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after smartphone battery ignites

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Safety protocols to manage equipment with lithium batteries on board the Spanish National Research Council (CSIC) fleet

27th ERVO

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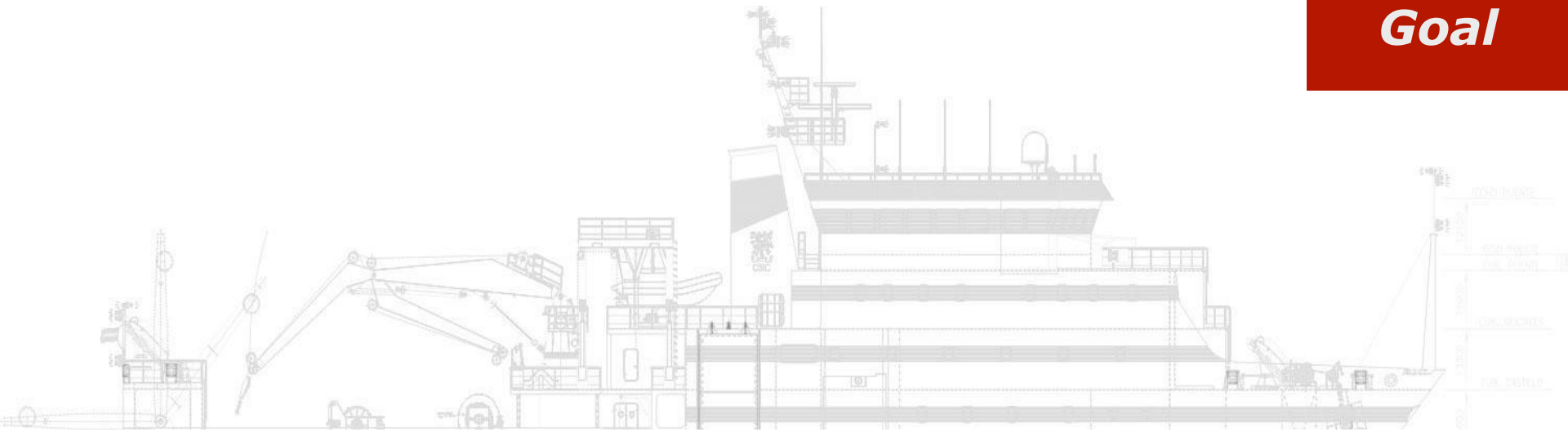
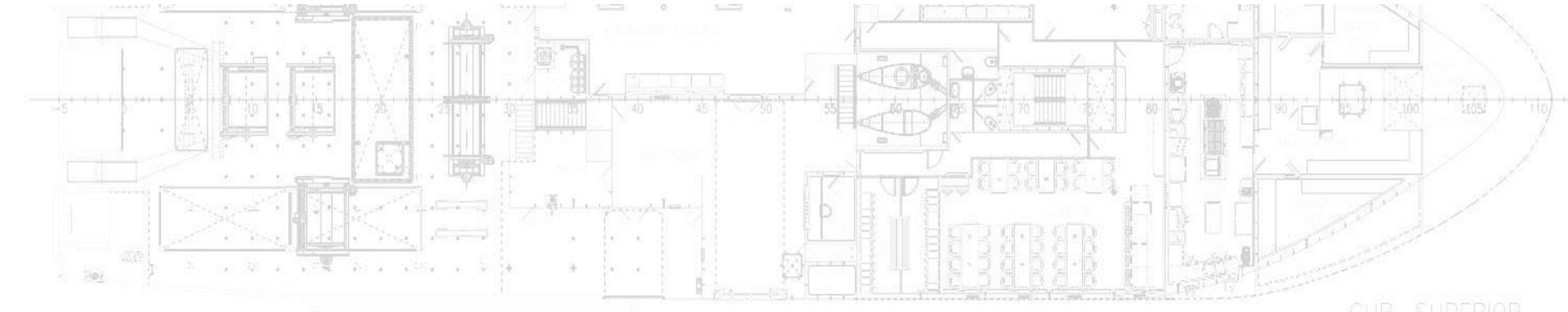
2-4 June 2025

