Safetytech Accelerator

PROGRAMME OVERVIEW - 2026

Cargo Fire & Loss Innovation Initiative (CFLII)

DOCUMENT STATUS

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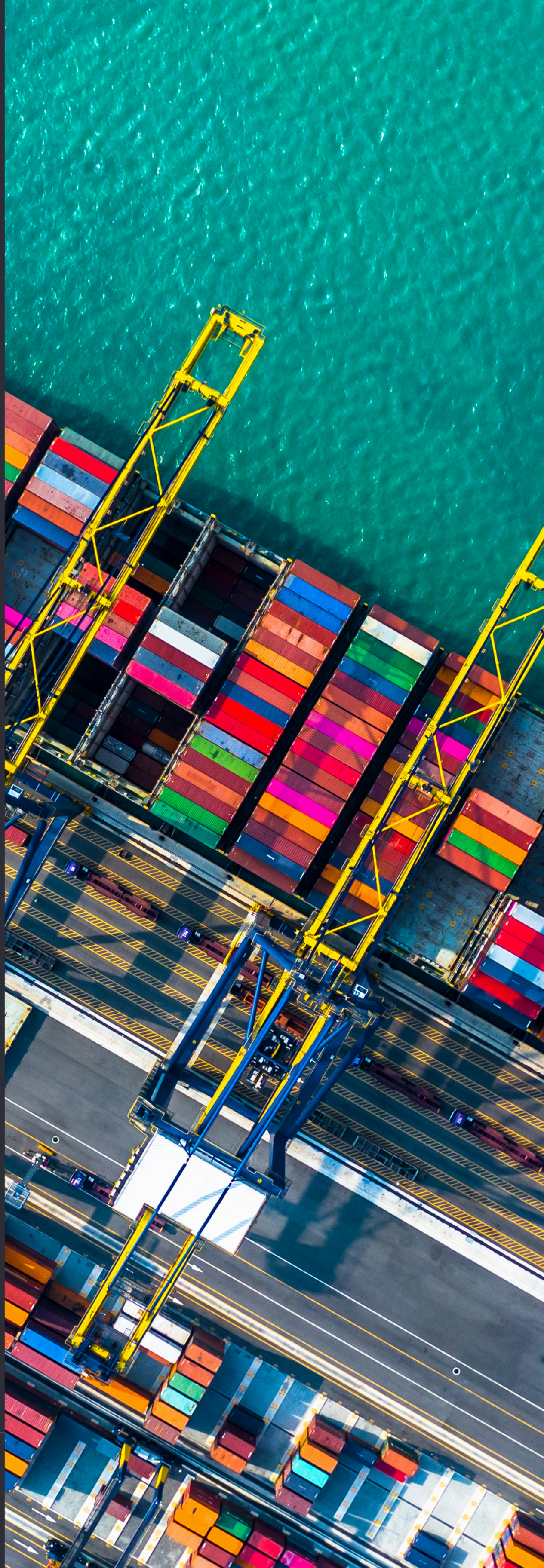

CFLII is a multi-stakeholder innovation programme that brings together the maritime industry to **systematically test and validate emerging technologies** for cargo fire detection, prevention, and cargo loss reduction.

Delivered by Safetytech Accelerator, the programme operates on a **shared-cost, shared-benefit model that unites major shipping lines, insurers, and industry bodies** around challenges that no single organisation could tackle alone. Lloyd's Register serves as a key technical partner, supporting certification pathways and contributing expertise on regulatory standards, while specialist testing partners including the Danish Fire Institute provide the rigour needed to generate evidence that the industry can act on with confidence.

For organisations that join as Anchor Partners, the programme offers direct access to a growing body of tested evidence, shared trial infrastructure, and a network of peers who are shaping the future of maritime safety, without bearing the full cost or complexity of innovation independently.

Current and past Anchor Partners include: Maersk, Evergreen, ONE, Zim, Offen Group, Tailwind, Seaspan, Cosco Shipping, HMM, TT Club, UKP&I, International Chamber of Shipping (ICS), Isle of Man Ship Registry.

