16- Hour Industrial Emergency Response
Large-volume fuels release
Participant Guide
July 2017

Acknowledgments

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The Midwest Consortium gratefully acknowledges the contributions of the following in program development and review: CARS, Minneapolis, BioUrja, and the United Brotherhood of Teamsters.

We encourage you to comment on these materials. Please give your suggestions to those teaching the program in which you are now enrolled, or forward them to the Midwest Consortium for Hazardous Waste Worker Training, University of Cincinnati, P.O. Box 670056, Cincinnati, Ohio 45267-0056 or click on 'contact us' at http://med.uc.edu/eh/academics/training/mwc.

Warning

 The material was prepared for use by facilitators experienced in the training of persons who are or who anticipate being employed at a hazardous waste worksite. Authors of this material have prepared it for the training of this category of workers as of the date specified on the title page. Users are cautioned that the subject is constantly evolving. Therefore, the material may require additions, deletions, or modifications to incorporate the effects of that evolution occurring after the date of this material preparation.

Disclaimer

The Occupational Safety and Health Administration (OSHA) rule to help assure worker health and safety during emergency responses requires introductory awareness training on basic hazard recognition and alerting, operations-level training for those who will control the spread of the hazard, away from the point of emission and technician level training for those who will work at the point of emission to stop the release. Additional categories of training are described for the Incident Commander and Specialist. See 29CFR1910.120.120(q) for complete details. This program builds on the operations-level program to increase the preparedness planning and response to a release of fuels transported by road, rail or pipeline.

Additional training is necessary to perform many activities. These activities include performing control actions (technician-level skills) and using specialized monitoring instruments. For information about additional training, consult the training facilitator, appropriate emergency plans, or your company health and safety representative.

All web links are active as of June 30, 2017; if you find an error, please inform the facilitator so that it can be updated.

Table of Contents

Overview

This training is designed for members of an emergency response team who may be called to a large-scale release of fuels during transport by rail, pipeline or over the road. This program is a review of the general responsibilities for operations-level responders with a focus on specific skills required to respond to a release in and around the community.

Incidents and emergencies are inevitable-- never planned and will always occur unexpectedly. An incident can create tunnel vision and confusion if you are not properly trained and prepared and this can negatively impact human health and result in long lasting health effects and even potential fatalities. Don't let this happen.

protect yourself first, be prepared, allow the response system to work

As noted by Wall Street Journal reporters in 2015:

All modes of transportation
Pipeline
Rail
Water
Truck
Have risks of spill and can be improved…

https://www.wsj.com/articles/how-to-transport-oil-more-safely-1442197722. (accessed January 7, 2016)

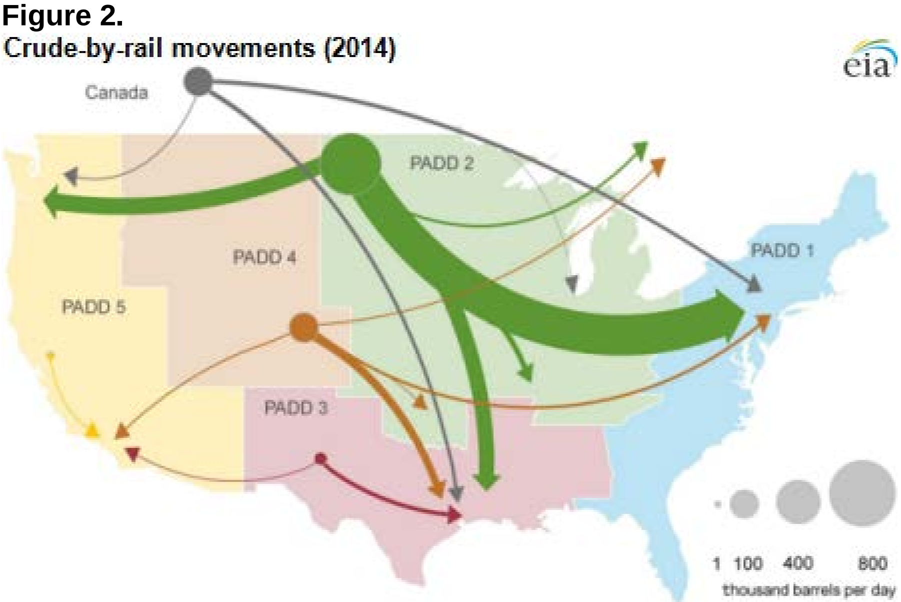
Best be prepared!

Challenges of a Fuels Release during Transport

Much of the US energy resource is brought to shipping points by road, then transported by rail or pipeline as shown in Figures 1 and 2 (rail) and Figure 3 (pipeline).

Figure 1. Source:http://www.bst-tsb.gc.ca/eng/rapports-reports/rail/2013/r13d0054/r13d0054.asp. Accessed Jan 4, 2107.

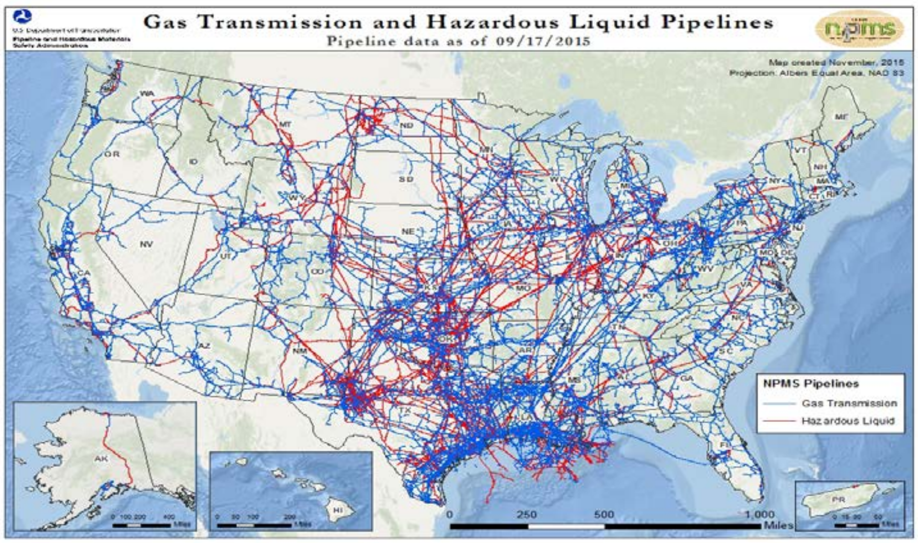
Figure 2.



Source: U.S. Energy Information Administration based on data from the Surface Transportation Board and other information
Note: Crude-by-rail movements greater than 1,000 barrels per day are represented on the map; short-distance movements between rail yards within a region are excluded. PADD denotes Petroleum Administration for Defense District. (Accessed January 7, 2017).

Additional maps can be created here: http://www.eia.gov/state/maps.cfm?v=Petroleum.

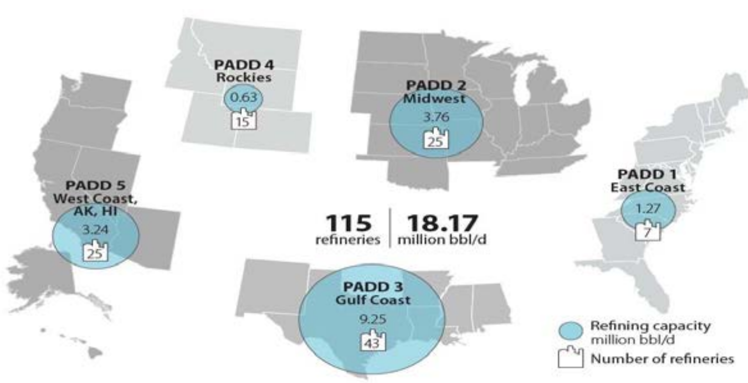
Figure 3. Pipeline graphic. Red is hazardous liquid lines as of September 2015.



Source: https://en.wikipedia.org/wiki/Pipeline_and_Hazardous_Materials_Safety_Administration. Accessed Jan 4, 2017.

Crude is also moved by pipeline from the Gulf Coast (PADD 3, Petroleum Administration for Defense District) into the Midwest (PADD 2), as shown in Figure 4 https://www.eia.gov/dnav/pet/pet_move_pipe_dc_R30-R20_mbbl_m.htm for monthly movement.

Figure 4. U.S. Refinery Capacity by PADD in 2012 (Congressional Research Service; Energy Information Administration https://fas.org/sgp/crs/misc/R43390.pdf accessed January 4, 2017)



What can happen along all of these routes? Usually nothing happens.

But sometimes releases occur that result in the need for response, including…..

Fire

Freight train burning in Lac-Megantic, Quebec, Canada
Source: **http://www.bst-tsb.gc.ca/eng/enquetes-investigations/rail/2013/r13d0054/r13d0054.asp**. Accessed Jan 4, 2016

Release to water and land

Booms on the Kalamazoo River to contain oil from Canada released from pipeline.
Source: https://www.epa.gov/enbridge-spill-michigan. Accessed Jan 4, 2017.

Release to land

Produced water truck overturned. North Dakota, fall 2016. Cliff Whitman photo.

Examples of Midwest releases:

North Dakota:

Near Casselton, 18 Bakken crude oil cars derailed
December 30, 2013
476,000 gallons spilled and ignited
Voluntary evacuation of the town of 2,400

Near Tioga, pipeline breach
September 2013
Farmer harvesting wheat noticed sheen on soft ground
865,200 gallons (20,600 barrels) released
23 acres of farmland required remediation

Wisconsin

Near Elena, 25 of 112 cars derailed including some carrying ethanol
November 1
Five cars leaked, releasing 18,000 gallons of ethanol to the Mississippi
75 people evacuated; road closure

Illinois

Near Galena, 21 of 105 cars derailed; six contained Bakken crude
March 5, 2015
Two burst into flames
Evacuation for 1 mile

Summary

The following is taken from remarks made by Dave Rogness, emergency manager of Cass County North Dakota, to the Regional Interagency Steering Committee meeting about the 2013 Casselton train derailment, discussing one derailment with release of fuel.

> The Casselton explosion was just one example of the hazards that can result from oil-car derailments.
>
> Chemical hazards, Rogness pointed out, include asphyxiation from hydrogen sulfide, cancer from benzene and the typical house-fire hazards of carbon monoxide, sulfur oxides, nitrogen oxides and smoke particles.

The explosion alone can also be devastating. He pointed to the example of the fireball of Bakken crude oil in Lac Megantic, Quebec, in July of 2013 that left 47 dead and 30 buildings destroyed. Blazing oil flowed over the ground, drained into storms sewers, and erupted as huge fires from other drains, manholes, and even chimneys and basements of other buildings.

How real is the threat? The U.S. Department of Transportation predicts more than 200 crude and ethanol trains will derail over the next 20 years, including 10 in urban areas, Rogness said. At least one of those urban derailments could be catastrophic.

Source: https://www.fema.gov/challenges-faced-during-2013-casselton-train-derailment. Accessed Jan 5, 2017

More local examples may be provided by the facilitator.

What is the Emergency Responder Preparedness Planning for high-volume fuel release program?

The increasing volume of fuels transported by surface, rail and pipeline has focused communities and responders on the need for large-scale planning to respond in the event of a release. Appropriate technology and materials are needed to protect and inform the public and emergency responders. Since information about monitoring methods available for emergency responders, decontamination procedures, or potential health effects of exposure, may need to be updated from time to time, it is recommended that you request updates annually as part of the Emergency Response Plan (ERP) review and/or the required operations-level refresher training.

This Emergency Responder training program adds to the Industrial Emergency Responder—Operations Level Program, by targeting planning for a specific type of emergency. Emergency response procedures and incident command system strategies are covered first. Then specific health hazards, monitoring methods, decontamination procedures, and protective equipment requirements for emergencies involving crude or ethanol and produced water (brine) are covered. Your instructors will make the Industrial Emergency Responder—Operations Level Program manual available to you in class for use as a resource.

During this program you will add to your operations-level training with knowledge and skills needed if there is a large-scale fuels release in your community, including:

- Potential releases in your community
- Incident Command and Unified Command structures
- Hazard recognition
- Health hazards
- Work practices
- Monitoring equipment procedures and use
- Personal Protective Equipment for a fuels release

When you finish, you will be better able to do the following:

- ➢ Assess the hazards of a release
- ➢ Work within a system set up for response actions
- ➢ Perform assigned response actions through termination

The exercises in this program include assessing the types of releases, health and safety hazards of potential releases, and collecting information needed for monitoring, selecting PPE and conducting operations-level response actions. As a team, you will simulate operations-level actions to support the response efforts.

Emergency Response

The Emergency Response Plan (ERP) contains vital information about procedures to be followed during an emergency situation. In the event of a predictable (even if rare) emergency, responders follow an action plan that has been developed in advance and practiced. Based on experience, train derailments or pipeline ruptures involving fuels is now considered ‘predictable’ and both responders and communities should plan for releases. Otherwise, residents may be exposed and responders will be into new roles for which they were not adequately prepared or equipped. Responses may be further hampered by slow implementation of command and logistical support infrastructures.

The response to a large-scale release may be followed by days or weeks of remediation effort and a longer time period for rebuilding at the community level. It may not be possible to prepare ourselves for every kind of emergency, but developing a basic emergency response procedure to be followed, along with a command system, will reduce the degree of confusion and uncertainty that could occur if a release occurs along the transportation routes.

NOTE: At petroleum storage and distribution facilities, this plan is known as the Emergency Response Action Plan (ERAP). ERP is used throughout this program to accommodate a wide audience of participants.

Section Objectives

When you complete this section you will be better able to:

- Describe some topics that should be covered in the ERP for a potential release impacting your community
- Describe the Incident Command System (ICS)
- Describe Unified Command
- Identify some Standard Operating Procedures (SOPs) that may be referenced in an ERP

Because ERPs are tailored to a specific region and hazard, all topics and SOPs are not covered in this program. Your facilitator may add locally important aspects.

Introduction

A large-volume fuels emergency requires special preparation as it may be too large for any single emergency response team to respond to without outside help. On the local and state levels this may include fire and police, county or regional authorities, State HazMat and Environmental agencies. Federal agencies such as the Department of Transportation and the Pipeline and Hazardous Materials Safety Administration (PHMSA), Occupational Safety and Health Administration (OSHA), State and US Environmental Protection Agency (EPA), and the FEMA National Response Team may be specified in your plan to assist. The company responsible for transport will also be involved.

Other States may be affected and procedures to warn/notify appropriate personnel are required. As a member of an emergency response team you must be aware of the potential hazards that you may encounter while responding to such a large-scale emergency. Pre-planning a response protocol along with hospitals, fire departments, and government agencies will be very helpful in preparing for situations where your community may be affected.

