Tony Mazzocchi Center

HAZWOPER Workbook — Facilitator's Guide

Edition 4.0, April 2016

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TONY MAZZOCCHI CENTER
For Health, Safety and Environmental Education

Hazardous Waste Operations and Emergency Response (HAZWOPER) 40-Hour Class

Facilitator's Guide

Edition 4.0
April 2016

UNITED STEELWORKERS
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Pre-class Preparation:

Verify the following:

- Number of books needed (curriculum, 2010 *NIOSH Pocket Guide*, 2012 DOT *ERG*)
- Class Participant Roster
- Classroom Scheduling
- Trainer Schedule (who is doing what)
- Training aids provided in your Trainer's Package:
    - Videos and PowerPoint Presentations (PPTs):
        - Activity 1 (Video — Anhydrous Ammonia Truck Overturns)
        - Activity 2 (PPT — Labor History; Video — Triangle Shirtwaist Fire and Remembrance)
        - Activity 3 (PPT — Rights and Responsibilities; Videos — Do You Live Near a Toxic Superfund Site? and The Love Canal Disaster Toxic Waste in the Neighborhood)
        - Activity 4 (PPT — Safety Systems; Videos — The Human Cost of Gasoline, Behind the Curve and Animation of Explosion at Tesoro's Anacortes Refinery)
        - Activity 5 (PPT — *NIOSH Pocket Guide*)
        - Activity 6 (PPT — Hazardous Materials Chemical and Physical Properties; Videos — Acetone Vapor Explosion and Reactions of Alkaline Metals with Water)
        - Activity 7 (PPT — Toxicology and Health Effects)
        - Activity 8 (PPT — Components of HCS 2012)
        - Activity 9 (PPT — HMIS and NFPA)
        - Activity 10 [PPT — USW DOT *ERG*; Videos — 2012 *ERG (Emergency Response Guidebook)* and FEMSA *ERG*]
        - Activity 11 (PPT — Chemical Game; Name That Chemical Game Cards)
        - Activity 13 (PPT — PPE)
        - Activity 14 (PPT — Site-specific Health and Safety Plan)

continued

Pre-class Preparation *(continued)*:

- Activity 16 (PPT — Site Characterization**;** Videos — Nonintrusive Characterization of the 618-11 Burial Ground and Starting Intrusive Characterization Work at High-hazard Waste Site)
- Activity 18 (PPT — Hazards of Noise Exposure; Videos — Hearing Loss Example, How Hearing Works and OSHA Safety Training Video OSHA Noise Standard and Occupational Hearing Loss)
- Activity 19 (PPT — Confined Spaces; Videos — Atmospheric Hazards Illustration, CSB Excel Energy Confined Space and Valero Nitrogen Tragedy)
- Activity 20 (PPT — Non-chemical Hazards; Videos — OSHA Trenching Prevention and Worker on Scissor Lift Electrocuted)
- Activity 21 (PPT— Ergonomics Fundamentals. . . An Overview)
- Activity 22 (PPT — Decontamination; Video — Loony Safety Donning and Doffing)
- Activity 23 (Videos — Emergency Response Scenario and Emergency Response Summary)
- Activity 24 (Video — Shock to the System Reality Check Activity Scenario)
- Activity 25 (PPT — Respiratory Protection; Video — Respirator Donning and Doffing and User Seal Checks)
- Activity 26 (PPT — Air Monitoring; Video — MultiRAE Lite Force Gas Monitor with PID)
- Activity 28 (PPT — Drum Handling and Sampling; Video — Hazardous Waste Drum Site Cleanup USEPA)
- Activity 29 (PPT — Final Field Activity and SDS file with Chemicals used in this Activity)
- Activity 30 (PPT — Mapping Hazards at Work)
- Activity 32 [PPT — Jeopardy Game (optional) and Jeopardy Game Wall Cards.]
    - Pdf "fillable" class certificate with instructions.
      (Note: Please read the instructions on how to complete these forms. There are no longer copies of the certificates in the back of each workbook. The certificates can now be completed and printed prior to the class.)

- Summary
- Pens, notepads, folders, etc.
- Flipcharts
- Computer, projector and screen

Class Paperwork:

Tony Mazzocchi Acknowledgement (page iii)

- Tony Mazzocchi Center Sign-in Sheet (Workbook 2 pages A-5–A-8 and Workbook 3 pages A-5–A-8)

Note: The order that paperwork is done varies from site to site. All paperwork should be completed before the class ends.

Preliminary Discussion When You Start the Class:

- Logistics:
  - Welcome
  - Introductions.
    (Make sure each table has at least one, and hopefully more, workers with a dangerous job. We don't want a table with all managers or all office workers.)
  - Restroom locations
  - Pager and cell phone use
  - Evacuation information
  - Breaks and lunch
  - Housekeeping
  - Encourage class participation
- USW Policy on Sexual Harassment (page A-2 in Workbook 2)
- Example of Factsheet Reading Method (page iv in Workbooks 1 and 3)
- Explain to class that pages marked "Notes" have been placed throughout the book for them to use, if necessary.

Things to Consider Throughout the Class

Time estimates: Day 1, Workbook 1

ACTION	TIME (Minutes)	NOTES	Actual Times for Each Activity
Introductions/ Paperwork/Logistics	30		7:00-7:30 a.m.
Activity 1	30		7:30-8:00 a.m.
Activity 2	20		8:00-8:20 a.m.
BREAK	10		8:20-8:30 a.m.
Activity 3	100		8:30-10:10 a.m.
BREAK	10		10:10-10:20 a.m.
Activity 4	40		10:20-11:00 a.m.
LUNCH	60		11:00-12:00 p.m.
Activity 5	50		12:00-12:50 p.m.
BREAK	10		12:50-1:00 p.m.
Activity 6	70		1:00-2:10 p.m.
BREAK	10		2:10-2:20 p.m.
Activity 7	70		2:20-3:30 p.m.

Time estimates: Day 2, Workbook 1

ACTION	TIME (Minutes)	NOTES	Actual Times for Each Activity
Activity 8	60		7:00-8:00 a.m.
BREAK	10		8:00-8:10 a.m.
Activity 9	50		8:10-9:00 a.m.
BREAK	10		9:00-9:10 a.m.
Activity 10	50		9:10-10:00 a.m.
BREAK	10		10:00-10:10 a.m.
Activity 11	50		10:10-11:00 a.m.
LUNCH	60		11:00-12:00 p.m.
Activity 12	35		12:00-12:35 p.m.
BREAK	10		12:35-12:45 p.m.
Activity 13	40		12:45-1:25 p.m.
BREAK	10		1:25-1:35 p.m.
Activity 14	50		1:35-2:25 p.m.
BREAK	10		2:25-2:35 p.m.
Activity 15	55		2:35-3:30 p.m.

Time estimates: Day 3, Workbook 2

ACTION	TIME (Minutes)	NOTES	Actual Times for Each Activity
Activity 16	50		7:00-7:50 a.m.
BREAK	10		7:50-8:00 a.m.
Activity 17	30		8:00-8:30 a.m.
BREAK	10		8:30-8:40 a.m.
Activity 18	90		8:40-10:10 a.m.
BREAK	10		10:10-10:20 a.m.
Activity 19	40		10:20-11:00 a.m.
LUNCH	60		11:00-12:00 p.m.
Activity 20	60		12:00-1:00 p.m.
BREAK	10		1:00-1:10 p.m.
Activity 21 (optional)	35		1:10-1:45 p.m.
BREAK	10		1:45-1:55 p.m.
Activity 22	50		1:55-2:45 p.m.
Break	10		2:45-2:55 p.m.
Activity 23	35		2:55-3:30 p.m.

Time estimates: Day 4, Workbook 3

ACTION	TIME (Minutes)	NOTES	Actual Times for Each Activity
Activity 24	45		7:00-7:45 a.m.
BREAK	10		7:45-7:55 a.m.
Activity 25	50		7:55-8:45 a.m.
BREAK	10		8:45-8:55 a.m.
Activity 25	50		8:55-9:45 a.m.
BREAK	10		9:45 9:55 a.m.
Activity 26	65		9:55-11:00 a.m.
LUNCH	60		11:00-12:00 p.m.
Activity 27	45		12:00-12:45 p.m.
BREAK	10		12:45-12:55 p.m.
Activity 28	70		12:55-2:05 p.m.
BREAK	10		2:05-2:15 p.m.
Activity 29	75		2:15-3:30 p.m.

Time estimates: Day 5, Workbook 3

ACTION	TIME (Minutes)	NOTES	Actual Times for Each Activity
Activity 29	75		7:00-8:15 a.m.
BREAK	10		8:15-8:25 a.m.
Activity 29	70		8:25-9:35 a.m.
BREAK	10		9:35-9:45 a.m.
Activity 29	75		9:45-11:00 a.m.
LUNCH	60		11:00-12:00 p.m.
Activity 29	60		12:00-1:00 p.m.
BREAK	10		1:00-1:10 p.m.
Wrap-up (certificates, questions, etc.)	10		1:10-1:20 p.m.
Activity 30 (optional)	90		
Activity 31 (optional)	30		
Activity 32 (optional)	45		
Activity 33	45		

- Walk around tables periodically to see how class participants are progressing with the tasks. This will allow you the opportunity to see if they need help and it will also help to keep them on task.
- Make sure class participants understand instructions for each task.
- Do not read all summary points. Touch on the points that were not addressed well in the activity.
- Keep class on task.
- Make sure that time allotted for breaks and lunch is not abused.
- Have class participants fill out the proficiency assessments at the end of each activity.

Final Tasks:

- Give out certificates
- Closing remarks
- Housekeeping

Notes for all 33 Activities begin with the next page.

Activity 1: Introduction

- This Activity should take about 30 minutes.
- Review purpose with class participants.
- This Activity requires showing the "Anhydrous Ammonia Truck Overturns" video. If this video is not available, please start on Activity 2.
- The video is a training video created by the Illinois State Police. Source: https://www.youtube.com/watch?v=DutRy6kbQts
- **Task answers:**

1. Lack of communication and proper training. The highway patrolman also responded to the accident alone. Emotions could have triggered the highway patrolman's response.
2. Hazard identification training, hazard awareness training, emergency response training, better communication between dispatcher and the highway patrolman responding and procedures for addressing incidents like this and use of the buddy system when patrolling rural roads.

Notes: _____

Activity 2: Labor History [PPT Only (Optional)]

- This Activity should take about 20 minutes.
- Sites with video capabilities — Have the Global Industrial Tragedies PPT and "Triangle Shirtwaist and Fire Remembrance" video ready to play.
- Give the class a 10-minute break after this Activity.

Notes: _____

Activity 2: Trainer's Notes from the Labor History PowerPoint Presentation

Note: As you work through the slides, make sure you emphasize the information in bold under the description of each disaster. These comments point out how each disaster contributed to the Worker Health and Safety laws (or lack of laws) that are in effect today in the U.S. and around the world.

Slide 1: Bhopal Disaster, Ship Breaking in Bangladesh, Triangle Shirtwaist Fire.

Slide 2: The Triangle Shirtwaist Factory fire in Manhattan, New York City, on March 25, 1911, was the deadliest industrial disaster in the history of the city and one of the deadliest in U.S. history.

- **Show "Triangle Shirtwaist Factory Fire Remembrance" video after displaying this slide.**
  (Source: http://en.wikipedia.org/wiki/Triangle_Shirtwaist_Factory_fire.)

- **The American Society of Safety Engineers (ASSE), America's oldest professional safety organization, was founded six months after the Triangle fire and was instrumental in achieving passage of the Occupational Health and Safety Act of 1970 and in establishing the National Institute for Occupational Safety and Health.**

- **More than 30 labor-related laws written by the New York (State) Factory Investigating Commission. The NFPA 101 Life Safety Code, in which the NFPA set standards for fire safety. The fire also was a major impetus for the state-based workers compensation system.**

Slide 3: Left pic shows smoke from the Consol No. 9 coal mine and right pic shows three of the miners being rescued.

- **The Farmington Mine disaster was an explosion that happened at approximately 5:30 a.m. on November 20, 1968, at the Consol No. 9 coal mine north of Farmington and Mannington, West Virginia, USA.**
- The explosion was large enough to be felt in Fairmont, almost 12 miles away. At the time, 99 miners were inside. Over the course of the next few hours, 21 miners were able to escape the mine, but 78 were still trapped. All who were unable to escape perished; the bodies of 19 of the dead were never recovered.
- **The cause of the explosion was never determined, but the accident served as the catalyst for several new laws that were passed to protect miners.**

Slide 4:

- **Note: This was one of the tragedies that led to the Process Safety Management of Highly Hazardous Chemicals (PSM) Standard which was enacted in 1992.**
- On December 3, 1984, more than 40 tons of methyl isocyanate gas leaked from a pesticide plant in Bhopal, India, immediately killing at least 3,800 people and causing significant morbidity and premature death for many thousands more.
- **The company involved in what became the worst industrial accident in history immediately tried to dissociate itself from legal responsibility.** Eventually, it reached a settlement with the Indian Government through mediation of that country's Supreme Court and accepted moral responsibility.
- It paid $470 million in compensation, a relatively small amount based on significant underestimations of the long-term health consequences of exposure and the number of people exposed.
- **The disaster indicated a need for enforceable international standards for environmental safety, preventive strategies to avoid similar accidents and industrial disaster preparedness.**
- **Following the events of December 3, 1984, environmental awareness and activism in India increased significantly. The Environment Protection Act was passed in 1986, creating the Ministry of Environment and Forests (MoEF) and strengthening India's commitment to the environment.**
- Under the new act, the MoEF was given overall responsibility for administering and enforcing environmental laws and policies. It established the importance of integrating environmental strategies into all industrial development plans for the country. However, despite greater government commitment to protect public health, forests and wildlife, **policies geared to developing the country's economy** have taken precedence in the last 20 years.
- **In the United States, public officials and Congress became alarmed when similar releases occurred in Union Carbide plants in West Virginia shortly after Bhopal.**
- **Although the releases in West Virginia were in isolated areas and did not have the same effect, Congress was very concerned that an incident like Bhopal could happen in the U.S. So in 1986, Congress passed the Emergency Planning and Community Right-to-Know Act. The law is also sometimes referred to as the Superfund Amendments and Reauthorization Act of 1986.**

(Source: http://www.usfa.fema.gov/downloads/pdf/coffee-break/hm/hm_2013_1.pdf.)

continued

Activity 2: Trainer's Notes from the Labor History PowerPoint Presentation *(continued)*

- In a settlement mediated by the Indian Supreme Court, UCC accepted moral responsibility and agreed to pay $470 million to the Indian government to be distributed to claimants as a full and final settlement. By the end of October 2003, compensation had been awarded to 554,895 people for injuries received and 15,310 survivors of those killed. The average amount to families of the dead was $2,200.
  (Source: http://www.ncbi.nlm.nih.gov/pmc/articles/PMC1142333.)

Slide 5: Note: This was one of the tragedies that led to the Process Safety Management of Highly Hazardous Chemicals (PSM) Standard which was enacted in 1992.

- **Right lower PIC is plant before tragedy and left lower PIC is of the Granite memorial (far) at 924 Jefferson Rd, Pasadena, Texas.**
- The Phillips disaster was a devastating series of explosions and fire that happened on October 23, 1989, near the Houston Ship Channel in Pasadena, Texas, USA. The initial blast registered 3.5 on the Richter scale, and the conflagration took 10 hours to bring under control. There were 23 employees killed and 314 injured.
- **OSHA's major findings included: Lack of process hazard analysis; inadequate standard operating procedures (SOPs); non-fail-safe block valve; inadequate maintenance permitting system; inadequate lockout/ tagout procedures; lack of combustible gas detection and alarm system; presence of ignition sources; inadequate ventilation systems for nearby buildings; fire protection system not maintained in an adequate state of readiness.**
- Additional factors found by OSHA included: Proximity of high-occupancy structures (control rooms) to hazardous operations; inadequate separation between buildings; crowded process equipment; insufficient separation between the reactors and the control room for emergency shutdown procedures.

Slide 6: The Hamlet chicken processing plant fire on September 3, 1991, was an industrial fire in Hamlet, North Carolina, at the Imperial Foods processing plant resulting from a failure in a hydraulic line**. There were 25 workers killed and 55 injured in the fire; trapped behind locked fire doors.**

- **In 11 years of operation, the plant had never received a safety inspection. Investigators believe a safety inspection might have prevented the disaster.** The fire was North Carolina's worst industrial disaster.

- On January 9, 1992, U.S. Labor Secretary, Lynn Martin, told North Carolina state officials they had a deadline of 90 days to improve enforcement of job safety and health regulations or federal agencies would take over. **The North Carolina General Assembly passed 14 new worker safety laws as a result, including provision of a system whereby workers could report violations without fear of job loss. The inspector corps was increased from 60 to 114.**
  (Source: http://en.wikipedia.org/wiki/Hamlet_chicken_processing_plant_fire.)

Slide 7: The Station nightclub fire was the fourth-deadliest nightclub fire in U.S. history, killing 100 people.

- The fire began at 11:07 p.m. EST, on Thursday, February 20, 2003, at The Station, a glam metal and rock and roll-themed nightclub located at 211 Cowesett Avenue in West Warwick, Rhode Island.
- The fire was caused by pyrotechnics set off by the tour manager of the evening's headlining band, Jack Russell's Great White, which ignited flammable sound insulation foam in the walls and ceilings surrounding the stage. A fast-moving fire engulfed the club in 5½ minutes**. In addition to the 100 fatalities, 230 people were injured. Another 132 escaped uninjured.**
  (Source: http://en.wikipedia.org/wiki/The_Station_nightclub_fire.)
- **After the fire, NFPA enacted tough new code provisions for fire sprinklers and crowd management in nightclub-type venues. Those provisions mark sweeping changes to the codes and standards governing safety in assembly occupancies.**
  (Source: http://www.nfpa.org/safety-information/for-consumers/occupancies/ nightclubs-assembly-occupancies/the-station-nightclub-fire.)

Slide 8: New Delhi — November 24, 2012 — The police in Bangladesh charged the owners of a garment factory and 11 of their employees with culpable homicide in the deaths of 112 workers in a fire that came to symbolize the appalling working conditions in the country's dominant textile industry.

- The case is the first time the authorities have sought to prosecute factory owners in Bangladesh's garment industry, so powerful that the state has long sought to protect owners from unionization efforts by workers and from international scrutiny of working conditions.
- The fire at the Tazreen Fashions factory on November 24, 2012, **was later eclipsed by a building collapse in April that cost the lives of 1,100 workers and brought global attention to the unsafe working conditions and low wages at many garment factories in Bangladesh, the No. 2 exporter of apparel after China.**

continued

Activity 2: Trainer's Notes from the Labor History PowerPoint Presentation *(continued)*

- **The fire also revealed the poor controls that top retailers had throughout their supply chain, since retailers like Walmart said they were unaware that their apparel was being made in such factories.**
- On the night of the fire, more than 1,150 people were inside the eight-story building, working overtime shifts to fill orders for various international brands. On some floors, managers ordered the employees to ignore a fire alarm and continue to work. Precious minutes were lost. Then, as smoke and fire spread throughout the building, many workers were trapped, unable to descend the smoke-filled staircases. They were blocked from escape by iron grilles on many windows.
- Desperate workers managed to break open some windows and leap to safety on the roof of a building nearby. Others simply jumped from upper floors to the ground.
  (Source: http://www.nytimes.com/2013/12/23/world/asia/bangladeshi-factory-owners-charged-in-fatal-fire.html.)

Slide 9: Bangladesh Worker Rights Violations

- **A lack of occupational health and safety standards, training or personal protection equipment provided.**
  - Limited or no access to treatment, emergency services and compensation when a worker is injured or killed on the job;
  - Less than minimum wages;
  - Use of child labor;
  - Extensive working hours with no right to overtime, sick or annual leave;
  - Lack of job security: no work, no pay; and
  - No right to join or form a trade union.
- In the majority of the shipyards, workers are being deprived of their rights. They work under risky conditions but have no access to safety equipment, job security or a living wage.
- **Over the last twenty years more than 400 workers have been killed and 6,000 seriously injured according to the Bangladeshi media. These are the ones that have been reported.** The explosion of the Iranian tanker TT Dena on May 31, 2000, alone is said to have caused 50 deaths. Add to this toll the thousands of cases of irreversible diseases which have occurred and will

continue to occur due to the toxic materials that are handled and inhaled without any precautions or protective gear.

- On average, one worker dies in the yards a week and every day a worker is injured ("End of Life Ships: The Human Cost of Breaking Ships"). (Source: http://www.shipbreakingbd.info/Worker%20Rights%20Violation.html.)

Slide 10: **The Cocoanut Grove Fire**, November 28, 1942, Boston, Massachusetts.

- **The deadliest nightclub fire in U.S. history, the conflagration at the Cocoanut Grove, killed 492 people.** The club was packed well beyond its legal capacity and panicked patrons scrambling for safety were unable to exit through the single revolving door.
- **Regulatory changes regarding fire safety soon followed, covering such areas as exits, combustible materials, emergency lighting and automatic sprinklers.**

Three Mile Island, March 28, 1979, Dauphin County, Pennsylvania.

- **The partial meltdown at the Three Mile Island nuclear reactors is considered the worst accident in U.S. commercial power plant history.** Although no lives were lost, small amounts of radioactive material were released into the environment.
- The incident inspired Yale sociologist Charles Perrow's "normal accident" theory, which holds that there's an inevitable risk inherent in highly complex systems.
- Nonetheless, public outcry was strong, prompting several investigations into the accident, and **the President's Commission report criticized the plant's owners and the NRC for lapses in quality assurance, maintenance, communication and management.**

The Space Shuttle Challenger Disaster, January 28, 1986.

- **A seemingly small problem — a failed O-ring seal — ultimately caused Challenger to disintegrate 73 seconds into its flight, killing all seven crew members on board, most memorably high school teacher Christa McAuliffe.**

continued

Activity 2: Trainer's Notes from the Labor History PowerPoint Presentation *(continued)*

- **The report of the presidential commission on the accident cited a number of factors, including poor decision-making flawed by faulty communication; a degree of normalization of deviance, where the problem was ultimately treated as an "acceptable flight risk;" and pressure on NASA to hew to an ambitious launch schedule.**

The Exxon Valdez Oil Spill, March 24, 1989.

- **When this oil tanker struck a reef and spilled 11 million gallons of crude oil into Prince William Sound, Alaska, it was considered one of the worst environmental disasters in history; it's still the No. 1 oil spill in terms of environmental damage.**
- The NTSB investigation identified five probable causes of the accident, ranging from possible inebriation of the ship's master to Exxon's failure to provide a rested and sufficient crew.
- **The Oil Pollution Act of 1990 was a direct response to the spill.**
  (Source: http://www.safety.com/articles/safety-last-10-preventable-accidents-changed-world.)

Slide 11: Top left pic — **The Sampoong Department Store Collapse**, June 29, 1995, Seoul, Korea.

- **The structural failure of this busy department store resulted in 502 deaths and 937 injuries. Various modifications to the building's original plans made it unsafe. Months before the collapse, visible cracks appeared in the building, but the warning signs were ignored. Lee Joon, the building's chairman, was charged with criminal negligence and sentenced to 10 years in jail.**

Top right pic — **The Deepwater Horizon Oil Spill** (aka the BP Oil Spill), April 22–July 15, 2010, Gulf of Mexico.

- **Following the explosion of a rig, oil gushed into the Gulf for 87 days; the oil discharge is estimated at 210 million gallons, making it the largest accidental marine oil spill in history. In the wake of the disaster, there was plenty of finger-pointing, but a White House commission report placed the blame squarely on BP. Environmental fallout from the spill persists to this day.**

Bottom left pic — **The Savar Building Collapse**, April 24, 2013, Bangladesh.

- **This recent disaster claimed the lives of 1,127 people, mostly garment workers, making it the deadliest accidental structural failure of modern times.**
- **The causes of the collapse are still being sorted out, but the structure had many clear safety violations. The building's owner has been arrested, and worldwide protests are calling for reforms in conditions for garment workers.**
  (Source: http://www.safety.com/articles/safety-last-10-preventable-accidents-changed-world.)

Bottom right pic — **The Texas City Disaster**, April 16, 1947.

- **The Texas City disaster was an industrial accident that occurred April 16, 1947, in the Port of Texas City. It was the deadliest industrial accident in U.S. history, and one of the largest non-nuclear explosions.**
- **Its cargo of approximately 2,300 tons (approximately 2,100 metric tons) of ammonium nitrate detonated, with the initial blast and subsequent chain-reaction of further fires and explosions in other ships and nearby oil-storage facilities killing at least 581 people.**
- **The disaster triggered the first ever class action lawsuit (on behalf of 8,485 victims) against the United States government under the then recently enacted Federal Tort Claims Act (FTCA).**
  (Source: https://en.wikipedia.org/wiki/Texas_City_disaster.)

Activity 3: Rights and Responsibilities

- This Activity should take about 100 minutes.
- Review purposes with class participants.
- Facilitator has the option of using the PowerPoint presentation or the factsheets in the *Participant's Manual*.
- **Task 1 answers:**

1.

Match This (Column 1)	Answer (Column 2)	With This (Column 3)
HAZWOPER	**A**	A. Hazardous Waste Operations and Emergency Response
Municipal Workers	**F**	D. 1970
RCRA	**H**	F. Not covered under OSHA
Superfund	**J**	B. Requires employers to provide safe conditions even where no specific standard exists
General Duty Clause	**B**	C. Year OSHA was created
1971	**C**	G. Raw materials → Recycled materials
Material Life-cycle	**G**	H. Establishes "cradle to grave" hazardous waste management
OSHAct	**D**	E. "Community right to know"
NIOSH	**L**	K. Interstate commerce
TSCA	**I**	L. National Institute for Occupational Safety and Health
HMTUSA	**K**	I. Addresses the production, importation, use and disposal of polychlorinated biphenyls
SARA	**E**	J. CERCLA

2. Answers will vary with class participants.

- **Task 2 answers:**

1. It provides a means of addressing hazards that are addressed in a particular standard. This is important because it prevents the employer from ignoring hazards that are not specifically addressed in a standard.

2. Answers will vary with class participants.

3. Answers will vary with class participants.

- **Task 3 answers:**

1. Answers will vary with class participants.

2. Answers will vary with class participants.

- Sites with video capabilities — Have "Do You Live Near a Toxic Superfund Site?" and "The Love Canal Disaster Toxic Waste in the Neighborhood" videos ready to play.
- **Activity 3: Rights and Responsibilities Review Questions**

1. What was the first federal law to provide legal health and safety rights to most American workers? **The Occupational Safety and Health Act of 1970 (OSHAct)**

2. Who shall provide a workplace free from recognized hazards that are causing, or are likely to cause, death or serious physical harm to his/her employees? **The employer**

3. What do workplace exposures that are not regulated by a specific OSHA standard fall under? **The General Duty Clause**

4. What standard covers activities at uncontrolled hazardous waste sites and cleanup operations which include treatment, storage, disposal and emergency response? **OSHA's HAZWOPER Standard (29 CFR 1910.120)**

5. An employee who refuses to accept a condition that he/she believes is likely to cause death or serious injury will be protected against later discrimination by what? **The OSHAct**

continued

Activity 3: Rights and Responsibilities *(continued)*

- Give the class a 10-minute break after this Activity.

Notes: _____

Activity 3: Trainer's Notes from the Rights and Responsibilities PowerPoint Presentation

Slide 1: Introduction to Activity.

Slide 2: Go over purposes with class participants.

Slide 3: Give class participants a chance to respond to the question and then transition in OSHA website BLS statistic. Then tell them about the two examples below:

Acute injuries or fatalities. Example: In 2005, in Graniteville, South Carolina, a train loaded with chlorine gas, sodium hydroxide and creosol wrecked. One of the tank cars carrying chlorine gas erupted and released 90 tons of the toxic gas out into the environment. There were nine fatalities and 250 people had to be treated for chlorine exposure.

Chronic injuries. Example: In 1976, during an accident in the plutonium finishing plant at Hanford, Washington, Harold McCluskey was exposed to approximately 500 times the occupational standard of americium, a plutonium by-product. Despite being isolated and undergoing chelation therapy for five months after the accident because of the risk of exposure to others, he survived. But the chronic effects of this accident were personally devastating. He was avoided by friends. Ulceration near his eye where he received the most exposure did not heal until 1978. He suffered from cataracts and needed a cornea transplant in one eye. It was also noted by the doctor who treated him that his body strength never fully recovered.

Slide 4: Explain to class participants that this pic is from a 2013 United Steelworkers' Health, Safety and Environment Conference — Day 2, Memorial Service; then transition in the statistic.

Slide 5: This is referenced from the International Labor Organizations (ILO) 2011 report on occupational disease.

Slide 6: Much of this hazardous material comes from HAZWOPER sites.

Slide 7: A regulation may also be called a rule or a standard.

The United States **Occupational Safety and Health Administration (OSHA)** is an ***agency*** of the ***United States Department of Labor***. OSHA's mission is to "assure safe and healthful working conditions for working men and women by setting and enforcing standards and by providing training, outreach, education and assistance."

continued

Activity 3: Trainer's Notes from the Rights and Responsibilities PowerPoint Presentation *(continued)*

The **United States Environmental Protection Agency (EPA)** is an ***agency*** of the ***U.S. Federal Government*** which was created for the purpose of protecting human health and the environment by writing and enforcing regulations based on laws passed by Congress.

The **United States Department of Energy (DOE)** is a ***Cabinet***-level department of the ***United States Government*** concerned with the **United States'** policies regarding energy and safety in handling nuclear material.

The **Department of Transportation (DOT)** oversees interstate travel and is a federal agency.

Slide 8: The **Clean Air Act (CAA)** is the comprehensive federal law that regulates air emissions from stationary and mobile sources. Among other things, this law authorizes EPA to establish National Ambient Air Quality Standards (NAAQS) to protect public health and public welfare and to regulate emissions of hazardous air pollutants.

The **Hazardous Materials Transportation Uniform Safety Act of 1990 (HMTUSA)** promulgates regulations for the safe transport of hazardous material in intrastate, interstate and foreign commerce. This also included designating materials as hazardous when they pose unreasonable risks to health, safety or property.

The **Resource Conservation and Recovery Act, 1976 (RCRA)** gives EPA the authority to control hazardous waste from the "cradle-to-grave." This includes the generation, transportation, treatment, storage and disposal of hazardous waste.

The **Comprehensive Environmental Response, Compensation and Liability Act (otherwise known as CERCLA or Superfund)** provides a federal "Superfund" to clean up uncontrolled or abandoned hazardous waste sites as well as accidents, spills and other emergency releases of pollutants and contaminants into the environment.

The **Superfund Amendments and Reauthorization Act of 1986 (SARA), or Superfund II,** reauthorized the CERCLA/Superfund I program for an additional five years. In 1991, Congress extended the law for three more years. SARA emphasizes emergency preparedness and community right-to-know.

The **Toxic Substances Control Act of 1976 (TSCA)** provides EPA with authority to require reporting, recordkeeping and testing requirements and restrictions relating to chemical substances and/or mixtures. TSCA addresses the production, importation, use and disposal of specific chemicals including ***polychlorinated biphenyls (PCBs), asbestos,*** radon and ***lead-based paint***.

Slide 9: At the vigorous urging of the labor movement, Congress passed the landmark Occupational Safety and Health Act in 1970 and created the Occupational Safety and Health Administration, or OSHA, to administer the law. At the time that OSHA was passed, there were an estimated 13,000 fatalities due to workplace injuries and another 100,000 deaths from diseases acquired on the job.

Primary functions of OSHA include:

- Making and enforcing standards.
- Inspecting work sites.
- Issuing citations against employers who fail to meet standards or who willfully violate the law.
- Enforcing the "General Duty" clause. The clause requires employers to provide safe conditions even where no specific standard exists. OSHA encourages employers to reduce hazards and to implement safety and health programs.
- Enforcing employees' rights and anti-discrimination provisions of the Occupational Safety and Health Act.
- Establishing reporting and recordkeeping procedures to monitor job-related injuries and illnesses.
- Protecting the health and safety of most U.S. workers.

Slide 10: OSHA makes and enforces rules and standards on safety in the workplace by:

- Inspecting work sites;
- Responding to employee complaints concerning safety and health;
- Issuing citations against employers who fail to meet standards or who violate the law;
- Requiring employers to provide a safe and healthy place to work;

continued

Activity 3: Trainer's Notes from the Rights and Responsibilities PowerPoint Presentation *(continued)*

- Encouraging employers to reduce hazards and to implement safety and health programs; and
- Prohibiting discrimination against employees who exercise their rights under the OSHAct.

Pursuant to ***Section 18 of the Occupational Safety and Health Act of 1970*** (Federal OSHA), States may administer their own job safety and health programs, or ***State Plans***, if they meet minimum federal requirements.

The Occupational Safety and Health Act of 1970 (OSHAct**) is the first federal law to provide legal health and safety rights to most American workers**. The OSHAct requires that the workplace be free of recognized hazards which may cause death or serious injury. It also requires that standards (regulations) be set to prevent workers from suffering illness or injury due to exposure to specific hazards. The OSHAct established the Occupational Safety and Health Administration (OSHA) as well as two other important agencies: The National Institute for Occupational Safety and Health (NIOSH) and the Occupational Safety and Health Review Commission (OSHRC).

Slide 11: There has been a significant drop in workplace fatalities over the years since the OSHAct, even with a large expansion of the workforce. Some of this is possible due to increase in laws, worker protection interventions, as well as high-hazard industries moving off U.S. soil.

Slide 12: Who cannot be covered under OSHA?

- Workers in workplaces regulated by another federal agency such as the Mine Safety and Health Administration (MSHA) and the Department of Transportation (DOT);
- Federal employees (although OSHA can inspect many federal agencies and make recommendations for protecting workers' health and safety, it cannot fine them for violations);
- State, county and municipal workers; and
- Self-employed persons.

State OSHA Plans
Under the OSHAct, states are permitted to develop and operate their own occupational safety and health enforcement programs. OSHA has two major requirements for state plans:

- The state regulations must be at least as stringent as the federal regulations.
- The regulations must cover public (government) as well as private employees.

Whenever OSHA issues a new regulation or requirement, the state must adopt it within six months of the federal promulgation. State Plan regulations are enforced generally by either state labor departments or state health departments.

Slide 14: Resource for case — California FACE Report #07CA008
Summary:

Read the General Duty Clause; explain the case; then ask the class how the General Duty Clause applies to this incident.

A 35-year-old Hispanic female material handler died when a backing forklift crushed her against a podium that was anchored against a steel beam. The victim had exited a trailer parked at the warehouse dock and walked to the adjacent podium to enter loaded items onto the manifest. A forklift on the dock was moving pallets and was backing up and turning to the left when it crushed the victim against the podium.

The forklift operator was not looking where he was backing at the time of the incident. The location of the podiums required the material handlers to have their backs to the activity on the dock. The CA/FACE investigator determined that, in order to prevent future occurrences, as part of their Injury and Illness Prevention Program (IIPP), employers should:

- Ensure forklift operators constantly look in the direction of travel.
- Engineer a podium that would have material handlers facing the activity on the dock.

In addition:

- Employer and manufacturers should consider additional warning systems for forklifts.
- Employers should consider changing the type of forklift being used on docks to those where the operator stands sideways.

continued

Activity 3: Trainer's Notes from the Rights and Responsibilities PowerPoint Presentation *(continued)*

Slide 15: You have a right to demand safe and healthy working conditions on the job without fear of punishment. That right is spelled out in Section 11(c) of the OSHAct. The law says employers shall not punish or discriminate against workers for exercising rights such as:

- Complaining to an employer, union, OSHA or any other government agency about job safety and health hazards;
- Filing safety or health grievances;
- Participating in a workplace safety and health committee or in union activities concerning job safety and health; and
- Participating in OSHA inspections, conferences, hearings or other OSHA-related activities.

If you believe that you are being punished for exercising safety and health rights, contact the nearest OSHA office **within 30 days of the time you realize that this has started.**

If you are in a union, get your union involved. If the 30-day period has lapsed, you are not covered by Section 11 (c). The quote was taken from a speech Dr. Michaels made during the 2012 Workers Memorial Day Ceremony, National Labor College Silver Spring, Maryland, Friday, April 27, 2012.

Slide 17: The OSHAct authorizes OSHA compliance safety and health officers (CSHOs) to conduct workplace inspections at reasonable times.

OSHA conducts inspections without advance notice, except in rare circumstances (e.g., Imminent Danger).

In fact, anyone who tells an employer about an OSHA inspection in advance can receive fines and a jail term.

Slide 20: The following were the top 10 most frequently cited standards by Federal OSHA in fiscal year 2014 (October 1, 2013, through September 30, 2014):

- Fall protection, Construction (29 CFR 1926.501)
- Hazard Communication Standard, general industry (29 CFR 1910.1200)
- Scaffolding, general requirements, construction (29 CFR 1926.451)
- Respiratory protection, general industry (29 CFR 1910.134)
- Powered industrial trucks, general industry (29 CFR 1910.178)

- Control of hazardous energy (lockout/tagout), general industry (29 CFR 1910.147)
- Ladders, construction (29 CFR 1926.1053)
- Electrical, wiring methods, components and equipment, general industry (29 CFR 1910.305)
- Machinery and Machine Guarding, general requirements (29 CFR 1910.212)
- Electrical systems design, general requirements, general industry (29 CFR 1910.303)

Slide 21: The OSHAct does provide limited protections for workers who refuse unsafe work. However, you are better protected when you refuse unsafe work if you have a union contract (or are in a union). OSHA will investigate and seek remedy from the employer if you are fired or disciplined for your refusal; provided OSHA thinks your refusal was valid.

