

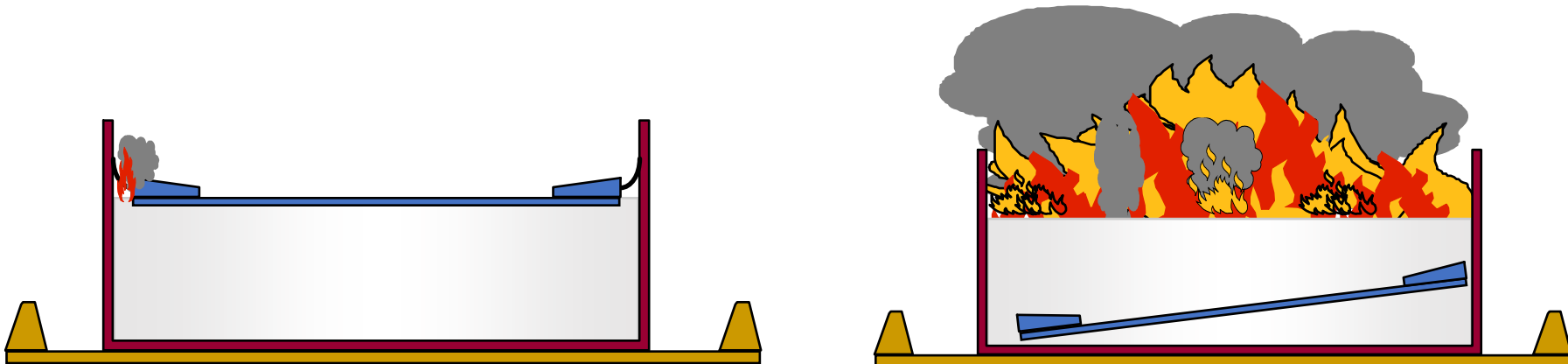
The transition to PFAS free firefighting foam Research, Design Standard changes and the challenges ahead – an update



The Organisation

A Joint Industry Project

A consortium of international oil companies developing best industry practice in storage tank **Fire Hazard Management** through operational feedback, networking, incident analysis and research



Sustainable Fire Fighting Foam and its Cradle to Grave Assurance



AFFF Transition

Update of current situation

Dr. Niall Ramsden





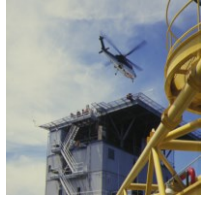
Niall Ramsden

30 + years experience as independent
Previously worked with foam companies
Member NFPA 11 committee (30+ years)
NFPA Foam Roadmap presenter and panel member
Member EN 13565 Part 2 (Systems) committee
UL 162 Steering Panel Member
LASTFIRE Project Coordinator
Oil, aviation, power generation experience

Heathrow



Schiphol



Aviation related experience of personnel Work at airports/heliports/helidecks



Heathrow

Schiphol

Changi

Reykjavik/Keflavik

DFW

Gamba, Rabi, Gabon

Oman

Brunei

BP UK North Sea

BP Angola

Bogota, Medellin

USAF

ARFF Foam Testing and Hangar Systems

Fuel terminal fire response

Foam usage review – airport and terminal, training (SAA)

Part of Arctic Council transition manual project

Large scale foam testing, Joint Foam Summits

Shell (but commercial airports) - Managing Fire Brigade

Oman Shell - Review of fire response at airstrips

Shell - Specification of ARFF trucks, Factory Testing etc.

System assurance procedures and testing of helideck systems

System assurance procedures and testing of helideck systems

Part of Colombia Environment Department Transition Study

Hangar protection systems

Also working with those who carried out DoD test work as part of NFPA

Research Foundation Project



Some projects specifically related to current work

LASTFIRE

- Test work

- Knowledge sharing

Arctic Council

NFPA Research Foundation Roadmap

South American airports review

A reminder!
Municipal, Aviation and Industrial firefighting
All critical but different emphasis

All use foam

Different applications

Different emphasis

Different critical performance

Spill Fires



**Many industrial and transportation sectors
Mostly business and asset protection**



Tank Fires

**Time not so essential
Foam stability critical!**

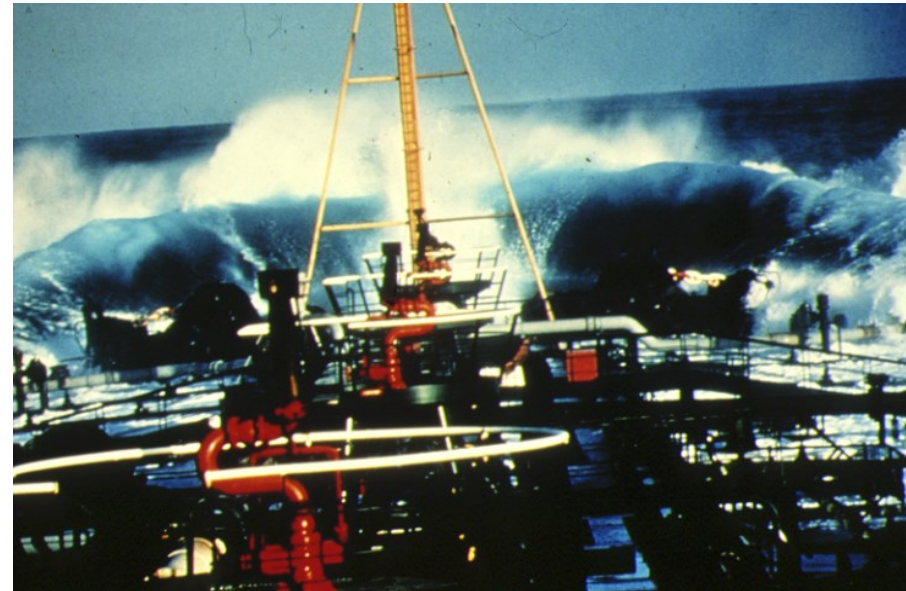


Other Specific applications

Jetties



Tankers



Spill Fires

Aircraft crash fires

Life Safety issue

Fast attack essential





**Aircraft
Hangars**

Helidecks



An example - Airport foam usage

Not just ARFF – though obviously the priority

Hangars

Fuel farms

Warehousing

Extinguishers!

Legally might not have the responsibility

But they still affect business and operations

Need to look holistically

A story – Heathrow Fuel Farm

Fuel Tank Fire Causes Cancellations At Miami's Airport

March 24, 2011 1:05 AM



93



57



12

[View Comments](#)



MIAMI (CBS4) – A number of travelers have found themselves stuck at Miami International Airport after an overnight fire in the fuel farm forced several airlines to cancel flights on Thursday.