Recent statistics

Ethanol

In 2016, the nation-wide 14.1 million gallon capacity to produce ethanol for fuel was centered in the Midwest (Renewable Fuels Association, 2016 RFA Ethanol Industry Outlook, http://www.ethanolrfa.org/pages/annual-industry-outlook, accessed February 7, 2017). To map these production facilities, see:

https://maps.nrel.gov/biofuels-atlas/. Ethanol is usually transported by rail or barge pipeline transport requires a dedicated line as it absorbs water and impurities normally present in pipelines. A single DOT-111 rail car has a capacity of 30,100 gallons.

```
      H   H
      |   |
  H—C—C—O—H          Ethanol
      |   |
      H   H
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Formulations are designated by E followed by a number reflecting the ethanol content.

E100	ethanol or ethyl alcohol or neat ethanol
E95-E99	denatured ethanol, contains 95-99% ethanol with remainder gasoline
E11-E99	more than 10% ethanol, named as ethanol and gasoline mixture ethanol and motor spirit mixture gasoline and ethanol mixture petrol and ethanol mixture
E1-E10	gasohol, 10% or less ethanol with larger component gasoline

Blends are the primary fuel transported in large quantity.

<u>Bakken crude</u> (light or sweet crude from the Bakken shale region—western ND, eastern MT, and southern Canadian provinces of Saskatchewan and Manitoba)

2016 production generally exceeded 1M barrels per day and gas production exceeded 1.5B cubic feet per day (https://www.eia.gov/petroleum/drilling/pdf/bakken.pdf, accessed January 7, 2017).

In 2014, about 40% of the natural gas was flared or lost (http://www.eia.gov/todayinenergy/detail.php?id=15511, accessed January 7, 2017).

Fuel recovery using hydraulic fracturing (fracking) generates substantial fluids that are also transported, known as “produced water”. While there are many chemicals in fracking fluids and produced water that can be toxic with sufficient exposure, little data exist to assess risk. This produced water is high in salts, organics and metals and spills during trucking do occur. (Elliott EG et al. A systematic evaluation of chemicals in hydraulic fracturing fluids and wastewater for reproductive and developmental toxicity. J Exp. Sci Environ Epid (2017) 27:90-99; Durant, B et al. Assessing dermal exposure risk to workers from flowback water during shale gas hydraulic fracturing activity. J Nat Gas Sci Eng (2016) 34:696-978).

Petroleum crude from Canada or the Gulf Coast (heavy or sour crude)

In 2016, crude moved into the Midwest (828,000 to 868,000 barrels per month) and through the northern Midwest to New England (130,000 to 1.2M barrels per month) from Canada.
(http://www.eia.gov/dnav/pet/PET_MOVE_RAILNA_A_EPC0_RAIL_MBBL_M.htm, accessed January 7, 2017). In the November 2016, just over 27M barrels flowed north each month from the Gulf through pipelines
(https://www.eia.gov/dnav/pet/pet_move_pipe_dc_R30-R20_mbbl_m.htm, accessed January 7, 2017).

Produced water from this extraction is a by-product from the surrounding rock formation rather than injection to frack the formation.

What is at risk during a release?

- Human health and safety.
- Tribal and local government or municipal services including
- Power
- Hospital/health care
- Fire
- EMS
- Police
- Water supply and water treatment
- Transportation access
- Communication
- Commercial establishments and businesses
- Personal property (including housing, outbuildings, equipment, livestock)
- Environment (air, water, land)

NOTE: Water and land use may include residential needs, recreation, livestock)

What makes a fuels release different from a 'regular' emergency?

- Limited number of hazardous materials
- High damage potential to life and property
- Extent of economic damage
- Critical system disruption—roadways or routes blocked
- Access to critical services blocked or disrupted (water, electricity, health care)
- Societal disruption (evacuation, inability to reach destination)
- Lack of preparation for shelter in place
- Long recovery phase

What needs to be taken into consideration while preparing for a fuels emergency?

Pre-emergency planning and coordination with outside parties. Included in this planning will be organizations such as:

- Local fire and police services
- Emergency medical service
- Hospital or medical clinic
- Local Emergency Planning Committee (LEPC)
- Clean-up contractor(s)
- Local, tribal, state and federal environmental and emergency agencies
- Community—businesses and residents

Information in a response plan

The plan is the critical resource for responders. Knowing the elements of the plan and practice before an incident will substantially reduce response time and minimize damage to human health, property and the environment.

Just in case, be ready

Know the plan

Know your role

Practice skills

Below is key content for several parts of a plan.

Personnel roles, lines of authority, training and communications

The role that each of the key personnel will perform should be included. Roles include:

- Response team member duties
- Off-scene responsibilities such as Public Relations and Agency notifications
- Lines of authority for on-scene operations should be defined in terms of a specific Incident Management System
- Off-scene (management) duties and their associated lines of authority should also be included

The level of training, frequency and content of all required training for equipment use should be addressed. The type and frequency of drills is described.

Means of communication both on-scene among responders and external should be described.

Procedure to limit unnecessary radio traffic and a list of phone numbers should be included.

Emergency recognition and planning

In order to plan for an emergency there must first be recognition of what could happen by conducting a hazard assessment, including:

- Types and magnitude of releases that could occur at:

  Pipelines
  Rail lines
  Surface roads

- How to recognize a hazard and the potential health effects

Based on this assessment of potential releases and hazards detailed in the hazard assessment section of a plan, preparations can be made for response.

The plan will include:

- Documenting location of response equipment and supplies.
- Consideration of specialized equipment, such as alcohol resistant foam if ethanol blend release is possible

- Inspection and maintenance procedures to assure equipment ready for use

Emergency alerting and response procedures

- What warning signs can be used specifically for an incident?
- When an emergency is observed how is the alarm to be sounded. The procedure for activating the alarm—and the criteria for doing so—need to be understood.
- The actions that the public is to take when the alarm sounds should be written

Evacuation routes and procedures

- A diagram showing routes of primary and secondary escape and assembly areas along with a procedure to determine which route to use.

Safe distance and places of refuge

- Areas located a safe distance from the potential sites of release are to be identified for assembly of public in case of evacuation.
- An alternate area should be designated to allow for wind direction shifts and other conditions.
- A designee at each of these areas to ensure rapid accounting of all personnel can be done to identify any missing. The procedure for accounting should also be specified.
- In what situations would places of refuge (shelter-in-place) be used?

Site security and control

- A procedure to minimize the number of personnel at the scene and for handling the media must be developed
- The procedure for accurate accounting of who is on-scene and who has made entry into the area must be specified

Decontamination procedure

- Procedures to prevent the spread of released material throughout the area by responders and equipment are required
- The standard procedure for decontamination of the response team and

any modification for certain materials are to be specified

Emergency medical treatment and first aid

- Arrangements with the local medical personnel (doctors, nurses, EMS) and hospital should be made to handle procedures for mass decontamination and treatment of large groups of civilians
- Advanced first-aid should be provided on-scene and a list and location of first-aid equipment needs to be available
- How the injured will be transported and how more information about the agent can be obtained or shared
- A crisis management psychologist should be identified

PPE and equipment

- A list of personal protective equipment available and their location
- Hazard detection and evaluation equipment
- Hazard control supplies

Termination

- Critique
- Follow-up
- Other SOPs for response actions (examples)

Documenting shut down or release at source

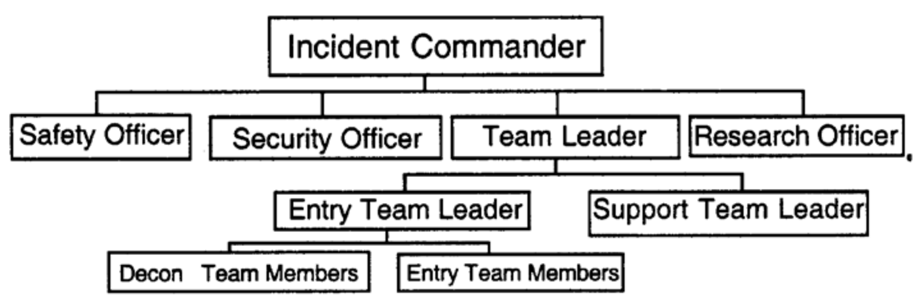
- Containment
- Conduct of operations on water
- Shoreline protection

The Incident Command System

To respond to an emergency, a preplanned chain-of-command system is required. This is usually referred to as the **Incident Command System** (ICS). The ICS includes personnel fulfilling a number of different roles. The number of people involved and the role of each person depends on the types and nature of emergencies that could occur during a terrorist attack. Preplanning, training, and practice are required to ensure that each person knows his/ her role within the overall ICS. Each member of the team must receive training for his/her anticipated role.

The ERP includes a section on chain-of-command, lines of authority, communication, and responsibilities shown on the chart below:

Basics of Incident Command Organizational Chart



Note: This should be adapted to be specific to the event and to match personnel available. Other personnel may be added; people may perform in more than one role. Members of the entry team may require special training in dealing with a specific hazard.

Some Jobs and Duties Performed by Personnel in the ICS chain-of-command

Incident Commander *also called senior official, project leader, on-scene coordinator, or on-scene incident commander*

Duties:

- Directs all aspects of the response
- Coordinates all team efforts
- Establishes a command post and chain of command
- Maintains ongoing communication with all teams
- Arranges for PPE and supplies, in consultation with each team
- Coordinates with off-site personnel
- Keeps a log of all response activities and maintains records

NOTE from Casselton response:

> Air traffic was thick from media and private operators wanting to see the fire. Fearing an air accident, the responders got the airspace closed.

Source: https://www.fema.gov/challenges-faced-during-2013-casselton-train-derailment. Accessed Jan 5, 2017

Team Leader *also called operations officer*

Duties:

- Reports directly to the Incident Commander
- Prepares and executes specific tasks such as entry, decontamination, sampling, and security, in consultation with the Incident Commander
- Supervises activity team leaders who coordinate operations

Security Officer

Duties:

- Reports directly to the Incident Commander
- Establishes all zones and access points, in consultation with the Incident Commander
- Maintains liaison with the local fire and law enforcement authorities, if assigned by the Incident Commander
- Coordinates evacuation, as assigned by the Incident Commander

Research Officer

Duties:

- Reports directly to the Incident Commander
- Identifies the most up-to-date information on the agent and prepares a research brief. (This includes incompatibilities, flammability and explosion hazard, symptoms, health effects, precautions, first aid methods, and other relevant information.)
- Advises the Incident Commander and team leaders on appropriate PPE and decon methods

Safety Officer

Duties:

- Reports directly to the Incident Commander
- Implements the safety plan
- Monitors condition of the entry team members in the warm zone
- Advises Incident Commander and team leaders on appropriate PPE and decon methods
- Acts as liaison with emergency medical personnel, as directed by the Incident Commander

Entry Team Leader

Duties:

- Reports to the team leader (operations officer)
- Coordinates entry plan
- Coordinates decon activities

Support Team Leader

Duties:

- Reports to the team leader (operations officer)
- Coordinates support functions

Entry Team Member

Duties:

- Reports to entry team leader
- Implements entry plan
- Dons appropriate PPE, as assigned
- Performs assigned tasks (sampling, monitoring, and containment)
- Follows decon procedures, as assigned
- Provides back-up to other entry team members

Decontamination (Decon) Team Members

Duties:

- Reports to the entry team leader
- Implements decon plan
- Dons appropriate PPE, as assigned
- Performs tasks at assigned station

- Follows decon procedures, as assigned

Unified Command

Although a single Incident Commander normally handles the command function, the ICS may be expanded to a Unified Command structure. The Unified Command includes the following:

- Brings together Incident Commanders of all major agencies and the transportation provider involved in the response
- Links response agencies to the incident and provides a forum to make consensus decision
- A representative from the agency with primary jurisdiction serves as the overall Incident Commander for Unified Command

NOTE from the Casselton response:

- … bringing in trained crews and expertise from BNSF [railroad company] into the command structure was critical to the success of the response. The railroad eventually deployed more than 300 staff and contractors to the event. “Bring that rail company in,” he says. “They are legally responsible for the derailment. Get them on your side before those issues arise.”
- Other units in the command structure included law enforcement (for scene control and also to investigate the incident), Emergency Medical Services (monitoring medical needs and assisting with the evacuation), and Public Health (monitoring the air quality as well as the spill recovery and mitigation).

Source: https://www.fema.gov/challenges-faced-during-2013-casselton-train-derailment. Accessed Jan 5, 2017

For many incidents involving a release of fuels or large-scale release of produced water, multiple agencies will respond and the transporter will be brought in (as shown in the Casselton response). In these situations, member of Unified Command should:

- Develop a common set of goals and objectives
- Share information
- Maximize available resources
- Improve the efficiency of each agency involved

(Should there be multiple points of emission that cross jurisdictional boundaries, an Area Command may be established.)

Specialized training is required for the Incident Commander and other leaders in either the Unified or Area command structures.

Physical Location and Facilities

Those involved in Unified Command must identify a location for carrying out command functions. This location is referred to as the Incident Command Post. The Incident Command Post is in a relatively safe area away from operational activities that is accessible to other arriving agency representatives. The facility should be large enough to accommodate the number of agency representatives that will be participating. When possible, the Post should be close enough to the response area to allow viewing the activities. Wind direction and needs of the participants (filtered air, bathrooms, food supply, power for communication technology) must be considered.

Communication

When Unified Command is activated, all communications involving decision-making that impact the strategic goals must go through the Post. For example, if Operations is in need of additional resources, this request goes to the Unified Command for response. If such a request bypasses the UC, the team will lose track of resources at the scene and future needs may not be met.

Primary Jurisdiction

