EAGLEPICHER TECHNOLOGIES

Cylindrical pack design using non-metallic cell capture for JSC-20793 compliance

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- Updated cylindrical pack design using non-metallic cell capture for JSC-20793 compliance

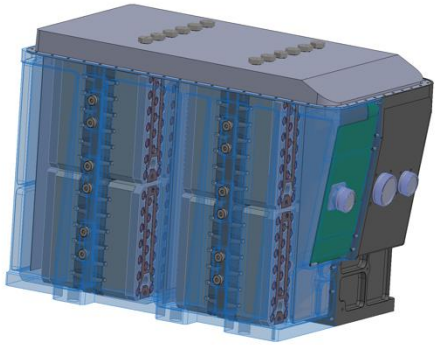
- The advent of higher voltages and higher power systems for either NASA Crew Space requirement or high reliability requirements have driven changes in COTS cell pack construction. These changes require multiple parallel cell groups arranged in series in one module. Prior design has been based on have a metallic lower capture plate which while plating can provide isolation along with other methods the risk for series cell can shorts is high. Changing to a non-metallic capture plates the electrical isolation can be provided by the material and still have the required thermal conduction to remove the heat generated by a cell in thermal runaway.

Topics

- Review of existing state of design
- Recent tests of existing state
- Why the design evolution
- Overview of the changes
- Images of the completed module
- Abuse test video
- Test data
- Where do we go with this solution

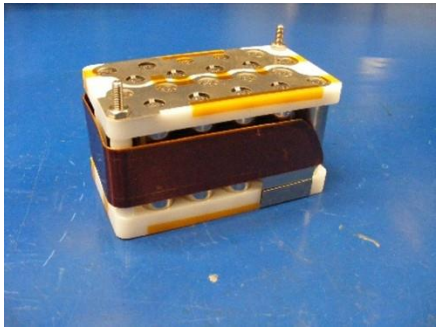
Present design

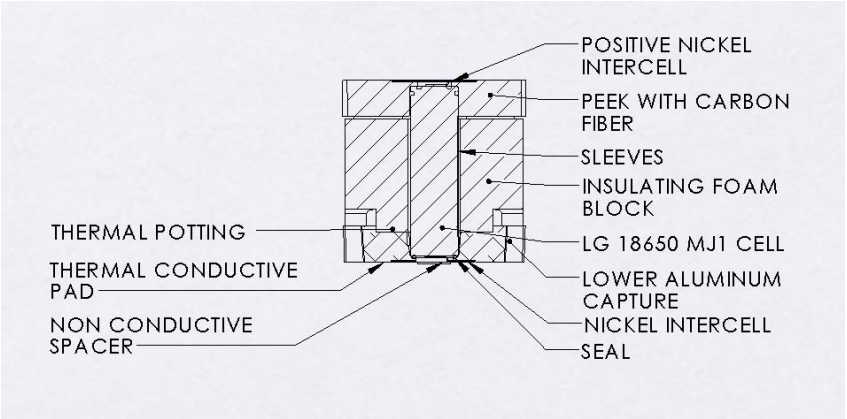
- The present proven design consists of the following materials:
  - Aluminum Lower Capture plate
  - Thermal transfer material between cell and lower capture plate
  - Cell wall sleeves (carbon fiber or Mica)
  - Syntactic Foam cell stack separator
  - Peek Upper capture plate
  - Adhesive to hold cells to lower capture
  - Fasteners to hold the pack together
  - Individually fused cells



Existing Design

- Cross section
- Used on Orion and other Crew space projects





Existing Design Post Battery Abuse

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Next Step

- 120V Crew rated craft voltages 32 series strings
- Lower capacity applications requiring fewer parallel cells
- Need for packs with multiple groups of parallel cells in series
- Solutions for both energy and power
- Peak power requests >120A with low capacity < 5kWh
- Handled by Astronauts or in their environment (JSC-20793 compliance)
- Packs with > 2 series stings with thermal management and mitigation for Thermal runaway

