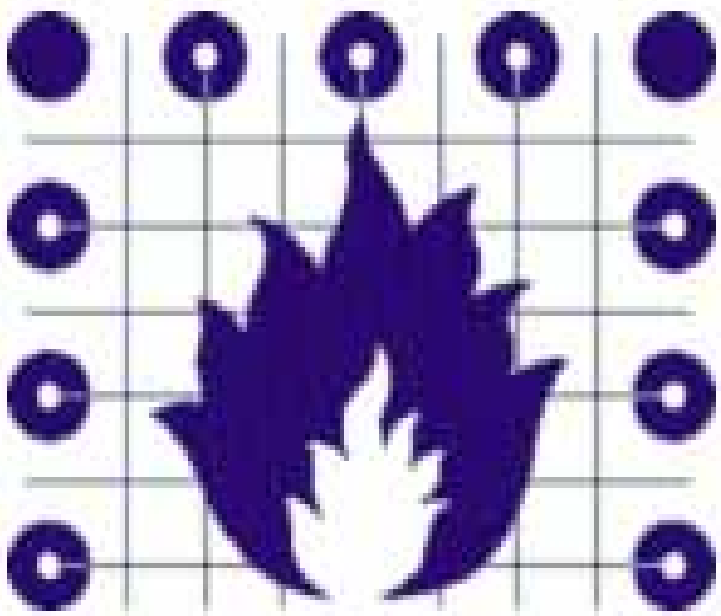


Resource
Protection
International

Resource Protection International

Independent Fire Hazard Management Consultants

Resource Protection International

Initially at Gold Command
Escorted to Bronze

Foam – minimum requirements

Foam sources

Foam application

Post incident investigation

Large Atmospheric Storage Tank Fires

An industry consortium of international oil companies reviewing the hazards and risks associated with storage tank fires

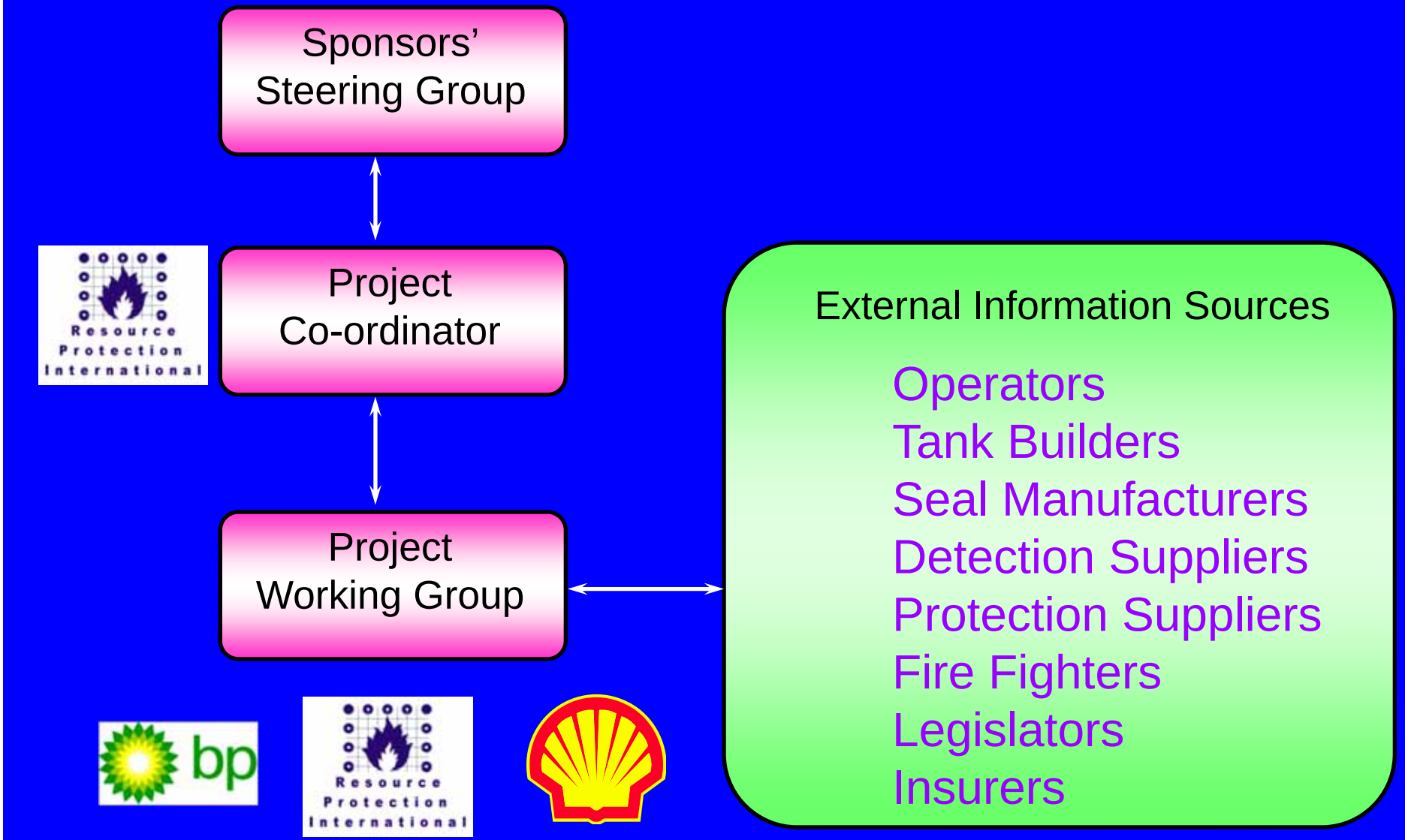
Initial Study 1993 – 1997 Project Sponsors

