EMERGENCY RESPONSE

CO2 TRAINING

CO_2 Characteristics and Hazards

Transportation of CO_2 in Pipelines

- Dense, supercritical fluid
- 1000 psi or more
- 8 – 36” diameter pipelines

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CO_2 Uses

- Dry Ice
- Carbonated Beverages

CO_2 Uses

- Fire Extinguishers
- Life Jackets

CO_2 Uses

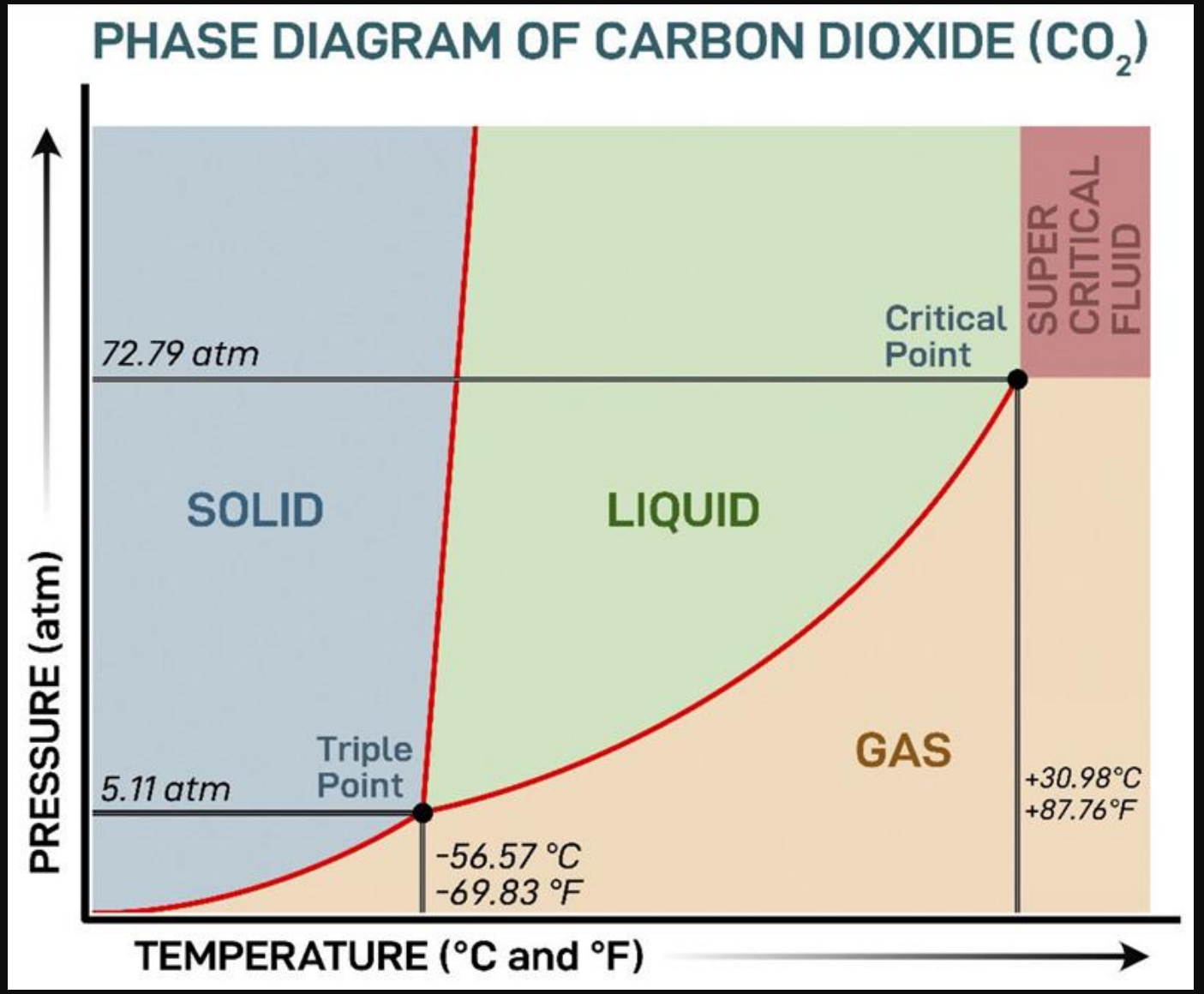
- Enhanced Oil Recovery

CO_2 Uses

- Carbon Capture and Storage

Characteristics

- Nonflammable
- Odorless
- Colorless



CO_2 in the Air

- Volcanoes
- Fires
- Respiration
- Vehicles
- Power plants

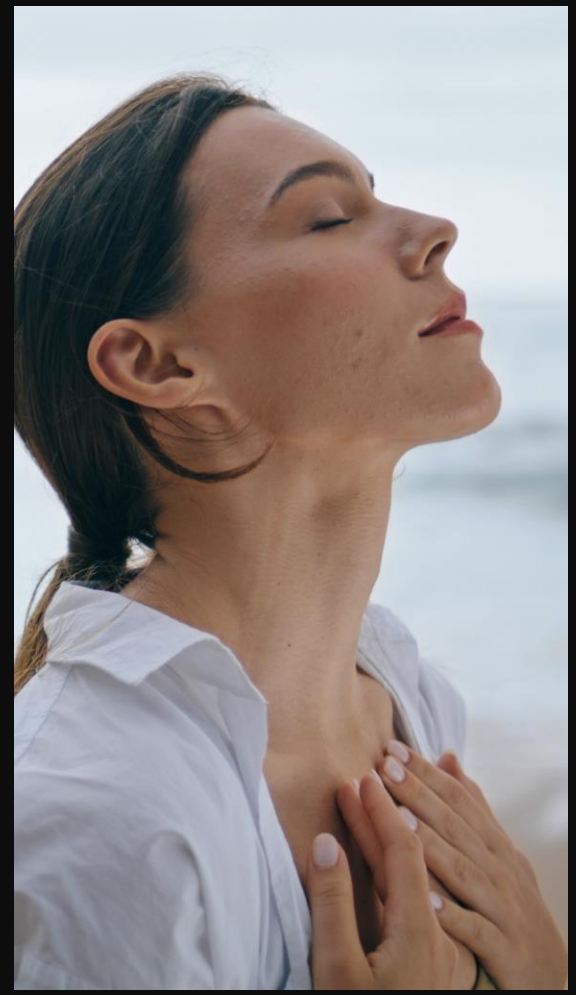
CO_2 in the Air

- Indoor air quality
- Ventilation evaluation
- Allows for quick evaluation

CO_2 in us

- Constant exposure
- Respiration by-product
- Normal air

  300-600 ppm



Physical Hazards

- Rapid expansion when released from a pressurized pipeline
- Can accumulate in low lying areas

Physical Hazards

- Dermal hazard
- Colorless

Canadian Frostbite Care Network

Physical Hazards

- Daytime – greater dispersion
- Nighttime – higher concentrations possible at night

Meteorological Effects on Physical Hazards			
Scenario	Potential Hazards		
	Reduced Visibility	Dermal Hazards	Accumulation of CO_2 in Low Areas
Daytime, sunny, with winds greater than 10 mph		X	
Daytime, cloudy, humid, with winds less than 3 mph		X	X
Nighttime, with winds greater than 10 mph		X	X
Nighttime, humid, with winds less than 3 mph	X	X	X

