Kitty Hawk Wind

AVANGRID

Construction and Operations Plan

Appendix D - Preliminary Hierarchy of Standards

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		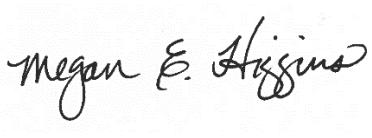
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D.1 Introduction

Kitty Hawk Wind, LLC (the Company) is designing, fabricating and installing offshore facilities as part of the for the Kitty Hawk North Wind Project (Project). This document presents the design-basis approach to applying codes and standards to the design of the facilities.

The following sections describe the standards that will be applied for the entire Project and for specific facilities within the Project. The organization of offshore wind farm facilities and applicable standards is shown in Figure D-1.

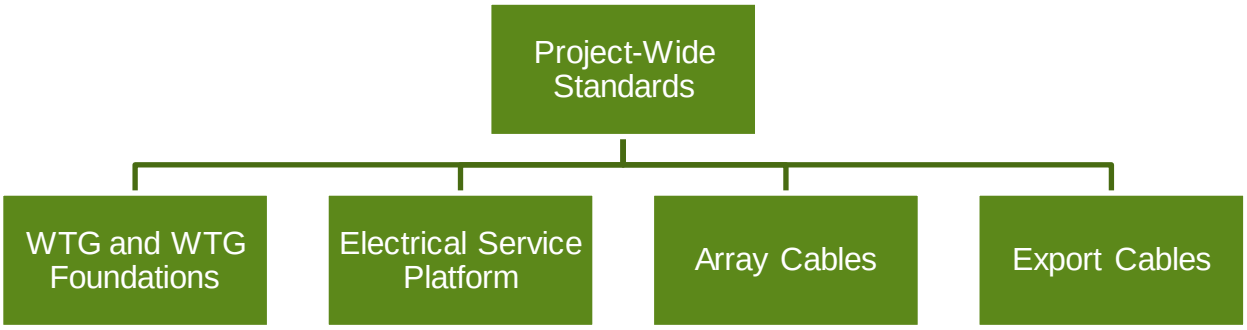

Figure D-1 Hierarchy of Standards

This document describes high-level design standards for the offshore facilities and will be submitted for approval by the Certified Verification Agent (CVA) for the Project, and subsequently to the Bureau of Ocean Energy Management (BOEM) for approval prior to commencement of the design. Accordingly, high level standards are presented herein. As design of the offshore facilities progresses, a more detailed list of the latest version of the applicable standards will be developed and presented in the design basis for each of the Project areas/facilities described above.

D.2 General Hierarchy of Standards

D.2.1 Overall Regulations and Governing Documents

BOEM has been granted jurisdiction over renewable energy activities on the Outer Continental Shelf (OCS) through the Section 388 of the Energy Policy Act of 2005. Regulations were promulgated by BOEM at 30 Code of Federal Regulations (CFR) § 585.

The U.S. Coast Guard (USCG) is a cooperating agency with BOEM, and there is a Memorandum of Agreement (MOA) in place between the Bureau of Ocean Energy Management, Regulation and Enforcement (predecessor agency to BOEM) and USCG.[1] Under the MOA, USCG will regulate vessels where USCG has an applicable regulation. The Bureau of Safety and Environmental Enforcement (BSEE)

[1] https://www.boem.gov/MOA-USCG-BOEMRE/

is a sister agency to BOEM and there is a Memorandum of Understanding (MOU) between the agencies regarding authorities on the OCS.[2]

The Company will follow the hierarchy below to determine the applicable standards for design of its facilities as described in the Project Construction and Operations Plan (COP):

1. U.S. laws, regulations, and applicable requirements:
    a. 30 CFR § 585
    b. Lease OCS-A 0508
    c. Permits issued to the Project

