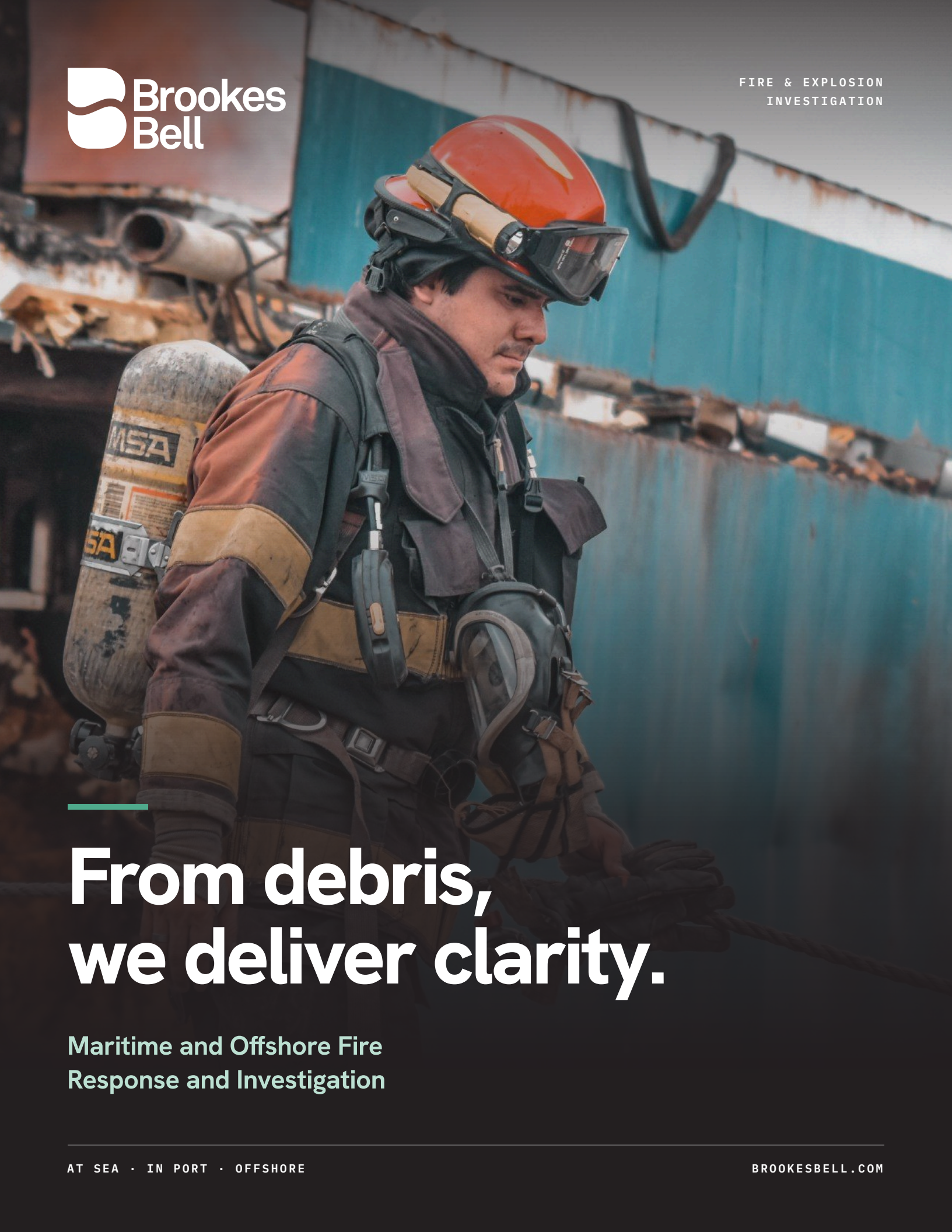
Brookes Bell

FIRE & EXPLOSION
INVESTIGATION



From debris, we deliver clarity.

Maritime and Offshore Fire Response and Investigation

AT SEA · IN PORT · OFFSHORE

BROOKESBELL.COM

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AT A GLANCE

Brookes Bell Fire & Explosion

One team of fire investigators, Master Mariners, marine engineers, scientists, metallurgists and naval architects, available 24/7.

Respond

Attendance on board, or remote advice, anywhere in the world.

Investigate

Origin and cause of fires and explosions at sea, in port and offshore.