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Primary Hazard – Oxygen Displacement

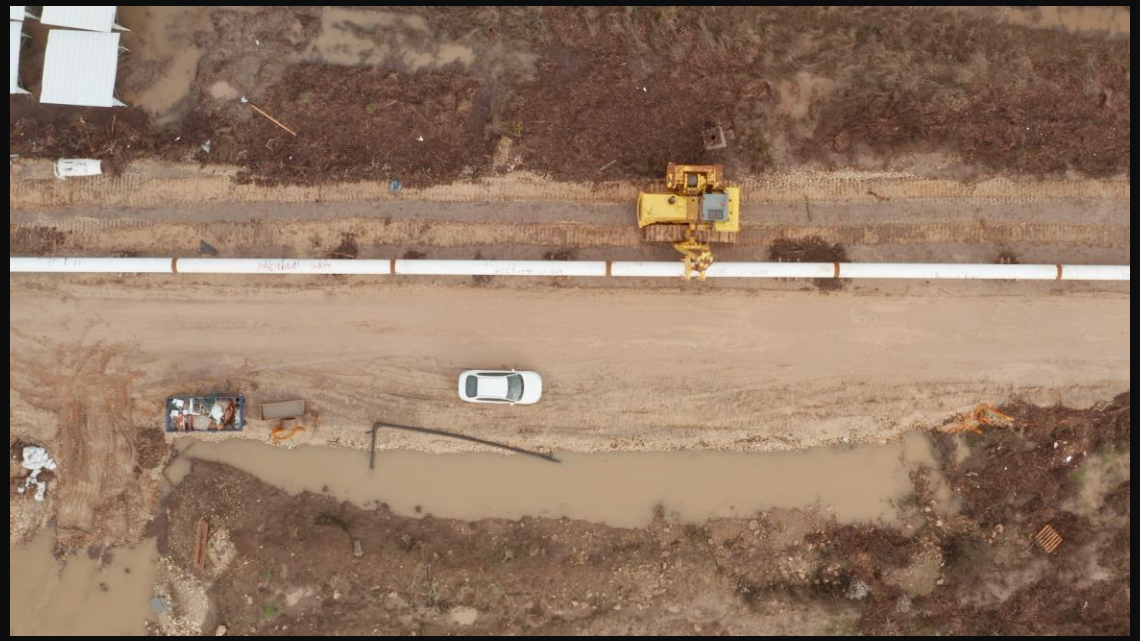
- 20.9% O_2 – Ambient air - Normal
- Below 19.5% O_2 – Oxygen deficient
- 6%-10% O_2 – Nausea, vomiting, unconsciousness
- Less than 6% - Seizures, Cardiac Arrest, DEATH

Exposure Limits

Product Name	CASRN	ACGIH TLVs		Units
		TWA (8 hr)[a]	STEL (15 min)[b]	
Carbon dioxide	124-38-9	5,000	30,000	ppm
Action Required for Responders		SAR or SCBA (if longer than eight hours of exposure)	Evacuation to fresh air or SAR or SCBA	

Emergency Preparedness and Planning

Operator Responsibility

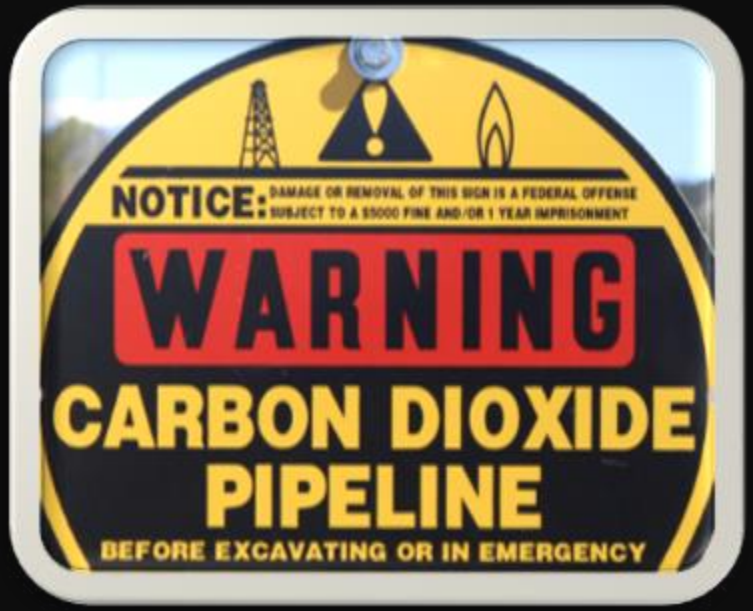


- Outreach to:
  - Affected public
  - Local emergency managers
  - FD/LEO/LEPCs
  - Excavators/Contractors
  - Public Officials

Operator Responsibility

- Work with schools, hospitals, etc. along the ROW
- Evacuation plans
- Educating emergency responders

Pipeline Markers



Response Drills & Exercises

Type of Drill	Frequency	Attendees
Internal notifications/tests	Quarterly	Controllers, emergency response team members
Tabletop exercise	Annually	Controllers, emergency response team members, third-party response organizations, local, state, and federal emergency response officials*
* Full-scale exercises with federal, state, and local emergency response officials are recommended at least once every three years.		

Response Drills & Exercises

Training	Frequency
Hazardous waste operations and emergency response (HAZWOPER) technician level	One time, then annual refresher
Incident command system (ICS)	One time, then routine refresher
Use of portable air monitoring/gas detection equipment*	Annual
Proper use of personal protective equipment*	Annual
Hazard communication (HAZCOM)*	Annual
Respiratory protection	Annual
First aid/CPR	Biennial
* Can be included in or conjunction with HAZWOPER training.	

Incident Command System (ICS)

Operator Responsibility

- ICS-200
- Understanding of ICS concepts

Fire Department Responsibility

- Multiple ICS classes
- Implementing the ICS

The Fire Department should

NEVER OPERATE ANY VALVES, EQUIPMENT, OR CONTROLS INVOLVING THE PIPELINE!

