

NAVY APPROACH TO LARGE LITHIUM BATTERY SAFETY ON SHIPS

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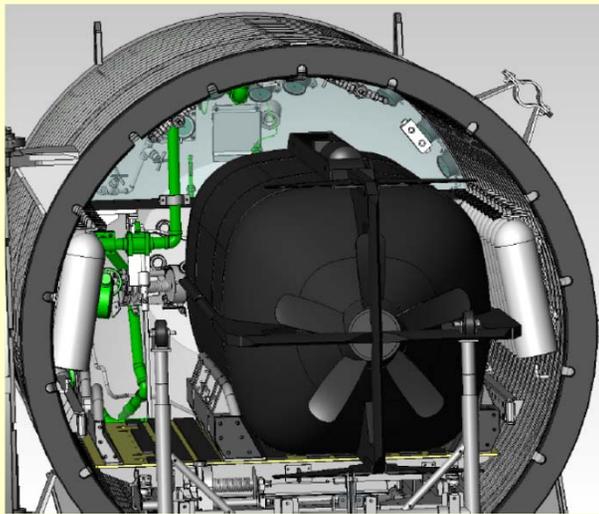
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The Navy's Energy Storage Challenge

- Overwhelming demand for new system concepts such as unmanned vehicles and directed energy weapons require ever higher energy densities in order to be viable.
- The Navy has had some very expensive and near catastrophic failures of large lithium batteries (e.g. Advanced Seal Delivery Vehicle fire in 2008)
- The demand signal for high density energy is not going to go away – it will only increase with new weapon concepts.
- The Navy in 2010 realized it needed a new approach and a fundamental reassessment to how we ensure safety.

Platform Impacts From High Energy Density Chemical Power Source Casualties

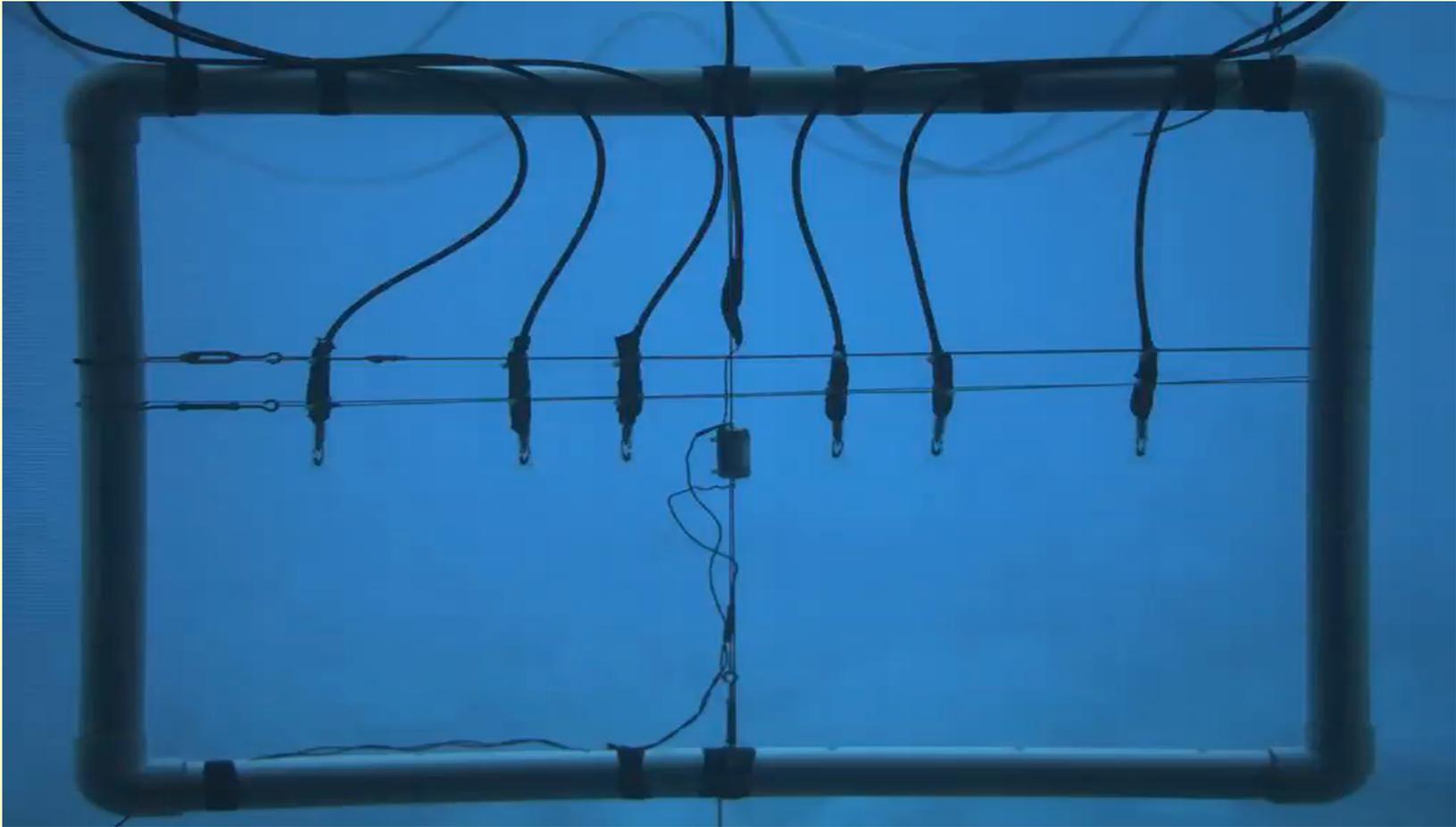
Platforms often have limited access and available space to manage a battery casualty (e.g. torpedo room)



