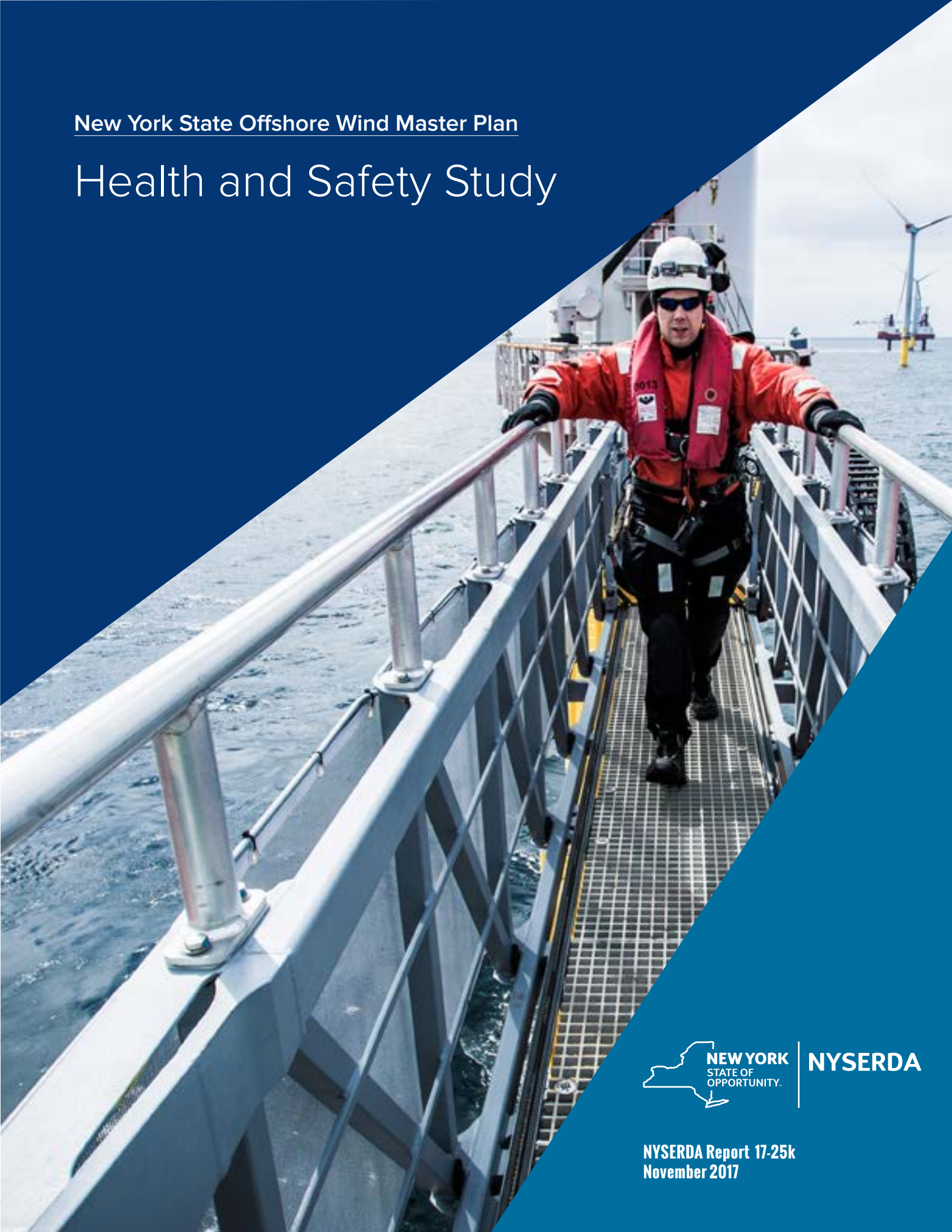
New York State Offshore Wind Master Plan

Health and Safety Study



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NYSERDA Report 17-25k
November 2017

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New York State Offshore Wind Master Plan

Health and Safety Study

Final Report

Prepared for:

New York State Energy Research and Development Authority

Prepared by:

The Renewables Consulting Group

New York, New York

NYSERDA Report 17-25k November 2017

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Information contained in this study, such as web page addresses, are current at the time of publication.

Table of Contents

List of Figures

Acronyms and Abbreviations

ANSI	American National Safety Institute
AoA	Area of Analysis
API	American Petroleum Institute
ASME	American Society of Mechanical Engineers
AWEA	American Wind Energy Association
BOEM	Bureau of Ocean Energy Management
BOSIET	Basic Offshore Safety Induction and Emergency Training
BSEE	Bureau of Safety and Environmental Enforcement
CBP	U.S. Customs and Border Protection
CFR	Code of Federal Regulations
COP	Construction and Operations Plan
CVA	Certified Verification Agent
CWA	Clean Water Act
DEC	NYS Department of Environmental Conservation
DOI	U.S. Department of the Interior
DOL	New York State Department of Labor
DOS	NYS Department of State
DOT	New York State Department of Transportation
EPA	U.S. Environmental Protection Agency
FAA	Federal Aviation Administration
FAR	Federal Aviation Regulation
FIR	Fabrication and Installation Report
GWO	Global Wind Organization
H&S	Health and Safety
HSAC	Helicopter Safety Advisory Conference
IEC	International Electrotechnical Commission
ISO	International Organization for Standardization
ISPS	International Ship and Port Security
NFPA	National Fire Protection Association
nm	Nautical Miles
NYCRR	New York Codes, Rules, and Regulations
NYS	New York State
NYSERDA	NYS Energy Research and Development Authority
OCRP	Offshore Compliance Recommended Practices
OCS	Outer Continental Shelf
OCSLA	Outer Continental Shelf Lands Act
OEM	Original Equipment Manufacturer

OGS	NYS Office of General Services
OSA	Offshore Study Area
OSHA	Occupational Safety and Health Administration
PFSP	Port Facility Security Plan
PPE	Personal Protective Equipment
PSC	Public Service Commission
SAPRHA	Rivers and Harbors Act
RP	Recommended Practices
SMS	Safety Management System
SSP	Ship Security Plan
Study	Health and Safety Study
TWIC	Transportation Worker Identification Credential
Uniform Code	Uniform Fire Prevention and Building Code
U.S.	United States of America
USACE	U.S. Army Corps of Engineers
USCG	U.S. Coast Guard

Executive Summary

This study provides an overview of health and safety requirements for offshore wind farms constructed in the Atlantic Ocean off the coast of New York State (NYS) from design through operation. The study also identifies the various federal and state agencies with jurisdiction over offshore wind development and describes the aspects of offshore wind that each such agency is responsible for regulating or overseeing.

The U.S. offshore wind industry is relatively new, with only one project in operation (none in NYS). Therefore, stakeholders, developers, and regulators need to consider the variety of potential safety risks, regulatory gaps, and associated mitigation approaches that have emerged and will continue to emerge during offshore wind farm development, construction, and operation in the Atlantic waters off NYS.

1 Introduction and Background

1.1 Introduction

This Health and Safety Study (Study) is one of a collection of studies prepared on behalf of New York State in support of the New York State Offshore Wind Master Plan (Master Plan). These studies provide information on a variety of potential environmental, social, economic, regulatory, and infrastructure-related issues associated with the planning for future offshore wind energy development off the coast of the State. When the State embarked on these studies, it began by looking at a study area identified by the New York State Department of State (DOS) in its two-year Offshore Atlantic Ocean Study (DOS 2013). This study area, referred to as the "offshore study area (OSA)," is a 16,740-square-mile (43,356-square-kilometer) area of the Atlantic Ocean extending from New York City and the south shore of Long Island to beyond the continental shelf break and slope into oceanic waters to an approximate maximum depth of 2,500 meters (Figure 1). The OSA was a starting point for examining where turbines may best be located, and the area potentially impacted. Each of the State's individual studies ultimately focused on a geographic Area of Analysis (AoA) that was unique to that respective study. The AoA for this study is described below in Section 1.2.

The State envisions that its collection of studies will form a knowledge base for the area off the coast of New York that will serve a number of purposes, including: (1) informing the preliminary identification of an area for the potential locating of offshore wind energy areas that was submitted to the Bureau of Ocean Energy Management (BOEM) on October 2, 2017 for consideration and further analysis; (2) providing current information about potential environmental and social sensitivities, economic and practical considerations, and regulatory requirements associated with any future offshore wind energy development; (3) identifying measures that could be considered or implemented with offshore wind projects to avoid or mitigate potential risks involving other uses and/or resources; and (4) informing the preparation of a Master Plan to articulate New York State's vision of future offshore wind development. The Master Plan identifies the potential future wind energy areas that have been submitted for BOEM's consideration, discusses the State's goal of encouraging the development of 2,400 megawatts (MW) of wind energy off the New York coast by 2030, and sets forth suggested guidelines and best management practices (BMPs) that the State will encourage to be incorporated into future offshore wind energy development.

Each of the studies was prepared in support of the larger effort and was shared for comment with federal and State agencies, indigenous nations, and relevant stakeholders, including non-governmental organizations and commercial entities, as appropriate. The State addressed comments and incorporated feedback received into the studies. Feedback from these entities helped to strengthen the quality of the studies, and also helped to ensure that these work products will be of assistance to developers of proposed offshore wind projects in the future. A summary of the comments and issues identified by these external parties is included in the Outreach Engagement Summary, which is appended to the Master Plan.