THIS CAN CAUSE MAJOR PROBLEMS AND PROLONG EMERGENCY OPERATIONS

EMERGENCY RESPONSE

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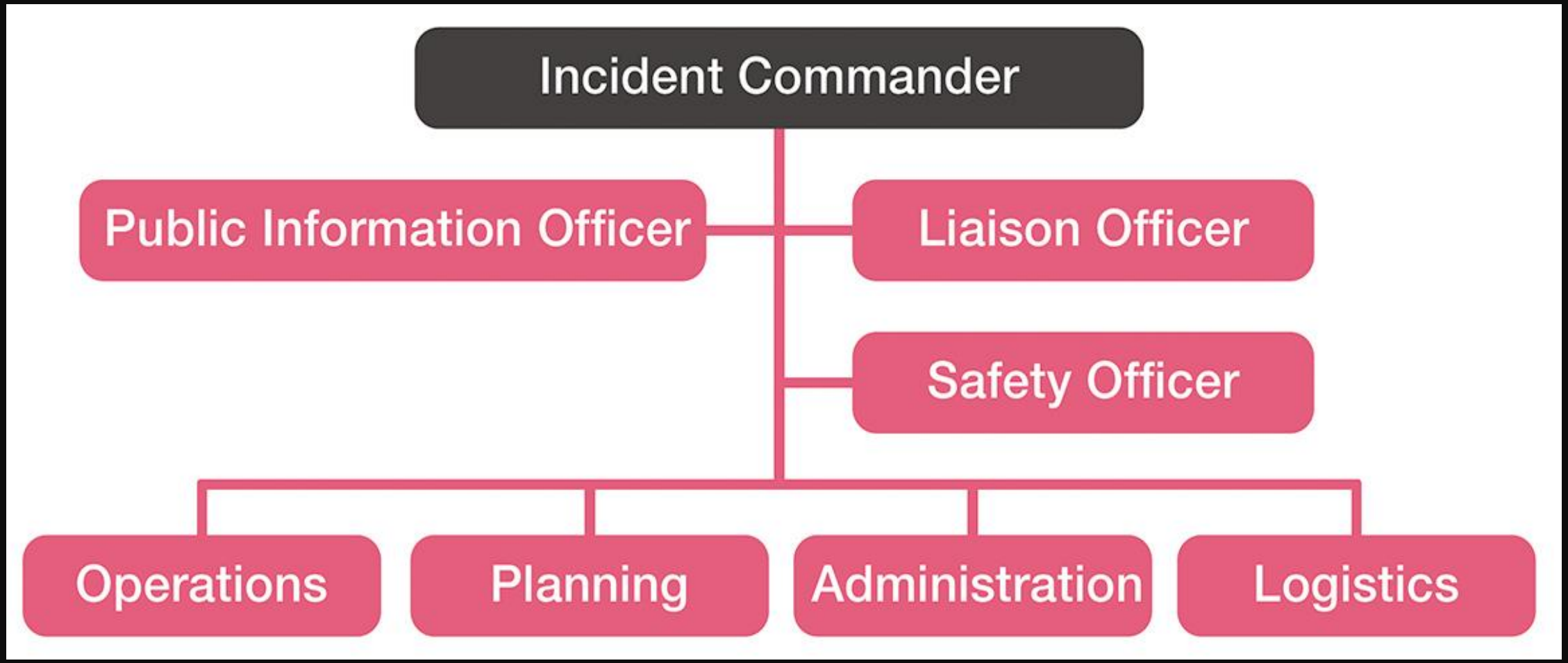
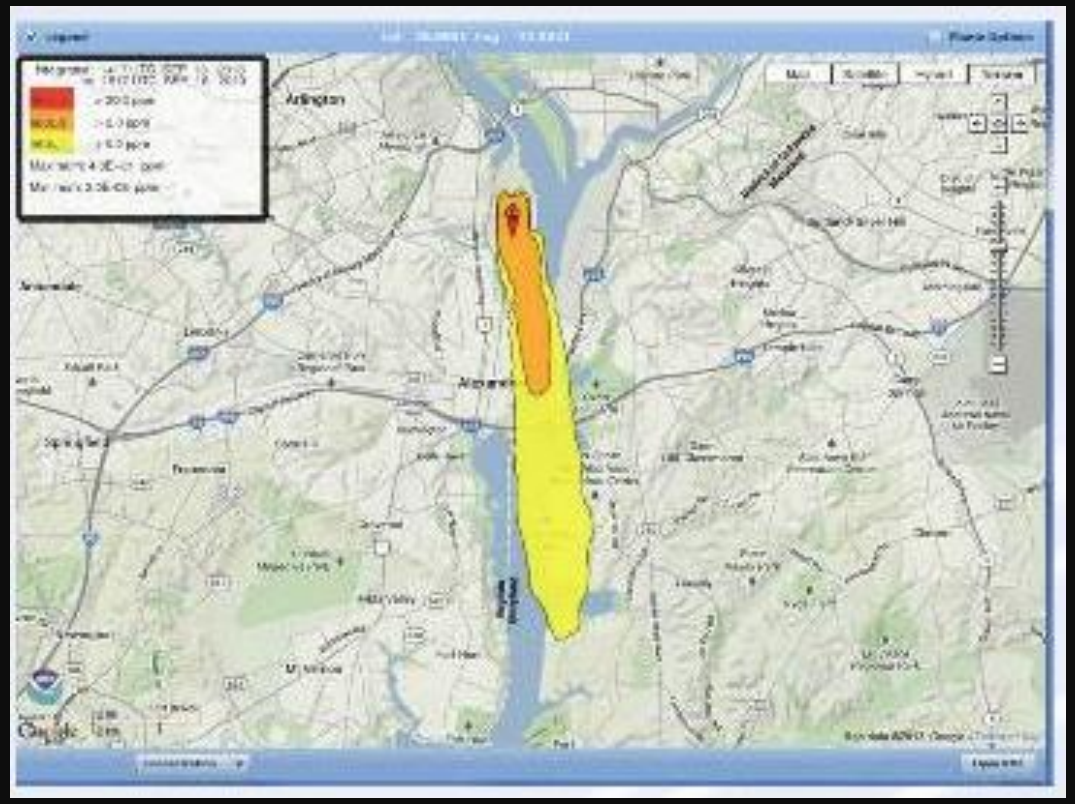


