

Health and Safety Issues in Natural Disasters

When the Emergency becomes the Workplace

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Agenda

- Introduction
- When the emergency becomes the workplace
- Preparing before the event
- Protecting those who respond
- Reentry, recovery, & return to operations
- Putting it into practice
- Resources and Q&A

Introduction (and disclaimer)

- Over 30 years of experience in emergency preparedness, response, and recovery and occupational and environmental safety & occupational health (S&H).
- Served on active duty for 20 years in US Coast Guard; specialized in pollution prevention, emergency response, and S&H.
- Post-retirement: consulted then reentered Federal service as civilian.
- Hold two Master of Science degrees: Industrial Hygiene (UMASS Lowell) and Emergency Management and Homeland Security (Arkansas Tech).
- Disclaimer:
 - Opinions shared are solely those of the author and do not represent the American Industrial Hygiene Association (AIHA) or my employer.

9/11 – 25 years later

Key points in recent research papers:

- Health effects of responders and survivors are long-term and may affect different parts of the body (e.g., lungs, liver, stomach) and increase risk of cancer.
 - “health effects may unfold over decades”
 - “integrated systems that link surveillance, research, and clinical care are essential for identifying and responding to emerging health risk”
- Psychological health effects include PTSD, anxiety, and depression.
- Exposed populations had lower (poorer) health-related quality of life indicators.



<https://www.cdc.gov/wtc/index.html>

When the Emergency Becomes the Workplace

- Even premiere organizations can be caught off guard.
 - USCG & Hurricane Katrina (2005)
 - Responders were victims
 - Continuity of operations plans had gaps
 - Command systems siloed
- Hazards included – in addition to physical safety hazards – contaminated floodwaters & dried sediment, animals, hazardous waste & materials, heat stress, fatigue, noise, carbon monoxide, asbestos, & lead.



Source: <https://catalog.archives.gov/>

What to take back on Monday

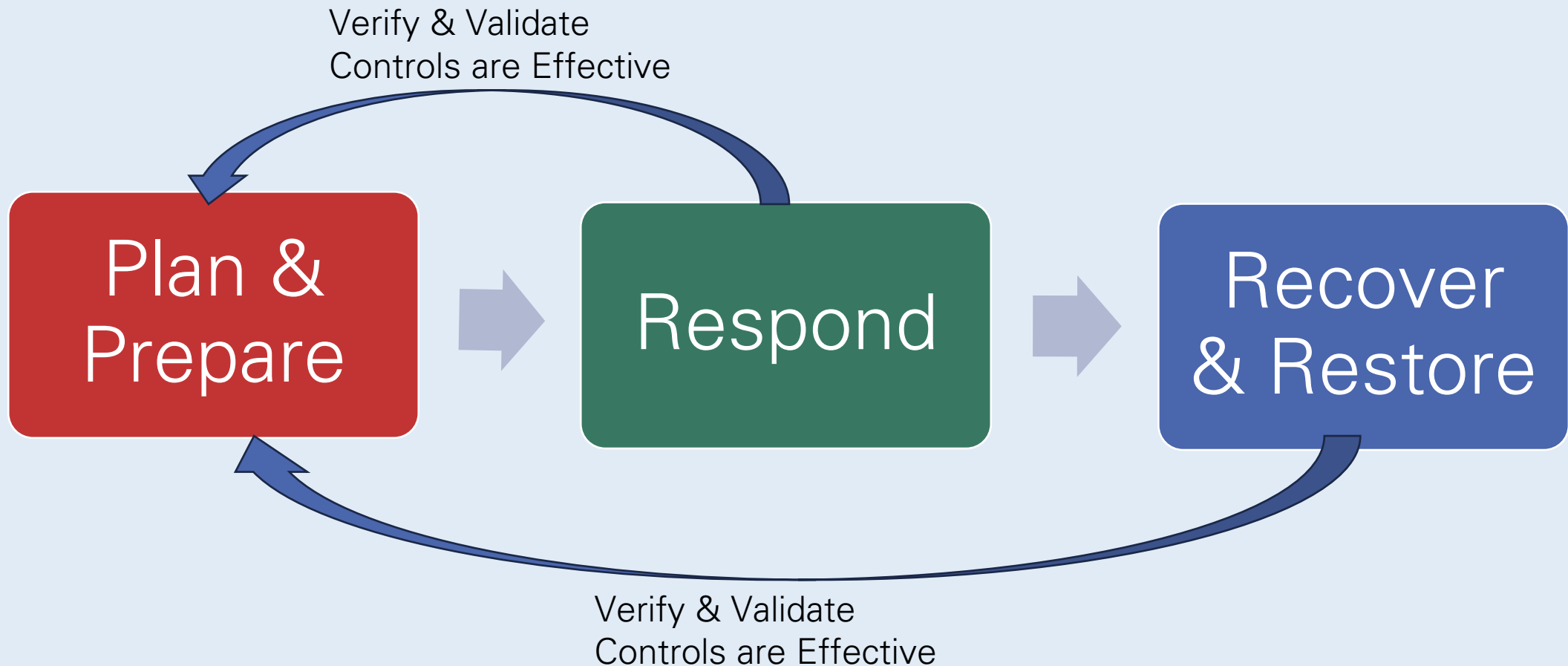
Goal: Protecting people before, during, and after natural disasters and events.



