ACCESS NUMBER: 00007

STUDY TITLE: Evaluation of Lighting Schemes for Offshore Wind Facilities and Impacts to Local Environments

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CONTRACT NUMBER: M12-PD-00007

SPONSORING OCS REGION: Atlantic Coast Region

APPLICABLE PLANNING AREA(S): Atlantic Coast

FISCAL YEAR(S) OF PROJECT FUNDING: 2012

COMPLETION DATE OF REPORT: August 1, 2013

COSTS: $219,512.00

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KEY WORDS: Aid to Navigation; artificial lighting; Aviation obstruction; Baltic Sea; bats; Belgium; birds; cetaceans; Denmark; environmental impacts; Europe; fish; Germany; harbor seal; IALA; illumination; impacts; Ireland; light; lighting; loggerheads; marine mammals; Marine Navigation; Nysted; mitigation; night-migrating songbirds; North Sea; offshore wind farms; Scotland; sea turtles; seabirds; Sweden; United Kingdom; United States

BACKGROUND: Given BOEM's authority under the EPAct, and the various considerations under the OCS Lands Act and NEPA, BOEM needs to garner a better understanding of the potential impacts to the environment from the development of offshore renewable energy projects, and to identify specific mitigation measures that can be taken to reduce or avoid such impacts.

OBJECTIVES: The overall purpose of the study is to review current regulations and lighting schemes in use and evaluate how proposed lighting schemes for offshore wind facilities may impact local environments and offshore waters as a desktop study, literature review and synthesis.

DESCRIPTION: The study was conducted in three parts: 1. a literature review of scientific studies, journals and grey literature of the potential direct and indirect impacts of various lighting schemes to birds, bats, marine mammals, sea turtles and fish was conducted; 2. a compilation of current international and domestic guidelines, rules and regulations for obstruction and navigation lights for offshore wind facilities was conducted, and project specific information was gathered from operational offshore wind facilities throughout the world describing various lighting schemes currently in use; and 3. using information from the literature review and project specific lighting schemes, measures to mitigate impacts to wildlife and coastal communities were identified and evaluated.

SIGNIFICANT CONCLUSIONS: In general, the literature review found few studies that were specific to the lighting of offshore wind turbines and their impact to the identified biological resources (birds, bats, marine mammals, sea turtles and fish). The primary tenet in reducing impacts to night-migrating birds from lighted structures is reducing the amount of light broadcast into the environment. Many of the studies reviewed agree on a few general principles regarding mitigation of impacts to avian resources from offshore lighting. These are the following.

1) Fewer lights are preferable to more lights.
2) Lower intensity lights are preferable to higher intensity lights.
3) White lights are the least favorable choice for lighting structures.
4) Strobing lights are preferable to steady lights.

Impacts to bats from offshore lighting are less well-defined than those for birds, and appear to be linked to insect attraction. Several references considered artificial lighting on marine mammals during the operational phase of wind farms to be in the low risk and low negative effect category. Intermittent flashing lights with a very short on-pulse and long off-interval have been shown to be non-disruptive to marine turtle behavior, irrespective of the color. These findings are consistent with flashing marine navigational lighting (MNL) currently being used at offshore wind farms not causing disorientation of turtles. Much of the literature appears to be based on direct lighting of the water surface, and it is unlikely that any indirect lighting from aviation obstruction lighting (AOL) or MNL will have any meaningful impact on fish, although the literature that investigated lighting impacts to fish indicated that the effects of artificial light on fish and other marine organisms needs to be studied in greater detail.

Currently operating offshore wind facilities (OWF) in Europe and elsewhere tend to follow international guidelines for the lighting and marking of offshore structures, although variations do exist on a case by case basis. The FAA and the USCG are generally consistent with international standards, and the guidelines that are currently in place in the U.S. appear to provide for the marking and lighting of OWF that will pose minimal if any impacts to birds, bats, marine mammals, sea turtles or fish.

STUDY RESULTS: Suggested Best Practices for minimizing impacts from lighting of OWF: Continue consultation and collaboration with the FAA and USCG. Existing guidelines and regulations appear to be adequate to develop safe lighting plans for OWF on a case by case basis. Minimize lighting whenever and wherever possible. This includes minimizing the number of lights, the intensity of lights, and the amount of time lights are turned on. The use of red lights for AOL should continue to be preferred over white, flashing lights should be used whenever practicable, and steady burning lights should be avoided. Flashing lights should use the lowest flash rate practicable for the application (i.e., 20 rather than 60 flashes per minute) to maximize the duration “off” between flashes. Avoid direct lighting of the water surface, and minimize indirect lighting on the water surface to the extent practicable once the OWF is in operation. During construction, it may not be possible to avoid temporary lighting of the water surface for short durations and still maintain worker safety and construction schedules. Direct lighting to where it is needed and avoid general area “floodlighting”. Area and work lighting should be limited to the amount and intensity necessary to maintain worker safety. Automatic timers and/or motion activated shutoffs should be considered for all lights not related to AOL or MNL. AOL should be most conspicuous to aviators, and the lighting spread below the horizontal plane of the light should be minimal. Allow for the automatic reduction of AOL lighting intensity when visibility sensors indicate that the meteorological visibility is conducive to safely do so; for example, reducing the AOL to 30% when visibility is 5 km (3.1 mi) or greater and to 10% when visibility is 10km or greater. Consultation with, and agreement by, the FAA will likely be necessary if this practice is to be considered.

STUDY PRODUCT(S):

ESS Group, Inc. 2012. Evaluation of Lighting Schemes for Offshore Wind Facilities and Impacts to Local Environments. Task 1 - Summary Report: Literature Review of Impacts of Lighting to Coastal and Marine Wildlife. Prepared for the U.S. Dept. of the Interior, Bureau of Ocean Energy Management, Office of Renewable Energy Programs, Herndon, VA. Contract No. M 12 PD 00007. 253 pp.

Gagnon, F. GL Garrad Hassan. 2013. BOEM - Evaluation of Lighting Schemes for Offshore Wind Facilities and Impacts to Local Environments – Task 2 (Guidelines, Rules, and Regulations). Prepared for ESS Group, Inc. under U.S. Dept. of the Interior, Bureau of Ocean Energy Management Office of Renewable Energy Programs, Herndon VA. Contract No. M 12 PD 00007. 109 pp.

ESS Group, Inc. 2013. Evaluation of Lighting Schemes for Offshore Wind Facilities and Impacts to Local Environments. Task 3 – Impacts and Mitigation Measures. Prepared for the U.S. Dept. of the Interior, Bureau of Ocean Energy Management, Office of Renewable Energy Programs, Herndon, VA. Contract No. M 12 PD 00007. 21 pp.

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