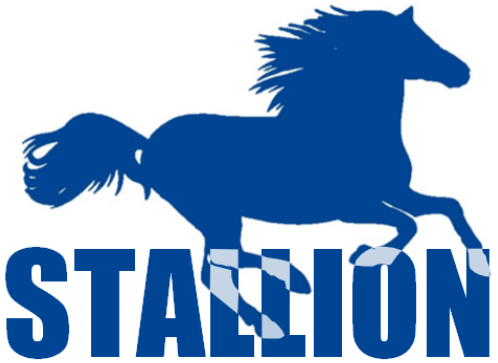


Supporting the deployment of safe Li-ion stationary batteries for large-scale grid applications

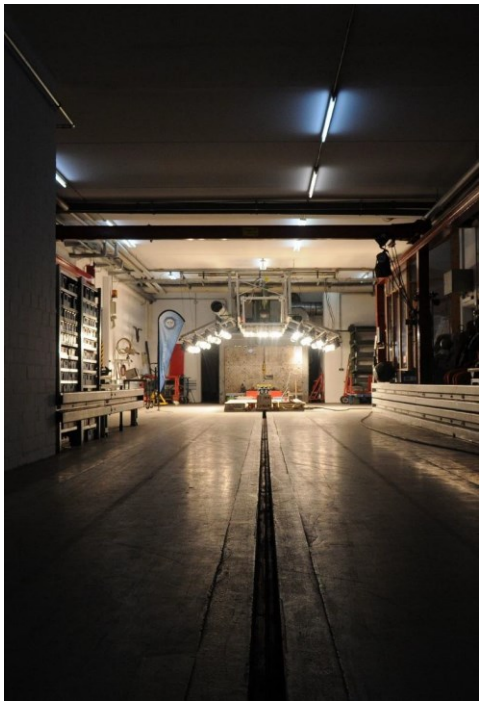
Procedures for stationary energy storage systems

Johannes Rößner, TÜV SÜD Battery Testing GmbH

Düsseldorf, 10 March 2015

TÜV SÜD Battery Testing GmbH

- TÜV SÜD Battery Testing GmbH provides testing of (lithium-ion) batteries.
- Covered are tests from cell level up to pack level and from performance tests to abuse tests.



TÜV SÜD Battery Testing

Procedures made from risk analysis

Test
Propagation within a module
Overcharge of a module
Polarity reversal of a cell
Rough handling of the case
Module cycling without cooling
External short circuit of a module
Deformation of a module
Flooding of a module
BMS temperature protection test
BMS current protection test
BMS voltage protection test

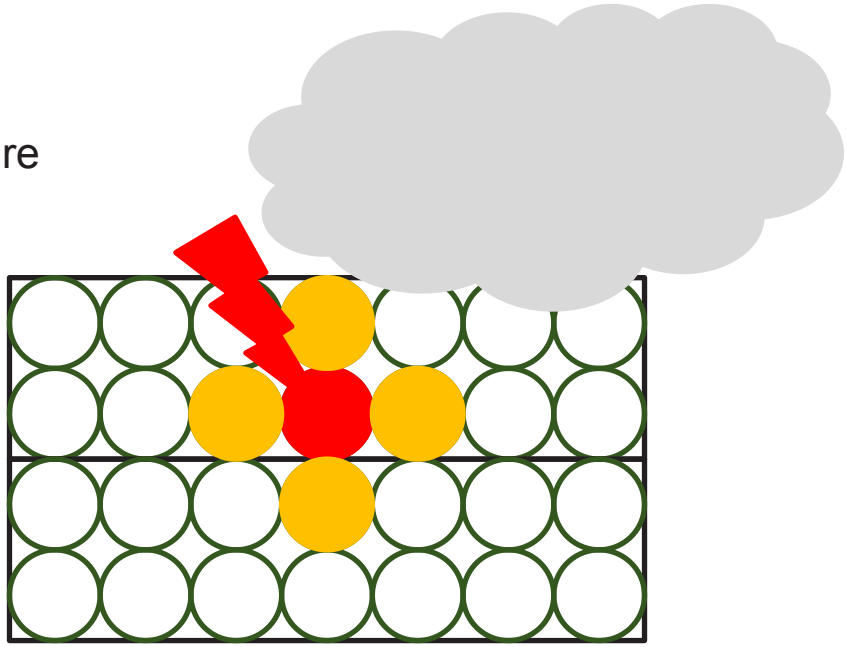
Deep dive: Propagation test

- Start a thermal runaway in one cell in a module; does this runaway spread to other cells?
- Motivation for this test:
  - An internal short circuit is the only risk no external control can guard
  - This can be induced by defects or contaminations during production
  - If the thermal runaway does not spread, a huge accident of a complete energy storage system may not occur

→ We want to find out if another cell starts a thermal runaway as well?

