

**INFORMATION FOR FIRST AND SECOND RESPONDERS
AND FIRE BRIGADE IN STORAGE FACILITY'S**

RESCUE AND TRAINING MANUAL

LITHIUM BATTERIES

IN A STORAGE FACILITY

CONTENT

1. General Information	Page 2.
2. Hazards Associated with a leaking Lithium Battery	Page 4.
3. Hazards Associated with a Lithium Battery Fire	Page 5.
4. Environmental Aspects	Page 7.
5. Specific requirements for packaging, storage and transportation of damaged Lithium batteries and batteries at end of life	Page 8.
6. Other Requirements	Page 9.
7. Explanation Used Symbols	Page 11.

**INFORMATION FOR FIRST AND SECOND RESPONDERS
AND FIRE BRIGADE IN STORAGE FACILITY'S**

**LITHIUM BATTERIES
IN A STORAGE FACILITY**

NAME & LOCATION OF THE FACILITY

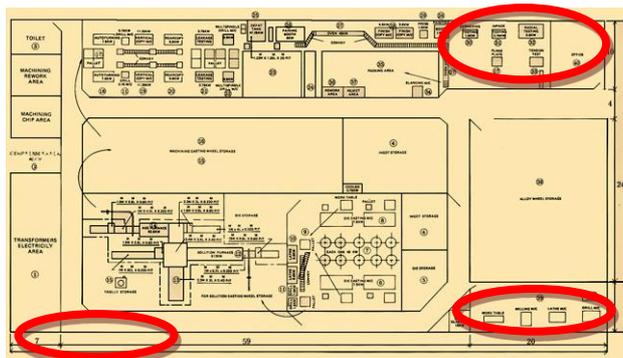
Detailed address: **XXX**
Info in case of emergency: **XXX**
Contact Person: **XXX**

Version: **XXX**

1. General Information

**1.1 Plan, drawing of the location where the Lithium batteries are stored in the facility
ILLUSTRATIVE EXAMPLE ONLY**

AREA I . High Voltage (HV) Batteries Lithium > 36.0 V



AREA II : Individual cells and Battery Packs
Lithium Batteries < 36.0 V

AREA III: waste batteries

Batteries types(e.g. Li –ion, high voltage, button cells...)	Location/area/fire compartment	Info: Type of storage and quantity (approx.)
1. XXX		
2. XXX		
3. XXX		

1.2 Present stationary fire extinguish measures to mitigate fire of the different batteries types: e.g. sprinkler installation and the location of this (mentioned on the plan).

1.3 Present other fire extinguish measures to mitigate fire of the different batteries types: : e.g. large quantizes of dry sand and the location of this and transport means to put this sand on the fire (mentioned on the plan).

1.4 Present water retention systems in order to collect waste fire extinguish water: XXX

1.5 Present fire compartments with fire walls to store Lithium batteries: XXX

1.6 General considerations in the event of damage to or fire with Lithium batteries.

- Warn/ inform all responders and dispatch that Li-ion batteries may be involved.
- Always assume that the batteries are energized and fully charged.
- High Voltage batteries present potential deadly electrical shock hazard even when the battery is partially or fully discharged. To avoid serious injury or death from severe burns or electric shock, never breach high voltage battery assembly cover under any circumstance.
- When Li-ion batteries have been mechanically damaged there is a risk of fire as a result of a rapid temperature elevation in the battery due to e.g. an internal or external short circuit. Physical damage to Li- ion batteries may result in immediate or delayed release of toxic and/or flammable liquids and gases with a risk of fire.
- Leaking electrolyte from a Li-ion battery gives a typical sweet/ether-like odour.
- Venting/off-gassing vapours are potentially hazardous and flammable, and could contain hydrogen, and hydrogen fluoride.
- In case of fire, parts of the battery (e.g. cells) may be ejected as projectile, and fumes could contain hydrogen fluoride, carbon monoxide and carbon dioxide.

1.7 Classification

Lithium Batteries are classified as Dangerous Goods for Transportation under UN 3090, 3091, 3480, 3481. Class of Hazard: Class 9 (Miscellaneous).

NFPA Code: **XXX**



1.8 General first aid measures:

Exposure to High voltage (case of batteries with voltage higher than 60V).

Use insulating gloves or protections.

Turn off the source of electricity, if possible. If not, move the source away from you and the person (victim), using a dry, nonconductive object made of cardboard, plastic or wood.

