Environmental Studies Program: Ongoing Study

Title	Real-time Opportunity for Development Environmental Observations (RODEO) (AT-14-01)
Administered by	Office of Renewable Energy Programs
BOEM Contact(s)	Mary Boatman
Principal Investigators(s)	Anwar Khan
Conducting Organizations(s)	HDR
Total BOEM Cost	$60,000 (task 1); $503,329 (task 2); $1,165,605 (task 3); $45,447 (task 4); $336,948 (task 5); $1,384,248 (task 6); $1,495,730 (task 7); $394,416 (task 8); $1,380,785 (task 9); $179,682 (task 10)
Performance Period	FY 2016–2020
Final Report Due	Multiple Dates
Date Revised	October 24, 2019
PICOC Summary	
Problem	During construction and operation, offshore wind facilities produce many potential impacts to the environment in the form of stressors such as sound, seafloor disturbance, and introduction of hard surfaces in a soft bottom environment.
Intervention	An improved understanding of the actual stressors, including the type and duration is important for making accurate assessments of the environmental impacts.
Comparison	Without these observations, impacts are determined by modeling that can inaccurately characterize the impact and result in mitigation measures that are unwarranted.
Outcome	Data about the actual activities that can inform assessments and models.
Context	Offshore wind development is anticipated along the entire Atlantic Coast over the next 20 years.

BOEM Information Need(s): BOEM is responsible for the approval of a construction and operations plan submitted by developers for wind facilities on the Outer Continental Shelf. The approval process includes the analysis of the environmental effects from the construction, operation, and decommissioning of these facilities. Real-time measurements of the construction and operation of the first facilities to be built will allow for more accurate assessments of the actual environmental effects. Without real time observations of the activities, best estimates based on perceived activities are used to make these determinations.

Background: The construction of the first turbines in the offshore environment offers an opportunity to address many of the environmental questions that are of concern to the public. Many Federal agencies have mandates to protect the environment and will need to know more precisely what wind development will involve. Through a collaborative effort with other Federal and state agencies, the construction and operation of offshore wind turbines can be studied to gain insight into the actual disturbances to the environment. Without these real-time observations, analyses are based on best guesses and scenarios that are conservative.

Analyses of the environmental consequences require knowledge or estimates of the duration and extent of the activity. For example, the extent of disturbance on the seafloor from anchors may be estimated to encompass a larger area than actually occurs. Vessels may use dynamic positioning, resulting in no disturbance from anchoring. An analyst relies on the best available information and assumptions about the activities based on previous experience. For offshore wind development, there is no previous experience, so the analyses and subsequent mitigation measures are based on an educated guess. These analyses would benefit from real-time, independent observations during actual construction activities.

The example of anchoring is only on aspect that is estimated. A full environmental analysis includes estimates of air emissions, sound produced by the activities, sea floor disturbance by cabling, and potential discharges from vessels, to name a few. The duration of these activities is also included in the analysis. Better estimates of these activities will result in more realistic mitigation measures that appropriately reduce or eliminate the impacts. Without accurate information, developers may be required to take measures that are ineffectual. In addition to actual measurements, mitigation methodologies and testing of monitoring equipment is included in the contract.

Following are the topics that this study, through a single or series of task orders, may address.

Assessment of sound environment during construction

- Evaluate pre-existing ambient noise levels associated with the project site prior to development.
- Evaluate the characteristics of sound (intensity, duration, and frequency) generated during construction activities, such as pile driving and cable laying.
- Evaluate the most effective scales (temporal and spatial) at which to measure a representative sample of construction and operation noise.
- Evaluate the level of sound created by the increase in vessel traffic during construction and operation periods.
- Evaluate the levels of sound generated and propagated during operations.
- Evaluate devices or technology for reducing sound levels during construction activities.

Evaluation of visual activities during and after construction

- Evaluate the visibility of activities from shore, both during the day and at night.
- Evaluate the types of lighting used and what can be seen from shore during both day and night.
- Evaluate how meteorological conditions affect visibility from shore.

