Li-ion Tamer®

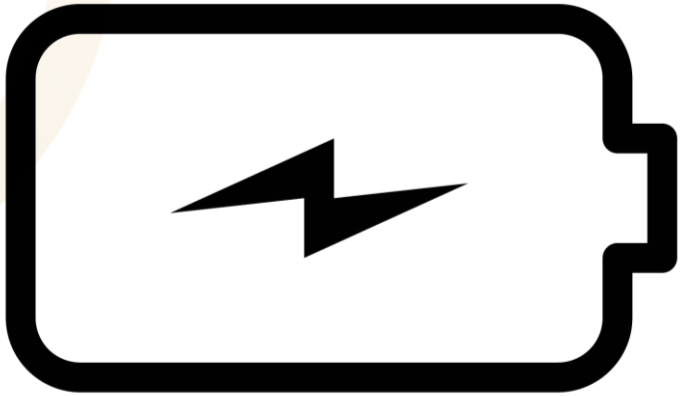
Comprehensive lithium-ion battery safety solutions

Presented to Sargent Lundy
May 15th, 2018

About Li-ion Tamer

Li-ion Tamer is a subdivision of Nexceris, LLC.
We are located in Columbus, Ohio, USA.
Our company is ISO 9001:2015 certified.

We design safety solutions for lithium-ion batteries.
Our solutions are product and service oriented.
Our global customer base is growing every day.

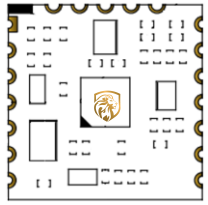


Li-ion Tamer solutions

Products

Li-ion Tamer SafeSpace
A comprehensive safety solution for lithium-ion energy storage systems

Li-ion Tamer Rack Monitor
An off-gas monitor for early indication of lithium-ion battery failures



Li-ion Tamer AWARE
A BMS implementable comprehensive solution for battery fault detection

...and many more!

Services

Participation in joint-development program for maritime rule making organizations on state-of-the-art battery failure detection methods

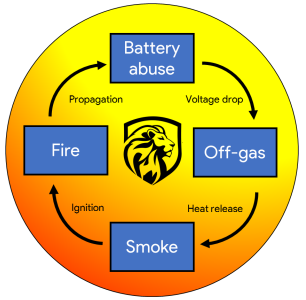
DNV·GL

Contracted for several projects to increase the safety of lithium-ion batteries installed on US Navy platforms

UNITED STATES NAVY

Design of lithium-ion battery modules for aviation, robotics, and maritime applications

Battery space and room design, as well as detection scheme and sensor suite consulting and implementation



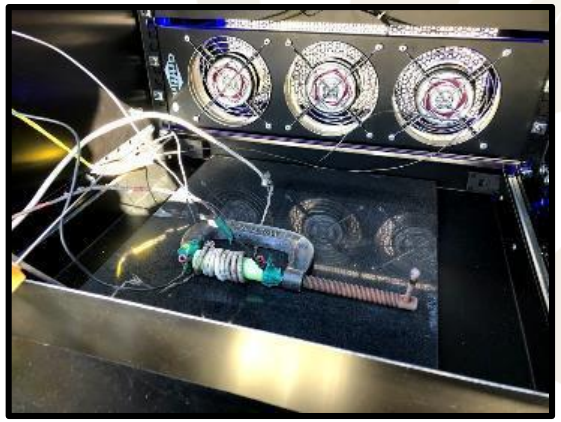
Li-ion Tamer History

Li-ion Tamer® products highlighted at the 2018 ARPA-E Energy Innovation Summit in Washington, DC

