WASTE BATTERIES AND SMALL WEEE FIRE CHALLENGES IN ITALY

Luca Campadello | Strategic Development & Innovation Manager | Erion Compliance Organisation

GRINNER x BATTERIES ROUNDTABLE

18 February 2025

Erion

Waste Batteries and small WEEE fire challenges in Italy

GRINNER event

Agenda

- Risks for PROs associated with fire incidents

- Treatment operator challenges (WB and WEEE)

- Framework for a comparative analysis of fire risk management

Fire risk exposure is becoming critical for WB and WEEE operators. Not only big events but also for micro events

continuity of operations – safety of workers – image of the industry

BIG EVENTS:

- Operation stop
- Transferring flows between operators
- Start of operations again
- Difficulties in understanding if the prevention practices are effective or not

MINOR DAILY EVENTS:

- Micro-stop of operations
- Part of usual operations practices
- Difficulties in tracing micro-events and understanding if the procedures in place are effective or not

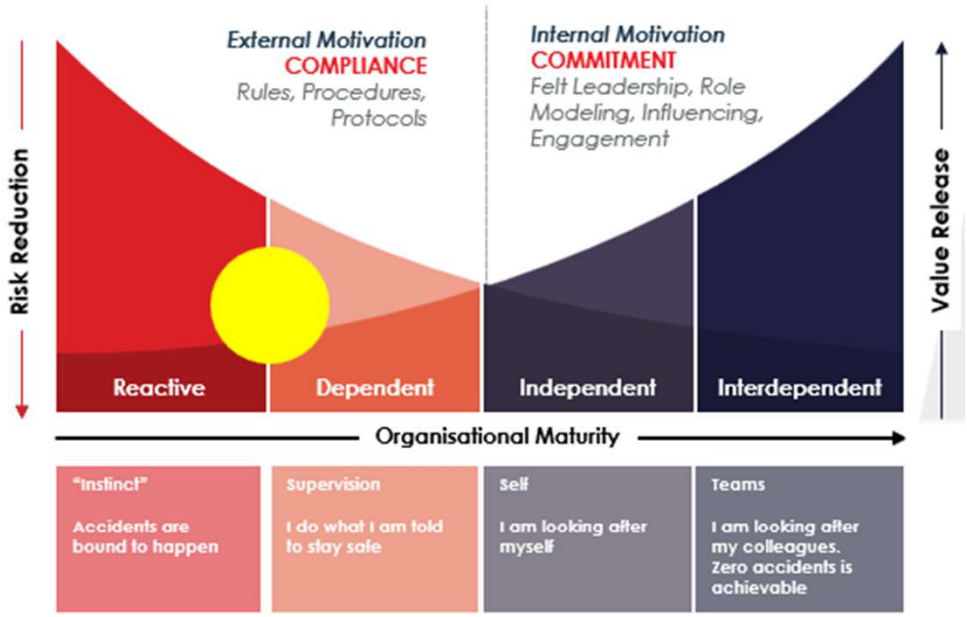
Developing a framework for understanding the dimensions of the fire risk mitigation

- Partner: DSS+
- Development of the framework
- Involvement of the Erion operations team and the innovation team
- Validation through 5 site visits

Framework for assessing Fire Risk management practices

Waste treatment sector is facing changes in the waste streams and operational conditions

- The waste treatment/recycling sector has been historically **perceived as a medium-low hazard sector.**
- In the last decade, the **risk profile has been changing** as a result, for example, of exponential growth of Li-ion batteries in WEEE. **Risk of fire is material** for these types of operations, with **most sites having experienced multiple fires in recent years.**
- **The fire events and the losses incurred** in recent years and increase of insurance premium (up to 6x in some cases) by the various treatment facilities **have triggered the need to reduce risk exposure** through a range of technical, organizational and administrative measures.
- It is clear to the sites that **ISO certifications** (early-stage ISO 9001, 14001, 45001, etc.), and **other waste permit prescriptions are not sufficient to reduce the risk exposure**, but just foundational compliance elements.
- Prevailing safety culture maturity and risk management practices still show **symptoms of early-stage maturity** (reactive/dependent on the Bradley Curve) compared to other sectors



dss+ Bradley Curve

dss+
Protect. Transform. Sustain.

erion

Fire risk is inherent to each treatment step

	Collection	Transportation	Storage	Dismantling	Recycling
					
Common Fire Risk Factors	Drop-off of defective batteries that may become unstable and trigger a thermal event	Thermal safety is affected by differential pressure/temperature in some transportation conditions	Unsuitable packaging material	Dismantling of defective batteries Improper stabilization may lead to thermal runaway	Batteries in devices arrive in bulk containers despite pre-sorting - damaged during discharge or relocation
	Incorrectly discarded batteries Unprotected LIB inside receptacles	Collision or impaling	Unsuitable storage location	Damage of batteries during dismantling	Damaged batteries in devices stored in large piles
	Sorting failure → batteries in devices damaged in bulk containers	Physical damage due to improper storage that may lead to electrolyte leaking, short circuit, structure crack	Lack of compartmentalization	Sorting and dismantling failure → batteries in devices damaged in bulk containers	Dismantling failure → batteries enter mechanical process
			Short circuits in stored batteries leading to thermal runaway		
Control Measure	Adequate packaging material Limit quantities of batteries Use of compliant containers	Sealing & isolation conditions Taping the battery terminals	Advanced detection measures Outdoor storage	Discharge of batteries Segregate battery holding areas	Chemical fire suppression system Enhanced water-based suppression

