



# **Columbia Power Technologies, Small Business Voucher Program, Experimental Design & Modeling to Advance Wave Energy Converter (WEC) Commercialization**

**Cooperative Research and Development Final Report**

**CRADA Number: CRD-16-00609**

NREL Technical Contact: Ryan Beach

**NREL is a national laboratory of the U.S. Department of Energy  
Office of Energy Efficiency & Renewable Energy  
Operated under Contract No. DE-AC36-08GO28308**

**Technical Report  
NREL/TP-5000-95652  
August 2025**

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### **Suggested Citation**

Beach, Ryan. 2025. *Columbia Power Technologies, Small Business Voucher Program, Experimental Design & Modeling to Advance Wave Energy Converter (WEC) Commercialization: Cooperative Research and Development Final Report, CRADA Number CRD-16-00609*. Golden, CO: National Renewable Energy Laboratory. NREL/TP-5000-95652. <https://www.nrel.gov/docs/fy25osti/95652.pdf>.

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## Cooperative Research and Development Final Report

**Report Date:** June 3, 2025

In accordance with requirements set forth in the terms of the CRADA agreement, this document is the CRADA final report, including a list of subject inventions, to be forwarded to the DOE Office of Scientific and Technical Information as part of the commitment to the public to demonstrate results of federally funded research.

**Parties to the Agreement:** Columbia Power Technologies, Inc.

**CRADA Number:** CRD-16-00609

**CRADA Title:** Columbia Power Technologies, Small Business Voucher Program, Experimental Design & Modeling to Advance Wave Energy Converter (WEC) Commercialization

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**Sponsoring DOE Program Office(s):**

Office of Energy Efficiency and Renewable Energy (EERE), Water Power Technologies Office

**Joint Work Statement Funding Table showing DOE commitment:**

<b>Estimated Costs</b>	<b>NREL Shared Resources Government In-Kind</b>
Year 1	\$100,000
TOTALS	\$100,000

**Executive Summary of CRADA Work:**

Columbia Power Technologies, Inc. (CPwr) had requested that NREL, through the Small Business Voucher Program, assist in the measurement of mechanical loads experienced by their StingRAY Wave Energy Converter during deployment.

### **CRADA benefit to DOE, Participant, and US Taxpayer:**

- Assists laboratory in achieving programmatic scope, adds new capability to the laboratory's core competencies
- Enhances U.S. competitiveness by utilizing DOE developed intellectual property and/or capabilities.

### **Summary of Research Results:**

**WP-1:** Technical collaboration between CPwr and NREL will set priorities and project requirements as follows:

1. A planning meeting will take place that establishes test and instrumentation requirements, detailed Project plan and schedule and will include at least the following:
  - a. Review of when to use Fiber Bragg gratings versus strain gages - CPwr has prior deployment experience and limited success with strain gauges and is relying on NREL's prior experience of using both.
  - b. Review of approaches for measuring slamming loads as actual pressures or local structural stains due to pressure, and the measurement extent and costs involved
  - c. A review of CPwr load and stress information, key design load cases and how to include additional load details from WP-3 (extreme loads analysis) to establish the locations and range for strain and load measurements
  - d. A Trade-off study between on board storage versus telemetry, for data downloads and review of available interfaces between CPwr SCADA and load-measurement system options
  - e. Measurement priorities review to assure that all essential load data is considered in the design
  - f. Developing acceptable criteria to appropriately compromise between load range, sensitivity and accuracy
2. Develop an instrumentation requirements and priority document
3. Develop a matrix of expected test conditions based on possible deployment sites
4. Develop an instrumentation plan and specifications w/ Review meeting. Specify all details needed to purchase, install, calibrate and operate the instrumentation system including load data post-processing guidance.

NREL will provide the following deliverables:

1. Specifications for a load measurement design that will include:
  - a. Frequency of data collection necessary for load validation
  - b. Range of load measurements
  - c. Data storage requirements
  - d. Load measurement acquisition system will either interface with CPwr SCADA system for data storage or store all data independent of SCADA. As a minimum, some critical loads must be made available to the SCADA system for real-time assessment of loads during deployment.
  - e. Installation procedures
  - f. Calibration and data post processing procedures
  - g. Available manufacturers and costs
  - h. Monthly budget progress and percentage complete notices
2. Using data provided by CPwr, NREL will identify proper WEC locations and sensors for load measurements that are necessary for validating numerical models under normal and extreme wave conditions.

No work was performed, and labor hours were spent on meetings and preliminary discussions and planning.

Columbia Power Technologies will:

1. Provide access to CPwr's SCADA system for use in integration with load measurement data acquisition system
2. Provide specifications on the FRP components to be tested including resin type and layup schedule.
3. Provide data from WP-3 needed to identify proper WEC locations and sensors for load measurements that are necessary for validating numerical models under normal and extreme wave conditions.
4. Review and give feedback on NREL provided deliverables.

CPwr will provide data that may be considered Proprietary Information, properly marked, in the following areas:

1. Wave energy converter design details
2. Generator design details
3. Wave energy converter performance and load information
4. Others may be added to this list during performance of CRADA work

Note: All Proprietary Information received from CPwr is to be destroyed within two years of receipt.

This CRADA was established to allow NREL to assist CPwr with a loads measurement campaign for their mega-watt scale “StingRAY” Wave Energy Converted (WEC) device.

Regular meetings were held between NREL and CPwr to discuss their requirements. Originally the project started as a mechanical loads measurement campaign that would quantify the forces experienced by various WEC components during deployment. The device design changed over time, and other aspects such as power quality and supervisory control were added at CPwr’s request. Ultimately no work was performed, and labor hours were spent on meetings and preliminary discussions and planning.

Different instrumentation and sensor types were discussed, data acquisition equipment was identified, system layout was initialized, and data communication was discussed. NREL purchased ~\$30k in fiber optic sensing equipment and began code development and system architecture stability studies.

Future work included detailed installation diagrams for sensors, wire routing, DAQ equipment build, and communication protocols. Load calibration procedures were also to be defined.

Ultimately, CPower never secured the funding needed (on the order \$10M+) to build and deploy the WEC, and the work came to an end.

Labor funds spent:

<b>Fiscal Year</b>	<b>Estimate Labor Costs</b>
2017	\$10,000
2018	\$4,000
2019	\$22,000
2020	\$7,000
2021	\$8,000
2022	\$2,000
Labor Total	\$53,000

In FY23 the remaining labor funds were redirected to support a separate CPower project in NREL’s 2.5MW dynamometer.

**References:** None

**Subject Inventions Listing:** No subject inventions under this CRADA

**ROI#:** None