Evaluation of air quality emission sources from construction activities

- Monitor how many ships and/or aircraft are used for construction of offshore wind energy facilities, including duration at the site, transit times, number of trips and other relevant parameters to evaluate the air and water emissions.
- Monitor how many ships and/or aircraft are used for initial operations of offshore wind energy facilities, including duration at the site, transit times, number of trips and other relevant parameters to evaluate the air and water emissions.
- Record the types of ships (e.g. jack-up rig) and/or aircraft (e.g. helicopter) used and estimate the emissions based on engine type, associated equipment, and other relevant factors, including duration of activities.

Evaluation of sediment disturbance and recovery

- Record the anchor patterns for vessels and floating offshore wind turbines, if appropriate.
- Observe and record scarring from the anchor chains.
- Evaluate the recovery time for scarring from anchor chains and record relevant parameters such as sediment type, local currents.
- Record the extent of disturbance during cable laying, if possible repeat for different installation methods, include the ship type, sediment type, burial depth, current speeds, and other parameters important for evaluating disturbance and recovery.
- Record the duration of cable laying, and if possible, for different installation methods, include relevant parameters for comparison.
- Evaluate the recovery time for the seafloor from cable laying, if possible, from different installation methods.
- Monitor before and after a major storm event to evaluate changes in cable burial depth.
- Monitor near wind energy structures for sediment erosion, at the base and at coarser scales, including sediment type, local currents, other parameters needed to evaluate local and regional scour.

Effects of mitigating measures or abatement measures

Evaluate the reduction or elimination of impact producing factors through the use of abatement or mitigation measures. For example, this task will involve close cooperation with the operator and may or may not be feasible.

Evaluate monitoring technologies or techniques

Evaluate equipment or technologies that may be used to monitor or measure impact producing factors or effects on receptors. The following are potential topics for evaluation, which may be requested in a task order or task orders:

- Evaluate the efficacy of monitoring technologies and techniques that may be deployed at these projects.
- Determine the types of observations to include within an environmental monitoring strategy.
- Evaluate types of equipment for effective monitoring that may be used to determine air quality, water quality, benthic environments, aquatic communities, sediment disturbance, wildlife, acoustics, or strike frequency.
- Evaluate the most effective and cost-effective method, or suite of methods, for detecting marine mammals during construction activities and how this method would vary by geographic region.
- Testing of monitoring methodologies during construction that may be used by industry, such as passive acoustic monitoring, to evaluate whale presence during construction activities.
- Testing of novel technologies for evaluating the environmental effects of construction and operation activities.
- Comparative testing of monitoring equipment to evaluate improved technology or methodology.

Objectives: The objective of this study is to acquire real-time observations of the construction and initial operation of wind facilities to aid the evaluation of environmental effects of future facilities.

Methods: The methods used will be dependent on the type of analyses to be preformed and defined within each task order.

Specific Research Question(s): What are the duration and intensity of the stressors from offshore wind construction and operation?

Current Status:

Task Order 1: For this task order, a field plan was prepared that described the activities to be performed during the installation of five wind turbine foundations at Block Island, Rhode Island. The field plan was used to define task orders 2 and 3.

Task Order 2: Under this task order, two scour monitors were attached to one foundation at Block Island, Rhode Island. The monitors were evaluated for their ability to observe any scour occurring by the legs of the foundation. The monitoring covered a sixteen month period. Results from this effort are included in the report for Task Order 3.

Task Order 3: For task order 3, an observer recorded the activities including the types and duration of the installation of two foundations at Block Island Wind Farm. Hydrophones, both moored and towed, measured the sound generated from pile driving. Geophysical surveys will be used to evaluate scour marks from anchoring and other bottom disturbance and the recovery. Measurements of sound from pile driving in air were made at Block Island and Point Judith. Particle motion detectors were deployed during pile driving. Results from Task Orders 1-3 are available:

Field Observations during Wind Turbine Foundation Installation at the Block Island Wind Farm, Rhode Island : **Appendix A**; **Appendix C**; **Appendix D**; **Appendix E1**; **Appendix E2**; **Appendix E3**; **Appendix F**

Task Order 4: For the second year of this study under this task order, a field plan will be developed to cover the anticipated activities with the continuation of the installation of the wind facility at Block Island. The field plan addresses the installation of cables and the completion of the construction of the five turbines.

