Peer Review Plan

Date: October 31, 2023

BSEE Funding Source or Author's Division: Office of Offshore Regulatory Programs
Emerging Technologies Branch 45600
Woodland Road
Sterling, VA 20166

Maine Marine Composites

Title: Evaluation of Technology Assessment Program (TAP) Project 758 – FATIGUE DESIGN METHODOLOGIES APPLICABLE TO COMPLEX FIXED AND FLOATING OFFSHORE WIND TURBINES

Subject and Purpose: The subject of this study is PEER REVIEW OF REPORT " FATIGUE METHODOLOGIES OF OFFSHORE WINDTURBINES." This peer review aims to verify the scientific and technical merit of the assumptions, inputs, methodologies, and results of the research conducted. This peer review focuses on evaluating the following study objectives 1.) Are existing design methods capable of predicting the fatigue life of mooring systems for Floating Offshore Wind Turbines (FOWT)? 2) Are commercial software analysis tools complete and accurate in modeling these systems? 3) Is sufficient and accurate environmental data available that existing software tools can accurately predict fatigue life? In addition, recommendations address rational, practical, fatigue design methods for offshore wind turbine support structures.

A major challenge in the design of FOWTs is predicting the life of the mooring system. Most analysis tools for the study of fatigue of FOWT are developed as hybrids of software for floating structures with aerodynamics codes that were developed initially for land-based wind turbines and later migrated to fixed-support wind turbines in coastal waters. Mooring analysis in many software tools is rudimentary and focused on the ultimate strength requirements needed to withstand an extreme environment. It is crucial to evaluate the ability of these software tools to predict fatigue induced failures, incorporating the unique factors described above.

Several case studies were evaluated to test fatigue design criteria and methodologies. The project team ran extensive simulations and analyses in each case study, exploring the impact of fatigue on the system's design. Various fatigue methodologies were tested, including classical fatigue analysis using the Miner-Palmgren hypothesis. Fatigue in the mooring system on a full-scale model of the DeepCwind FOWT was calculated using the methods described in the American Petroleum Institute (API) standard RP 2SK, including frequency-domain and time-domain based algorithms. There was wide variation in fatigue life predictions using the different methods. Furthermore, there was significant variation in fatigue life predictions using the same method as implemented using different software tools.

The project team devoted significant resources to studying the effects of seafloor abrasion on

mooring chains. As there are no mooring system software packages that model this effect directly, scripts were developed to use the OrcaFlex system to study the effect of abrasion on shortened fatigue life. An energy-based algorithm was developed and demonstrated. This algorithm uses existing marine motion simulation software to predict abrasion loss in catenary mooring chains. Therefore, this peer review will evaluate and assess the TAP 758 project report.

Impact of Dissemination: BSEE considers this study is highly influential scientific information, which requires a robust evaluation that the scientific community and stakeholders will accept. This study's findings may directly impact the production methods, industry specifications, best practices, and selection for equipment utilized for high-pressure and high-temperature offshore oil and gas operations. The results from this study are essential for reviewing new projects in deeper waters for offshore operations.

Upon conclusion of the peer review, BSEE will post all possible contracted deliverables, tasks, data, analyses, and information, including the peer-review reporting, reports, and comments on BSEE's research records website: https://www.bsee.gov/research-record.

Timing of Review: October 01, 2022 – November 30, 2023 (Total peer review process of not more than 13 months is desired for this project.)

Manner of Review, Selection of Reviewers, and Nomination Process:

This peer review shall be conducted through the contract BSEE BPA Process. This process will provide for a panel of qualified subject matter experts (SMEs) selected by the agency in order to achieve an optimum level of expertise across the spectrum of issues. The SMEs will be required to maintain both balance and independence while minimizing any potential conflicts of interest. The public will not be consulted in the nomination of potential peer reviewers.

Primary criteria for peer reviewers include the following:

- Specializes in motion prediction for ships and platforms, analyses of fluid/structural dynamics, and mooring system design and simulation.
- Advanced Hydrodynamics Analysis using Computational Fluid Dynamics (CFD), ANSYS Aqwa
- Finite Element Analyses of complex structures and materials
- Mooring System Design and Analysis using OrcaFlex, Aqwa with Cable Dynamics
- Ship and Barge Seakeeping and Stability Analysis using Aqwa
- Analysis and Simulation of Complex Marine Systems using multi-body simulation in OrcaFlex
- Areas you deem your company has energy-related expertise
- Risk identification, assessment communication, and mitigation
- Evaluation of best practices, industry standards, and applications

The secondary tier of criteria should include the following:

- No more than two persons from renewable energy industry
- At least one from outside of the renewable energy industry

Disclaimer: The content of this peer review plan has been verified in compliance with the peer review handbook. For peer review contracts executed prior to peer review plan release, there may be differences in language used between the peer review plan and the executed contract.

Reviewers may be selected from academia, industry, and federal government. The group of reviewers shall not include multiple reviewers from the same affiliation and shall strive to include various perspectives on the issue considered.

Expected Number of Reviewers:
Three reviewers, plus contractor oversight, and writing personnel.

Requisite Expertise:

- Subject Matter Experts with five years of experience in a relevant field and should also have some other strong credentials, e.g., a Ph.D. with a substantial publication or patent record specific to the evaluated technology, a young investigator award, or a strong pedigree (e.g., a Ph.D. from a high caliber institution or under a recognized leader in the field).
- Publications and Patents. Qualified experts often have many peer-reviewed journals and/or patents on the evaluated technology.
- Other evidence is that the person is a recognized expert in the field. Qualified experts have often managed a public policy program that has had a national impact, has a record of bringing innovations to the market or holds vital patents.
- In a relevant field, an advanced degree - Ph.D., Sc.D., D.Eng., MS, or MBA. Experts with only a bachelor's degree should have other experience and or a record of significant accomplishments indicating their expertise.
- Relevant awards. Qualified experts may have received a prestigious award such as the National Medal of Science, American Chemical Society National Award, Young Investigator Award, R&D 100 Award, or other awards specific to technology (e.g., Fuel Cell Seminar Award).
- Key Society Membership. Qualified experts may be members of a society like the National Academy of Sciences (NAS), the National Academy of Engineering (NAE), the American Physics Society, a National Laboratory Fellow, etc.

Opportunity for Public Comment:

At the time of this peer review plan's posting, the research report will be available on BSEE's Peer Review Public Posting website located here: https://www.bsee.gov/what-we-do/research/peer-review. BSEE welcomes public comment, especially from those with experience with tension leg platforms. BSEE invites the public to comment within the 30-day window indicated on the website through the process described below, which is consistent with the guidance on the website:

- For comments pertaining to this peer review plan, send emails to: bsee_peerreviewplancomments@bsee.gov
- For comments pertaining to the research, send emails to: bsee_researchpubliccomment@bsee.gov

In the subject line list of a public comment email, please state: "TAP 758 – FATIGUE DESIGN METHODOLOGIES APPLICABLE TO COMPLEX FIXED AND FLOATING OFFSHORE WIND TURBINES" + the words "peer review plan" or "research" + the words "public comment."

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- List out any comments, questions, feedback by number (ex. 1, 2, 3, etc.)
- If referencing any sources of published information, please list the complete source information in a recognized reference format (such as APA)
- Please include your name, contact information, and affiliation

The agency will provide public comments deemed significant and relevant to the peer reviewers to address during their review.

Agency Contact: Joshua Toepfer