Characterization of super-low frequency electromagnetic fields produced by an undersea transmission cable in a homogeneous fluid

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WAVE ENERGY AND THE POTENTIAL ENVIRONMENTAL IMPACTS

Clean, Renewable Wave Energy: Offshore renewable energy is an important resource in the United States, and has the potential not only to add to our clean energy mix, but to create jobs as well. The National Renewable Energy Laboratory estimates that the United States could harvest 54 gigawatts (GW) of offshore wind by 2030 — enough to power more than 42 million homes. This would generate an estimated $200 billion in new economic activity and create more than 450,000 permanent, well-paid jobs.

Environmental Issues: There are a number of high priority issues including those that might have potential impacts on marine mammals and seabirds, the effects on the physical environment, and changes to the ocean floor habitat. For fish and mammal species, sensory perception, migration, orientation, and even entanglement can be caused by perturbations in the electric and magnetic fields.

MAXWELL’S EQUATIONS TO CALCULATE B_E AND E_R

\[ \mathbf{\nabla} \times \mathbf{B} = \mu_0 \mathbf{J} \]

\[ \mathbf{\nabla} \cdot \mathbf{E} = \frac{\rho}{\varepsilon_0} \]

\[ \mathbf{B} = \frac{\mu_0}{2 \pi r} \int \frac{I \, dl}{R^2} \]

\[ \mathbf{E} = \frac{1}{\varepsilon_0} \int \frac{I \, dl}{R^2} \ln \left( \frac{L}{a} \right) \]

Maxwell’s Equations: The fundamental set of electromagnetic equations can be used to calculate the angular magnetic field component and the radial electric field component. The excellent correlation between theoretical and experimental measurements is independent of the homogenous medium i.e. the result is the same for both air and conductive water.

THE HERTZ VECTOR TO CALCULATE THE INDUCED ELECTRIC FIELD

Sommerfeld, Stratton, Wait, and Inman: While Maxwell’s equations can be represented using both vector and scalar potentials, these two methods of representing Maxwell’s equations are not the only possible choices. By introducing a more regular “superpotential” called the Hertz vector potential or polarization potential, the points of discontinuity are placed away from the measurement point, thus allowing for a continuous prediction of the field strength.

Gauthier, Shakur, Heald, and Griffiths: Maxwell’s equations can explicitly be solved in terms of the electric field \( \mathbf{E} \) and the magnetic field \( \mathbf{H} \). The method that was brought up in 1969 by Shakur and discussed by Gauthier treats the problems using \( \mathbf{E} \) and \( \mathbf{H} \) directly. Gauthier suggested that the global geometry of the problem needs to consider the energy sources in the system in order to account for the deforming dephasing. Griffiths added that the constant \( K \) depends on the history of the current in the conductor.

REFERENCES:


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