
Safety of stationary storage using Li-ion batteries

Return of experience

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Confidential

Restricted

Public

Internal

Energy storage - Safety is a business quality carrier

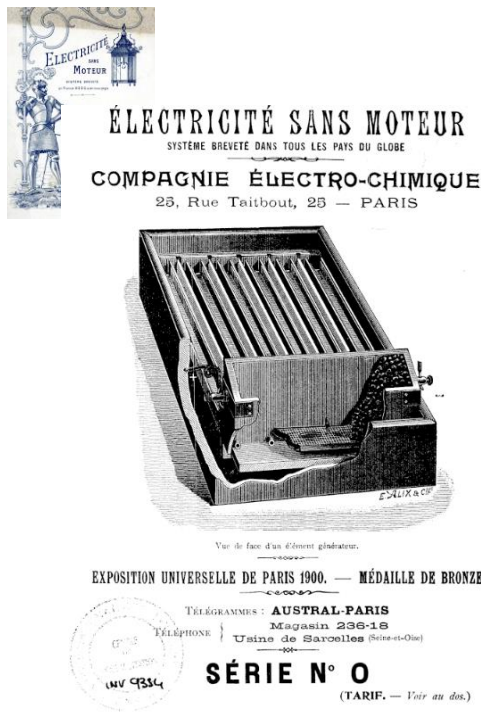
[...]

La solution à trouver consistait avant tout en un appareil simple, pratique et robuste, facile à mettre en marche et à entretenir et ne donnant pas lieu à plus d'attention et de soins que l'entretien des appareils usuels, lampes à huile ou à pétrole, et, de plus, fournissant la lumière à un prix pas ou peu supérieur à celui de ces dernières.

Le fonctionnement de nos appareils n'occasionne ni bruit, ni odeur, ni dégagement quelconque et l'on peut à la rigueur les placer dans une pièce d'appartement sans en être nullement incommodé.

Sous un autre rapport, il ne peut donner lieu à aucun accident de quelque nature que ce soit, c'est-à-dire n'occasionner ni explosion, ni incendie, ni commotion, les applications pour l'usage domestique se faisant toujours à basse tension.[...]

Compagnie Electro-chimique (1900)



[...] It should be realized at the start that storage batteries are notorious for their very low energy output per unit weight and volume, but are at the same time unique in that they become most important where other sources of energy are impossible. As a result, there are no airplanes driven by storage batteries, and there are no submarines, at least up to 1952, which are not driven by storage batteries while under water. Competition between batteries and other sources of power is limited to a very few applications.

To balance the great weight of storage batteries as a source of power, they have certain advantages, namely: they can deliver a large amount of power instantly; they can be overloaded tremendously; they operate at almost any temperature; they do not give off poisonous gases; they do not consume air; their stand-by loss is minor; and their energy is readily converted to light, heat, sound, and can operate radio equipment.

Where a storage battery appears to be the best source of power, the choice of the type of battery may depend on such prosaic quantities as cost, availability, or weight, and it may involve other properties not normally considered, such as shelf life, vibration resistance, impact resistance, corrosion of surroundings, and behavior at high rates of discharge or low temperatures.[...]