Goal of the project

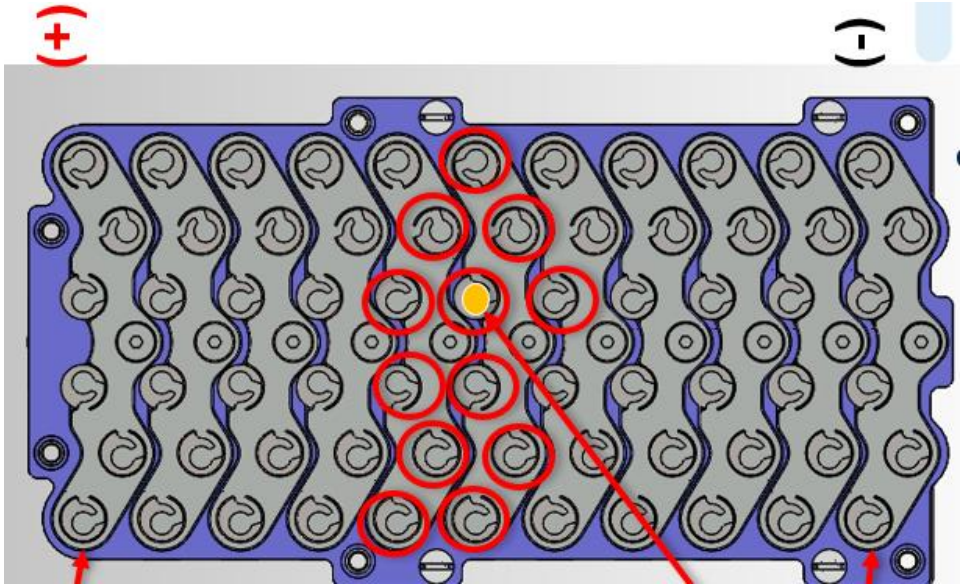
- Develop a cylindrical cell pack design that provides:
- Redundant Electrical isolation between strings
- Thermal conductivity to an external to the pack thermal mass/cooling
- Ability to handle Power Cells operating to 15C levels under pulse loads
- Reuse proven materials and components where possible
- The pack solution must work with existing housing, venting, cell monitoring and mitigation technologies
- Solution can not be based on higher cell spacing that drives the battery solution larger and heavier

The Solution

- The updated design consists of the following materials:
  - Peek Lower Capture plate
  - Thermal transfer material between cell and lower capture plate
  - Cell wall sleeves (carbon fiber or Mica)
  - Syntactic Foam cell stack separator
  - Peek Upper capture plate
  - Adhesive to hold cells to lower capture
  - Fasteners to hold the pack together
  - Individually fused cells
  - Cell pack top cover material
  - Intercells welded to cells and then welded to high current capable backers