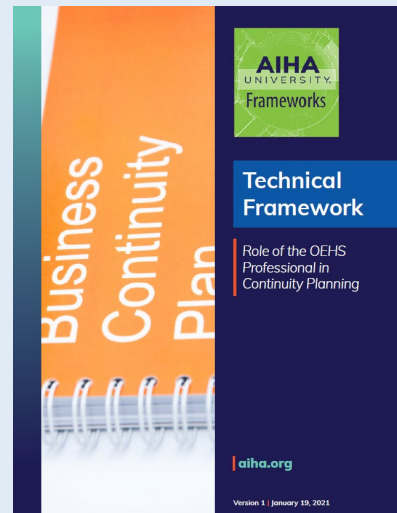
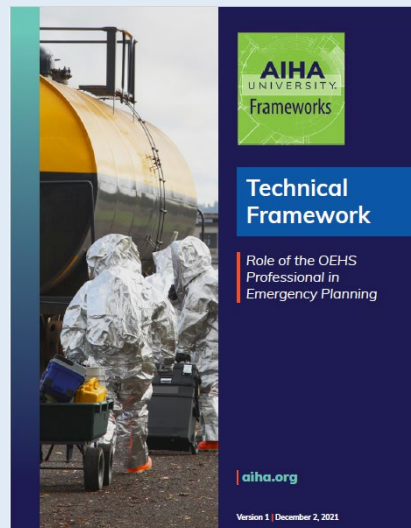
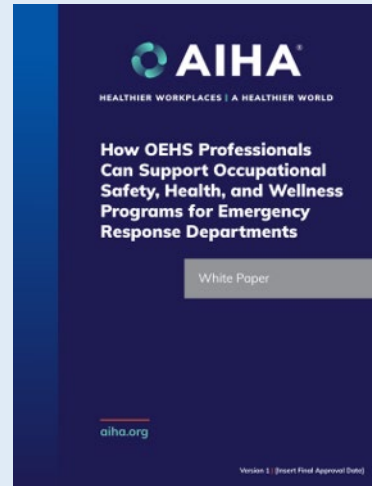
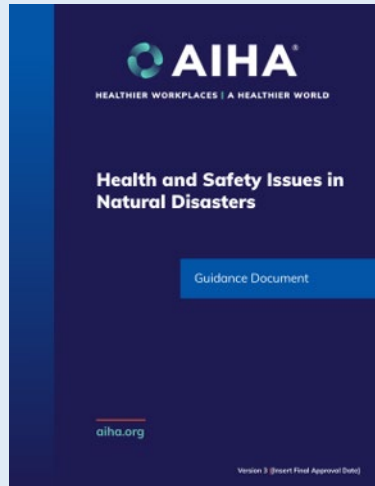
Consider: Who “owns” the S&H of workers before, during, and after a disaster or event. Are they involved in all phases?

What to take back on Monday (alt view)

Another way to look at the cycle (PDCA & FEMA's 4 Phases).



Preparing before the event: AIHA Resources



Preparing: Who will respond?



