fire protection
TECHNOLOGIES

Temperature Monitoring of Battery Packs or Stationary Power Supply (Energy storage solution with lithium-ion battery)

White Paper

MOBOTIX
BeyondHumanVision

CONTENT

1. Fire Protection & Batteries

1.1. New technology creates new challenges & opportunities

Lithium-ion batteries are steadily increasing in the industry through power generation and buffering, especially with the use of renewable energy and e-mobility.

Incorporating, using and storing battery technology is challenging for companies, especially in fire risk and extinguishing operations. Unique risks exist in the life cycle of batteries, such as

- Deep discharge
- Overcharging and overheating during charging
- Incorrect/defective chargers or incorrect operation
- Damage (due to temperature fluctuations, transport, production errors, physical impact)

Damaged batteries can no longer provide full power. Damage and incorrect handling also lead to an increased risk of fire and explosion. Rapid fire detection is essential. It must be precisely matched to the requirements on site, take effect quickly and be reliable to save values and lives effectively.

1.2. Special risk “Thermal Runaway”

The characteristic of lithium-ion storage is the high energy content per volume. A particular risk of battery fires is the “thermal runaway.” Such a chain reaction takes less than 60 seconds from start to explosion.

What is a Thermal Runaway?

An unstoppable chain reaction is set in motion in the case of a thermal runaway of lithium-ion batteries. The temperature rises significantly within seconds and the energy stored in the battery is released abruptly, with parts of the battery becoming gaseous. This results in a fire with temperatures of more than 1,000°C, which is difficult to extinguish by conventional means. The risk of a thermal runaway starts at around 60°C and becomes critical at 100°C and above. Whether and when a lithium-ion battery catches fire depends on the cause, environment, type, processing, and use of the battery.

up to 1.000°C and more	Fire with high temperature
More than 250°C	Abrupt Release of energy, danger of thermal runaway
from approx. 200°C	Exothermic reaction (fire) starts, danger of explosion
From approx. 125°C	Function disturbed, decomposition of anode and cathode
60° C	Heating of the battery/accu

The battery heats up quickly when it exceeds a specific temperature limit. The heat triggers further reactions, such as “thermal propagation,” when a cell with its thermal reaction spreads to other neighboring cells.

From 200 - 250° C, the battery ignites or even explodes so that burning parts can be thrown around. The exact temperature here also depends on the individual battery cell, the design and other external factors.

Once a fire has started, it is tough to extinguish. Batteries, whether large or small, are doused with water. Above all, cooling is mandatory, as there is a risk of back ignition. Firefighters often monitor lithium-ion batteries until well after they have been extinguished. Affected batteries should always be moved to a safe location.

2. Project description for monitoring a battery pack (battery cluster)

2.1 What is a Battery-Pack?

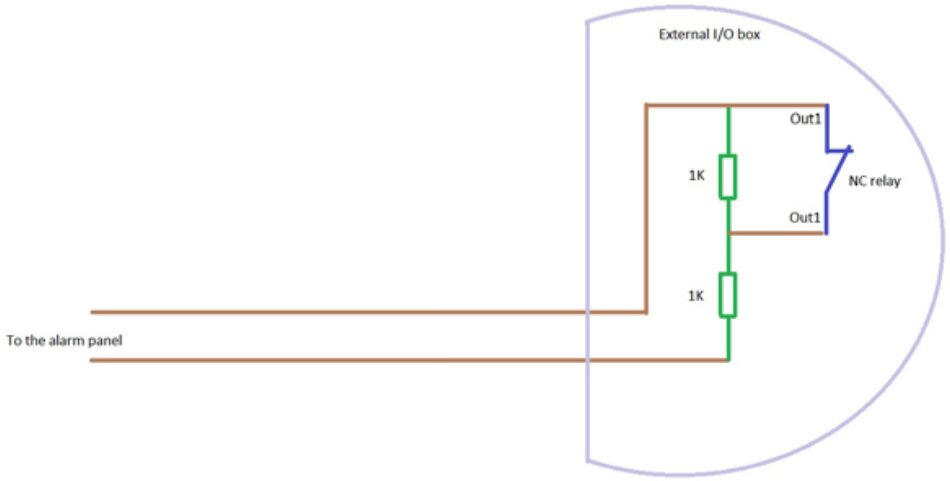
A battery pack is a group of batteries that are interconnected in such a way that the accumulated capacity of the batteries serves as an energy buffer. Such systems are used mainly in solar and wind farms and wherever energy peaks occur due to high loads.