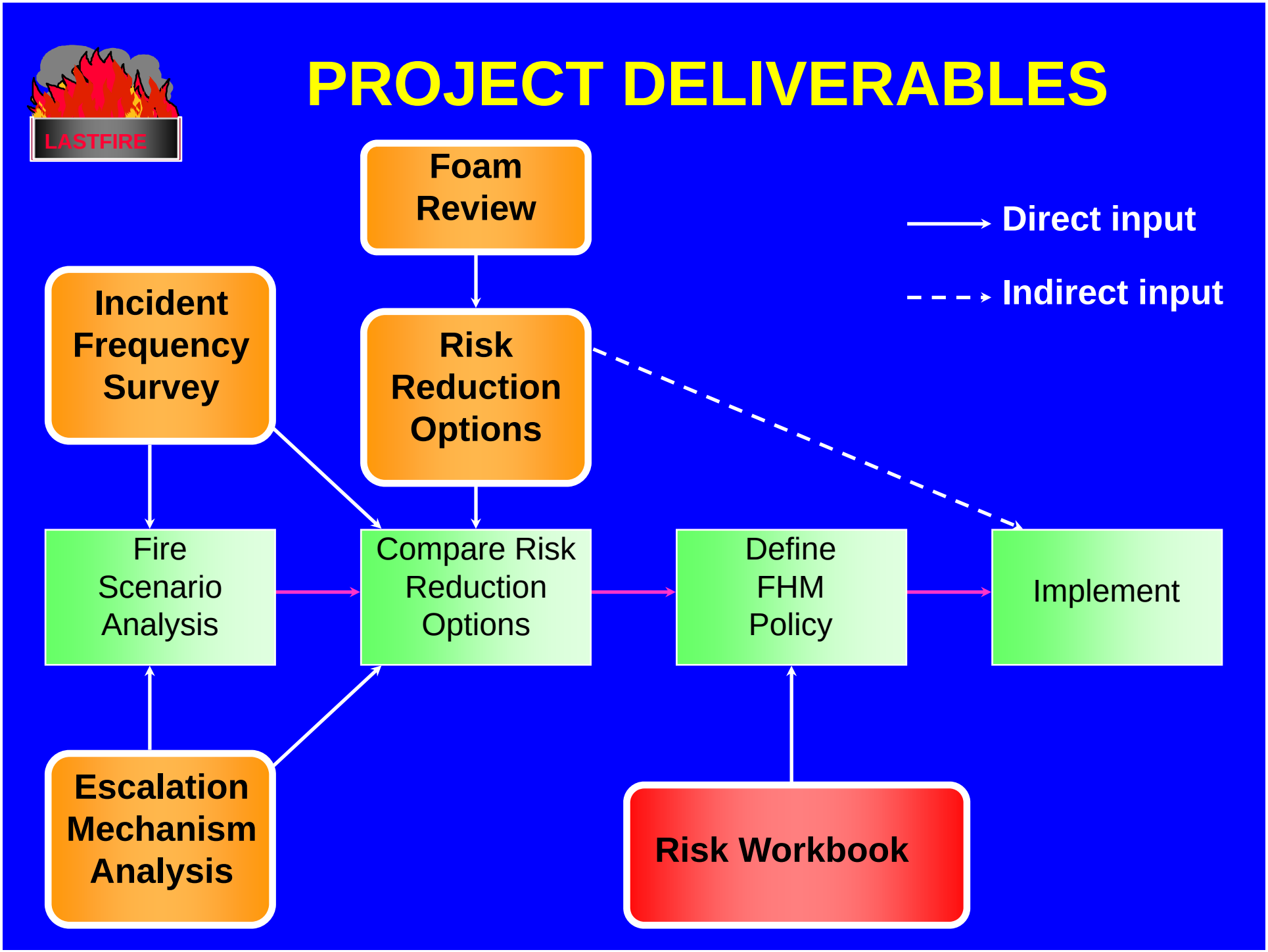
- Agip Petroli
- BP
- Conoco
- DEA
- Elf
- Exxon
- MOL
- Mobil
- OMV
- PetroFina
- Repsol
- Saudi Aramco
- Shell
- Total
- Veba
- WRG

OBJECTIVES

- Determine current levels of risk
- Establish Design & Operational Practice & make knowledge available throughout industry
- Establish techniques to determine site- specific levels of risk and identify appropriate & cost-effective risk reduction measures

PROJECT STRUCTURE




PROJECT DELIVERABLES
LASTFIRE
Foam Review
Direct input
Indirect input
Incident Frequency Survey
Risk Reduction Options
Fire Scenario Analysis
Compare Risk Reduction Options
Define FHM Policy
Implement
Escalation Mechanism Analysis
Risk Workbook

Time for an update?

Scope of Work

- Review of Incidents
  - Extend database to fixed roof and internal floaters
- Assess current practices and latest developments in risk reduction measures
  - Detection systems
  - Foam systems
  - Major incident response systems
  - Tank / seal constructions
- Research Work
- Become industry focal point / forum

Objectives of update study

To extend the study to include all atmospheric tank types

To continue LASTFIRE's role as the established recognised international oil companies forum on best practices of

Fire Hazard Management

of Storage Tanks

Comparison with 1997 data

	Rim Seal Fire	Vent Fire	Pipe, Flange, Valve Fire	Bund Fire	Spill on Roof Fire
Current	3.77×10^{-4}	1.31×10^{-5}	1.3×10^{-5}	1.62×10^{-5}	6.48×10^{-6}
Original	$1.5 - 1.6 \times 10^{-3}$	-	9.0×10^{-5}	$6.0 - 9.0 \times 10^{-5}$	3.0×10^{-5}
	Full Surface Fire	**Boilover**	**Other**	**Vapour Space Explosion**	**Pontoon Explosion**
Current	4.21×10^{-5}	Note [1]	4.86×10^{-5}	3.06×10^{-5}	3.77×10^{-5}
Original	3.0×10^{-5}	Escalation probability 1.0	-	-	-

	Indicates a reduction in incident frequency since the Incident Survey published in 1997
	Indicates increase in incident frequency since the Incident Survey published in 1997
	Indicates new data since the Incident Survey published in 1997

Risk Reductions Options

Industry Guidance
Based on Operational Experience

LASTFIRE
Risk Reduction Options

Figure 2.2.1 - Geodesic domes can be built on the ground and lifted into place or built directly on the existing floating roof tank and winched into place. A variety of methods are available for erection, including "jack stand" erection (top), "grip hoist assembly (bottom left) and "tower assembly (bottom right).

