DNV·GL

STATEMENT OF FEASIBILITY

Statement No.: SOF-DNV-OSS-312-01318-1
Issued: 2016-02-24

Issued for:
Qualification of New Technology
of
StingRAY S1 500kW
Specified in Annex 1

Issued to:
Columbia Power Technologies
4920A SW 3rd Street
Corvallis
Oregon 97333
USA

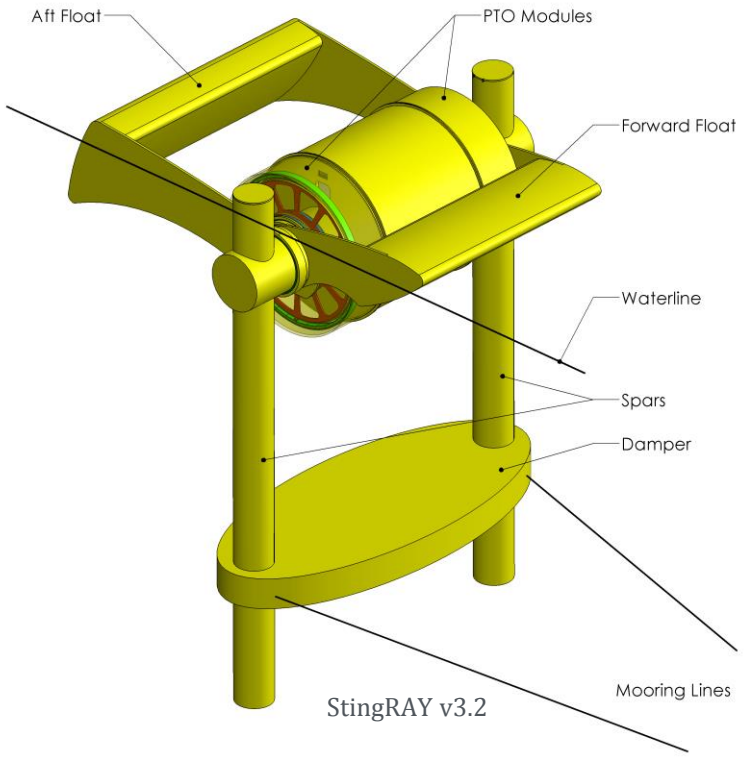
According to:
DNV-OSS-312:2008-10 Certification of Tidal and Wave Energy Converters

Based on the document:
CR-F-DNV-OSS-312-01318-1 Certification Report, dated 2016-02-24
CP-F-DNV-OSS-312-01318-1 Certification Plan, dated 2016-02-24

Changes of the design are to be approved by DNV GL.

London, 2016-02-24
For DNV GL Renewables Certification
Kimon Argyriadis
Innovation Manager

London, 2016-02-24
For DNV GL Renewables Certification
Claudio Bittencourt
Senior Principal Engineer



StingRAY v3.2

Direct Drive Wave Energy Buoy

Ken Rhinefrank
Columbia Power Technologies, Inc.
krhinefrank@columbiapr.com (541)760-1833
February 2017

Direct Drive Wave Energy Buoy

The Challenge:

Prepare for initial open-ocean demonstration of full-scale wave energy converter

Partners:

Ershigs Inc.
DNV-GL RA
DNV-GL RC
Concept Systems
Oregon State University/Northwest National Marine Renewable Energy Center

Program Strategic Priorities

U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

Technology Maturity

- Test and demonstrate prototypes
- Develop cost effective approaches for installation, grid integration, operations and maintenance
- **Conduct R&D for innovative MHK components**
- Develop tools to optimize device and array performance and reliability
- Develop and apply quantitative metrics to advance MHK technologies

Deployment Barriers

- Identify potential improvements to regulatory processes and requirements
- Support research focused on retiring or mitigating environmental risks and reducing costs
- Build awareness of MHK technologies
- Ensure MHK interests are considered in coastal and marine planning processes
- Evaluate deployment infrastructure needs and possible approaches to bridge gaps

Market Development

- Support project demonstrations to reduce risk and build investor confidence
- Assess and communicate potential MHK market opportunities, including off-grid and non-electric
- Inform incentives and policy measures
- Develop, maintain and communicate our national strategy
- Support development of standards
- Expand MHK technical and research community

Crosscutting Approaches

- Enable access to testing facilities that help accelerate the pace of technology development
- Improve resource characterization to optimize technologies, reduce deployment risks and identify promising markets
- Exchange of data information and expertise

Project Strategic Alignment

Prepare utility-scale grid-connected ocean wave energy demonstration

Technology Maturity

- Test and demonstrate prototypes
- Develop cost effective approaches for installation, grid integration, operations and maintenance
- **Conduct R&D for innovative MHK components**
- Develop tools to optimize device and array performance and reliability
- Develop and apply quantitative metrics to advance MHK technologies

Project Impact:

- Advancement of CPower's technical readiness for open-ocean deployment
- Increased stakeholder confidence
- 1st DNV-GL certification client, helping to establish process for industry

Technical Approach

- Prepare for open-water demonstration through risk reduction, design improvement, detailed design completion, and fabrication and logistical planning:
  - Scaled-prototype testing (FY13)
  - SCADA system design and build
  - Deployment site selection and logistics planning
  - Analytical modeling of environmental forces and associated loads
  - Full-scale wave energy converter (WEC) design
  - Independent design certification

