

UNITED STATES DEPARTMENT OF THE INTERIOR
Bureau of Ocean Energy Management
Office of Renewable Energy Programs

April 28, 2021

Guidelines for Lighting and Marking of Structures Supporting Renewable Energy Development

Except to the extent that the contents of this document derive from requirements established by statute, regulation, lease, contract, or other binding legal authority, the contents of this document do not have the force and effect of law and are not meant to bind the public in any way. This document is intended only to provide clarity to the public regarding legal requirements, related agency policies, and technical issues.

I. Introduction

This guidance provides lighting and marking recommendations for wind energy facilities, which include meteorological towers, wind turbine generators and electrical service platforms, on Federal renewable energy leases on the Outer Continental Shelf (OCS). This guidance also outlines the types of information that the Bureau of Ocean Energy Management (BOEM) would find helpful as it reviews a lessee's Site Assessment Plan (SAP), Construction and Operations Plan (COP), or General Activities Plan (GAP). This information will assist BOEM in determining whether the lighting and marking of OCS wind energy facilities comply with BOEM's statutory authorities and regulations (see below), and particularly whether the lighting and marking:

- are safe;
- do not unreasonably interfere with other uses of the OCS;
- do not cause undue harm or damage to natural resources; life (including human and wildlife); property; the marine, coastal, or human environment; or sites, structures, or objects of historical or archaeological significance;
- use best available and safest technology; and
- use best management practices.

BOEM will review lighting and marking information, in consultation with other Federal agencies, as part of its plan review and approval process. Under 30 CFR 585.701, BOEM may request more detailed lighting and marking specifications in a lessee's Facility Design Report following plan approval. BOEM recommendations are offered to assist lessees in demonstrating that their plans adequately address the concerns enumerated above. These recommendations are guidance and do not prescribe additional regulatory requirements.

II. Authorities and Regulations

BOEM is responsible under the Outer Continental Shelf Lands Act (43 U.S.C. § 1337(p)(4) (A)) and its implementing regulations (30 CFR part 585) for ensuring that activities on Federal renewable energy leases are carried out in a manner that provides for safety and protection of the environment. BOEM regulations require lessees to include a description of the project design as

part of their plan submittals (*see* 30 CFR 585.610(a)(6) (SAP), 30 CFR 585.626(b)(6) (COP), 30 CFR 585.645(b)(6) (GAP)). BOEM interprets this project design description to include lighting and marking information.

The Federal Aviation Administration (FAA) has regulatory requirements for the lighting of offshore structures. See 14 CFR part 77. For structures covered by 14 CFR 77.9 and within 12 nautical miles (nmi) from shore, a lessee must file a Notice of Proposed Construction or Alteration (FAA Form 7460-1) with the FAA under 14 CFR 77.7. This filing is necessary if the structure's height exceeds any obstruction standard contained in 14 CFR part 77. The FAA will then conduct an obstruction evaluation to determine whether the structure would pose a hazard to air traffic. If it does not, the FAA will issue a Determination of No Hazard.

The FAA recommends voluntary marking or lighting, or both, of a meteorological tower less than 200 feet (ft) in height above the sea surface to promote the safety of low-level aviation operations and to enhance the conspicuity of these towers. Depending on the type of meteorological tower, the use of spherical marker balls may enhance conspicuity of these typically skeletal structures.¹

Although FAA regulatory authority ends at the extent of the U.S. territorial sea, generally 12 nmi from shore, BOEM recommends implementing the same FAA requirements beyond 12 nmi from shore for consistency and aviation safety.

The U.S. Coast Guard (USCG) also has regulatory requirements and authorities for marking and lighting of offshore structures. The specific lighting and marking for facilities will be determined on a case-by-case basis, considering the navigation circumstances affecting the waterway in which the offshore wind facility is located. The USCG will determine lighting and marking requirements for a particular wind energy facility by considering the types, maneuverability, and size of the vessels using the affected waterway; the density of the maritime traffic in the area; prevailing weather (e.g., fog, rain, snow); structural configuration and spacing of the facility; and other factors. Additionally, USCG may direct changes in marking and lighting as maritime traffic changes, signal technology evolves, and more wind turbines are constructed nearby, particularly if abutting existing wind energy facilities.