The solution presented below is used for early warning of abnormal temperatures to prevent catastrophic failures in the expensive battery pack system.

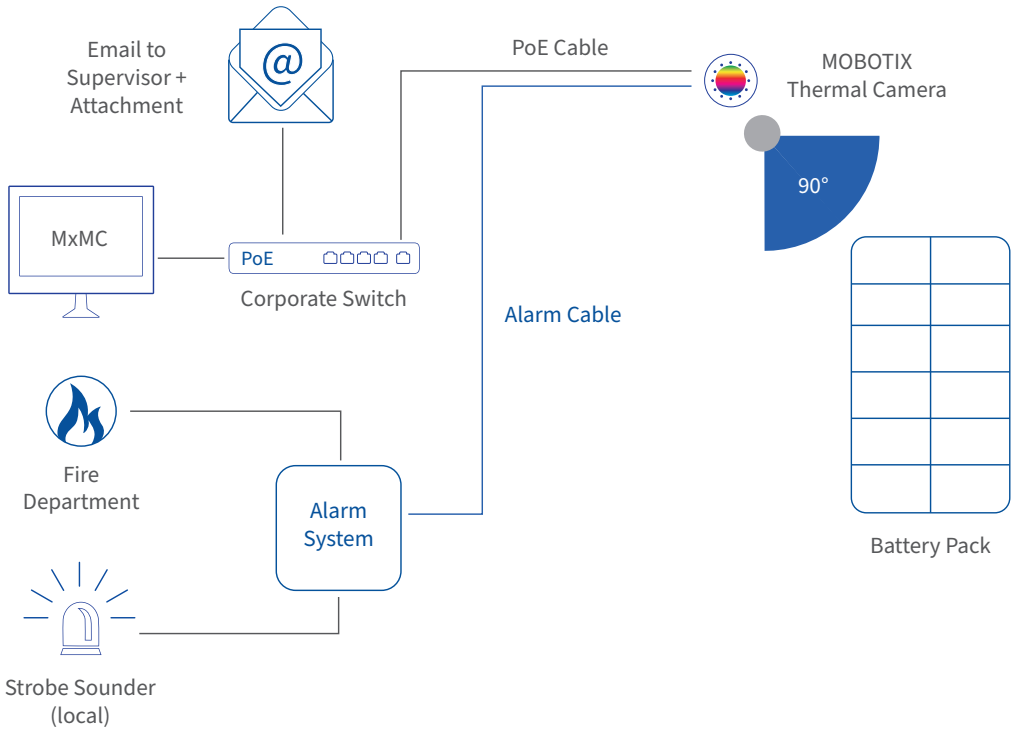
2.2 Project Example “Battery-Pack (Buffer)” of a wind power plant

The following picture shows a battery pack (BP) that serves as a buffer for the energy generated by wind turbines. Here, a solution was required that offers both safety of the surroundings and people and protection of the plant.

A stand-alone solution was required in the project to enable thermographic measurements on the top of the BP. The responsible engineering team and the fire department were to be alerted directly as soon as the temperature leaking from the cooling fans reached or exceeded a certain level (event and action). At the same time, the system should be able to send email notifications to a specified list of recipients and, in parallel, trigger the alarm via the existing alarm system (by triggering a special input in the alarm system). In this way, the rapid evacuation of the area is initiated.



The BP was installed in a context area, with the Ethernet cable laid by a local installer. The core task of the installation requirements was the appropriate distance of the installation point of the camera to the BP, as the available space was less than two meters.



