



Repeatability in Abuse Testing: Comparison Across Labs

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Objective

Collaboration with the National Institute of Technology and Evaluation (Japan) to evaluate current techniques for initiating failure events in high energy lithium-ion cells for stationary energy storage and to identify critical parameters that could impact the reliability and repeatability of the tests.

Key Questions

- How does abuse response compare from cell-to-cell and from lab-to-lab?
 - Under what abuse conditions are the results the same?
 - When different, what is the underlying cause?
- What are the implications with regard to standards, test protocols, and integration of cells into a battery system?

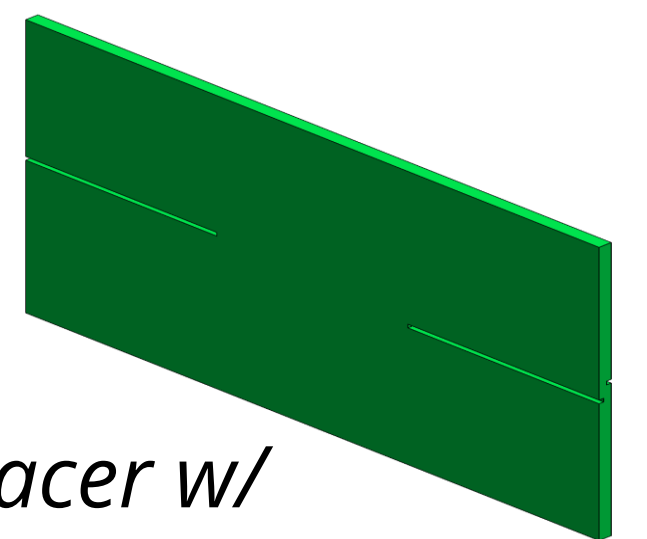
Methodology

Test parameters followed by NITE and SNL. The test setup was mimicked to the extent of each lab's capabilities

- Thermal ramp at 50°C/min
- 3-cell pack heated through one block only
- 100% State of charge with no electrical connection