The fire broke out around 11 p.m. Wednesday in one of the tanks in the fuel storage area located east of the runways. The fuel farm has six fuel tanks, each holding up to a million gallons of fuel.

'Normal' still days away at Miami airport after fuel-tank fire

Flight disruptions continued at Miami International Airport, stranding thousands at the start of a busy tourism weekend. Repairs from a fuel-tank fire could take months.

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Related

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By Hannah Sampson

The Miami Herald

The massive fire at Miami International Airport's fuel farm that has forced the cancellation of hundreds of flights rendered the airport's hydrant fuel pump system a total loss that will take months to replace.

"There was discussion about them possibly being repaired," said airport spokesman Greg Chin. "That's out of the question now."

What makes a good fire test?

Relevant to application and critical specific aspects

Rapid rescue?

Industrial/Tank application?

Simulates “real life” scenario conditions

Fuel/Foam Properties/Equipment/Application type/Preburn

Validated through larger scale testing

Validated against incident experience

Includes safety margin over design

Application Rate < Design

Reproducible

Well defined

Procedure/Equipment/Conditions

Possible at different locations

Not Operator dependent

Differentiates/Grades

Reasonable cost!

Adaptable if required

Fuel types, application devices, innovations



LASTFIRE – Current Members 2024



Full members



Research Work – Rational Progression - more than 600 tests



Small scale
Simulated tank fire
Critical application rates



Crude oil

Phases have included
Different foams
Different nozzles
Different application methods
Different rates
Different fuels (including crude)
Different preburns
Fresh/Salt water



Subsurface tests

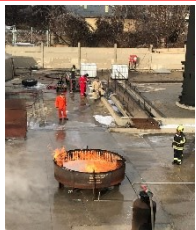


Spill fire
Critical application rates

Larger scale
“Real life” Application
NFPA rates



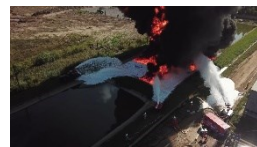
Longer flow
“Real life” Application
NFPA rates



Self
expanding
foam



Vapour
suppression



Hybrid
Medium
Expansion



Further
obstructed spill
fire testing



Polar solvent
fires



Mobile Monitor application



Fixed System Pourer application



Monitor application

GESIP France 300m² Pit Tests





Typical pourer test

Crude Testing



- Initial phase – 5m² (50 ft²) tank
- Different application techniques
 - LASTFIRE Nozzles
- Different foams
- 30 minutes+ protection
- Thermocouple

They can work!
Some interesting learning points re crude oil fires in general!



LASTFIRE

Large Atmospheric Storage Tank Fires

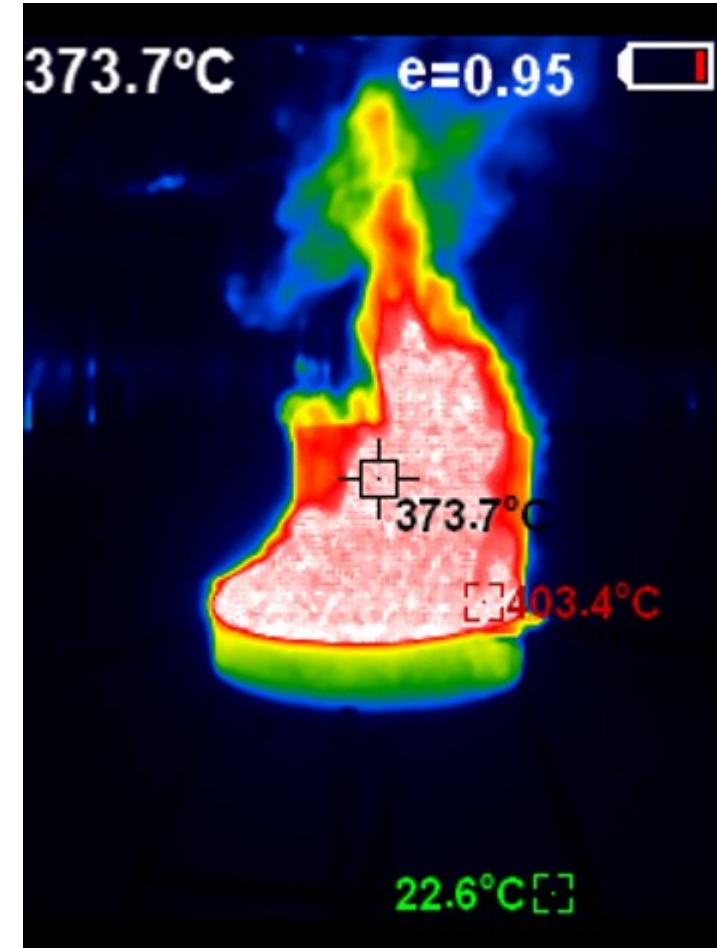


Work with water soluble fuels Ethanol, methanol etc.



Xylene
Methyl methacrylate
Butanol
Acetone
1.2 Dichloroethane
Acetic acid
Ethyl acetate
etc. (>40)

Work with water soluble fuels
This is methanol burning!



“The most comprehensive series of rigorous, end-user managed, larger scale tank foam application tests for more than 35 years*”



Key points

FFF worked!

Bubble structure important

Always has been but more important with FFF

Balance between throw/fuel pick up/application etc

For full reports
Contact
info@lastfire.org

Overall results?

Gave confidence in PFAS free foam application

Developed best practice tactics for deep spill fires

Relevant to ARFF?

Yes – but ???

Certainly for other scenarios

Of course it is not just about the foam concentrate



It's not just about firefighting performance

Suitability for system

Proportioning system

Application equipment – will it provide the foam characteristics you want?

Materials compatibility

Clean out of equipment/Systems

How clean is clean?

Use special cleaning agent?

Environmental Impact

Environmental Data

Greenscreen?

