CTIF Norway

Handling fire in Lithium-ion batteries

Risk levels

Efforts against fires in Lithium-ion batteries are divided into four risk levels:

Level 1: Simple and small fires in PCs, mobile phones, electric bicycles, electric scooters and the like.

Level 2: Electric cars, hybrid cars, buses or similar that are outdoors.

Level 3: Fires in electric cars, buses or similar indoors (e.g. garage). Energy storage in houses or industry and the like.

Level 4: Battery fire in all-electric or hybrid vessels, larger buildings/energy storage systems. which require large, complicated and risky efforts.

Brann i Litium-ion batterier risikonivåer

Level 1	Level 2	Level 3	Level 4
Fire in smaller LIB	Fire in larger LIB	Fire in larger LIB, enclosed space	Fire in larger LIBs on board a vessel or larger building
• Mobile phone • Electric bike • PC • Electric scooter	• Electric cars • Electric buses • Electric trucks • Electrical construction machinery and battery banks for charging them	• Electric car in garage • Electric car in tunnel without ventilation • Energy storage, containers (ESS) • Battery storage in houses and industry	• All-electric or hybrid vessel • Building with large battery bank systems, hospitals
Low risk	Low to medium risk	Medium to high risk	High risk
Firefighting efforts can be carried out by civilians, provided they are not exposed to dangerous fire smoke. The fire department should control the incident.	Firefighting efforts must be carried out by the fire department. May require large quantities of water (over 10,000 liters) and efforts over time.	Slokkeinnsats vil kreve riktig kompetanse i form av opplæring i batteribrann.	Firefighting efforts will require the expertise of specially trained firefighters in the form of a RITS group or CBRNE unit that has been trained in, and is trained in, handling battery fires. Staff is being established. Obtain resource persons.

Litiumioniakkupalojen riskitasot

Taso 1	Taso 2	Taso 3	Taso 4
Pienempi litium-ion akku	Suurempi litium-ion akku	Suurempi litium-ion akku, suljettu tila	Suurempi litium-ion akku, laivalla tai suuressa rakennuksessa
• Kännykkä • Sähköpyörä • PC • Sähköskuutti	• Sähköautot • Sähköbussit • Sähkörekat • Sähköiset rakennuskoneet ja niiden lataamiseen tarkoitetut akkuvarastot	• Sähköauto autohallissa • Sähköauto tunnelissa ilman ilmanvaihtoa • Energiavarastot ja säiliöt (ESS) • Akkuvarastot kodeissa ja teollisuudessa	• Täyssähköiset kulkuneuvot ja alukset • Suuret akkuvarastorakennukset, sairaalat
Matala riski	Matala tai keskitason riski	Keskitason tai korkea riski	Korkea riski
Sammutusta voivat tehdä kansalaiset sillä edellytyksellä, että he eivät altistu vaarallisille palokaasuille. Pelastuslaitoksen pitää tarkastaa tilanne.	Pelastuslaitoksen pitää sammuttaa palo. Sammutus voi vaatia suuria vesimääriä (yli 10 000 litraa).	Sammutustyöt vaativat todellista akkupalojen asiantuntemusta ja koulutusta.	Sammutustyöt vaativat todellista akkupalojen koulutettua asiantuntevaa henkilöstöä (RITS –ryhmä tai CBRNE –yksikkö).

Risk level 1 Fire in smaller Lithium-ion batteries

STEP 1

Read the accident and do a risk assessment..

Risk assessment:
- High risk of fire spread.
- Inhalation of hazardous fire smoke.
- High temperature in the fire.
- Small explosions in battery cells may occur.

Incident development:
- Batteries can spontaneously vent large amounts of gas without warning.
- Batteries can spontaneously ignite without warning
.• Can burn for longer time than in more common materials.

STEP 2

Find possible actions**.**

Resource access:
- Here, the caller will be able to carry out a first response, provided that he is not exposed to fire smoke. Use available extinguishing agent, house fire hose, hand extinguisher, fire blanket or similar.
- The fire department will be able to carry out a safe and effective response with a fire extinguisher/fire truck.

Step 3

Objectives off the efford and tactical plan

Objectives of the effort:
- Prevent the spread of fire.
- Prevent exposure to dangerous fire smoke.

Protection level:
- Normal clothing provided that you are in a smoke-free environment.
- Normal fire clothing.

