Reduction of NATECH risks: industrial accidents triggered by natural hazards

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Background

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Expected increase in Natech risk:

→ more hazards

(climate change, industrialisation)

→ higher vulnerability

(urbanisation, interconnectedness)

Status:

No methodologies, tools and guidelines for Natech risk assessment & management

**From a JRC survey on the status of Natech risk reduction in EU MS and OECD*

E. Krausmann, D. Baranzini (2012) Natech risk reduction in the European Union, J Risk Research 15(8): 1027-1047

Priority work areas*:

– Implement and enforce regulations for Natech risk reduction

– Develop methods, tools and guidance for Natech risk management

– Develop dedicated Natech emergency management plans

– Develop Natech risk maps

– Raise awareness and improve risk communication

– Train stakeholders on Natech risk reduction

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Source: Kyodo AP

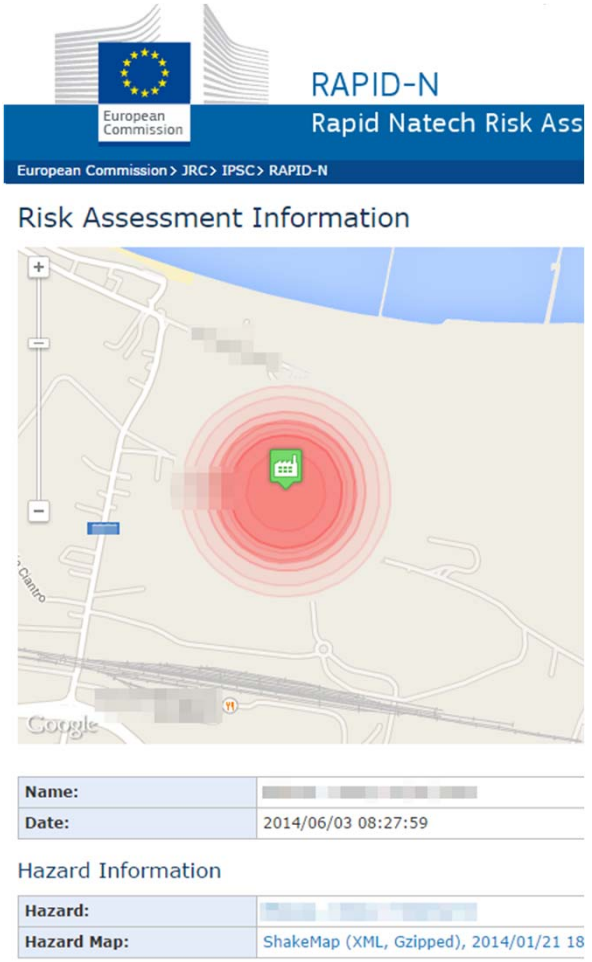
JRC activities

Accident analysis and guidance for risk reduction

- Site surveys for damage assessment (China, Japan)
- Lessons learned & recommendations for RR
- Natech database: **eNatech**
  http://enatech.jrc.ec.europa.eu

Risk analysis tools

- **Web-based framework for Natech risk assessment and mapping: RAPID-N**
  http://rapidn.jrc.ec.europa.eu



