Executive Summary

In today's DDG-51 Class Destroyer propulsion systems, power is generated by gas turbines which power the propeller shafts through a reduction gear. Ship's service turbine generators convert mechanical energy into electrical power for combat systems and other loads. With the advent of integrated power on DDG-1000 and T-AKE, there is interest in providing the flexibility of an integrated power generation schema to the DDG-51 class. In an Integrated Power System (IPS), the propulsion and auxiliary gas turbines are replaced with a system of gas turbine generators supplying electrical power. All of the power generated by the turbine generators is then sent to a common electrical bus for allocation. Through flexible distribution and switching architecture, the common electrical bus can supply power to both non-propulsion and propulsion electrical loads and optimize gas turbine loading for efficiency. Thus, the power previously reserved exclusively to propel the ship at high speeds is now available for other uses when maximum speed is not required.

Using current technology, a minimally redesigned DDG-51 Flight IIA IPS ship appears feasible. This IPS design reduces the number of gas turbines from 7 to 4. With lighter, high frequency (high pole count) water-cooled generators and permanent magnet propulsion motors, the overall weight increase in the ship preserves as much as 70-80% of the full service life allowance. Although less power is available exclusively for propulsion, the speed requirement of 30 knots appears reachable. IPS increases mission capabilities, specifically electrical power which will allow future projected weapons and sensors to be powered and need the full 20% SLA for electrical load capacity. Future technologies will also likely allow further weight and volume savings making the IPS ship much more flexible in future design iterations.