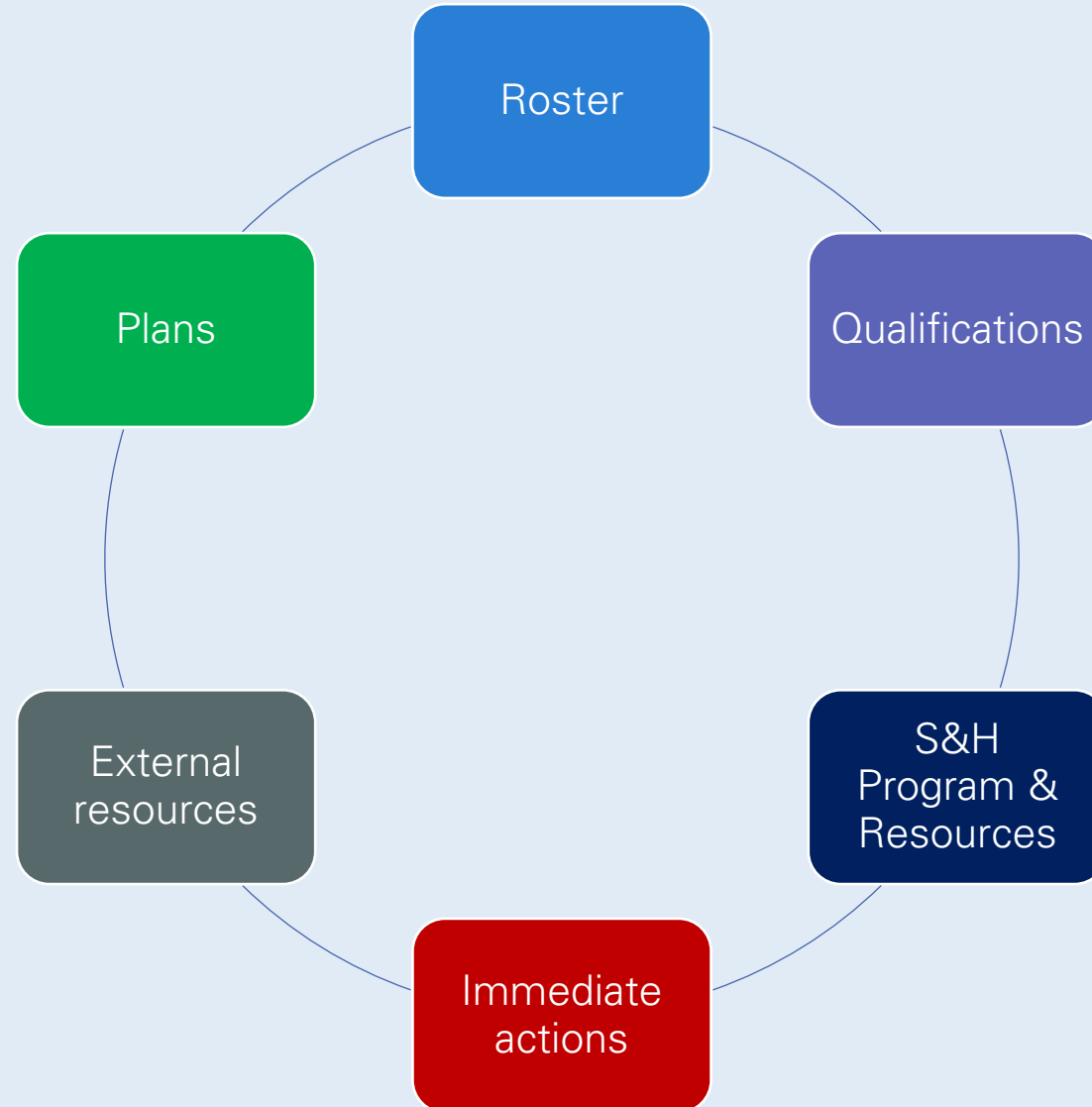
Preparing: Build the system before the incident

- Strong, established S&H program provides baseline that makes incident safety planning faster & safer.
- Corporate / facility S&H program provides baseline roles, training, medical clearances, and equipment.
- Incident S&H Plan addresses the specific hazards, risks, and controls for event.
- S&H support needs to be integrated into all phases to prevent, mitigate, prepare, respond, and recover from disaster.



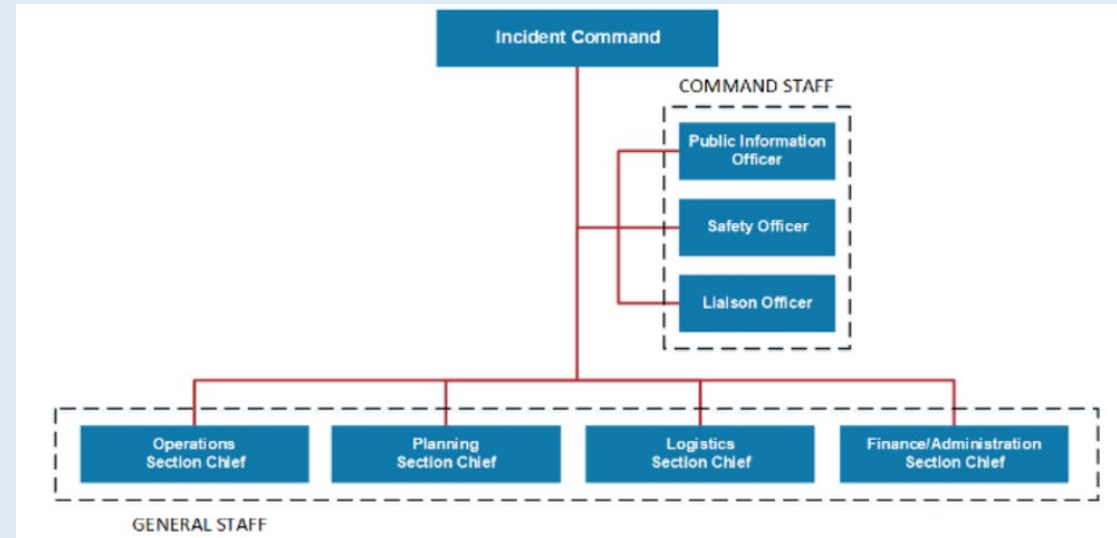
US Army Corps of Engineers, Flood Fight
<https://media.defense.gov/2013/Jun/07/2000746024/-1/-1/0/130604-A-CE999-028.JPG>

Preparing: 6 things that should already exist



Preparing: Test the system before disaster

- Know how your organizational structure will change.
- Understand how organization integrates with public incident command system.
- What can you pre-plan based on data? History?
- Establish and maintain contacts. Do external resources provide what you expect?
- Communicate and coordinate before, during, and after.
- Test and then test again pushing systems (not people) to find failure points.



