



LASH FIRE

Legislative Assessment for Safety Hazards of Fire
and Innovations in Ro-Ro Ship Environment

The LASH FIRE project – Results overview
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CFIS 2023
2023-06-28, Pula

RISE Research Institutes of Sweden

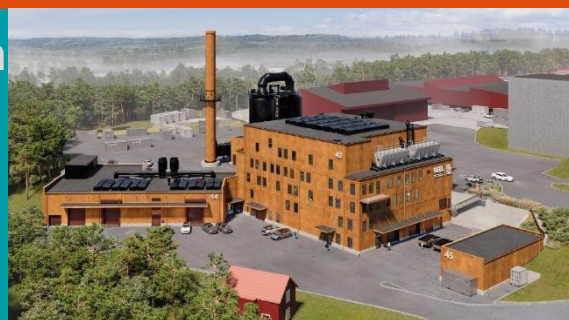
- Non-profit, 3 200 employees
- Department of **Fire and Safety**
- Test facilities in Sweden and Norway



RI.
SE

Battery Safety Lab opening in 2023

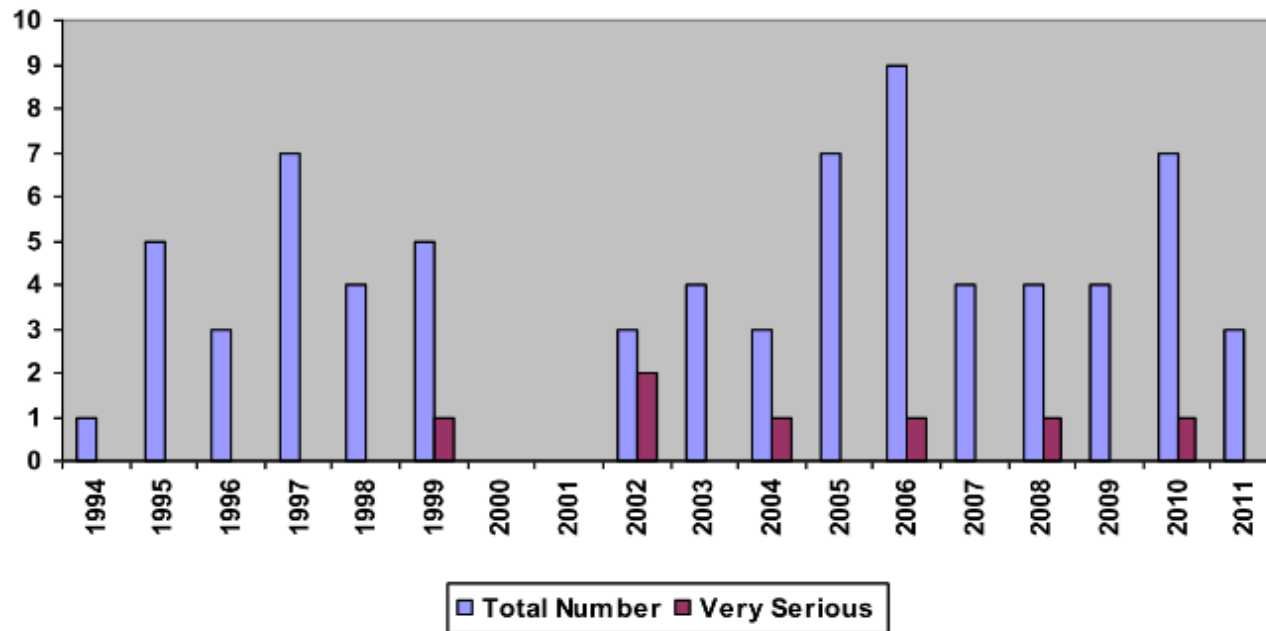
Electrical abuse and Cycling during Climate, Vibration, Mechanical, and Fire abuse



LASH FIRE Background

IMO initiatives

FSI 21/5 (2012): “There have been a number of significant fire incidents on ro-ro passenger vehicle decks since 1994 and there is no sign of these diminishing.”



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IMO initiatives

- **MSC97 (2016)**: New output on the agenda of IMO sub-committee “Ship Systems and Equipment” (SSE)
- “Review SOLAS chapter II-2 and associated codes to minimize the incidence and consequences of fires in ro-ro spaces and special category spaces of new and existing ro-ro passenger ships”.
- **MSC107 (June 2023)**: Draft amendments were finalized, with a view of adoption at MSC108





LASH FIRE

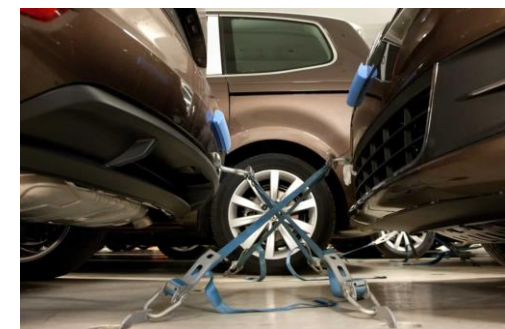
**challenges:
accepted**

Legislative Assessment for Safety Hazards of Fire and Innovations in Ro-ro ship Environment

Lash [lɑʃ]

verb strike forcefully against
bind down, secure, control

noun ...