Task Order 5: The installation of the cable between Block Island and the mainland was evaluated under this task order. The types of measurements included measuring the rate of particle settling after they are disturbed by the jet plow. The task order is complete and the final report is available:

Observing Cable Laying and Particle Settlement During the Construction of the Block Island Wind Farm

Task Order 6: Under this task order, observations were made and recorded during the installation of the tower, nacelle, and blades at two of the turbines during the summer of 2016. Acoustic measurements both in air and under water were made during the initial operation of the wind turbines. Visual assessments were made both during the day and at night from several locations. Benthic monitoring under the turbine structures is also included. Final reports for Tasks 4 and 6 are available:

Field Observations During Wind Turbine Installation at the Block Island Wind Farm, Rhode Island

Field Observations During Wind Turbine Operations at the Block Island Wind Farm, Rhode Island

Underwater Acoustic Monitoring Data Analyses for the Block Island Wind Farm, Rhode Island

Benthic Monitoring During Wind Turbine Installation and Operation at the Block Island Wind Farm, Rhode Island

Task Order 7: This task order continues the benthic monitoring and seafloor disturbance and recovery for another two years. The second year report is available here:

Benthic Monitoring During Wind Turbine Installation and Operation at the Block Island Wind Farm, Rhode Island – Year 2

Task Order 8: This task order is for three additional months of underwater sound monitoring during operations. The results from this Task Order are reported with Task Order 6.

Task Order 9: This task order is for underwater sound monitoring during the installation of a meteorological tower in the Maryland Wind Energy Area; for sound monitoring during the installation of two turbines off the coast of Virginia; and for monitoring of corrosion, turbidity and biofouling on the two Virginia turbines. The meteorological tower is delayed. The monitoring off the coast of Virginia will occur in Spring of 2020.

Task Order 10: This task order includes additional monitoring of underwater sound during the installation of a meteorological tower in the Maryland Wind Energy Area.

Task Order 12: This task order includes additional epifouling analysis at the Block Island Wind Farm. Field work is complete and the results will be reported with Task Order 7.

Publications Completed:

Observing Cable Laying and Particle Settlement During the Construction of the Block Island Wind Farm

Field Observations during Wind Turbine Foundation Installation at the Block Island Wind Farm, Rhode Island : **Appendix A**; **Appendix C**; **Appendix D**; **Appendix E1**; **Appendix E2**; **Appendix E3**; **Appendix F**

Field Observations During Wind Turbine Installation at the Block Island Wind Farm, Rhode Island

Field Observations During Wind Turbine Operations at the Block Island Wind Farm, Rhode Island

Underwater Acoustic Monitoring Data Analyses for the Block Island Wind Farm, Rhode Island

Benthic Monitoring During Wind Turbine Installation and Operation at the Block Island Wind Farm, Rhode Island

Benthic Monitoring During Wind Turbine Installation and Operation at the Block Island Wind Farm, Rhode Island – Year 2

Arthur E. Newhall, Ying T. Lin, James F. Miller, Gopu R. Potty, Kathy Vigness-Raposa, Adam Frankel, Jennifer Giard, Dennis R. Gallien, Jamey Elliot, Tim Mason. 2016. Monitoring the acoustic effects of pile driving for the first offshore wind farm in the United States. The Journal of the Acoustical Society of America 139, 2181; http://doi.org/10.1121/1.4950483

Gopu R. Potty and James H. Miller, Shear wave inversion using horizontal to vertical ratio of Scholte wave particle velocity. Proceedings of the IEEE-OES OCEANS Meeting, Charleston, October 22-25, 2018 (to be published).

Affiliated WWW Sites: None.