FEMA example of incident command system organization.
https://emilms.fema.gov/_is_0200c/groups/92.html

Protecting Responders



Protecting Responders: Secondary Emergencies

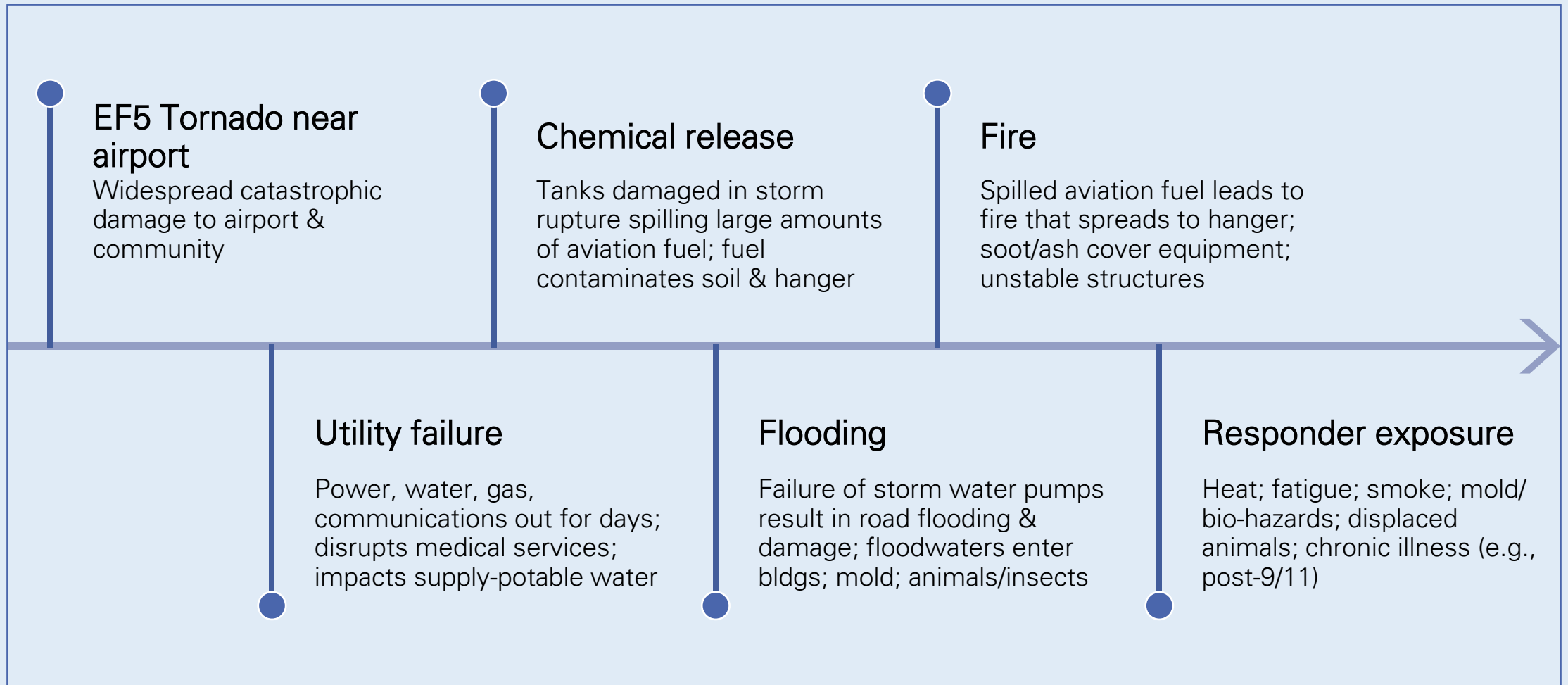
- Some natural disasters and events are a single impacting event.
- In many cases, natural disasters result in secondary emergencies or cascading events. Secondary emergencies include:
 - Fires and explosions
 - Landslides or mudslides
 - Water-borne diseases
 - Infectious diseases
 - Sewage releases
 - Electricity, water, or natural gas outages
 - Sump pump or stormwater pump failures
 - Petroleum and chemical spills



Author, Hurricane Maria, Puerto Rico, 2017

Protecting Responders: Seeing Beyond the First Disaster

Instead of solely planning for the event, plan for the hazards that result.



