

VENTUS.

FIRE SAFETY REPORT

Date	2023-07-11
Revision	2A



This document serves as a description of technology & functionalities used for battery energy storage system VENTUS line to ensure fire protection & safety.



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SAFETY

is very important part to provide stable & secure system operation over long time. System consist many parts which provide measures to prevent hazard situations & active solutions in the event of unexpected events.



The whole system is secured several times against overvoltage thanks to fuses, grid protections as well as continuous monitoring of all key parameters in the system



A reliable and correctly dimensioned cooling system (with CFD analysis) provides protection against overheating of the technology



Included detection systems warn of the emergence of undesirable situations like exceeding the temperatures of modules or inverters



The battery cell technology itself is built to prevent their deformation up to a temperature of 800 ° C and a normal life of 20+ years (evidenced by UL9540 certification)



An integrated fire alarm system that detects problems in time and can activate the necessary technologies



Container system as modular system to prevent the spread of potentially dangerous situations



Central stop system integrated in each container units

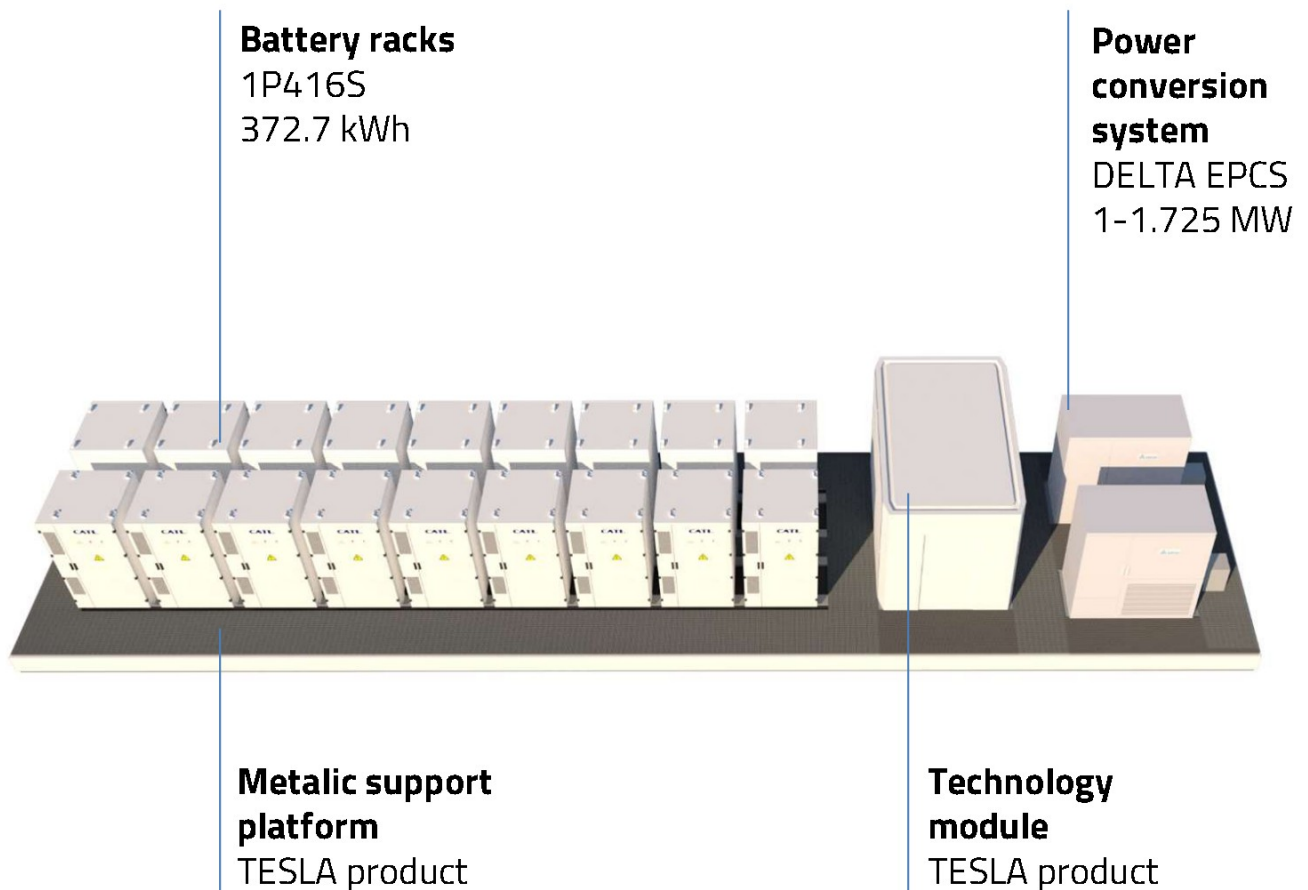


Extinguishing agent which, in the event of a fire, expels the air out of the endangered parts of the container and prevents the system from igniting (this system prevents combustion and thus also the potential formation of hazardous substances)



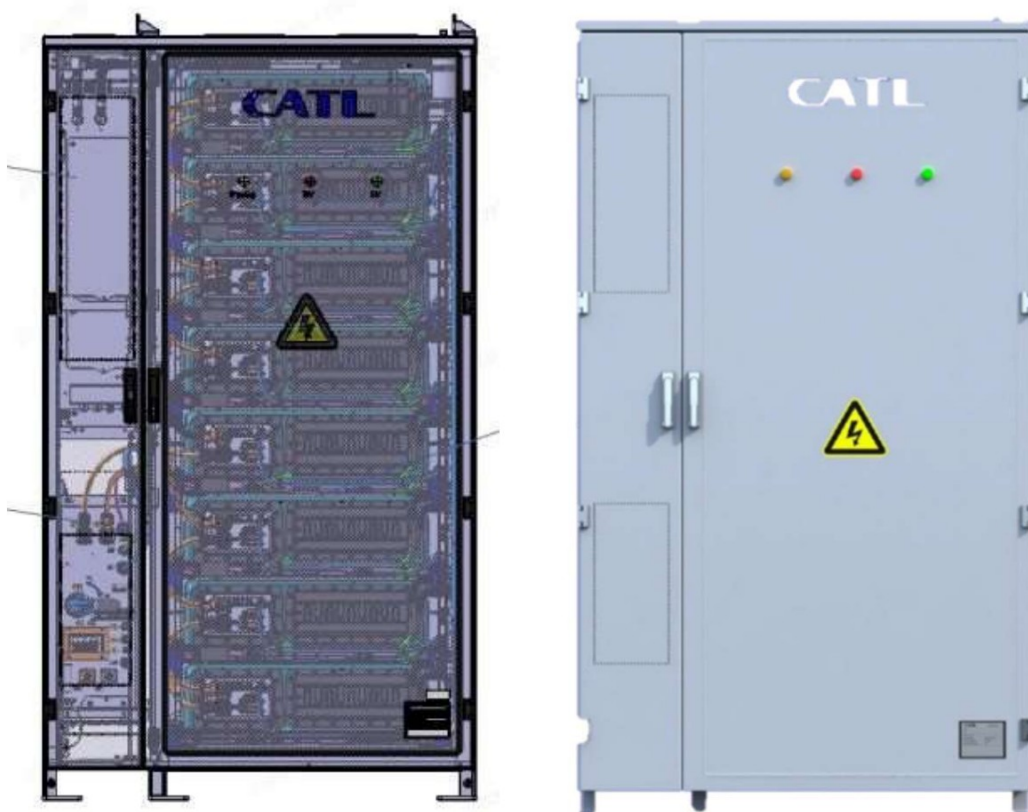
VENTUS COMPOSITION

of the system in individual parts as a modular system for quick installation and customization for the customer.