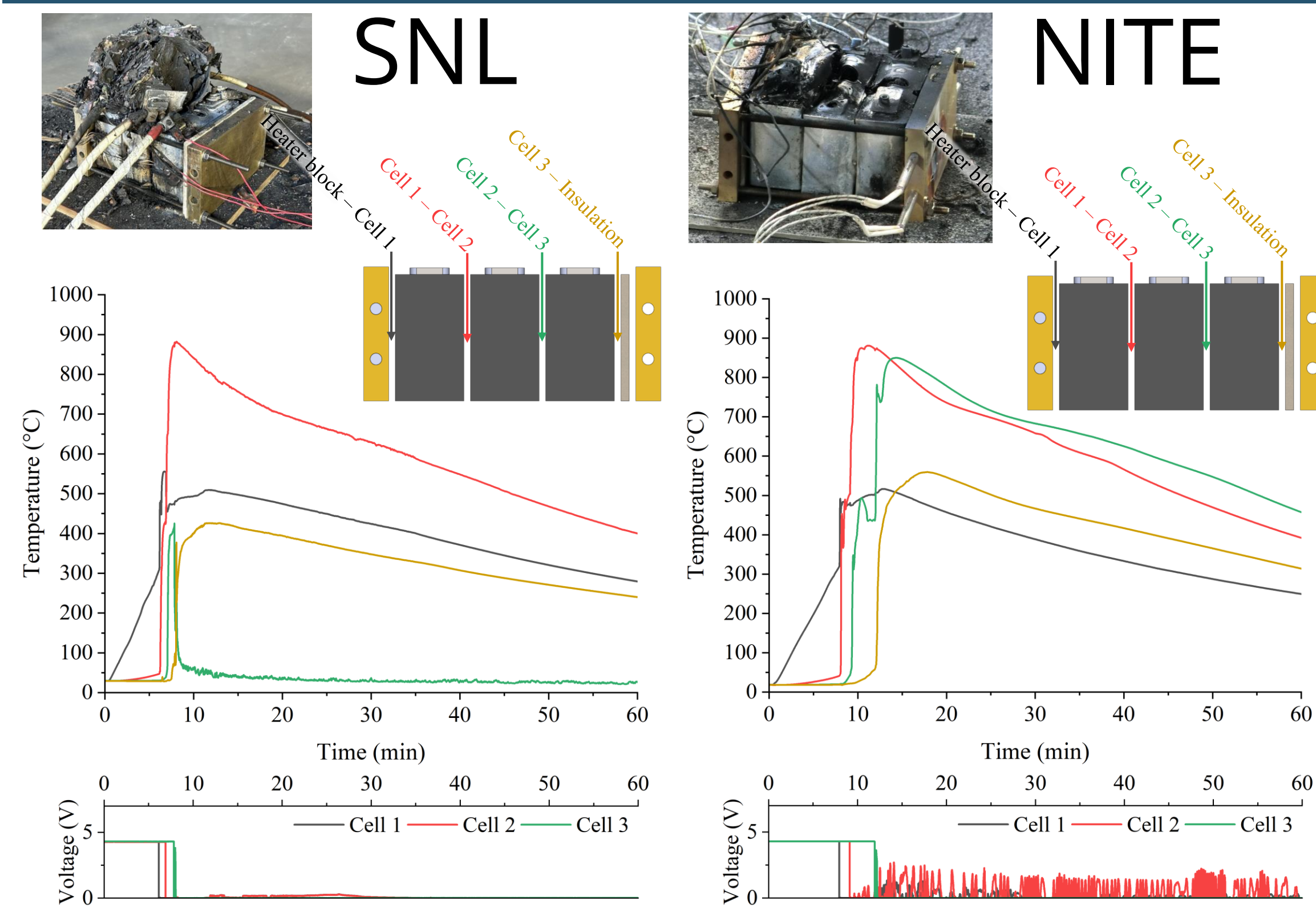


Unit under test: 100Ah
Prismatic
NMC/Graphite Cell



1/16" or 1/8" Garolite spacer w/
grooves for thermocouples

Results



