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Abstract

GS Yuasa is a manufacturer of large format lithium-ion cells for space application with over 5.0MWh deployed with zero on-orbit failures.

Large format cells offer high energy density for demanding applications while also reducing the number of electrical connections required in battery systems compared to approaches using smaller cells. However, a thermal runaway event in a single large-format cell can release substantial energy which can propagate to adjacent cells. Traditionally passive propagation resistance is believed to be difficult to achieve with large format cells.

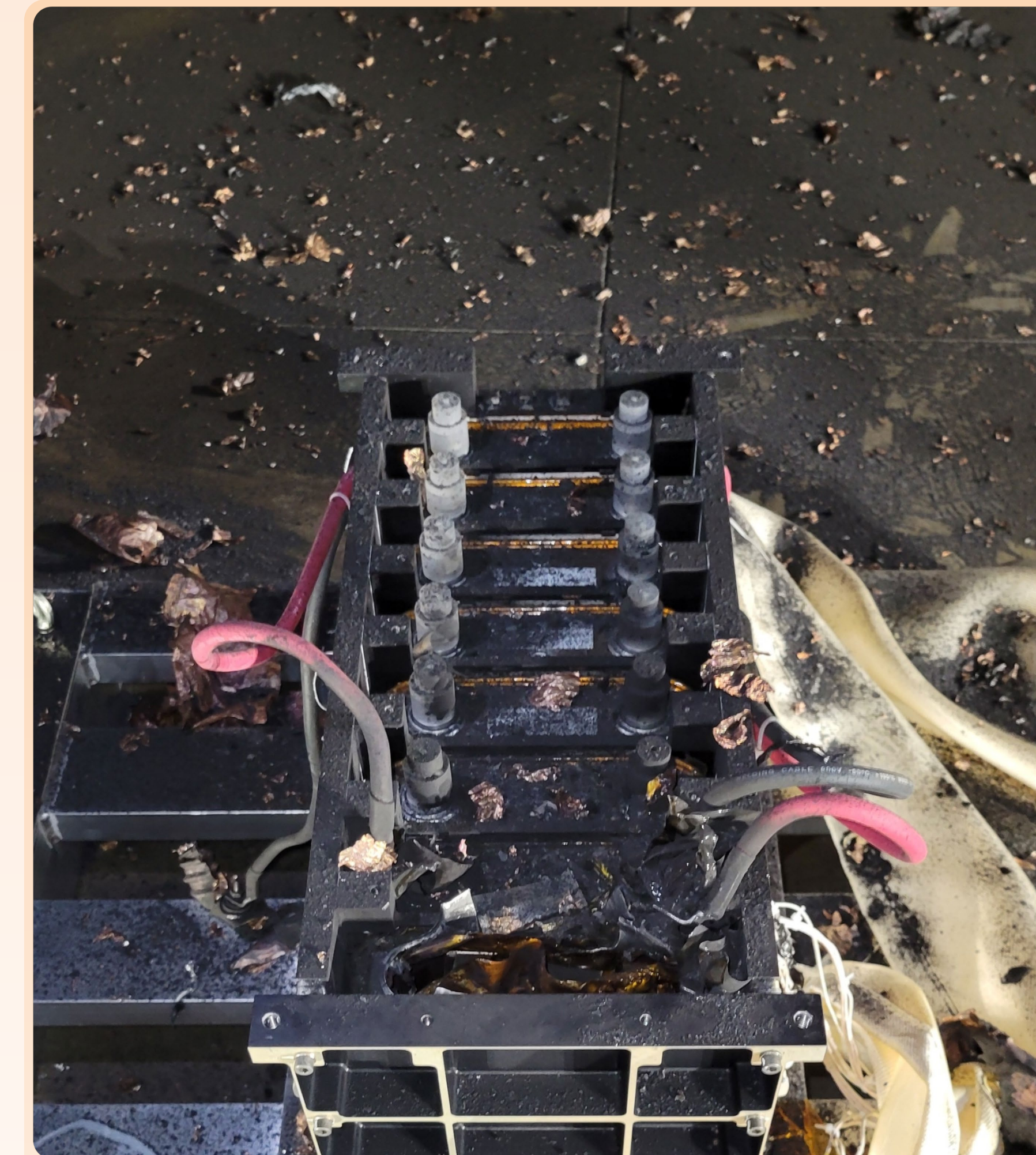
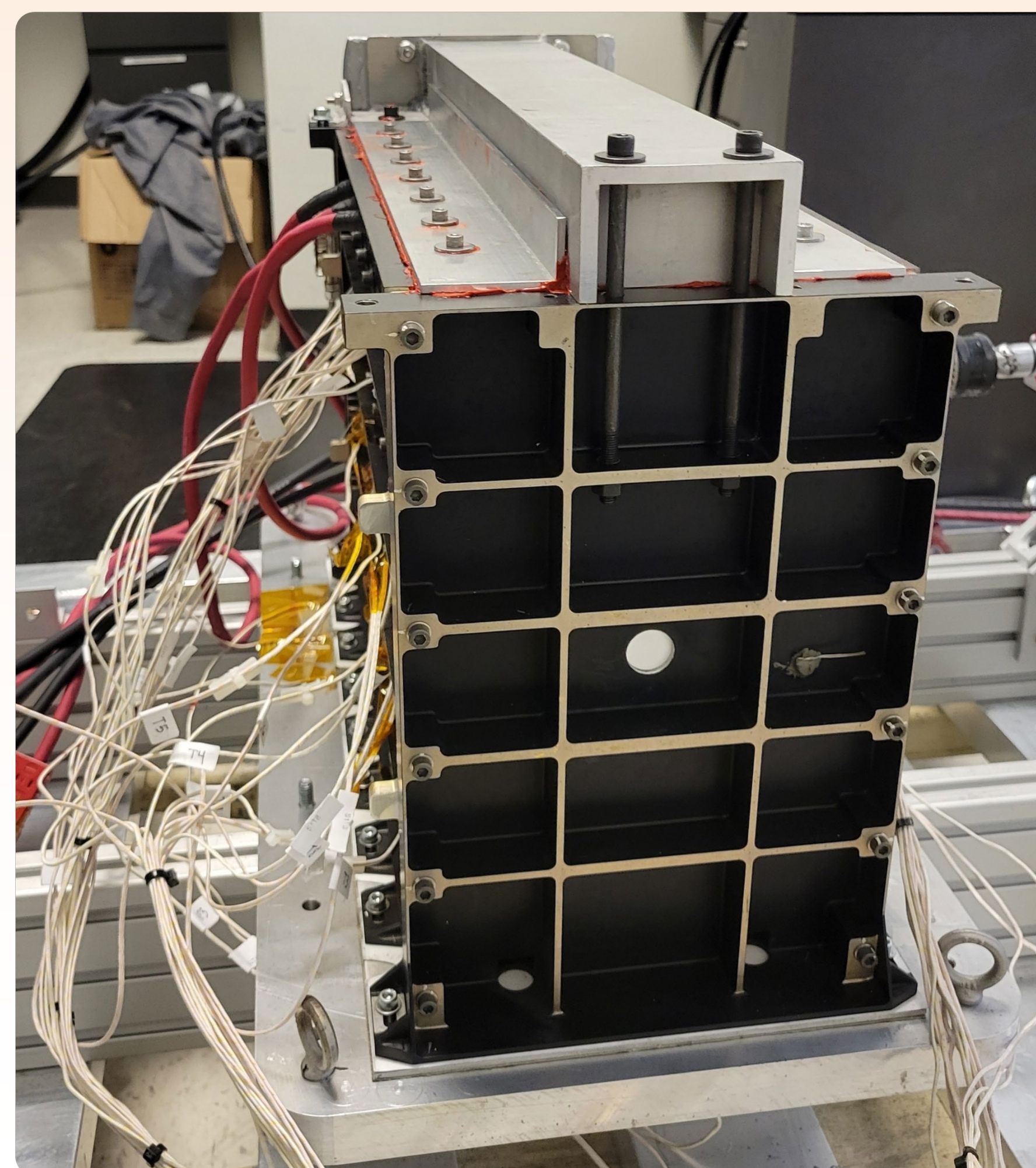
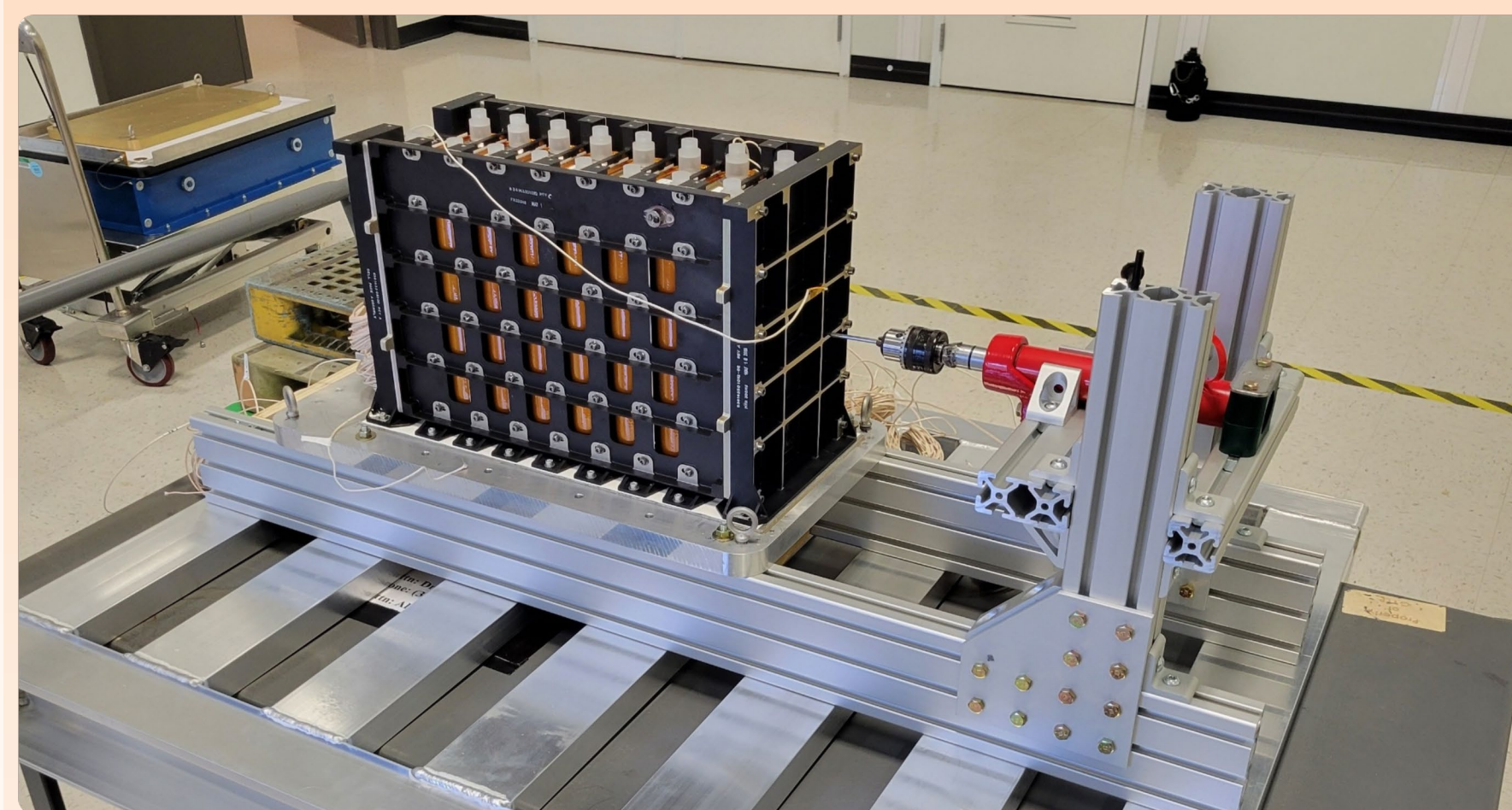
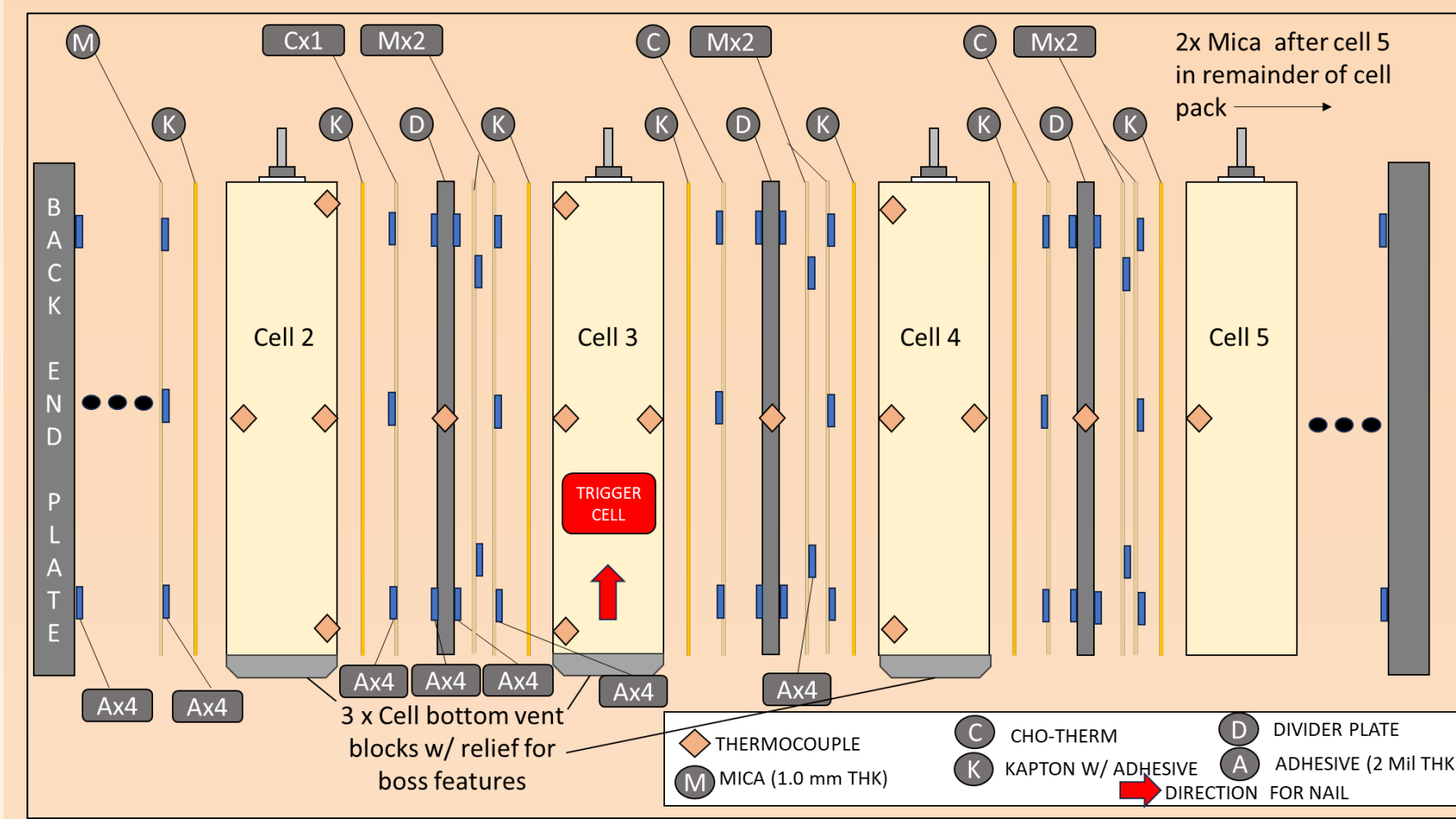
Using relatively straightforward design techniques, GS Yuasa has demonstrated that passive propagation resistance is achievable and ejecta can be collected and directed away from critical components with minimal impact to existing battery designs.