At a large incident, various agencies will have responsibilities for different aspects of the incident, at the direction of the Unified Command. For example, in a response to derailment involving hazardous materials, the fire department or state environmental agency may have initial jurisdiction. If the incident also involves a release to land crossing state lines or an Interstate highway, other state and federal agencies may be involved. Public health officials may have a significant role in providing assistance for displaced persons (evacuated from homes or businesses) and for monitoring the need for medical assistance.

If situations arise where members of the UC cannot reach consensus, the UC member from the agency with primary jurisdiction likely would have the authority to make the final decision.

Parallel Operations

When a Unified Command structure is in place, individual agencies will continue to have specific responsibilities. Individuals involved in the Unified Command have a responsibility to the UC, but also to their own agency or organization. UC members do not give up agency authority, responsibility or accountability. The addition of UC allows responders to carry out their own duties, while working cooperatively in a response management system.

To be effective, UC members must be able to:

- Agree on an incident response organization
- Agree on appropriate Command and General Staff position assignments
- Commit to speak with one voice through the Public Information Officer
- Agree on methods to provide logistical support
- Agree on cost-sharing procedures

NOTE from the Casselton response:

Media issues were a problem. Passersby were taking photos and posting them on social media that went worldwide before responders even got there. The public information officer was getting calls from as far away as Africa and Asia. He would hang up from one call on his cell phone and find 6-10 messages waiting.

Source: https://www.fema.gov/challenges-faced-during-2013-casselton-train-derailment. Accessed Jan 5, 2017

Relationship with Emergency Operations Center

The county or state may establish an Emergency Operations Center (EOC) to coordinate the emergency operations, especially if the needs of the incident exceed the resources of the command site. Some important points about the activation of the EOC:

- The EOC does not become operational for all incidents
- The local emergency response plan should specify the conditions under which it is activate, and who is authorized to activate
- Normally, the elected person responsible for the jurisdiction (mayor, county executive) or his/her designee is in charge of the EOC

One of the first tasks at any emergency is to assess the situation quickly to determine if the size or severity warrants activating the EOC. Staffing the EOC may be as simple as asking people to leave their offices and walk down the hallway to the EOC. It may require calling people in from various locations. Once an EOC is established, the on-scene Unified Command structure should coordinate all decision-making through the EOC. For example, the EOC should coordinate and approve any releases by the Public Information Officer.

Communication/Alerting

Notification procedures

The first person to detect a problem may be

Train—on-train personnel
Pipeline—farmer, remote monitor system or drone, passer-by
Truck—driver or motorist

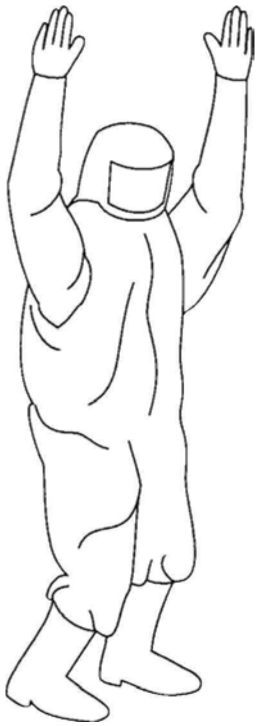
The first person to identify a release initiates the alert by calling 911 or other designated number, and then the pre-planned alerting protocols are initiated.

On-scene communication

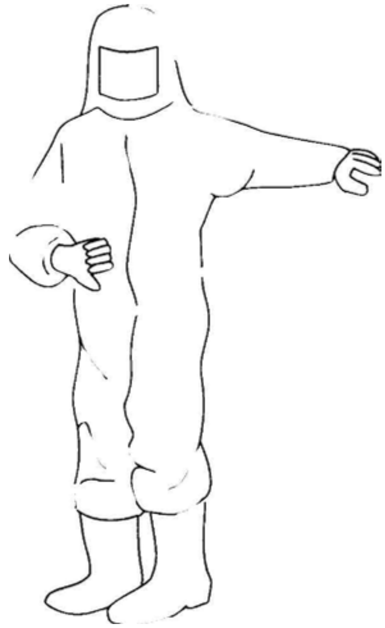
The "buddy system" is a protective procedure where workers perform in pairs or within close proximity of one another in order to safeguard other's safety and health. A buddy provides assistance, observes his/her partner for signs of chemical or heat exposure, periodically checks the integrity of the partner's protective clothing, and notifies the command post supervisor or others

if emergency help is needed. Buddies should work in line-of-sight contact or communication with each other and the command post supervisor. When wearing protective clothing, workers must make sure that hand signals are understood. Some common hand signals are shown on the next page.

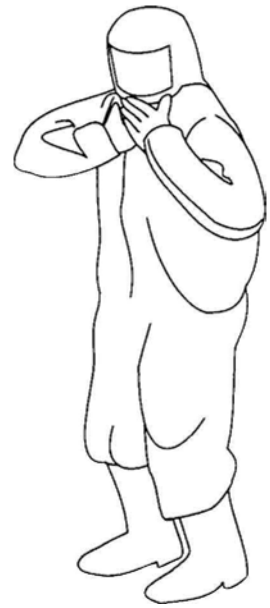
Communication systems are established to alert responders to changing situations, transmit information, and initiate changes in response activities. Communication systems may be internal or external. Internal systems consist of visual cues such as hand signals, lights, flags, and audio cues such as bells, whistles, or compressed-air horns. External systems include telephones or radios; the use of these may be limited due to static electricity or constraints of protective clothing. Anyone who may be impacted by the emergency must be trained to recognize and use these emergency systems.



Trouble: need help getting out of suit.



Task cannot be completed with remaining air.



Out of air.

Initial Actions

The area must first be secured to assure that access is limited to trained personnel.

An initial hazard zone (more detail below) is established using available information and the Emergency Response Guide Book or other resources using the procedures in the response plan. Zone boundaries will be evaluated as the incident progresses and may be changed as conditions evolve.

> NOTE from the Casselton response:
>
> The command post was originally set up one-quarter mile from the scene, but they had to pull back to a half mile because it was too hot for the responders even inside their rigs. It was later moved to the school when they realized the response would take hours and they needed to get out of the cold.

The initial assessment is conducted at a safe distance and as appropriate upwind and uphill. Follow procedures in the Response Plan for information gathering and reporting.

Depending on the incident, zones as described below may be set up under the direction of the IC/UC.

Zones

The purpose of work zones is to reduce the accidental spread of hazardous substances while responders work in the incident area, as described in the Decontamination section. Zones are described here because specific activities occur in each zone.

Zones help:

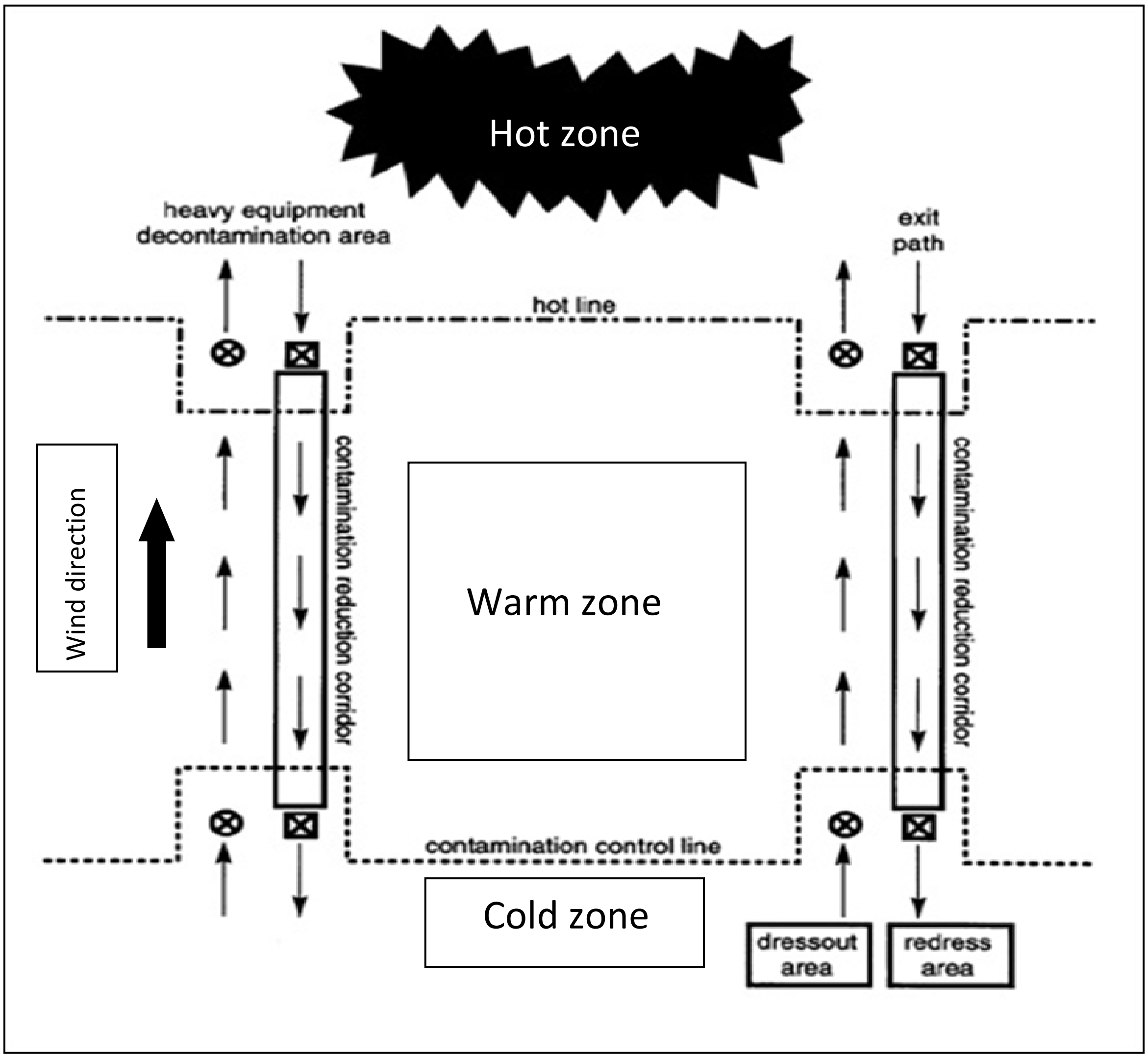
- Ensure that personnel are properly protected from the hazards present
- Keep work activities and contamination confined to the appropriate areas
- Provide a way to quickly locate and evacuate personnel in an emergency

A number of things should be considered when determining locations of zones

- Accessibility for people and supplies
- Extent of release
- Resources—phone, water, utilities, lighting
- Visibility
- Scene geography
- Wind direction, natural ventilation flow
- Escape routes

The setup of the three zones (hot, warm, and cold) should be based on site layout, visual observation, and monitoring results. Consideration should be given to entry and exit routes and to the amount of hazardous materials that could possibly be released. Movement of personnel and equipment in these areas should be minimized and restricted to specific pints to prevent spread of contamination.

These zones are shown in the figure below:



Primary Activities in Each Zone

The general layout of zones for an emergency response was shown in the section on Decon. The activities conducted in each area are described here.

In each zone, certain activities are performed by specific personnel. The personnel who can be in each zone should be outlined in the ERP.

<u>Zone</u>	<u>Typical Personnel</u>
Hot Zone	Entry Team
Warm Zone	Decontamination Team
Cold Zone	Incident Commander Team Leader Security Officer Research Officer Entry Team Members Providing Back-up

Hot Zone

This zone is where the <u>release occurred</u>. The size of the zone is determined by the extent of the spill or release, characteristics of the scene, and access points. The "Hotline" is the outer boundary and should be clearly marked with hazard tape, lines, signs, or ropes. Further subdivision of the area may be necessary depending on the hazard, presence of incompatible materials or other conditions determined by the IC/UC.

<u>Procedures</u>

- Size-up the scene
- Control, confinement, and containment of materials
- Clean up work

<u>Personnel</u>

- Entry teams working in pairs
- Specialists (as needed)

PPE

- The level of PPE necessary will be determined by the material released, monitoring, and the ERP
  - Usually Level A or Level B, initially. *Note: Operations-level emergency responders may work in the hot zone in a defensive fashion. Only persons trained at the technician level will approach an active point of fuel release.*
- The entry team may include people with several levels of training
- The site of attack may require evacuation, triage and crowd control, as first actions

Warm Zone or Contamination Reduction Corridor (CRC)

This zone is the transition area between contaminated and clean. Decontamination takes place in the warm zone in a designated area called the Contamination Reduction Corridor (CRC). The degree of contamination increases closer to the hot zone.

Procedures

- Decontamination line
- Equipment resupply
- Sample packaging for on-scene and off-scene laboratories
- Entry team rest area
- Drainage of water and other decon liquids
- Surveillance of response activities

Personnel

- Safety officer
- Decontamination team members
- Specialists, as needed

PPE

- Usually one level lower than hot zone (same level as hot zone may be needed for specific material) *Note: Operations-level emergency responders will generally be included in the personnel in the Warm Zone. Activities may include decontamination and equipment resupply.*

Cold Zone

This zone is the zone free of contamination. The cold zone is the location of administrative and other support functions which keep the warm and hot zone activities running smoothly. In a massive attack, there may be some contamination in this zone, but it will be substantially less than the hot zone.

Procedures

- Command post
- Staging
- Communication with outside personnel or agencies
- Surveillance of response activities
- Food/water supplies

Personnel

- Incident Commander/Unified Command
- Project team leaders
- Public information officer
- Back-up teams
- Specialists, as needed

PPE

- Level D (perhaps Level C in early stages of the operation).

Note: Operations-level Emergency Response may provide a number of functions in the Cold Zone, including assisting with staging.

Summary

The impact of a high volume release of fuel can be widespread

There are important differences between a large release and a small release

Response considerations such as planning and plan practice are critical to safeguarding life and property

ICS and UC are used to manage a response in an organized manner

Communication and alerting systems must be known to everyone potentially at risk

Maintaining defined zones help assure safety of responders and minimizes spread of contamination

Hazard Recognition

Many chemical, physical and psychological hazards may be associated with response to a large-scale release. Always be alert, even if a situation doesn't "look bad". Conditions can change rapidly.

Routine methods to recognize hazardous materials in industry are applicable to these events; however, some of the 'clues' that often available may be masked by orientation, fire or the landscape (rough terrain, vegetation).

Section Objectives

When you complete this chapter, you will be better able to:

- Recognize visual clues associated with fuels transportation
- Recognize specific hazards associated with ethanol, Bakken crude, produced water and petroleum oil
- Use resources available to research hazards associated with potential releases that may affect your community

Introduction

Identifying the potential for releases in your community starts with listing what is transported (by surface, rail, pipeline) through or near your jurisdiction. Shippers and the managers of oil storage locations must have an Emergency Response Action Plan that includes actions needed in a range of releases that could be anticipated, including a 'worst case' scenario. Several types of required facility drills and exercises are included in the ERAP:

- Facility response drills (FRDs) conducted at least annually
- Qualified Individual notification drill conducted at least quarterly
- Tabletop exercise for Spill Management Team conducted at least annually
- Equipment Deployment exercise conducted at least semi-annually
- Unannounced spill response exercise conducted at least annually
- External exercise with community partners at least every three years

What are the hazardous materials that may impact your community?

What are some sources of information?

Signs and markings:

Information posted for public and anyone entering the facility—contact number, hazards, restrictions.

Midwest Consortium photo taken from public road in New Town, ND. November 2016

Required pipeline posting, with contact information. These are in the area of a pipeline, but do not identify exact location.

Midwest Consortium photo taken from public roadway, New Town, ND. March 2017.

Surroundings and container shapes:

Large storage tanks and rail cars at loading facility near a body of water. Midwest Consortium photo taken from public road in New Town, ND. March 2017.

Rail car shape provides information on contents
Midwest Consortium photo taken from public road in New Town, ND. November 2016.

Rail cars in Minneapolis, showing nearby residences, businesses and downtown area
Photo courtesy of CARS, Minneapolis MN

Placards:

Close up of rail car placard. Use DOT ERG to identify contents.
Midwest Consortium photo, courtesy of BioUrja, New Town, ND. March 2017.

Transportation vehicle. Note placard showing on side and rear—required on all sides.
Midwest Consortium photo taken at public parking area, New Town, ND. March 2017.

If vapor clouds are observed rising around transportation vehicles, it may indicate a release; a growing frost deposit on piping or surfaces may indicate that pressurized gas is being released.

Water and surface contamination:

Oil visible on the surface of the water following Belle Fourche Pipeline leak, ND, Dec. 2016 https://www.flickr.com/photos/145935260@N04/30765473074/in/album-72157677768444415/. Accessed Jan 5, 2017

Work activity:

Cleanup work at the site of the ethanol spill on the Mississippi River, near Alma, WI.

Clean up operations following train derailment that spilled up to 20,000 gallons of ethanol into the Mississippi near Alma WI, November 2015. Note booms, earth moving equipment.

U.S. Environmental Protection Agency. Source: http://www.wpr.org/officials-environmental-impact-alma-ethanol-spill-remains-unclear.

Accessed Jan 5, 2017.

Vegetation damage:

Salt scar near Lake Skiatook, Oklahoma, caused by a produced-water spill. Photo Credit: David W. Morganwalp, USGS. https://toxics.usgs.gov/highlights/ph20.html. Accessed Jan. 5, 2017.

Releases occur during winter months, inclement weather or the high heat of summer. Review the physical hazards described in the 24-hour Industrial Emergency Response training and discuss additional hazards that may be present near your community. For example, waterways may represent a need for protective equipment and work practices to prevent drowning; in winter months, air boats may be needed.

Weather and changes in weather may impact a release. Rain or other precipitation, temperature and wind direction are critical inputs to many aspects of a response. Rain may be helpful in fire suppression, but may also increase run-off to spread contamination. Temperature affects responders, the transport vessels and the dispersal of the fuel released. Wind direction and shifts in direction or speed may alter decisions about evacuation or shelter-in-place, and the placement of the Command Center.

EPA on-scene coordinators use air boats on the frozen Galena River near the oil train derailment. (03-08-2015) (https://www.epa.gov/il/galena-train-derailment, accessed February 9, 2017)