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RAPID-N

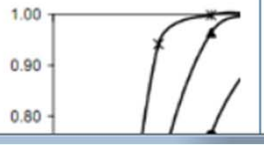
Rapid Natech Risk Assessment Tool

Recent Natural Hazards

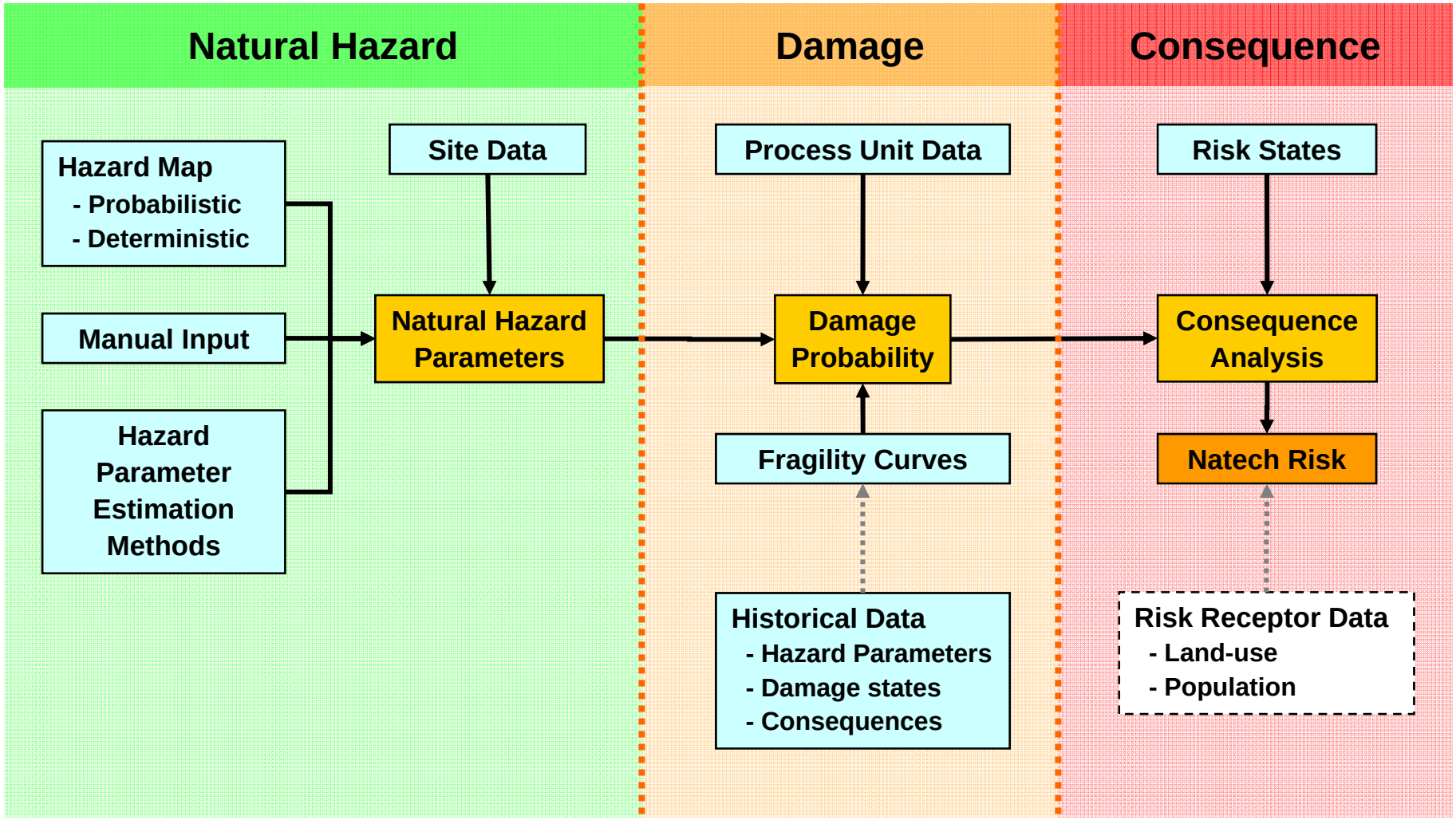
Date	Name
2015/03/05	255km SSE of Sinabang, Indonesia
2015/03/03	50km NW of Sikabaluan, Indonesia

RAPID-N: Rapid Natech Risk Assessment Tool

Natural-hazard triggered technological accidents (Natechs) involving the releases of hazardous



