



# **SWAY/NREL Collaboration on Offshore Wind System Testing and Analysis**

**Cooperative Research and  
Development Final Report**

**CRADA Number: CRD-11-459**

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**Cooperative Research and Development Final Report**

In accordance with Requirements set forth in Article XI, A(3) of the CRADA document, this document is the final CRADA report, including a list of Subject Inventions, to be forwarded to the Office of Science and Technical Information as part of the commitment to the public to demonstrate results of federally funded research.

**Parties to the Agreement:** SWAY AS

**CRADA Number:** CRD-11-459

**CRADA Title:** SWAY / NREL Collaboration on Offshore Wind System Testing and Analysis

**Joint Work Statement Funding Table Showing DOE Commitment:**

<b>Estimated Costs</b>	<b>NREL Shared Resources</b>
Task 1	\$ 534,200.00
Task 2	\$ 200,000.00
TOTALS	\$ 734,200.00

**Abstract of CRADA Work:**

This Shared Resources CRADA defines collaborations between the National Renewable Energy Laboratory and SWAY. Under the terms and conditions described in this CRADA agreement, NREL and SWAY will collaborate on the SWAY 1/5th-scale floating wind turbine demonstration project in Norway. NREL and SWAY will work together to obtain measurement data from the demonstration system to perform model validation.

**Summary of Research Results:**

From this collaboration between NREL and SWAY, NREL had the opportunity to install additional measurement equipment on the SWAY floating wind turbine, thus building experience at NREL in working with measurement systems in an offshore environment. While NREL has a lot of experience in testing land-based wind systems and is gaining experience in offshore testing through the MHK program, this project constituted our first experience in the testing of wind turbine systems offshore. As such, much was learned from this project to inform future efforts in this area. Some of the lessons learned include the usefulness of certain sensors and instruments in a marine environment; how to install and work with instruments in an offshore environment; the difficulties in integrating separate data acquisition systems, which can be an issue for offshore wind systems where the support structure built by one company is mated to a wind turbine built by a different company; and the need for well-defined processes to develop a test program. A big lesson was learned after the sinking of the SWAY 1:5 scale model on the need for all components of a down-scaled model subjected to a real and full scale offshore environment to be water-tight.

Through the collaboration, NREL obtained the measurements from the SWAY system on the metocean conditions, loads, and motion, and used these to validate a coupled aero-hydro-elastic model of the system. The validation work provided SWAY with a better understanding of the performance of their system, and NREL with a better understanding of the unique dynamics of the SWAY system (a tethered spar), and the ability for the FAST tool to model the system behavior. Some difficulties encountered in this process included the lack of knowledge of measurement units; drift in sensor measurements and lack of continuous calibration; failure of some sensors; corruption of the wave measurement due to close-shore interaction; uncertainty in the tide level; and the inability of FAST to easily model the change in tide level. The findings of this work were summarized in a technical paper to be published at NREL.

**Subject Inventions Listing:**

N/A

**Report Date:**

January 15, 2015

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