BATTERY RACKS

Manufacturer	CATL
Rack nominal capacity	372.7 kWh
Model typ	1P416S
Nominal power	1331.2 VDC+-12.5%
Battery cell type	280 Ah
Battery cell capacity	896 Wh
Battery cell chemistry	LiFePO ₄
Maximum C-rate	1.0
Depth of discharge	up to 95%
Guaranteed capacity	80%@6000cycles, 95%DoD, 25°C, 0.5C
Technical service life	>12 years
Battery efficiency	> 93.5%
Self-discharge	< 3.5 % monthly
Rack dimensions	2280 x 1300 x 1300 mm (H x W x D)
Rack weight	3550 kg
Ingress rating	IP66
Ambient temperature	-30~55°C
Cooling type	Liquid (50% ethylene glycol/ 50% aqueous solution)
Fire safety system	Areosol (Heptafluoropropane)
Certification	IEC61000-6-2/-4, IEC62477, IEC62619, UN3.83, UL9540A, UL1973, VDE-AR-E 2510-50, IEC62477



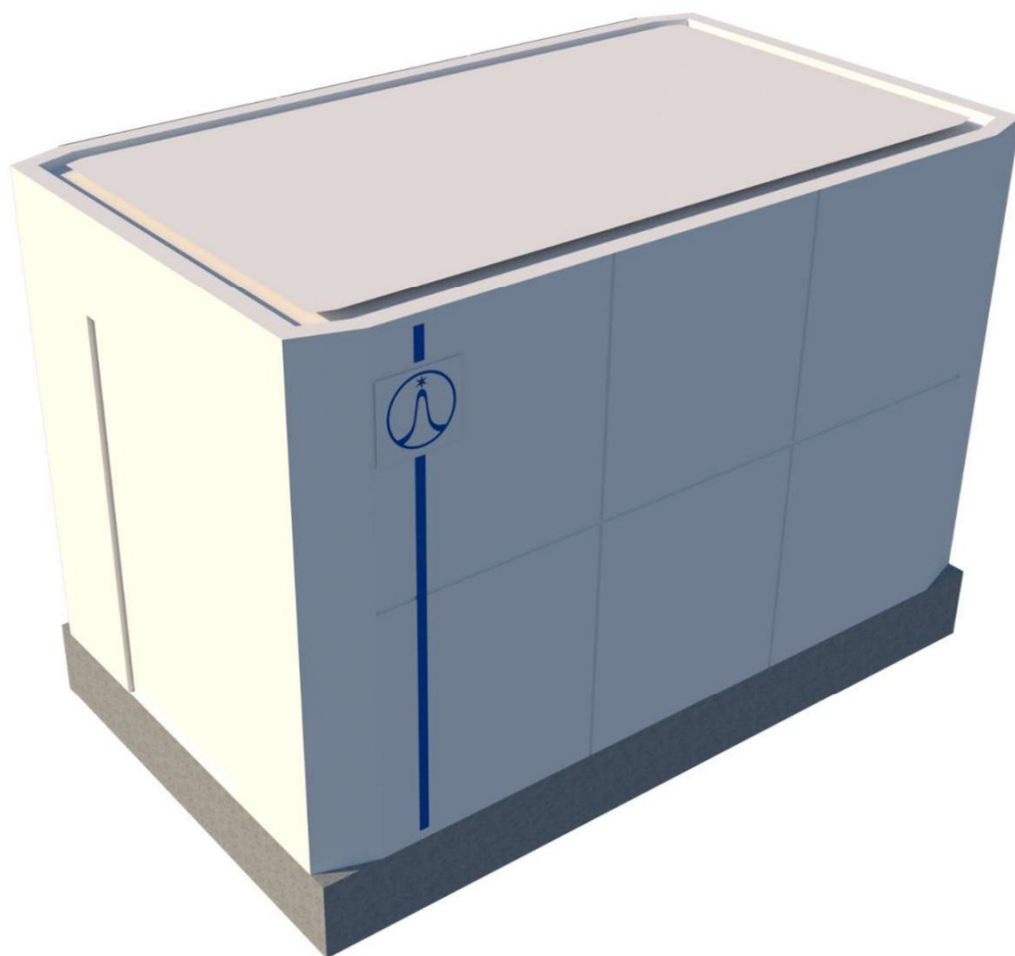
INVERTERS

Manufacturer	DELTA
Type	EPCS1000-1725-IEC
Nominal AC power	1000-1725 kW@40°C
AC voltage level	400-690 V +-10%
DC voltage range	up to 1500 VDC
Max efficiency	> 98.3%
Frequency	50 Hz
Reaction time	< 200 ms
Dimensions	2260 x 2200 x 1100 mm (H x W x D)
Weight	2600 kg
Ingress rating	IP55
Ambient temperature	-30~60°C
Functionalities	Advanced P/Q, Frequency/Voltage, and VSG control Utility-grade protection designed for harsh environment DC and AC-coupled storage applications Automatic voltage and frequency regulation Active and reactive power compensation, Anti-Islanding detection, islanding control operation
Cooling type	Forced air
Grid standard	ENTSO-E
Certification	IEC 62477, IEC 61000-6-2, IEC 61000-6-4 AR-N 4110, G99



TECHNOLOGY MODULE

Manufacturer	TESLA
Type	BLUE4200
Dimensions	4200 x 2440 x 2900 mm
Weight	4000-4500 kg
Material	Aluminium plates with isolation
Cooling type	Forced air
Ingress rating	IP45
Equipment	DC combiner box Control cabinet Local controller cabinet Fire control panel Auxiliary consumption cabinet UPS back-up EMS system



STEPS TO FOLLOW

to provide measures which can help to ensure the safe use of Li-ion batteries and minimize the risk of fire.