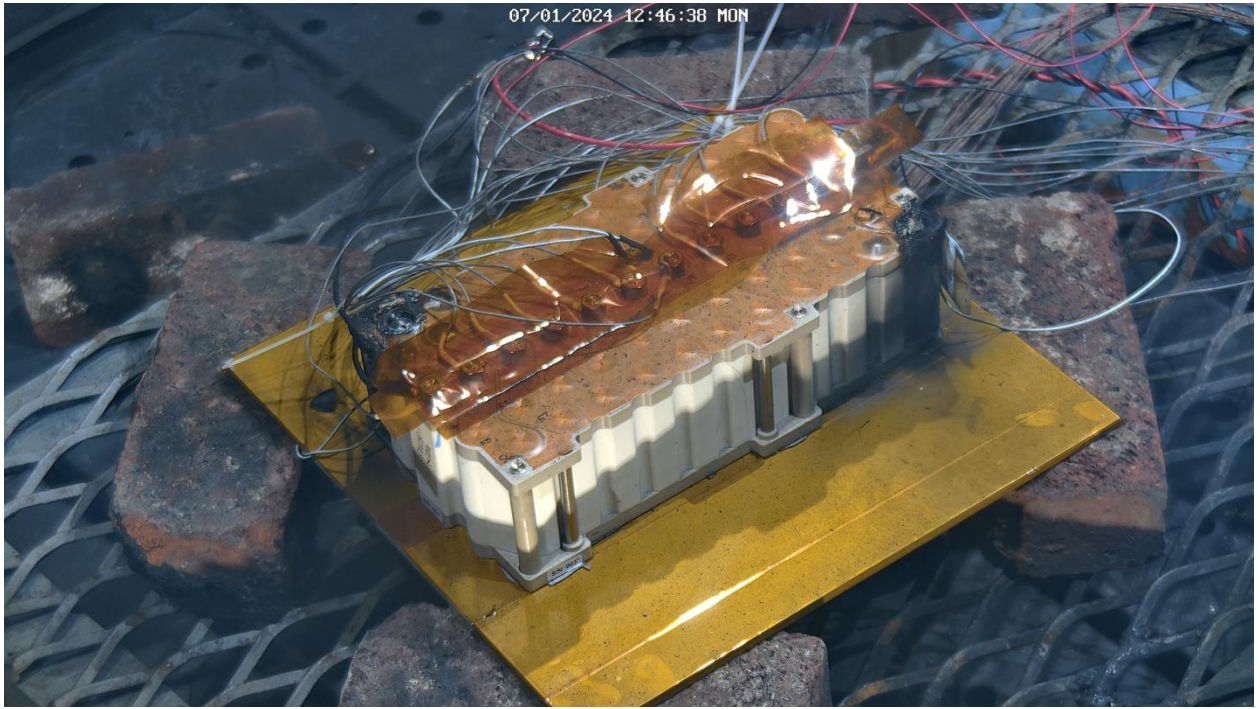
Cell pack Assemble

Test Pack is build with ICS trigger cells with patch heaters surrounded by normal cells with thermocouples