Check for signs of life (breathing, coughing or movement). If absent, begin cardiopulmonary recovery (CPR) immediately.

Prevent shock. Lay the person down and, if possible, position the head slightly lower than the body with the legs elevated.

After coming into contact with electricity, the person should see a doctor to check for internal injuries, even if he or she has no obvious signs or symptoms.

Exposure to Material/Electrolyte Mixture:

The following actions are recommended if direct contact occurs with Electrolyte or Material mixture due to damage of battery pack or cells:

- Inhalation** : Leave area immediately, move to fresh air and seek medical attention if irritation occurs.
- Eye contact** : Rinse eyes with water for 15-20 minutes and seek medical attention immediately.
- Skin contact** : Wash area thoroughly with soap and water and seek medical attention if irritation occurs.
- Ingestion** : Do not give anything by mouth to a victim who is either unconscious or is losing consciousness. If swallowed, rinse mouth with water and have victim spit the wash water out. Repeat. Do NOT induce vomiting. If vomiting occurs naturally, have victim lean forward to avoid aspiration. Call poison control centre immediately

Always contact medical assistance

1.9 Content of chemical products of the different stored batteries: If possible to determine

- The battery contains the following substances (in % by weight of the battery: **XXX** %).
- Total weight battery : **XXX**

NAME:XXX	Weight %:	UN Nr: XXX	CAS #:XXX
NAME:XXX	Weight %:	UN Nr: XXX	CAS #:XXX
NAME:XXX	Weight %:	UN Nr: XXX	CAS #:XXX
NAME:XXX	Weight %:	UN Nr: XXX	CAS #:XXX
NAME:XXX	Weight %:	UN Nr: XXX	CAS #:XXX

2. HAZARDS ASSOCIATED WITH LEAKING LITHIUM BATTERY

LEAKING BATTERIES and SPILLAGE

Specific Attention



2.1 Risk of Inhalation and contact in non-fire situations

The electrolyte used in the Li-ion battery cells contains a volatile flammable organic solvent and a corrosive substance.

- **Inhalation:** High vapour concentrations may cause respiratory tract irritation.
- **Eye contact:** Eye contact may cause severe irritation and possibly a burning sensation or corneal tissue injury.
- **Skin contact:** skin contact may cause irritation. Prolonged contact with electrolyte mixture may result in more severe irritation.
- **Ingestion:** swallowing electrolyte mixture may cause gastrointestinal tract burns. May cause nausea and vomiting.

<p>Safety Measures</p> 	<p>2.2 Recommended Personal Protective Equipment:</p> <p>Use personal protective equipment. Avoid contact with skin and eyes. Ventilate the area. Position yourself in the wind direction. The information below refers to exposure to the substances contained in the battery.</p> <ul style="list-style-type: none"> - Respiratory track protection Protective mask for acidic vapours or Self Contained Breathing Apparatus (SCBA) or Air-purifying respirator equipped with acid gas cartridge - Hand protection Neoprene or nitrile gloves (EN 374) or equivalent. - Eye protection Safety glasses with side-shields conforming to EN166, or face shield equivalent. - Skin and body protection Boots, apron, long sleeved clothing. <p>Absorption/neutralisation see chapter 4: Environmental aspects.</p>
---	--

3. Hazards Associated with a Lithium Battery Fire

<p>FIRE</p>	
<p>Specific Attention</p> 	<p>3.1 Hazards in case of fire involving a Lithium Batteries in a Storage Area.</p> <ul style="list-style-type: none"> - Lithium batteries can generate heat and contains flammable substances. - When one cell ignites there is a risk a propagation of the fire to neighbour cells (Thermal runaway). - Parts of the battery (e.g. cells) may be ejected as projectile. When the inside cells of the battery are damaged flammable liquid may be expelled from the battery, - If you detect leaking fluids, sparks, smoke, flames, increased temperature, gurgling or bubbling sounds from a Lithium-Ion battery storage area, anticipate a potential battery fire. <p>3.2 Hazard of gaz inhalation in Fire Situations</p> <ul style="list-style-type: none"> - Toxic gases are emitted as by-products of combustion, including carbon monoxide, carbon dioxide and <u>hazardous</u> fluorinated substances. - In case flames are extinguished, flammable gaz can be emitted by the cells, containing hydrogen, hydrogen fluoride, carbon monoxide, carbon dioxide, aldehydes, and short chain hydrocarbons.
<p>Safety Measures</p> 	<p>3.3 Recommended Personal Protective Equipment:</p> <ul style="list-style-type: none"> - Wear always full Personal Protective Equipment suitable for organic solvents and Self-Contained Breathing Apparatus (SCBA). - To avoid serious injury or death from severe burns or electric shock, never breach or remove the high voltage battery assembly protection under any circumstance.

