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# Fire Investigation

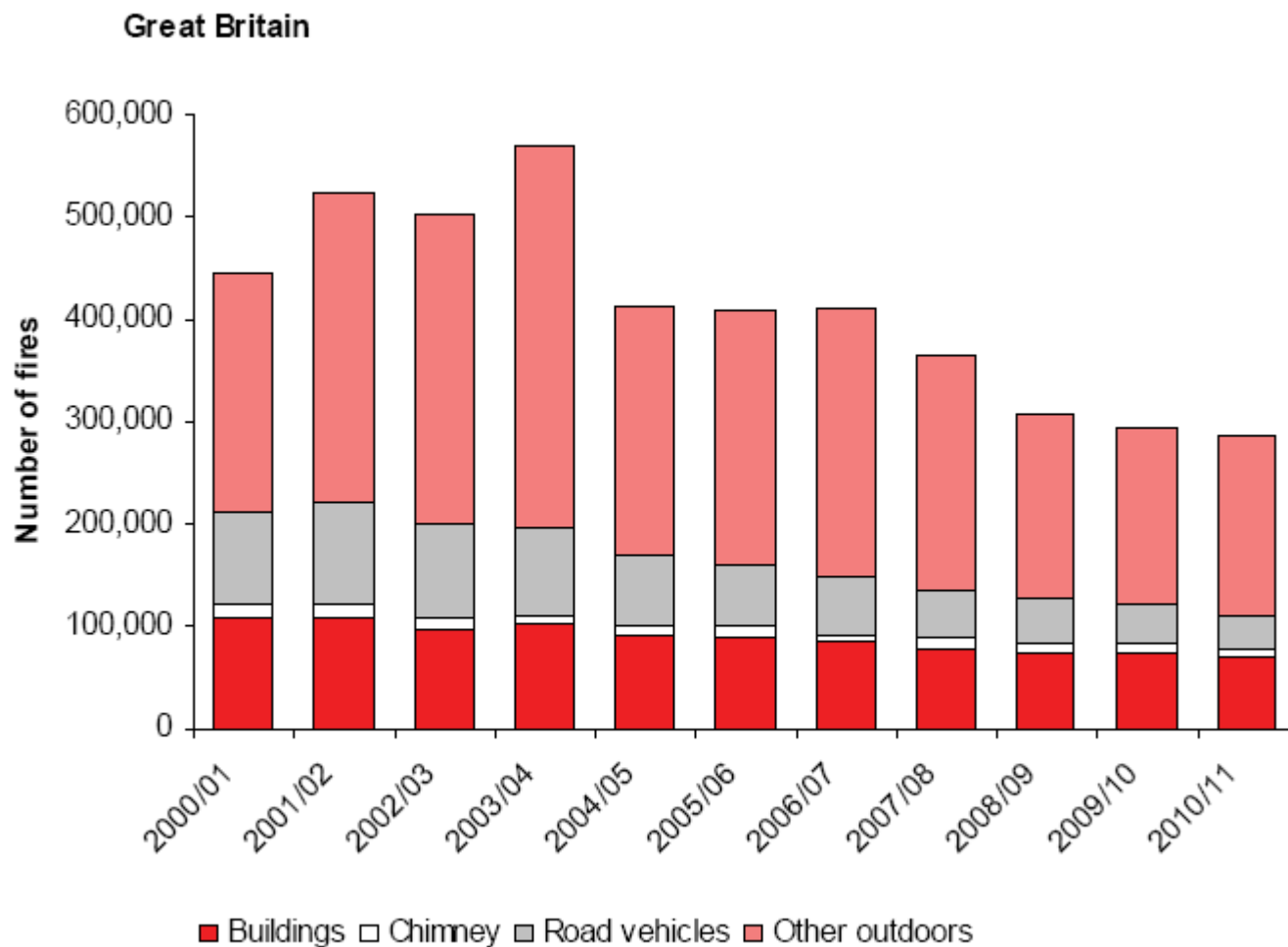
## From Folklore to Science?

# Introduction

- Number of fires reducing
- % of deliberate fires reducing
  - Dwellings <20%
  - Commercial ~30%
- Cost of fires increasing
- Cost of Arson increasing



# UK 2010-2011 Stats





# Cost of Fire across the EU


	GDP IMF 2011 (\$millions)	Fire Losses (% of GDP)	Cost of Fire (\$millions)
<a href="#">United States</a>	15,094,025	0.22	33,207
<a href="#">Germany</a>	3,577,031	0.18	6,439
<a href="#">France</a>	2,776,324	0.17	4,720
<a href="#">United Kingdom</a>	2,417,570	0.14	3,385
<a href="#">Sweden</a>	538,237	0.2	1,076
<a href="#">Poland</a>	513,821	0.09	462
<a href="#">Norway</a>	483,650	0.28	1,354
<a href="#">Denmark</a>	333,238	0.22	733
<a href="#">European Union</a>	<u>17,577,691</u>		



# Estimated Cost of Arson

- 2006 - £1.9 billion 23% of total cost of fire
- 2008 - £1.7 billion 14% of total cost of fire
- Between 2002 and 2008 the average fire claim increased from £8,000 to £21,000
- Total fire costs up +18% (ABI)
- Arson, now accounts for half of all commercial fires
- UK ABI says undetected fraud £2 billion





10 Billion







USA  
50%





USA

50%

UK  
2.5%

Where have we come from?





CHARLES GRIFFIN & Co., Ltd., Publishers

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Being a Systematic Study of their Causes and Means of Prevention.

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FOR THE USE OF FIRE INSURANCE OFFICIALS, FIRE BRIGADE OFFICERS, MEMBERS OF THE LEGAL PROFESSION, LAW OFFICERS, COUNCILLORS, FACTORY INSPECTORS AND FACTORY OWNERS.