Potential Fire Risk Level (higher risk with darker colour)

Example of risk control measure

dss+
Protect. Transform. Sustain.

erion

Multi-site LiB Fire Risk Comparison – Key Dimensions (1/3)

We have developed a framework for comparative analysis of Fire Risk across multiple sites built on 3 key dimensions

Performance

This dimension captures the recent past performance in terms of **fire events occurred**. For this specific sector that is still experiencing fairly frequent fires, recent performance can be seen as a **proxy for near future** performance (until additional controls or strengthening of existing controls have taken place)

Risk & Control

This dimension captures the degree of **opportunities** that exist to further reduce risk of LIB fires across different site areas, through **new controls** and/or **strengthening of existing controls**, also considering practices adopted across the sector.

Management System & Culture

This dimension capture the prevailing **maturity of key management system elements**, including organizational culture and capabilities, as underpinning any risk reduction journey. Moreover, some specific elements (e.g. emergency response, procedures, etc.) are also directly correlated to the **adequacy/effectiveness** of some of the control measures adopted to prevent/mitigate risk as mentioned in the Risk & Control dimension.

dss+
Protect. Transform. Sustain.

erion

Multi-site LiB Fire Risk Comparison – Key Dimensions (2/3)

Level 1: Dimension	Level 2: Element	Level 3: Specific Item (e.g. Control Measures
Performance	Last 4 years fire incidents	
Risk & Control	Incoming WEEE Waste & Unloading	
	Main incoming WEEE Storage	
	Pre-Treatment Area - Operational Storage	Specific operating procedure for control of volume/inventory of LiB present in treatment Area/Hall. There should not be more material stored in the treatment hall than can be processed by the end of the shift. Any excess material must be stored in dedicated and safe storage areas such as bunkers.
	Pre-Treatment Area - Manual Dismantling	Video camera installed in local storage area for continous video surveillance. Video surveillance should be monitored onsite by personnel able to respond to a hazard.
	Pre-Treatment Area - Conveyour Belt & Shredding	Thermal (infrared) camera installed in the local storage area. Detection set point should be set as low as possible, but sufficiently above equipment operating temperatures to avoid false alerts. Material must also stay in field of view of camera for sufficient duration to be detected.
	Storage of Pre-Treated Material	Smoke detection installed in local storage area. Smoke detection can be an early indicator of a hazardous condition. 2024 IBC calls by reference NFPA 72.
	Storage of Fractions	Continuous presence of operators (with adequate PPE) at the stockpile, with prompt intervention in case of anomalies detected (presence guaranteed also during stops/breaks to avoid the area being unattended)
	Storage of Batteries	Separation wall/barrier (fire proof) between WEEE stockpile and treatment line to minimize potential for spreading of fire from stockpile to treatment line (with adequate height compared to height of stockpile)
Management System & Culture	Risk Assessment & Risk Awareness	Smoke/fume evacuation/extraction system above the stockpile area to reduce spreading of toxic/heavy smoke/fumes inside the building and facilitate emergency response activities
	Rules & Procedures	Hydrants / fire hoses installed in the vicinity of the internal stockpile. Hydrants are not required by code inside structures but adequate water flow is required for fire supression.
	Emergency Preparedness & Response	Portable foam injection or multiple portable fire extinguisher types. This must include appropriate training or labeling for different fire scenarios.
	Incident Management	Specific mobile equipment (e.g. scrap-handler with sufficient range and long enough extension arm) that can be used to remove burning waste from the stockpile
	Management of Chance & Pre-Start Up Safety Re	Surveillance during non operating hours (e.g. weekend, after working shifts), with portable thermal camera, pre-defined surveillance plan and focus on higher risk areas - note: better if routine surveillance is carried out by site personnel with adequate training and ability to carry out prompt intervention in case of anomaly/early fire detection, for speed of response
	Asset Integrity (of safety critical elements)	
	Governance & Performance Management	
	Insurance	
	Training & Capabilities	
	Leadership Commitment	

How the framework works

- The Framework is structured with 3 levels of increasing granularity:
  - Level 1: Dimension
  - Level 2: Element
  - Level 3: Specific Item (to date **132 control measures mapped**)
- The **Risk & Control** and **Management System & Culture** dimensions **consist of multiple elements that are being evaluated**
- The **Risk & Control dimension is structured around 8 elements.** These relate to the typical areas of WEEE recycling/treatment where LiB related Fire Risk can occur (identified based on the 4 pilot sites visited). For each of these 8 elements, a set of typical control measures are reviewed in more detail and evaluated
- Similarly, the **Management System & Culture** dimension **consist of 10 elements** which represent the prevailing management system and cultural aspects underpinning a robust safety/risk management program. For each of this element, specific items have been defined.