DDS/hyperbaric chambers/diver support areas, etc, have limited ability to manage atmosphere quality in closed volumes

Weapon rooms, well-decks and hangars are particularly susceptible to battery casualty events due to proximity to other energetics





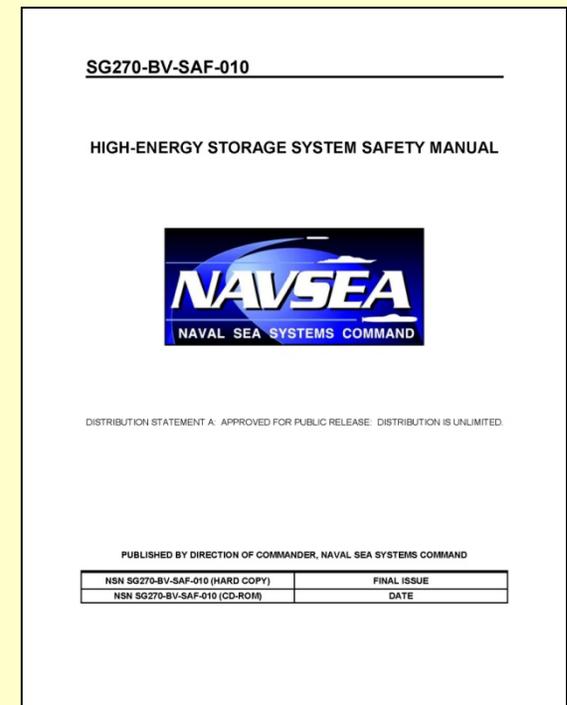
Basis For a New Safety Approach

- “Maximum Reasonable Assurance” against serious personnel and platform casualties
- Batteries and fuel cells cannot be made risk free – need to consider effects of casualty on platform and personnel
- Need to verify risk mitigations work correctly before going to sea
- Need to combine battery/fuel cell expertise with ship design expertise to come up with effective and affordable risk mitigations
- Need an independent system safety advocate similar to Submarine Safety Program or Weapons Safety Program



What is NAVSEA's New Safety Assessment Process

- Requires involvement of System Developer, Program Sponsor, Ship Design Manager, Technical Area Authorities, and battery technical experts to collaborate to effectively deal with risk.
- Preliminary Hazard Analysis (PHA) taking shipboard environment into account.
- Using PHA as a basis, develop risk mitigations where needed. Can be hardware or procedural.
- Develop a Test Plan that will validate assumptions on battery mishap behavior and verify mitigations are effective.
- Safety Program Manager verifies all PHA mitigations and Test Plan are executed prior to concurring with at-sea use of system.



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