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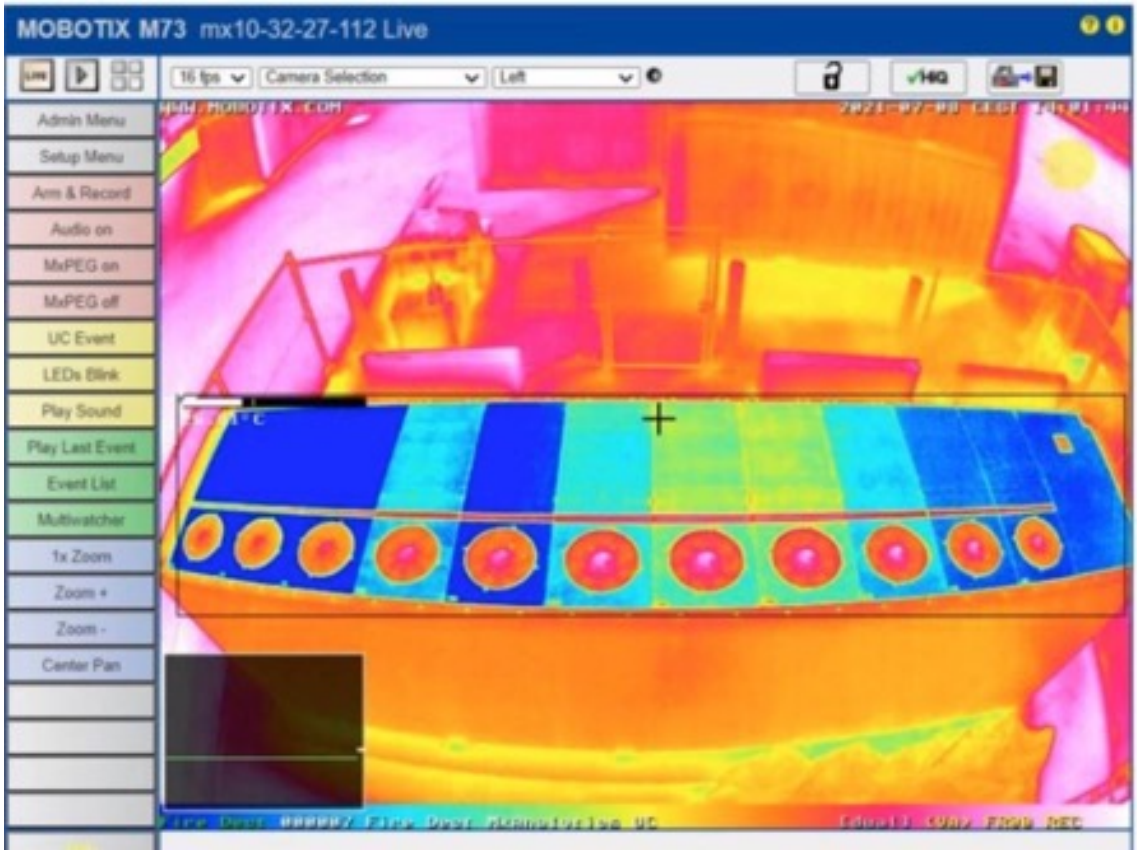
The planning and calculation agreed on a bi-spectrum (VGA thermography and optical 4K camera), which was installed at a distance of 1.60 m from the BP, at the height of 7 m. the thermographic module with a 90-degree field of view (FoV) can completely cover the 7.70 m long ceiling of the BP. One of the main reasons for choosing MOBOTIX technology for this project was that we can flexibly cover different angles of view depending on the requirements. The final installation looked like this:



The proposed bill of quantities (BoQ) for each BP was defined as follows:

Part Number	Description
Mx-M73A-LSA	M73 Body with LSA Connector Box (white)
Mx-O-M73TA-640R050	Thermal module 640-R050 with front plate for M73
Mx-O-M7SA-4DN050	95° 4MP IR Cut Day & Night Low Light Sensor Module WIDE
Mx-M-PM-M73	Pole mount for M73 models
PS-PreConfig-IoT	Professional Servies Pre-Configuration per IoT-Camera
PS-Remote-Service-Hour	Professional Servies Remote Support Hourly Rate
	UPS Standard

