Fire detection on weather decks

CFIS 2023
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CONFERENCE ON FIRE SAFETY AT SEA

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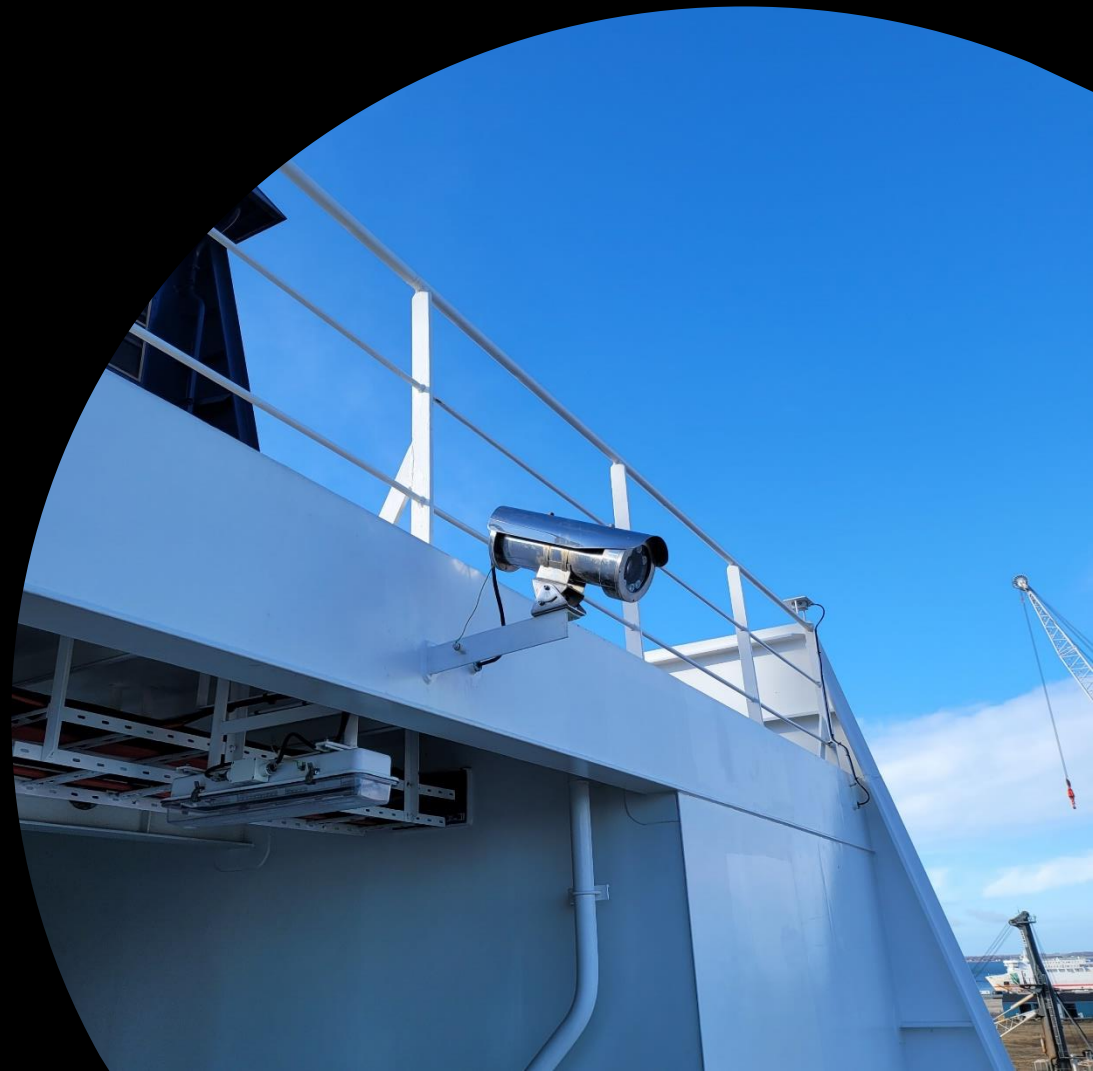
Main challenges for fire detection on weather decks