If an employee refuses dangerous work under these conditions, OSHA may move to protect that employee from discipline or firing. First, the dangerous condition must be one that a reasonable person would conclude is a real danger. Secondly, there must not be enough time to eliminate the danger through normal OSHA procedures. Lastly, employees must have asked their employer to eliminate the danger. Although this is an important right, it may take several years of legal proceedings for a worker to obtain justice, such as reinstatement after being fired.

Slide 22: Before refusing to do unsafe work:

Inform your employer of the condition and ask that he/she correct the situation before you get hurt. Document reasons why you think the situation is unsafe. Let your coworkers know about the unsafe condition (and if you are in a union, notify your steward). Keep records of all meetings and discussions regarding the unsafe conditions.

Explain to your employer that you are willing to do the work when the danger is corrected. Meanwhile, ask that you be assigned to work in a safer area.

Slide 26:

1. Establish procedures for workers to report, without reprisal, job-related fatalities, injuries, illnesses, incidents and hazards and make recommendations about appropriate ways to control those hazards;

continued

Activity 3: Trainer's Notes from the Rights and Responsibilities PowerPoint Presentation *(continued)*

2. Provide for prompt response to such reports and recommendations;
3. Provide for regular communication with workers about workplace safety and health matters;
4. Establish procedures to permit workers to stop work or decline to perform an assigned task because of a reasonable belief that the task poses an imminent risk in circumstances where there is insufficient time to use normal hazard reporting and abatement procedures; and
5. Use appropriate means to inform workers of their rights and responsibilities.

Slide 27: The Use of Respirators and Other PPE is the Least Satisfactory Method!

Engineering and work practice controls are generally regarded as the most effective methods to control exposures to airborne hazardous substances. OSHA considers the use of respirators to be the least satisfactory approach to exposure control because. . .

- Respirators provide adequate protection only if employers ensure, on a constant basis, that they are properly fitted and worn.
- Respirators protect only the employees who are wearing them from a hazard, rather than reducing or eliminating the hazard from the workplace as a whole (which is what engineering and work practice controls do).
- Respirators are uncomfortable to wear, cumbersome to use and interfere with communication in the workplace, which can often be critical to maintaining safety and health.
- The costs of operating a functional respiratory protection program are substantial and include regular medical examinations, fit testing, training and the purchasing of equipment.

Slide 29: Get the class to discuss why PPE may not be the best option. Ask them with what other means could personnel handle a bomb investigation/disposal. Then show the last photo of the robot (Hazbot III).

HDS/FBI trained bomb technician is wearing a bomb suit designed for personal protective equipment.

Slide 30: Ask students what activity is more risky. Ask them which one has the highest level of hazard. What level of risk and hazard will the average worker see as opposed to personnel who work in hazardous waste cleanup, asbestos abatement, the military?

Slide 34: List class participant's answers on a flipchart.

1. Provide a workplace free from recognized hazards.
2. Comply with all OSHA standards, rules and regulations that apply to the workplace.
3. Post the OSHA Job Safety and Health poster in a prominent location.
4. Report to the nearest OSHA office, within eight hours, the occurrence of any workplace accident resulting in an employee fatality, or which results in the hospitalization of five or more employees.
5. Keep records of work-related injuries and illnesses and post the annual summary (OSHA Form 300) throughout the month of February each year.
6. Cooperate with the OSHA inspector by supplying the name of the authorized employee representative who will accompany the inspector during the OSHA inspection.
7. Never discriminate against employees who exercise their rights under the OSHAct.
8. Post OSHA citations of alleged violations at or near the work site involved for at least three days or until the violation is corrected.
9. Correct hazards within the time period set by OSHA in a citation.
10. Post a notice of "petition for modification of abatement" [an appeal for OSHA to change its order to abate the hazard (abate means, "to put an end to")].
11. Post a summary of any "variance request" and inform workers of their right to request a hearing. (A variance request is when the employer wants to correct the problem in a manner different than the way OSHA said to do it.)

Slide 35: As an employee, you have the responsibility to comply with all OSHA standards, rules, regulations and orders applying to your job. While there are no legal sanctions for employees who violate OSHA rules, the Review Commission has thrown out citations for employee misconduct.

continued

Activity 3: Trainer's Notes from the Rights and Responsibilities PowerPoint Presentation *(continued)*

Slide 37: Let the students know that this training will touch on aspects of the HAZWOPER Standard, paragraphs b-o. The class will give them the tools to identify when their worker's rights and safety are in jeopardy.

[b] A safety and health program

[c] Site characterization and analysis

[d] Site control

[e] Training

[f] Medical surveillance

[g] Controls, work practices and equipment for employee protection

[h] Monitoring

[i] Information programs

[j] Drum and container handling

[k] Decontamination

[l] Emergency response

[m] Lighting ("illumination")

[n] Sanitation

[o] New technology programs

Slide 38: Much of the standard is directed toward activities at uncontrolled hazardous waste sites and cleanup operations. These are sites where quantities of often unidentified chemicals have been abandoned. The site is being investigated and cleaned up due to either an order by a state or federal agency or by the voluntary action of an owner.

Examples include underground tanks or drum farms, landfills and abandoned industrial sites.

Slide 39: Let's take a look at who can be covered under the 1910.120 Standard. Keep in mind though that this standard, like all standards, is the minimum that we should do.

- Cleanup operations as required by a governmental body;
- Voluntary cleanup operations recognized by governmental bodies as uncontrolled hazardous waste sites;

- Corrective actions at cleanup sites covered by the Resource Conservation and Recovery Act (RCRA);
- Hazardous waste operations at a treatment, storage and disposal (TSD) facility; and
- Emergency Response operations.

While the above list gives you an overview on who can be covered, for a more detailed explanation please refer to 1910.120 (a) *Scope, Application and Definitions.* There you will find exceptions, notes and definitions that will more clearly define the application at your site.

Slide 40: The *National Priorities List* (NPL) is the list of national priorities among the known releases or threatened releases of hazardous substances, pollutants or contaminants throughout the United States and its territories. The NPL is intended primarily to guide the EPA in determining which sites warrant further investigation.

There are roughly 1,700 Superfund sites on the National Priority List, which are the sites the EPA considers to be most hazardous and prioritizes for cleanup using Superfund money. National priority sites are selected from tens of thousands hazardous waste sites nationwide. EPA tracks this information in an online database. This map is of proposed and active NPL sites in the continental U.S.

Slide 43: Trainer has the option of showing one of two videos:

"Do You Live Near a Toxic Superfund Site?" (short video/2 minutes).

"The Love Canal Disaster Toxic Waste in the Neighborhood Retro Report *The New York Times*" (long video/10 minutes).

Slide 44: Use class discussion for review questions.

Activity 4: The Consequences of Failed Safety Systems

- This Activity should take about 40 minutes.
- Review purpose with class participants.
- Sites with video capabilities — Have "Tesoro Refinery Fatal Explosion and Fire" video ready to play.
- Facilitator has the option of using the PowerPoint presentation or the factsheets in the *Participant's Manual*.
- Review the Safety Systems chart on page 88 in the workbook with the class.
- Start the Safety Systems PPT.
    - **If you are not** using the PPT presentation:
        - Use the Factsheet Reading Method for Factsheets 1 through 11.
        - Factsheets 2 thru 9 in the workbook — Emphasize that the factsheets also list Safety Systems examples in non-industrial settings as well as work.
- Task, page 101 in the *Participant's Manual* (chart on the next page) — Make sure class understands that they can also refer to the Safety Systems chart on page 88 to help them answer the questions.
- For sites without video capabilities, after you have completed the task, use the information sheets on the following pages of this guide to report to the class.
- Sites with video capabilities — Have "Behind the Curve" and "Human Cost of Gasoline" videos ready to play.

Flaws that Led to Injuries/Fatalities	Fixes that You Recommend	Safety System You Would Use
1. Heat exchanger catastrophically failed due to long-term damage from what is known as high-temperature hydrogen attack (HTHA).	Look at replacing the heat exchangers with ones that are not as susceptible to the HTHA. Establish a more comprehensive and frequent maintenance and inspection program of the heat exchangers to include verifying the integrity of the exchanger.	Mitigation and Maintenance and Inspection
2. Heat exchangers had a history of developing leaks during startup; something that refinery personnel had come to see as normal.	Determine what is causing the leaks and correct the problems; provide training to help workers with hazard recognition; and establish procedures to address leaks during startup.	Maintenance and Inspection, Training, Procedures
3. Additional operators from other nearby units were called upon to assist with the startup, including mitigation of potential leaks.	Establish a preventive maintenance and inspection program, and develop training and procedures that will keep the manually operated valves easy to open/close. Consider using some type of automatic valve instead of the manually operated valves.	Maintenance and Inspection, Mitigation, Training, Procedures
4. Employees working at a nearby process unit heard a loud hissing noise when vapor began to leak as the heat exchanger cracked at its weakest point.	Install alarms that would alert the workers that there is a problem. Provide awareness training on the dangers associated with the process.	Warning Devices and Training
5. Hot hydrogen and naphtha vapor rapidly vented from the exchanger and spontaneously ignited upon contact with air, resulting in a massive fire that consumed the heat exchanger structure.	Install some type of fire suppression system that could automatically extinguish the fire.	Mitigation

Activity 4: The Consequences of Failed Safety Systems *(continued)*

- **Activity 4: The Consequences of Failed Safety Systems Review Questions**

1. What are the major safety systems (from highest or most effective to lowest or least effective — called the Hierarchy of Controls)?

- **Design;**
- **Work Organization (can be a part of Design, but can also be part of the other safety systems);**
- **Mitigation;**
- **Maintenance and Inspection;**
- **Warning Devices;**
- **Training;**
- **Procedures; and**
- **Personal Protective Equipment.**

2. Within what safety system is the hazard actually eliminated? **Design Safety System**

Notes: _____

Key Findings:

- The rupture of the E heat exchanger was the result of the carbon steel heat exchanger being severely weakened by a damage mechanism known as HTHA. The B heat exchanger did not fail, but was constructed with the same materials and operated under the same conditions as the E heat exchanger. The B heat exchanger was also severely weakened by HTHA damage. HTHA is a damage mechanism that results in fissures and cracking and occurs when carbon steel equipment is exposed to hydrogen at high temperatures and pressures. The resulting damage severely degrades the mechanical properties of the steel.
- The startup of the NHT heat exchangers was hazardous, non-routine work. Leaks routinely developed that presented hazards to workers conducting the startup activities. Process Hazard Analyses (PHAs) at the refinery repeatedly failed to ensure that these hazards were controlled and that the number of workers exposed to these hazards was minimized.
- The Shell Anacortes Refining Company was owned and operated by the Shell Oil Company (Shell Oil) prior to 1998. The 1996 Shell Oil NHT unit PHA simply cited ineffective, non-specific, judgment-based, qualitative safeguards to prevent equipment failure from HTHA. The 2001 and 2006 Tesoro PHA revalidations did not address or modify the analysis performed in the 1996 Shell Oil PHA. The Tesoro 2010 NHT unit PHA failed to identify HTHA as a hazard for the shell of the B and E heat exchangers.
- Shell Oil and Tesoro periodically performed damage mechanism hazard reviews (DMHRs) called corrosion reviews. However, these reviews did not identify HTHA as a credible failure mechanism for the B and E heat exchangers.
- Tesoro did not monitor actual operating conditions of the B and E heat exchangers within the NHT heat exchanger banks, even though it would have been technically feasible to do so.
- Tesoro procedures did not prohibit or effectively limit the use of additional personnel during the non-routine hazardous startup of the NHT heat exchangers. The heat exchanger startup procedure specifies the use of only one outside operator to perform startup operations of the NHT heat exchanger banks. However, on the day of the incident, a supervisor requested five additional operators to assist with the startup of the A/B/C heat exchanger bank.

continued

Key Findings *(continued)*:

- The NHT heat exchangers frequently leaked flammable hydrocarbons during startup, sometimes resulting in fires. Tesoro management had been complacent about these hazardous leaks and did not always investigate the cause of the leaks. Tesoro did take some actions to prevent the leaks, but these actions did not effectively prevent the leaks before the April 2010 incident. Additional operators, such as those present during the April 2010 heat exchanger startup, were frequently needed during startup of the NHT heat exchanger banks to respond to potential hydrocarbon leaks or fires. This past practice contributed to the presence of the six additional workers in the unit during the April 2010 incident.
- The NHT heat exchanger banks were designed with large, difficult-to-manipulate manual block valves on different levels of the NHT heat exchanger structure. These valves were used to start up the NHT heat exchanger banks and typically required numerous adjustments to maintain temperature specifications. The difficulties with valve operation during startup typically resulted in the need for additional operator assistance. This past practice contributed to the presence of some of the six additional workers in the NHT unit during the April 2010 incident.
- The CSB found several indications of process safety culture deficiencies at the Tesoro Anacortes Refinery. Refinery management had normalized the occurrences of hazardous conditions, including frequent leaks from the NHT heat exchangers, by using steam to mitigate leaks; ineffectively identifying methods to prevent leaks from the heat exchanger flanges and gaskets; commonly requiring additional operators during NHT heat exchanger startups; and exceeding the staffing levels that procedures specified.
- The refinery process safety culture required proof of danger rather than proof of effective safety implementation. For years technical experts used design parameters to evaluate the B and E heat exchangers for HTHA susceptibility.
- API RP 941, "Steels for Hydrogen Service at Elevated Temperatures and Pressures in Petroleum Refineries and Petrochemical Plants," is written permissively such that there are no minimum requirements to prevent HTHA failures.
- API RP 941 provides industry guidance to predict the occurrence of HTHA in various materials of construction by using the Nelson curves. The Nelson curves are predicated on past equipment failure incidents and are plotted based on self-reported process conditions that are ill-defined and lack consistency.

- The CSB found that the carbon steel Nelson curve is inaccurate and cannot be relied on to prevent HTHA equipment failures or accurately predict HTHA equipment damage. API RP 941 does not require industry to use inherently safer materials to prevent HTHA failures. Risk-based Inspection Technology is written permissively, so that there are no minimum requirements to prevent HTHA failures.

Recommendations:

- **The U.S. Environmental Protection Agency**:
  - Revise the Chemical Accident Prevention Provisions under 40 CFR Part 68 to require the documented use of inherently safer systems analysis and the hierarchy of controls to the greatest extent feasible in establishing safeguards for identified process hazards.
  - Until this revision is in effect, enforce through the Clean Air Act's General Duty Clause the use of inherently safer systems analysis and the hierarchy of controls to the greatest extent feasible when facilities are establishing safeguards for identified process hazards.
  - In addition, effectively participate in the oversight of the process safety culture program at the Tesoro Anacortes Refinery.
- **Washington State Legislature, Governor of Washington**:
  - Augment the existing process safety management regulatory framework with the more rigorous safety management attributes identified in this report for petroleum refineries in the state of Washington.
  - Washington State Division of Occupational Safety and Health and Labor and Industries perform verifications at all Washington petroleum refineries to ensure prevention of equipment failure because of HTHA and ensure that effective programs are in place to manage hazardous non-routine work.
  - In addition, effectively participate in the oversight of the process safety culture program at the Tesoro Anacortes Refinery.

continued

Recommendations *(continued)*:

- **American Petroleum Institute:**
  - Revise API RP 941 and API RP 581 to prohibit the use of carbon steel equipment in HTHA-susceptible service and require verification of actual operating conditions.
  - Make additional revisions to API RP 941 to establish minimum requirements to prevent HTHA failures and to require the use of inherently safer design.
- **Tesoro Refining & Marketing Company LLC**:
  - Participate with API in the API RP 941 revisions to establish minimum requirements to prevent HTHA failures and to require the use of inherently safer design.
  - Following the API RP 941 revisions, develop and implement a plan to meet the new API RP 941 requirements.
  - Improve process safety management programs for damage mechanism hazards to require the hierarchy of controls and the use of inherently safer design.
- **Tesoro Anacortes Refinery** — Implement a process safety culture program that will assess and continually improve any identified process safety culture issues at the Tesoro Anacortes Refinery.
- **United Steelworkers Local 12-591** — Effectively participate in the process safety oversight committee to continually improve any identified process safety culture issues at the Tesoro Anacortes Refinery.

Activity 4: Trainer's Notes from The Consequences of Failed Safety Systems PowerPoint Presentation

Slide 1: This set of slides contains the factsheets for Activity 4 and leads into the first small group activity. Have the participants follow along in their student manuals. The slide order matches the order of the factsheets in the manual.

Slide 2: Go over purpose with class participants.

Slide 3: Show "Tesoro Refinery Fatal Explosion and Fire" video.

Slide 4: Systems of Safety is a program that outlines how the workplace should operate safely. It is designed to prevent disaster, injuries and illnesses from occurring.

Slide 5: Design Safety System fixes include: the use of inherently safer technologies and chemicals, ergonomic design of equipment and control panels, reducing inventories of hazardous chemicals, safe siting, hardware and software, processes and equipment design.

Slide 6: This Safety System could include concepts such as job enlargement, frequent breaks, work rotation and/or scheduling work at different times of the day (to avoid the heat of day for example).

Slide 7: The picture on the left shows a brick wall with some of the brick becoming loose and falling off. The picture on the right shows a mitigation fix where a metal wrap was placed around the border of the brick wall to prevent the loose brick from falling.

Slide 8: The Mitigation Safety System does not eliminate the hazard. The water was not completely stopped by the wall. The shields will not stop all the arrows and the metal hull will not stop the laser beams.

Slide 9: If your workplace uses the phrase "If it ain't broke don't fix it," your maintenance system is a failure. Examples of the Safety System include:

- Preventive and predictive maintenance programs;
- Equipment inspections;
- Timely completion of work repair requests; and
- Properly trained maintenance workers.

Slide 10: Other examples include backup alarms on vehicles and fire, spill and evacuation alarms.

Slide 11: Examples of training include workplace health and safety, emergency response and hazard identification and response.

continued

Activity 4: Trainer's Notes from The Consequences of Failed Safety Systems PowerPoint Presentation *(continued)*

Slide 12: Many processes and tasks require written procedures. Examples include operating procedures, procedures for emergency response and permit programs for hot work, lock and tag and confined space.

Slide 13: Procedures could be inadequate to address the hazard or not followed.

Slide 14: PPE is the least effective safety system. PPE should be only used temporarily until the hazard can be eliminated or reduced.

Employer's responsibilities — before using PPE employers must:

- First evaluate the hazard; then use all feasible engineering and work practices and administrative controls to eliminate the hazard or reduce it if it cannot be eliminated.
- If these controls do not eliminate the hazards, then employers must use the correct PPE to protect the workers until the hazards can be eliminated. Examples include:
    - Hard hats;
    - Safety glasses;
    - Gloves; and
    - Earplugs.

Slide 15: Ask class participants why they think PPE should be considered the last line of defense. You should always try to eliminate or control the hazard with one of the higher safety systems. Once you get to the PPE Safety System, the only thing between you and the hazard is the PPE you are wearing.

Slide 16: After all participants have had a chance to view the picture ask them to explain why PPE is important in this scenario. (The workers are exposed to a chemical/substance that can cause harm on contact as well as thru the respiratory system.) The workers being decontaminated are in Level A protection (maximum).

Slide 17: This photo shows a great example of the Design Safety System. Changed from a hazardous chemical to a water-based chemical.

Slide 18: Workers have a unique understanding of the hazards related to the processes that they operate and maintain.

Slide 21: Show "Behind the Curve" and "The Human Cost of Gasoline" videos.

Slide 22: Use class discussion for review questions.

Activity 5: *NIOSH Pocket Guide*

- This Activity should take about 50 minutes.
- Review purpose with class participants.
- Facilitator has the option of using the PowerPoint presentation or the factsheets in the *Participant's Manual*.
- **Task:**
  - Hazards:
    - Unlabeled/damaged drums/containers
    - Damaged roof that showed signs of leaking
    - Phosphoric acid:
      - *NIOSH Pocket Guide* — IDLH (1000 mg/m^3), OSHA PEL† (TWA 1 mg/m^3), incompatibles and reactivities [strong caustics, most metals (note: readily reacts with metals to form flammable hydrogen gas. DO NOT MIX WITH SOLUTIONS CONTAINING BLEACH OR AMMONIA)]
      - SDS — Store away from reactive materials, causes burns.
    - Caustic Soda:
      - *NIOSH Pocket Guide* — IDLH (10 mg/m^3), OSHA PEL† (TWA mg/m^3), incompatibilities and reactivities: water, acids, flammable liquids, organic halogens, metals such as aluminum, tin and zinc, nitromethane (note: corrosive to metals), non-combustible solid but when in contact with water may generate significant heat to ignite combustible materials.
      - SDS — POISON, may be corrosive to metals, reacts violently with acids, reacts exothermically on dilution with water and avoid exposure to moisture.
    - Sodium Hydride: (This chemical is not located in the *NIOSH Pocket Guide*).
      - SDS — Flammable solid, in contact with water releases flammable gases which may ignite spontaneously, reacts with water to form hydrogen gas, causes severe skin burns and eye damage, avoid heat, flames and sparks, extremes of temperature and direct sunlight and exposure to moisture.

continued

Activity 5: *NIOSH Pocket Guide (continued)*

- After the task has been completed, ask the class participants if the SDSs used in this task were GHS compliant.
  - Phosphoric Acid SDS — has no pictograms or signal words.
  - Caustic Soda SDS — has no pictograms and "Poison" is not one of the two signal words.
  - Sodium Hydride — compliant.
- **Activity 5: *NIOSH Pocket Guide* Review Questions**

1. What number is unique to for each chemical? **Chemical Abstract Service (CAS) number**
2. What is the difference in an OSHA PEL and a NIOSH REL? **An OSHA PEL is the law and a NIOSH REL is a recommended exposure limit**
3. What Index may be helpful in identifying a chemical if the names on the labels are names which you are unfamiliar? **Synonyms and Trade Names Index**
4. What numbers indicate that the chemical is regulated by DOT? **DOT ID numbers and Guide numbers**

- Give the class a 10-minute break after this Activity.

Notes: _____

Activity 5: Trainer's Notes from the *NIOSH Pocket Guide* PowerPoint Presentation

Slide 1: Instruct participants to take out their *NIOSH Pocket Guides*. Discuss with the class that this resource is a cornerstone of basic industrial hygiene information. Take them through the prefix chapters in the beginning of the *Guide* and explain that "How to use this *Guide*" describes abbreviations outlined in those chapters.

Below is the introduction presented in the *Guide*:

"The *NIOSH Pocket Guide to Chemical Hazards* is intended as a source of general industrial hygiene information for workers, employers and occupational health professionals. The *Pocket Guide* presents key information and data in abbreviated tabular form for 677 chemicals or substance groupings (e.g., manganese compounds, tellurium compounds, inorganic tin compounds, etc.) that are found in the work environment. The industrial hygiene information found in the *Pocket Guide* should help users recognize and control occupational chemical hazards. The chemicals or substances contained in this revision include all substances for which the National Institute for Occupational Safety and Health (NIOSH) has recommended exposure limits (RELs) and those with permissible exposure limits (PELs) as found in the Occupational Safety and Health Administration (OSHA) General Industry Air Contaminants Standard (29 CFR 1910.1000)."

Slide 2: This slide contains 16 boxes which will appear and disappear around each major grouping of data found for a chemical. Have participants follow along for the example of hydrogen fluoride.

Slide 3: Exposure limits are a way to compare a worker's exposure on the job with an assumed safe limit, which was derived from scientific study. It can be argued that many exposure limits are too low and most chemicals do not have an exposure limit. However, they are all we have to assist us in protecting workers. Some exposure limits are guidelines (usually more protective) and some are the Law (though usually not as protective as guidelines). Below are the three main exposure limits used to protect workers.

- OSHA Permissible Exposure Limits (PELs). **PELs are the Law!**
- ACGIH Threshold Limit Values (TLVs)
- NIOSH Recommended Exposure Limits (RELs)

Exposure limits are based on 8-hour time weighted averages (TWA) for OSHA and ACGIH or 10-hour TWAs for NIOSH RELs, ceilings (cannot exceed) or 15-minute peak exposures. Exposures must be kept below OSHA PELs. Most exposure limits are for airborne exposures. Exposure limits do not take into account exposure from multiple chemicals.

continued

Activity 5: Trainer's Notes from the *NIOSH Pocket Guide* PowerPoint Presentation *(continued)*

Slide 5: Definitions of terms from the *NIOSH Pocket Guide*: **IDLH** — A condition that poses a threat of exposure to airborne contaminants when that exposure is likely to cause death or immediate or delayed permanent adverse health effects or prevent escape from such an environment; **Ca** — Any substance that NIOSH considers to be a potential occupational carcinogen.

Slide 12: **Have class participants to look up CAS# 50-00-0. Ask them what chemical it represents.** Answer: Formaldehyde.

Slide 13: Ask class participants the following questions:

- **Is formaldehyde DOT regulated?** Answer: No.
- **What is the CAS# for formalin?** Answer: It doesn't have a CAS number because the chemical is made up of more than one chemical. Remember, the CAS number is unique to a pure chemical. Some chemicals may have more than one CAS number.
- **Is formalin DOT regulated?** Answer: Yes.
- **Why would a chemical have more than one DOT ID number?** Answer: Some chemicals have more than one physical make up (solid, liquid, gas, etc.).

Slide 14: Ask class participants to look up DOT ID number 1005. Answer: Ammonia.

Slide 15: Review numerous DOT ID numbers associated with ammonia.

Have class participants to turn to Appendix G, page 362 and review the information on what a Vacated PEL is.

Slide 16: Explain to the class participants that the Chemical Synonym and Trade Name Index are in alphabetical order.

Slide 17: Ask the class participants to look up the chemical name for aspirin. Answer: Acetylsalicylic acid.

Slide 18: Use class discussion for review questions.

Activity 6: Hazardous Materials: Chemical and Physical Properties

- This Activity should take about 70 minutes.
- Review purposes with class participants.
- Facilitator has the option of using the PowerPoint presentation or the factsheets in the *Participant's Manual*.
- Sites with video capabilities — Have "Acetone Vapor Explosion" video ready to play.
- **Task 1 answers:**

1.

Chemical	CAS #	Form	VP	MW	LEL	Fl.P.
MEK	78-93-3	liquid	78 mmHg	72.1	200°F 1.4%	16°F
Toluene	108-88-3	liquid	21 mmHg	92.1	1.1%	40°F
Gasoline	8006-61-9	liquid	38-300 mmHg	110 (approx.)	1.4%	-45°F
Sulfuric Acid	7664-93.9	liquid	0.001 mmHg	98.1	NA	NA
Hydrofluoric Acid	7664-39-3	liquid	783 mmHg	20	NA	NA
Acetone	67-64-1	liquid	180 mmHg	58.1	2.5%	0°F

continued

Activity 6: Hazardous Materials: Chemical and Physical Properties *(continued)*

2. Hydrofluoric acid — If a chemical has a high vapor pressure, more of it will be in the air than a chemical with a low vapor pressure.
3. MEK, Toluene and Gasoline — All three have a Fl.P. lower than 100°F which makes them a high flammable risk.

- **Task 2 answers:**

1.

Chemical	Vapor Density	Incompatibles/Reactivities
Chlorine	5.2 (MW/29)	Water, acids, CO_2, metals, oxygen. The chemical is a strong base causing the generation of considerable heat in contact with moisture or water.
Uranium (insoluble compounds, as U)	8.2 (MW/29)	Carbon dioxide, carbon tetrachloride, nitric acid, fluorine.
Carbon Oxychloride	3.4 (MW/29)	Moisture, alkalis, ammonia, alcohols, copper. Reacts slowly with water to form hydrochloric acid and carbon dioxide.
Nitrogen Dioxide	1.6 (MW/29)	Combustible material, water, chlorinated hydrocarbons, carbon disulfide, ammonia. Reacts with water to form nitric acid.
Caustic Soda	1.4 (MW/29)	Water, acids, flammable liquids, organic halogens, metals such as aluminum, tin and zinc. Corrosive to metals.
Cesium Hydroxide	2.4 (MW/29)	Reacts explosively or forms explosive compounds with many common substances such as acetylene, ether, turpentine, ammonia, fuel gas, hydrogen and finely divided metals.
Methyl Bromide	3.3 (MW/29)	Aluminum, magnesium, strong oxidizers. Attacks aluminum to form aluminum trimethyl which is SPONTANUOUSLY flammable.

2. They are heavier than air so they settle near the floor, ground, etc.

3. Less than 2 and greater than 12.5.

- For sites with video capabilities, show "Reactions of Alkaline Metals with Water" video.
- **Activity 6: Hazardous Materials: Chemical and Physical Properties Review Questions**

1. What is the minimum temperature of a liquid needed to generate enough vapor so that it can be ignited by a spark called? **Flashpoint (Fl.P.)**

2. In terms of flammability, the most dangerous chemical is one that has a low _____ and a wide flammable range, such as hydrogen gas. **LEL**

3. _____ chemicals are substances that are normally unstable. They easily undergo violent change, react violently with water or produce toxic gases or vapors when mixed with water. **Reactive**

4. Solutions with very low and very high _____ are dangerous. If these materials contact your skin, they will cause severe chemical burns. **pHs**

5. If a chemical has a _____ _____ greater than 1, it may be able to collect in low areas or confined spaces at high enough levels to cause an explosive atmosphere or to replace oxygen in the air. **Vapor Density**

6. _____ radiation has low penetration ability and externally poses little danger but is extremely dangerous internally. **Alpha**

- Give the class a 10-minute break after this Activity.

Notes: _____

Activity 6: Trainer's Notes from the Hazardous Materials: Chemical and Physical Properties PowerPoint Presentation

Slide 2: Go over purposes with class participants.

Slide 3: What we are really describing here are physical and chemical properties of matter. Matter is anything that has mass (weighs something) and takes up space (has volume). Matter has four forms or physical states (solid, liquid, gas and plasma) which will be presented further in the presentation. However, for this course we will only be focusing on hazardous materials as matter.

Slide 4:

1. **Describe the two properties to the class and then ask them for some examples of physical properties.**
2. **Show the provided list.**
3. **Ask for some examples of chemical properties and then show the provided list.**
4. **Finish by telling the class that we will be focusing on a limited mixture of the two properties; those which most affect worker health and safety.**
    - **Chemical properties:** Characteristics involved when a hazardous material interacts with another substance to change its chemical make-up.
    - **Physical properties:** Observed without changing the substance into something else.

Slide 5: You can also tell the class that the forms chemicals take are different states of matter. No need to discuss plasma in depth here unless you want to.

- **Gas (acetylene, oxygen, carbon monoxide, nitrogen)**
- **Liquid (aerosol, mist, gels, adhesives)**
- **Solid (aerosol, dust, fiber, fume)**
- **Plasma (ionizing gas, flame, lightning)**

Slide 6:

- **Gas – Vapor**
    - Fluid;
    - Fills the container it occupies; and
    - Compressible.

- **Liquid**
  - Fluid; and
  - Takes shape of the part of container it occupies.
- **Solid**
  - Rigid;
  - Shape is independent of container; and
  - Particle size may make it act like a gas.

Slide 9: Melting point is the temperature at which a substance changes its state from solid to liquid. Under standard atmospheric pressure different pure crystalline solids will each melt at a different specific temperature; thus **melting point** is a characteristic of a substance and can be used to identify it. When heat is applied continuously and in sufficient quantity to such solids, the temperature rises steadily until it reaches the point at which liquefaction occurs. Here the rise ceases and no further change in temperature is observed until all of the substance has been converted to liquid. The heat being applied to the substance at that temperature is consumed in bringing about the change of state, and none is available to raise the temperature of that part of the substance already liquefied until all of it has changed to liquid. **Ice**, for example, requires approximately 80 calories of heat to change each gram to water at its melting point. Because its heat of fusion is relatively high, ice is used in refrigeration. In **freezing** (the reverse process, i.e., the change from liquid to solid), heat is given off by the substance undergoing the change and the amount given off is the same as that absorbed in melting.

Super-cooling is the process of lowering the temperature of a liquid or a gas below its freezing point without it becoming a solid.

Slide 10: Vapor pressure is the pressure exerted by a liquid in equilibrium with its pure liquid phase at a given temperature. The vapor pressure of a liquid is dependent only upon the nature of the liquid and the temperature. Different liquids at any temperature have different vapor pressures. The vapor pressure of every liquid increases as the temperature is raised.

Pressure above liquid exerted on closed container.

Slide 12: The boiling point of a substance is the temperature at which the vapor pressure of the liquid equals the environmental pressure surrounding the liquid.

Slide 15: Volatility is directly related to a substance's vapor pressure. At a given temperature, a substance with higher vapor pressure vaporizes more readily than a substance with a lower vapor pressure.

continued

Activity 6: Trainer's Notes from the Hazardous Materials: Chemical and Physical Properties PowerPoint Presentation *(continued)*

Slide 16:

- **Fire Point**
  The temperature at which a liquid gives off sufficient vapor to sustain the burning process.
- **Auto-Ignition Temperature**
  The minimum temperature of a material required to initiate self-sustained combustion in air with no other source of ignition.
- **Hypergolic Materials**
  Ignite when contacting each other
  Oxidizer and fuel
  - Examples include:
    - LOX and asphalt;
    - Glycerin and permanganate; and
    - HTH and brake fluid.
- **Pyrophoric**
  - Spontaneous ignition with contact with air;
  - Solid or liquid; and
  - May require moist air to ignite.

Slide 18: Combustion of hazardous materials may produce extremely toxic materials. Combustion may consume toxic materials.

Slide 19:

- Lower Explosive Limit (LEL) or Lower Flammable Limit (LFL)
- Upper Explosive Limit (UEL) or Upper Flammable Limit (UFL)
- Flammable Range (FR)

Slide 23: Show "Acetone Vapor Explosion" video.

Slide 25: Graphic design from CPWR. Fire, shock, chemical and pressure exposure.

Slide 27: pH tends to increase with temperature.

Acids

- Lemon juice: pH ≈ 2
- Soft drinks and vinegar: pH ≈ 3
- Beer: pH ≈ 4.5

Bases

- Detergents: pH ≈ 8.5
- Household ammonia: pH ≈ 10

Wastes with pH less than 2 and more than 12 are legally defined as hazardous.

Slide 28: Specific gravity at 68°F (unless a different temperature is noted) referenced to water at 39.2°F (4°C). Measured using a hydrometer (NPG).

Relative density, sometimes called **specific mass** or **specific gravity**, is the ratio of the density (mass of a unit volume) of a substance to the density of a given reference material. Specific gravity usually means relative density with respect to water. The term "relative density" is often preferred in modern scientific usage. Temperature and pressure must be specified for both the sample and the reference. Pressure is nearly always **1 atm** equal to 101.325 kPa. Where it is not, it is more usual to specify the density directly. Temperatures for both sample and reference vary from industry to industry. Relative density can also help quantify the buoyancy of a substance in a fluid, or determine the density of an unknown substance from the known density of another.

Slide 31: Solubility is the property of a solid, liquid or gaseous chemical substance to dissolve in a liquid to form a homogeneous solution. The solubility of a substance strongly depends on the used solvent as well as on temperature and pressure. The extent of the solubility of a substance in a specific solvent is measured as the saturation concentration where adding more solute does not increase the concentration of the solution.

The solvent is generally a liquid, which can be a pure substance or a mixture. One also speaks of solid solution, but rarely of solution in a gas (see vapor-liquid equilibrium instead). The extent of solubility ranges widely, from infinitely soluble (fully miscible) such as ethanol in water, to poorly soluble, such as silver chloride in water. The term ***insoluble*** is often applied to poorly or very poorly soluble compounds.

MEK = 2-Butanone; Sol = 28% (NPG; p. 36)

continued

Activity 6: Trainer's Notes from the Hazardous Materials: Chemical and Physical Properties PowerPoint Presentation *(continued)*

Gasoline; Sol = Insoluble (NPG; p. 151)

Solubility in water at 68°F (unless a different temperature is noted), % by weight (i.e., g/100 ml) — NPG.

Slide 32: Viscous liquids can be difficult to clean up and may require "thinning" with a solvent to make them more manageable.

Slide 33: **Miscible** is the property of liquids to mix in all proportions, forming a solution. Substances are said to be **immiscible** if, in some proportion, they do not form a solution. Diesel is immiscible in water. The bright rainbow pattern is due to thin film optical interference.

Slide 34: Radioactivity is the property of certain atoms to emit particles, electro-magnetic-wave energy or both, spontaneously.

Slide 36: The next few slides will review the four types of ionizing radiation with the class.

- **Alpha:**
  - Large and low energy particle;
  - Low penetrating ability;
  - Short travel distance (< 2");
  - Stopped by intact skin or paper;
  - Little danger externally; and
  - Extremely dangerous internally.
- **Beta:**
  - Mass of electron;
  - Some penetrating power;
  - Stopped by dense materials (aluminum 0.5" thick);
  - Travel distances up to 20 feet (typically less than 10 feet);
  - External burn possible; and
  - Hazard to eyes, internal hazard.