BY DR. VON SCHWARTZ

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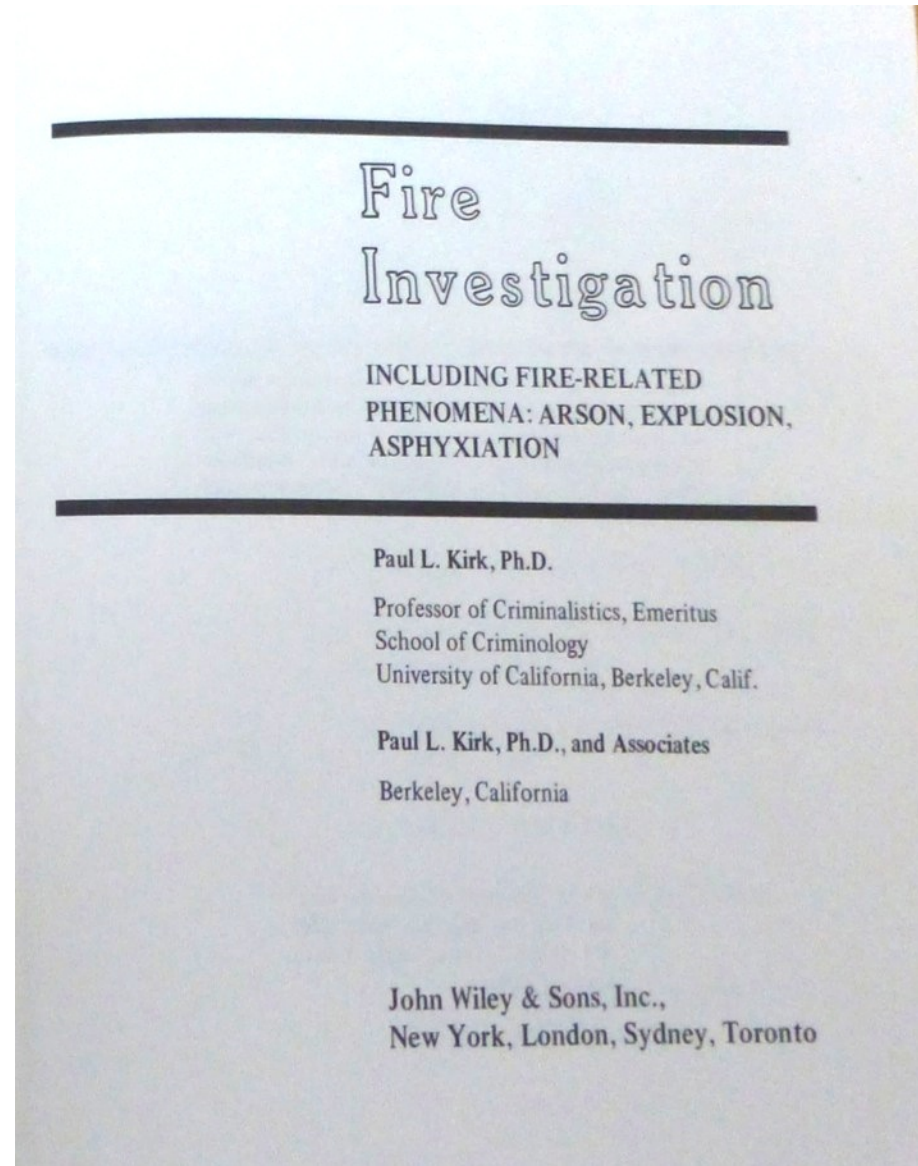
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# Paul Kirk

