Mitigating Risks of Explosion and Fire

Battery Energy Storage System

10th Edition Energy Storage SUMMIT 2025

VIGILEX ENERGY® By STIF

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STIF FRANCE

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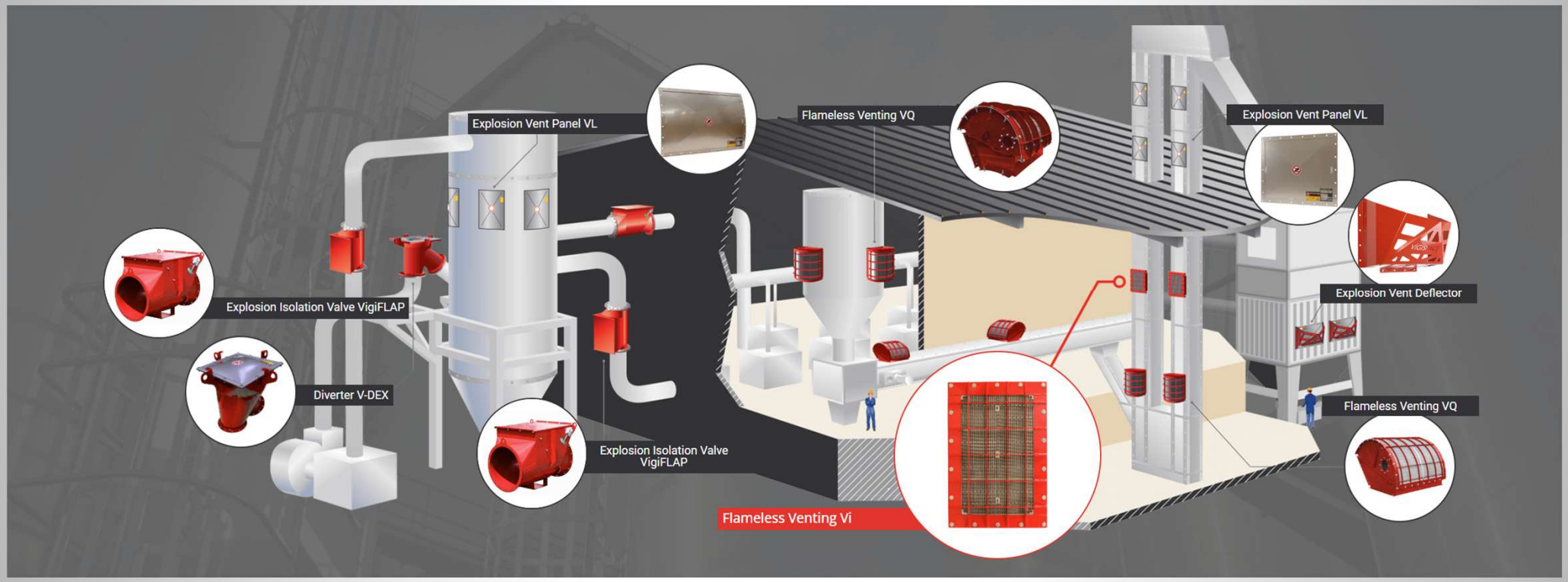
Our Backgroud



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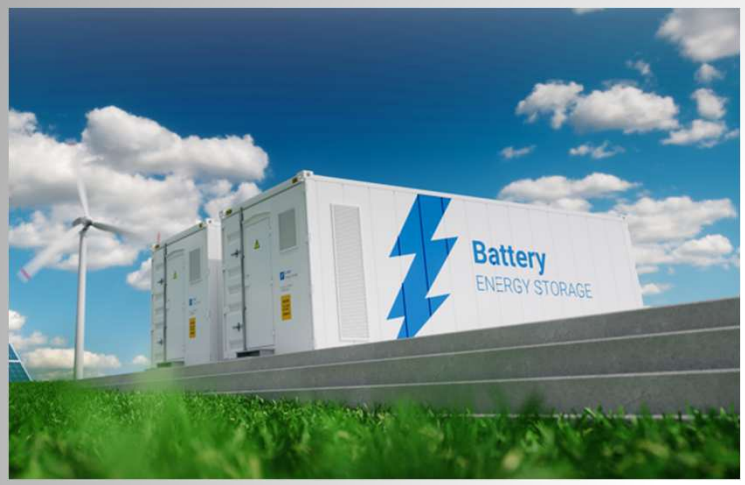
A division for BESS



A STIF division created and dedicated to the protection of BESS

VigilexEnergy - Store with serenity, use with security

Moss landing Event

January 16, 2025, World's largest BESS on fire

What we Know :

- Evacuation of 1,500 residents, no injuries reported.
- No public health risk detected.
- Battery Chemistry : NMC
- This type of incident is **rare** but **still occurs**
  85 cases recorded over the past ten years (source: EPRI).

