps of Engineers
- US Coast Guard
- US Department of Energy
- Us Environmental Protection Agency
- US Federal Aviation Administration
- US Air Force
- US Fish and Wildlife Service
- Cape Cod Commission
- Massachusetts Department of Environmental Protection
- Massachusetts Energy Facilities Siting board
- Massachusetts Executive Office of Environmental Affairs
- Massachusetts Historical Commission
- Town and County of Nantucket
- Town of Barnstable
- Barnstable Municipal Airport

The following Federal agencies accepted a BOEMRE invitation dated March 16, 2006 to become a cooperating agency with BOEMRE:

- US Coast Guard
- US Army Corps of Engineers, New England District
- US Environmental Protection Agency

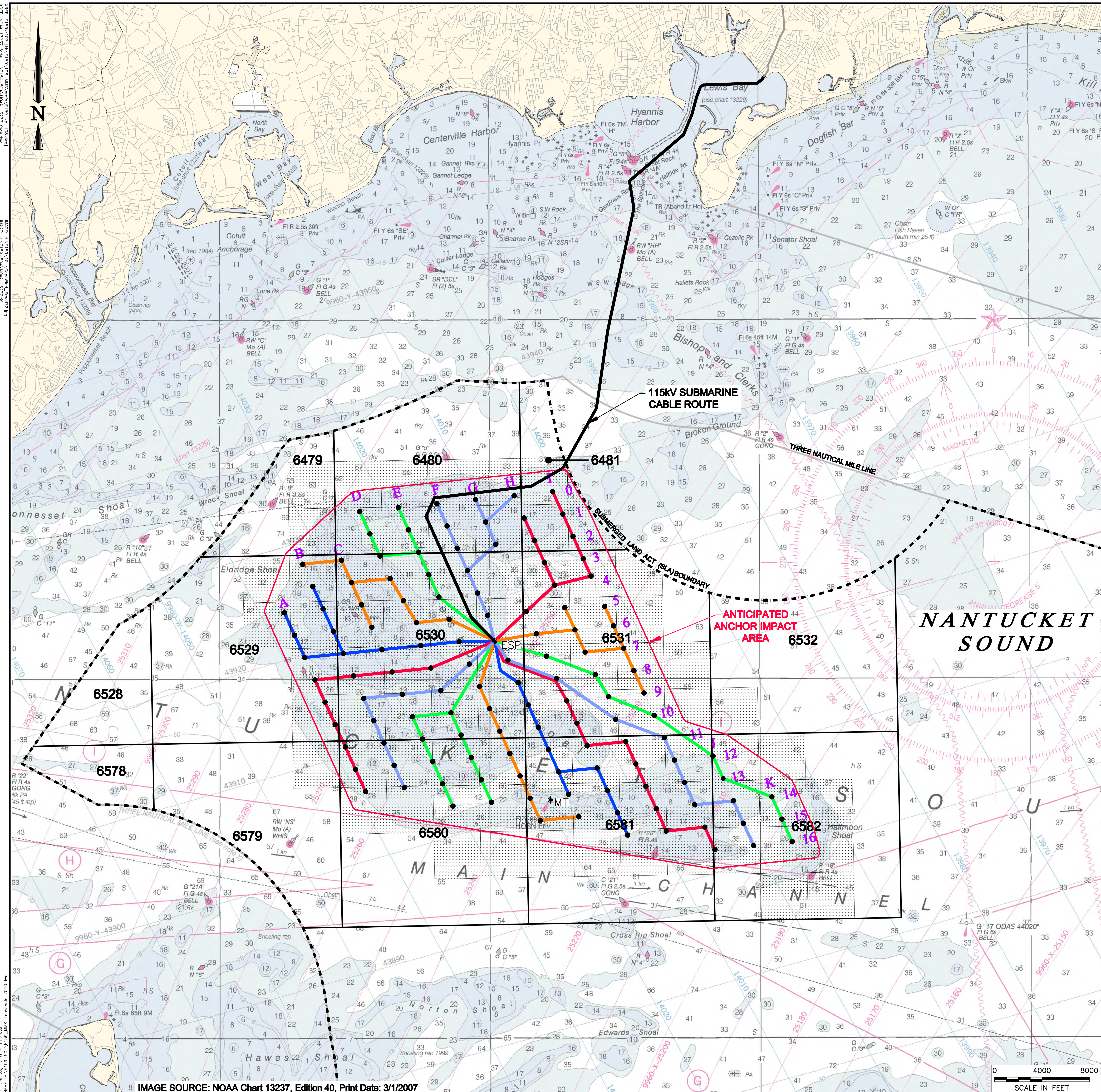
Some or all of the agencies listed above have been contacted, consulted and otherwise involved in the review of the Project at various stages throughout the regulatory process as noted in the additional permitting documents listed below.

