Summary of revisions to ACP OCRP-1 in response to comments
2.22.22

1. Throughout the document, references to standards from "DNVGL" have been revised to the current nomenclature "DNV". The relevant numbers that designate the standards remain the same.

2. Throughout the document, when the abbreviation "Sec." was used, it has been revised to the full word "Section".

3. Throughout the document the section symbol "§" has been removed when used in conjunction with a Code of Federal Regulations (CFR) citation.

4. Throughout the document, references to the OCRP-1 "2021 Edition" have been changed to "Edition 2" to reflect that the document was not finalized in 2021.

5. Roster updates – individual names and companies – have been made.

6. Throughout the document, when the abbreviation "US" was used, it has been revised to "U.S."

7. Section 1 has been revised as follows to clarify applicability of this document to floating offshore wind turbine. The same edit is made in Section 5.1.

The initial planning activities for offshore wind facilities, which include site development, ecological issues, socio-economic issues, and other leasing and permitting issues, are not covered by this document. This document is not intended to address land-based wind turbines; or service, installation, or survey vessels. Floating wind farm assets are included by reference to ACP OCRP-2 *U.S. Floating Wind Systems Recommended Practices*. Where the guidance for floating wind farm structures in OCRP-2 conflicts with this document, OCRP-2 shall govern. ~~; or floating wind farm assets.~~

8. Section 2.4 has been revised as follows to clarify the intent of the inclusion of the PE, MWS and CVA section:

2.4 Discussion of roles of PE, MWS, and CVA

The information in this section is included for context and information only. It is not intended to establish requirements, and should not be a substitute for understanding and complying with applicable regulations.

Professional Engineer

The practice of engineering is regulated through Boards of Professional Engineering which are appointed by individual U.S. states. Engineers must be licensed through a state board in order to perform public or private work which requires engineering training, education, and experience. An individual who has met the licensing requirements of a state board – including successful testing, evidence of experience, professional

9. Section 2.6 revised as follows to add "commissioning" to the list of activities covered by codes and standards and the hierarchy was changed to a numbered list rather than a bulleted list.

2.6 Hierarchy of Codes and Standards

The design, fabrication, installation, commissioning, operation, and eventual decommissioning of wind farms requires the use of codes and standards from multiple sources. The overarching code hierarchy that should be followed is ranked as follows:

1. Applicable U.S. legislation and regulations and lease requirements
2. Codes and standards identified by this document (ACP OCRP-1) as best practice
3. U.S. codes and standards
4. International codes and standards (e.g. ISO and IEC)
5. Codes and standards and recommended practices from class societies

Byars, Rain R SEPCO-IGN/R/S
Change Note – changed from bulleted list to numbered list, however this is not marked as a change by Microsoft Word..

10. Section 3 Terms and Definitions revised as follows to (1) clarify figure 1 shows components of a fixed offshore wind turbine (2) clarify figure 2 shows components of a floating offshore wind turbine (3) add a definition of "bulk power system" (4) clarify definition of "certification body" (5) changed "design life" to "design lifetime" (6) grammatical revisions to "marine warranty surveyor" definition and "transition piece" definition.

3 Terms and Definitions

For the purposes of this document, the following terms and definitions apply. Definitions are aligned with IEC 61400-1 and IEC 61400-3-1 wherever possible.

The components of a fixed ~~n~~ offshore wind turbine are shown in Figure 1. The components of a floating offshore wind turbine are shown in Figure 2.

3.6
bulk power system
facilities and control systems necessary for operating an interconnected electric energy transmission network (or any portion thereof); ~~and)~~and electric energy from generation facilities needed to maintain transmission system reliability (see NERC Glossary of Terms).

~~3.6~~3.7
certification body
body that performs conformity assessment services, also called conformity assessment body ~~body that conducts certification of conformity~~

~~3.9~~3.10
design lifetime
The period of time defined in the design basis as the intended minimum useful lifetime of a wind farm component, spanning from the time of installation to the time of decommissioning.

~~3.24~~3.25
marine warranty surveyor (MWS)
an individual or organization who provides independent third-party technical review and approval of high value and/or ~~high risk~~high-risk marine construction and transportation project operations, from the planning stages through to the physical execution

~~3.48~~3.49
transition piece
part of an ~~monopile~~ offshore wind turbine sub-structure, particularly a monopile, that may be used to provide a connection between the tower and the sub-structure pile (see Figure 1).

11. The following revisions were made to the acronyms section: (1) spelling out the correct organizational name for ACP (2) removing DNV GL from the list (3) adding HAZOP, SCADA and SLS to the list of acronyms (4) correcting the name of the NESC

ACP American ~~Wind Energy~~Clean Power Association

~~DNV GL Det Norske Veritas Germanischer Lloyd~~

HAZOP hazard and operability study

SCADA supervisory control and data acquisition

SLS service limit state

NESC National Electrical Safety Code

12. Removal of "or" from "and/or" in Section 5.2 as follows:

5.2 Hierarchy of Codes and Standards

Designers of offshore wind farm assets should endeavor to determine and select, with a certified verification agent (CVA), certification body, and~~/or~~ regulatory authority approval, a consistent codes and standards hierarchy that meets their requirements.

The overarching code hierarchy is provided in section 2.6.

13. Removal of "generally" from 5.2.1 along with grammatical edits as follows.

5.2.1 Design basis approach toward the selection of standards

Where design requirements are not covered by U.S. legislation and regulations or codes and standards recommended by this document, then the use of ~~generally~~ accepted industry standards shall be applied in the design.

