Marine tidal energy:

a case study in legislative challenges and environmental impacts

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IEEE Conference on Technologies for Sustainability (SusTech2014)
Portland OR, USA, 24-26 July 2014

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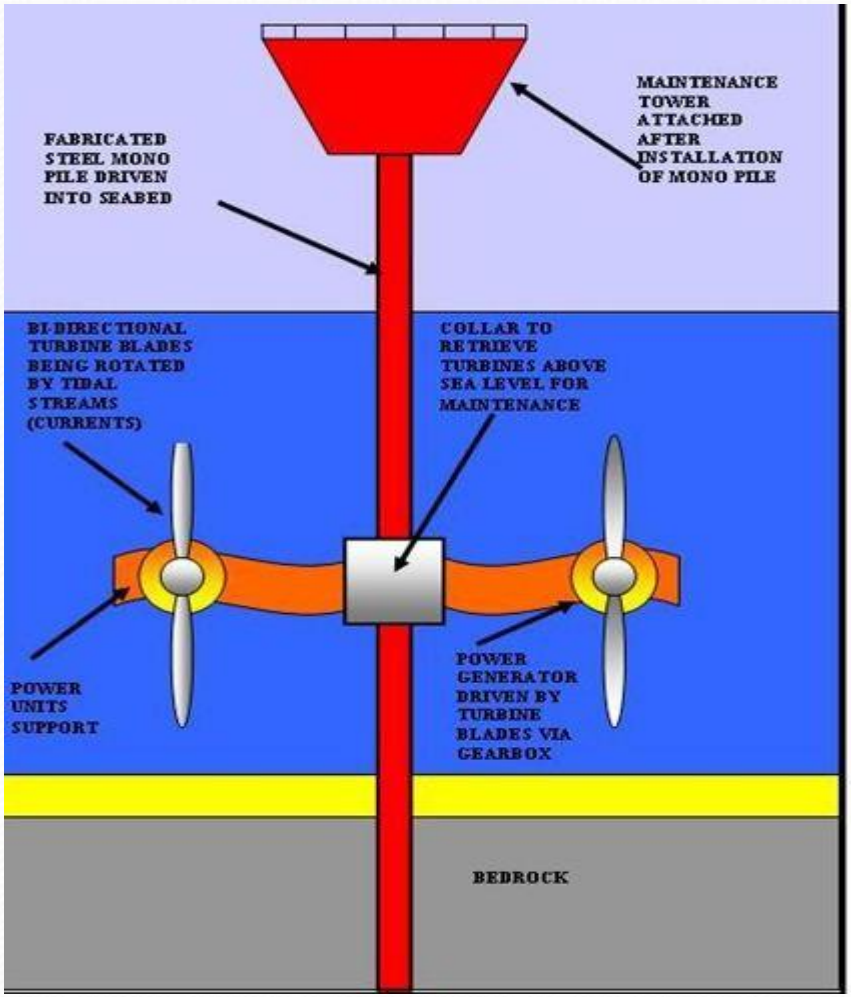
Introduction

- The UK is committed to increasing proportion of electricity generated from renewable sources.
  - In 2000, introduced obligation on electricity suppliers to supply an increasing proportion of electricity from renewable sources toward a target of 10 per cent by 2010.
  - In 2009, the UK Renewable Energy Directive increased the target to 15 per cent by 2020.
- Marine tidal energy is another alternate source for renewable energy and has the potential to make a significant contribution toward this objective.
  - Marine tidal energy is produced by marine turbines that harvest energy by the rising and falling of the sea and the tidal flow across turbine rotors which generate electricity to the grid.
  - The UK is a world leader in the development of this technology.

Marine tidal energy – how it works

- Tidal turbines are very much like underwater windmills except the rotors are driven by consistent, fast-moving currents. The submerged rotors harness the power of the marine currents to drive generators, which in turn produce electricity.
- Water is 832 times denser than air and consequently tidal turbine rotors can be much smaller than wind turbine rotors thus they can be deployed much closer together and still generate equivalent amounts of electricity.
- Devices that harness marine current energy present a unique set of engineering challenges in terms of design, installation and maintenance.



