

A grayscale photograph of industrial machinery, likely a large-scale manufacturing or processing plant. The image shows various pipes, valves, and mechanical components, with a prominent large, perforated cylindrical object in the lower-left foreground. The background is filled with a complex network of pipes and structural elements, creating a sense of depth and industrial scale.

Going Global on Public Safety

Lou Gritzso, Ph.D.
Vice president, research and
international codes and standards

Welcome Back!



Same Business Model for > 180 Years



Mutual Ownership

**“Majority of Loss is Preventable” -
Through Research/Engineering**

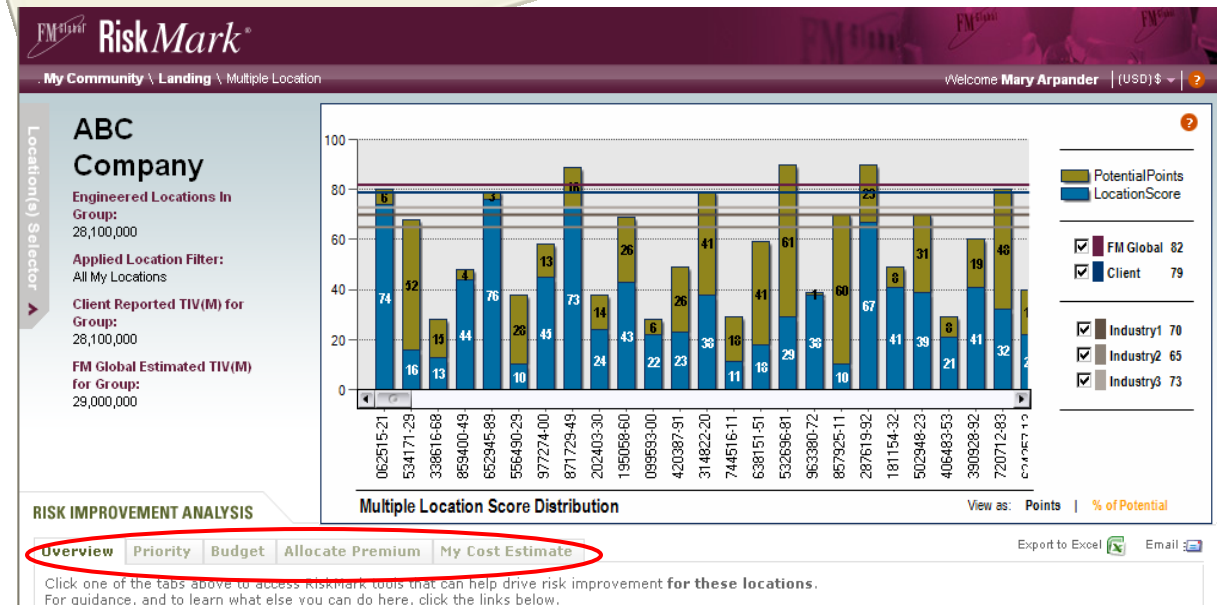
**Commercial and Industrial Property
Insurance - A Specialty Company**



FM Global - Vital Stats

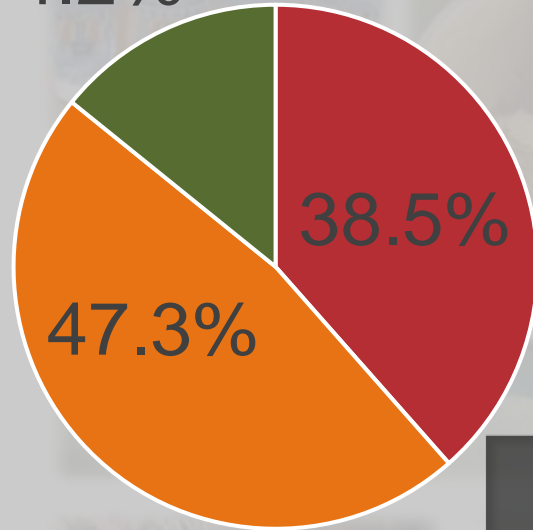


- > 5,000 employees
- 1,800 engineers
- 39 offices worldwide
- > 100,000 client facility risk assessments/year
- Engineering-Based Underwriter



Public and Businesses: Same Hazards

14.2%



- Natural Hazards
- Fire/Explosion
- Equipment Failure



Property



Business Interruption



Stakeholder Value



Reputation



Advance

building codes and loss prevention standards and practices in targeted nations so they become more receptive to FM Global standards and practices.



Research Campus – 2017



Large Fire Tests

135

Small Burn Lab Tests

476

Explosion Tests

85

Earthquake Tests
Tour Groups

161

Visitors

2504

Trends in Industry

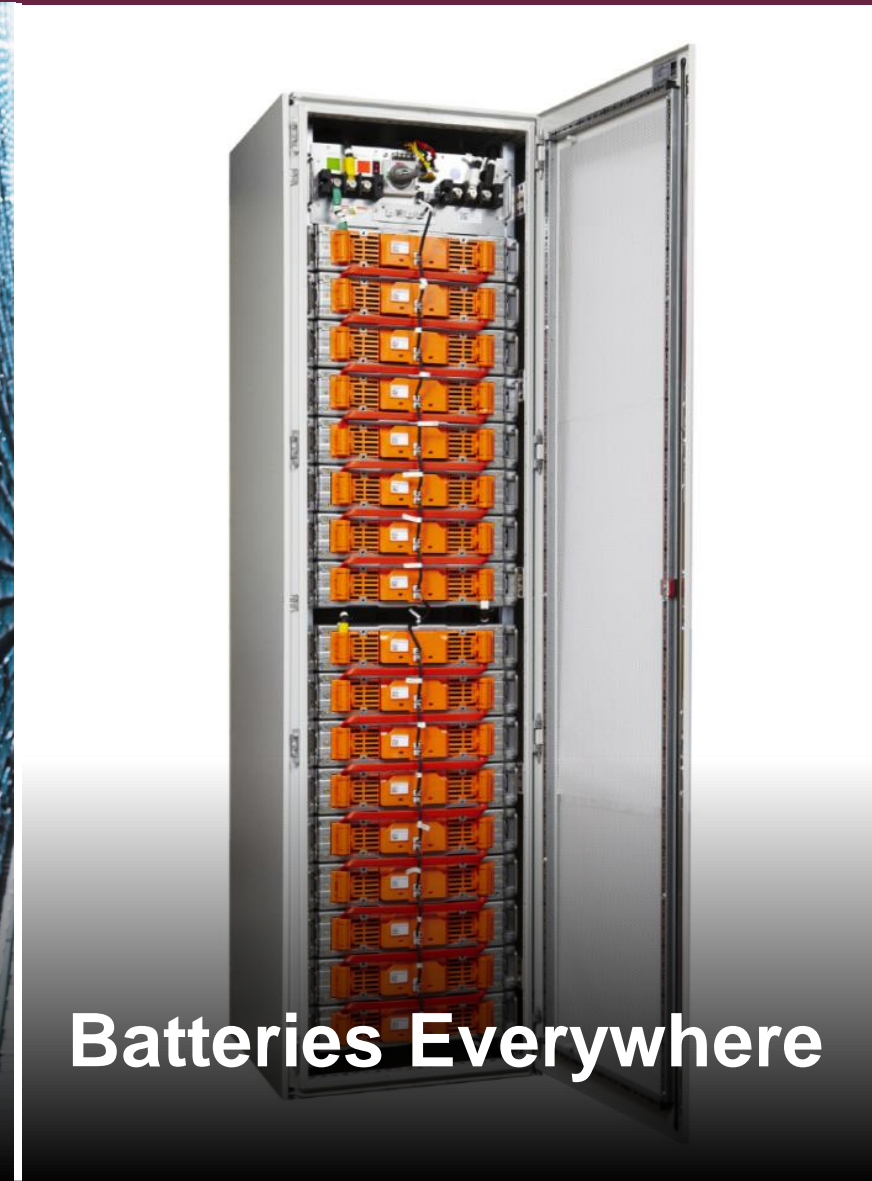


Automation

- Manufacturing
- Storage



Plastics/Composites



Batteries Everywhere

IRI CTO FORUM
May 10-11, Maple Grove, MN

"DIGITAL TRANSFORMATION"



