levittsafety

YOUR PARTNER IN ALL THINGS SAFETY

Products, service and training solutions.

Agenda

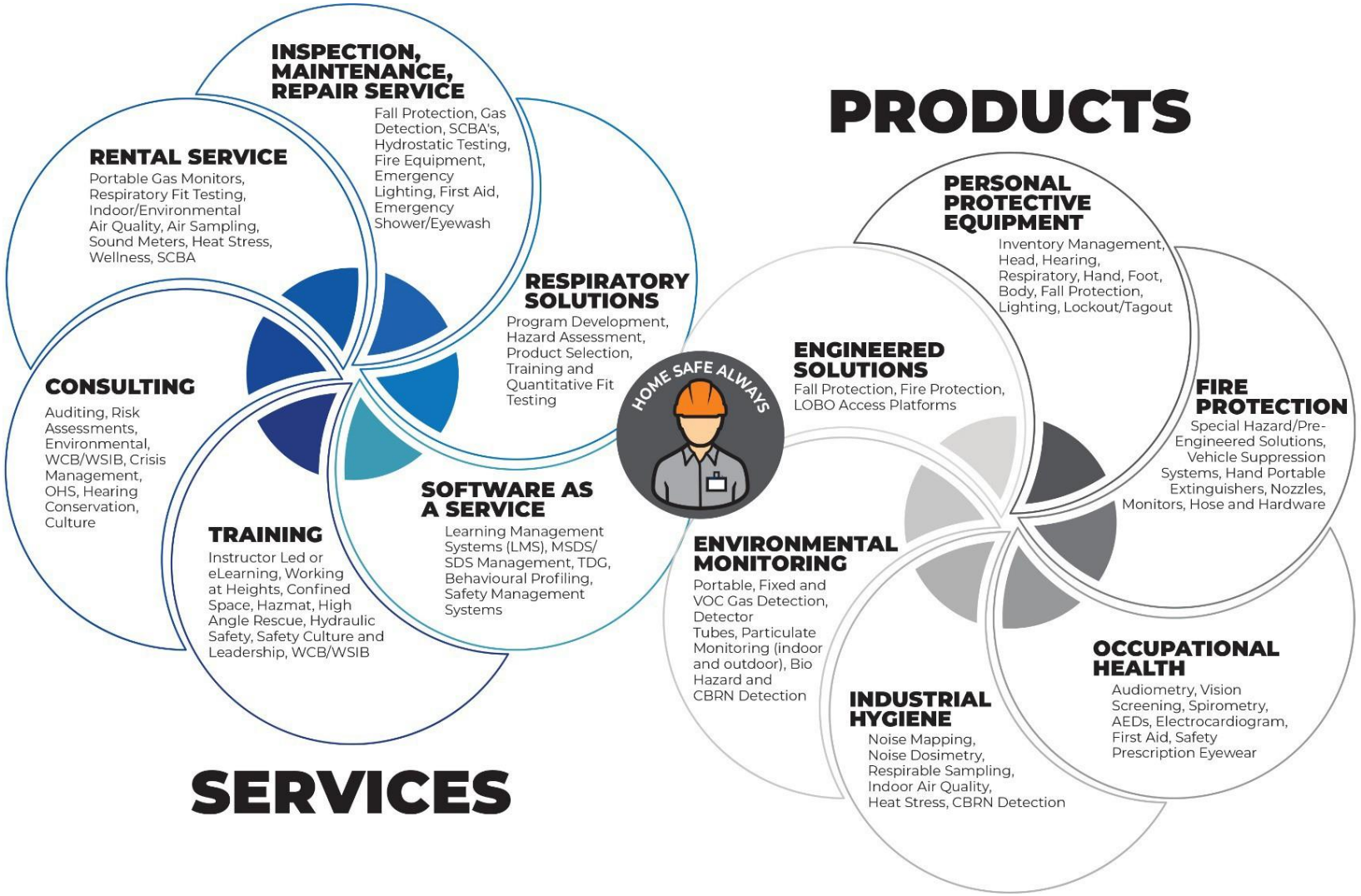
- Introduction
- Fire Risk of Li-ion Batteries
- Understanding of Battery Failure Cycle
- Lithium-Ion Risk Prevention System
- Battery Charging Solution

Who we are

We are Levitt-Safety, a Canada-wide provider of life, fire and environmental safety products and services.

The big picture

Making your job easier is how we know we've done our job. We're an everything safety company, including products, services and training.



Lit-Ion Batteries the Dangers

Battery failures are not common but when they do happen they are major events. The need to catch up with risk mitigation vs applied technologies is very real.

Why Lithium-Ion batteries?

A Lithium-Ion (Li-Ion) battery is a type of **rechargeable battery.**

Lithium-Ion batteries are commonly used for portable electronics and electric vehicles and for energy storage in **wind farms, solar farms, and data center** back-up power applications.

Advantages

- High energy density - potential for yet higher capacities.
- Relatively low self-discharge - self-discharge is less than half that of nickel-based batteries.
- Low maintenance - no periodic discharge is needed; there is no ‘memory effect’.

Lithium-Ion battery limitations and risks

Requires protection circuit to maintain voltage and current within safe limits.

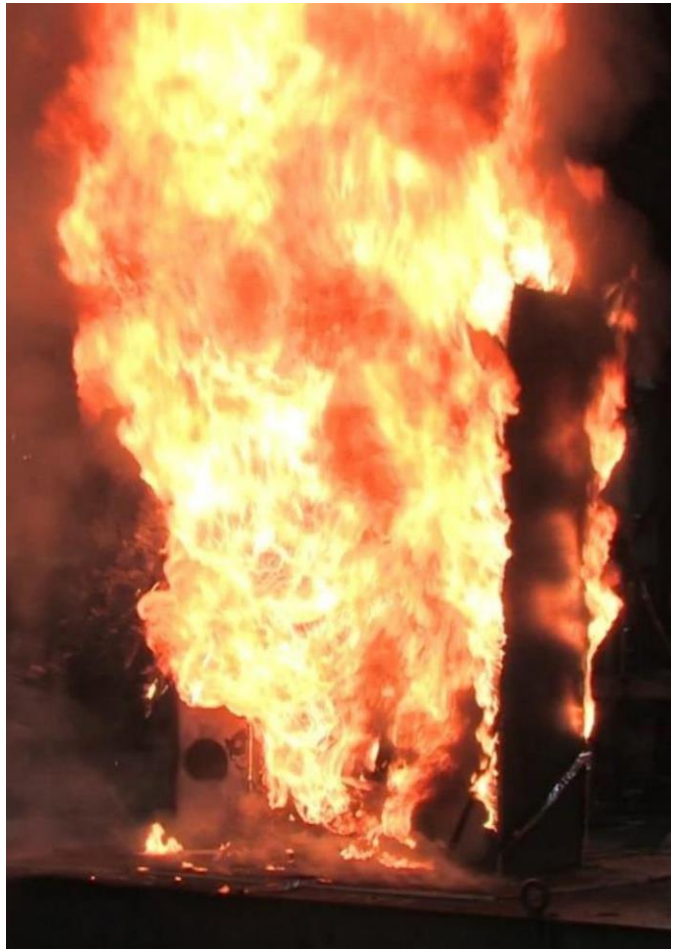
Complex battery management systems need to continuously adapt to battery cell aging.