The design basis does not need to be common for all wind farm assets and can be established separately for the offshore wind turbine, OSS, and cables. Code systems are internally calibrated;~~, and~~ code mixing for a specific asset should be avoided~~,~~ as this might lead to an unknown safety level. If standards from different code and standards systems are mixed it should be justified that the intended safety level is achieved.

objectives of the U.S. codes and standards, especially with respect to environmental~~,~~ health~~,~~ and safety. This document provides guidance on selecting appropriate codes and standards to form the project design basis.

14. Section 5.3, revised references to "unmanned" to "unattended" and "manned" to "attended", grammatical edits.

The exposure category for an offshore wind turbine per API RP 2A-LRFD or API RP 2A-WSD is based on medium consequence of failure C2 and an ~~unmanned~~ unattended[2] structure S3 resulting in an exposure category L-2. An offshore wind turbine has a ~~low level~~low-level risk of causing damage to the ocean environment, but due to the size and asset value of an offshore wind turbine, it is found reasonable to classify the consequences of failure as C2. This safety level ~~is considered to correspond~~corresponds to a normal safety class inherently given in the IEC 61400-1 and IEC 61400-3-1.

OSS structures should be considered to have high consequence of failure C1 as defined by API RP 2A-LRFD or API RP 2A-WSD, resulting in an exposure category L-1 whether ~~manned~~ attended (S1 or S2) or ~~unmanned~~ unattended (S3). This safety level ~~is considered to~~ corresponds to a high safety level in ~~DNVGL-ST-0145~~DNV-ST-0145.

Other structures in an offshore wind farm (e.g., meteorological towers) may be considered as low consequence of failure (C3) and ~~unmanned~~ unattended (S3) as defined by API RP 2A-LRFD or API RP 2A-WSD (i.e., L-3) so long as the loss of the structure would not impact the ability of the wind farm to continue operating. Where the loss of a structure would impair continued operation of the wind farm, that structure should be considered as either medium (C2) or high (C1) consequence of failure, depending on the degree of potential disruption, resulting in a higher exposure category.

Offshore wind farm assets	**Applicable exposure category, per API RP 2A-LRFD or API RP 2A-WSD**
Offshore wind turbine	(L-2) Medium consequence of failure and ~~unmanned~~unattended
Offshore sub-station	(L-1) High consequence of failure whether ~~unmanned~~unattended or ~~manned~~attended
Other bottom fixed offshore wind farm assets (e.g. meteorological towers)	(L-3) Low consequence of failure and ~~unmanned~~unattended

2 "Unattended" structures are referred to as "unmanned" in some standards including API RP 2A-LRFD and API RP 2A-WSD. The terms are equivalent. Similarly, "attended" and "manned" are equivalent.

15. Section 5.4 added "external" prior to platform, spelled out "1,000-year" and added "elevation" after wave crest. Changed "should" to "shall" with respect to loads from wave run-up being included in the design of access platforms.

5.4 Deck Clearance

The deck (or external platform) clearance shall exceed the ~~1,000 yr~~1,000-year wave crest elevation, in accordance with API RP 2A-LRFD or API RP 2A-WSD, unless the designer can demonstrate that the global structural integrity and structural robustness are not affected by a lower platform elevation and clearance. When considering a lower platform clearance, global structural integrity shall be assessed under design-level[3] wave loading on the lower platform; structural robustness shall be assessed with wave loading on the lower platform according to S~~s~~ections 5.6.2 and 5.7.2. Loads from wave run-up ~~should~~ shall be included in the design of access platforms, and these loads may be determined from 50-year event wave data.

3 Design-level loading includes all factored loads considered in the evaluation of the integrity of the structure for its exposure category as defined in Section 5.3.

16. Section 5.4 added 100-year wave crest recommendation for OSS, deck and platform clearances per a referenced API standard:

At a minimum, deck or platform clearance shall not be less than the 50-year wave crest plus an air gap not less than 0.2 times the 50-year spectral significant wave height or 1.0 m defined in IEC 61400-3-1. For the OSS, deck or platform clearance should not be less than the 100-year wave crest plus 1.5 m air gap, from

API RP 2A-LRFD Section A6.1.3.2. Site-specific considerations may increase the required air gap. This lower limit on deck clearance does not apply to rest- or shifting platforms.

17. Section 5.6.1 removal of "considered":

It is intended that this document be used in conjunction with IEC 61400-3-1. The information contained in this section provides exceptions, additions, and revisions to IEC 61400-3-1 and does not replicate provisions in IEC 61400-3-1 that are ~~considered~~ directly applicable to U.S. waters. This document along with IEC 61400-3-1 and other documents referenced herein are to be used together to form a broad guideline for offshore wind turbine design.

18. Section 5.6.1.1. addition of "type" prior to "certificate":

For the certificate to be considered valid, the external conditions at the site shall be assessed according to IEC 61400-3-1 and shall be within the load envelope described within the type certificate. Inclusion of 60Hz operation in the type certificate is recommended for wind turbines installed in the US.

19. 5.6.2 added references to other relevant OCRP documents -2, -3, and -4:

5.6.2 Loads

Loads considered in the design of the offshore wind turbine should be based on the IEC TC-88 standards, including IEC 61400-3-1 and IEC 61400-1. For floating offshore wind turbines, refer to OCRP-2.

Any conditions that have an impact on loads shall be considered. Additional guidance is found in OCRP-3 and OCRP-4. These conditions should include, but not be limited to, the following:

20. 5.6.2.1 added a requirement ("shall") that hurricane related loading be considered:

5.6.2.1 Tropical Cyclone/Hurricane Loading and Structural Robustness

Tropical cyclone/hurricane related loading on the offshore wind turbine shall be considered.