Boston Scientific

IRI CTO FORUM
Oct 29-30, Houston, TX

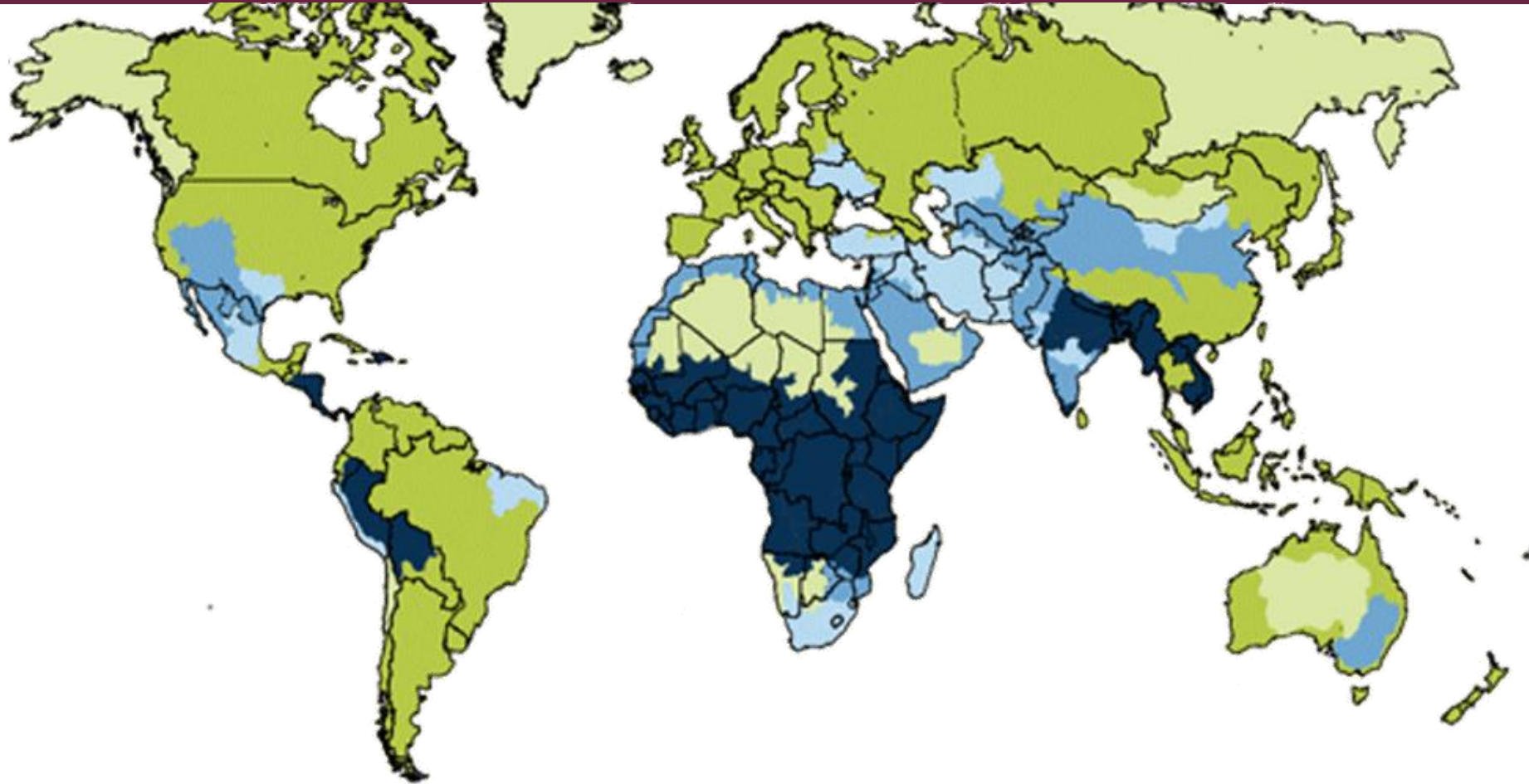
"DIGITAL TRANSFORMATION"



**Hosted by
Chevron Corporation**



Water Scarcity (Global Physical and Economic)



Little or None

Physical

Approaching Physical

Economic

No Estimate



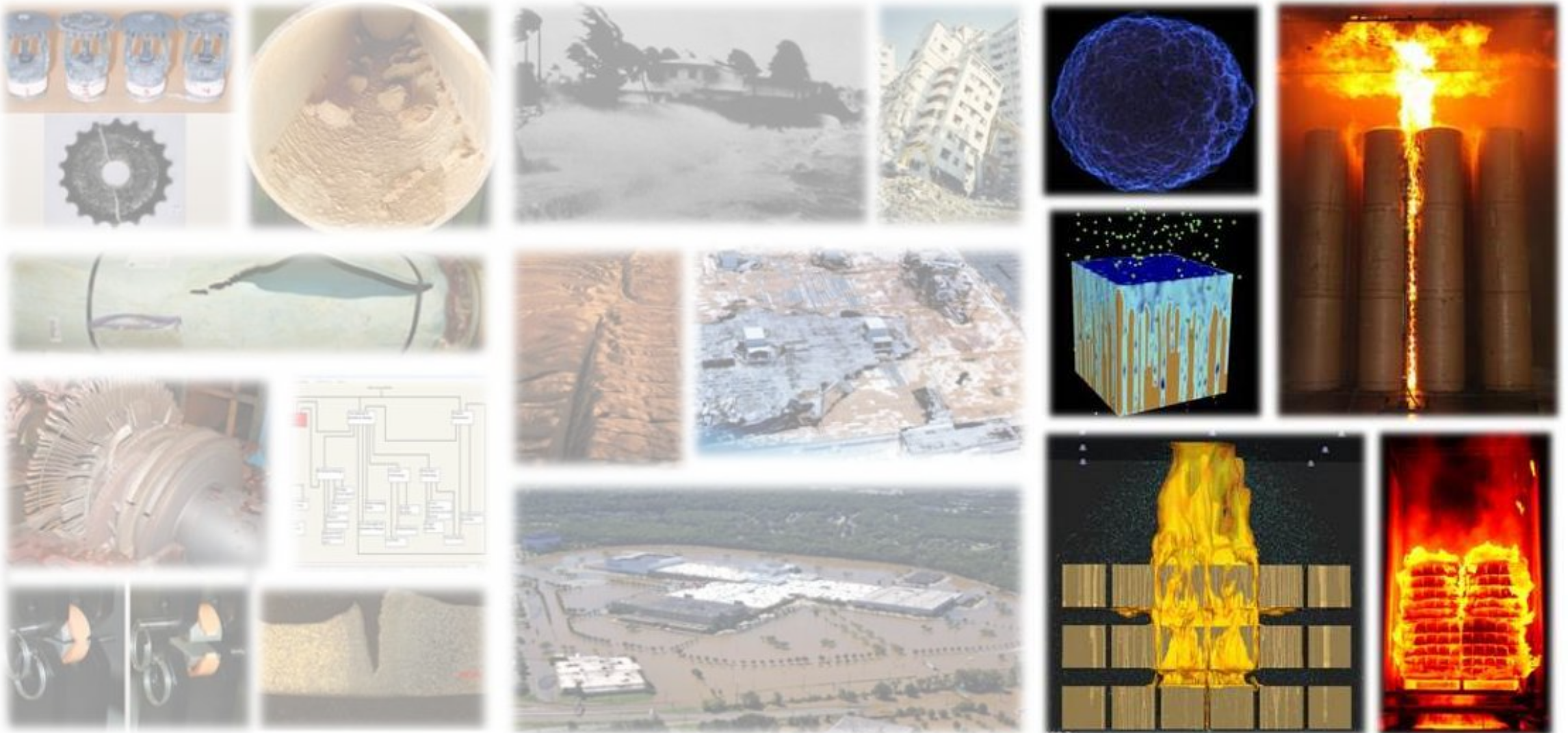
Resilience Index



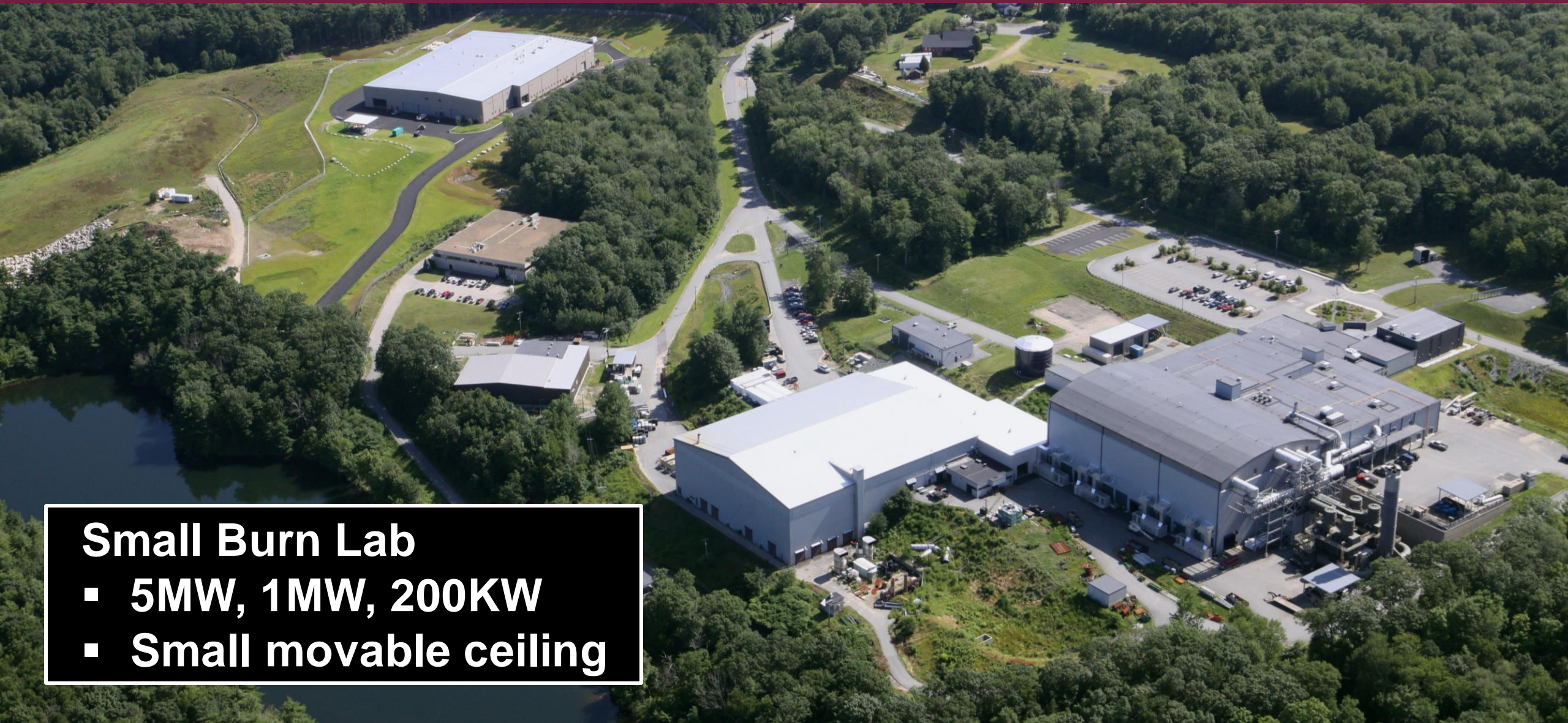
		FACTORS			
DRIVERS	ECONOMIC	SUPPLY CHAIN	RISK QUALITY		
		Oil Intensity	Local Supplier Quality	Exposure to Natural Hazard	
		Political Risk	Control of Corruption	Natural Hazard Risk Quality	
		Productivity	Quality of Infrastructure	Fire Risk Quality	
		Urbanization Rate	Supply Chain Visibility	Inherent Cyber Risk	