- **Gamma:**
  - High energy wave or photon;
  - High penetrating power;
  - Travel distance of up to 1 mile;
  - Highly reactive with tissue; and
  - Stopped by thick, dense materials.
- **Neutron particle:**
  - No charge;
  - Has mass;
  - Range in air is very far;
  - High penetrating power;
  - Difficult to stop;
  - Whole body exposure; and
  - The hazard is generally external.

Note: All of the ionizing radiation graphics that follow were developed by Mizula, LLC for the IUOE from NIEHS grant no. 5U45ES009763-19.

Slide 37: All of the ionizing radiation graphics that follow were developed by Mizula, LLC for the IUOE from NIEHS grant no. #5U45ES009763-19.

Slide 41:

- No mass or charge
- Electromagnetic wave or photon
- Similar to one another (difference is the place of origin)
- Range in air is very far
- It will easily go several hundred feet
- Very high penetrating power since it has no mass and no charge
- Concrete, water, lead
- Whole body exposure
- The hazard may be external and/or internal. This depends on whether the source is inside or outside the body.

continued

Activity 6: Trainer's Notes from the Hazardous Materials: Chemical and Physical Properties PowerPoint Presentation *(continued)*

Slide 43:

- No charge
- Has mass
- Range in air is very far
- Easily can go several hundred feet
- High penetrating power
- Difficult to stop
- Water, concrete, plastic (high hydrogen content)
- Whole body exposure
- The hazard is generally external

Slide 46: Show "Water Reactive Explosions" video.

Slides 47 and 48: Use class discussion for review questions.

Activity 7: Toxicology and Health Effects

- This Activity should take about 70 minutes.
- Review purposes with class participants.
- Facilitator has the option of using the PowerPoint presentation or the factsheets in the *Participant's Manual*.
- **Task 1 answers: Answers will vary with class participants.**
- **Task 2 answers:**

1.

Chemical	PEL	REL	IDLH	Exposure Routes	Target Organs	Cancer Causing
Benzene *NIOSH Pocket Guide* Page 26						
Anhydrous Ammonia *NIOSH Pocket Guide* Page 15						
Camphor *NIOSH Pocket Guide* Page 49						
Silica, crystalline *NIOSH Pocket Guide* Page 278						
1,1,1-Trichloroethane *NIOSH Pocket Guide* Page 203						
Methyl Isocyanate *NIOSH Pocket Guide* Page 213						
Sodium Hydroxide *NIOSH Pocket Guide* Page 284						
Hydrogen Fluoride *NIOSH Pocket Guide* Page 168						

continued

Activity 7: Toxicology and Health Effects *(continued)*

2. Camphor, Methyl Isocyanate, Hydrogen Fluoride
3. Methyl Isocyanate, Sodium Hydroxide, Hydrogen Fluoride

- **Activity 7: Toxicology and Exposure Limits Review Questions**

1. What two types of hazards do chemical substances present? **Physical hazards and health hazards**
2. _____ harm results from materials which inhibit the body's normal biological functioning. **Poisonous**
3. What are the four routes for chemicals to enter your body**? Inhalation, absorption, ingestion and injection**
4. _____ _____ is the amount of time chemical effects lay "dormant" until the symptoms and signs of disease show up. **Latency period**
5. _____ exposures are usually less than 24 hours and usually entail a single exposure (one point in time) to one or multiple chemicals or agents. **Acute**
6. _____ exposures include low exposure over a long period of time and have the potential to cause disease or other irreversible effects. **Chronic**

Notes: _____

Activity 7: Trainer's Notes from the Toxicology and Health Effects PowerPoint Presentation

Slide 1: Photo: DOE.gov — Biologist using dissecting microscope. Cancer and toxicology research in the Biology Division of Oak Ridge National Laboratory centers on the biological effects of chemical and physical agents in the environment. Here a biologist uses a dissecting microscope to test for tumor-like properties of Syrian hamster cells after exposure to potential environmental cancer-inducing agents.

Slide 2: Review purposes with class participants.

Slide 3: Generally speaking, chemical substances present two types of hazards:

- Physical hazards; and
- Health hazards.

Physical hazards act indirectly to cause harm. They include fires (thermal harm) or explosions and mechanical harm such as being struck by flying debris. Gasoline is a good example. Classified as a flammable liquid, it is both a fire hazard and an explosive hazard. Even the vapors can be explosive. Slip, trip and fall hazards are also physical hazards found in the workplace.

Health hazards cause direct harm. If these products contact your body directly, they cause biological reactions; destroying tissue or making you ill. The response or adverse reaction may be immediate or delayed.

Irritants are substances that cause immediate or delayed pain or reddening of skin, eyes and breathing passages where contact has occurred. PCBs, for example, cause irritations when they come in contact with the skin.

Slide 4: Explain to the class that, as with the example from the photo (a DOE nuclear fuel production facility), many worksites and tasks may subject workers in hazardous waste operations to multiple types of harm and chemical hazards at once!

Two or more types of harm potential at most incidents:

- Hazardous Materials (HAZ Mats);
- Thermal;
- Corrosive;
- Poisonous;
- Mechanical;
- Radiological; and
- Physical.

continued

Activity 7: Trainer's Notes from the Toxicology and Health Effects PowerPoint Presentation *(continued)*

Slide 6: Examples: being struck by an object or slip, trip and falls.

Slide 8: Considered poisonous to the body. Examples: sarin, parathion.

Slide 10: In larger quantities, camphor is poisonous when ingested and can cause seizures, confusion, irritability and neuromuscular hyperactivity. In extreme cases, even topical application of camphor may lead to hepatotoxicity. Lethal doses in adults are in the range 50–500 mg/kg (orally). Generally, two grams cause serious toxicity and four grams are potentially lethal.

Slide 13: The worst case of a teratogen exposure to a population en mass is the Minamata Bay, Japan, incident which was discovered in 1956. In this case, methyl mercury was used as a catalyst in a chemical process at Chisso Corp's chemical factory, which continued to dump the product into Minamata Bay from 1932 to 1968.

Slide 14: A manufacturer is required to list any carcinogens in their product even if the amount is as low as 0.1% of the product. The allowable exposure limits for carcinogens are either extremely low or zero.

Slide 16:

Acids
Destroy tissues
Typically generate heat
Cause chemical and thermal burns

Bases (alkalis or caustics)
React with fatty tissue
Not initially painful
May cause severe damage

Slide 18: Go through the list with students. The third bullet can potentially lead to cancer or other diseases that cause the body to function abnormally.

There is no damage.
If ionizing radiation passes into the cell and does not damage anything, that is a good thing for workers! However, we cannot rely on this to always happen. Also, ionizing radiation is a carcinogen, and according to the National Institute of Occupational Safety and Health, there is no safe exposure level for a carcinogen. This means workers should attempt to have zero exposure to carcinogens.

Cells are damaged but are able to repair the damage and operate normally.
The body of most cells is primarily water. When ionizing radiation hits a cell, it is most likely to interact with the water in the cell. One by-product of radiation-induced ionization of water is hydrogen peroxide. Hydrogen peroxide can damage a cell's atomic structures.

Ionizing radiation can also hit the nucleus of the cell. The nucleus contains the vital parts of the cell, such as chromosomes. The chromosomes determine cell function. When chromosomes duplicate themselves, the chromosomes transfer their information to new cells. Radiation may cause a change in the chromosome that does not affect the cell.

Damage to chromosomes and other cell structures can be repaired. In fact, our bodies repair a very large number of chromosome breaks every day.

Cells are damaged and operate abnormally.
Cell damage may not be repaired or may be only partially repaired. In these cases, the cell may not be able to function properly. It is possible that a chromosome in the cell nucleus could be damaged but not be repaired correctly. If the cell continues to reproduce, this is called a mutation and may result in cancer.

Cells die as a result of the damage.
At any given moment, thousands of our cells die and are replaced by normal functioning cells. However, the radiation damage to a cell may be so extensive that the cell dies prematurely.

Radiation sickness
Short duration high level exposure
Up to months to recover
Radiation injury
Direct exposure to a source
Local injuries such as burns
Radiation poisoning
Internalization of radioactive material
Alpha particles are a common source

Slide 19: Poisonous substances are produced by plants (phytotoxins), animals (zootoxins) and bacteria (bacteriotoxins). Poisonous substances also occur in man-made compounds.

continued

Activity 7: Trainer's Notes from the Toxicology and Health Effects PowerPoint Presentation *(continued)*

An example of phytotoxins is water hemlock — the most violently toxic plant that grows in North America. Only a small amount of the toxic substance in the plant is needed to produce poisoning in livestock or in humans. The toxin cicutoxin, acting directly on the central nervous system, is a violent convulsant. Clinical signs of poisoning occur when a threshold dose is reached after which grand mal seizures and deaths occur.

Slide 21: The amount of chemical entering the body is called the dose. Dose is usually given as (mg of chemical/kg of body weight = mg/kg). The dose is dependent upon:

- The environmental concentration;
- The properties of the toxicant;
- The frequency of exposure;
- The length of exposure; and
- The exposure pathway.

Slide 23: Go through the dose response curve with the class. Ask if they know what the different parts of the curve mean. [After a discussion, fill them in making sure to hit the No Observed Adverse Effects Level (NOAEL), Threshold Value, LD_{50} and the 100% effects dose.]

An **exposure** is the amount of chemical that is in the air you breathe or is on your skin or on the food that you eat. The **dose** is the amount of the substance that you actually absorb into your system. With most chemicals, it is easier to measure the exposure than the dose. In general, as the exposure increases, dose also increases — so the higher the exposure, the greater the number of people who experience symptoms. This is called a **dose/response relationship.**

During laboratory studies of chemical effects, a dose-response curve is developed for a specific effect. Most dose response curves take on a characteristic "S" shape as shown in the slide.

Slide 24: Give an example of the dose response curve relating to shots of whiskey. While people may not feel the response of drunkenness with one shot, 100% of the group will feel the response of drunkenness after five shots.

Slide 25: The variety of responses among organisms that get the same dose of a chemical is due to individual susceptibility.

Dose and individual susceptibility play roles in all situations involving chemicals, including medicine and caffeine.

Age, body fat, nutrition, health conditions and previous or concurrent exposure can all affect changes in excretion and metabolism rates.

Factors related to individuals' physiological makeup. Examples:

- Gender;
- Heredity;
- Race;
- Age; and
- Level of physical fitness.

Slide 29: Normally expressed as milligrams of substance per liter of air or water (mg/L) or as ppm.

Slide 30: Chemicals are only a hazard when you have been exposed to them. There are four major routes in which chemicals can enter your body. The most common type of exposure is through **inhalation**. You inhale the chemical, which would then enter your lungs, where it would be absorbed into your bloodstream. The majority of our exposure to chemicals is through inhalation. We breathe approximately 20 to 25 thousand breaths in one day, which averages a total volume of 10,000 to 14,000 liters of air in a day.

The second most common type of workplace chemical exposure is **absorption through the skin**. Once certain chemicals are absorbed through the skin, they go into the bloodstream.

The third most common type of chemical exposure is through **ingestion**, where the chemical enters the body through your mouth and is absorbed through the digestive tract. Good hygiene habits will minimize the ingestion route. Wash your face and hands prior to eating and drinking.

The last type of chemical exposure is through **injection**; the chemical enters the body through a sharp object like a needle.

continued

Activity 7: Trainer's Notes from the Toxicology and Health Effects PowerPoint Presentation *(continued)*

Slide 33: Ask the students how it would be possible for workers to ingest chemicals. The following are some possibilities for how chemicals can enter the digestive tract:

- Chemicals can rub off dirty hands and contaminate food, drinks or tobacco products.
- Chemicals in the air can settle on food or drink and be swallowed.
- Chemicals can be caught in mucus and be swallowed.

Slide 34: Photo on left is from Hackleburg, Alabama, July 28, 2011 — Severe damage to Hackleburg High School caused by a tornado that struck Hackleburg on April 27th.

Photo on right is from a grain elevator explosion where the Nebraska Taskforce 1 USAR (Urban Search and Rescue) team was called for rescue in 1989.

These types of projects put workers at risk to injection puncture hazards.

Slide 35: Duration and frequency are also important components of exposure and contribute to dose.

Acute refers to the application of a single or short-term (generally less than a day) dosing by a chemical. If toxic symptoms are expressed, they are referred to as symptoms of "acute toxicity."

Chronic refers to the expression of toxic symptoms after repeated, usually small, exposures to a chemical in doses regularly applied to the organism for a time of 5 to 25 years. If toxic symptoms are expressed, they are referred to as symptoms of "chronic toxicity."

There is also a subchronic category where toxic symptoms are expressed after repeated applications for a relatively short time frame (months to 5 years) but more often than a single dose or multiple doses applied for only a short time. If toxic symptoms are expressed, they are referred to as symptoms of "subchronic toxicity."

Below are some characterizations of acute, subacute, subchronic and chronic exposures:

- Acute exposure — less than 24 hours; usually entails a single exposure.
- Repeated exposures are classified as:
  - Subacute — repeated for up to 30 days;
  - Subchronic — repeated for 30 to 90 days; and
  - Chronic — repeated for over 90 days.

Slide 40: Ask this question then show the definition. Give the example of bones being the target organ for lead. Ask if students can think of any other chemical/target organ examples. Some are: cadmium/kidney, organic solvents/central nervous system.

Not all organs are equally affected by chemicals. There is greater susceptibility of the target organs and you will find higher concentration of active compound(s) at the target organs.

Below are examples of how specific organs react to toxicants:

- Liver — high blood flow, oxidative reactions;
- Kidney — high blood flow, concentrates chemicals;
- Lung — high blood flow, site of exposure;
- Neurons — oxygen dependent, irreversible damage; and
- Bone marrow— intestinal mucosa rapidly divide.

Below is a list of target organs and common xenobiotics* that affect them:

- **Liver**
  Agents: ethyl alcohol and solvents that contain chlorine.
  Effects include liver failure, cirrhosis and hepatitis (called hepatotoxins).
- **Kidneys**
  Agents: cadmium, mercury and solvents that contain chlorine (called nephrotoxins).
  Damage to the kidney often occurs before symptoms appear.

* Xenobiotics are substances that are foreign to the body or to an ecological system.

continued

Activity 7: Trainer's Notes from the Toxicology and Health Effects PowerPoint Presentation *(continued)*

- **Blood**
  Agents: lead, benzene, arsine gas and phosphine gas (called hematopoietic toxins).
- **Nervous system**
  Agents: lead, mercury and many solvents (called neurotoxins).
  Symptoms include headaches and dizziness.
- **Respiratory system**
  Agents: asbestos, silica, ozone and hydrogen sulfide gas.
  Exposures can cause both acute and chronic effects from immediate paralysis caused by hydrogen sulfide to burning and edema caused by phosgene gas to long-term scarring by silica and asbestos.
- **Reproductive system**
  Agents: lead, mercury and ethyl alcohol.
  Causes low sperm count, impotence, menstrual irregularities, infertility, miscarriage, low birth weight and birth defects.
- **Nasal Sinus**
  Agents: nickel carbonyl and hard woods.
  Causes cancer.

Slide 41:
Nepho
Kidney damage
Edema, protein urea
Examples: Uranium, Halogenated Hydrocarbons

Hepa
Liver damage
Jaundice, liver enlargement
Examples: Carbon tetrachloride, Ethanol, Nitromines

Neuro
CNS — Central Nervous System
Changes in consciousness
PNS — Peripheral Nervous System

Numbness, tingling, loss of strength
Examples: Arsenic, Lead, Toluene

Cutaneous
Dermal layer damage
Rashes, irritation, defattening
Examples: Ketones, Chlorinated Compounds

Ocular
Eye or visual capacity
Conjunctivitis, corneal damage
Examples: Organic Solvents, Acids

Hemo
Function of the blood
Cyanosis, loss of consciousness
Examples: Carbon monoxide, Benzene

Pulmonary
Damage to lungs or pulmonary tissue
Cough, shortness of breath
Examples: Silica, Asbestos, Hydrogen Chloride Gas

Slide 42: Additive Effect is the term used when two or more drugs are taken at the same time and the action of one plus the action of the other results in an action as if just one drug had been given (e.g., a barbiturate and a tranquilizer given together before surgery to relax the patient).

- **Potentiation** occurs when two drugs are taken together and one of them intensifies the action of the other. This could be expressed by **a + b = B** (e.g., Phenergan®, an antihistamine, when given with a pain killing narcotic such as Demerol® intensifies its effect, thereby cutting down on the amount of the narcotic needed).
- **Synergism** is similar to potentiation. If two drugs are taken together that are similar in action, such as barbiturates and alcohol (both depressants), an effect exaggerated out of proportion to that of each drug taken separately at the given dose may occur. Normally, taken alone neither substance would cause serious harm, but if taken together, the combination could cause coma or death (e.g., a person taking a dose of alcohol and a dose of a barbiturate).

continued

Activity 7: Trainer's Notes from the Toxicology and Health Effects PowerPoint Presentation *(continued)*

- **Antagonism** is action in which two drugs given together will have an opposite effect on the body (an example might be the use of a tranquilizer to stop the action of LSD). Some stimulants will counteract the effects of depressants and thus are used to treat overdoses of barbiturates and narcotics.

Slides 44 and 45: Use class discussion for review questions.

Activity 8: Components of HCS 2012

- This Activity should take about 60 minutes.
- Review purposes with class participants.
- Facilitator has the option of using the PowerPoint presentation or the factsheets in the *Participant's Manual*.
- **Task 1 answers:**

1. No; does not have supplier identification information and supplemental information.
2. Flammable and health hazards.
3. No; the exclamation mark pictogram should not be on there because of the skull and crossbones pictogram.
4. Corrosion and acute toxicity.
5. No; does not have supplier identification information and supplemental information.
6. Flammable, health, irritant, dermal sensitizer, acute toxicity, narcotic effects, respiratory tract irritant, hazardous to ozone layer (non-mandatory).

- **Task 2 answers:**

1.

SDS Information	SDS Section
OSHA PEL	Section 8
Case Number	Section 3
Vapor Pressure	Section 9
UN Number	Section 14
Incompatibles	Section 10
Cleanup Methods	Section 6
Pictograms	Section 2

continued

Activity 8: Components of HCS 2012 *(continued)*

2. **Health Hazards icon** — Carcinogens, mutagenicity, reproductive toxicity, respiratory sensitizer, target organ toxicity and aspiration toxicity.

   Exclamation Mark icon — Irritants, dermal sensitizers, acute toxicity, narcotic effects, respiratory tract irritant.

3. Yes; it has all components required to be GHS compliant.

4. Category 1 poses the greatest risk and category 5 poses the least risk.

5. Chloroform (96.1%)
   Yes; Ethanol — Class IB Flammable Liquid, target organs (eyes, skin, respiratory system, CNS, liver, blood, reproductive system). Chloroform — when heated to decomposition, forms phosgene gas, target organs (liver, kidney, heart, eyes, skin, CNS, carcinogen).

- **Note:** OSHA Hazard Communication Standard QuickCards have been provided on the following pages as additional resources for the GHS HazComm Standard.
- **Activity 8: Components of HCS 2012 Review Questions**

1. You have the right under _____ to receive information and training about hazardous chemicals in your work area. **HCS 2012**

2. What has GHS done to hazard communication? **Helped to standardized it**

3. Name the four GHS hazard communication tools. **Hazard characterization, pictograms, labels and safety data sheets**

- Give the class a 10-minute break after this Activity.

Notes: _____

OSHA® QUICK CARD™

Hazard Communication Safety Data Sheets

The Hazard Communication Standard (HCS) requires chemical manufacturers, distributors, or importers to provide Safety Data Sheets (SDSs) (formerly known as Material Safety Data Sheets or MSDSs) to communicate the hazards of hazardous chemical products. As of June 1, 2015, the HCS will require new SDSs to be in a uniform format, and include the section numbers, the headings, and associated information under the headings below:

Section 1, Identification includes product identifier; manufacturer or distributor name, address, phone number; emergency phone number; recommended use; restrictions on use.

Section 2, Hazard(s) identification includes all hazards regarding the chemical; required label elements.

Section 3, Composition/information on ingredients includes information on chemical ingredients; trade secret claims.

Section 4, First-aid measures includes important symptoms/effects, acute, delayed; required treatment.

Section 5, Fire-fighting measures lists suitable extinguishing techniques, equipment; chemical hazards from fire.

Section 6, Accidental release measures lists emergency procedures; protective equipment; proper methods of containment and cleanup.

Section 7, Handling and storage lists precautions for safe handling and storage, including incompatibilities.

(Continued on other side)

For more information:

OSHA® Occupational Safety and Health Administration

U.S. Department of Labor

www.osha.gov (800) 321-OSHA (6742)

OSHA 3493-02 2012

OSHA® QUICK CARD™

Hazard Communication Safety Data Sheets

Section 8, Exposure controls/personal protection lists OSHA's Permissible Exposure Limits (PELs); Threshold Limit Values (TLVs); appropriate engineering controls; personal protective equipment (PPE).

Section 9, Physical and chemical properties lists the chemical's characteristics.

Section 10, Stability and reactivity lists chemical stability and possibility of hazardous reactions.

Section 11, Toxicological information includes routes of exposure; related symptoms, acute and chronic effects; numerical measures of toxicity.

Section 12, Ecological information*
Section 13, Disposal considerations*
Section 14, Transport information*
Section 15, Regulatory information*

Section 16, Other information, includes the date of preparation or last revision.

*Note: Since other Agencies regulate this information, OSHA will not be enforcing Sections 12 through 15 (29 CFR 1910.1200(g)(2)).

Employers must ensure that SDSs are readily accessible to employees.
See Appendix D of 29 CFR 1910.1200 for a detailed description of SDS contents.

For more information:

OSHA® Occupational Safety and Health Administration

U.S. Department of Labor

www.osha.gov (800) 321-OSHA (6742)

OSHA 3493-02-2012

OSHA® QUICK CARD™

Hazard Communication Standard Labels

OSHA has updated the requirements for labeling of hazardous chemicals under its Hazard Communication Standard (HCS). As of June 1, 2015, all labels will be required to have pictograms, a signal word, hazard and precautionary statements, the product identifier, and supplier identification. A sample revised HCS label, identifying the required label elements, is shown on the right. Supplemental information can also be provided on the label as needed.

For more information:

OSHA® Occupational Safety and Health Administration

(800) 321-OSHA (6742)
www.osha.gov

SAMPLE LABEL

CODE _____
Product Name _____
Product Identifier

Company Name _____
Street Address _____
City _____ State _____
Postal Code _____ Country _____
Emergency Phone Number _____
Supplier Identification

Hazard Pictograms

Signal Word
Danger

Keep container tightly closed. Store in a cool, well-ventilated place that is locked.
Keep away from heat/sparks/open flame. No smoking.
Only use non-sparking tools.
Use explosion-proof electrical equipment.
Take precautionary measures against static discharge.
Ground and bond container and receiving equipment.
Do not breathe vapors.
Wear protective gloves.
Do not eat, drink or smoke when using this product.
Wash hands thoroughly after handling.
Dispose of in accordance with local, regional, national, international regulations as specified.

In Case of Fire: use dry chemical (BC) or Carbon Dioxide (CO_2) fire extinguisher to extinguish.

First Aid
If exposed call Poison Center.
If on skin (or hair): Take off immediately any contaminated clothing. Rinse skin with water.

Precautionary Statements

Highly flammable liquid and vapor.
May cause liver and kidney damage.
Hazard Statements

Supplemental Information

Directions for Use

_____
_____
_____

Fill weight: _____ Lot Number: _____
Gross weight: _____ Fill Date: _____
Expiration Date: _____

OSHA 3492-02 2012

OSHA® QUICK CARD™

Hazard Communication Standard Pictogram

As of June 1, 2015, the Hazard Communication Standard (HCS) will require pictograms on labels to alert users of the chemical hazards to which they may be exposed. Each pictogram consists of a symbol on a white background framed within a red border and represents a distinct hazard(s). The pictogram on the label is determined by the chemical hazard classification.

HCS Pictograms and Hazards

Health Hazard  • Carcinogen • Mutagenicity • Reproductive Toxicity • Respiratory Sensitizer • Target Organ Toxicity • Aspiration Toxicity	**Flame**  • Flammables • Pyrophorics • Self-Heating • Emits Flammable Gas • Self-Reactives • Organic Peroxides	**Exclamation Mark**  • Irritant (skin and eye) • Skin Sensitizer • Acute Toxicity (harmful) • Narcotic Effects • Respiratory Tract Irritant • Hazardous to Ozone Layer (Non-Mandatory)
Gas Cylinder  • Gases Under Pressure	**Corrosion**  • Skin Corrosion/ Burns • Eye Damage • Corrosive to Metals	**Exploding Bomb**  • Explosives • Self-Reactives • Organic Peroxides
Flame Over Circle  • Oxidizers	**Environment** (Non-Mandatory)  • Aquatic Toxicity	**Skull and Crossbones**  • Acute Toxicity (fatal or toxic)

For more information:

OSHA® Occupational Safety and Health Administration

U.S. Department of Labor

www.osha.gov (800) 321-OSHA (6742)

OSHA 3491-02 2012

Activity 8: Trainer's Notes from Components of HCS 2012 PowerPoint Presentation

Slide 1: Let the class know that the next part of the module will focus on the GHS pictograms and labels. These are two of the most notable hazard communication elements under GHS.

Slide 2: Explain to the class that it took approximately 20 years from the date of the mandate (1992) until March of 2012 for the United States to adopt the GHS. The mandate stated: "A globally harmonized hazard classification and compatible labeling system, including safety data sheets and easily understandable symbols, should be available, if feasible, by the year 2000."
[Source: Foreword, *Purple Book*, Rev. 4, 2011, p. 3.]

Slide 3: The above quote is from a USW Member — Read quote to class participants.

Mike Wright is a former member of the Program Advisory Committee of the International Program on Chemical Safety and served on the international coordinating group overseeing the effort to harmonize chemical classification and labeling systems throughout the world, whose work was completed in 2003. (Source: *Federal Register*/Vol. 77, No. 58, Monday, March 26, 2012, Rules and Regulations, 17579.)

Slide 4: Ask the question, **"Why is GHS necessary?"** and flip to the slide text; then facilitate a discussion. **Ask if they ever used conflicting health and safety information concerning the same chemical or if they saw different hazard warnings or labels used for the same chemical.** Use the following excerpt from the *Purple Book* to help explain why.

1.1.1.2 While these existing laws or regulations are similar in many respects, their differences are significant enough to result in different labels or SDS for the same chemical in different countries. Through variations in definitions of hazards, a chemical may be considered flammable in one country, but not another. Or it may be considered to cause cancer in one country, but not another. Decisions on when or how to communicate hazards on a label or SDS thus vary around the world, and companies wishing to be involved in international trade must have large staffs of experts who can follow the changes in these laws and regulations and prepare different labels and SDSs. In addition, given the complexity of developing and maintaining a comprehensive system for classifying and labeling chemicals, many countries have no system at all.
(Source: http://www.unece.org/fileadmin/ DAM/trans/danger/publi/ghs/ghs_rev04/English/ST-SG-AC10-30-Rev4e.pdf, p. 9.)

continued

Activity 8: Trainer's Notes from the Components of HCS 2012 PowerPoint Presentation *(continued)*

Other possible answers include:

- To improve safety and health of workers through more effective communications on chemical hazards.
- GHS provides a standardized approach, including detailed criteria for determining what hazardous effects a chemical poses, as well as standardized label elements assigned by hazard class and category.
- Enhances both employer and worker comprehension of the hazards which will help to ensure appropriate handling and safe use of workplace chemicals.
- The harmonized format of the safety data sheets will enable employers, workers, health professionals and emergency responders to access the information more efficiently and effectively, thus increasing their utility. (Source: OSHA HAZCOMM website under FAQs.)

Slide 5: Ask the question, **"What other OSHA standards will be affected by the revised standard?"** Then advance to show that 41 OSHA standards have been affected by GHS.

Below are some of the effected standards:

29 CFR 1910.106 Flammable/Combustible Liquids;

29 CFR 1910.119 Process Safety Management; and

29 CFR 1910.120 HAZWOPER, 29 CFR 1910.252 Welding.

Ask the question **"What is the common denominator for these standards?"** They all deal with chemicals. U.S. agencies with requirements for labels and SDSs are actively involved in the GHS development process, which may be adopted by legislation in congress or by regulation in each agency.

US Agencies Affected by GHS:

Environmental Protection Agency (EPA): Pesticides Program

Department of Transportation: Hazardous Materials Regulations (already using the UN Transportation Standard)

Consumer Product Safety Commission (CPSC)

Occupational Safety and Health Administration (OSHA)

Slide 6: Chemical Reaction during Cargo Transfer: NTSB:

- Louisville, Kentucky;
- November 19, 1998;
- MC-307 Cargo Tank;
- Seven workers injured;
- 2,400 people were evacuated from the plant and surrounding businesses;
- 600 local residents were told by authorities to remain inside their homes;
- Nickel nitrate and phosphoric acid solution reacting with sodium nitrite solution; and
- Chemical reaction during cargo transfer.

Description of incident:

About 7:15 a.m. EST time on November 19, 1998, a truck driver driving a Matlack, Inc. cargo tank truck arrived at Ford Motor Company's Kentucky truck plant in Louisville, Kentucky. He was there to deliver a liquid mixture of nickel nitrate and phosphoric acid (a solution designated CHEMFOS 700 by the shipper).

A plant employee told the truck driver to park his vehicle next to the chemical transfer station outside the bulk storage building and to wait for a pipefitter to assist him in unloading the chemical. According to testimony, a short time later, the pipefitter arrived at the transfer station and told the driver that he would assist him in unloading the cargo tank. The pipefitter opened an access panel containing six identical pipe connections. Each pipe connection served a different storage tank, and each connection was marked with the plant's designation for the chemical stored in that tank.

The driver told the pipefitter that he was delivering CHEMFOS 700 and then went to the driver's side of the cargo tank and took out a cargo transfer hose. The pipefitter connected one end of the hose to one of the transfer couplers, while the driver connected the other end of the hose to the cargo tank's discharge fitting. Unknown to the pipefitter or the truck driver, the pipefitter had inadvertently attached the hose to the coupler marked "CHEMFOS LIQ. ADD" instead of to the adjacent coupler marked "CHEMFOS 700." The storage tank served by the coupler marked "CHEMFOS LIQ. ADD" contained sodium nitrite solution.

The driver climbed to the top of the cargo tank, connected a compressed air hose to a fitting and pressurized the cargo tank. The driver and the pipefitter then reviewed the cargo manifest and bill of lading. The pipefitter signed three different certifications

continued

on the cargo manifest, one of which certified that the transfer hose was "connected to the proper receiving line." The pipefitter asked the driver how long it would take to unload the contents of the cargo tank, and the driver told him the transfer would take about 30 to 40 minutes. The pipefitter then left the loading area, leaving the driver to complete the unloading by himself.

About 8:15 a.m., after the air pressure was built up in the cargo tank, the truck driver started the transfer. When the nickel nitrate and phosphoric acid solution from the truck mixed with the sodium nitrite solution in the storage tank, a chemical reaction occurred that produced toxic gases of nitric oxide and nitrogen dioxide. The driver stated that about 10 minutes after he started the transfer, he saw an orange cloud coming from the bulk storage building. He said he closed the internal valve of the cargo tank to stop the transfer of cargo and waited for someone to come out of the building. After several minutes, the pipefitter ran out of the building and gestured for the driver to stop the unloading process.

The chemical transfer station for unloading cargo tanks was on the outside of the bulk storage building. The system consisted of six 2-inch pipe connections enclosed in an access panel. The connections were identical stainless steel quick-connect couplers, and each had a shutoff valve. Each connection led to a different chemical storage tank. The couplings were not equipped with caps or locks, nor could the access panel be secured when the system was not in use.

The connection for the nickel nitrate and phosphoric acid solution was labeled "CHEMFOS 700" in black print on a yellow background. An identical adjacent pipe had similar labeling, but the wording on the label was "CHEMFOS LIQ. ADD," which was partially obscured by tape (see close-up of two yellow labels).

At the time of the accident, Ford Motor Company had written procedures for unloading cargo tanks at its Louisville truck facility and a training program for employees involved in unloading bulk chemicals. On June 26, 1998, the pipefitter involved in this accident received training covering *Local Work Instruction No. EI100-3*, dated May 26, 1998. This work instruction had been revised on June 23, 1998, and certain requirements had been added that were to be met during the unloading process. These new requirements included covering storm drains in the unloading area, verifying that sufficient capacity is available in the holding tank and remaining with the truck driver to observe the unloading process. The pipefitter did not receive training on the revised local work instruction or its new requirements before the accident.

According to the company's manufacturing process engineer, another written company instruction included a step-by-step procedure for unloading bulk tankers. This procedure was developed to meet the company's ISO 9000 certification process in May 1997. This unloading procedure was not disseminated to Ford Motor Company pipefitters responsible for the unloading of cargo tanks. It was placed in the company's phosphate process manual, and the process engineer said he advised the pipefitters to review it.

The procedure was also posted on a bulletin board inside the bulk storage building. According to interviews, the company did not train the pipefitters on the written unloading procedure, which included the requirement to double-check connections to verify the proper connection.

The pipefitter stated that he was unaware of any written instructions or procedures covering the unloading of a cargo tank. Training records did indicate that the pipefitter had been given a copy of *Local Work Instruction No. EI100-3*, dated May 26, 1998. He further stated that if he had double-checked the connection before he left the transfer area, he probably would have noticed that the transfer hose was connected to the wrong coupling.

Slide 7: Get a discussion going of where and what type (what they stand for) of pictograms participants may be familiar with.

A pictogram, also called a pictogramme or pictograph or simply picto, is an ideogram that conveys its meaning through its pictorial resemblance to a physical object. Pictograms are often used in writing and graphic systems in which the textual characters can be easily represented in pictorial form. In the simplest statement, a pictogram is a symbol or picture that represents a word or idea without the need for text.

A graphical composition that includes a symbol, plus a border, background pattern or color that is intended to convey specific health, physical and environmental hazard information, assigned to a GHS hazard class and category.

Slide 8: Image on the left is a Chinese stop sign.

Slide 9: There are nine hazard symbols used in the GHS (eight mandatory): flame, flame over circle, exploding bomb, corrosion, gas cylinder, skull and cross bones, exclamation mark, health hazard and environmental hazard (non-mandatory under OSHA HCS 2012).

With the exception of the symbols depicting an exclamation mark, health hazard and environmental hazard, all are part of the standard symbols set used in the United Nations Recommendations on the Transport of Dangerous Goods (UNRTDG).

continued

Activity 8: Trainer's Notes from the Components of HCS 2012 PowerPoint Presentation *(continued)*

Slide 10: There are nine pictograms in the GHS and only eight under HCS 2012. The ninth pictogram (environmental) is not used under OSHA.

Each pictogram is assigned to the hazard or its category or division.

All pictograms should be in the shape of a square set at a point.

For labels of products being supplied or distributed to clients, the pictograms have a black symbol on a white background with a red frame.

A competent authority may choose to give suppliers and employers discretion to use a black border for domestic use.

The requirements for making GHS-based labels include symbols or pictograms, signal words, hazard statements, precautionary statements, product identifiers/declaration of ingredients and supplier identification.

Pictograms shall be in the shape of a square set at a point and shall include a black hazard symbol on a white background with a red frame sufficiently wide to be clearly visible. A square red frame set at a point without a hazard symbol is not a pictogram and is not permitted on the label.

Slide 13: Inclusion of "Irritants" denotes "Skin and Eye" issues.

Acute toxicity refers to those adverse effects occurring following oral or dermal administration of a single dose of a substance, or multiple doses given within 24 hours or an inhalation exposure of 4 hours.

Slide 16: While the GHS includes criteria on classifying chemicals for aquatic toxicity, these provisions were not adopted in the GHS Final Rule because OSHA does not have the regulatory authority to address environmental concerns. However, the "building block approach" is utilized here to provide classification and labeling guidance to support the goals of harmonization that are useful to other regulatory authorities (e.g., EPA).

Slide 17: Precautionary pictograms can be used where allowed by the competent authority. The GHS has no harmonized precautionary pictograms. These are examples from European Union. (Note that a copy of the OSHA Quick Card on Hazard Communication Standard Pictogram is located on page 222 of your *Participant's Manual*.)

Slide 18: The labeling system of the GHS applies the principle of precedence of hazard information. Let the class know that this means the hazards are "ranked" in order of most severe receiving the top, or sometimes only, spot on a label.

Where a substance or mixture presents more than one GHS hazard, the following principles of precedence apply for health hazards:

- If the skull and crossbones symbol applies, the exclamation mark should not appear.
- If the corrosive symbol applies, the exclamation mark should not appear where it is used for skin or eye irritation.
- If the health hazard symbol appears representing respiratory sensitization, the exclamation mark should not appear for skin sensitization or for skin or eye irritation.

Slide 19: For the GHS, the assigned pictogram, signal word and hazard statement are given in that order for each category of the hazard class. This slide is one example of allocation of label elements for acute toxicity. Pictogram "Skull and Crossbones" is assigned to Categories 1, 2 and 3. "Exclamation Mark" is assigned to Category 4, none for Category 5.

