

SUBMARINE CABLE EMF CHARACTERIZATION



PROJECT HIGHLIGHTS

- Rapid expansion of submarine power cables is raising environmental concerns, particularly for EMF-sensitive marine species.
- Current EMF assessments are hindered by unreliable electric field data and discrepancies between measured and modeled magnetic fields.
- Lab experiments will investigate how cable design and environmental conditions affect EMF models and measurement accuracy.
- Results will provide robust, evidence-based EMF data to enhance the credibility of environmental impact assessments and inform regulatory decisions.

Background, Objectives, and New Learnings

The global expansion of subsea power cables (SPCs) to support renewable energy and energy security has raised concerns about their environmental impact, particularly on marine species sensitive to electric and magnetic fields (EMFs), such as elasmobranchs, salmonids, and eels. Accurate assessment of these impacts requires detailed characterization of the EMF environment around SPCs, which is more complex in marine settings than on land due to conductive seawater and dynamic ocean conditions.

Current research shows a lack of reliable electric field measurements and inconsistencies between measured and modeled magnetic fields, especially for AC and HVDC systems. Factors like cable configuration, burial depth, and ocean currents significantly influence EMF behavior but are often overlooked in standard models.

This project aims to:

- Conduct lab experiments to understand how design and environmental factors affect EMF measurements.
- Develop guidelines to align magnetic field calculations with real-world measurements.
- Improve methods for estimating cable burial depth using magnetic field data.
- Enhance the credibility of environmental assessments and support regulatory processes with robust, evidence-based EMF data.

Benefits

Provides reliable data for environmental assessments, supports regulatory compliance, and advances scientific knowledge.

Improves public/regulatory confidence and supports responsible expansion of subsea cable infrastructure while safeguarding marine ecosystems and aiding informed decision-making.

Project Approach and Summary

EPRI intends to conduct the following:

- 1. Select and Procure Instrumentation**
Identify and procure options for instruments sensitive enough to measure underwater electric and magnetic fields from undersea cables.
- 2. Test Plan**
Develop a test plan detailing the experiments to be conducted in the laboratory. Plans should include measurement of magnetic field and electric field under DC and AC conditions, with and without conducting water flow.
- 3. Magnetic Field Measurements**
Conduct magnetic field measurements per the test plan. At a minimum, measurements should be taken near the cable surface and at varying distances from the cables and with varying core and sheath currents. Results should distinguish cable fields from background fields due to the earth and other field sources in the laboratory. Experiments should consider separation between cables and cable twist (either inherent in cable design or by introducing cases with twist in the cable lay).
- 4. Electric Field Measurements**
Conduct measurements to determine electric fields in seawater surrounding the cable(s). Design experiments to separately establish electric field contributions from Faraday effects given flow of the water in the presence of cable magnetic fields, flow of water in the presence of static background magnetic fields, and field contributions from non-zero voltages on the sheath. Take measurements at various locations and under a range of other key variables.
- 5. EMF Computation**
Compute electric and magnetic fields to support test plan development and to compare with laboratory and field measurements. Refine analytical or numerical simulation techniques and develop guidelines for best practices to determine undersea cable electric and magnetic fields with reasonable accuracy.

6. Documentation

Prepare a report documenting the research project. Include all laboratory and field measurement details and results. Interpret the findings in the context of the environmental assessment application.

Deliverables

Technical Report and Webcast. The non-proprietary results of this work will be incorporated into EPRI R&D Program P60, and made available to the public, for purchase or otherwise.

Price of Project

\$120k per funder – minimum of three funders required. Qualifies for Self-Directed Funding (SDF).

Project Status and Schedule

This project is anticipated to take 24 months from the date of securing the first funder.

Who Should Join

Any utilities or facility owners that have or will be deploying submarine power cables.

Contact Information

For more information, contact the EPRI Customer Assistance Center at 800.313.3774 (askepri@epri.com).

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