Fire Research



Fire Experiments at FM Global



Small Burn Lab

- 5MW, 1MW, 200KW
- Small movable ceiling

New Tools: High Fidelity CFD-Based Fire Model



FireFOAM

- OpenFOAM toolbox
 - Imperial College
- Open source (fmglobal.com/modeling)
- Promote cooperation with academia and industry



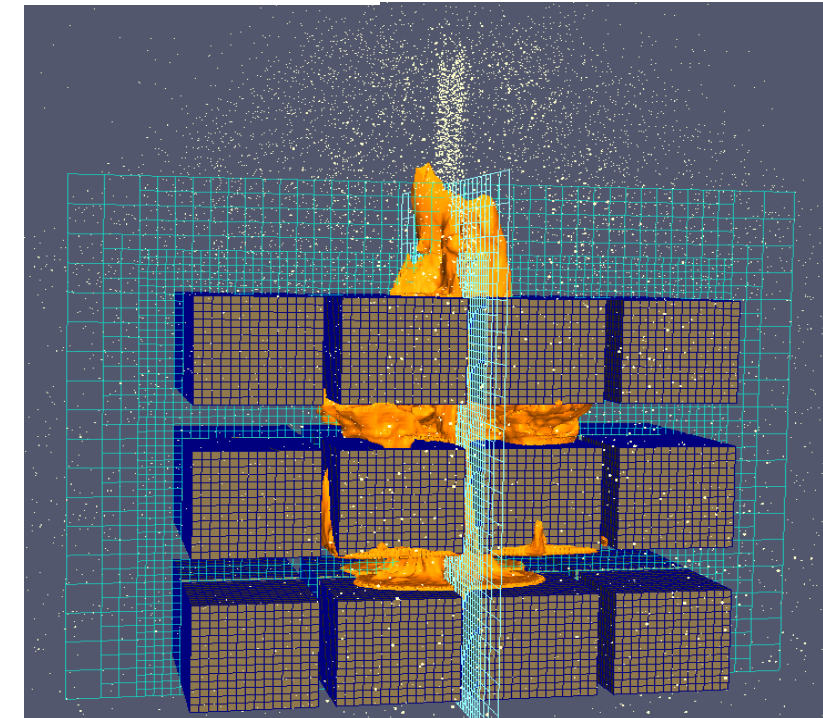
WPI

Kingston University
London



Technique

- All equations solved on grids in multiple time steps
 - Mass, Momentum, Energy, Chemistry, Soot
- Multiple Grid Transport
 - Solid, liquid, gas phase, spray droplets



Achieving Better Fire Protection



Automated Storage and Retrieval (ASRS)



Data Sheet 8-34

Current

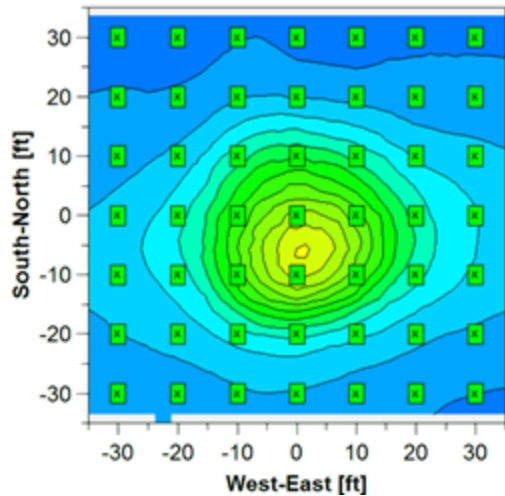
- 14 sprinklers @ 113 lpm
 - 1900 lpm hose demand
 - 120 minutes duration
- ≈ 6400 lpm; 776,000 liters**

New

- No ceiling design
 - 6 AS @ 375 lpm
 - 950 lpm hose demand
 - 60 minutes duration
- ≈ 3600 lpm; 227,000 liters**

Water Challenge: SMART/Zonal Sprinkler

Ceiling Only – 2016

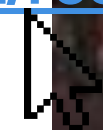


		(South Up)		
	Node: 08e5 14.19	Node: 0a4c 13.29	Node: 0a48 13.94	
Node: 0a66 14.58	Node: 0741 16.00	Node: 0a54 21.03	Node: 0934 17.29	Node: 0a4a 16.52
	Node: 0a27 16.26	Node: 0730 17.29	Node: 0a50 17.03	
		Node: 6180 15.87		



Red Zonal Approach
 Reduces: Storage Height, Damage, Water Supply

fmglobal.com/researchreports



Batteries and Energy Storage



Energy Storage Systems

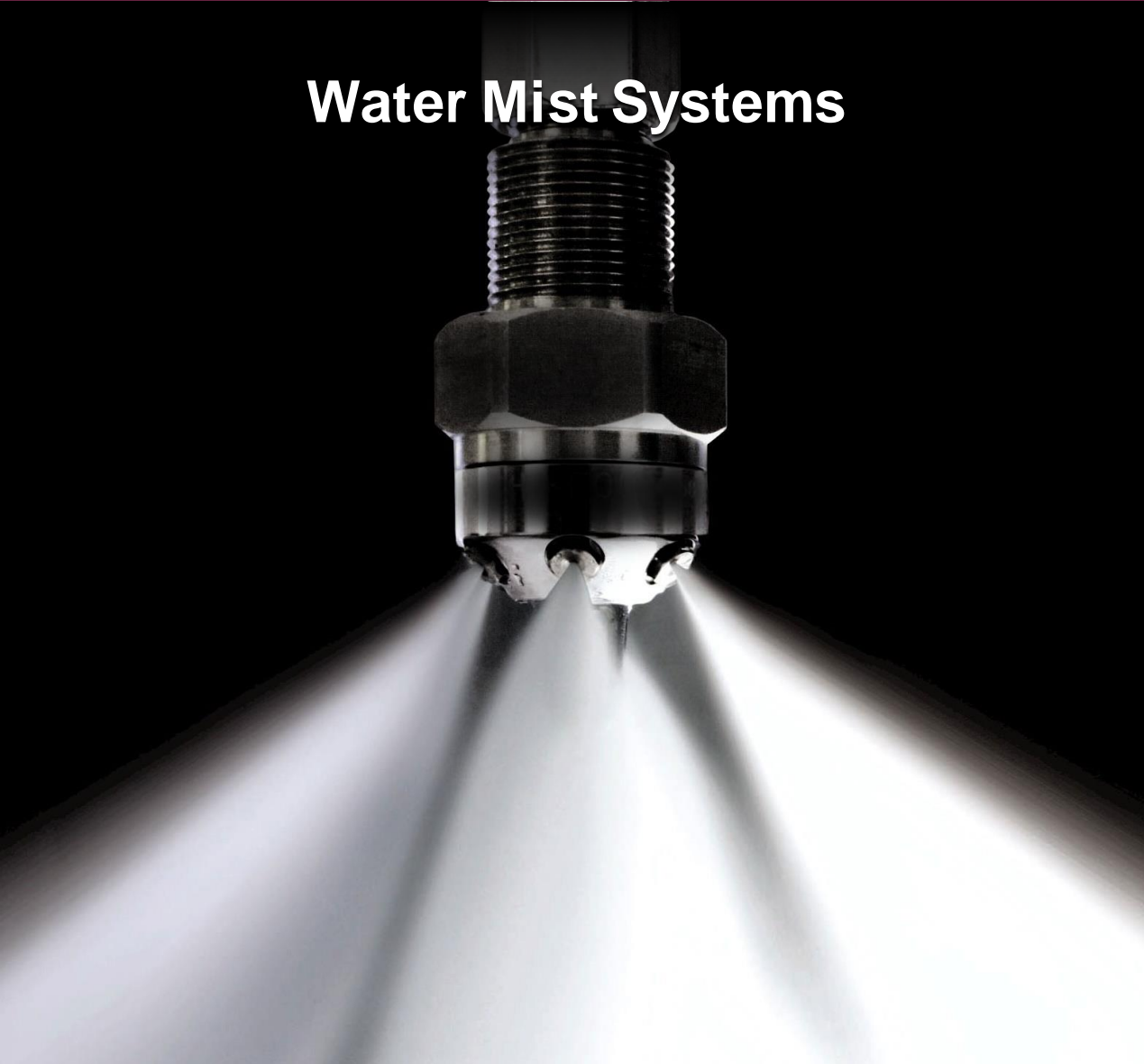
Data Sheet 5-33 Electrical Energy Storage Systems