Extinguish Measures



3.3 Extinguish Fire

1st Objective

- In case of a large fire, cool down the batteries with an overflow of water in order to reduce the temperature of the battery and the environment.

Note: Nevertheless, the decision to use an overflow of water is depending on the local circumstances (water retentions systems, environment risks,...).

Caution for the use of water

- If water is used on active batteries, caution should be taken to avoid the electrical hazard that may be present (in case of high voltage battery (> 36 Volts).
- the decision to use large amount of water is depending on the local circumstances (water retentions systems, environment risks,...).
- In case of fire of large Lithium metal or Lithium metal polymer batteries, the use of water may increase the energy /heat release. In such case, stop the use of water and allow the energetic fire of the battery during 15 minutes. Protect or cool with water the surrounding to avoid propagation of the fire.

2nd Objective:

- Shutting off the oxygen supply to the fire: foam can be used on that purpose, or other suitable mineral agents (e.g. sand, vermiculite...).

Offensive attack

Use copious quantities of water with 3% AFFF.(see 1st Objective)

- During application, caution should be exercised as flammable particles may be ejected from the fire
- If necessary use monitors to guaranty safe distance

Make sure the area is ventilated in order to avoid any accumulation of hydrogen or other explosive gas, particularly in case of waste containing Li-metal batteries

Defensive attack

- Recommended if the high voltage batteries are involved and no exposures are present. Due to the difficulty in reaching the burning cells inside the battery with the extinguishing agent, the Incident Commander may choose to allow it to burn itself out. Any individuals without SCBA should remain upwind of the fire and avoid inhalation, due to toxic compounds in the smoke.
- Fire crews may utilize a water stream or fog pattern to protect exposures or to control the path of smoke.
- Fire Fighters may utilize a water stream or fog pattern to protect exposures or to control the path of smoke
- Allow battery to cool to ambient temperature before approaching. Measure temperature remotely with an infrared temperature (IR) gun or similar device, if available

WARNING: There is a possibility for delayed ignition or re-ignition of a lithium-ion battery fire even after it is believed to be extinguished. This may remain an issue until the batteries are properly handled/ managed/ conditioned by a qualified person. Re-ignition may appear even after a few days.

4. Environmental Aspects

IN ALL CASES

Specific Attention



4.1 Absorbent materials.

- To confine the spillage of liquids and the fire: use dry materials such as sand or mineral absorbing agents.
- Cleanup all spills/leaks immediately using an absorbent material such as vermiculite or dry sand. Neutralization is not necessary.
- Collect all contaminated absorbent material in a designated approved plastic waste container (non-conductive).
- After intervention, rinse the affected areas with water adequately

4.2 Recommended Personal Protective Equipment:

- Handle Li- ion spills using the following personal protective equipment (PPE)
 - Safety glasses or face shield
 - Chemical resistant neoprene or nitrile gloves
 - Protective apron or coveralls
 - Protective mask for acidic vapours or SCBA.

Safety Measures



Perform gross decontamination by removing affected clothing. Wash skin with water and soap.

4.2 Treatment of Waste Water.

- Confine the effluent or the contaminated material and collect it as hazardous waste (water) for appropriate treatment.
- Pick up and transfer to properly labelled containers.
- Dispose of in accordance with local waste management legislation and emissions regulations.

5. Specific requirements for packaging, storage and transportation of damaged Lithium batteries.

Safety Measures During Storage and Transport

When damaged, lithium batteries can release substances with corrosive properties and are offering a risk of fire.

In case of waste mix, the higher the concentration of Lithium batteries in the waste mix, and the more damaged they are, the higher the risk of fire.

Among others, it is recommended to maintain the ratio of Lithium Batteries in Zinc-Alkaline collections streams low in order to keep the risk of fire low for transport and storage.