- Fire Investigation  
1969



# Andraus 1972



# Joelma 1974



# Summerland 1973





# Flixborough 1974

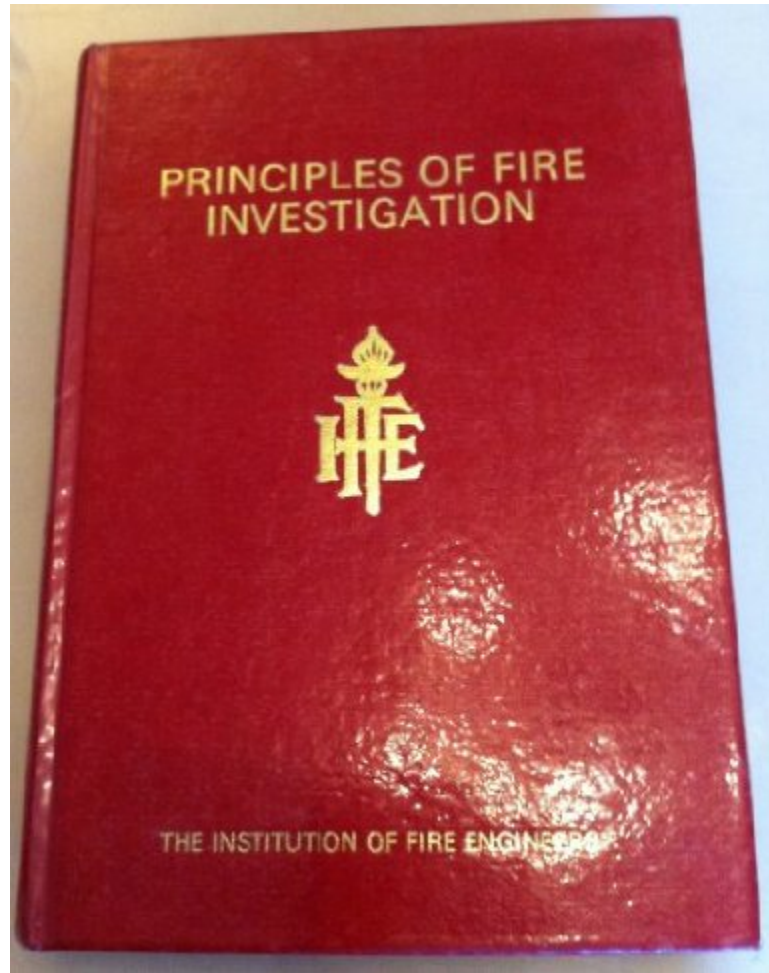


# Stardust 1981



1980 to 1999

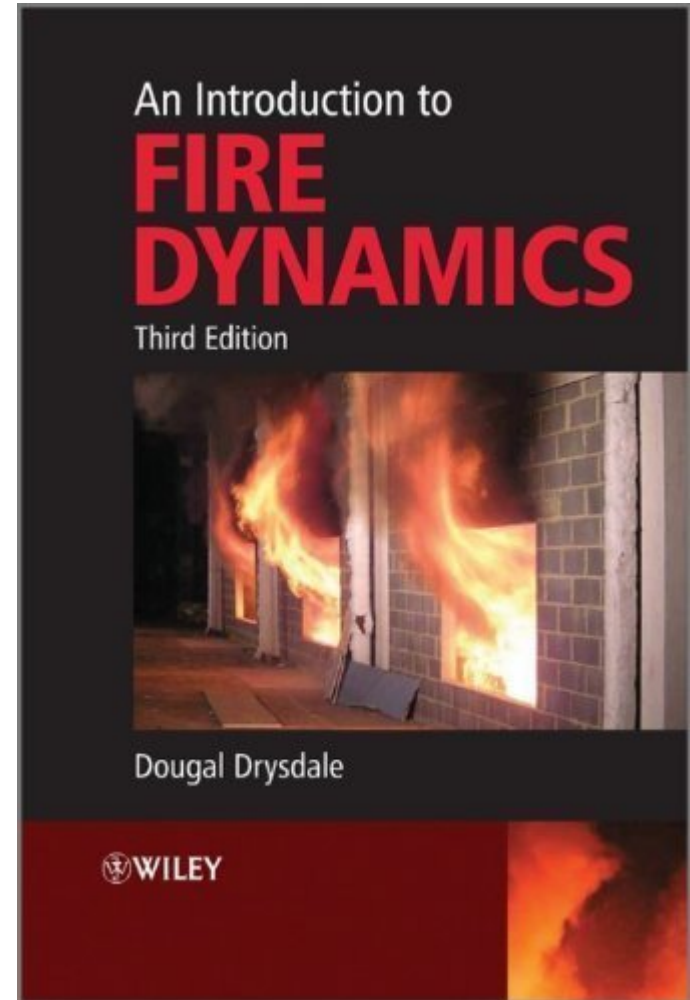
# Cooke & Ide 1985





# Drysdale 1985

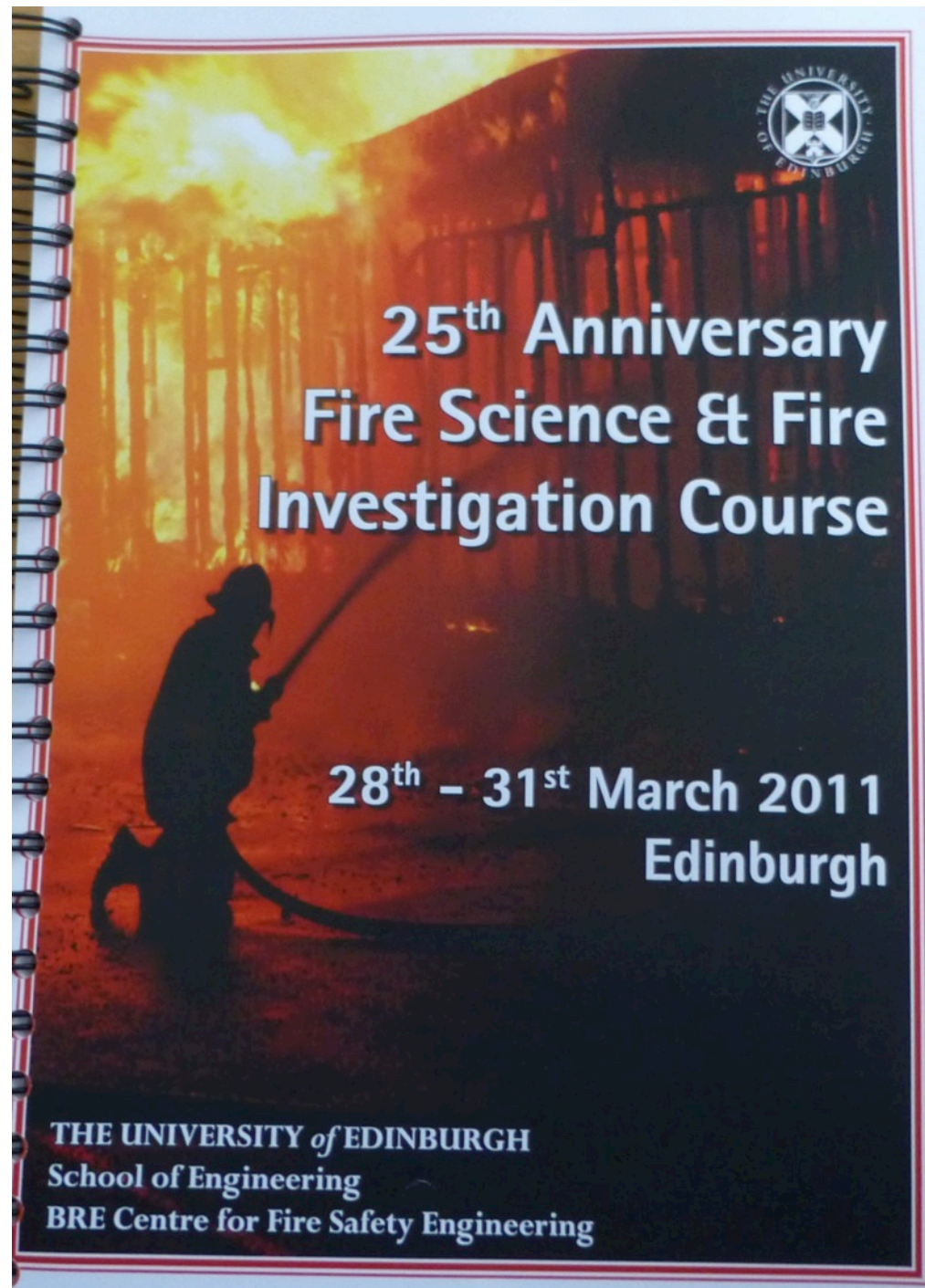
- 2<sup>nd</sup> edition 1999
- 3<sup>rd</sup> edition 2011