- First public standard
- All occupancies
- Different Li-ion battery chemistries
- Multi-scale hazard comparison
- Sprinkler protection effectiveness



Protection Options

Water Mist Systems



Hypoxic Systems



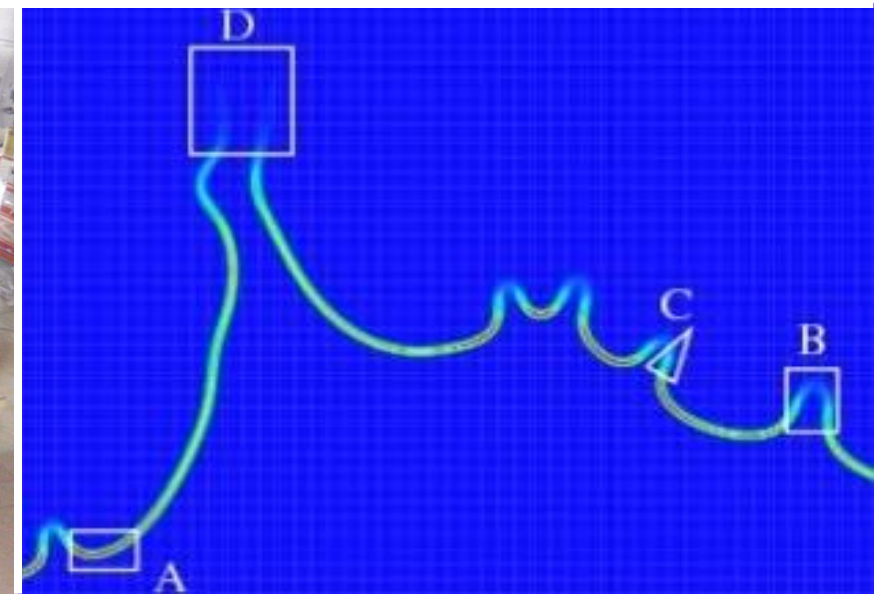
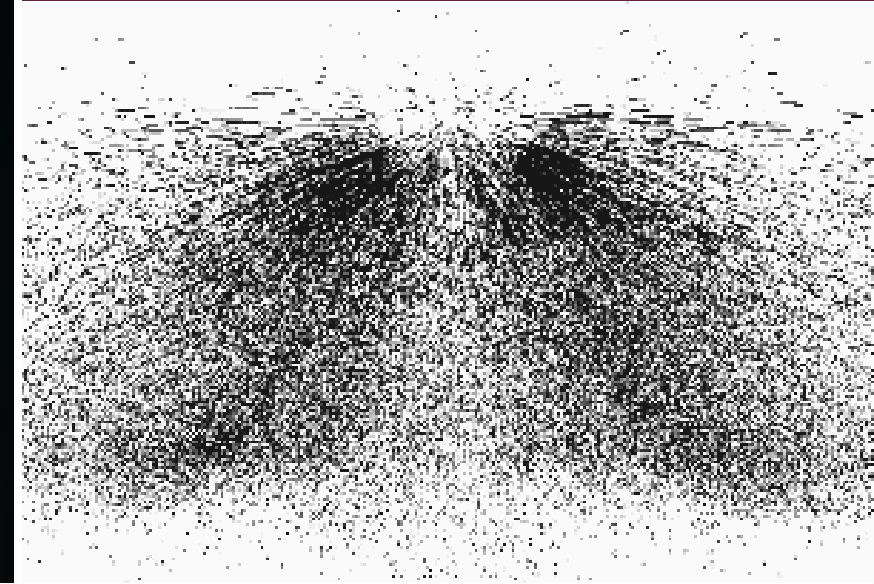
New Models for Water Mist