Thermal ramp with TC gaps

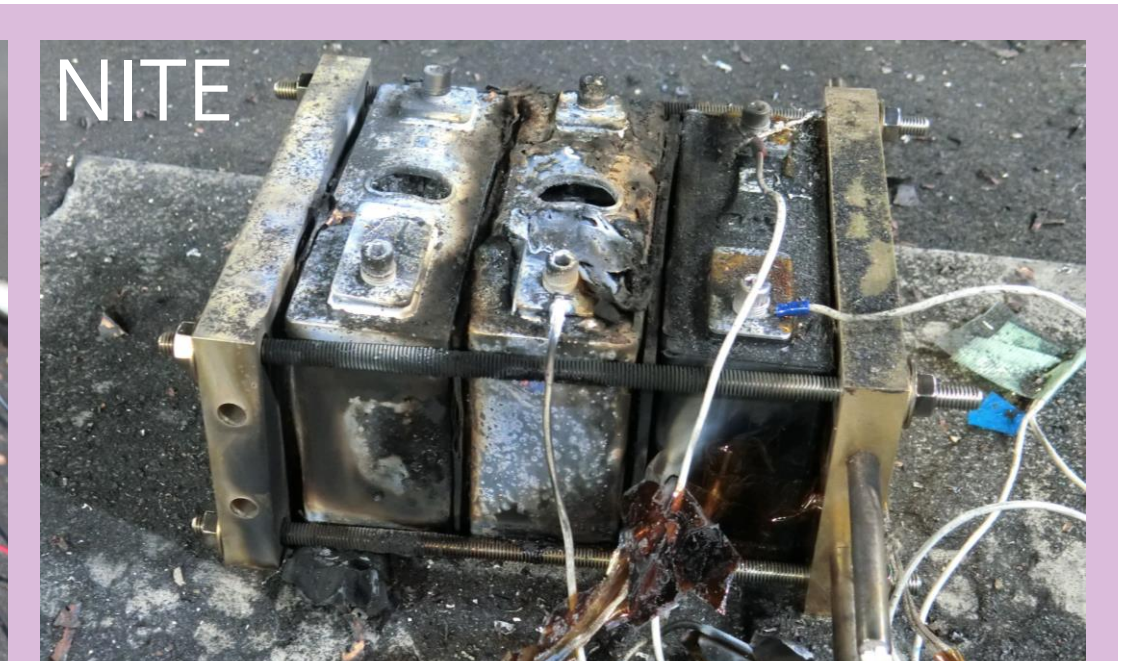
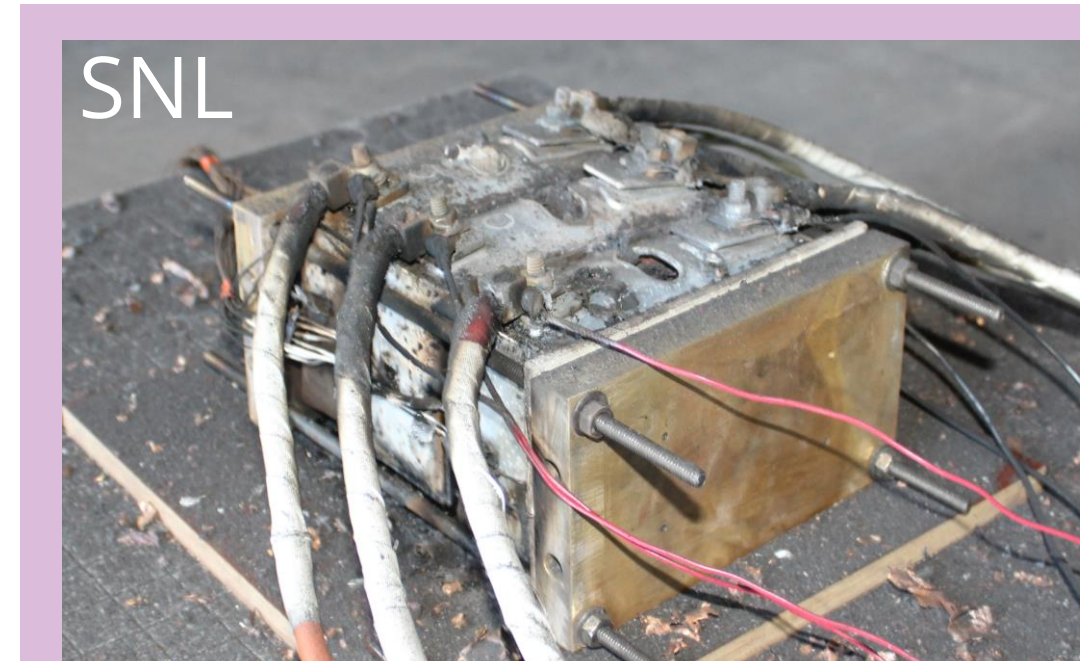
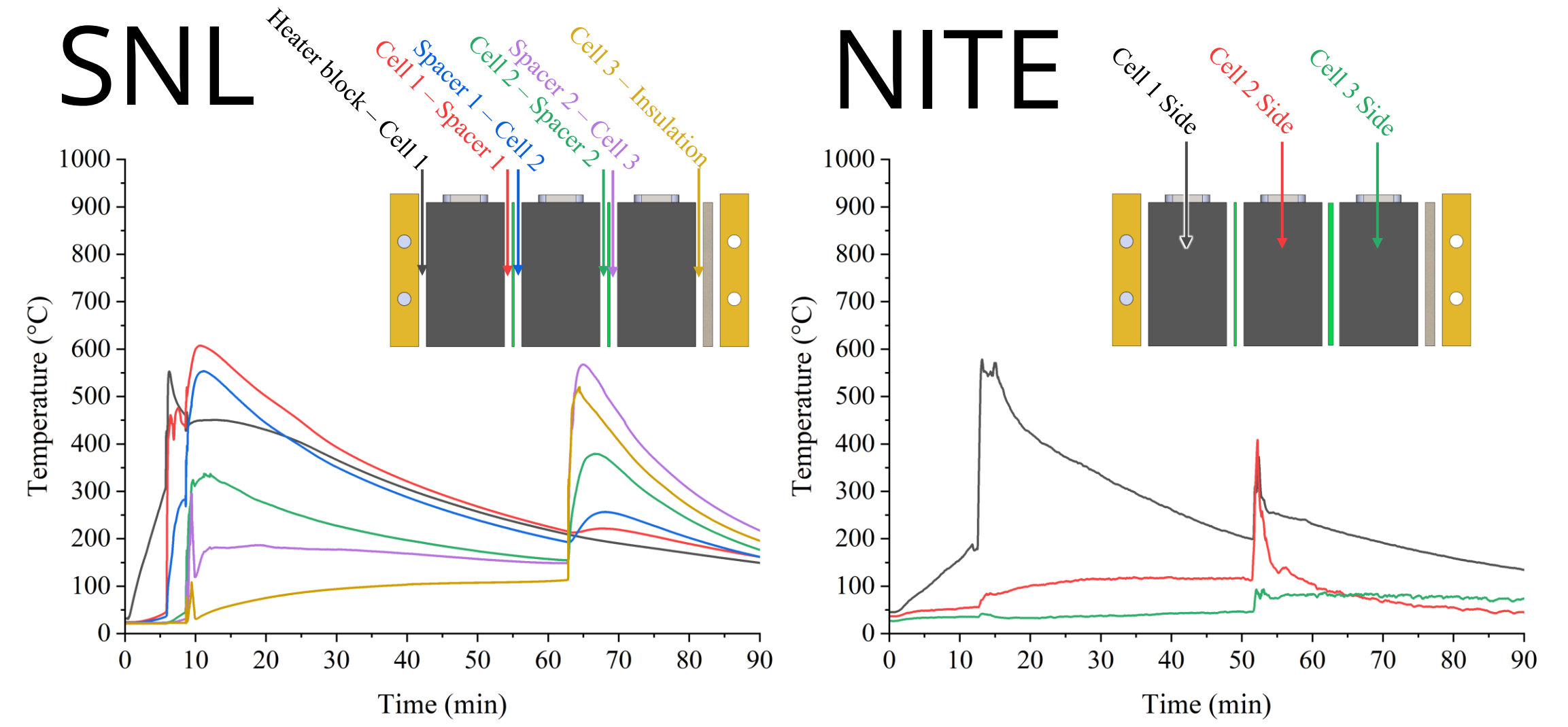
Similarities

