LI-ION TAMER® GORE STREET CAPITAL CASE STUDY

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Preface

Li-ion Tamer from Xtralis has been used extensively in a wide range of Lithium-Ion battery installations. In this document, we provide details on the Gore Street Capital installation at Cremzow in Germany. Early detection of battery electrolyte solvent vapours is vital to help prevent thermal runaway and avoid catastrophic consequences.

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Introduction

The global shift towards renewable energy sources is helping the world reduce its dependence on fossil fuels. However, the intermittent nature of wind and solar power challenges the electrical grid's stability. Battery Energy Storage System (BESS) technology helps address this problem by storing excess energy and feeding it back into the grid when demand rises.

While BESSs based on Lithium-ion (Li-ion) technology have ideal characteristics to provide the frequency regulation needed for the grid, they can present significant fire safety risks. This case study examines how an early-warning electrolyte vapour detection system has helped prevent fires at a BESS facility in Cremzow (northeast Germany), located in an area with a high concentration of wind turbines. This site is operated by Gore Street Capital (GSC), a renewable energy investment manager with several BESS assets across the UK, Europe, and USA.

Challenges

Li-ion cells are vulnerable to a condition known as thermal runaway, an exothermic reaction caused by electrical, thermal, or mechanical abuse. BESS facilities like the one in Cremzow contain multiple Li-ion cells in close proximity to one another. There is, therefore, a danger of thermal runaway in one cell setting off a chain reaction in the other cells, leading to a catastrophic failure.

Regulations and standards are constantly evolving as the BESS industry grows to implement new requirements that reduce the risk of a Li-ion fire incident. One of the areas that new regulations are targeting is the need for early warning of thermal runaway. Insurers are also focusing on this area by making increasing demands on safety measures for risk reduction. Some insurers are even making early warning systems a criterion for policy approval.

Many BESS installations are equipped with standard detection that does not provide adequate protection, with traditional smoke detectors being too slow to respond to a thermal runaway event. By the time smoke is detected, battery failure is already far advanced, making it impossible to prevent a fire incident.

One way to prevent a fire incident is to detect volatile organic compounds (VOC) emitted during the initial failure stages of a Li-ion cell. These off-gases are present before the incident develops into an exothermic reaction and enters thermal runaway, allowing battery management systems to shut down the affected cell before it is too late.

Solution

After extensive research, Xtralis has developed a technology that can detect electrolyte vapours released in the initial stages of battery failure preceding thermal runaway. This new technology is known as Li-ion Tamer and offers the early warning detection that BESS operators need to prevent fire incidents.

GSC chose this technology for its risk reduction initiative at the Cremzow installation.

The Cremzow site consists of 11 containers, each with an array of Li-ion cells. Every container has its own Li-ion Tamer solution connected to the others by a network infrastructure. The system design within each container comprises:

- 16 monitoring sensors spread out over the 32 cells in each container.
- Four reference sensors in each container measuring contaminates entering the space to prevent false alarms.
- Two Li-ion Tamer GEN 2+ controllers to interpret the results and trigger a cell shutdown if necessary.
- An E-Stop loop that shuts down battery racks within the affected container in response to a Li-ion off-gas trigger to prevent the failure from escalating into a thermal runaway.

