

HYBRIDRIVE[®] COMPOUND HYBRID-FUEL CELL BUS

The BAE Systems Compound Hybrid-Fuel Cell Bus blends energy from three different sources to provide a vehicle that is on a path to zero emissions and also offers improved fuel economy. This technical demonstration vehicle utilizes a heavy duty urban transit bus platform, which includes a conventional Cummins ISB diesel engine, a full suite of electrical accessories, two Hydrogenics HyPM™ HD 12 fuel cells, and a BAE Systems HybriDrive propulsion system featuring nano-phosphate lithium-ion battery technology.

The combination of a fuel cell and a conventional series hybrid propulsion system produces an architecture that occupies the middle ground between a conventional hybrid electric bus and a fully fuel cell powered, zero emissions vehicle. The architecture improves fuel economy and allows the vehicle to operate with significantly reduced emissions while using a relatively low-cost fuel cell power plant. The vehicle requires less Hydrogen than a zero-emissions vehicle (ZEV), allowing the bus to operate where the Hydrogen supply is limited. Under certain conditions, the vehicle can achieve speeds of 25-30 mph while in ZEV operating mode. When the total vehicle power demand exceeds the maximum available power of the fuel cell, the diesel engine starts and provides additional power. Initial vehicle road tests reveal a range of 300-350 miles on a

full fill of hydrogen and diesel fuel economy of in the neighborhood of 10 mpg*.

Vehicle power is provided by a Cummins ISB07, 6.7 liter, 260 hp diesel engine and two series connected fuel cells, delivering a total of 24 kW. The fuel cell's output voltage is boosted by a DC/DC converter that is connected to the 600 V DC propulsion link. This allows the fuel cells to provide the first 24 kW of (base load) power for both propulsion and accessory operation. The BAE Systems HybriDrive propulsion system is a 200 kW series hybrid system containing advanced lithium ion energy storage and an AC traction motor that provide smooth acceleration, regenerative braking, and increased fuel economy. The vehicle also includes a suite of electric accessories powered by the HybriDrive accessory power supply; making it a fully-electrified vehicle that can operate with the diesel engine shut off.

Frequently Asked Questions

Q: Can the vehicle operate on fuel cell power only?

A: Yes. The vehicle can operate in three different modes: fuel cell only, engine only and both fuel cell and engine operating.

Q: Does the vehicle require a 260 hp engine?

A: No. A smaller engine is possible considering the additional base power provided by the fuel cell.

Q: What is the advantage of having two power plants?

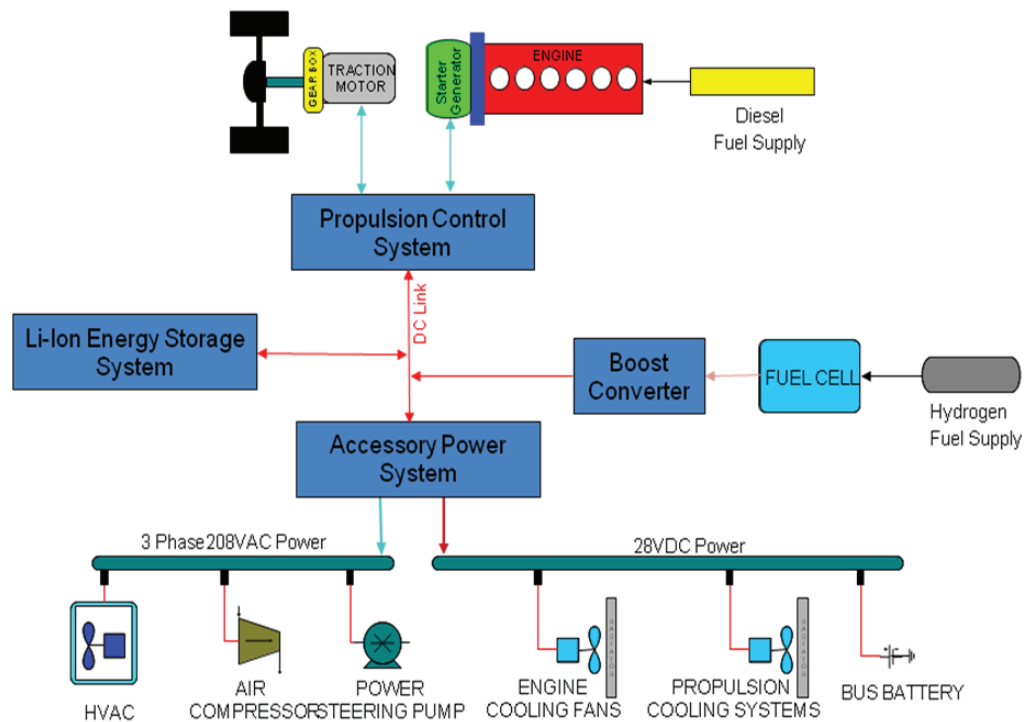
A: The combination of a smaller, lower cost fuel cell power plant and an internal combustion engine aims to provide a significant fossil fuel economy improvement and emissions reductions and to achieve the reductions at a lower cost.

* Estimated value based on limited testing



HYBRIDRIVE® COMPOUND HYBRID-FUEL CELL BUS

BAE Systems Compound Hybrid-Fuel Cell Bus facts	
Bus chassis	Daimler Buses North America, Orion VII
Model year	2008
Length/width/height	40 ft/102 in/11 ft, 7 in
GVWR	42,540 lbs
Drive system	BAE Systems® series hybrid-electric propulsion & power system
Electric propulsion	HybriDrive® AC induction traction motor 200 kW
Powerplant	Cummins ISB07, 6.7L, 260 HP powering a HybriDrive® 200 kW PM integrated starter/generator; two hydrogens HyPM HD 12, 12 kW each (24 kW total)
Accessories	Electrically-driven engine cooling, air conditioning, power steering, air compressor and 24V dc supply
Fuel/storage	Diesel fuel, 120 gallon tank; gaseous hydrogen, 32 kg at 350 bar, type III tanks
Energy storage	HybriDrive® lithium-ion energy storage system, ±200 kW peak
Range	300-350 miles**
Emissions	Path to zero emissions



** Range to be confirmed during simulated revenue service testing

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