As liquids, any spilled material will filter into land and flow to the lowest surface. Surface water can be contaminated directly by the spill; leaching may contaminate groundwater.

A train may carry cargo other than the fuel that is the focus of this program. The content of each car is shown on the Train List, appended to the Way Bill held by the conductor.

Special Considerations for fuels

Ethanol

Neat ethanol PEL 1000 ppm; IDLH 3300 ppm (10% of the LEL)

Flammable solvent that mixes completely with water (miscible)

Ethanol vapor heavier than air, and can collect in low areas and reach explosive concentrations in areas with little mixing (examples: pipes or sewers)

Flashpoint increases as it is diluted with water; still flammable at 20% strength

Flashpoint decreases with addition of gasoline
(E100, 55^{o}F; E95, -5^{o}F; E85, -20^{o}F)

DOT placard identifies concentration

Ethanol (neat)	1170
Denatured ethanol (95-99% ethanol)	1987
Ethanol and gasoline (>10% ethanol)	3479
Gasohol (1-10% ethanol)	1203

Fuel blends contain gasoline-related compounds (BTEX)

Anaerobic biodegradation of ethanol in soils results in methane (weeks after spill), but could build up in confined space

Bakken crude

A 'light' crude

Highly flammable (more than heavy crude. See
http://www.sightline.org/2014/01/21/why-bakken-oil-explodes/)

DOT placard 1267

Crude from Canada or the Gulf Coast

'Heavy' crude

Wildlife hazard (nonvolatile components do not degrade rapidly)

DOT placard 1267

Written Sources of Information

Shipping papers are in the cab of any truck during transit; they are removed only when the shipment is at the final destination.

The Way Bill and the Train List shows the contents of a train. This should be obtained as part of the assessment at the scene. Local emergency responders can obtain the Flow Report describing the contents of cars passing through the area during the previous quarter. For example of BNSF data see http://www3.bnsf.com/in-the-community/environment/hazardous-materials-information-request.html.

If these documents are not available due to release, the 2016 Emergency Response Guide Book includes pages of container shapes and placards, as well as the guides. The response plan should include resources for information if written documents cannot be accessed. For example, the carrier may be identified by signage and if a major carrier, the emergency contact information would be listed in advance for use as needed.

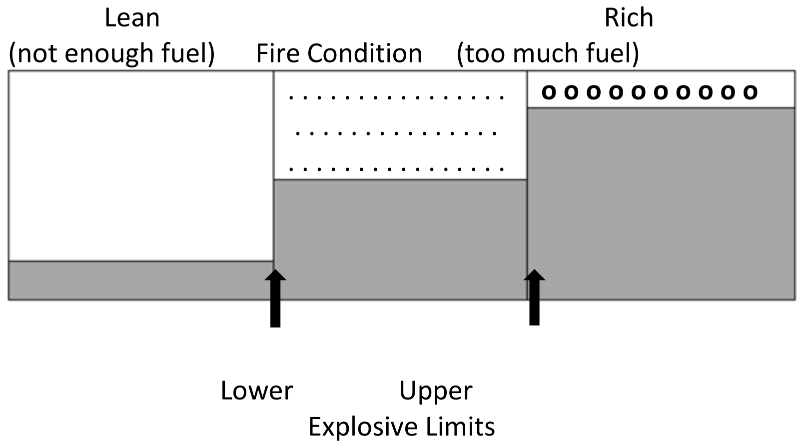
Fire and Explosion Hazards

In some events, the fire is immediate, as at Casselton ND. The fire can spread, or result in explosion hazards depending on materials near the fire site.

Determining whether there is a possibility of fire or explosion is critical. Flammable and explosive atmospheres develop when reactions occur with oxygen in the air, evaporation of flammables, gas leaks, and dust accumulation. Potentially flammable atmospheres must be monitored frequently in accordance with the Emergency Response Plan (ERP). Protective clothing and respirators which protect the worker from toxic hazards provide little, if any, protection against fire or explosions.

Explosive Limits

Monitoring results reported as percent can provide information about substances in the air which may potentially cause an explosion. For flammable vapors and dusts, explosive limits have been determined. Two limits are defined below:
Lower Explosive Limit (LEL) is the minimum concentration of a flammable gas in the air that can result in ignition. Concentrations below the LEL will not ignite. Below the LEL, the mixture is called “lean.”
Upper Explosive Limit (UEL) is the maximum concentration of a flammable gas in the air which can result in ignition. Concentrations above the UEL will not ignite. Above the UEL, the mixture is called “rich.”
NOTE: UEL and LEL are determined in a controlled lab situation. Changes in oxygen concentration will potentially affect the values.



Explosive Range is the concentration of a flammable gas in the air between the LEL and UEL. In this range, the substance will readily ignite if an ignition source is present.

Boiling Liquid Expanding Vapor Explosion (BLEVE)

A BLEVE is commonly defined as a container rupture caused by heat. When a container holding a liquid is heated, the heat is absorbed into the liquid, causing the vapor pressure to rise. If the container, such as a tank car or storage vessel, is equipped with a safety valve system, the build-up of pressure will result in product vapor being released through the valve where it can flame off. As the vapors are released, the contents of the container are cooled. For graphics of what happens in a fixed-site propane tank, see https://www.youtube.com/watch?v=UM0jtD_OWLU.

If the source of heat continues to impinge on the container, it will eventually begin heating the metal surface that is not in contact with the liquid. The pressure relief is usually not designed to relieve the amount of gas generated by the fire. The vapor behind the metal surface cannot remove the heat as fast as the liquid, and the tank shell heats up, losing its strength. When the strength of the metal is reduced enough, the container shell will tear open as the hot vapors ignite. The container will break up more or less violently depending on how much product is left. Rail cars/pieces have been found nearly a mile from the BLEVE site. https://www.youtube.com/watch?v=K-tUQTw_Vtk

A BLEVE can be prevented in a number of different ways. First, and most importantly, the source of ignition should be removed to prevent the heating of the tank or container. Second, water can be applied at a minimum of 500 gallons per minute at each point of flame impingement with an unmanned nozzle to keep the container cooled.

In situations where massive amounts of water cannot be applied, such as in incidents on isolated transportation routes, the area may have to be evacuated as the container is allowed to burn. Although property may be destroyed, lives will be saved.

Corrosivity

Corrosives (acids or bases, having significantly low or high pH) can have adverse health effects, including damage to skin, eyes and the respiratory system. In addition, they can damage monitoring equipment and PPE. Corrosive compounds in the air can be detected using pH paper. If strong acids or bases are present, the pH paper will change color.

Exercise—Hazard Assessment

Describe exposure scenarios. List the hazardous substance that could be released, worst case, more expected release, populations affected, special considerations. The facilitator will assist in finding information, as needed.

Describe Incident Scenario	Hazard Released	Worst Case release (volume)	Most probable release (volume)	Populations affected	Special considerations

Exercise - Operations-level activities

In small groups, use your operations-level training to discuss the following for each scenario:

a. what actions might be assigned to me as a responder?

b. what other knowledge and skills would better prepare me to complete the assignment safely?

Prepare a report back to the larger group.

Summary

The ERG includes container shape, placards and marking that can be used to identify fuels.

Ethanol and Bakken crude are highly flammable; heavy crude is less flammable but is a high threat to wild life.

Fire, explosion and corrosive hazards are key considerations in a fuel release.

Health Hazard Recognition

First responders need to be aware of potential hazards to their health while responding to any emergency. To the usual hazardous materials release hazards; a fuels release adds dangers of explosion and fire that can burn for days impacting health and safety.

Section Objectives

When you complete this chapter, you will be better able to:

- Use resources to identify health effects of identified hazards
- Discuss ways to protect your health
- Describe key requirements of medical surveillance

Recognizing psychological responses due to what you may see at a major response are not covered in this program. If your group is interested in this topic, please seek guidance from the Facilitator or his/her program director; useful resources are shown at https://tools.niehs.nih.gov/wetp/index.cfm?id=2528.

Introduction

For several fuels and produced water, hazardous components are listed in the table below.

Fuel or related material	Representative hazardous components	Route(s) of Exposure
Crude oil (Canada, Gulf coast)	VOCs* BTEX** Oil	Inhalation Inhalation, Dermal Dermal
Crude oil (Bakken)	VOCs BTEX Hydrogen sulfide	Inhalation Inhalation, Dermal Inhalation
Ethanol (E100)	Ethanol	Inhalation, Dermal
Ethanol (E10-99)	Ethanol BTEX	Inhalation, Dermal Inhalation, Dermal
Produced water	Salts Metals Organics	Dermal Dermal Dermal

VOCs Volatile Organic Compounds
**BTEX Benzene-Toluene-Ethyl benzene-Xylene

A recent analysis of produced water lists the following possible exposures:

Metals: Aluminum, Antimony, Arsenic, Barium, Beryllium, Cadmium, Copper, Iron, Lead, Manganese, Thallium
Organics: Benzene, Benzo(a)pyrene, Dibromochloromethane, 1,2-Dichoroethane, Heptachlor, Heptachlor epoxide, Pentachlorophenol, Vinyl chloride

Resources for detailed health effects of this range of potential exposures include:

New Jersey Fact Sheets: https://web.doh.state.nj.us/rtkhsfs/factsheets.aspx or at WISER https://wiser.nlm.nih.gov/.

Light crude: https://www.cdc.gov/nceh/oil_spill/docs/Light_Crude_Oil_and_Your_Health.pdf
Heavy crude oil: https://toxtown.nlm.nih.gov/scenes/port/scene.php
VOCs: https://toxtown.nlm.nih.gov/text_version/chemicals.php

Summary health effects information is found in the NIOSH Pocket Guide and the ERG; both can be accessed through WISER.

A large release could result in plume of airborne vapors. Some of the components of fuels above such as BTEX are listed by the Environmental Protection Agency as a hazardous air pollutant (HAP). For each HAP, a lifetime reference concentration (RfC) has been modeled for a specific health outcome. These values are much lower than occupational guidelines, as each has been developed to protect against an effect over a longer period of time and includes children and older adults. For example, the OSHA limit for benzene is 1 ppm; the RfC for benzene is .0094 ppm.

NOTE: all RfC values are in mg/m^3. To convert to ppm, use this calculator https://www.cdc.gov/niosh/docs/2004-101/calc.html

Information on all 187 HAPs is shown here: https://www.epa.gov/haps/health-effects-notebook-hazardous-air-pollutants.

There is no ambient standard for VOCs.

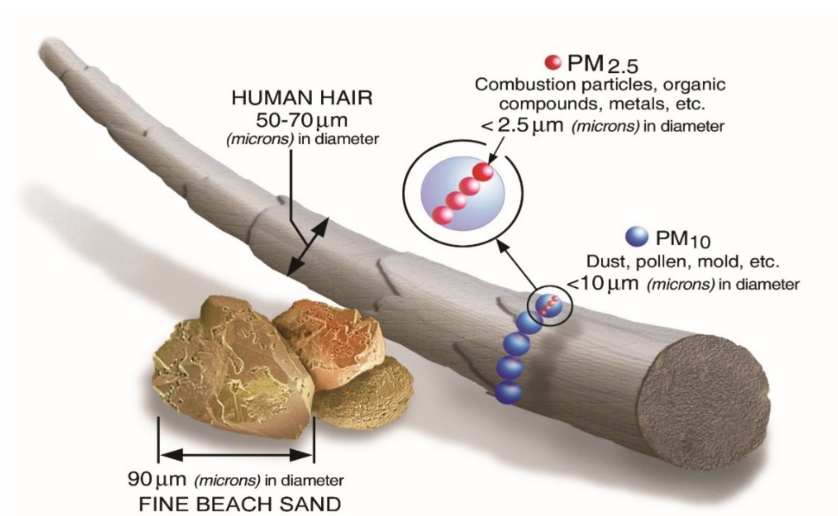
General guidance actions to take when there is a potential hazard of from a chemical release is shown here: http://www.lung.org/our-initiatives/healthy-air/outdoor/emergencies-and-natural-disasters/chemical-releases.html.
If a fire results, an additional exposure to residents and responders is particulate in the air.

Plume carrying particles from burning fuel release.
03-06-2015 at Galena, IL. (https://www.epa.gov/il/galena-train-derailment, accessed February 9, 2017)

Particle exposure in the community is regulated by EPA as one of six criteria air pollutants.

Particles in ambient air are usually referred to as PM_{10} or $PM_{2.5}$, where the number refers to the 50% point in collection—the PM_{10} result includes collection of 50% of the particles that behave in the air as if the diameter was 10 microns; as the diameter decreases from 10, more and more of the particles are collected and as the diameter increases from 10 fewer and fewer of the particles are collected. This mimics the action of breathing—not everything can be inhaled (too big) and not everything is retained in the lung (never impacts the surface or is too little to fall out of the airstream).

Comparative size of particles is shown below:



(https://www.epa.gov/sites/production/files/2016-09/pm2.5_scale_graphic-color_2.jpg; accessed February 8, 2017)

Current standards for particulate pollution are shown below:

Pollutant		Primary/ Secondary*	Averaging Time**	Exposure Level	Form ***
Particle Pollution (PM)	$PM_{2.5}$	primary	1 year	12.0 µg/m^3	annual mean, averaged over 3 years
		secondary	1 year	15.0 µg/m^3	annual mean, averaged over 3 years
		primary and secondary	24 hours	35 µg/m^3	98th percentile, averaged over 3 years
	PM_{10}	primary and secondary	24 hours	150 µg/m^3	Not to be exceeded more than once per year on average over 3 years

*A primary standard is developed to protect public health; secondary standards protect the public against decreases in visibility or damage to animals, crops, vegetation, buildings. Note that secondary standards are higher than primary.
** The level of exposure allowed is averaged over this time. Example: 24-hour averaging time might include: a 12 hour exposure at 20 ug/m^3 and 12 hour exposure at 5 ug/m^3 so the time weighted average is 12.5, ((12/24 x 20) + (12/24 x 5)).
*** Other averaging criteria. For example, $PM_{2.5}$ annual averages are also averaged over three years and the primary standard cannot exceed the value shown

See https://www.epa.gov/criteria-air-pollutants/naaqs-table for all criteria pollutants and details.

The shortest averaging time for particulates in air is a 24-hour day; decisions to evacuate or shelter-in-place are based on a much shorter time frame. Evacuation determinations also include considerations of spread of the fire and safety of residents due to other hazards such as on-site storage of flammable chemicals.

Exercise - Health Effects

For your emergency scenario(s), complete the Health Effects worksheet, using the resources above, WISER and other sources.   Show the source of the information.

Work in small groups, and follow up with a report back to identify any ‘best resources’ and possible differences in information.

Health Effects Worksheet

Exposure	Health Effect(s)	Source of Information

As part of report back, be prepared to discuss approaches to protect your health by reducing or eliminating exposure.

How can the general population reduce exposures?

Medical Surveillance

Medical surveillance is a program to protect employee health. It may include an occupational history, physical examination, and medical laboratory tests. Medical surveillance can be done:

- Prior to a new job assignment
- On a routine basis
- At termination of a job or job assignment
- If an employee exhibits signs or symptoms which may have resulted from exposure to hazardous substances during the course of an emergency incident

The purposes of medical surveillance include determining:

- Fitness for a specific job
- Possible effects of exposures in the work place
- Fitness to wear a respirator
- Fitness to wear protective clothing, especially in hot weather

Legal Requirements for Medical Surveillance

Under HAZWOPER, certain groups of workers exposed to hazardous materials are legally eligible for medical surveillance. The groups of first responders who are eligible are:

- Members of official hazardous materials response teams
- First responders who have signs or symptoms resulting from exposures at an incident
- Workers who wear respirators more than 30 days a year
- Workers whose exposure has exceeded exposure limits for more than 30 days a year

Many employers include other workers in routine medical testing programs. A licensed physician must perform all medical testing and examinations or supervise those who do. The employer must provide the physician a copy of the HAZWOPER standard (29CFR 1910.120) and appendices and other specific information. This information includes:

- A description of the employee's job duties
- The employee's previous exposure levels or anticipated exposure level
- A description of personal protective equipment that has been or will be used

- Information from previous medical examinations of the employee which is not readily available to the examining physician

When a person who has been exposed to potentially hazardous substances sees a doctor, he or she should make sure the doctor understands what work tasks are performed daily and what things are done only occasionally. Understanding the patient's job will help the doctor be more effective.