The Energy Policy Act of 2005 amended Section 8 of the Outer Continental Shelf Lands Act (OCSLA) to give BOEM the authority to identify offshore wind development sites within the Outer Continental Shelf (OCS) and to issue leases on the OCS for activities that are not otherwise authorized by the OCSLA, including wind farms. The State recognizes that all development in the OCS is subject to review processes and decision-making by BOEM and other federal and State agencies. Neither this collection of studies nor the State's Master Plan commit the State or any other agency or entity to any specific course of action with respect to offshore wind energy development. Rather, the State's intent is to facilitate the principled planning of future offshore development off the New York coast, provide a resource for the various stakeholders, and encourage the achievement of the State's offshore wind energy goals.

1.2 Purpose

Issues affecting human health and safety (H&S) are key considerations for the Master Plan process. Future offshore wind projects will need to be designed and delivered in a way that minimize risks to the safety of workers and the public. Adoption of best practices and lessons learned from prior experience, as described in Section 7 of this study, along with thoughtful planning and preparation by future project developers and participants will also be required.

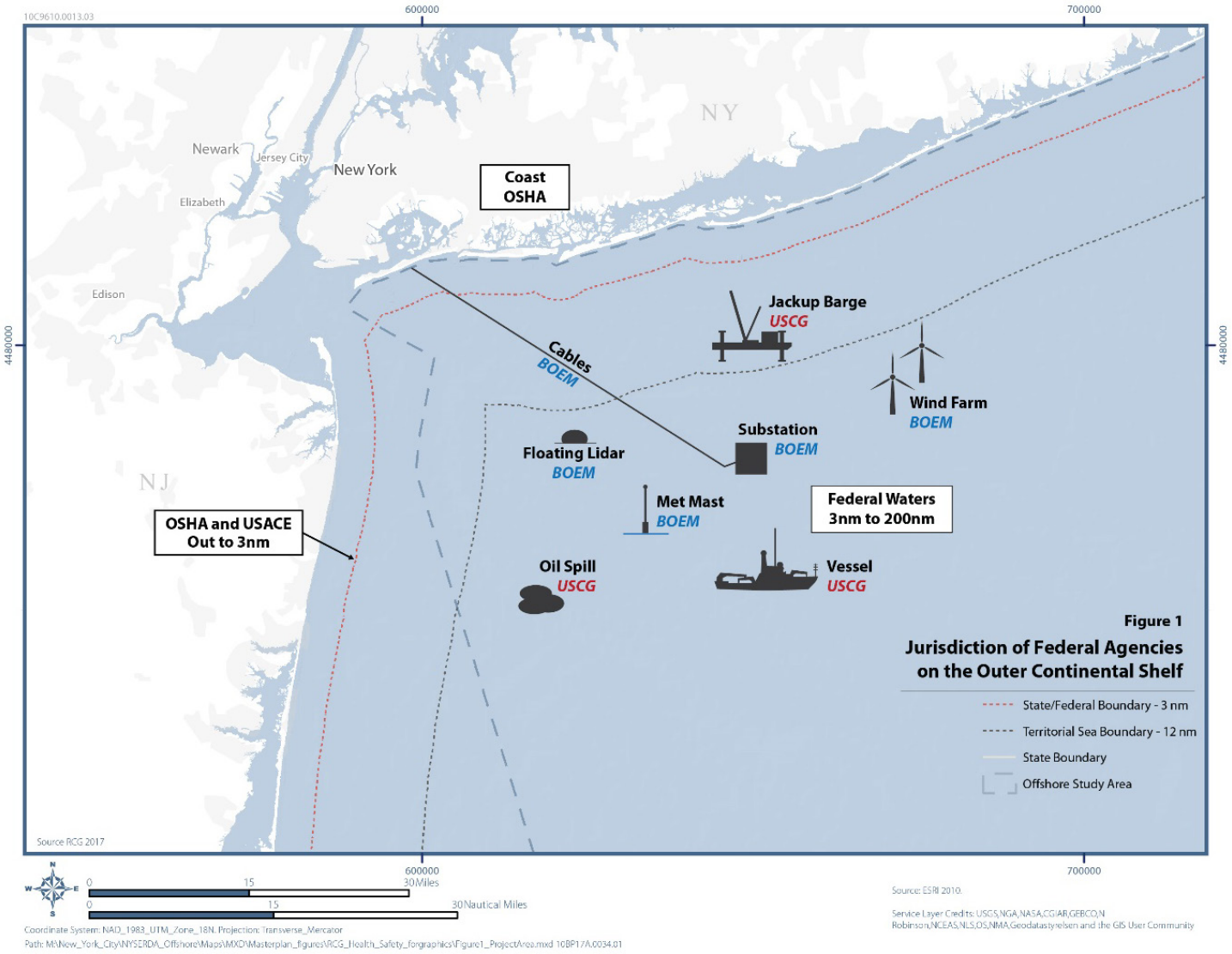
The focus of this study is to provide an overview of the H&S requirements for offshore wind turbine design and project construction, operations, and maintenance. The issue of public safety near offshore wind farms is addressed in a separate Master Plan study on shipping and navigation. The AoA for this Study is the entire area within the OSA, as well as onshore jurisdictions within the State of New York.

2 Regulatory Framework

Federal, state, and local authorities are responsible for regulating and permitting various aspects of offshore wind projects. According to the OCSLA, state jurisdiction is limited to waters and submerged lands up to 3 nautical miles (nm) from shore in the Atlantic Ocean. The rest of the OCS up to 200 nm is under federal jurisdiction. The jurisdictional boundary between New York State and the federal government is shown on Figure 1 below, with some examples of the types of responsibilities certain authorities have that may pertain to future offshore wind farm permitting and operations.

Figure 1. Jurisdiction of Federal Agencies on the OCS.

Source: Renewables Consulting Group LLC 2017



3 Federal Health and Safety Requirements

All portions of the OSA offered by BOEM for future offshore wind development beyond 3 nm from shore must be permitted in accordance with federal law. However, since portions of any such future development also will occur within 3 nm from shore and onshore, project developers also will be required to ensure that activities within this boundary are consistent with State and local laws and regulations.

The following federal agencies are involved in the regulation and permitting of H&S aspects of offshore wind farms:

- Bureau of Ocean Energy Management (BOEM).
- Bureau of Safety and Environmental Enforcement (BSEE).
- Occupational Safety and Health Administration (OSHA).
- U.S. Coast Guard (USCG).
- U.S. Army Corps of Engineers (USACE).
- U.S. Environmental Protection Agency (EPA).
- Federal Aviation Administration (FAA).

Developers of offshore wind farms in New York will need to consult with these federal agencies regarding H&S planning and be prepared to comply with the requirements established by law, including those identified in this report. In the absence of clear requirements, the U.S. Department of the Interior (DOI) recommends early consultations between the developer, design team, Certified Verification Agent (CVA), and BOEM/BSEE to form consensus on which design and H&S codes will govern the proposed project. These governing codes should be listed in the Construction and Operations Plan (COP) (and required CVA nomination) for BOEM approval.

3.1 Bureau of Ocean Energy Management

BOEM's responsibility for regulating offshore wind farms is set forth in the Code of Federal Regulations at 30 CFR 585. In general, BOEM is responsible for siting and ensuring the design safety of facilities located in federal waters on the OCS.

3.1.1 BOEM Safety Management System requirements

BOEM requires that projects have a fully functional Safety Management System (SMS) in place prior to the start of the activities described in a project's approved Site Assessment Plan, General Activities Plan, or COP (30 CFR 585.810). Respectively, these documents describe the:

- Activities necessary for the characterization of a commercial lease area, such as the installation of meteorological towers and buoys (30 CFR 585.605).
- Proposed construction, activities, and conceptual decommissioning plans for all planned facilities under a Limited Lease, Right-of-Way Grant, and Right-of-Use and Easement Grant (30 CFR 585.640).
- Construction, operations, and conceptual decommissioning plans under a commercial lease (30 CFR 585.620).

The purpose of a SMS is to define the project organization's H&S policies and the responsibilities of key personnel, identify and mitigate hazards associated with the activities undertaken by employees and contractors, and take appropriate precautions to decrease the likelihood of incidents and the impact of those that may occur. According to 30 CFR 585.810, a SMS should address:

- How the lessee will ensure the safety of personnel or anyone on or near the facilities.
- Remote monitoring, control, and shutdown capabilities.
- Emergency response procedures.
- Fire suppression equipment, if needed.
- How and when the lessee will test the SMS.
- How the lessee will ensure facility operators are properly trained.

3.1.2 Hierarchy of Design Standards

BOEM uses type certification of wind turbines to the maximum extent practicable as part of its due diligence and assurance activities. Internationally manufactured machines are generally type certified in conformance with International Electrotechnical Commission (IEC) requirements. These machines are approved for use in U.S. projects on a case-by-case basis, with the type certificate and suitability for use being reviewed and verified by the CVA, which considers site-specific hazards at a proposed location.

Type certification for wind turbines does not extend to include offshore wind turbine foundations. Foundations and substations manufactured in the U.S. are routinely designed to comply with OSHA regulations. Foundations and substations sited within state waters are subject to OSHA regulations. Foundations and substations sited on the OCS are subject to DOI requirements, which may vary from OSHA requirements. H&S requirements should be proposed in the COP (and required CVA nomination) and approved as part of that plan approval.