The signal word, "Danger" is assigned to Categories 1, 2 and 3. "Warning" to Category 4 and Category 5. Hazard statement, "Fatal if swallowed" is used for Categories 1 and 2. Precautionary statements are not described in this table.

Slide 20: After you have transitioned the sample label onto the PPT slide, transition each element one at a time showing the class where it is located on the sample label. As of June 1, 2015, all labels were required to have pictograms, a signal word, hazard and precautionary statements, the product identifier and supplier identification. A sample revised HCS label, identifying the required label elements, is shown.

A word about operating emergency telephone number lines. If a company has an emergency telephone number, the operation and management of the emergency answering system depends on many factors including: completeness SDS, toxicity/physical hazards, frequency chemical use and availability of information through other sources.

Substances: chemical identity (name as determined by IUPAC, ISO, CAS or technical name).

continued

Activity 8: Trainer's Notes from the Components of HCS 2012 PowerPoint Presentation *(continued)*

Mixtures: chemical identities of all ingredients contributing to acute toxicity, skin or eye corrosion, mutagenicity, carcinogenicity, reproductive toxicity, skin or respiratory sensitization or target organ toxicity.

UN proper shipping name also to be used on the package when substance or mixture covered by the UNRTDG.

There are many other label elements that may appear on a label that have not been standardized in the harmonized system.

Some of this information clearly needs to be included on the labels. For example, the type of gloves to be used as exposure control measures has not been standardized in the GHS, but this information is essential and must be included in the precautionary statements.

Competent authorities may require additional information, or suppliers may choose to add supplementary information on their own initiative.

Excerpts from APPENDIX C TO 1910.1200-ALLOCATION OF LABEL ELEMENTS (MANDATORY) have been provided below as a resource to use when describing each element.

C.1 The label for each hazardous chemical shall include the product identifier used on the safety data sheet.

C.1.1 The labels on shipped containers shall also include the name, address and telephone number of the chemical manufacturer, importer or responsible party.

C.2 The label for each hazardous chemical that is classified shall include the signal word, hazard statement(s), pictogram(s) and precautionary statement(s) specified in C.4 for each hazard class and associated hazard category, except as provided for in C.2.1 through C.2.4.

C.2.1 Precedence of hazard information:

C.2.1.1 If the signal word "Danger" is included, the signal word "Warning" shall not appear;

C.2.1.2 If the skull and crossbones pictogram is included, the exclamation mark pictogram shall not appear where it is used for acute toxicity;

C.2.1.3 If the corrosive pictogram is included, the exclamation mark pictogram shall not appear where it is used for skin or eye irritation;

C.2.1.4 If the health hazard pictogram is included for respiratory sensitization, the exclamation mark pictogram shall not appear where it is used for skin sensitization or for skin or eye irritation.

A label, of course, may have lots of other information not related to its hazards, such as amounts, advertising, directions for use, etc. But the label **must** conform to the new HCS 2012 which incorporates GHS labeling criteria.

This paragraph has been extensively rewritten. While the HCS 1994 had a simple and performance-oriented approach to labels, this Final Rule sets forth detailed and specific provisions for labeling. Additionally, a new, mandatory Appendix C indicates what specific information is to be provided for each hazard class and category once a chemical is classified.

Under this revised paragraph, chemical manufacturers and importers must provide a label that includes: the product identifier, supplier information (which is to include name, address and phone number of the manufacturer), importer or distributor and the signal word, pictogram and hazard statement for each hazard class and category. Precautionary statements must also be provided. The HCS 1994 does not require the use of pictograms, specific signal words or precautionary statements.

(f)(1) Labels on shipped containers. The chemical manufacturer, importer or distributor shall ensure that each container of hazardous chemicals leaving the workplace is labeled, tagged or marked. Hazards not otherwise classified do not have to be addressed on the container. Where the chemical manufacturer or importer is required to label, tag or mark, the following information shall be provided:

(f)(1)(i) Product identifier;

(f)(1)(ii) Signal word;

(f)(1)(iii) Hazard statement(s);

(f)(1)(iv) Pictogram(s);

(f)(1)(v) Precautionary statement(s); and

(f)(1)(vi) Name, address and telephone number of the chemical manufacturer, importer or other responsible party.

(f)(2) The chemical manufacturer, importer or distributor shall ensure that the information provided under paragraphs (f)(1)(i) through (v) of this section is in accordance with Appendix C to §1910.1200, for each hazard class and associated hazard category for the hazardous chemical, prominently displayed and in English (other languages may also be included if appropriate).

continued

Activity 8: Trainer's Notes from the Components of HCS 2012 PowerPoint Presentation *(continued)*

(f)(3) The chemical manufacturer, importer or distributor shall ensure that the information provided under paragraphs (f)(1)(ii) through (iv) of this section is located together on the tag, label or mark.

(f)(4) Solid materials

> (f)(4)(i) For solid metal (such as a steel beam or a metal casting), solid wood or plastic items that are not exempted as articles due to their downstream use, or shipments of whole grain, the required label may be transmitted to the customer at the time of the initial shipment and need not be included with subsequent shipments to the same employer unless the information on the label changes;
>
> (f)(4)(ii) The label may be transmitted with the initial shipment itself or with the safety data sheet that is to be provided prior to or at the time of the first shipment; and
>
> (f)(4)(iii) This exception to requiring labels on every container of hazardous chemicals is only for the solid material itself, and does not apply to hazardous chemicals used in conjunction with, or known to be present with, the material and to which employees handling the items in transit may be exposed (for example, cutting fluids or pesticides in grains).

(f)(5) Chemical manufacturers, importers or distributors shall ensure that each container of hazardous chemicals leaving the workplace is labeled, tagged or marked in accordance with this section in a manner which does not conflict with the requirements of the Hazardous Materials Transportation Act (49 U.S.C. 1801 et seq.) and regulations issued under that Act by the Department of Transportation.

(f)(6) Workplace labeling. Except as provided in paragraphs (f)(7) and (f)(8) of this section, the employer shall ensure that each container of hazardous chemicals in the workplace is labeled, tagged or marked with either:

> (f)(6)(i) The information specified under paragraphs (f)(1)(i) through (v) of this section for labels on shipped containers; or
>
> (f)(6)(ii) Product identifier and words, pictures, symbols or combination thereof, which provide at least general information regarding the hazards of the chemicals, and which, in conjunction with the other information immediately available to employees under the hazard communication program, will provide employees with the specific information regarding the physical and health hazards of the hazardous chemical.

(f)(7) The employer may use signs, placards, process sheets, batch tickets, operating procedures or other such written materials in lieu of affixing labels to individual stationary process containers, as long as the alternative method identifies the containers to which it is applicable and conveys the information required by paragraph (f)(6) of this section to be on a label. The employer shall ensure the written materials are readily accessible to the employees in their work area throughout each work shift.

(f)(8) The employer is not required to label portable containers into which hazardous chemicals are transferred from labeled containers, and which are intended only for the immediate use of the employee who performs the transfer. For purposes of this section, drugs which are dispensed by a pharmacy to a health care provider for direct administration to a patient are exempted from labeling.

(f)(9) The employer shall not remove or deface existing labels on incoming containers of hazardous chemicals, unless the container is immediately marked with the required information.

(f)(10) The employer shall ensure that workplace labels or other forms of warning are legible, in English, and prominently displayed on the container, or readily available in the work area throughout each work shift. Employers having employees who speak other languages may add the information in their language to the material presented, as long as the information is presented in English as well.

(f)(11) Chemical manufacturers, importers, distributors or employers who become newly aware of any significant information regarding the hazards of a chemical shall revise the labels for the chemical within six months of becoming aware of the new information, and shall ensure that labels on containers of hazardous chemicals shipped after that time contain the new information. If the chemical is not currently produced or imported, the chemical manufacturer, importer, distributor or employer shall add the information to the label before the chemical is shipped or introduced into the workplace again.

Slide 21: Tell the class that HCS 2012 requires that labels on shipped containers contain much more information than required by Hazcom 1994, such as:

- The product identifier;
- Signal word;
- Hazard statement(s);
- Pictogram(s);

continued

Activity 8: Trainer's Notes from the Components of HCS 2012 PowerPoint Presentation *(continued)*

- Precautionary statement(s); and
- The name, address and telephone number of the chemical manufacturer, importer or other responsible party.

Labels are to be updated within three months of getting new and significant information about the hazards, or ways to protect those exposed.

However, much of this additional information is already included on labels by manufacturers, particularly for those following the ANSI Standard Z129 for precautionary labeling.

These elements are intended to be the minimum information to be provided on labels by manufacturers and importers.

So, if chemical manufacturers and importers want to provide additional information regarding the hazards of a chemical, as well as precautions for safe handling and use, they are free to do so:

- As long as the information is accurate; and
- Does not conflict with the required label elements.

OSHA is maintaining the current approach to allowing alternatives to labels on each stationary process container.

The exception for portable containers under the control of the person who filled them with the chemical remains the same.

Labels on incoming containers are not to be removed or defaced unless immediately replaced by another label.

Workplace labels are to be prominently displayed and in English, although other languages are permitted as well.

Employers are responsible for maintaining the labels on the containers, including, but not limited to, tanks, totes, drums and for training their employees on the hazards listed on the labels in the workplace.

Labels must continue to be:

Legible, contain the pertinent information (such as the hazards and directions for use), not able to be defaced, (i.e., fade, get washed off) or removed in any way as stated in revised Hazard Communication Standard, 29 CFR 1910.1200(f)(9).

Slide 22: Make sure you discuss with the class:

1. **What precautionary statements are;**
2. **The four types of precautionary statements; and**
3. **Different notifications that are used (see next slide).**

What is a precautionary statement? It is a phrase that describes recommended measures that should be taken to minimize or prevent adverse effects resulting from exposure to a hazardous product, or improper storage or handling of a hazardous product.

Precautionary statements consist of four types: Prevention, Response, Storage and Disposal. This table shows examples of precautionary statements for acute toxicity as seen in the Annex of the GHS text.

All precautionary statements assigned to the hazards of a product may not be described in a label due to space constraints. Consideration should be given to select precautionary statements for each target audience, worker, commercial user or consumer.

> Appendix C text concerning "precautionary statements."
>
> **C.2.4 - Precautionary statement text**
>
> C.2.4.1 There are four types of precautionary statements presented, "prevention," "response," "storage" and "disposal." The core part of the precautionary statement is presented in bold print. This is the text, except as otherwise specified, that shall appear on the label. Where additional information is required, it is indicated in plain text.
>
> C.2.4.6 – Precautionary statements may be combined or consolidated to save label space and improve readability. For example, "Keep away from heat, sparks and open flame," "Store in a well-ventilated place" and "Keep cool" can be combined to read "Keep away from heat, sparks and open flame and store in a cool, well-ventilated place."

continued

Activity 8: Trainer's Notes from the Components of HCS 2012 PowerPoint Presentation *(continued)*

C.2.4.7 – In most cases, the precautionary statements are independent (e.g., the phrases for explosive hazards do not modify those related to certain health hazards, and products that are classified for both hazard classes shall bear appropriate pre-cautionary statements for both). Where a chemical is classified for a number of hazards, and the precautionary statements are similar, the most stringent shall be included on the label (this will be applicable mainly to preventive measures). An order of precedence may be imposed by the chemical manufacturer, importer or responsible party in situations where phrases concern "Response." Rapid action may be crucial. For example, if a chemical is carcinogenic and acutely toxic, rapid action may be crucial, and first aid measures for acute toxicity will take precedence over those for long-term effects. In addition, medical attention to delayed health effects may be required in cases of incidental exposure, even if not associated with immediate symptoms of intoxication.

C.2.4.8 – If the chemical manufacturer, importer or responsible party can demonstrate that a precautionary statement is inappropriate to a specific substance or mixture, the precautionary statement may be omitted from the label.

Slide 23: Discuss with the class that the issue of GHS vs. HMIS and NFPA (or other labeling systems) has received much attention and can be confusing! The standard does allow for other labels with some restrictions. Alternative labeling systems such as the National Fire Protection Association (NFPA) 704 Hazard Rating and the Hazardous Material Information System (HMIS) are permitted for workplace containers; however, the information supplied must be consistent with the revised HCS. It is important to point out that the **DOT hazard class system does rank hazards** in a similar fashion to GHS ranking, so there has already been a hazard communication system where a low number equates highest severity and a high number equates lowest severity. Since GHS is "new," it will require training and "time in the workplace" before it is understood as well as DOT, NFPA and HMIS labels.

Excerpt from NFPA article "Working Together," *NFPA Journal*, May/June 2013, Guy Colonna, P.E.

"The GHS is an international effort that, like NFPA 704, provides a standardized approach to classification and labeling of hazardous chemicals, including detailed criteria for determining the dangers posed by chemicals and standardized label elements assigned by hazard class and category. But the GHS guidelines incorporated into the HCS differ in fundamental ways from the hazard identification and rating system in NFPA 704, including how the numerical rating scale is organized. OSHA has allowed the NFPA 704 system to remain in workplaces as long as employees are

trained on how to understand and use both systems, but concerns have arisen over the possibility for confusion between the two. NFPA and OSHA are now working to reconcile possible problems by developing a fact sheet that highlights the purposes and differences for each system. The organizations are also working jointly to promote awareness of the applicability for each system so that employers and workers can be trained on how to effectively comply with both."

Slide 25: Use this slide as an introduction to the SDS slides that follow.

Slide 26: The Safety Data Sheet (SDS) is another hazard communication tool. It should provide comprehensive information about a chemical substance or mixture for use in the workplace.

Which chemicals need to have an SDS?

An SDS must be produced for all substances and mixtures which meet the harmonized criteria for physical, health or environmental hazards under the GHS.

Under the HCS, the safety data sheet is the detailed reference source on the chemical, addressing all aspects of hazard information as well as methods for safe handling and use. The HCS specifies what information must be included on the data sheet, but does not specify a format or order of information. Having a standardized order of information should improve comprehensibility and should make it easier for chemical manufacturers to comply by providing them with a template to follow.

- Health, physical and environmental hazard criteria for substances and for classification of mixtures;
- Consistent with voluntary industry consensus standards, such as ANSI;
- Should improve comprehensibility and issues regarding accuracy of information;
- SDS in the workplace for each hazardous chemical which is used;
- OSHA requires these forms for each hazardous chemical;
- Readily accessible during each work shift to employees when they are in their work area(s);
- Identifies chemicals by name;
- Tells potential harm and how chemicals will enter the body (inhalation, ingestion and/or skin absorption);

continued

Activity 8: Trainer's Notes from the Components of HCS 2012 PowerPoint Presentation *(continued)*

- Explains signs and symptoms of exposures; and
- Explains emergency procedures.

Safety Data Sheets, previously referred to as Material Safety Data Sheets, will now require a 16-section format that is essentially the same as the ANSI standard for Hazardous Workplace Chemicals-Hazard Evaluation and Safety Data Sheets and Precautionary Labeling Preparation (ANSI Z400.1 & Z129.1 - 2010), already familiar to U.S. employers.

Paragraph (g) lists the sections in the order they are to be provided on the Safety Data Sheets.

This paragraph is supplemented by a new mandatory Appendix D, which details the information to be included under each heading. The HCS 1994 required similar information, but allowed any format to be used. This Final Rule is designed more in-line with the GHS, which has a uniform approach. This uniformity will improve the effectiveness of the safety data sheet, as well as make compliance easier for employers.

The appendix to this side-by-side analysis compares the requirements of the new mandatory Appendix D of the Final Rule to the current requirements of the HCS 1994.

(g)(1) Chemical manufacturers and importers shall obtain or develop a safety data sheet for each hazardous chemical they produce or import. Employers shall have a safety data sheet in the workplace for each hazardous chemical which they use.

(g)(2) The chemical manufacturer or importer preparing the safety data sheet shall ensure that it is in English (although the employer may maintain copies in other languages as well), and includes at least the following section numbers and headings, and associated information under each heading, in the order listed (see Appendix D to §1910.1200 – Safety Data Sheets for the specific content of each section of the safety data sheet):

(i) Section 1, Identification;

(ii) Section 2, Hazard(s) identification;

(iii) Section 3, Composition/information on ingredients;

(iv) Section 4, First-aid measures;

(v) Section 5, Fire-fighting measures;

(vi) Section 6, Accidental release measures;

(vii) Section 7, Handling and storage;

(viii) Section 8, Exposure controls/personal protection;

(ix) Section 9, Physical and chemical properties;

(x) Section 10, Stability and reactivity;

(xi) Section 11, Toxicological information.

(xii) Section 12, Ecological information;

(xiii) Section 13, Disposal considerations;

(xiv) Section 14, Transport information;

(xv) Section 15, Regulatory information; and

(xvi) Section 16, Other information, including date of preparation or last revision.

Note 1 to paragraph (g)(2): To be consistent with the GHS, an SDS must also include the headings in paragraphs (g)(2)(xii) through (g)(2)xv) in order.

Note 2 to paragraph (g)(2): OSHA will not be enforcing information requirements in sections 12 through 15, as these areas are not under its jurisdiction.

(g)(3) If no relevant information is found for any subheading within a section on the safety data sheet, the chemical manufacturer, importer or employer preparing the safety data sheet shall mark it to indicate that no applicable information was found.

(g)(4) Where complex mixtures have similar hazards and contents (i.e., the chemical ingredients are essentially the same, but the specific composition varies from mixture to mixture), the chemical manufacturer, importer or employer may prepare one safety data sheet to apply to all of these similar mixtures.

(g)(5) The chemical manufacturer, importer or employer preparing the safety data sheet shall ensure that the information provided accurately reflects the scientific evidence used in making the hazard classification. If the chemical manufacturer, importer or employer preparing the safety data sheet becomes newly aware of any significant information regarding the hazards of a chemical, or ways to protect against the hazards, this new information shall be added to the safety data sheet within three months. If the chemical is not currently being produced or imported, the chemical manufacturer or importer shall add the information to the safety data sheet before the chemical is introduced into the workplace again.

continued

Activity 8: Trainer's Notes from the Components of HCS 2012 PowerPoint Presentation *(continued)*

(g)(6)(i) Chemical manufacturers or importers shall ensure that distributors and employers are provided an appropriate safety data sheet with their initial shipment, and with the first shipment after a safety data sheet is updated; (g)(6)(ii). The chemical manufacturer or importer shall either provide safety data sheets with the shipped containers or send them to the distributor or employer prior to or at the time of the shipment; (g)(6)(iii). If the safety data sheet is not provided with a shipment that has been labeled as a hazardous chemical, the distributor or employer shall obtain one from the chemical manufacturer or importer as soon as possible.

(g)(6)(iv) The chemical manufacturer or importer shall also provide distributors or employers with a safety data sheet upon request.

(g)(7)(i) Distributors shall ensure that safety data sheets, and updated information, are provided to other distributors and employers with their initial shipment and with the first shipment after a safety data sheet is updated;

(g)(7)(ii) The distributor shall either provide safety data sheets with the shipped containers, or send them to the other distributor or employer prior to or at the time of the shipment;

(g)(7)(iii) Retail distributors selling hazardous chemicals to employers having a commercial account shall provide a safety data sheet to such employers upon request, and shall post a sign or otherwise inform them that a safety data sheet is available;

(g)(7)(iv) Wholesale distributors selling hazardous chemicals to employers over-the-counter may also provide safety data sheets upon the request of the employer at the time of the over-the-counter purchase, and shall post a sign or otherwise inform such employers that a safety data sheet is available;

(g)(7)(v) If an employer without a commercial account purchases a hazardous chemical from a retail distributor not required to have safety data sheets on file (i.e., the retail distributor does not have commercial accounts and does not use the materials), the retail distributor shall provide the employer, upon request, with the name, address and telephone number of the chemical manufacturer, importer or distributor from which a safety data sheet can be obtained;

(g)(7)(vi) Wholesale distributors shall also provide safety data sheets to employers or other distributors upon request; and

(g)(7)(vii) Chemical manufacturers, importers and distributors need not provide safety data sheets to retail distributors that have informed them that the retail distributor does not sell the product to commercial accounts or open the sealed container to use it in their own workplaces.

(g)(8) The employer shall maintain in the workplace copies of the required safety data sheets for each hazardous chemical, and shall ensure that they are readily accessible during each work shift to employees when they are in their work area(s). (Electronic access and other alternatives to maintaining paper copies of the safety data sheets are permitted as long as no barriers to immediate employee access in each workplace are created by such options.)

(g)(9) Where employees must travel between workplaces during a workshift, i.e., their work is carried out at more than one geographical location, the safety data sheets may be kept at the primary workplace facility. In this situation, the employer shall ensure that employees can immediately obtain the required information in an emergency.

(g)(10) Safety data sheets may be kept in any form, including operating procedures, and may be designed to cover groups of hazardous chemicals in a work area where it may be more appropriate to address the hazards of a process rather than individual hazardous chemicals. However, the employer shall ensure that in all cases the required information is provided for each hazardous chemical, and is readily accessible during each work shift to employees when they are in their work area(s).

(g)(11) Safety data sheets shall also be made readily available, upon request, to designated representatives, the Assistant Secretary and the Director, in accordance with the requirements of 29 CFR 1910.1020(e).

Slide 27: Instruct the class to turn to the Phosphatidylethanolamine in Chloroform 50 mg/ml SDS located on pages 210 through 216 of their workbook. The information in the SDS should be presented using the 16 headings. Tell participants that the appearance of the headings must follow strictly the order given in the slides.

Each Safety Data Sheet will have 16 Sections.

Electronic access and other alternatives to maintaining paper copies of the safety data sheets are permitted as long as no barriers to immediate employee access in each workplace are created by such options.
[Source: 29 CFR 1910.1200(g)(8)]

continued

Activity 8: Trainer's Notes from the Components of HCS 2012 PowerPoint Presentation *(continued)*

The trade secret provisions of the GHS are consistent with the HCS 1994 and therefore only a few changes were made to this section. The GHS, unlike the current HCS, requires disclosure of the percentage composition of mixtures on the SDS. This Final Rule adopts this requirement, but allows the manufacturer to claim trade secret protection for this requirement. This is the only substantive change to the existing HazComm Standard's trade secret protections.

In chronological order, the 16 headings are:

Identification of the substance or mixture and of the supplier;

Hazard(s) identification. Under this, GHS label elements should be described;

Composition/information on ingredients;

First-aid measures;

Firefighting measures;

Accidental release measures;

Handling and storage;

Exposure controls/personal protections;

Physical and chemical properties;

Stability and reactivity;

Toxicological information;

Ecological information;

Disposal considerations;

Transport information;

Regulatory information; and

Other information, including information on preparation and revision of the SDS.

Minimum additional information is specified, where applicable or available, under the relevant headings. Items under each heading can be seen by double clicking the heading.

Slide 28: Labeling (yellow labels with black symbols) used in Europe.

(WHMIS CLASSIFICATION) Workplace Hazardous Material Information System (Used in Canada).

Numbering in Hazard and Precautionary Statements from the *Purple Book.*

Explanation of H335: Hazard statements are assigned a unique numerical code which can be used as a handy reference when translating labels and SDSs written in other languages. The codes are not a substitute for writing out the entire text of the statement.

The codes have the form Hnxx where H stands for "hazard statement," n=2 for physical hazards, n=3 for health hazards and n=4 for environmental hazards; and xx is a sequential numbering scheme.

Thus, an SDS or label might bear a statement such as "May be corrosive to metals (H290)." H indicates a Hazard, the 2 indicates a physical hazard and 90 is part of the numbering scheme.
(Source: http://www.unece.org/fileadmin/DAM/trans/danger/publi/ghs/ghs_rev04/English/07e_annex3.pdf)

Slide 34: Depending on the age of the SDS, if possible, you should reference the latest edition of ACGIH TLVs for accuracy.

Slide 37: The SDS must also contain Sections 12 through 15 to be consistent with the UN Globally Harmonized System of Classification and Labeling of Chemicals (GHS), but OSHA will not enforce the content of these sections because they concern matters handled by other agencies.

Twelve of the 16 sections are enforced by OSHA.

Slide 40: The reference for the United Nations *Purple Book* is the 6th Edition which is the latest version available. The *Purple Book* is updated every two years.

Slide 41: Use class discussion for review questions.

Activity 9: HMIS and NFPA Hazard Rating Systems

- This Activity should take about 50 minutes.
- Review purposes with class participants.
- Facilitator has the option of using the PowerPoint presentation or the factsheets in the *Participant's Manual*.
- **Task answers:**

1. NFPA label — Instability Hazard (4) — May explode at normal temperatures and pressures. Flammability Hazard (3) — Could be ignited under almost all ambient temperatures. Reacts violently or explosively with water.

   HMIS Label — Health Hazard (4) — Severe Hazard, Life-threatening — major or permanent damage may result from single or repeated overexposures. Reactivity Hazard (3) — Serious Hazard — materials that may form explosive mixtures with water and are capable of detonation or explosive reaction in the presence of a strong initiating source. Materials may polymerize, decompose, self-react or undergo other chemical change at normal temperature and pressure with moderate risk of explosion.
2. Reacts violently or explosively with water.
3. Airline hood or mask, gloves, full-suit and boots.
4. Respiratory, skin and nervous system.
5. No. Both are flammable and reactive.

- **Activity 9: HMIS and NFPA Hazard Rating Systems Review Questions**

1. What system was developed to provide limited, but crucial, information for firefighters and offsite emergency responders? **NFPA**
2. What two hazard rating systems provide quick information on flammability, reactivity, health and special hazards associated with the chemical? **NFPA and HMIS**
3. Under the GHS hazard rating system would a "4" be considered a slight hazard or severe hazard? **Slight hazard**
4. Eight of the nine GHS pictograms are regulated by OSHA. The ninth pictogram is regulated by whom? **Environmental Protection Agency (EPA)**
5. How many sections are the GHS formatted Safety Data Sheets (SDS) required to have? **16**

- Give the class a 10-minute break after this Activity.

Activity 10: DOT *ERG*

- This Activity should take about 50 minutes.
- Review purposes with class participants.
- Facilitator has the option of using the PowerPoint presentation, the factsheets in the workbook or the video to review the DOT *ERG*. **Note:** The trainer has two different options for which video to use.
- **Task 1 answers:**

1. Hazard Classification — Gases could be 2.1 (flammable gases), 2.2 (non-flammable, non-toxic gases) or 2.3 (toxic gases), but based on additional information on the placard, it should be 2.3.
2. Poison/Toxic.
3. Hydrogen chloride, anhydrous.

- **Task 2 answers:**

1. Guide number 155.
2. The chemical is highly flammable and will be easily ignited by heat, sparks or flames. Vapors from explosive mixtures. Most vapors are heavier than air. They will spread along ground and collect in low or confined areas (sewers, basements and tanks). Vapors may travel to source of ignition and flash back. Substance will react with water (some violently) releasing flammable, toxic or corrosive gases and runoff. Contact with metals may evolve flammable hydrogen gas. Containers may explode when heated or if contaminated with water. Toxic; inhalation, ingestion or contact (skin, eyes) with vapors, dusts or substances may cause severe injury, burns or death.
3. 150 m (500 ft).
4. Night — 5.9 km (3.7 mi).
5. Call 911, CHEMTREC, CHEMTEL, Inc., INFOTRAC, 3E Company and Nationwide Poison Control Center.

- **Activity 10: Department of Transportation *Emergency Response Guidebook* Review Questions**

1. What resource is designed for first responders during the initial phase of a dangerous goods/hazardous materials transportation incident? **DOT *ERG***

continued

Activity 10: DOT *ERG (continued)*

2. What section of the DOT *ERG* is designed for the first 30 minutes of a hazardous materials release? **The green section**

3. What colored section of the DOT *ERG* would you reference if you knew the DOT ID number of the chemical? **Yellow section**

4. What kind of information does the orange section provide you with?

   a. **Potential hazards — Health, fire or explosion**

   b. **Public safety — protective clothing, evacuation**

   c. **Emergency response — Fire, spill or leak, first aid**

5. What colored section of the DOT *ERG* would you reference if you know the name of the chemical? **Blue section**

- Give the class a 10-minute break after this Activity.

Notes: _____

Activity 10: Trainer's Notes from the DOT *ERG* PowerPoint Presentation

Slide 1: Show DOT *ERG* video to class and hold a brief discussion of the video. From there, move to systematically explaining the *ERG* and its use over the next few slides.

The *Emergency Response Guidebook 2012* (*ERG 2012*) is primarily a guide to aid first responders in quickly identifying the specific or generic hazards of the material(s) involved in the incident, and protecting themselves and the general public during the initial response phase of the incident.

Photo and case study courtesy of DOT:

About 11:36 a.m. on January 5, 2002, a tractor pulling a cargo tank semitrailer departed the plant entrance and the trailer catastrophically failed. This failure occurred in the void area between the first and second tank, and the trailer broke into two pieces.

This cargo tank semitrailer was constructed with three independent stainless steel U.S. Department of Transportation (DOT) specification MC-307 cargo tanks. These tanks were joined to form a single trailer using stainless steel tie bands that overlapped the adjoining ends. The cargo tank motor vehicle was covered with flexible insulation and a thin stainless steel jacket that was connected to the frame assembly at the bottom of the trailer.

At the time of the accident, the cargo tank contained 5,152 gallons of polypropylene glycol. Although this chemical is not regulated by the DOT as a hazardous material and no release occurred, this type of specification cargo tank is authorized to transport hazardous materials requiring a specification package. There were no fatalities, injuries or evacuations; however, the intersection was closed for seven hours. Damage, cleanup and lost revenues were estimated at $18,000.

Slide 2: Go over purposes with class participants.

Slide 13: The yellow section contains four digit ID numbers first. With the ID number you can determine guide number and chemical (or chemical family).

Slide 20: See pages 257 and 258 of the workbook.

Slides 23 and 24: Use class discussion for review questions.

Activity 11: Chemical Review Game

- This Activity should take about 50 minutes.
- Review purposes with class participants.
- Facilitator has the option of using the PowerPoint presentation or the factsheets in the workbook.
- Verify that each participant has a copy of the 2010 *NIOSH Pocket Guide* and 2012 DOT *ERG* (if available).
- For sites with video capabilities — Have the Chemical Game PPT ready to use.
  - If you are not using PPT presentation:
    - Make sure that the class understands how to use the *NIOSH Pocket Guide*, DOT *ERG* and SDSs before you begin the game. (**Note:** When demonstrating how to use an SDS, refer to one of the examples on pages 270 through 298 in the workbook if not using the PPT presentation.)
    - Review pages VIII through XVI of the *NIOSH Pocket Guide* with class participants. These pages address the different categories for each chemical listing.
- Information on the SDS and how to obtain a DOT *ERG* and *NIOSH Pocket Guide* has been provided on page 299.
- You have the option of playing the Chemical Game the way the game has been played in previous years using the colored cards or using an alternate electronic version:
  - **Colored cards version:** Proceed with game per instructions in the workbook.
  - **Electronic version:** Instructions for this version start on the next page.
- **Activity 11: Chemical Review Game Review Questions**

1. There are many good reference resources, but they should not be used as a substitute for a good _____ ____ _____ ____. **Health and Safety Plan**
2. Various hazardous material references may provide different, and sometimes contradictory, recommendations. It is best to consult several sources of information and then follow the most _____ or _____ recommendations. **Restrictive or protective**
3. What three resources we studied in this activity are all excellent sources for identifying signs and symptoms of overexposure to hazardous materials? **SDSs, the *NIOSH Pocket Guide* and the DOT *ERG***

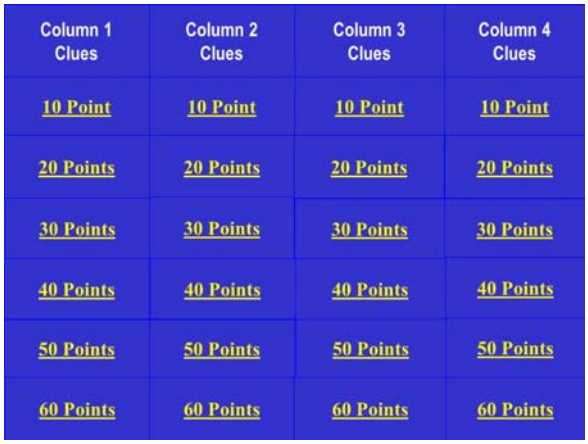
Alternate Electronic Version of Name That Chemical Game

Have the Chemical Game PowerPoint ready to show.

The rules of the Chemical Review Game:

1. Place the Chemical Name Cards on the wall to use as a reference to the chemicals to which the clues will match.

   Pull up the game screen on your computer.



2. Draw a table number from a "hat." That group will be the first to choose a clue. Control of the board moves in ascending table number order starting with the table number drawn.

3. The table will choose a column number and a point value and you will review the clue.

   The table will have two minutes to provide the correct answer.

   All of the tables will work on the response to the clue at the same time and will use the resources to determine the chemical to which the clue responds.

4. The answer must include the name of the chemical **and** the resource where the answer was found.

5. Read the "clue" and the table scribe will give the group's response. If the response is correct, that table will get the points. If the answer is incorrect, go to the table whose table scribe raised their hand second, and that table will get a chance to respond, etc.

continued

Activity 11: Chemical Review Game *(continued)*

6. If the question rotates to another table or tables and they give the correct answer, they do not lose their turn to have control of the board and choose a column and point value. Example: If table 2 chooses a column and point total and fails to respond correctly and the question moves through tables 3 and 4 to table 5 before a correct response is given, then control of the board moves back to table 3 to choose the next column and point value.

7. The trainer will be responsible for keeping table scores on a flip chart.

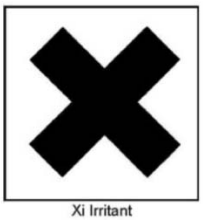
Note: Each card will best match one and only one chemical.

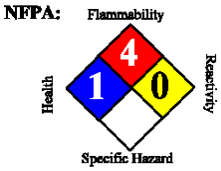
Notes: _____

_____

_____

_____

Chemical Name — Methyl Ethyl Ketone			
	Clue		**Location**
2	**2-Butanone**	**Green**	***NIOSH*** **Page 36**
4	**Acute toxicity LD (oral rat): 2737 mg/kg**	**Red**	**SDS Page 3**
3	 F Highly flammable	**Pink**	**SDS Page 5**
4	**CAUTION: All these products have a very low flash point**	**Blue**	**DOT *ERG* Page 193**
1	**TWA 200 ppm (590 mg/m^3), ST 300 ppm (885 mg/m^3)**	**Orange**	***NIOSH*** **Page 363**
3	 F Highly flammable  Xi Irritant	**Yellow**	**SDS Page 5**

Chemical Name — Propane, Commercial Grade			
	Clue		**Location**
4		**Green**	**SDS Page 1**
1		**Red**	**SDS Page 1**
2	**Caution: Hydrogen (UN1049)**	**Pink**	**DOT *ERG* Page 168**
3	**IDLH: 2100 ppm [10% LEL]**	**Blue**	***NIOSH* Page 263**
4	**BP: -44°F**	**Orange**	***NIOSH* Page 263**
1	**Partition coefficient 2.36 log Pow**	**Yellow**	**SDS Page 5**

Chemical Name — Sodium Hydroxide			
	Clue		**Location**
3	**H314: Causes severe skin burns and eye damage**	**Green**	**SDS Page 1**
2	**Small fire • Dry chemical, CO_2 or water spray**	**Red**	**DOT *ERG* Page 247**
4	**MW: 40**	**Pink**	***NIOSH* Page 284**
1	**Incompatibilities and Reactivities: [Note: Corrosive to metals]**	**Blue**	***NIOSH* Page 284**
3	**ACGIH TWA CEIL: 2 mg/m^3**	**Orange**	**SDS Page 3**
2	**Product Code (780068)**	**Yellow**	**SDS Page 1**

Chemical Name — Anhydrous Ammonia			
	Clue		**Location**
1		**Green**	**SDS Page 1**
3	**First ISOLATE in all directions 30m (100 ft.)**	**Red**	**DOT *ERG* Page 292**
1	**[. . . Easily liquefied under pressure]**	**Pink**	***NIOSH* Page 15**
2	**Toxic: May be fatal if inhaled, ingested or absorbed through skin.**	**Blue**	**DOT *ERG* Page 188**
2	**(Note: Corrosive to copper and galvanized surfaces)**	**Orange**	***NIOSH* Page 15**
4		**Yellow**	**SDS Page 1**

Activity 12: Placing Medical Surveillance under Surveillance

- This Activity should take about 35 minutes.
- Review purpose with class participants.
- **Task 1 answers:**
  - Is the doctor specially trained to look at worker diseases?
  - Does he/she have formal training in occupational medicine?
  - Is he/she Board-certified or Board-eligible in occupational medicine?
  - Does he/she have extensive experience in diagnosing and treating occupational diseases?
  - Does USW International, or do other worked-oriented occupational health specialists, know and respect this doctor's work?
  - Is the physician who reads the chest x-rays a qualified "B" reader?
  - Did the employer's program do the right tests to detect possible problems with the chemicals workers are exposed to?
  - Can the worker expect test results?
  - Are the tests the doctor is performing safe for the worker?
  - Are medical findings kept confidential for the worker?
- **Task 2 answers:**

  1a. Not enough information.

  1b. Not enough information.