Goal

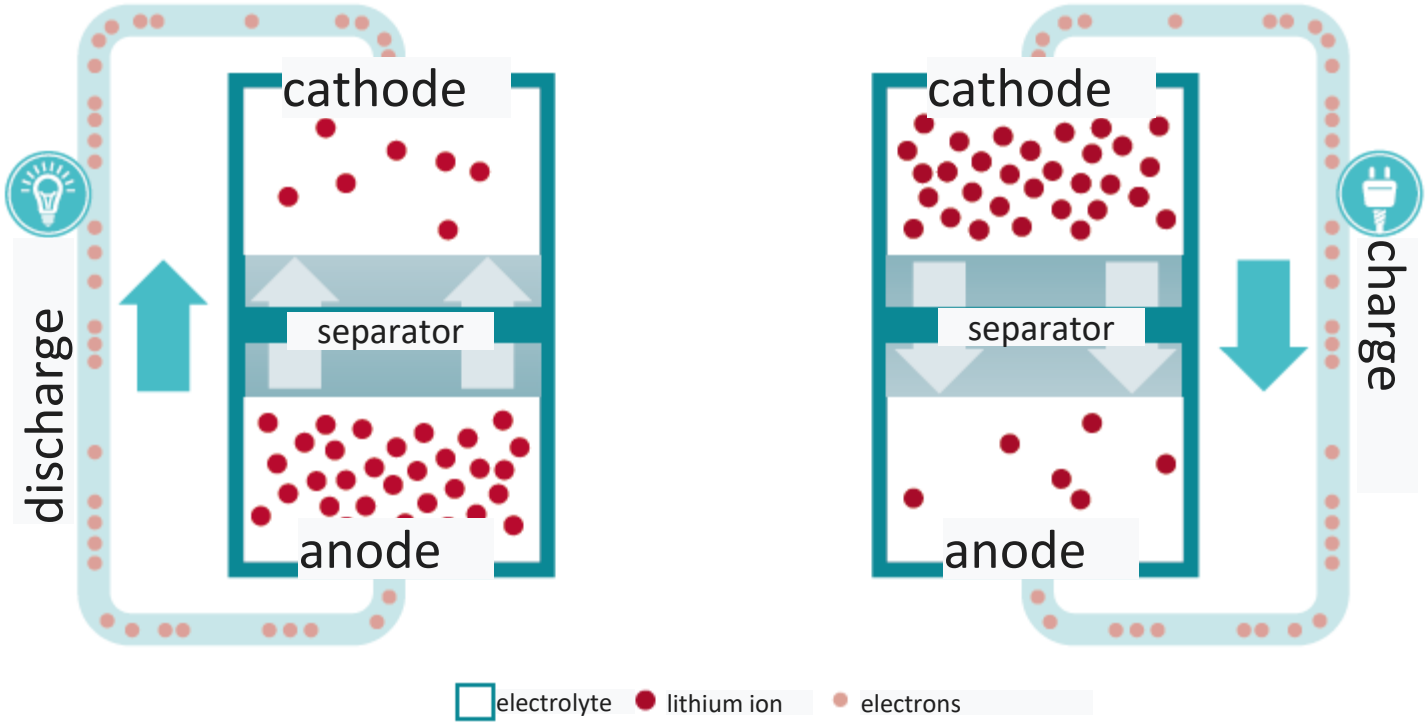


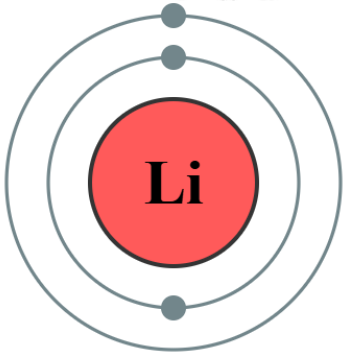
- ✓ *Introduction. Lithium Batteries: characteristics and types*
- ✓ *Lithium Batteries in Oceanographic Research Vessels, main risks*
- ✓ *From the theory to the practice: key points*
- ✓ *From the theory to the practice: Implementation in the research vessels fleet*



1. Introduction. Lithium Batteries: characteristics and types

A lithium battery is a type of energy storage device that uses lithium ions to generate and store electricity.





Lithium is the lightest metal and the most electropositive, which means it readily gives up its electrons, allowing lithium-ion batteries to achieve a high energy density

Electrolyte: Lithium salt in an organic solvent
Separator: Prevents direct contact between anode and cathode

1. Introduction. Lithium Batteries: characteristics and types

The commercial deployment of lithium batteries is relatively recent.

Characteristics:

- ✓ High energy density
- ✓ Low weight
- ✓ Long lifespan

Classification Criteria:

- ✓ By capacity/power
- ✓ By application
- ✓ By technology
- ✓ .....