Programme: H2020-MG-2018-2-2

Duration: Sept 2019 - Aug 2023

www.lashfire.eu

Call topic: Marine Accident Response, Subtopic C

Total Budget: 13.5 M€

Coordinator: RISE Research Institutes of Sweden

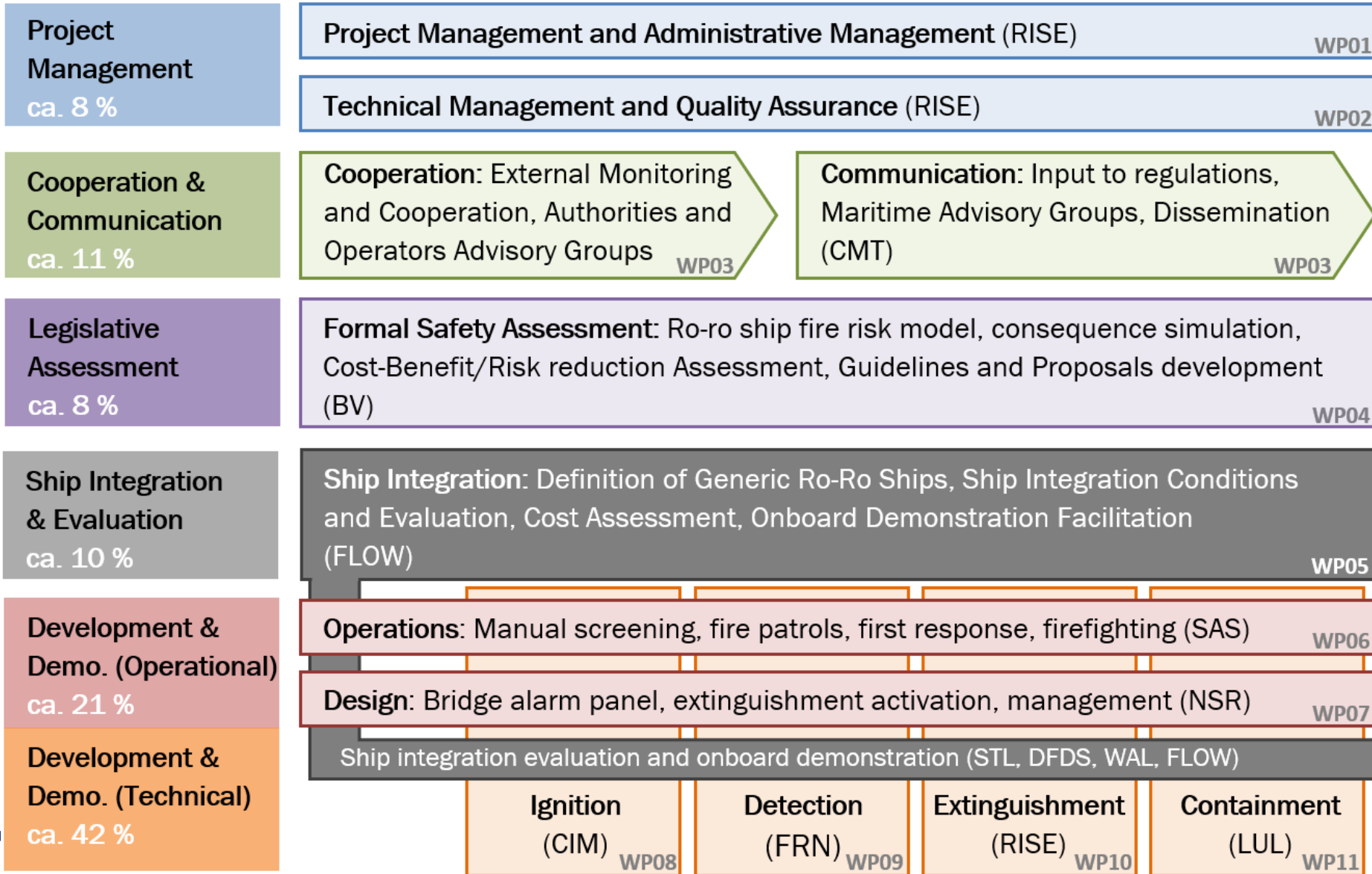
Instrument: Innovation Action (IA)