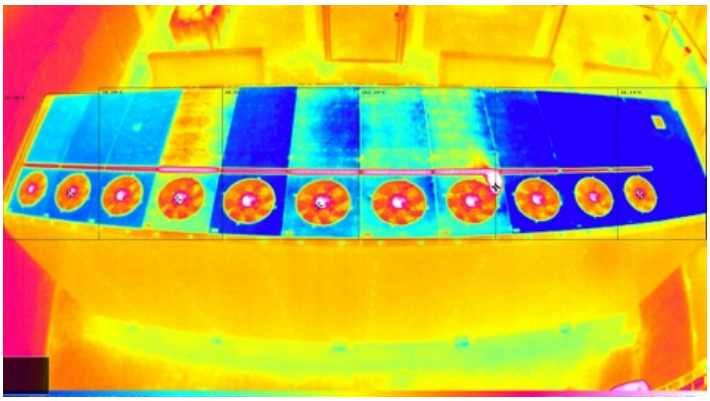
2.3 Integrating the Alarm Output

To integrate the alarm output of the camera into the existing alarm system, the limitations and specifics of the input logic of the alarm control panel were determined. Since the alarm control panel was not floating and also to define resistors the exact input zone number, a MOBOTIX RS232 box (as described below) was set up.

This box is installed on the camera side and connected to the M73 camera via the USB interface.

2.4 Special external impact – solution by meta-events

One particular problem that occurred during the acceptance tests was a rainy day. The water formed small puddles on the stainless and chrome top of the BP. This caused unwanted random reflections of the sun's rays. Until the water was completely drained, the camera sensor showed abnormal temperatures. See the following example where the crosshairs are pointed at a puddle of water offering 162°C degrees.



We asked the manufacturer of the BP why the water was not draining properly and whether the design or the chrome materials could be revised. Still, unfortunately, this was not possible for various reasons.

Our solution was to use meta-events (another USP of MOBOTIX). We counted the events generated in a certain period and then triggered the actions (notification fire department and alarm center).

We introduced a thermal event type called Delta Threshold, which served as a suitable addition to the meta-event for such applications with the latest version. With the Delta Threshold, the stability of a measurement range is checked. The operator defines a threshold value for this purpose. The camera checks the tendency of the measurement to exceed or fall below this threshold in a certain period. For example: "Check if the temperature rises above x degrees within x seconds and then create an event."

The following image is from a recent project where we are measuring transformers in an HV-substation (400Kv), combining threshold events and delta threshold events.

2.5 Multifunction in one camera

The next project step is the integration of security measures: Using the same camera, passing or parked cars that are not authorized (permission list) are identified and indexed.

This is done with the help of software installed on the camera and operating directly there - in this case, that of the Vaxtor MMC ANPR application. It forwards special events (security events) with different actions to different action groups. For example, there is a risk of damage to the BP by intruders, protesters, or saboteurs who want to act against these installations. Thus, the operator can use the same camera infrastructure (unified solution) for operational security and general installation protection.

Thermal imaging and MOBOTIX

MOBOTIX offers a complete solution specifically for battery monitoring based on reliable, high-quality and ‘German-made’ hardware and software. The solutions include thermal imaging cameras and sensors such as the MOBOTIX M73 and S74. These are supported by software used to control and monitor the devices and manage data collection. Software applications and industry-specific APIs ensure that MOBOTIX technology can be seamlessly integrated into dedicated existing security systems to provide highly monitoring solutions.

Alongside its technology, MOBOTIX has a network of specialist business partners who can provide expert industry advice. Using the MOBOTIX thermal imaging technology and their industry knowledge, they can develop, implement, and support specific solutions.

For more information about MOBOTIX thermal imaging solutions contact
https://www.mobotix.com/en/solutions/solution-packs/batteries

This whitepaper is dedicated to our great colleague and friend Sarunas Pavilionis (1973 - 2022).

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- FM-200® (HFC-227ea.)
- Carbon Dioxide (CO_2)
- Hybrid Systems (N_2 / Water)
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- Enclosure Integrity Testing Equipment
- Pipe & Fittings

Water Suppression

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- Water Mist - Intermediate Pressure
- Water Mist - Low Pressure
- Hybrid Systems (Water / N_2)
- Monitors & Delivery Systems
- High Speed Deluge

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- Foam Proportioning
- Foam Delivery Systems
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- Explosion Isolation
- Explosion Vents & Pressure Relief
- Spark Suppression
- Explosibility Testing

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- Linear Heat Detection - Fibre Optic
- Linear Heat Detection - Micro Chip
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- Video Imaging Detection
- Spark Detection
- Control & Indicating Equipment
- Thermal Imaging Detection
- Aspirating Smoke Detection

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