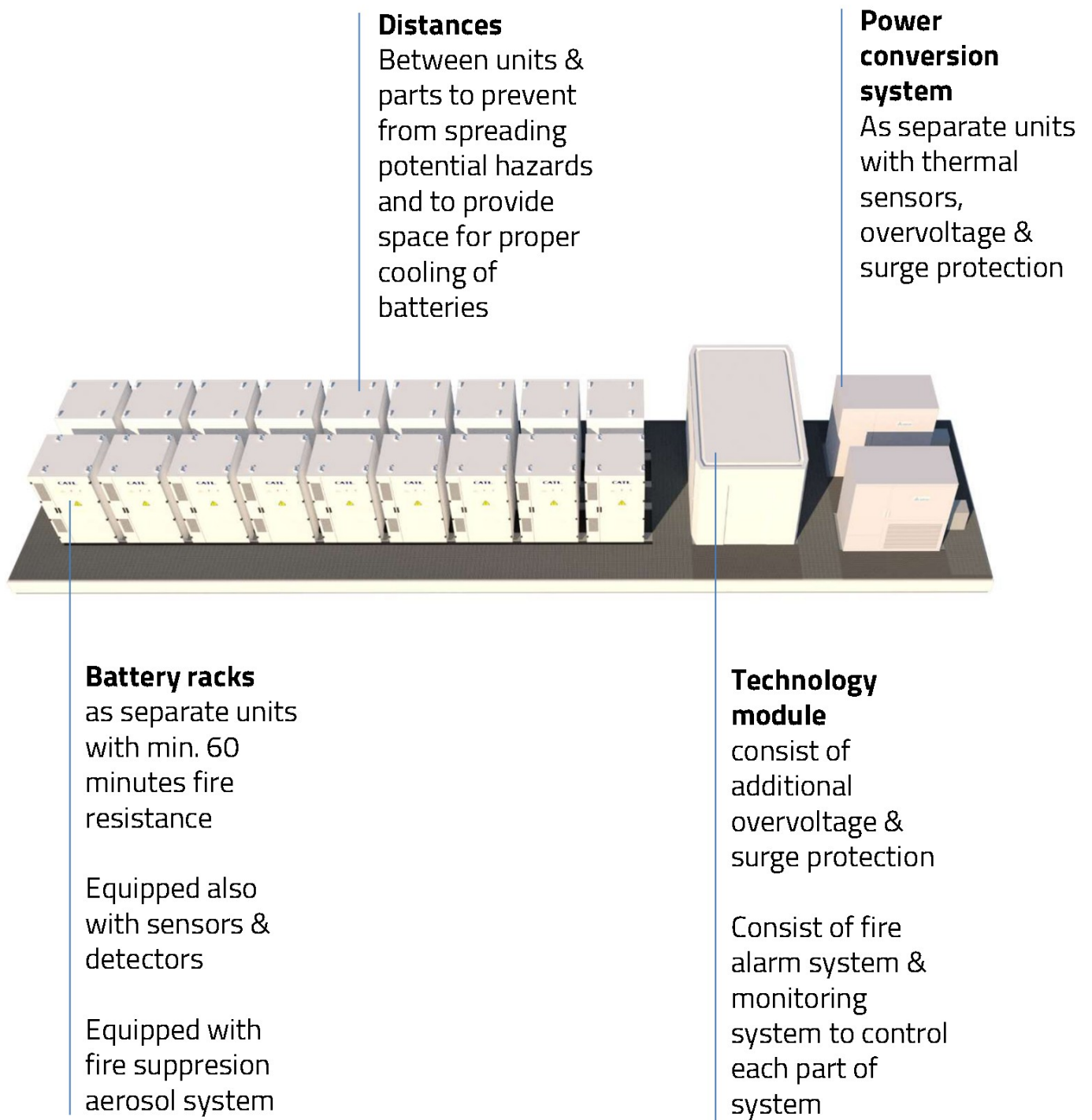
Lithium-ion (Li-ion) batteries are commonly used in various applications, including electronic devices, electric vehicles, and renewable energy systems. While Li-ion batteries offer high energy density and long cycle life, they can also pose fire hazards if not properly designed, manufactured, and used. Here are some measures to provide fire safety for Li-ion batteries:

1. **Design and manufacture:** Li-ion batteries should be designed and manufactured with safety in mind. This includes using high-quality materials, ensuring proper cell spacing, and adding safety features such as overcharge and over-discharge protection, thermal runaway prevention, and a battery management system (BMS).
2. **Storage:** Li-ion batteries should be stored in a cool, dry place away from flammable materials. Avoid storing them in direct sunlight or near sources of heat.
3. **Charging:** Use only chargers that are specifically designed for Li-ion batteries and follow the manufacturer's charging instructions. Overcharging, undercharging, or charging too quickly can cause the battery to overheat and catch fire.
4. **Transportation:** Li-ion batteries should be transported in accordance with the relevant regulations and guidelines. This includes using approved packaging and labeling, avoiding extreme temperatures, and preventing physical damage.
5. **Use:** Li-ion batteries should be used in accordance with the manufacturer's instructions. Avoid exposing them to extreme temperatures, overloading them, or puncturing them.
6. **Monitoring:** Regularly monitor the temperature and voltage of the battery during charging, use, and storage. If you notice any abnormalities such as swelling, overheating, or leaking, stop using the battery immediately and seek professional help.



FIRE PROTECTION DESIGN

as starting point to provide safety from design & construction of battery storage.



FIRE PROTECTION DESIGN

for battery racks as most important part consisting li-ion battery cells.

Smoke detector

Heat sensor

Door sensor

Aerosol capsule
for fire
extinguishing
system

Chiller
for providing
temperature
management for
each battery rack

Control box
providing DC/AC
+ data connection

Battery packs
consist battery
cells, electrical
connection &
liquid
heating/cooling
system

Enclosure
with IP66 & 60
minutes fire
resistance



FIRE PROTECTION DESIGN

for battery cells as key element of whole battery energy storage system.

Cell, modules and rack have all passed the UL9540A test, and the test results show that thermal runaway is strictly controlled within the initiating cell, there is no flaming, flying debris or gas explosion. And adjacent cells and modules function well after test. On this basis, we designed the fire detection and suppression system.

The battery cell technology itself is built to prevent their deformation up to a temperature of 800 ° C and a normal life of 20+ years (evidenced by UL9540 certification).

UL9540 as safety standard for energy storage systems include: safety of BESS, functional safety, fire detection suppression, containment, environmental performance and more.


