

# Structural Integrity of Offshore Wind Turbines

## Oversight of Design, Fabrication, and Installation

**T**he United States is poised to begin building its first offshore wind energy power projects. Several offshore wind energy power projects have been proposed or are under development, primarily along the Eastern Seaboard and the Great Lakes. To facilitate the orderly development of offshore wind energy and support the stable economic development of this nascent industry, the United States needs a set of clear requirements that can accommodate future design development. Central to the regulation of offshore wind energy power projects is the U.S. Department of the Interior's Bureau of Ocean Energy Management, Regulation, and Enforcement (BOEMRE). The report recommends that BOEMRE develop a set of requirements that establish goals and objectives with regard to structural integrity, environmental performance, and energy generation. The committee found that the risks to human life and the environment associated with offshore wind farms are substantially lower than for other industries such as offshore oil and gas, because offshore wind farms are primarily unmanned and contain minimal quantities of hazardous substances. This finding implies that an approach with significantly less regulatory oversight may be taken for offshore wind farms. Under this approach, industry would be responsible for proposing sets of standards, guidelines, and recommended practices that meet the performance requirements established by BOEMRE.

### ISSUE

The U.S. Department of the Interior's Bureau of Ocean Energy Management, Regulation, and Enforcement (BOEMRE) is responsible for the orderly, safe, and environmentally responsible development of offshore renewable wind energy facilities on the outer continental shelf (OCS). Currently, BOEMRE requires the submission of several documents before it approves a proposed facility; however, BOEMRE has not specified any criteria that offshore wind turbine projects must meet to secure approval. Instead, the regulations require that a third party—a “certified verification agent” (CVA)—be charged with reviewing and commenting on the adequacy of design, fabrication, and installation of wind farms, and submitting reports to BOEMRE indicating the CVA's assessment of adequacy.

When a general level of performance such as “safe” is identified, no guidance is provided on how to assess whether this level of performance has been met.

Successful exploitation of offshore wind energy will require not only that turbines operate with low risk to human safety and the environment, but also that they prove highly reliable and become economically competitive with other sources of electricity. Because further improvements in cost, reliability, and efficiency are needed if offshore wind is to be a competitive energy source, regulations need to allow for innovative technologies and encourage the introduction of novel concepts.

European countries have taken the lead in matters related to the regulation, installation, and operation of offshore wind farms because of earlier development of offshore wind energy in Europe. European countries use a combination of national regulatory requirements, international standards and guidelines, and recommended practices developed by industry. The main international standards have been developed by the International Electrotechnical Commission (IEC). Nongovernmental organizations and private companies that establish and maintain technical rules and guidelines for the design, construction, and operation of ships and offshore structures—commonly known as classification societies—have developed standards that are more comprehensive than those developed by the IEC. The committee found, however, that these combinations of regulations, standards, and guidelines have clear deficiencies, particularly if applied to planned installations along the U.S. East Coast and Gulf of Mexico.

## **PROBLEM**

Current BOEMRE regulations and accompanying guidance lack the clarity and specificity needed for the development of offshore wind energy on the OCS. Permitting of sites in U.S. waters is proceeding without a clear set of national regulations for the design, fabrication, installation, and commissioning of offshore wind turbines.

Existing standards, on their own, do not cover all aspects of the design and construction of offshore wind turbines that would have to be considered for the United States, such as wave and wind loadings brought about by storms and hurricanes on the Atlantic coast and in the Gulf of Mexico. Further delays in developing an adequate national regulatory framework are likely to impede development of offshore wind facilities in U.S. waters or lead to inconsistent safety and performance across projects.

## **STUDY SCOPE**

In the absence of such standards and guidelines for the United States, BOEMRE asked the National Research Council (NRC) to review its approach to overseeing the development and safe operation of wind turbines on the OCS, with a focus on structural safety. The study provides findings regarding

1. The applicability and adequacy of existing standards and practices for the design, fabrication, and installation of offshore wind turbines;
2. The expected role of the CVAs in identifying standards to be used and conducting monitoring and onsite inspections to verify compliance with the standards; and,
3. The expected experience level, technical skills and capabilities, and support equipment and computer hardware and software needed to be considered a qualified CVA.

## **FINDINGS AND RECOMMENDATIONS**

### ***Safety and Environment***

The risks to human safety and the environment and the consequences associated with those risks are much lower for offshore wind projects than for offshore oil and gas platforms, ships, and land-based civil structures such as buildings. Oversight of offshore wind development should take this into account and will also need to reflect the importance of successful and reliable operation of offshore wind turbines to policy goals.