(a) Video Smoke Detection

This type of system uses standard CCTV equipment linked to a self contained processing system capable of recognising small amounts of smoke within the video image, and alerting the system operator both at the processor and by a variety of remote outputs.

These systems detect smoke rapidly by looking for small areas of change within the image at the digitisation stage and only passing these pixel changes to the main processor for further filtering.

The video information is passed through a series of filters, which seek particular characteristics that can be associated with smoke behaviour.

The system installer has the ability to vary the amount of smoke signal, and the length of time that the smoke exists before an alarm condition is raised to cater for situations where there may be background smoke present. The installer can also divide the video image into zones and programme the system to alarm only if smoke is present in two or more zones.

Fig 5.4.10 – Principal MIRU package components, including (from top left) – mobile or containerised pump(s) and Large Diameter Hose, bulk foam concentrate, hose delivery/retrieval vehicle, mobile large throughput foam monitor, proportioner, additional foam monitor(s), and ancillary items such as adaptors and fittings, vehicle access ramps and additional ground water monitors. Site-specific packages must be engineered!

Above - Fig 2.3.2.1(c). Spill channels should lead away from tanks and preferably be fitted with flame traps to prevent fire spread

Right - Fig 2.3.2.1(d). Bund drain valves apart from those to remote containment basin should be normally kept closed

Above - Fig 2.3.2.1(e). Pictures (a) and (b) showing bund sealing (note impermeable membrane). Pictures (c) and (d) show good practice sealing of bund transits and poor practice with no seals. NB: Sealant materials should be sufficient to withstand fire conditions.

Typical Research and Development Work

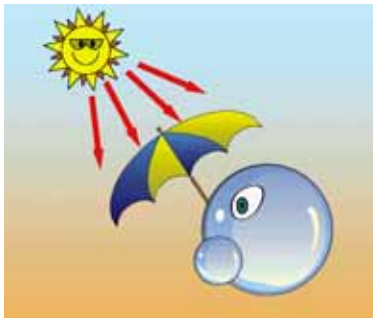
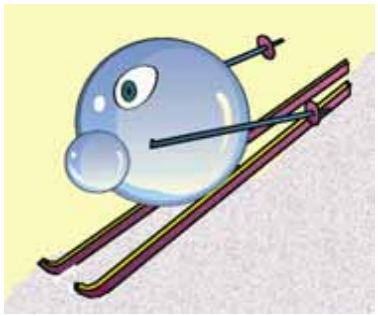
Foam

The most important tool for controlling large flammable liquid fires!

Yet often no detailed

PERFORMANCE SPECIFICATION

prepared when purchases made!


Fire Performance Testing should be one element of specification!

Foam Test For Storage Tank Fires

Used by oil companies to evaluate foam performance and as part of procurement specification

Tank Firefighting Workshop


110
117

Research Work

- Boilovers
- New techniques
- Radiant Heat Impact
- Internal Floating Roof Tanks
- Vapour suppression with foam
- Ethanol Issues
- Biodiesel

Boilovers

100 litre demonstration

The real thing

Boilover

The fundamental questions

- Will it boilover
- If so, when?
- What conditions are needed?
- Is water amount important?
- ..And fuel amount?
- What fire spread on BO?
- Are there rules of thumb?
- Are rules of thumb appropriate?
- Can we avoid them?