  1c. Not enough information.

  2. Not enough information.

  3. Not enough information.

  4. Answers will vary with class participants.

continued

Activity 12: Placing Medical Surveillance under Surveillance *(continued)*

- **Activity 12: Placing Medical Surveillance Under Surveillance Review Questions**

1. What OSHA Standard entitles you to your individual test results? **1910.1020**
2. Who is covered under HAZWOPER's Medical Surveillance?

   a. **Employees who are or may be exposed to hazardous substances or health hazards at or above permissible exposure limits or if there is no permissible exposure limit, above published exposure levels without regard to the use of respirators, for 30 days or more per year.**

   b. **All employees who wear a respirator for 30 days or more a year as required by 1910.134.**

   c. **All employees who are injured become ill or develop signs or symptoms due to possible overexposure involving hazardous substances or health hazards from an emergency response or hazardous waste response.**

   d. **Members of HAZMAT Teams.**

3. A _____ __ _____ should read x-rays and a _____-_____ doctor for _____ medicine should be running the employer Medical Surveillance Program. **Qualified "B" reader, board-certified, occupational**
4. When are medical evaluations required?

   a. **Prior to assignment**

   b. **Periodically (at least once every year)**

   c. **At termination of employment**

   d. **As soon as possible once the employer has been notified of symptoms of exposure or over exposure**

- Give the class a 10-minute break after this Activity.

Activity 13: Personal Protective Equipment

- This Activity should take about 40 minutes.
- Review purposes with class participants.
- Facilitator has the option of using the PowerPoint presentation or the factsheets in the *Participant's Manual*.
- **Task answers:**

1. No, because the breakthrough time on that particular CPC for carbon disulfide is immediate.

2. Level A protection because of the respiratory and skin contact hazards associated with the chemical.

3. Anything over 50 ppm use any supplied-air respirator operated in a pressure-demand or other positive-pressure mode. NIOSH REL: TWA 1 ppm (3 mg/m^3) ST 10 ppm (30 mg/m^3) [skin] OSHA PEL†: TWA 20 ppm C 30 ppm 100 ppm (30-minute maximum peak, IDLH: 500 ppm).

4. Heat stress, contents and condition of unmarked metal drums. Incompatibilities and Reactivities: strong oxidizers; chemically active metals such as sodium, potassium and zinc; azides; rust; halogens; amines. (Note: Vapors may be ignited by contact with ordinary light bulb.)

- **Activity 13: Personal Protective Equipment (PPE) Review Questions**

1. What are the four levels of protective clothing and which provides the most protection? **A, B, C, D and A provides the most protection**

2. According to OSHA, what must employees be trained on in regards to PPE?

   a. When PPE is necessary?

   b. What type of PPE is necessary?

   c. How to properly don, doff and wear PPE

   d. Limitations of PPE

   e. How to properly care for and dispose of PPE

continued

Activity 13: Personal Protective Equipment *(continued)*

3. What health and safety issues can be caused from wearing PPE?
   a. **Heat stress**
   b. **Limited vision**
   c. **Limited hearing**
   d. **Limited agility and dexterity**
   e. **Issues with claustrophobia**
4. What are some things to consider when selecting PPE and CPC?
   a. **Permeation**
   b. **Degradation**
   c. **Penetration**
   d. **Breakthrough**

- Give the class a 10-minute break after this Activity.

Notes: _____

Activity 13: Trainer's Notes from the Personal Protective Equipment PowerPoint Presentation

Slide 2: Go over purposes with class participants.

Slide 5: 1917.96(a) Except as provided by paragraphs (b) through (f) of this section, the protective equipment [including personal protective equipment (PPE)] used to comply with this part, shall be provided by the employer at no cost to employees.

Slide 6: Go over these key requirements with the class.

- Employers should make sure that each employee demonstrates an understanding of the PPE training as well as the ability to properly wear and use PPE before they are allowed to perform work requiring its use.
- If an employer believes that a previously trained employee is not demonstrating the proper understanding and skill level in the use of PPE, that employee should receive retraining.
- Other situations that require additional or retraining of employees include changes in the workplace or in the type of required PPE that make prior training obsolete.

Slide 7: Get the class to discuss why PPE may be necessary. Try to get some specific examples (e.g., going into a sewage digester tank to clean or fix it, inspecting a structure after a disaster, etc.).

- Respiratory hazards;
- Skin contact;
- Thermal and chemical burns;
- Skin rashes and irritation; and
- Absorption of chemicals into the body.

Slide 11: Vapor tight, liquid tight, positive pressure, contains air supply.

Slide 13: Typical Level B:

- Encapsulated splash protection:
- Fully encloses SCBA and wearer;
- NOT vapor tight; and
- Examine zippers, valves, boots and gloves.

continued

Activity 13: Trainer's Notes from the Personal Protective Equipment PowerPoint Presentation *(continued)*

Slide 15: Typical Level C:

- Coverall;
  - Hooded/hoodless;
- Coverall and full hood;
- Pant and coat; and
- Apron and visor.

Slide 17: Level D definition as given by the EPA (general guideline):

Level D protection is the minimum protection required. Level D protection may be sufficient when no contaminants are present or work operations preclude splashes, immersion or the potential for unexpected inhalation or contact with hazardous levels of chemicals. Appropriate Level D protective equipment may include gloves, coveralls, safety glasses, face shields and chemical-resistant, steel-toe boots or shoes.

- Work clothing;
- No known hazards; and
- Nuisance contamination.

Use when:

- No splash or immersion potential; or
- No inhalation hazard.

Examples:

- Hard hat;
- Coveralls;
- Gloves;
- Escape mask;
- Faceshield; and
- Safety glasses.

Slide 25: Physical deterioration of the suit caused by:

- Chemical exposure;
- Sunlight; and
- Improper storage.

Visible signs include:

- Cracking, delamination and color changes;
- Brittle fasteners; and
- Visor separation and delamination.

Slide 26: Suit design deals with how a garment is put together. Seams are an important aspect of suit design. Two pieces of material can be joined by stitching or welding. The stitching process can create pin holes that may allow chemicals to penetrate. Welded seams involve cementing or welding tape over the stitched seam. The welded (sealed) seam offers a higher level of protection against exposure to contaminants.

Slide 28: Good sense work practices and calculated deliberate approach.

Slide 29: Ask the class participants to name some things to remember when donning and doffing PPE. After they have had time to respond, transition in bulleted answers.

Slide 33: Use class discussion for review questions.

Activity 14: Site-Specific Health and Safety Plan

- This Activity should take about 50 minutes.
- Review purposes with class participants.
- Facilitator has the option of using the PowerPoint presentation or the factsheets in the *Participant's Manual*.
- **Task 1 answers:**

1. What hazards are associated with permit required confined space (PRCS)?
   What was the process equipment used for?
   What is the oily substance?
   Was the SCBA used because of what was used in the process or the PRCS?
   Were both of the cylinders labeled Carbonyl Dichloride empty?
   Were all the fittings, copper, etc., used in the process?

2. Research done on what has been done in the building in the past including:
   — What process equipment was used to determine what hazards might be present.
   — Verification of contents of the two cylinders.
   — Air monitoring done in and around the building.
   — Confined space evaluation including air monitoring and ventilation.

- **Task 2 answers:**

1. The fact that Carbonyl Dichloride is not compatible with water.
   Did any of the rain water leach into the PRCS?

2. Re-evaluate confined space using Level "A" PPE.
   Do continuous air monitoring.
   Have onsite emergency response team on alert.

- **Activity 14: Site-Specific Health and Safety Plan (HASP) Review Questions**

1. What is considered one of the most important health and safety tools that workers have at a hazardous waste site? **The Health and Safety Plan (HASP)**

2. Always _____ and _____ the hazards and safety precautions when site conditions change unexpectedly. **Assess, reassess**

3. The _____ is a living document and should be changed every time a new hazard is exposed. **HASP**

4. According to 1910.1020 the employer has _____ days to respond to your request for medical or exposure records. **15**

- Give the class a 10-minute break after this Activity.

Notes:

Activity 14: Trainer's Notes from the Site-Specific Health and Safety Plan PowerPoint Presentation

Slide 2: Go over purposes with class participants.

Slide 3: A health and safety plan is required under 29 CFR 1910.120 if certain conditions exist. Take the class to Factsheet 3 in the curriculum book to review those conditions.

A HASP is considered a living document. When conditions change, the HASP should be changed as well.

Slide 5: The hazards have to be identified and assessed in order to properly protect the workers, community and environment from them.

Slide 6: 1910.120(e)(1)(i) All employees working on site (such as, but not limited to, equipment operators, general laborers and others) exposed to hazardous substances, health hazards or safety hazards and their supervisors and management responsible for the site shall receive training meeting the requirements of this paragraph before they are permitted to engage in hazardous waste operations that could expose them to hazardous substances, safety or health hazards, and they shall receive review training as specified in this paragraph.

Slide 7: 1910.120(g)(5) *Personal Protective Equipment (PPE) Program*. A personal protective equipment program, which is part of the employer's safety and health program required in paragraph (b) of this section or required in paragraph (p)(1) of this section and which is also a part of the site-specific safety and health plan shall be established.

The PPE program shall address the elements listed below. When elements, such as donning and doffing procedures, are provided by the manufacturer of a piece of equipment and are attached to the plan, they need not be rewritten into the plan, as long as they adequately address the procedure or element.

PPE selection based upon site hazards;

PPE use and limitations of the equipment;

Work mission duration;

PPE maintenance and storage;

PPE decontamination and disposal;

PPE training and proper fitting;

PPE donning and doffing procedures;

PPE inspection procedures prior to, during and after use;

Evaluation of the effectiveness of the PPE program; and

Limitations during temperature extremes, heat stress and other appropriate medical considerations.

Slide 8: 1910.120(f)(3) *Frequency of medical examinations and consultations.*

Prior to assignment:

At least once every 12 months for each employee covered unless the attending physician believes a longer interval (not greater than biennially) is appropriate; at termination of employment or reassignment to an area where the employee would not be covered if the employee has not had an examination within the last six months.

As soon as possible upon notification by an employee that the employee has developed signs or symptoms indicating possible overexposure to hazardous substances or health hazards, or that the employee has been injured or exposed above the permissible exposure limits or published exposure levels in an emergency situation;

At more frequent times, if the examining physician determines that an increased frequency of examination is medically necessary.

Slide 9: 1910.120(b)(4)(ii)(E) Frequency and types of air monitoring, personnel monitoring and environmental sampling techniques and instrumentation to be used, including methods of maintenance and calibration of monitoring and sampling equipment to be used.

Slide 10: 1910.120(d)(3) *Elements of the site control program*. The site control program shall, as a minimum, include: A site map; site work zones; the use of a "buddy system;" site communications including alerting means for emergencies; the standard operating procedures or safe work practices; and identification of the nearest medical assistance. (Note: Each PIC represents one of the minimum requirements listed above.)

continued

Activity 14: Trainer's Notes from the Site-Specific Health and Safety Plan PowerPoint Presentation *(continued)*

Slide 11: A decontamination procedure shall be developed, communicated to employees and implemented before any employees or equipment may enter areas on site where potential for exposure to hazardous substances exists.

Standard operating procedures shall be developed to minimize employee contact with hazardous substances or with equipment that has contacted hazardous substances.

All employees leaving a contaminated area shall be appropriately decontaminated; all contaminated clothing and equipment leaving a contaminated area shall be appropriately disposed of or decontaminated.

Slide 12: An emergency response plan shall be developed and implemented by all employers to handle anticipated emergencies prior to the commencement of hazardous waste operations. **The plan shall be in writing and available for inspection and copying by employees, their representatives, OSHA personnel and other governmental agencies with relevant responsibilities.**

Slide 13: 1910.120(l) Elements of an emergency response plan include:

- Roles, lines of authority, training and communication;
- Emergency recognition and prevention;
- Safe distances and places of refuge;
- Site security and control;
- Evacuation routes and procedures;
- Decontamination procedures which are not covered by the site safety and health plan;
- Emergency medical treatment and first aid;
- Emergency alerting and response procedures;
- Critique of response and follow-up; and
- PPE and emergency equipment.

Slide 14: Tell participants about the four generations of family members that were lost in a confined space incident.

Wednesday, July 4, 2007

Four members of a Shenandoah Valley dairy farming family and a hired hand died Monday evening after breathing methane gas fumes inside a manure pit, Rockingham County authorities said yesterday.

The deaths occurred in rapid succession, as the hired hand tried to save the farmer, who was overcome with fumes while working inside the pit, which was enclosed and poorly ventilated, authorities said. The farmer's wife and two daughters then jumped into the 10-foot hole, where they also died from exposure to the odorless gas, a by-product of liquefied manure.

Slide 15: 1910.120(j)(1)(viii) Where major spills may occur, a spill containment program, which is part of the employer's safety and health program required in paragraph (b) of this section, shall be implemented to contain and isolate the entire volume of the hazardous substance being transferred.

Slide 16: Under OSHA's 1910.1020, workers have the right to sign a release authorizing that their medical records be turned over to the union or a physician of their choice.

1910.1020 also gives the worker and the union:

- The right to all industrial hygiene data and health monitoring data by asking that all individual identifiers be removed.
- The right of access to any study or research done upon workers. This includes health effect and exposure studies.
- 1910.1020 gives the employer 15 days to respond.

Most importantly, all workers should be aware that they have the right to request their own records for their own use and viewing.

Slide 17: (This is for DOE sites only. Skip this slide if it is not relevant.) It is critical that workers be involved in the development of the HASP. Site workers know where the hazards are buried and their "institutional knowledge" should be utilized from the inception.

The most effective way to get workers involved in health and safety is to involve them in the development, implementation and monitoring of safety and health practices.

Slide 19: Use class discussion for review questions.

Activity 15: Site Control

- This Activity should take about 55 minutes.
- Review purposes with class participants.
- **Task 1 answers:**

1. Sodium cyanide — Incompatibilities and Reactivities — Strong oxidizers (such as acids, acid salts, chlorates and nitrates), IDLH 25 mg/m^3, target organs — eyes, skin, cardiovascular system, central nervous system, thyroid, blood.

   Sulfuric acid — Incompatibilities and Reactivities — Organic materials, chlorates, carbides, fulminates, water, powdered metals [note: Reacts violently with water with evolution of heat. Corrosive to metals.], IDLH 15 mg/m^3, eyes, skin, respiratory system, teeth.

   Unknown chemicals secondary to incomplete records.

2. Engineering controls, defining administrative controls, setting up work zones and personal protective equipment (PPE).

3. Site preparation;

   Ignition sources;

   Exposed electrical wiring;

   Sharp or protruding edges which can puncture protective clothing;

   Any sources of slips, trips and falls;

   Provide adequate illumination for work activities and, if possible, clear any debris or weeds to allow for better visibility;

   Site security;

   Communication; alert team members to emergencies;

   Pass along safety information, such as the amount of air time left on SCBAs;

   Maintain site control;

   Coordinate emergency response with local emergency;

   Coordinate site activities with management;

   Maintain contact with essential personnel;

Site Safety Plan and Engineering and Administrative Controls;

Employee training requirements;

Personal protective equipment (PPE);

Medical surveillance requirements;

Air monitoring, personnel monitoring and sampling techniques;

Decontamination procedures;

Operation of the emergency response plan;

Confined-space entry procedures; and

Spill containment.

- **Task 2 answers:**

1. Answers will vary with class participants.

2. Hot Zone
   Level of Protection: A

   Decontamination Zone
   Level of Protection: B

   Clean Zone
   Level of Protection: D

   Type of Respirator: Vapor respirator. Be sure to use an approved/certified respirator or equivalent. Wear appropriate respirator when ventilation is inadequate.

3. The size of the work zones;

   Wind direction;

   Support trailer should be upwind from hot zone; and

   Personnel decon line should be upwind from Hot Zone.

- **Activity 15: Site Control Review Questions**

1. What is the purpose of site control?

   a. To minimize potential contamination of workers;

continued

Activity 15: Site Control *(continued)*

b. To protect the public from the site's hazards; and

c. To prevent vandalism.

2. What does the necessary degree of site control depend on?

   a. Site characteristics;

   b. Site size; and

   c. The surrounding community.

3. When should the site control program be established? **It should be established in the planning stages of a project and modified based on new information and site assessments.**

Notes:_____

Activity 16: Site Characterization

- This Activity should take about 50 minutes.
- Review purpose with class participants.
- Facilitator has the option of using the PowerPoint presentation or the factsheets in the *Participant's Manual*.
- **Task 1 answers:**

1. No.

   Did not contact and interview former employees.

   Do not know where waste was buried.

   Do not know the material was buried.

   Do not know what kinds of materials were buried.

   Relying on employer records completely.

   Didn't gather as much information as possible.

   Not enough offsite characterization, onsite characterization and ongoing monitoring.

   Should never stop evaluating and re-evaluating.

   Didn't call experts to help.

   Even well-documented site may contain surprises.

   Did they use proper sampling and monitoring techniques?

   No maps of the site, including terrain.

   Do not know all previous activities performed on the site.

   No weather data.

   No geologic and ground water data.

   No information on previous site assessment and remediation work.

   Visual observation of the site.

   Historical photos along with current photos can be useful information.

   Potentially explosive or flammable situations.

   Extremely hazardous materials (such as cyanide phosgene and radioactive sources).

   Visible vapor clouds.

continued

Area where biological indicators (such as dead animals or vegetation) are located.

2. Key personnel;

   Hazard analysis;

   Training;

   Personal Protective Equipment (PPE);

   Temperature Extremes;

   Medical Surveillance;

   Air monitoring;

   Emergency response and action plan;

   Decontamination and spill containment;

   Confined space entry; and

   Site control.

- **Task 2 answers:**

1. No. They are entering the unknown.
2. Assessment of all possible hazards must be done in order to properly plan a course of action.

   The hazard assessment used to develop the first health and safety plan is based entirely on preliminary data.

   Many chemicals and radiation readings are taken from the surface and may not indicate what is buried.

   The readings may skyrocket once you begin digging.

   Soil concentrations are not a good indicator of concentrations in the air.

   On site also has to deal with heat and cold stress:

   Noise exposure;

   Physical hazards;

   Heavy equipment;

   Confined spaces; and

   Wearing PPE for extended periods of time.

Don't go if you don't know: Don't get very good soil samples.

Possibly miss hot spots all together.

Unknown radiation once the soil has been moved around which could cause airborne levels to increase.

Radiation can change dramatically while working.

3. Yes; because conditions can change dramatically while working you assess and reassess.

   Constantly monitor for hazards.

   Site survey plan updated as conditions change.

   Continual monitoring of site conditions is performed.

   Samples taken during the initial survey may not necessarily reflect the true content of the site and this is why it is extremely important to:

   Be flexible during the course of a cleanup;

   Not reduce PPE equipment requirements too early;

   Work remotely, if possible;

   Don't go if you don't know;

   Use a machine, if possible; and

   Not exceed exposure limits such as ppm (parts per million) or mrems/hr. (millirems per hour).

- For sites with video capabilities, you have the option of showing two short videos on non-intrusive and intrusive characterization.
- **Activity 16: Site Characterization Review Questions**

1. Why should a preliminary evaluation of a site's characteristics be performed? **To determine what level of PPE is required.**

2. What two conditions should be identified during the preliminary survey?

   a. All suspected conditions that may pose immediately dangerous to life or health (IDLH); or

   b. Conditions that may cause death or serious harm. Never stop evaluating and re-evaluating information concerning the site.

continued

Activity 16: Site Characterization *(continued)*

3. When should evaluation and re-evaluation of information concerning the site be stopped? **Never**

4. As work progresses, the site changes. It is vital to have _____ monitoring on the site. **Continuous**

- Give the class a 10-minute break after this Activity.

Notes:_____

Activity 16: Trainer's Notes from the Site Characterization PowerPoint Presentation

Slide 1: Pic is from the DOE Hanford site. Shows an intrusive characterization going on at the site.

Slide 2: Go over the purpose with class participants.

Slide 3: Hazardous waste sites shall be evaluated to identify specific site hazards and to determine the appropriate safety and health control procedures needed to protect employees from the identified hazards.

We use our eyes, memories, instruments and experts during site characterization to learn what's out there before we begin the job. The more information that is gathered before entering a waste site, the safer we will be.

What Is Site Characterization?

Site characterization is an investigation.

> It helps us to evaluate the hazards before anyone is exposed to them.
>
> It also allows us to protect initial entry personnel.
>
> It is a series of steps to figure out as much as possible about the potential hazards of a cleanup site before we start to clean it up.
>
> It is all about gathering information before we enter the great dangerous unknown called a waste site.
>
> It is all about never forgetting that cleanup work is just about the most dangerous work in the history of humankind.

Slide 4: A preliminary evaluation of a site's characteristics shall be performed prior to site entry in order to aid in the selection of appropriate employee protection methods prior to site entry. A more detailed evaluation of the site's specific characteristics shall be performed immediately after initial site entry in order to further identify existing site hazards and to further aid in the selection of the appropriate engineering controls and personal protective equipment for the tasks to be performed.

All suspected conditions that may pose inhalation or skin absorption hazards that are immediately dangerous to life or health (IDLH) or other conditions that may cause death or serious harm shall be identified during the preliminary survey and evaluated during the detailed survey.

continued

Activity 16: Trainer's Notes from the Site Characterization PowerPoint Presentation *(continued)*

Examples include:

- Confined space entry;
- Potentially explosive or flammable situations;
- Visible vapor clouds; or
- Areas where biological indicators such as dead animals or vegetation are located.

Slide 5: The information (to the extent available) that shall be obtained by the employer prior to allowing employees to enter a site is:

- **Location and approximate size of the site.**
- **Description of the response activity to be performed.**
- **Duration of the planned employee activity.**
- Site topography and accessibility.
- **Safety and health hazards expected at the site.**
- **Pathways for hazardous substance dispersion.**
- Emergency response team capabilities and accessibility.
- Hazardous substances and health hazards on site.

Slide 6: The personal protective equipment (PPE) used during initial site entry shall be based upon the results of the preliminary site evaluation. This PPE should provide protection below permissible exposure limits and published exposure levels for the known, or suspected, hazardous substances and health hazards as well as other known and suspected hazards identified during the preliminary site evaluation. If there is no permissible exposure limit or published exposure level, the employer may use other published studies and information as a guide to appropriate PPE.

Other requirements include:

- An escape self-contained breathing apparatus of at least five minutes duration shall be carried by employees during initial site entry if a positive-pressure self-contained breathing apparatus is not used for respiratory protection.

- If the preliminary site evaluation does not produce sufficient information to identify the hazards (or suspected hazards) of the site, Level B PPE shall be provided as minimum protection and direct reading instruments shall be used as appropriate for identifying IDLH conditions.
- Once the hazards of the site have been identified, the appropriate PPE shall be selected and used.

Slide 7: The following monitoring shall be conducted during initial site entry when the site evaluation produces information which shows the potential for ionizing radiation or IDLH conditions, or when the site information is not sufficient reasonably to eliminate these possible conditions:

- Monitoring with direct reading instruments for hazardous levels of ionizing radiation.
- Monitoring the air with appropriate direct reading test equipment for IDLH and other conditions that may cause death or serious harm.
- Visually observing for signs of actual or potential IDLH or other dangerous conditions.
- An ongoing air monitoring program shall be implemented after site characterization has determined the site is safe for the startup of operations.

Slide 8: Once the presence and concentrations of specific hazardous substances and health hazards have been established, the risks associated with these substances shall be identified. Employees who will be working on the site shall be informed of these risks.

Any information concerning the chemical, physical and toxicological properties of each substance known or expected to be present on site shall be made available to the affected employees prior to the commencement of their work activities.

Slide 9: Trainer will have the class participants turn to page 117 in the curriculum book.

Slide 11: It's very important to remember that site characterization should be a continuous process.

- Never stop evaluating and re-evaluating information concerning the worksite.
- We shouldn't hesitate to call in outside experts to help interpret the information gathered during these tasks.

continued

Activity 16: Trainer's Notes from the Site Characterization PowerPoint Presentation *(continued)*

- We shouldn't hesitate to call in outside experts to help interpret the information gathered during these tasks.
- Even the best documented site may contain surprises.
- Sampling and monitoring techniques used to determine hazards on a waste site are not perfect.
- The reality of the situation may be very different from the characterization report.
- When the digging begins, that difficult preliminary characterization can change for the worse and change rapidly.
- Develop new health and safety plans and work strategies as new situations develop.

Slide 12: One of the most important sources of information for characterizing hazardous waste sites is us, the current workforce. What do we know?

We know better than anybody:

- Where wastes were buried;
- How the material was buried; and
- What kinds of materials were buried.

Using the historical knowledge of the workforce to design sampling and monitoring plans is the only solution to the difficult problem of assessing hazards on hazardous waste sites.

Our working knowledge of the site allows for a better assessment of its hazards. It will also lower the cost of characterizing the site by avoiding unnecessary sampling and analysis.

Our knowledge, based on years of work on production, will also be critical during onsite characterization and during the actual cleanup. As items are recovered (drums, containers, casks, etc.) the workers can identify the hazards that are present.

Markings or labels that mean nothing to the common cleanup crew may be critical in identifying hazardous materials and avoiding a very dangerous situation. As they say in New Jersey, we know where the bodies are buried.

Slide 13: An assessment of all possible hazards must be done in order to properly plan a course of action.

Remember:

- The hazard assessment used to develop the first health and safety plan is based entirely on preliminary data.
- Many chemical and radiation readings are taken from the surface and may not indicate what is buried.
- The readings may skyrocket once you begin digging.
- Soil concentrations are not a good indicator of concentrations in the air.
- As you perform work on the site, constant air monitoring should be in place to assure that conditions do not change.

On site you will also have to deal with:

- Heat and cold stress;
- Noise exposure;
- Physical hazards;
- Heavy equipment; and
- Wearing PPE for extended periods of time.

Slide 14: (Make this statement then transition in the bulleted answers.) Because conditions can change dramatically while working on a waste site, it is imperative that:

- The site be constantly monitored for hazards;
- The site safety plan is updated as conditions change; and
- Continual monitoring of site conditions is performed.

(Make this statement then transition in the bulleted answers.) The samples taken during the initial survey may not necessarily reflect the true content of the site. This is why it is extremely important to:

- Be flexible during the course of a cleanup;
- Not reduce the protective equipment requirements too early, as this can be a costly mistake;
- Work remotely, if possible;

continued

Activity 16: Trainer's Notes from the Site Characterization PowerPoint Presentation *(continued)*

- Not go if you don't know; and
- Use a machine, if possible.

Slide 15: Trainer will have the class participants turn to page 123 in the curriculum book.

Slide 16: Use class discussion for review questions.

Activity 17: Radiation, Health and ALARA (Optional)

- This Activity should take about 30 minutes.
- Review purpose with class participants.
- **Task answers:**

1. 5 REM.
2. No. Studies have shown that levels as low as 1 REM can cause cell damage which can lead to cancer.
3. Using the concepts of ALARA which include time, distance and shielding. Use radiological controls such as:

   Use engineering controls whenever possible [glove boxes, long-handled tools, High Efficiency Particulate Air (HEPA) filter units, etc.].

   Perform mock-ups and/or simulator training before doing the actual job.

   Pre-job briefings of jobs ensure that the right people (workers, engineers, supervision, health and safety) can discuss the layout of the work required, with the workers' radiation dose in mind.

   Design equipment and facilities so that exposure to personnel and the public can be kept down to a minimum.
4. The consequences of radiation exposure can be deadly. Exposure can produce both acute and chronic effects.

- **Activity 17: Radiation, Health and ALARA Review Questions**

1. What does ALARA stand for? **As Low As Reasonably Achievable**
2. Can radiation harm the body's cells even at very small dose levels? **Yes**
3. What are three fundamental ways to reduce exposure? **Time, distance, shielding**
4. What are the employer's responsibilities under ALARA?

   a. Engineer out exposures;

   b. Substitute safer materials; and

continued

Activity 17: Radiation, Health and ALARA *(continued)*

c. Develop policies that are based upon minimizing exposure of the workers.

5. Workers cannot rely solely upon the radiation exposure standard to protect them. What does the best frontline defense against unnecessary exposures include?

   a. Knowledge;

   b. A questioning attitude; and

   c. A good safety culture

- Give the class a 10-minute break after this Activity.

Notes: _____

Activity 18: The Hazards of Noise Exposure

- This Activity should take about 90 minutes.
- Review purpose with class participants.
- Facilitator has the option of using the PowerPoint presentation or the factsheets in the *Participant's Manual*.
- Sites with video capabilities — have the "Hearing Loss Example" video ready to play.
- Sites with video capabilities — have the "How Do We Hear?" video ready to play.
- **Task 1 answers:**

1. Yes. It can cause health problems in a number of ways:
   - o Temporary hearing loss
   - o Permanent hearing loss due to chronic exposure
   - o Permanent hearing loss due to acute exposure
   - o Stress (headaches, upset stomach, etc.)
   - o Health problems (ulcers, loss of sleep, etc.)
2. No. There is also the noise from the concrete removal project and the moving equipment in the area.
3. It is where a combination of different types of noise intensifies the effect of the noise exposure. Yes, the noise from the process combined with the noise from the moving equipment and concrete removal process creates a synergistic effect.

- **Task 2 answers:**

1. No. Decibels (dB) measure the loudness of the noise. This measure is based on the mathematical shorthand of multiplication rather than addition. This short-hand scale is used because of the tremendous range in power between quiet sound and noisy sound. When decibels go up by 3, loudness and sound energy doubles. For example, 93 dB is twice as loud as 90 dB; 90 dB is 10 times louder than 80 dB; and 100 dB is 100 times louder than 80 dB.
2. The slight increase in the noise level is a much bigger increase than they are telling the workers about in the memo. The hearing tests should be mandatory.

continued

Activity 18: The Hazards of Noise Exposure *(continued)*

3. The company must institute a hearing conservation program.

- Sites with video capabilities — have the "OSHA Safety Training" video ready to play.
- **Task 3 answers:**

1. No, they need to request that the company implement a hearing protection program and use engineering controls to lessen the noise level. This includes addressing the additional noise in the area caused by the construction work going on in the area.

2. The ear plugs with the NRR of 21 meets OSHA's minimum requirements [85 db(A)]. It is borderline though. Company should implement hearing conservation program. The ear plugs with the NRR of 19 do not provide adequate protection. The company must implement a hearing conservation program.

3. They should implement a hearing conservation program as well as take measures to lessen the high noise level in the area.

- **Activity 18: The Hazards of Noise Exposure Review Questions**

1. How do you know if your hearing is at risk at your workplace?

   a. You have to shout to be heard by a coworker an arm's length away

   b. You hear ringing or humming in your ears after you leave work

   c. You experience temporary hearing loss when leaving work

2. Noise can cause a severe stress reaction called _____ or _____ which can lead to serious health problems, such as heart disease and high blood pressure. **Fight or flight**

3. Some chemicals and pharmacological agents, as well as heat, vibration and different types of noise, can combine to cause a more serious threat to our hearing and health. What is this called? **Synergistic effect**

4. What action level does OSHA require for engineering controls or administrative controls to be installed? **90 dB(A) action level**

5. What action level does OSHA require for the implementation of a hearing conservation program? **85 dB(A) action level**

6. Hearing protectors (ear plugs, muffs) should be used? **As the last line of defense against noise hazards.**

- Give the class a 10-minute break after this Activity.

Notes: _____

Activity 18: Trainer's Notes from the Hazards of Noise Exposure PowerPoint Presentation

Slide 1: Occupational hearing loss is the most common work-related illness in the United States. Approximately 22 million U.S. workers are exposed to hazardous noise levels at work, and an additional 9 million are exposed to ototoxic chemicals. An estimated $242 million is spent annually on worker's compensation for hearing loss disability. (Source: http://www.cdc.gov/niosh/topics/noise/.)

Slide 2: Go over purpose with class participants.

Slide 3: For sites with video capabilities, show the "Hearing Loss Example" video.

Slide 4: Ask the class participants to tell you what noise is. After they have had time to respond, transition in the answer.

Slide 5: Ask the class participants to name some ways they can tell if their hearing is at risk in their workplace. After they have had time to respond, transition in the answers on the PPT slide and let them compare their answers.

Slide 6: For sites with video capabilities, you have the option of showing the "How Hearing Works" video.

Slide 7: How do we hear?

Noise causes sound waves that make our ear drums vibrate. These vibrations are received by hair cells in the inner ear, which flatten according to the frequency and loudness of the sound and stimulate nerves that pass messages to the brain.

The **outer ear** collects and funnels sound waves along the ear canal to the eardrum.

The **middle ear** contains three tiny bones called ossicles. When sound waves strike the eardrum, the ossicles conduct the vibration to the cochlea in the inner ear.

Hair cells within the **inner ear** respond to vibrations by generating nerve impulses. The brain interprets this as sound. (Hair cells that are damaged by excessive noise may lead to deafness.)

Slide 8: Very loud sounds make the hair cells collapse and flatten temporarily, resulting in temporary deafness. This is referred to as a **temporary threshold shift** and may last hours or longer depending on the degree of noise exposure. This temporary hearing loss may also be accompanied by a ringing sensation called **tinnitus**.

If this severe noise exposure is repeated over many years, the hair cells in the inner ear become permanently damaged resulting in permanent hearing loss. This is referred to as **permanent threshold shift**.

Immediate permanent hearing loss can also occur if someone is exposed to very intense or explosive sounds (e.g., gunshot or an explosion). This type of damage is known as **acoustic trauma**. In some cases, a very intense sound can actually perforate the eardrum.

The harmful effects of noise exposures add up, so you need to watch your noise exposure outside the workplace as well.

Slide 9: Experiencing noise can initiate a stress response and can potentially cause noise-induced hearing loss depending on the length of exposure to, or loudness of, the sound.

Noise is a big trigger for stress responses. Whenever we perceive a threat, whether imagined or imminent, our sympathetic nervous system (SNS) kicks into high gear, releasing hormones to begin several metabolic processes to immediately prepare the body to deal with the threat. Researchers and experts know that the sympathetic nervous system initiates this adrenaline-fueled "flight or fight response."

Transition in the question "**What happens to your body during this response?**" and give them time to respond.

Go over the answers below with them after they have had time to respond:

- Adrenaline is released which increases heart rate, breathing and blood pressure.
- Oxygen-rich blood is moved to the brain very quickly, as well as to the muscles, to prep them for fight or flight.
- Adrenaline also causes rapid release of glucose and fatty acids into the blood-stream, to give the body plenty of energy.
- The body becomes less pain-sensitive and the senses keener.
- Other hormones shut down or put on hold the immune system, growth and reproduction to divert energy to the stress response.
  (Source: http://www.captel.com/news/hearing-loss/protect-noise-induced-stress-hearing-loss/.)

Slide 10: Ask the class participants to name some early warning signs of job stress. After they have had time to respond, transition the answers onto the screen for comparison.
(Source: http://www.cdc.gov/niosh/docs/99-101/default.html.)

continued

Activity 18: Trainer's Notes from the Hazards of Noise Exposure PowerPoint Presentation *(continued)*

Slide 11: Review chart with class participants.

OSHA cites specific studies of workers that demonstrated "significant differences in the number of cardiovascular and circulation disorders, as well as other health problems."

The studies compare one group of workers in high noise areas to similar workers (the control group) who work in lower noise areas.

The chart summarizes the results of an often cited German study of steel and iron workers. According to the study, 62 percent of the workers continually exposed to 90 decibels (dB) of noise suffered circulatory problems, compared to 48 percent of the workers in lower noise areas.

Other illnesses include: musculoskeletal, ulcers, loss of sleep, abnormal secretion of hormones and stress reactions.
(Source: https://www.osha.gov/dts/osta/otm/noise/health_effects/effects.html#other.)

Slide 12: Synergistic Effects: two problems that combine to form a problem that is bigger or different from the sum of the two original problems create a synergistic effect.

This is what happened in a study reported by OSHA when two kinds of noise were combined.

OSHA reported that impulsive noise (like a jack hammer) combined with a continuous noise (like a diesel engine) produces a synergistic effect.

The sum of the combined effect problem was greater than the sum of the two noises experienced individually. According to OSHA, "hearing loss was exacerbated" and considerably more damage was found than would be expected from just continuous noise.

Noise and heat are suspected to interact in this way, according to the Australian Council of Trade Unions.

A study of Russian women who worked around weaving equipment found that noise and vibration combined have a damaging synergistic effect on hearing.

Impact noise (or impulsive noise): Impact noise is created by the impact of one surface on another and is of a short duration. Impulsive noise is typically an air noise that has a short duration, such as the shooting of a firearm or the explosion of a fire-work. The standard states that exposure to impulsive or impact noise should not exceed a **140-dB** peak sound pressure level. Impulsive or impact noises are consi-dered to be much more harmful to hearing than continuous noises.

(Sources: Morata, T. C., "Chemical Exposure as a Risk Factor for Hearing Loss," *Journal of Occupational and Environmental Medicine*, 45(7): 676-682, 2003; Prasher, D., et al., NOISECHEM: An European Commission Research Project on the Effects of Exposure to Noise and Industrial Chemicals on Hearing and Balance; *International Journal of Occupational Medicine and Environmental Health*, 15(1): 5-11, 2002, Australian Council of Trade Unions, "Guidelines for the Control of Noise at Work," *Health and Safety Bulletin (of the ACTU)*, September 1983; and *Federal Register*, 46 FR 4078, January 16, 1983; and https://www.osha.gov/dts/osta/otm/new_noise/index.html#appendixd.)

