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Concept Design of Power Source for High Temperature Superconducting Ship Deperming Coil System

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Deperming of ship has been conducted since the World War II by several Navies and faces hard work for the deperming of large-size ships. We have been investigating a ship deperming system using High Temperature Superconducting coil laid flat on seabed of shallow water. The investigation started from the calculation of magnetic field to be imposed on ship. Considering deperming procedure, the ship hull comprised of high-tensile steel is firstly depermed, and then under the effect of ship-hull on-board machinery comprised of steel is depermed. Magnetic field to deperm ship-hull is estimated from the magnetic property of steel, and for the on-board machinery consideration is needed of the shielding effect by ship-hull. Maximum magnetic field to deperm ship is several milli-Tesla and imposing this field over whole ship body at once requires the shape of the coil to cover the projected area of the ship which is stationed on sea surface. Our design of the coil is based on a set of race-track shaped multi-turn conductor in one coil, where the conductor is of HTS material assembled of CORC®s cooled by liquid hydrogen. Considering a large surface ship and a submarine ship of Japanese Maritime Self Defense Forces as targets, three sets of the basic coil component with different size are to be laid on seabed with common center. Magnetic field to deperm ship has to have a time sequence of alternative sign and decreasing intensity from the field to saturate magnetization of steel to zero intensity. Time dependent electric current through the coil conductor causes energy dissipation and large inductance of the coil needs large greater power. On the other hand, the deperming of ship will be required to complete in as short time as possible from the operational necessity. Optimization of power source design is discussed.

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