Hybrid 320 Ton Off Highway Haul Truck: Quarterly Technical Status Report 10, DOE/AL68080-TSR10

This tenth quarterly status report for the Hybrid Off Highway Vehicle (OHV) project, DOE Award DE-FC04-2002AL68080 presents the project status at the end of March 2005, and covers activities in the tenth project quarter, January– March 2005.

Project Management

As of last quarter, the demonstration of the vehicle at the Proving Grounds of Komatsu was planned for November 2005. This date will likely slip into early 2006 as both General Electric and Komatsu have needed to allocate engineering resources to urgent customer requests. These request have delayed the project by three months. Weekly teleconferences and monthly visits to Komatsu / GE are working to keep all parties involved with the design process and truck integration.

To supplement General Electric engineering resources, an outside contractor has been secured to assist with development and testing in Erie as well as truck integration at the Proving Grounds. The contractor is scheduled to start working with GE during the first week of May and will remain on the project through its completion.

Technical Status

Full-scale testing

The full-scale static test equipment is installed. All twelve ZEBRA Z12 batteries have been installed and the CAN communication bus for the battery system has been tested. CAN cards for the Propulsion System Controller (PSC) have been installed and are operational. These cards allow the truck control system to communicate with the battery system status parameters such as temperatures, status of charge, etc.

During initial power-up, one BMI suffered a failure due to reversed polarity on the power supply. A replacement and spare will be ordered and installed. The system can be operated with 11 batteries while the BMI replacement is procured.

Full power testing is expected to begin shortly and will proceed in parallel with the design and fabrication of the on-truck battery enclosures.

Truck Integration

Final design reviews of the battery enclosures and mounting structure are pending and expected to be completed in May. The battery and control enclosures are being designed through GE Rail in Erie. Komatsu is designing all mounting means and structural additions to the vehicle. Integration of components on the vehicle is expected to begin in July. Approximately two months will be allocated for complete installation, wiring, and testing of the components followed by system testing and control algorithm development and test.

Life testing

MES-DEA, manufacturer of the ZEBRA battery, has been actively testing ZEBRA cells, as they will be applied in the demonstration vehicle. Two operating points are being investigated: a nameplate operating point, and a high charge power operating point. The test measures charge resistance and discharge resistance at critical portions of the profile. Resistance rise will be the dominant factor in determining useful life of the battery system. Excessive resistance will limit the power rating of the system and generate excessive heat causing decreased hybrid benefits and thermal failures of cells.

The normal operating point utilizes the ZEBRA battery at 32kW per Z12 for 384kW total hybrid system power. The test applies the power we expect to see from the Proving Ground demonstration route as calculated by GE's mission analysis model. The test has successfully reached 710 nameplate cycles (9750 OHV cycles, or about 6 months time) with minimal resistance rise.

The normal operating point test experience two more cell failures. The failure mode of both cells was identical to the first cell failure in this test, reported in the last TSR. The failures were due to mishandling after production of the cell and prior to installation in the test stand. The cell was tipped and caused a current concentration that fractured the cell. Post-mortem analysis clearly shows the fault mode and current production practices virtually eliminate any chance of this failure mode occurring in production cells.

The high charge power test operates at 50kW per Z12 for a 600kW total hybrid system. This test has achieved 3,000 OHV cycles, however, the resistance less stable during the testing and is showing that the higher power charge operating point is near the limit of the cells. Testing continues to better understand operation in this new application of ZEBRA technology.

In addition to the electrical characteristics of the cells, a vibration test of the battery is planned at GE Rail in Erie, PA. The vibration test will be an accelerated test to gain knowledge of how the battery will perform on the vehicle. The OHV has many vibration sources, primarily from the engine but also from tire lug vibration and loading shocks. This test will better define the suitability of ZEBRA batteries in the OHV.