LI-ION TAMER® GEN3 APPLICATION IN ADVANCED PREFABRICATED POWER MODULE CASE STUDY

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Contents

Introduction

This case study outlines the installation of the Li-ion Tamer GEN3 system within a Power Module at a major data center, to protect lithium-ion batteries against thermal runaway events.

Project Background

The Li-ion Tamer GEN3 system has been selected by a world-leading global power management solution manufacture for installation into their prefabricated power module data center infrastructure, providing reliable detection of the early signs of thermal runaway in lithium-ion batteries.

The Power Module is a high-performance 1000 kW, 20-foot container that contains 10 lithium-ion battery cabinets (UPS), power distribution units (PDUs) and integrated switchboards.

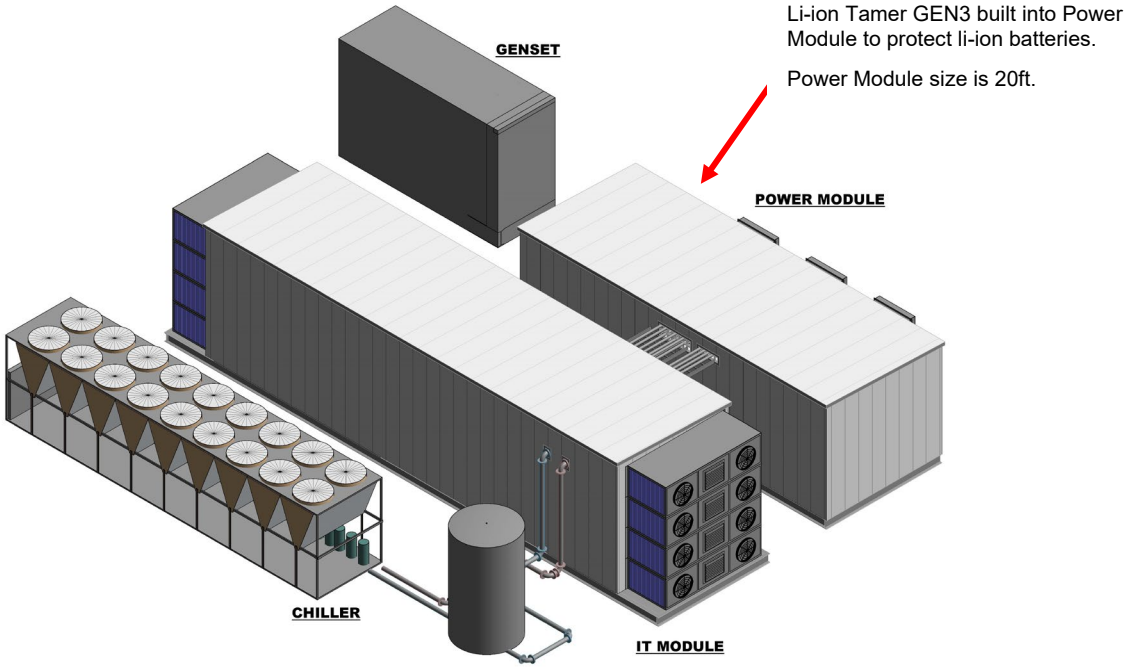

Figure 1: Data Center - Power Module (1000 kW, 10 Racks, Air/ Liquid Cooled Li-ion Batteries)

Lithium-ion Battery Safety Challenges

Lithium-ion batteries are inherently fragile and are prone to failure which can lead to damaging fires. A lithium-ion battery failure happens in three stages:

- Abuse (thermal, electrical, mechanical)
- Initial venting of electrolyte vapours (off gassing)
- Fire (thermal runaway)

