

HYBRID ELECTRIC VEHICLE DESIGN, FABRICATION, AND TEST

Program Capabilities:

SwRI was presented with a concept drawing of a hybrid electric vehicle system from which SwRI generated several different mechanical packaging configurations with different bearing, cooling and motor sizes in order to develop an optimal system for installation in the space allotted. All auxiliary pumping and cooling system requirements were determined by SwRI and commercially available components were selected, and integrated into the vehicle.

For the design phase, a vehicle model was created with the architecture of the proposed hybrid system. The hybrid vehicle model was exercised over numerous driving cycles to establish optimum motor, power electronics and battery size. SwRI focused on the energy storage system examining 12 different system schemes consisting of various combinations of battery types, number of batteries, ultracapacitors, and dc/dc converters coupled in series and parallel to determine an optimal system, based on voltage levels, state of charge, temperature effects, durability, volume, weight, cost and technical risk.



To further evaluate the hybrid system performance, ten different hybrid driving cycles were developed to challenge the system. State diagrams were developed to include conventional interrelated vehicle systems such as air conditioning, power steering, power brakes, lights and ignition switch.

Algorithms were developed for the master system controller. The controller was fabricated and tested using computer simulation, auto code generation, hardware-in-the-loop and system integration. Five prototype controllers were fabricated. The hybrid system controllers were progressively tested with higher levels of system interaction. The testing included sub-system testing, no-load spin testing, engine-driven eddy current and inertia wheel testing using a dynamometer test cell, chassis dynamometer testing, emissions, noise and vehicle performance testing. Testing was conducted on nine different test stands and venues over 430 hours and 1,600 miles.

In addition to designing, fabricating and testing the system, SwRI performed all vehicle integration functions necessary to install the system in the vehicle. This included installing all hybrid electric components, cooling systems, electrically operated engine accessories, master controller, pressure transducers, thermocouples, current sensors, voltage sensors along with signal and control wiring.

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