Mist delivery is key

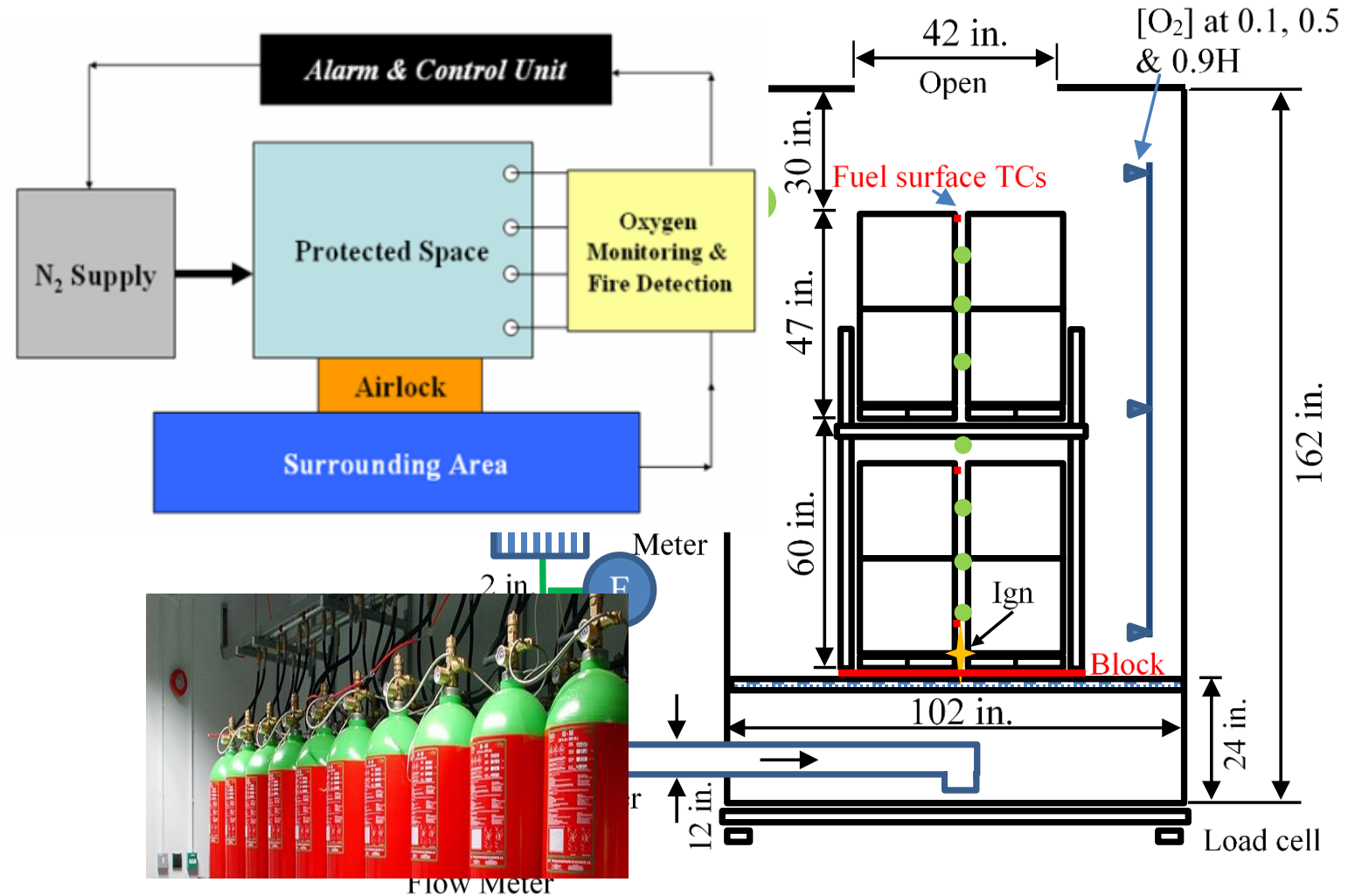
- Spray entrainment
- Penetration

Flame extinction and re-ignition modeling

Reduce requirement for testing each configuration



Hypoxic System Testing

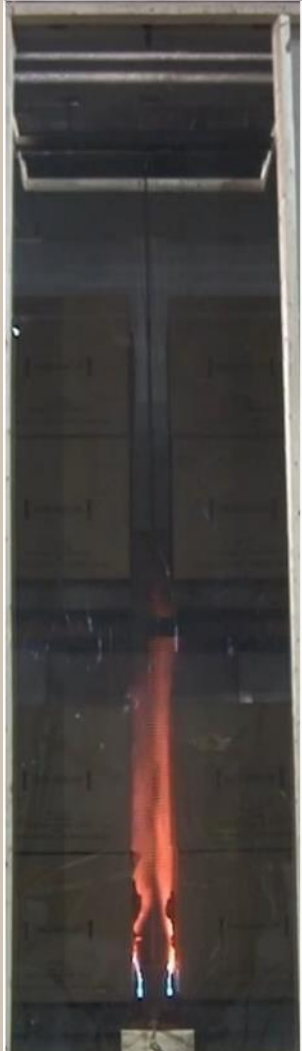


Results: Class 3, 11.4% Oxygen

ignition start



20s



40s



70s



igniter shutoff



3s after shutoff

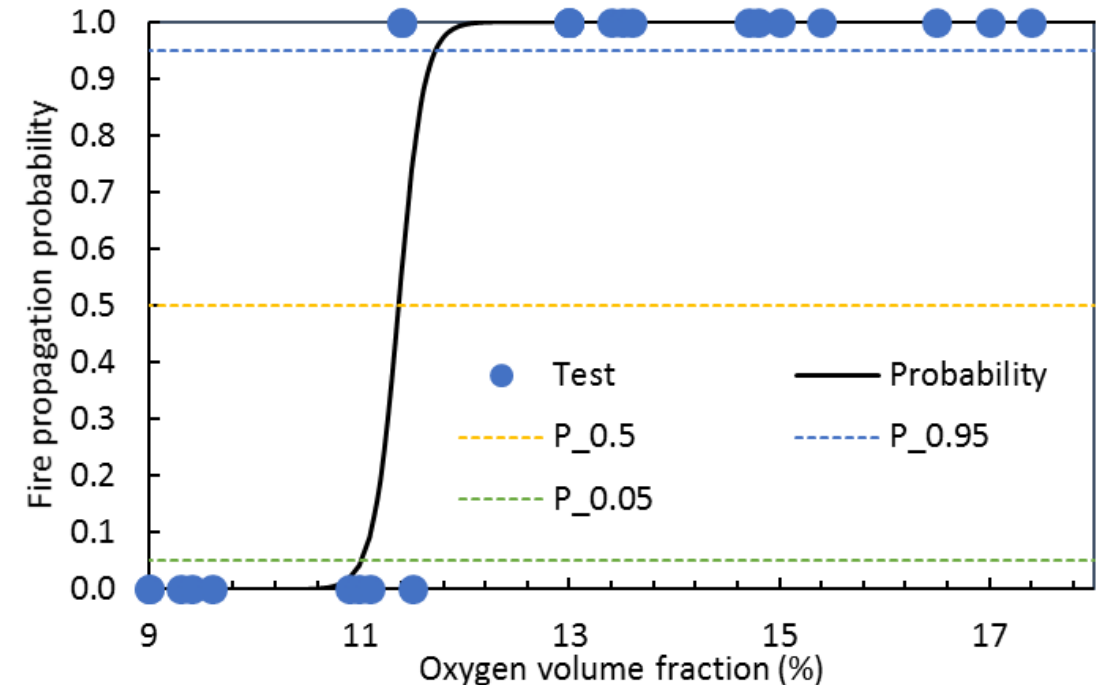


Hypoxic Systems are Difficult to Apply

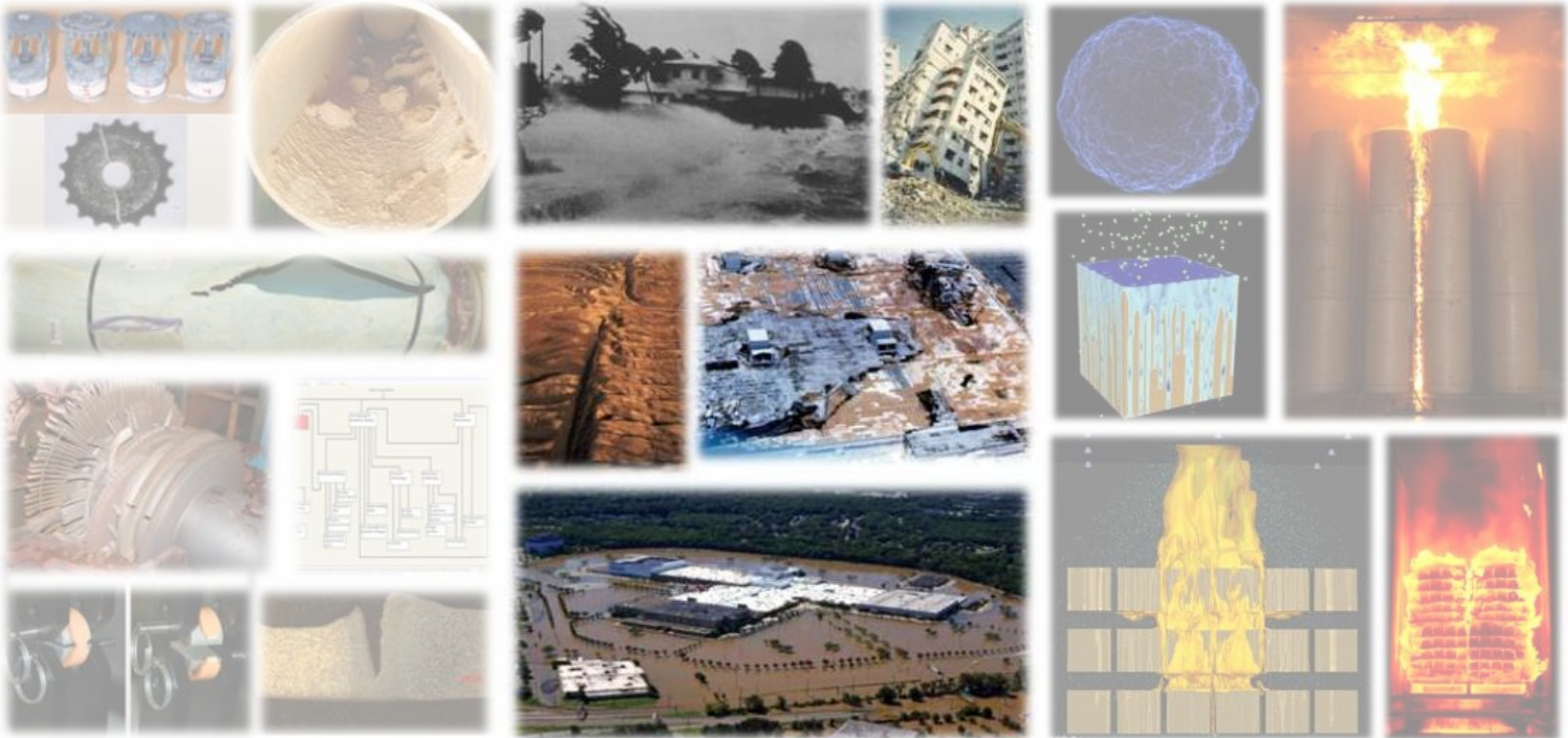
- Low Oxygen (<11.5%) Required
- Best for Small, Enclosed Spaces

The results illustrate that, although not a replacement for the fire sprinkler protection in general, ORS with adequate availability may be used in well-sealed and unoccupied enclosures that can consistently maintain a uniform reduced oxygen concentration. The oxygen concentration in the enclosure needs to be designed based on robust LOC fire tests and the system availability needs to be analyzed to determine ITM cycles. It is expected that the ORS satisfying these conditions can provide adequate protection with relatively low level of fire damage under certain conditions.

Cartoned Commodity With Sustained Igniter



Natural Hazards Research



The Most Frequent Impact: Severe Weather



“More people are affected by extreme weather events than any other type of natural hazards, be they floods, storms or drought, which are responsible for 95 percent of disaster-affected populations”

MAMI MIZUTORI

Special Representative of the Secretary-General for Disaster Risk Reduction



An aerial photograph of a tropical coastline. The land is green and hilly, with a dark blue river or road cutting through it. The ocean is a deep blue. A large, billowing plume of white smoke or steam rises from the water's surface, extending towards the top right of the frame. The overall scene suggests a volcanic eruption or a major industrial accident in a coastal area.