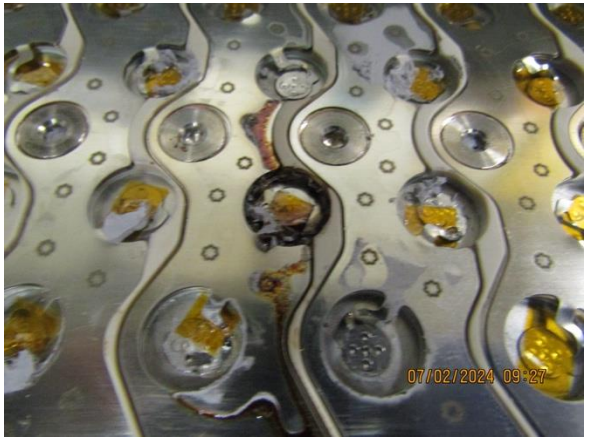


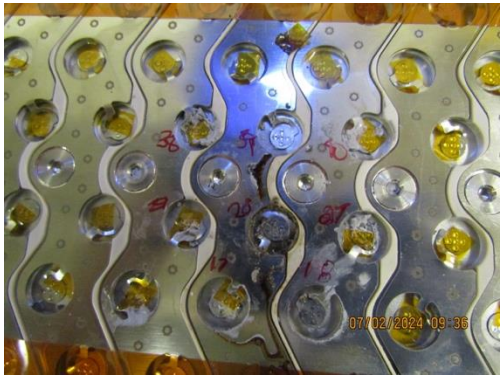
Propagation testing

- Pack setup in test chamber

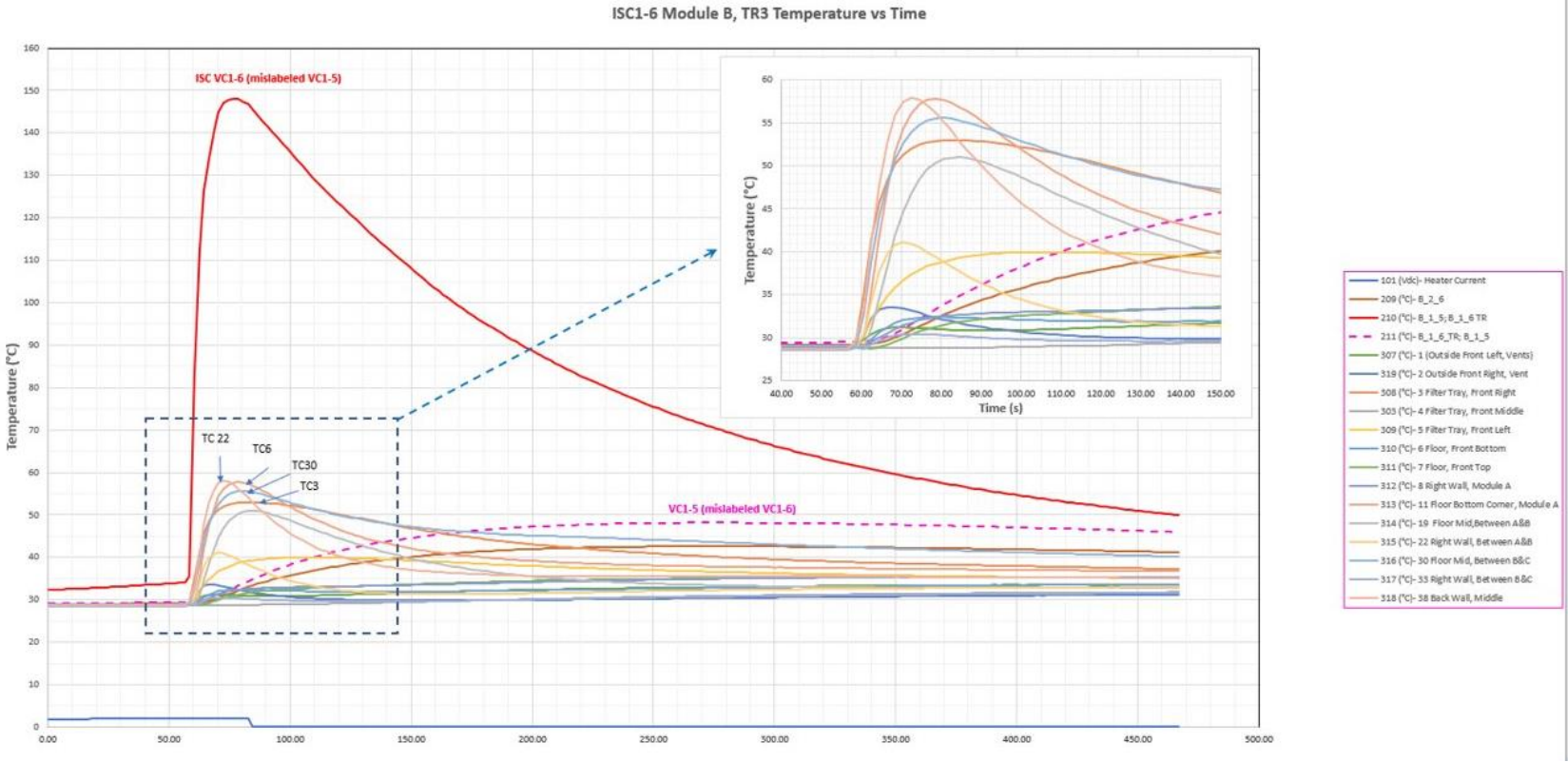


Post Test Image





Temperature profiles



Summary

- The use of non-metallic components within the pack assembly does not imped the ability to meet JSC-20793
- This design ability allows for packs with a higher number of string cells with redundant levels of electrical isolation

Where do we go from here

- Continue to evolve the design of both cylindrical cell packs
- Look at ways to mitigate larger cells with energy densities over 5Ah.

EVOLUTION based on known and proven engineering

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