Link to ARPA-E video highlighting Li-ion Tamer products

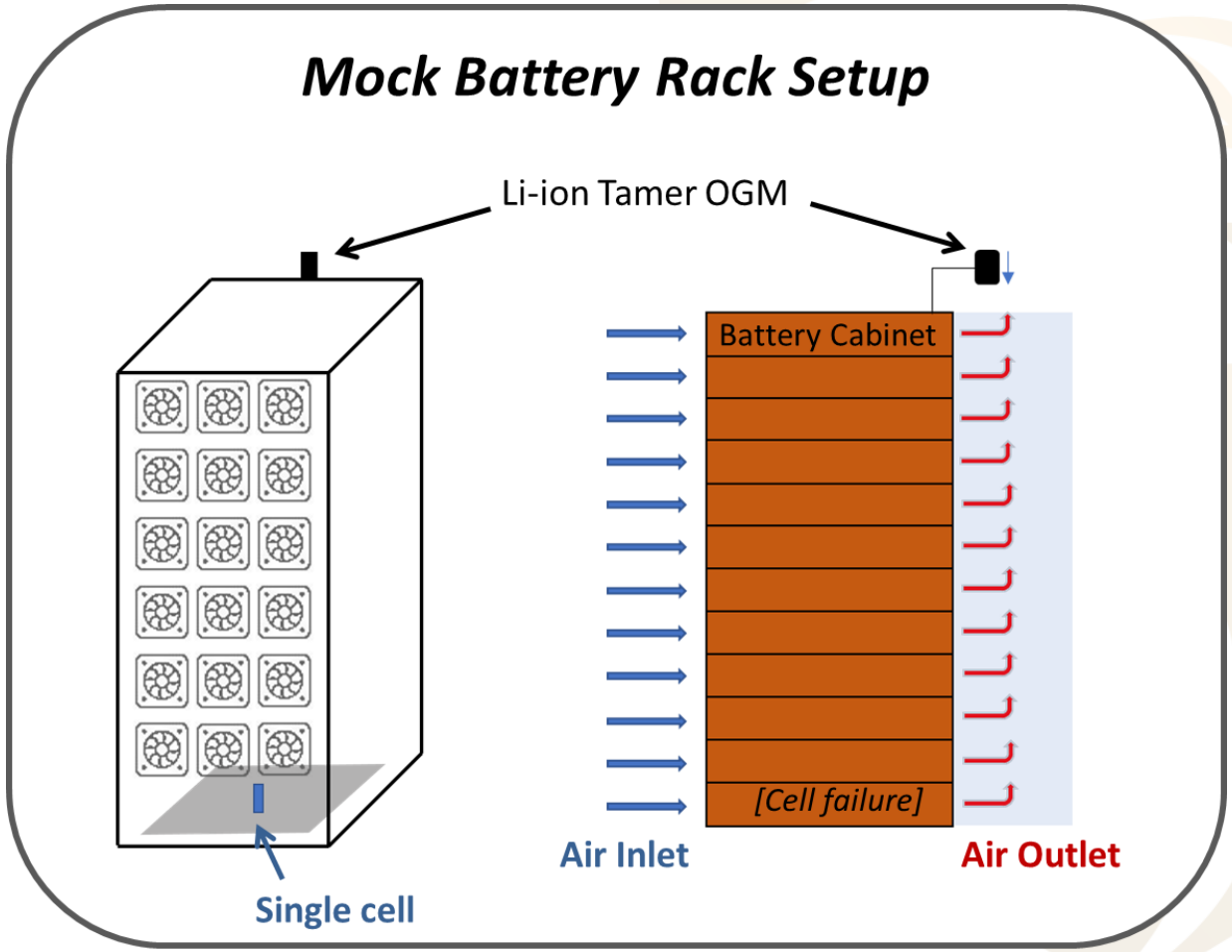
Failure Testing Capabilities

Battery rack failure testing



Battery module failure testing

Li-ion Tamer Capability



Test set up used to demonstrate *single cell* detection in battery rack with one Li-ion Tamer off-gas monitor

Battery Failure Testing

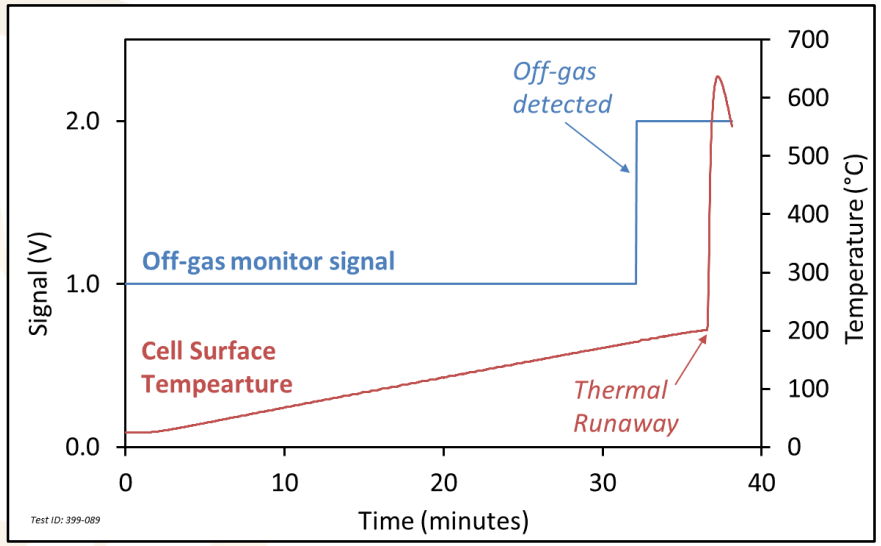
Link to early warning of failure in li-ion battery rack overheat test