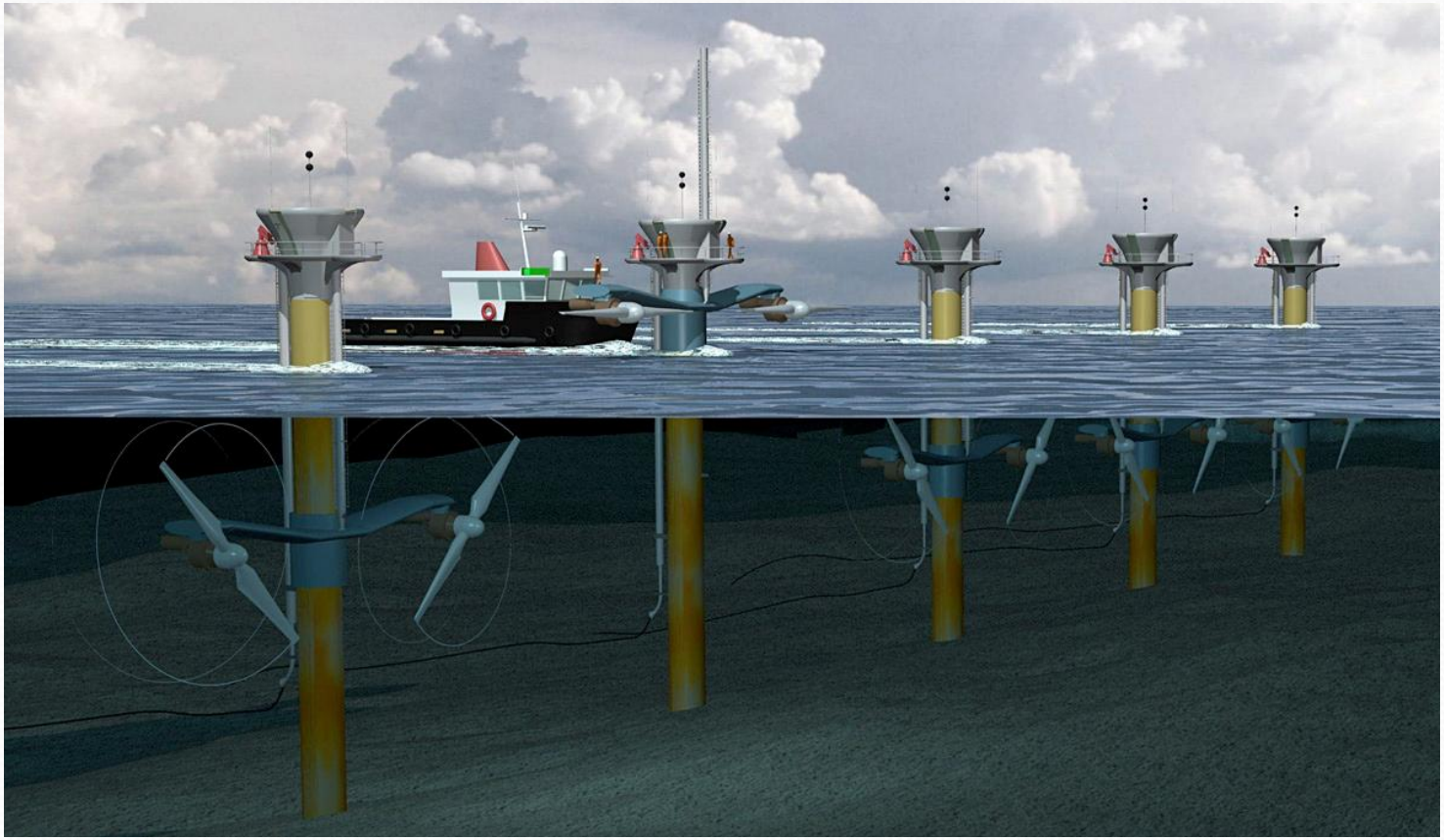
SeaGen Case Study

Marine Current Turbines (MCT) Ltd is one of several companies developing technology that can generate electricity from marine current energy.