2. Guidance documents issued by agency having jurisdiction:
    a. BOEM COP Guidelines[3]

3. National Organization Standards:
    a. American Wind Energy Association (AWEA) Offshore Compliance Recommended Practices 2012
    b. American Petroleum Institute (API)

4. International Organization Standards:
    a. International Electrotechnical Commission (IEC), including IEC Renewable Energy (IECRE)
    b. American National Standard Institute (ANSI)
    c. International Organization for Standardization (ISO)

5. Classification Society Standards:
    a. DNV GL
    b. American Bureau of Shipping (ABS)

6. Foreign Organization Standards:
    a. European Standard (EN)

Where specific editions of standards are not provided, the edition is assumed to be the most current in effect upon approval of this Hierarchy of Standards.

D.2.2 Certification

Certification of the Project will be carried out by a CVA in accordance with 30 CFR § 585.705 et seq., an approved Verification Plan, IECRE OD-502, 2018 Edition.

D.2.3 Safety

BOEM pre-empts the authority of the Occupational Safety and Health Administration (OSHA) for renewable energy on the OCS.[4] However, to comply with 30 CFR § 585 Subpart H, Kitty Hawk Wind, LLC will adopt OSHA requirements at 29 CFR § 1910 for design of Project-specific components, specifically including transition pieces and Electrical Service Platforms (ESPs). If referenced safety standards conflict, the more stringent shall apply.

[2] https://www.boem.gov/Environmental-Stewardship/Environmental-Studies/Partnerships/MOU-BOEM-BSEESigned-20111001.aspx
[3] https://www.boem.gov/COP-Guidelines/
[4] https://www.boem.gov/TAP-686/

D.2.4 Suppliers

Certification under ISO 9001 Quality Management 2015 is preferred. If the preferred certification is not available, the contractors and suppliers shall provide evidence to the Project (including the CVA) of a consistent quality management system including documentation processes, covering all aspects of their scope of supply.

D.3 Wind Turbine Generators (WTGs) and Foundations

D.3.1 Structural and Mechanical Design

D.3.1.1 Primary Standards

The primary standards for the design of the wind turbine generators (WTGs) and foundations will be:

- IEC 61400-1 – Wind Turbines Part 1: Design Requirements, 2019 Edition
- IEC 61400-3-1 – Wind Turbines Part 3-1: Design requirements for fixed offshore wind turbines, 2019 Edition.

WTG components that have a Component Certificate issued pursuant to IECRE OD-501 for U.S. conditions (i.e., 60 Hertz) will follow the design standards prescribed in the Component Certificate. The standards for the tower will be specified in the design basis and will follow standard industry practice. The following guidelines will apply to components designed specifically for the Project.

D.3.1.2 Supplementary Standards and Guidelines

D.3.1.2.1 General

- DNVGL-ST-0126 - Support structures for wind turbines.
- DNVGL-ST-0437 - Loads and site conditions for wind turbines.

D.3.1.2.2 Tropical Cyclones

- AWEA Offshore Compliance Recommended Practices (2012), Section 5.9

D.3.1.2.3 Robustness Check

- API – Recommended Practice for Planning, Designing and Constructing Fixed Offshore Platforms – Working Stress Design (API-RP2A-WSD, version 22).

D.3.1.2.4 Other Supplementary Standards

- API RP 2GEO – as applicable
- 33 CFR Navigation Aids as applicable
- API RP 2A WSD 22nd Edition – boat landings, hoists
- Federal Aviation Administration (FAA) lighting requirements as specified in a Determination of No Hazard
- DNV GL recommended practices for design
- Eurocode 3 series

D.3.2 Electrical Design

As previously noted, WTG components that have a Type Certificate issued pursuant to IECRE OD-501 will follow the design standards prescribed in the Type Certificate. The following guidelines will apply to components designed specifically for the Project.