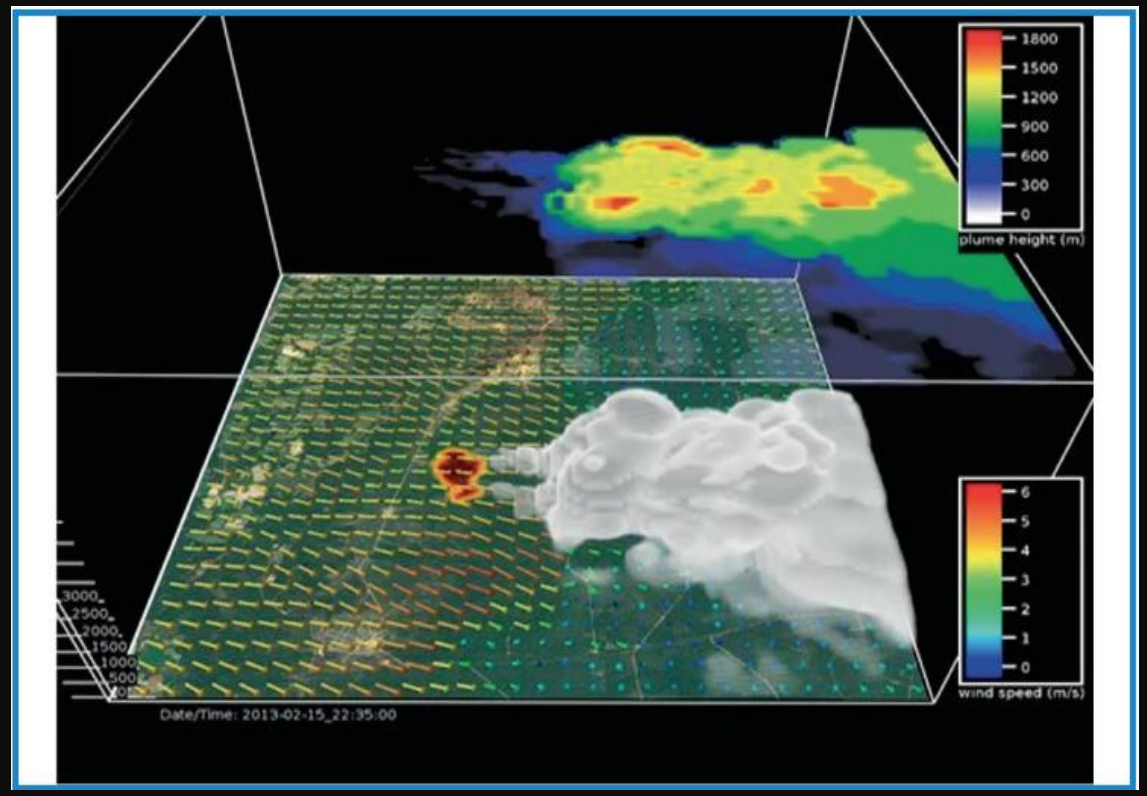
Texas School Safety Center



National Oceanic and Atmospheric Administration

Dispersion Modeling

- Estimates worse-case scenario for high consequence areas (HCAs)
- Worst rupture in the worst place at the worst time



Liu, Y. *et al.* (2022). Smoke Plume Dynamics. In: Peterson, D.L., McCaffrey, S.M., Patel-Weynand, T. (eds) Wildland Fire Smoke in the United States. Springer, Cham. https://doi.org/10.1007/978-3-030-87045-4_4

Dispersion Modeling

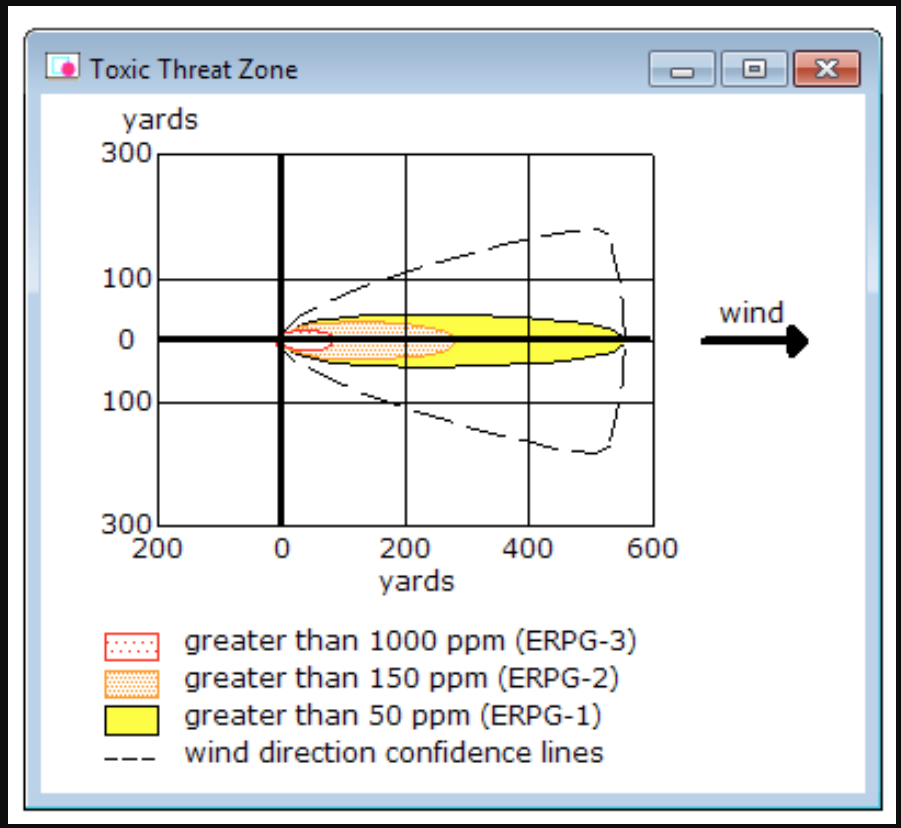
- Pipeline parameters
- Meteorological conditions
- Isolation valves and times
- CO2 concentrations of interest