Should push the market to improuve the safety of BESS and lead to stronger prevention and protection measures

The good point:

For 5 years the safety of BESS has been constantly evolving and an adoption from the market of LFP chemistries considered to be safer...

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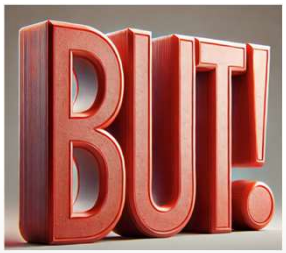
NMC vs LFP

Criteria	NMC ($LiNiMnCoO_2$)	LFP ($LiFePO_4$)
Energy Density	150-250 Wh/kg (higher)	90-160 Wh/kg (lower)
Lifespan (cycles)	1,000 - 3,000 cycles (shorter)	4,000 - 10,000 cycles (longer)
Safety	Medium (risk of overheating and thermal runaway)	Very high (low thermal risk)
Thermal Runaway Temperature	~210-250°C (higher risk)	~270-300°C (lower risk)
Cost	More expensive (due to rare metals)	Cheaper (no cobalt or nickel)
Environmental Impact	Higher (cobalt and nickel extraction)	Lower (no cobalt)

LFP is **safer** , **more durable**, and **cost-effective**, though with a **lower energy density**.



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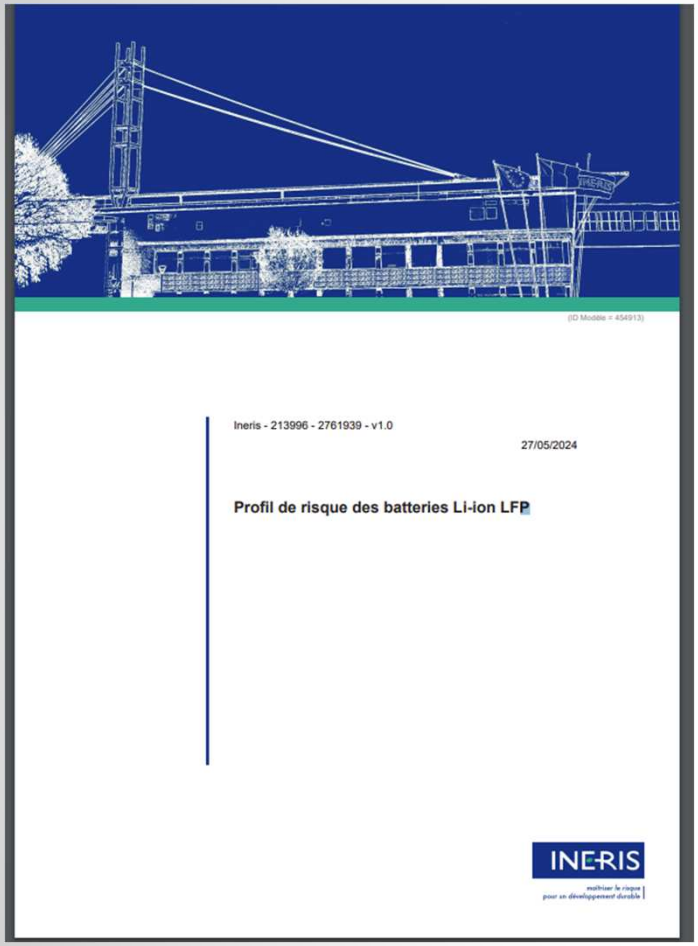
Ineris : LFP risk



INERIS Report : Risk profil of FLP Battery

(Source : www.inéris.fr / report : Ineris - 213996 - 2761939 - v1.0)

INERIS = **National Institute for Industrial Environment and Risks**.
(our Notified Body in France)

- **Risk of Explosive Atmosphere Formation:**

During thermal runaway, LFP batteries can emit flammable gases. If these gases mix with air in appropriate proportions, they can form an explosive atmosphere.

The explosion of an LFP battery does not originate directly from the cell itself but rather from the accumulation of unburned flammable gases, which create an explosive atmosphere in the presence

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Temp Event

Parameter	LFP Cells	NMC Cells
Thermal runaway onset temperature (Tonset)	200-270°C	270-313°C
Maximum cell body temperature	399-600°C	835-998°C
Temperature rise rate	1.5°C per minute	200-470°C per minute
Thermal stability	More stable	Less stable
Risk of ignition	Moderate	High

- During a thermal runaway, the gas mixture is largely composed of H2 (between 40 and 60%)
- H2 Auto-ignition between 500 and 600°C (average value)

- Result: LFP cells temperature could reached the auto-ignition temperature of H2 and then lead to an explosion.