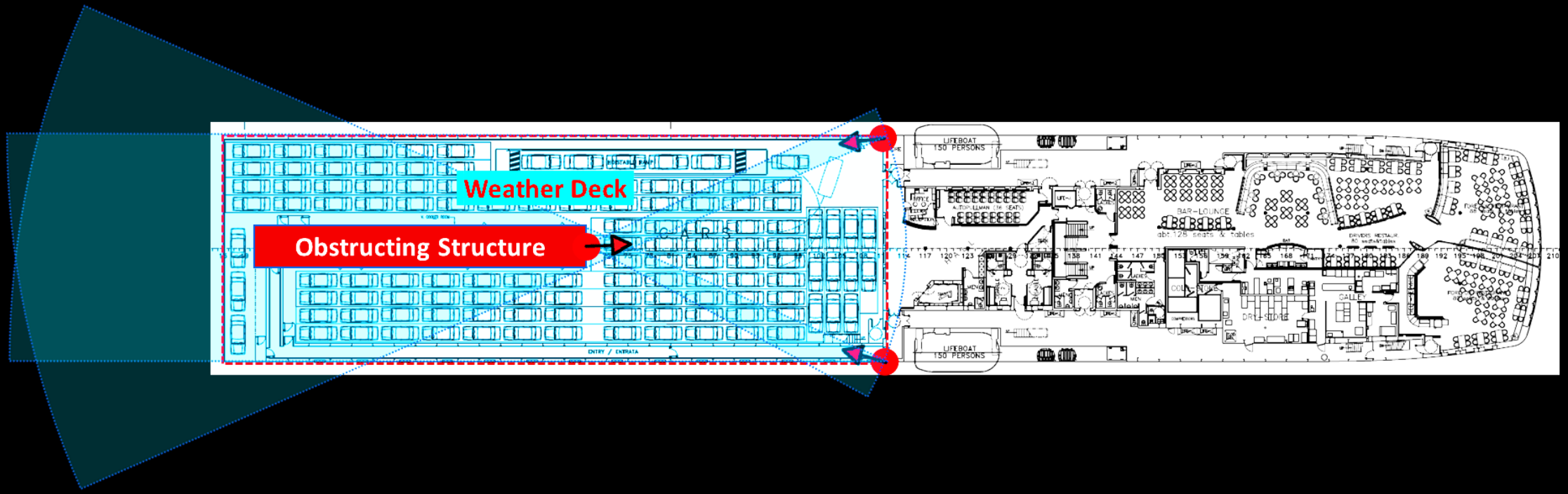
- *Environmental factors (rain, snow, frost, condensation, sunlight, vibrations, wind, etc.)*
- *Long distances (up to ~270 m)*
- *Absence of deckhead and limited mounting positions*
- *Obstructions (cargo, ship casing, etc.)*
- *Vehicles with normally hot exhaust mufflers*

Optical fire detectors now

- *Standard detection requirement at 30 meters for a 33 cm heptane pool fire within 30 seconds*
- *Some class approvals and certificates although not always used for the relevant technology*
- *Alarm and fault relays for fire alarm panels*
- *May come with integrated video camera*
- *Different costs:*
  Thermal imaging cameras **>** *IR flame detectors and hybrid detectors* **>** *video detection*



Coverage and placing limitations



RISE Fire Research, Norway

- Fire detection on weather decks
- Fire detection in open and closed ro-ro spaces
- Technologies for visual fire confirmation and localization