There are:

- ✓ primary batteries (non-rechargeable)
- ✓ secondary batteries (rechargeable or accumulators)

2. Lithium Batteries in Oceanographic Research Vessels, main risks

Lithium is a highly chemically reactive metal with a risk of unwanted reactions that can occur violently.

Lithium batteries are susceptible to ignition under conditions such as :

- ✓ mechanical damage
- ✓ thermal overload
- ✓ electrical overcharge

hydrogen gas
(highly flammable)

lithium hydroxide
(corrosive)

What happens if lithium comes into contact with water? $2Li+2H_2O \rightarrow 2LiOH+H_2\uparrow$

Lithium batteries, especially those containing metallic lithium, can react dangerously when in contact with water.

Risks in a maritime environment:

If a lithium battery becomes wet or is punctured and comes into contact with seawater (which also contains salts that accelerate the reaction), the risk of spontaneous fire increases significantly.

2. Lithium Batteries in Oceanographic Research Vessels, main risks

Key Considerations for Handling Lithium Battery Equipment on Vessels :

1.Transportation protocols

Ensure compliance with regulations for hazardous materials.

2.Charging and discharging procedures

Follow manufacturer guidelines and implement safety monitoring systems.

3.Storage requirements

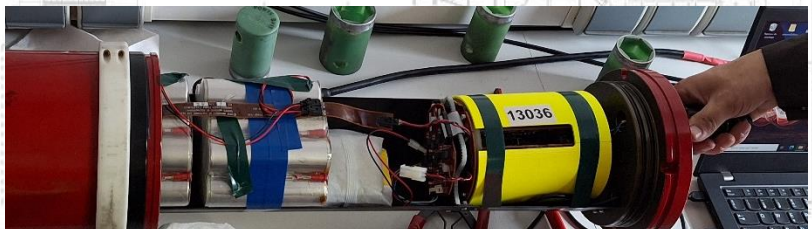
Maintain appropriate temperature, ventilation, and fire protection measures.

4.Battery installation and removal

Use proper tools and personal protective equipment (PPE) to prevent damage or injury.

5.End-of-life management

Apply correct procedures for the disposal and recycling of spent batteries in accordance with environmental regulations.

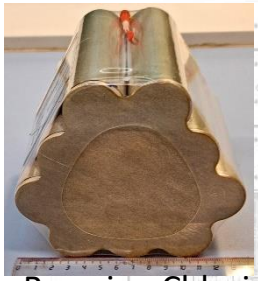


3. From the theory to the practice: Key points

It is important to establish work protocols/procedures for lithium batteries.

- ✓ **Identify** the UTM departments that work with equipment containing lithium batteries and the volume involved.
- ✓ **Identify** the different types of lithium batteries (primary or secondary cells, sizes, energy density, weight, etc.).

Primary lithium battery



Bromine Chloride

Model SLB-150 Battery Pack

Lithium thionyl chloride

Hermetic-cell construction
Water-resistant packaging

3.6 V Primary lithium-thionyl chloride ($Li\text{-}SOCl_2$)

Secondary lithium battery

$LiFePO_4$

BP-280 Li-Ion Battery Pack

Li-Ion, 7.2V 2280 mAh battery pack

3. From the theory to the practice: Key points

Examples of equipment with lithium batteries.

OBSs (Ocean Bottom Seismometers)

LADCP (Acoustic Doppler Current Profiler)

compass-retriever

birds

3. From the theory to the practice: Key points

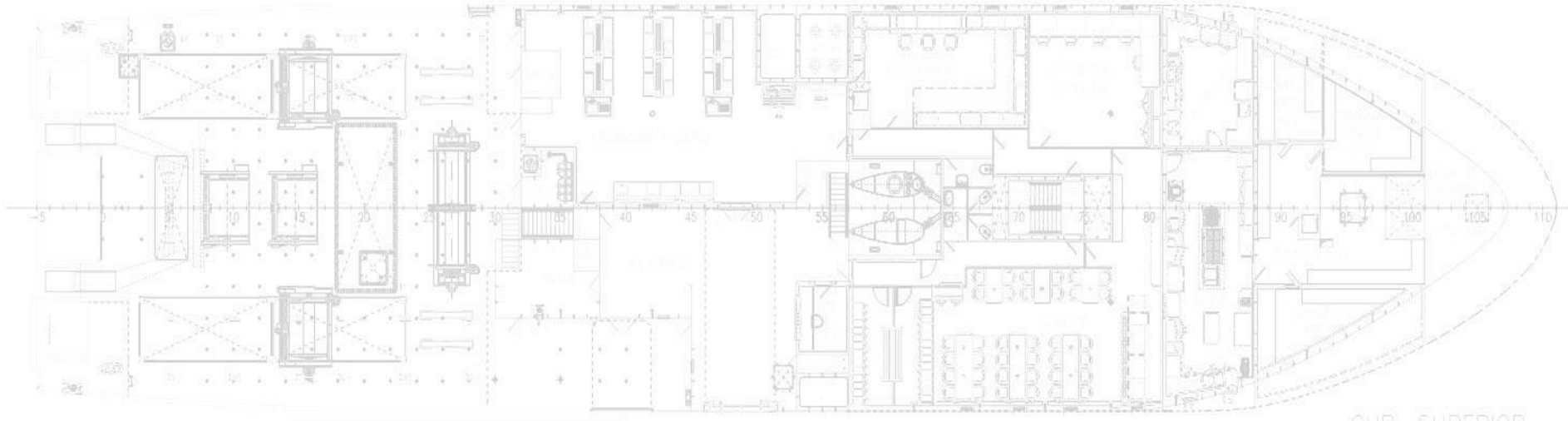
✓ **Protocols/Procedures** must cover:

- Transportation of lithium batteries.
- Charging/discharging and storage of lithium batteries on land.
- Handling and storage of lithium batteries on land and on vessels.
- End-of-life management of lithium batteries
- Action in case of an incident/accident.

3. From the theory to the practice: Key points

Which key points should be taken into account?

- ✓ **Information**. Inform all workers: about protocols, procedures
- ✓ **Training**. Train staff
- ✓ **Provide** workers with the necessary **personal protective equipment (PPE) and fire containment elements**



3. From the theory to the practice: Key points

Example of Information

- Previous oceanographic survey, during the coordination of business activities, the scientific team is asked whether they will be bringing lithium batteries on board and, if so, the type of battery and volume.
- If the scientific team is carrying lithium batteries, the ship's captain and the chief technician are informed so they are aware and can take it into account when determining their placement on the vessel.

3. From the theory to the practice: Key points

Example of Training

- Training for workers : In September 2024, the ASECOS company gave a talk to UTM staff about the types of lithium batteries, the risks, and preventive measures.
- Specific training is still lacking depending on the type of battery/work equipment. Instruction is needed in problem detection and appropriate response depending on the situation.

3. From the theory to the practice: Key points

Example of personal protective equipment (PPE) and fire extinguishing elemets

- In progress:

A. Procurement of personal protective equipment (gloves, masks, and apron).

B. Procurement of fire containment elements (quarantine boxes for potentially damaged batteries, fire extinguisher, fire blanket, and LITH-X (dry chemical extinguishing agent)).

4. From the theory to the practice: Implementation in the research vessels fleet

What is the reality on research vessels?

- **Zero risk is unattainable**

Incidents and accidents can occur despite precautions.

- **Preventive measures are essential**

Implementing comprehensive safety protocols helps minimize risks.

OBSs (Ocean Bottom Seismometers)

2024

4. From the theory to the practice: Implementation in the research vessels fleet

What is the reality on research vessels?

LADCP

(Acoustic Doppler Current Profiler)

4. From the theory to the practice: Implementation in the research vessels fleet

What is the reality of research vessels?

- ✓ **Diversity of organizations/companies.** Participation of different organizations in oceanographic survey. Raise awareness among all parties about the risks associated with lithium batteries.
- ✓ There is a lack of **personal protective equipment** and **fire suppression means** in all locations where lithium batteries are stored, transported, or handled.
- ✓ Most oceanographic vessels do not include **safety cabinets for lithium batteries** in their design.
- ✓ There is **limited training** available on how to respond to lithium battery fires, and even less so for fires occurring on board ships.

Conclusions

- ✓ *The top priority is to minimize as much as possible the risks associated with working with lithium batteries.*
- ✓ *On oceanographic vessels, all personnel must be aware and well-informed.*
- ✓ *There must be established protocols and procedures for working with lithium batteries.*
- ✓ *In all areas where lithium batteries are present, it is essential to have personal protective equipment available to act in case of an accident.*
- ✓ *There must also be extinguishing/containment means such as fire extinguishers, fire blankets, and similar equipment.*

I would like to thank all the UTM staff, especially those who provided images and information for this presentation

OBS Department (Ocean Bottom Seismometers)
Seismic Department
Spanish Antarctic Base Juan Carlos I Department (BAE JCI)
AUV (Autonomous Underwater Vehicles) Department
Electronics Department
Mechanics Department

Thank you all for your attention

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