If things go wrong, the fires are extremely challenging.

1:00:20

1:10:10

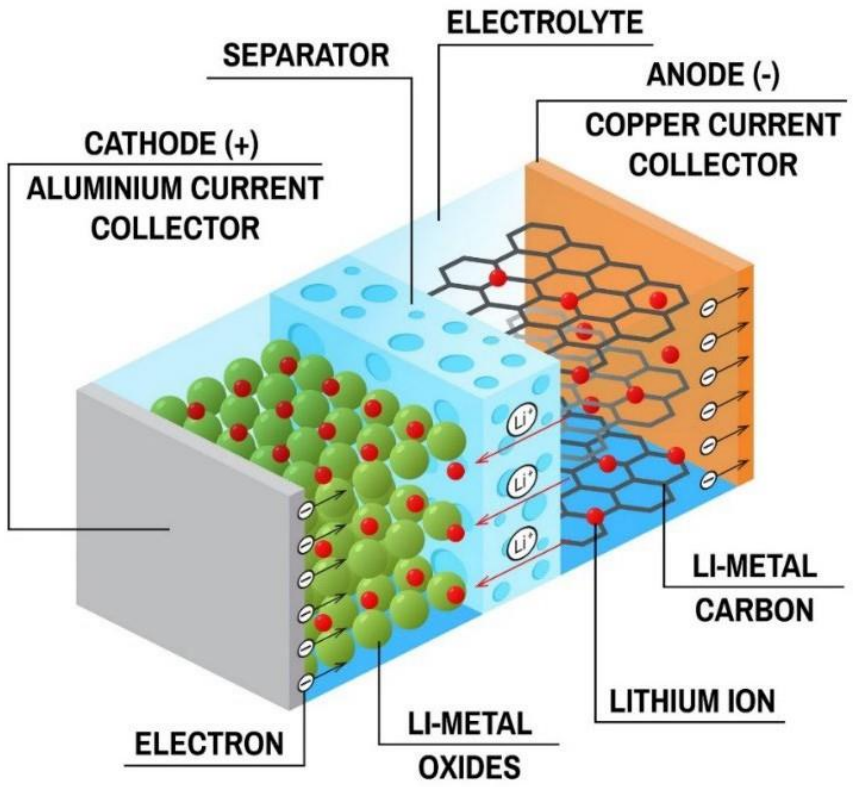
1:28:50



Sources: FM Global Research project RW000029

Lithium-Ion fire risks and Thermal Runaway

Lithium-Ion
battery discharge



Lithium-Ion battery fires

- Separator failure
- Battery cell temperature and pressure increases
- Decomposition of electrolyte
- Venting of flammable gases

Energy storage systems
Lithium-Ion battery fire challenges

High heat release fires

- Rapid extreme temperature rise.
- Battery Rack designs maximize energy storage density = worse case for fire spread.
- Results in fire spreading to adjacent batteries and construction materials.
- Flammable and toxic gases released.

Fire Suppression systems can slow fire growth and heat release, but do not provide complete extinguishment.

Fires can result in catastrophic losses!

Sources: FM Global Research project RW000029

Fire Risks with Lithium-Ion ESS's

Source: *stopthesethings.com*

Source: *Korean Electric Times*

APS storage facility explosion questions about battery safety

AUTHOR
HJ Mai

PUBLISHED
April 30, 2019

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Utilities across the country are increasingly turning to ene
technology is vital as it turns power generated by non-disp
sources, such as wind and solar, into dispatchable ones, in
reliability and allowing the integration of even more renev

However, there are some concerns regarding the safety of
storage facilities, in particular those using lithium-ion batt

A recent explosion at an Arizona Public Service (APS) facil

Source: *utilitydrive.com*


"ESS 폭발 원인은 BMS 오류"

김규환 의원, 관리기준·인증항목 없고 안전관리 가이드 조차 없어

ESS 사고현황

사업 장	용 도	용 량	제조사	화재발생일	재산피해	사고원인
고창 변전소	해상풍력 연계	17MWh	A	'17.8.2	15억원	관도상실BMS오류 추정
경산 변전소	주파수조정	12MWh	B	'18.5.2	23억원	BMS 오류
영암 풍력	풍력 연계	15MWh	B	'18.6.2	88억원	BMS 오류
군산 태양광	태양광 연계	19MWh	C	'18.6.15	9억원	조사중
해남 태양광	태양광 연계	3MWh	C	'18.7.12	5억원	조사중
거창 풍력발전소	풍력발전 연계	9.0MWh	B	'18.7.21	30억원	BMS오류 가능성 높음
세종 아세아제지(주)	피크제어용	18MWh	B	'18.7.28	30억원	작업자부주의 추정