Tactical plan:
- Water is a good extinguishing agent for extinguishing small battery fires.
- Burning LIBs can be difficult to extinguish, use plenty of water or put the battery in a container of water.
- Other extinguishing agents such as foam, powder and fire blankets can be used, but will have a lower cooling effect.
- The battery is moved to a safe area where any spontaneous combustion will not cause a risk of spread.
- Smaller batteries can be rendered harmless by placing them in a container of salt water. This both cools and slowly discharges the battery.

Risk level 2 Fire in bigger Lithium-ion batteries

STEP 1

Read the accident and do a risk assessment..

Risk assessment:
- High risk of fire spread.
- Inhalation of dangerous fire smoke.
- High temperature in the fire.
- Small explosions in battery cells may occur.
- Electrical hazard.

Incident development:
- Batteries can spontaneously vent large amounts of gas without warning.
- Batteries can spontaneously ignite without warning.
- Can burn for a long time.

STEP 2

Find possible actions**.**

Resource access:
- Extinguishing/cooling down fires in larger LIBs requires access to large amounts of water. Consider water supply, bring water tank if necessary.
- Civilians are not recommended to start extinguishing.

Step 3

Objectives off the efford and tactical plan

Objectives of the effort:
- Prevent the spread of fire.- Prevent exposure to hazardous fire smoke.

Protection level:
- Ordinary firefighting clothing with full respiratory protection.

Tactical plan:
- Block the vehicle to prevent it from driving itself.
- Disconnect the external power source if the vehicle is charging. See, for example, Crash Recovery/Euro Rescue for information on relevant vehicles.
- Trigger the stop switch on the charger if it is present. If the external power source is not disconnected, the fire shouldbe considered a fire in a live installation. Use the correct protective equipment (1000-volt gloves).

• Use plenty of water to extinguish/cool the battery fire. In the case of an electric car fire, under-washing is most effective.
• Fire blankets can be used to reduce smoke production, prevent the spread of fire and extinguish interior fires. Should be used in combination with cooling on the underside.
• If necessary, pull the vehicle away to prevent the spread of fire.
• Never cut, nick or cut the battery to get to the fire extinguishing water.
• Use a fan to control the smoke.
• Vehicles that have been exposed to fire/collision can spontaneously ignite.
• Heat build-up in batteries is difficult to measure as batteries are well encapsulated and protected by covers.
• Transport the vehicle to a suitable location at least 10 meters away from other flammable material.
• Avoid tunnels, consider following the recovery vehicle.
• Inform the recovery vehicle about the risk of a new internal short circuit in the battery and re-ignition.

Risk level 3 Fire in Lithium-ion batteries, closed room

STEP 1

Read the accident and do a risk assessment..

Risk assessment:

- Risk of gas explosion.
- High risk of fire spread.
- Risk of inhalation of toxic fire smoke.
- Risk of corrosive damage.
- Risk of short circuit in battery, high short circuit effect and arcing.
- Risk of current flow.
- Is the gas above the LEL? If you see flames, there is little risk of explosion.

Incident development:

- *The fire:* In the event of a battery fire in a closed room, fire gases without complete combustion can collect and form an explosive atmosphere. Even small batteries vent a lot of gas and could pose a risk.
- Assess the degree of encapsulation against the flammability area.
- *Surroundings/building*: Assess the risk of spread.
- *People*: Evacuate.

STEP 2

Find possible actions.

Immediate measures:•

Evacuate, no unprotected persons near the battery fire.

- Cool and extinguish visible fire with water.

Possible measures:

- Start cooling, if safe < LEL.
- Start ventilation, if safe < LEL.

Step 3
Objectives off the efford and tactical plan

Objectives of the effort:
• Prevent explosion.
• Avoid personal injury.•
Prevent fire spread.
• Prevent exposure to hazardous fire smoke.

Protection level:
• Ordinary firefighting clothing with full respiratory protection.• Consider using splash/chemical protection suit when entering battery compartment.

Battery compartment entry:
• Battery compartment entry should not be carried out until you have a complete overview of the gas concentration in the room.
• Always use full protective equipment.
• A battery affected by heat can spontaneously self-ignite.
• A battery affected by heat can spontaneously vent large quantities of hazardous gas.
• Do not touch batteries as they are live.• Gases can collect in lower parts of the structure also outside the battery compartment.

Tactical plan:
• Defensive approach until you have a complete overview of explosive gases in the room.
• Perform detection with adapted detection equipment (Ex measuring instrument).
• Explosions rarely occur during a fire. If you see flames, you have control of the situation. Explosive gases burn up.
• In the case of garage and house fires, consider using shear extinguishers/fog spikes to reduce the risk of explosion.
• Do not use shear extinguishers/fog spikes directly on/in batteries as this can short-circuit the battery internally.
• Make sure that fire gases are not vented to areas where people are present.