Fixed-bottom offshore wind turbines in the U.S. are likely to be designed to the IEC standard 61400-3. IEC 61400-3 was developed specifically for offshore wind turbines, but it does not address all aspects of their design, construction, and operation, nor does it apply to other components involved in offshore wind farms such as offshore substations and cables.

IEC 61400-3 was developed to give designers of offshore wind turbines guidance on determining the loads reasonably expected to be experienced by the turbines. IEC 61400-3 refers the designer of offshore wind turbines to a recognized structural design code for determining the proper solution for resisting those loads. Existing structural design codes continue to undergo revision and updates to incorporate the latest in design guidance for resisting site-specific hazards. Early consultations between the developer, design team, CVA, and BOEM/BSEE are recommended to form consensus on which design codes will govern the proposed project as well as any additional requirements that may be required by BOEM/BSEE to fill gaps in the existing codes.

The American Wind Energy Association (AWEA) Offshore Compliance Recommended Practices 2012 (AWEA OCRP 2012) is recognized as an informative document, comprising a first step towards U.S. national consensus on design guidance for fixed-bottom-founded offshore wind facilities. However, in the years since its publication, industry experience and ongoing research has generated new insights and knowledge regarding the design and construction of offshore wind facilities. As a result, additional consultations with BOEM and BSEE are recommended to form consensus on which design codes will govern a proposed project and identify any additional BOEM and/or BSEE requirements. Note that AWEA OCRP 2012 does not provide guidance for floating offshore wind turbines.

AWEA OCRP 2012 provides the following hierarchy to be followed in cases where conflicting information is found in the design standards documents:

1. AWEA OCRP 2012.
2. IEC 61400-3, Wind turbines – Part 3: Design requirements for offshore wind turbines.
3. IEC 61400-1, Wind turbines – Part 1: Design requirements.
4. International Organization for Standardization (ISO) 19900, Petroleum and natural gas industries – General requirements for offshore structures (API-modified version).
5. ISO 19902, Petroleum and natural gas industries – Fixed steel offshore structures (API-modified version).
6. ISO 19903, Petroleum and natural gas industries – Fixed concrete offshore structures (API-modified version).

7. American Concrete Institute 357R, Guide for the design and construction of fixed offshore concrete structures.
8. American Petroleum Institute (API) Recommended Practices (RP) 2A-WSD, Recommended practice for planning, designing, and constructing fixed offshore steel platforms – Working stress design.

In the absence of a specific U.S. standard (or set of standards) providing complete design guidance for offshore wind components, this hierarchy is recommended by industry experts, in part, as a means of ensuring adequate levels of safety are achieved.

3.1.3 BOEM Design Verification Process

It is primarily a future lessee's responsibility to ensure that, from a design standpoint, an offshore wind farm meets state and federal safety requirements. BOEM and BSEE play important oversight roles in that regard, in part using an independent CVA as described in 30 CFR 585.705-714.

During the verification process, the CVA will have the opportunity to comment on various steps of the design process. Throughout the process for the design of the tower and foundation, the turbine original equipment manufacturer and foundation designer will be able to respond to CVA comments and resolve any questions or concerns. Once the design is complete, future lessees will be required to submit a Facilities Design Report and a Fabrication and Installation Report to the CVA for certification before submitting to BOEM. Lesses may begin to fabricate and install the approved facilities after BOEM notifies that it has received the reports and has no objections. If BOEM receives the reports, but does not respond with objections within 60 days, BOEM is deemed not to have objections to the reports, and the lessee may commence fabrication and installation.

The CVA should provide real-time review and engagement during the design process to give the CVA the opportunity to raise concerns and objections during the design, which will afford the inclusion of revised design methods or assumptions in the project design, if necessary.

3.1.4 BOEM Incident Reporting Requirements

As set forth in 30 CFR 585.830-833, future lessees will be required to verbally report the following kinds of incidents to BOEM immediately:

- Fatalities.
- Incidents that require the evacuation of person(s) to shore or to another offshore facility.

- Fires and explosions.
- Collisions that result in property or equipment damage of any value greater than $25,000.
- Incidents involving structural damage to an OCS facility that is severe enough so that activities on the facility cannot continue until repairs are made.
- Incidents that damage or disable safety systems or equipment, including firefighting systems.
- Incidents involving crane or personnel/material handling activities if they result in a fatality, injury, structural damage, or significant environmental damage.
- Other incidents resulting in property or equipment damage of any value greater than $25,000.
- Any other incidents involving significant environmental damage or harm.

In addition, future lessees will be required to provide a written report to BOEM within 15 days after the following:

- Injuries preventing the injured person from returning to work or resuming all his/her normal duties on the day after the injury occurred.
- Incidents requiring on-site personnel to muster for evacuation for reasons not related to weather or drills.

A list of verbal reporting requirements is set forth in 30 CFR 585.833. There are additional reporting requirements under 30 CFR 585.813 for removing equipment from service. BOEM may also require additional information on a case-by-case basis.

3.1.5 BOEM Inspection Requirements

BOEM is responsible for inspecting OCS facilities and any vessels engaged in activities related to those facilities (30 CFR 585.820). BOEM ensures activities are being conducted in compliance with the OCSLA, with 30 CFR 585, with terms and conditions of a specific lease, and with other applicable laws and regulations. BOEM will perform scheduled and unscheduled inspections to determine whether proper safety equipment has been installed and is operating properly according to the SMS. Section 3.4.7 describes how the USCG and BOEM inspect vessels.

An annual self-inspection plan (for all facilities) must be developed by a future lessee and made available to BOEM inspectors upon request. The self-inspection plan will be required to specify the following:

1. The type, extent, and frequency of on-site inspections of above-water and the below-water structures and pertinent components of the mooring systems for any floating facilities.
2. How the corrosion protection systems for above-water and below-water structures will be monitored.

In addition, lessees must submit an annual report to BOEM detailing the list of facilities inspected in the previous 12 months, the overall structural condition of each facility, the type of inspection method (i.e., visual, magnetic particle, ultrasonic testing), and a summary of the inspection indicating what repairs, if any, were needed and made.

3.1.6 BOEM Environmental Requirements

BOEM's environmental requirements are set forth in 30 CFR 585 Subpart H. These regulations include necessary mitigation measures and monitoring requirements for protecting threatened and endangered species, critical habitats, marine mammals, essential fish habitats, and archaeological resources.

If a facility is damaged such that a risk to the environment is posed, the lessee must file a corrective action plan within 30 days of discovery and follow up with a report detailing remedial actions taken, once completed.

3.2 Bureau of Safety and Environmental Enforcement

The BSEE enforces safety and environmental regulations that govern the exploration, development, and production of oil and gas on the OCS and is responsible for the inspection of offshore facilities.

Currently, BSEE's authority does not extend to offshore renewable energy installations (Figure 2 shows an inspection at an offshore oil and gas facility), but BSEE is in the process of developing health, safety, and environmental management guidelines for offshore wind construction and operation activities. These guidelines will combine applicable information from the U.S. offshore oil and gas sector, as well as lessons learned and best management practices from the international experience with offshore wind to help ensure that future construction and operation activities are conducted in a safe and environmentally sound manner.

Figure 2. BSEE Inspection of an Offshore Oil and Gas Facility.

Source: BSEE 2013

3.3 Occupational Safety and Health Administration

OSHA is responsible for safety regulations at workplaces in the U.S., which includes offshore locations that are within 3 nm of the coast of the U.S. and in the Great Lakes. For offshore wind projects, OSHA's regulations encompass design and workforce safety practices at ports, onshore maintenance facilities, and onshore locations with electrical infrastructure. The following OSHA labor regulations should be considered as best practices for future offshore wind development in federal waters:

- 29 CFR 1910 for operation and maintenance of an existing wind farm.
- 29 CFR 1926 for construction during the active construction process offshore.

Unless an OSHA-approved "state plan" is in effect, future wind developers and their contractors will be required to follow the regulations set forth by OSHA (Occupational Safety and Health Administration, 2017). NYS has such a plan; however, it only applies to State and local government workplaces. OSHA retains responsibility for all private sector workplaces, such as those used for offshore wind projects. Therefore, a future wind project lessee should expect to follow OSHA regulations that include, but are not limited to, the following:

- 29 CFR 1904 – Recordkeeping.
- 29 CFR 1910 – General Industry.
- 29 CFR 1926 – Construction.
- 29 CFR 1915 – Shipyard Employment.

- 29 CFR 1917 – Marine Terminals.
- 29 CFR 1918 – Longshoring.

3.3.1 OSHA Recordkeeping and Reporting Requirements

OSHA's recordkeeping and reporting requirements are set forth in 29 CFR 1904. Employers with more than ten employees are required to keep a record of serious work-related injuries and illnesses. This does not include minor injuries requiring only first aid. Records must be kept on site for at least five years, and during the months of February, March, and April, employers must post a summary of the injuries and illnesses recorded in the previous year using OSHA's Form 300 report.

Employers must report a worker fatality within eight hours. Employers must also report any amputation, loss of an eye, or hospitalization involving care or treatment of a worker within 24 hours by telephone, electronic submission, or in person at the OSHA Area Office nearest to the site of the incident.