- BOEMRE EA

- BOEMRE FEIS Appendix B: contains 357 pages detailing Project correspondence since 2002 with federal, state and local agencies, consultations, public notices and cooperating agency acceptance letters.
- EFSB Final Decision
- BOEMRE DEIS
- MEPA FEIR
- USACE DEIS/MEPA DEIR/CCC DRI
- MEPA ENF

Drawings

Location Plat



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3	A6	41 30 18.40254	70 23 25.83975	6.6
4	A7	41 29 59.71501	70 23 14.59952	7.9
5	A8	41 29 41.02910	70 23 03.33086	9.8
6	A9	41 29 22.34190	70 22 52.09290	7.4
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8	A11	41 28 44.96457	70 22 29.62366	8.3
9	A12	41 28 26.27541	70 22 18.39108	9.2
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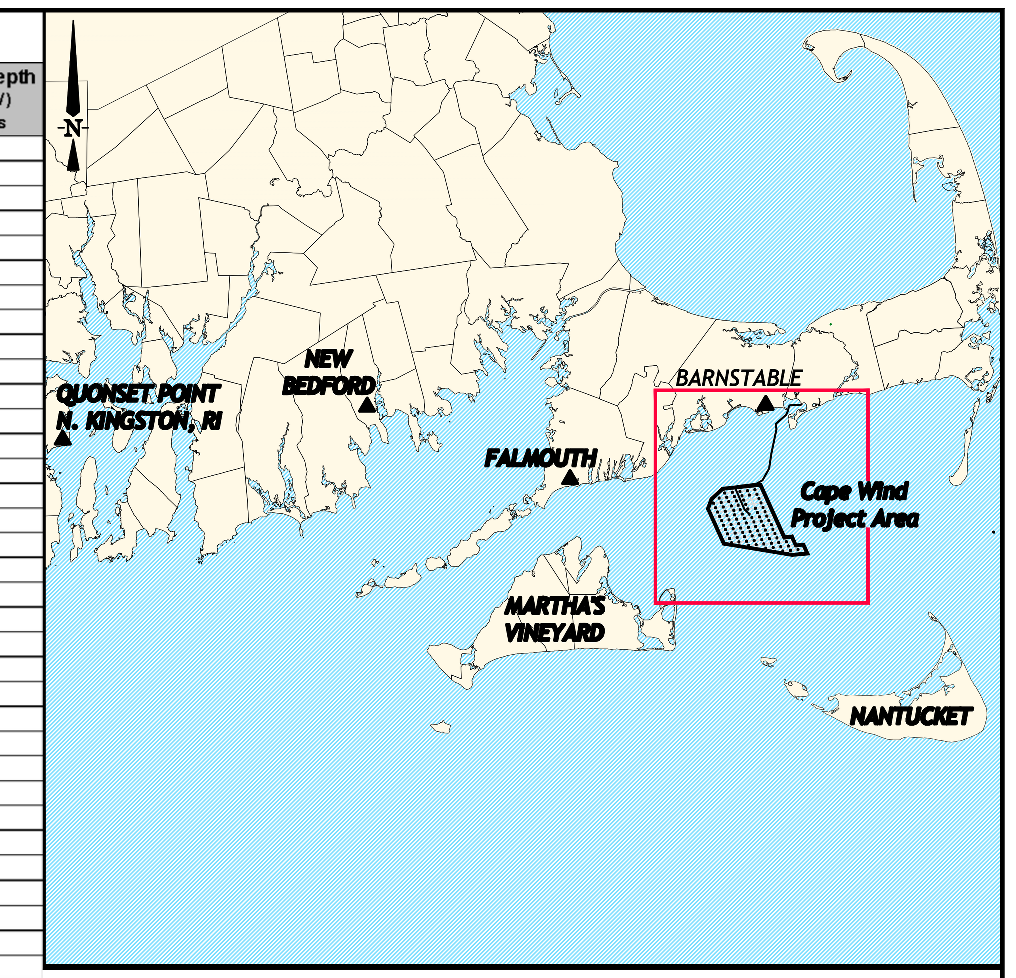