November : Belgium Grid Connected Lithium-Ion System fire

- Public Hazard – resulted in a city-wide shelter

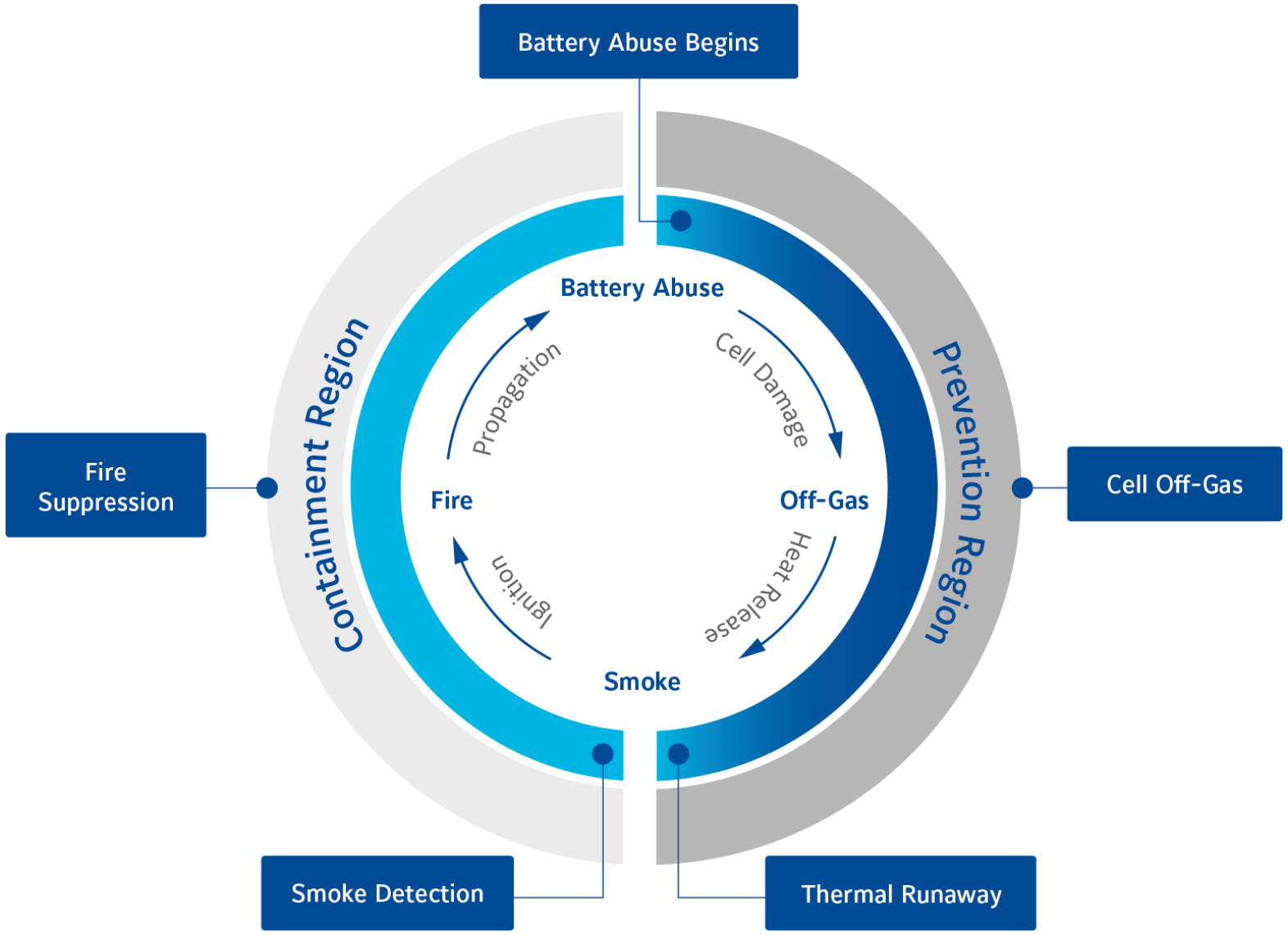
Korea : 30+ Major ESS Fires in Korea.

- Major political issue
- Government shutdown ESS until a safe solution can be deployed
- Loss of more than $18M in property

APS Arizona Public Service

- Lithium-Ion battery system explosion
- 8 firefighter's severe injuries
- Safety becomes a key focus of US energy utilities

Understanding battery failure and ‘Off-Gases’ and how they can be used to prevent Thermal Runaway?



Lithium-Ion Risk Prevention
offers advanced early failure monitoring of Lithium-Ion batteries by detecting Off-Gases.

1

Stage 1: Battery Abuse
Thermal, electrical or mechanical abuse

2

Stage 2: Off-Gas Generation
Time to take ACTION

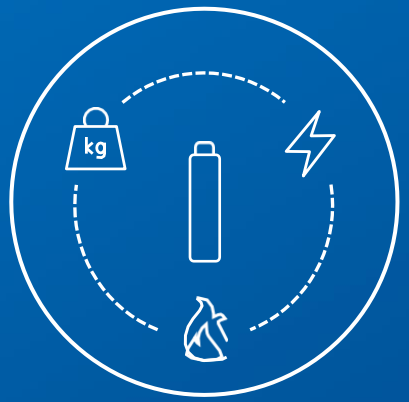
3

Stage 3: Smoke Generation
Catastrophic failure is imminent

4

Stage 4: Fire Generation
Propagation occurrence

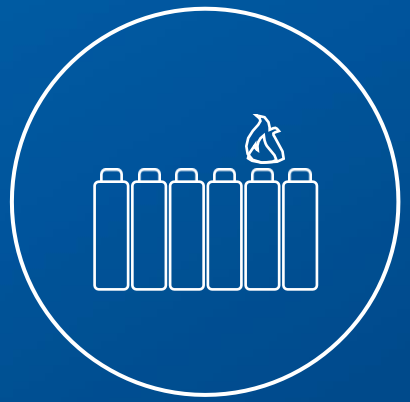
Lithium-Ion battery failure



1

Abuse

- Crushing/puncturing – mechanical damage
- Charging failures
- Manufacturing defects
- External heating



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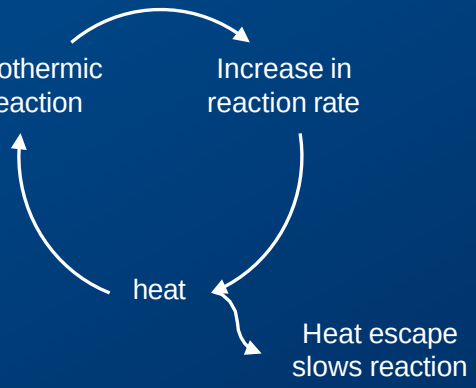
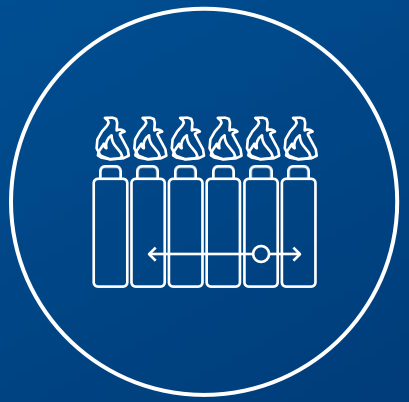
Thermal Runaway





3

Propagation

- Thermal Runaway spreads from one cell to neighboring cells
- Increased generation of Off-Gas materials

Lithium-Ion battery failure

- Once Thermal Runaway has occurred, gaseous suppression and water systems have limited impact on extinguishment.
- Currently, the most effective method of extinguishing these types of fires is with copious amounts of water applied for many, many hours – even days.
- In many areas, this is neither desirable, nor achievable.