3.3.2 OSHA General Industry Regulations

29 CFR 1910 sets forth OSHA's general industry H&S regulations. These regulations, which apply to all workplace in the U.S., include design requirements for walking and working surfaces (i.e., floors, stairs, roofs, ladders, ramps, scaffolds, elevated walkways, and fall protection systems), exit routes, fire protection, and machinery. The general industry regulations also require that occupational health and environmental controls be followed during all phases of a project.

3.3.3 OSHA Construction Regulations

29 CFR 1926 sets forth OSHA's H&S regulations for construction. Electrical safety requirements for employees involved in construction work are set forth in in Subpart V. In addition, specific OSHA regulations for working over or near water, which are set forth in 29 CFR 1926.1053, include requirements for sea survival equipment such as USCG-approved life jackets and ring buoys.

3.3.4 OSHA Shipyard Employment Regulations

29 CFR 1915 sets forth OSHA's regulations specific to shipyard employment. The shipyard employment regulations cover employees that work in shipyards, who may perform work fabricating or manufacturing foundations, and vessels involved in offshore wind farms.

3.3.5 OSHA Marine Terminal and Longshoring Regulations

29 CFR 1917 and 1918 set forth OSHA's regulations specific to the marine terminal and longshoring industries. The marine terminal and longshoring regulations cover employees that perform marine cargo-handling operations onshore or aboard vessels.

3.3.6 OSHA General Training Requirements

As required by OSHA, employers are responsible for ensuring their employees are trained to recognize and avoid unsafe conditions and are aware of the regulations applicable to their work environments so that hazards are controlled, if not eliminated. This type of training must be provided at no cost to the employee. OSHA has developed a set of training programs for each of the following industries:

- General Industry.
- Maritime.
- Construction.
- Agriculture.
- Federal Employees.

Training should be specific to the role of each employee. For example, offshore workers should receive both maritime and construction training. Accredited courses can be taken at a variety of local and regional facilities.

Note that BOEM has issued no prescriptive training requirements for activities on the OCS. Lessees are required to include in their SMS exactly how they plan to ensure their personnel will be qualified and trained.

3.3.7 OSHA-specific Training Requirements

In addition to its general training requirements, OSHA mandates that workers receive specialized training before performing certain activities. The following regulations describe training that may be relevant to offshore wind farms.

- 29 CFR 1910.38 – Emergency Action Plans.
- 29 CFR 1910.39 – Fire Prevention Plans.
- 29 CFR 1910.66 – Powered Platforms for Building Maintenance.
- 29 CFR 1910.95 – Occupational Noise Exposure.
- 29 CFR 1910.106 – Flammable and Combustible Liquids.
- 29 CFR 1910.120 – Hazardous Waste Operations and Emergency Response.
- 29 CFR 1910.132 – Personal Protective Equipment.

- 29 CFR 1910.134 – Respiratory Protection.
- 29 CFR 1910.145 – Specifications for Accident Prevention Signs and Tags.
- 29 CFR 1910.146 – Permit-required Confined Spaces.
- 29 CFR 1910.147 – Control of Hazardous Energy (lockout-tagout).
- 29 CFR 1910.151 – Medical Services and First Aid.
- 29 CFR 1910.155-156 – Fire Protection (and portable fire extinguishers).
- 29 CFR 1910.178 – Powered Industrial Trucks (forklift operator training).
- 29 CFR 1910.179 – Overhead and Gantry Cranes.
- 29 CFR 1910.180 – Crawler, Locomotives, and Truck Cranes.
- 29 CFR 1910.184 – Slings (material handling).
- 29 CFR 1910.269 – Electric Power Generation, Transmission, and Distribution.
- 29 CFR 1910.332-333 – Electrical Safety Related Work Practices.

3.3.8 OSHA Safety and Health Program Management Guidelines

Like BOEM's SMS requirements, OSHA-developed Recommended Practices for Safety and Health Programs in Construction (OSHA 2016) updated in 2016 present a step-by-step approach for implementing a H&S program built around seven core elements:

- Management Leadership.
- Worker Participation.
- Hazard Identification and Assessment.
- Hazard Prevention and Control.
- Education and Training.
- Program Evaluation and Improvement.
- Communication and Coordination for Host Employers, Contractors, and Staffing Agencies.

3.3.9 OSHA Personal Protective Equipment Requirements

The requirements for personal protective equipment (PPE) are set forth in OSHA's General Industry and Construction regulations (29 CFR 1910 and 29 CFR 1926). 29 CFR 1926.20(f)(1) and 1910.9(a) require employers to provide PPE if employees are exposed to known hazards. Hazards associated with an offshore wind farm include, but are not limited to, the following: working from height, confined spaces, fires, electrical, machine guarding, crane, and derrick and hoist operations. PPE required in the construction, commissioning, and maintenance in a wind farm should include the following:

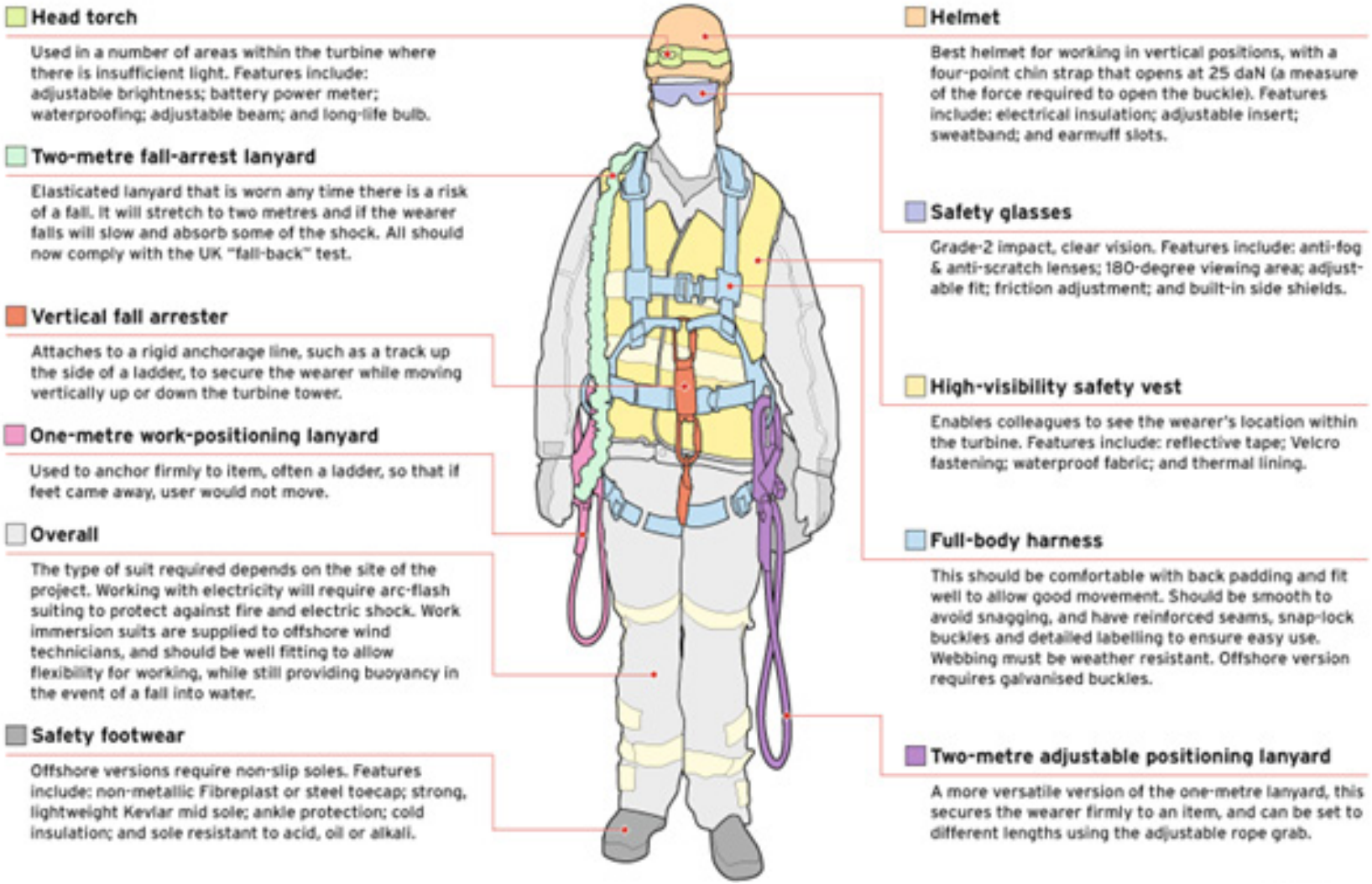
- Head protection – such as hard hats to provide protection from falling objects.
- Head light – used in areas of low illumination.
- High-visibility vests – enables the wearer to be more visible to others on the job site during operation of the crane and other low-visibility tasks.