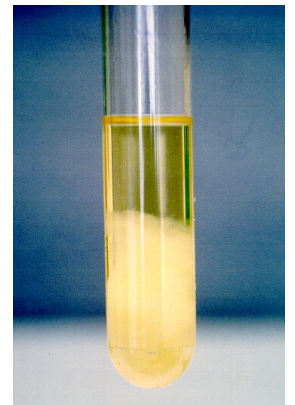
Shelf Life Guarantees

Storage Issues

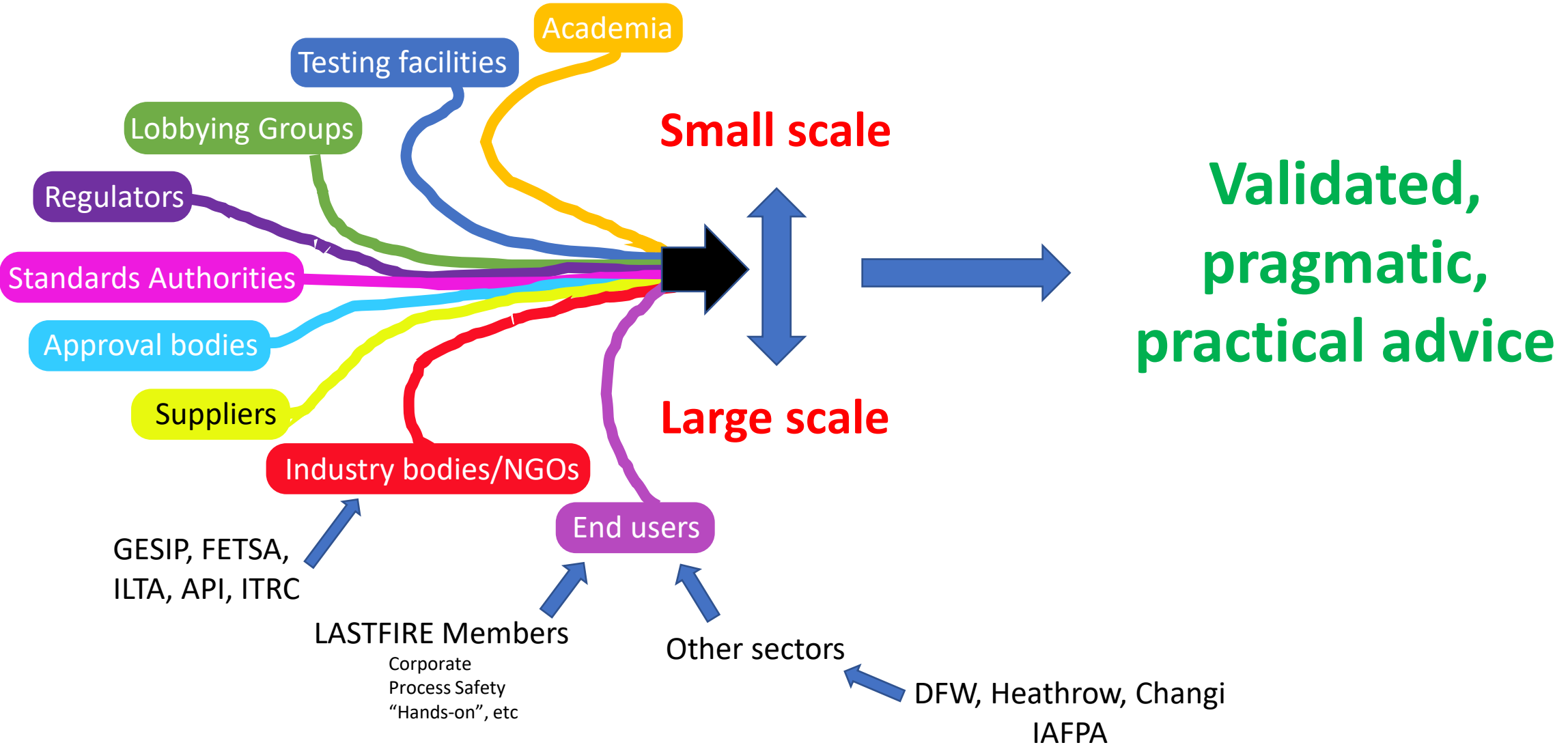
Long term availability

A key issue!

Important to get procurement specification right!



Our overall aim – a focal point!



Arjan Bruinstroop AIFireE

Senior Advisor / Instructor
Fire Department Schiphol Airport
Amsterdam, The Netherlands
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Fluorine Free Foam



Schiphol

Welcome to Amsterdam Airport

LASTFIRE Learning from others



Changing to Fluorine Free Fire Fighting Foam – A Case Study

Graeme Day Heathrow

Heathrow
Making every journey better



Case Study - AMPOL Risk Management Framework for Foam Transition

LASTFIRE Foam Summit GESIP – April 2024

Jannie Cloete – Senior Emergency Response Coordinator

Craig Tabor – Senior Project Manager

LASTFIRE And internally!



Foam Transition to SFFF

@

EXXONMOBIL
ANTWERP REFINERY

Energy lives here™

Bob De Vos
Fire Chief ARFD

April 2024 for Lastfire Foam summit



PETRONAS PFAS Phasing Out Initiatives

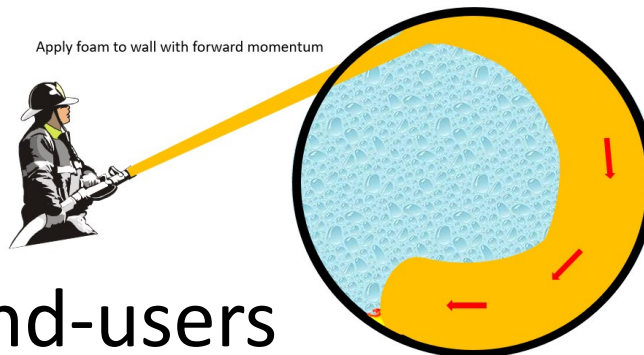
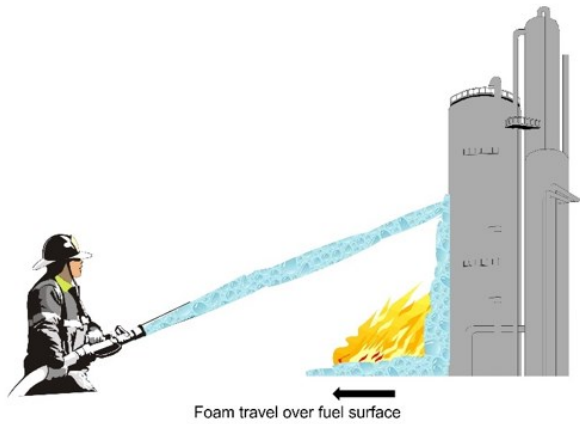
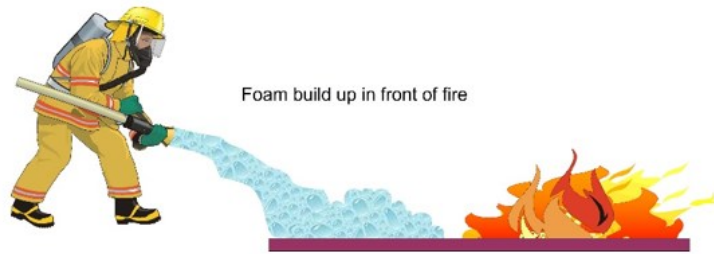
M. Roselan, Fire & HAZMAT Response Management, Group HSE

LASTFIRE Foam Summit 2024
22-25 April 2024

The PETRONAS Group adopts zero tolerance against all forms of bribery and corruption. We abide by the PETRONAS Code of Conduct and Business Ethics (COBBE) & Anti-Bribery and Corruption (ABC) Manual, guided by our Shared Values and Statement of Purpose.