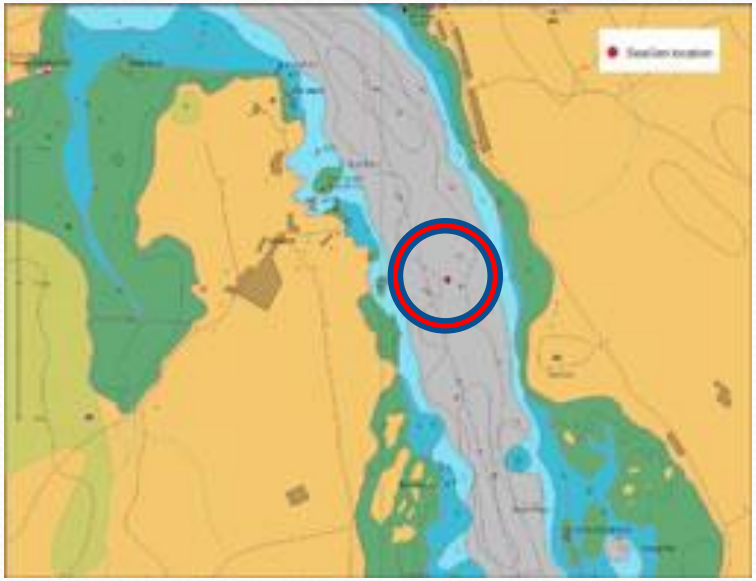
MCT is wholly owned by Siemens AG and forms part of Siemens Hydro and Ocean Business.

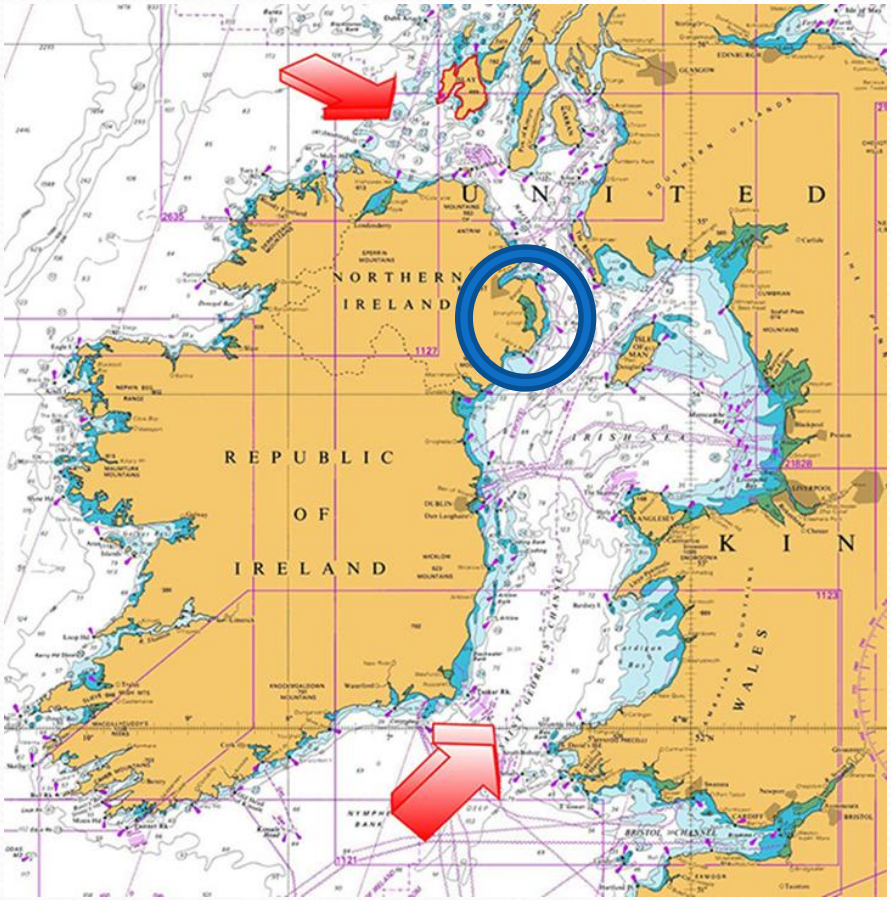
Sea Generation (SeaGen) Ltd is a subsidiary of MCT and was established to develop the Strangford Lough project in Northern Ireland, and manage the installation and operation of the SeaGen S device – a twin axial-flow turbine supported on a structure with the ability to raise the moving components out of the water for maintenance.