J.C. White, JECS (1952) - Introduction

Distributed Energy Management and Batteries Team

BATTERY HEART

Electrochemistry & Materials Testing



**DOMINIQUE
CORBISIER**



**AUORE
CASTETS**



**ELISE
NANINI-MAURY**



**ANTHONY
SENECAT**

TECHNOLOGY MANAGER

RAFAEL JAHN



USE

**MICHEL
VAN LUMIG**

Microgrid



Smart Home

**CATHY
CRUNELLE**

**ERWIN
BROUWERS**

B2C



Electric Mobility

**LAURENT
DE VROEY**

**JELLE
SMEKENS**

B2B



**PIERRE
MOENCH**



**HELOÏSE
GENNART**



**ELISE
NANINI-MAURY**

SYSTEM



EMS - Communication

**DRIES
LEMMENS**



**NABIL
BOUCHAR**



**DJEF
BRAK**



**ERWIN
BROUWERS**



Power System

**SYLVAIN
DOUCEMENT**



Integration

**HANNES
LAGET**

The BatteriesLab deploys services and expertise worldwide

Selection of projects and services



GCN USA
Due Diligence

EDT Tahiti
20 MW BESS

Hybrid solutions Guinea
Telecom towers

Arica Chile
Spinning Reserve

Tubarão
EOS 0,5 MW-
S 2MWh

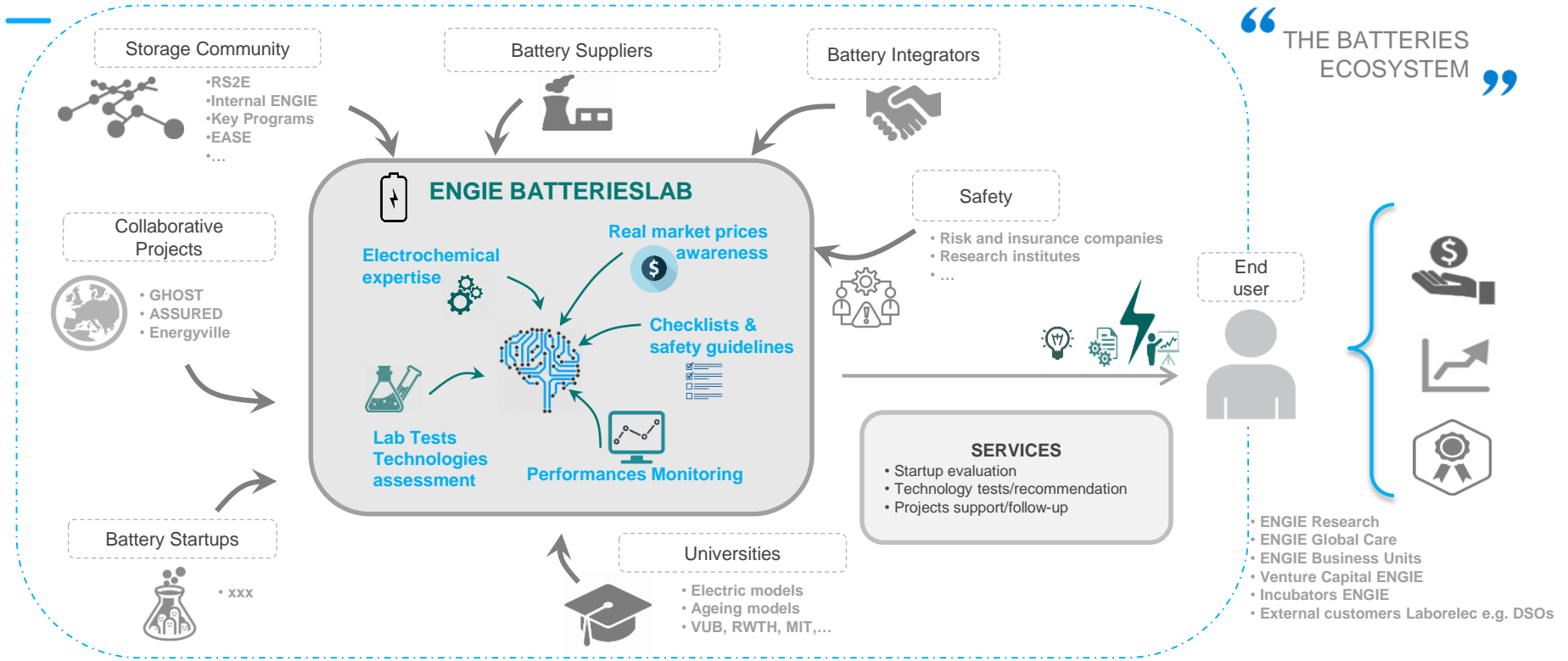
Boomerang Australia
Grid stabilization

GOGORO Taiwan
Due Diligence

- ENGIE Batteries Lab
- GRID/μGRID
- B2C
- B2B
- RES Integration
- Due Diligence / Tech Evaluation
- Study / EU Projects
- Training / Workshop
- FAT / SAT
- Suppliers visit



Panorama of the ENGIE BatteriesLab interactions



Possible hazards with batteries

- Human error

- Electrical



- Fire or explosion



- Chemical



- Mechanical

- Thermal



- Environmental

- ...



