## BETTER BATTERY STORAGE



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The United States Navy, along with the rest of the armed forces, has long had an immense energy need. With new technology on the rise, the demand for power and energy is constantly growing. Lithium-ion batteries have become the enabling technology to address these power and energy demands to support surface, undersea, air and ground requirements. Lithiumion batteries also bring inherent risks of fire and explosion hazards if handled incorrectly, and therefore, containment strategies are critical to their successful deployment.



This photo shows the aftermath a battery burn demonstration with no containment. The battery burn demonstration took place Nov. 4, 2021, at Aberdeen Proving Ground, Maryland. (Photo courtesy of Thomas Hays)

During recent local area assessments, we found many instances of lithium-ion and alkaline batteries and waste batteries being improperly stored. Units have assumed high fire and explosion risks by storing the two different types of batteries together, not properly taping up and labeling used batteries, not properly turning in used batteries, and keeping batteries on hand in unit spaces more than 30 days.

The concept of container solutions provides both transportation and storage functionality and ensures risk reduction in the event of a battery casualty. For the last several years, Naval Surface Warfare Center Carderock Division, Maryland, has tested commercial and government-designed container solutions, developing different container storage methods to reduce platform risk associated with transporting lithium-ion batteries.

Battery containment is not a new concept. For more than a decade, battery testers evaluated the heat and gas released from high-energy, dense lithium batteries intended for transport on amphibious assault ships. The data was used in the development of the Lithium Battery Facility, which was specially designed with separated lockers, ventilation and fire suppression systems specifically to store, transport and manage the lithium-ion batteries within a compartment. The container was also equipped with dual-trigger smoke and heat detectors, gas extraction systems and water suppression. Testing demonstrated that a battery casualty could be contained to a single locker. The division's Battery Certification and Integration Branch has designed two container solutions. The most notable one is the Charging-capable Lithium-ion Autonomous Safe Storage Interservice Container, also known as CLASSIC.

The CLASSIC container weighs in at about 2,000 pounds and was created as a solution to transport aggregated small lithium-ion batteries safely by air. CLASSIC incorporates the Universal Battery Charger, sensors capable of detecting a battery casualty, active fire mitigation agent and passive mitigation measures to prevent propagation of failure to other batteries stored within.

Thomas Hays, a materials scientist in Carderock's Expeditionary and Developmental Power and Energy Branch, led a battery burn demonstration using the CLASSIC at the Aberdeen

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Proving Ground, Maryland, in November 2021. Hays' demonstration showed the severity of a potential fire when batteries are not stored properly. Navy and public testing have demonstrated water and some aqueous fire suppressant agents to be effective against lithium batteries. Lithium and water reactions are typically minimal due to the relatively small quantity or absence of metallic lithium as a battery component, the compartmentalization of lithium within individual cells and the quantity of organic solvents and other flammable material as the predominant fuel. Water may not be appropriate when other hazards such as high voltage are present. Also, cell voltages are high enough to drive electrolysis-creating hydrogen, which is concern for hydrogen detonation in confined or poorly ventilated spaces.

In addition to being good at containing fire, the CLASSIC system is robust, so it can help protect the batteries from damage. The CLASSIC is good at what it does, but it is very large, so units would need other containers for certain situations. Ultimately, the overall goal is for decision-makers to understand the need for new transport and storage containers, provide funding



The Charging-capable Li-ion Autonomous Safe Storage Interservice Container (CLASSIC), was developed at Naval Surface Warfare Center, Carderock Division, Maryland, and is a 4-foot by 5-foot, 4-foot tall container weighing just under 3,000 pounds. (Photo courtesy of Thomas Hays)

to support the new containment units, and continue to support research for new power source technologies.

More efforts will look to address modular container strategies as a streamlined set of solutions within the Navy, particularly in aviation. The intention of the container is to cover a large range of lithium batteries and capabilities, and containment units like the CLASSIC system could decrease the risks associated with handling, servicing and storing aviation batteries; however, aviation unit personnel must be educated in the established procedures of handling, storing and disposing of both lithium-ion, alkaline and lead-acid batteries, and everyone must adhere to established policies and procedures.

Cover: Fire and smoke flare up during a battery burn demonstration Nov. 4, 2021, at Aberdeen Proving Ground, Maryland. Thomas Hays, a materials scientist in the Expeditionary and Developmental Power and Energy Branch at Naval Surface Warfare Center, Carderock Division, Maryland, conducted the demonstration to show what can happen when lithium ion batteries catch fire if they are not properly stored. Hays' team developed the Charging-capable Li-ion Autonomous Safe Storage Interservice Container, or CLASSIC, to contain lithium ion batteries onboard ships and aircraft in order to prevent hazards. (Photo courtesy of Thomas Hays)