Slide 13: According to studies by the Environmental Protection Agency (EPA), certain chemical substances can actually injure the inner ear, leading to deafness.

Workers are commonly exposed to multiple agents. Physiological interactions with some mixed exposures can lead to an increase in the severity of harmful effects. This applies not only to the combination of interfering chemical substances, but also in certain cases to the co-action of chemical and physical factors. In this case, effects of ototoxic substances on ear function can be aggravated by noise, which remains a well-established cause of hearing impairment.
(Source: https://www.osha.gov/dts/osta/otm/new_noise/appendixd.pdf.)

Slide 14: Physical hazards associated with noise include:

- The inability to hear moving equipment (forklifts, etc.) because of loud noise areas;
- Backup alarms on moving equipment;
- Evacuation alarms;
- Hearing protection; and
- Unable to hear forklifts, etc., where the walkways are shared with pedestrians.

Slide 15: Have class participants turn to page 153 in the curriculum book and complete task.

Slide 16: OSHA's Occupational Noise Exposure Standard is broken down into two parts. Each section has a different "action level." An action level is a measurement of noise that triggers some required action on the part of the employer.

continued

Activity 18: Trainer's Notes from the Hazards of Noise Exposure PowerPoint Presentation *(continued)*

Slide 17: Decibels (dB) measure the loudness of the noise. This measure is based on the mathematical shorthand of multiplication rather than addition. This shorthand scale is used because of the tremendous range in power between quiet sound and noisy sound. When decibels go up by 3, loudness and sound energy doubles. For example, 93 dB is twice as loud as 90 dB; 90 dB is 10 times louder than 80 dB; and 100 dB is 100 times louder than 80 dB.

Hertz (Hz) The disturbing effects of noise depend both on the loudness (intensity) and the pitch of the tones. Higher frequency noise is generally more annoying than low frequency noise. Also, single frequencies (pure tones) can be somewhat more harmful to hearing than broad-band noise.

Frequency is measured in hertz (Hz). The higher the number of hertz, the higher the frequency. An example of a high frequency noise is a compressed air jet in a plant. A low frequency example is a large truck rumbling by.

At the same intensity, the noise from the truck is less disturbing than the noise from the compressed air jet because the truck noise is at a lower frequency.

Frequency is measured both when analyzing the noise of a machine and when measuring hearing loss. Noise causes hearing to be lost first in the upper frequencies, especially around 4,000 Hz.

Slide 18: The action level for this part is 90 decibels (dB) over a time-weighted average (A), sometimes written as 90 dB(A).

Slide 19:
EPA – 75 dB
Council of European Communities – 80 dB
NIOSH – 85 dB(A)
UAW – 85 dB
Parts of Canada and Australia – 85 dB

Slide 20: Have class participants turn to page 158 in the curriculum book.

Slide 21: Explain to the class participants that once the dB TWA (decibel time weighted average) reaches 85 the employer has to implement a hearing conservation program.

Slide 22: For sites with video capabilities, show the "OSHA Safety Training" video.

Slide 23: After video has been shown, review the following with class participants:

The employer must monitor work site noise levels to identify work areas where workers are exposed to **85 dB or more** during an eight-hour shift (TWA). Hearing conservation program minimum requirements include:

- Monitoring program;
- Audiometric testing program;
- Hearing protection devices (HPDs);
- Employee training and education; and
- Recordkeeping.

Slide 24: Monitoring Program

The employer must develop and implement a monitoring program whenever information indicates that any employee's exposure may equal or exceed the action level.

The sampling strategy must identify all employees that should be included in the hearing conservation program.

The employer should choose a monitoring method that best suits each individual work situation. Either personal or area monitoring may be used.

Noise measurements must integrate all continuous, intermittent and impulsive noise levels from 80 to 130 dBA.

Monitoring must be repeated whenever a change in production, process, equipment or controls increases noise exposures to the extent that additional employees may be exposed at or above the action level or the attenuation provided by hearing protectors used by employees may be rendered inadequate.

The employer must notify each employee who is exposed at or above the action level of the results of the monitoring.

The employer must provide affected employees or their representatives with an opportunity to observe noise monitoring procedures.
(Source: https://www.osha.gov/dts/osta/otm/noise/hcp/index.html#monitoring.)

Slide 25: Within six months of an employee's first exposure at or above the action level, the employer must establish a valid baseline audiogram against which subsequent audiograms can be compared.

continued

Activity 18: Trainer's Notes from the Hazards of Noise Exposure PowerPoint Presentation *(continued)*

A standard threshold shift (STS) is a change in hearing threshold relative to the baseline audiogram of an average of 10 dB or more at 2,000, 3,000 and 4,000 Hz in either ear.

Each employee's audiogram must be compared to their baseline audiogram to determine if the audiogram is valid and to determine if a standard threshold shift (STS) has occurred.

An annual audiogram may be substituted for the baseline audiogram when the audiologist, otolaryngologist or physician evaluating the audiogram determines that the standard threshold shift (STS) revealed by the audiogram is persistent or the hearing threshold shown in the annual audiogram indicates significant improvement over the baseline audiogram.

If comparison of the annual audiogram to the baseline audiogram indicates a standard threshold shift (STS) has occurred, the employee must be informed in writing within 21 days of the determination.

Audiometric tests must be performed by:

- A licensed or certified audiologist, otolaryngologist or other physician.
- A technician who is certified by the Council of Accreditation in Occupational Hearing Conservation, or who has satisfactorily demonstrated competence in administering audiometric examinations, obtaining valid audiograms and properly using, maintaining and checking calibration and proper functioning of the audiometers used.
- A technician who operates microprocessor audiometers does not need to be certified.
- A technician who performs audiometric tests must be responsible to an audiologist, otolaryngologist or physician.
  (Source: https://www.osha.gov/dts/osta/otm/noise/hcp/audiometric_ testing.html.)

Slide 26: Hearing protection devices (HPDs) are considered the last option to control exposures to noise. HPDs are generally used during the necessary time it takes to implement engineering or administrative controls, or when such controls are not feasible.

Basic Requirements:

- **Employers must make HPDs available to all employees exposed at or above the action level.** These must be provided at no cost to employees and must be replaced as necessary.

- **Employers must ensure that HPDs are worn by employees**: When administrative and engineering controls fail to reduce sound levels within those listed in or who are exposed at or above the action level and who have not yet had a baseline audiogram established or have experienced a standard threshold shift (STS).
- **Employees must be given the opportunity to select their HPDs from a suitable variety.** Generally, this should include a minimum of two devices, representative of at least two different types.
- **The employer must provide training in the use and care of all HPDs provided to employees.** The employer must ensure proper initial fitting of HPDs and supervise their correct use.
- **HPD attenuation refers to the damping or decrease of noise levels as a result of wearing HPDs. The employer must evaluate HPD attenuation for the specific noise environments in which the HPD will be used.** HPDs must attenuate employee exposure to at least an eight-hour time-weighted average of 90 dBA. For employees who have experienced a standard threshold shift (STS), HPDs must attenuate exposure at or below the action level of 85 dBA-TWA (time-weighted average). The adequacy of the HPDs must be re-evaluated whenever employee noise exposures increase to the extent that they may no longer provide adequate attenuation. The employer must provide more effective hearing protectors as necessary.
  (Source: https://www.osha.gov/dts/osta/otm/noise/hcp/index.html#hpd.)

Slide 27: The advantages of Foam and PVC earplugs are:

1. Small and lightweight;
2. Comfortable in hot environments; and
3. Easily used with other safety equipment.

The disadvantages of earplugs are:

1. May work loose and require occasional refitting;
2. Require specific fitting instructions; and
3. Are frequently soiled.

(Source: http://www.free-training.com/osha/ppe/hear/510.htm.)

continued

Activity 18: Trainer's Notes from the Hazards of Noise Exposure PowerPoint Presentation *(continued)*

Slide 28: The advantages of earmuffs are:

1. Easy for your employer to supervise the wearing of this device;
2. One size fits all; and
3. Fits better for longer periods of time.

The disadvantages of earmuffs are:

1. May fit tight on your head;
2. Uncomfortable in a warm environment; and
3. Problems occur when used with other equipment.

(Source: http://www.free-training.com/osha/ppe/hear/511.htm.)

Slide 29: Hearing protectors are evaluated under laboratory conditions specified by the American National Standards Institute in ANSI S3.19-1974. Each HPD is assigned a noise reduction factor.

Use the following examples to demonstrate how to determine the effectiveness of HPDs:

A common method used for **single protection** (either muffs or plugs) is as follows:

1. Determine the laboratory-based noise attenuation provided by the HPD. This is referred to as the Noise Reduction Rating (NRR) and is listed on the packaging.
2. Subtract the NRR from the C-weighted TWA workplace noise level, as follows:

   Estimated Exposure (dBA) = TWA (dBC) - NRR

If C-weighted noise level data is not available, A-weighted data can be used by subtracting a 7 dB correction factor from the NRR, as follows:

Estimated Exposure (dBA) = TWA (dBA) - (NRR - 7)

Example:

TWA = 100 dBA, muff NRR = 19 dB

Estimated Exposure = 100 - (19 - 7) = 88 dBA

For **dual protection** (ear muffs and plugs are used simultaneously) use the following:

1. Determine the laboratory-based NRR for the **higher** rated protector (NRR_h).
2. Subtract 7 dB from NRR_h if using A-weighted sound level data.
3. Add 5 dB to the field-adjusted NRR to account for the use of the second hearing protector.
4. Subtract the remainder from the TWA as follows:

   Estimated Exposure (dBA) = TWA (dBC) - (NRR_h + 5); or

   Estimated Exposure (dBA) = TWA (dBA) - [(NRR_h - 7) + 5]

   Example:

   TWA = 110 dBA, plug NRR = 29, and muff NRR = 25 dB

   Estimated Exposure = 110 - [(29 - 7) + 5] = 83 dBA

(Source: https://www.osha.gov/dts/osta/otm/noise/hcp/attenuation_estimation.html.)

Slide 30: The employer must institute a training program for all employees with noise exposures at or above the action level and ensure employee participation.

Training must be repeated annually for each employee in the hearing conservation program and information must be updated to be consistent with changes in protective equipment and work processes.

The employer must ensure that each employee is informed of the following:

- The effects of noise on hearing.
- The purpose of hearing protectors, the advantages, disadvantages and attenuation of various types, and instructions on selection, fitting, use and care.
- The purpose of audiometric testing and an explanation of test procedures.

The employer must:

- Make copies of the noise standard available to affected employees or their representatives and post a copy in the workplace.
- Provide affected employees with any informational materials pertaining to the standard that are supplied to the employer by OSHA.
- Provide, upon request, all material relating to the employer's training and education program to OSHA.
  (Source: https://www.osha.gov/dts/osta/otm/noise/hcp/index.html#hpd.)

continued

Activity 18: Trainer's Notes from the Hazards of Noise Exposure PowerPoint Presentation *(continued)*

Slide 31: The purpose of OSHA recordkeeping regulations is to assist employers in recognizing and correcting workplace hazards by tracking work-related injuries/ illnesses and their causes.

Exposure measurements — Employers must maintain an accurate record of all employee exposure measurements. These records must be retained for two years.

Audiometric test records — The employer must maintain accurate records of the background sound pressure level measurements in audiometric test rooms. These records must include: Name and job classification of the employee, date of the audiogram, the examiner's name, date of the last acoustic or exhaustive calibration of the audiometer and employee's most recent noise exposure assessment. These records must be maintained for the duration of the affected worker's employment.

Access to records — All records required by the noise standard must be provided upon request to employees, former employees, representatives designated by the individual employee and OSHA.

Transfer of records — Employers who cease to do business must transfer to the successor employer all records required by the noise standard. The successor employer must retain these records for the remainder of the periods described previously.
(Source: https://www.osha.gov/dts/osta/otm/noise/hcp/index.html#hpd.)

Slide 32: According to OSHA, if noise exposure rises above the levels set forth in Standard 1910.95, the employer must use "engineering controls" (changes in the physical work environment such as sound dampening measures on noisy machines) or "administrative controls" (such as limits on the individual worker's exposure time) in order to comply with the law.

"If such controls fail to reduce sound levels within the prescribed levels, then Personal Protective Equipment (ear plugs, ear muffs) shall be provided and used to reduce sound levels within the OSHA prescribed levels."

Examples of engineering controls include:

- Sound absorbing ceiling and wall coverings in noisy areas where workers must spend time, such as heavy equipment cabs or buildings;
- Mufflers for the air outlets of pneumatic valves;
- Enclosures for especially noisy machine parts in a sound absorbent structure;
- Mufflers for intakes of air compressors; and

- Dual flow mouthpieces for compressed-air cleaning tools.
  (Source: U.S. Department of Labor, Occupational Safety and Health Administration, Occupational Safety and Health Standards, 29 CFR-1910.95: *Occupational Noise Exposure*; available at: http://www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=STAN.)

Slide 33: Have class participants to turn to page **171** in the curriculum book.

Slides 34 and 35: Use class discussion for review questions.

Activity 19: Permit-required Confined Spaces

- This Activity should take about 40 minutes.
- Review purposes with class participants.
- Sites with video capabilities — have the "Xcel Energy Company Hydroelectric Tunnel Fire" video ready to play.
- Facilitator has the option of using the PowerPoint presentation or the factsheets in the *Participant's Manual*.
- Sites with video capabilities — have the "Atmospheric Hazards Illustration" video ready to play.
- Sites with video capabilities — have the "Asphyxiation Tragedy" video ready to play.
- **Task 1 answers:**

1. Yes. The fact that there will be welding going on inside the pipe creates a hazard as well as the fact that the piece of pipe is lying in a 10-foot open trench.
2. Yes. The physical hazards of having to go down into the open trench (engulfment) include, slips, trips and falls, strains, deadly welding fumes, ultraviolet light, heat, as well as sparks (burns) from the welding task.
3. Possibly yes; depending on the type of soil that the pipe is lying in. You still have the possibility of engulfment when you are outside the confines of the pipe. If there is no possibility of engulfment, then it would not be considered a permit-required confined space but it would be considered a confined space.
4. Shoring or stepping back the trench, forced air ventilation, continuous air monitoring, proper PPE, buddy system, fire watch and proper equipment/tools.

- **Task 2 answers:**

1. Attendants, authorized entrants, entry supervisors and rescue team members.
2. Lack of training, procedures, proper equipment, production type atmospheres, inadequate or improper warning signage, inadequate hazard analysis, lack of continuous air monitoring and lack of communication.
3. Proper warning signage and barriers, proper hazard identification, enforcement of procedures, good work management techniques and good communication.

- **Activity 19: Permit-required Confined Spaces Review Questions**

1. What kind of hazards can permit-required confined spaces present? **Atmospheric, mechanical or physical hazards.**

2. What is the leading cause of death in a permit-required confined space? **Asphyxiation due to lack of oxygen.** What is the second leading cause of death? **Inhalation of toxic vapors**

3. When should permit-required confined spaces be monitored? **Before and during entry is essential.**

4. According to the OSHA Standard, what four groups of people are required to receive training?

   f. Workers entering permit-required confined spaces;

   g. Attendants;

   h. Entry supervisors; and

   i. Members of the rescue team.

5. What percent of all permit-required confined spaces fatalities are workers trying to rescue their coworkers? **Approximately 60 percent**

Activity 19: Trainer's Notes from the Permit-required Confined Spaces PowerPoint Presentation

Slide 2: Go over purposes with class participants.

Slide 3: After showing the video to the class participants, ask them to name some of the things that went wrong. No emergency action plan; improper hazard analysis; and inadequate or improper training.

Slide 4: Some examples of confined spaces include but are not limited to:

Storage tanks	Pressure vessels	Silos	Reaction vessels	Exhaust ducts
Compartments of ships and barges	Pits	Vats	Boilers	Sewers
Process vessels	Valve pits	Degreasers	Ventilation ducts	Tunnels
Underground utility vaults	Annealing furnaces	Recuperators	Gas mains	Chutes
Large pipelines	Q-BOP vessels	Check chambers	Hoppers	Dust and waste gas collection systems
Re-burning furnaces	BOP vessels	Skip pits	Bin	Waste water collection systems
Trenches	Construction trenches/small excavations	Ovens	Sump pits	Compartments within structures
Hot metal ladles	Storm drains	Blast furnace stoves	Blast furnace stacks	Blast furnace distributor hoppers
Elevator pits	Pump hose buildings/rooms where water flows into a trough and into a sewer system			

A confined space is not necessarily enclosed on all sides like a room or closet. It can be an open top pit, tank or vessel with no natural ventilation or draft. An example would be a Q-BOP vessel with a low-pressure leak pushing oxygen into the bottom. Since pure oxygen is slightly heavier than air, it would "layer" in the bottom of the vessel.

Slide 5: Non-Permit Required Confined Space (NPRCS): A confined space that does not contain or, with respect to atmospheric hazards have the potential to contain, any hazard capable of causing death or serious physical harm. (Note: When welding, cutting and burning in a NPRCS, the space shall be re-classified as a PRCS.)

Confined Spaces Determined Not to Be Entered: If the confined space is not to be entered as determined during the safety planning meeting or at another time, measures shall be taken to prevent employees from entering the confined space. The re-evaluation of the confined space shall be conducted.

Slide 6: Could it become a confined space? How?

Slide 7: Before transitioning to next slide have class participants make a list of confined space hazards. Record them on a flipchart.

Slide 8: Ask participants to give examples of each type of hazard.

Slide 9: Show "Atmospheric Hazards Illustration" video.

Slide 10: Both animal and plant life requires oxygen to live. One of the primary hazards of entering confined spaces is **oxygen deficiency.**

Oxygen (O_2) can also be present in concentrations that are too high. O_2 greater than 23.5 percent is too **oxygen rich** and can cause combustible materials to ignite very quickly.

Slide 11: Trenches, ravines and other excavations may also be considered confined spaces if there is a potential for accumulation of toxic gases, engulfment and/or the depletion of oxygen.

Slide 12: Classification and characterization of all confined spaces is required. Confined spaces are to be classified as non-permit confined spaces (NPCS) or permit-required confined spaces (PRCS).

Once a space has been classified as a PRCS, the following procedures shall be set in place prior to entry:

The PRCS is to be posted with a sign reading DANGER — PERMIT-REQUIRED CONFINED SPACE, DO NOT ENTER or using other similar language that would satisfy the requirement for a sign.

A written permit space program is required by the standard (this program has been developed to meet this requirement of the standard).

Slide 16: Ask the class who is required to be trained.

Slide 17: Entry Supervisor, Authorized Entrant, Attendant, Rescue Team.

continued

Activity 19: Trainer's Notes from the Permit-required Confined Spaces PowerPoint Presentation *(continued)*

Slide 18: Entry Supervisor is the person responsible for determining if acceptable entry conditions are present at a Permit-required Confined Space when and where entry is planned, for authorizing entry, overseeing entry operations and for terminating entry as required by this section.

Entry Supervisors shall be responsible for:

- Knowing the hazards that may be faced during entry, including information on the mode, signs or symptoms and consequences of the exposure;
- Verifying by checking that the appropriate entries have been made on the Confined Space Entry Permit, that all tests specified by the Confined Space Entry Permit have been conducted and all procedures and equipment specified by the Confined Space Entry Permit are in place before endorsing the Confined Space Entry Permit and allowing entry to begin;
- Ensuring that only trained personnel have been assigned to the entry team;
- Ensuring that Authorized Entrants and Attendants know their responsibilities;
- Terminating the entry and canceling the permit as required if a condition arises that is not in compliance with the entry permit;
- Verifying that rescue services are available and that the means for summoning them are operable;
- Removing unauthorized individuals who enter or attempt to enter the Permit-required Confined Space during entry operation; and
- Determining, whenever responsibility for Permit-required Confined Space entry operation is transferred and at intervals dictated by the hazards and operations performed within the space, that entry operations remain consistent with terms of the Confined Space Entry Permit and that acceptable entry conditions are maintained.

Slide 19: Authorized Entrant is an employee authorized to enter a Permit-required Confined Space. Authorized Entrants shall be responsible for:

- Knowing the hazards that may be faced during entry, including information on the mode, signs or symptoms and consequences of the exposure;
- Properly using equipment as required;

- Communicating with the Attendant, as necessary, to enable the Attendant to monitor entrant status and to enable the Attendant to alert entrants of the need to evacuate the space as required;
- You should review communications, the exit command word and any other one word control words;
- Alerting the Attendant whenever:
    - The Authorized Entrant recognizes any warning sign or symptom of exposure to a dangerous situation; or
    - The Authorized Entrant detects a condition prohibited by the entry permit.
- Exiting from the Permit-required Confined Space as quickly as possible whenever:
    - An order to evacuate is given by the Attendant or the Entry Supervisor;
    - The Authorized Entrant recognizes any warning sign or symptom of exposure to a dangerous situation;
    - The Authorized Entrant detects a prohibited condition; or
    - An evacuation alarm is activated.

Slide 21: An attendant is an individual stationed outside a Permit-required Confined Space who monitors the Authorized Entrants and who performs all Attendant duties assigned in the Confined Space Entry procedure. Attendants shall be responsible for:

- Knowing the hazards that may be faced during entry, including information on the mode, signs or symptoms and consequences of the exposure;
- Being aware of possible behavioral effects of hazard exposure to Authorized Entrants;
- Continuously maintaining an accurate count of Authorized Entrants in the Permit-required Confined Space and ensuring that the means used to identify Authorized Entrants does accurately identify those in the Permit-required Confined Space;
- Under no circumstances is the attendant to leave the Permit-required Confined Space until relieved by another qualified attendant and by Entry Supervisor's approval;

continued

Activity 19: Trainer's Notes from the Permit-required Confined Spaces PowerPoint Presentation *(continued)*

- Effective and continuous communicating with Authorized Entrants, as necessary, to monitor entrant status and to alert entrants of the need to evacuate the space;
- Monitoring activities inside and outside the Permit-required Confined Space to determine if it is safe for entrants to remain in the space and ordering the Authorized Entrants to evacuate the Permit-required Confined Space immediately under any of the following conditions:
  - If the Attendant detects a condition prohibited by the entry permit;
  - If the Attendant detects the behavioral effects of hazard exposure to an Authorized Entrant;
  - If the Attendant detects a situation outside the space that could endanger the Authorized Entrants;
  - If the Attendant loses communication with any unauthorized entrants; and
  - If the Attendant cannot effectively and safely perform all the duties required.
- Performing no duties that might interfere with the Attendant's primary duty to monitor and protect the Authorized Entrants;
- Summoning rescue and other emergency services as soon as the Attendant determines that Authorized Entrants may need assistance to escape from Permit-required Confined Space hazards;
- Taking the following actions when unauthorized persons approach or enter a Permit-required Confined Space while entry is underway:
  - Warning the unauthorized person that they are to stay away from the Permit-required Confined Space;
  - Advising the unauthorized persons that they are to exit immediately if they have entered the Permit-Required Confined Space; and
  - Informing the Authorized Entrants and the Entry Supervisor if an unauthorized person has entered the Permit-required Confined Space.

Slide 22: Here are some of OSHA's minimum requirements:

- Prohibit untrained coworkers from attempting rescues;
- Require companies to have in-house or outside rescue teams;

- Employers must ensure that rescue teams practice simulated rescues once every 12 months; and
- Outside rescue teams must be made aware of the hazards they may confront.

- **Slide 23: Who is required to pay for the training and PPE? The employer.**

Slide 24: What does adequately trained mean? Certification in First Aid and CPR. What does near proximity mean? Three to four minute response time.

Slide 29: Use class discussion for review questions.

Activity 20: Non-chemical Hazards

- This Activity should take about 60 minutes.
- Review purpose with class participants.
- Facilitator has the option of using the PowerPoint presentation or the factsheets in the *Participant's Workbook.*
- **Task 1 answers:**

Biological Hazards	Precautions/Measures
1. Poisonous plants	**Herbicides, PPE**
2. Snakes, wildlife	**Awareness, PPE**
3. Insects, mosquitoes	**Insecticides, repellants, PPE**
4. Rodents	**Awareness, PPE**
5. Poor air quality, mold	**Ventilation, PPE**
6. Histoplasmosis (bird/bat droppings)	**Ventilation, PPE**

- Sites with video capabilities — Have "OSHA Prevention" video ready to play.
- **Task 2 answers:**

1. No; elevated work, jackhammering, concrete dust, electrical, heavy equipment, excavation, welding and cutting operations, lockout/tagout (LO/TO) operations, sanitation, hand and portable powered tools, walking working surfaces and ergonomics.

2.

Hazards	How Could You Eliminate the Hazards?
1. Electrical	**Use air and cordless tools.**
2. Dust	**Use water to remove dust.**

3.

Hazard	How Could You Mitigate the Hazard?
1. Heavy equipment	**Use barriers, traffic controls, flaggers.**
2. Concrete removal	**Use heavy equipment instead of jackhammer.**

- **Activity 20: Non-chemical Hazards Review Questions**

1. What types of hazards are considered the most common hazards at a worksite? **Non-chemical hazards.**

2. What do biological hazards have the potential to cause? **Various types of diseases.**

3. What illnesses can be caused by heat related temperature extremes? **Heat rashes, heat cramps, heat exhaustion and heat stroke** What illnesses can be caused by cold related temperature extremes? **Frostbite, trench foot, musculoskeletal complaints and impaired abilities**

4. Electrical shock is a real hazard. What should be done before starting work? **Be sure all circuits and electrical parts are de-energized**

5. _____ are among the most common causes of serious work related injuries and deaths. **Falls**

continued

Activity 20: Non-chemical Hazards *(continued)*

6. What are some hazards associated with excavations and trenches? **Cave-ins, falls, falling loads, hazardous atmospheres and incidents involving mobile equipment**

- Give the class a 10-minute break after this Activity.

Notes: _____

Activity 20: Trainer's Notes from the Non-chemical Hazards PowerPoint Presentation

Slide 2: Go over purpose with class participants.

Slide 4: Bloodborne Pathogens are pathogenic microorganisms that are present in human blood and can cause disease in humans.

Diseases include malaria, syphilis, Hepatitis B, Hepatitis C and Human Immuno-deficiency Virus (HIV).

All workers who could be "reasonably anticipated" to face contact with blood and/or other potentially infectious materials as a result of performing their job duties.

"Good Samaritan" acts, such as assisting a coworker with a nosebleed, would not be considered (by the Standard) as occupational exposure.

Slide 5: Employers are required to:

- Establish an exposure control plan to eliminate or minimize occupational exposures. This plan must be updated annually.
- Implement the use of Universal Precautions (treating all human blood and other potentially infectious materials (OPIM) as if known to be infectious for blood-borne pathogens.
- Identify and use engineering controls. These are devices that isolate or remove the bloodborne pathogens hazard from the workplace. They include sharps disposal containers and self-sheathing needles.
- Identify and ensure the use of work practice controls, such as appropriate practices for handling and disposing of contaminated sharps, handling specimens, handling laundry and cleaning contaminated surfaces and items.
- Provide personal protective equipment (PPE), such as gloves, gowns, eye protection and masks.
- Make available hepatitis B vaccinations to all workers with occupational exposure at no cost to the worker.
- Make available post-exposure evaluation and follow-up to any occupationally exposed worker who experiences an exposure incident.
- Use labels and signs to communicate hazards.
- Provide information and training to workers.

continued

Activity 20: Trainer's Notes from the Non-chemical Hazards PowerPoint Presentation *(continued)*

- Maintain worker medical and training records.
  (Source: https://www.osha.gov/OshDoc/data_BloodborneFacts/bbfact01.pdf.)

Slide 6: Signs or symptoms include:

- Red rash within a few days of contact;
- Possible bumps, patches, streaking or blisters;
- Swelling; and
- Itching.

Treatment of poison ivy, oak and sumac is all about comfort. You want to relieve the itching and inflammation:

- Cold compresses on the rash for 15 to 20 minutes, several times per day.
- Use calamine lotion, topical antihistamine or hydrocortisone cream to reduce itching.
- Your doctor may suggest taking oral antihistamines, such as Benedryl (diphenhydramine), to reduce itching.
- Call 911 if you have any trouble breathing. This is especially true if you inhale smoke from burning poison ivy.
- Call the doctor if the rash is on or around your eyes, covers a large part of your body or seems to be infected (fever, swelling or oozing).

Slide 8: Venomous spiders found in the United States include the black widow, brown recluse and hobo spiders. They can be dangerous to outdoor workers including farmers, foresters, landscapers, groundskeepers, gardeners, painters, roofers, pavers, construction workers, laborers, mechanics and any other worker who spends time outside.

Ask class participants to identify spiders. As they answer, transition in the correct answer under each pic.

Slide 9: Read instructions for tick removal to class participants.

Slide 10: Top left: Fire ant (stings and bites).

Top center: Wasp (stings).

Top right: Centipede.

Bottom left: Scorpion.

Bottom center: Hornet (stings).

Bottom right: Yellow jacket (stings).

Slide 11: NOTE: BEFORE TRANSITIONING TO SNAKE BITE PICS, NOTIFY CLASS PARTICIPANTS OF THE GRAPHIC CONTENT.

Venomous snakes found in the United States include rattlesnakes, copperheads, cottonmouths/water moccasins and coral snakes. They can be dangerous to workers who spend time outside. Although rare, some workers with a severe allergy to snake venom may be at risk of death if bitten. It has been estimated that 7,000 to 8,000 people per year receive venomous bites in the United States and about five of those people die. The number of deaths would be much higher if people did not seek medical care. It is important for employers to train their workers about their risk of exposure to venomous snakes; how they can prevent and protect themselves from snake bites; and what they should do if they are bitten.

What is another name for a water moccasin? Cottonmouth

Snake bite story:

"On July 21, 2002, just after my 13th birthday, I was bitten by a Northern Pacific rattlesnake (the snake was originally identified as a Western Diamondback rattle-snake, but that species is not found near Yosemite). I was on a trail in a hiking area near Yosemite National Park, California. The bite occurred while I was sitting on a small boulder at a distance of 4.5 miles from the trailhead with my cabin group at camp. I had my arms dangling at my side and a 5-foot long rattlesnake bit me in the middle of my left palm.

From this point, an amazing rescue took place, taking 4 hours to transport me the 4.5 miles to the trailhead. The camp director had previously called the hospital and a helicopter was waiting at the trailhead. During the 30 minute helicopter ride, I was going in and out of consciousness and having trouble keeping my eyes open. We arrived at the Modesto, California hospital, where the doctor in the emergency room decided that my case was too severe to treat at that medical center. He told me this, which was the last thing I heard before going unconscious." **Note: Emphasize how quickly the snake's venom caused the individual to lose consciousness.**

continued

Activity 20: Trainer's Notes from the Non-chemical Hazards PowerPoint Presentation *(continued)*

The individual was taken from the Modesto hospital to the UC Davis Medical Center in Sacramento, which was the trauma center for Northern California. Over a 20-month period, the individual's ordeal included 30 vials of anti-venom, 13 surgeries and numerous long term hospital stays.
(Sources: http://www.cdc.gov/niosh/topics/snakes/ and http://www.rattlesnakebite.org/rattlesnakepics.htm.)

Slide 13: Note: Wildlife can also cause accidents when they cross roads or physically attack people.

Slide 14: Sources: http://www.mayoclinic.org/diseases-conditions/histoplasmosis/basics/definition/con-20026585, http://www.life-worldwide.org/assets/uploads/images/histoplasmosis-disseminated-lesions.png.

Slide 17: First aid for heat rashes:

- Try to work in a cooler, less humid environment when possible.
- Keep the affected area dry.

First aid for heat cramps:

- Have worker rest in shady, cool area.
- Worker should drink water or other cool beverages.
- Wait a few hours before allowing worker to return to strenuous work.
- Have worker seek medical attention if cramps don't go away.
  (Source: https://www.osha.gov/SLTC/heatstress/index.html.)

Slide 18: First aid for heat exhaustion:

- Have worker sit or lie down in a cool, shady area.
- Give worker plenty of water or other cool beverages to drink.
- Cool worker with cold compresses/ice packs.
- Take to clinic or emergency room for medical evaluation or treatment if signs or symptoms worsen or do not improve within 60 minutes.
- Do not return to work that day.

First aid for heat stroke:

- Call 911.

While waiting for help:

- Place worker in shady, cool area.
- Loosen clothing; remove outer clothing.
- Fan air on worker; cold packs in armpits.
- Wet worker with cool water; apply ice packs, cool compresses or ice if available.
- Provide fluids (preferably water) as soon as possible.
- Stay with worker until help arrives.
  (Source: https://www.osha.gov/SLTC/heatstress/index.html.)

Slide 19: As the humidity rises so does the level of heat stress. Give an example using the chart.

Other factors include:

- Air movement;
- Radiant heat sources;
- Level of clothing and protective equipment;
- Physical exertion;
- Contact with hot objects;
- Direct exposure to sunlight; and
- Personal factors such as age, heath, medications, etc.
  (Source: https://www.osha.gov/SLTC/heatstress/index.html.)

Slide 20: As you transition in each prevention technique, ask the class participants to give examples of each.

- **Engineering controls** such as air conditioning, ventilation and misters; and
- **Administrative controls** such as:
  - Work/rest cycles;
  - Drinking water often;
  - Providing an opportunity for workers to build up a level of tolerance to working in the heat; and

continued

Activity 20: Trainer's Notes from the Non-chemical Hazards PowerPoint Presentation *(continued)*

- Training, which should include how to know and look out for the ***symptoms*** of heat-related illness in yourself and others during hot weather and an emergency action plan, acclimatization and water and restroom breaks.

The WGBT (Wet Globe Bulb Temperature) is different than a dry temperature reading because it combines air temperature, air movement, humidity and the effect of radiant heat. This is a useful number because there are actual work/rest cycles that have been developed based on these numbers. If radiant heat is not a factor (in other words if the work is done indoors and there are no glowing furnaces or molten metals or molten glass) then the heat index is often used. The heat index is not the same as the WBGT because it does not include radiant heat or the effect of air movement — it is just a combination of the air temperature and the humidity.

The Personal or Location Temp & Humidity Data Logger measures temperature and humidity. It is designed to be worn by an individual, and it records conditions throughout the work shift. The information can then be downloaded onto a computer and the temperature and humidity numbers can be combined to give the heat index. (Source: https://www.osha.gov/dte/grant_materials/fy10/sh-20867-10/extreme_ temperatures.pptx.)

Slide 22: Review chart with class participants.

Slide 23: Engineering controls include:

- Minimize air velocity;
- Use wind deflectors and barriers;
- Insulate metal handles and bars; and
- Functioning exit apparatus on inside doors.

Administrative controls include:

- Training;
- Adequate breaks;
- Buddy System; and
- PPE — PPE design.

Even though air movement inside the workplace usually does not reach speeds that can be used in wind chill calculations, air movement has an effect on worker comfort and safety.

Anemometers help identify patterns of air movement.

Temperature and humidity data loggers might be useful in workplaces where the cold is not the result of carefully regulated conditions.
(Source: https://www.osha.gov/dte/grant_materials/fy10/sh-20867-10/extreme_ temperatures.pptx.)

Slide 26: Cave-ins pose the greatest risk and are much more likely than other excavation-related accidents to result in worker fatalities. Other potential hazards include falls, falling loads, hazardous atmospheres and incidents involving mobile equipment. One cubic yard of soil can weigh as much as a car. An unprotected trench is an early grave. **Do not enter an unprotected trench.**

Slide 28: OSHA standards require safe access and egress to all excavations, including ladders, steps, ramps or other safe means of exit for employees working in trench excavations four feet (1.22 meters) or deeper. These devices must be located within 25 feet (7.6 meters) of all workers.

OSHA standards require that employers inspect trenches daily and as conditions change by a competent person before worker entry to ensure elimination of excavation hazards. A competent person is an individual who is capable of identifying existing and predictable hazards or working conditions that are hazardous, unsanitary or dangerous to workers, soil types and protective systems required, and who is authorized to take prompt corrective measures to eliminate these hazards and conditions.

Slide 29: Sites with video capabilities, show the "OSHA Trenching Prevention" video.

Slide 30: General Trenching and Excavation Rules:

- Keep heavy equipment away from trench edges.
- Identify other sources that might affect trench stability.
- Keep excavated soil (spoils) and other materials at least two feet (0.6 meters) from trench edges.
- Know where underground utilities are located before digging.
- Test for atmospheric hazards such as low oxygen, hazardous fumes and toxic gases when > four-feet deep.
- Inspect trenches at the start of each shift.
- Inspect trenches following a rainstorm or other water intrusion.

continued

Activity 20: Trainer's Notes from the Non-chemical Hazards PowerPoint Presentation *(continued)*

- Do not work under suspended or raised loads and materials.
- Inspect trenches after any occurrence that could have changed conditions in the trench.
- Ensure that personnel wear high-visibility or other suitable clothing when exposed to vehicular traffic.

Slide 31: Hazards include:

- Traffic controls in and near work zones;
- General heavy equipment operation (applicable to all heavy equipment);
- Forklift and powered industrial truck (PIT) operations;
- Material falling from vehicles;
- Silica, nuisance dust, dried mud or silt;
- Noise;
- Fueling;
- Discovery of unknown chemicals; and
- Other potential hazards.