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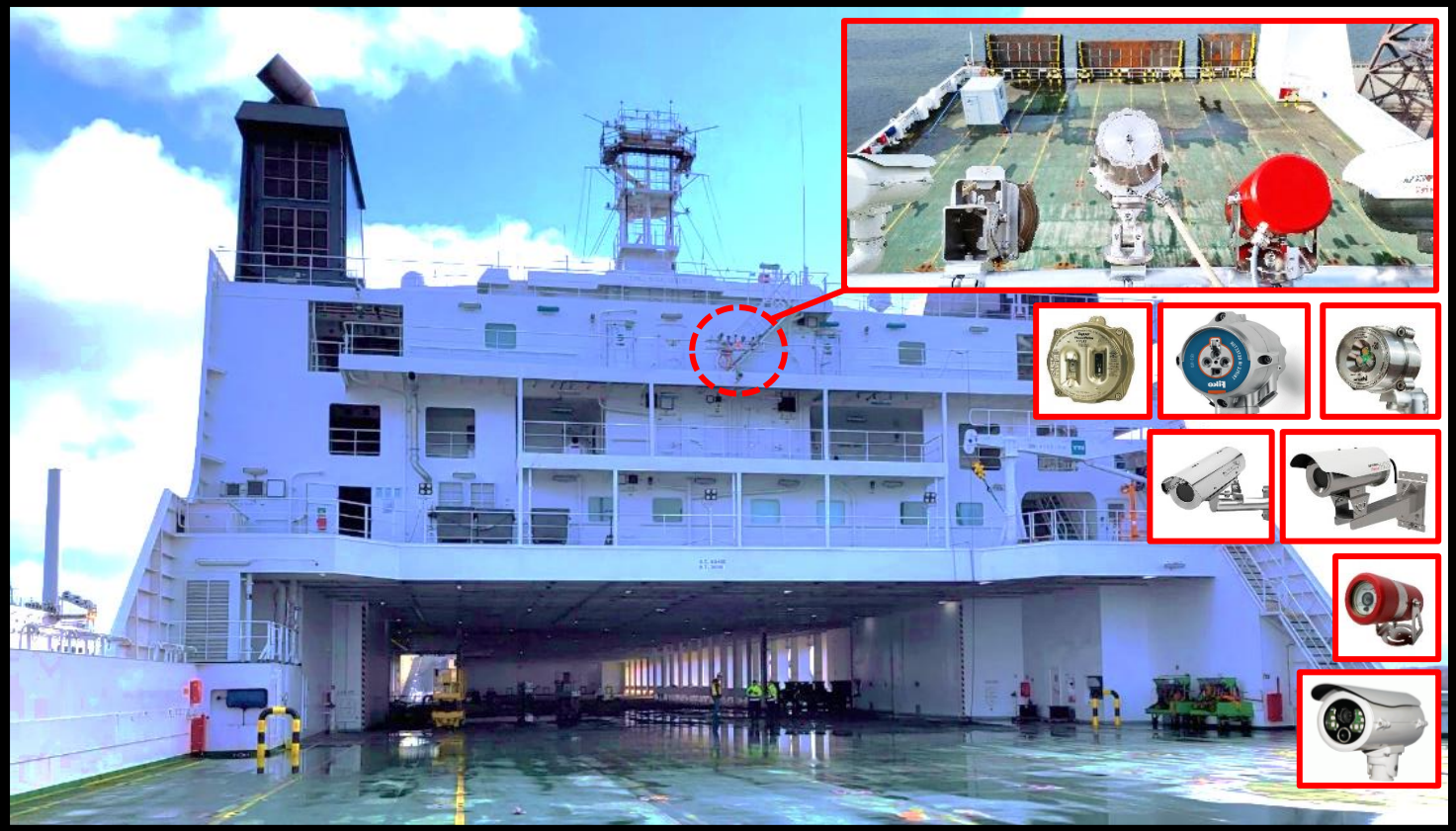
Hollandia Seaways

Operational evaluations on Hollandia since Feb 2022

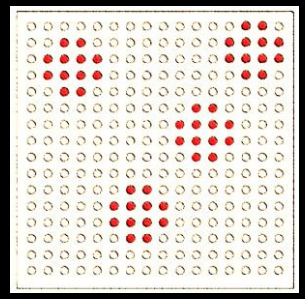


- *Multiband IR flame detectors*
  → IR array and IR3 systems
- *Thermal imaging cameras*
- *Video flame detector*
- *Hybrid (video + heat) detector*