The contents of the medical exam are not specified in HAZWOPER. The physician determines what the exam will include. Some typical items include:

- Baseline medical history and physical exam
- History of claustrophobia
- Lab studies (for example, blood and urine tests)
- EKG—resting vs. stress and stress with protective gear
- Pulmonary function testing
- Chest x-ray
- Hearing testing
- Other tests as necessary for a specific job

Employers are legally required to pay for mandatory medical surveillance exams. In addition, employees are not to lose pay for the time the exam takes. The exams should be scheduled at a time and place convenient for the employee.

After a medical surveillance examination has been completed, several things are required under HAZWOPER. These include:

- The employer will receive a copy of the physician's written opinion relative to the individual's employment. (Findings not impacting on employment will not be included.)
- The employee will receive a copy of the physician's opinion which was sent to the employer. The employee may also request a complete medical report from the physician.
- The employer must keep a record of this exam and other exposure records for the duration of that individual's employment plus 30 years thereafter. The record must include at least the following:
  - Name and social security number and employee physician's report
  - Employee reports of health effects related to exposure
  - A copy of information provided to employer except for OSHA 1910.120

Summary

Resources to research health effects include written and internet sources.

Team members can identify approaches to reduce or eliminate exposure to harmful chemicals.

The general population exposure limits are lower than worker exposure limits as they are designed to protect the elderly, the very young and everyone for a lifetime.

Medical surveillance is required. The content of exams is determined by the health care professional. Work required exams must be paid for by the employer.

Monitoring

The airborne hazards in a fuel-related release are related to the substance released, including any products of fire that may result. As this is an emergency, direct reading instruments are generally used for size up and hazard assessment.

Is monitoring part of your responsibilities?

If yes, you will need training in the use of any equipment.

If no, the results of any monitoring will be useful to you in order to document any exposures, or the absence of exposure.

Monitoring procedures are reviewed and the use and characteristics of some equipment are covered in this section.

Section Objectives

When you complete this section, you will be better able to:

- Identify some types of monitoring equipment that may be used at an emergency response for fuels release

- Demonstrate use of available monitoring equipment for expected exposure scenario(s), as appropriate for your role

Sampling

Uses of some types of instruments and tools for taking samples of air or evaluating pH are described in this section, specifically:

- pH paper
- Oxygen/Combustible Gas/Combination Instruments
- Colorimetric tubes
- Personal Alarms
- Hydrocarbon Detectors
- Flame Ionization Detectors
- Particulate monitors

Usual application, readout and notes are shown below for each of these. These overviews do not replace manufacturer instructions.

ALWAYS

Use/operate according to manufacturer instructions

Follow the sampling protocol in the response plan

Alert the Safety Officer to any problems

It is not expected that any response will require all these instruments or tools. The facilitator will tailor the discussion to include those that are appropriate for the expected releases, based on your risk assessment. Information on other tools may be a useful resource in the future.

Before sampling…

For any monitoring, first make sure you have been trained in the use of the device. A monitor may look simple to use, but training helps assure that the information is valid. It is also important to be trained to recognize problems during use and who to alert if you need assistance.

Below are several considerations for use of instruments during exposure monitoring:

1. **Calibrate**
   Check with the safety officer to be sure that it has been properly calibrated. Calibration involves exposing the instrument to a known concentration of a compound and documenting or adjusting for the proper response value. It is important that all instruments be calibrated on a regular basis. Some direct-reading instruments are compatible with a docking station interface (consult manufacturer's data for more information).
2. **Be conservative.**
   If the instrument gives an unexpectedly high response, assume that it is correct. If the reading is suspiciously low, assume that there may be an instrument problem.
3. **A zero reading does not mean clean air.**
   Always remember that a reading of zero does not mean that the air is free of hazards. Some highly toxic materials are not detected by common direct-reading instruments. A reading of "zero" may mean contaminants are present but at levels below the detection capability of the instrument.
4. **Read even a small response as positive.**
   Any response, even a small one, on a direct-reading instrument should be interpreted as indicating a potentially dangerous situation. It is far safer to assume that if the instrument can detect a chemical, the concentration may be high enough to pose a health threat.
5. **Use multiple instrument types.**
   Whenever possible, use more than one type of direct-reading instrument. Remember that each type of instrument has different capabilities, so a reading of zero on one instrument could turn out to be a high reading on another instrument.
6. **Have maintenance guidelines been followed?**
   All equipment is supplied with a recommended maintenance schedule. Follow it. Should any indication of malfunction be noted during routine checks or usage, report it to the safety officer or other designated person.
7. **Are there special circumstances?**
   wind, cold, heat, difficult to access location

The following is taken from remarks made by Dave Rogness, emergency manager of Cass County in North Dakota to the Regional Interagency Steering Committee meeting about the 2013 Casselton train derailment.

> Chemical hazards, Rogness pointed out, include asphyxiation from hydrogen sulfide, cancer from benzene and the typical house-fire hazards of carbon monoxide, sulfur oxides, nitrogen oxides and smoke particles.
>
> The cold weather made the air pollution monitoring unreliable.

Source: https://www.fema.gov/challenges-faced-during-2013-casselton-train-derailment. Accessed Jan 5, 2017

Special considerations when considering measuring exposures related to fuels:

Overall
- Some exposure assessment equipment is not reliable in extreme temperatures

Ethanol
- Detection/measurement is difficult
  - PID detectors have a low response as ionization potential is 10.47ev
    - Select appropriate lamp, if used for ethanol
  - Water solubility limits head space analysis

Gasoline components in ethanol blends
- Benzene, Toluene, Ethyl benzene and xylene are measureable markers

Crude oil
- Benzene, Toluene, Ethyl benzene and xylene are measureable markers

Bakken crude
- Benzene is a measureable marker
- Hydrogen sulfide may be present in spaces above oil

Resource:
https://www.uscg.mil/hq/nsfweb/foscr/ASTFOSCRSeminar/Presentations/RemovalandResponseTech/AirMonGuidanceTables09Ed2.pdf

Monitoring tools and instruments

pH paper (useful when produced water is released)

When exposed to a chemical, pH paper changes color.

Use:

- Measure presence of corrosive substance

Read-out:

- Observed color matched to chart

Notes:

- When pH paper changes color in the presence of corrosive vapors, the color change is easy to interpret. The color change may be harder to interpret when testing liquids.
- Hydrocarbons, which are neutral, may appear to change the color of the paper. In this case, the border between the wet and dry sides of the paper will be straight. If the border is jagged, multicolored, and the liquid seems to be wicking through the pH paper, the liquid is actually corrosive.
- The result may be difficult to interpret depending on the chemicals that are present; for example, in the presence of hydrocarbons, use of pH paper may provide an inaccurate result.
- When using the wetted pH paper for corrosive vapor detection, a neutral reading should not give you a sense of security. Other hazards may be present.
- pH paper can be attached to a stick or an extension tool when approaching an unknown environment, such as during hazard assessment.
- Utilize two pieces of pH paper (one wetted and one dry). The wetted paper reacts more quickly than the dry paper especially for low levels of a chemical in the air. The wetted pH paper is used for detecting corrosive vapor and dry is used to dip into liquids.

> Tip: pH meters are subject to interferences, so pH paper is preferred.

NOTE: The presence of strong oxidizers may change the colors and give false results.

Oxygen and Combustible Gas Meters, and Other Combination Meters

<u>Oxygen Meter</u> (useful for vapors of all fuels)

Use:

- To sample oxygen concentration, particularly near and in confined spaces

Read-out:

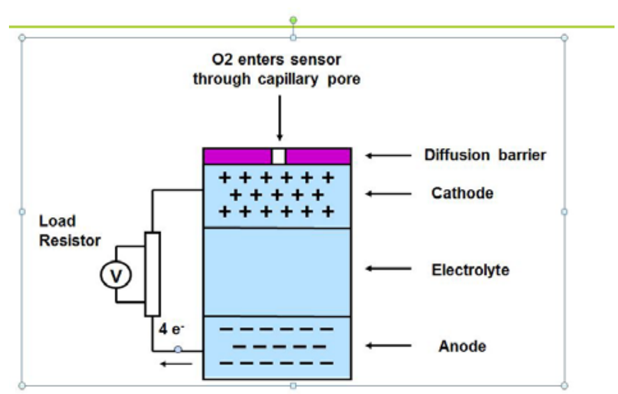
- Usually 0%–25% oxygen concentration.
- At greater than 23.5% oxygen, the explosion hazard increases.
- The normal oxygen concentration is 20.9% - any deviation from this is abnormal and should be investigated as to why there is a change. (Theoretically, a 0.1% decrease in oxygen due to displacement of the air by another chemical is indicative of a concentration of approximately 5,000 ppm of other chemicals –replacing 1/5 of O_2 and 4/5 of N_2).
- At less than 19.5%, **do not enter without an SCBA or SAR**.

Notes:

O2 sensors

- Need about 2-3 minutes to warm up
- Continuously react with the air
- Contain electrolyte solution
- Typical operating range: -5° to 120°F

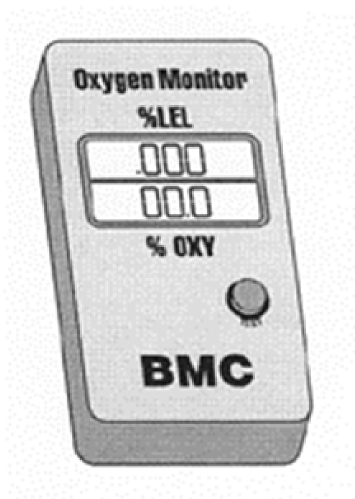
Oxygen Sensor (Simplified)



- Affected by temperature and pressure.
- High carbon dioxide levels may affect reading.
- Typically the meter calibrates for oxygen during each startup.
- Requires maintenance. (Life of sensor is approximately 2 years under normal use.)
- Acid vapors shorten the life of the electrochemical sensor
- Condensation and/or absorption may occur in long probes
- User must be trained

Tip: At -5°F to 32°F sensor reaction time slows and eventually will freeze at extreme temperature

Combustible-Gas Indicator (CGI)/ LEL Meter/Explosion Meter (useful for all fuels)



Use:

- To measure flammable vapor concentration in percent, particularly near and in confined spaces
- General purpose for most combustible hydrocarbons
- Responds to all combustibles present

Read-out:

- % LEL (sometimes referred to as Lower Flammability Limit, or LFL)
- A reading above 10% should be considered a potentially explosive atmosphere. (Know what to do when a potentially dangerous reading is noted—for example: leave the area, notify safety officer or incident commander). For added safety, many teams use lower values such as any positive reading, or 5%. The primary reason for this is for a flammable chemical that is also toxic. A low meter reading, or no reading at all, could still be a dangerous environment.
- Accurate over most of its range

Notes:

- Requires periodic calibrations. Normal practice is at least every 30 days.
- Relatively unaffected by temperature and humidity
- Does not respond the same to all vapors (final measurement value may be corrected based on calibration and known contaminant; see example below)
- Oxygen must be measured first. Many combustible-gas instruments require sufficient oxygen (consult manufacturer's manual) in order to determine LEL.
- User must be trained.
- Calibration should be checked or done before each use, as per the manufacturer's requirements. Recommendations vary by manufacturer, but before each use is best practice. It is a good idea to check calibration after using an instrument to verify good data and confirm the sensor was not compromised or injured.
- Should be bump tested to ensure that all sensors are operating before each use
- Nonspecific. Reflects total combustibles present. The specific flammable(s) is not identified. The %LEL is read as if the flammables were the calibration gas. (If a single flammable is present, the manufacturer may provide correction factors.)
- Not recommended for chlorinated hydrocarbons or tetraethyl lead-containing compounds
- Avoid exposing sensors to the following: lead compounds, compounds with sulfur, silicones, phosphates and phosphorous and inhibitors such as hydrogen sulfide and halogenated hydrocarbons.

Example: nothing shows on meter, but contaminant present

LEL of methane is 5% by volume
100% LEL = 5% VOL = 50,000 PPM (ignite)
10% LEL = 5,000 PPM Alarm
1% LEL = 500 ppm (LEL 1)
449 PPM ⇒ meter displays 0

Example: use of correction factors

calibrated with methane, used in an atmosphere known to only contain pentane
See manufacturer data for correction factors

reading of 5%

pentane correction factor is 2.0

→actual value is 10% (reading of 5% x correction factor 2) of the pentane LEL

Tip: The common LEL meter is calibrated to read 100% at the LEL of the calibration gas. A small % reading on the meter, while indicating a low risk of fire/explosion <u>at the meter</u> may indicate a potentially toxic concentration. For methane a reading of 5% on the meter indicates a methane concentration of 0.25% or 2,500 ppm.

Important background: LEL sensor technology is typically either catalytic bead on a wire or infrared (IR). The flammable is burned at the bead, increasing the resistance in the wire; the resistance is adjusted for air temperature using a Wheatstone bridge and converted to a reading of LEL. Therefore, oxygen is needed for the meter to function; typically 10-12% is the minimum required (see manufacturer specs). The IR sensor does not require oxygen for operation.

Problem:

At a release, several rail cars containing crude oil from the Gulf coast have been breached. Evaluation of the air 30 feet from a source results in an the LEL reading of 8%, and is used to evaluate toluene exposure. The calibration gas was methane. Using the toluene correction factor of 1.3, answer the following:

What is the LEL % for toluene?

What is the ppm?

What type of respiratory protection should be used?

<u>Combination Instruments</u>

The meter shown above for combustible gases and vapors is also used to measure oxygen. This is a common combination. Combination real-time monitors for oxygen and flammability (LEL, explosivity, combustibility) are approved for use in flammable environments where the oxygen does not exceed 20.9%, unless tested and approved for use in high-oxygen environments. An alternative is to have sample tubing (probe) to draw the air into the meter that is positioned at a location with acceptable oxygen concentration. The length of the sample tubing will vary for each meter, but typically ranges from 30 to 100 feet. Common problems with drawing samples through tubing include condensation of vapors, and absorption onto the tubing.

Three or more hazards can be measured with other combination meters. These multi-gas instruments, which may be called 3-gas or 4-gas meters or something similar, are used to measure oxygen and combustibles and other gases such as carbon monoxide and/or hydrogen sulfide. They are often used to test the atmosphere before entry into a confined space.

Notes:

- The chemical sensors respond to a specific chemical or class of chemicals. Interferences are usually limited (refer to manufacturer literature).
- In addition to temperature, a limitation of these electrochemical sensors is that use in high concentration atmospheres may use up all the reactivity of a cell in a single measurement, rendering the cell useless until there has been time (hours) for the cell to re-stabilize.

