Li-ion Tamer®
Comprehensive lithium-ion battery safety solutions

Presented to Sargent Lundy
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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

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

- 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

- **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

Battery system hierarchy

<table>
<thead>
<tr>
<th>Module</th>
<th>Rack</th>
<th>Room</th>
</tr>
</thead>
<tbody>
<tr>
<td>Li-ion Tamer® AWARE</td>
<td>Li-ion Tamer® Rack Monitor</td>
<td>Li-ion Tamer® SafeSpace</td>
</tr>
</tbody>
</table>

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## 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

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