Traffic controls in and near work zones

- Develop and use a site plan that provides traffic flow details.
- Use flaggers, traffic cones and/or highway channeling devices to steer traffic away from response and recovery workers along the roadway. Use flaggers, standard road signs (e.g., "work zone ahead") or message boards to warn approaching vehicles of work area.
- Give motorists plenty of warning of upcoming work zones.
- Ensure that the work zone is well lit.
- Develop and use a site plan that provides traffic flow details.
- Limit access, barricade or set up controlled access zones where the equipment will be used.

- Establish/follow traffic control patterns (e.g., cones, barrels, barricades) in work areas.
- Use spotters where visibility is limited.
- Do not drive in reverse gear with an obstructed rear view unless the vehicle has an audible alarm or a signaler is used.
- Ensure that spotters and heavy equipment operators have communications equipment or agree on and use hand signals.
- Response and recovery workers and other pedestrians should make eye contact with heavy equipment operators before proceeding near equipment or operating areas.
- Train response and recovery workers not to position themselves between mechanical equipment and a fixed object.
- Provide barricades around excavations and structures such as debris reduction observation towers.

Forklift and powered industrial truck (PIT) operations:

- All vehicles must have:
  - A service brake system, an emergency brake system and a parking brake system;
  - Working headlights, tail lights and brake lights;
  - An audible warning device (horn); and
  - Intact windshield with working windshield wipers.
- Ensure that all operators have been trained on the equipment they will use.
- Check vehicles at the beginning of each shift to ensure that the parts, equipment and accessories are in safe operating condition. Repair or replace any defective parts or equipment prior to use.
- Do not operate vehicle in reverse with an obstructed rear view unless it has a reverse signal alarm capable of being heard above ambient noise levels or a signal observer indicates that it is safe to move.
- Vehicles loaded from the top (e.g., dump trucks) must have cab shields or canopies to protect the operator while loading.
- Ensure that vehicles used to transport workers have seats, with operable seat belts, firmly secured and adequate for the number of workers to be carried.

continued

Activity 20: Trainer's Notes from the Non-chemical Hazards PowerPoint Presentation *(continued)*

- Equipment should have rollover protection and protection from falling debris hazards as needed.
- Prior to permitting construction equipment or vehicles onto an access roadway or grade, verify that the roadway or grade is constructed and maintained to safely accommodate the equipment and vehicles involved.
- Do not modify the equipment's capacity or safety features without the manufacturer's written approval.
- Where possible, do not allow debris collection work or other operations involving heavy equipment under overhead lines.

FORKLIFT AND POWERED INDUSTRIAL TRUCK (PIT) OPERATIONS

- Only handle loads within the rated capacity of the truck.
  - Use rough-terrain trucks where conditions warrant their use.
  - Carry loads low.
  - When necessary, travel in reverse so the driver/operator has a clear view of the path of travel.
  - Ascend or descend grades slowly. When ascending or descending grades in excess of 10 percent, loaded trucks should be driven with the load positioned upgrade.
  - Ensure that forklifts/PITs are not modified without the written approval of the manufacturer.
  - When left unattended, ensure that the load-engaging means are fully lowered, controls are neutralized, power is shut off and brakes are set.

MATERIAL FALLING FROM VEHICLES

- Do not overload vehicles.
- Ensure that loads are balanced and are fully contained within the vehicle. Trim loads where necessary to ensure loads do not extend beyond the sides or top of the vehicle.
- Cover and secure loads before moving the vehicle.
  (Source: https://www.osha.gov/SLTC/etools/hurricane/heavy-equip.html#ad.)
- **Slide 32:** Pic reference: http://www.theemployerhandbook.com/bridge.jpg.

Slide 33: OSHA requires that fall protection be provided at elevations of four feet in general industry workplaces and six feet for construction industry workplaces and that fall protection be provided when working over dangerous equipment and machinery, regardless of the fall distance.

To prevent employees from being injured from falls, employers must:

- Guard every floor hole into which a worker can accidentally walk (using a railing and toeboard or a floor hole cover).
- Provide a guard rail and toe-board around every elevated open sided platform, floor or runway.
- Regardless of height, if a worker can fall into or onto dangerous machines or equipment (such as a vat of acid or a conveyor belt) employers must provide guardrails and toe-boards to prevent workers from falling and getting injured.
- Other means of fall protection that may be required on certain jobs include safety harness and line, safety nets, stair railings and hand rails.

Note: What's this? It is a safety net covering a sky light.
(Source: https://www.osha.gov/SLTC/fallprotection/.)

Slide 34: Four main types of electrical injuries: Shock, falls, burns and electrocution.

An average of one worker is electrocuted on the job every day.

Electrical shock is received when current passes through the body. Severity depends on path of current, amount of current and length of time body is in circuit.

Electrical burns are the most common shock-related non-fatal injury; usually occurs on the hands; is considered a serious injury; and can cause internal damage.

Falls occur when workers in elevated locations experience a shock and fall, resulting in serious injury or death.

Electrocution is death caused by electrical shock.

Slide 35: Sites with video capabilities, show the "Worker on Scissor Lift Electrocuted" video.

Slide 36: Even normal use of electrical equipment causes wear and tear that results in insulation breaks, short-circuits and exposed wires. If there is no ground-fault protection, it can cause a ground-fault that sends current through the worker's body.

continued

Activity 20: Trainer's Notes from the Non-chemical Hazards PowerPoint Presentation *(continued)*

Safeguards include double insulated tools, GFCIs and inspection of tools.

Extension Cords

Normal wear on cords can loosen or expose wires. Cords that are not 3-wire type, not designed for hard-usage or that have been modified, increase your risk of contacting electrical current:

- Use only equipment that is approved to meet OSHA standards.
- Do not modify cords or use them incorrectly.
- Use factory-assembled cord sets and only extension cords that are 3-wire type.
- Use only cords, connection devices and fittings that are equipped with strain relief.
- Remove cords from receptacles by pulling on the plugs, not the cords.

Slide 37: Other hazards include:

- Fires and explosions — Fires and explosions kill more than 200 and injure more than 5,000 workers each year.
- Welding and cutting operations.
- Hazards associated with truck pic include radiological, slips, trips and falls, motor vehicles and forklifts.
- Other hazards not mentioned yet include lockout/tagout (LO/TO) operations, sanitation, hand and portable powered tools, walking working surfaces and ergonomics.

Slides 39 and 40: Use class discussion for review questions.

Activity 21: Ergonomics Fundamentals. . . An Overview (Optional)

- This Activity should take about 35 minutes.
- Review purposes with class participants.
- Facilitator has the option of using the PowerPoint presentation or the factsheets in the *Participant's Manual*.
- **Task 1 answers:**

  1. Answers will vary with class participants.

  2. Answers will vary with class participants.

- **Task 2 answers:**

  1. Answers will vary with class participants.

  2. Answers will vary with class participants.

- **Activity 21: Ergonomics Fundamentals . . . An Overview Review Questions**

1. What is considered the science used to design workstations, equipment, processes and job activities to achieve the optimum interaction between the worker and their work environment? **Ergonomics**
2. What are some symptoms of musculoskeletal disorders (MSDs)? **Pain, numbness, tingling, swelling and limitation of motion**
3. What are some causes of MSDs? **Force, repetition, posture, vibration, temperature and contact stress**
4. What tool can be used to identify patterns of occupational diseases and injuries among workers? **Body mapping**

- Give the class a 10-minute break after this Activity.

Notes: _____

_____

_____

_____

Activity 21: Trainer's Notes from the Ergonomics Fundamentals. . . An Overview PowerPoint Presentation

Slide 2: Go over purposes with class participants.

Slide 7: Transition in the first pic and ask class if the man is working at a neutral posture. After they have had time to respond, transition in the second pic which shows the man using a neutral posture position.

Slide 8: Working from the power/comfort/handshake zone ensures that you are working from proper heights and reaches, which reduces MSD risk factors and allows for more efficient and pain-free work.

Slide 9: Stretching reduces fatigue, improves muscular balance and posture and improves muscle coordination. Everyone is an athlete in life, so you need to prepare your body for work by warming up to improve performance and lower injury risk. A warm-up stretching regimen is a great way to prepare your body for work.

It is also beneficial to take periodic stretch breaks over the course of your work day to get your blood moving and restore your energy.

Slide 10: After class participants have had an opportunity to answer the question, transition in the pics.

Eliminating excessive force requirements will reduce worker fatigue and the risk of MSD formation in most workers. Using mechanical assists, counter balance systems, adjustable height lift tables and workstations, powered equipment and ergonomic tools will reduce work effort and muscle exertions.

Slide 12: Some examples of contact stress include:

- Resting wrists on the edge of a desk or workstation while performing tasks;
- Tasks that require hand hammering; and
- Sitting without adequate space for the knees.

Slide 13: Hand-arm vibration can cause a range of conditions collectively known as hand-arm vibration syndrome (HAVS), as well as specific diseases such as white finger or Raynaud's syndrome, carpel tunnel syndrome and tendinitis. Vibration syndrome has adverse circulatory and neural effects in the fingers. The signs and symptoms include numbness, pain and blanching (turning pale and ashen).

Slide 14: Transition in pics after reading statement.

Dimly lit work areas and glare can cause eye fatigue and headaches and improperly lit areas put workers at greater risk for all types of injuries.

Providing workers with adjustable task lighting is often a simple solution to lighting problems. Take steps to control screen glare at computer work stations, and make sure that the monitor is not placed in front of a window or a bright background.

Slide 16: Ask the class participants to name MSDs.

Slide 17: Ask the class participants to name some causes of MSDs.

Slide 27: To reduce the chance of injury, work tasks should be designed to limit exposure to ergonomic risk factors. Wherever possible, engineering controls are the most desirable. Administrative or work practice controls may be appropriate in some cases where engineering controls cannot be implemented or when different procedures are needed after implementation of the new engineering controls. Personal protection solutions have only limited effectiveness when dealing with ergonomic hazards.

How do these controls work?

- Engineering Controls (implement physical change to the workplace, which eliminates/reduces the hazard on the job/task).
- Administrative and Work Practice Controls (establish efficient processes or procedures).
- Personal Protective Equipment (use protection to reduce exposure to ergonomics-related risk factors).

Slides 32 and 33: Use class discussion for review questions.

Activity 22: Decontamination

- This Activity should take about 50 minutes.
- Review purposes with class participants.
- Facilitator has the option of using the PowerPoint presentation or the factsheets in the *Participant's Manual*.
- **Task 1 answers:**

1.

- If the chemical is allowed to come into contact with moisture, water or acids will cause toxic phosphine gases. Note: Pure phosphine gas is odorless.
- Potential health hazards:
  - Mild inhalation exposure causes malaise (indefinite feeling of sickness), ringing of ears, fatigue, nausea and pressure in the chest, which is relieved by removal to fresh air.
  - Moderate poisoning causes weakness, vomiting, pain just above the stomach, chest pain, diarrhea and dyspnea (difficulty in breathing).
  - Symptoms of severe poisoning may occur within a few hours to several days, resulting in pulmonary edema (fluid in lungs) and may lead to dizziness, cyanosis (blue or purple skin color), unconsciousness and death.
  - In sufficient quantity, phosphine affects the liver, kidneys, lungs, nervous system and circulatory system.
  - Inhalation can cause lung edema (fluid in lungs) and hyperemia (excess of blood in a body part), small perivascular brain hemorrhages and brain edema (fluid in brain).
  - Ingestion can cause lung and brain symptoms but damage to the viscera (body cavity organs) is more common.
  - Phosphine poisoning may result in (1) pulmonary edema; (2) liver elevated serum GOT; LDH and alkaline phosphatase; reduced prothrombin; hemorrhage and jaundice (yellow skin color); and (3) kidney hematuria (blood in urine) and anuria (abnormal or lack of urination).
  - Pathology is characteristic of hypoxia (oxygen deficiency in body tissue).
  - Frequent exposure to concentrations above permissible levels over a period of days or weeks may cause poisoning.
  - Treatment is symptomatic.

- Piling of fragmentation dust from tablets can create heat (ignition source).
- A spill, other than incidental to application or normal handling, may produce high levels of phosphine gas and, therefore, attending personnel must wear self-contained breathing apparatus (SCBA) or its equivalent when the concentration of phosphine gas is unknown.
- Other NIOSH/MSHA approved respiratory protection may be worn if the concentration of phosphine gas is known.
- Do not use water at any time to clean up a spill of FUMITOXIN®.
- Water in contact with unreacted FUMITOXIN® will greatly accelerate the production of phosphine gas, which could result in a toxic and/or fire hazard.
- Wear gloves of cotton or other material when handling aluminum phosphide.
- Return all intact aluminum flasks to cardboard case or other suitable packaging which has been properly marked according to DOT regulations.
- Was the proper PPE (including respiratory protection) being provided for the amount of chemical that had been spilled onto the ground?
- The fact that the soiled clothing was worn to the locker room and then removed and placed in an open garbage can in the same room.
- The locker room and the shower area were in the same area/building.
- The adequacy of the decontamination process.

2. Set up decontamination lines outside in an open area and place soiled clothing in closed containers for proper disposal. Verify that the proper PPE (including respiratory protection) is being used based on the amount of contaminant.

- **Task 2 answers:**

1. Diagram should include:
    - o All three zones and distances;
    - o Wind direction;
    - o Emergency response provisions;
    - o Steps taken in each zone; and
    - o Command post.

continued

Activity 22: Decontamination *(continued)*

2. Use decontamination methods that do not require water. Use special disposal methods that would minimize exposure to moisture. Also must consider the fact that the chemical has the potential to produce heat and become an ignition source.

3. Level A or B (respiratory protection) because of the potential for the chemical to produce phosphine gas if exposed to moisture.

- Sites with video capabilities, show the "Loony Safety Donning Doffing" video. **Ask the class to look for thing that might be wrong when viewing the video.**
- **After the class participants have had the opportunity to view the video, ask them to name some things they saw wrong with the decontamination process example in the video.**
    - o Decon person was not wearing a respirator or rubber booties.
    - o Decon person did not do thorough decon.
    - o The worker placed the protective clothing and respirator in trash dispenser.
    - o When he stepped off the second pool he was still in the decon area.
    - o When he was finished doffing, he did not step into the clean area.
- **Activity 22: Decontamination Review Questions**

1. What is the removing and/or neutralizing of chemical and/or radiological material which has accumulated on the worker, protective clothing, equipment and/or tools called? **Decontamination**

2. What three zones should be established during hazardous waste activities? **The Hot Zone, the Warm Zone and the Cold Zone.**

3. Anyone who goes into the Hot Zone must go through what? **The decontamination station.**

4. To what level should workers who work on the decontamination line be protected below? **No more than one level of protection**

5. Why is it just as important to decontaminate the equipment, tools and PPE as it is to decontaminate people? **Because they can become a major source of contamination**

- Give the class a 10-minute break after this Activity.

Activity 22: Trainer's Notes from the Decontamination PowerPoint Presentation

Slide 2: Go over purposes with class participants.

Slide 3: Contamination is any hazardous material that has escaped normal containment and can be moved from one location to another.

Contamination can be in the form of:

- A gas (such as uranium hexafluoride);
- A liquid (such as PCBs); or
- A solid (such as asbestos or plutonium dusts).

Decontamination is the process of removing or neutralizing contaminants that have accumulated on personnel and equipment. Decontamination protects workers from hazardous substances that may contaminate and eventually permeate the protective clothing, respiratory equipment, tools, vehicles and other equipment used on site.

It protects all site personnel by:

- Minimizing the transfer of harmful materials into clean areas;
- It helps prevent mixing of incompatible chemicals; and
- It protects the community by preventing uncontrolled transportation of contaminants from the site.

Slide 5: The decontamination plan should:

- Determine the number and layout of decontamination stations.
- Determine the decontamination equipment needed.
- Determine appropriate decontamination methods.
- Establish procedures to prevent contamination of clean areas.
- Establish methods and procedures to minimize worker contact with contaminants during removal of personal protective clothing and equipment (PPE).
- Establish methods for disposing of clothing and equipment that are not completely decontaminated.
- The plan should be revised whenever the type of personal protective clothing or equipment changes, the site conditions change or the site hazards are reassessed based on new information.

continued

Activity 22: Trainer's Notes from the Decontamination PowerPoint Presentation *(continued)*

Slide 6: The first step in decontamination is to establish procedures that minimize contact with waste and thus the potential for contamination. For example:

- Stress work practices that minimize contact with hazardous substances.
- Use remote sampling, handling, and container-opening techniques (e.g., drum grapplers, pneumatic impact wrenches).
- Protect monitoring and sampling instruments by bagging them.
- Wear disposable outer garments and use disposable equipment where appropriate.
- Cover equipment and tools with a strippable coating which can be removed during decontamination.
- Encase the source of contaminants (e.g., with plastic sheeting or overpacks).

Standard Operating Procedures should be established that maximize worker protection. These procedures should include:

- PPE should be checked prior to use to ensure that it contains no cuts or punctures that could expose workers to wastes.
- Dressing should be prior to entering the Exclusion Zone which will minimize the potential for contaminants to bypass the protective clothing and escape decontamination.
- Make sure all fasteners are used (i.e., zippers fully closed, all buttons used, all snaps closed, etc.).
- Gloves and boots should be tucked under the sleeves and legs of outer clothing, and hoods (if not attached) should be worn outside the collar.
- All junctures should be taped to prevent contaminants from running inside the gloves, boots, and jackets (or suits, if one-piece construction).
- Workers with injuries to the skin surface, such as cuts and scratches and large areas of damaged skin should be kept from working on site until the skin heals.

All personnel should be trained in the Standard Operating Procedures for minimizing contact and maximizing worker protection, and these procedures should be enforced throughout site operations.

Slide 7: Surface contaminants may be easy to detect and remove; however, contaminants that have permeated a material are difficult or impossible to detect and remove. If contaminants that have permeated a material are not removed by decontamination, they may continue to permeate to the surface of the material where they can cause an unexpected exposure.

Five major factors affect the extent of permeation:

- **Contact time.** The longer a contaminant is in contact with an object, the greater the probability and extent of permeation.
- **Concentration.** Molecules flow from areas of high concentration to areas of low concentration. As concentrations of wastes increase, the potential for permeation of personal protective clothing increases.
- **Temperature.** An increase in temperature generally increases the permeation rate of contaminants.
- **Size of contaminant molecules and pore space.** Permeation increases as the contaminant molecule becomes smaller and as the pore space of the material to be permeated increases.
- **Physical state of wastes.** As a rule, gases, vapors and low-viscosity liquids tend to permeate more readily than high-viscosity liquids or solids.

Slide 8: Refer to Factsheet 6 for description of what each level of PPE involves. Level A — Maximum protection (skin and respiratory).

Slide 9: Illustration shows the three different work zones:

- Zone 1 — Hot, Dirty, Exclusion (actual work is done in this zone).
- Zone 2 — Warm, Decontamination, Contamination Reduction (decon line is set up in this zone). Note: Level of PPE cannot go down a minimum of one level from Zone 1 to Zone 2.
- Zone 3 — Cold, Clean, Support.

Slide 10: Illustration shows a cleanup site with a decontamination line set up in the blue area.

Practical aspects of the job which should be considered include:

- A Contamination Reduction Zone (Decon Zone) from 10 to 25 feet is common.

continued

Activity 22: Trainer's Notes from the Decontamination PowerPoint Presentation *(continued)*

- The size of the work zones are not based on evacuation distances (i.e., DOT *ERG*).
- The support trailer is usually established upwind from the Hot Zone within the Support Zone (Cold Zone).
- The personnel decon line is usually established upwind from the Hot Zone within the Contamination Reduction Zone (Warm Zone).
- It is important to consider changes in prevailing winds.
- The Support Zone should be large enough for all of the support equipment.
- Remote sites will require extensive support equipment; such as labs, generators for power, drinking water and decon water, etc.
- There are inherent logistical problems with the use of airlines and SCBAs.
- Airlines limit distance and SCBAs limit time.

Slide 12: These include removal of physical and chemical contamination. It also includes equipment and emergency decontamination methods.

Slide 13: Safe removal of contamination.

Slide 14: Give students a chance to answer the question, then give the two common removal methods. Decon equipment should be specified in the HASP so let students know that they should refer to this document when in doubt.

Under 1910.120(k)(4), all equipment and solvents used for decontamination shall be decontaminated or disposed of properly.

All workers, clothing, equipment and samples leaving contaminated areas must be decontaminated by:

- Physical removal;
- Chemical removal; or
- Combination of both methods.

Issues with high-pressure washers: These devices may indeed remove contamination from an object, but they are very dangerous! They should not be used on personnel. They should be used sparingly on heavy equipment as it is likely to cause overspray and may embed contaminants into surfaces.

Physical removal includes methods such as scraping, brushing, wiping, rinsing or evaporation.

Chemical removal includes use of water and detergent, water and bleach or specific decon agent.

Contaminants that can be removed by physical means can be categorized as follows:

- Loose contaminants include dusts and vapors that cling to equipment and workers or become trapped in small openings, such as the weave of the clothing fabrics, can be removed with water or a liquid rinse. Physical removal methods for gross contaminants also include scraping, brushing and wiping.
- Some contaminants adhere by forces other than electrostatic attraction. Adhesive qualities vary greatly with the specific contaminants and the temperature. Removal of adhesive contaminants can be enhanced through certain methods such as solidifying, freezing (e.g., using dry ice or ice water), adsorption or absorption (e.g., with powdered lime or kitty litter) or melting.
- Volatile liquid contaminants can be removed from protective clothing or equipment by evaporation followed by a water rinse. Evaporation of volatile liquids can be enhanced by using steam jets. With any evaporation or vaporization process, care must be taken to prevent worker inhalation of the vaporized chemicals.

Chemical Removal

Physical removal of gross contamination should be followed by a wash/rinse process using cleaning solutions. These cleaning solutions normally utilize one or more of the following methods:

- Chemical removal of surface contaminants can be done by dissolving them in a solvent. The solvent must be chemically compatible with the equipment being cleaned.
- Halogenated solvents generally are incompatible with personal protective equipment and are toxic. They should only be used for decontamination in extreme cases where other cleaning agents will not remove the contaminant.
- Surfactants enhance physical cleaning methods by reducing adhesion forces between contaminants and the surface being cleaned, and by preventing redeposit of the contaminants. Household detergents are among the most common surfactants.

continued

Activity 22: Trainer's Notes from the Decontamination PowerPoint Presentation *(continued)*

- Solidifying liquid or gel contaminants can enhance their physical removal. The mechanisms of solidification are:
  - Moisture removal through the use of absorbents such as grounded clay or powdered lime;
  - Chemical reactions via polymerization catalysts and chemical reagents; and
  - Freezing using ice water.

Slide 15: To minimize the spread of contamination, always follow proper doffing procedures.

Slide 16: This is the first half of a doffing procedure for Level C protection. Discuss with class participants.

Slide 17: This is the second half of a doffing procedure for Level C protection. Discuss with class participants.

Slide 18: The equipment listed below is the minimum needed for proper decontamination and should be on site before the operation begins:

- Drop cloths;
- Collection containers;
- Absorbents;
- Wading pools or their equivalent;
- Wash solutions;
- Rinse solutions;
- Long-handled, soft-bristled brushes;
- Metal or plastic drum for collecting contaminated wash and rinse solutions;
- Plastic sheeting;
- Shower facilities or personal wash sinks; and
- Water or other liquids (for the prevention of heat stress).

Workers in the decontamination station must have appropriate PPE to protect them from the contaminants' hazards. This means that although they don't need to be as protected as workers in the Hot Zone, they must be protected no more than one level of protection below the Hot Zone workers.

Slide 19: Decontamination in emergencies always requires a judgment call. Adjustments are always made to protect and save human life. To make these judgment calls requires training, practice and procedures used by a trained rescue team!

An emergency response plan must prepare for emergency decontamination for victims.

- When dealing with injured or ill workers, the first priority is to save human lives. Sometimes this means that decontamination is not done until the victim is stabilized.
- Life-saving care should be instituted immediately by the workplace rescue team without decontamination.
- For heat stroke, the most serious of the heat stress illnesses, medical intervention must begin immediately with little or no decontamination.

It's always important to send along a worker who is familiar with the incident, the contamination and the decontamination procedures so that he or she can alert attending medical personnel.

- Care must be taken to minimize the contamination of the attending medical personnel.
- Failure to decontaminate injured workers has contaminated ambulances, hospital rooms and other hospital areas.

Slide 20: In emergency situations, the decontamination station may not be as elaborate as in a fixed site; but, according to OSHA, it must be just as effective.

- The decontamination station (DS) must be positioned upwind of the Hot Zone.
- The decontamination station must provide an organized process to reduce the level of contamination. This can be extensive or quite simple. It must do the job though.

Typical site decontamination station layout:

- Drop equipment onto plastic sheeting or into appropriate container;
- Decontaminate outer garments with water/soap rinse;
- Remove boot covers and outer gloves and place in appropriate container;
- Remove boots/gloves and outer garments and place in separately marked container for offsite decontamination;
- Remove respirator and place on table available for this purpose;

continued

Activity 22: Trainer's Notes from the Decontamination PowerPoint Presentation *(continued)*

- Step off pad into Clean Zone; and
- Survey for contamination.

Slide 21: Review chart with class participants. Tell them they can follow along in the book.

Slides 23 and 24: Use class discussion for review questions.

Activity 23: Emergency Response

- This Activity should take about 35 minutes.
- Review purpose with class participants.
- Sites with video capabilities — Have the "Emergency Response Scenario" video ready to play.
- Page 273 in the workbook — Read information in the box at the bottom of the page to the class.
- Factsheet 3, page 275 in the workbook — Emphasize the fact that the responsibility of the First Responder, Awareness Level is to "sound the alarm and get out."
- **Task answers:**

1.

  - Awareness level — Sound the alarm and get out, then notify authorities of release.
  - Operations level — Should respond in a defensive fashion, protecting nearby persons, property and the environment.
  - Hazardous Materials Technician level — Trained to take offensive actions to stop the release.
  - Hazardous Materials Specialist level — Act as special assistants to the HAZMAT team providing support to them.
  - Safety Officer — Should conduct most release air monitoring; determine proper levels of PPE including chemical protective clothing.
  - Incident Commander — Controls all response activity.

continued

Activity 23: Emergency Response *(continued)*

2.

Emergency Response Actions	Level of Training
1. Alert	Awareness Level
2. Control	Hazardous Materials Technician
3. Critique	Hazardous Materials Specialist Safety Officer Incident Commander
4. Decontaminate	Hazardous Materials Technician
5. Evacuate	Operations Level
6. Notify	All Levels
7. Rescue	Hazardous Materials Specialist
8. Size up	Hazardous Materials Specialist Safety Officer Incident Commander

- Sites with video capabilities — Have "Emergency Response Summary" video ready to play.
- **Activity 23: Emergency Response Review Questions**

1. We need to know the limits of our role as first responders. What should we do if we don't have the appropriate training and the right equipment? **We should leave the area immediately.**
2. Does this training qualify you for any level of emergency response activity? **No**
3. **Do Not Become a Casualty Yourself!** As a first responder at the awareness level what should you do?
   - **Leave the dangerous area immediately;**
   - **Sound the alarm; and**
   - **Be ready to direct emergency response personnel when they arrive.**

Notes for the 16-Hour Class (Activities 24 through 33) begin with the next page.

Activity 24: Reality Check

- This Activity should take about 45 minutes.
- Review purpose with class participants.
- Sites with video capabilities, show the "Shock to the System" video.
- **Task 1 answers:**

1. Answers will vary with class participants.
2.

- Avoid the manual interruption of evaporators in defrost and ensure control systems are equipped with password protection to ensure only trained and authorized personnel have the authority to manually override systems.
- When designing ammonia refrigeration systems, each evaporator coil should be controlled by a separate set of valves.
- Shutting down the refrigeration system may have resulted in a smaller release since all other ammonia-containing equipment associated with the failed rooftop piping continued to operate.
- An emergency shutdown should be activated in the event of an ammonia release if a leak cannot be promptly isolated and controlled. Doing so can greatly reduce the amount of ammonia released during an accident.

3. Answers will vary with class participants.

- **Task 2 answers:**

1. PPE, Training, Procedures, Mitigation.
2. Look at doing remote sampling, use proper PPE, provide proper training and procedures.
3. Answers will vary with class participants.

- **Activity 24: Reality Check Review Questions**

1. We all want to help our coworkers, but untrained rescuers often end up as _____ themselves. **Victims**
2. According to a NIOSH alert what percentage of confined space fatalities are would be rescuers? **60 percent**

3. We need to make sure that our sites have adequately trained _____ _____ on site. **Rescue teams**

4. Does this training qualify you to do emergency rescue or to intervene in any way in rescue operations? **No**

- Give the class a 10-minute break after this Activity.

Notes: _____

Activity 25: Respiratory Protection

- This Activity should take about 100 minutes.
- Facilitator has the option of using the PowerPoint presentation or the factsheets in the *Participant's Manual*.
- Review purposes with class participants.
- **Task 1 answers:**

1. They need to establish a respiratory protection program, provide physicals and conduct fit tests. They must provide the correct level of protection for hazard. Respirator use should not be optional in areas where one is required.
2. No.
3. No.
4. Hydrogen Fluoride — Not enough information.
   Methylene Chloride — No

- **Task 2 answers:**

1. Hydrogen Fluoride — No.
   Methylene Chloride — No.
2. Hydrogen Fluoride — No.
   Methylene Chloride — Yes (OSHA violation).
3. Hydrogen Fluoride — Yes
   Methylene Chloride — No (OSHA violation).

- **Task 3 answers:**

1. Hydrogen Fluoride — Not enough information.
   Methylene Chloride — No.
2. Hydrogen Fluoride — No.
   Methylene Chloride — No.
3. Hydrogen Fluoride — No.
   Methylene Chloride — No.
4. No training, medical evaluation, fit testing or respiratory program.

- Sites with video capabilities, show the "Respirator Donning and Doffing and User Seal Checks" video.
- **Activity 25: Respiratory Protection Review Questions**

1. Respirators can be a dangerous control technology. When should respirators be used? **Only as a last resort**

2. What is the ratio of ambient concentration of an airborne substance to the concentration of the substance inside the respirator called? **Assigned protection factor**

3. _____ ___ _____ is the maximum level or concentration of a substance in an environment a worker can enter while wearing a given respirator. **Maximum Use Concentration (MUC)**

4. Workers must understand the limitations of respirator equipment and all the responsibilities for respirator use. All wearers of respirators must be:

   a. Medically qualified;

   b. Mask fit tested; and

   c. Trained.

5. Which fit test uses an instrument to determine the fit and the user's protection factor? **Quantitative fit test**

6. When donning (putting on) the respirator what two fit checks must be performed on the respirator? **Negative pressure fit check and positive pressure fit check**

- Give the class a 10-minute break after the first 50 minutes and second 50 minutes of this Activity.

Activity 25: Trainer's Notes from the Respiratory Protection PowerPoint Presentation

Slide 2: Go over purposes with class participants.

Slide 4: Explain to the class that we will be discussing each of these topics more in this activity.

Slide 14:

- Primary routes of exposure;
- How to recognize and handle emergencies; and
- How to don and doff.

Slide 16: Respiratory equipment is a hazard within itself. Limited movement, stress and heat are among many other hazards introduced. This is why PPE is the last resort.

Slide 19:

Advantages (FFAPR):

- Reduces respiratory contamination (ANSI Protection Factor = 100);
- Lightweight; and
- Easy to use.

Disadvantages (FFAPR):

- Cannot be used in IDLH atmospheres;
- Low PF;
- Cannot be used in low oxygen environments;
- Filter specific protection;
- Harder to breathe (negative pressure); and
- Must know contaminant and concentration.

Slide 20:

Advantages (PAPR with facepiece):

- Reduces respiratory contamination (ANSI Protection Factor = 1000); and
- Easy to breathe (positive pressure).

Disadvantages (PAPR with facepiece):

- Cannot be used in IDLH atmospheres;
- Low PF;
- Cannot be used in low oxygen environments;
- Filter specific protection; and
- Must know contaminant and concentration.

Slide 22:

Advantages (PAPR Hood):

- Reduces respiratory contamination (ANSI Protection Factor = 1000);
- Easy to breathe (positive pressure); and
- Facial hair/personal glasses allowed.

Disadvantages (PAPR Hood):

- Cannot be used in IDLH atmospheres;
- Low PF;
- Cannot be used in low oxygen environments;
- Filter specific protection; and
- Must know contaminant and concentration.

Slide 26: SAR/SKA-PAK and SCBAs may offer respiratory protection permissible in an IDLH situation, but we shouldn't believe they give us all the protection we require. In fact, even supplied-air systems have severe limitations that could cost us our lives in an emergency situation.

The **SKA-PAK** is designed for easy use and versatility for entry into or escape from hazardous or IDLH environments. It is available with a lightweight, chemical-resistant Polypropylene harness or a spark-resistant Kevlar® harness. The SKA-PAK is available with 5-, 10- or 15-minute rated cylinder egress durations.

Slide 27: Ask the class, "Is this a respirator?" The answer is NO. There is no NIOSH approval indication. This is a dust mask to filter nuisance dusts but offers no rating for respiratory protection.

continued

Activity 25: Trainer's Notes from the Respiratory Protection PowerPoint Presentation *(continued)*

Slide 28: Ask the class "Is this a respirator?" The answer is "YES." The N95 respirator is the most common of the seven types of particulate filtering facepiece respirators. This product filters at least 95 percent of airborne particles but is not resistant to oil.

Slide 30: The employer shall identify a physician or other licensed health care professional (PLHCP) to perform medical evaluations using a medical questionnaire or an initial medical examination that obtains the same information as the medical questionnaire.

The medical questionnaire and examinations shall be administered confidentially during the employee's normal working hours or at a time and place convenient to the employee. The medical questionnaire shall be administered in a manner that ensures that the employee understands its content.

The employer shall provide the employee with an opportunity to discuss the questionnaire and examination results with the PLHCP.

The following information must be provided to the PLHCP before the PLHCP makes a recommendation concerning an employee's ability to use a respirator:

- The type and weight of the respirator to be used by the employee;
- The duration and frequency of respirator use (including use for rescue and escape);
- Expected physical work effort;
- Additional protective clothing and equipment to be worn; and
- Temperature and humidity extremes that may be encountered.

Slide 31:

Quantitative Fit Test:

Pros:

- Objective measurement;
- Gives an exact numerical protection factor; and
- Calculates protection factor for size and brand.

Cons:

- Expensive.

Qualitative Fit Test:

Pros:

- Inexpensive.

Cons:

- Subjective measurement;
- Some irritant may not be detectable by wearer; and
- Just a general indication of fit.

Slide 32: Ask if anyone recognizes this person? True story — There was wide-spread use of chemical warfare during World War I. This particular person could not get a proper seal on his respirator facepiece due to his handlebar moustache; so he trimmed it back. . .

Slide 33: And this is why Adolph Hitler had his trademark "Toothbrush" moustache.

Slide 34: The respirator user is responsible for:

- Maintaining current training, fit testing and medical evaluation;
- Ensuring that the mask is the correct size and brand;
- Wearing only equipment you have been trained and fitted to use;
- Inspecting all respiratory equipment for damage;
- Prior to use, ensuring equipment is in proper working condition;
- Performing alarm checks;
- Understanding the uses and limitations of respirator equipment;
- Properly using and caring for respiratory protection equipment;
- Maintaining control of respiratory equipment at all times; and
- Promptly reporting any respiratory malfunctions, damage or other respiratory issues.

continued

Activity 25: Trainer's Notes from the Respiratory Protection PowerPoint Presentation *(continued)*

Slide 35:

- Cleaning and disinfecting. The employer shall provide each respirator user with a respirator that is clean, sanitary and in good working order.
- All respirators shall be stored to protect them from damage, contamination, dust, sunlight, extreme temperatures, excessive moisture and damaging chemicals, and they shall be packed or stored to prevent deformation of the facepiece and exhalation valve.
- The employer shall ensure that respirator inspections include:
  - A check of respirator function;
  - Tightness of connections;
  - The condition of the various parts including, but not limited to, the facepiece, head straps, valves, connecting tube and cartridges, canisters or filters; and
  - A check of elastomeric parts for pliability and signs of deterioration.
- Repairs or adjustments to respirators are to be made only by persons appropriately trained to perform such operations and shall use only the respirator manufacturer's NIOSH-approved parts designed for the respirator.

Slide 39: An employee was using an air hammer to chip residue out of a furnace at an aluminum foundry. He was wearing an airline respirator. Two compressed gas lines with universal access couplings were attached to a nearby post. The one on the right was labeled "natural gas." The gas line on the left had a paper tag attached with the word "air" handwritten on it; however, this line actually contained pure nitrogen. A splitter diverted one part of the gas stream to the air hammer and the other part of the stream to the airline respirator. The employee was asphyxiated and killed when exposed to pure nitrogen.
(Source: www.osha.gov/dts/shib/shib042704.pdf.)