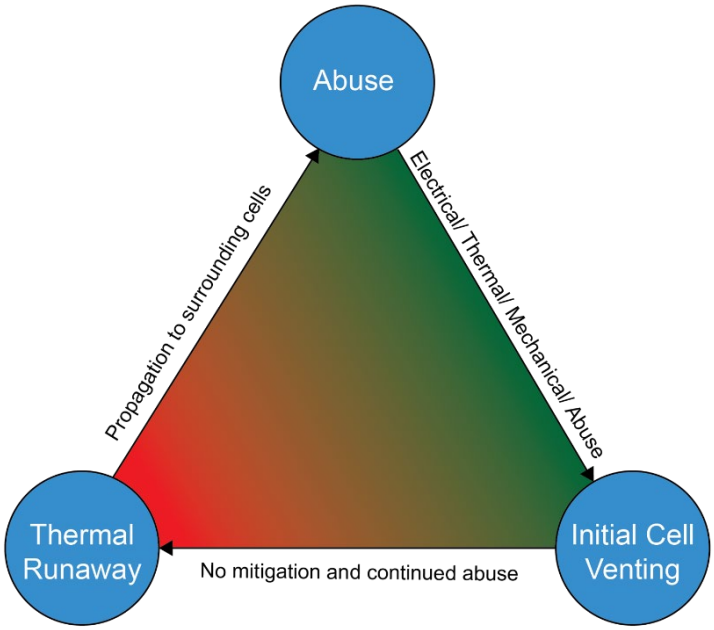

Figure 2: Lithium-ion Battery Failure Journey

Once a lithium-ion battery undergoes thermal runaway, the generated heat will cause thermal abuse to the surrounding batteries, causing them to also go into thermal runaway. This is why lithium-ion battery failures are often costly and catastrophic, a failure originating from a single battery can lead to a complete destruction of all batteries.

Solution

The Li-ion Tamer GEN3 solution was selected to provide very early warning of lithium-ion battery failures, offering up to 30 minutes of advance detection prior to the onset of thermal runaway. Utilizing its reference-based sensing technique, the Li-ion Tamer GEN3 system significantly minimizes false (positive) alarms caused by external contaminants with the placement of reference sensors at the air ventilation entry points of the module.

The Li-ion Tamer GEN3 layout consists of:

- **10 x Monitoring Sensors**: mounted on the top side of each lithium-ion battery cabinet.
- **2 x Reference Sensors**: each mounted near the two ventilation system entry points.
- Controller, Hub, Ethernet Switch and Power Supply housed in the module power distribution cabinet.

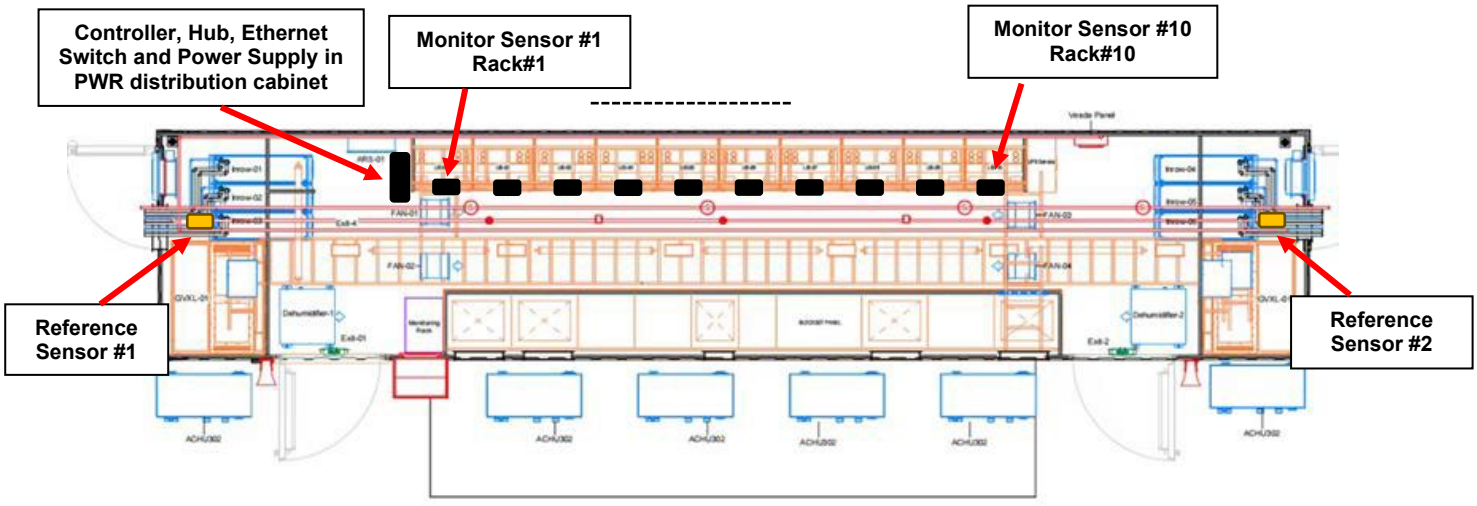

Figure 3: Li-ion Tamer GEN3 System Layout in Power Module

The Li-ion Tamer GEN3 Controller was interfaced to the EMS management system via TCP/IP MODBUS interface for real-time data transmission to the control center of the status of the system.