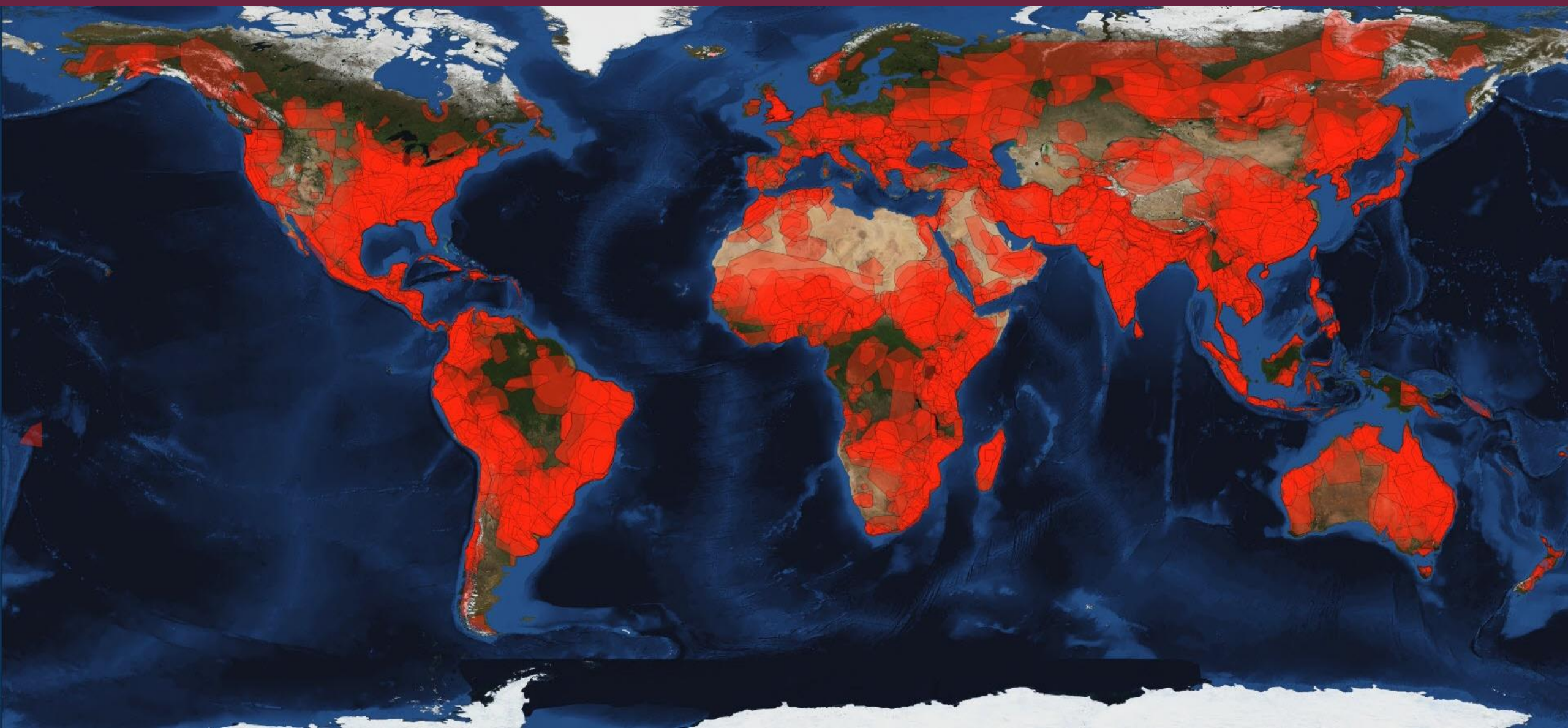
**Natural
Hazards:**

**How are they
changing?**

More Flooding!



Floods: 1985-2016 Dartmouth Flood Observatory



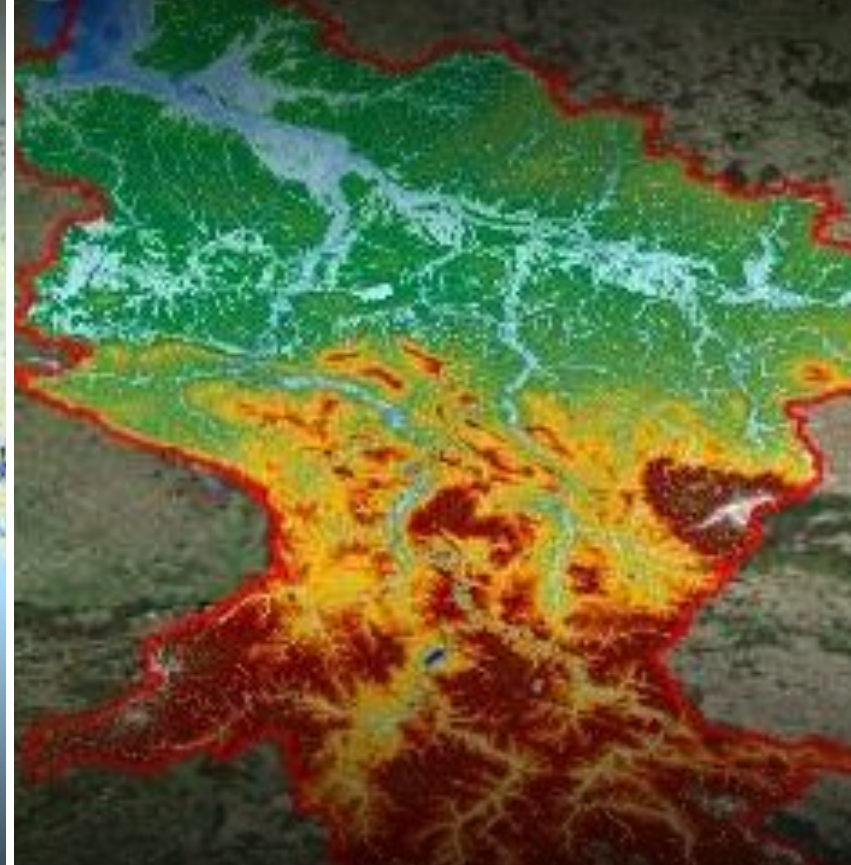
Riverine Flood Modeling

Global Flood Mapping
Resolution: Low (~90m) - In/Out



Low Resolution

Local Flood Mapping
Resolution: High (~5-20m)



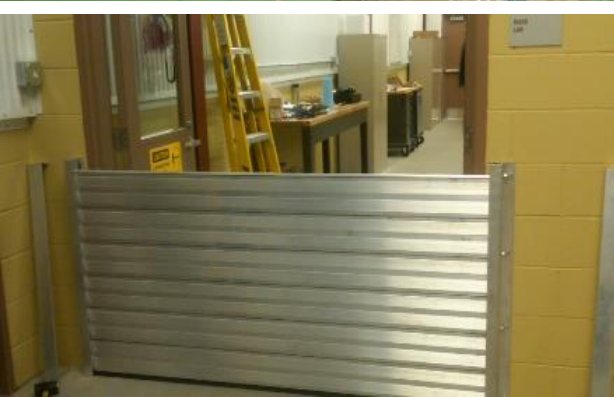
More Details

Regional Flood Mapping
Resolution: Medium (~30m)
Tiawan, Sao Paulo, Malaysia



High Resolution

Flood imminent? You have options.