Tropical cyclone/hurricane related loading may be considered as described in IEC 61400-3-1, Annex I. The load cases included in this annex are sufficient to demonstrate fulfilment of the robustness level analysis as described in API RP 2A-LRFD or API RP 2A-WSD. The loading associated with these load cases should be applied toward evaluation of the support structure including the top connection between the RNA and tower. Refer also to section 5.3.

21. 5.6.3 added references to OCRP-2 and-4, corrected DNV references, and made a grammatical edit:

5.6.3 Structural Design

The design of the offshore wind turbine shall be in conformance with IEC 61400-3-1. System and component resistances shall be determined according to IEC 61400-1 and the ISO 19900 suite of standards, API RP 2A-LRFD and associated standards, or other recognized offshore structural and geotechnical design standards. Guidance specific to offshore wind turbine structural design is also available in ~~DNVGL~~DNV-ST-0126 and the ABS BOWT guide. For floating offshore wind turbines, refer to OCRP-2. For foundation design, refer to OCRP-4.

The safety level inherent in the normal safety class for wind turbines defined in IEC 61400-1 can be considered to comply with the API RP 2A-LRFD or API RP 2A-WSD exposure category L-2. This ~~is considered to~~ corresponds to a normal safety level in ~~DNVGL~~DNV-ST-0126.

22. 5.6.3 added "conditions" after "geotechnical":

- Geotechnical conditions

23. Section 5.6.3.2, added a third DNV reference standard and corrected other DNV references:

5.6.3.2 Steel design

The following standards apply to the design of steel support structures, secondary structures, and other steel elements:

- API-RP 2A LRFD
- ~~DNVGL~~DNV-ST-0126
- DNV-OS-C101
- ~~DNVGL~~DNV-RP-C203 (for fatigue design)
- ABS BOWT Guide

24. Section 5.6.3.4 clarified permitted use of corrosion allowance:

5.6.3.4 Corrosion Protection

Corrosion protection is achieved through a combination of coatings and cathodic protection, as described in the following sections. ~~In some cases~~Use of a corrosion allowance ~~may also be used~~is permitted in some standards, e.g. where coating maintenance is impractical. The standards chosen for the design shall be included in the design basis.

25. 5.6.3.5 Ship collision section, navigation safety risk assessment information added for context. Clarifies two different impact scenarios to assess for structural design: (1) boat landing and (2) accidental ship impact on the support structure. Referenced standards and guidance documents remain the same.

5.6.3.5 Ship Collision

A navigational risk assessment for the wind farm is performed as part of the COP; the details of that assessment are not covered in this document. The navigational risk assessment determines among other

(Continued below)

things the likelihood of impacts from vessels of various sizes and is used as input to the ship collision risk analysis, considering the types of service vessels as well as other ship traffic passing through or nearby.

For impact scenarios found to be likely within the lifetime of the wind farm, the effect of those vessel impacts should be evaluated. For structural design two scenarios should be considered. An operational impact to assure structural design of boat landing and an accidental ship impact on the support structure.

Guidance on collision impact assessments can be found in API RP 2A-LRFD and API RP 2A-WSD

Guidance on service vessel load on boat landing can be found in:

- IEC 61400-3-1
- DNV-ST-0437
- The Wind Partnership OE-RP-02

At a minimum, the accidental ship collision load should be taken as the load from the maximum expected service vessel size during the operation period of the wind farm. According to API RP 2A-LRFD, the vessel is assumed to be drifting towards the structure with 2 m/s unless the designer can demonstrate that a lower speed can be used.

In the post damage situation the primary structure shall remain intact and without further damage for such time as it takes for repairs to be effected and for the primary structure to be made fit-for-service. An appropriate return period for loads considered in the post damage situation shall be included in the design basis. For reference, API RP 2A-WSD states that the minimum return period is 1 year.

Guidance on risk assessments can be found in:

- ABS *Guidance Notes on Accidental Load Analysis and Design for Offshore Structures*
- Center for Marine and Petroleum Technology (CMPT) *A Guide to Quantitative Risk Assessment for Offshore Installation*

(Revisions continued below)

~~Ship collision risk should be assessed for the wind farm considering the types of service vessels as well as other ship traffic passing through or nearby. For impact scenarios found to be likely within the lifetime of the wind farm, an impact assessment should be performed on the structure.~~

~~The threshold for likelihood of impact and selection of design parameters including weight of vessel, speed at time of impact, and resulting impact energy should be stated in the design documentation.~~

~~Guidance on the collision impact assessment can be found in API RP 2A-LRFD and API RP 2A-WSD~~

~~Guidance on service vessel load on boat landing can be found in:~~

- ~~IEC 61400-3-1~~
- ~~DNVGL-ST-0437~~
- ~~The Wind Partnership OE-RP-02~~

~~Guidance on the risk assessment can be found in:~~

- ~~ABS *Guidance Notes on Accidental Load Analysis and Design for Offshore Structures*~~
- ~~Center for Marine and Petroleum Technology (CMPT) *A Guide to Quantitative Risk Assessment for Offshore Installation*~~

~~The accidental ship collision load should be taken as the load from the maximum expected service vessel size during the operation period of the wind farm. According to API RP2A LRFD, the vessel is assumed to be drifting towards the structure with 2 m/s unless the designer can demonstrate that a lower speed can be used.~~

~~In the post damage situation the structure shall remain intact and without further damage for such time as it takes for repairs to be effected and for the structure to be made fit-for-service. An appropriate return period for loads considered in the post damage situation shall be included in the design basis. For reference, API RP 2A WSD states that the minimum return period is 1 year.~~

26. 5.6.4.1. correcting NEC reference and grammatical edits:

5.6.4.1 General Requirements

The electrical installations on the offshore wind turbine shall be designed to generally accepted industry standards. This may include NFPA 70, *National Electrical Code (NEC)* and IEEE C2 *National Electrical Safety Code (NESC)*, which are considered state of the art for electrical and power generation equipment

In some instances, specific standards may be required by the interconnection agreement or by other interfacing entities. These standards shall be included in the design basis as long as they are not in conflict with U.S. regulations.