Letter of Attestation

Document: 80028282 Master Contract: N/A
Project: 80051872 Date Issued: Sep 30, 2020

Issued to: Contemporary Amperex Technology Co., Limited
No. 2 Xingang Road, Zhangwan Town, Jiaocheng District
Ningde City, Fujian Province 352100, P. R. China
Attention: Ms. Sandy Lv

CSA Group hereby confirms that it has completed an evaluation of: Li-ion Battery Rack, models R852280-P-T-I-1, R852280-E-T-I-1, Rx52280-P-T-U-1, Rx52280-E-T-U-1, FRx52280-P-T-U-0, FRx52280-E-T-U-0, OX52280-P, OX52280-E (x means module number 4-8)

CSA Group hereby attests that the products identified above and described in test report 80028282 dated Jan 17, 2020 complies with the following standards/tests, to the extent applicable:

UL 9540A Test Method for Evaluating Thermal Runaway Fire Propagation in Battery Energy Storage Systems, 3rd edition, Revision Date Jun 15, 2018, Section 8 Unit Level Testing.

Issued by: 
Joseph Zhou
CSA Group

THIS LETTER OF ATTESTATION DOES NOT AUTHORIZE THE USE OF THE CSA MARK ON THE SUBJECT PRODUCTS.
QUOTATIONS FROM THE TEST REPORT OR THE USE OF THE NAME OF THE CANADIAN STANDARDS ASSOCIATION AND CSA GROUP OR ITS REGISTERED TRADEMARK, IN ANY WAY, IS NOT PERMITTED WITHOUT PRIOR WRITTEN CONSENT OF CSA GROUP.

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UL 9540 A – Definition

- **"BATTERY ENERGY STORAGE SYSTEM (BESS)"** - Stationary equipment that receives electrical energy and then utilizes batteries to store that energy for later use in order to supply electrical energy when needed. The BESS consists of one or more modules, a power conditioning system (PCS) and balance of plant components.

a) **INITIATING BATTERY ENERGY STORAGE SYSTEM UNIT (INITIATING BESS)** – A BESS unit which has been equipped with resistance heaters in order to create the internal fire condition necessary for the installation level test (Section 8).

b) **TARGET BATTERY ENERGY STORAGE SYSTEM UNIT (TARGET BESS)** – The enclosure and/or rack hardware that physically supports and/or contains the components that comprise a BESS. The target BESS unit does not contain energy storage components, but serves to enable instrumentation to measure the thermal exposure from the initiating BESS.

- **"CELL"** - The basic functional electrochemical unit containing an assembly of electrodes, electrolyte, separators, container, and terminals. It is a source of electrical energy by direct conversion of chemical energy.

- **"DUT"** – Device under test.

- **"ELECTRICAL RESISTANCE HEATERS"** – Devices that convert electrical energy supplied from a laboratory source into thermal energy.

- **"FLEXIBLE FILM HEATERS"** – Electrical resistance heaters of a film, tape or otherwise thin sheet like construction that easily conform to the surface of cells.

- **"MODULE"** – A subassembly that is a component of a BESS that consists of a group of cells or electrochemical capacitors connected together either in a series and/or parallel configuration (sometimes referred to as a block) with or without protective devices and monitoring circuitry.

- **"STATE OF CHARGE (SOC)"** – The available capacity in a BESS, pack, module or cell expressed as a percentage of rated capacity.

- **"THERMAL RUNAWAY"** – The incident when an electrochemical cell increases its temperature through self-heating in an uncontrollable fashion. The thermal runaway progresses when the cell's generation of heat is at a higher rate than the heat it can dissipate. This may lead to fire, explosion and gas evolution.

- **"UNIT"** – A frame, rack or enclosure that consists of a functional BESS which includes components and subassemblies such as cells, modules, battery management systems, ventilation devices and other ancillary equipment.



FIRE PROTECTION DESIGN

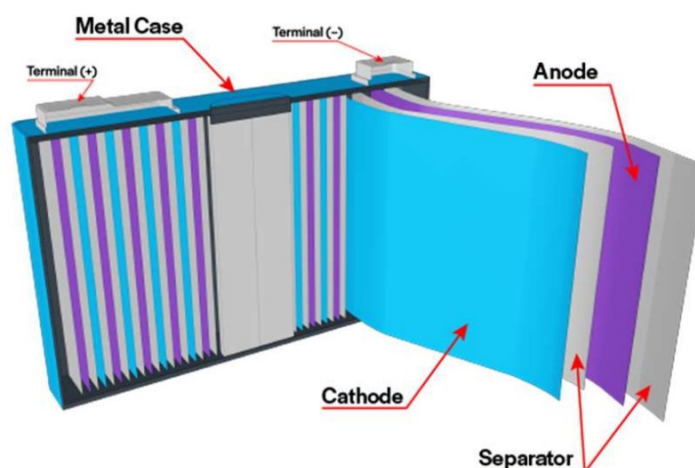
for battery cells as key element of whole battery energy storage system.

UL 1973 is a safety standard for stationary batteries for energy storage applications that is not specific to any one battery technology or chemistry and can apply to Li-ion BESSs, as well as ESSs using other battery chemistry. The standard includes construction requirements, safety performance tests and production tests.

UL 1973 contains a series of construction parameters, including requirements for nonmetallic materials, metallic parts resisting corrosion, enclosures, wiring and terminals, electrical spacing and separation of circuits, insulation and protective grounding, protective circuits and controls, cooling/thermal management, electrolyte containment, battery cell construction, and system safety analysis.

Mechanical tests are also required by UL 1973, including a vibration test, shock test, and crush test, which only apply to LER applications. Other mechanical tests that apply to all systems include a static force test, impact test, drop impact test, wall mount fixture/handle test, mold stress test, pressure release test, and a start-to-discharge test. Additional environmental tests are also required by UL 1973, including a thermal cycling test, resistance to moisture test, and a salt fog test

The internal fire test is meant to demonstrate how the ESS will prevent a single cell failure within the battery system from cascading into a fire and/or explosion. In the internal fire test, the fully charged Energy storage solution is subjected to heating until thermal runaway of one internal battery cell that is centrally located within the ESS. Once the thermal runaway is initiated, the mechanism used to create thermal runaway is shut off or stopped and the ESS is subjected to a one hour observation period. Fire cannot propagate during this observation period or result in an explosion.



FIRE PROTECTION DESIGN

for battery racks, which ensures the fire resistance of the cover for at least 60 minutes. This security is intended to enable the fire suppression system to limit the spread of fire and extinguish it, as well as to ensure sufficient time for the arrival of rescue services.



中国认可
国际互认
检测
TESTING
CNAS L6069



Test Report

Report No. TC.21.10.004759

Date of Issue 11/05/2021

Conclusion	The test lasted for 60 min. At 14min, thermocouple TC4 fall off, so insulation couldn't be determined. Integrity: 60 min
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Appendix:



Graph 3-Test photos



FIRE PROTECTION EQUIPMENT

for monitoring the status of batteries and unwanted situations.