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Training material



Pragmatic advice
Developed by experienced end-users

Water absorption by foam concentrate

Different foams

Fresh/Sea water

Different initial water quantities

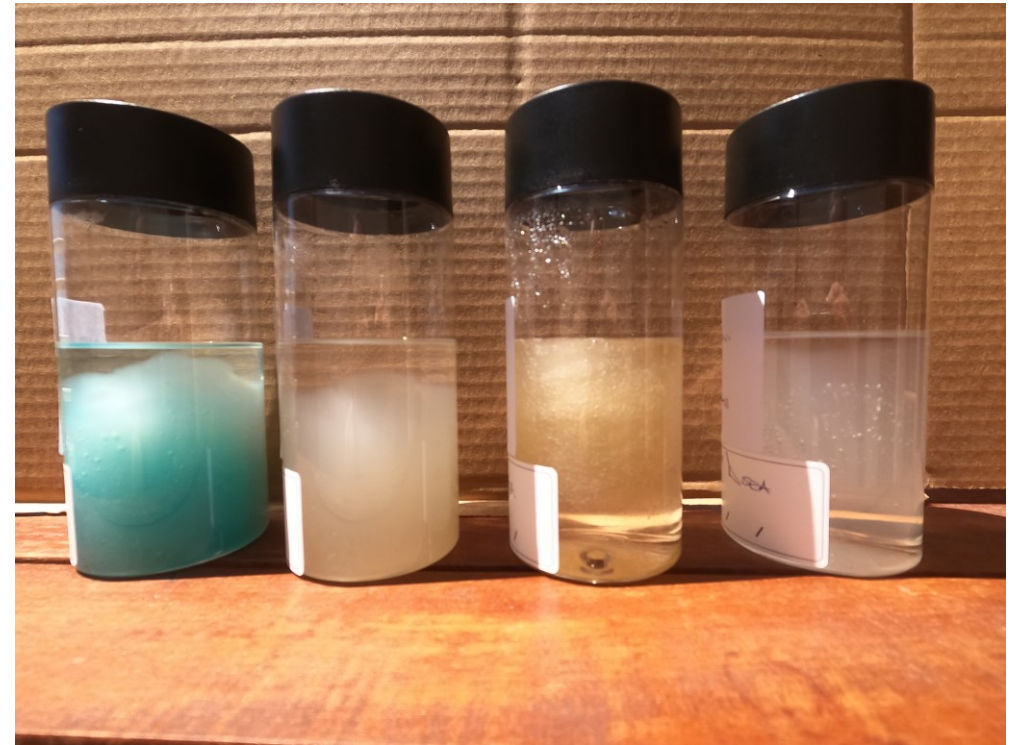
Added more water to samples over time

Water absorption by foam concentrate

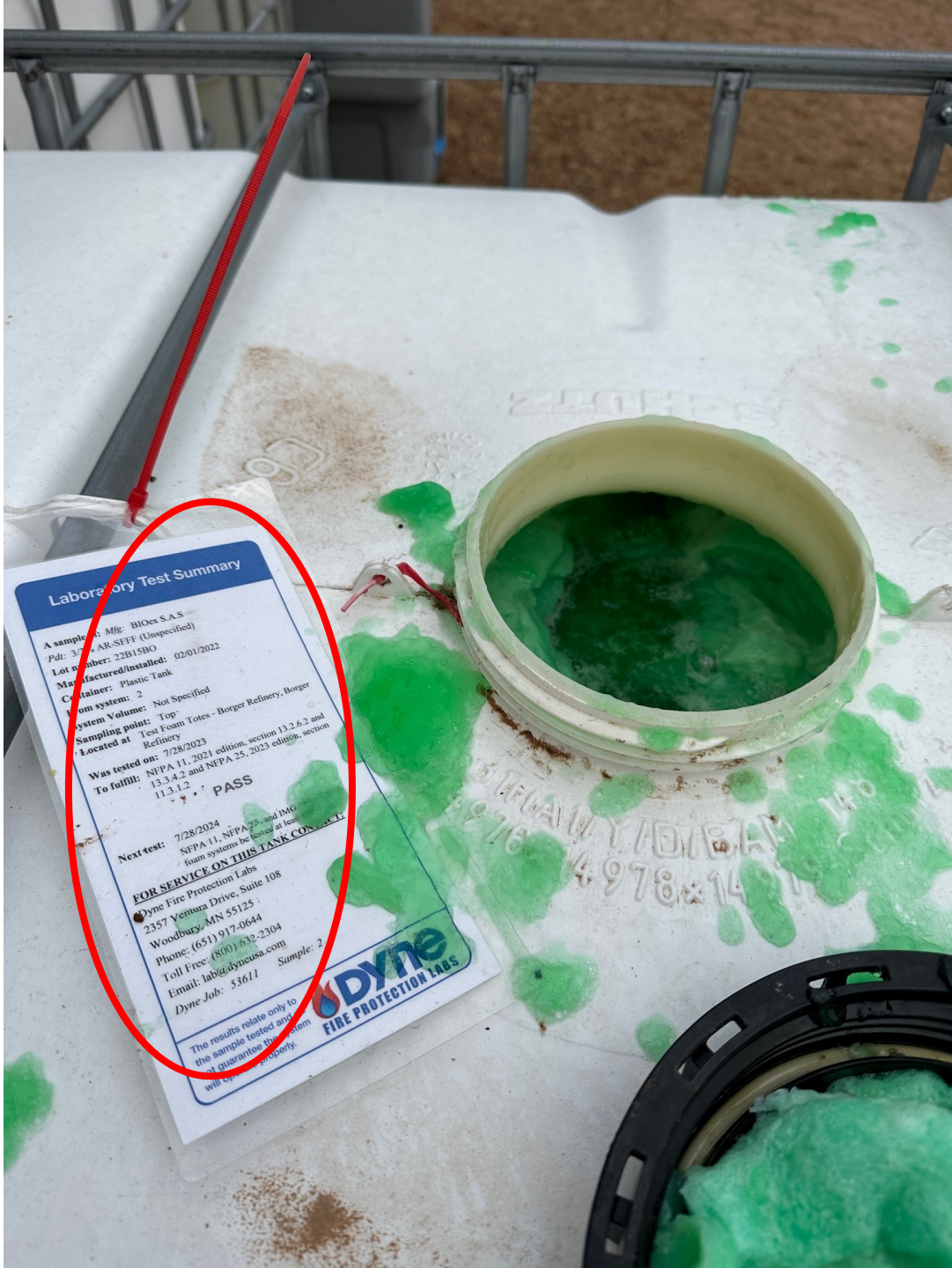
All showed absorption to some degree
So a potential storage problem with all
Speed and level of absorption varied