27. 5.6.4.2 addition of reference to HAZOP:

Control measures shall be taken~~,~~ where such code-mixing between electrical systems occurs, to ensure installation and maintenance work can be safely carried out and that proper grounding is applied. These control measures can include wire identification and documentation of interface schematics. A HAZOP may be performed to determine the control measures needed at the interface.

28. Revision in 5.6.4.3 to Change of “be in accordance” to “should be in accordance...” as follows:

5.6.4.3 Testing and approval of electrical design

It is recommended that electrical component testing, evaluation, and listing be performed or witnessed by accredited electrical testing laboratories[4] and that such testing, evaluation, or listing should ~~it~~ be in accordance with the applicable electrical codes and standards used in the design.

29. 5.6.4.5 Addition of colon and change of “should” to “shall” with respect to safeguarding and safe working procedures as follows:

5.6.4.5 Electric Shock

Reduction of risk is necessary to ensure:

- safety of persons and property
- consistency of control response
- ease of maintenance

The first opportunity for attaining these safety measures is at the design and development phase. Safeguarding and safe working procedures ~~should~~ shall be considered. The extent of safeguarding, which includes means for safeguarding and awareness, shall be determined by means of a risk assessment.

30. 5.6.4.7 Correction to CFR references and addition of “electric” prior to “arc flash hazard”:

5.6.4.7 Arc Flash

Electric cabinets, regardless of voltage, shall comply with the electrical hazard identification requirements of 29 CFR 1910.335(b)(1). This shall include information regarding the electric arc flash hazard as specified in 29 CFR 1910.269(i~~l~~)(8). Further details regarding the hazard analysis are given in 29 CFR 1910 Appendix E. To fulfil this requirement, the designer should perform an arc flash hazard analysis on each cabinet according to the procedures outlined in NFPA 70E, IEEE 1584, or using other methods which may reasonably predict the incident heat energy as specified by 29 CFR 1910.269(i~~l~~)(8)(ii) Note 1.

31. 5.6.54.8 Changes reference from “low voltage” equipment to “auxiliary power for” equipment and corrects CFR citation:

5.6.4.8 Main Transformer Installation and Protection

This section refers to the main transformer installed at the wind turbine, which increases the voltage from the wind turbine generator or inverter to the collection voltage.

This section does not refer to transformers on circuits exporting the power from multiple wind turbines, for example on the OSS. This section also does not refer to transformers only supplying ~~low voltage~~auxiliary power for equipment on the offshore wind turbine.

Guidance for indoor installations of transformers should be applied where suitable for the transformer technology and level of exposure. When the main transformer is installed inside the wind turbine tower or nacelle, it should meet the requirements for indoor installation according to IEC 61400-1[6] and one or more of the following:

- 29 CFR 1910.~~ *Subpart S – Electrical* section~~ 305 (j) (5)
- the NEC Sections 450.21 through 450.27 and 450 Part III

32. 5.6.5.5 Correction of CFR citation and DNV standard citation:

5.6.5.5 Cranes and hoists

General requirements for cranes and hoists may be found in the ASME B30 series and ~~OSHA~~ 29 CFR 1910.179, or the EN 13001 series of standards. EN 12999 provides specific requirements toward hydraulic powered cranes and the EN 14492 series provides requirements for winches and hoists. Additional electrical requirements towards hoisting machines may be found in IEC 60204-32.

Cranes used for loading or unloading from vessels shall comply with standards appropriate for the type of crane in use. Commonly used standards include API SPEC 2C, EN 13852-1, ~~DNVGL~~DNV-ST-0378, and ABS Guide for Certification of Lifting Appliances.

Cranes and hoists shall be certified by accredited third parties according to the relevant design standards.

33. 5.6.5.6 and 5.6.5.7 Correction of CFR citation:

5.6.5.6 Lock-Out Tag-Out

Wind farm assets should be designed so that Lock-Out Tag-Out (LOTO) procedures compliant with 29 CFR 1910~~ Subpart J, Section,~~. 147 can be used during operation.

ISO 14118 provides additional guidance on safe design of machinery for isolating and preventing start-up. IEC 60204-1 and ISO 4413 provide specific information on isolation of electrical and hydraulic fluid power systems, respectively.

5.6.5.7 Confined Space

Wind farm assets should be designed so that confined space procedures compliant with 29 CFR 1910. ~~Subpart J, Section~~ 146 can be used during installation and maintenance activity.

34. 5.6.5.14 and 5.7.1 Revised terminology from manned and unmanned to attended and unattended:

5.6.5.14 Fire Safety

The design of offshore wind farm assets for fire safety should take into consideration the operational philosophy and whether the asset classifies as a ~~manned~~attended or ~~unmanned~~unattended facility according to 33 CFR 140.10. The offshore wind turbine is generally assumed to be an ~~unmanned~~unattended facility.

Design considerations for fire safety should be taken into account on the basis of a fire hazard analysis and/or fire risk assessment.

For areas of the wind farm asset where fire-fighting systems are necessary as a risk reduction measure, storage locations should be made available for the systems specified by 33 CFR 145.

5.7.1 General

This section covers an OSS topside on a steel or concrete support structure. These requirements pertain to an ~~unmanned~~unattended OSS; there are additional requirements for a ~~manned~~attended OSS outside the scope of this document.