Dispersion Modeling

- Always consider the topography

Dispersion Modeling

- EPA ALOHA Software



EPA

EMERGENCY RESPONSE

CO2 INCIDENTS

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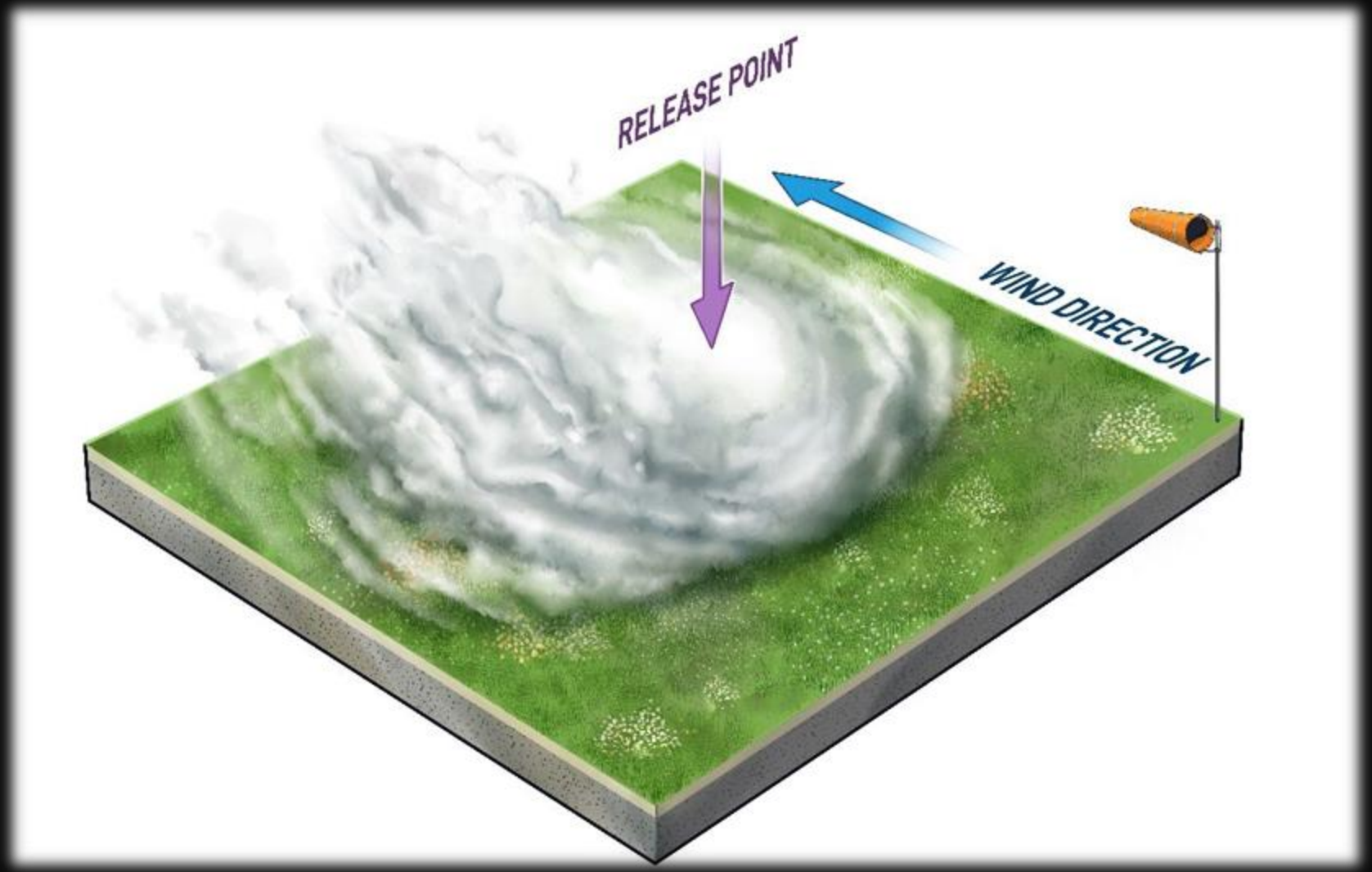
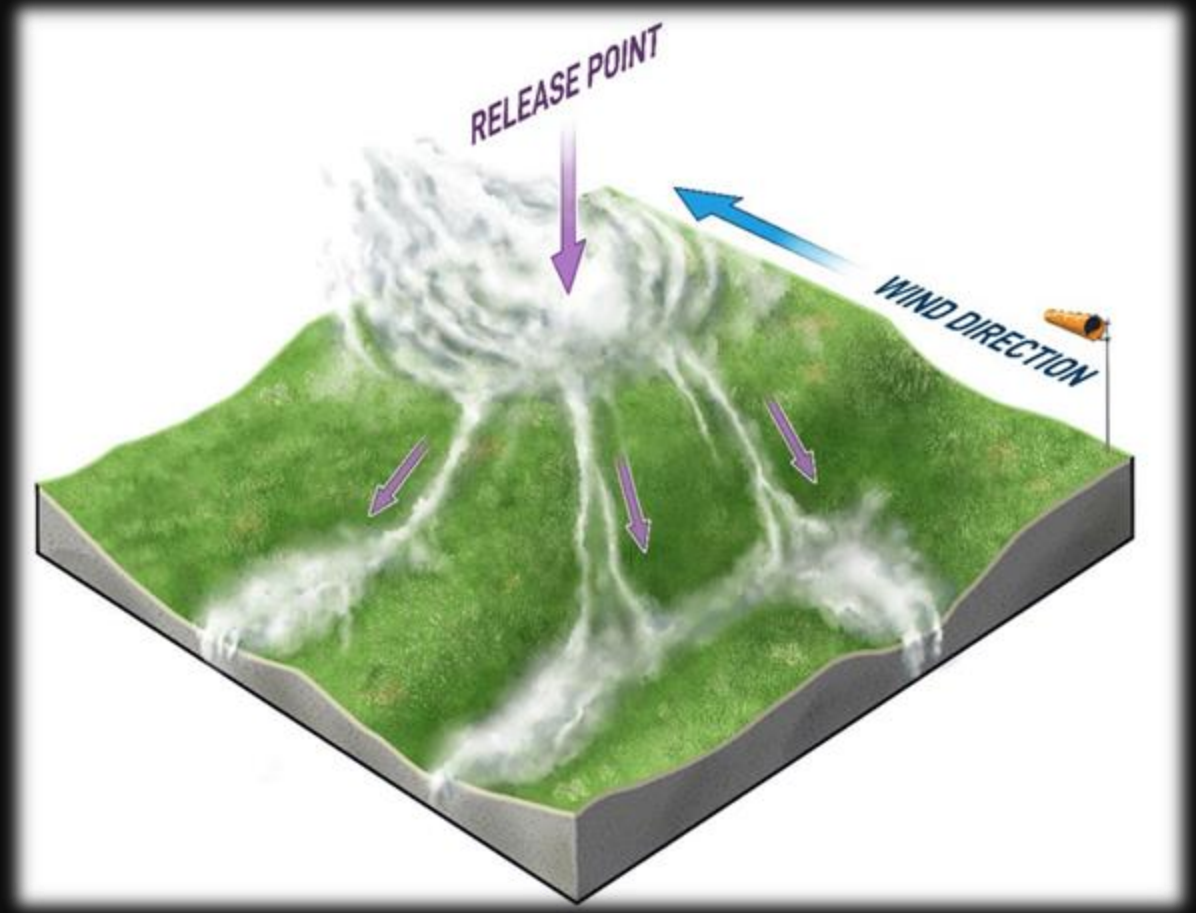


Dispersion Modeling Assistance

- MEMA/FEMA
- NWS
- ALOHA
- Pipeline Operator



CO_2 Pipeline Leak Detection & Identification

- Sight
- Sound
- Smell

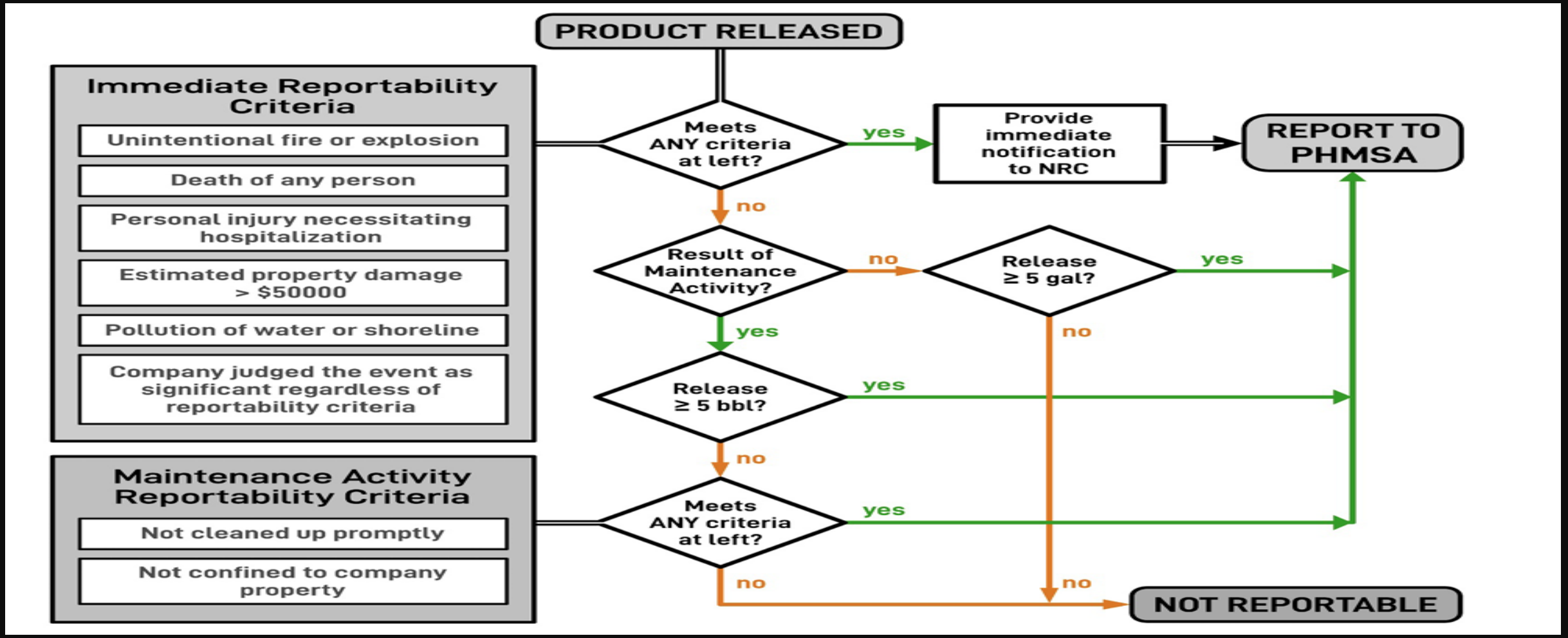
CO_2 Pipeline Leak Detection & Identification