Fresh



Sea



LASTFIRE – Some relevant deliverables

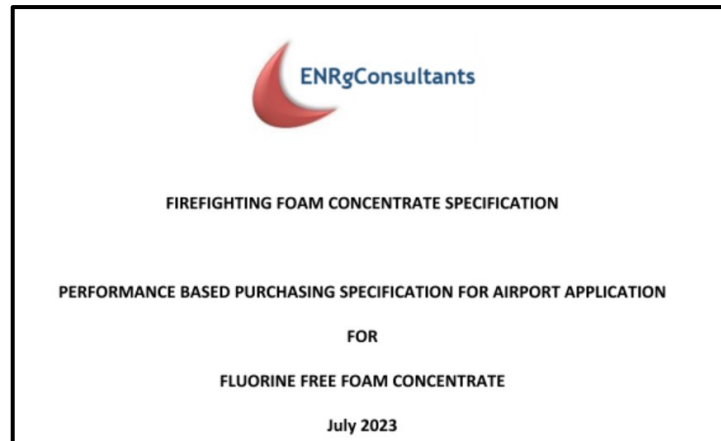
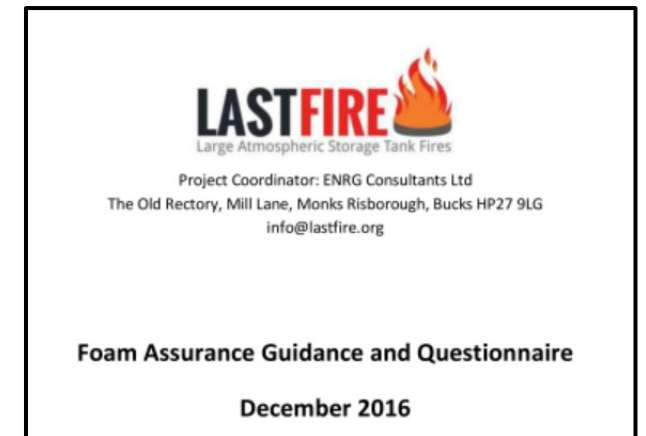
Test reports

Tactics

Foam Assurance Protocol

Typical procurement specification

Adapted to ARFF application





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Traditional Indigenous Khanty camp near Salekhard, Russian Federation. Photo: Rosa-Máren Magga

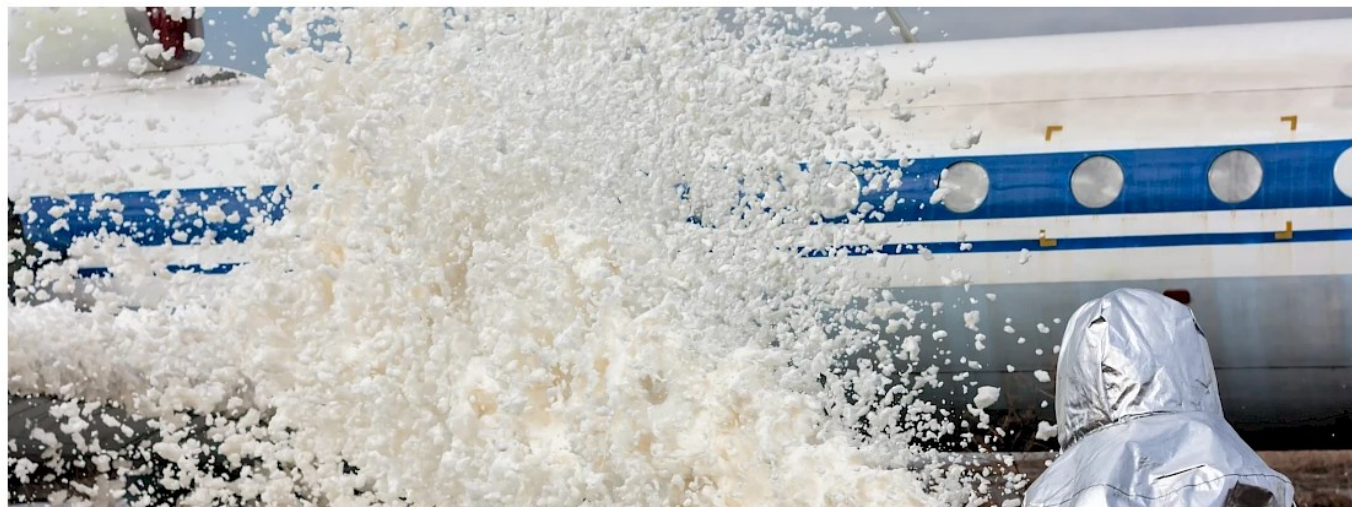
ARCTIC COUNCIL

The leading intergovernmental forum promoting cooperation in the Arctic.

ABOUT THE ARCTIC COUNCIL

The Arctic Council is the leading intergovernmental forum promoting cooperation, coordination and interaction among the Arctic States, Arctic Indigenous peoples and other Arctic inhabitants on common Arctic issues, in particular on issues of sustainable development and environmental protection in the Arctic. It was formally established in 1996.

The members of the Arctic Council are the [eight Arctic States](#) and the [six Indigenous Permanent Participant organizations](#). There are [six Working Groups](#) within the Arctic Council, each of which focuses on a particular set of issues for the Arctic Council. In addition, the Arctic Council has more than [35 Observer states and organizations](#).