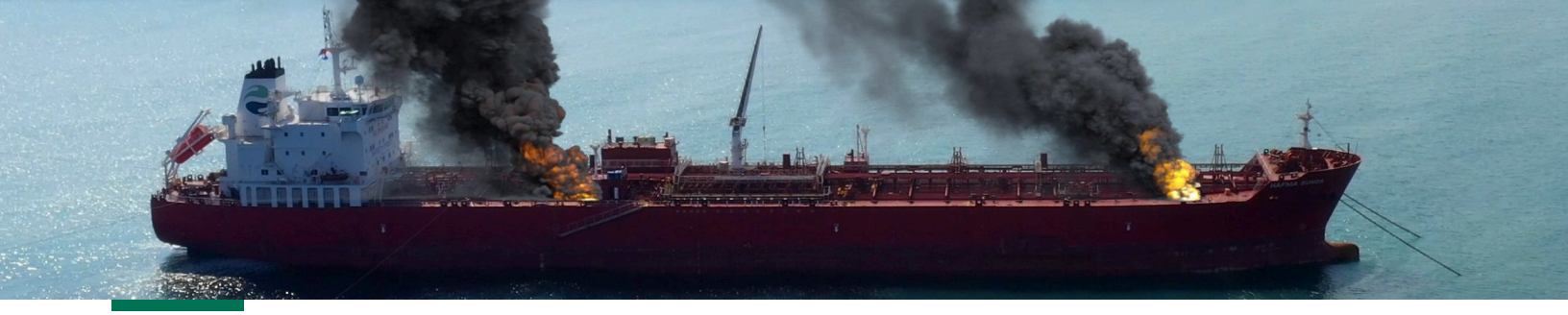
Advise and prevent

Lithium-ion, fire-safe design and codes and regulations.

800+
incidents examined

24/7
global response

1903
serving the industry since



INTRODUCTION

When Fire Breaks Out at Sea

A fire or explosion on a ship or offshore installation can change everything in minutes.

People are at risk. Cargo and equipment can be lost. Evidence may start to disappear as soon as the fire is extinguished.

Brookes Bell's Fire & Explosion Investigation Team responds to and investigates fires at sea, in port and offshore. We work with shipowners, P&I clubs, H&M underwriters, charterers, cargo interests, and law firms. Fire investigators, Master Mariners, marine engineers, scientists, metallurgists, and naval architects work as a team for you.

We answer the questions that follow every incident.

01 **Where did it start?**

02 **What caused it?**

03 **Why did it spread?**

04 **What contributed to the loss?**

Fire at Sea: The Numbers

200+

fire incidents on large vessels in 2025, the second-highest total in a decade.

9+

total losses involving fires on large vessels in 2025.

Every 17 days

roughly how often a container ship fire occurs worldwide.

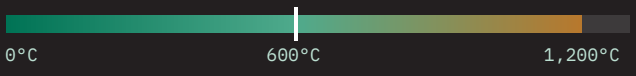
6x LITHIUM-ION

growth in lithium-ion battery deployment over five years.



1,200°C LITHIUM-ION

how hot an EV battery fire can burn. Aluminum melts at 600°C.



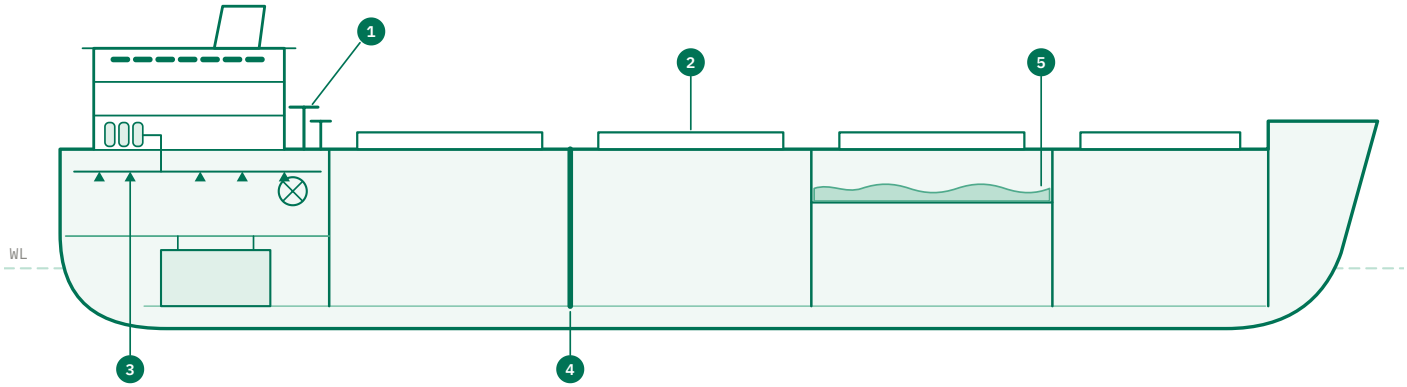
Source: Allianz Commercial, Safety & Shipping Review 2026.