Commercial VRLA battery showing signs of thermal runaway

S. Hoff, K. Steeves "New Insights into Thermal Runaway of Valve Regulated Lead-Acid Batteries", (2005) Battcon



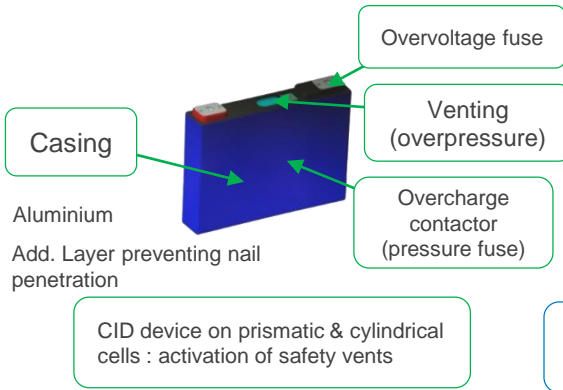
Commercial Li-ion cell undergoing thermal runaway in external heating abuse test (18650 type)

F. Larsson, "Lithium-ion Battery Safety - Assessment by Abuse Testing, Fluoride Gas Emissions and Fire Propagation," Chalmers University of Technology, Göteborg, Sweden, 2017.

Many battery applications, many battery chemistries, many concerns

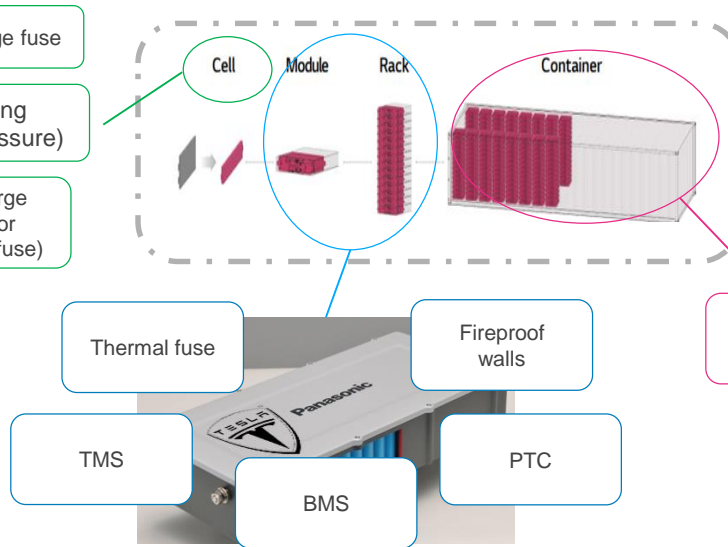
Technical concerns

How to increase performances?



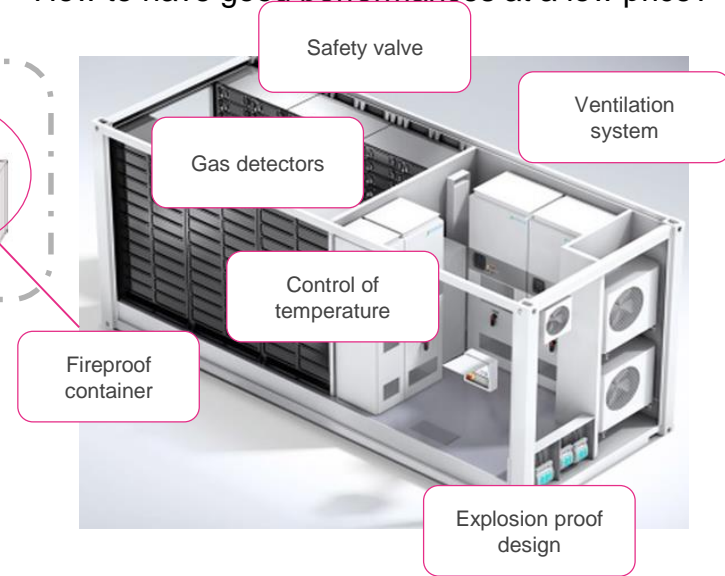
Batteries Lab Main concern

How to keep safety?