Link to early warning and prevention of thermal runaway on li-ion overcharge test

Battery Failure Data

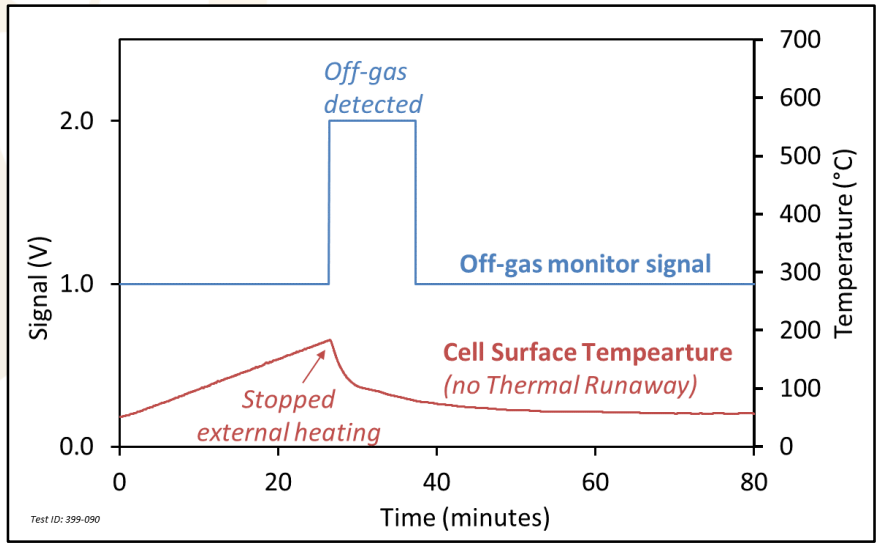
Battery Fault Detection

- Off-gas is precursor to battery failure
- Detection of off-gas can provide early warning
- Advanced safety diagnostic for battery systems