THE CHALLENGE

Why Fire at Sea Is Different

At sea, the crew are the first responders and may be the only ones for some time.

At sea, the crew are the first responders and may be the only ones for some time. Escape routes are limited. Ventilation, closures, fixed fire-fighting systems and watertight boundaries all shape how a fire grows. Water used to fight a fire can collect on deck and affect stability.



1 Ventilation · 2 Closures · 3 Fixed fire-fighting systems · 4 Watertight boundaries · 5 Water collecting on deck

Our response brings seagoing experience, fire science, and naval architecture together from the first call.

Seagoing experience + Fire science + Naval architecture

What We Do

Respond

- Attendance on board, or remote advice, anywhere in the world.
- Support and advice during fire-fighting and salvage operations.
- Management and coordination of fire and explosion incidents.
- Evidence collection and preservation at the scene.

Investigate

- Origin and cause: engine room, cargo hold, accommodation, car deck, and yacht fires.
- Solid, liquid, chemical, and gas-phase explosions.
- Failure analysis of machinery, electrical equipment, and fire protection systems.
- Laboratory analysis (FTIR, SEM-EDX, LIBS, PMI-OES), and non-destructive testing.
- Documentary evidence: evaluation and opinion.
- Digital site preservation and computer modeling.

Advise and prevent

- Lithium-ion and other battery fires: proactive and reactive advice.
- Fire safety in ship design, including SOLAS Alternative Design and Arrangements.
- Fire and escape simulation analysis.
- Thermographic surveys.
- Interpretation of codes and regulations, such as SOLAS and the IMDG and IMSBC Codes.

OUR METHOD

How We Investigate

We follow the scientific method, a seven-step process in which we recognize and define the problem, collect and analyze the data, develop a working hypothesis, test it, and finally select the hypothesis that the evidence supports.



THE SCIENTIFIC METHOD · 7 STEPS

01	02	03	04	05	06	07
Recognize the problem	**Define** the problem	**Collect** the data	**Analyze** the data	**Develop** a working hypothesis	**Test** the hypothesis	**Select** the hypothesis the evidence supports

Because fires and explosions move fast, and one can cause the other, we establish a chronology early, and a rapid response by properly equipped investigators helps ensure that evidence is identified, collected, and preserved before it is lost.

We then test every possible ignition source against every available fuel and eliminate whatever the evidence rules out, considering the usual causes of human error, thermal reaction, electrical fault, mechanical failure, and design failure. Where physical evidence is limited, simulation allows us to test many hypotheses without the need for full-scale physical testing.

The usual causes we consider

01 Human error

02 Thermal reaction

03 Electrical fault

04 Mechanical failure

05 Design failure

STANDARDS

Standards & Qualifications

Our investigators work to recognized methods, including NFPA 921, the UK Fire Investigation Code of Practice and the ENSFI Best Practice Manual for the Investigation of Fires and Explosions.

METHODS

- NFPA 921
- UK Fire Investigation Code of Practice
- ENSFI Best Practice Manual

They meet or exceed NFPA 1033 and are prepared to give expert evidence, and our processes follow the requirements of NFPA 1321, ISO/IEC 17020 and ISO 21043.

INVESTIGATORS

- NFPA 1033

PROCESSES

- NFPA 1321
- ISO/IEC 17020
- ISO 21043

Where We Work



Engine Rooms

Our fire investigators and marine engineers investigate engine room fires and explosions and assess the nature and extent of the heat and fire damage. Working with our naval architects, they can also investigate flooding of machinery spaces, and thermographic surveys can be arranged to support an investigation or for loss prevention.



Cargo Holds

Our scientists investigate self-heating cargoes, electrical faults, ignition sources and inadequate ventilation, and because some cargoes – including biomass and wood pulp – can generate carbon monoxide even in normal carriage, gas readings matter before a hold is opened.

For coal and related cargoes we advise before loading, during the voyage, and at discharge, with 24/7 cover. Scrap cargoes are an emerging concern as lithium-ion batteries from consumer products reach the recycling stream.

15cm On some car carriers, vehicles are stowed just 15cm apart.