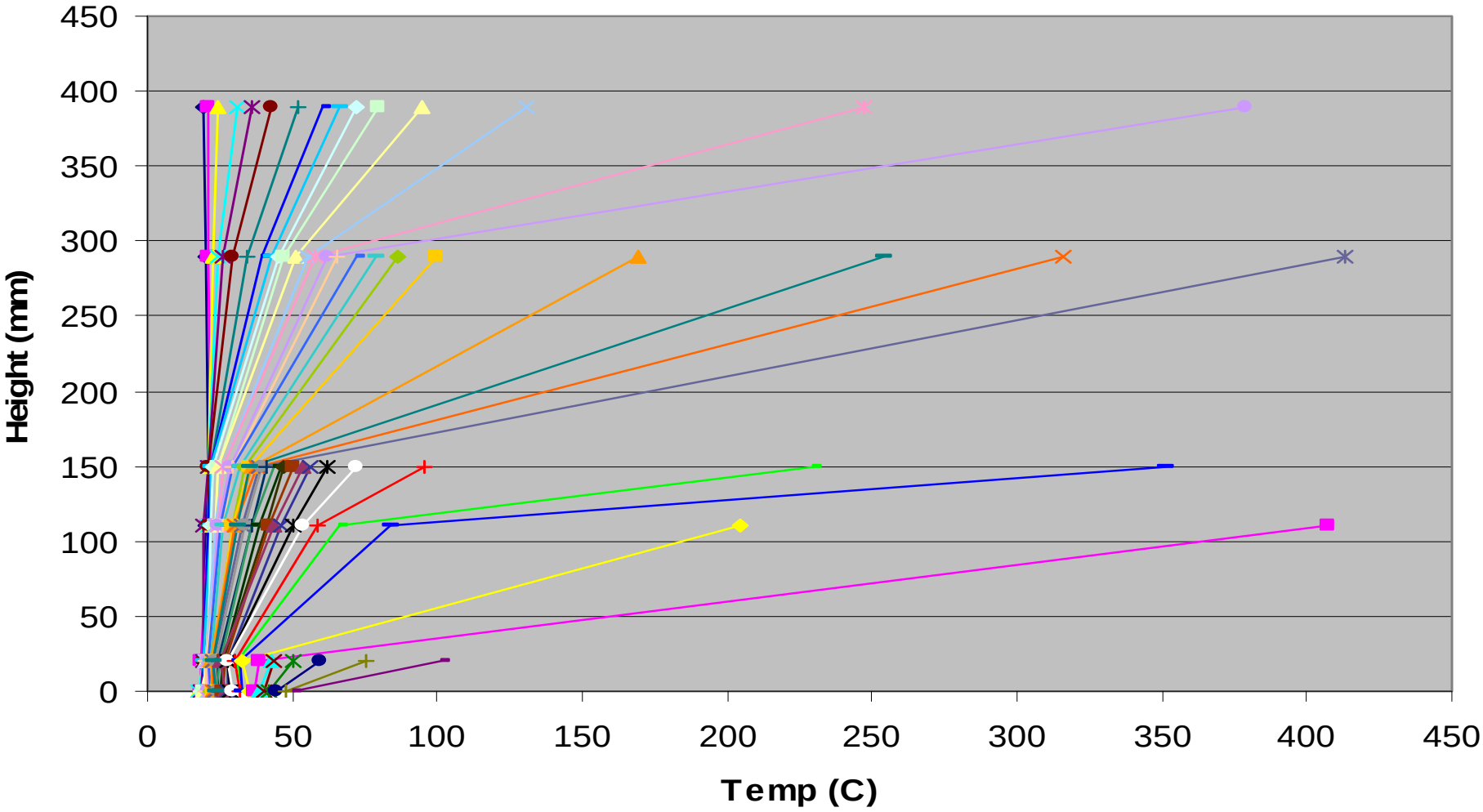
Phase 4 - Hungary

- Further testing of biodiesels
- Refined products test fires

Loughborough University

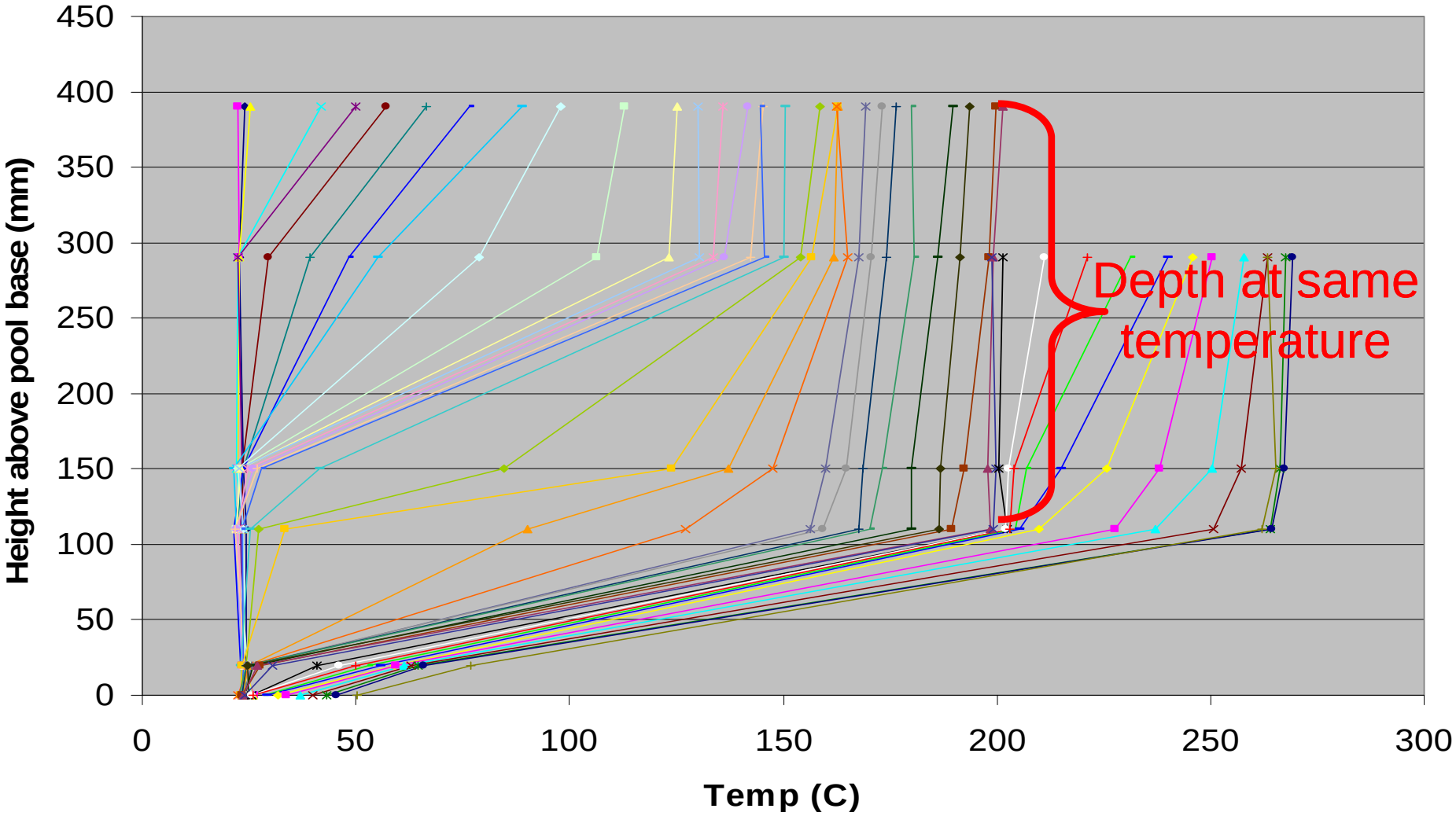
Analysis

Diesel Fire



Each colour line is a specific time