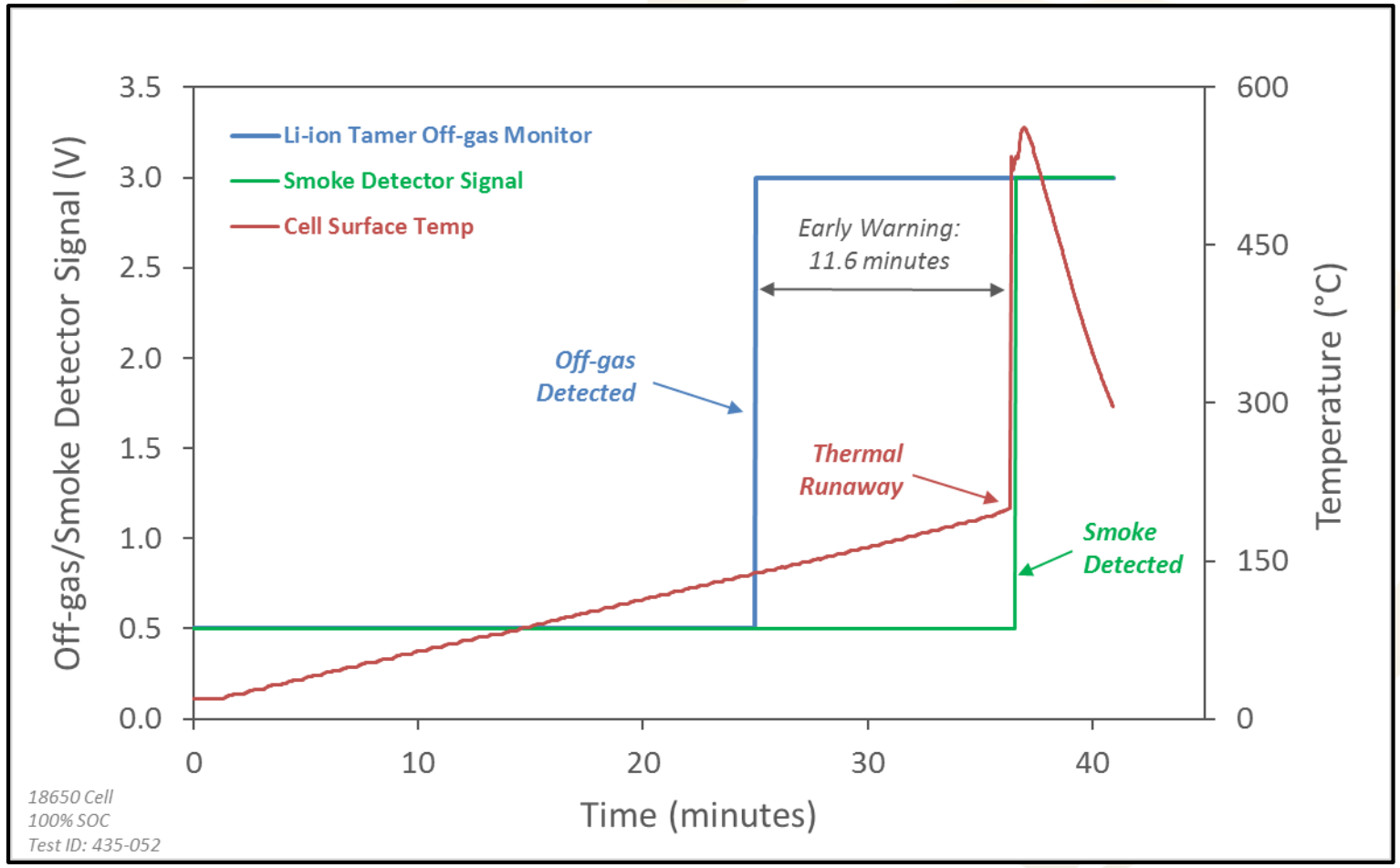


Battery Fault Mitigation

- Off-gas monitoring can enable mitigation
- Isolate from charge/load when off-gas occurs
- Enables thermal runaway prevention



Battery Failure Data



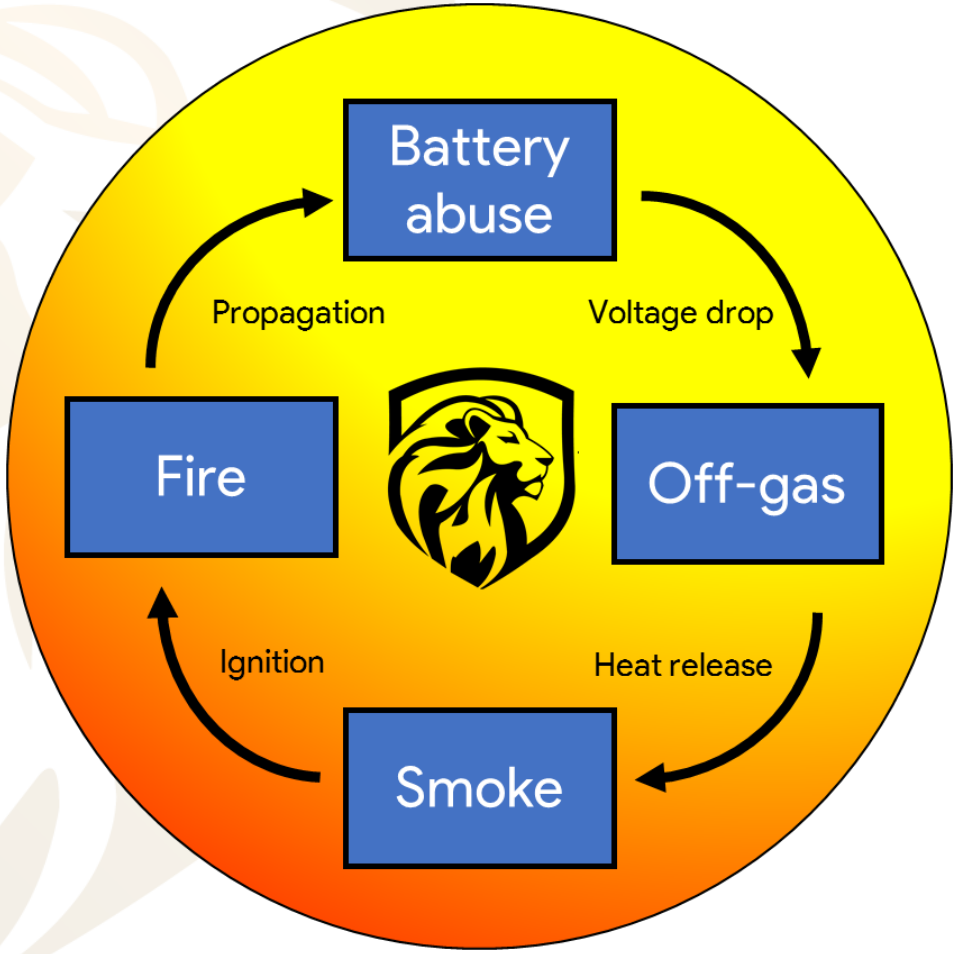
Li-ion Tamer® detects off-gas *prior* to thermal runaway