Ro-Ro, Ro-Pax & Car Carriers

Vehicle decks on these ships are long and open, with no transverse bulkheads, so a fire can spread along the deck, and on some car carriers vehicles are stowed just 15cm apart. On a full deck a fire team can need 5–10 minutes to reach a single vehicle while a breathing apparatus holds about 20 minutes of air. Because fire-fighting water can build up on deck, stability also needs close monitoring by naval architects.

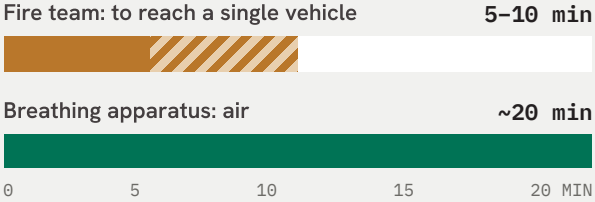


Container Ships

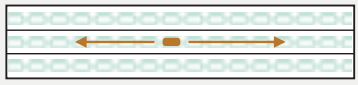
A container ship carries thousands of sealed units, which means that finding and reaching the right container can be the hardest part of the response. Misdeclared cargo accounts for around a quarter of cargo-related incidents. Our IMDG enquiry service reviews safety data sheets and dangerous goods queries.

RO-RO, RO-PAX & CAR CARRIERS

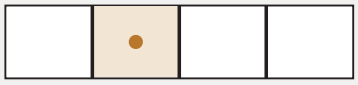
On a full deck



WHY FIRE SPREADS ALONG VEHICLE DECKS



Vehicle deck: long and open, with no transverse bulkheads



Cargo hold: divided by transverse bulkheads

Lithium-Ion Batteries & EVs

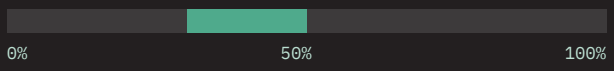
01 **Cell failure**
When a lithium-ion battery fails it can enter thermal runaway, a self-sustaining reaction

02 **Vapor, not smoke**
that releases a large volume of vapor rather than smoke.

03 **Gas composition**
That vapor can contain hydrogen, carbon monoxide, hydrogen fluoride, and hydrogen cyanide,

H_2	CO	HF	HCN
Hydrogen	Carbon monoxide	Hydrogen fluoride	Hydrogen cyanide

Hydrogen share of vented gas **30–50%**



04 **Late ignition**
and if it ignites late it can cause a vapor cloud explosion.

1,200°C



Fires can exceed 1,200°C, hot enough to melt aluminum decking. Fire water and surfaces can carry toxic residues after the flames are out.

Our advice follows three steps:

Detect
Using heat, smoke and gas detection, and CCTV.

Contain
Using drenchers, CO2 or water mist.

Protect
Through boundary cooling and expert consultation.

We also advise on PPE, containment, detection, and crew training – both before and after an incident.



Superyachts

Superyachts pack fuel, batteries, electrics, and high-value fit-out into a small space, and common origins of fire include electrical faults, engine-related issues, battery faults, and galley fires. We investigate the cause and advise on risk mitigation, including fire simulation at the design stage.



Offshore

We identify ignition sources and system failures on offshore platforms, and in a published study our engineers modeled diesel fires in two platform modules and tracked smoke across six wind angles to test whether people could reach muster areas with smoke below 2.3% by volume.

2 platform modules

6 wind angles

2.3% smoke by volume

DIGITAL PRESERVATION

Capturing the Scene

Site conditions change quickly and access to a shipboard or offshore scene may later be restricted, while photographs and notes capture only part of the story. Our digital preservation service therefore creates a permanent, measurable record that everyone involved can revisit as a claim or dispute develops.



Bronze 01

360° immersive imagery for virtual site tours and remote briefings.



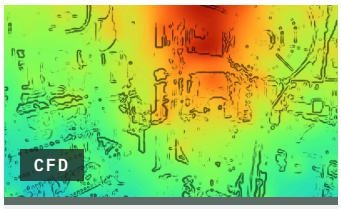
Silver 02

Precision laser scanning and 3D point clouds.



Gold 03

Detailed 3D computer models for reconstruction and scenario testing.



Platinum 04

Advanced CFD modeling that replicates the incident and tests modes of failure; for marine structures, scan data can also support strength, stability, and seakeeping analysis.

THUMBNAILS ILLUSTRATIVE

Our fire models run millions of calculations to simulate fire growth, smoke spread, suppression performance and thermal effects, using Fire Dynamics Simulator (FDS) and ANSYS Fluent.