Protecting Responders: Anticipate & Recognize Hazards

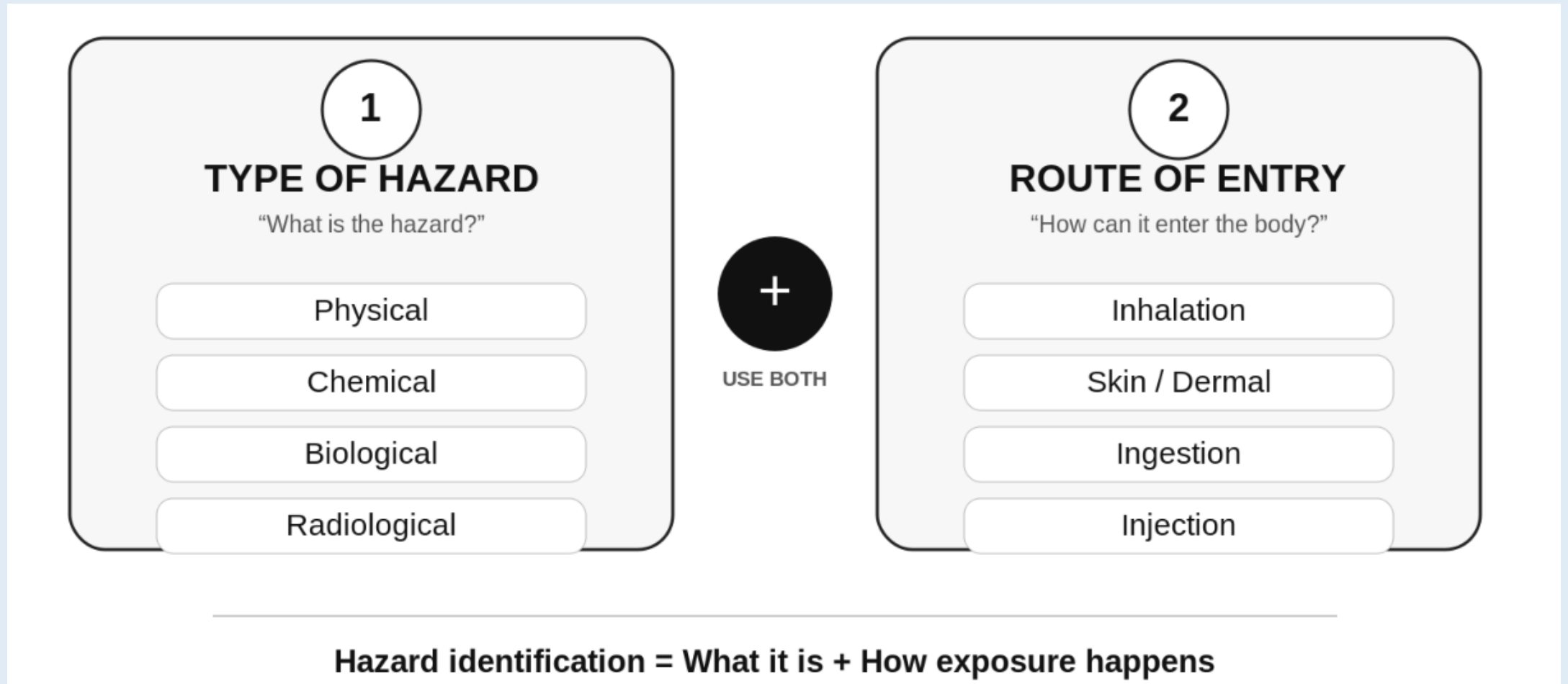
Consider after a storm such as a hurricane or tornado, what hazards do you expect?



Author, Puerto Rico, 2017, Hurricane Maria Recovery, USACE Debris Removal Mission

Protecting Responders: Anticipate & Recognize Hazards

Classify the hazard itself and how exposure can occur



Protecting Responders – Hazards Common to Disasters

- Hazards may include:
 - Structural damage
 - Electrical hazards including solar panels
 - Natural gas and other fuels
 - Thermal Stress (heat/cold)
 - Hazardous materials (e.g., asbestos, lead, petroleum products, etc.)
 - Water damage, mold, and other microbial growth
 - Biological and infectious agents
 - Animals (domestic and wild)
 - Food and drinking water contamination
 - Psychological and physical stress (injuries, fatigue) for victims and responders

Protecting Responders: Assess Risk – Fires

- Risk = likelihood x severity
- Triage hazards
 - Life safety first
- Inhalation hazards (measure when able)
 - Primary route of entry
 - Smoke and ash contain myriad gases and particulates; wildland/urban interface increases complexity
 - Exist during and after fire
 - Small enough to reach lower lungs
 - Difficult to characterize & measure
 - Firefighters have highest risk to long term health effects including cancer (IARC, 2023)