Smoke detector provides *no* early warning of failure

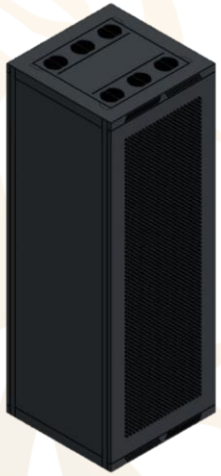
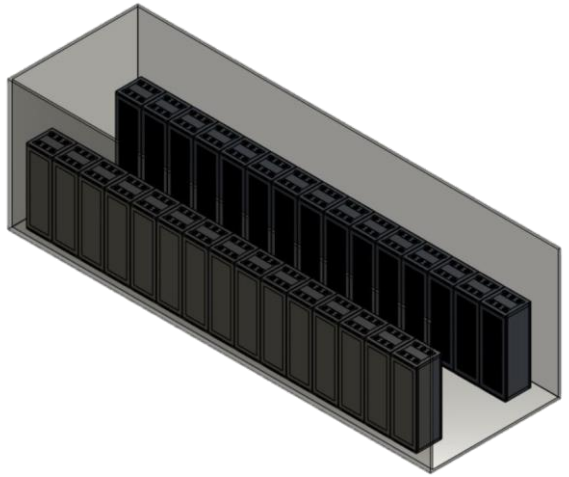
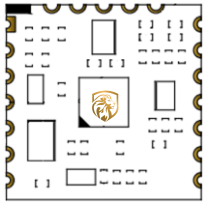
Battery Failure Stages

Battery Failure Stages

- Stage 1: Abuse factor
  - Thermal, electrical, or mechanical abuse
- Stage 2: Off-gas generation
  - Occurs regardless of cell form-factor
- Stage 3: Smoke generation
  - Catastrophic failure is imminent
- Stage 4: Fire generation
  - Likelihood of propagation drastically increases



Li-ion Tamer Monitoring Products

	Module	Rack	Room
Battery system hierarchy			
Li-ion Tamer products	 Li-ion Tamer® AWARE	 Li-ion Tamer® Rack Monitor	 Li-ion Tamer® SafeSpace

Applications

Stationary ESS

- Rack Monitor integration into 2 MWhr battery system in UK
- Rack Monitor integration into first rooftop battery system in NYC
- Li-ion Tamer apart of first system-level UL 9540 test
- Currently in product evaluation period with several USA market leaders

Marine

- Awarded >$5M in Government funding for increasing the safety of US Navy lithium-ion batteries
- Integration into battery spaces of li-ion battery market leader in marine industry
- Currently in product evaluation period for direct battery module integration of several customers

Automotive

- Integration into packs of European EV Bus Manufacturer
- Currently in product evaluation period for BMS integration into tier 1 OEM car manufacturer EV packs
- Seeking further partner channels to help proliferate Li-ion Tamer products

Other

- Integration into environmental chambers for battery cycling in US National Laboratory
- Consulted for EV Battery Testing Room detection scheme for tier 1 automotive supplier
- Designed safest battery pack for aviation industry FAA project

Questions?

Visit us at:

www.li-iontamer.com

Acknowledgements

arpa·e CHANGING WHAT'S POSSIBLE

DNV

NAVSEA NAVAL SEA SYSTEMS COMMAND

BIC