- Foot protection – such as steel-toed boots will be utilized as per risk assessment.
- Suitable clothing – in general, all personnel working on wind power locations should wear long pants and shirts.
- Environmentally suitable clothing – all personnel must be equipped with work clothing that adequately protects them from environmental conditions.
- Biological hazards – where protection is required from biological hazards such as bird excrement/vomit, disposable or limited-use protective coveralls should be worn.
- Flame-retardant clothing – for electrical and substation work.
- Fall protection – for activities performed at elevation on wind power locations where there is a risk of falling from heights. A personal fall protection system/work restraint system must be worn if other protection is not available.
- Eye protection – for exposure to eye or face hazards from flying particles, molten metal, liquid chemicals, acids or caustic liquids, chemical gases or vapors, or potentially injurious light radiation. Personnel with prescription lenses shall wear eye protection that incorporates the prescription in its design, or wears eye protection that can be worn over the prescription lenses without disturbing the proper positioning of the prescription lenses or the protective lenses.
- Hearing protection – used where a risk assessment has identified the potential for hearing injury.
- Hand protection – for exposure to hazards with the potential to cause hand injuries.
- Smoke hoods – used where hot work is being performed.

Figure 3 shows some of the items listed above.

Figure 3. Wind Industry PPE (typical).

Source: Green 2011



3.3.10 OSHA Electrical Safety Design Requirements

In addition, OSHA's general industry requirements for safety-related electrical work practices (set forth in in 29 CFR 1910.269 and 332-335) are applicable to offshore wind turbines and substations. These requirements are based on the National Fire Protection Association's (NFPA's) standard NFPA 70E, Electrical Safety Requirements for Employee Workplaces.

3.3.11 OSHA Vertical Transportation Device Requirements

Design requirements for vertical transportation devices (ladders and lifts) are set forth in OSHA's general industry regulations (29 CFR 1910). 29 CFR 1910 Subpart D sets forth the minimum requirements for compliance with the design regulation for ladders. It is generally considered safer to design a stairway than a ladder or stepladder.

29 CFR 1910.68 sets forth OSHA's requirements for lift design. The American National Safety Institute (ANSI) standard for man-lifts (ANSI A90.1-1969) is referenced as the key standard for all new man-lift installations. Furthermore, the U.S. has adopted the following American Society of Mechanical Engineers (ASME) standards: ASME A17.7, ASME A17.1-2013, and ASME A17.8- 2016. These standards cover rescue and evacuation, mechanical, environmental, and other safety requirements.

3.3.12 OSHA Fire and Emergency Response Requirements

Regulations for fixed/automatic fire extinguishing systems, detection equipment, and portable fire extinguishers are set forth in 29 CFR 1910.155-165. However, NFPA 850, Recommended Practice for Fire Protection for Electric Generating Plants and High-Voltage Direct Current Converter Stations, is used in practice as it meets and exceeds the OSHA minimum requirements. Regulations covering means of egress and emergency requirements are set forth in 29 CFR 1910 Subpart E. However, the standard for evacuation is NFPA 101-2009, Life Safety Code, which is more stringent than the OSHA regulations.

3.4 U.S. Coast Guard

The USCG is responsible for enforcing H&S regulations on the OCS for non-renewable energy projects. The DOI is responsible for regulating renewable energy projects on the OCS, but the USCG has determined itself to be a cooperating agency for navigation safety, and a subject matter expert for marine safety.

Under the provisions of the Ports and Waterways Safety Act, the USCG is given authority to regulate and supervise vessel traffic and protect safe maritime navigation and the marine environment. In addition, the Clean Water Act (CWA), which was amended by the Oil Pollution Act of 1990, provides the USCG with authority for pollution prevention, contingency planning, and response activities within the 200-mile Exclusive Economic Zone for oil and hazardous substances. The USCG is also authorized to respond to and investigate spills of hazardous substances and oil in the coastal zone, including all U.S. waters subject to the tide, the Great Lakes, and deep-water ports.

In the case of offshore wind farms, the USCG is responsible for emergency response planning and execution, vessel inspections, marine safety, and coordination (Figure 4).

Figure 4. USCG at the Block Island Wind Farm.

Source: Green 2011

3.4.1 USCG Marine Safety and Coordination Requirements

The USCG may assist with the coordination of installation vessels and monitor the proximity of recreational vessels to offshore construction activities. It may even, at its own discretion, enforce temporary boundaries around offshore construction activities to ensure public safety. Developers (or their designated contractors) should plan to coordinate offshore construction activities with the USCG so that the USCG can issue Local Notices to Mariners, which provide other commercial and recreational vessels with information about construction activities.

3.4.2 USCG Helicopter Underwater Egress Training

If helicopters are used as a means of access or egress, all personnel using them must receive Helicopter Underwater Egress Training that meets the standards contained in API RP T-7, T-4, T-1, and USCG Title 33. The certificate obtained after undertaking training at one of the many facilities across the country offering Helicopter Underwater Egress Training is valid for four years.

3.4.3 USCG Reporting Requirements

All instances in which a vessel is involved in a marine casualty must be reported to the USCG by the owner, agent, master, operator, or the person in charge of the vessel. Specific requirements for incident reporting are set forth in 46 CFR 4.05. Similar provisions are set forth in 33 CFR 146 for casualties on OCS facilities, including diving casualties and pollution incidents. Both 46 CFR 4.05 and 33 CFR 146 require oral communications and written reports.

3.4.4 USCG Oil Spill Reporting Requirements

Under the Oil Pollution Act of 90, the BSEE is responsible for federal oversight of oil discharge planning and preparedness activities for regulated offshore facilities located seaward of the coastline in both state and federal offshore waters. These responsibilities include review and approval of Oil Spill Response Plans, inspections of all oil spill response equipment listed in the Plans, and unannounced exercises to test plan holder readiness.

3.4.5 USCG Personal Protective Equipment Requirements

Under 33 CFR 142.45, the USCG requires personnel to wear personal flotation devices if they are working in locations where, in the event of a fall, they would likely fall into the water. A work vest meeting the requirements of 33 CFR 146.20, or a life preserver meeting the requirements of 46 CFR 160.002, 160.005, or 160.055 (except when using the safety belts and lifelines required by 33 CFR 142.42) are required for work over water. All PPE should follow U.S. standards for material quality and performance. As a best practice, immersion suits should be worn when transferring during or after sunset or when the water temperature drops below 53.6 degrees Fahrenheit. Life jackets and immersion suits must be compatible with one another. Workers should also wear personal beacons during transfer operations.

3.4.6 USCG Private Aid to Navigation Requirements

33 CFR 67 sets forth USCG requirements for the design and use of private aids to navigation (PATONs) for artificial islands and fixed marine structures. The Aids to Navigation Manual published by the USCG includes guidelines for equipping offshore wind turbines with aids to navigation such as lights and foghorns. Additionally, as described in 33 CFR 67.35, the lessee must obtain a permit or a letter of no objection from the USCG after review of the proposed navigation aids. The USACE must have approved the project prior to the Private Aids to Navigation application being filed (Office for Regulatory Innovation and Assistance 2017).

3.4.7 USCG Vessel Inspection Requirements

Pursuant to the BOEM-USCG Memorandum of Agreement (BOEM 2011), the two agencies work cooperatively to address overlapping regulations with respect to vessels involved with offshore renewable energy installation activities. The USCG has jurisdiction over all vessels, including offshore wind construction and installation vessels, crew transport vessels, and maintenance vessels and is responsible for vessel inspections to be carried out on an annual or periodic basis. Vessel inspection is also a requirement for certification.

3.4.8 USCG Vessel Security Requirements

Per 33 CFR 104, vessel owners and captains are responsible for establishing access controls to prevent unauthorized entry onto their vessels and cargo facilities, maintain control of employees and visitors, and protect company assets. An employee identification system must be in place for positive identification and access control. Employees should be given access only to those secure areas needed for the performance of their duties.

The company security officer is responsible for the development and maintenance of the Ship Security Plan (SSP), which describes the security protocols required under the International Ship and Port Security (ISPS) code (Deutsche Flagge 2017). The ship security officer is responsible for implementation of the SSP. The SSP identifies methods for the escort of visitors and service providers. Consistent with the vessel's SSP, all passengers may be subject to a search when boarding or disembarking a vessel.

The individual port operator is responsible for developing and implementing access controls to prevent unauthorized entry to port facilities. These controls should include the positive identification of all employees, visitors, service providers, government officials, and vendors at all restricted access points. Shore employees and service providers should have access only to those areas of the port authorized by the harbormaster, the official responsible for enforcing the security regulations of the port.

3.4.9 USCG Port Security Requirements

The port facility security officer must be designated as responsible for the development, implementation, revision, and maintenance of the Port Facility Security Plan (PFSP). The purpose of the PFSP is to establish the following (Risk Intelligence 2017):

- Measures designed to prevent weapons, or any other dangerous substances and devices intended for use against persons, ships, or ports, and the carriage of which is not authorized, from being introduced into the port facility or onboard a ship.
- Measures designed to prevent unauthorized access to the port facility, to ships moored at the facility, and to restricted areas of the facility.
- Procedures for responding to security threats or breaches of security, including provisions for maintaining critical operations of the port facility or ship/port interface.
- Procedures for responding to any security instructions the Contracting Government, in whose territory the port facility is located, may give at security level 3.
- Procedures for evacuation in case of security threats or breaches of security.
- Duties of port facility or other site management personnel that are responsible for various security aspects of security.
- Procedures for interfacing with ship security activities.
- Procedures for the periodic review of the plan and updating.
- Procedures for reporting security incidents.
- Identification of the port facility security officer, including 24-hour contact details.
- Measures to ensure the security of the information contained in the plan.
- Measures designed to ensure effective security of cargo and the cargo-handling equipment at the port facility.
- Procedures for auditing the PFSP.
- Procedures for responding if the ship security alert system of a ship at the port facility has been activated.
- Procedures for facilitating shore leave for ship's personnel or personnel changes, as well as access of visitors to the ship, including representatives of seafarers' welfare and labor organizations.