Lithium-Ion battery failure

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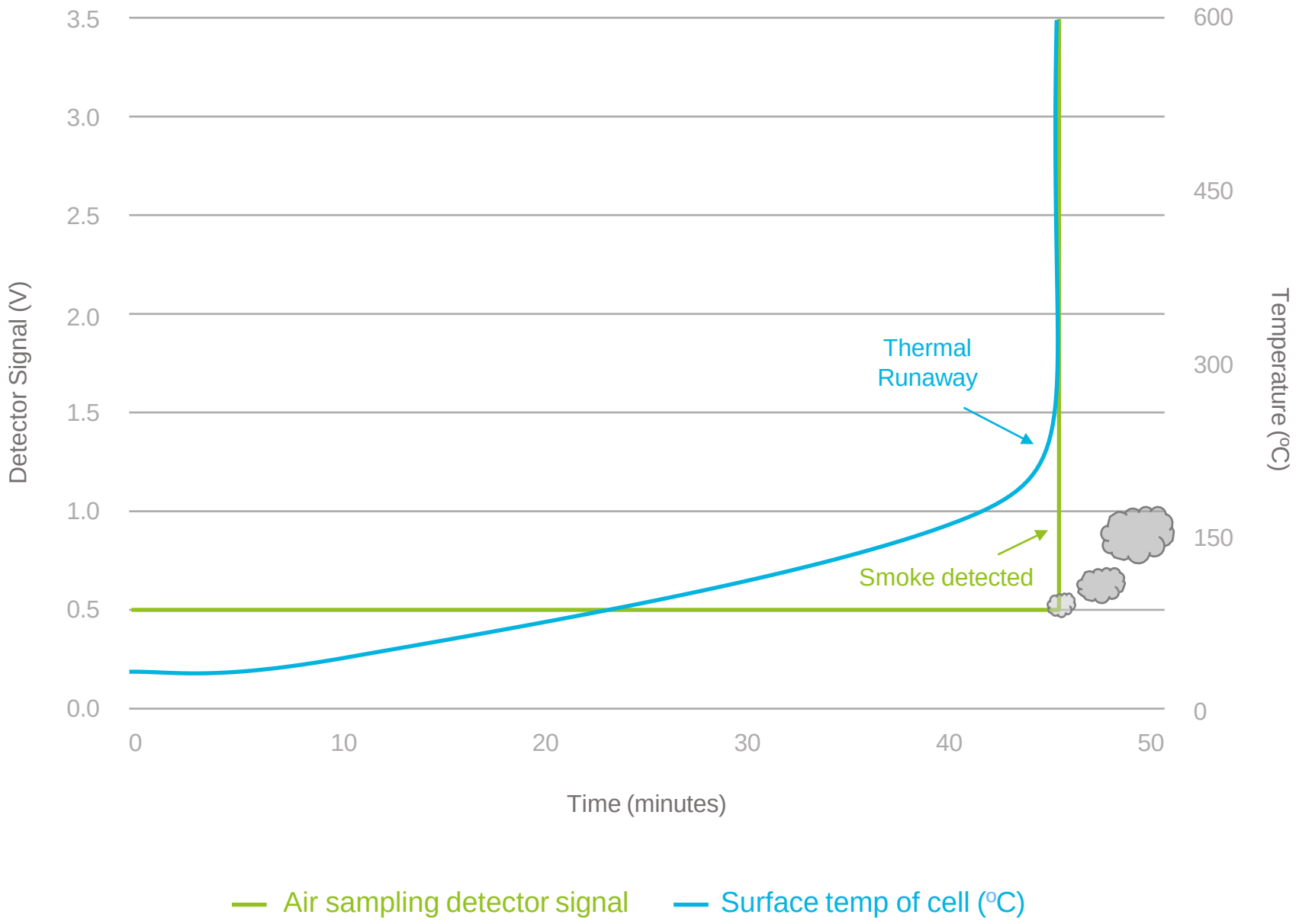
- Currently, the most effective method of extinguishing these types of fires is with copious amounts of water applied for many, many hours – even days.
- In many areas, this is neither desirable, nor achievable.

So... better to prevent the Thermal Runaway from occurring.

Early intervention!

Can we use smoke detectors for early intervention purposes?

Detection of smoke/heat happens after Thermal Runaway has begun



Prevent Thermal Runaway by detecting for Lithium-Ion ‘Off-Gases’