Example:
While sizing up a fire scene for CO exposure, putting the CO monitor near the exhaust of a support vehicle may 'blow it away' and require replacement or recalibration of the sensor.

Colorimetric Detector Tubes (Draeger, MSA, Sensidyne, RAE) (useful for a wide range of chemicals including markers of fuels, VOCs, hydrogen sulfide)

A colorimetric detector tube is a glass tube filled with a solid material or gel that has been impregnated with an indicator chemical. When the detector tube is used, the ends are broken off and the tube is inserted into a bellows or piston pump. An arrow on the tube indicates which end of the tube to insert into the pump orifice. A predetermined volume of air is pulled through the tube. The contaminant of interest reacts with the chemical in the tube. This reaction produces a stain in the tube with a length proportional to the concentration of the contaminant. Reagent changes include color intensity, length of change and change of color. Compare color to unused tube as changes can be very subtle.

Use:

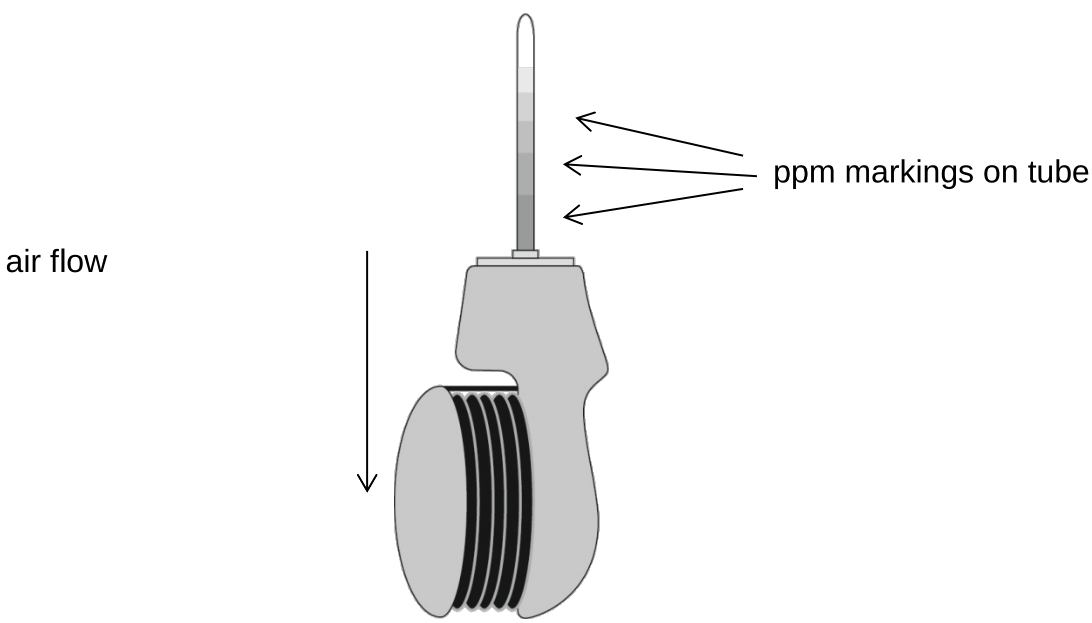
- Measure gas or vapor concentration
- Identify chemical family of contaminant using manufacturer decision charts and tables.

Read-out:

- Concentration in ppm, mg/m3 or percent is indicated by color change or length of color stain.

Notes:

- Not very accurate—within 25% of the real value at best
- Pump must be checked for leaks and calibrated.
- Tubes have a limited lifetime, so the expiration date on the container should be checked before use.
- User must be trained in reading the scales on the tubes used.
- User must follow specific pump-stroke requirements and all other directions.
- Interferences are possible; not very specific.
- May be misread if the sample-taker is color blind
- Specific temperature and humidity ranges shown in directions
- Tube heaters are available from some manufacturers
- Tubes may be marked with number of required pump strokes



Tip: The Draeger Chip Measurement System (CMS) is supplied with a chip that will perform 10 measurements of the concentration of a single chemical, instead of utilizing individual detector tubes. It provides an electronic readout of concentration. Note that there are not as many chemicals available in the CMS as there are when using single colorimetric tubes.

Personal Alarms (availability includes: O_2, CO, H_2S, LEL, VOCs, benzene)

Monitors worn on the belt or in a pocket are used to detect a contaminant and sound an alarm to exit the area when a pre-set level is exceeded. Workers in areas where there may be an oxygen deficiency or exposure to carbon monoxide or hydrogen sulfide are among those who may use personal alarms.

Oxygen meter with two alarms, audible and visible

A vibration alarm is available on some meters.

Use:

- To detect specific gas or vapor compared with a pre-set concentration in any work space
- Alert workers to levels of contaminants to which they should not be exposed

Read-out:

- Audible alarm and sometimes visible alarm and/or display of concentration (examples: ppm or %).

Notes:

- Inaccurate readings may be given if there are interferences.
- Battery-operated.
- Wearers must be trained in actions to take if the alarm sounds.

Hydrocarbon Detectors (useful for fuels and markers of fuels)

The total amount of all detectable flammable organic compounds can be measured using a device with either a Flame Ionization Detector (FID) or a Photoionization Detector (PID). These devices are used to measure exposure to solvents, fuels and volatile organic compounds (VOCs); results are compared with exposure guidelines.

Photoionization Detectors (PID)
In PID instruments, ultraviolet radiation is used to ionize (break apart the molecules) gases and vapors. The current produced is proportional to the number of ions and is a measure of concentration.
The energy needed to ionize a compound is its characteristic "ionization potential" (IP), expressed in electron volts (eV). Ionization potentials for selected materials are shown below.

Chemical	IP(eV)	Chemical	IP(eV)
Ethanol*	10.47	Hydrogen sulfide	10.5*
Methane	13.0	Hexane	10.2
Chlorine	11.5	Acetone	9.7
Benzene	9.2	Phenol	8.5

*consult with manufacturer for lamp selection. The usual 10.6 eV
lamp will not be sensitive for detection of compounds with IPs close to the value of the

lamp. Lamps are available in a range of eV values, depending on the gas used to fill the detector.

Use:

- To sample toxic and some flammable vapor concentration, particularly near and in confined spaces
- Detects organic and some inorganic gases such as Ammonia, Arsine, Phosphine, Hydrogen Sulfide, Bromine, and Iodine (0.1 – 10,000ppm) (most 1-2000 ppm.)
- Alerts user to areas of exposure or contamination
- Result identifies sources of emission.

Readout:

- Concentration in ppm

Notes:

- Ability to detect wide variety of chemicals in small amounts
- Does not destroy sample
- Quick response
- Can operate in low-oxygen environment
- Detects only those compounds with ionization potentials less than the energy of the lamp.
- Response affected by composition of mixed gases.
- Only quantifiable if measuring a known substance
- Lamps affected by high humidity, high levels of methane and dust
- Does not detect methane, CO, CO_2, or SO_2
- Cannot separate mixtures
- Other voltage sources may interfere.
- Requires calibration (usually with isobutylene).
- User must be trained.
- Must know lamp voltage and correction factor (CF).
- Requires regular maintenance

Correction Factors (10.6 eV Lamp)

	RAE	BW	Ion		IP (eV)
Acetaldehyde	5.5	4.6	4.9		10.21
Acetone	1.1	0.9	0.7		9.69
Ammonia	9.7	10.6	8.5		10.2
Benzene	0.5	0.55	0.5		9.25
Butadiene	1	0.9	0.85		9.07
Diesel fuel	0.8	0.93	0.75		n/a
Ethanol	12	13.2	8.7		10.48
Ethylene	10	11	8		10.52
Gasoline	0.9	0.73	1.1		n/a
n-Hexane	4.3	4	3.3		10.18
Jet fuel (J.P.8)	0.6	0.51	0.7		n/a
Kerosine	n/a	1.11	0.8		n/a
Methylethylketone	0.9	0.78	0.77		9.53
Naptha (iso-octane)	1.2	1.2	1.1		9.82
Styrene	0.4	0.45	0.45		8.47
Toluene	0.5	0.53	0.51		8.82
Turpentine	0.4	0.45	0.45		n/a
Vinyl chloride	2	2.19	2.2		10.0
Xylene	0.4	0.5	0.43		8.5

NOTE: correction factors differ for lamps with lower or higher eV values.

--calibrated with isobutylene

PIDs are often calibrated with isobutylene, which has a correction factor of 1.0. If you know that a single gas is present in the atmosphere, you multiply the correction factor for that gas by the instrument reading to obtain the true concentration of the chemical.

Example:
A RAE instrument is being used to measure toluene, with a CF of 0.5.

The instrument calibrated with isobutylene reads 100 ppm.
The actual concentration is:

$$C = 0.5_{CF} \times 100 \text{ ppm}_{iso} = 50 \text{ ppm of toluene}$$

Flame Ionization Detectors (FID)

In FID instruments, the gases and vapors are ionized (molecules broken apart) in a flame. A current is produced which is proportional to the number of carbon atoms. The current is converted to a measure of concentration.

Use:

- To detect many organic gases and vapors
- Can see chemicals with higher IP than PID (more accurate) (1.0-100,000ppm)
- Only organics

Readout:

- ppm

Notes:

- Requires gas chromatography option to identify and measure specific compounds
- Does not detect inorganics
- Affected by low temperatures, high contaminant concentrations, and oxygen-deficient atmospheres
- Must be calibrated
- User must be trained
- Requires maintenance and leak checks
- Must be intrinsically safe if used where explosive atmospheres may exist. Some models are not intrinsically safe
- Flame out in high wind
- Only carries limited amount of hydrogen
- Destroys sample
- Needs O_2 to operate

Deciding between PID and FID?

Consider

- Size and portability
- Range of compounds to be detected
- Cost
- Flame
- Presence of methane
- Humidity
- Wind

Discuss with the supplier
- your monitoring needs
- training needed for operation
- maintenance and calibration schedule

There are combination units that include both PID and FID.

PID/FID combination

Particulate monitoring

There are direct reading monitors to measure particle exposure due to a fire or work activities at a response. These hand-held units can be used to measure particles in a range of sizes (e.g. PM10 or PM2.5) or all airborne particles.

Use
- Particle concentration in air

Readout:

- mg/m3 or ug/m3

Alternatively, for initial assessment, particle density may be estimated visually, based on experience of EPA at wildfires. As shown in the table below, visibility is related to particulate levels.

Estimating particulate matter concentrations from visibility assessment

Categories	Visibility in Miles	Particulate matter levels* (1-hour average, µg/m3)
Good	10 miles and up	0 - 40
Moderate	6 to 9	41 - 80
Unhealthy for Sensitive Groups	3 to 5	81 - 175
Unhealthy	1 1/2 to 2 1/2	176 - 300
Very Unhealthy	1 to 1 1/4	301 - 500
Hazardous	3/4 mile or less	over 500

*In wildfire smoke, most particles are less than one micrometer, so the values obtained by measuring either PM10 or PM2.5 are virtually interchangeable, and are treated as such in this document. Therefore, in the table above, the different particle levels can be measured using either PM10 or PM2.5 monitors.

Source: https://www3.epa.gov/ttnamti1/files/ambient/smoke/wildgd.pdf. Table 1. Accessed February 8, 2017.

Exercise - Monitoring

For the expected scenarios you described above, work in small groups to select monitoring equipment to be used during a response.
Is the equipment available to your response team? Is there an alternative approach?

Exercise - Demonstrating Use of a Monitoring Device

If part of your operations-level activities will involve monitoring, an additional exercise will be conducted as practice in using your equipment. The facilitator will distribute information on the scenario, operational characteristics and a checklist.

Summary

Direct-reading instruments are used at responses as information is needed immediately—there is no time to send samples away for analysis.

Monitoring provides essential information for the conduct of a response.

Those conducting monitoring must be trained and follow an SOP.

A wide range of instruments are available; selection is made based on the hazard expected.

Work Practices

Developing, practicing and using good work practices during a response limits exposure, protects safety and reduces the potential for spreading contamination. Written Standard Operating Procedures (SOPs) in a fuel-release ERP might include some of the following:

Dike, block, absorb	Safety around electrical hazards
Working around ponds, rivers, wetlands	Confined Space work

Section Objectives

When you complete this section, you will be better able to:

- Identify specific work practices that may be needed when doing operations-level activities at a response scenario you described in Hazard Assessment

- Demonstrate an ability to perform an operations-level activity working in a team

NOTE: An employer-specific written work practice is referred to as an SOP. If the written work practice is generic, or 'for training only' it is referred to as a Standard Operating Guide (SOG).

Before describing Work Practices, the hierarchy of controls used for workplace hazards is presented.

Hierarchy of Controls

The hierarchy of controls refers to the preferred methods of hazard control. Traditionally, in order from most-preferred to least-preferred, they are:

Hierarchy of Controls for hazard reduction

Control	Highest preference
Eliminate	
Substitute	
Prevent	
Modify	
Contain	
Ventilate	
Work Practice Change	
Personal Protective Equipment	Lowest preference

During an emergency response it is not possible to eliminate all hazards. However, a range of controls can be employed. The hierarchy can also be used to reduce hazards during routine operations, reducing the hazard if a material is released.

The following are examples of controls along the hierarchy:

Elimination

Disconnecting power during an emergency (eliminating electrical hazards) is one example.

Substitution

Using a ‘green’ pesticide made from household chemicals to irradicate poison ivy near the storage area (where there is potential for a release) would reduce chemical exposure to the applicators while reducing risk of contact by a responder.

Modify

When practices are changed to no longer require entry into a confined-space a modification has reduced the potential exposure.

Contain

Double sided tanks provide added ability to contain a material, and reduce the potential for a release that is an emergency

Ventilate

Removing solvent vapors prior to a confined space entry using mechanical exhaust is an example of ventilation.

Work Practice Change

Adding a sign-off during chemical delivery to assure that the material is going to the proper receptacle a change in the work practice.

Personal Protective Equipment

When the above controls are not possible, personal protective equipment is used. For example, an emergency responder may need Level B to block a drain if the conditions pose a risk of splash and the chemical is a skin and respiratory hazard.

Hazard controls are further defined as **Engineering** or **Administrative**.

When engineering controls are used to control hazards, a piece of technology is used to reduce exposure. Examples include having an air-conditioned control rooms for chemical operators to reduce employee heat exposure and shielding to reduce radiation exposures. When use of confined-space entry permitting process is the only way of accomplishing a task, a ventilation fan is used to provide fresh breathing air inside the confined space, helping to reduce the risk. Ventilation is a commonly-used engineering control.

Administrative controls are policies and practices written before the work begins to minimize exposure to chemical and physical hazards. Examples include industrial hygiene monitoring programs, medical surveillance programs, confined-space entry and hot-work permits and policies, and lock-out procedures. Other examples are work plans limiting the duration of exposure (e.g., to noise and radiation), developing a written plan describing the maintenance of protective clothing, and implementing specific work practices which reduce or prevent exposure. All of these controls are examples of a universal Standard Operating Guideline (SOG). At your worksite, hazards are addressed with site-specific Standard Operating Procedures (SOPs).

Standard Operating Procedures

Standard Operating Procedures (SOPs) are carefully planned and detailed written work instructions intended to provide workers with necessary guidelines to carry out work tasks safely. Some SOPs are used in routine plant operations; others provide guidelines for actions that should and should not be taken during an emergency.

In this program we may use the term Standard Operating Guide (SOG)—generic guidance on how to do a task.

Operations-Level First Responder Activities

According to HAZWOPER, an operations-level first responder is one who will respond to releases or potential releases of hazardous substances as part of the initial response to the site for the purpose of **protecting nearby persons, property or the environment** from the effects of the release (Emphasis added, OSHA Standard 1910.120(q)(6)(ii)).

HAZWOPER also requires that operations-level first responders respond in a "defensive fashion without actually trying to stop a release." (1910.120 (q) (6) (ii)). The release should therefore be contained from a safe distance and kept from spreading. Prevention of exposure to the material is an important consideration. More aggressive actions should be attempted only by responders trained at or above the Hazardous Materials Technician level.

Basic control is the first step to prevent further release. This step may include shutting off a valve or shutting off a piece of machinery or system from a remote location. Other situations defined in the ERP may call for the responder to shut off valves/machinery at the incident scene. (In some cases, a remote operator may shut down flow at the source before the response team arrives—but material in the system will continue to flow.)

