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Category:	*Floating Offshore Wind Turbines*
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Subject:	*Floating Wind Turbines*
Performing Activity:	American Bureau of Shipping (ABS)
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Contracting Agency:	Bureau of Safety and Environmental Enforcement
Summary:	This study focused on the technical feasibility of FOWTs; the interaction among the wind turbine rotor, control system, floating platform, and mooring/cable system; and how different loading events impact these systems. The researchers conducted a state-of-the-art review of the existing technology of floating wind turbines, identified critical technical challenges to deploying floating wind turbines on the U.S. OCS, and proposed a design guideline for permitting the deployment of floating wind turbines on the U.S. OCS.
Key Findings:	• Existing load analysis and global performance analysis software for FOWTs lack essential calibrations using experimental model test data or, preferably, full-scale field measurements. While extensive code-to-code comparisons have been made, the validity of the software is not fully confirmed, partially because most analysis tools used in the comparative study are based on similar theoretical models and assumptions for the aerodynamic load calculation that were originally developed for land-based wind turbines. Further research is recommended to collect relevant model test data and field measurements and use these data to verify and enhance the capability and robustness of global performance analysis software for FOWTs. • The recognized design practices for floating offshore oil and gas platforms, including the design wave and spectral analysis methods, may be adapted with further considerations of the effect of aerodynamic loads and possible unconventional hull forms. However, more studies are needed to justify the application of these methods to the floating support structures of FOWTs and develop a recommended design practice. • Innovative designs of the stationkeeping system are often adopted by FOWTs in order to achieve cost savings and cope with the unique motion responses of FOWTs. In addition to studies conducted in this project, further research is needed to evaluate the impact of using these new designs, which are typically non-redundant systems and may not be able to find directly applicable experience in the offshore oil and gas industry, to the overall safety level of the stationkeeping system. • The wind model recommended in API RP 2A-WSD (2007), API

	Bulletin 2INT MET (2007), and ISO 19902 (2007) is based on the measurement of offshore storm wind conditions near the Norwegian coast. It has been used extensively by the offshore oil and gas industry for the design of topside structures and stationkeeping systems subjected to hurricane or extra tropical storm wind conditions. On the other hand, IEC 61400-3 (2009) refers to IEC 61400-1 (2005) for the turbulent wind models that are developed that mostly consider on-land wind measurements for terrains with small surface roughness. Some studies have been performed to compare various turbulent wind models, but no clear recommendation has been made. More research is needed to gain further insight into hurricane wind modeling and its applicability to the design of FOWTs. • IEC Technical Committee TC-88 recently formed a workgroup to develop a technical specification for floating offshore wind turbines. The research findings obtained from this project and future studies sponsored under the BSEE TAP program could contribute greatly to the development of new IEC guidelines for FOWTs.

Recommendations:	• More research is needed in the following areas:
	  ○ The calibration of existing design programs to test full-scale field measurements;
	  ○ The design of station-keeping systems for FOWTs; and
	  ○ Appropriate hurricane wind models for the design of FOWTs.
	• A design guideline for FOWTs should be drafted (see Subsequent Studies/Activities).

Subsequent Studies/Activities:	• TAP 670: *Design Standards for Offshore Wind Farms* • TAP 705: *Design Guidelines for Station Keeping Systems of Floating Wind Turbines* • American Bureau of Shipping (ABS; 2013): *Guide for Building and Classing Floating Offshore Wind Turbine Installations*. • FY 2014 study award: *Fatigue Design Methodologies Applicable to Complex Fixed and Floating Wind Turbines*
Report Link:	AA: Floating Wind Turbines, Final Report, ABS, May, 2012