The USCG requires that offshore wind lessees and grantees obtain permits for private aids to navigation (PATON, *see* 33 CFR part 67) for all structures located in or near navigable waters of the United States (*see* 33 CFR part 66) and on the OCS. PATON regulations require that individuals or organizations mark privately owned marine obstructions or other similar hazards. The USCG's marking requirements are found in 33 CFR part 64. Unlike FAA regulations, PATON requirements for structures owned or operated by persons subject to U.S. jurisdiction apply beyond the U.S. territorial sea boundary to include the entire OCS. BOEM will include as a condition of plan approval for SAPs, COPs, and GAPS a requirement that lessees and grantees submit a PATON permit application to the appropriate USCG district and provide a copy to

¹ For more detailed information on the marking and lighting of wind turbines, see Chapter 13 of the FAA Advisory Circular (AC) 70/7460-1L Obstruction Marking and Lighting. FAA guidance applies equally to both onshore wind facilities and offshore wind facilities sited within 12 nmi of shore. (https://www.faa.gov/documentLibrary/media/Advisory_Circular/AC_70_7460-1L_-_Obstuction_Marking_and_Lighting_-_Change_2.pdf).

BOEM.²

The USCG requires meteorological towers and buoys to be displayed on the National Oceanic and Atmospheric Administration nautical charts. The USCG *Aids to Navigation Manual* (*COMDTINST Manual* (CIM 16500.7A)) established requirements for offshore wind facilities in chapter 4, section G.

III. BOEM Recommendations

The following is guidance and is not intended to prescribe additional regulatory requirements. Lessees may propose alternative design parameters outside of the recommended Federal regulatory requirements to provide for aviation and navigation safety, avoid harm to wildlife, avoid interference with other users, or address other criteria for plan approval.

A. Aviation and Navigation Safety Recommendations

For BOEM-approved facilities, BOEM recommends the following lighting and marking design parameters:

Aviation Lighting (recommended for structures 200 ft or more in height above the sea surface beyond 12 nmi from the coast, i.e., outside of FAA jurisdiction).

Subject to the considerations noted in part II above, “Authorities and Regulations,” BOEM recommends the following for aviation lighting safety on wind energy facilities, consistent with FAA regulatory requirements for structures within 12 nmi of the shore:

- Red wavelength light emitting diode lighting should be in the infrared portion of the spectrum between 800 and 900 nanometers to ensure compatibility with night vision goggles;
- Lights should have photometric values of an FAA Type L-810, L-864, and L-885 medium intensity red obstruction light;
- Lights should flash simultaneously at 30 flashes per minute (FPM);
- Structure lights should be visible in all directions in the horizontal (i.e., visible spread from 360 degrees);
- For any turbines with a tip height of 699 ft or less, lighting should be placed at the highest point of the turbine nacelle. For any turbines with a tip height greater than 699 ft, lighting should be placed at both the highest point of the turbine nacelle and mid-mast;
- Every turbine should be outfitted with a light, but not all turbine lights need to be turned on as long as there are no unlit separations or gaps of more than 0.5 statute miles between the turbines around the perimeter of the entire facility;
- There should be no unlit separation or gaps of more than 1 statute mile within the facility (or cluster of turbines within the facility); and

² These guidelines are consistent with the recommendations published by the USCG as of April 28, 2021. Applicants are encouraged to consult with the USCG district in which the project will be located to assess compatibility of these guidelines with USCG practices in that district.

- All turbines above 499 ft should remain lit during nighttime hours unless connected to an approved aircraft detection lighting system (ADLS).