Pattern typical of conduction

Crude Oil

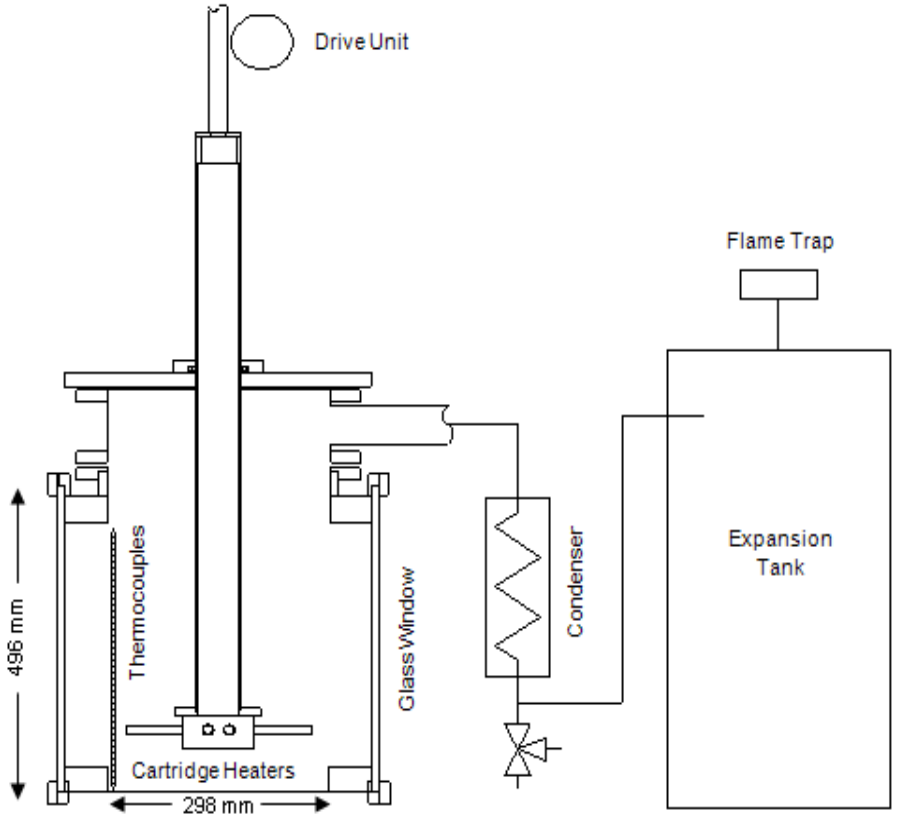


Pattern typical of hot zone build up


5m (~16.5ft) dia. tank

Experimental Arrangement

- **Boilover Rig**

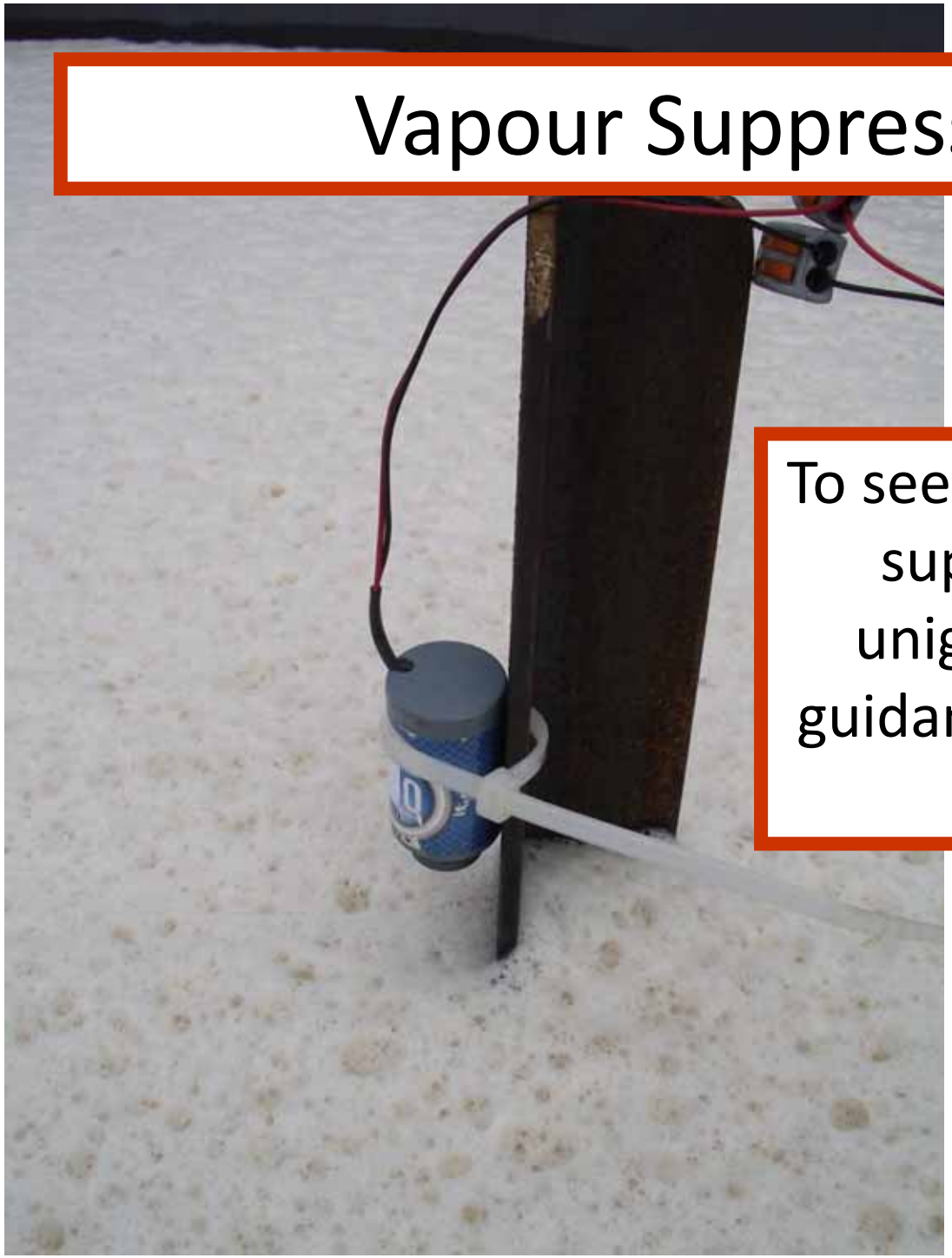


Loughborough University

Other Techniques?