Figure 1: Li-ion Tamer Gen 2+ Controllers

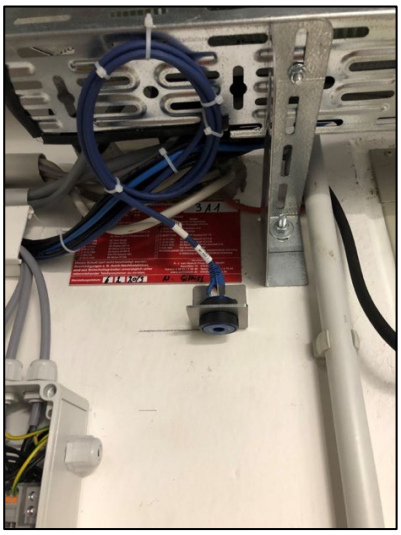


Figure 2: Li-ion Tamer Reference Sensor

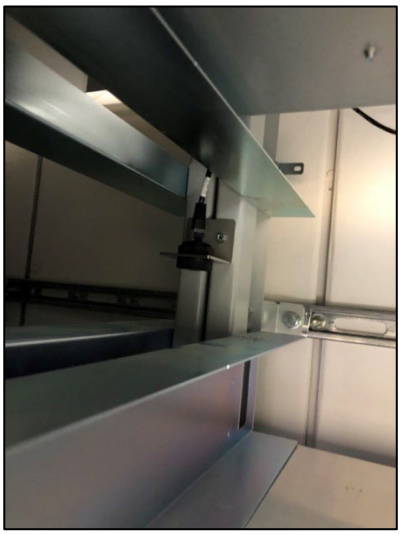


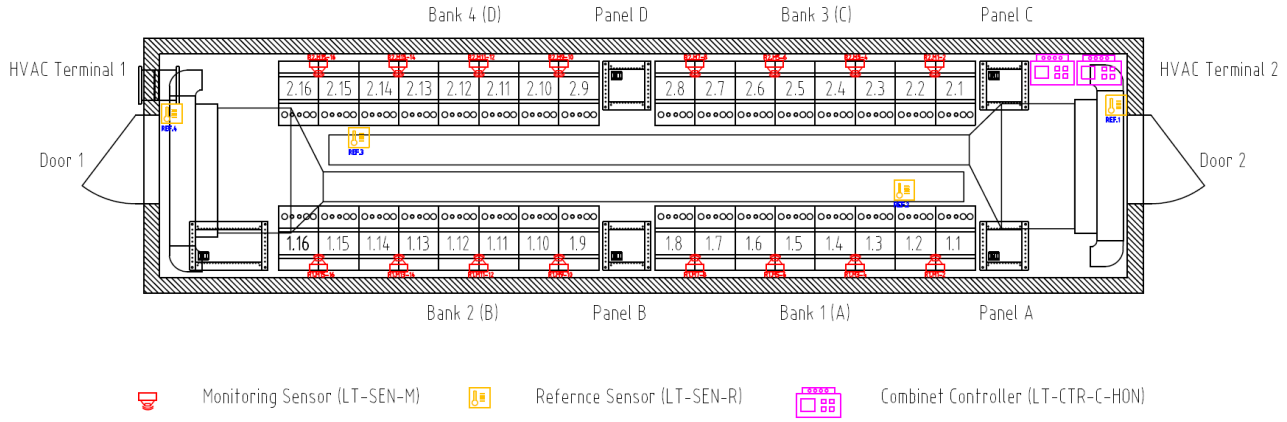
Figure 3: Li-ion Tamer Monitoring Sensor

Preventing thermal runaway protects the BESS from catastrophic failure while minimising the need to activate fire suppression measures. Automatic fire suppression can damage Li-ion cells and other equipment resulting in extensive downtime to execute repairs. On the other hand, once Li-ion Tamer has triggered a shutdown of an affected cell, this cell can be replaced without taking the entire BESS offline. This preventative approach allows Cremzow to achieve very high levels of reliability.

Li-ion Tamer also has the ability to connect to Supervisory Control and Data Acquisition (SCADA) systems using Modbus. This feature allows operators to view system and individual sensor status from remote locations. As this information is live and can be made available in the cloud, a SCADA connection offers a window into the BESS's health from anywhere in the world. GSC has not implemented this integration at Cremzow but has the ability to do so at a later stage.

Installation Details

As can be seen in the installation diagram below, the Li-ion Tamer solution used at Cremzow includes reference sensors, monitoring sensors, and controllers. The controllers in each container are connected to each other via a network.



A third-party installer implemented the system at Cremzow with support from Xtralis. Li-ion Tamer's ease of installation allowed the project to be executed without any delays, thus minimising any BESS downtime. Li-ion Tamer's multiple mounting options simplify installation, adapting to most Li-ion battery rack designs. In addition, easy commissioning with a simple bump test using liquid battery electrolyte compounds (diethyl carbonate) help to reduce installation time.

Performance

Both internal and independent studies show that a Li-ion Tamer system such as the one installed at Cremzow is a faster and more effective way to detect early signs of thermal runaway than Aspirated Smoke Detectors (ASD) and Aspirated Gas Detectors (AGD). As can be seen from the graphs below, Li-ion Tamer provided a 25-minute warning before thermal runaway whereas both ASD and AGD technology only detected an incident after thermal runaway had already begun.