In consultation with the FAA and the Department of Defense, BOEM will consider the use of ADLS or dimming technologies to minimize visual impacts from lighting. BOEM is not mandating use of these technologies.

Marine Lighting and Marking (recommended for all structures).

Subject to the considerations noted in part II above, “Authorities and Regulations,” BOEM recommends the following for marine navigation marking safety on wind energy facilities:

- All turbines should be marked conspicuously and distinctly for both day and night recognition;
- The foundation base of all turbines should be painted yellow, RAL 1023, all around from the level of Mean Higher High Water (MHHW) to 50 ft above MHHW;
- Ladders at the foundation base of all turbines may be painted in a color that contrasts with the recommended yellow. Painting the ladders in a distinguishable color will allow for ease of identification for operations and maintenance personnel;
- Wind energy facilities should have flashing yellow lights energized from sunset to sunrise and from sunrise to sunset in restricted visibility. Structure lights should be visible in all directions in the horizontal (i.e., visible spread from 360 degrees);
- Retro-reflective material (white, yellow or silver) may be used, visible through a 360-degree arc, and should be applied in at least 2-foot bands around structures, no less than 30 ft above MHHW;
- Each wind turbine generator in a wind energy facility should be designated, marked, and charted with a unique alphanumeric designation, which enables quick recognition and reference by mariners and agencies for search and rescue, law enforcement, and other purposes. The bottom of the alphanumeric characters should be located at least 30 ft and no more than 50 ft above MHHW. The alphanumeric characters should be as near to 9.8 ft in height as practicable, should be visible above any service platforms in a 360-degree arc from the water’s surface, and should be applied with retro-reflecting paint or material to enhance visibility under low light conditions. If feasible, each generator’s unique alphanumeric designation should be duplicated below any servicing platform;
- Significant Peripheral Structures (SPS) (i.e., “corners” or other significant peripheral points) should be marked with quick flashing yellow lights with an operational range of not less than 5 nmi;
- Intermediate Perimeter Structures (IPS) are those located along a wind energy facility’s outside boundary between SPSs. IPSs should be marked with 2.5-second flashing yellow lights with an operational range of not less than 3 nmi;
- For larger wind energy facilities with multiple levels, inner boundary towers may be identified as those immediately inside the line of IPS and SPS towers. These should be marked with 6- or 10-second flashing yellow lights with a 2-nmi operational range;
- Other turbines inside the wind energy facility should be marked with 15-second flashing yellow lights with a 1-nmi operational range;
- Lights serving the same function (SPS, IPS, inner boundary, etc.) should be synchronized.

- In the case of 2 or more adjacent wind energy facilities, USCG may coordinate marking and lighting characteristics or synchronization across the wind energy facilities to best support safe navigation through all abutting areas; and
- All temporary foundation base, tower, and construction components should be marked only with quick flashing yellow obstruction lights visible in a 360-degree arc with a 5-nmi operational range. This lighting configuration requires USCG notification, but not a PATON permit, for appropriate marine notices and broadcasts until the final structure marking is established.

Sound Signals.

- Sound signaling devices should be placed on all SPS and on IPS as necessary to ensure spacing between devices does not exceed 3 nmi.
- Each device should sound a 4-second prolonged blast at intervals not to exceed 30 seconds with a range of 2 nmi.
- Each device should be capable of Mariner Radio Activated Sound Signal (MRASS) activation by keying VHF radio frequency 83A 5 times within 10 seconds and must continue to sound its signal for 45 minutes after VHF activation.

Automated Identification System (AIS) Transponder Signals.

- AIS transponders should be placed on all SPS or other significant locations within the wind energy facility and should be capable of transmitting signals marking the locations of all structures within the facility.
- The transponders should be approved by USCG based on the recommendation from the respective USCG district office.

The USCG may require appropriate marking, lighting, sound signaling, and AIS changes over the lifespan of the installation as further development takes place.

