EASA
European Union Aviation Safety Agency

LOKI-PED - Lithium Batteries Fire/Smoke Risks in Cabin

Contractor

Fraunhofer Gesellschaft (FHG)

Consortium Members

Airbus

Contract period

22/8/2022 – 21/07/2025

Budget

800.000€

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Main objectives:

The amount of lithium metal and ion batteries transported by air is constantly growing. Lithium batteries, regardless of whether they are contained in equipment or not, are one of the main causes of incidents reported in the cabin. The main risks are fire and smoke, which can lead to catastrophic events. LOKI-PED aims to:

- → **Fully characterise the hazards** related to the carriage of lithium batteries and PEDs by passengers in the aircraft cabin.
- → **Determine the extent of the consequences of fire and smoke** caused by an event on the safe conduct of the flight, using modelling and numerical simulation and involving operational safety experts.
- → **Assess the limits related to battery design and number of PEDs** on board to maintain acceptable risk level(s) and determine the relationship between the risk and the increase/decrease of both battery energy and number through the experimental data available.
- → Compare the scenarios assessed with the **limits established by the applicable regulations** to identify potential gaps and needs for change and justify the conclusions.
- → **Assess and evaluate current emergency procedures** and identify potential improvements of the existing emergency procedures.
- → **Establish whether additional mitigating measures** in relation to the hazard would need to be applied, determining whether the use of certain solutions may minimise or increase the risks and consequences and justifying whether manufacturing or testing.

Impacts & benefits

The LOKI-PED project will provide a deeper understanding of the thermal runaway consequences and the associated risks and will raise awareness for critical situations from passengers and crew.

Furthermore, operators will be enabled to conduct their risk assessment based on scientific information and authorities will be provided with evidence for the existing regulations or proposals for necessary improvements.

This project has been funded from the European Union's Horizon Europe research and innovation programme.

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Further reading

In the today's world, a life without portable electronic devices is hardly imaginable. Mobile phones, notebooks, tablets, cameras, e-book readers, e-cigarettes, smartwatches are electronic devices nobody wants to miss. Consequently, people take many of those electronic helpers with them.

There is not only the demand in numbers of energy storage devices. Additionally, the market demands smart and small means to minimize the size of any electronic gadget without drawbacks in capacity or weight. This customer requirement led to the **emergence of Lithium cells**, which today comprise a variety of chemical compounds which have one property in common: they all deliver a significantly higher energy density compared to classic cells. This higher energy density comes along with a higher tendency to suffer from an internal short circuit, caused for example by misuse like mechanical damage, vibration, overheating or overcharging, or by poor build quality of the cell. This failure will eventually lead to a so-called **thermal runaway** with all the associated consequences of this phenomenon.

Although the event of a thermal runaway of a personal electronic device (PED) in the cabin has not led to a fatal accident, the thermal runaway inside a mobile phone or a notebook, involving already more than ten cells, requires a well-trained cabin crew equipped with suitable measures to cope with such kind of fires like handheld extinguishers and boxes or bags to place the burning, smoking, potentially exploding device inside.

The need for high energy in small enclosure makes Lithium cells vulnerable to many scenarios like damage, e.g. by moving a business class seat, when the mobile phone falls inside, like overloading or deep discharge, constant vibration or reverse polarity when charging. The same phenomena are valid in the cockpit, where the former paper handbooks become more and more replaced by **electronic flight bags**, powered with Lithium batteries. The energy source of these PEDs are lithium-based batteries, which can potentially release their chemically stored energy very quickly in uncontrolled thermal runaway events, releasing very hot toxic and explosive gases, smoke and even fragments of the PED housing. Caused by a short circuit in the electronic system of the in-flight entertainment subsequently leading to ignition of the insulation, the crash of Swissair Flight 111 with 229 fatalities in 1998 tragically demonstrated the catastrophic effect of fast spreading of fire and smoke in the cockpit. Whereas most of those incidents, the vast majority taking place in the cabin, have not left the incident status, they constitute an **alarming issue**, which requires a scientific examination of the possible consequences and an assessment of the emergency procedures in place today.

LOKI-PED will address these challenges by using experimental, numerical as well as latest risk assessment methods.

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