Intumescent Spheres Testing

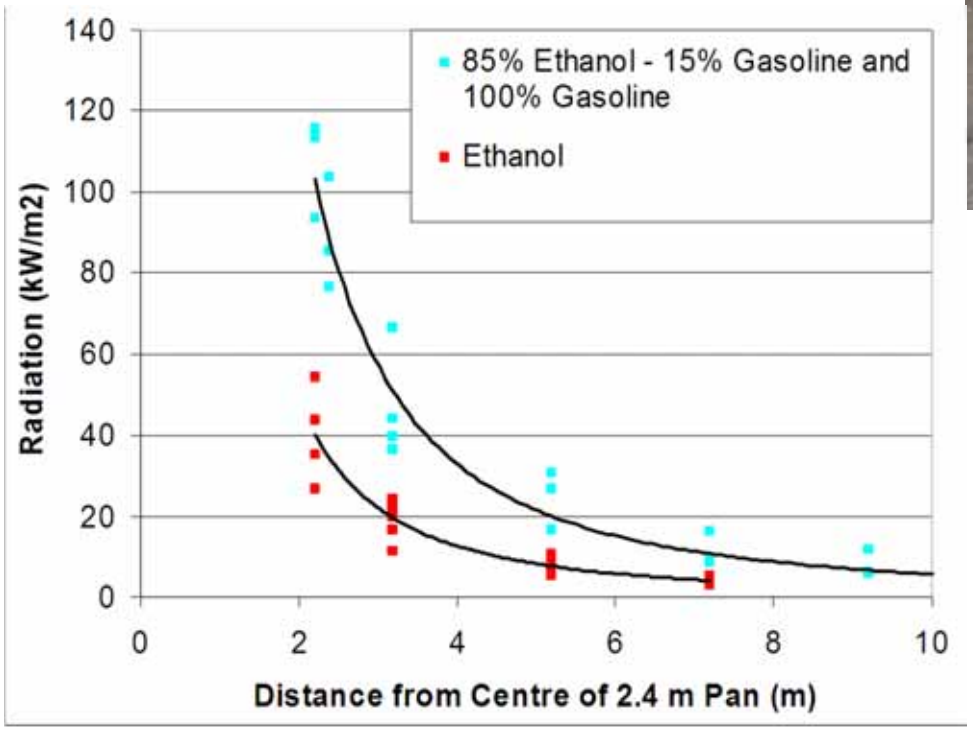
Vapour Suppression Work



To see how effective foam is at suppressing vapours on unignited fuel and to give guidance on foam blanket top up requirements

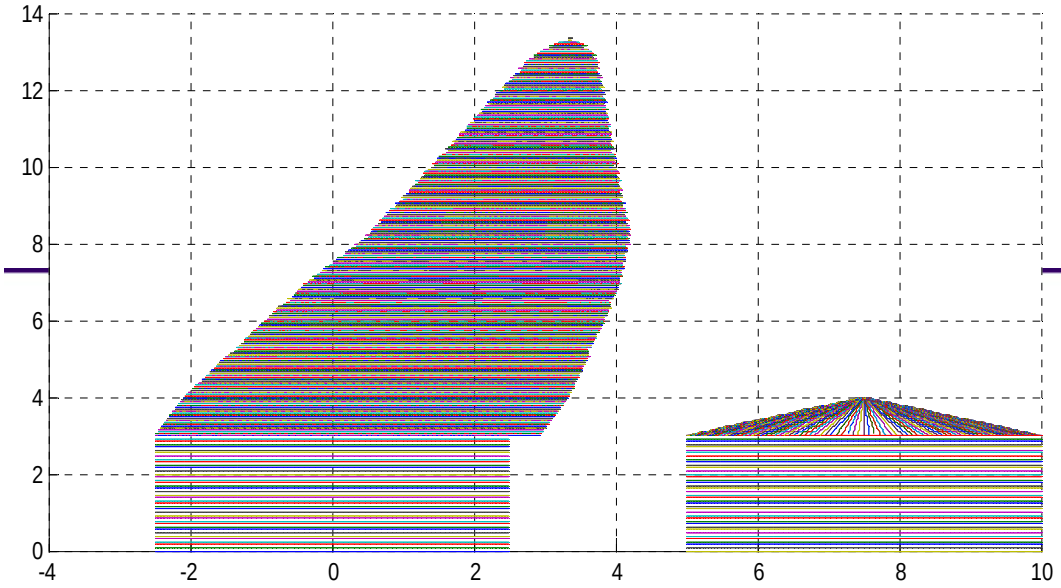
Lastfire Test for Polar Solvents

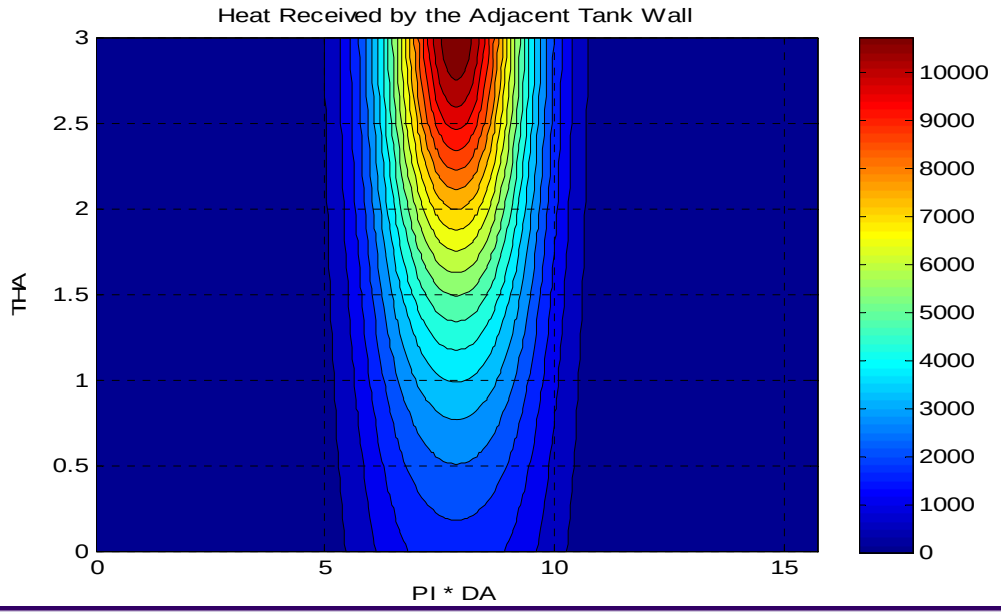
Fire test methodology to enable assessment of commercially available foams on polar solvents

