Nondestructive Battery Evaluation Laboratory (NOBEL)

Vibration table, containment units simulate real-world stress to test batteries for durability

Two chemical storage units are available to test vehicle batteries for resilience in various conditions of temperature and humidity.

As hybrid, plug-in hybrid and electric vehicles continue to gain acceptance, automakers and battery manufacturers looking for better performance have turned to the U.S. Department of Energy's Vehicle Technologies Office and Idaho National Laboratory to gather data on reliability and durability. For this purpose, highly specialized equipment has been installed at INL's Nondestructive Battery Evaluation Laboratory (NOBEL), allowing researchers to study in detail how batteries perform in aggressive environments.

Temperature and excessive vibration are two factors that affect a battery's ability to discharge consistently over long periods of time. INL researchers are now equipped with state-of-the-art technology that allows them to push energy storage devices to levels of stress short of catastrophic failure and to gather information about long-term performance prospects.

VIBRATION TESTING

Vibration testing has been used for decades in the automotive and aerospace industries to gather information on the reliability of components. A device under test (DUT) is securely mounted on a

Securing a sample for testing on the Brüel & Kjær LDS V8-640 SPA56k Hydrostatic Bearing Slip Table.

Idaho National Laboratory

Vibrations from the hydrostatic slip table can be measured down to very small frequencies.

The view from inside one of the chemical storage units being used to test battery reliability.

shaker table or actuator, which may be operated by hydraulic or electrodynamic force. A signal source drives the amplifier, and an accelerometer measures the vibration response of the DUT. The signal source usually attempts to simulate the real-world environment in which the test article will operate. The most commonly used methodologies are:

- Sine sweep, in which the frequency is swept back and forth with amplitudes corresponding to the desired test levels.
- Random testing, in which the frequency spectrum is shaped to represent the environment in which an article will operate.
- Classical shock testing, in which an article is subjected to one or more high-level shock pulses (similar to a one-time drop that might occur in shipping).

INL has a vibration test station to test mechanical durability based on accepted standardized test protocols and the ability to develop new vibration procedures.

Since early 2016, NOBEL has been home to a Brüel & Kjær LDS V8-640 SPA56k Hydrostatic Bearing Slip Table. Measuring 6-by-8 feet, this vibration system is capable of achieving all of the short-duration random vibration tests for vertical, longitudinal and lateral measurements that would be experienced during operation of a light-duty vehicle, including the ability to perform vibration and electrical testing of the battery in parallel. In one test, driving data from a variety of road conditions was simulated and condensed into a single 96-hour test. Bracketing allowed researchers to pinpoint resonant frequencies most likely to affect voltage levels.

MILDY AGGRESSIVE TESTING CONDITION ROOMS

NOBEL has installed two SUPERloc four-hour fire-rated chemical storage units, used to test vehicle batteries for resilience in various conditions of temperature and humidity. Made by U.S. Chemical Storage, typically for outdoor storage of hazardous or "energetic" materials, these custom-designed units come equipped with sprinkler systems, 180-gallon sump pumps and 2,000-gallon runoff tanks. They have a four-hour fire rating and are rated for Category C seismic events.

TESTING TO STANDARDS

The work at NOBEL covers multiple disciplines: electrochemistry, materials science, mechanical and electrical engineering. The unified goal is aggressive, real-life, nondestructive battery testing. In addition to batteries, ultracapacitors and other electronics can be tested to standards for their applications. One goal is to develop diagnostics, prognostics, assessment and validation methods that can be used by industry and other national laboratories to determine where gaps and limitations in technologies exist to shorten the path to commercialization.

FOR MORE INFORMATION

Technical contact
Tanvir Tanim
208-526-5713
tanvir.tanim@inl.gov

General contact
Abby Todd
Communications Liaison
208-526-6166
abby.toddbloxham@inl.gov

www.inl.gov

A U.S. Department of Energy National Laboratory

20-50443-016-R2 (Updated: 2021)