WHAT IS THERMAL RUNAWAY WITHIN A BESS ?

THIS ...

Is happening ...

Inside THIS ...

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How to protect ?

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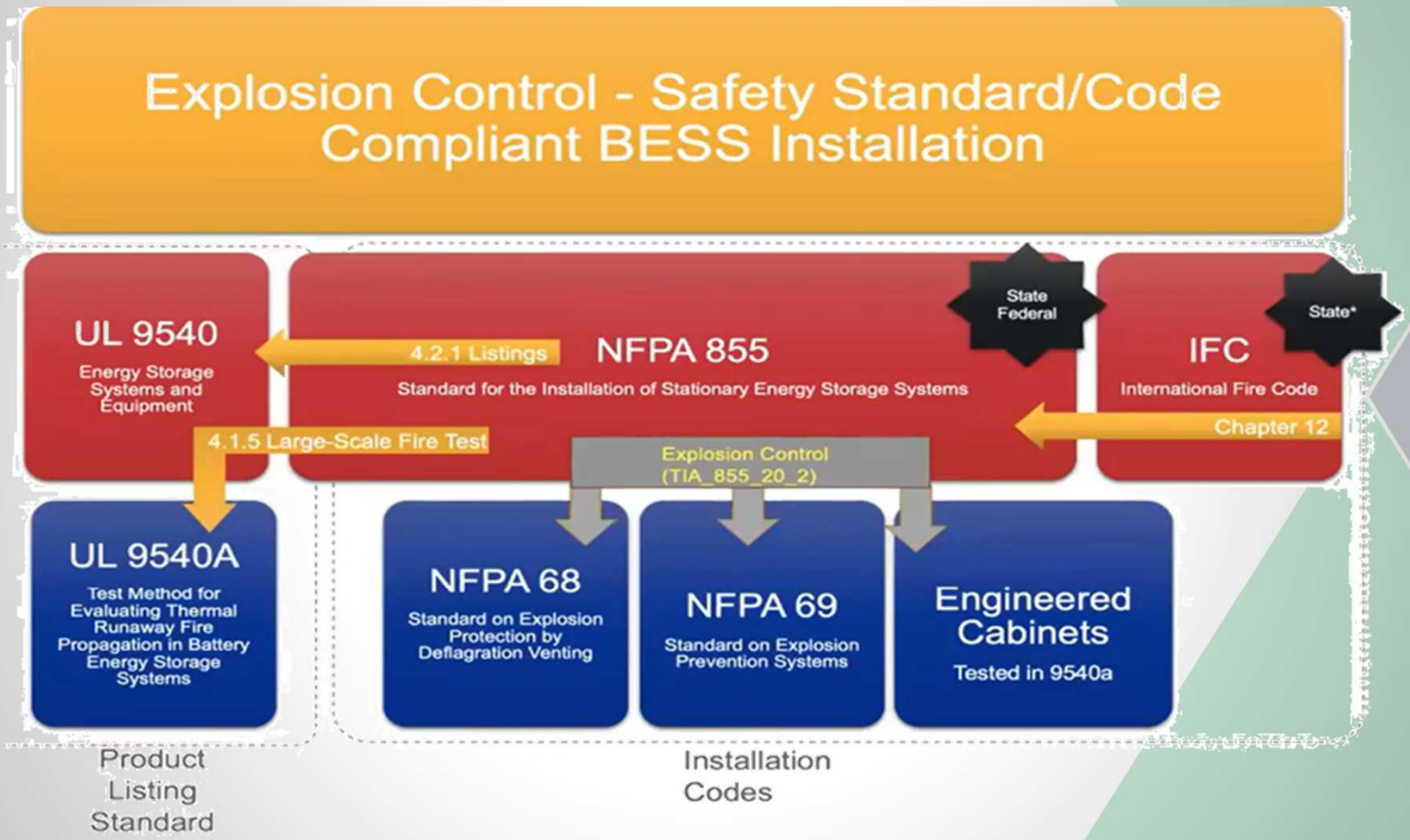
Codes & Standards



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Npfa evolution 2026

NFPA 855 Update (2026): ESS Safety
Goal: Enhance energy storage systems safety

- New clauses for explosion control
  - Mandatory system (NFPA 69) [9.6.6.6.3*]
  - Partial deflagration evaluation (NFPA 68) [9.6.6.6.3.1]