Concerns of users

How to have good performances at a low price?



Batteries are selecting according to various requirements
Safety is key and major subject for ENGIE Batteries Lab


Energy Storage Park at Drogenbos

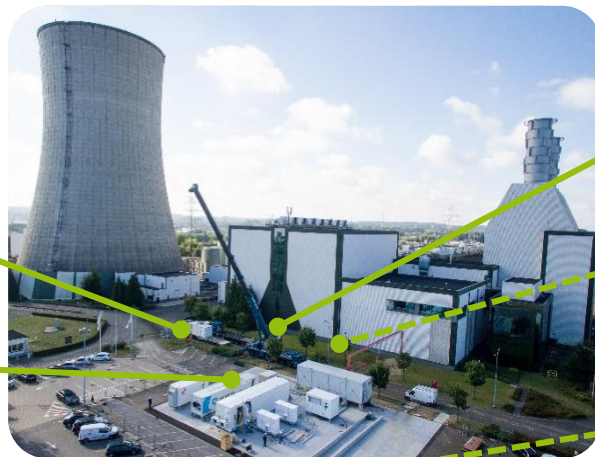


Context

- Potential **20 MW / 20 MWh** storage park
- **Li-ion batteries from different suppliers**, (7 MW / 6,3 MWh)
- Dedicated to the **Frequency Control Regulation (FCR)**
- Deploy later for other applications

 **INEO SCLF**
1 MW – 1 MWh

 **ALFEN**
1 MW - 1MWh



GENERAL ELECTRIC
2 MW - 2 MWh

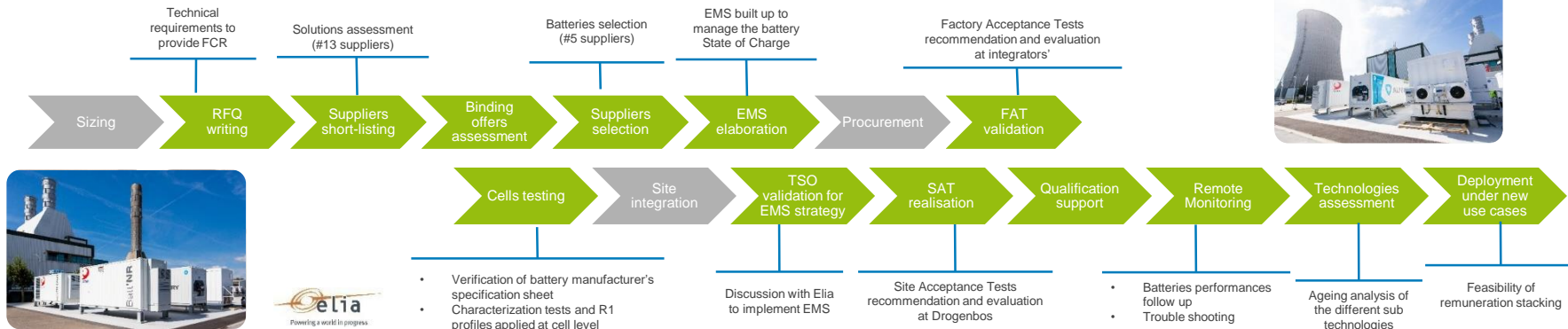


YOUNICOS
2 MW - 2MWh

Younicos

Toshiba TOSHIBA
1 MW- 0,35 MWh
(Q1 2018)

The ENGIE Batteries Lab is in charge of :