- Operators SCADA can remotely detect leaks
- Pressure may take hours to bleed off

CO_2 Pipeline Leak Detection & Identification

- Vandalism
- Erosion
- Exposed pipe
- Third-party excavation

Operator Reporting Requirements



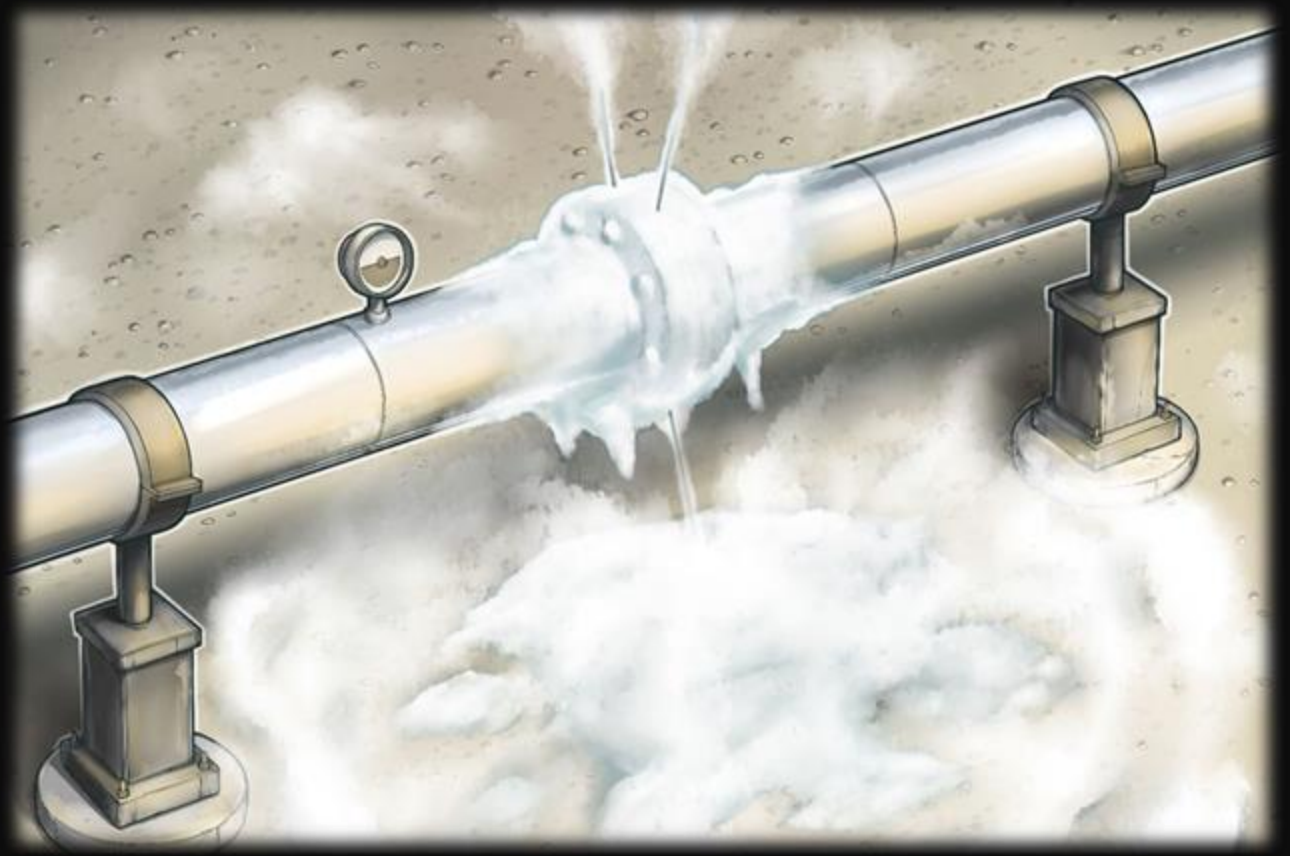
CO_2 Pipeline Release Response Actions

- Protect the public
- Safety of personnel
- Stabilizing the incident

Emergency Responder Safety

Responder Safety

- PPE – to protect from flying debris and dermal injuries (frostbite)
- SCBA
- Hearing protection



Responder Safety

- If no CO_2 detector is available – monitor O_2 levels
- Below 19.5% O_2 – evacuate or use SCBA