## *Standards and Practices*

In reviewing existing sets of standards and guidance documents, the committee found that many could be applied in the United States but that no one set was complete. BOEMRE's own regulations and accompanying guidance are inadequate, in that they do not identify specific criteria that a proposed project must meet to be approved and gain the necessary permits. To remedy deficiencies in existing standards, regulations, guidance, and practices, BOEMRE should proceed immediately with development of a set of goal-based standards governing the structural safety of offshore wind turbines and power platforms. These regulations should be informed by risk assessment and should cover design, fabrication, and installation. Under this approach, project developers would be responsible for proposing project-specific sets of standards, guidelines, and practices that meet the performance requirements established by BOEMRE. It is anticipated that classification societies and standards development groups will be interested in offering for preapproval packages of standards and guidelines that meet BOEMRE's performance requirements. Because offshore wind projects are already under way, BOEMRE must provide industry with a clear regulatory framework as soon as practical. Once BOEMRE deems a set of rules to be in full compliance with the goal-based standards, it should approve such rules for application to U.S. offshore wind facilities.

## *Role of the Certified Verification Agent*

The responsibility for proposing a comprehensive package of standards, guidelines, and practices should rest with project developers. The CVA's role should be to review and comment on the adequacy of the proposed package in meeting the objectives defined in BOEMRE's goal-based standards. Although BOEMRE should consider the documentation provided by the developer and the report of the CVA, the responsibility for approval of the proposed packages and for determination of their compliance with the goal-based standards should rest solely with the agency. BOEMRE must have staff competent to select qualified third parties and to approve projects. BOEMRE should consider

creating an expert panel to provide feedback and guidance to BOEMRE in developing goal-based standards and a framework that will guide the CVA in assessing compliance with goal-based standards.

## *Qualifications of Certified Verification Agents*

In evaluating potential CVAs, BOEMRE should seek organizations and individuals that

- Are independent and objective;
- Have experience, technical expertise, and engineering judgment sufficient to independently verify assumptions, conclusions, and results;
  - Have experience with the dominant environmental effects for the project location;
  - Have experience in the specific areas of design, fabrication, and installation described in the report;
  - Have clearly defined roles and responsibilities with adequate oversight by a registered professional engineer (or international equivalent); and
  - Have an auditable quality plan for the processes and record keeping involved in the CVA activities.

BOEMRE should make a priority of hiring sufficient staff with adequate technical expertise to oversee the development of offshore wind farms in U.S. waters and should approve CVAs on a project-specific basis as opposed to maintaining an approved list of qualified CVAs. BOEMRE should actively manage the CVA process for offshore wind facilities by disseminating lessons learned from the CVA process to promote best practices to the industry.

## *Implementation*

In the committee's view, unless BOEMRE's staffing levels and experience are substantially enhanced, the agency will be unable to provide the leadership and decision-making capability necessary for development of U.S. offshore wind facility standards. BOEMRE should establish a substantial core competency within the agency with the capacity and expertise to lead the development of the goal-based standards; review the standards,

guidelines, and practices submitted by the project developers and rulemaking bodies; and review the qualifications of proposed CVAs. As a means of filling the experience gap for both industry and regulators, BOEMRE should consider creating an expert panel to provide the agency with guidance and feedback for the development of goal-based standards; for the review of proposed standards, guidelines, and practices for compliance with the goal-based standards; and for the initial wind development projects. BOEMRE should also be fully engaged in the national and international process for developing standards for offshore wind turbines, and it should be represented on the IEC's technical committees and on other relevant national and international committees.

## REPORT CONCLUSIONS

The United States urgently needs a set of clear standards and regulations to reduce uncertainty in the requirements that offshore wind projects must

meet, facilitate the orderly development of offshore wind energy, and support the stable economic development of a nascent industry. Goal-based standards are a regulatory framework that best meets two government objectives: (a) fulfilling BOEMRE's mission of overseeing the safe, orderly, and environmentally responsible development of the OCS and (b) fostering innovation and competitiveness. The success of offshore wind energy in U.S. waters may depend in part on how quickly and effectively BOEMRE develops the regulations and oversees compliance. It is critical that BOEMRE establish within the agency a substantial core competency with the capacity and expertise to lead the development of the goal-based standards; review the standards, guidelines, and practices submitted by developers and rulemaking bodies; and review the competency of proposed CVAs in order to enable the development of safe and reliable offshore wind energy solutions for the United States.

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