This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 814975

The consortium





20 challenges



NEC addressed

WP06 Effective Manual Operations		Validation
6-A	Manual screening of cargo fire hazards and effective fire patrols	Onboard/Terminal
6-B	Quick manual fire confirmation and localization	Onboard
6-C	Efficient first response	Onboard
6-D	Effective and efficient manual firefighting	Onboard/Field
WP07 Inherently Safe Design		Validation
7-A	Improved fire detection system interface design	Onboard/Virtual
7-B	Efficient extinguishing system activation and inherently safe design	Onboard
7-C	Firefighting resource management centre	Onboard/Virtual
WP08 Ignition Prevention		Validation
8-A	Automatic screening and management of cargo fire hazards	Onboard/Shore
8-B	Guidelines and solutions for safe electrical connections	Onboard
8-C	Fire requirements for new ro-ro space materials	Lab
WP09 Detection		Validation
9-A	Detection on weather deck	Onboard
9-B	Detection in closed and open ro-ro spaces	Onboard
9-C	Technologies for visual fire confirmation and localization	Onboard
WP10 Extinguishment		Validation
10-A	Automatic first response fire protection systems	Lab
10-B	Weather deck fixed fire-extinguishing systems	Onboard
10-C	Updated performance of alternative fixed fire-fighting systems	Lab
WP11 Containment		Validation
11-A	Division of ro-ro spaces	Lab/Onboard
11-B	Ensuring safe evacuation	Virtual/Shipyard
11-C	Safe design with ro-ro space openings	Virtual/Lab
11-D	Ro-ro space ventilation and smoke extraction	Lab/Onboard

Selection of Risk Control Options (RCOs)

Development & Demonstration



Manual Operations



Safe Design



Ignition Prevention



Detection



Extinguishment



Containment

>50
solutions
proposed

MAAG

Maritime
Authorities
Advisory Group



**BUREAU
VERITAS S.A.**



**European Maritime
Safety Agency**



MOAG

Maritime
Operators
Advisory Group



**16 RCOs selected for
full assessment**



Formal Safety Assessment

Work outline

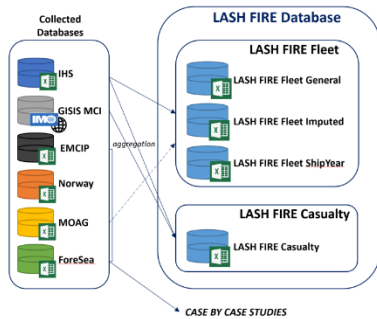
Risk assessment

Review of accident causes and hazard identification – report D04.1 [here](#)



Review of fire investigations and lessons learned
Multi-disciplinary workshop including operators to identify sources of fire

Ro-ro space fire database and statistical analysis – report D04.2 [here](#)



Identification of alternative databases
Data processing and development of a ro-ro space fire and a ro-ro ship database
Statistical analysis

Tool for consequence quantification and simulation – report D04.3 [here](#)

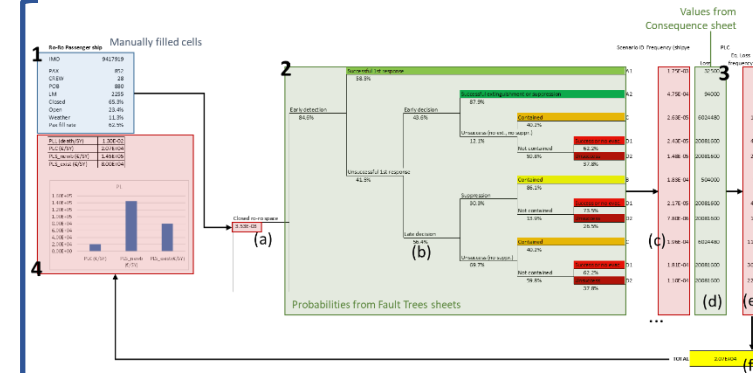


CFD and probabilistic network model to predict fire and smoke spread, quantify cargo and ship damages

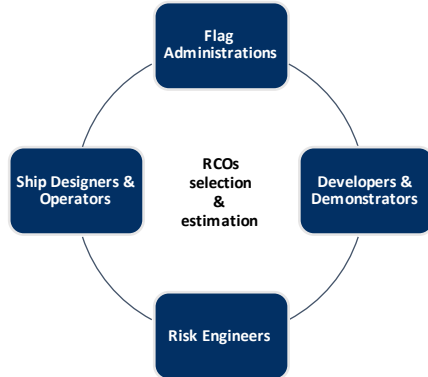
Holistic fire risk model

– report D04.5 [here](#)

6 event trees, 154 fault trees, 1000+ nodes quantified



Cost & risk reduction integration of 16 Risk Control Options (RCOs)



Quantification of risk reduction of RCOs
Estimation of marginal cost of RCOs (installation, operation, maintenance)



Cost-effectiveness assessment



Cost-effectiveness assessment – report D04.6 [here](#)

Uncertainty and sensitivity analyses – report D04.7 [here](#)

Development of new proposals for regulations – on-going

Except as provided in paragraph 4.3.1, there shall be provided a fixed fire detection and fire alarm system complying with the requirements of the Fire Safety Systems Code. On passenger ships, the fixed fire detection and fire alarm system shall provide smoke and heat detection throughout vehicle, special category and ro-ro spaces; on cargo ships, the type of detectors shall be to the satisfaction of the Administration. The fixed fire detection system shall be capable of rapidly detecting the onset of fire. The ~~type of detectors and their spacing of the detectors and their location~~ shall be to the satisfaction of the Administration, taking into account the effects of ventilation and other relevant factors. [...]