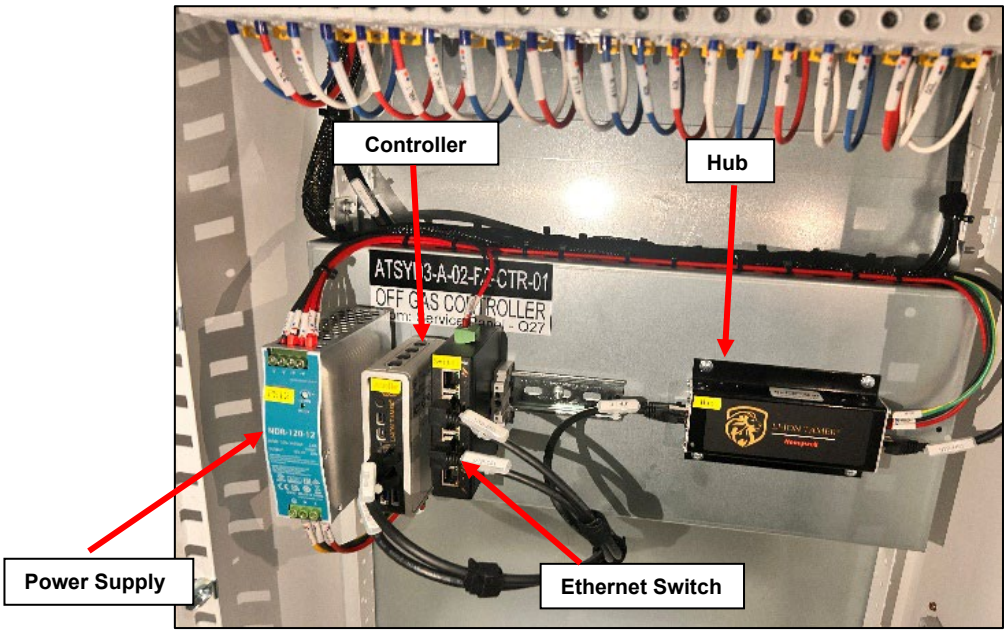

Figure 4: Li-ion Tamer GEN3 Controller/ Ethernet Switch/ Hub/ Power Supply Installation