SeaGen S installation in Strangford Lough



Artist impression of a SeaGen S tidal array





The position of SeaGen at Strangford Lough

- The main objective of the Strangford Lough project is to demonstrate that MCT's SeaGen S technology is a viable renewable energy source with no carbon emissions.
  - The unique design of SeaGen allows capture of the maximum amount of tidal energy whilst keeping maintenance and connectivity costs low.
- Strangford Lough is considered to have one of the best tidal resources in the world, and its sheltered environment and ease of access make it ideal site for exploring the potential of tidal energy.
  - During operation, the force of the tidal flow in Strangford Lough is equivalent to a 345 mph wind generating 100 tonnes of thrust on the rotors.
- ***Coincidentally, Strangford Lough is also of significant international importance for nature conservation, supporting a wide array of flora and fauna.***
- The Strangford Lough site was acquired in 2004 and Royal Haskoning Ltd were appointed to scope the environmental considerations and conduct the environmental impact assessment. Their environmental study was completed in June 2005.

- The positive outcome of the environmental statement resulted in MTC being granted a license to continue developing the installation under the proviso that an Environmental Monitoring Plan (EMP) and a number of risk mitigation treatment plans were implemented.
- Following these extensive environmental studies, the project was awarded a five year licence by the Northern Ireland government in early 2008. The SeaGen S device was installed in August of that year and has since been the subject of an ongoing extensive environmental monitoring program.

- The SeaGen S 1.2MW device was the world's first grid connected commercial scale tidal device and since installation has generated over 8GWh of electricity. The success of the project to date has led to a licence extension until 2018.
- The Strangford Lough project is funded by a combination of public and private funds, as well as receiving support from United Kingdom government grants.
- With a large support base from key stakeholders and government investment, the unified marine sector, Climate Change Committee, scientists, private investors, engineers and technologists, the development of the marine tidal energy generation sector has backing to continue development of this renewable energy.
- MCT is applying the lessons learnt in Strangford Lough to develop the SeaGen technology further, and plans to install commercial arrays in United Kingdom waters from 2015.

Legislative and political background

- As part of European Union wide action to increase the use of renewable energy, the UK has committed to generating 15 per cent of its energy from renewable sources by 2020, with an aspirational 20 per cent by 2020. The targets for Scotland are higher.
    - Since 2008 the SeaGen S project has been contributing toward achieving these targets.
- The construction of SeaGen marine turbines was granted under the Food and Environment Protection Act (1985). Part II Deposits in the Sea stipulates:

  '(f) for the loading of a vessel, aircraft, hovercraft, marine structure or floating container in the United Kingdom or United Kingdom waters with substances or articles for deposit anywhere in the sea or under the sea-bed;'

- However, this Act does not cover any form of renewable energy structures or energy harvesting being constructed in the Sea, and when reviewing alignment to The Kyoto Protocol, it stipulates the following in regards to renewable energy:

  Article 2 (a) (iv) Research on, and promotion, development and increased use of, new and renewable forms of energy, of carbon dioxide sequestration technologies and of advanced and innovative environmentally sound technologies;

- The Energy and Climate Change Committee called for further investment into the development of the marine turbine technology.
  - The current understanding of the impact to marine life and potential pollutants, noise and migration paths, needs further investigation; for example, current research does not clearly identify the impacts to seals in Strangford Lough from the SeaGen installation.
  - The United Kingdom has since established the Renewables Obligation, with current funding for marine renewables set at £20 million; the Scottish government has a £18 million budget.