Except as provided in paragraph 4.3.1, there shall be provided a fixed fire detection and fire alarm system complying with the requirements of the Fire Safety Systems Code, so as to provide smoke and heat detection throughout vehicle, special category and ro-ro spaces. The fixed fire detection system shall be capable of rapidly detecting the onset of fire. The ~~type of detectors and their spacing of the detectors and their location~~ shall be to the satisfaction of the Administration, taking into account the effects of ventilation and other relevant factors. [...]

Review of existing regulations

Development of new proposals for regulations

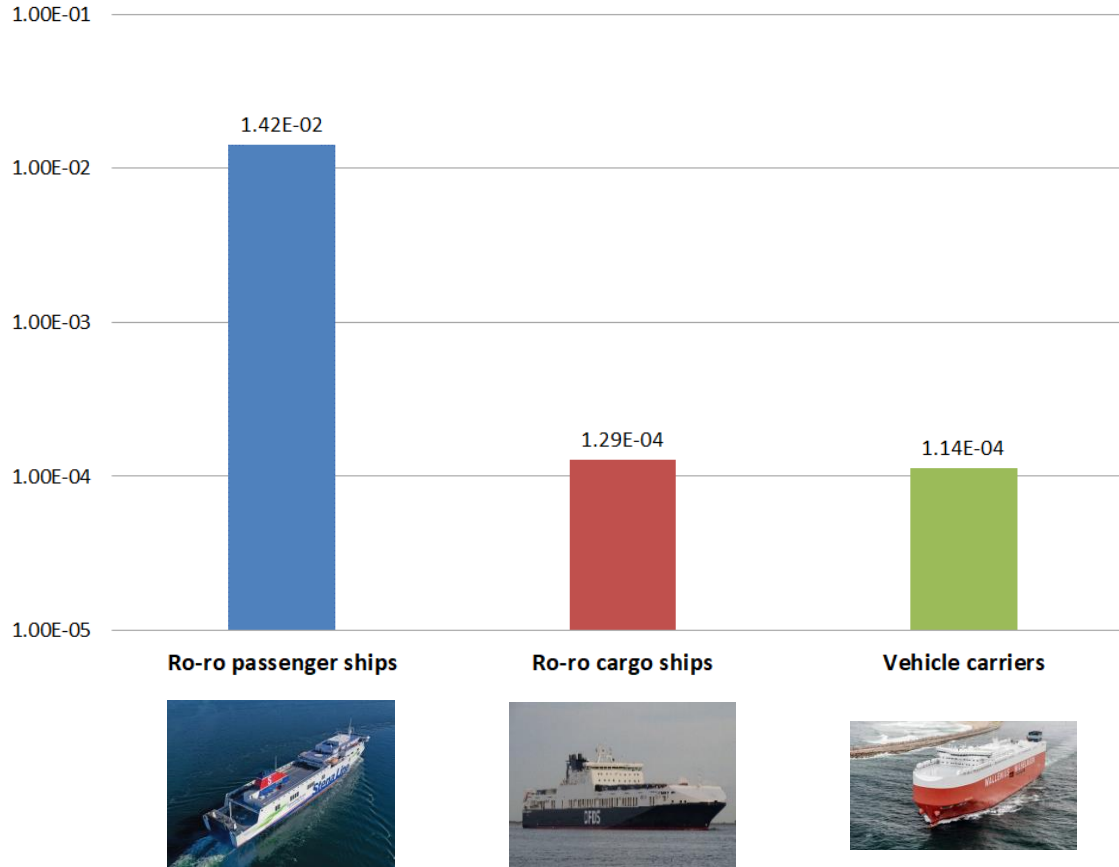


What type of ro-ro ship/space has
the highest fire risk?