Consistent with the PFSP, which must meet the ISPS requirements, all persons may be subject to a search when entering or exiting a facility or vessel. Port security must maintain a visitor log and issue temporary visitor passes as required by the PFSP. All workers and visitors must display the identification specified in the PFSP. Port security is monitored by the USCG and U.S. Customs and Border Protection (CBP).

Federal regulations require all workers (or delivery truck drivers) with access to secure or restricted areas of maritime facilities or vessels to possess a Transportation Worker Identification Credential (TWIC). The TWIC is administered by the Transportation Security Administration and USCG. Foreign nationals need to obtain a B-1 visa to obtain a TWIC card. The USCG may periodically inspect or audit port security protocols, ensuring that port operators and tenants are complying with security measures in place, including TWIC requirements.

3.5 United States Customs and Border Protection

The U.S. CBP is responsible for facilitating international trade with the U.S., collecting import duties, and enforcing U.S. regulations involving trade, customs, and immigration. CBP works to prevent terrorists and their weapons from entering the U.S., apprehends individuals attempting to enter the U.S. illegally, and is charged with stemming the flow of illegal drugs and other contraband into the country.

Developers and contractors importing offshore wind components will need to comply with CBP requirements. For commercial shipments, the invoice accompanying the importation should include a statement certifying that the components qualify as originating goods. A commercial invoice should contain enough information for a CBP Officer to determine whether the goods being imported are admissible. If admission is granted, the correct classification and valuation of goods is an important part of the importation and entry process (CBP 2017).

3.6 U.S. Army Corps of Engineers

The responsibility of the USACE pertaining to offshore wind regulation is set forth in Section 404 of the CWA and Section 10 of the Rivers and Harbors Act (RHA). Under the CWA, the USACE requires all lessees to obtain a permit for the discharge of dredged or fill materials into U.S. waters. This may be required prior to the installation of foundations and for any buried transmission lines, onshore or offshore.

Under the RHA, the USACE is responsible for regulating the placement of fill material and structures in, over, or under Navigable Waters of the U.S., and is responsible for reviewing and approving the general design of offshore wind foundations. For the Block Island Wind Farm, the USACE delegated to the USCG its responsibility for reviewing and approving such plans for the general design and placement of safety lines and access ladders.

Future offshore wind lessees will be required to obtain Department of the Army permits from the USACE for work performed within New York waterways, such as the installation and shore-crossing of export cables and any cable or pipeline crossings. Lessees can use the CWA permitting process to comply with the RHA provisions as there is a combined Section 404/Section 10 permit application.

3.7 Environmental Protection Agency

3.7.1 EPA Oil Spill Response Requirements

The EPA has established requirements to report spills to navigable waters or adjoining shorelines of the U.S.. The EPA's oil spill reporting requirements are set forth in 40 CFR 110.6. Any discharge of oil must be reported to the National Response Center, which is staffed by the USCG. If direct reporting to the National Response Center is not possible, reports may be made to the USCG or EPA pre-designated On-Scene Coordinator for the geographic area where the discharge occurred. An oil spill response plan must be approved by BSEE and included in a future lessee's COP.

3.7.2 EPA Emissions Requirements

40 CFR 55 sets forth the OCS Air Regulations, which require that future developers obtain permits from the EPA for emissions sources during project construction and operations.

3.8 Federal Aviation Administration

The FAA, which is responsible for ensuring airspace safety within the U.S., requires that projects are sited and illuminated (potentially) in a manner that is safe for existing air traffic.

3.8.1 FAA Aviation Lighting Requirements

FAA Advisory Circular 70/7460-1L states that, for wind turbines, “any temporary or permanent structure, including all appurtenances, that exceeds an overall height of 200 feet (61m) above ground level (AGL) or exceeds any obstruction standard contained in 14 CFR 77 should be marked and/or lighted.” This applies to structures out to 12 nm from the coast. For structures beyond 12 nm, BOEM has jurisdiction. BOEM has not yet provided guidance or design requirements relating to this subject but is expected to do so by early 2018.

3.8.2 FAA Determination of No Hazard Requirements

To ensure that projects do not pose a risk to aviation, the FAA requires that structures over 200 feet above ground level receive Determination of No Hazard permits prior to construction. The requirements for filing with the FAA for proposed structures are set forth in 14 CFR 77.9 and vary based on factors such as height, proximity to an airport, location, and frequencies emitted from the structure.

4 New York State and Local Health and Safety Requirements

Approvals from NYS agencies are not required for the construction of assets located in federal waters, but such approvals will be needed for the construction of the export cable (through State waters), upland transmission cable, and any onshore facilities or activities.

NYS does not have specific laws or regulations pertaining to offshore construction, but future offshore wind developers and their contractors should comply with NYS regulations pertaining to onshore construction and business operations (such as employee licensing) and any other requirements borne out of permits issued by the State to perform activities relating to an offshore wind project.

4.1 New York State Agencies

The following NYS authorities may require permits for future offshore wind projects:

- Public Service Commission (PSC).
- Office of General Services (OGS).
- Department of State (DOS).
- Department of Environmental Conservation (DEC).
- Department of Labor (DOL).
- Department of Transportation (DOT).

Future developers of offshore wind farms in New York should consult with these state agencies regarding H&S planning and be prepared to comply with the requirements established by law and identified in this study.

4.1.1 New York State Public Service Commission

A certification issued by the PSC must be obtained before constructing any transmission or generation facilities connecting directly to an electrical grid in the State. As part of its review process, the PSC considers compliance with environmental laws and regulations and the risk that such facilities might pose to public safety.

4.1.2 New York State Office of General Services

Easements for all pipelines, cables, docks, wharves, moorings, and permanent structures within NYS jurisdiction must be obtained from the OGS. Easements will ensure that public safety and environmental impacts are considered.

4.1.3 New York State Department of State

The DOS will review future offshore wind projects to ensure they are consistent with the enforceable policies of the State's federally approved coastal zone policies, which are contained in the New York Coastal Management Program, Local Waterfront Revitalization Programs, and Long Island Sound Coastal Management Program.

This consistency review is a requirement of the federal Coastal Zone Management Act of 1972 (16 USC 1451) and implementing regulations at 15 CFR Part 930 and 923; State Executive Law Article 42; and 19 New York Codes, Rules, and Regulations (NYCRR) Part 600 and 6 NYCRR Part 617. This step advances the goal of the Coastal Zone Management Act to "preserve, protect, develop, and where possible, to restore or enhance the resources of the nation's coastal zone."

4.1.4 New York State Department of Environmental Conservation

DEC is responsible for the safeguard of protected streams and navigable waters, coastlines, water quality, storm water, wetlands, and endangered and threatened species. DEC is also responsible for air, solid waste, and storm water permitting for the state of New York.

4.1.5 New York State Department of Labor

The DOL is responsible for managing workforce-related issues within the State, including issuing State licenses for certain occupations (administered by the DOL Safety and Health License and Certification Unit).

Crane operator is the only profession relevant to the offshore wind industry that requires a certificate of competence under NYS law. This certificate is required in order to operate cranes with a maximum rated capacity exceeding five tons or a boom length over 40 feet, and to operate all tower cranes used in NYS.

4.1.6 New York State Department of Transportation

The DOT is responsible for issuing permits for roadway construction, which would be required for the installation of the upland duct bank and transmission cable. Any utility work in a State highway right-of-way requires a highway work permit from the DOT, whether it is for construction and installation of facilities, or for repairs and maintenance. This is to ensure that work completed on the right-of-way, and the finished projects, satisfy public safety standards and policies and highway laws and regulations. Typical examples of this work are permanent or temporary driveway installations and related improvements (e.g., drainage design, slope design, land development) and the various activities of utilities in maintaining and installing utility lines and equipment in the right-of-way.

4.2 Local Authorities

Depending on the location of onshore activities associated with future offshore wind development (e.g., staging area operations, upland duct bank construction, upland transmission cable installation, and interconnection work), local authorities may have jurisdiction over construction activities.

4.2.1 Worker Licensing

As required by NYS, other than for certain trades or activities where a State license is required, local government entities are responsible for the licensing of specific trades (e.g., electricians) at their discretion.

4.2.2 Building Permits

If onshore assembly sites need to be constructed or modified, a building permit will likely be required. An inspection of the building, structure, or work by a representative of the State building department, affiliate (e.g., electrical inspector, fire inspector, mechanical inspector), or both is required prior to the issuance of a Certificate of Occupancy granting permission to use the building. The State requires that a building permit be obtained for any work that must conform to the Uniform Fire Prevention and Building Code (Uniform Code). The permit must prescribe minimum standards for fire prevention, building construction, and compliance with the State Energy Conservation Construction Codes. The energy code defines building energy standards requirements (DOS 2017), including, but not limited to, the construction, enlargement, alteration, improvement, removal, relocation, or demolition of any building or structure or any portion thereof.