35. 5.7.2 Corrected DNV standard citations, provided OCRP-3 and -4 and a DNV document as additional citations:

5.7.2 Loads

Loads considered in the design of the OSS should be based on API RP 2A-LRFD or API RP 2A-WSD, ~~DNVGL-ST-0145~~DNV-ST-0145, or ABS Rules for Offshore Installations. The selected codes and standards shall be included in the design basis described in Section 5.2.1.

Any conditions that have an impact on loads shall be considered. Additional guidance is found in OCRP-3 and OCRP-4. These conditions should include, but not be limited to, the following:

Load cases related to transport, lifting, load-out, sea transportation and installation shall be considered. Criteria shall be defined for acceptable external conditions during these various load cases. These should include, for example, maximum acceptable wind speed and wave height. The vessels used and the duration of the operations in question should also be considered. The main requirements are given in API RP 2A-LRFD or API RP 2A-WSD, ~~and~~ API RP 2MOP, and DNV-ST-N001.

36. Added new subsection under Loads and the OSS regarding tropical cyclone/hurricane loading:

<ins>5.7.2.1 Tropical Cyclone/Hurricane Loading and Structural Robustness</ins>

<ins>Tropical cyclone/hurricane related loading on the OSS shall be considered by a robustness level analysis for an L-1 structure as described in API RP 2A-LRFD or API RP 2A-WSD. Refer also to section 5.3.</ins>

37. 5.7.3 Corrected DNV standard citation, caution added on mixing standards, and added "conditions" after "geotechnical":

5.7.3 Structural Design

The exposure category for the OSS structures should be designated as L-1 as defined by API RP 2A-LRFD or API RP 2A-WSD. This is considered to correspond to a high safety level in ~~DNVGL-ST-0145~~<ins>DNV-ST-0145</ins>. Refer to Section 5.3.

It might be necessary to use a combination of standards, and in such cases the designer shall demonstrate that the intended safety level is achieved. <ins>Particular care shall be taken when mixing LRFD and WSD/ASD standards, which is generally not recommended. The selected standards shall be included in the design basis and shall not be in conflict with U.S. regulations.</ins>

For the support structure the following items shall as a minimum be considered:

- Codes and standards
- Geotechnical<ins> conditions</ins>

38. 5.7.4.1 Corrected reference to NEC and NESC and added a reference to NERC BES rules:

5.7.4 Electrical design for OSS

5.7.4.1 General requirements

The electrical installations on the OSS shall be designed to generally accepted industry standards following the hierarchy and design basis approach outlined in section 5.2. This may include NFPA 70, *National Electric<ins>al</ins> Code (NEC)* and IEEE~~ / ANSI~~ C2 *National Electric<ins>al</ins> Safety Code (NESC)*, which are considered state of the art for electrical and power generation equipment and installations in the U.S. This may also include IEC standards which are considered state of the art for electrical and power generation equipment and installations internationally.

In some instances specific standards may be required by the interconnect agreement or by other interfacing entities. These standards shall be included in the design basis as long as they are not in conflict with U.S.

regulations or best practice.<ins> NERC requirements for the design and operation of the Bulk Power System[10] may also apply, but are outside the scope of this document. Refer to Section 10.1.</ins>

<ins>[10] Note that the Bulk Power System is distinct from the Bulk Electrical System discussed in Section 5.8.</ins>

39. 5.7.4.8 changed manned/unmanned to attended/unattended:

According to national and international standards the unit should be designed to withstand the maximum sustained short circuit current and maximum Basic Insulation Levels. Guidance can be found in IEEE C57.12.00. The likelihood of a catastrophic failure should take into consideration reliability requirements, replacement cost and duration, and if the platform is ~~manned~~<ins>attended</ins> or ~~unmanned~~<ins>unattended</ins>.

40. 5.7.4.8 clarified type of lock out function:

pressure and temperature. To ensure transformer protection after an incident, a lock out ~~relay~~ function shall be used (e.g. electromechanical lockout relay or intelligent electronic device). ~~Depending on~~Depending on the voltage level and criticality, a primary/backup relay redundancy may be employed.

41. 5.7.4.13 Clarified DNV standard references and changed a "should" to "shall" with respect to designing emergency and standby power systems according to generally accepted industry standards:

5.7.4.13 Emergency and Standby Power Systems

The design of emergency and standby power systems ~~should~~ shall be according to generally accepted industry standards following the design basis approach. Guidance can be found in:

- ~~DNVGL-ST-0145~~DNV-ST-0145
- ~~DNVGL~~DNV-OS-D201

5.7.5 Design for Occupational ~~H~~Health and ~~S~~Safety

The design of the ~~offshore~~ OSS~~asset~~ should be compliant with all local, state, and/or federal legal requirements pertaining to occupational health and safety. This may vary according to the location of the offshore wind farm and the agencies having jurisdiction. The use of generally accepted industry standards is

required in the occupational health and safety related design of the ~~asset~~OSS. The application of these design standards should follow the design basis approach as described in Section 5.2.1.

43. 5.7.5.1 Clarified CFR references and changed "unmanned" to "unattended":

5.7.5.1 Requirements from U.S. Code of Federal Regulations

Refer to section 5.6.5.1.

To ensure that the design of the OSS is in compliance with Safety Management System requirements from 30 CFR 585.810 the following should be accounted for in the OSS design:

- The OSS shall be designed to allow safe execution of emergency response procedures. This should include following 33 CFR. ~~Subchapter N Section~~ 143.101 *Means of escape*
- The OSS shall be designed to incorporate measures for fire suppression. This can involve providing secure storage locations for portable fire extinguishers as required by 33 CFR. ~~Subchapter N Section~~ 145.01 and ~~Section~~ 33 CFR 145.10 for ~~unmanned~~unattended facilities.