D.3.2.1 Primary Standard

- IEC 61400-1 – Wind Turbines Part 1: Design Requirements, 2019 Edition

D.3.2.2 Supplementary Standards and Guidelines

- National Electrical Manufacturers Association (NEMA)
- National Fire Protection Association (NFPA) 70, 70E, IEEE 1584 –National Electric Code (NEC)
- National Electric Safety Code
- IEC 61400-24 - Wind turbines - Part 24: Lightning protection
- IEC 60364-1 - Low-voltage electrical installations - Part 1: Fundamental principles, assessment of general characteristics, definitions
- IEC 60204-1 - Safety of Machinery - Electrical Equipment of Machines - Part 1: General Requirements
- IEC 60204-11 - Safety of Machinery - Electrical Equipment of Machines - Part 11: Requirements for HV Equipment for Voltages Above 1,000 V AC or 1,500 V DC and Not Exceeding 36 kV
- IEEE applicable Std for Equipment, Battery System, Equipment connections and grounding

D.3.3 Structural and Mechanical Fabrication

D.3.3.1 Primary Standard

The applied fabrication standards shall follow the design standards. Primary fabrication standards shall be:

- DNVGL-OS-C401 – Fabrication and Testing of Offshore Structures
- EN 1090 Execution of steel structures.

D.3.4 Quality Management

- ISO 3834-2 Quality requirements for fusion welding of metallic materials -- Part 2: Comprehensive quality requirements.

D.4 Electrical Service Platform (ESP)

D.4.1 Structural and Mechanical Design

The structural and mechanical design of the ESP may be carried out under U.S. standards or European standards, as defined below. An ESP designed to U.S. standards must be manufactured to U.S. standards, and an ESP designed to European standards must be manufactured to European standards, as defined in Section 4.3.

D.4.1.1 Safety Class

For either U.S. or European design and manufacturing standards, a safety class of L-1 will be applied.

D.4.1.2 U.S. Design

D.4.1.2.1 Primary Standard

- API RP 2A WSD – 22nd edition

D.4.1.2.2 Supplementary Standards

For designs carried out under API, the following supplementary standards will be applied as appropriate:

- API 2MET – Derivation of Metocean Design and Operation Conditions
- API RP 2EQ – Seismic Design Procedures and Criteria for Offshore Structures
- API RP 2GEO – Geotechnical and Foundation Design Considerations
- API RP 2SIM – Structural Integrity Management of Fixed Offshore Structures
- API RP 2L – Recommended Practice for Planning, Designing and Constructing Heliports for Fixed Offshore Platforms
- API 2C – Specification for Offshore Pedestal-mounted Cranes
- API Bulletin 2U - Stability Design of Cylindrical Shells
- NACE SP0176-2007 – Corrosion Control of Submerged Areas of Permanently Installed Steel Offshore Structures Associated with Petroleum Production

D.4.1.3 European Design

D.4.1.3.1 Primary Standard

- DNVGL-ST-0145 – Offshore Substations, April 2016 Edition

D.4.1.3.2 Supplementary Standards

- DNVGL-OS-C101 - Design of offshore steel structures, general - LRFD method
- DNVGL-OS-C401 - Fabrication and testing of offshore structures
- DNVGL-ST-0126 - Design of support structures for wind turbines
- DNV GL recommended practices for design
- Eurocode 3 series

D.4.1.3.3 Additional Robustness Check

For designs carried out under DNV GL, an additional robustness check of the DNV GL design will be performed for the extreme storm condition under API RP 2A WSD – 22nd edition.

D.4.2 Electrical Design

The electrical design will follow the standards listed in this Section 4.2 regardless of the path chosen under Section 4.1.

D.4.2.1 Primary Standards

The primary electrical design standards will be Institute of Electrical and Electronics Engineers (IEEE) and IEC applicable standards.

National Electric Safety Code (NESC) and NFPA 70 National Electric Code.