dss+

erion

Multi-site LiB Fire Risk Comparison – Key Dimensions (3/3)

Dimension: Risk & Control → Element (Area): Pre-Treatment Area - Operational Storage

	Hazard/Risk & Key Control			Risk Control Type					Risk Management System Element
Treatment area - Operational storage of WEEE (nearby	Hazard/Risk	Inherent Risk Materiality Considerations	Key Risk Control Description	Prevention/ Mitigation/ General	Specific - Administrative/Procedural	Specific - Technical Engineering	General - Management System	Hot	
X	Hot spot / fire event likely to develop in the WEEE stockpile (containing Lion batteries) located near-by the treatment line as a result of damages to Lion batteries during unloading and material movement. If undetected, the fire can rapidly spread across the stockpile as well as generated large volume of toxic fumes posing challenges in emergency response	**Likelihood** - LIB contained in the WEEE operational stockpile can be damaged (due to incorrect transport, unloading/movement on site, etc), hence a hot spot/early fire is likely to develop in the stockpile **Potential Consequence** - The WEEE stockpile is located inside the building, nearby treatment line. An undetected fire developing in the stockpile can rapidly affect the entire stockpile volume and possibly impact the building and near-by treament line. Toxic fumes developing from the fire might create difficulties to emergency crew to access the building and attack the fire	Specific operating procedure for control of volume/inventory of LIB present in Treatment Area/Hall. There should not be more material stored in the treatment hall than can be processed by the end of the shift. Any excess material must be stored in dedicated and safe storage areas such as bunkers.	P/M	X				
X			Video camera installed in local storage area for continous video surveillance. Video surveillance should be monitored onsite by personnel able to respond to a hazard.	P/M		X			
X			Thermal (infrared) camera installed in the local storage area. Detection set point should be set as low as possible, but sufficiently above equipment operating temperatures to avoid false alerts. Material must also stay in field of view of camera for sufficient duration to be detected.	P/M		X			
			Smoke detection installed in local storage area. Smoke detection can be an early indicator of a hazardous condition. 2024 IBC calls by reference NFPA 72.	P/M		X			
X			Continuous presence of operators (with adequate PPE) at the stock pile, with prompt intervention in case of anomalies detected (presence guaranteed also during stops/breaks to avoid the area being unattended)	P/M	X				
X			Separation wall/barrier (fire proof) between WEEE stockpile and treatment line to minimize potential for spreading of fire from stockpile to treatment line (with adequate height compared to height of stockpile)	M		X			
X			Smoke/fume evacuation/extraction system above the stockpile area to reduce spreading of toxic/heavy smoke/fumes inside the building and facilitate emergency response activities	M		X			
X			Hydrants / fire hoses installed in the vicinity of the internal stockpile. Hydrants are not required by code inside structures but adequate water flow is required for fire supression.	M				X	
X			Portable foam injection or multiple portable fire extinguisher types. This must include appropriate training or labeling for different fire scenarios.	M		X			
X			Specific mobile equipment (e.g. scrap handler with sufficient range and long enough extension arm) that can be used to remove burning waste from the stockpile	M				X	
X			Surveillance during non operating hours (e.g. weekend, after working shifts), with portable thermal camera, pre-defined surveillance plan and focus on higher risk areas - note: better if routine surveillance is carried out by site personnel with adequate training and ability to carry out prompt intervention in case of anomaly/early fire detection, for speed of response	P	X				

Short description of the fire hazard in this specific area

Specific Risk Controls/Measures typically adopted to prevent/mitigate the fire risk in this specific area

Characterization of the Specific Risk Controls/ Measures

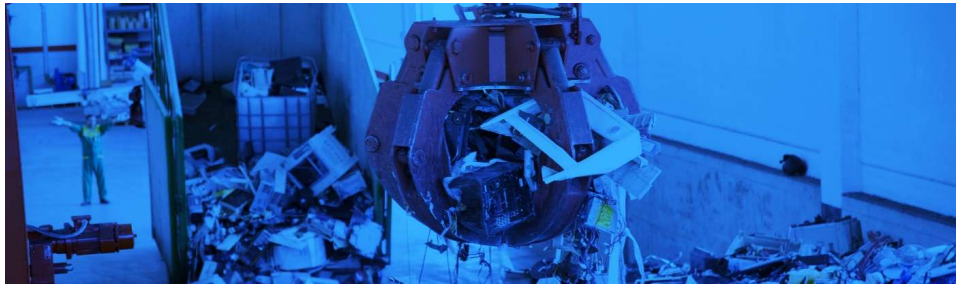
dss+
Protect. Transform. Sustain.

erion

Conclusions

It was possible to develop a framework for the assessment of the fire risk management by:

- developing objective criteria
- developing methodologies to evaluate the gap and the effectiveness of the measures
- developing internal competences (innovation team, operations team)



Luca Campadello
Strategic Development & Innovation Manager
luca.campadello@erion.it

erion