REX on documented incidents on batteries

From April 2016

Permitted in cabin

On your person **only**

Hand luggage **only**



Cigarette lighters



Matches



Power banks & spare batteries



E-cigarettes



ARIFA

La référence du retour d'expérience sur accidents technologiques

Fuite de batterie de chariot élévateur

Accidents

N° 49519 - 10/04/2017 - FRANCE - 68 - COLMAR
C28.92 - Fabrication de machines pour l'extraction ou la construction



Vers 19 h, la batterie d'un chariot élévateur chute d'une hauteur de 1 m, dans un local batterie d'une entreprise de fabrication de machines et d'équipements. La batterie fuit. Quelques litres d'acide sulfurique s'écoulent au sol. La fuite est arrêtée en retournant la batterie. Les pompiers absorbent le produit à l'aide de buvards et le dilue. Un périmètre de sécurité est mis en place. Les locaux sont ventilés et l'électricité est coupée. Les buvards sont traités, le sol est lavé à grandes eaux. La batterie est stockée à l'air libre sur une zone isolée.

Why lithium-ion batteries go up in flames

Elizabeth Weise | USATODAY
Published 12:30 AM EDT Sep 4, 2016



DF
TIP

Megabatterij veroorzaakt brand bij Engie Electrabel in Drogenbos

11 november 2017 14:22

Tech LE SOIR .be

Risque d'incendie: HP rappelle des batteries d'ordinateurs

Par Etienne Froment - 5 janvier 2018

"Ces batteries sont susceptibles de surchauffer, et exposent les clients à un risque d'incendie et de brûlures", écrit le groupe sur son site internet.



HP and the battery manufacturers believe that certain battery packs shipped in some notebook PC products may pose a potential safety hazard to customers. The batteries can overheat, posing a fire and burn hazard.

We are taking this action as part of our commitment to provide the highest quality of service to our notebook customers. We are proactively notifying you of this issue and are prepared to replace all verified, affected battery packs.

Panasonic



IMPORTANT: FZ-G1 BATTERY RECALL

A recall has been issued for the Panasonic FZ-G1 tablet battery pack (model: FZ-VSU84U). Devices with this battery pack could overheat and ignite causing a fire hazard. Customers with affected devices should immediately request a free replacement battery pack and return the affected model through our FZ-G1 Battery Recall Exchange Program. In addition, a **mandatory** BIOS utility download must be downloaded by users with affected models to minimize the risk of overheating and ignition.



Market consultancy

NTSB takes interest in Tesla fire involving family of 'West Wing' actress

David Pan | USA TODAY
Published 6:17 PM EDT Jun 18, 2018

"This is an extraordinarily unusual occurrence, and we are investigating the incident to find out what happened," Tesla said.

REX on documented incidents on batteries

- Goals

- Understand risks and learn how to manage them
- Improve ENGIE guidelines and good practices for battery projects

- Listing of battery incidents from 1994 until S1-2018, classified in 4 categories:

Mobility / Stationary / Embedded / Others (Transportation/R&D/Recycling/Storing...)

Where/When?
Date/Country/City



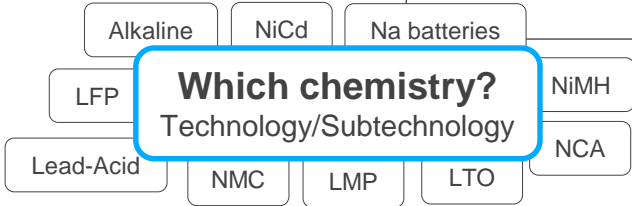
What?
Type of device/model

What happened?
Incident type/details



How was it handled?
Action taken/lessons learned

Which chemistry?
Technology/Subtechnology



Who?
Device/battery/cell vendors



Which consequences?
Victims/Environmental impact



Conclusions

- All battery chemistries are subject to incidents
 - The consequences are highly dependent on the chemistry
 - Norms and standards vary from the usage and from the chemistry
- How to keep safety while performances and technologies are developing?
- Lessons learned from documented incidents improve guidelines and requirements for future products
 - Safety is not technological only (low risk chemistry) but also a matter of industrial risk analysis and improved market solutions
- ENGIE is expecting a higher level of maturity, also for the sake of market credibility

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