Maui wildfires 2023

<https://www.war.gov/News/News-Stories/Article/Article/3492803/defense-department-committed-to-assisting-hawaii-as-wildfire-recovery-continues/>

Protecting Responders: Assess Risk – Fires cont'd

- Dermal exposures
 - Soot, ash (polycyclic aromatic hydrocarbons), PFAS, particulates (metals, corrosives)
 - Can become inhalation hazards again
 - Flame retardants
- Radiation
 - Smoke detectors & exit lighting
- Exposure during decontamination
 - Gross & detailed
- Exposure to illicit drug labs
 - Toxic chemicals
 - Residue/persistent contamination
 - Cross contamination



California wildfires 2025

https://www.army.mil/article/283376/chemical_corps_soldiers_support_wildfire_response_mission_in_southern_california

Protecting Responders: Assess Risk – Floods

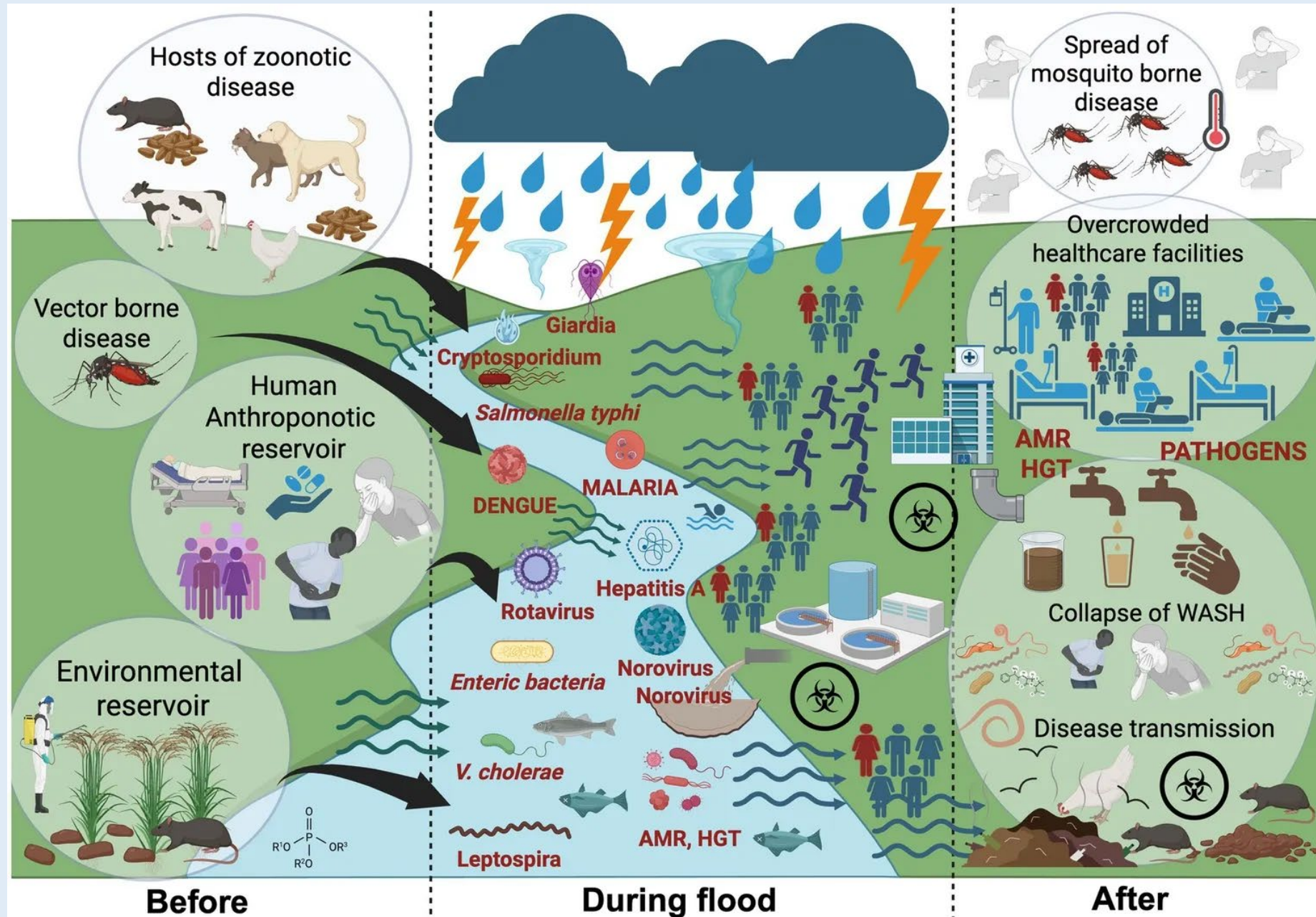
- Physical hazards
 - Drowning
 - Structural stability
 - Damaged roads, sink holes, landslides
 - Electrical
 - Heat stress
- Chemical
 - Release of hazmat
- Biological
 - Sewage contamination (water, soil)
 - Mold & other microbial growth
 - Animal & insect vectors
 - Contaminated/spoiled food & drinking water