The most hazardous waste are the sorted lithium batteries waste (particularly when damaged e.g. as in the case of batteries from WEEE scrap after shredding), or lithium batteries production scraps. Transport and handling of such waste without batteries short circuit protection or cushioning material is not recommended

- Use insulative materials for damaged or non-insulated Lithium batteries handled in bulk:
 - example of quantities ratios (by weight) for a safe homogenous mix of batteries and several cushioning materials:

	vermiculite	sorbix	Pyrobubbles	Absorbant	sand
weight ratio vs battery	0,4	0,4	0,6	0,6	1
volume ratio vs battery	10	5,5	5	1,7	1,6

- Use adapted process controls, and detectors (Very Early Smoke Detection Alert, thermal cameras,...). In case of transport of containers/drums of high fire risk material, monitor the risk of overheat during the following 24h at least.
- Immediately isolate the batteries in a safe place if, during operation, they emit an unusual smell, develop heat, change shape/geometry, or behave abnormally (see part 1.4).

Li-ion Batteries and Li-Metal batteries are classified as Dangerous Goods for transport according to the UN Model regulation for the Transport of Dangerous Goods. They are classified under CLASS 9 Dangerous Goods due to their dual hazard properties associated with their chemical and electrical content

UN 3090 : Lithium-Metal Batteries

UN 3091 : Lithium-Metal Batteries contained in equipment or packed with equipment.

UN 3480 : Lithium-Ion Batteries

UN 3481 : Lithium-Ion Batteries contained in equipment or packed with equipment.

Damaged or defective batteries can only be transported according to the UN Regulation for the transport of dangerous goods (UN 3480).



6. Other Requirements

General Storage requirements

Consider the specific risk of the material before selecting adapted storage conditions.

- keep the waste Lithium batteries in a separate storage. Do not mix different waste batteries type in the same storage area.
- Keep in a dry, cool and well-ventilated place.
- Keep away from heat sources (max 60°C) and sources of ignition. Protect from direct exposure to sunlight.
- Keep away from water and condensation

- In case of storage of higher fire risk materials (e.g. concentration of lithium batteries only,...), consider specific isolated buildings, equipment's with detectors and/or sprinklers protection systems, and external surveillance.

It may be advisable to store limited quantities in a given area (E.G. <10 m²), the quantity should not be larger than 6 euro pallets or an equivalent of 6.0 m³ of batteries or equipment containing batteries. The storage of the pallets should not be higher than 2 meters.

Safety measures for storage shall be organized with the relevant safety team at the plant. It shall be adapted to the local Emergency Response Capacity.

It can be mentioned that the EU Batteries Directive 2006/66/EC, in its Annex 2 Part A, Treatment § 2. requires...

"treatment and any storage including temporary storage at treatment facilities shall take place in sites with impermeable surfaces, and suitable weatherproof covering or in suitable containers."

Author: XXX
Sources: XXX

Following text may never be deleted!

This template is developed as an “example of good practice” in cooperation with RECHARGE and CTIF
This document is not legally binding. It is prepared with the best information available to the authors at the time of its preparation.
The information contained in this template rescue and training manual may be updated without notice.

The information on this template must be further filled in (XXX) and specific adapted to the type of battery by the car manufacturer!
The information in the template has to be approved by the car manufacturer before distribution of this specific document.
The manufacturer is always the final author of the “filled in training and rescue manual” and it relays always under his responsibility.

This template is built for fire fighters/rescue workers/towing and maintenance, as free information source at the scene and after.
Also usable for training purposes.

Misuse of this document, containing specialized and lifesaving information, in any form or shape is punishable by law.

All rights reserved, Copyright protected. ©

8. Explanation used symbols

Only mention used symbols in the list

	Use water to extinguish
	Do not break open
	Use heat Camera
	Danger electricity/electric shock
	Wear safety boots
	Wear safety gloves
	Wear protective clothing
	Wear face shield
	Wear protective mask

	<p>Wear breathing apparatus</p>
	<p>Disassembly only allowed by qualified persons</p>
	<p>NFPA 704 Hazard Identification System (To be filled in)</p>
	<p>Explosive</p>
	<p>Flammable</p>
	<p>Corrosives</p>
	<p>Caution harmful</p>
	<p>Acute toxicity</p>
	<p>Environmental hazard</p>

	General warning
	Indication of life threatening situation! Not acting on provided information can lead to life threatening consequences...
	ADR Class 9 (Miscellaneous)
	Lithium ion battery, high voltage