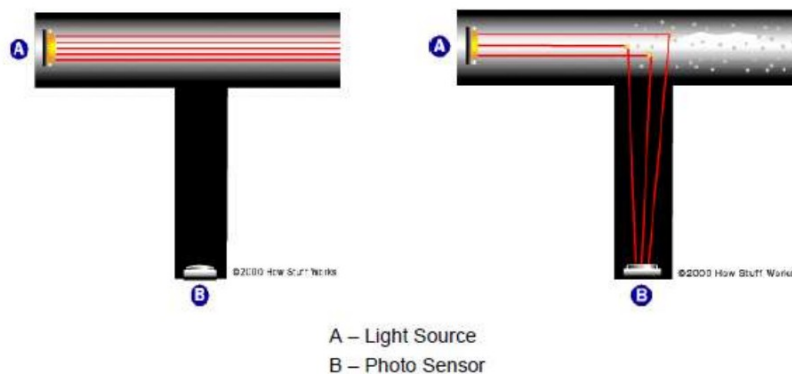
Photoelectric Smoke Sensor

The principle of using a light source and a photosensitive sensor arranged so that the rays from the light source do not normally fall onto the photosensitive sensor. When smoke particles enter the light path, some of the light is scattered by reflection and refraction onto the sensor.

The light signal is processed and used to convey an alarm condition when it meets preset criteria.

In the normal case, the light from the light source on the left shoots straight across and misses the sensor.

When smoke enters the chamber, however, the smoke particles scatter the light and some amount of light hits the sensor.



Heat Sensor

The working principle of temperature detector is to detect fire by using heat sensitive elements. In the initial stage of fire, on the one hand, a lot of smoke is produced, on the other hand, a lot of heat is released in the combustion process, and the ambient temperature rises sharply. The thermal element in the detector has physical change, so that the temperature signal is converted into electrical signal, and the alarm processing is carried out.



FIRE PROTECTION EQUIPMENT

for monitoring the status of batteries and unwanted situations.



Photometric Smoke Detector Series 65 A

Smoke detector works on the light scatter principle and is ideal for applications where slow burning or smouldering fires are likely.

- Responds well to slow burning, smouldering fires
- Unaffected by wind or atmospheric pressure
- High-sensitivity option



Heat Detector Series 65 A

Heat detector monitors temperature by using a dual thermistor network providing a voltage output proportional to the external air temperature. The nine detectors inside are designed to suite variety of operating conditions. The ratio of the resistance of the thermistors is monitored electronically and an alarm is initiated if the ratio exceeds the factory pre-set level.



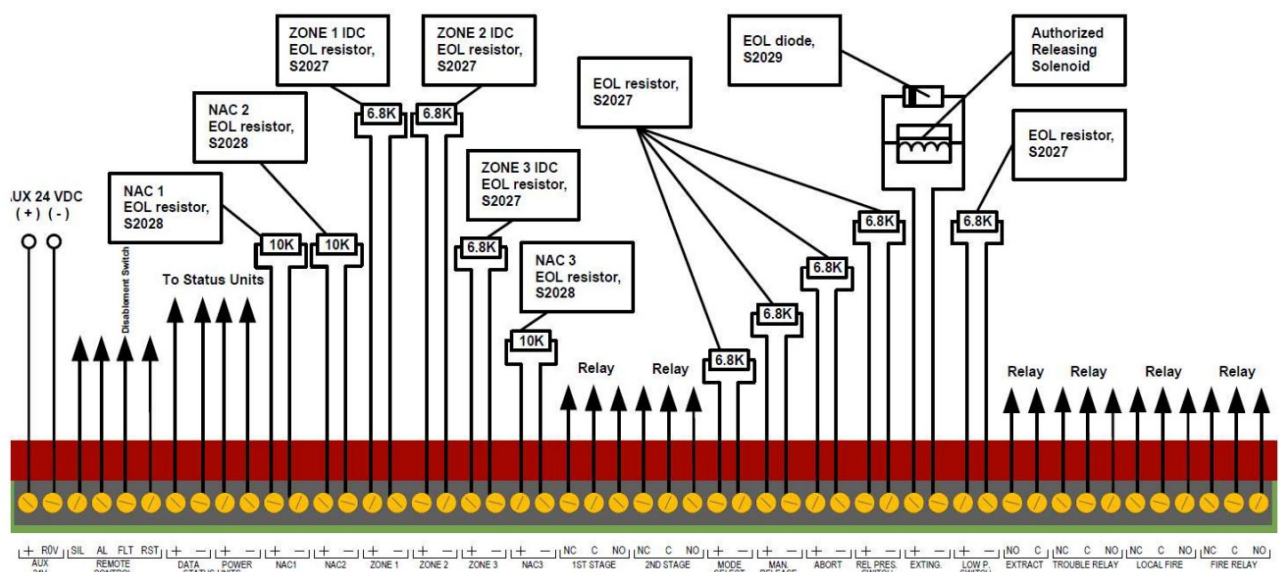
FIRE CONTROL PANEL

as an important element for ensuring the monitoring of the condition of all equipment for detecting and extinguishing a possible fire.

The Sigma A-XT Releasing Fire Control Panel is a conventional fire control panel and releasing system.

The fire control panel provides connections for Detection Zones, Notification Appliance Circuits (NACs), Releasing Circuits, Relay Outputs, Status Units and AUX 24 V power. Models of the Sigma A-XT Releasing Fire Control Panel provide 115 VAC or 230 VAC operation in modes for regulated and special application environments.

System is connected with master BMS (battery management system) and local controller system (LCC – AMOS) to provide all indication about status in battery racks.



FIRE CONTROL PANEL

as an important element for ensuring the monitoring of the condition of all equipment for detecting and extinguishing a possible fire.

The Sigma A-XT Releasing Fire Control Panel provides functions for:

Zone Testing	The zone testing function provides an automatic reset of zones in alarm.
NAC Delay	The NAC delay function suspends the NAC output and permits alarms to be verified before premises are evacuated.
NAC Reactivation	The NAC reactivation function provides an alarm resound.
Voltage Free Relay Contacts	Voltage free relay contacts are provided for local control and signalling.
Releasing Delay	The releasing delay function suspends the releasing signal for up to 60 seconds.
Releasing Signal	The releasing signal provides identification of the pending extinguishant release and the flow of extinguishant during the releasing process.
Low Pressure	The low pressure function provides releasing agent monitoring using a pressure switch to measure low pressure conditions.
Abort	The abort function provides suspension of the releasing count-down when contacts on an external-momentary-switch are closed.
Deactivation Time	The deactivation time function provides a delay setting to control the output quantity of the releasing agent.
Manual Only Mode	The manual only mode disables the releasing operation using automatic detection devices.
Relays	First and second stage relay contacts are provided to trigger equipment outside the system.
Warnings	Pre-discharge and release warnings are provided with separate audible tones and frequencies. These operating characteristics allow the two warnings to be differentiated on the fire control panel.
Supervisory	The supervisory signal function provides audible and visual indications on the fire control panel and on external status units. This mode also operates the output of the TROUBLE RELAY. All supervisory conditions are non-latching.
Power Source	The power source failure function provides immediate audible and visual indications at the fire control panel. The audible and visual indications are also provided on external status units. Status Units can operate the output of the TROUBLE RELAY.
Interconnected	status units are provided with a limited set of indicators and functions compared with those provided on the Sigma A-XT Releasing Fire Control Panel. Status unit functions are non-configurable on the fire control panel.