- Full propagation through pack
- Temperature peak ~900C

Differences

- Time between propagation longer for NITE testing
- Thickness of TC sheath between cells

Thermal ramp without TC gaps between cells



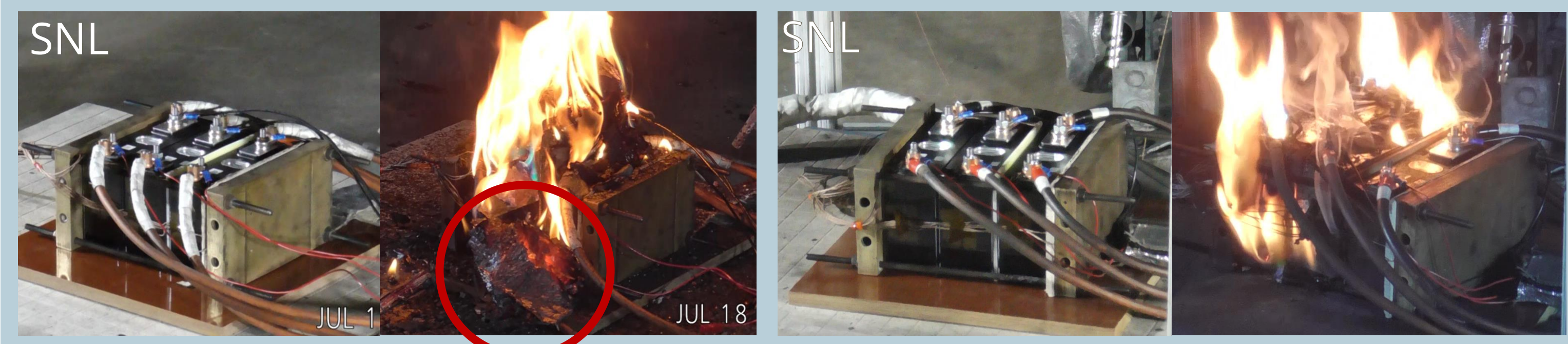
Similarities

- Propagation through cell 1 and 2
- Temperature peak ~600C

Differences

- NITE used 1/8" spacer between cell 2 & 3
- Propagation to cell 3 for SNL
- Time to runaway