Objectives

Per JSC 20793 Rev. D TR Requirements:

- Only triggered cell achieves Thermal Runaway
- Other cells in the battery are not damaged, vented, ignited or leaking electrolyte, the CIDs, PTCs and/or fuses have not triggered
- Neighboring cells can be cycled within +/- five percent of pre-test capacity
- No flames exit the battery enclosure

Test Configuration and Apparatus

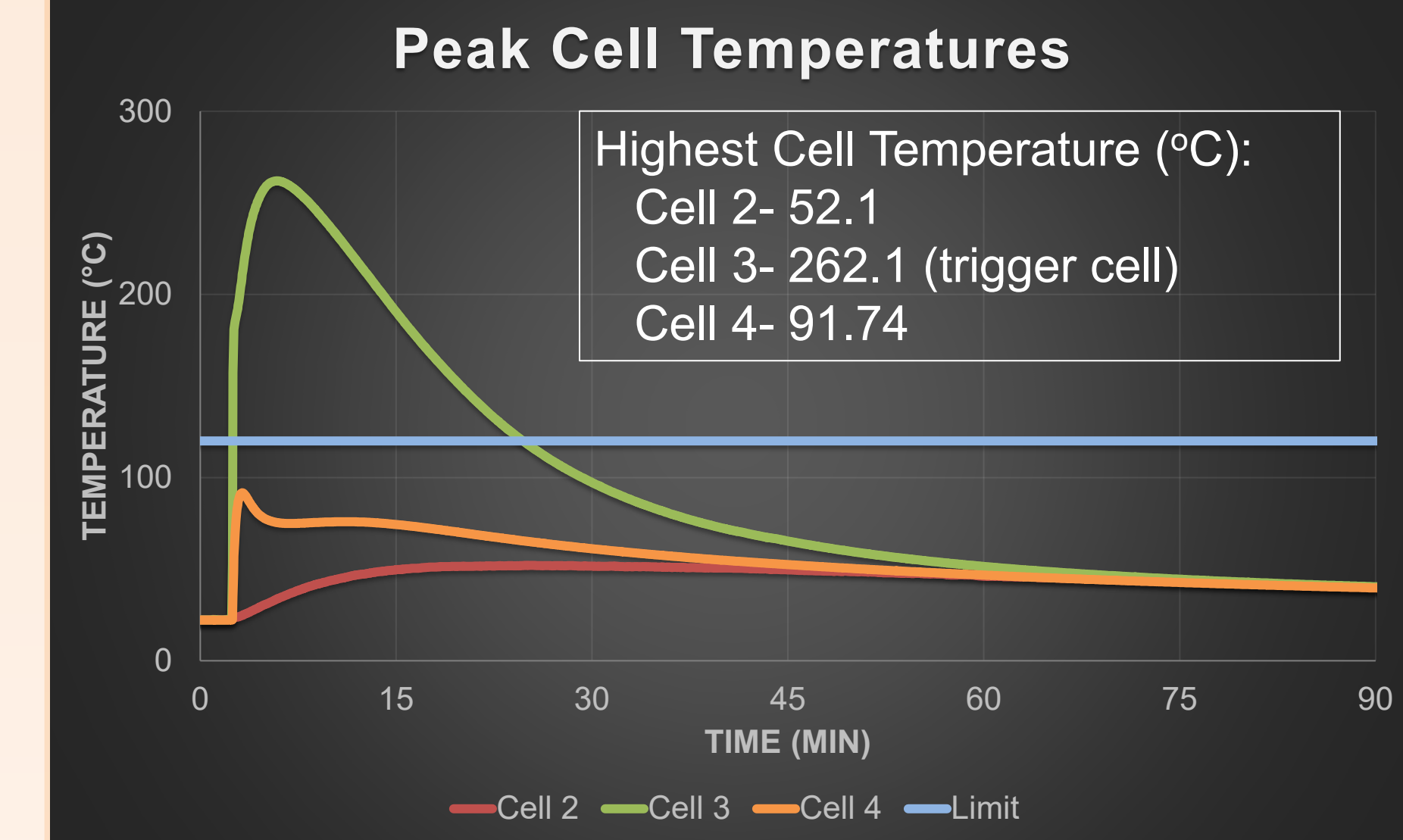


TR ejecta without effluent management ↑



TR ejecta with effluent management ↓

Results



Test Cell 2 Initial (Ah)	Test Cell 2 Post (Ah)	Test Cell 4 Initial (Ah)	Test Cell 4 Post (Ah)
200.4	199.8	198.6	198.1
0.2% < 5% PASS		0.3% < 5% PASS	

Conclusions

- ✓ Objective 1: Multiple tests demonstrated TR occurred in trigger cell only.
- ✓ Objective 2 : Adjacent cells were not damaged.
- ✓ Objective 3: Adjacent cells showed less than 1% capacity degradation post event.
- ✓ Objective 4: No flames exited the battery during the TR event.
- Demonstrated the ability to prevent thermal runaway propagation across multiple tests.
- Passive TR propagation resistance was achieved through simple modifications to a heritage design with minimal impact on mass.
- Successfully demonstrated effluent management technique to collect and direct TR ejecta and contain flames.

References / Contact

NASA, *Crewed Space Vehicle Battery Safety Requirements*, JSC-20793 Rev. D, Mar. 8, 2017

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