Payneway, AR 2011 Flood fight

<https://www.dvidshub.net/search/2.0?q=flood+fight&state=Arkansas>

Protecting Responders: Assess Risk – Floods cont'd



Protecting Responders: Assess Risk – Tornado

- Physical hazards
 - Structural stability
 - Debris (flying, fallout) & sharp objects: jagged metal, broken glass, exposed nails
 - Heat stress
 - Electrical
 - Damaged roads
- Chemical
 - Release of hazmat
 - Exposed, friable asbestos
 - Damaged household goods & vehicles
- Biological
 - Stray dogs, displaced wildlife, insects



Little Rock, AR 2023 Tornadoes

<https://www.embracerelief.org/donation/little-rock-tornado-relief>

Protecting Responders: Assess Risk – Heat

Recognize heat stress signs and symptoms, which may include for adults:

Condition	Signs and Symptoms
Heat exhaustion	heavy sweating; cool, moist skin; fast, weak pulse with fast, shallow breathing; paleness; faintness; cramping; tiredness; headache; dizziness; nausea and/or vomiting
Heatstroke	reduced sweating; red, hot, dry skin; rapid, strong pulse; dizziness; nausea; headache; confusion; uncontrolled twitching or loss of consciousness
Heat cramps	muscle spasms or pain that usually occurs in the abdomen, arms, or legs
Heat rash	painful, a red cluster of pimples or small blisters most likely on the neck, upper chest, in the groin area, under the breast, or in the creases of the elbow or knee

AIHA Guidance Document: Health and Safety Issues in Natural Disasters (2026)

Protecting Responders: Assess Risk – Fatigue

Consequences of Fatigue for Emergency Responders

Health & Well-being	Physical	Cognitive
↑ illness/injury ↓ mental health ↑ sleep disturbances ↑ chronic fatigue syndrome ↑ use of sick leave ↑ medical & insurance costs ↑ overtime costs ↑ lost worktime & absenteeism ↑ stress on coworkers ↓ morale	↓ strength & endurance ↓ vigilance ↑ accidents ↑ injuries (e.g., slips, trips, falls and over-exertion) ↑ risk of non-performance ↑ liability	↑ decision-making errors ↑ memory impairment ↓ effective communication ↓ response time ↓ safety behaviours ↓ situational awareness

Source: Marvin et al. 2023. *Occupation-Induced Fatigue and Impacts on Emergency First Responders: A Systematic Review*.

AIHA Whitepaper: How OEHS Professionals Can Support Occupational Safety, Health, and Wellness Programs for Emergency Response Departments (2026)

Protecting Responders: Assess Risk – Stress

Stress Responses:

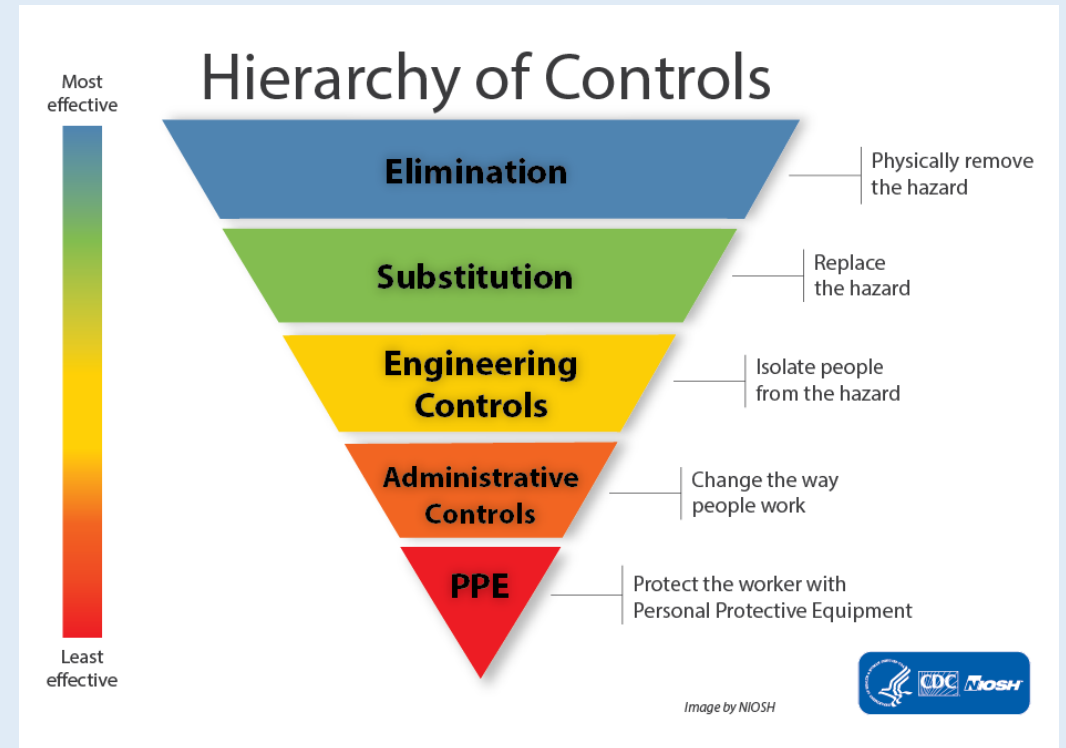
- Behavioral
 - sleep disturbance, use of drugs/ alcohol, aggression, absenteeism, isolation
- Emotional
 - depression, anxiety, irritability, PTSD
- Cognitive
 - difficulty concentrating, worrying, poor memory
- Physiological
 - muscle tension/pain, increased BP/heart rate
- Biochemical
 - stress hormones released (e.g., cortisol, adrenaline)