Thermal ramp with TC gaps and 1/8" spacer with grooves for TCs

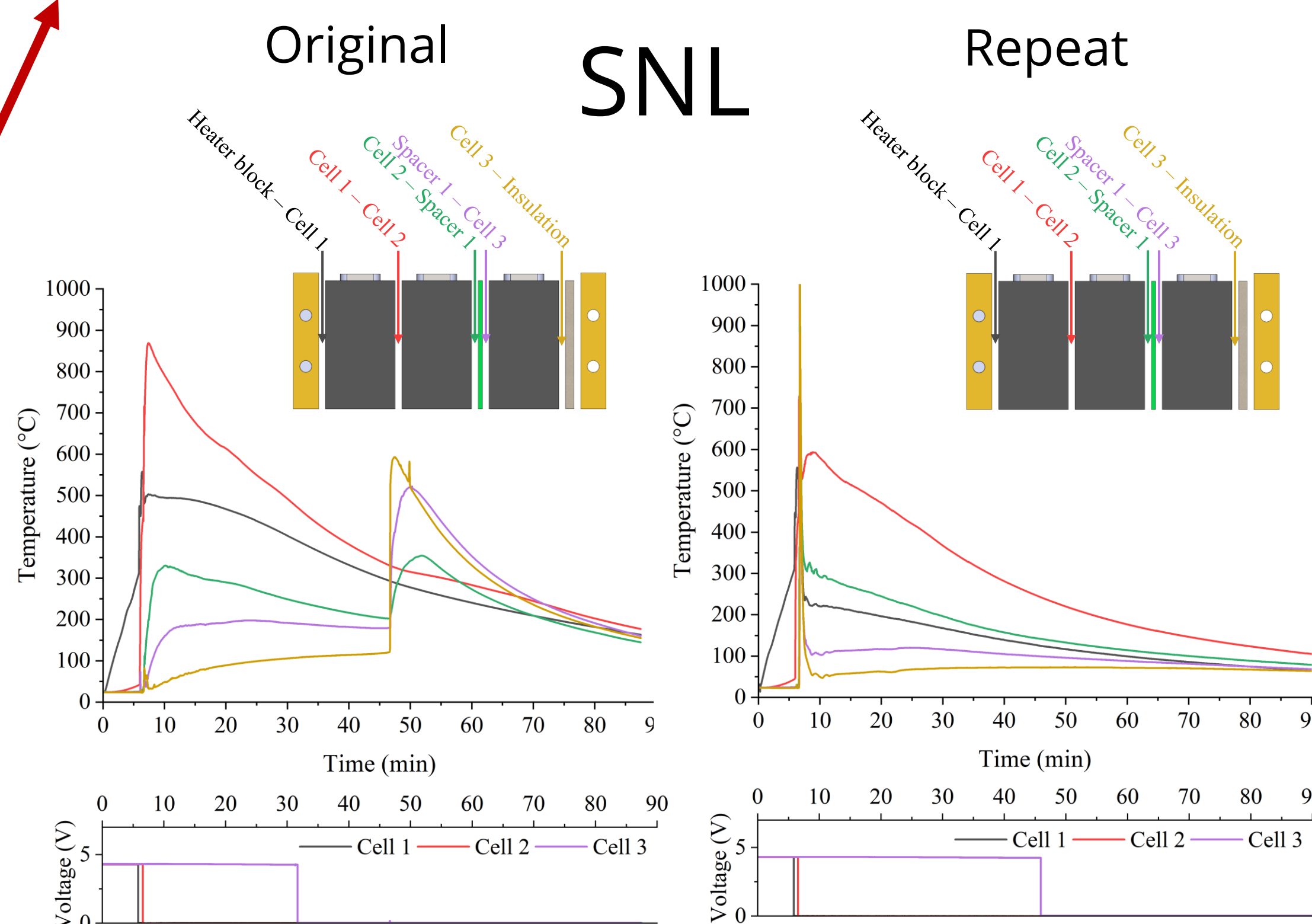


Similarities

- All cells lost voltage
- Cell 1 & 2 runaways in close succession

Differences

- Cell 2 of original ejected burning jellyroll near cell 3
- Cell 3 did not runaway in repeat
- Peak temp of repeat higher
- Cell 2 of repeat vented out bottom
- TC on insulation of repeat ~1000C



Take-Aways

- Runaway behavior (direction of ejecta, flame, etc.) has an impact on how a propagation will proceed, and is generally unpredictable
- Communication of methodology can be interpreted in vastly different ways
- Slight variations in test details (e.g. thickness of TC outer sheath) impact test outcomes

Future Plans

Repeat testing with:

- Increased detail and tighter controls on methodology
- Identical materials for fixturing and pack setup
- Test cells of one manufacturing lot to reduce construction variance