For specific components, the following primary standards apply:

- Medium and High Voltage Equipment: Applicable IEEE and IEC standard.
- High Voltage Power Cables:

  - IEC 60229 Electric cables – Tests on extruded oversheaths with a special protective function
  - IEC 60287 Electric cables - Calculation of the current rating
  - IEC 60811 Electric and optical fibre cables - Test methods for non-metallic materials
  - IEC 60840 Power cables with extruded insulation and their accessories for rated voltages above 30 kV (U_m = 36 kV) up to 150 kV (U_m = 170 kV) - Test methods and requirements

- Grounding: IEEE80 Guide for Safety in AC Substation Grounding

- Lighting:
  - NFPA 101 Life Safety Code
  - API 14FZ Recommended Practice for Design, Installation, and Maintenance of Electrical Systems for Fixed and Floating Offshore Petroleum Facilities for Unclassified and Class I, Zone 0, Zone 1, and Zone 2 Locations

- Batteries:
  - IEEE484 IEEE Recommended Practice for Installation Design and Installation of Vented Lead-Acid Batteries for Stationary Applications
  - IEEE485 IEEE Recommended Practice for Sizing Lead-Acid Batteries for Stationary Applications

- Fire Protection:
  - NFPA
  - USCG 33CFR145

- Lightning: NFPA 780 – UL 96

D.4.2.2 Supplementary Standards

The following supplementary standards apply for specific components:

- High Voltage Power Cables: IEC 60228 Conductors of insulated cables
- Grounding: IEEE665 Standard for Generating Station Grounding
- Underwriters Laboratories (UL)
- Lighting: Illuminating Engineering Society of North America (IESNA)

D.4.3 Structural and Mechanical Fabrication

D.4.3.1 U.S. Manufacturing

D.4.3.1.1 Primary Standard

- ASTM International and American Welding Society (AWS) D1.1.

D.4.3.1.2 Supplementary Standards and Guidelines

U.S.-sourced steel will be purchased in accordance with the applicable ASTM standard. Additional supplementary standards:

- API 2MOP – Marine Operations

D.4.3.2 European Manufacturing

D.4.3.2.1 Primary Standard

The applied fabrication standards shall follow the design standards. Primary fabrication standards shall be:

- DNVGL-OS-C401 – Fabrication and Testing of Offshore Structures
- EN 1090 Execution of steel structures.

D.4.4 Quality Management

D.4.4.1 U.S. Design and Manufacture

- ASTM and AWS D1.1.

D.4.4.2 European Design and Manufacture

- ISO 3834-2 Quality requirements for fusion welding of metallic materials -- Part 2: Comprehensive quality requirements.

D.5 Power Cables (PC)

D.5.1 Array Cables

- Primary Standard: IEC 60287 Electric cables - Calculation of the current rating
- Supplementary Standards:
    - DNVGL-ST-0359 Subsea power cables for wind power plants
    - DNVGL-ST-N001 Marine operations and marine warranty
    - International Council on Large Electric Systems (CIGRE)
        - CIGRE TB490 Recommendations for testing of long AC submarine cables
        - CIGRE TB623 Recommendations for mechanical testing of submarine cables
    - IEC 60793 Optical fibres
    - IEC 60794 Optical fibre cables

D.5.2 Export Cable

- Primary Standard: IEC 60287 Electric cables - Calculation of the current rating
- Supplementary Standards:
    - DNVGL-ST-0359 Subsea power cables for wind power plants
    - DNVGL-ST-N001 Marine operations and marine warranty
    - International Council on Large Electric Systems (CIGRE)
        - CIGRE TB490 Recommendations for testing of long AC submarine cables
        - CIGRE TB623 Recommendations for mechanical testing of submarine cables
    - IEC 60793 Optical fibres
    - IEC 60794 Optical fibre cables

- IEC 62067 Power cables with extruded insulation and their accessories for rated voltages above 150 kV (U_m = 170 kV) up to 500 kV (U_m = 550 kV) - Test methods and requirements