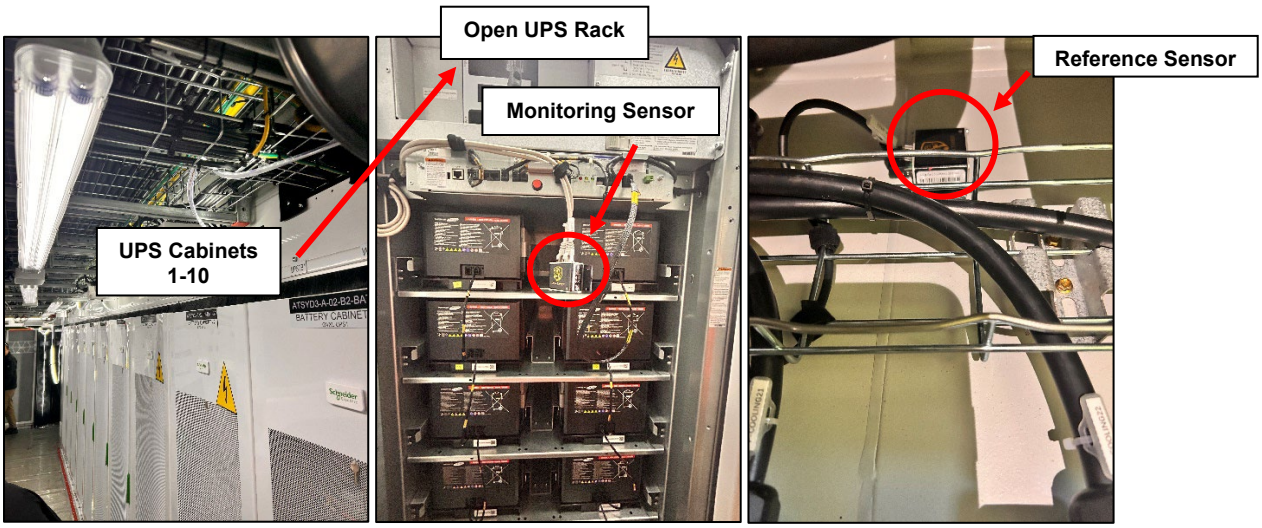

Figure 5: Li-ion Tamer GEN3 Monitoring/ Reference Sensors Installation

The Li-ion Tamer GEN3 software interface was used to configure the system, enabling the mapping of sensors to specific battery cabinets for fully addressable responses as well as providing comprehensive status reporting (normal, alarm, fault, initialization, temperature/ humidity measurements and scalar value).

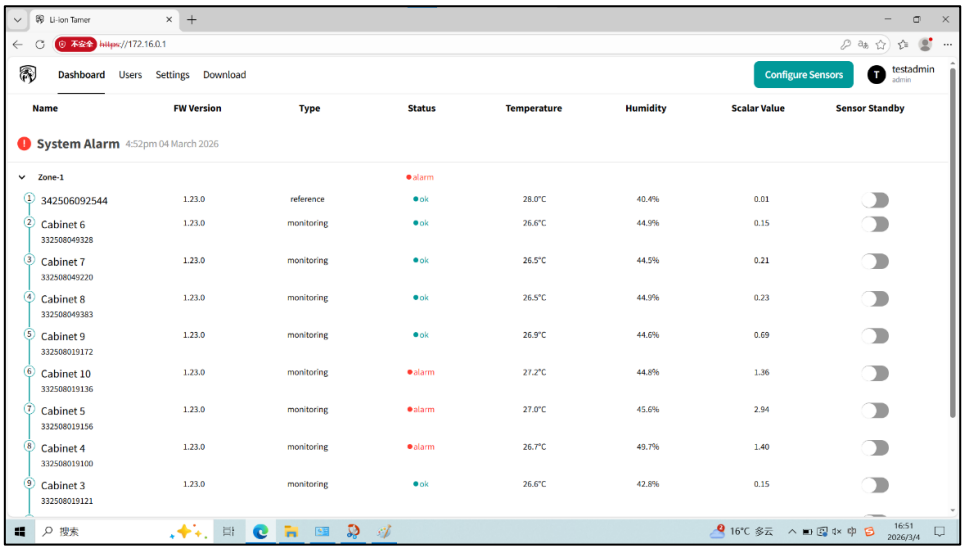

Figure 6: Li-ion Tamer GEN3 Software User Interface

In the event of off-gas detection, the Li-ion Tamer GEN3 system will issue an alarm to the management system, triggering an automatic shutdown of power to the lithium-ion batteries within the affected cabinet.

Conclusion and Value

The Li-ion Tamer GEN3 built on the recognized Li-ion Tamer detection technology is the ultimate safety solution for the protection of lithium-ion UPS applications.

The Li-ion Tamer GEN3 system provides the earliest possible warning of imminent battery failures by detecting the off-gas phase that occurs early in the failure mode of lithium-ion batteries. An alert to a battery off-gas event enables investigation and proper mitigation steps to be taken at an early stage to avoid progression to the most catastrophic phase (thermal runaway) which can pose serious threat to occupants' safety, damage assets/ property and result in loss of capacity of delivering power to customers. It is noteworthy that the detection of the off-gas phase in a failing lithium-ion battery is widely recognized by industry standards and insurers as a reliable method for providing pre-thermal-runaway warning.

The Li-ion Tamer GEN3 with its advanced detection capabilities, calibration-free and 10-year sensors' lifespan, multiple integration capabilities including mapping relays configuration, TCP/IP Modbus, communication makes it an indispensable solution for the safe and efficient operation of UPS infrastructures.

Client Quote

"We used to rely on 'seeing smoke'—now we rely on 'smelling danger'. Li-ion Tamer GEN3 turns invisible risks into controllable data."

— *System Architecture Engineer, Major Data Center*

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