Dictionary

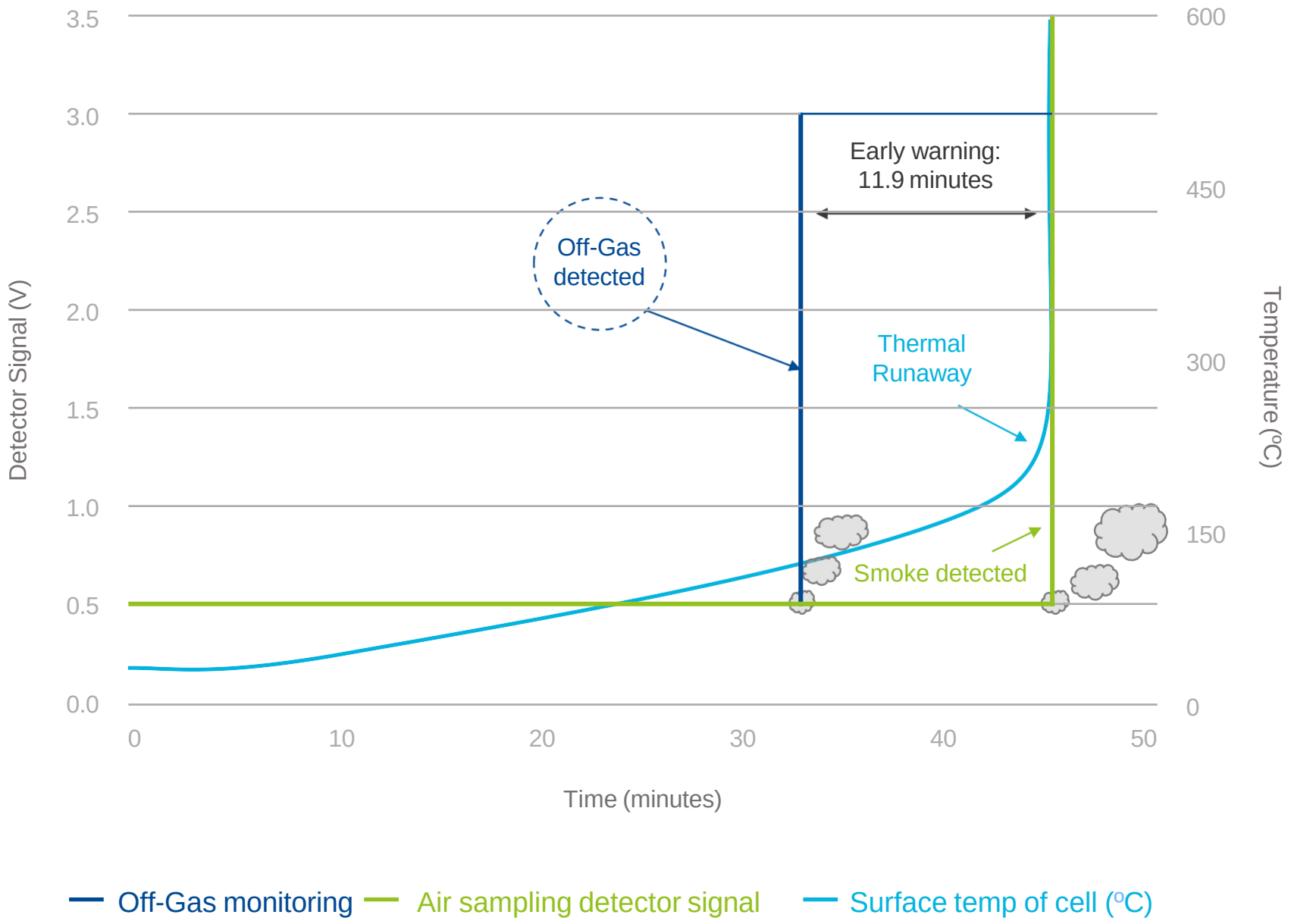
off-gas

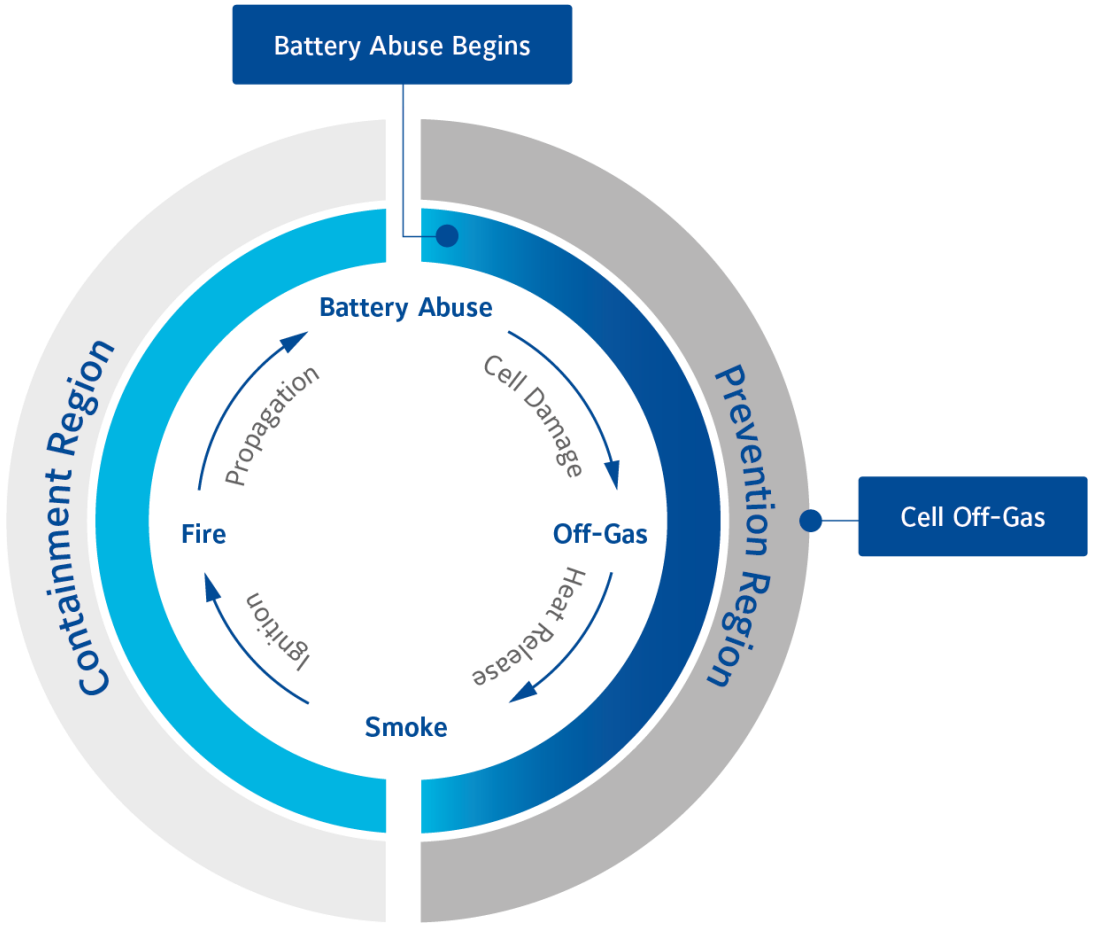
/ˈɒfgas/

noun

1. a gas which is given off, especially one emitted as the by-product of a chemical process.

In the case of Lithium-Ion Batteries when the battery starts to fail, the chemical process produces electrolyte vapor from the battery cells.



