

# STARTER-ALTERNATOR HYBRID ELECTRIC

## Program Capabilities:

This project involved the implementation and integration of a combined starter-alternator into an SUV. SwRI was responsible for the installation of the starter-alternator and associated drive system onto the engine. Because the alternator was also required to provide the starter function and its associated engine starting torque, the belt and pulley system was completely redesigned and hardware fabricated to handle the increased torque. SwRI then developed a full authority controller that seamlessly integrated the functions of the following controllers:

- Engine
- Automatic Transmission
- Alternator-Starter
- Battery Management

SwRI was tasked to implement the operating philosophy of this system which shutdown the engine when the vehicle speed was stationary without turning the key to the engine off position. The engine was then restarted when the driver released the brake pedal. In order for SwRI to implement this off-engine strategy, a significant amount of interrelated engine, transmission, accessory, display and diagnostic signals, and control functions had to be overridden. To make the vehicle operational, these signals had to be made active when the engine was shutdown, or made immediately available when the pedal was depressed. Literally hundred's of such signals and diagnostics functions were dealt with.

At the completion of the project the hybrid electric vehicle operating strategy worked flawlessly. When the engine startup function was requested by the driver, the engine startup function was immediate and totally transparent to the driver. The shift feel characteristics during launch were very comfortable and linearly increased with throttle position. Vehicle feedback to the driver was excellent and no instrument panel lights were illuminated. Most importantly, the vehicle demonstrated a cost effective energy saving through implementation of an engine off strategy coupled with regenerative braking.



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