Project Summary - Advanced, Modular Power Take-Off Design for Marine Energy Converters (MP-WAVE)

At present, the generator and power converter are two separate units that make up a PTO system. Combining and modularising these two units could potentially lead to significant cost reductions over existing methods of build and maintenance. The challenge was to demonstrate a modular PTO that has been design and built specifically for a wave energy converter, operating under realistic conditions. This would allow the performance of the modular PTO as part of a drive train to be investigated and would enable the stated benefits to be verified. This project aimed to verify and quantify, in terms of performance and reliability, the benefits of modular PTO for wave energy converters.

This was achieved through the following project objectives:

- Produce an optimised design of a modular integrated power electronics and permanent magnet generator topology based on real world wave data inputs and wave energy converter specifications. The simulation of this design will be incorporated into the C-GEN core design and used to assess the benefits of proposed system to industrial partners.
- The design and fabrication of integrated modules will deepen the manufacturing knowledge of the engineering team. Specifically, how to best incorporate the power electronics to optimise manufacture while allowing the requirements for heat dissipation from both the core electronics and stator coils.
- The production data which will feed into an LCOE & O&M analysis of the fabricated system when compared with existing non-integrated modules.
- Employ modern materials and manufacturing processes to investigate the effectiveness of injection moulding as a protective coating method for offshore marine machine operation. Specifically, whether such a method can be utilised while enabling the integrated system to maintain required heat dissipation.

Through work packages to design, model, and simulate electrical generator and power electronics stages, a prototype modular PTO was successfully built and tested. Further analysis of results are needed to understand how performance can be optimised to better utilise the modular design. For materials and manufacture, recommendations were made for coil manufacturing techniques and suitable material based on physical testing for structural integrity and modelling to assess structural deflection under load. There is a need to carry out thermal and fatigue analysis of coil blades potted within the chosen medium, immersion studies on candidate materials, and coil blade aging test to assess the life span of materials when used in an offshore environment.

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