Author, USACE personnel,
Hurricane Maria, 2017

Protecting Responders: Reduce Risk

- Use hazard controls according to hierarchy as feasible
- PPE is necessary but not only plan
 - PPE should rarely be blanketed
 - Needs to align to hazards
 - Protect without increasing risks
- Many administrative controls can be preplanned (response plans, medical clearances, fit testing respirators, training)
- For prolonged recovery efforts, higher level controls should be developed and implemented
- National Fire Protection Assoc. has several standards to help (e.g., NFPA 1550, 1581)



<https://www.cdc.gov/niosh/hierarchy-of-controls/about/index.html>

Reentry, Recovery, & Return to Operations

- Post-disaster recovery is hazardous work; however,
 - May be fewer immediate life safety hazards
 - Sites may be better characterized with hazards identified and risks assessed
- Level of acceptable risk may decrease during this phase
- S&H support remains important during each step of recovery effort
 - Qualified post-restoration S&H and engineering
 - Obtain post-restoration verification before re-occupancy, if needed

Example of how the process may be performed.



Reentry, Recovery, & Return Considerations

- People want to know “just how bad it is” & “when can we go back?”
- Facility (or home) familiarity does not equate to post-disaster safety.
- Time (*generally*) changes and worsens conditions. What do you expect 30, 60, 90 days out?



Structure

- Roof
- Walls
- Floors
- Debris
- Rodents



Electricity/Batteries

- Downed power lines
- Generators
- Wet panels
- Wet wires
- Li-ion batteries



Fuel & chemicals

- Natural gas leak
- Compressed gas cylinders
- Fuel oil
- Chemicals
- Incompatible mixtures



Atmosphere

- Carbon monoxide
- Low oxygen
- Volatile organic compounds (e.g., solvents, fuel)
- Smoke, soot, ash residue
- Hydrogen sulfide



Water intrusion

- Rotting of materials
- Standing water
- Sewage
- Mold
- Microbial growth
- Contaminated with chemicals

Reentry, Recovery, & Return Considerations cont'd

- Have a trained S&H person measure what they can and document what they cannot.
 - Multi-gas meter with photoionization detectors: oxygen, carbon monoxide, hydrogen sulfide, and volatile organic compounds
 - Particulate/aerosol monitor (less common): particulates
 - Wet Bulb Globe Temperature meter: heat stress (see also AIHA app: <https://www.aiha.org/public-resources/healthierworkplaces/workplace-hazards/thermal-heat-stress-resources-oehs-professionals>)
 - Air and/or bulk sampling (if indicated) (e.g., asbestos, lead)
 - Medical follow-up (e.g., surveillance, exposures)
- Document who entered (when, where, how), tasks performed, controls used, symptoms reported, decon, medical follow-up, reentry decision, etc.

Putting it into practice



Identify and include all responsible Safety & Health Professionals

Resources

- AIHA® Guidance Document: *Health and Safety Issues in Natural Disasters* (free) (<https://www.aiha.org/>)
- AIHA® White Paper: *Industrial Hygienist's Role and Responsibilities in Emergency Preparedness and Response White Paper*
- AIHA® Technical Framework: *Role of the OEHS Professional in Emergency Planning*
- AIHA® Technical Framework: *Role of the OEHS Professional in Continuity Planning*
- AIHA® Technical Framework: *Emergency Preparedness and Response for the Industrial Hygienist*
- AIHA Incident Preparedness and Response Working Group (<https://www.aiha.org/get-involved/volunteer-groups/technical-committees/incident-preparedness-and-response-working-group>): *Resources*
- American Red Cross: *Learn Ways to Be Prepared and Stay Safe* (<https://www.redcross.org/>)
- Federal Emergency Management Agency: *Preparedness Activities & Research* (<https://www.fema.gov/emergency-managers/individuals-communities/preparedness-activities-research-webinars>)

Questions?

Thank you!

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