Electromagnetic Fields

POTENTIAL FOR CONCERN

As marine renewable energy (MRE) arrays are developed and more power cables are installed in the marine environment, there is concern that the Electromagnetic Field (EMF) signatures emitted from the power cables, moving parts of devices, and underwater substations or transformers may affect marine organisms that use the Earth's natural magnetic field for orientation, navigation, and hunting.

Marine organisms such as certain species of elasmobranchs (cartilaginous fish), marine mammals, crustaceans, sea turtles, and other fish species have electro- or magneto-receptors that allow them to detect electrical or magnetic fields. The introduction of additional EMF into the marine environment can potentially disrupt or alter these animals' ability to detect or respond to natural magnetic signatures, potentially altering their survival, reproductive success, or migratory patterns.

STATUS OF KNOWLEDGE

EMFs are generated in the oceans as electricity is transmitted through cables or from moving parts of machines, such as MRE devices. The electrical field can be contained by a grounded metallic sheath and rapidly diminishes in the marine environment; however, the magnetic field can persist over longer distances and induces a secondary electrical field. Although the Earth has a naturally occurring static geomagnetic field generated by earth and tidal motions, the addition of extra EMF signatures in the marine environment may affect certain organisms. Anthropogenic EMF signatures are not new to the marine environment as many subsea cables, bridges, and tunnels have been deployed and currently provide measurable electromagnetic signatures in the ocean.

To better understand how EMFs may affect marine animals, scientists have identified marine organisms that are known to be sensitive to magnetic and electrical signatures to better understand the mechanisms by which these animals detect EMFs and how they behave around specific levels of EMFs. Scientists have also modeled potential EMF signatures for power cables and MRE devices, providing an estimate of how far electrical and magnetic signatures may persist from a given cable. Laboratory and field studies have shown certain EMF-sensitive species are attracted to/or avoid sources of EMF, suggesting changes in animal behavior due to exposure to EMF signatures. However, it is unclear how these changes may affect animals over long periods of time, and no data have been collected that suggest additional EMFs from MRE devices will have significant effects on marine animals. Studies have shown that, for certain EMF sensitive animals, exposure to high levels of EMF may alter early life stages of the animal's development, although it is not clear that these potential alterations will affect populations of animals, or whether animals may be exposed to such high levels of EMFs in the marine environment.

HOW WE UNDERSTAND THE PROBLEM

Based on the evidence to date there is no demonstrable impact (negative or positive) of EMF related to MRE devices on any sensitive marine species. The potential for EMF to cause an impact is considered most likely for organisms living on or near the seabed (e.g., eggs, larvae, benthic or demersal species), especially species with limited mobility or in critical habitat areas, because mobile species are able to avoid/move away from areas with EMFs if necessary. While laboratory and field data have helped advance our understanding of the potential effects of EMF signatures, collection of additional data around MRE devices is needed to better understand this interaction and how it may affect marine animals. To date the only available data on EMF associated with MRE devices has been reported by the recently completed European Commission MaRVEN project (Environmental Impacts of Noise, Vibration and Electromagnetic Emissions from Marine Renewable Energy). This project was aimed at addressing some of the gaps in knowledge about EMF (among other energy emissions) associated with MRE devices by conducting field-based studies at MRE device sites.

FUTURE RECOMMENDATIONS

While progress has been made to better understanding the potential effects of EMF signatures on marine animals and habitat, certain research and information gaps remain. Additional research is needed to better understand the varying sources of EMF from high powered cables, including DC systems; emissions from multiple cables in close proximity; and specific EMF signatures from different MRE device designs. Laboratory studies are needed to better understand how specific animals may respond to varying intensities of EMF, including changes in feeding, reproduction, rearing, and sheltering behavior. From these studies, targeted mitigation measures for EMF emissions from MRE devices may be developed, if needed.

FOR MORE INFORMATION

Annex IV State of the Science full report and executive summary available at: *http://tethys.pnnl.gov/publications/state-of-the-science-2016*

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Go to *http://tethys.pnnl.gov* for a robust collection of papers, reports, archived presentations, and other media about MRE development.

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