Deep dive: Propagation

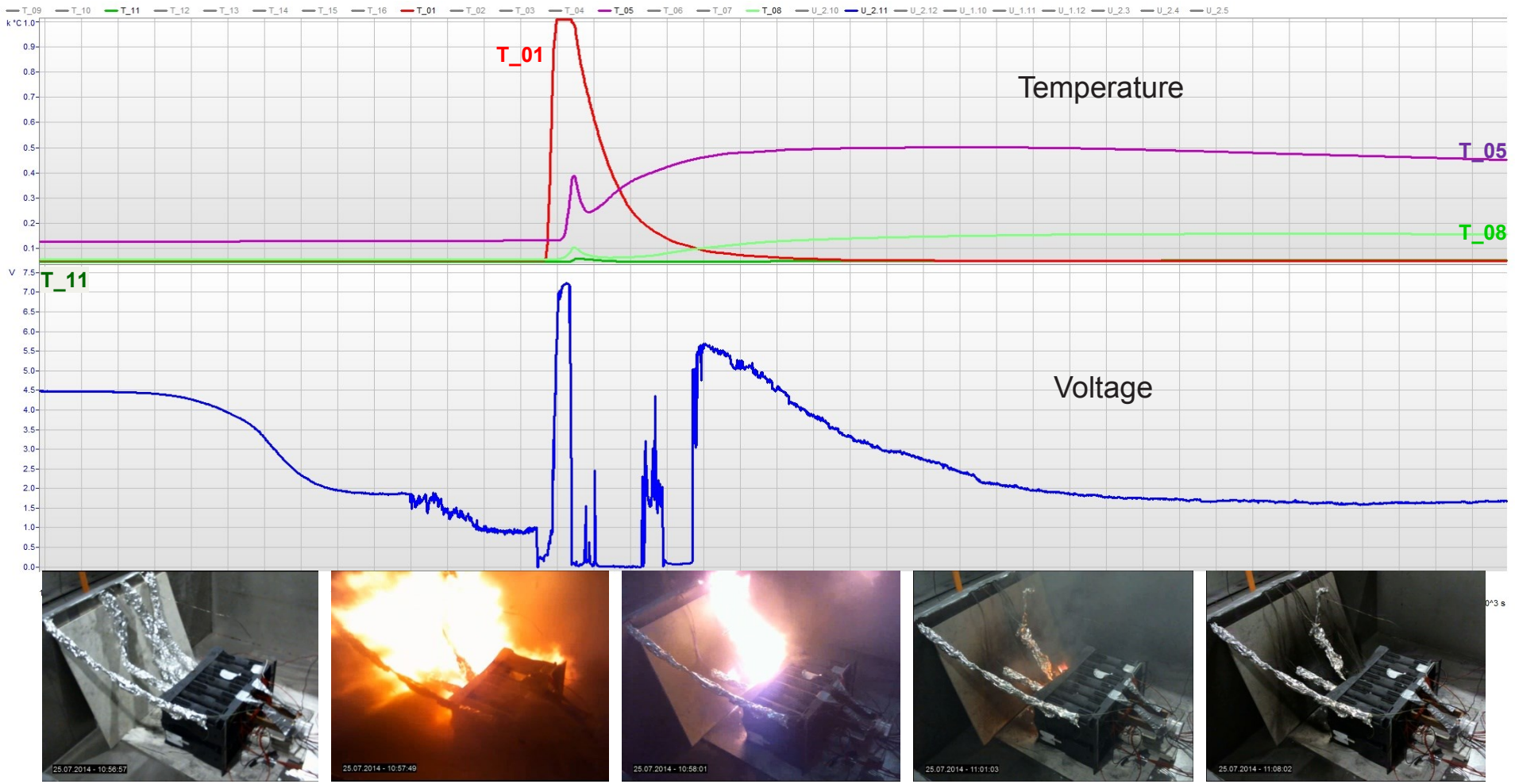
Circumstances:
Maximum operating temperature
100% SOC



Measurements:
- Temperatures of the cell treated and the sourrounding cells
- Voltages
- Gas emissions in case of household application
- Storage afte the test

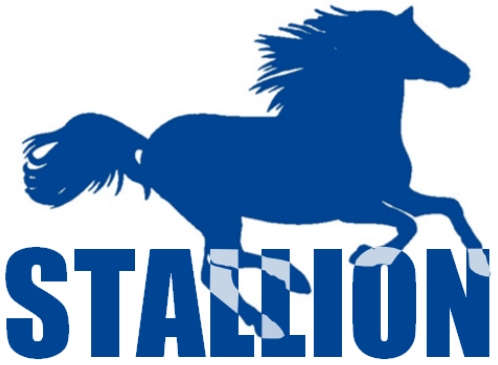
Examples for applicable misuse tests:
- Overcharge
- Short Circuit
- Local heating
- Mechanical misuse e.g. nail penetration test

Deep dive: Propagation test



Wrap up: Procedures

- Propagation within a module
- Overcharge of a module
- Polarity reversal of a cell
- Rough handling of the case
- Module cycling without cooling
- External short circuit of a module
- Deformation of a module
- Flooding of a module
- BMS temperature protection test
- BMS current protection test
- BMS voltage protection test



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Thank you!
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Düsseldorf, 10 March 2015