Collision modelling for marine mammals and tidal turbines

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The announcement of consent for Europe's largest tidal energy project in the Pentland Firth recently was the conclusion of years of research for the first environmental statement to be submitted for a tidal array in Scottish waters. As a result of being the first Environmental Impact Assessment (EIA) for a large scale tidal turbine array, it was also the first quantified marine mammal impact assessment for a large scale tidal turbine array in Scottish waters and a learning process that will no doubt shape the approach of future developments.

Collision between marine mammals and submerged turbine blades is perceived to be one of the main potential impact mechanisms for tidal arrays. The current approach to this impact is to undertake 'encounter' modelling, where a mathematical model is used to estimate the number of marine mammals that may share the same space as the turbine blades at any given time.

Since this model only predicts encounter, the next step is to consider how many animals might fail to respond to the turbine blades and consequently collide with the device. However, as a result of the novel nature of tidal devices, only a small number of individual devices have been in the water, for a short period of time, and evidence describing such interactions is lacking. There is no evidence to date of animals colliding with tidal turbines, but whether this represents a true absence of interaction is impossible to say with available data.

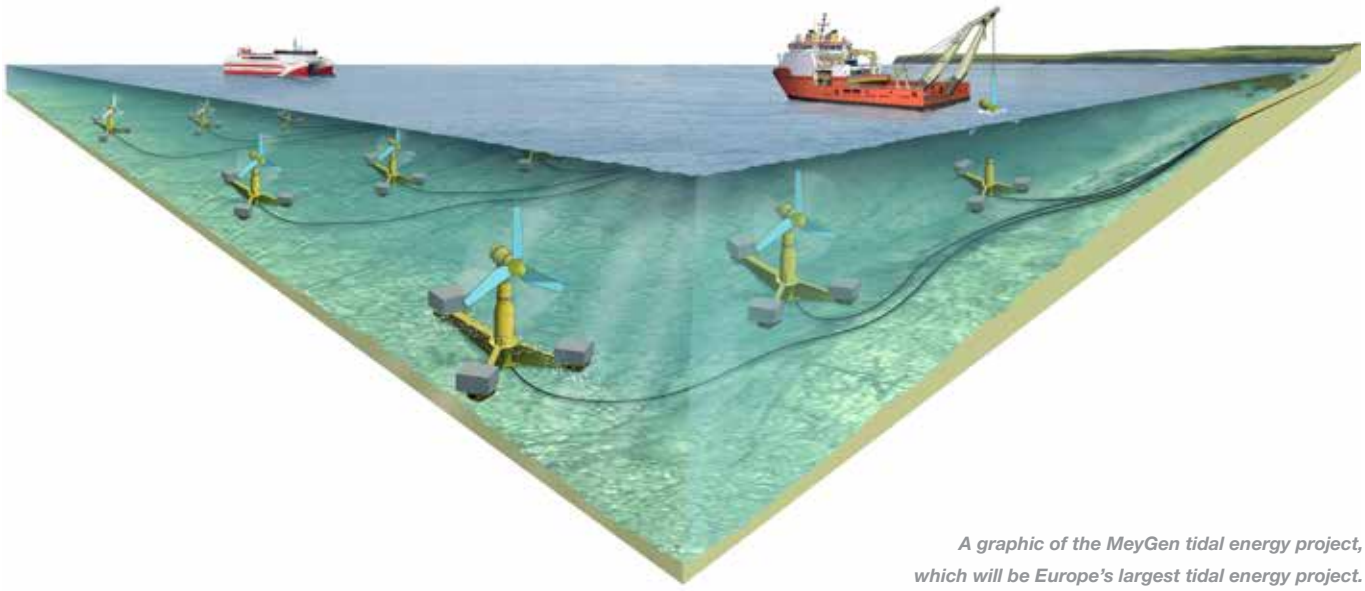
To determine the risk in a large development, encounter models are used to perform calculations in a quantitative sense. Unlike wind developments where one model prevails (the band model), many models are currently available to tidal developers and their consultants.

Ongoing discussions on developing an industry standard model for marine mammals and tidal turbines would significantly facilitate the consenting process by removing the need for regulators to critically review from scratch the integrity of every new model they see.

Modelling can be useful for focusing attention on the species likely to be of most concern. In the case of the north of Scotland, killer whales could be excluded from the assessment early on, along with the likes of minke whales and grey seals, allowing us to dedicate effort to the species (e.g. harbour seals, harbour porpoise) most likely to be affected.

We encountered and overcame a number of issues when determining collision risk for marine mammals for our north of Scotland site. The information from two years of dedicated site surveys was not able to provide all the information required for the modelling. For example, it is important to understand how animals use the water column at specific sites, which classic site characterisation surveys are not able to do. Working with research organisations, information was made available for the EIA which provided the necessary data. With specific data requirements and such sparse information available, this highlights the value of consultant/academic relationships.

Not being able to fully understand the way animals behave around tidal devices is a common problem across tidal developments. Installed devices are generally single devices at test sites, and they may have conditions of use that limit how much can be drawn from monitoring (e.g. turbines may shut down if a mammal is detected close to a device)



A graphic of the MeyGen tidal energy project, which will be Europe's largest tidal energy project.

To incorporate this uncertainty into EIA, we can take the number of animals which may encounter the device and divert from it – the 'avoidance rate' – which we might presume can be anywhere from 50% to 100%. Taking such an approach allows us to refine the number of encounters and collisions in the face of a general lack of data.

Clearly, however, consent for such developments cannot be granted on a base of insufficient evidence to support conclusions and the only real way to remove that uncertainty is to consent a limited array of devices and monitor them with a high degree of effort – this is known as 'deploy and monitor'. A key output from our ongoing work with our client's site will therefore be the development of a comprehensive monitoring programme.

This monitoring programme is likely to draw on a range of methodologies and technologies, which may include underwater imagery, SONAR, marine mammal observers, acoustic monitoring and even coastal walk surveys for dead or injured animals. Strain gauges on the turbine blades to detect collisions between marine mammals and the devices are also a possibility.

Although avoidance or evasion of tidal devices is likely to have strong device-based, location-based and species-based components, results from these early monitoring programmes will provide developers, consultants and regulators with a much better idea of the number of animals that might be affected. This can only result in an increased likelihood of consent for future developments, with fewer subject of stringent control or monitoring measures as these first developments ■