FIRE CONTROL PANEL

as an important element for ensuring the monitoring of the condition of all equipment for detecting and extinguishing a possible fire.

Certificate:

Certificate of Compliance	
Certificate Number	20110628-S8485B
Report Reference	S8485, 2011 May 30
Issue Date	2011 June 28
Page 1 of 1	
 Underwriters Laboratories	
Issued to:	KENTEC ELECTRONICS LTD
	VES FIRE DETECTION SYSTEMS FAWKES AVE, UNITS 25-27,DARTFORD TRADE DARTFORD, KENT DA1 1JQ UNITED KINGDOM
This is to certify that representative samples of	CONTROL UNITS, SYSTEM Fire Alarm Equipment: Releasing Panel – Elite XT Panel Series, Models VF1810-10, -11, -40, -41, K1810-12, -13, -43, -44.
	Have been investigated by Underwriters Laboratories Inc.® (UL) or any authorized licensee of UL in accordance with the Standard(s) indicated on this Certificate.
Standard(s) for Safety:	UL864, Control Units and Accessories for Fire Alarm Systems, Ninth Edition
Additional Information:	See UL On-Line Certification Directory at www.UL.com for additional information.
Only those products bearing the UL Listing Mark should be considered as being covered by UL's Listing and Follow-Up Service.	
The UL Listing Mark generally includes the following elements: the symbol UL in a circle;  with the word "LISTED"; a control number (may be alphanumeric) assigned by UL; and the product category name (product identifier) as indicated in the appropriate UL Directory.	
Look for the UL Listing Mark on the product	
William R. Carney Director, North American Certification Programs Underwriters Laboratories Inc. Any information and documentation involving UL Mark services are provided on behalf of Underwriters Laboratories Inc. (UL) or any authorized licensee of UL. For questions, please contact a local UL Customer Service Representative at http://www.ul.com/global/eng/pages/corporate/contactus/	



AEROSOL FIRE SYSTEM

It ensures the elimination of the formation and spread of fire as well as its elimination.

Introduction

Fireaway LLC aerosol fire suppression systems are designed for total flooding applications in accordance with established design criteria. Application methods, design criteria, and limitations are contained within this manual. In any situation not specifically covered by this manual, the application and installation of the system must be in accordance with the appropriate and/or applicable standards. All installations must meet the requirements of the local authority having jurisdiction.

Fire suppression systems produce a highly effective, technologically advanced fire suppression agent with unique operational and flow characteristics. Since these systems are designed and installed in a manner different than other suppression systems with which the system designer may be familiar, the system designer must become thoroughly familiar with the design criteria contained in this manual in order to properly input design data and parameters. There are a number of limitations, which must be observed in entering parameters if accurate results are to be obtained.

Fire suppression systems combine an environmentally safe fire suppression agent, specially developed components, and highly effective detection devices for rapid agent application. The resulting timely suppression of fire reduces property damage and products of combustion to the lowest possible levels. These systems are electrically activated, are extremely compact, and totally eliminate the expensive pressure vessels, nozzles, and distribution piping associated with other fire suppression systems. Stat-X® fire suppression systems offer significant weight and space savings. Generators are strategically placed throughout the hazard area and are designed to discharge in seven to thirty six seconds, depending on the size of the generator.

The agent produced is a Potassium based aerosol with particle sizes primarily in the ≤ 2 micron size. The aerosol has the flow characteristics of a gas and has been determined to be non-toxic to humans when exposed for short periods at recommended design concentrations.



AEROSOL FIRE SYSTEM

It ensures the elimination of the formation and spread of fire as well as its elimination.

Certificated

CERTIFICATE OF COMPLIANCE

Certificate Number 20180724-EX15004
Report Reference EX15004
Issue Date 2018-July-24

Issued to: FIREAWAY INC
5852 Baker Rd
Minnetonka, MN 55345 USA

This is to certify that
representative samples of Fixed Condensed Aerosol Extinguishing System Units

Have been investigated by UL in accordance with the
Standard(s) indicated on this Certificate.

Standard(s) for Safety: ANSI/UL 2775, "Fixed Condensed Aerosol Extinguishing
System Units."

Additional Information: See the UL Online Certifications Directory at
www.ul.com/database for additional information

Only those products bearing the UL Certification Mark should be considered as being covered by UL's
Certification and Follow-Up Service.

Look for the UL Certification Mark on the product.

See addendum page.

B. Mahlen

Bruce Mahlenholz, Director North American Certification Program
UL LLC

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contact a local UL Customer Service Representative at <http://ul.com/about/locations/>



AEROSOL FIRE SYSTEM

It ensures the elimination of the formation and spread of fire as well as its elimination.

Extinguishing agent

The aerosol produced upon activation of the Fireaway LLC system is composed of ultra-fine particles of Potassium salts with secondary inert gases. Potassium salts have long been recognized as one of the most effective fire suppression agents available. It suppresses fire by a combination of chemical and physical mechanisms similar to the Halons without any negative effect on the environment. Because of the aerosol's ultra-fine particle size (≤ 2 micron) there is a dramatic increase in the surface area interaction between the agent and the fire. Potassium based aerosol has been shown in numerous tests to be a highly effective alternative to other extinguishing agents.

Unlike gaseous agents the aerosol does not decompose in the presence of fire nor does it extinguish by oxygen deprivation. System s listed under the United States Environmental Agency (EPA) Significant New Alternatives Program (SNAP) for unoccupied and normally unoccupied areas. The aerosol is considered non-toxic to humans when applied in normal design concentrations necessary to extinguish most fires; however, there is a high obscuration factor and certain safety restrictions should be observed when applying and handling the generators. Exposure to the aerosol should be limited and unnecessary exposure to the particulate should be avoided. Exposure to the aerosol is generally of less concern than is exposure to the decomposition products of a fire.

Toxicity

Tests conducted by the Institute of Biophysics (Department of Public Health and Medicine Russian Federation) as well as others have shown that the aerosol does not present a health hazard due to limited accidental exposure at normal design concentrations. Exposures under five minutes are normally considered safe. Gas byproducts are several times less than that allowable for automobile airbag systems.

While the components of the aerosol are not considered toxic at normal concentration levels, ingestion of the ultra-fine particulate may cause short-term discomfort and unnecessary exposure should be avoided. Tests have shown no long-term negative effects from exposure to the aerosol. In addition the aerosol has a high obscuration factor as noted above.



