University of Victoria | Graduate Studies

Notice of the Final Oral Examination
for the Degree of Master of Applied Science

of

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BSc (Capital Normal University, 2013)

"Identifying British Columbia's Strategically Important Wave Energy Sites"

Department of Mechanical Engineering

Tuesday, December 11, 2018
12:00 P.M.
Clearihue Building
Room B017

Supervisory Committee:
Dr. Brad Buckham, Department of Mechanical Engineering, University of Victoria (Co-Supervisor)
Dr. Bryson Robertson, Department of Mechanical Engineering, UVic (Co-Supervisor)
Dr. Rosaline Canessa, Department of Geography, UVic (Outside Member)

External Examiner:
Dr. Levi Kilcher, National Renewable Energy Laboratory, National Wind Technology Centre

Chair of Oral Examination:
Dr. Lisa Mitchell, Department of Anthropology, UVic

Dr. David Capson, Dean, Faculty of Graduate Studies

Abstract

The West Coast of Vancouver Island (WCVI), with an average gross wave energy flux of 40-50 kW/m at the continental shelf, possesses one of the most energetic wave climates in the world and has the potential to meet the electric demands of the utility grid on Vancouver Island and numerous coastal remote communities. However, the development of wave energy sites has the potential to interrupt other existing marine activities and wave energy operations could damage the sensitive marine ecosystems.

The objective of this thesis is to identify strategically important sites for wave energy – sites that have great economic potential in an energy generation context yet have minimal impacts on existing economic uses and minimal ecological impacts. Wave energy technology agnostic frequency and directional filters were developed based on a unionized representation of Wave Energy Converter (WEC) performance generated by combining four types of WEC performance characteristics. These two filters improved the quantification of extractable wave resources by accounting for the technological limits of wave frequencies and directions.

Subsequently, a detailed economic evaluation was developed to estimate the influence of the distance to the coastline and transmission network, market sizes, and a technology agnostic description of WEC farm physical layout on the selection of wave energy sites. The technology agnostic description of WEC farm physical layouts was designed based on the cable properties, cable termination/distribution, and cable protection used in real-world projects. The WEC farm capacities are constrained by the transmission cable to minimize the cost for developing wave energy sites.

Lastly, a multi-criteria analysis, which includes four stakeholder perspective scenarios, was developed to identify the strategically important sites for future wave energy development along the WCVI. A total of 16 regions, covering an area of 392 km2 and having an average of 35.68 kW/m wave energy flux, were identified as strategically important sites for wave farms. These regions show the potential to meet the electric demand of Vancouver Island, and they are worth further investigation when selecting a location for future wave energy development.