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M2Or2A-02 [Invited]: Design of MW-Class Ship Propulsion Motors for US Navy by AMSC

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Because of low rotational speed, conventional ship propulsion motors are characteristically large, heavy and have poor efficiency. For direct drive propulsors, the drive motor is in line with the propulsor located at bottom of the ship hull. The V-shape hull usually has limited space for drive motors. Because of this, multiple motors are employed in line to drive a propulsor. Compared to conventional motors, superconducting motors could be 5-6 times smaller and lighter than conventional motor with better overall efficiency. Also compared with a permanent magnet motors, the superconducting motors are 2-3 time more compact and lighter with option to turn off field excitation in event of an internal fault in the stator winding. During the late 1990's, lighter and more compact sub-systems capable of fitting in constricted space on naval ships were sought. Potentially attractive features of superconducting motors encouraged building a single motor capable of fitting within the available space in the hull. To assess suitability of superconducting motors, the Office of Naval Research (ONR) funded AMSC to develop a sub-scale demonstrator (5 MW, 230 RPM) motor. This motor was built with 6-poles with High Temperature Superconducting (HTS) excitation coils and conventional copper stator –no magnetic iron was used inside the machine. Following extensive factory testing, the motor was delivered to ONR in 2003. Later full-load testing was conducted on behalf of the U.S. Navy at the Florida State University in 2004. The motor met or exceeded all design goals. The successful testing of this motor led ONR to award AMSC to build a full-size 36.5 MW, 120 RPM motor. It was successfully tested to full-load at the Philadelphia Naval Surface Warfare Center (NSWC) in 2008. This machine established a record of being the largest motor ever built in a single frame - this record has not been surpassed yet. The machine still resides at the NSWC-Philly.
This talk covers experiences of designing, building and testing these machines and highlights lessons learned.

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