3	30+	9+
years of structured testing	types of technologies assessed across 200 companies	Current anchor partners

THE PROBLEM

Cargo fires and cargo loss are industry-wide problems that the industry has not yet solved.

Every year, fires in cargo holds cause loss of life, vessel damage, and environmental harm at a scale the industry continues to underestimate. Existing detection systems were not built for the conditions inside a container ship, and the gap between when a fire starts and when it is detected remains dangerously wide. Cargo loss from parametric roll and misdeclared weight compounds the risk. These are not fringe events. They represent material exposure for every shipping line and insurer operating today.

WHAT WE DO

A rigorous, shared approach to finding what actually works.

CFLII brings together shipping lines, insurers, and industry bodies to test emerging technologies against real maritime conditions. Every technology is put through a structured process from initial assessment through to live vessel pilot, with findings shared transparently across the full partner group. The result is an evidence base that no single organisation could build independently, and investment decisions grounded in proof rather than vendor claims.

THE CHALLENGE AREAS

01 Early detection in the hold

The cargo hold presents a uniquely complex detection challenge. Cargo composition changes with every voyage, and fires can develop from a wide range of sources.

We test solutions holistically across commodities and fire types, looking at gas, particulate, and heat signals together, to understand how accurately and how early technology can identify a developing fire.

02 Early detection on deck

Fires on the upper deck present a different set of challenges around deployment, line of sight, and environmental exposure.

We have assessed technologies adapted from adjacent industries to understand what genuinely performs in a maritime context.

03 Container Loss

Parametric roll and misdeclared cargo weight represent significant and underaddressed financial and safety risk.

We are testing wave radar analytics and exploring screening solutions to give operators better data and better decision making at sea.

WHAT THREE YEARS OF TESTING HAS SHOWN

- Novel sensors from adjacent industries consistently outperform the smoke detectors currently used onboard. These technologies were not designed for the marine environment, so a core part of the programme's work is understanding what it takes to marinise them and adapt existing onboard systems alongside industry stakeholders including smoke sampling system manufacturers.
- Wireless connectivity is a foundational requirement. Without certified onboard networks, the most capable sensors cannot be deployed safely or at scale. The programme is working with Lloyd's Register to certify LoRaWAN connectivity for safety-critical applications onboard vessels.

YEAR 3 UPDATE

Testing has moved from feasibility to validation. Large-scale comparative fire trials are underway at the Danish Fire Institute, benchmarking sensor performance across commodities including battery fires and thermal runaway scenarios. Two technologies are progressing through Lloyd's Register certification, one for wireless connectivity in safety-critical applications and one for an in-container sensor. These are important steps that lead to industry-wide deployment.

Staying Ahead of the Curve

CFLII ensures that the technologies we test are not only effective but certifiable and aligned with the direction of travel in maritime regulation. We work directly with Lloyd's Register on certification pathways for the technologies in the programme, and in close alignment with bodies including the IMO and the World Shipping Council to ensure regulatory requirements feed into how we design tests and which technologies we prioritise. The goal is not just to find solutions that work in a controlled environment but to ensure they can be adopted at scale within the frameworks the industry operates under. For organisations that join the programme, that means being part of a process that is actively shaping the standards of the next decade rather than adapting to them after the fact.

Technologies Tested Across Three Years

The technologies assessed through CFLII span a range of sensing approaches, from radiowave disruption analytics and multi-gas and particulate sensors to fibre optic heat detection and wave radar analytics for cargo loss. Each has been put through a structured evaluation process, progressing from initial assessment and feasibility studies through to proof of concept and, where relevant, live vessel pilots.

To understand how these technologies perform in context, results are benchmarked against the existing smoke sampling systems currently used across the industry. The baseline detection times for that system in the box below came from the CARGOSAFE report and is used a reference point for the findings in the table.

