The Research Challenges in Delivering a Robust, Cost Effective International Tidal Energy Industry

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Introduction

The extraction of energy from tidal flows has been identified as having potential to deliver highly valued and predictable renewable energy based electricity. In an effort to utilize this potential, considerable research and technology development programs have been undertaken in Europe, Asia and North America. This has also seen considerable investments being made by numerous Governments in an attempt to stimulate the development of an international tidal energy Industry.

Within the last 10 years, a plethora of engineering technologies has been developed to harness energy from tidal flows. Some of these have progressed through progressive technology development programs which have seen technology prototyped, scaled tested then scaled up and deployed within pre-commercial technology demonstration projects. These have demonstrated technology robustness and shown energy can be successfully extracted from real sea conditions. This has resulted in more than 10 different engineering concepts being demonstrated at a utility scale > 0.5MW.

In recent times, the first tidal arrays have been commissioned, with initial operational statistics showing to be highly positive in the context of operational hours and energy exported to the electrical network.

The important factor associated with these developments is the learning journey undertaken and the experiences gained from the design, manufacture, installations and commissioning processes. The next stages of tidal energy developments require the feeding of this information into the technology and project evolution process to inform the next generation of technology development and installation and intervention procedures. This is the stage where new, additional research challenges are identified and the need to expedite the addressing of these in an economic manner in order to evolve the sector towards commercial acceptability.

Achievement of commercial acceptability requires research focused on engineering product development and optimization for performance enhancement. Additionally, cost engineering is an important aspect identifying where costs can be reduced and taken out of specific technology, the installation and intervention processes. The levels of cost reductions to be attained are likely to be beyond those of cost reductions associated with volume production. Therefore, greater emphasis on product development with a focus on reduced weight, greater use of more durable and lower cost materials and ease of manufacture will be a significant

influence on the research and development focus.

Tidal technology deployments to date have successfully demonstrated the harnessing of energy from tidal flows over a range of operating environments. The experiences and lessons learned from these are now feeding back into research and development programs to inform the next stages of technology development and commercial evolution. In undertaking the engineering development and testing, the information provided is also being used to investigate the economics of these technologies; and attainable cost reductions to be achieved.

To date, a substantive percentage of overall project costs is associated with installing and commissioning a tidal project, as identified in Figure 1.

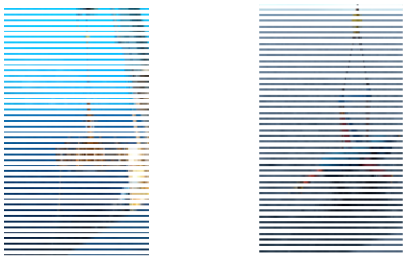

Figure 1: Example of a pre-commercial tidal turbine installation.

The use of large dynamic positioning vessels in undertaking installations results in: high upfront capital costs associated with vessel charter, together with; additional costly engineering challenges associated with 'heavy' handling and the installation of such devices at sea. In undertaking the installation and deployment of these pre-commercial systems, the use of large marine vessels with dynamic positioning capabilities developed for the offshore engineering and oil and gas sectors. An example of which is shown in Figure 2.

Utilising such vessels for installing and recovering tidal turbines results in high installation and operational and maintenance costs being encountered which can be detrimental to the viability of these deploy and test programs.

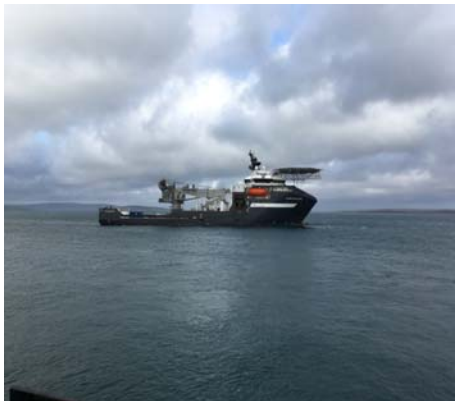

Figure 2: Larger DP vessel being used for a tidal turbine installation

In the deployment of initial arrays, building a dependency on such installation methods result in these arrays becoming financially challenging. New engineering development is being undertaken on the development of new installation practices and methods. This enables the use of smaller, lighter and lower costs vessels which substantively reduce installation and intervention costs.

From the experiences of deploying and operating a 0.5 MW tidal device, this paper will report on the technical and engineering approaches being adopted in developing both the tidal energy converter technologies and the manner in which they are being inter-connected within these initial arrays. It will identify the challenges being faced in developing tidal current technology, site installation practices, while remaining cost effective. The paper will conclude by drawing on the conclusions of the lessons learned to date when deploying and operating utility scale tidal technology and identify the areas and opportunities where technology breakthroughs may be made in order to deliver a more cost effective, utility scale multi MW tidal array.