Multiband flame detectors based on infrared radiant energy

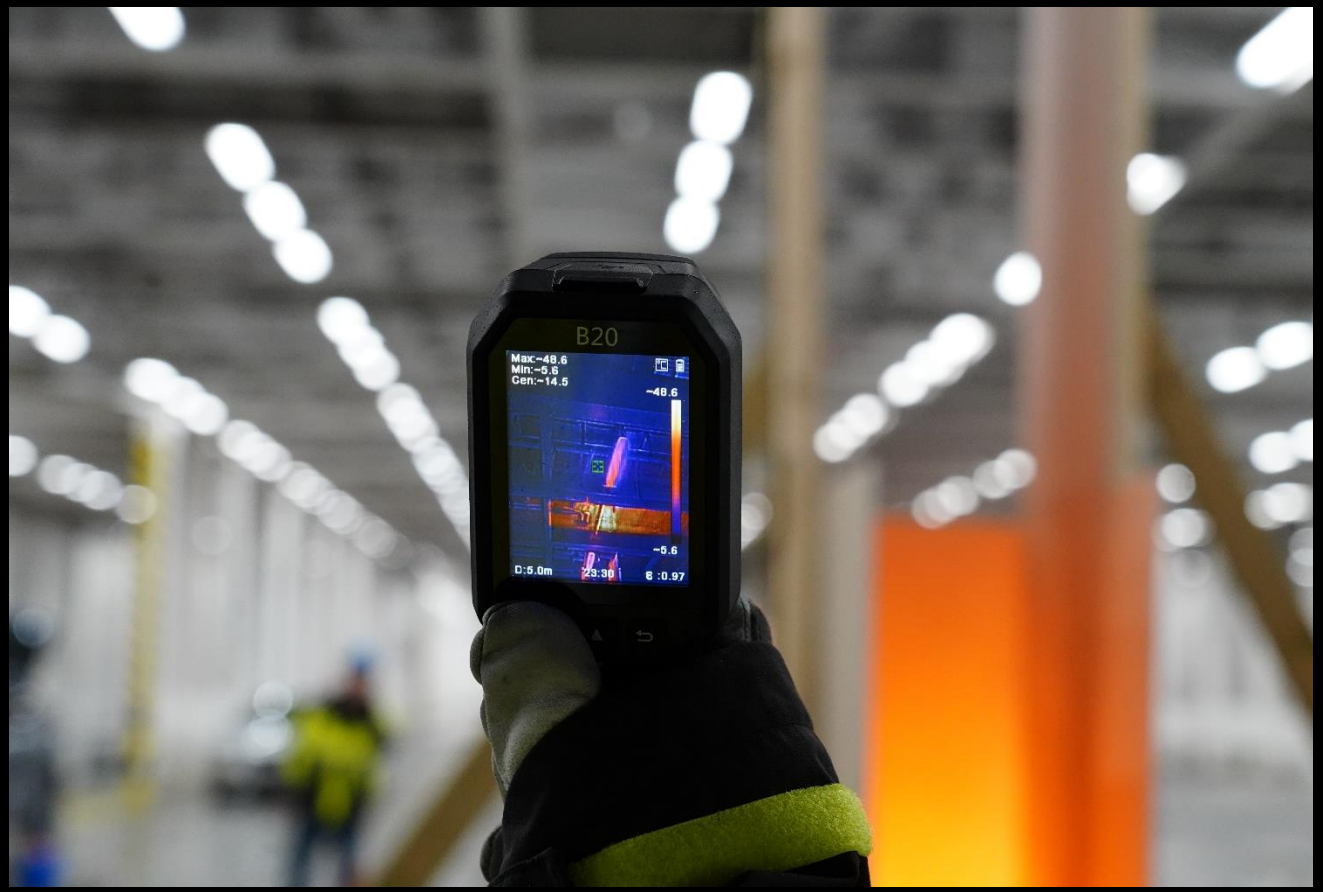
IR3 detectors have 3 sensors that can monitor 3 infrared radiation thresholds and their ratios for the detection of flames and their distinction from non-flame sources.

IR array detectors have an array of infrared sensors (e.g., 16 by 16) and can locate the flame within the different sections of their view in a way that can be used to find XY coordinates for one or multiple flames.



Thermal imaging cameras

Thermal imaging cameras measure the infrared radiation emitted from objects and can be used to estimate the temperature of objects.