Containment includes those procedures taken to keep a material in its container. For the operations-level first responders, containment activities will generally not be undertaken except to assist the HazMat Technician from an area away from the release.

Confinement includes those procedures taken to keep a material in a defined area. These activities will vary from plant to plant and will be determined by the ERP. The operations-level first responder may confine a spill or release by: (a) diking, (b) blocking, (c) absorption, and/or (d) collection.

<u>Diking</u>—Dikes may be built of sand, earth, straw, sorbent, or similar materials around the perimeter of the leak. The type of diking material used must be compatible with the spill material. Plastic sheeting can be used as an additional barrier to slow leakage, if appropriate.

A special type of diking is the use of booms on waterways to confine the materials and prevent spread downstream. Booms are effective if the materials float on the water (specific gravity < 1) and are insoluble. Personnel who may be involved in laying booms must receive specific training in working in or near water, the impact of weather on the use of single or multiple booms, and the rate at which spilled material may spread on the water surface.

The construction and surveillance of dams to away may be an operations-level activity. Dams can be constructed to collect heavy, insoluble materials or to separate uncontaminated water from lighter, contaminated material floating on the surface.

Planning for these types of controls requires an assessment of:

- whether the dam materials are compatible with the spill.
- whether there is an adequate volume of dam material.
- whether the material can be moved quickly, without increasing the hazard.

Specialized planning and training are required for each instance in which dams are part of the emergency response plan.

Blocking—Drains, ditches, or storm sewers should be covered and blocked to prevent run-off of spill materials. This blocking can be done with a sorbent pad, a piece of plastic, or a rubber pad. If flammable or toxic materials enter these systems, the potential for damage to property or people is increased.

Absorption—Run-off can sometimes be absorbed with dirt, sand, soda ash, sawdust, wood chips, peat moss, vermiculite, or other material. The sorbent materials should be positioned so that spill material runs into it. Care must be taken to be certain that the absorbent is compatible with the spill.

SOGs for Responses

In addition to the specific confinement activities, the following work requires detailed procedures to protect the responder:

Work on Lakes, Rivers, Ponds and Lagoons

Preventing migration of released fuels to water ways or wetlands or spread of contamination in waterways are major concerns in many incidents.   As a responder, these water ways may be visible, or the surface may be obscured by ice formation or other unstable surfaces that increase risk of injury.

The hazards around lakes, rivers, ponds and lagoons include:

- drowning
- a partially solidified surface
- corrosive or toxic materials
- gases or vapors

Work practices that should be taken around ponds and lagoons include:

- observing conditions of railings or barriers
- observing surface conditions
- using protective equipment such as life jackets, safety belts, or life lines when working close to unrailed areas
- wearing protective clothing if material could cause injury if contacted or inhaled
- limiting access by marking or establishing barriers
- Selecting appropriate float support if entry to the water surface is needed
- Controlling contamination

These and other local aspects will be included in an SOP in the ERP. For example, if you are part of team that may deploy booms to a lake in the winter, the SOP will include cold stress/frost bite recognition and where to find treatment.

Confined-Space Entry

A confined space generally has three distinct properties which set it apart from other areas and dramatically increase the risk of injury or illness.

<u>Properties of Confined Spaces</u>

- Is large enough and so configured that an employee can bodily enter and perform assigned work
- Has limited or restricted means for entry or exit (for example, tanks, vessels, silos, storage bins, hoppers, vaults, and pits are spaces that may have limited means of entry
- Is not designed for continuous employee occupancy

Some common confined spaces that are found at manufacturing facilities include, but are not limited to:

- Ditches, culverts, and ravines
- Excavations and trenches
- Tank cars

- Vaults
- Sewer systems with manhole entrances
- Vats
- Tanks

The OSHA Permit-Required Confined-Space Entry Standard (29 CFR 1910.146) requires that the employer survey all confined spaces and designate those for which a permit is required. Remember that in an emergency, the hazards of a space may change. For example, a ditch not usually containing any hazard could be a catch basin for spilled material. Although not designated a permit-required confined space, it has become one as a result of the release.

A permit-required confined space (permit space) means a confined space that has one or more of the following characteristics:

- Contains or may contain a hazardous atmosphere
- Contains a material that has the potential for engulfing an entrant
- Has an internal configuration such that an entrant could be trapped or asphyxiated by inwardly converging walls or by a floor which slopes downward and tapers to a smaller cross-section
- Contains any other recognized serious safety or health hazard

All personnel must be informed of the hazards before entry

Entry into confined spaces poses many dangers. Chemical vapors can accumulate quickly in confined spaces. A confined space might also contain a material that could trap a worker or a moving part that could trap or injure. Entry into confined spaces may block your view of what else is happening around you.

Lack of natural ventilation makes it easier for toxic or flammable materials to accumulate. Something as simple as rusting metal or the operation of fuel-powered engines can deplete the existing oxygen supply. Decaying organic materials such as plants or animals can create hydrogen sulfide gas.

Many toxic gases don’t have any warning properties, so emergency responders about to enter the confined space have no way of knowing what hazards they might face without first testing the air. The most common confined-space injuries are asphyxiation from lack of oxygen, being overcome by very high concentrations of toxic vapors, or rapid skin absorption of organic solvents.

Other common confined-space hazards involve explosions or fires. Getting in and out of a confined space can cause injuries and hinder rescue efforts in emergencies. Responders who may be required to rescue victims must be provided training in the types of spaces at the facility and perform a simulated rescue annually.

Several steps must be taken to make work safer in confined spaces. Careful advance planning for confined-space entry can help minimize the risk of injury. This advance planning must include the following points:

- Identifying confined spaces (Determine which require a permit to enter)
- Developing written standard operating procedures (SOPs)
- Arranging for and strategically locating adequate supplies of air-supplying respirators and protective and life-saving equipment
- Training personnel who must enter permit-required confined spaces to deal with emergency events
- Training personnel how to monitor and properly safeguard the space before and during entry
- Posting a qualified and trained safety attendant who is ready to provide assistance, if required, outside the confined-space entrance at all times
- Training personnel to recognize when the hazards of a confined space may have changed

The hazards of confined-space entry are further reduced by:

- Monitoring confined spaces before entry and during work for oxygen deficiency and flammable or toxic atmospheres. Monitoring must be conducted throughout the space, not just at the entry point.
- Providing appropriate ventilation before and during the work.
- Complying with the permit and logging system. Under this system, confined-space entry is permitted only after information about oxygen and toxic and flammable vapor levels has been collected. The permit must be signed by a properly trained supervisor.

No personnel can enter the confined space without a signed entry permit. Permits are valid only for a specific date, time, and place.

A confined-space entry standard operating procedure (SOP) minimizes danger by trying to control factors that may cause or contribute to accidents or emergencies through careful monitoring, training, and planning. These required SOPs are an administrative control.

Lock-out Procedures

Lock-out procedures are used whenever there is work around machinery that may become activated or conduits that may release fluids. The equipment is locked out of operation so that it will not be made operational by someone who is unaware of the activity of another responder.

Know the site lock-out procedure before attempting any operation.

Never assume a machine, circuit, or pipe is locked out just because it should be.

When in doubt, lock it out!

Common examples of equipment requiring lock-out include the following:

- Electrical junction boxes
- Pipelines when flow is blocked

Lock-out requirements are described in 29 CFR 1910.147, The Control of Hazardous Energy (Lock-Out/Tag-Out).

Example of a lock-out tag:

LOCKED OUT

This tag must always be used and completely filled out before it is used.

Do Not Start! **Do Not Open!** **Do Not Close!** **Do Not Energize!**

Do Not Operate!

1. Employee name ____
2. Date lock placed ____
3. Time lock placed ____
4. Was starter pushed to determine equipment to be worked on did de-energize?

   Yes ◻ No ◻

5. Has the undersigned verified that the correct main breaker has been locked out?

   Yes ◻

   No ◻

6. Has the equipment been isolated from other energy systems such as hydraulic or pneumatic which could endanger others?

   Yes ◻

   No ◻

   Comments ____

The following list identifies the minimum recommended procedures for lock-out.

- Get lock-out approval/permit (lock-out tag).
- The first person to work on a piece of equipment should be sure the primary power source is turned off and install a personal lock with a lock-out clamp. This clamp must be installed so that the disconnect cannot be turned on with the clamp and lock in place. The switch is then activated to see if the circuit is truly de-energized. (This will also bleed off any stored energy.)
- Each person who works on the equipment must go through the standard process described above.
- Each person must remove his or her lock after completing the job and all personnel are out of the danger area. After the last lock and clamp are removed, the warning tag can be removed and the equipment re-energized.
- A lock must be removed only by the person who installed it. Any exceptions are detailed in the SOP and must be included in the site-specific training.
- Critique any problems and revise the SOP.
- Annually, review and update the SOP if needed.

Failure to follow lock-out procedures may result in an emergency immediately hazardous to life and property. Hazards to responders' safety and health when the lock-out policy is not followed include electrocution; chemical or other bums; or being caught in or crushed by mechanical, pneumatic, or other moving parts.

Typical Lock-Out Device with Multiple Locks

Fire Prevention

Although it is necessary to monitor for the presence of flammable vapors, constant attention must also be given to preventing fires and explosions. Prevention is the responsibility of both the employer and the employee.

Special Considerations--Ethanol Conducts electricity Protect the sources of firefighting water from contamination Vapors can reach a concentration to be a rich fuel mixture—keep engine intakes at distance

<u>Employer Responsibilities for Fire Prevention</u>

- Maintaining adequate supplies of fire-extinguishing media appropriate for the hazards
- Making certain that fire-extinguishing equipment and supplies are properly positioned
- Ensuring that responsible fire brigade crews are adequately trained to use the specific firefighting equipment and supplies for the hazards which may be present
- Conducting routine evacuation and fire-response drills
- Conducting frequent walk-through inspections for fire safety purposes
- Inspecting fire-suppression equipment routinely
- Posting evacuation routes
- Training personnel in hazard recognition

<u>Responder Responsibilities for Fire Prevention</u>

- Using non-sparking tools
- Observing no-smoking rules
- Using non-sparking radios and other electrical equipment
- Following other reasonable rules to reduce the possibility of fire

Evacuation

The ERP must describe conditions requiring an evacuation, who can authorize an evacuation and how it should be done. The ERP should specify evacuation routes alarm or communication systems which will be used, the gathering place for those who evacuate and methods to verify the completeness of compliance with the evacuation.

Shelter in Place

The ERP must describe conditions when residents and others in the area of a release will be asked (ordered) to shelter in place, who makes this decision and how the information will be disseminated to those affected. The ERP should specify alarm or communication systems that will be used. By planning in advance, some individuals with special needs may be identified that require evacuation even though most can shelter-in-place.

Decontamination

Prevention of spread of the hazard includes removing the contamination from protective clothing and equipment. A description of SOG is included in the Operations-level manual.

Pre-planning includes:

- Determine equipment needed for decon operation
- Determine necessary protective clothing
- Determine personnel needs:
  - o Decon team
  - o Back-up, if necessary
- Identify other exposure control methods:
  - o Engineering
  - o Containers for decon materials and solutions
- Review work plan and resolve any issues after discussions with the incident commander and the team

Emergency Medical Treatment and First Aid

The ERP must specify who can provide emergency medical treatment and First Aid. Certified training in these topics is needed to qualify those who will provide emergency medical treatment or First Aid. Each emergency responder must know who to notify, should medical treatment be needed. Specific training in emergency medical treatment and First Aid is outside the scope of this program.

Termination Procedures

Termination procedures are the actions to close out an emergency response. These procedures may involve transfer of responsibility to an outside responder or clean-up contractor, decontamination of equipment and PPE, and disposal of hazardous wastes. Termination procedures may also address those internal and external reports that must be filed and filing deadlines. Personal notes or copies of reports, if available, may be useful for future reference.

Post-Response Critique and Follow-up

Supplies should be restocked and stored and equipment inspected and recharged as soon as possible to prepare for any future use. Following a response, the person in charge should conduct a meeting to critique the response. Each step of the response from initial actions to termination, should be reviewed.

This discussion may result in suggestions to improve pre-planning, including the need for additional equipment, resources, training, or revisions in the ERP.

Emergency Response Equipment and Supplies

