Type 45 Destroyer
Daring Class
World’s First Full Electric Propulsion Combatant

The Type 45 Destroyer, Daring (or ‘D’) Class is the Royal Navy’s new state-of-the-art Air Defence Destroyer. The class not only provides a step change in capability, but also truly represents a landmark in power and propulsion. With a 4.16kV system and full electric propulsion fitted to a front line combatant, integrated full electric propulsion (IFEP) has truly arrived in the naval arena. The propulsion system is militarized and has a high power density, with as much propulsion power as is normally found on a ship 10 times the displacement.

The backbone of naval air defense
The Type 45 Anti-Air Warfare Destroyers will provide the backbone of the Royal Navy’s air defenses for the first half of the 21st century, replacing the ageing Type 42s. With state-of-the-art radar, weapons and electric propulsion she is billed as ‘The world’s most advanced warship’.

Six of the class are built; the first of class ‘Daring’, was launched in February 2006 followed by the next five ships: Dauntless, Diamond, Dragon, Defender and Duncan.

The decision making process
A decision conference to review the various propulsion systems proposed for the Type 45 was undertaken in early 2000, involving the UK’s Ministry of Defence, BVT Surface Fleet, GE’s Power Conversion business (then known as Convertteam) and UK industry.

The review compared the Baseline COGAL (Combined Gas and Electric) system with more classical fits as well as Integrated Full Electric Propulsion.

The direct drive IFEP with fixed pitch propellers was selected as the best option in terms of through-life costs, performance and risk, recognizing the fact it would be by far the highest power, most compact, militarized IFEP package to go to sea.

High power IFEP
Although Type 45 is not the highest power IFEP ship at sea, she is by far the highest power relative to the ship’s displacement. A high power contemporary Cruise Liner such as Queen Mary 2 has a power to weight ratio around 0.5MW/1000 Tones, Type 45 has a ratio of 5.5MW/1000 Tones, more than 10x higher, and to a military spec.

Full electric propulsion
Advanced Induction Motor - combines rugged construction with high power density for improved efficiency and availability
Transformerless PWM propulsion converters eliminates bulky equipment and improves overall system efficiency.
IFEP eliminates gearboxes thus eliminating a source of potential mechanical failures and ongoing mechanical maintenance.

The IFEP system selected includes four prime movers, two large advanced cycle gas turbines powering 21MWe alternators and two 2MWe diesel generator sets. All the main power generation is at 4.16kV which also forms the input voltage to the propulsion converters, removing the need for propulsion transformers.

The two main HV switchboards are separated in the vessel and each connects 50% of the generation, propulsion and services in a perfectly symmetrical architecture.

The propulsion power is provided by Power Conversion’s Advanced Induction Motors (AIM) and VDM25000 PWM Converters providing 40MW of highly compact propulsion power without the use of heavy and bulky transformers or gearboxes.

The power and propulsion system is operated from the Ship’s Platform Management System via the Electric Power Management System (EPMS) supplied and fully integrated with the power system by Power Conversion.
Derisking
A well-coordinated set of derisking events formed part of Power Conversion's delivery under the Type 45 Contract. This included full power characterization of the propulsion system in a back to back test undertaken in 2004 in Power Conversion's factory, a comprehensive PMS/EPMS combined test, and Integration testing of a complete half ship set of equipment at Power Conversion's land based test facility known as the Electric Ship Technology Demonstrator in 2006.

HMS Daring undertook her first sea trials in July 2007 and with an initial design target of 28 knots, the ship soon comfortably exceeded 30 knots and was proven to reach top speed in little over two minutes from a standing start, an outstanding performance for a ship of this size. Following a further two Sea Trials in 2008, Daring was accepted by the MoD and handed over to her RN crew in December 2008. Daring sailed from the Shipyard in Glasgow to her home port of Portsmouth, in January before entering service with the Royal Navy towards the end of 2009.

Type 45's high power, high voltage, transformerless, gearboxless, compact, militarized IEP system represents a truly significant milestone in naval propulsion technology.