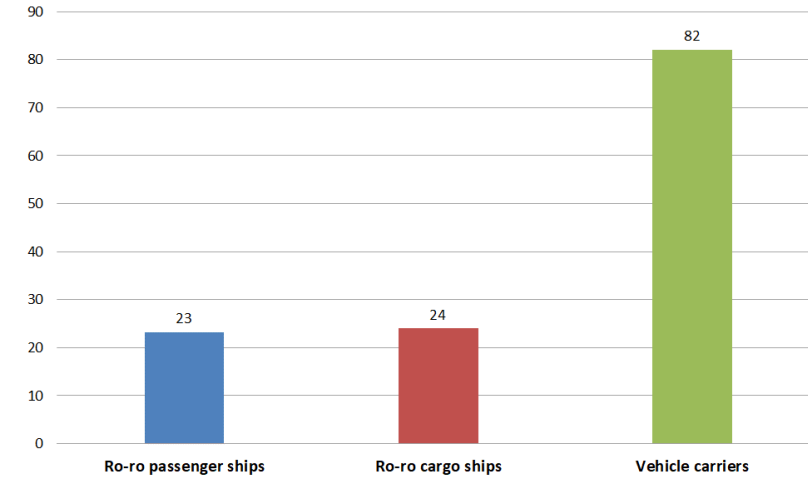
Fire risk of ro-ro ships



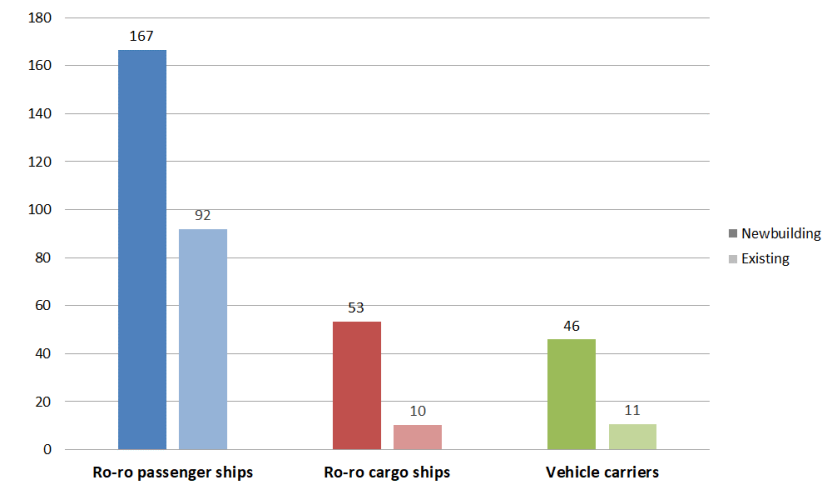
Potential Loss of Life (equivalent fatalities per shipyear)



Potential Loss of Cargo (10³ euros per shipyear)



Potential Loss of Ship (10³ euros per shipyear)