The type and amount of emergency response equipment will be determined during preplanning. Specific hazards in the plant, the scope of response by personnel, and the level of training will be determining factors. The following are some examples of typical equipment and supplies that operations-level first-response team members might use:

Communication Gear

- Hand-held radios

Recordkeeping and Related supplies

- Paper and note pads, checklists
- Pens, pencils, markers
- Clipboards
- Green marking tape (perimeter)
- “Restricted Area” signs

Tools, Supplies, and Equipment

- Portable wash unit
- Disposable towels
- Detergent
- Plastic drop sheet
- Clean water supply
- Duct tape
- Wrecking bar (non-sparking, 30” x 3/4”.)
- Shovel (D handle, round point, non-sparking)
- Garden hose (50 ft., 5/8” in. ID)
- Scrub brushes
- Plastic buckets
- Plastic garbage cans
- Diking materials
- Heavy plastic sealing mat

Monitoring and Observation Equipment

- Combustible-gas indicator
- Oxygen meters
- Specific gas detectors
- Binoculars

Respiratory and Personal Protective Equipment

- Positive-pressure, self-contained breathing apparatus with extra air cylinder
- Full-face, air-purifying respirators with appropriate canisters
- Fit-testing equipment
- Chemical-resistant goggles/face shield
- Anti-fog solution
- PVC disposable gloves
- Neoprene gloves
- Butyl gloves
- Natural rubber gloves
- PVC disposable boots
- Splash suits

Resource and Reference Materials

- ERG
- NIOSH/OSHA Pocket Guide to Chemical Substances
- Access to Internet

Note: This list is for training purposes only and is not intended to be comprehensive.

Work Practice Workshop

This workshop is divided into two different sections: a small group exercise and hands-on activities.

The first section is a small-group exercise in which you and other group members will detail what is needed for an operations-level activity that might be expected for response to a release identified in your hazard assessment (examples: documenting that flow through a pipeline has been locked out, deploying boom on water, deconning those who deployed boom). A work sheet is provided for you to record needs for the activity.

Personnel acting as the Incident Commander and/or Team Leader will go over this information during report back.

The hands-on activities will be done working in a group as a team, just as if an emergency had occurred.

Some checklists are shown in the following pages as examples; actual checklists for the release in your locale will be provided by the facilitator.

Worksheet—Equipment and supply needs for an operations-level activity

Activity:____

Needed Equipment and supplies

Name________________________________

Diking/Absorbing Performance Checklist

Please answer the following questions by checking the appropriate box.

1. Did the team size up and plan the diking task ....□ Yes □ No

Was the chemical identified?...□ Yes □ No

2. Were the tools and equipment required for the diking task assembled? ....□ Yes □ No

3. Was diking/absorbing material used? ....□ Yes □ No

4. Did the team start to apply the diking material far away enough from the spill?..□ Yes □ No

5. Did the team work from the edge of the spill inward?................□ Yes □ No

6. Was diking/absorbing material handled so as to minimize contact with the spilled chemical? ....□ Yes □ No

7. Did you make an effort to minimize your contact with the spilled chemical? ....□ Yes □ No

8. Did you remove your disposable contaminated clothes correctly? ....□ Yes □ No

9. Did you place your contaminated tools/materials in a barrel........□ Yes □ No

10. Could all tools be decontaminated?...□ Yes □ No

11. Did you place your contaminated disposable clothes in a waste barrel? ....□ Yes □ No

12. If this was a real incident, should you have gone through the decon line?...□ Yes □ No

_______ Facilitator Initials

Name______________________________

Blocking the Flow Performance Checklist

Please answer the following questions by checking the appropriate box.

1. Did the team size up and plan the blocking task together?..□ Yes □ No

2. Were the tools and equipment needed for the blocking assembled?..□ Yes □ No

3. Did the team select the right tools and equipment for the blocking task?..□ Yes □ No

4. Did you make an effort to minimize your contact with the spilled chemical?...□ Yes □ No

5. Was contaminated blocking material handled so as to minimize contact with team members? ....□ Yes □ No

6. Was the flow successfully blocked?..□ Yes □ No

7. If this was a real response, should you have gone through decon?...............□ Yes □ No

_______ Facilitator Initials

Name______________________

Performance Skills Checklist—Termination

Activity	Yes	No
1) Did you resupply equipment?		
a) Suit		
b) Gloves		
c) Boots		
d) Hard Hat		
e) Tape		
f) Decon Bags/Pads		
2) Did you inspect the following equipment before putting it in the inventory?		
a) Suit		
b) Gloves		
i) Outer		
ii) Inner		
c) Boots		
d) Hard Hat		
e) Tape		
f) Unused supplies		
g Neutralizing solution/decon additives		

3) Were any extra boxes inspected?

4) Were all materials and equipment returned to storage?

5) Did you write up any identified deficiencies?

______ Facilitator Initials

Name______________________________

Decon

Please answer the following questions by checking the appropriate box.

1. Did the team size up task to be done together? □ Yes □ No

2. Were the tools and equipment needed for decon assembled? □ Yes □ No

3. Did the team select the right tools and equipment for decon? .... □ Yes □ No

4. Did you make an effort to minimize your contact with the hazardous chemical? .... □ Yes □ No

5. Was the contaminated items handled so as to minimize contact by team members? .... □ Yes □ No

8. Was the decon successful?.. □ Yes □ No

9. If this was a real response, should you have gone through decon?.............. □ Yes □ No

_______ Facilitator Initials

Summary

A detailed description for each work practice/activity is included in the response plan.

These SOPs may be updated/revised based on response experiences discussed in Termination debriefing.

Training on each SOP is required for efficient and effective responses.

RPE+CPC=PPE

Respiratory Protective Equipment (RPE) and Chemical Protective Clothing (CPC) together form a collection of Personal Protective Equipment to limit exposure to responders during a release or the events following a release.

Adequate pre-planning results in identifying the PPE needed for response actions anticipated based on a risk assessment. PPE must be selected to protect employees from known or likely potential hazards associated with the fuel release. The proper selection of PPE is based on many factors, including:

- Potential hazards
- What is known: name of chemical(s)l and concentration(s), temperature and other site factors
- Surrounding required activities

PPE needs will be re-evaluated throughout the response, as conditions change and monitoring information is received.

As covered in operations-level training, responders using respiratory protection shall:

- Be issued respirators only upon verification of medical approval, training and fit testing
- Perform user checks of their respirators to ensure a proper seal before entering areas requiring respirator use
- Be clean-shaven in the area of face-face piece seal
- Use corrective lenses, if needed that are approved for respirators
- Be instructed to leave the work area when experiencing respirator failure

Section Objectives

When you complete this section, you will be better able to:

- Identify appropriate PPE to be used during a scenario resulting from the hazard assessment

Exercise – Select PPE for a Work Practice

Working in groups, show the PPE for each of the Work Practices that you identified as operation-level activities for the scenario. Complete the Worksheet, below:

Activity:____

Needed PPE

Summary

PPE is selected based on the hazard and may change during the response.

A general rule for which level of protection to use is: **“The less you know, the higher you go.”**

Remembering Levels of Protection
A helpful way to remember the levels of protection is: Level A - ”A”ll Covered, gas/mist tight Level B - ”B”reathing Air, splash protection Level C - ”C”artridge Respirator or air purifying respirator Level D – “D”on’t Expect Protection”, regular work clothes

If respiratory protection is required, the OSHA Respiratory Protection standard must be followed (29CFR1910.134), including fit testing and medical clearance to wear a respirator.

DISCUSSION

Throughout these exercises, there have been several references to the Casselton train derailment. Take a few minutes to read the entire posting below, and then join a discussion using the questions show at the end.

Challenges Faced During 2013 Casselton Train Derailment

Dave Rogness, emergency manager of Cass County in North Dakota, talked at the Regional Interagency Steering Committee meeting about the 2013 Casselton train derailment. He began by pointing out that roughly 80-120 trains a day come through Cass County. Each week more than 40 of those trains, each a mile long, is hauling more than three million gallons of Bakken crude oil. That is the most crude-by-rail traffic in North Dakota.

The county realized the potential problem from Bakken crude oil and had sent a plan for dealing with oil car explosions to all fire departments and done training exercises for derailments. Casselton, for example, has an all-volunteer fire department; however, all 28 firefighters are trained to National Fire Protection Association 472 Awareness Level, most to the operations level, and there is a regional hazmat team based in Fargo that is trained to the technician level.

Dave Rogness, Emergency Manager in Cass County, North Dakota, talked about the oil-car explosion that rocked the small town of Casselton.
On December 30, 2013 in Casselton, a BNSF westbound train with 112 grain cars went off the tracks. Thirteen of the cars derailed, and one fell on the eastbound tracks. Within two minutes, a BNSF eastbound crude oil train hit that car. That caused two front locomotives, a hopper car, and twenty cars on the eastbound train to derail, and 18 of them ruptured, exploded, and released 450,000 gallons of Bakken crude oil.

The explosion was observed for 20 miles; it is the largest release of Bakken crude oil by rail in the U.S. so far.

No one on the train crews was hurt.

If the explosion had happened in just a slightly different location, the results could have been much worse. It happened in the countryside, 20 miles west of Fargo, a city of 100,000, and ¼ mile west of Casselton, with a population of 2500. It was also just one-quarter mile east of a large ethanol plant. It was adjacent to a city park – but with a temperature of minus 1 degree Fahrenheit, and a wind chill factor of 20 below, the park was empty. The school, a little more than a mile away, was out for Christmas vacation.

Initial callers thought people were still on the trains, and that the fire was from either grain or ethanol. When responders saw the placards on the railroad cars, they were able to learn within 15 minutes that the train was carrying Bakken crude.

Rogness then described the key incidents and problems of the response to the disaster:

- The command post was originally set up one-quarter mile from the scene, but they had to pull back to a half mile because it was too hot for the responders even inside their rigs. It was later moved to the school when they realized the response would take hours and they needed to get out of the cold.
- Rogness said bringing in trained crews and expertise from BNSF into the command structure was critical to the success of the response. The railroad eventually deployed more than 300 staff and contractors to the event. “Bring that rail company in,” he says. “They are legally responsible for the derailment. Get them on your side before those issues arise.”
- Other units in the command structure included law enforcement (for scene control and also to investigate the incident), Emergency Medical Services (monitoring medical needs and assisting with the evacuation), and Public Health (monitoring the air quality as well as the spill recovery and mitigation).
- Media issues were a problem. Passersby were taking photos and posting them on social media that went worldwide before responders even got there. The public information officer was getting calls from as far away as Africa and Asia. He would hang up from one call on his cell phone and find 6-10 messages waiting.

- There were few options for fighting the fire. Water should not be put on exploding crude oil. Firefighters did not have enough foam in four counties together to put the fire out, plus the foam would freeze in the cold. Dry chemicals were not available. The only choice was to let it burn, which BNSF responders said would take about 12 hours. It took more than 24. Political leaders were skeptical of the strategy.
- Air traffic was thick from media and private operators wanting to see the fire. Fearing an air accident, the responders got the airspace closed.
- The cold weather made the air pollution monitoring unreliable.
- A shelter-in-place advisory shifted to an evacuation advisory as the wind shifted; the evacuation area was later expanded to the whole township, and the 19 residents and two pets that had come to the local shelter were moved to a school in Fargo. The evacuation order was lifted at 3 p.m. the following day.
- Demolition and removal of the cars began in the early morning hours after the accident, even though a few of the oil cars were still burning.
- Assets began demobilizing at the close of business the day after the event.

The Casselton explosion was just one example of the hazards that can result from oil-car derailments.

Chemical hazards, Rogness pointed out, include asphyxiation from hydrogen sulfide, cancer from benzene and the typical house-fire hazards of carbon monoxide, sulfur oxides, nitrogen oxides and smoke particles.

The explosion alone can also be devastating. He pointed to the example of the fireball of Bakken crude oil in Lac Megantic, Quebec, in July of 2013 that left 47 dead and 30 buildings destroyed. Blazing oil flowed over the ground, drained into storms sewers, and erupted as huge fires from other drains, manholes, and even chimneys and basements of other buildings.

How real is the threat? The U.S. Department of Transportation predicts more than 200 crude and ethanol trains will derail over the next 20 years, including 10 in urban areas, Rogness said.

At least one of those urban derailments could be catastrophic.

Source: https://www.fema.gov/challenges-faced-during-2013-casselton-train-derailment. Accessed Jan 5, 2017

Discuss:

What are 'lessons learned'?

What 'good luck' was involved?

Could the event have resulted in injury?

Was preplanning valuable?

Emergency Response Exercises

In this exercise, one of the scenarios identified in your hazard assessment will be conducted from alerting to termination as a table top simulation.   First the response will be to a release only and may be conducted as a table top or field exercise; another scenario with a fire will be conducted from alerting to termination as a table top.

The Facilitator will provide checklists for use during each.

Objectives

When you have completed this exercise, you will be better able to:

- Demonstrate ability to participate in a response
- Demonstrate ability to conduct the activities for an assigned role

CLOSING AND PROGRAM EVALUATION

Thank you for participating in this program.

This is an opportunity to ask any questions you may have, or to discuss how the knowledge and skills learned can be used at work. Were all of your initial questions answered?

Please take the next 10 minutes to complete the program evaluation forms. These are important for improving the program. The Midwest Consortium does take your comments seriously and has made changes in content and the skill exercises based on feedback. Your comments are anonymous.

We hope to see you at another Midwest Consortium program in the future.