	Severity									
Occ	1	2	3	4	5	6	7	8	9	10
10	Low	Med	Med	High	High	High	High	High	High	High
9	Low	Low	Med	Med	High	High	High	High	High	High
8	Low	Low	Low	Med	Med	High	High	High	High	High
7	Low	Low	Low	Low	Med	Med	High	High	High	High
6	Low	Low	Low	Low	Low	Med	Med	High	High	High
5	Low	Low	Low	Low	Low	Low	Med	Med	High	High
4	Low	Low	Low	Low	Low	Low	Low	Med	Med	High
3	Low	Low	Low	Low	Low	Low	Low	Low	Med	Med
2	Low	Low	Low	Low	Low	Low	Low	Low	Low	Med
1	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low

Risk Table

Accomplishments and Progress

Completion of critical-path, cost- and risk-reduction tasks for open-water demonstration

- U.S. Navy's Wave Energy Test Site (WETS) selected for the open-ocean deployment
- Completed full-scale detailed design and validation of a novel WEC, removing end-stops
- Improved understanding of manufacturing and logistics requirements
- SCADA designed, built, tested, and installed

Pioneering DNV-GL WEC Certification

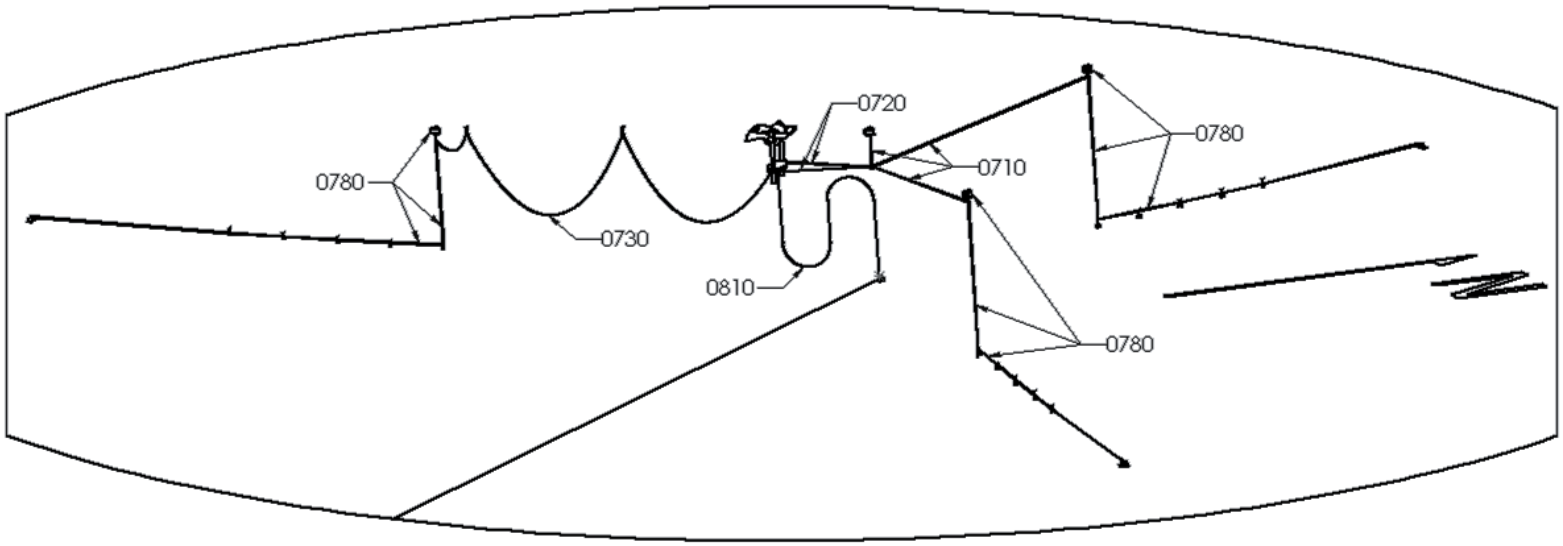
- Completion of Failure Modes, Effects, and Criticality Analysis
- Issuance of the Statement of Feasibility

Project completed FY16

Presentation of Statement of Feasibility at International Conference on Ocean Energy 2016 with U.S. Dept. of Energy, DNV GL & CPower

Project Plan & Schedule

- Project Period of Performance: 01/01/13 – 03/31/16
- Project delays
  - Initiated certification process with Germanischer Lloyd; acquisition by DNV caused restart of certification process
- Go/No-Go was not required for this project



WETS Mooring Configuration

Project Budget

Budget History					
FY2014		FY2015		FY2016	
DOE	Cost-share	DOE	Cost-share	DOE	Cost-share
$315K	$315K	$340K	$340K	$185K	$335K

- 100% expended
- Oregon Wave Energy Trust provided $100K of cost share

Research Integration & Collaboration

Partners, Subcontractors, and Collaborators:

Ershigs Inc. – Structural Design
DNV-GL RA – Certification
DNV-GL RC – Certification
Concept Systems – SCADA
OSU/NNMREC – Test Facility & Support

Communications and Technology Transfer:

- 2014 DOE Water Power Peer Review, presentation and poster display
- Numerous domestic and international conferences, sharing of MHK relevant lessons learned, highlighting the v3.2 WEC design, single-point mooring and certification [Global Marine Renewable Energy Conference VI, VII; Ocean Renewable Energy Conference VIII, IX, X; International Conference on Ocean Energy 2014; OSU Marine Energy Forum; Renewable UK Wave & Tidal; IEEE Power & Energy Society 2015]

Next Steps and Future Research

Proposed future research:

- Extended use of the SCADA System in an open-ocean, grid-connected test at WETS in 2018
- WEC prototype testing
  - Universal small-scale PTO
  - Programmable mooring controller