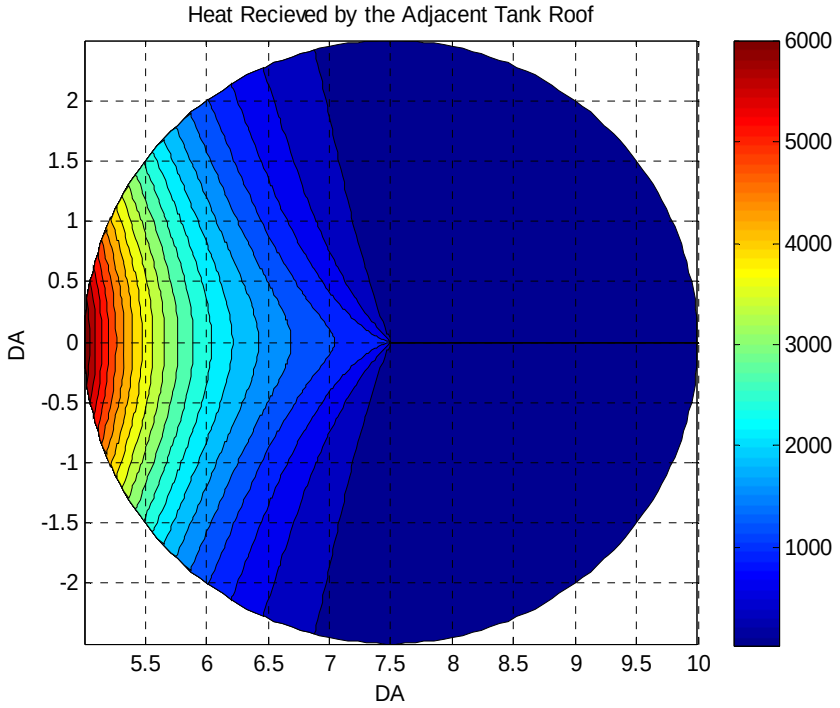


LASTFIRE first experiment (Radiant heat received by the radiometer)

Tank Dimensions: D = 5 m , H = 3 m







Loughborough University

Last week
Diesel/Biodiesel boilover tests


Always check
manufacturers’ claims!

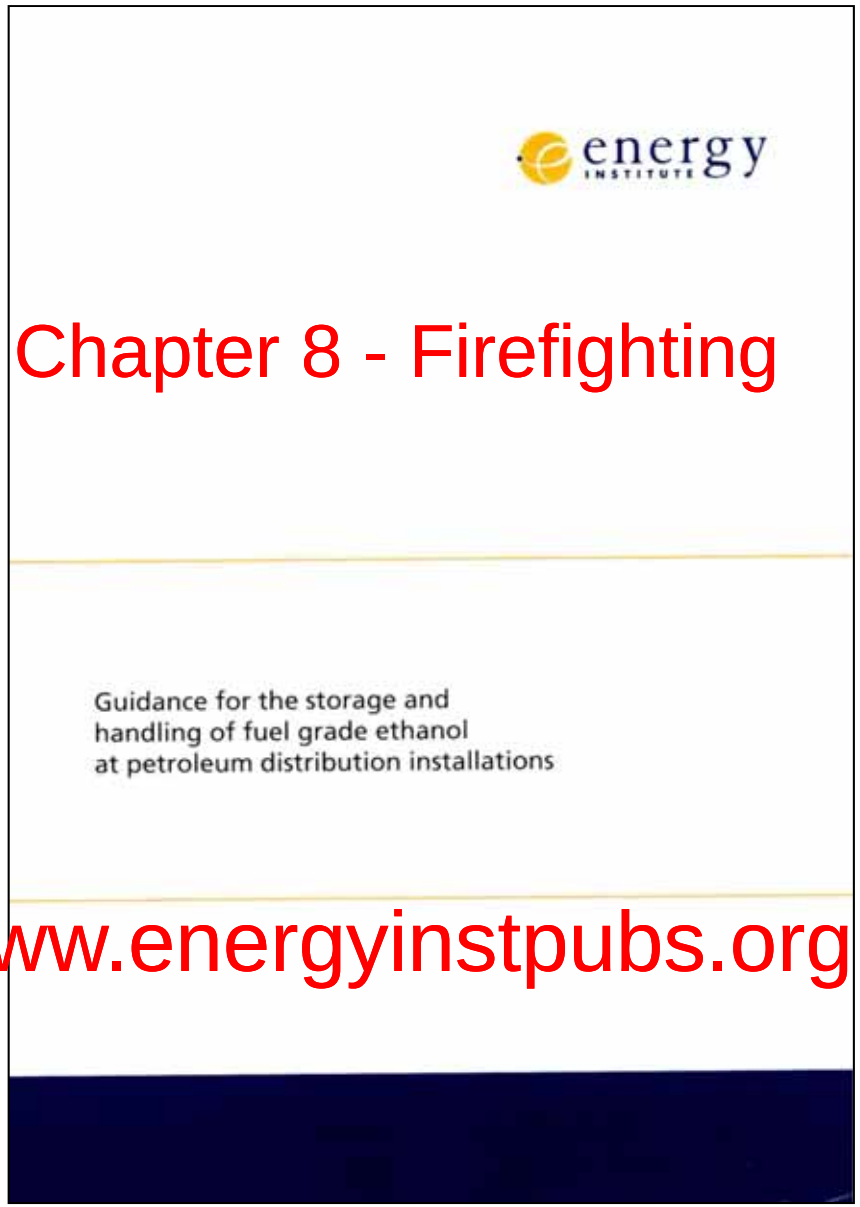
LASTFIRE Member Involvement, Existing and Future Benefits