©

Projects

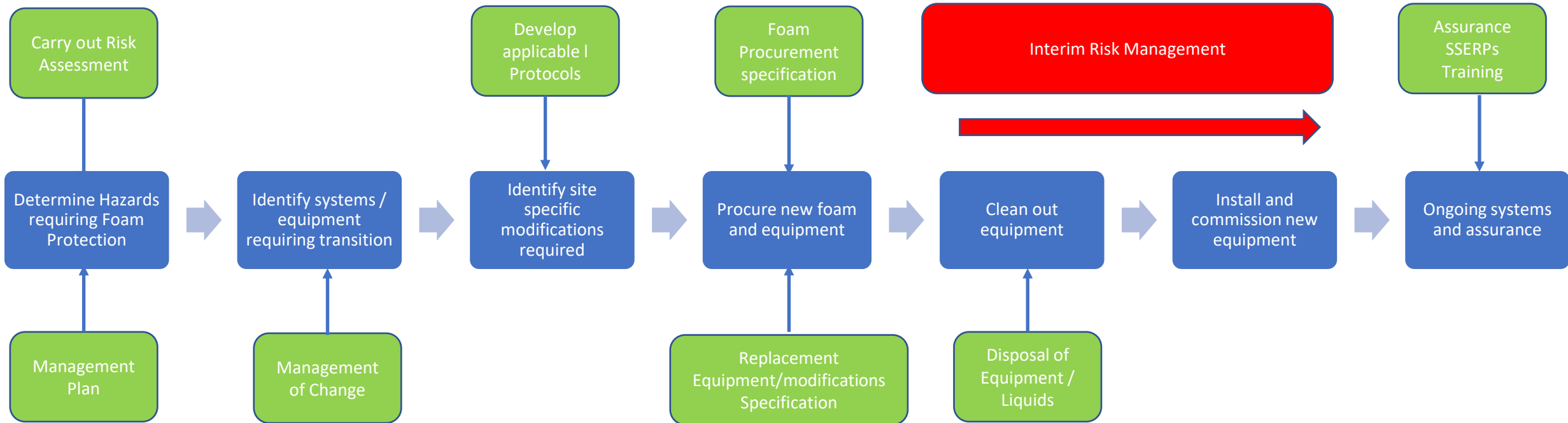
AFFF (AQUEOUS FILM FORMING FOAM) AND OTHER PFAS-CONTAINING FOAM PHASE OUT IN THE ARCTIC

AFFF Phase Out in the Arctic

Project Key Objectives:

- To develop cost effective and appropriate recommendations for the removal of PFAS-based fire fighting foams for all applications within the Arctic region, without jeopardising risk reduction.
- To arrest legacy issues at current levels before they become an unmanageable problem.

Transition Process



Transition Manual Contents

- General overview
 - Overview of the project / Stakeholders / typical facilities
 - How to use the Transition Manual
- Background to the current situation and why the need to transition
- General protocols – common to all installations
 - Review of fire hazard assessment – do you need foam?
 - Foam procurement specification
 - Management of Change
 - Commissioning
 - Ongoing assurance
 - Scenario specific Emergency Response Plans
 - Training / System assurance
- Interim requirements prior to transition
 - Management plan / containment / Testing/training / preplanning for containment
- General notes and instructions applicable to all protocols
 - Key considerations
 - Worker Health and Safety Concerns associated with foams
 - Assessment of PFAS Content
- Specific Protocols

Key points

Greater awareness

What is the issue?

Foam assurance and usage – the basics

Chemical handling – the basics

Not just ARFF - Hangars, Fuel Tank Farms

Use opportunity to do what we should have been doing before!!



Key points



We found PFOS based foam still being used!
We have found it elsewhere!



Arctic Council– Some relevant deliverables



Transition Manual Training modules

- Module 1 – The PFAS in Foam Issue
- Module 2 – The Project Scope and Methodology
- Module 3 – Project Deliverables
- Module 4 – The Transition Manual Process and Implementation
- Module 5 – Interim measures
- Module 6 - Using Fluorine Free Foam
- Module 7– Ongoing assurance of foam systems



RESEARCH FOUNDATION

Emergency Response

Firefighting Foams: Fire Service Roadmap



Overall objective

- To develop a strategic roadmap for the fire service while transitioning from fluorinated foam usage to fluorine free foam technology.
- To enhance firefighter safety and health by developing recommendation of best practice for firefighting foam operations and handling,
 - For all types of applications of firefighting foam that provide possible exposure pathways to firefighters and others.



Opportunity

- All sectors
- Close ties with other work
 - Particularly SERDP etc
 - Big input to FAA practices
 - Performance test protocol
 - Tactics

ARFF Type Fire Scenarios

Spill Fire Scenario

400 gallons F-24 (Jet A)

2400-2800 ft²

~0.05 gpm/ft² application rate



Debris Pile Fire Scenario

Steel enclosure, fuel cascade, cinder blocks

45 gpm F-24 (Jet A)

Spill fire, 3D running fuel, highly obstructed



Naval Research Laboratory

Washington, DC 20375-5320



NRL/6180/MR—2023/1

Fluorine-Free Foam (F3) Application Techniques and Firefighting Tactics

JOHN P. FARLEY, PA
STANLEY KARWOSKI

*Shipboard and Field Operations Section
Chemistry Division*

GERARD G. BACK
ROBERT DARWIN

*Jensen Hughes
Baltimore, MD*

ERIC S. SIEVERT
JASON L. LINT

*NAWS - China Lake
Ridgecrest, CA*



May 18, 2023

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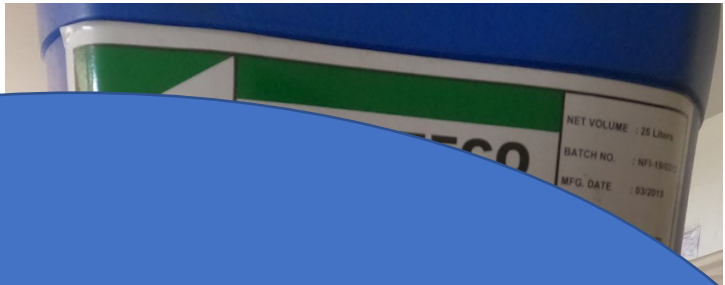


Different applications
Different tactics
Sharing and learning

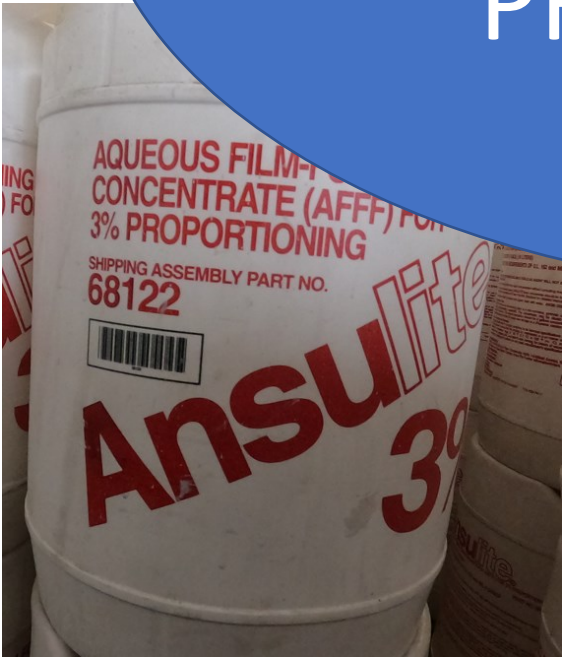
South American Airports Transition issues

UNEP Funded





Many sorts of foam –
including potentially
PFOS containing



Many foams
Detailed performance specification
Application specific

Is it really?