AEROSOL FIRE SYSTEM

It ensures the elimination of the formation and spread of fire as well as its elimination.

Systems shall only be applied in unoccupiable & normally unoccupied spaces – which complies with using battery energy storage system.

Cleanliness

The ultra-fine aerosol discharge remains in suspension for an extended period of time and can be easily vented by a fan or air handling; system. Minor amounts of aerosol, which may have settled on the floor or other horizontal surfaces, can be easily vacuumed or wiped clean. Settled particulate is minor and is much less than the particulate produced by the decomposition products of the fire.

Storage

Aerosol generator is sealed with a non-permeable membrane and has been evaluated for temperature cycling (- 40°C to + 54°C) and humidity (up to 95% relative humidity). Accelerated aging tests have shown the generator's charge maintains its viability for 10 years.

Safety datasheet

These devices are sealed and present no ecological hazards. The aerosol produced upon ignition has no global warming potential and an ozone depletion potential = 0.

Components – Chemical (Hazardous Components ≥ 1%)	CAS#	COMMENTS:
Potassium Nitrate	7757-79-1	Components are blended and pressed into a highly stable, molded form. Molded composition is contained within a sealed double walled steel housing – no environmental exposure
DCDA	461-58-5	
Organic Resin	9003-35-4	
Appearance & Odor:		Beige to white in color. No odor.
Auto-Ignition Temperature:		300°C
Solubility in Water:		Slightly Soluble

Toxic by-products of combustion are extremely low. Main by-products are listed below with 15-minute TWA values for a maximum 100g/m³ concentration in a hermetically sealed volume.

Gas	15 minute Time Weighted Average in parts per million
NO ₂	1.08
NO	0.97
CO	84.20



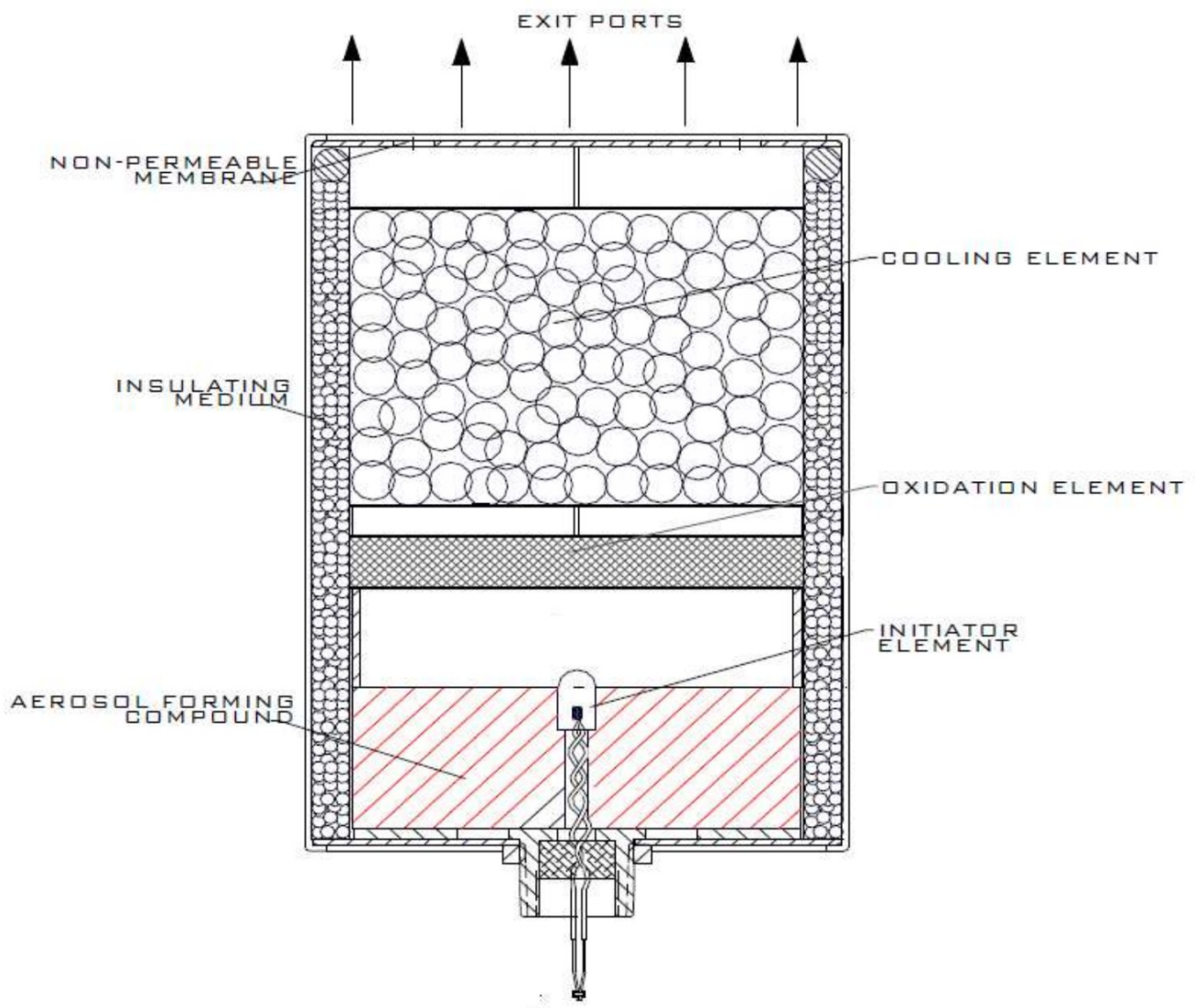
AEROSOL FIRE SYSTEM

It ensures the elimination of the formation and spread of fire as well as its elimination.

Component description

Aerosol generator is comprised of an insulated stainless steel housing containing the aerosol