EMERGENCY RESPONSE

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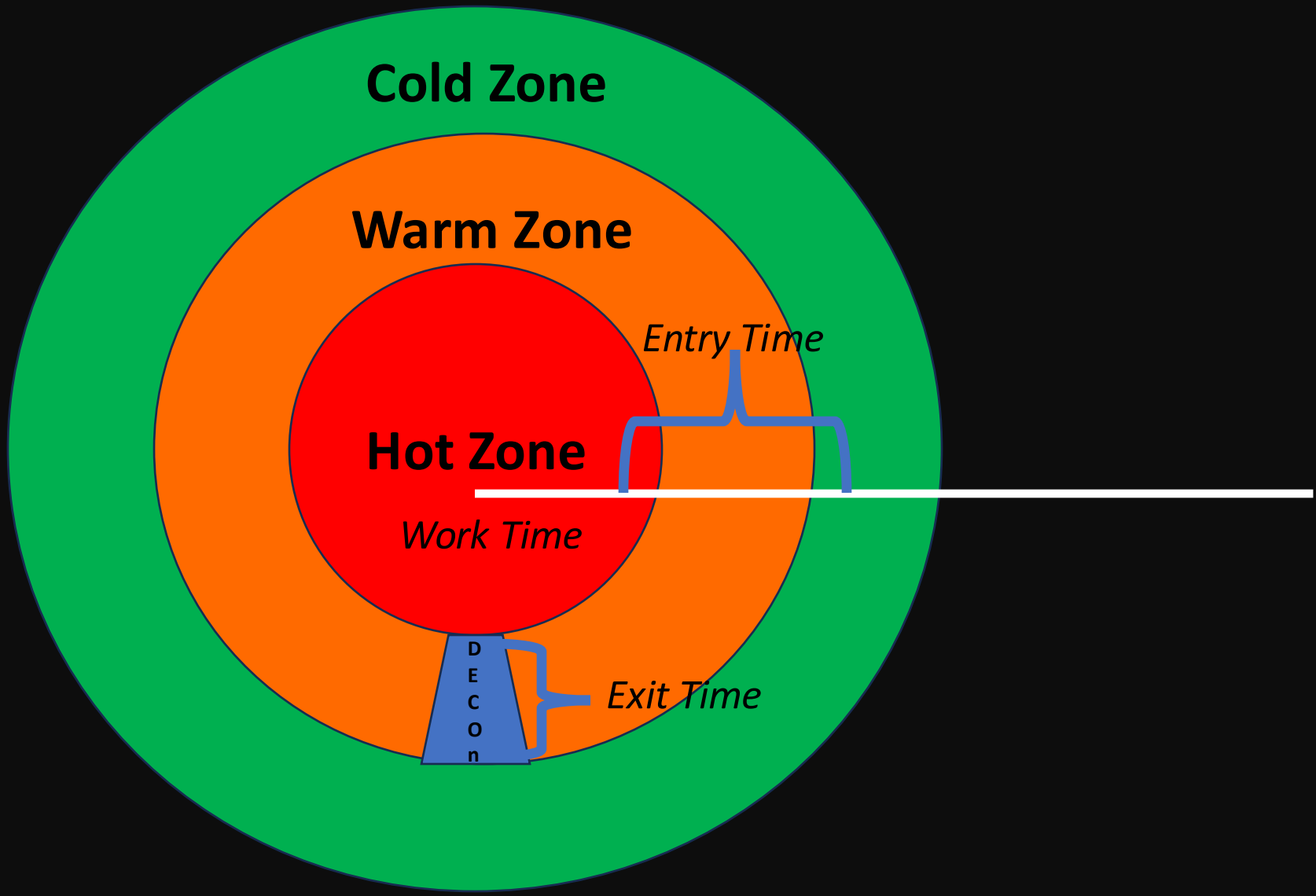


Isolation/Control Tactics

- Operators will control valves
- **FD should NEVER control pipeline valves!**

Isolation/Control Tactics

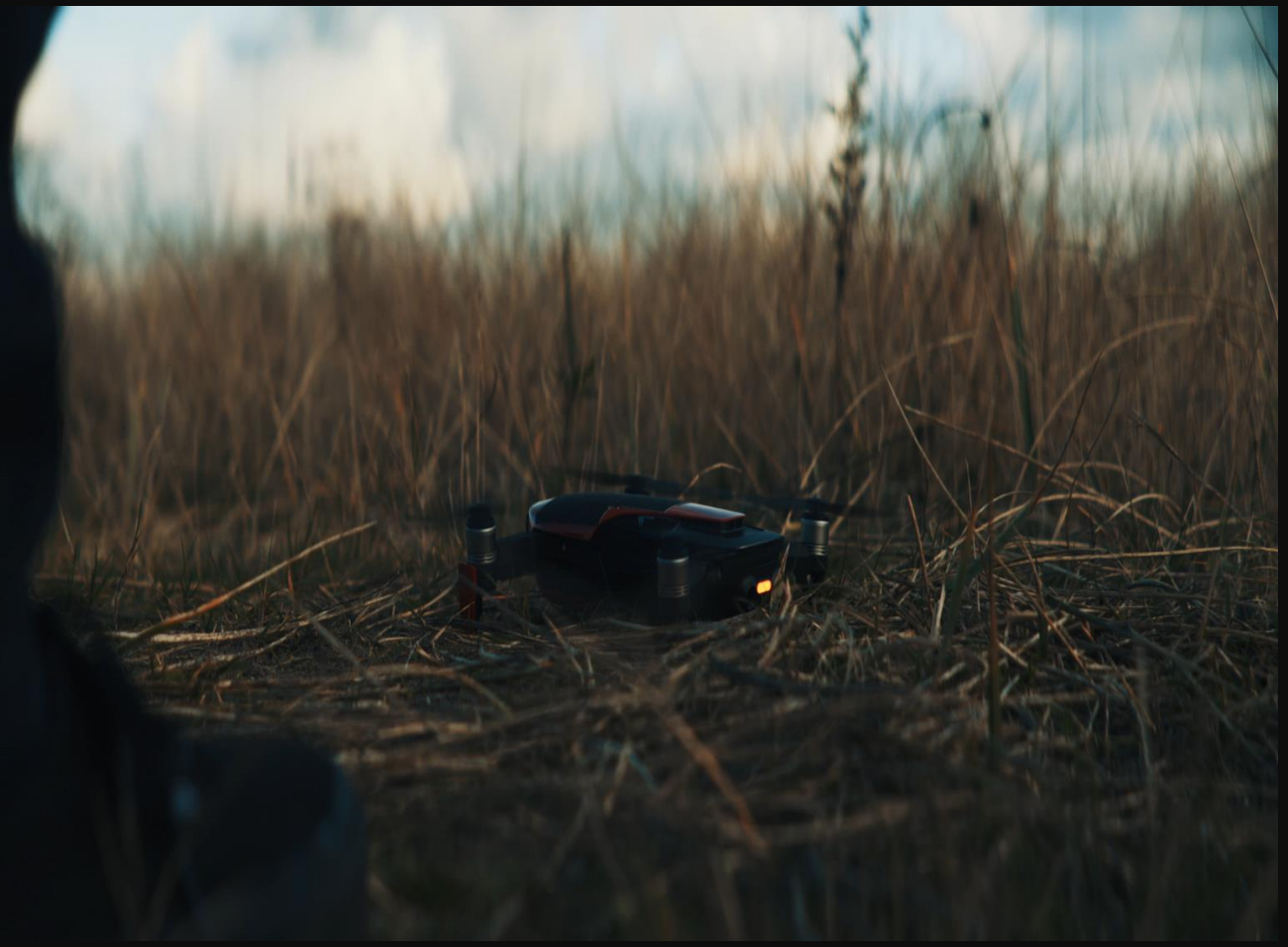
- The operator may vent the pipeline from a remote location.
- Air monitoring will be important during these operations

Isolation/Control Tactics

- Forced air ventilation can help improve visibility, disperse vapors, and improve air quality
- Helps operators reach valves

Plume Predictions

- Wind direction is the most common predictor
- Topographical effects
- Plane and drone surveys
- Operator and National Weather Service can assist



Third-party Responders

- Air monitoring
- Help establish hot, warm, and cold zones
- Assist in Unified Command
- Contracted by the operator

Air Monitoring

- Work area monitoring
- Community monitoring
- Site Assessment

Air Monitoring Techniques	
Procedure	**Description**
Real-time handheld survey	Staff members may utilize handheld instruments (e.g., colorimetric detector tubes) to measure airborne chemical concentrations. These handheld instruments will primarily be used to monitor the ambient air quality at breathing zone level. Additionally, measurements may be made at grade level, as well as in elevated workspaces, as indicated by chemical properties or site conditions. These techniques may also be used to verify detections observed by the network of portable fixed-detection systems.
Radio-telemetering network	A radio-telemetering network of fixed-detection systems may be deployed in locations where monitoring from a remote location would be beneficial. These instruments will relay readings back to a centralized location that is monitored by the third-party provider.
Fixed real-time monitoring locations	Multiple community locations may be identified and monitored at the same location approximately once per hour using handheld instruments. This allows the use of statistical analysis more effectively than with a random approach.