Methodology



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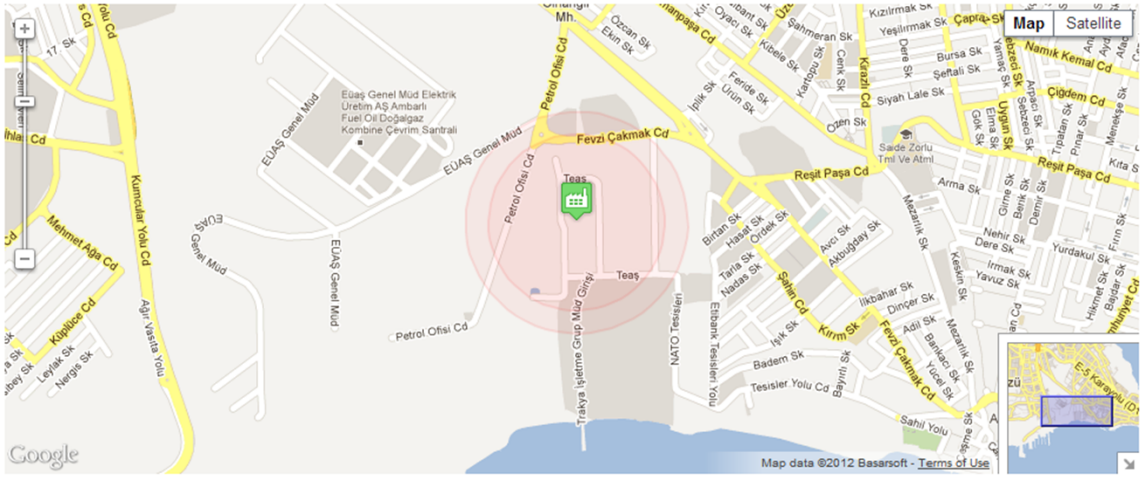
Output

Risk Assessment Information



Name:	Kocaeli Earthquake Single Plant
Date:	2012/08/28 13:11:13
Type:	Private

Hazard Information

Hazard:	Kocaeli Earthquake, 1999/08/17
Hazard Map:	ShakeMap (XML, Gzipped), 2008/11/09 03:19:14

Facility Information

Facility:	[redacted] Power Plant, Turkey

Damage Estimation

Damage Classification:	Auto
Flexible fragility curve selection:	Yes

Facilities

1. [redacted] Power Plant, Turkey

No	Process Unit	Hazard Parameters	Fragility Curve	Damage Estimate	Damage Parameters	End-point Distance
1.	Storage Tank (T-STR) * [Gasoline]	PGA: 18.777 %g; EMS: Slightly damaging; MM: Strong; MSK: Strong; MMI: 6.4866; d_e: 101.38 km; d_h: 102.79 km; PGA_h: 74.415 cm/s2; PGV: 15.573 cm/s «	OS00-F50-G	≥ DS2: 4.0546%	Fire/Explosion Event: Vapor Cloud Explosion; $Q_{involved}$: 4250 kg; $f_{m,\ passive}$: 1; $P_{c,\ fire}$: 100%; $f_{V,\ involved}$: 10 %v; $V_{involved}$: 5.7432 m3; $P_{c,\ release}$: 30%; f_{yield}: 0.1; RMP Scenario: Worst-case; $t_{release}$: 10 min; $q_{release}$: 425 kg/min; $Q_{released}$: 4250 kg; A_{pool}: 6146.1 ft2; h_{pool}: 1 cm; $q_{release,\ r}$: 425 kg/min; τ_a: 1; R: 0.4; q_R: 5000 W/m2; t_{exp}: 40 s; D_T: 342 TDU; d_e: 270.58 m; Q_{fuel}: 4250 kg; P_{damage}: 4.0546%; P_{natech}: 4.0546% «	271 m: 4.0546%
				≥ DS3: 0.004631%	Fire/Explosion Event: Vapor Cloud Explosion; $Q_{involved}$: 8500 kg »	341 m: 0.004631%
				≥ DS4: Very low	-	-

Status

- **Currently implemented for earthquakes and fixed hazardous installations**
- **~ 20,000 earthquakes (> M 5.5)**
- **~ 10,000 shakemaps**
- **> 5,500 industrial facilities**
  - Refineries
  - Power plants
- **> 64,000 plant units**
  - Storage tanks

Rapid local and regional Natech risk assessment

Application areas:

- **Land-use and emergency planning**
- **Early warning**
- **Damage assessment**
- **Identification of neighbouring infrastructures at risk**

Case study

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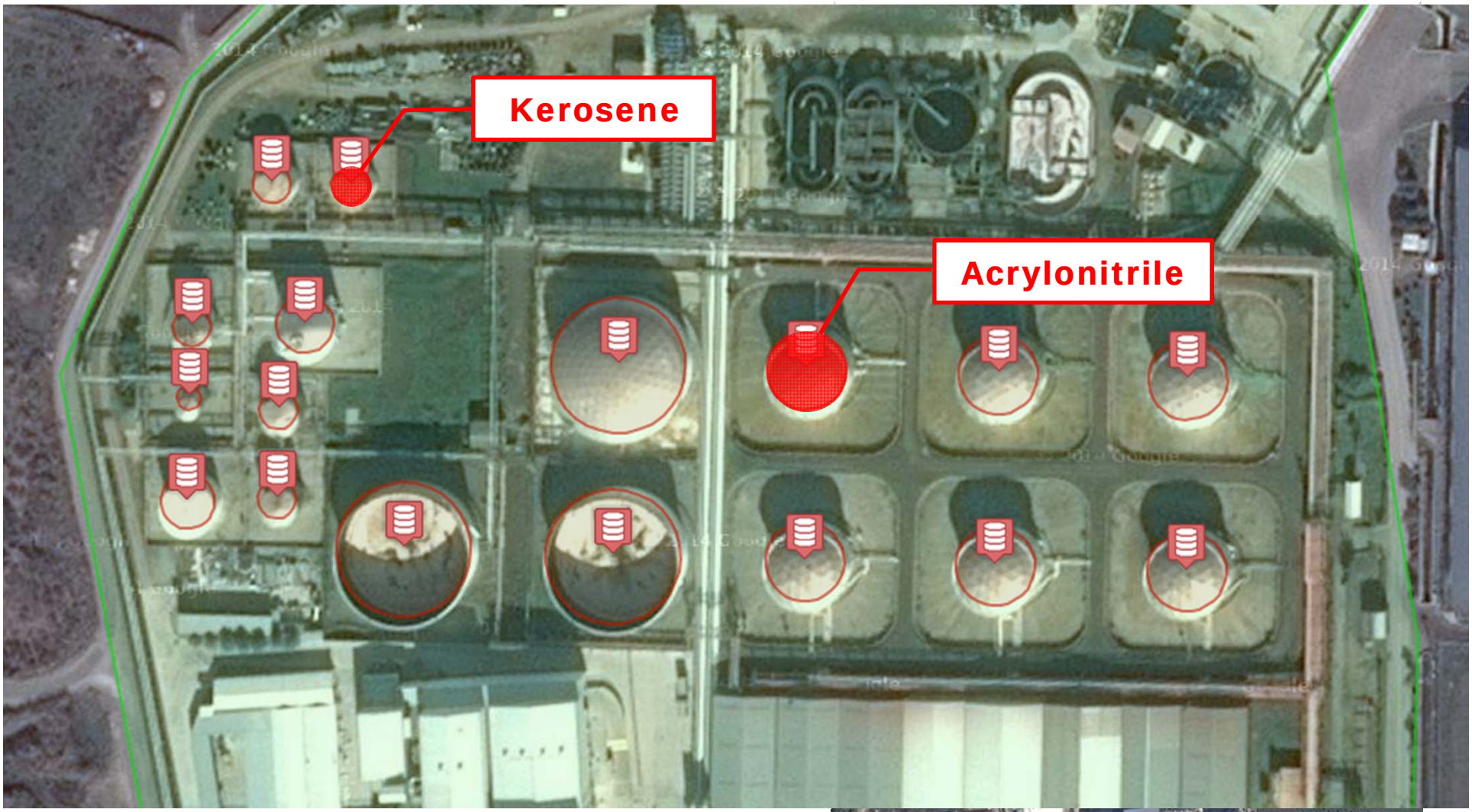

