Solutions to Improve Battery Safety in Heavy Vehicles

Keeping bus passengers safe: Impacts of battery failure can be mitigated through proper venting and packaging

San José, Calif., Monday, October 24, 2016 — The future of mass transportation is clearly moving towards increased use of hybrid and electric vehicles. With the introduction of high-power/high-energy storage devices such as lithium ion battery systems serving as a key element in the system, valid safety and security concerns emerge. This is especially true when the attractive high-specific-energy and power-chemistry lithium nickel cobalt aluminum oxide (NCA) is used. NCA chemistry performs well but presents a safety and security risk when used in large quantities, such as for a passenger bus. If triggered, the cell can completely fuel its own fire, and this triggering event occurs more easily than one may think.

Researchers at the Mineta National Transit Research Consortium, led by principal investigator Timothy Cleary, partnered with advanced chemistry battery and material manufacturers to study the safety concerns of NCA batteries for use in transit buses. The research team ran various experiments and triggering events were tested at both the battery cell and module level, including overcharge, short-circuit, nail puncture, and crash scenarios. An investigation into packaging materials was also performed during these tests to help determine the response of a full battery system. Results are documented in the *Safety of Lithium Nickel Cobalt Aluminum Oxide Battery Packs in Transit Bus Applications* report.

According to lead author, Mr. Cleary, the "findings indicate that when considering the use of an NCA battery system in a transit bus application, material and structural design is critical to keeping passengers safe. Common plastics such as acetal and PET have acceptable structural properties, but their swift and sustained combustibility under the high temperatures of a nearby thermal event poses a risk of rapid and severe events."

Ultimately, say the researchers, "the greatest safety concern when using high-energy, NCA batteries is ensuring passenger safety when a cell's electrolyte boils and causes the ventilation of high-temperature toxic material." Though no system is perfect, a properly functioning and intelligent battery management system with redundant voltage measurement and real-time internal temperature modeling or a virtual sensor should be mandatory to avoid cell-venting events. In addition, following a venting event, the large format battery cells can remain at extremely high temperatures for long periods so appropriate cooling mechanisms are essential as part of crash or incident recovery and system design.

ABOUT THE RESEARCH TEAM

Timothy Cleary, MS, directs the Battery Application Technology Testing & Energy Research Laboratory (BATTERY) at the Larson Institute at Penn State. **Marc Serra Bosch** (previously a BATTERY research assistant) is a project engineer at ESI Group. **James A. Kreibick** (previously a BATTERY research assistant) is an electrical engineer at McKean Defense. **Joel R. Anstrom, PhD,** directs the Hybrid and Hydrogen Vehicle Research Laboratory and the DOE Graduate Automotive Technology Education Program at the Larson Institute at Penn State.

ABOUT THE MINETA TRANSPORTATION INSTITUTE

The Mineta Transportation Institute (MTI) conducts research, education, and information transfer programs regarding surface transportation policy and management issues, especially related to transit. Congress established MTI in 1991 as part of the Intermodal Surface Transportation Efficiency Act. MTI won national re-designation competitions in 2002, 2006 and 2012. The Institute is funded through the US Department of Transportation, the US Department of Homeland Security, the California Department of Transportation, and public and private grants. The internationally respected members of the MTI Board of Trustees represent all major surface transportation modes. MTI, the lead institute for the nine-university Mineta National Transit Research Consortium, is affiliated with San Jose State University's Lucas College and Graduate School of Business. Visit transweb.sjsu.edu

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