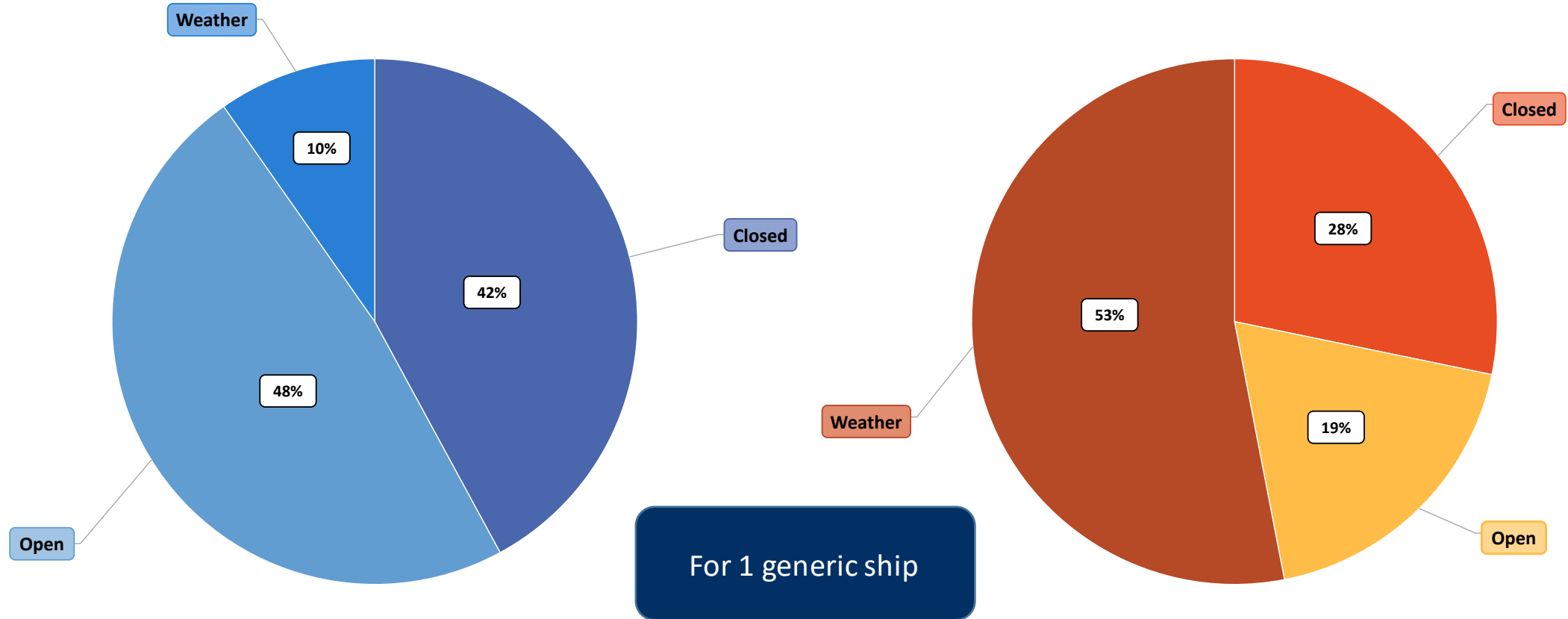


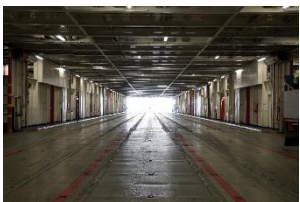
Fire risk in ro-ro spaces

Potential Loss of Life contribution per ro-ro space (equivalent fatality per shipyear)