LOCUS MAP
Scale: 1"= 12 Miles

LEGEND:

- 6580 — OCS Blocks Official Protraction Diagram (OPD) Providence NK19-07
- Cape Wind Associates LLC Lease Area
- Submerged Land Act (SLA) Boundary
- Inner Array - 33kV Submarine Cable (Multi-colors)
- 115kV Submarine Cable
- Wind Turbine

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Scientists
Consultants

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No.	REVISION	DATE	APP BY

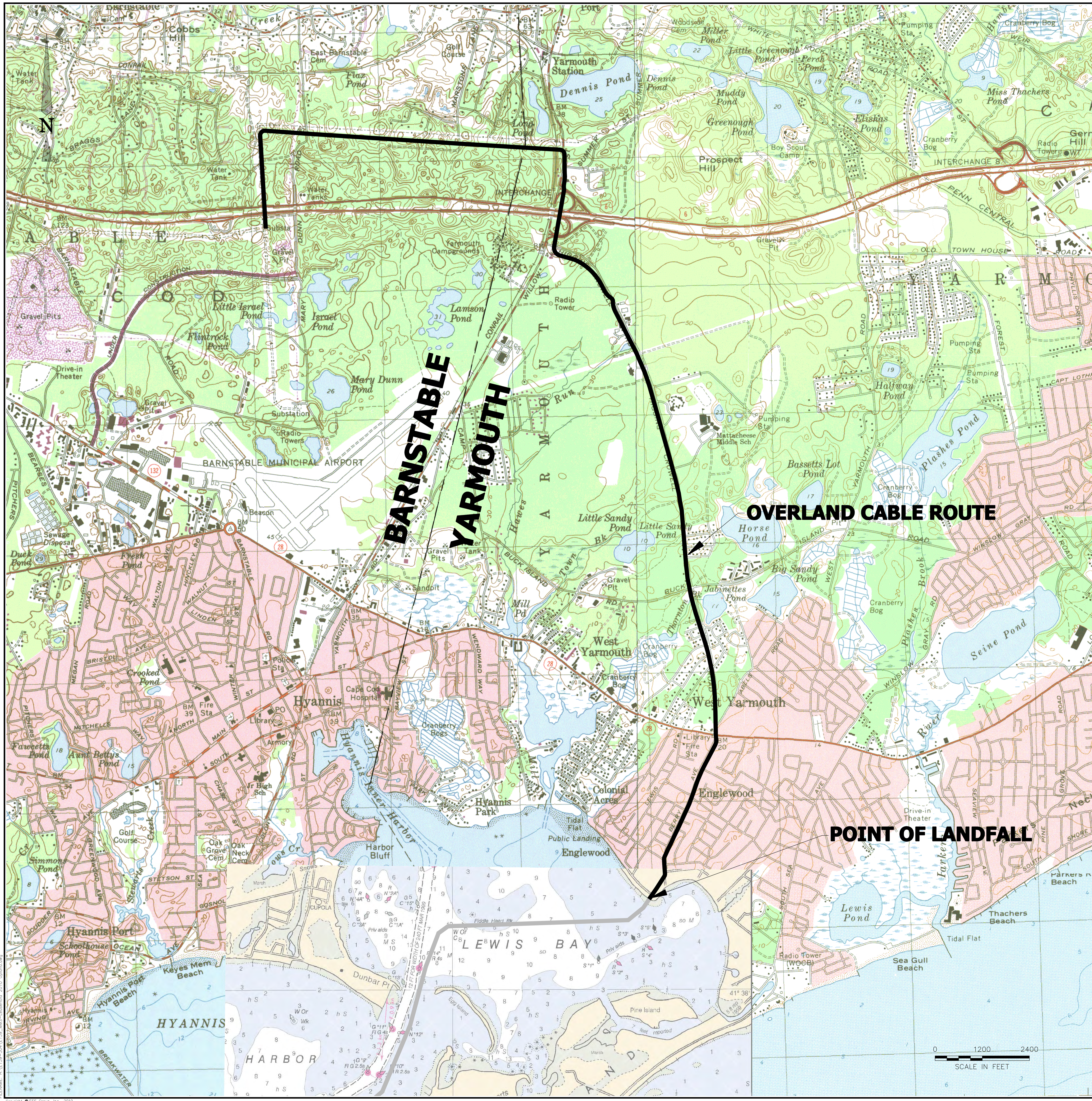
DRAWN BY: KCW | CHECKED BY: PRW
DESIGNED BY: | APPROVED BY: PRW

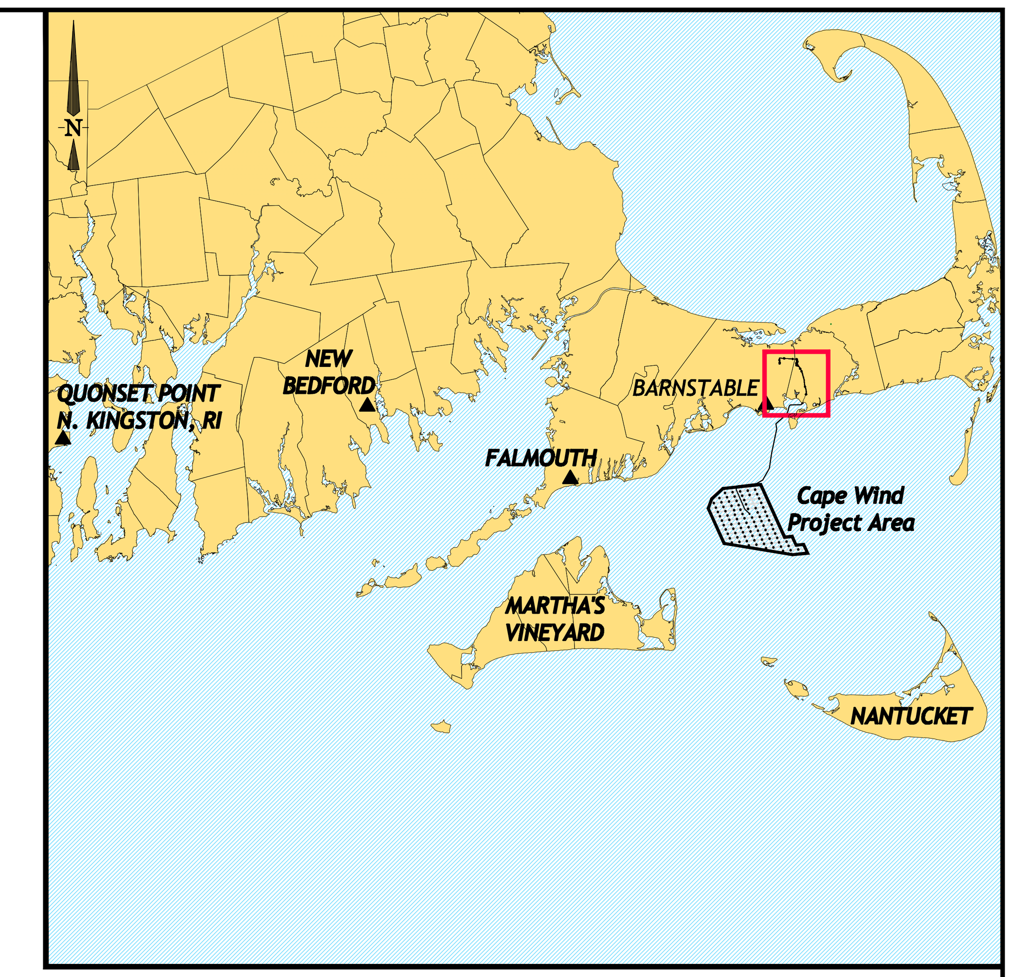
Cape Wind Associates, LLC

Cape Wind Project

Location Plat

PROJECT No.: E159-504.1
DATE OF ISSUE: October 2010
SHEET No.: 1 of 2
SCALE: As Shown
DRAWING No. 1





LOCUS MAP
Scale: 1"= 12 Miles

LEGEND:

Upland Cable

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Scientists
Consultants

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No.	REVISION	DATE	APP BY

DRAWN BY: KCW | CHECKED BY: PRW
DESIGNED BY: | APPROVED BY: PRW

Cape Wind Associates, LLC

Cape Wind Project

Location Plat (Upland)

PROJECT No.: E159-504.1
DATE OF ISSUE: October 2010
SHEET No.: 2 of 2
SCALE: As Shown

DRAWING No. 1