4.2.3 Fire Safety Permits

Per the Uniform Code, new and existing buildings, structures, systems, and equipment located in NYS must comply with the 2015 International Fire Code. Recent changes to the scope of the code, specifically Section 101.2 of the 2016 Uniform Code Supplement, specify that wind turbines not attached to buildings are an exception and fall outside the responsibilities of local code enforcement officers (DOS 2016). Therefore, it is not expected that permits will be required by local authorities for assembly operations within their jurisdictions. However, permits may be required for other onshore activities, depending on the type of work and jurisdiction.

4.2.4 Elevator Permit

Requirements for elevators are set forth in the Uniform Code. The code specifies that no permit is required for new elevators installed in NYS; however, regular inspections by a Qualified Elevator Inspector are required. Since this code does not apply to wind turbine structures, permits, or official inspections are not required for the use of lifts during assembly activities within local jurisdictions.

For elevators located in onshore manufacturing facilities (possibly including wind turbine assembly facilities), which fall under the definition of "factory" according to the DOL (DOL L § 2 [2014]), approval of plans for new or altered elevators is required if more than six people are employed in the facility (New York State 2017). In addition, design requirements set forth in the Uniform Code must be followed.

5 Offshore Personnel Transfers

Currently, no safety regulations or requirements regarding personnel transfers in the U.S. via helicopter or vessel relate specifically to offshore wind facilities, but there are requirements pertaining to offshore transfers in the general maritime and aviation industries. There are also a variety of secondary aspects of offshore transfers that are subject to regulation, as well as review as part of the permitting process (e.g., boat ladder design, helipad design, and vessel and helicopter design, and operational requirements).

A combination of European offshore wind and U.S. offshore oil and gas best practices should be followed for offshore transfers at U.S. offshore wind farms. Providing employees with adequate training is currently the best practice for offshore personnel transfer in the U.S. (excluding helicopter transfer). According to International Marine Contractors Association guidance, responsibility for the safety of personnel during transfer operations lies with the Masters of the vessels involved or the Offshore Installation Manager.

Offshore personnel transfers should only be considered once the following conditions have been met:

- A risk assessment, including vessel compatibility review, has been performed and understood by all personnel involved in the transfer.
- All vessel controls, including engine and steering, have been tested and are in working order.
- Weather and sea conditions (e.g., wave height, tides, wind) have been assessed.
- Radio and visual communication have been established between vessels and personnel involved. These should be maintained throughout.
- All participants involved in the transfer have been briefed on the procedures to be followed.

5.1 Marine Personnel Transfer Requirements

The following methods exist for transferring between vessels or between a vessel and an offshore wind platform.

5.1.1 Personnel Transfer Carrier (Crane Transfer)

This method is generally used in offshore wind projects for transfers to and from jack-up installation vessels. The collapsible net, rigid basket, and rigid capsule (shown in Figure 5) are the three main devices used in crane transfers. Each has a different level of safety depending on conditions and application; the use of a rigid capsule is recommended, followed by rigid basket and then collapsible net.

Figure 5. Collapsible Net, Rigid Basket, and Rigid Capsule (left to right).

Source: Marine Transfer Forum 2016

5.1.2 Gangway Transfers

There are a wide variety of gangway types; however, motion-compensated hydraulic gangways (Figure 6) have often been used for offshore wind transfers in Europe due to the raw conditions at sea. Gangways should be fit for purpose and should be fitted with non-slip walkways and handrails. They should be regularly inspected and maintained. In addition, where there is the possibility of personnel falling from the gangway, an appropriate safety net should be used. If a gangway type with enclosed railings (e.g., an Ampelmann™ [Figure 6]) is to be used, then the use of a safety net may not be required.

Figure 6. Example of Hydraulic Gangway.

Source: Siemens 2015

5.1.3 Vessel Bow Transfers

Transfers from small vessels to the offshore wind turbine boat landing often occur using vessels equipped with a "surfer" bow (Figure 7). This is often a purpose-build device on the bow of crew boat ('male' section), designed to fit into a receptacle frame or structure on an offshore wind turbine ('female' section). Under no circumstances is a bow-to-bow transfer to take place.

Figure 7. Block Island Wind Farm Vessel Bow Transfer Example.

Source: Rhode Island Fast Ferry 2016

5.1.4 Access System Transfers

These mechanical devices, which either grip the boat landing and/or provide a dynamically stabilized access to a ladder (Figure 8), have been developed for the offshore wind industry to increase both the safety and availability of transfers in heightened weather conditions.

Figure 8. Personnel Transfer from a Vessel using a Transfer Access System.

Source: IMCA 2014

5.1.5 Alongside Approach Transfer

Docking of a crew transfer vessel alongside another vessel or offshore structure is an alternative means of performing an offshore transfer. In this scenario, the relative movements and elevation of the steps over which the personnel transfer is made should be considered from a safety perspective. Personnel, equipment, or both should be available on each side of the transfer to provide assistance. Given the increased risk associated with this method, it should only be used as a last resort.

5.2 Helicopter Personnel Transfer Requirements

With respect to offshore helicopter transfers, the FAA is responsible for ensuring safe use of airspace in the U.S. The FAA's authority is set forth in 14 CFR, the Federal Aviation Regulations (FARs). As a rule, all aircraft in the U.S. must comply with FAR 91, which sets forth general operating and flight procedures, including airspace and aircraft requirements. For offshore helicopter personnel transfers, BSEE recommends complying with FAR 135.

The FAA does not regulate the design or use of helidecks on OCS facilities as they are considered to be "private" airports. However, the Helicopter Safety Advisory Conference (HSAC) and the Helicopter Association International have developed design standards that are available in the HSAC document library at [http://www.hsac.org/library].

6 Health and Safety Plan Recommendations

Any SMS relating to future offshore wind development that is submitted to BOEM should contain the project's H&S plan. Since each project contractor will likely have its own pre-existing H&S plan, the future lessee must ensure that its SMS and H&S plan either supersedes those plans or bridges gaps between them so that the work can be performed and coordinated safely.

BOEM is responsible for ensuring that the lessee's activities are compliant with the project's SMS. BOEM's SMS requirements are described in Section 3.1.1.

6.1 Objectives of an H&S Plan

Generically, the objective of an H&S plan is to describe the organization and arrangements for addressing potential impacts of a project on human H&S and the environment, in this case, a future offshore wind farm. Completing the project without incident or injury to personnel and without damage to equipment and the environment should be the lessee's main goal when developing the H&S plan. The plan establishes the minimum accepted level of H&S performance for the site. All contractors must be able to document that their H&S plan meets or exceeds the requirements set forth in the project's SMS.

6.2 Recommended SMS and H&S Plan Contents

An SMS is intended to be used as guidance for the regulated community; it is not intended to set information or data standards or prescribe additional requirements.

An effective SMS should describe a structured approach that the developer can use to accomplish its quality-based objectives, including safety and environmental performance. This approach requires the developer to identify hazards, manage risk through various tools and actions, and develop and implement policies and processes to reach goals. This approach should also include a process by which managers regularly track, measure, and assess the outcomes of implemented programs and policies and take corrective action as needed to continually improve the quality of performance. Taking this more holistic approach helps drive continuous improvement for all aspects of health, safety, and environmental performance, rather than just achieving compliance with minimum regulatory requirements.

Sections 6.2.1 through 6.2.4 describe the common components of management systems that could be useful in effectively controlling health, safety, and environment risks for the offshore renewable energy industry, including those that the regulations require be managed.

6.2.1 Safety and Environmental Policy and Organization

- Policy and commitment for ensuring worker H&S (including, for example, how to achieve safety and environmental performance expectations in 30 CFR 585.800-803).
- Authority and responsibilities for key positions.
- Personnel qualifications, training, and competency.
- Management commitment and employee participation.

6.2.2 Planning

- Hazards analysis.
- Health, safety, and environmental hazard mitigation, including a hierarchy of hazard controls.
- Operating procedures, including robust job safety analyses.
- Management of change.
- Emergency preparedness, prevention, and response.
- Quality assurance, mechanical integrity, maintenance (including, for example, how to meet the performance expectations in 30 CFR 585.813-816).
- Commissioning.

6.2.3 Implementation

- Communication.
- Procurement.
- Contracting and contractors.
- Incident investigation and reporting (including, for example, how to meet the performance expectations in 30 CFR 585.830-833).
- Audits.
- Inspections (including, for example, how to meet the performance expectations in 30 CFR 585.820-825).
- Records and documentation.

6.2.4 Checking and Continuous Improvement

- Performance monitoring, measurement, and key performance indicators.
- Corrective and preventive actions.
- Continual improvement (including program evaluation and management review).

The following resources provide a more in-depth understanding of management systems and best practices for offshore H&S. These are not requirements; rather, they are suggested resources to assist in identifying hazards, assessing risk and determining appropriate mitigations, and developing a performance-based management system.