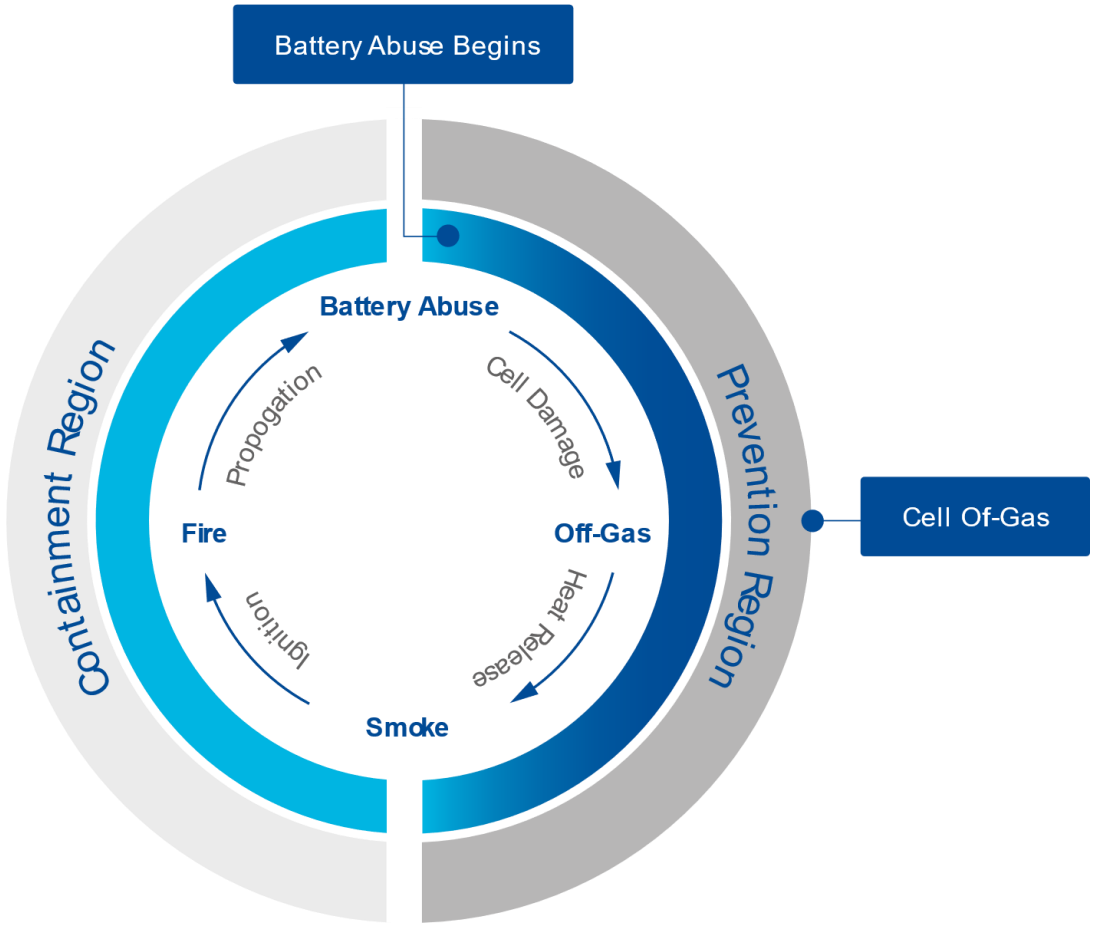


Reacting whilst still in the Preventative Region

We should be aiming to react in the **'Preventative Region'…**

…but we need another means of detection:

With these applications, Smoke Detectors are not able to react quickly enough to help us prevent Thermal Runaway.



Reacting whilst still in the Preventative Region

We should be aiming to react in the **'Preventative Region'…**

…but we need another means of detection:

With these applications, Smoke Detectors are not able to react quickly enough to help us prevent Thermal Runaway.

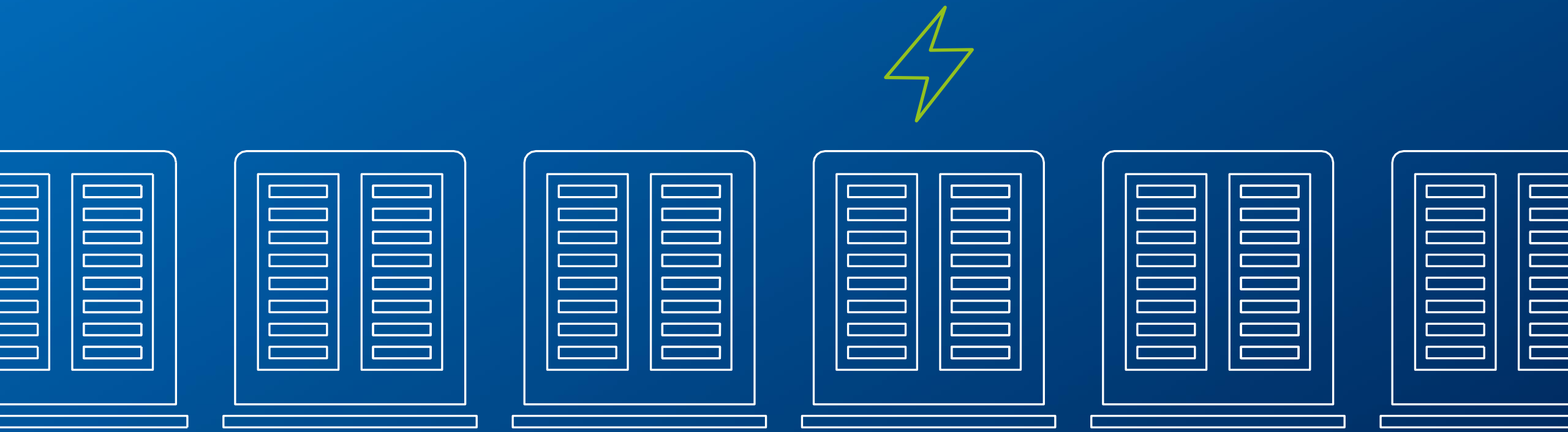
We should detect for the presence of Off-Gases.

We can use this signal to shut down the affected battery stacks and prevent Thermal Runaway.