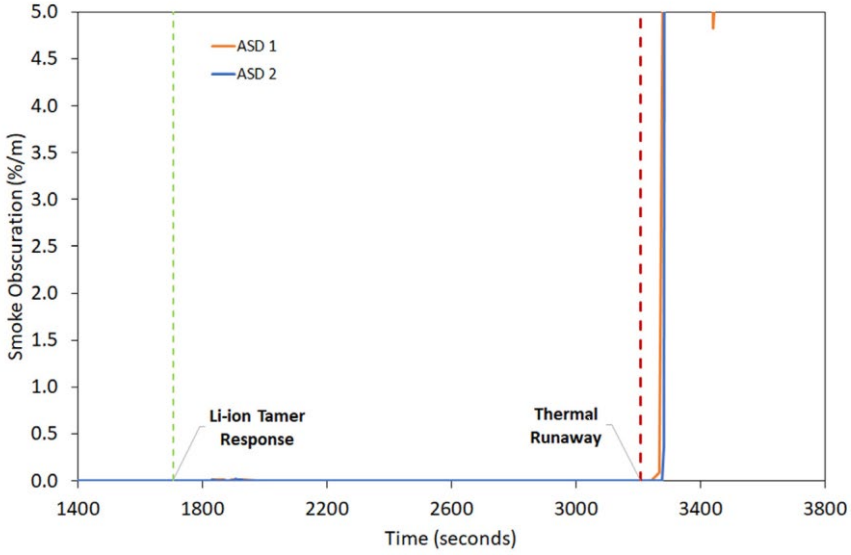


Figure 4: Li-ion Tamer and ASD response (Thermal Runaway noted by perforated red line) (Source: Xtralis)

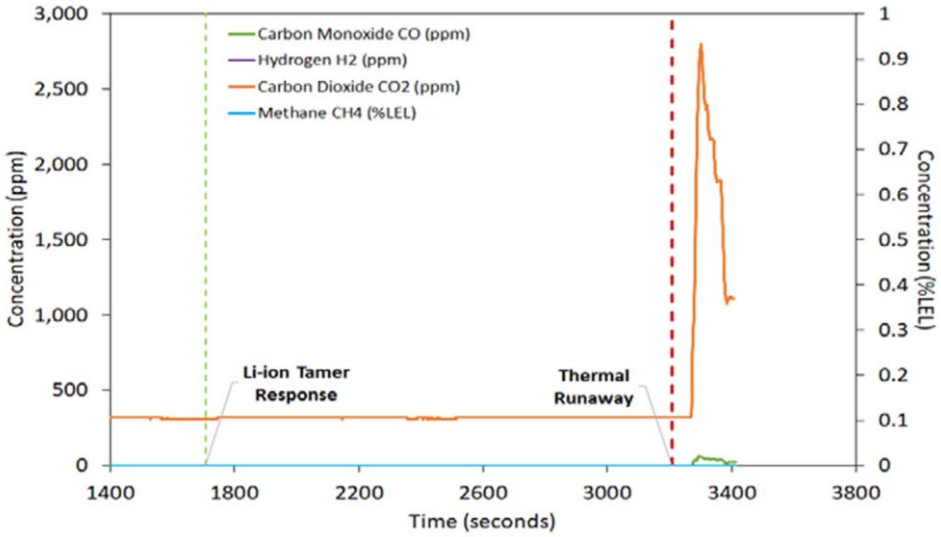


Figure 5: Li-ion Tamer and Gas Detectors (AGD) response (Thermal Runaway noted by perforated red line) (Source: Xtralis)

An independent study by DNV-GL also compared different battery monitoring technologies to assess their effectiveness in detecting thermal runaway. They found that Li-ion Tamer was the only sensor to activate before thermal runaway, giving an average of six minutes of warning time.

	Off-gas release	Off-gas sensor	Thermal Runaway	Cell Voltage	LEL Sensor
Average time of occurrence relative to thermal runaway (seconds)	-381	-371	0	+7	+28

Summary

GSC has a substantial portfolio of BESS facilities with further potential for rapid expansion in line with market growth. As an ongoing exercise in risk management, GSC regularly evaluates the risks of its sites to prioritise mitigation measures, including the use of early warning systems to prevent thermal runaway.

Xtralis implemented the Li-ion Tamer system at the GSC Cremzow facility. The design included reference sensors, monitoring sensors, and control units in each of the 11 containers. If any monitoring sensor triggers, the system will activate an E-stop loop to shut down the affected cell.

Li-ion Tamer has been proven to deliver a far quicker response time than other technologies, like ASD and AGD. Independent tests show that Li-ion Tamer gives an average of six minutes of warning before thermal runaway occurs.

As a result, GSC has considerably lowered its risk of an incident at Cremzow, making it easier to negotiate insurance terms and ensure compliance with future regulations. The company has active engagement with Li-ion Tamer and is in late-stage reviews for retrofits at many of its sites in the UK, as well as incorporating the sensors into its pipeline projects.