- The Act by which the research and development of the tidal turbines has been granted under does not accommodate for the development of renewable energy initiatives within the UK.
- It is, however, realised under the Marine Energy Action Plan 2010 Executive Summary & Recommendations. The Action Plan stipulates that there are many challenges that need to be addressed:
    - Environment, planning and consenting;
    - Finance and funding;
    - Infrastructure, supply chain and skills; and
    - Tidal range.

- To allow for further development and planning of marine renewable energies, the UK implemented the Planning Act 2008 and the Marine and Coastal Access Act 2009.
    - These Acts need to be completely imbedded to support the development of renewable energy sources and technology development for marine structures.
- The Planning Act 2008 (c. 29) covers the underlying gap of the original issue of license to MCT, which did not stipulate the location of the structure and that there is now a defined Renewable Energy zone.

The Marine and Coastal Access Act stipulates the following:

13 Safety zones: functions under section 95 of the Energy Act 2004

(1) The functions of the Secretary of State specified in subsection (2) are transferred to the MMO.

(2) Those functions are any functions of the Secretary of State under section 95 of the Energy Act 2004 (c. 20) (safety zones around renewable energy installations), so far as relating to any renewable energy installation that meets the requirements of subsections (3) and (4).

(3) The renewable energy installation must be in waters subject to regulation under section 95 of the Energy Act 2004, other than—

(a) any area of Scottish waters, or

(b) any area of waters in a Scottish part of a Renewable Energy Zone.

(4) The renewable energy installation must have a capacity such that the construction or extension of the installation would not be a nationally significant infrastructure project (within the meaning given by sections 14 and 15 of the Planning Act 2008 (c. 29)).

HOWEVER

- **Neither of these Acts** stipulate a defined marine pollution or noise control that is required for the license of the SeaGen turbine to operate.
- **There is no specific requirement or legislative statement** that stipulates there shall be minimal or no impact by the construction of the renewable energy structures, or to prove that the natural migration path of marine life is not impacted by the structure by noise, pollution or obstruction.

- A separate research initiative conducted in 2010 by the University of Manchester found that stakeholder perceptions of tidal stream energy supported application of the precautionary principle, and that the government should provide funding into further research and development.
- Stakeholders also felt that intergenerational equity should play a part in the decision to ensure alignment to the Ecological Sustainable Development (ESD) principles:
  - With the realisation that there may be damage, what would be the impacts in the future?
  - How would the seabed and marine life recover from such disruption due to the installation process?
- At this stage these are unknown.
  - Further technology that simulates these scenarios needs to be developed to enable modelling of impacts.

Australian legislation embodied in the Renewable Energy (Electricity) Act 2000 has captured this level of detail by calling out the alignment to ESD principles as follows:

"ecologically sustainable means that an action is consistent with the following principles of ecologically sustainable development:

(a) decision-making processes should effectively integrate both long-term and short-term economic, environmental, social and equitable considerations;

(b) if there are threats of serious or irreversible environmental damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation;

(c) the principle of inter-generational equity, which is that the present generation should ensure that the health, diversity and productivity of the environment is maintained or enhanced for the benefit of future generations;

(d) the conservation of biological diversity and ecological integrity should be a fundamental consideration in decision-making;

(e) improved valuation, pricing and incentive mechanisms should be promoted. [Section 17 calls out the definition of:]

17 What is an eligible renewable energy source?

(1) The following energy sources are eligible renewable energy sources:

(a) hydro;

(b) wave;

(c) tide;

(d) ocean;

(e) wind;

(f) solar;

(g) geothermal-aquifer;

(h) hot dry rock;

(i) energy crops;

Supporting data

- The Environmental Report of the 2011 Offshore Energy Strategic Environmental Assessment (SEA) determined that further investigation and analysis needs to occur as to the impacts to marine life and the environment, and recommended that licensing for tidal energy installations be 'To restrict the areas offered for leasing and licensing temporally or spatially' until those investigations and analyses are conducted.
- The SEA is an ongoing program, and impacts to the environment are being considered through '*A review of the potential impacts of wave and tidal renewable energy developments on Scotland's marine environment*' and the '*Marine (wave and tide) renewables development in Scotland: Assessing impacts on birds*'.
  - These papers place emphasis on the need for data collection and further investigation to the impacts to the marine life and surrounding environment.