We have seen PFOS in some cases



(PFOS) Perfluorooctane sulfonic acid	1763-23-1	0.02	mg/kg	488
(PFDS) Perfluorodecane sulfonic acid	335-77-3	0.02	mg/kg	<1.88
EP231 TOP B: Perfluoroalkyl Carboxylic Acids				
Perfluorobutanoic acid (PFBA)	375-22-4	0.1	mg/kg	64.7
Perfluoropentanoic acid (PFPeA)	2706-90-3	0.02	mg/kg	170
Perfluorohexanoic acid (PFHxA)	307-24-4	0.02	mg/kg	59.8
Perfluoroheptanoic acid (PFHpA)	375-85-9	0.02	mg/kg	66.0
Perfluorooctanoic acid (PFOA)	335-67-1	0.02	mg/kg	1350
Perfluorononanoic acid (PFNA)	375-95-1	0.02	mg/kg	<1.88
Perfluorodecanoic acid (PFDA)	335-76-2	0.02	mg/kg	<1.88



Many issues
Basic understanding



Fortifying Infrastructure for Responsible Extinguishments (FIRE) - GEF ID 11110

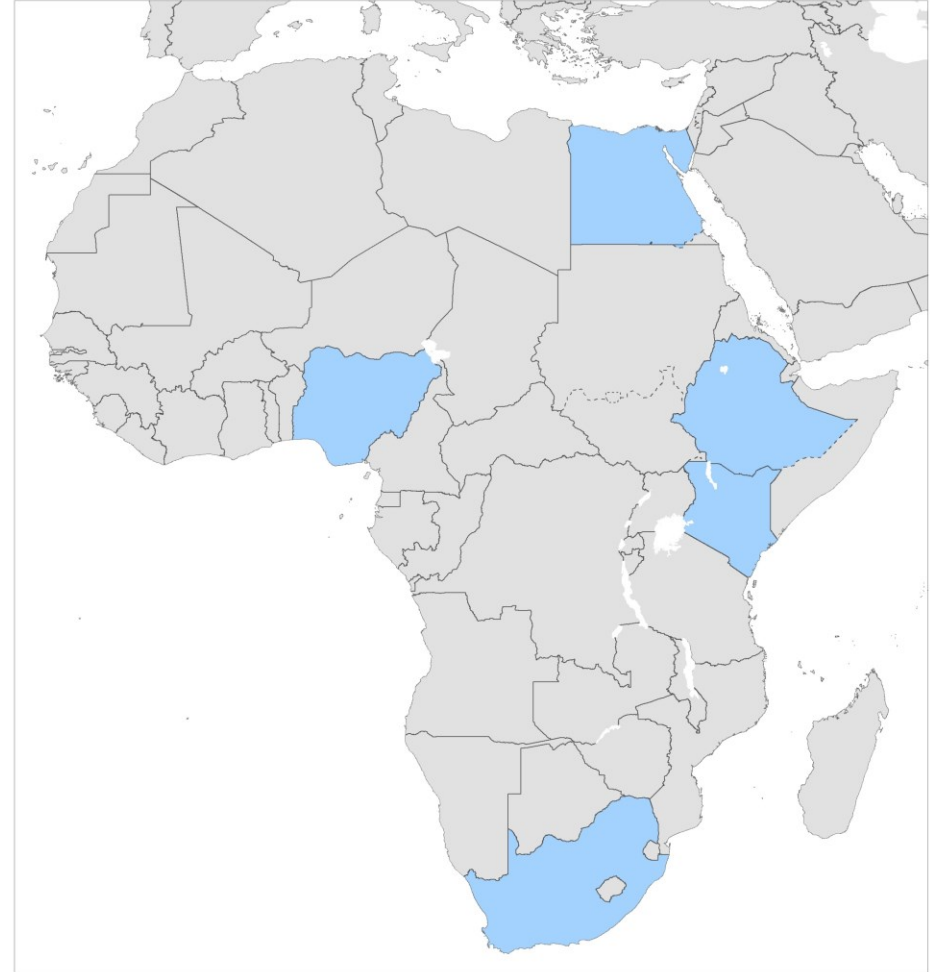
Project Objective: Uncontrolled releases of PFAS from airports are eliminated

Report reviewed

Probably implemented next year

Project details

- **Countries:** Egypt, Ethiopia, Kenya, Nigeria, South Africa
- **Proposed timeline:** 60 months, 2024–2028
- **Implementing Agency:** United Nations Environment Programme (UNEP)
- **Executing Agency:** International Civil Aviation Organization
- **Expected Global Environmental Benefits:** 5.2: Five large marine ecosystems (LMEs) with reduced pollution; 9.1: 50 tonnes of AFFF concentrate destroyed; 9.6: 4,068 tonnes PFAS contaminated material avoided



