

Accepted Manuscript

Monitoring the condition of Marine Renewable Energy Devices through underwater Acoustic Emissions: Case study of a Wave Energy Converter in Falmouth Bay, UK

Jodi Walsh, Imran Bashir, Joanne K. Garrett, Philipp R. Thies, Philippe Blondel, Lars Johanning



PII: S0960-1481(16)30914-4

DOI: [10.1016/j.renene.2016.10.049](https://doi.org/10.1016/j.renene.2016.10.049)

Reference: RENE 8237

To appear in: *Renewable Energy*

Received Date: 15 October 2015

Revised Date: 16 October 2016

Accepted Date: 22 October 2016

Please cite this article as: Walsh J, Bashir I, Garrett JK, Thies PR, Blondel P, Johanning L, Monitoring the condition of Marine Renewable Energy Devices through underwater Acoustic Emissions: Case study of a Wave Energy Converter in Falmouth Bay, UK, *Renewable Energy* (2016), doi: 10.1016/j.renene.2016.10.049.

This is a PDF file of an unedited manuscript that has been accepted for publication. As a service to our customers we are providing this early version of the manuscript. The manuscript will undergo copyediting, typesetting, and review of the resulting proof before it is published in its final form. Please note that during the production process errors may be discovered which could affect the content, and all legal disclaimers that apply to the journal pertain.

Monitoring the condition of Marine Renewable Energy Devices through underwater Acoustic Emissions: Case study of a Wave Energy Converter in Falmouth Bay, UK

Jodi Walsh^{1,2*}, Imran Bashir¹, Joanne K Garrett¹, Philipp R Thies¹, Philippe Blondel², Lars Johanning¹

¹ College of Engineering, Mathematics and Physical Sciences, Renewable Energy Research Group, University of Exeter, Cornwall Campus, Treliever Road, Penryn, TR10 9FE, UK

² Department of Physics, University of Bath, Claverton Down Road, Bath, BA2 7AY, UK

*Corresponding Author Email: jw631@exeter.ac.uk

Abstract

Maintaining the engineering health of Marine Renewable Energy Devices (MREDs) is one of the main limits to their economic viability, because of the requirement for costly marine interventions in challenging conditions. Acoustic Emission (AE) condition monitoring is routinely and successfully used for land-based devices, and this paper shows how it can be used underwater. We review the acoustic signatures expected from operation and likely failure modes of MREDs, providing a basis for a generic classification system. This is illustrated with a Wave Energy Converter tested at Falmouth Bay (UK), monitored for 2 years. Underwater noise levels have been measured between 10 Hz and 32 kHz throughout this time, covering operational and inactive periods. Broadband MRED contributions to ambient noise are generally negligible. Time-frequency analyses are used to detect acoustic signatures (60 Hz – 5 kHz) of specific operational activities, such as the active Power Take Off, and relate them to engineering and environmental conditions. These first results demonstrate the feasibility of using underwater Acoustic Emissions to monitor the health and performance of MREDs.

Keywords

Underwater Acoustics; Acoustic Emission; Condition Monitoring; Health Monitoring; Marine Renewable Energy; Wave Energy Converter.

1. Introduction

Marine Renewable Energy Devices (MREDs) are potential future contributors to the global energy mix and associated reductions in greenhouse gas emissions, as acknowledged in the UK [1] and through international policies (e.g. [2,3]). Latest UK reports show for example that 20% of the UK's current electricity demand could be met using tidal stream devices and Wave Energy Converters (WECs) [4]. Their contributions to energy production are expected to grow annually by 15.2% on average until 2030 [5]. However, their use is limited by technological obstacles and the high costs associated with Operation & Maintenance (O&M) activities.

Tidal stream devices and WECs have not yet converged to unified designs, unlike for example the three-bladed horizontal-axis turbine design of the wind industry. For WECs alone, 1,000+ patents have been allocated across North America, Japan and Europe [6], covering 9 main categories [7] and making a standardised approach to O&M more problematic. MREDs are expected to work in harsh oceanic environments, in which extreme weather may damage or cause the failure of devices [8] (improving the survivability of devices is another area of current development within the WEC industry). Also, typical weather conditions make marine intervention more difficult or impossible [9] (WECs are for example located in the areas where large waves are expected for long periods of time). This is compounded by the high costs associated with O&M, using specialised ships and highly skilled labour which might not always be readily available, potentially increasing any downtime. MREDs must therefore be reliable, robust and maintained effectively to reduce the likelihood of unexpected downtime and maintenance. These economies can then translate into more energy generated over longer periods, at lower costs.

Download English Version:

<https://daneshyari.com/en/article/4926819>

Download Persian Version:

<https://daneshyari.com/article/4926819>

[Daneshyari.com](https://daneshyari.com)