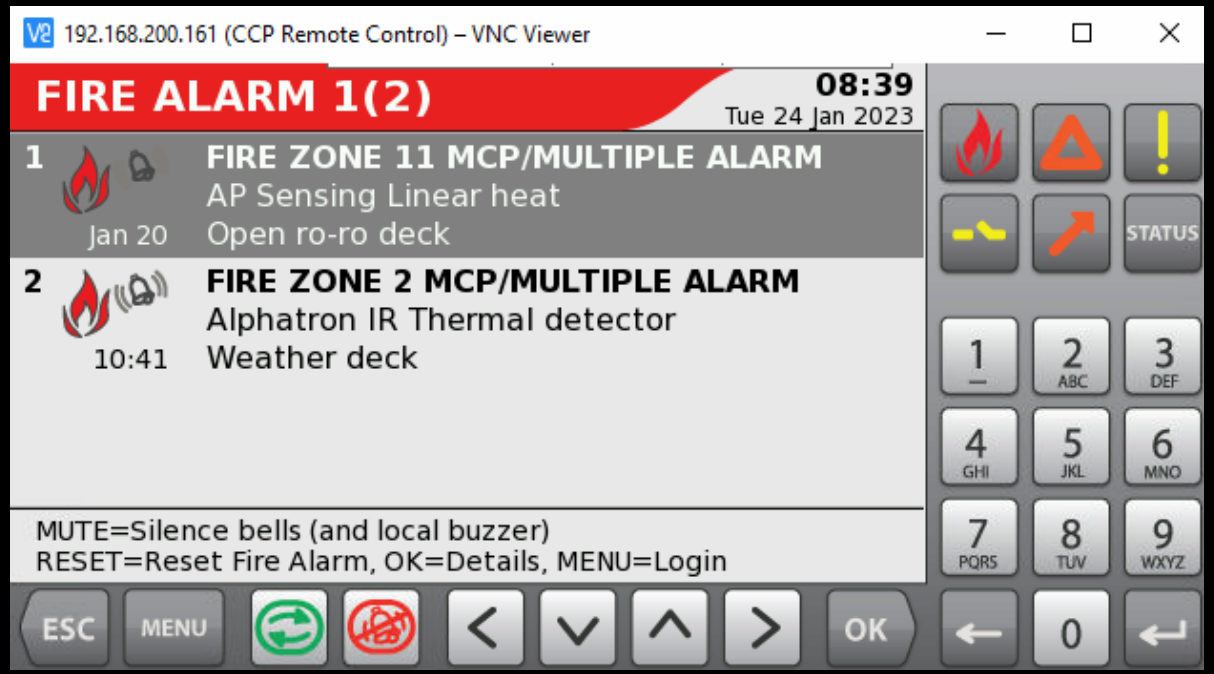


Operational observations

Some connections loosened over time. The design of the connections is important.

Operational observations

Fire control panels allow for one alarm per system at a time. The existing alarm must first be dismissed and only then a new alarm may be registered.



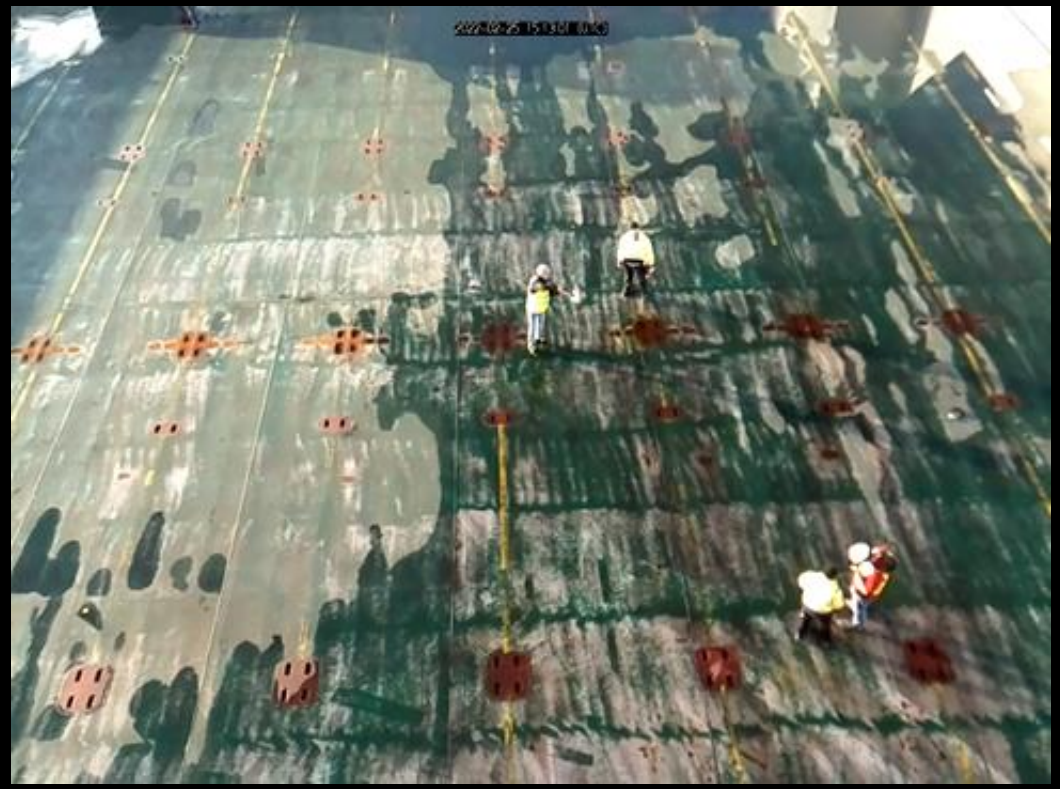
Detection systems with non-latching relays produce a non-stop alarm signal which cannot be dismissed on the fire control panel. Dismissing such alarms may only be done through the dedicated software of the said systems.