Incident Management

EMERGENCY RESPONSE

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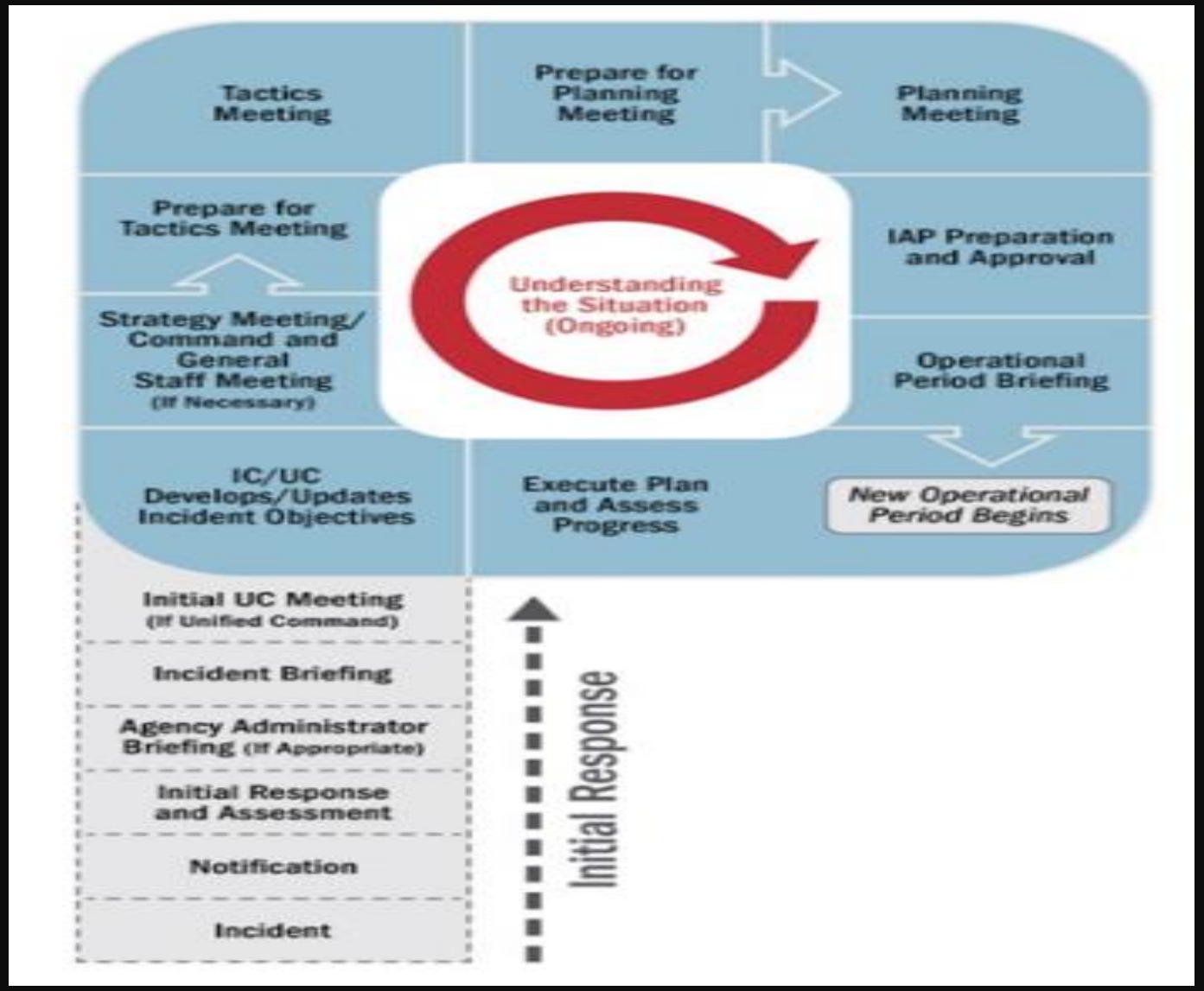

Incident Management

- Incident are typically short
- Always prepare for extended incidents
- ICS 201 Form

EMS Considerations for CO2

Atmospheric Hazards

- CO_2 is **colorless, odorless, and heavier than air**, meaning it can accumulate in **low-lying or confined areas**, creating an **oxygen-deficient atmosphere**.
- Always **monitor the atmosphere** using a **multi-gas meter** before entering; treat the area as **IDLH (Immediately Dangerous to Life or Health)** if oxygen levels are below 19.5%.

Protective Equipment

- Use **SCBA (Self-Contained Breathing Apparatus)** in confined spaces or suspected high CO_2 concentrations.
- Consider **thermal gloves and eye protection**—liquid CO_2 can cause **cryogenic burns** on contact.

Decontamination

- Typically, no chemical decon is required, but **remove clothing** contaminated by the liquid to prevent **cold injury progression**.

Patient Assessment

Primary Concerns

- **Asphyxiation / Hypoxia** – CO_2 displaces oxygen; the patient may present with altered mental status, confusion, headache, or loss of consciousness.
- **Frostbite / Cryogenic Burns** – Skin contact with liquid CO_2 can cause deep cold injury similar to thermal burns.
- **Respiratory Irritation** – Inhalation of high concentrations can cause coughing, shortness of breath, and hypercapnia.

Initial Assessment

- Quickly remove the patient from the contaminated area to fresh air.
- Assess **airway, breathing, circulation**, and **neurological status**.
- Pay attention to **skin color**, **respiratory effort**, and **mental status** (CO_2 narcosis can mimic intoxication).

Treatment Priorities

Oxygen Therapy

- Administer **high-flow O_2** via non-rebreather mask as soon as possible.
- For severe cases or unconscious patients, **assist ventilations** or **intubate** as indicated.

Cryogenic Burn Management

- Remove any restrictive clothing or jewelry.
- Treat affected areas as **frostbite or thermal burns**: cover loosely with dry, sterile dressings; **do not rub or apply heat**.
- Manage pain appropriately and monitor for **shock**.

Special Considerations

- **Multiple Casualties:** CO_2 incidents often affect several people due to confined-space displacement.
- **Secondary Contamination:** Minimal risk, but responders should still ensure victims' clothing isn't releasing trapped liquid gas.
- **Coordination:** Work with **HazMat** and **Fire** for air monitoring, leak control, and scene stabilization.

EMERGENCY RESPONSE

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Hazard Type	Patient Effect	EMS Treatment
Asphyxiation (O_2 displacement)	Hypoxia, AMS, LOC	Remove to fresh air, high-flow O_2, assist ventilations
CO_2 Inhalation	Headache, confusion, respiratory distress	Oxygen, monitor EtCO_2, support respirations
Cryogenic Burn	Frostbite, tissue necrosis	Remove clothing, dry sterile dressing, prevent rewarming injury
Scene Hazard	Oxygen-deficient environment	Use SCBA, continuous air monitoring, coordinate with HazMat

Questions/Comments