Member Involvement/Benefits

- Direct involvement in development of latest practices, codes and standards:
  - LASTFIRE Risk Reduction Options
  - Energy Institute IP19
  - EI / API Lightning Study
  - EI Ethanol Document

Technical input & review

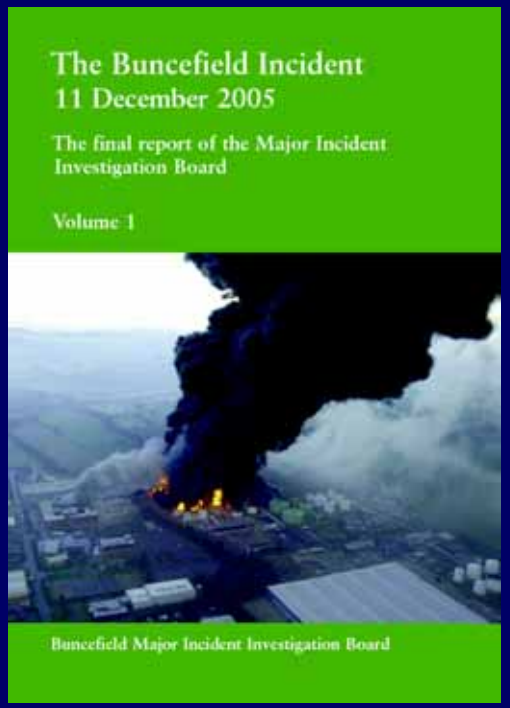
Energy Institute Guidance on Ethanol

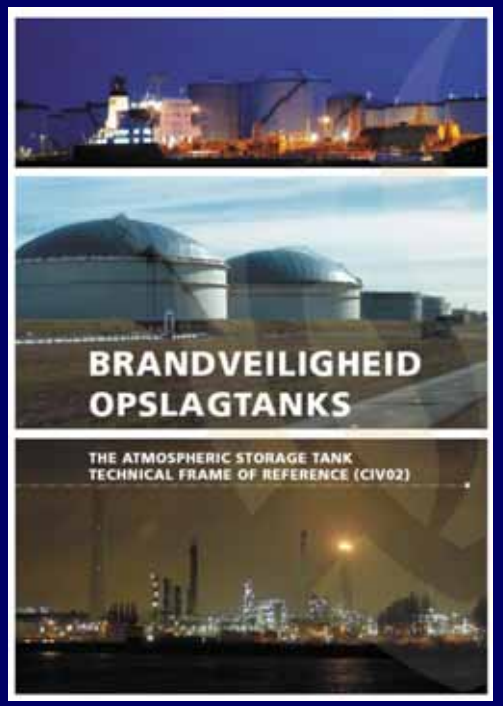


Chapter 8 - Firefighting

http://www.energyinstpubs.org.uk

Industry Influence





Member Involvement/Benefits

- Contribution to LASTFIRE Incident database (anonymously)
  - Most comprehensive statistical database for tank fires and tank related incidents
  - Used for input into safety cases and hazard assessments

Database continually updated

Member Involvement/Benefits

- Practical guidance on implementation of FEHM Measures
  - Risk Reduction Options Document
  - What are the cost effective FEHM measures
  - What are typical & best practices

Incident prevention, detection, protection and response guidance

Research – Boilovers

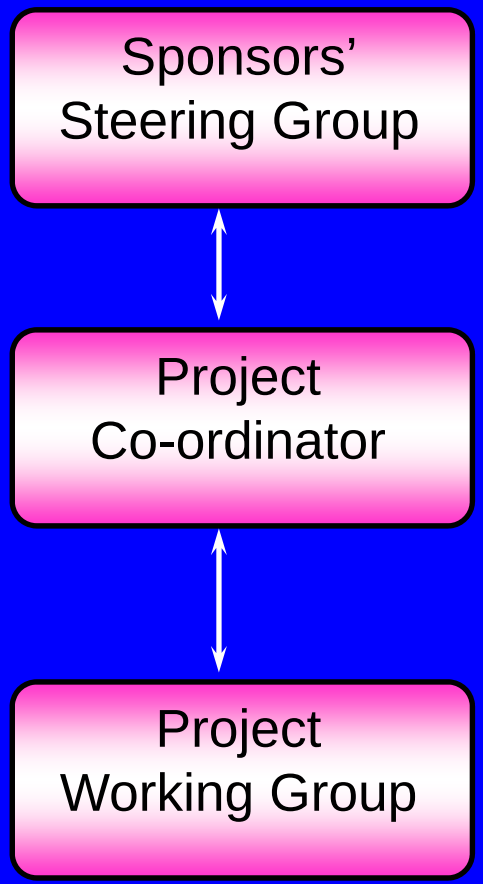
- Access to boilover study data and analyses – largest database on BO
- Access to information on boilover probability/consequences
- Development of safe, cost-effective practical guidance on boilover prevention, mitigation and fire fighting strategies

Time for an update?

Member commitments

- Two Steering Group members
- Questionnaire completion
- Suggest issues for review
- Advise coordinator on relevant issues / experiences
- Host meetings
- Encourage membership

PROJECT STRUCTURE



It could work for ETANK Project

Joint funding
Networking
Practical input

More Information about LASTFIRE Membership from:

Resource Protection International

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HP20 2HU, UK

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