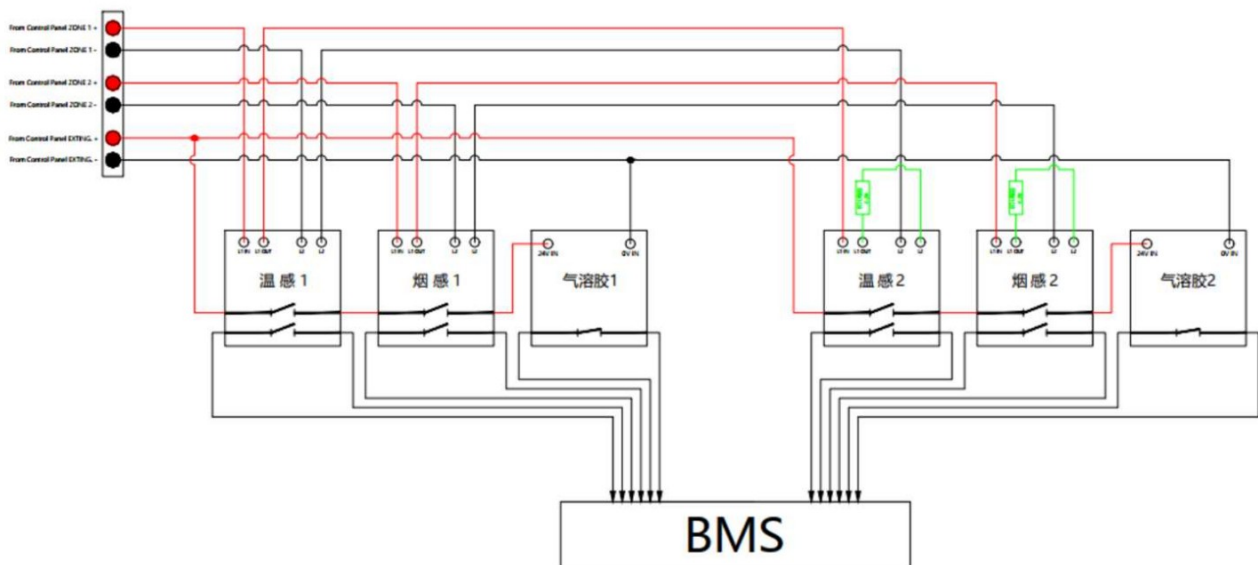
forming compound, initiator, insulating medium, and internal elements for oxidation and cooling of the aerosol stream prior to its discharge from the unit. The initiator utilizes a secure two-wire connector for electrical activation and a proprietary thermal detector for thermal activation. Each generator is sealed and utilizes a non-permeable membrane to maintain the internal integrity of the unit even in humid and high temperature environments.



SYSTEM ACTIVATION

in the event of an incident.

When only a detector is triggered, it's defined as first-level fire alarm. When both of the two detectors are triggered, it's defined as second-level fire alarm. At the same time, the aerosol fire extinguishing system interacts with the battery management system (BMS). When the BMS detects a first-level fire alarm, the alarm cabinet quits the state of operating and send signal to the EMS. When the BMS detects a second-level fire alarm, the aerosol of the alarm cabinet is released, with all of the electrical cabinets in the system out of operation and signal reported to the EMS.



Wiring diagram of protection system



CONTROL SYSTEM

It ensures the monitoring of all important Bess parameters on the basis of which the evaluation can be detected all potential problems before the emergence of dangerous situations.

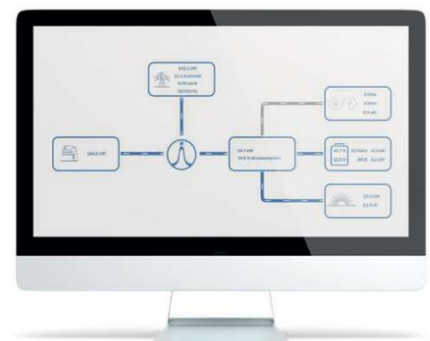


DATA GATHERING & ANALYTICS

- ✓ The collection of the maximum possible data from BESS - realtime is monitored over 200 signals from all devices
- ✓ Evaluation of collected data and their immediate evaluation for monitoring compliance with KPI - key performance indicators
- ✓ All deviations or exceedances are immediately signaled to both the client and our service department to ensure the fastest possible analysis and availability of BESS

REAL-TIME CONTROL*

- ✓ System management based on minimization of own consumption and losses (total round-trip efficiency)
- ✓ Management to ensure maximum battery life
- ✓ Possibility to set functionalities always according to current needs
- ✓ The system is managed on the basis of TOTAL COST OF ENERGY
- ✓ - ie. realizes from the selected multifunctionalities those that will bring maximum benefits



PREDICTION & FUTURE*

A system that is able to self-learn based on historical data and courses

The system is able to implement prediction based on machine-learning algorithms of future needs & system usage so that the battery is always in the optimal state of charge / discharge to maximize its use



Q&A

to answer more specific questions.

How quick is reaction time of fire alarm system?

Usually within 1 second, in better cases, the first and second level fire faults can be detected within 300ms.

How quick after detection is provided release of suppression system?

There is a 30-second delay to prevent false alarms or to provide time for manual actions.

Its provided aerosol system required periodic maintenance or change of aerosol regularly?

The service life of the aerosol is 10 years, and maintenance and replacement are required every 10 years. In addition, it is recommended to inspect the temperature and smoke sensors every 12 months. If the indicator light flashes every few seconds, it is in normal working condition.

In case of fire, is it safe to open battery rack?

It is not recommended to open the cabinet. During the short time when the fire extinguishing agent is activated, the battery cell that has undergone thermal runaway may have already burned or produced an open flame, but its temperature and internal chemical properties are still unstable. If the cabinet door is hastily opened, external oxygen will rush into the cabinet, which may cause a reignition risk.

Is there any procedure for fire department how to provide in case of fire incident?

If a fire is triggered, it is recommended to perform safety maintenance and inspection after 24 hours of inactivation. If the fire flame does not disappear, activate the water-based fire extinguishing system directly. It is not safe to suddenly open the cabinet without any inactive time after extinguishing the fire.

In case of fire is there automatic disconnection of DC power to battery rack?

When a fire occurs, the DC circuit of the cabinet will be disconnected, and the contactor will be opened. However, the auxiliary power supply will not be disconnected, and the power supply is provided externally, which needs to be disconnected externally from the AC power supply.



Q&A

to answer more specific questions.

Is aerosol supposed to just control fire or it can provide fire suppression?

Fire extinguishing is provided.

After releasing of aerosol – when only some part (cells / module) is effected – how it can be proceed to use battery rack again – just some cleaning of aerosol or whats requirements after such incident?

It is not recommended to use it again without submitting the situation at the time of the project for evaluation. Aerosol fire extinguishing is a space-level release, not for a single pack. If timely suppression is carried out, after the technical evaluation of the product, it will not affect other packs and other packs can still be used, but this pack cannot be used.

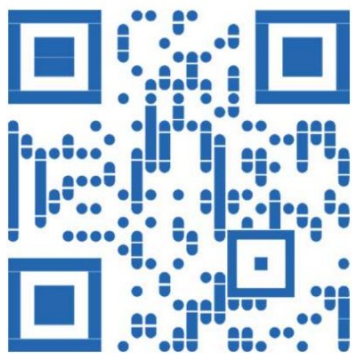
After battery cell is affected is possible still to use battery module or must be replaced all?

At least replace the pack.



AC	Alternating current
AMOS	Advanced microgrid optimization system
BESS	Battery energy storage system
DC	Direct current
EMS	Energy management system
ESS	Energy storage system
FSS	Fire safety system
HVAC	Thermal management system





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