B. Environmental Recommendations

Based upon review of existing studies and literature related to impacts to birds, bats, marine mammals, turtles, and fish from offshore lighting, and the experience gained from reviewing operational offshore wind facilities' lighting, BOEM recommends the following:

- Turbines and towers should be painted with color no lighter than RAL 9010 Pure White and no darker than RAL 7035 Light Grey;
- Lighting should be minimized whenever and wherever possible, except as specified above, including number, intensity, and duration;
- Flashing lights should be used instead of steady burning lights whenever practicable, and the lowest flash rate practicable should be used for the application to maximize the duration between flashes. BOEM recommends 30 FPM to be a reasonable rate in most instances;
- Direct lighting should be avoided, and indirect lighting of the water surface should be minimized to the extent practicable once the wind facility is in operation;
- Lighting should be directed to where it is needed, and general area "floodlighting" should

- be avoided;
- Area and work lighting should be limited to the amount and intensity necessary to maintain worker safety;
- Using automatic timers or motion-activated shutoffs for all lights not related to aviation obstruction lighting (AOL) or marine navigation lighting should be considered; and
- AOL that is most conspicuous to aviators, with minimal lighting spread below the horizontal plane of the light but still within the photometric values of a FAA Type L-864 medium intensity red obstruction light, should be used.³

Additional lighting and marking information may be recommended on a project-specific basis. For example, if the project design includes transit corridors through the facility to reduce conflicts with other ocean users such as recreational boaters or commercial fishermen, such corridors may need additional markings to fulfill that purpose.

IV. Resources for Additional Information

Bureau of Ocean Energy Management:

BOEM OCS Study 2013-0116 (<https://www.boem.gov/ESPIS/5/5298.pdf>): *Evaluation of Lighting Schemes for Offshore Wind Facilities and Impacts to Local Environments.*

BOEM OCS Study 2016-002 (<https://www.boem.gov/offshore-lighting-guidance/>): *Development of Guidance for Lighting of Offshore Wind Turbines Beyond 12 Nautical Miles.*

U. S. Coast Guard:

USCG Navigation and Vessel Inspection Circular No. 01-19 (<https://www.dco.uscg.mil/Portals/9/DCO%20Documents/5p/5ps/NVIC/2019/NVIC%2001-19-COMDTPUB-P16700-4-dtd-01-Aug-2019-Signed.pdf?ver=2019-08-08-160540-483>).

Aids to Navigation Manual (https://media.defense.gov/2017/Mar/29/2001724016/-1/-1/0/CIM_16500_7A.pdf), Chapter 4, Section G on Offshore Renewable Energy Installations.

Federal Aviation Administration:

Advisory Circular (AC) 70/7460-1L (https://www.faa.gov/documentLibrary/media/Advisory_Circular/AC_70_7460-1L_Change_2.pdf): Chapter 13 - Marking and Lighting Wind Turbines.

³ Aviation lighting with photometric values equivalent to FAA Type L-810, L-864, and L-885 lights promote aviation safety (see “Aviation Lighting” in part III.A above). Type L-864 can be used specifically to mitigate possible environmental impacts. BOEM may request other environmental mitigation and analysis if Type L-810 or L-885 or equivalent lights are used.

Advisory Circular (AC) 150/5345-43J
 (https://www.faa.gov/airports/resources/advisory_circulars/index.cfm/go/document.current/documentnumber/150_5345-43): Specification for Obstruction Lighting Equipment

Engineering Brief No. 98
 (https://www.faa.gov/airports/engineering/engineering_briefs/media/eb-98-NVG.pdf):
 Infrared Specifications for Aviation Obstruction Light Compatibility with Night Vision Goggles (NVGs)

International Association of Marine Aids to Navigation and Lighthouse Authorities (IALA):⁴

IALA Recommendation O-139
 (<http://www.iala-aism.org/product/markings-of-man-made-offshore-structures-o-139/>):
 Marking of Man-Made Offshore Structures O-139

V. Contact Addresses

For further information or inquiries regarding these guidelines, please contact the BOEM Office of Renewable Energy Programs by telephone (703-787-1758) or by email (renewableenergy@boem.gov).

