Propulsion for Marine “Airborne” Vessels: When Ships Fly Across the Sea

Both Surface Effect Ships and Air Cushion Vehicles use lightweight, high power gas turbines to keep them skimming across the water.

CHALLENGE

Design a propulsion and lift system that allows a vessel to “rise above the sea” to reduce drag and increase speed.

SOLUTION

A specially designed system using gas turbines and reduction gear assemblies that can both provide propulsive force and air pressure in a very lightweight package.

RESULTS

Using gas turbine power to create air pressure as well as propulsive force allows vessels and craft of various types to meet high speed requirements and even traverse on land.

OVERVIEW

There is a special class of marine vessels that can travel at high speed while hauling a heavy payload, or simply go where conventional hulls cannot. These vessels are air cushion vehicles (ACVs) and surface effect ships (SESs). What they have in common is the use of air to lift the vessel out of the water. Some like the SES are lifted partially out of the water while the ACV literally rides on top of the water. These vessels (two shown below) all employ this approach to get their cargoes to their destination in the least amount of time. These vessels also use lightweight Vericor TF Marine Gas Turbines in their machinery systems.

The Vericor TF Series Marine Gas Turbine engines were developed specifically to operate in the marine environment, with corrosion resistant components and fully marinized accessories.

These compact powerplants are unique in their ability to be adapted to a variety of propulsion systems. Developing 3000 to 5000 hp, they are ideally suited both for conventional propulsion systems but also systems with unique location requirements or where the space and weight constraints are especially stringent.

Vericor gas turbines have been used to drive lift fans, air pressurization fans and propulsion fans, both separately, and in combined systems. No other gas turbine has been used in as many examples of the these types of systems.

LCACs and other air assisted vessels operate worldwide.

.

Case Study Details and the Advantages of a Gas Turbine Lift and Propulsion System.

A key design feature of the TF engine that allows these types of power trains is full and direct mounting of the gas turbine to the main reduction gear (MRG). This allows a very high degree of design and configuration flexibility. The gas turbine can literally be mounted wherever in space that allows the smallest possible package. The TF gas turbines do not require mounting frames and can literally hung off of the MRG where needed. Furthermore, gear assemblies can accommodate multiple gas turbines and multiple outputs. In the design below, two TF marine gas turbines are driving a gear assembly with one output directed aft to the propulsion fans and one that is directed forward to the lift fans.

On the US Navy LCAC, and simlar craft in service in Korea and Japan there are four gas turbines each mounted to a small right angle turning gear that then directs the power both forward and aft. This fleet of rugged LCACs operate in the worst environment possible.

In other vessel systems, the lift and propulsion powerplants are completely independent,

located as needed in the craft. Because the TF engines are two shaft, free turbine designs, they can be paired with synchronizing clutches that allow engines to be brought on line or shutdown, as needed while the vessel is in operation, maximizing efficiency.

Vericor TF gas turbines are derivatives of flight engines which means they have been designed from the outset for this type of duty and they have literally millions of hours in the air and on the sea.

Vericor is the Original Equipment Manufacturer for the TF and ASE Series marine and industrial gas turbines and provides engineered systems and packages using these engines to customers and operators worldwide. TF engines power high performance fast ferries, megayachts, fast patrol boats and corvettes. There are more TF Series marine gas turbines engines in propulsion service than any other in this size class.