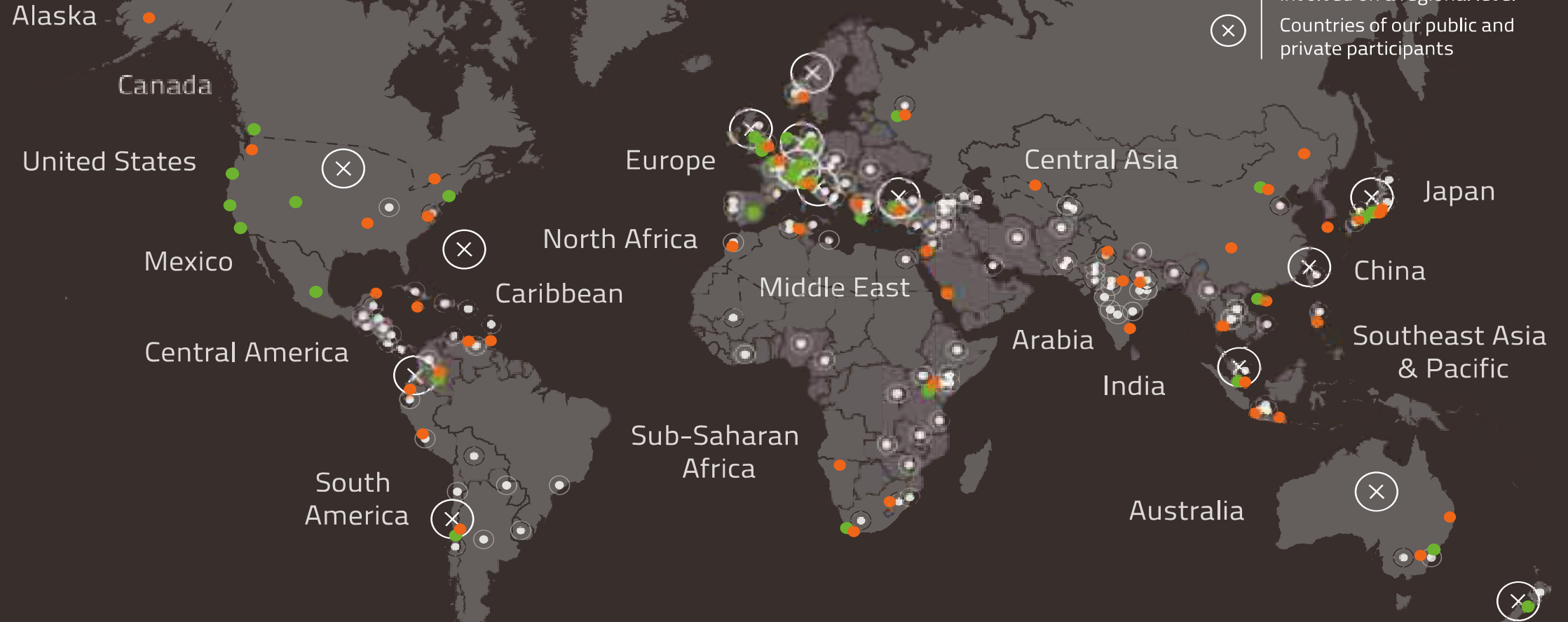
Global EQ Map - Target 2019



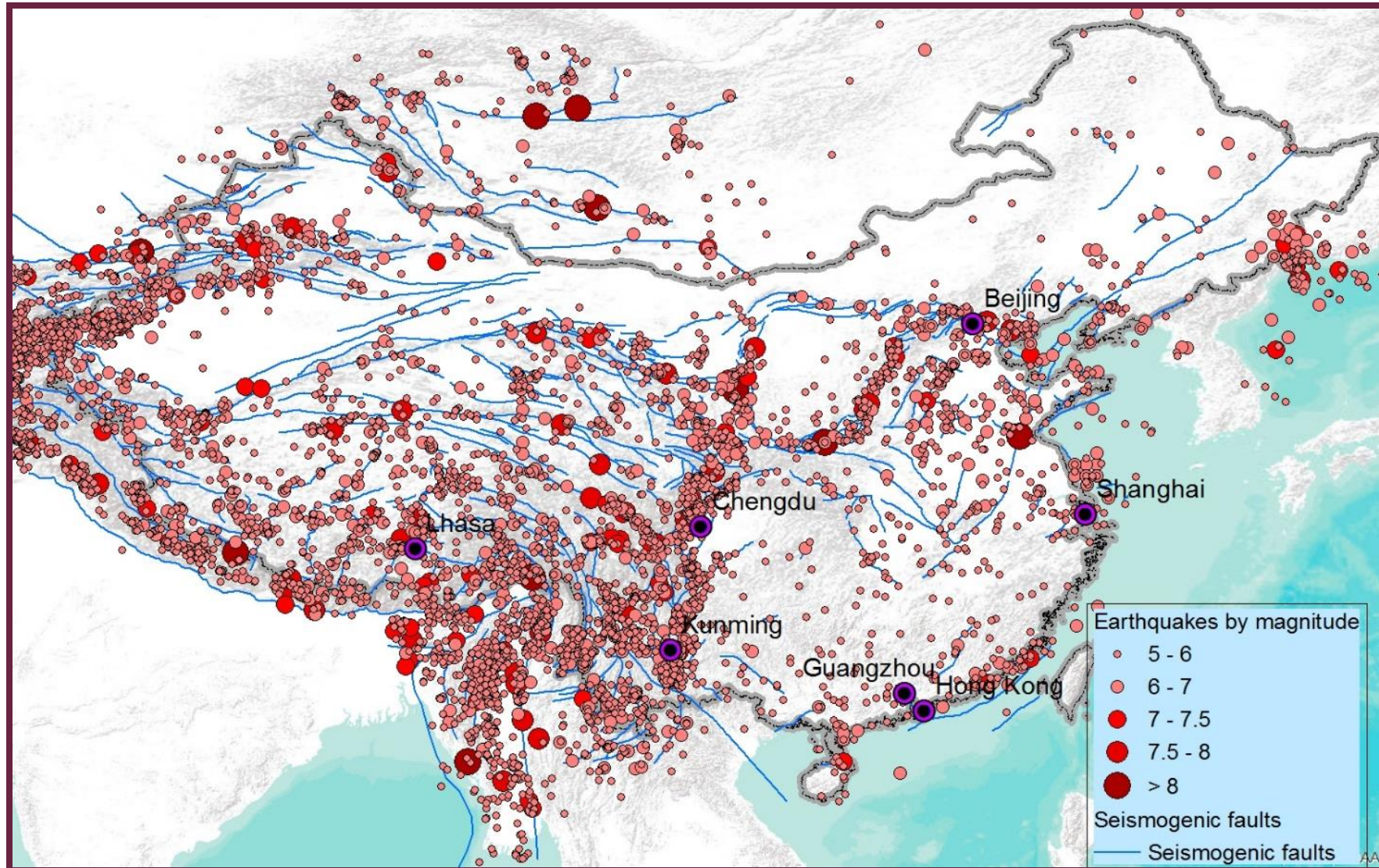
Associate Participants



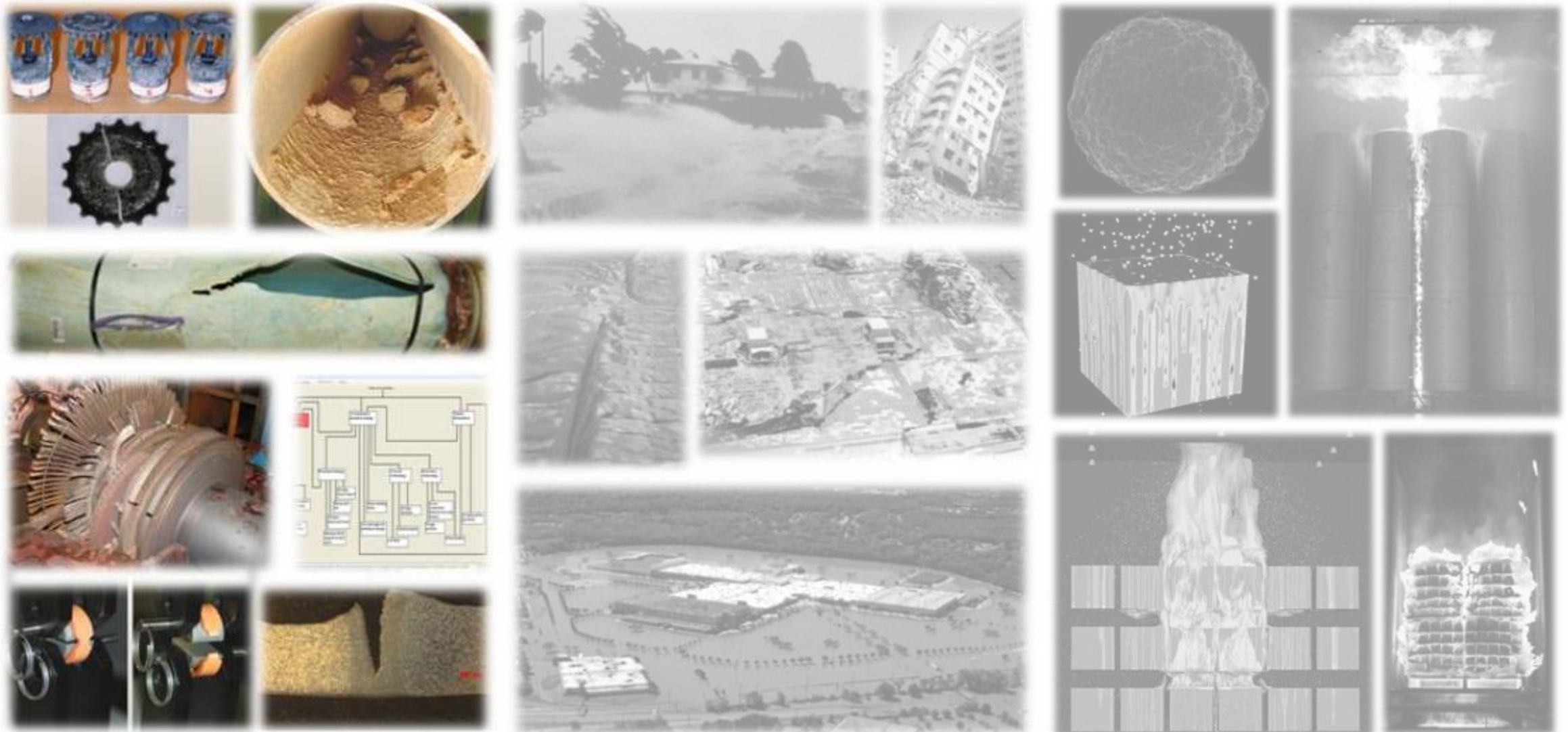
- Global Component Institution Locations
- Regional Workshop/ Meeting Locations
- Individuals & organisation involved on a regional level
- Countries of our public and private participants