**Table 1
 BOEM Contact Information for Other Renewable Energy Inquiries**

Project Location by State (Offshore)	Filing Address
Maine New Hampshire Massachusetts Rhode Island New York New Jersey Delaware Maryland Virginia North Carolina South Carolina Georgia Florida (South Atlantic and Straits of Florida Planning Areas)	Bureau of Ocean Energy Management Office of Renewable Energy Programs Attn: Program Manager Mail Stop VAM-OREP 45600 Woodland Road Sterling, Virginia 20166 Phone: (703) 787-1300 Email: renewableenergy@boem.gov

⁴ The IALA is a not-for-profit international technical association that offers assistance to navigation authorities, manufacturers, and consultants to develop and apply effective and harmonized marine aids to navigation.

<p>Florida (Eastern Gulf of Mexico Planning Area) Alabama Mississippi Louisiana Texas</p>	<p>Bureau of Ocean Energy Management Gulf of Mexico Regional Office Attn: Renewable Energy Program Lease Applications – Mail Stop GM312 RUE Applications – Mail Stop GM235D ROW Applications – Mail Stop GE1035A 1201 Elmwood Park Boulevard New Orleans, Louisiana 70123-2394</p> <p>Phone: (800) 200-GULF</p> <p>Email: renewableenergygomr@boem.gov</p>
<p>Alaska</p>	<p>Bureau of Ocean Energy Management Alaska Regional Office Mail Stop AM500 Centerpoint Building 3801 Centerpoint Drive, Suite 500 Anchorage, Alaska 99503-5823</p> <p>Phone: (907) 334-5200</p> <p>Email: renewableenergyakr@boem.gov</p>
<p>Washington Oregon California Hawaii</p>	<p>Bureau of Ocean Energy Management Pacific Regional Office Mail Stop CM102 760 Paseo Camarillo, Suite 102 Camarillo, California 93010-6002</p> <p>Phone: (855) 320-1484</p> <p>Email: renewableenergypocs@boem.gov</p>

Table 2
Additional Contact Information

Bureau of Safety and Environmental Enforcement Submittal Address	
<p>Safety Management System</p>	<p>Bureau of Safety and Environmental Enforcement Office of Offshore Regulatory Programs 45600 Woodland Road Mail Stop VAE-ORP Sterling, Virginia 20166</p> <p>E-mail: bseerenewableenergy@bsee.gov</p>

VI. BOEM Guidance Document Statement

BOEM issues guidance documents to clarify and provide information about legal requirements, related policies, and technical issues, such as recommended data and formats for various submittals. This guidance document sets forth policy on and interpretation of statutory, regulatory, lease, contractual, or plan approval provisions or technical issues to provide additional information regarding BOEM's approach to managing its renewable energy program. Except to the extent that provisions of this guidance document derive from requirements established by statute, regulation, lease, contract, or other binding legal authority, they do not have the force and effect of law and are not meant to bind the public in any way. If you wish to use an alternate approach that you believe is consistent with the governing statute and regulation, we recommend you contact BOEM in advance.

Although the provisions of these guidelines are non-binding recommendations and guidance, the provisions may be made mandatory in whole or part through stipulations or conditions of approval from BOEM or BSEE in leases, permits, or other authorizations. In that case, you must comply with those provisions.

VII. Paperwork Reduction Act Statement

An agency may not conduct or sponsor a collection of information unless it displays a currently valid Office of Management and Budget (OMB) control number. OMB has approved the information collection requirements in 30 CFR part 585 under OMB control number 1010-0176. This guidance document does not impose any additional information collection requirements subject to the Paperwork Reduction Act of 1995.