Ro-ro passenger ships

Ro-ro cargo ships

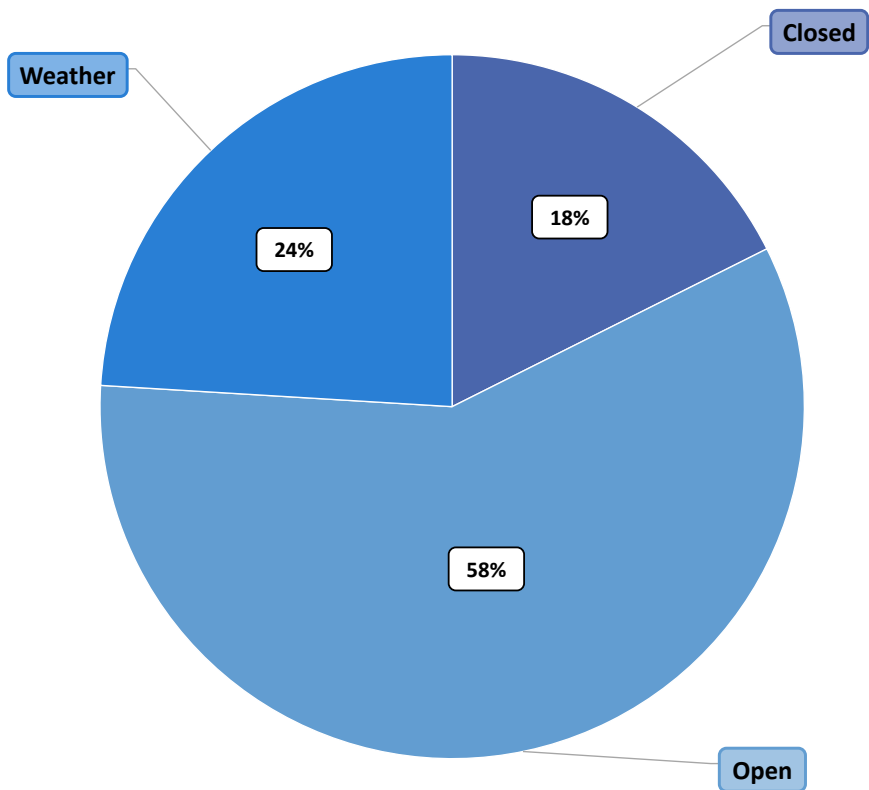




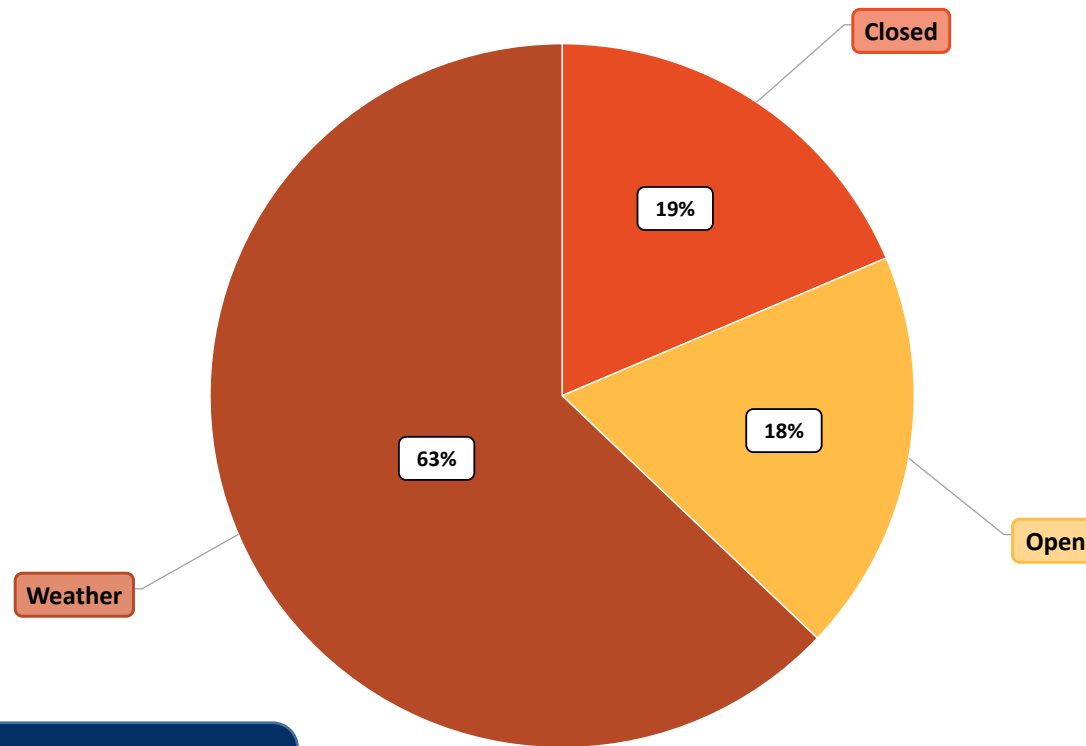
Fire risk in ro-ro spaces

Potential Loss of Life contribution per ro-ro space (equivalent fatality per shipyear and per lane meter)

Ro-ro passenger ships



Ro-ro cargo ships



For 1 lane meter

How can fire safety be improved?

Cost-effectiveness assessment

Ro-ro passenger ships – GCAF factor (cost-effective if < 1):

Ref	Designation	Newbuidling	Existing
RCO1	Improved fire patrols, fire confirmation & localization	0.05	0.07
RCO2	Signage and markings for effective wayfinding and localization	0.07	0.25
RCO3	Efficient first response	0.05	0.07
RCO4	Manual firefighting of Alternatively Powered Vehicles	0.31	0.43
RCO5	Improved alarm system interface	0.07	-
RCO6	Process to ensure efficient activation of extinguishing system	0.04	0.31
RCO7	Training module for efficient activation of extinguishing system	0.18	0.26
RCO8	Safe electrical connection of reefers	0.17	0.35
RCO9	Safe electrical connection of reefers and electric vehicles (EVs)	0.22	0.44
RCO10	Fire detection on weather decks	1.70	2.85
RCO11	Alternative fire detection in closed and open ro-ro spaces	0.41	-
RCO12	Visual system for fire confirmation and localization	0.34	0.84
RCO14	Fixed remote-controlled fire monitors using water for weather decks	0.52	0.91
RCO15	Fixed autonomous fire monitors using water for weather decks	0.61	1.08
RCO16	Improved knowledge in fire ventilation for closed ro-ro spaces	3.15	4.34

Cost-effectiveness assessment

Ro-ro cargo ships – NCAF factor (cost-effective if < 1):

Ref	Designation	Newbuidling	Existing
RCO1	Improved fire patrols, fire confirmation & localization	-37	-14
RCO2	Signage and markings for effective wayfinding and localization	-18	42
RCO3	Efficient first response	-39	-16
RCO4	Manual firefighting of Alternatively Powered Vehicles	-6	30
RCO5	Improved alarm system interface	-34	-
RCO6	Process to ensure efficient activation of extinguishing system	-42	41
RCO7	Training module for efficient activation of extinguishing system	-13	26
RCO8	Safe electrical connection of reefers	73	214
RCO10	Fire detection on weather decks	9	47
RCO11	Alternative fire detection in closed and open ro-ro spaces	57	-
RCO12	Visual system for fire confirmation and localization	80	179
RCO14	Fixed remote-controlled fire monitors using water for weather decks	-10	13
RCO15	Fixed autonomous fire monitors using water for weather decks	-8	17
RCO16	Improved knowledge in fire ventilation for closed ro-ro spaces	1622	2199

Cost-effectiveness assessment

Vehicle carriers – NCAF factor (cost-effective if < 1):

Ref	Designation	Newbuilding	Existing
RCO1	Improved fire confirmation & localization	-178	-92
RCO2	Signage and markings for effective wayfinding and localization	-215	-75
RCO3	Efficient first response	-85	-70
RCO4	Manual firefighting of Alternatively Powered Vehicles	-160	-69
RCO5	Improved alarm system interface	-258	-
RCO6	Process to ensure efficient activation of extinguishing system	-277	-226
RCO7	Training module for efficient activation of extinguishing system	-148	-60
RCO11	Alternative fire detection in closed and open ro-ro spaces	75	-
RCO12	Visual system for fire confirmation and localization	629	1345
RCO13	First response dry-pipe sprinkler system for vehicle carriers	331	-

Impact of LASH FIRE solutions to
SOLAS Ch. II-2 and the IMO
developments?

