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Programme Area: Marine

Project: Tidal Modelling

Title: Executive Summary - Tidal Modelling

Abstract:

As more of the UK tidal resource is extracted by some combination of tidal stream and tidal range technologies in the future, the interactions between distant installations may become more significant. The aim of this Project is to develop a set of assessment tools to allow an examination of these interactions, and to conduct an initial analysis of them. The key deliverable is a hydrodynamic numerical model of the UK Continental Shelf (the CSM) that can be used to simulate combinations of tidal range (i.e. barrage, lagoon and fence) and tidal stream systems in UK waters for the purpose of estimating combined hydrodynamic effects and energy outputs. The Project has now delivered an analysis of the interactions under various different build out scenarios from 2020 to 2050.

Context:

Launched in October 2011 this project involved Black & Veatch, in collaboration with HR Wallingford and the University of Edinburgh to develop a model of the UK Continental Shelf and North European Waters, 100 times more accurate than existing marine data. This has been used to assess the tidal energy potential around the UK (tidal range and tidal streams), to inform the design of energy harnessing schemes, to assess their interactions, and to evaluate their impact on European coasts. It can also be used to renew and inform flood defences, coastal erosion and aggregate extraction. Now completed, the project has been launched to market under the brand of SMARTtide. This is available to the marine industry under licence from HR Wallingford.

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ETI Executive Summary

Programme:	Marine
Project Name:	Tidal Modelling
Deliverable:	D7

Introduction

As more of the UK tidal resource is extracted by some combination of tidal stream and tidal range technologies in the future, the interactions between distant installations may become more significant. The aim of this Project is to develop a set of assessment tools to allow an examination of these interactions, and to conduct an initial analysis of them.

The key deliverable is a hydrodynamic numerical model of the UK Continental Shelf (the CSM) that can be used to simulate combinations of tidal range (i.e. barrage, lagoon and fence) and tidal stream systems in UK waters for the purpose of estimating combined hydrodynamic effects and energy outputs. The Project has now delivered an analysis of the interactions under various different build out scenarios from 2020 to 2050.

Key findings

The aim of the TRM scope of work has been to address the following three fundamental questions:

- **How will the impacts of tidal range and tidal current energy schemes positioned around the UK combine to form an overall effect?**

The 30 scenarios that have been run so far provide a good representation of possible tidal deployments through to 2050. From these scenarios, the implications on the overall near-field (local to the installation) and far-field (downstream of the installation) effects is that the extraction of tidal current energy has been shown to have a severe near-field effect when extraction is unlimited and therefore extraction requires close management of the resource both within and between nearby projects to ensure that the resource is not over exploited (which could potentially cause detrimental economic and environmental effects). However, there is no far-field effect by tidal current that impacts any tidal range locations.

The extraction of tidal range energy in UK waters has been shown to have wide-scale and significant effects in the extreme cases. The combination of all schemes on the west coast causes tidal range changes of up to 0.5M. A change of tidal range of 0.1M or more is generally considered unacceptable. Therefore, optimisation for environmental/human

impact, energy output, economics or power smoothing is needed if the overall tidal resource is to be exploited to its full potential.

- **Will the extraction of tidal energy resources in one area affect the tidal energy resources at distant sites around the UK and Europe?**

The results of the scenario runs completed using the DCSM give the most in-depth and accurate assessment of energy output from a combination of UK schemes to date. The CSM scenario run outputs give a clear indication as to the impact at far-field UK sites. The impacts across Europe vary depending on the scenario but the most extreme case of both tidal range and tidal current deployment, shows that there would be an impact on the European coastline.

- **What constraints might these interactions place on the design, development and location of future systems?**

The interactions within and between schemes shows that the level of tidal range deployment (for near-field and far-field effects) and tidal current deployment (mainly near-field to regional impacts) would place constraints on the schemes. Both effects could potentially impact the success of projects. Importantly, the installation of later schemes could have an impact (positive or negative) on an existing scheme or its effects.

Further work

The CSM is proving to be an extremely useful tool for the analysis of tidal characteristics on the UK's continental shelf. Modelling runs against pre-defined scenarios of tidal stream and tidal range installations have shown that there will be significant interactions resulting from large scale tidal range installations. The development of the UK's tidal resource therefore needs to be carefully managed. The model should be used by investors, project developers and those involved in permitting and licensing of tidal sites to enable tidal resources to be optimised.