Solution: Lithium-Ion risk prevention system – Off-Gas monitoring with suppression

Lithium-Ion risk prevention system

Operation

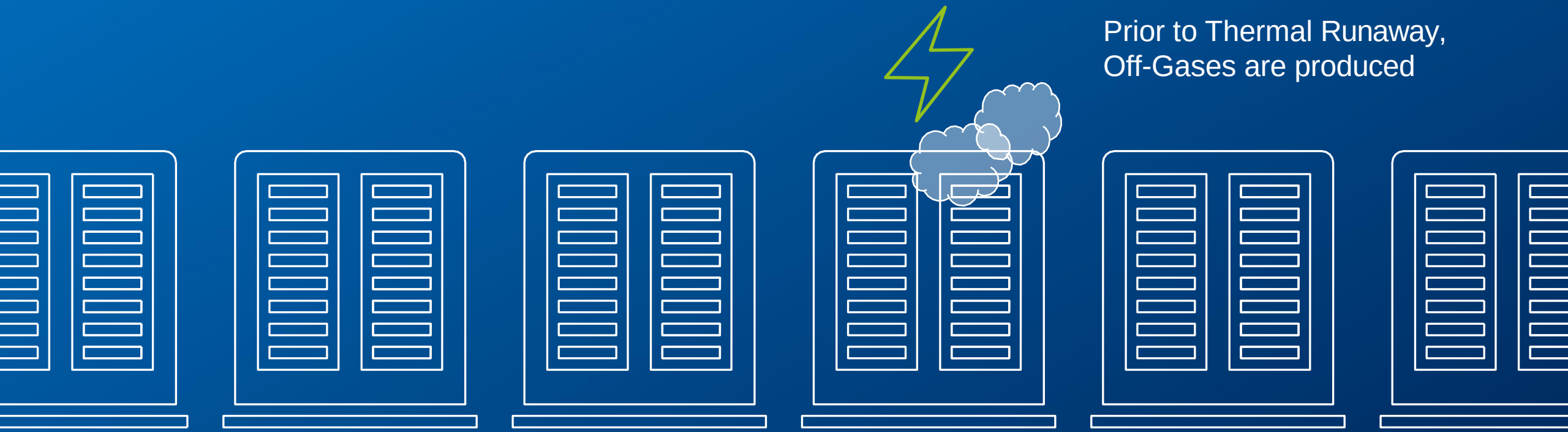


Lithium-Ion battery racks

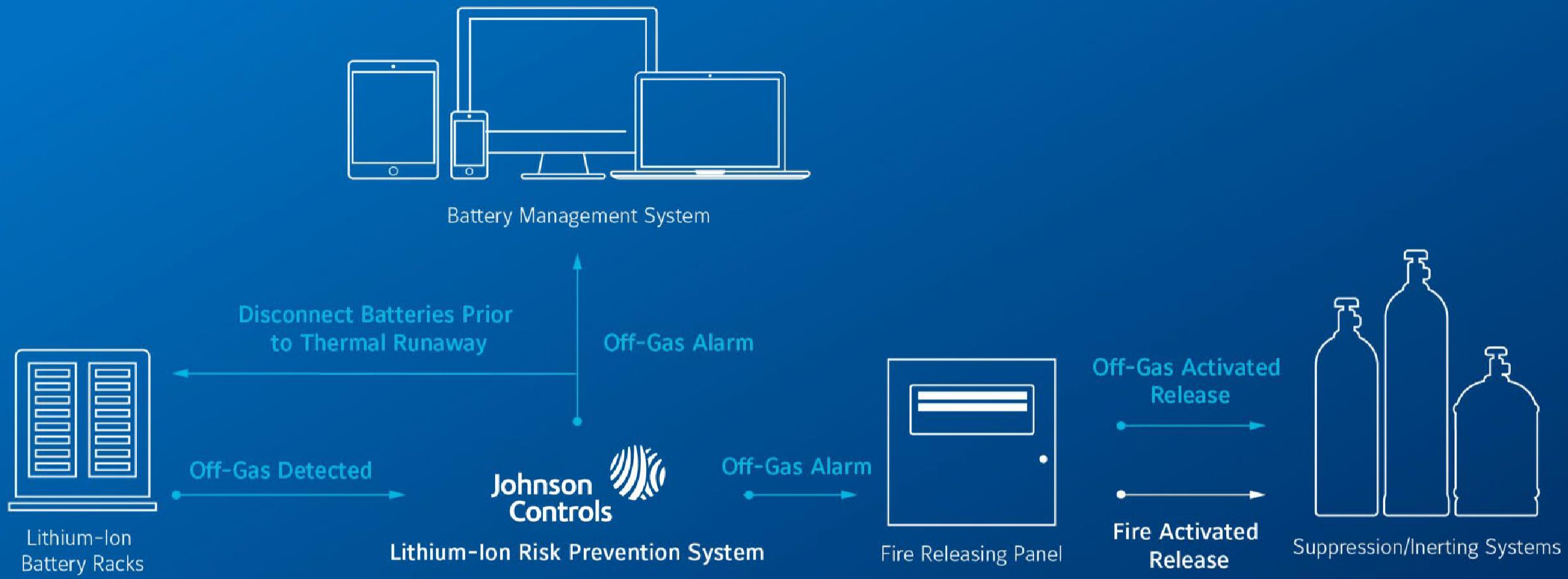
Lithium-Ion risk prevention system

Operation

Prior to Thermal Runaway,
Off-Gases are produced



Lithium-Ion battery racks



For Clarity: If Off-Gases cannot be removed from the room, JCI recommends releasing agent at the Off-Gas alarm stage. When releasing agent at this stage, the design concentration must be set at Inerting levels.

Note: These Suppression/Inerting Systems may not fully extinguish if Thermal Runaway has already occurred.