# Bradford 1985



1986  
First Fire Science  
and Investigation  
Course at  
Edinburgh





# Kings Cross 1987



# NFPA 921:1992

- Emphasis on the scientific method

# Windsor Castle 1992

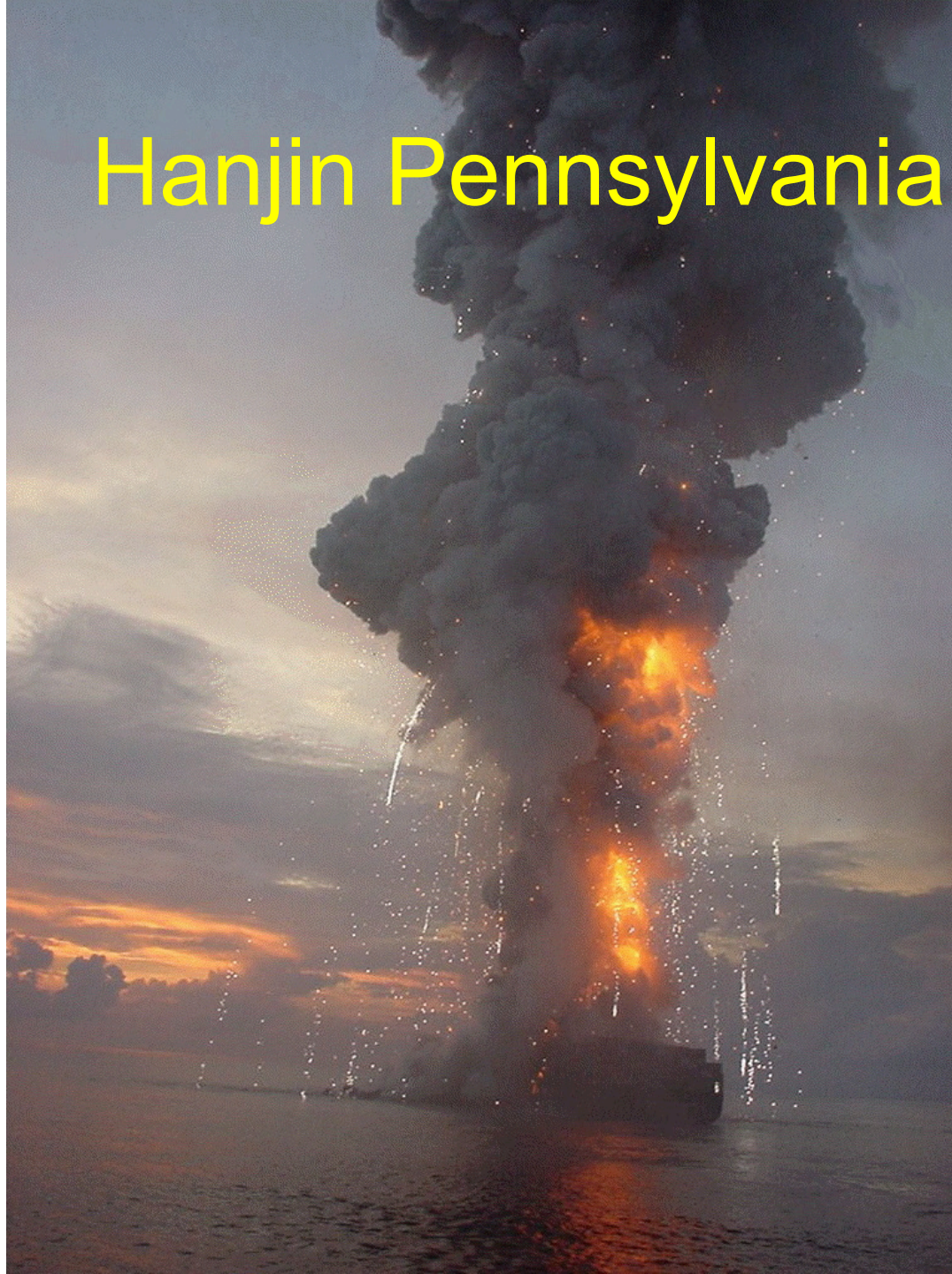


2000 onwards





# Hanjin Pennsylvania

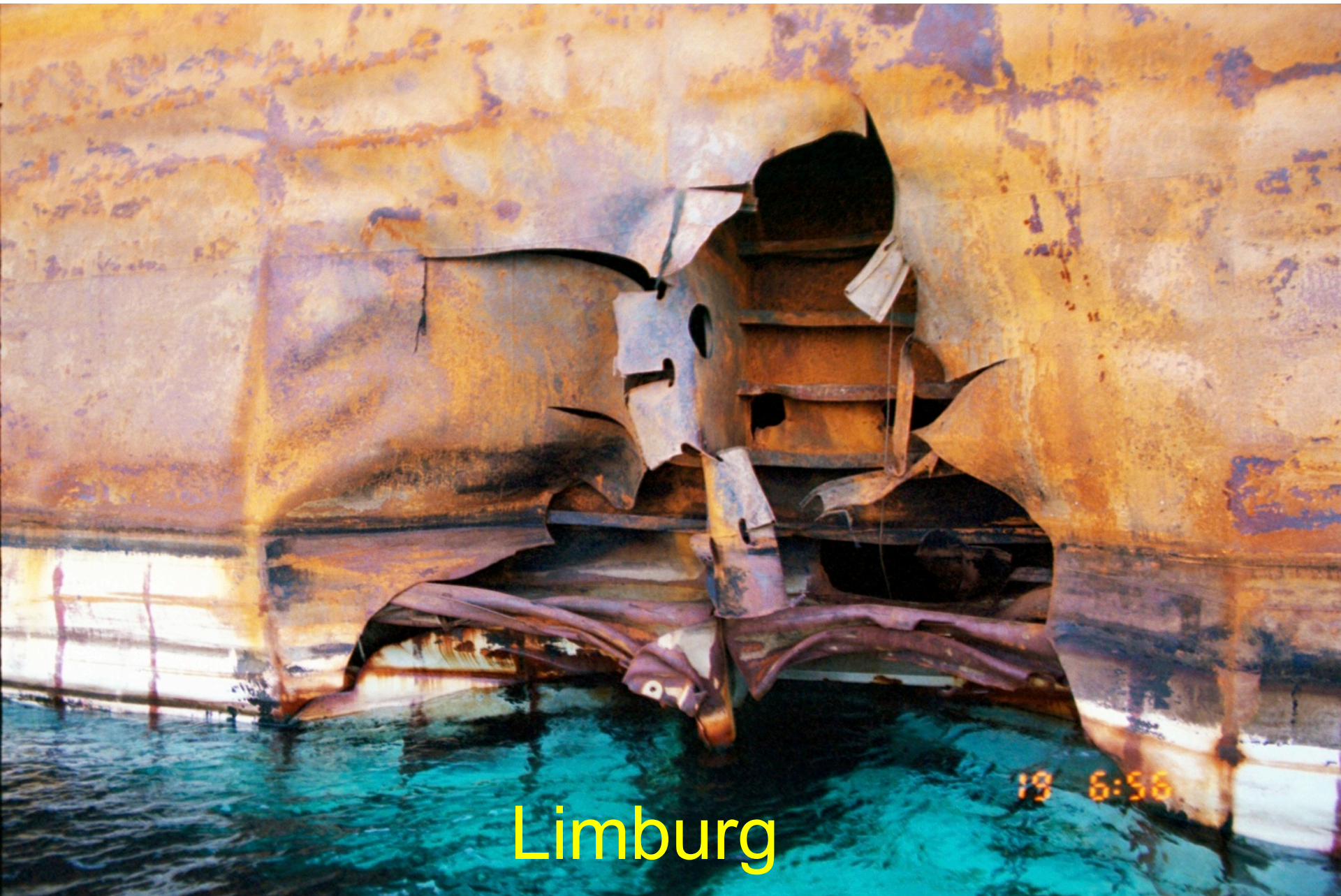




Limburg







Limburg

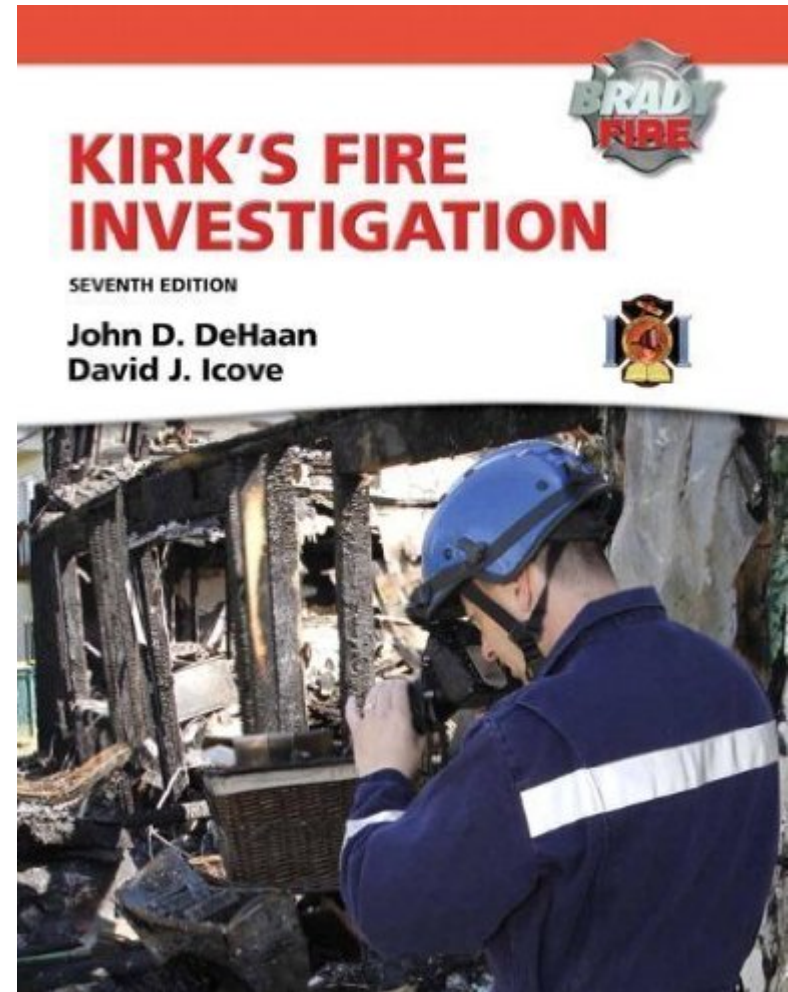
19 6:56





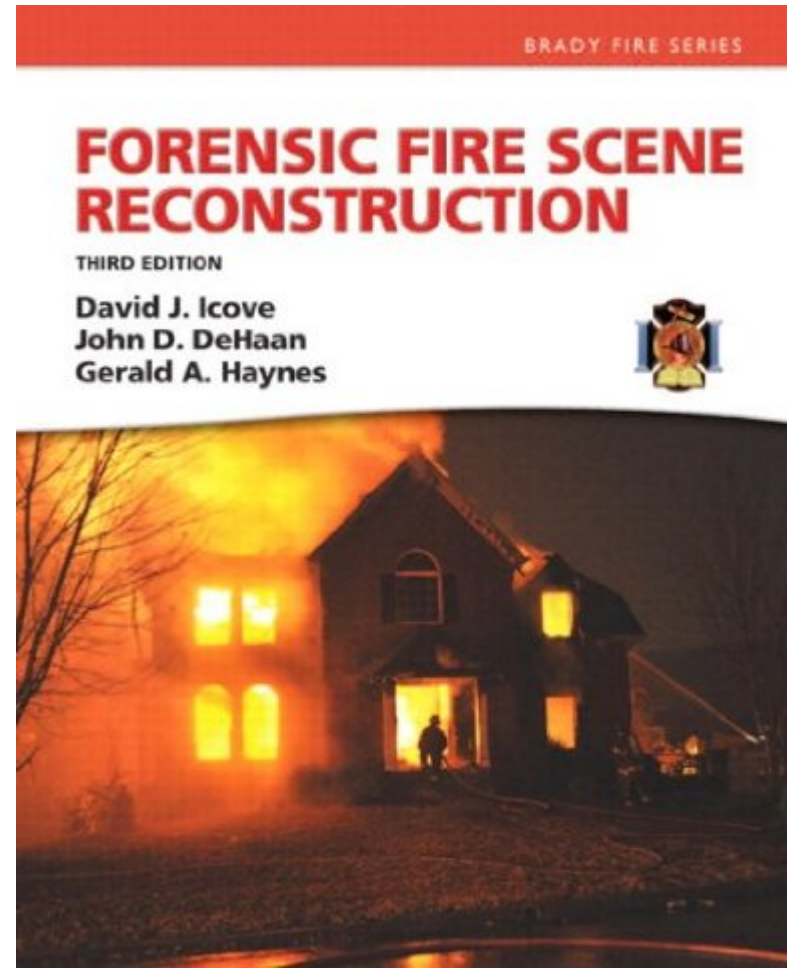
# Kirk's – DeHaan

- 5<sup>th</sup> edition 2002
- 6<sup>th</sup> edition 2006
- 7<sup>th</sup> edition 2011



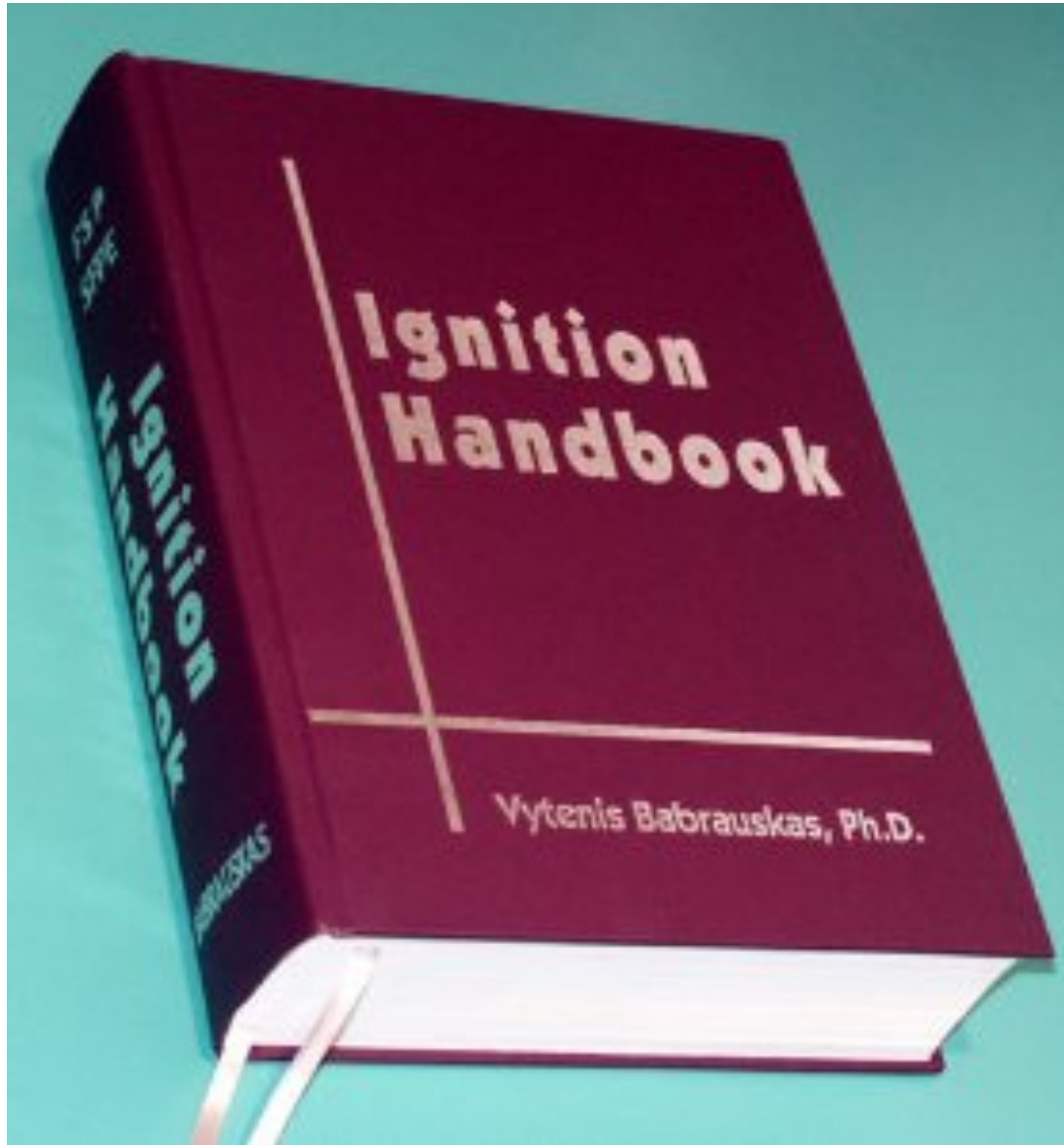
# Fire Scene Reconstruction

1st edition 2004  
2nd edition 2008  
3rd edition 2012





# Ignition Handbook 2003



2011 EDITION

# NFPA 921

GUIDE FOR  
FIRE & EXPLOSION  
INVESTIGATIONS



International  
Association of  
Arson Investigators



International  
Association  
of Fire Chiefs


**FIRE INVESTIGATOR**  
**FIELD GUIDE**  
SECOND EDITION

Second Edition

# Scientific Protocols for FIRE INVESTIGATION

John J. Lentini

A volume in the  
Protocols in Forensic Science Series

 CRC Press  
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# KIRK'S FIRE INVESTIGATION

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### A Letter From the President

The International Association of Arson Investigators serves its members, private industry, law enforcement and the entire fire investigation community with expertise, resources and training. [\(more\)](#)



[\(news archive\)](#)

## FEATURED MODULE

# NFPA 1033 Standard for

### [NFPA1033 and Your Career](#)

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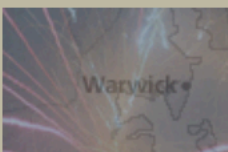
[Ethics & Social Media](#)