Operational alarms

	Thermal 1	Thermal 2	Hybrid	IR3-1	IR3-2	IR Array
Feb-22	3	0	0	0	0	0
Mar-22	4	4	2	0	0	0
Apr-22	5	3	3	0	0	0
May-22	22	9	0	0	0	0
Jun-22	2	0	1	0	0	0
Jul-22	0	5	0	0	0	0
Aug-22	0	1	0	0	0	0
Sep-22	0	0	0	0	0	0
Oct-22	4	0	0	0	0	0
Nov-22	1	0	0	0	0	0
Dec-22	1	0	0	0	0	0
Jan-23	3	0	0	0	0	0
Feb-23	2	0	0	0	0	0
Mar-23	2	0	0	0	0	0
Apr-23	1	0	1	0	0	0
May-23	6	0	0	0	0	0
Jun-23	6	0	0	0	0	0

Flame detection tests on board

A test in March 2022 where a flame detector detects a small flame while it is difficult to see with the naked eye.



March 2022

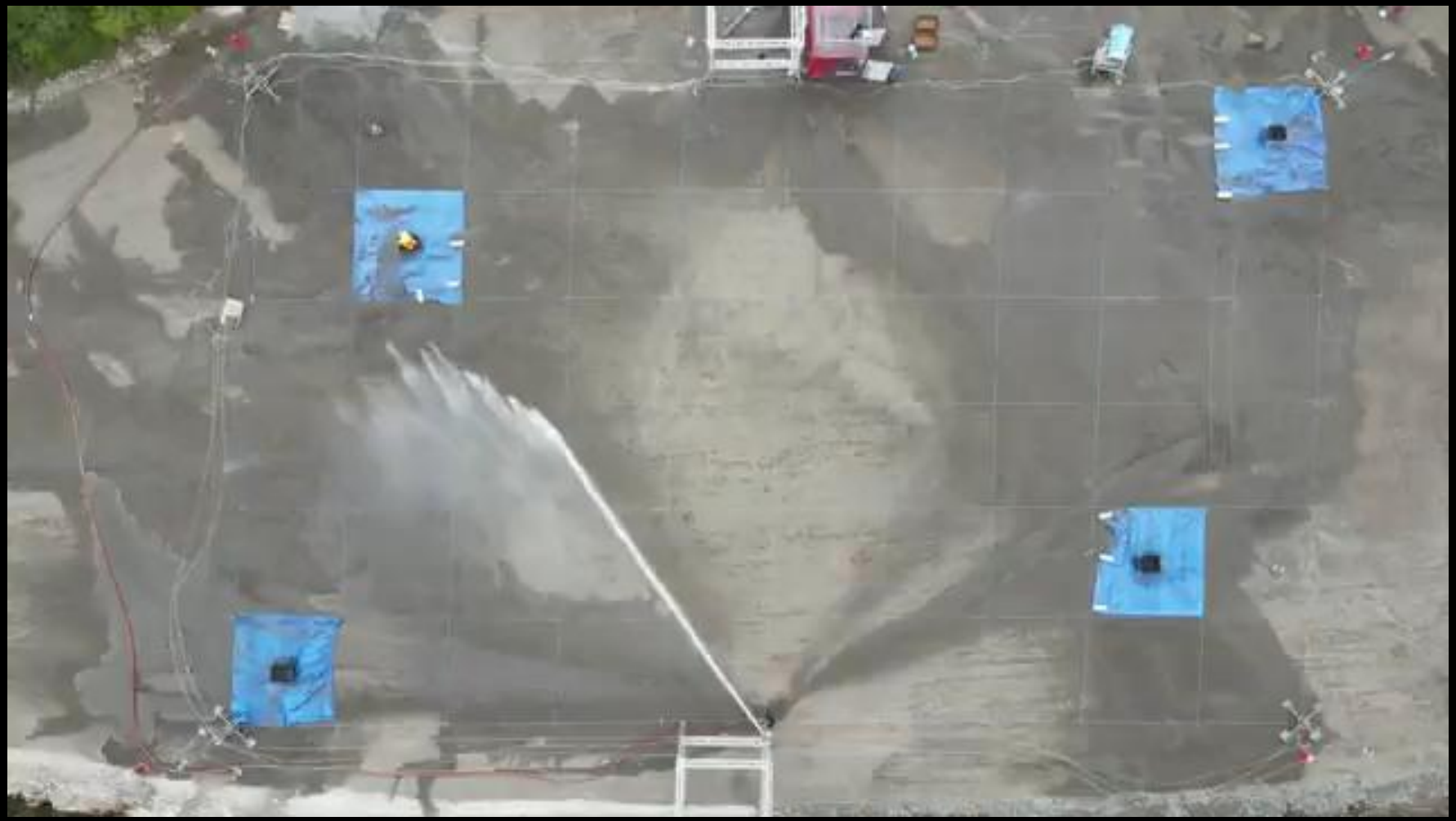
A test in March 2023 where a flame detector detects a gas fire equivalent to a 1 ft square heptane pool fire.