Battery Management System

Disconnect Batteries Prior to Thermal Runaway

Off-Gas Alarm

Off-Gas Detected

Off-Gas Alarm

Off-Gas Activated Release

Fire Activated Release

Fire Detected

Lithium-Ion Battery Racks

Johnson Controls

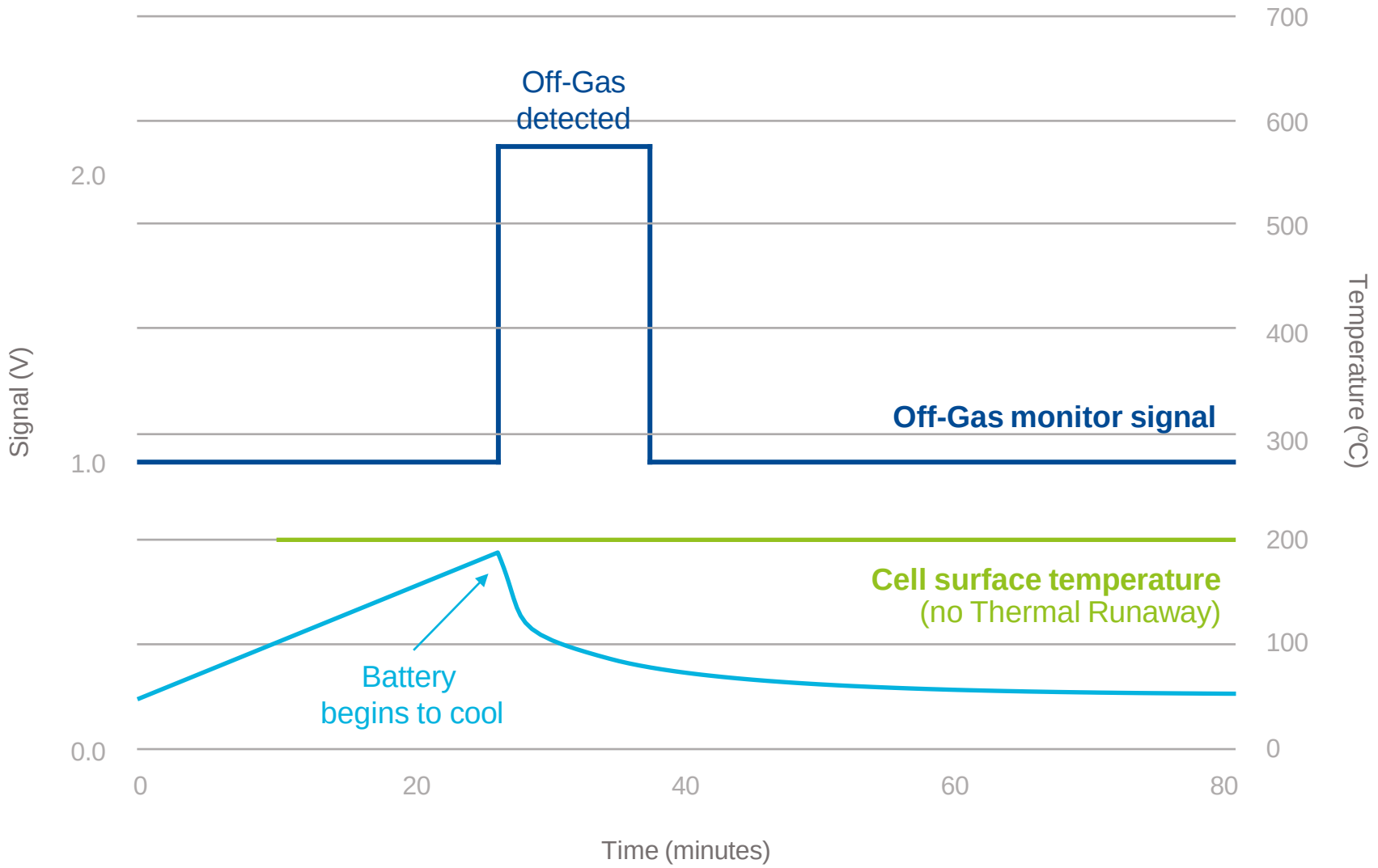
Lithium-Ion Risk Prevention System

Fire Releasing Panel

Suppression/Inerting Systems

Fire Detection (entire system)

The Lithium-Ion risk prevention solution



Components

Lithium-Ion Off-Gas monitoring

Control modules

Combination control module:

- 12 monitoring sensors, 3 reference sensors

Common specifications:

- 210mm (w) x 113mm (l) x 63mm (h)
- ModBus communication
- Low level voltage alarm output
- Power - 24V up to 6.6W
- Module expansion linking
- 10-year life

Compliance specifications:

- IEC 61010, IEC 6100-4, MIL-901D Shock, MIL-167-1A Vibration

CE

ETL LISTED
Intertek

Monitoring / reference sensors

Monitoring sensor:

- Monitors battery racks for presence of Lithium-Ion Off-Gases
- Sensitive to Lithium-Ion battery electrolyte solvent vapors (1ppm)
- Compatible with all Lithium-Ion chemistries

Reference sensors:

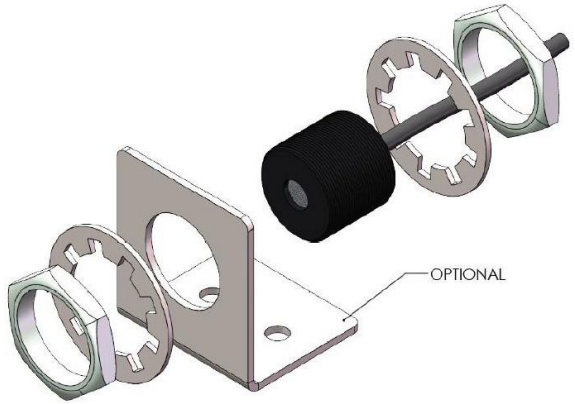
- Monitor room environment air quality

Common specifications:

- -10 to 80ºC temperature range
- 5 to 95% RH
- Power – 75mW each
- 10-year life

Compliance specifications:

- Class 1 B T2 environment, Division 2 Zone 2 Cat 3 location rating
- IEC 61010, IEC 6100-4, MIL-901D Shock, MIL-167-1A Vibration



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The Lithium-Ion risk prevention solution

Integrates existing systems with Off-Gas monitoring

Off-Gas Monitor

Lithium-Ion Risk
Prevention System

Fire Detection

Fire Suppression

SAPPHIRE suppression systems

Inergen with iflowtechnology

Benefits

- The earliest possible indication of battery failures.
- Compatible with all Lithium-Ion chemistries.
- Easy integration – does not require electrical or mechanical contact with the battery cells.
- The system can be integrated into live working environments (upgrade existing systems).
- The ANSUL Lithium-Ion Risk Prevention System can identify Lithium-Ion Battery failures before Thermal Runaway occurs and mitigate against catastrophic failure.

Industry Initiative and Field Test

AGNICO EAGLE

To:	Derek McEwen – Market Segment Manager – Fire Systems and Mining Technology
From:	Norm Ladouceur – Corporate Manager of Health and Safety
Date:	September 22, 2022
Subject:	**Re: Li-ion Battery Safety Cabinet Project Testimonial**

This is a testimonial letter detailing the partnership and work accomplished to make our industry safer regarding Li-ion battery use in Mining operations.

The Solution

- Scalable fire rated enclosures and early detection
- V2 Suppression solutions

The Solution

- The right partners
- Scalability
- Serviceability
- Further Innovation
- Handheld tooling to BEV
- Early Detection-Containment-Suppression

Levitt Safety would like to thank our vendor partners

Thank you for your time and consideration.

ANSUL®
Innovative Fire Solutions

U.S. CHEMICAL storage®
Justrite Safety Group

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