- Implications:
  - Lead probably to a use of Deflagration panels
  - CFD analysis required

France : Revision of the ICPE 2925 (2025)
New requirements expected: obligations regarding the use of deflagration Panel

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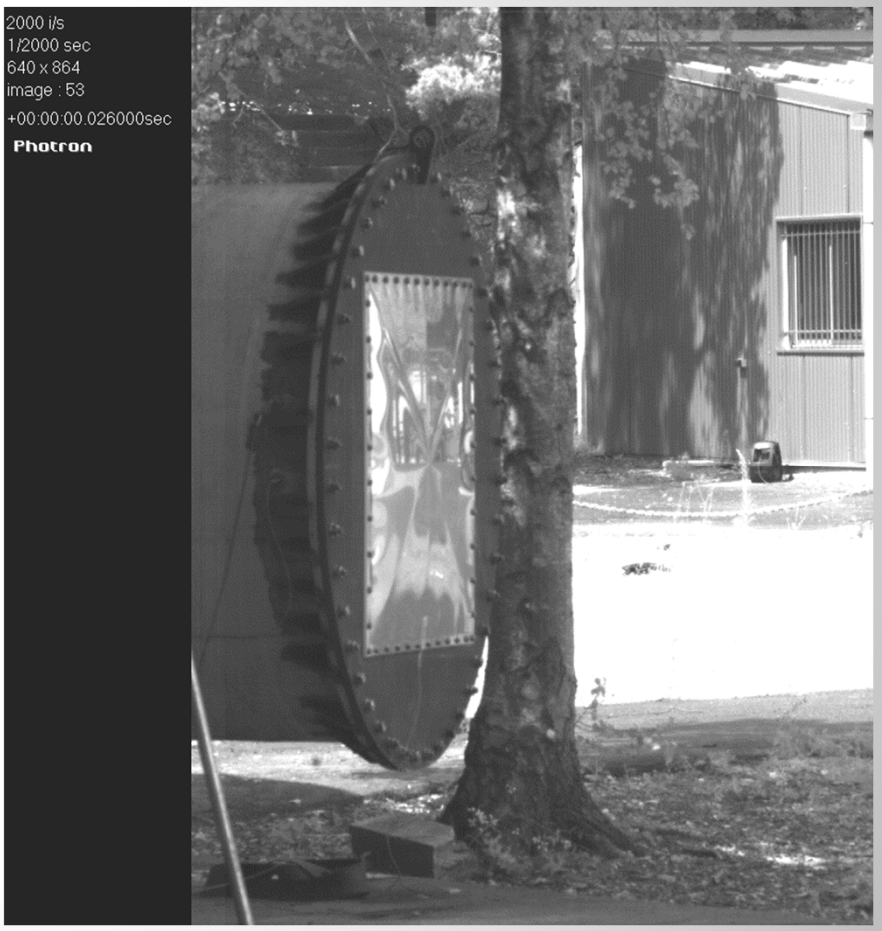
Deflagration vent Panel

➢ EXPLOSION TEST VIDEOS



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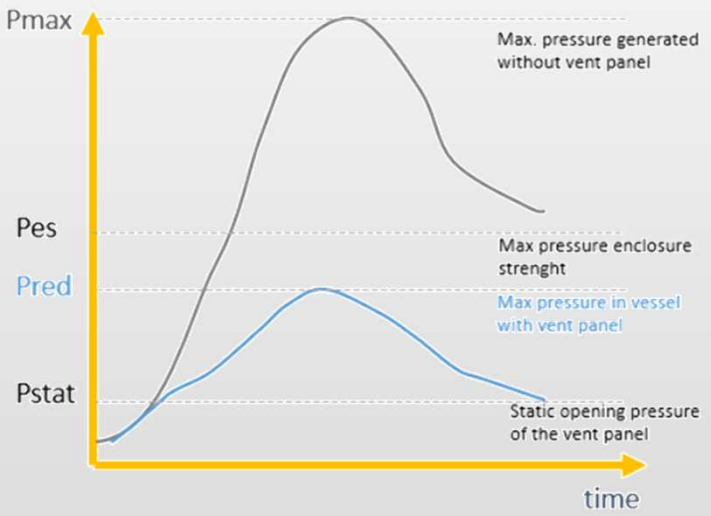
Vent sizing NFPA 68 C7



Key Points for Vent Calculation (NFPA 68)

NFPA 68 approach: worst-case scenario
Based on stoichiometric ratio of the gaz mixture

- Gas mixture composition (based on UL9540A)
  H2, CO, CO2, light hydrocarbons
  Varies with battery chemistry
- Vent area sensitive to composition
  Same chemistry ≠ same vent area
- Obstruction factor (Aobs)
  Impact of internal obstacles
- Enclosure strength (Pred,max)

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Passive & Active safety

Why use both Active and Passive solution?