44. 5.7.5.3 Changed a citation from an API reference to a CAP reference:

5.7.5.3 Helidecks

Helidecks shall be designed according to accepted industry standards.

The FAA and USCG publish regulations for helicopter landing areas.

- FAA AC150/5390-2C and API RP 2L provide regulations governing the design, marking, and lighting of helicopter landing decks.
- Coast Guard 46 CFR 108.231

Additional information can be found in the below guidelines:

- HSAC RP Nbr 161 *New Build Helideck Design Guidelines*
- ~~API RP 2L~~ CAP 437

45. Changed “Unmanned” to “unattended” and clarified a DNV citation:

5.7.5.13 Fire Safety

- Refer to Section 5.6.5.14.

The offshore substation is generally assumed to be an ~~unmanned~~unattended facility.

Additional guidance can be found in NFPA 850 *Recommended Practice for Fire Protection for Electrical Generating Plants and High Voltage Direct Current Converter Stations*.

For passive fire protection design guidance can be found in ~~DNVGL-ST-0145~~DNV-ST-0145.

46. 5.8 Clarified applicability to the wind farm control system, not just substation.

5.8 Cybersecurity

The ~~Offshore Substation~~wind farm electrical control systems risks production discontinuity from potential cybersecurity threats. Control systems on wind farm ~~substation~~ assets should be designed according to industry and regulatory standards. Cybersecurity best practice utilizing a Defense-in-Depth security architecture allows for cyber threat deterrence, detection and delaying of the bad actor’s penetration and potential detrimental action.

Another important distinction for the offshore ~~substation~~ wind farm control system related to confidentiality, integrity and availability (CIA) typical in information technology security is the operational technology security reprioritization to focus on system availability and data integrity as the cybersecurity objectives.

Guidance on the offshore ~~substation~~ wind farm control system cybersecurity can be found in:

- ISA/IEC 62443 series *Industrial communication networks - Network and system security*
- IEEE 1686 IEEE *Standard for Intelligent Electronic Devices Cyber Security Capabilities*
- IEC 62351 series *Power systems management and associated information exchange - Data and communications security*

Depending on the wind farm generation capacity and export transmission voltage, the relevant offshore ~~substation~~ wind farm assets shall be assessed to the applicable regulatory standards for the Bulk Electric System. ~~Awareness of the~~ Bulk Electric System (BES) regulatory standards for ~~guidance on~~ control systems can be found in the ~~:~~

47. 5.9 Updated lighting and marking references:

5.9 Navigational Aids

The facility design report of the Construction and Operations Plan outlined in 30 CFR 585.701 requires a marking concept for aids to navigation and aviation obstruction lighting. BOEM relies on the FAA and USCG and subsequently IALA for the basis of their requirements.

Guidelines on marking an offshore wind farm can be found in the following sources.

General

- BOEM ~~*Draft Proposed*~~ *Guidelines for* ~~*Providing Information on*~~ *Lighting and Marking of Structures Supporting Renewable Energy Development*

Obstruction Lighting

- FAA Advisory Circular 70/7460-~~1L~~ 1M *Obstruction Marking and Lighting*
- FAA Advisory Circular 150-5345-~~43H~~ 43J *Specification for Obstruction Lighting Equipment*

48. 5.11 Revised recommendation from referring to a single document on design assumptions to "into documentation" for O&M manuals and instructions:

5.11 Collection of Input to Operations and Maintenance Manuals

It is recommended that design assumptions are compiled ~~in a single document~~into documentation for "~~I~~input to ~~Operation~~ operation ~~&~~ and ~~Maintenance~~maintenance manuals and instructions~~"~~. ~~This document~~ The documentation should list the design assumptions to be sustained throughout the lifetime of the facility and to be ensured through the operation and maintenance of the facility.

49. 6.1 Changed "shall" to "should" with respect to design basis standard if other generally accepted industry standards are applied in the case of quality management systems:

6.1 Quality Management Systems

The manufacturing of components for offshore wind facilities should be performed by contractors with demonstrated manufacturing experience that employ a Quality Management System compliant with ISO 9001.

Guidance for quality control, welding, inspection, and testing can be found in API RP 2A-LRFD and API RP 2A-WSD.

If other generally accepted industry standards are applied, the design basis approach ~~shall~~ should be followed according to Section 5.2.1, with relevant justification.

50. 7.5 Grammatical edits and DNV reference clarifications:

7.5 Transport

When offshore wind farm components are transferred between various locations, a range of factors relating to how they will be transported shall be considered. This may include; from their point of manufacture to the site where they are installed to ~~operate; between~~operate; between their offshore operating location and a repair or decommissioning facility; or any other required locations.

Guidance on the transport of offshore wind farm components can be found in ISO 29400, Section 16 and distributed throughout both DNV~~GL~~-ST-0054 and DNV~~GL~~-ST-N001.

7.5.1 Pre-installation Transport

Transport between the point of manufacture and the installation marshalling port may involve modes of transport that include land-based road and/or rail, inland and/or nearshore waterways, and ~~ocean going~~ocean-going voyages. To provide ease of handling and protection of nacelles when they are being transported, a purpose-built and certified transport frame is used as the interface between the nacelle and the vehicle or vessel on which it is being transported.

Guidance on pre-installation transport and transport frames can be found in ISO 29400, Section 8 and DNV~~GL~~-ST-0054, Sections 3.3.1 and 3.3.2.