> **Baseline: existing smoke sampling system:** fast-growing fire 6.5–41 min · slow-growing fire up to 12.4 hrs · explosion-induced: after the explosion.
> *Where indicated (*), figures are modelled against the CARGOSAFE baseline.*

CHALLENGE 1 — EARLY DETECTION IN THE CARGO HOLD

Technology	What it is	Key finding	Status
Radiowave disruption analytics	AI analysis of WiFi signal disruption detecting surface-level heat changes at the container.	Fastest technology tested: avg. 3 min (fast-growing), 17.5 min (slow-growing), 100 min advance warning before explosion. **Year 3 focus:** reducing false positives and improving localisation.	Currently testing
Multi-gas and particulate sensors	Multi-sensor arrays from the forest fire industry detecting gas, particulate, temperature and humidity.	Outperform existing smoke sampling across all fire types.* Avg. 15 min (fast-growing), 4.5 hrs (slow-growing), 24 min advance warning before explosion. **Year 3 Focus:** Comparative Fire Testing in a lab and tests to see feasibility of augmenting existing smoke sampling systems.	Currently testing
In-container temperature sensor	Sensor placed inside containers to detect heat and support fire localisation.	New technology entering testing in 2026. Working with LR and the Danish Fire Institute for validation and certification.	Currently testing
LoRaWAN connectivity	Onboard wireless network enabling IoT sensor deployment at scale in safety-critical applications.	Validated as the key enabler for wireless detection. Physical deployment confirmed viable. Currently progressing through LR certification.	Currently testing
Fibre optic linear heat detection	Cable installed in the hold detecting ambient temperature change.	Detects reliably above 160°C with good localisation. A 10-degree ambient variability on live vessels raises the effective threshold in practice. Cost of full vessel installation is prohibitive for scale.	Concluded
Nanotechnology / E-nose	Carbon nanotubes profile molecular air signatures; AI classifies events.	Orders of magnitude more sensitive than smoke detection. Robustness confirmed on live vessel across multi-week deployment. Remaining challenge is AI model training at scale across varied cargo types and vessel environments.	Concluded
IoT wireless temperature probes	Distributed wireless temperature sensors across cargo holds.	Physical deployment confirmed viable. Key finding: ship-to-shore data connectivity cannot be assumed and requires route-specific planning. This work directly informed the LoRaWAN workstream.	Concluded

** Multi-gas and particulate sensor performance modelled against the CARGOSAFE baseline.*

CHALLENGE 2 — EARLY DETECTION ON THE DECK

> *Deck detection feasibility work produced important evidence on maritime deployment constraints.*
> *After Year 2, the programme refocused on the cargo hold to consolidate results but it is open to revisiting the challenge later.*

Technology / Company	What it is	Key finding	Status
Multi-gas and particulate sensors	Forest fire multi-sensor arrays adapted for outdoor deck deployment.	Detected battery fire at 36m in under 5 min with uncalibrated AI. 5.3x more alarms than industry-standard sensor. AI calibration requires approximately 3 days of environmental baseline learning. Paint and lithium-ion battery fires produced the most distinct signatures.	Concluded
Thermal imaging cameras	Dual-lens thermal and optical cameras mounted on lashing bridges.	Technically capable and certified. Line-of-sight gaps between fixed camera positions and container stacks create coverage limitations. Estimated full deployment cost of £1.5m or above makes this technology unviable at scale.	Concluded

CHALLENGE 3 — CARGO LOSS

Technology / Company	What it is	Key finding	Status
Wave radar analytics	X-band radar measuring wave and sea state data to support parametric roll avoidance.	Currently being tested. Exploring integration with the LR RollRight App to enhance bridge team decision-making. Results pending.	Currently testing

KEY IMPLICATIONS

01 **No single technology is the answer.** The evidence points towards a layered approach combining different sensing methods as the most effective path to earlier detection.

02 **Technologies from adjacent industries outperform existing onboard systems,** but marinisation is a core part of the path to deployment, not a minor consideration.

03 **The most capable sensors cannot be deployed at scale without certified onboard wireless networks.** This is an infrastructure challenge as much as a technology one.

04 **The existing system can be augmented** Placing capable sensors on existing extraction pipes is the most immediately deployable path to meaningful improvement.