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Release of toxic substance

Impact area for 1-hr exposure without irreversible health effects

Ongoing and future research

- **Extension to other natural hazards and infrastructures**
  - Pipelines (2014-2015), Floods (2015)
- **Automated Natech damage and consequence estimation (Alert)**
  - Reporting to interested parties and authorities
- **Cascading effects**
- **Consideration of risk receptors**

eNatech Database

Data collection for lessons learning

- Open, collaborative, international database
- **Specifically designed for Natech accident data collection**

http://enatech.jrc.ec.europa.eu


enatech.jrc.ec.europa.eu/Natechs?country_code=&hazard_code=&status=&site=&from_date=&to_date
Google
test-server eNatech
Most Visited
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JOINT RESEARCH CENTRE
eNATECH - Natural hazard-triggered technological accidents
European Commission > JRC > IPSC > eNatech
Natechs
Country: - All -
Hazard: - All -
Status: - All -
Site:
Date: -
List
37 record(s) found. Page: 1 Rows: 20 Sort by: Date Descending
No Date Country Natural Hazard Site
1. 2012/02/10 France Freeze Plant 18
2. 2012/02/07 France Freeze Plant 20
3. 2011/09/17 France Lightning Plant 13
4. 2011/07/11 Cyprus Extreme temperature variation Plant 24
5. 2011/03/11 Japan Tōhoku Earthquake Cosmo Oil Refinery
6. 2011/03/11 Japan Tōhoku Tsunami Plant 15
7. 2011/03/11 Japan Tōhoku Tsunami Plant 26
8. 2011/03/11 Japan Tōhoku Tsunami Plant 27
9. 2011/03/05 United States EF2 Tornado Plant 28
10. 2010/07/14 France Storm Plant 12

Features

- **Natural Hazard**
  - Type and date
  - Location
  - Occurrence
    - Triggering hazard, parameters
  - Consequences
- **Site**
  - Type and industrial activity
  - Location
  - Site description
  - Operator
- **Attachments**
  - Documents
  - Reference materials
- **Natech**
  - **Event sequences**
    - Units, events, contributing factors, substances involved
  - **Weather conditions**
  - **Emergency response**
    - Response planning, response to natural hazard, response to Natech
  - **Consequences**
    - Human health, environmental, economic losses, community disruption
  - **Remedial activities**
    - Decontamination, remediation, restoration
  - **Lessons learned**
    - Equipment, human, organizational, mitigation measures, emergency response

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Example

Table 4 Key lessons learned and accompanying recommendations for earthquakes, floods and lightning

	Lessons learned	Recommendations
Earthquakes	Floating-roof tanks are prone to fire scenarios during an earthquake. Liquid sloshing can result in bouncing of the metallic roof against the side wall which could create sparks and ignite the tank content if flammable	The risk associated with floating roof tanks in areas where an earthquake hazard exists needs to be re-evaluated
	Liquid sloshing can compromise the structural integrity of tanks which are full or nearly full	Liquid sloshing and the resulting dynamic loading on the tank wall needs to be taken into account in the risk assessment in earthquake-prone areas
	Rigid connections between pipes and equipment are vulnerable to shaking damage and failure which can lead to the release of hazardous materials	Specific connections should be used in earthquake-prone areas
	Safety barriers to prevent an accident or mitigate its consequences, such as e.g. catch basins around tanks or sprinkler systems, may fail under earthquake loading	Critical active and passive safety barriers in the facility need to be designed to withstand the forces of the expected earthquake
	Non-anchored equipment can suffer damage through lateral displacement and/or uplifting	Anchoring or restraining of equipment could effectively avoid displacement and keep the equipment intact
	Earthquakes can trigger multiple releases at a single chemical facility or from several affected hazardous installations simultaneously.	The characteristics of an earthquake impact on a chemical facility, and the possibility of a domino effect*, need to be considered in land-use-planning decisions and when preparing emergency response plans. In

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THANK YOU
FOR YOUR ATTENTION!

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