FDS | ANSYS Fluent | Fire growth | Smoke spread | Suppression | Thermal effects

> **A permanent, measurable record that everyone involved can revisit as a claim or dispute develops.**

FIRE-SAFE DESIGN

Designing Out the Risk

As ships grow in size and complexity, SOLAS allows alternative designs that depart from prescriptive rules provided they are shown to be safe. We support Alternative Design and Arrangements submissions by testing whether a proposed design is suitable from a fire safety perspective.

Our simulations show how fire and smoke could spread through compartments, allowing us to assess the effect on structure, the performance of passive and active fire protection, and the exposure of crew and passengers to heat and smoke. When fire protection fails, we compare how it was designed to perform with how it actually performed.

OUR PEOPLE

The Team



Dr. Paul Ayres

Forensic Scientist and Fire & Explosion Investigator

HOUSTON



Dr. Michael Tynan

Cargo Scientist and Fire Investigator

SINGAPORE



Yvonne Tung

Senior Scientist and Fire Investigator

GLASGOW



Kaitn Walker

Scientist and Fire Investigator

LIVERPOOL

800+

FIRE & EXPLOSION INCIDENTS EXAMINED

Between them, our investigators have examined more than 800 fire and explosion incidents during their careers, and they are backed by Master Mariners and Special Casualty Representatives with direct command experience of passenger ships, car carriers, Ro-Ro ferries, container ships and tankers.



Why Brookes Bell?

One team

Fire science, seagoing experience, engineering, naval architecture, metallurgy, and an in-house laboratory, all with a single point of contact.

24/7

Global

Investigators in the UK, Asia, and the Americas, available 24/7.

Independent

We equip you with all of the facts, good and bad, and then advise.

1903

Experienced

Serving the maritime industry since 1903.

PRACTICAL GUIDANCE

The First Hours After a Fire

What happens before investigators arrive often decides what can be proven later.

Use this checklist to keep people safe and keep evidence intact until the scene has been examined.

SAFETY FIRST Nobody re-enters the affected space until it has been ventilated, gas-tested and declared safe.

01 Crew on board

- [ ] Do not clear debris, move items or restart machinery in the affected area.
- [ ] Keep failed or suspect components. Do not discard or repair them.
- [ ] Photograph and video the scene as found.
- [ ] Save VDR data and keep alarm, engine and fire-detection logs.
- [ ] Write down who saw what, and when, while it is fresh.
- [ ] Monitor fire-fighting water on deck and its effect on stability.

02 Owners & managers

- [ ] Notify the P&I club, H&M underwriters, flag state and class.
- [ ] Secure CCTV, monitoring and machinery data.
- [ ] Gather maintenance records, cargo documents and crew lists.
- [ ] Restrict access to the scene until it has been examined.
- [ ] Call Brookes Bell early. We can advise remotely while we travel.

03 Clubs, insurers & lawyers

- [ ] Appoint an investigator before the scene is cleaned or repaired.
- [ ] Agree joint inspections and evidence protocols with other parties.
- [ ] Ask that removed items are labeled, bagged and kept.
- [ ] Hold off repairs or cargo discharge in affected areas until evidence is recorded.

LITHIUM-ION BATTERIES

Treat damaged batteries as live. They can re-ignite after a fire appears to be out, and residues can be toxic.

NOT SURE WHAT TO KEEP?

If in doubt, leave it where it is and photograph it. Contact details are on the back page.

BEYOND FIRE

Related Services

Fire cases rarely sit in one discipline. Our wider teams work alongside the fire investigators from the first call.

01

Marine Engineering

Machinery failures, engine damage and repair oversight.

02

Naval Architecture

Stability, structural strength and damage assessment.

03

Cargo Science

Self-heating cargoes, cargo damage and dangerous goods advice.

04

Metallurgy & Laboratory

Materials failure analysis in our in-house laboratory.

05

Master Mariners

Navigation, operations and casualty investigation.

06

Casualty Response

Special Casualty Representatives supporting owners and insurers.

07

Expert Witness

Independent expert evidence in arbitration and court.

08

Onshore Fire

Fire and explosion investigation for buildings, industry and energy sites.

ONSHORE FIRE

We also investigate fires and explosions on land. Ask for our onshore fire and explosion brochure.

BROOKESBELL.COM

Brookes Bell

GET IN TOUCH

Speak to Brookes Bell about a fire or explosion, or about avoiding one.

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