## AVAILABLE PROGRAMS



### [A Ventilation-Focused Approach to the Impact of Building Structures and Systems on Fire Development](#)

The program examines the importance of assessing the impact of ventilation on a fire. [\(more\)](#)



### [An Analysis of the Station Nightclub Fire](#)

A fire occurred on the night of Feb. 20, 2003, in The Station nightclub at 211 Cowesett Avenue, West Warwick, Rhode Island. [\(more\)](#)

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This program discusses how to access insurance information, understand insurance documents, ask key questions of witnesses, and apply the information learned. ([more](#))



### [Introduction to Evidence](#)

This program introduces the fire investigator to the issues related to the collection, handling and use of evidence related to a fire investigation. ([more](#))



### [Introduction to Fire Dynamics and Modeling](#)

This program takes you inside the National Institute of Standards and Technology (NIST) archives of some of the most interesting and instructive test burns and fire model simulations they have ever conducted. ([more](#))



### [Investigating Fatal Fires](#)

This module provides a thorough understanding of the ways an investigation changes when a fire-related death occurs. ([more](#))



### [Investigating Motor Vehicle Fires](#)

This program will introduce the fire investigator to the basic methodologies use to investigate vehicle fires. ([more](#))



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This program discusses the latest developments in expert testimony under the Daubert standard, including the MagneTek case recently decided in the United States Circuit Court of Appeals. ([more](#))



### [Managing Complex Fire Scene Investigations](#)

This module focuses on how to manage investigations that have "complicating" factors. ([more](#))



This module uses the Motive, Means, and Opportunity case study to demonstrate how responsibility is determined in an arson case. ([more](#))



### [Physical Evidence at the Fire Scene](#)

The program illustrates for the fire investigator, how non-traditional fire scene evidence can be helpful during an investigation. ([more](#))



### [Postflashover Fires](#)

This module introduces the postflashover topic, describes ventilation-controlled fire flow, illustrates how the damage left by a postflashover can be significantly different than if that fire was extinguished preflashover. ([more](#))



### [Preparation for the Marine Fire Scene](#)

This module lays the groundwork for understanding marine fires by covering four basic concepts that the investigator must understand before investigating a marine fire. ([more](#))



### [Search and Seizure](#)

This module explains the principles of search and seizure under the Fourth Amendment, as contained in the amendment and according to subsequent case law, and applies them to typical fire scene scenarios. ([more](#))



### [The Fire Investigator & the 2011 NFPA 921 Changes](#)

The 2011 edition of NFPA 921 Guide for Fire and Explosion Investigation was issued in January of 2011 ([more](#))



### [The HAZWOPER Standard](#)

This module provides introductory information on the Hazardous Waste Operations and Emergency Response (HAZWOPER) standard – 29 CFR 1910.120. ([more](#))



### [The Potential Value of Electronic Evidence in Fire Investigations](#)

This module demonstrates the investigative potential of information stored on electronic devices. ([more](#))



### [The Practical Application of the Relationship Between](#)





### [The Scientific Method for Fire and Explosion Investigation](#)

The basics of the scientific method are deceptively simple: observe, hypothesize, test, and conclude. ([more](#))



### [Understanding Fire Through the Candle Experiments](#)

This program presents the results of flame experiments conducted with a candle. ([more](#))



### [Using Resources to Validate your Hypothesis](#)

This module will advise fire investigators on how to approach the fact-finding procedures necessary and validate a hypothesis. ([more](#))



### [Vacant and Abandoned Buildings: Hazards and Solutions](#)

This module provides an overview on how structures can become vacant and eventually abandoned. ([more](#))



### [Wildland Fires Investigation](#)

This module illustrates how wildland fires spread, explains how to interpret burn patterns unique to these types of fires. ([more](#))



### [Writing the Initial Origin and Cause Report](#)

This module presents the key elements of the initial origin and cause report and methods of clearly presenting findings in a professional manner. ([more](#))

Search

GO!

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## FEATURED STORY

**2012****IAAI****Fire Investigator  
of the Year**

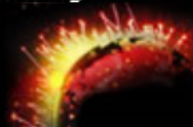
Capt. William M. "Willie" Nelson

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watch the video](#)

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LEGAL  
DEVELOPMENTS**

## Knowledge Challenges For Fire Investigators

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- [CFITrainer.Net® Survey Reveals Extraordinary USER Satisfaction Level](#)
- ["Who are you going to call?"](#)
- [Bomb Arson Tracking System \(BATS\): Expanding the Fire Department Toolkit](#)
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Welcome to [interFIRE.org](#), the complete resource for fire services, fire insurers, law enforcement and others whose duties involve arson investigation, fire investigation safety and fire scene training. Our [online training center](#) provides interactive tutorials on critical fire and arson investigation procedures. Our latest topic is [First Response from an Investigative Perspective](#). This interactive tutorial will allow you to view the same incident from the experiences of fire, police and EMS professionals.

While you are here, visit our [fire investigation resource center](#) by subject or date. Our resources cover fire investigation from before the fire through to follow up and legal preparation. You will be able to access fire investigation materials that include arson investigation abstracts, articles and tutorials, United States Fire Administration technical reports, fire investigation links and more.

Get hands on training by assessing our calendar of [fire investigation training programs](#) covering topics from arson awareness to fire insurance fraud and fire codes and standards.

Every month we update the site with the latest addition of fire investigation resources, so come

# Willingham Case

- 23 December 1991 Todd Willingham's three daughters die in a fire which he escaped.
- Investigators conclude fire deliberately set
- 1992 found guilty
- 2004 executed
- 2009 Texas Forensic Science Commission instruct Dr Craig Beyler to examine case



# Willingham Beyler Review

- Relied on myths and folklore
- Ignored “scientific method”
- Witnesses misinterpreted
- Burn patterns misinterpreted
- “None of these determinations have any basis in modern science”
- 2010 Judge Baird issues a judgement exonerating Willingham

# Debunking of Myths and Old Wives Tales

- Floor and puddle patterns
- V patterns
- Low char burning
- High floor temperatures indicates accelerant
- Window breaking indicates arson
- Crazed glass
- Tiles burned from underneath
- Floor burned under bed
- Aligatoring / Crocidiling

# Recognition that Post Flashover Fire Investigation is Difficult

- 2005 NIST tests
  - Only 3 out of 53 investigators were able to identify the quadrant of origin from brief visual examination
- Interpretation of clean burn patterns (cf Carman)





# Buncefield 2005



# NFPA 921:2014

- Now in colour
- Doubled to over 400 pages compared to 2001 Edition
- Includes new chapter on fire protection systems
- NFPA 1033: 2014 adjusted to reflect NFPA 921:2014



# Where are we going?





# Regulation of Fire Investigators

- Forensic Regulator
- Regulation of providers
- ISO 17020 General criteria for the operation of various types of bodies performing
- inspection
- Competency framework
- Regards FI in same category as Anthropologists and Fingerprint specialists
  - Interpretation of patterns

- NFPA 1033:2014
- Skills for Justice National Occupational Standards



# National Occupational Standards

- **SFJ FRS FI1** Prepare to investigate an incident involving fire and/or explosion
- **SFJ FRS FI2** Investigate an incident involving fire and/or explosion
- **SFJ FRS FI3**
- Report on the investigation of an incident involving fire and/or explosion





# SFJ FRS FI1

## Prepare to investigate an incident involving fire and/or explosion



---

### Overview

This unit is about preparing to investigate an incident involving fire and/or explosion. It covers:

#### **Determining the nature and scope of the investigation**

This involves identifying and evaluating available information about the incident and its development, including the hazards and risks.