New China Earthquake Map



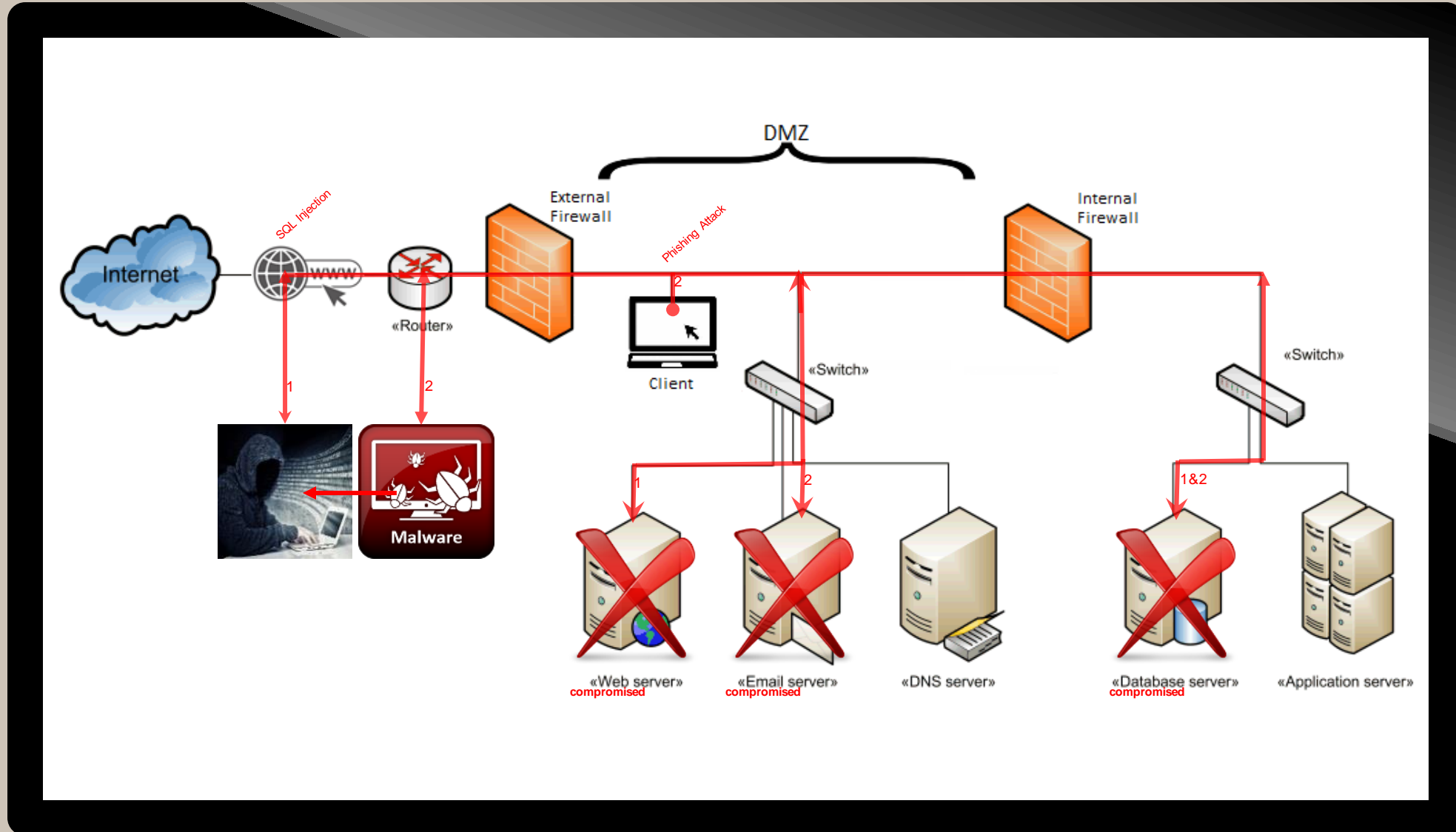
Risk, Reliability and Forensics Research



A person wearing a dark hoodie with the hood pulled up, standing in a dark environment with a teal glow. The person's face is obscured by the hood. The background is filled with blurred, glowing teal shapes that resemble data or code.

**U.S. Patent Application No. 15/633,242 ~ Alkemper et al.
For: SYSTEMS AND METHODS FOR CYBER SECURITY RISK ASSESSMENT**

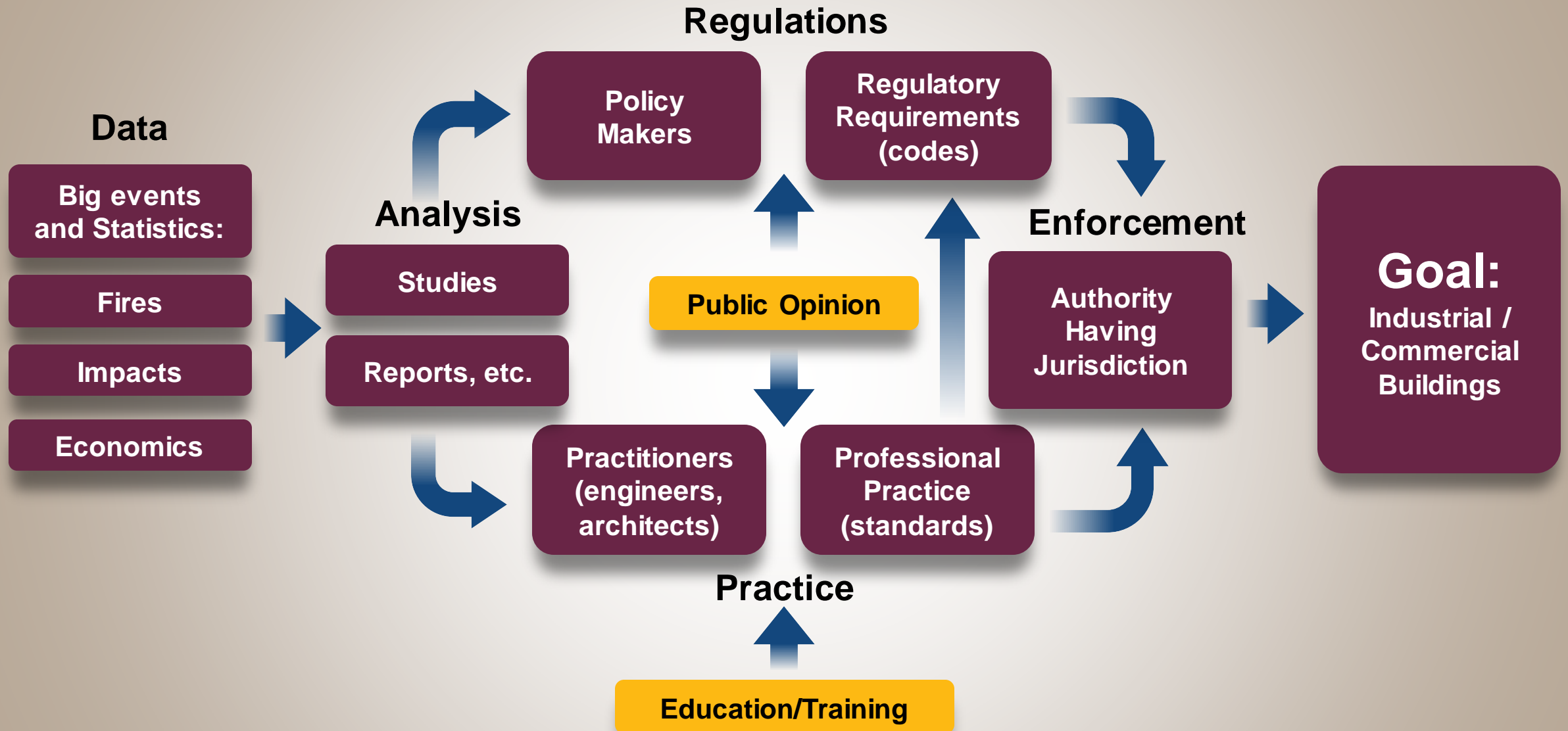
Cyber: Lab Concept



International Codes and Standards



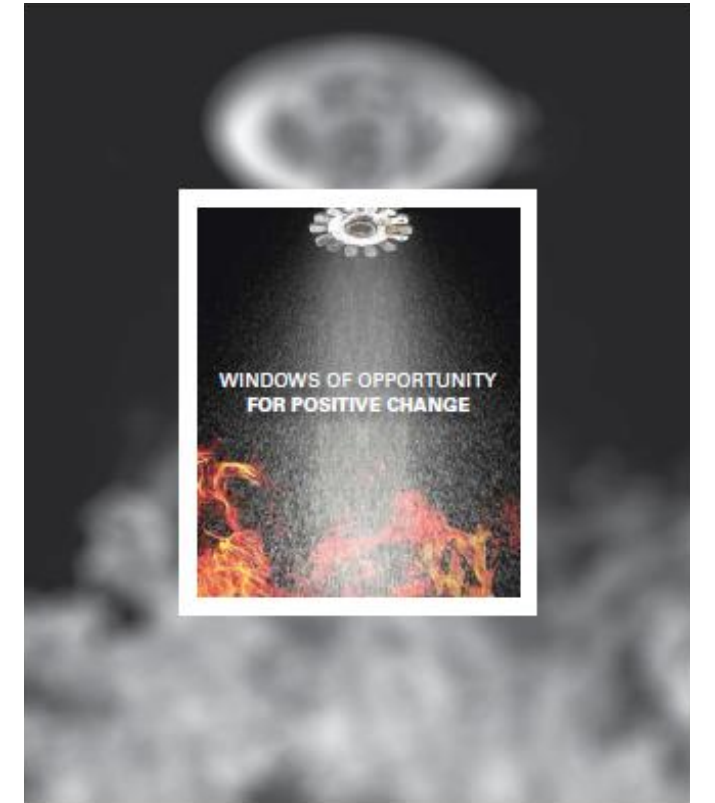
International Codes and Standards Strategy



Progress on Resilience



China



- Poland, Mexico and Germany...

A grayscale background image of industrial machinery, showing various pipes, valves, and mechanical components. A dark red horizontal band is overlaid across the middle of the image, containing white text.

Thank you. Any questions?

louis.gritzo@fmglobal.com



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