51. 7.5.3 Added DNV standard as a reference:

Guidance on pre-assembly requirements can be found in ISO 29400, Section 10 and DNV~~GL~~-ST-0054 Section 3.2~~.~~

52. 7.5.4 Revised "should" to "shall" with respect to SSA prior to jack-up vessel elevating at quayside:

7.5.4 Harbor Infrastructure

Infrastructure in harbors where specialized jack-up installation vessels operate should be able to accommodate their unique operating characteristics. In addition to being able to safely maneuver and having safe clearance from obstacles, either above or below the water, the ability of the seabed adjacent to the quayside to withstand repeated jacking operations is crucial. Prior to a jack-up vessel elevating at a quayside, an SSA as outlined in 7.1.3 above ~~should~~ shall be carried out.

53. 7.7.3 Clarified DNV references and OCRP-2 as a reference:

7.7.3 Foundation Installation

A range of substructure types may be deployed as the foundation for a fixed-bottom offshore wind turbine. Floating deployment of offshore wind turbines is outside the scope of this document and installation of foundation options for floating offshore wind turbine are not addressed here. Reference is given to OCRP-2.

Listed below are the types of fixed-bottom foundations currently in use today, along with references to relevant guidance about the options available for their installation:

- monopile and transition piece arrangement
- See ~~DNVGL~~DNV-ST-N001, Section 8.7.1, and ~~DNVGL~~DNV-ST-0054, Section 4.1.2
- jacket structure in either a lattice, twisted or hybrid configuration
- See ~~DNVGL~~DNV-ST-N001, Section 13, and ~~DNVGL~~DNV-ST-0054, Section 4.1.3
- gravity based structure (GBS)
- See ~~DNVGL~~DNV-ST-N001, Section 6, and ~~DNVGL~~DNV-ST-0054, Section 4.1.1
- suction bucket or caisson design
- See ~~DNVGL~~DNV-ST-N001, Section 8.7.3, and ~~DNVGL~~DNV-ST-0054, Section 4.1.4

Fixed-bottom foundations may be transported from the loadout port to the installation site by a variety of means, as outlined in ~~7.5Sec.~~Section 7.6.1 above. In addition, it is possible that the wet tow method outlined in ~~Sec.~~Section 7.6.4 may be used to bring monopile, jacket, or GBS foundations to the installation site.

Further to the above referenced guidance, additional information regarding installation of fixed-bottom foundations is also available throughout ISO 29400 and ~~DNVGL~~DNV-ST-N001.

54. 7.7.3 Revised grouted connections language with a “shall”:

Guidance on inspections that are required for installation of monopiles and/or pin-piles are defined in API RP 2A-WSD, Section 16.6.2. In addition, blow count records should be maintained, including both the blow count per 1m (3 ft) of penetration and the total blow count at every 1m (3 ft) of penetration, until the design penetration is achieved, the blow count limits are reached, or pile refusal is encountered. For grouted connections relative movement during curing shall be limited to prevent significant early age cyclic loading. Guidance on limiting values can be found in ~~DNVGL~~DNV-ST-0126. Substructure installation inspection should also confirm that verticality is within the range required to allow the offshore wind turbine tower to be installed within the turbine manufacturer’s tolerances.

55. 7.7.3 Added “typically” with respect to scour protection when scour exists, added reference to OCRP-4 and clarified DNV citations:

If it has been determined through site investigations that a risk of scour exists, scour protection will typically be installed around the base of a foundation. This will protect against potential movement of seabed sediment as a result of either current and/or wave motion at the site, which may undermine integrity of the foundation itself and/or expose cables in the immediate vicinity, thereby making them susceptible to physical damage. Refer also to OCRP-4.

General guidance on scour protection can be found in ~~DNVGL~~DNV-ST-N001, Sections 6.5.7 and 8.4.5, with additional guidance also available in ISO 29400, Section 18.20.4, and ~~DNVGL~~DNV-ST-0054, Section 4.2.

56. 7.7.4 Made grammatical changes, clarified DNV citations, added a separate reference to OCRP-5 with respect to subsea cables as already referenced with respect to array and export cables:

7.7.4 Array Cable and Export Cable Installation

Following installation of fixed-bottom foundations, array cables are generally installed between each turbine location and the OSS, prior to the installation of towers, nacelles and blades.

~~Guidance on the installation of both array and export cables can be found in OCRP-5 and is beyond the scope of this document.~~ Installation of array and/or export cables is outside the scope of this document. Reference is given to OCRP-5. However, for general information purposes, reference can be made to ~~DNVGL~~DNV-ST-N001~~,~~ Section 7~~,~~ and Appendices H.3 and H.4, with additional information available in ISO 29400~~,~~ Section 20, and ~~DNVGL~~DNV-ST-0054~~,~~ Section 4.4.

~~Guidance on installation of subsea cables can be found in OCRP-5.~~

57. 7.7.6 Clarification that it applies to OSS installation, clarified DNV citations:

7.7.6 Offshore Substation (OSS) Installation

The OSS collects power generated by turbines in an offshore wind farm through the array cable system and sends that power to the electrical grid ashore through export cables. Components of the OSS will generally be installed in two phases, with the support structure installed first followed by the topside structure.

The type of support structure to be installed will be determined during the design of the offshore wind farm. For fixed-bottom installations a jacket structure is generally used, although other types of support structure such as monopiles and/or self-installing arrangements are also sometimes employed.

Guidance on the installation of jacket structures can be found in ISO 29400, Sections 18.10.2 through 18.10.4, ~~DNVGL~~DNV-ST-N001, Section 13, and ~~DNVGL~~DNV-ST-0054, Sections 3.7.2 to 3.7.5.

58. 8.0 Clarified this section’s applicability to floating OSW:

8 Operations and In-Service Inspections

The present chapter covers operations and in-service inspections of offshore wind farm assets in U.S. waters. For floating wind farm structures, refer also to ACP OCRP-2 *U.S. Floating Wind Systems Recommended Practices*. Where the guidance for floating wind farm structures in OCRP-2 conflicts with this document, OCRP-2 shall govern.