#### **Setting up working arrangements to carry out an investigation**

This involves establishing working arrangements including the involvement of specialists and other agencies.

#### **Target Group**

The unit is recommended for all practitioners with responsibility for fire investigation

# SFJ FRS FI2

## Investigate an incident involving fire and/or explosion



---

### Overview

This unit is about an on-scene investigation of an incident involving fire and/or explosion. It covers:

#### **Recovering and preserving physical and documentary evidence relevant to the investigation**

This involves identifying, recording and preserving physical and documentary evidence relevant to the investigation.

#### **Collecting witness evidence relevant to the investigation**

This involves identifying and interviewing witnesses.

#### **Compiling and providing available evidence**

This involves organising and evaluating the available evidence (physical, documentary and witness), and providing this evidence along with a supporting report.

#### **Target Group**

The unit is recommended for all practitioners with responsibility for fire investigation.

# SFJ FRS FI3

## Report on the investigation of an incident involving fire and/or explosion



---

### Overview

This unit is about reporting on the investigation of an incident involving fire and/or explosion. It covers:

#### **Evaluating the results of an investigation**

This involves organising and evaluating the outcomes of an investigation.

#### **Reporting the conclusions of an investigation**

This involves analysing the outcomes of an investigation and identifying hypotheses and conclusions and producing a final report.

#### **Target Group**

The unit is recommended for all practitioners with responsibility for fire investigation.



**Knowledge and understanding**

*You need to know and understand:*

- K1 the methods and equipment for handling and storing evidence to preserve continuity, avoid damage and any cross contamination
- K2 the principles of investigation based on scientific methodology
- K3 the benefits of conducting an internal and external survey of the structure and surrounds which may influence fire suppression and development including any environmental effects
- K4 the potential and actual contribution of the structure, finishes, fittings, equipment and processes to the incident
- K5 the techniques for excavating fire debris whilst preserving key evidence
- K6 the importance of accurately correlating burn patterns to identify area of origin and evaluate fire/explosion behaviour
- K7 the principles of fire scene reconstruction
- K8 the potential ignition sources, their identification and process of elimination
- K9 the behaviour of people involved in fire
- K10 how to identify and adequately record evidence of obvious accidental causes of fire and deliberate ignition
- K11 the use of basic fire science in fire investigation
- K12 fire dynamics, chemistry and physics of combustion and heat transfer
- K13 the importance of maintaining continuity and integrity of evidence
- K14 the rules of evidence, continuity issues and methods for provision of secure storage and transport
- K15 how to recover evidence in a incident involving a fatality(ies) and liaise with appropriate personnel
- K16 how to avoid unnecessary distress of people and treat any deceased with respect giving due regard to your objectives and the nature of risk
- K17 methods for recording the scene
- K18 the roles, responsibilities and limits of your own personal authority and of other personnel and agencies at the investigation



# Areas of Concern

- Sandwich panel buildings
- Refurbishment of buildings
- Timber framed buildings
- Renewable energy



# Records on Fire



Cody 5 Fire, Bromley-by-Bow, London E3, 12 July 2006

# Records Storage Fires – Cody 5



Chambers 1 and 2 fully engulfed at 1:36 a.m.



# Records Storage Fires – Cody 5



Only defensive firefighting possible

# Records Storage Fires – Cody 5



Cody 5 was thus an unsprinklered building!

# Records Storage Fires – Cody 5





# Records Storage Fires – Cody 5



*Primary electric fire pump isolation lever found in "OFF" position by first-responding firefighters from Poplar Station, London Fire Brigade*



# Records Storage Fires – Cody 5



*Standby diesel pump also found in "OFF" position by first responding firefighters from Poplar Station, London Fire Brigade*

# Lakanal House

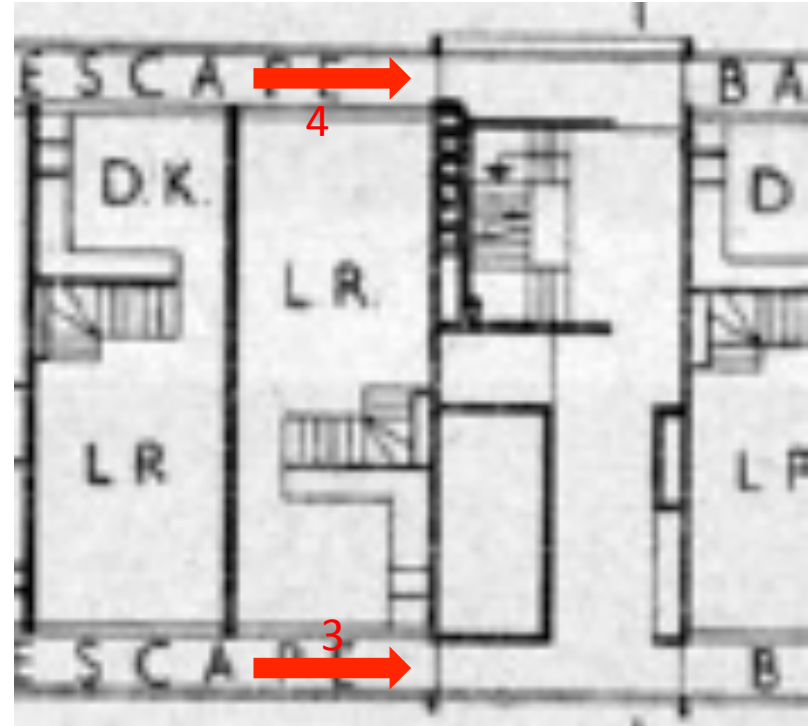
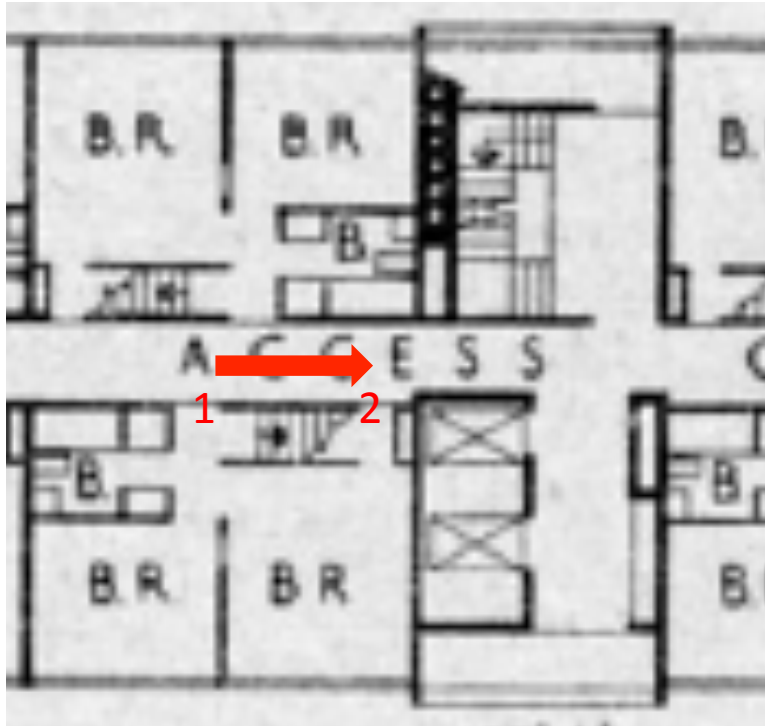




