Electrical propulsion system for Navy destroyers

GE’s Power Conversion business supplies high power electrical propulsion system for the latest model of U.S. Navy destroyers.

Futuristic generation of destroyers
The DDG 1000 Zumwalt-class destroyer is the U.S. Navy’s most advanced multi-mission destroyer. It has been developed as a successor to the DD(X) program, which in turn evolved from the DD-21 program.

Designed for surface warfare, anti-aircraft and naval fire support, the ship’s revolutionary technologies extend from its outward appearance to its internal equipment. That external appearance is significantly influenced by the wave-piercing tumblehome hull form, the reverse slopes of the smooth deck, the superstructure and guns. This significantly reduces the radar cross-section, returning much less energy than a more hard-angled hull form. The Navy designed the ship in this way because it wanted a stealth platform that could sail at 30 knots, and it required significant electrical power onboard to support the all electric ship and potential power available for future high energy weapons.
GE’s Power Conversion business became involved with the Navy with a related technology demonstration contract in the late ‘90s when we supplied an Advanced Induction Motor (AIM) and Pulse-Width Modulation (PWM) converter for testing at NAVSSES in Philadelphia, Pa. The DD(X) contract was awarded in April 2002 to a team led by Northrop Grumman, and it originally baseline a permanent magnet machine for the propulsion motor.

More recently, Power Conversion provided a double-flanged AIM to the Navy’s land-based test site in Philadelphia to operate in conjunction with a water brake, as part of a four-quadrant load test facility for testing high power naval machines. The already-proven AIM system originally was a fallback option for the DD(X) program, with the favorite for selection being a more novel, less proven, design at the high power levels required.

First American destroyer to be equipped with electrical propulsion

For a number of technical, risk and program reasons, the AIM solution eventually was selected to be fitted on the first two ships of the class. In July 2007, Power Conversion finalized details with Northrop Grumman Ship Systems (NGSS) for the DDG1000 High Voltage Single System Vendor (HVSSV). The agreement covered the dual lead ships of the class at NGSS shipyard in Pascagoula, Miss., and at the General Dynamics Bath Iron Works shipyard in Maine.

DDG1000 key facts
Operator: U.S. Navy
Shipyard: Northrop Grumman/
General Dynamics
In service: 2015
Length: 600 feet
Displacement: 15,000 tons
Power Conversion is responsible for integration support of the complex power generation, distribution and propulsion systems on board the revolutionary vessels. Equipment supply includes two Tandem AIBs powered by transformer-less VDM25000 PWM variable-speed drives as employed on the UK Navy’s Type 45 Destroyer and Queen Elizabeth Class (QEC) aircraft carrier programs. Also included are high voltage switchboards and harmonic filters. The electric propulsion system is one of the highest power systems of its kind fitted to a vessel of this displacement.

**Scope of work: power and propulsion**
- HV switchboards
- Harmonic filters
- PWM AIB main propulsion motors
- Tandem motor configuration
- 3 converter channels per motor
- System integration support
Benefits of the Integrated Power System (IPS)

- The AIM combines rugged construction with high power density for improved efficiency and availability.

- Transformer-less PWM propulsion converters decrease the volume of the equipment and improve overall system efficiency.

- IPS eliminates gearboxes, thereby removing a source of potential mechanical failures and ongoing mechanical maintenance.

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