59. 8.3.1 Revised to acknowledge there may be more than one O&M manual:

~~7.10.1~~8.3.1 Maintenance Manual

~~A~~The maintenance manual(s) should be developed to track all scheduled and unscheduled maintenance activities for the offshore wind farm, including any manufacturer-specified planned maintenance procedures. Both above- and below-water equipment and systems should be included. The maintenance manual(s) should designate safety critical equipment as noted in the safety management system (SMS) documentation. Additional information on the maintenance manual(s) can be found in BSEE TAP 633AC referenced above.

60. 8.4.1 Added "cathodic protection system(s)" to list for structural inspection and clarified the scope of the ISIP related to design assumptions:

Structural inspections should focus on identifying damage or degradation such as dents, holes, signs of plastic strain, missing members, loose connections, crack indications, wear, ~~and~~ corrosion, and cathodic protection system(s).

The ISIP should address all points relevant to design assumptions identified in the design phase for input to operation and maintenance manuals and instructions ~~The ISIP should address all points in the document "Input to Operation & Maintenance" created in the design phase~~ (see Section 5.11).

61. 8.4.4 Added cathodic protection structures to list of items subject to subsea inspections:

~~7.11.4~~8.4.4 Subsea Support Structure Inspections

Routine below-water inspections should be performed to detect, measure, and record any defects, deterioration, or anomalies that affect the structural integrity or operation of the offshore wind turbine or OSS. These inspections are typically categorized into structural or equipment components and are performed by divers or a ROV. The splash zone region may be included in either the below-water inspections or the above-water inspections, but it is important that this region be targeted in the inspection campaign. These topics are further addressed in BSEE TA&R 627, ISO 19902, ISO 19903, API RP 2A-WSD, and API RP 2SIM.

The below-water structural components are the portions of the substructure below the waterline. In addition to general inspection of the below-water support structure during inspections, more intensive inspections may be specified for critical areas, as defined during the design process or from existing in-service conditions. These include areas of previous damage or repair and areas known to have higher frequency of degradation.

The below-water equipment are the (non-structural) components related to the operation of the facility below the waterline, including cables, risers, J-tubes, umbilicals, cathodic protection system(s), etc. In addition to general inspection of below-water equipment systems, more intensive inspections should be specified for critical areas, as defined during the design process or from existing in-service conditions. These include areas of previous damage or repair and areas known to have higher frequency of degradation. At a minimum, the following below-water equipment should be included in any general inspection:

- Risers/J-tubes and attachments to the sub-structure
- Electrical and control cables within field with particular attention to cables crossing other infrastructure according to OCRP-5
- Electrical cables to shore with particular attention to cables crossing other infrastructure, according to OCRP-5
- Connectors and junction boxes
- Scour protection system, and any significant changes in the seabed surrounding the facility which could impact its support characteristics for the foundation structure
- Cathodic protection system(s), including anodes, electrical cabling and connections

62. 8.4.5 Added rectifiers to the list of above water electrical and mechanical systems that should be inspected and maintained:

The electrical and mechanical systems include the drivetrains, electrical cabling, junction boxes, panels, transformers, generators, rectifiers, hydraulic systems, control systems, etc. Electrical and mechanical systems should be inspected and maintained in accordance with manufacturer recommendations to ensure efficient and safe operations.

63. 8.4.7 Added language to the inspection review on what happens if flaws are found along with two references on assessing flaws:

Additional information on review of inspection data can be found in BSEE TA&R 627, ISO 19902, and ISO 19903 as referenced above. If flaws are identified during in service inspections, their acceptability for fitness for service needs to be demonstrated. Guidance on the assessment of flaws can be found in BS 7910 and API 579.

64. 9.2.2 Clarified lessee prepares decommissioning plan:

A decommissioning plan shall be developed by the lessee and approved by regulators, as applicable, so that the level of equipment, structure, and cable removal is clearly defined, and the level of site remediation is understood.

65. 9.2.2.1 Added that special attention should be given to potentially hazardous or contaminated fluids in decommissioning plan:

- Provisions for waste disposal, recycling, and/or use of materials for approved artificial reefs. Special attention should be given to potentially hazardous or contaminated fluids, such as lubricants or ballast.

66. 9.3.1 In useful life reassessment, added additional DNV references and corrosion protection system consideration:

Useful life reassessment should be informed by the inspections performed during operations as identified in ~~Sec.~~Section 8. There should be special focus on elements that are critical to structural integrity. Additional guidance can be found in DNV~~GL~~-SE-0263 and DNV-ST-0262. Performance of corrosion protection system including cathodic protection data and coating condition should also be considered.

9.6.4 Transportation and Decommissioning Operations

Decommissioning operations and transportation for decommissioning should follow the same standards, requirements, and considerations discussed in Section 7.

68. 10.1 Added section in the limitations discussion that the document does not cover power system studies:

This document does not detail the power system studies that must be considered when connecting the offshore substation to an onshore substation and to the interface electric utility. Such studies follow the performance-based methodology defined by the relevant NERC Region. Those facilities identified as elements of the Bulk Power System may be subject to reliability requirements from the NERC Region.

69. 9.3 Removed the recommendations for future revisions section:

~~9.3 Recommendations for Future Revisions~~

~~This document relies heavily on references to IEC 61400-3-1. Several other countries have nationalized and adopted IEC 61400-3-1 and other IEC TC 88 standards. A U.S. nationalized version of IEC 61400-3-1 should be considered as a companion to future revisions of the OCRP suite of standards. Similarly, U.S. adoption of ISO 29400 should be considered.~~