Battery fire extinguishing:
• Extinguishing water can have a high PH value (Alkaline with PH 8–14).
• Cool batteries with large amounts of water.
• Battery rooms are monitored by monitoring the gas concentration in the room. Use a calibrated Ex measuring instrument.
• Start continuous ventilation of battery rooms.
• Equipment and clothing that have been exposed to smoke should be decontaminated after use.

Risk Level 4
Fire in larger Lithium-ion batteries on board a vessel or large building

STEP 1

Read the accident and do a risk assessment..

Risk assessment:
- High risk of gas explosion.
- Risk of inhalation of toxic fire smoke.
- Risk of corrosive damage
.• Risk of short circuit in battery, high short circuit effect.
- Risk of current flow.

Damage site factors:
- Vessel/building: Type of vessel/type of building.
- Fire: Detected TR or fire in battery compartment?
- Position: Is the vessel at berth or at sea.
- People: Number of passengers and crew. Passengers requiring assistance pose additional challenges.
- Weather: Consider weather conditions.

STEP 2

Find possible actions**.**

immediate actions:
- Inform crew/employees of potential hazards.
- Consider activating the vessel/building's fire extinguishing system.
- Start evacuation.
- Consider isolating the battery compartment.

Possible actions:
- Start cooling, if safe < LEL.
- Start ventilation, if safe < LEL.
- Obtain information from the vessel/building's monitoring system.

Resource access:
- Firefighting efforts will require the expertise of specially trained firefighters in the form of a RITS group or CBRNE unit that has been trained in and is trained in handling a battery fire.
- Establish communication with HRS.
- Establish communication with vessel/captain.
- Obtain resource persons.
- Contact the manufacturer of the battery installation.

Step 3
Objectives off the efford and tactical plan

Objectives of the effort:
• Prevent explosion.
• Avoid personal injury.
• Prevent fire spread.
• Prevent exposure to hazardous fire smoke.

Protection level:
• Ordinary firefighting clothing with full respiratory protection.
• Consider using splash/chemical protection suit when entering battery room.

Tactical plan:
• Obtain information from the vessel/building's monitoring system, Battery Management System (BMS). Monitor cell temperatures and cell voltage. In some cases, this can be read externally. Contact the battery manufacturer.
• The alarm system may be linked to gas sensors and video surveillance.
• Obtain a floor plan and assess the risk of spread.
• Make sure that fire gases are not vented to areas where people are present.
• Consider triggering the vessel's extinguishing system if this has not been triggered.
• Avoid supplying oxygen if the battery compartment is closed.
• If possible, carry out detection with adapted detection equipment (Ex measuring instrument).
• Explosions rarely occur during a fire. If you see flames, you have control of the situation. Explosive gases burn up.
• Replacement of fire gases with inert gas (From UEL to LEL).
• Avoid using salt water.
• Short circuits in the battery installation can occur even when using clean water.
• The water binds particles such as ash, soot, salts and metal particles which make it conductive, use large amounts of water.

Entering the battery compartment:
• Entering the battery compartment should not be carried out until you have a complete overview of the gas concentration in the compartment.
• Always use full protective equipment.
• A battery affected by heat can spontaneously ignite.
• A battery affected by heat can spontaneously vent large quantities of hazardous gas.
• Do not touch batteries as they may be electrically conductive.
• Gases can collect in lower parts of the structure also outside the battery compartment.

Battery room post-extinguishment:
• Extinguishing water may have a high pH value (basic pH 8–14).
• Cool batteries with large amounts of water.
• Battery rooms are monitored by monitoring the gas concentration in the room. Use a calibratedEx measuring instrument
.• Start continuous ventilation of the battery room.
• Equdecontaminatedipment and clothing that have been exposed to smoke must be after use.

STEP 4
Organize the damage site and select KO.

Disaster site organization:

• For vessels under way, consider access to the vessel, can the vessel be transported to the quay or must emergency personnel be transported to the vessel?

• Consider the location of the vessel. Important factors; Possibility of evacuation of personnel, access for emergency personnel, can buildings around the quay be exposed to smoke/explosion?

• Is a port of refuge available?

• Is there a need for measures against acute pollution?

Management support:

• Contact resource persons; Other fire departments, expert on site, the Armed Forces, marine resources, battery system supplier