14  
13  
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6



# Escape routes







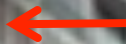
**Bedroom 1  
flat 65  
9<sup>th</sup> floor**



**Smoke block escape via  
west balcony 10<sup>th</sup> floor**



**Smoke penetrates  
the stairwell**



16:38:06 East View of Lakanal House fire escaping Flat 65 Living room





17:02:57 West elevation Flat 79 Bedrooms alight



20:10 West elevation Fire extinguished, search and rescue being carried out





## Risk Guidance Note 37

### Fire Safety of Timber Frame Buildings

Advice on the Suitability, Construction and  
Occupation of Timber Framed Buildings



# Timber Frame

- Speed of spread

# Hendon 2006



First observation of fire

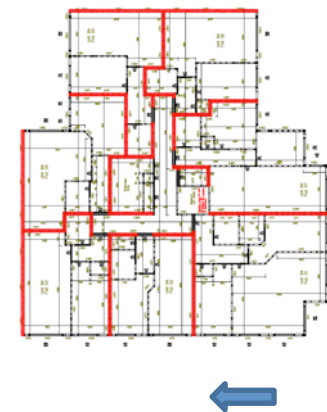




# 1540:28 Light smoke

Looking west along  
Aerodrome Road.  
Light smoke roughly half  
way along south elevation  
interface B4/B5

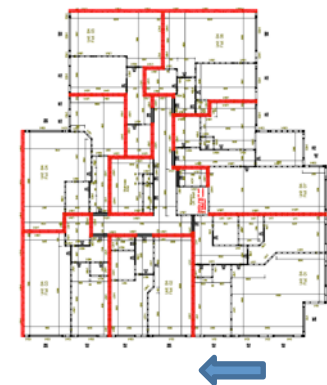
Man in HiViz vest looking  
over hoarding arrowed in  
yellow



# 1542:09 Light smoke

Looking west along  
Aerodrome Road

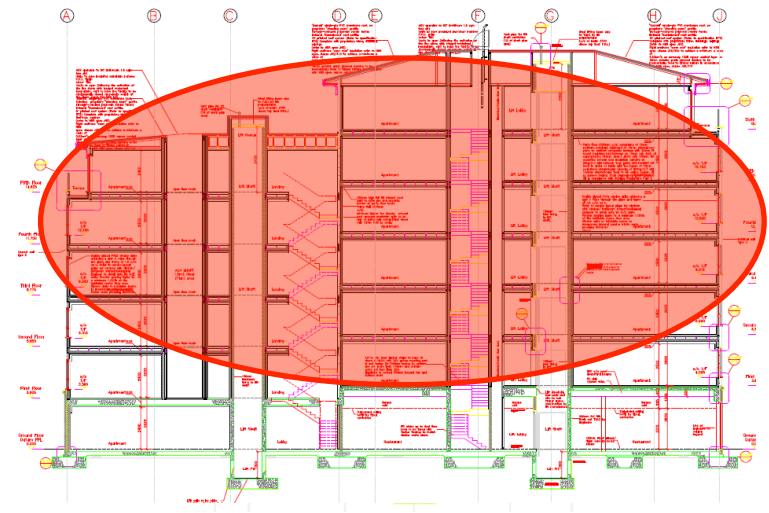
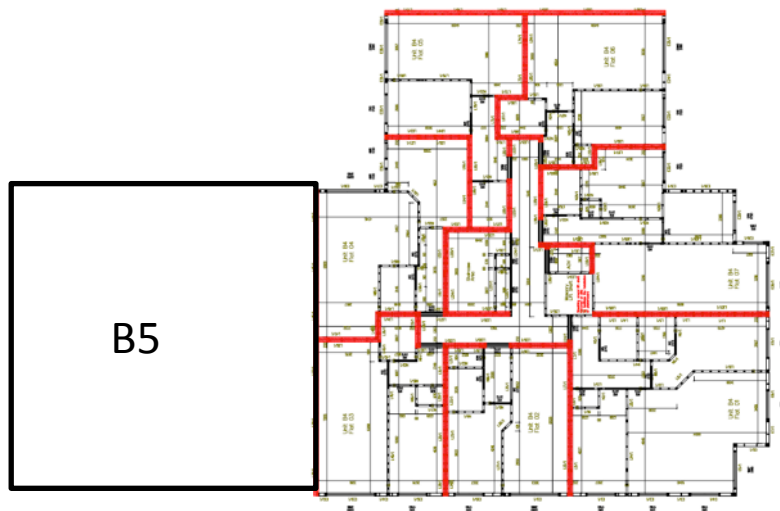
Light smoke in road



# 1548 Fire at the SW corner B5

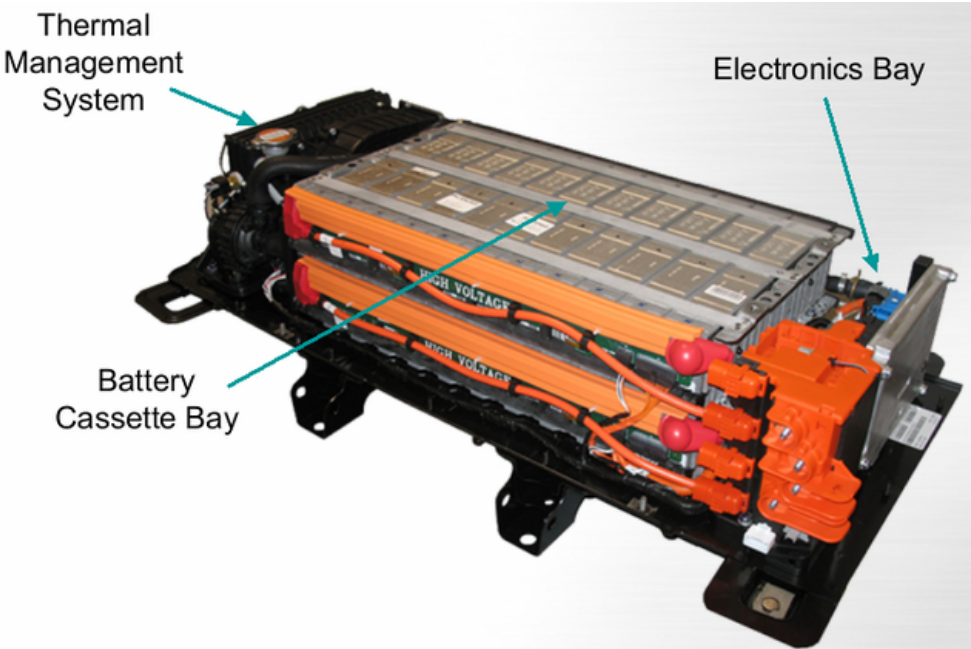
Fire has spread through and engulfed B5

Fire burning second floor to sixth floor in B5



# Battery Fires

Photo courtesy of National Transportation Safety Board





# Failing to remember the past

- Texas City  
1947





# West, Texas 2014



# Technical Excellence Rapid Response

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