- LASH FIRE solutions include general ro-ro cargo ships and vehicle carriers
- LASH FIRE solutions include 9 RCOs which are not covered by IMO draft amendments: RCOs 1, 3, 4, 6, 7, 8, 9, 13, 16
- The IMO draft amendments only cover technical (engineering) measures, disregarding the technical solutions regarding ignition prevention and the operational solutions (not fitted for SSE's scope)

LASH FIRE solutions VS. IMO developments

- Difference between draft amendments to SOLAS Chapter II-2 and relevant LASH FIRE solutions:

Draft IMO amendments	LASH FIRE solutions	
Combined heat and smoke detectors in CRS and ORS	Det4	ADDITION: Adaptive threshold settings for detection
Enhanced fire alarm interface in CRS and ORS	RCO5	HOW: Improved alarm system interface
Linear heat detectors accepted in CRS and ORS	RCO11	HOW: Alternative fire detection in CRS and ORS
Fixed fire detection system on WD	RCO10	HOW: Fire detection on weather decks
Video monitoring in CRS and ORS	RCO12	ADDITION: Visual system for fire confirmation and localization
Specification of structural fire protection of decks within ro-ro spaces when the drencher system cannot cover both levels	Cont1b	EQ: A-30 fire insulation & extinguishing system simultaneously activated above and below sub-dividing deck
Arrangement of openings in CRS and ORS	Cont10	ADDITION: Safety distances between side and end openings and critical areas
Arrangement of WD	-	-
Fixed water-based fire-extinguishing on WD based on monitor(s)	RCO14-15	ADDITION: Fixed remote-controlled or autonomous fire monitors using water for WD
Suitable signage and marking in CRS and ORS	RCO2	HOW: Signage and markings for effective wayfinding and localization



28 JUNE 2023
PULA, CROATIA

CFIS 2023
CONFERENCE ON
FIRE SAFETY AT SEA

register
now

Go to
lashfire.eu!

- Deliverables/reports
- Guidelines
- 2-pagers
- Training videos

Make your registration for CFIS 2023 here!

LASH FIRE is an international research project aiming to significantly reduce the risk of fires on board ro-ro ships. The project is running from September 2019 to August 2023.

Facts and Myths About Fires in Battery Electric Vehicles



LASH FIRE Facts & Myths

As new energy carriers make their way into the market, some misconceptions will naturally also make their way to the public. The objective of this report is to respond to some of the most common misconceptions and myths regarding battery electric vehicle fires, while highlighting the latest research and available data.

Read our 2-pager [here](#).
Read the full report [here](#).



Short introduction to the LASH FIRE project

For a quick overview of the project and its objective, watch our short introduction animation here. (2 minutes)



"It's kind of a future thing"

For the development of a centralized fire resource management center (FRMC), our researchers from Sasemar, NSR, NTNU and RISE have accompanied fire drills on Stena ferries to study crew procedures and actions on board. Learn more about the development of the FRMC in our new [video](#).

Funded by



This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement n° 814975

Dissemination & Exploitation

LASH FIRE videos on YouTube:

https://youtube.com/playlist?list=PLi4tb8wkruNdRwLD525MQnC_zqx73-ZU6



LASH FIRE - Fighting EV fires: Film 01
34 views • 12 days ago



LASH FIRE - Tests on weather deck fixed fire-extinguishing systems
66 views • 2 months ago



LASH FIRE - Interview with Calle Ortner, Safetygroups - Fire Safety Meet - DSM2022
29 views • 4 months ago



LASH FIRE - Tests on fighting electric car fires
588 views • 4 months ago



LASH FIRE - Tests on fighting electric vehicle fires: first response firefighting
827 views • 4 months ago



LASH FIRE - Tests on fighting electric car fires: freeburn test 1
277 views • 4 months ago



LASH FIRE - Tests on fighting electric car fires: fires in closed space 3
125 views • 4 months ago



LASH FIRE - Development of a Digital Fire Management Central
102 views • 5 months ago



Safe and Suitable Firefighting - PPE for firefighting at sea - interview with Julia...
29 views • 5 months ago



LASH FIRE - How to prevent and fight fires on ferries
708 views • 1 year ago



LASH FIRE - Expert judgement explanatory
129 views • 1 year ago



LASH FIRE - Teaser
641 views • 1 year ago

Thank you for your attention!

Any questions?



This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 814975. This publication reflects only the authors' views and neither the Agency nor the members of the LASH FIRE consortium are responsible for any use that may be made of the information it contains.

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