- Transportation Research Board of the National Academies – Worker Health and Safety on Offshore Wind Farms – Special Report 310. Identifies common hazards for offshore wind farms and recommends the offshore wind industry adopt more comprehensive SMS requirements similar to the SEMS requirements in 30 CFR Part 250 Subpart S (next reference). (see: https://www.nap.edu/catalog/18327/worker-health-and-safety-on-offshore-wind-farms-special-report-310).
- BSEE's Offshore Oil and Gas Guidance "Safety and Environmental Management Systems – SEMS." Mandatory for offshore oil and gas facilities; however, provides useful information that can be applied for offshore wind facilities. (see: https://www.bsee.gov/resources-and-tools/compliance/safety-and-environmental- management-systems-sems, and Regulatory Requirements at 30 CFR 250.1900).
- Technology Assessment Program (TAP) project #709, "Example Safety Management System and Audit Criteria." Provides a sample offshore wind energy SMS and SMS audit checklist (see: https://www.bsee.gov/research-record/tap-709-technical-and-business- proposal-example-safety-management-system-and-audit).
- AWEA OCRP 2012 includes a section (Chapter 9) on SMS, Safety Equipment, and Navigational Aids (see: http://www.awea.org/offshore-wind-standards).
- USCG's Outer Continental Shelf Activities regulations. Although only mandatory for manned and unmanned offshore oil and gas facilities, this provides useful information for determining appropriate safety features for manned and unmanned offshore wind facilities. (see: 33 CFR Subchapter N).
- American National Standards Institute (ANSI) Z10-2012, "Occupational Safety and Health Management Systems," American Industrial Hygiene Association, 2012.
- Occupational Health and Safety Assessment Series (OHSAS) 18001: 2007, "Occupational Health and Safety Management Systems Requirements," July 2007.
- ISO 14001:2015, "Environmental management systems, Requirements with guidance for use."

6.3 Risk Assessment Guidelines

A risk assessment is a thorough analysis of situations, processes, and physical conditions that may cause harm to people and/or property. Once a risk is identified, the likelihood of occurrence and potential consequences should be evaluated, and mitigation measures should be identified and implemented. Risk assessments form an integral part of a H&S management plan. A future wind lessee's process for conducting risk assessments should be described in the SMS.

Some guidelines to consider when identifying risk mitigation measures include:

- Remove the hazard at the source, e.g., remove or replace the source.
- Substitute the source with something less hazardous.
- Isolate the hazardous process, item, or substance from people.
- Add engineering controls, such as safety barriers or exhaust ventilation.
- Adopt safe work procedures, training, and supervision to minimize the risk.
- Where other means are not sufficient or practicable, provide personal protective equipment.
- Implement and monitor the controls identified.

7 Best Practices and Lessons Learned

Many lessons have been learned from other offshore wind projects in Europe and the U.S., which should be considered in the development, construction, and operation of potential offshore wind farms in NYS. Offshore wind projects in the U.S. will benefit from improvements in component design, assembly, and installation, but project construction and operations activities will need to be executed in a manner that minimizes potential H&S risks to workers and the public.

7.1 European Best Practices

The development of the offshore wind industry began in Denmark in 1991. Since then, approximately 13,000 megawatts of offshore wind power have been installed across 87 projects throughout Europe. It is essential that the lessons learned from European offshore wind farm development, construction, and operations experience are applied to the emerging offshore wind industry in the U.S.

7.1.1 Design and Development

The design phase has a significant impact on the remaining lifecycle of an offshore wind project. H&S should be considered as early as possible in the design process, and stakeholders should be brought in to provide input on their preferred methods of performing activities within their scope. This will ensure that all parties will be aligned to effectively manage risks and interfaces. Some topics that should be considered early in the planning process in the context of safety include the following:

- Geotechnical inputs to design basis for foundations (turbine and substation).
- Unexploded ordinance and other subsea risks.
- Electrical design safety.
- Access and egress (ladder design, vessel transfers, lifting equipment, PPE).
- Shipping and navigation risks.
- Equipment and vessel selection (method statements for heavy lifting and handling activities).
- Vessel handling (tension wires, anchors, dynamic positioning).
- Quality Control and Quality Assurance (throughout manufacturing, assembly, installation, and commissioning).
- Public safety and security.
- Metocean conditions and emergency response planning.
- Cable burial and protection.
- Minimization by design of diving and other high-risk activities.

Preconstruction planning is essential to the successful construction and operation of an offshore wind farm. Input from the supply chain and stakeholders is critical to identifying and mitigating any risks posing safety hazards early in the design process.

7.1.2 Installation and Commissioning

Specific risks to safety depend on the type of component being installed, the method of installation, quality of equipment used, environmental conditions, and the skill and experience of operators and workers involved. During installation or commissioning activities, workers and project managers should implement daily the following safety precautions, regardless of the activity performed:

- Pre-shift or pre-task safety talks.
- Right to stop work encouragement.
- Regular PPE and equipment inspections.
- Thoughtful planning of tasks, use of correct PPE, equipment and materials.
- Permit to work process (to confirm thoughtful task planning and appropriate credentials).
- Use of experienced workers and teams (effective communication is key).
- Consideration of environmental conditions and third-party risks.
- Implementation of zones and exclusion perimeters for hazardous areas.
- Use of safety indicators (warning lights, signage, and sounds).
- Worker condition assessment (fatigue, dehydration, temperature, intoxication, etc.).
- Rest periods.

7.1.3 Handover and Operations

The timing and the nature of when and how an offshore wind construction project is handed over to the operations team are critical to the management of the safety of assets, personnel, and third parties. It is often the case that installation and commissioning teams move on quickly to another project and take essential project-specific knowledge with them.

To alleviate hand-over issues, it is essential that future involved parties agree on the following:

- Responsibilities for SMS compliance and on-site safety management.
- Work areas and communication responsibilities (when commissioning and operations teams may overlap).
- Process for transitioning responsibility for critical safety systems (e.g., electrical) from construction teams to operations teams.
- Overlap between on-site H&S management (if separate), so that lessons learned and best working practices are transferred.

7.2 Lessons Learned From the Block Island Wind Farm

7.2.1 Adoption of European Experience

As the offshore wind industry has developed in Europe, a resource pool of experienced and skilled workers has also grown. In the U.S., there are strong onshore wind, maritime construction, and offshore oil-and-gas industries. However, the number of experienced U.S. offshore wind project managers is very small, and the number of U.S. offshore wind workers is even smaller. To ensure that the Block Island Wind Farm was well planned and executed, European resources frequently managed and assisted U.S. colleagues throughout the lifecycle of the project, from the top to the bottom of the supply chain.

7.2.2 Preparation for Offshore Logistics

One of the challenges with offshore logistics on the Block Island Wind Farm was coordinating the use of the single crew transfer vessel to be used on the project, which was based in Quonset, while many commissioning workers were based on Block Island. It is critical that future offshore wind farms in the U.S., which will likely be further from shore than the Block Island Wind Farm, engage in the same degree of planning to ensure that emergency response procedures are well planned. The workers and responders must also be prepared for a variety of types of emergencies or unplanned situations.

7.2.3 Sea Survival Training

Although not explicitly required by the USCG, employers should provide or arrange for sea survival training to prepare offshore workers and visitors for the risks associated with offshore construction. The Global Wind Organization (GWO) is the standard international course provider for sea survival and other skills necessary for offshore wind construction. GWO training is not required by law in NYS or elsewhere in the U.S.; however, it is an option by which employers can satisfy OSHA's training requirements.

Although ubiquitous across Europe, the U.S. has only a few GWO-accredited courses and training centers. The existing courses focus on serving the onshore wind industry; however, the necessary training facilities and course materials to teach a complete GWO Sea Survival course are not available. Basic Offshore Safety Induction and Emergency Training (BOSIET) is a sea-survival training program that offers roughly the equivalent of a GWO course. Designed for oil and gas workers, BOSIET is available at various facilities in the U.S. Gulf of Mexico area.

7.2.4 Coordination of Multiple Contractors

For the Block Island Wind Farm, multiple project contractors used a single staging area to execute their respective scopes of work relating to the wind turbines. In situations where multiple contractors are operating in close vicinity to one another, it is critical that H&S risks are communicated to and implemented by all parties present, and that individual priorities do not outweigh the need to maintain an accident-free workplace. This principle should apply to all offshore wind workplaces where simultaneous activities occur, such as construction work at staging areas or on vessels, and energization activities where risks can cross contract package boundaries.

7.2.5 Safety Zone Implementation

During construction of the Block Island Wind Farm, the USCG enforced a temporary 500-yard Safety Zone around each wind turbine location and issued Local Notices to Mariners containing construction planning information submitted by the lessee. Due to the proximity of the Block Island Wind Farm to shore and concurrence with a busy time of year for recreational boating, the offshore wind farm was a very popular attraction for boaters interested in construction of the project. The USCG was challenged (initially) to maintain the Safety Zone during implementation of the exclusion zone due to public interest. This will likely be less problematic for any future NYS and other U.S. offshore wind projects further from shore.

8 Conclusion

Offshore wind development in the U.S. is subject to regulation by a variety of federal, state, and local authorities, each of which will play a role in ensuring that future projects are designed, constructed, and operated with the best available safeguards. The risk of injury or death, along with the potential reputational and financial risks associated with accidents and injuries, can be significant; therefore, developers and stakeholders must be aware of H&S risks, and comply with local, state, and federal requirements.

Beyond these baseline requirements, future offshore wind projects developed off NYS should benefit from the decades of European experience managing safety risks, as well as the years of thoughtful planning that is required to complete a successful project in the U.S. Future offshore wind developers and their contractors should be well prepared to safely plan and execute offshore wind farms in NYS and the U.S. and ensure that safety is an absolute priority throughout the lifecycle of an offshore wind farm.

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