- Active solutions can fail
- In Feb 2024 , a report made by CEA has showned that :
  26 % BESS inspected had quality issues with fire detection and suppression suppression systems
  (source : CEA BESS Quality Risks Report.pdf)
- Active solutions **are NOT** designed to reduce the effect of an over pressure during an explosion
- Passive solutions Increased Safety
  Explosion protection panels offer enhanced safety
- Passive solution are designed to:
  Quickly evacuate pressure, flames, and gaz in case of explosion
- **Protect people and industrial equipment**
- Preserve the integrity of the BESS container

Passive and active solutions

DUAL-VENT®

A GAS VENTING

NFPA 69

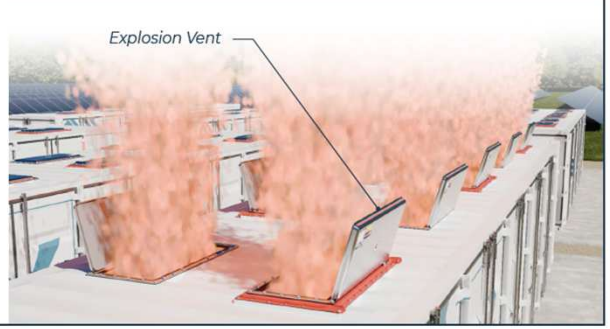
Door **triggered** by **gas detector**

AUTOMATIC RECLOSING AFTER VENTING

B EXPLOSION VENTING

NFPA 68

Integrated vent panel **activated** by **explosion pressure**



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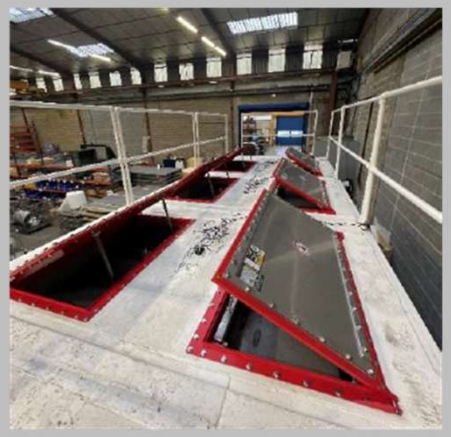
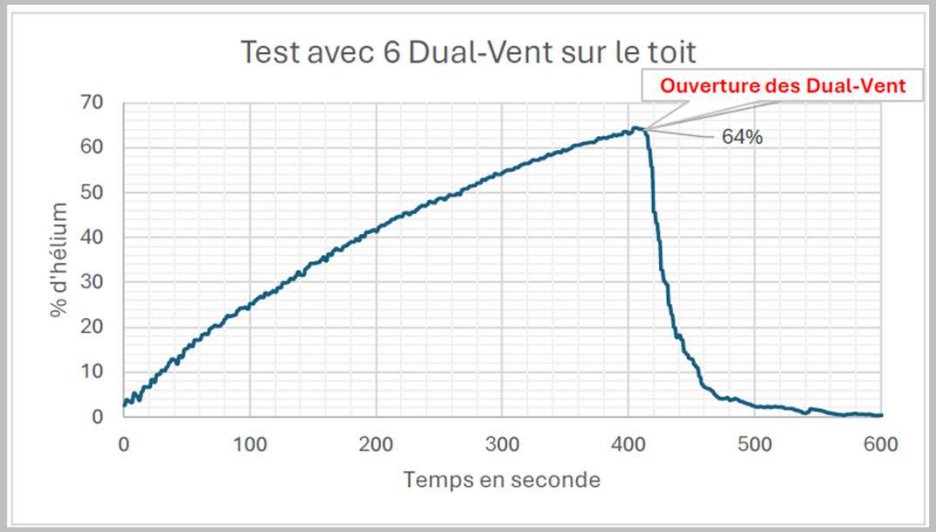
Dual-vent Testing





Helium test :
6x DUAL-VENT 520x1020 (on roof)

Gas evacuation flow :
(rapid Phase)
310m3/h per m² ventilation surface

1 DV could exhaust 10x/h the internal atmosphere (consiéring a 20’ empty container)

Fyi :
Hélium density 2x than H2

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BESS safety Group

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THANK YOU

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