- The results of such studies should enable the UK to establish a position, after approximately five years of data collection, on tidal turbines. The outputs of such data analyses will help inform amendments to the current legislation within the UK, and potentially worldwide.
- With the body of data now available, the outcomes of the SeaGen EMP provides the key case study for marine tidal energy, and therefore can be used in conjunction with the SEA to inform policy and guidance in the UK.

Recommendations

1. Develop legislation that caters for the environmental impact to marine life; pollution, noise and potential electromagnetic field impacts;
2. Establish governance frameworks around new technology development for best practice standards;
3. Form a strategic working group to develop a planning and consent roadmap for all of marine renewables;
4. Build a United Kingdom marine energy supply chain to utilize the skills base established from the offshore wind, oil and gas, and maritime industries;
5. Establish marine zones specifically designed for research and development under strict adherence to the Planning Act 2008;
6. Leverage equity from private investors and therefore project capital into the sector;

Recommendations (cont..)

7. Manage the risks and costs of research, development and design by developing and delivering a coordinated and targeted program;
8. The outcomes of the Strategic Environmental Assessment (SEA) consultation must assist with policy development and closure of legislative gaps, and that alternative 3 '*To restrict the areas offered for leasing and licensing temporally or spatially*' is implemented;
9. Establish a global standard for wind and water generation so that knowledge can be shared and ratified internationally, potentially using a treaty through the United Nations similar to the Rotterdam Rules;
10. Incorporate environmental protection provisions into current legislation by implementing legislation similar to the Australian Environment Protection and Biodiversity Conservation Act (EPBC Act);

Recommendations (cont..)

11. The Energy Act 2008 (Consequential Modifications) (Offshore Environmental Protection) Order 2010 needs to incorporate reference to marine tidal turbines as it currently only refers to petroleum installations; and
12. Provide subsidies and long term loans to lower socio-economic countries to establish the technology in these regions. Scientific research of the regions should be undertaken as part of a global initiative.

Conclusion

- Through a joint review of the Marine Energy Action Plan, the UK government with private industry looks at the key areas that should be developed to ensure the continued investment and movement towards achieving the UK's Renewables Obligation vision by 2020.
- To realize these objectives, the marine turbine industry will need continued investment and development until it achieves maturity as a viable and sustainable platform for government and investors.
- With the above considerations, the development of covering legislation within the UK should be based on sound ESD principles and provide for review at regular intervals.
- Data collected and analysed through SEA and SeaGen EMP initiatives must inform the development of base-lined energy and environment legislation, so that ongoing technology development is not impeded by the law that it is bound by.

Stop Press!!

- The Crown Estate, manager of the UK seabed, announced on 8 July 2014 that it has agreed seabed rights for new demonstration zones and project sites around the UK's coast.
- The rights include six new wave and tidal current demonstration zones and five tidal current project sites each with the potential to deliver a project of between 10 and 30MW capacity.
- MCT has secured Agreements for Lease (AfLs) for three new commercial-scale tidal projects: Mull of Galloway on the west coast of Scotland, Portland Bill on the south coast of England and Strangford Lough in Northern Ireland. The sites were identified following a UK-wide assessment of locations with the potential to be economically viable tidal projects suitable for MCT's next generation SeaGen technology.
- The locations for the demonstration zones and project sites include three off the coast of England, four off the coast of Scotland, one in Northern Ireland and three off the coast of Wales.

Thank You

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