Fortifying Infrastructure for Responsible Extinguishments (FIRE) - GEF ID 11110

Project Objective: Uncontrolled releases of PFAS from airports are eliminated

Personal conclusions from first phase

Should be holistic approach

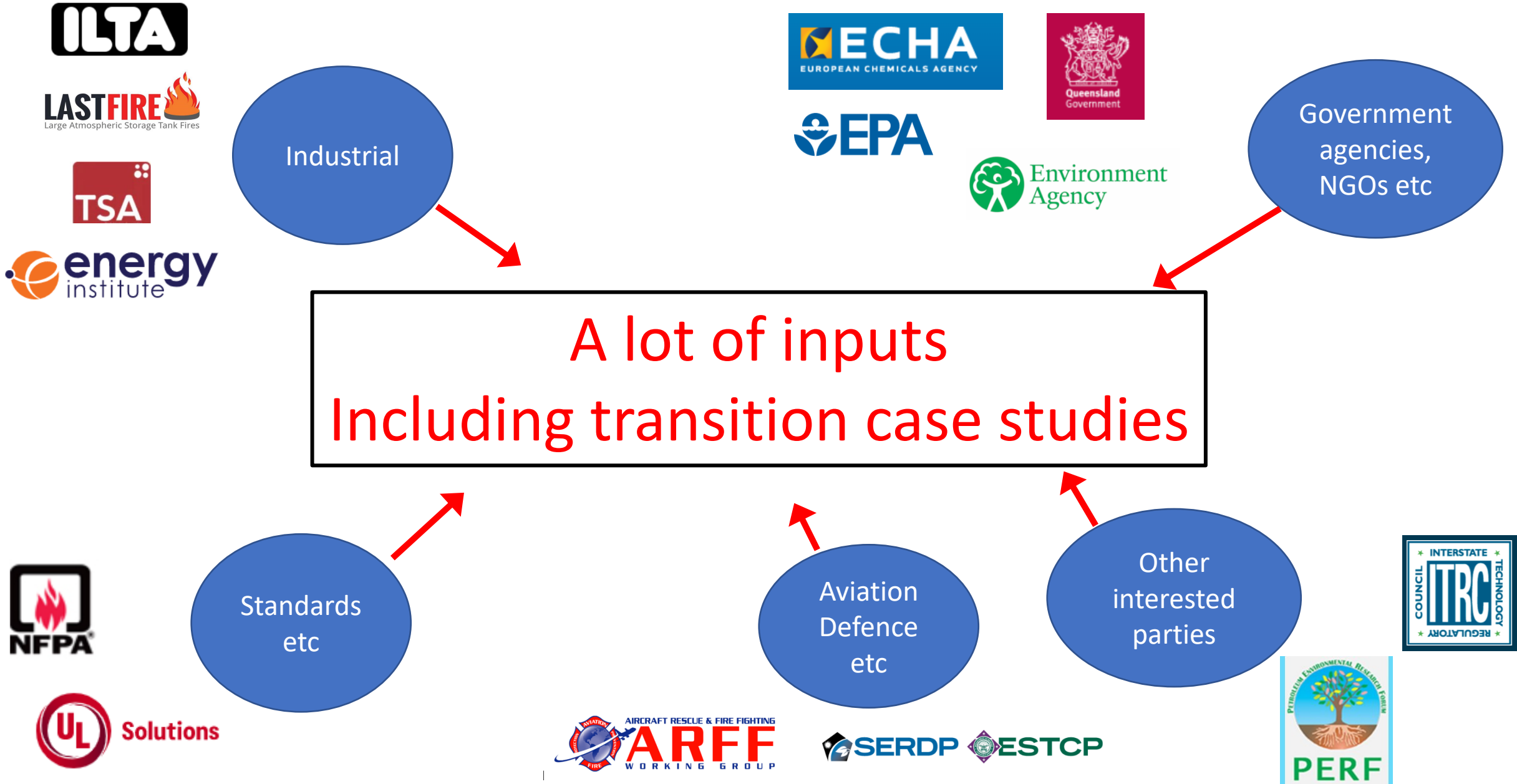
Must be done by those who recognise and understand the risks and firefighter needs

Summary of Findings – Lessons Learned

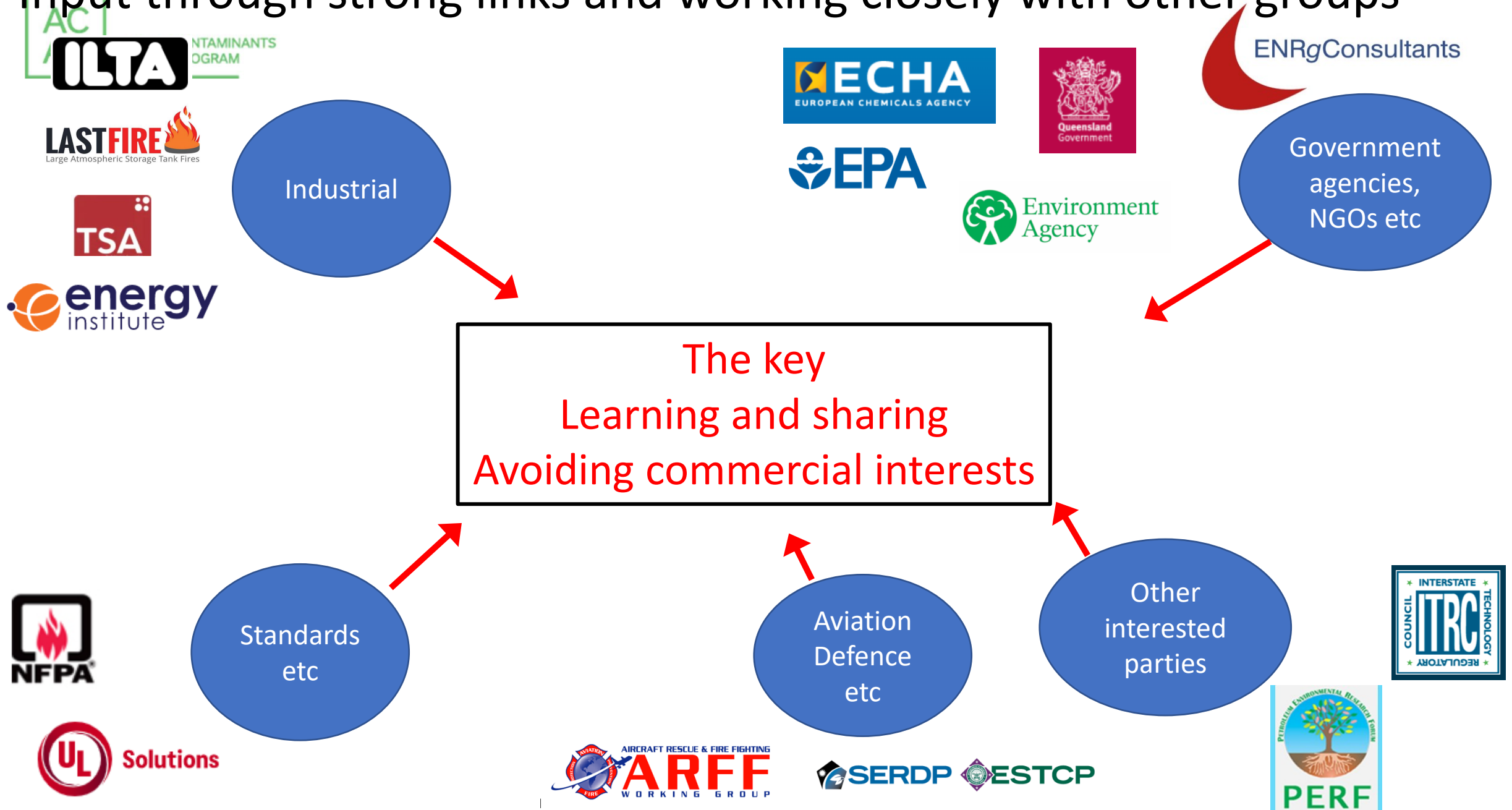
NB From multiple locations!!

- Recognition and awareness of the issue
 - Site wide approach
- Multi-discipline team is required to solve the problem of PFAS removal End users are involved in this process
- Pragmatic approach
 - Development of discharge specifications
 - Timescales
- Basics
 - Detailed performance based procurement specification
 - Chemical handling
 - Foam assurance/knowledge
 - Real fuel training and proper tactics

Input through strong links and working closely with other groups



Input through strong links and working closely with other groups



The PFAS in firefighting foam issue

An opportunity

Do things better!

niall.ramsden@enrgconsultants.co.uk

