



University
of Victoria

Graduate Studies

Notice of the Final Oral Examination
for the Degree of Doctor of Philosophy

of

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MA (University of Victoria, 2006)
BSc (ITESM, 2001)

**“Design and Experimental Evaluation of a Unidirectional Flow
Collective Air Pumps Wave Energy Converter”**

Department of Mechanical Engineering

Thursday, December 21, 2017
9:00 A.M.
Clearihue Building
Room B017

Supervisory Committee:

Dr. Afzal Suleman, Department of Mechanical Engineering, University of Victoria (Supervisor)
Dr. Brad Buckham, Department of Mechanical Engineering, UVic (Member)
Dr. Nikitas Dimopoulos, Department of Electrical and Computer Engineering, UVic (Outside Member)

External Examiner:

Dr. Luis M.C. Gato, Department of Mechanical Engineering, University of Lisbon

Chair of Oral Examination:

Dr. Graham McDonough, Department of Curriculum and Instruction, UVic

Dr. David Capson, Dean, Faculty of Graduate Studies

Abstract

Commercial viability of Wave Energy Converters (WEC) depends on addressing not only the energetic efficiency, but also in solving the practical issues related to manufacturing methods, access to technology, handling, transportation and installation, operation and maintenance, impact on marine life and most importantly the cost per kW-h. The UFCAP WEC is one concept which has the potential to facilitate handling, manufacturing, and installation activities as well as to be able to lower the current wave energy cost per kW-h, however its feasibility had not been properly assessed nor proved. It consists of multiple interconnected Oscillating Water Columns (OWC) chambers, it is modular, and simple, with no-moving parts in contact with the water and can use a simpler one-direction turbine which is more economic, and more efficient than self-rectifying turbines used in most of the OWCs devices. Testing of the device to fully assess its feasibility required an ultra-low check-valve, and a customized turbine which were developed during the present work. Check-valves are widely used in the industry for medium or high-pressures, but were not available at all for large-flows with low-pressure-differences. A novel check-valve was devised for this application, along with the scaled UFCAP prototypes developed to be tested in a wave-flume and in the ocean to validate UFCAPs concept feasibility, and identify critical design parameters and features such as the conduit/air-chamber ratio. Ocean tests allowed to observe performance at component and assembly levels, learning new failure-modes and stablishing best-practices for future deployments. Testing confirmed the UFCAP WEC is not only an idea, but a concept which works indeed and can solve WECs problems generating electricity at a competitive cost.