March 2023

Flame detection tests on board

Sometimes the detectors maintained a fire alarm or fault status after fire detection and could not be reset to detect new fires.

Experiments with autonomous fire monitors guided by 2 IR array detectors



Real-scale experiments at RISE Fire Research in Norway

Experiments with concealed fires at RISE Fire Research in Norway

A fire inside a container is detected using a thermal imaging detection system before any open flame or smoke is visible to the naked eye.

Highlights of infrared flame detectors

Positives

- Detection of infrared wavelength radiation from flames over a large area
- Fire location data for automatic fire suppression systems in certain configurations
- Can detect even small flames that may be missed during manual observations
- Can be combined with a video camera to provide live images
- The most suitable option for weather decks with minimal false alarms

Negatives

- Only open flames and their reflections are detected (no detection of smoke, heated surfaces, or concealed fires)

Highlights of thermal imaging detection systems

Positives

- Detection of hot surfaces using an infrared camera over a large area
- Live heat images for surveillance
- Fire location data for automatic fire suppression
- Can be combined with ordinary cameras and video detection

Negatives

- Prone to false alarms because they can detect heat sources unrelated to fire (e.g., exhaust pipes of vehicles, reflection of light over shiny surfaces, etc.)
- More expensive than other systems

Highlights of video fire detection systems

Positives

- Highly suitable for closed environments with fixed light levels
- Very economic
- Easy to understand the footage

Negatives

- Flames or their reflections must be visible and have contrast from the background
- More frequent false alarms in open environments with changing light conditions
- No relevant European standards for testing, only American (FM3232)

Highlights of hybrid (heat + video) detection systems

Positives

- More immune to false alarms than either technology alone
- Cheaper than thermal imaging cameras

Negatives

- Flame or its reflection must be visible and have contrast from the background
- More frequent false alarms in open environments with changing light conditions
- No relevant European standards for testing, only American (FM3232)

The main takeaways

- *Multiband infrared flame detectors are the best option for weather decks.*
- *IR array flame detectors can be used to obtain XYZ coordinates for autonomous fire suppression systems*
- *The initial detection of fire is easily achievable but its continued monitoring for the fire growth observations is more difficult, especially for larger fires.*
- *Thermal cameras are excellent for surveillance of hot spots and developing fires, but they are prone to raising false alarms if connected to the fire alarm system.*
- *Standards and certificates must be considered for the given technology at hand.*

Thank you for your attention.

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