Slide 40: An employee hooked the fresh air line of his supplied-air respirator into a plant's compressed air lines and began abrasive blasting. The plant operators, unaware that their plant air was being used as breathing air, shut down the fresh air compressor for routine, scheduled maintenance and pumped nitrogen into the system to maintain pressure and control the valves in the refinery. The employee was overcome by the nitrogen in the air lines and died of nitrogen asphyxia.
(Source: www.osha.gov/dts/shib/shib042704.pdf.)

Slide 41: This is a posed picture. Respirators are improperly donned, hair in the facepiece seal, but most importantly, there are no filters on the face pieces.

Slide 42: The trainer has the option of conducting a practical demonstration of how to don and doff a respirator or using the "Respirator Donning and Doffing and User Seal Checks" video.

Slides 44 and 45: Use class discussion for review questions.

Activity 26: Air Monitoring

- This Activity should take about 65 minutes.
- Facilitator has the option of using the PowerPoint presentation or the factsheets in the *Participant's Manual*.
- Review purposes with class participants.
- **Task 1 answers:**

1. The atmosphere should be tested to determine level of PPE required, ventilation, Lockout/Tagout and other hazards present in the pit.
2. Initial and continuous.
3.

Units	Substance
%	Oxygen
ppm	Organic solvent vapors
Mg/m^3	Dust
Fibers/cc	Asbestos

- For sites with video capabilities, show the "MultiRAE Lite 4 Gas Monitor with PID" video.
- **Task 2 answers:**

1. Yes; it must be rated greater than 8.82.
   No; it must be rated greater than 11.07.
2. Yes, not IDLH conditions, explosive atmospheres; (>10% LEL) oxygen-deficient atmospheres; (<19.5%).
3. It will not detect any inorganic gases or vapors.
4. Yes; personal sampling gives only average exposures.
5. Intrinsically safe.

- **Activity 26: Air Monitoring Review Questions**

1. Why must air monitoring be conducted? **To ensure proper selection of engineering controls, work practices and personal protective equipment.**

2. When should remote sampling be required? **To avoid entering potentially dangerous atmospheres in spaces such as vaults or tanks**

3. What should be your first concern when conducting air monitoring? **To make sure that no one is working in an atmosphere which presents an immediate danger to life or health.**

4. When should direct reading instruments and sampling pumps be calibrated? **Before and after each use.**

Activity 26: Trainer's Notes from the Air Monitoring PowerPoint Presentation

Slide 1: Ask students if any of them have had to interpret monitoring data, collect monitoring samples or institute corrective actions based on monitoring data. Discuss any issues that they had with these events.

Monitoring of hazardous waste sites is covered in the Standard under 1910.120(h).

Photo: A USCG/EPA response member monitors for hazardous atmospheres, courtesy EPA.

Slide 2: Go over purposes with class participants.

Slide 4: Let the class know that monitoring is covered under paragraph (h) of the HAZWOPER Standard in addition to initial entry requirements as outlined below.

The HAZWOPER Standard is clear that a hazard identification process must be implemented upon initial site entry. This means that "all suspected conditions that may pose inhalation or skin absorption hazards that are immediately dangerous to life or health (IDLH) or other conditions that may cause death or serious harm shall be identified during the preliminary survey and evaluated during the detailed survey. Examples of such hazards include, but are not limited to: Confined space entry, potentially explosive or flammable situations, visible vapor clouds or areas where biological indicators such as dead animals or vegetation are located." **1910.120(c)(3)**

Slide 5: After giving students a chance to discuss this question, let them know that it often falls on site supervisors to review sampling data (with or without an IH), make adjustments to site control measures and SOPs; take samples; or any two or three actions above.

Air monitoring must be conducted to ensure proper selection of engineering controls, work practices and personal protective equipment. These practices ensure that employees are not exposed to levels which exceed permissible exposure limits, or published exposure levels if there are no permissible exposure limits, for hazardous substances.

Slide 7: 1910.120(h)(2) *Initial entry*. Upon initial entry, representative air monitoring shall be conducted to identify any IDLH condition, exposure over permissible exposure limits or published exposure levels, exposure over a radioactive material's dose limits or other dangerous condition such as the presence of flammable atmospheres or oxygen-deficient environments.

1910.120(h)(3) Periodic monitoring. Periodic monitoring shall be conducted when the possibility of an IDLH condition or flammable atmosphere has developed or when there is indication that exposures may have risen over permissible exposure limits or published exposure levels since prior monitoring. Situations where it shall be considered whether the possibility that exposures have risen are as follows:

> **1910.120(h)(3)(i)** When work begins on a different portion of the site.
>
> **1910.120(h)(3)(ii)** When contaminants other than those previously identified are being handled.
>
> **1910.120(h)(3)(iii)** When a different type of operation is initiated (e.g., drum opening as opposed to exploratory well drilling).
>
> **1910.120(h)(3)(iv)** When employees are handling leaking drums or containers or working in areas with obvious liquid contamination (e.g., a spill or lagoon).

Slide 9: Air monitoring is particularly difficult at hazardous waste sites. Unlike industrial settings, the chemicals and chemical mixtures at a hazardous waste site are usually unknown. Airborne contaminants are also free to move throughout the site.

Constantly changing site activities and weather conditions can cause large fluctuations in the concentrations of airborne contaminants.

In order to monitor such variable conditions, an air monitoring plan should be developed by an occupational health and safety professional. The air monitoring plan should be part of the HASP. Before an air monitoring plan can be developed you must decide what you want to learn from the monitoring you will do. There are three basic things you can determine from these measurements:

- Is there an immediate danger to employees at the site?
- Are workers being exposed to concentrations above exposure limits?
- Are contaminates moving into uncontaminated areas?
- Are contaminates moving offsite?

Once you have determined what you are looking for you can start answering more specific questions about the plan, such as:

- What instruments are appropriate?

continued

Activity 26: Trainer's Notes from the Air Monitoring PowerPoint Presentation *(continued)*

- When and where should I monitor?
- How many samples?
- How do I evaluate the results?
  (Photograph from the Uranium Tailings Investigation at the Watertown, Massachusetts, GSA site.)

Slide 12: Four drops of ink in a 55-gallon barrel of water produces a 1 ppm "ink concentration."

Slide 19: Air monitoring in confined spaces presents conditions which should be considered in the air monitoring plan. Remote sampling is often required in order to avoid entering potentially dangerous atmospheres in spaces such as vaults or tanks. These spaces are so poorly ventilated that layering of gases and vapors may occur. These conditions may require additional measures which include:

- Monitoring at different levels to evaluate the conditions in the space.
- If work must be done, frequent or continuous monitoring should be performed unless the space is ventilated.

It is also important to understand that measuring instruments have parameters that affect measurements that you will get. These parameters include:

- Response time is the amount of time it takes for the instrument to adjust to a new concentration when going from clean air to contaminated air (or from places of lower concentrations to higher concentrations).
- Lag time gives us the amount of time it takes for the instrument to return to zero once you leave the contaminated environment (or go from a higher concentration to a lower concentration).
- Correction factors are a way to correct measurements depending on the calibration gas you used and the actual chemical you are looking for.

Slide 20: Response time is the length of time the monitor takes from when it "senses" a contaminant until it generates data. Response times for direct-reading instruments may range from a few seconds to several minutes.

Slide 21: Real-time analysis will give snapshot results right away, while collected/lab analyzed samples may take days to come back (you can speed this up by doubling or tripling the lab costs).

Slide 23: An oxygen meter is used to measure the concentration of oxygen in the atmosphere. This instrument usually gives the concentration in percent. The range is from 1 to 25 percent. Oxygen meters are often combined with a CGI in a single instrument. This allows the user to determine if there is enough oxygen for the CGI to operate. Oxygen meters are affected by temperature and pressure. Oxidizers can cause high readings. Carbon dioxide can reduce instrument sensitivity.

Advantages:

- General purpose detector for most combustible hydrocarbons;
- Accurate over most of its range;
- Indicates total combustibles present; and
- Relatively unaffected by temperature and humidity changes.

Disadvantages:

- Nonspecific;
- Requires oxygen for (air) operation; and
- Not recommended for chlorinated hydrocarbons or tetraethyl lead containing compounds.

Slide 24: Multiple gas detectors usually detect three or more gases, two of which are % O_2 and % LEL. The other sensors detect gases such as chlorine, sulfur dioxide, nitrogen dioxide, nitric dioxide, hydrogen sulfuric, carbon monoxide, ammonia, methane and pentane. These sensors will usually be chosen according to the chemicals you use at your company.

Advantages:

- Detect more than one chemical;
- Direct reading;
- Can be downloaded to a computer to get a time/exposure record; and
- Alarms can be set for low level and high level (i.e., PEL and IDLH).

Disadvantages:

- Must know the gas/vapor trying to detect; and
- If trying to detect more gases/vapors than sensors the Four-Gas instrument can house, then more than one instrument will be needed.

continued

Activity 26: Trainer's Notes from the Air Monitoring PowerPoint Presentation *(continued)*

Slide 26: A PID uses an ultraviolet (UV) lamp to ionize molecules, causing them to release an electron and form a positive ion. This will occur when the Ionization Potential (IP) of the molecule is less than the electron volt (eV) output of the UV lamp (i.e., 10.6eV).

Ions formed in the air are driven in one direction by a bias electrode and accumulated at a collecting electrode. The ion current is then amplified and converted to a digital meter readout in parts-per-million (ppm). The most common UV lamps used in field work are 10.6eV, 11.7eV and 11.8eV.

The useful lifespan of the 10.6eV is about 3,000 hours, the 11.7eV is about 200 hours and the 11.8eV is about 500 hours. Of course, these lifespans are all dependent on how carefully the lamps are used and maintained.

Advantages:

- Good general purpose detector;
- Durable and reliable;
- Wide common use;
- Common contaminant ionization potentials (IP) are readily available in the *NIOSH Guide to Hazardous Chemicals*; and
- Ranges up to 10,000 ppm or down to ppb.

Disadvantages:

- Nonspecific;
- Response varies with contaminant;
- Affected by humidity; and
- Does not detect methane.

Slide 27: IP: Ionization potential in electron volts (eV) for a vapor or gas.

This will signify a photoionization detector may be used to detect the presence of material.

Slide 28: The flame ionization detector (FID) can also be used for surveying purposes. This instrument uses a hydrogen flame to ionize the sample. It will detect any flammable organic compound. The FID has a similar range as the PID but will not detect any inorganic gases or vapors. The FID will detect most hydrocarbons such as methane that a PID will not.

Slide 29: Colorimetric tubes indicate concentration following a reaction. The chemical reaction that occurs between an airborne contaminant and chemicals in the tube produce the colored stain. The stain length or intensity is related to the concentration of the scale printed on the glass tube.

Biotech drum removal NEWTON, North Carolina — Contractors at a Biotech facility work to remove hundreds of drums containing hazardous materials, February 10, 2011. The Gulf Strike Team assisted the Environmental Protection Agency with the removal of hundreds of rusted, dented and punctured drums of corrosive, flammable and toxic substances. U.S. Coast Guard photo.

Slide 30: Advantages of colorimetric tubes include simple operation, economical, rapid results and the availability of tubes for many compounds.

Slide 31: Ask the question on the slide and discuss the group's answers. Can you think to any disadvantages of using colorimetric tubes? Click once to display the answers. Disadvantages or limitations of colorimetric indictor tubes include: Limited accuracy, interferences, the need to know the contaminant before sampling, shelf-life is only a couple of years, the results may not be entirely clear and they only represent a "snap-shot" of the exposure or concentration.

- Simple operation;
- Economical;
- Many types for many contaminants:
  - Limitations;
  - Sensitivity;
  - Accuracy;
  - Interferences; and
  - Instantaneous results.
- Color changes with time — read ASAP;
- Read in daylight or incandescent light;

continued

Activity 26: Trainer's Notes from the Air Monitoring PowerPoint Presentation *(continued)*

- Leading edge of stain hard to determine;
- Test on known concentration;
- Accuracy +/- 25% to 35%;
- Never mix brands; and
- Never use beyond expiration date.

Slide 32: Read the question on the slide, then take answers from the group. What can be done to ease the reading of colorimetric tubes? Click once to display four answers. They should be read in adequate lighting but not in direct sunlight. The full length of the stain should be read and compared with an unused tube against a white background.

Slide 35: The HAZWOPER Standard requires that personal sampling be performed during all phases of remediation except initial site characterization. The usual procedure is to sample workers who are most likely to have high exposures. If these workers are below exposure limits, other workers are not likely to be over exposed.

Slide 36: When working in areas which may contain a flammable atmosphere, you don't want your instrument to become an ignition source. To insure that this does not happen you should use instruments which have been certified to be intrinsically safe by an OSHA-approved testing laboratory such as Factory Mutual Research Corp. (FM) or Underwriters Laboratory Inc. (UL). An intrinsically safe instrument is one that will not serve as an ignition source when used in a flammable atmosphere.

Slide 37: Direct reading instruments and sampling pumps need to be calibrated before and after each use. Direct reading instruments also need to be zero-checked in clean air.

Records should be maintained and included in the HASP. Although it will give you readings, an uncalibrated instrument gives meaningless information. If sampling pumps are not calibrated properly, the measured exposure level will be incorrect.

The "Bump Test" is a quick check that the sensors are responding correctly to a known gas typically within ±10% accuracy. The "Full Calibration" is when you follow the manufacturer's suggested calibration procedure which commonly starts with a fresh air calibration and ends with a span calibration of the instrument's sensors.

For sites with video capabilities, show the "MultiRAE Lite 4 Gas Monitor with PID" video.

Slide 40: Use class discussion for review questions.

Activity 27: Monitoring the Monitors

- This Activity should take about 45 minutes.
- Review purpose with class participants.
- **Task answers:**

Question	Yes/No	Explanation/ Recommended Changes
1. Did the employer monitor all the chemicals about which the workers were concerned?	No	They did not check for Methylene Chloride or the "various other solvents." Also, they did not check the drums of soil containing chemicals.
2. Did the employer test the right workers?	No	Should have tested the workers that were experiencing the problems.
3. Were the employer's sample results below the OSHA levels?	Yes	They were for each individual chemical NOTE: Gasoline had a vacated PEL of TWA: 300 ppm 8 hours.
4. Were the employer's sample results below the NIOSH levels?	No	Ca TWA 0.1 ppm ST 1 ppm. Benzene
5. Did the employer take enough samples to make certain that the testing took into account the wide variation of work routines of the workers?	No	Only sampled for one chemical per worker. They should sample each person for each chemical.
6. Did the employer sample enough hours for each chemical?	No	They only checked for three hours once a week for three months. Sampling needs to be done during exposure time. This would provide total job coverage. Sampling should be done every day for 30 days to get an accurate sample.
7. Did the sampling take place at the correct time of day for the most hazardous chemicals?	No	Sampling took place from 1 p.m. to 4 p.m. The workers were experiencing the problems in the morning time.

2. Yes; all three are GHS Category 2 hazards.

3. Toxico Chemical needs to have the monitoring done by individuals that are competent in occupational exposures.

- **Activity 27: Monitoring the Monitors Review Questions**

1. ___ _____ on hazardous waste sites gives you valuable information. **Air monitoring**

2. When should air samples be taken? **At peak exposures and as averages for a full day's exposure to protect our health.**

3. We need to be certain that the sampling is done either for all kinds of _____ or for the _____ we think are most exposed. **Workers**

- Give the class a 10-minute break after this Activity.

Notes: _____

Activity 28: Drum Handling and Sampling

- This Activity should take about 70 minutes.
- Review purpose with class participants.
- Facilitator has the option of using the PowerPoint presentation or the factsheets in the *Participant's Manual*.
- For sites with video capabilities, before beginning Task 1, show the "Hazardous Waste Drum Site Cleanup USEPA" video.
- **Task 1 answers: Answers will vary with class participants.**
- **Task 2 answers: Answers will vary with class participants.**
- **Activity 28: Drum Handling and Sampling Review Questions**

1. When is a thorough inspection of the integrity of drums, barrels, tanks and |other containers essential? **Prior to proper storage, movement or sampling operations.**
2. What are some elements that should be included on a Standard Operating Procedure? **Proper handling, sampling, opening, sample packaging and transportation.**
3. You should always exercise caution when approaching drums that are _____, _____ or _____. **Bulging, leaking, deteriorated**
4. Should incompatibles be stored in the same vicinity? **No**
5. What things should always be on hand when doing drum handling and sampling? **Overpacking, absorbent materials and a fire**
6. What can be a valuable resource when determining the proper PPE? **Safety Data Sheet (SDS)**

- Give the class a 10-minute break after this Activity.

Notes:

Activity 28: Trainer's Notes from the Drum Handling and Sampling PowerPoint Presentation

Slide 1: Review purpose with class participants. The appropriate procedures for handling drums depend on the drum contents.

Slide 2: Sites with video capabilities, before beginning Task 1, show the "Hazardous Waste Drum Site Cleanup USEPA" video.

Slide 4: If they cannot be inspected in place (e.g., because they are buried or stacked), move them to an accessible location and inspect them prior to further handling.

Slide 5: Note: PICs are metal and plastic drums (top), nickel and stainless steel (bottom).

- Closed-top metal drums normally contain noncorrosive products in liquid form.
- Closed-top plastic drums or composite drums (plastic inside of metal or cardboard) often contain corrosive liquids.
- Open-top metal drums often contain noncorrosive solids or sludge.
- Open-top plastic drums usually contain corrosive solids or sludge.
- There are other types of drums; such as stainless steel, nickel and "monel," which are used for chemicals that require special containers for safety reasons. These would contain highly toxic materials.

Slide 6: Assume that containers hold hazardous substances until the contents can be positively identified and labeled. Conditions in the immediate vicinity of the drums may provide information about drum contents and their associated hazards. Monitoring should be conducted around the drums using instruments such as a gamma radiation survey instrument, organic vapor monitors and a combustible gas meter. Keep in mind that drums are frequently mislabeled, particularly drums that are reused. Thus, a drum's label may not accurately describe its contents.

Slide 7: Ask the class participants to name some drum handling precautions. Once they have had time to respond, transition in answers. Keep absorbent and overpack equipment available where leaks or spills might occur; transfer contents from damaged or unsafe containers into sound containers to avoid ruptures and spills. Every step of the operation should be carefully planned, based on all the information available at the time.

Slide 8: Open containers in a way that will allow internal pressure to be relieved safely. If this cannot be done remotely, then place a shield between the workers and the drums/containers to prevent injury.

Slide 9: Consider the risk of explosion; provide shielding, open drums remotely or provide other protection in the area where this may be a hazard.

Slide 10: Ask the class participants for examples; then reveal bulleted items.

The separations, either by distance or physical barriers, should be enough to prevent the mixing of two incompatibles if a container is dropped and breaks a second container. Extremely toxic (and/or carcinogenic) or dangerous materials should be double containerized.

Slide 11: Ask the class participants for examples, then reveal bulleted items.

Slide 12: Laboratory packs are drums containing individual containers of laboratory materials normally surrounded by cushioning absorbent material. Lab packs can be an ignition source for fires at hazardous waste sites. They sometimes contain shock-sensitive materials. Such containers should be considered to hold explosive or shock-sensitive wastes until otherwise characterized.

Lab packs can sometimes be identified by packing lists taped on the side of the drum. This packing list should contain:

- A listing of all chemicals; and
- Quantities within the drum.

Slide 13: Ask the class participants for examples then reveal bulleted items.

Slide 14: SDSs are a good source of information on the hazards associated with the chemical.

Slide 15: Standing on barrels.

Slide 16: If broken or leaking hazardous chemical containers are found with debris, contact a supervisor/hazardous material personnel for evaluation/removal before continuing work in the area.

Slide 17: Note: Ask class participants to name some of the components of a good sampling plan.

Drum sampling can be one of the most hazardous activities to worker safety and health because it often involves direct contact with unidentified wastes. Prior to collecting any sample, develop a sampling plan.

continued

Activity 28: Trainer's Notes from the Drum Handling and Sampling PowerPoint Presentation *(continued)*

Slide 18: Ask class participants the question and give them time to respond. Then compare their answers with the following:

Slides 19:

- Do not open unstable containers manually.
- Use non-sparking hand tools only.
- Avoid contact with drum surface by covering with plastic sheeting.
- Do not stand on or lean over drums.
- Do not use contaminated rags or other materials during sampling. The contaminants may not be compatible with the waste in the container.
- Use direct-reading air monitoring equipment during sampling to warn personnel of potential hazards.
- Clean up spills promptly to avoid mixing of incompatible materials.
- Be aware of — and use — the protective gear necessary for the job.

Slide 20: The most widely used implement for sampling drum liquids is a glass tube commonly referred to as a glass thief. This tool is cost effective, quick, and disposable. Glass thieves are typically 6mm to 16mm I.D. and 48 inches long.

Slide 21: Static is generated when liquids move in contact with other materials. A static charge may accumulate under certain conditions. If the accumulation is sufficient, a static spark may occur. In the presence of a flammable liquid or vapor, this static charge must be safely discharged by bonding the two containers together and by grounding them.

This spark can be avoided by a practice known as bonding and grounding.

- Bonding is the process of connecting two or more conductive containers (such as metal drums or tanks) by means of a conductor.
- Grounding is the process of connecting a metallic container to the ground.

Bonding must occur in a specific order.

1. Attach bonding first to the tank to be filled.
2. Then attach to the container from which the flammable liquid will be loaded.

3. To prevent ignition of vapors, connection should be made at some distance from the opening where flammable liquid is discharged.

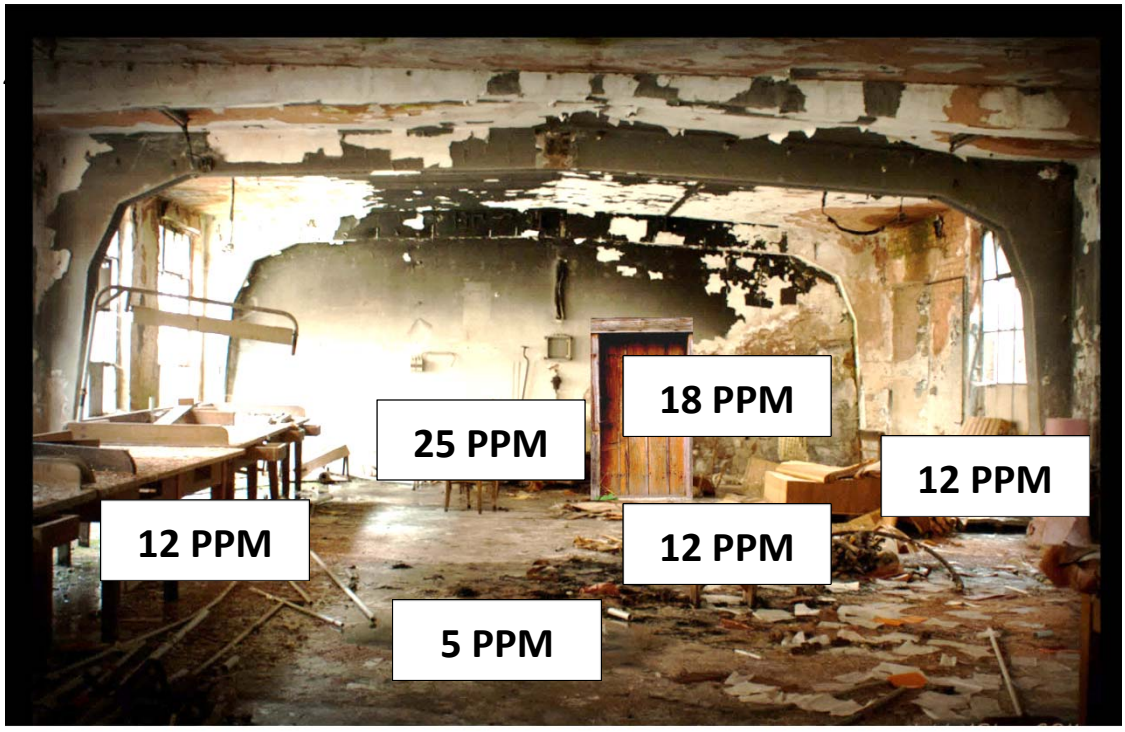
Slide 22: Ask the class participants to name some things that would be included in proper drum handling. After they have had time to respond, transition in the answers for comparison with what they came up with.

Slide 24: Use class discussion for review questions.

Activity 29: Final Field Activity

- This Activity should take about 355 minutes (for all five segments).
- Review purposes with class participants.
- Facilitator has the option of using the PowerPoint presentation or the factsheets in the *Participant's Manual*.
- SDS's can be found at the following links:
  - Acetone — http://www.labchem.com/tools/msds/msds/LC10420.pdf
  - 4% Bleach — http://cleanplus.com.au/cleanplus/wp-content/uploads/2013/04/SDS300.pdf
  - 1,1,2 — Trichloroethane-http://megaloid.ca/MSDS/Trichloroethylene.pdf
  - Sodium Permanganate — https://www.fishersci.ca/viewmsds.do?catNo=AC209630500
- **Task 1 answers:**

  Upon entering the room, if you are requested to perform continuous monitoring, these will be your readings for Acetone (nothing else will be detected).



One facilitator will play the role of IH/HP-RCT. His or her task is to give readings from appropriate instruments during entry to the site. In addition, the IH/HP-RCT will take any requested measurements.

The IH/HP-RCT should also have pH paper in case one or more of the groups ask. This can be simulated. The readings will be typical for the chemical(s) involved.

The readings will remain the same as the initial readings or you can vary them as you desire.

Site Setup Information (to be set up by facilitators prior to beginning of the Field Activity).

Below is a picture of what will be discovered by the ID Team upon entry:

continued

Activity 29: Final Field Activity *(continued)*

You have the option of using this picture as a simulation or setting up your own site and placing labels on containers.

The ID Team will need to report back what they have identified from the set-up. There should be a re-assessment of the HASP. As soon as the Sampling Team enters and begins sampling, the trainer should tell them that an emergency situation has just occurred. The floor beneath them has collapsed and the entire team has fallen through. The trainer will then instruct the Sample Team to remain quiet. It is now up to the Command Team to react. If their plan has included an Emergency Response Plan then enacting this should be simulated, however let them make the decision.

- This Activity contains five segments. The first 75 minutes will be at the end of day four. Give the class a 10 minute break after the second segment (75 minutes). Give the class a 10 minute break after the third segment (70 minutes). Give the class a lunch break after the fourth segment (75 minutes). Give the class a 10 minute break after the fifth segment (60 minutes).

continued

Activity 29: Final Field Activity *(continued)*

- **Activity 29: Final Field Activity Review Questions**

1. Overheating is a very serious concern when working in protective gear. What should you do if you get into trouble? **Get out of the area and out of the suit.**
2. Why is it important that you take your training seriously? **What you learn in training may save your life**
3. What should be done to the work plan when new information about the site is discovered? **Always debrief and reassess**

Notes:

Activity 29: Trainer's Notes from the Final Field Activity PowerPoint Presentation

Slide 2: Go over purpose with class participants.

Slide 3: Your group is part of a team that is preparing for the decommissioning and decontamination of a facility that was primarily used to decontaminate and clean respiratory equipment, personal protective equipment and other items used at a low level radioactive materials processing site. The building is located approximately one mile from your present location. The facility hasn't been used in over 15 years and has been basically abandoned in place. Historically, the facility used high grade chemical cleaning agents. Some chemicals known to be used are Chlorine Bleach, Acetone, 1,1,2-Trichloroethane and Sodium Permanganate.

Slide 4: You remind the FM that conditions have changed and the HASP will need to be revised. So your crew is given the go-ahead to develop a new plan to gain entrance to the room, ID (gather information) and perform necessary sampling based on what you find. IH monitoring outside of the padlocked room indicates only trace amounts of acetone in the air (25 parts per million). No radioactivity above normal back-ground is detected.

Slide 6: As facilitator you should:

- Divide into four work teams;
- Display a visual description of the layout for the task (2 slides above); and
- Portray the role of IH/HP (or RCT) if you need one.

Slide 7: IH monitoring outside of the facility indicates only trace amounts of acetone in the air (25 parts per million). No radioactivity above normal background is detected. No other levels of contaminants are detected.

Slide 8: The four groups will be given time to develop their work plans and report back to the whole group.

Slide 9: Once report-backs have been completed, the class participants will have the opportunity to execute their plan. They should send in their ID team and then report their findings to the whole group.

Slide 10: Industrial Hygiene monitoring shows no increased readings. No radio-activity above typical background and 25 PPM Acetone.

Slide 11: The work plan should be revised based on new information.

continued

Activity 29: Trainer's Notes from the Final Field Activity PowerPoint Presentation *(continued)*

Slide 12: Have the class revise their plans and report back.

Slide 14: Give class participants time to respond to question.

Slide 16: Give class participants time to respond to questions.

Slide 17: Use class discussion for review questions.

Activity 30: Mapping Hazards at Work (Optional)

- This Activity should take about 90 minutes.
- Verify that you have colored markers and flip chart paper for each table.
- Facilitator has the option of using the PowerPoint presentation or the factsheets in the *Participant's Manual*. (Note: PPT slides are self-explanatory.)
- Review purposes with class participants.
- Task 2 — Ask the individual presenting their table's hazard map during report back the two questions from step 5.
- Task 3 is optional depending on time constraints.
- **Activity 30: Mapping Hazards at Work Review Questions**

1. Because we have been doing it for so long, we sometimes forget that we often work in a very _____ environment. **Hazardous**
2. What tool is used to identify workplace hazards so that those hazards can be targeted for elimination? **Hazard Mapping**
3. What are we doing when we create a Hazard Map? **We are making a visual representation of workplace hazards that could lead to injury, illness or even death.**
4. Hazard Mapping enables workers to make valuable contributions to health and safety based on what? **Their collective skills, experience and know-how.**
5. Hazard Mapping utilizes three important principles that are used in the Small Group Activity Method which include: **Respect, Sharing the Power and Working Collectively.**

Notes:

Activity 31: Lessons Learned (Optional)

- This Activity should take about 30 minutes.
- Review purposes with class participants.
- Factsheet 1 in the workbook — Make sure the class understands that when the root causes of accidents are identified as Safety Systems failures, they need to be fixed.
- Factsheet 4 in the workbook — Make sure the class understands the concept of the "Ripple Effect."
- Give the class a brief overview of how the logic tree works (page 186):
  - Starts with the Top Event (injury, fatality, etc.).
  - Legs of the tree are produced from relevant facts from the investigation.
  - Legs of the tree subsequently end with the root causes with one of the following qualifiers:
    - Safety System Failure;
    - Need More Information (NMI); or
    - No Safety System Failure.
  - The ultimate goal of the logic tree is to identify the root causes of the accident/incident.
- **Activity 31: Lessons Learned Review Questions**

1. What is the objective of Lessons Learned? **To prevent accidents by identifying and correcting underlying defects in Safety Systems.**
2. What must be done to achieve maximum prevention? **All recommended changes should be made (unless a higher-level fix eliminates the need for a lower-level fix).**
3. Corrective action resulting from Lessons Learned is one of the best methods for achieving a proactive health and safety atmosphere. How is maximum prevention achieved? **By correcting the conditions that led to this incident at other locations in the workplace.**
4. A Safety Systems-based analysis helps identify the underlying causes of incidents and is valuable for determining what _____ _____ should be taken as a result of the Lessons Learned. **Corrective measures**

5. The greatest measure of prevention always takes place at what phase of any management safety system? **The design phase**

6. What is the purpose of the logic tree? **To determine the root cause of an incident or accident**

Notes:

Activity 32: Jeopardy Review Game (Optional)

- This Activity should take about 45 minutes.
- Review purposes with class participants.
- Make sure that you understand the directions for the game (Regular Jeopardy and Final Jeopardy) before you explain them to the class.
- Sites with video capabilities — Verify that the PowerPoint presentation is working properly. Have it ready to play before the Activity begins. Practice using the game before class to ensure movement between slides will be smooth.
- Sites without video capabilities — Place cards on board/wall before beginning the Activity.
- Be consistent with timing allowances for answering questions.
- Make sure that you allow enough time to complete paperwork, etc., at the end of the game.

Notes:

Jeopardy Game Instructions

The Rules of the Jeopardy Game:

All books and notes must be put away before the game begins.

1. The trainer will draw a table number from a "hat." The table number drawn will be the table that will be the first to choose a card and respond. Control of the board moves in ascending table number order starting with the table number drawn.

2. The table will choose a category and a point value from the display. All of the workers at the table will work together on the response. Answers must be stated by the table Scribe.

3. The trainer will display the "question" on the screen and the table Scribe will give the group's response.

4. The table will have ten seconds to begin responding. If the table cannot respond correctly in ten seconds, the opportunity will go to the next table. (**Note**: The table will not lose points if they cannot respond correctly.)

5. If the question rotates to another table, or tables, and they give the correct answer, they do not lose their turn to have control of the board and choose a category and point value. Example: If table 2 chooses a category and point total and fails to respond correctly and the question moves through tables 3 and 4 to table 5 before a correct response is given, then control of the board moves back to table 3 to choose the next category and point value.

6. The trainer will be responsible for keeping table scores on a flipchart.

7. There will be two Double Jeopardy questions. If a table selects a category and point value that has one of the Double Jeopardy questions, the trainer will read the question from this guide. Below are the two DAILY DOUBLES.

    - HAZWOPER Jeopardy III — 40 point question
    - HAZWOPER Jeopardy IV — 30 point question

continued

Jeopardy Game Instructions *(continued)*

8. Once the Regular Jeopardy Game is complete, Final Jeopardy will begin:

   - After all questions have been answered, the facilitator will ask each table to make a wager. (**Note:** They can wager any amount of the total points that they have accumulated in Regular Jeopardy.)
   - The facilitator will list each table's wager on a flipchart.
   - The facilitator will then display the Final Jeopardy question.
   - Each scribe will record their table's answer on a sheet of paper with their respective table number at the top of the paper. (**Note:** The tables will have 20 seconds to record their answers. If they do not turn their answers in to the facilitator within the 20 seconds, they will be disqualified from the Final Jeopardy Game.)
   - The facilitator will then display the answer to the class and mark the results on the flipchart.
   - The wager from each table that gave the correct answer will be added to their existing score and the wager from each table that gave the incorrect answer will be deducted from their existing score.

PowerPoint Presentation Instructions:

Windows 7*:

1. Open PowerPoint presentation.
2. Click on "Slide Show" at top of the screen.
3. Click on "From Beginning" on the top left corner of the screen.
4. Click on "Click to begin" in the bottom left corner of the screen.
5. Click on the question (category and point value). The question will be revealed.
6. To reveal the answer, move the cursor to the middle of the screen and hit the Space Bar.
7. To return to the Jeopardy screen for the next question, move the cursor to the right side of the slide and single click the mouse. (Note: The cursor will change from a pointer to a hand.)
8. After each point value has been selected, it will change colors on the Jeopardy screen so that you can keep up with which point values have been selected.
9. After all point values have been selected, go to the bottom left-hand corner of the screen and hit the left arrow. Use this arrow to advance the screen until it displays "Click Here for Final Jeopardy."
10. After the tables have made their wagers, click the left arrow to display the question. Click the timer/speaker icon in the bottom right-hand corner to play Jeopardy Thinking Music.

    Note: Jeopardy Music file has to be on the flash drive in order for it to work in the PowerPoint Presentation.
11. After the tables have turned in their answers, click the right arrow to display the answer.
12. The game will only reset if you close the program and reopen it.
13. If you make a mistake during the Jeopardy Game, you can do the following to get back to the Jeopardy Game screen without losing your place in the game:
    - Press the "Escape (ESC) Key;"
    - Press the "From Beginning" button in the top left corner of the screen; and
    - Click on the "Click to Begin" instruction on the screen.

***** These instructions have not yet been used on a computer with a Windows 8 Operating System. If you have Windows 8, make sure and review the game to make sure these instructions work accurately for Windows 8 before you do the Activity.

Q&As for HAZWOPER Jeopardy I				
10	**20**	**30**	**40**	**50**
What Safety System actually eliminates the hazard?	What is the HAZWOPER Standard?	What is Toxicology?	What does CAS stand for?	What are the four types of radiation?
Design Activity 4, FS 11	**29 CFR 1910.120** Activity 3, Rights and Responsibilities PPT, Slide 36	**The study of the effects of poisons** Activity 7, FS 4	**Chemical Abstract Service Number** Activity 5, FS 3	**Alpha, Beta, Gamma, Neutron** Activity 6, FS 13

Q&As for HAZWOPER Jeopardy II

10	20	30	40	50
What does GHS stand for?	What percentage of confined space fatalities are potential rescuers?	What is the HMIS/NFPA numerical hazards rating system?	This resource section is designed for the first 30 minutes of an emergency release.	How long does the employer have to respond to a request for your exposure/medical records?
Globally Harmonized System of Hazard Classification Activity 8, FS 1	**60 to 70 percent** Activity 19, FS 3	**Severe – 4, Serious – 3, Moderate – 2, Slight – 1, Minimal – 0** Activity 9, FS 11	**Green Section DOT *ERG*** Activity 10, FS 11	**15 days** Activity 12, FS 4

Q&As for HAZWOPER Jeopardy III

10	20	30	40	50
What level of PPE provides the highest level of protection?	What document is considered a "Living Document?"	Give two names for each of the three work zones.	**DAILY DOUBLE** What does ALARA stand for?	Once dB TWA reaches ___ the employer has to implement a hearing conservation program.
Level "A"	**The HASP (Health and Safety Plan)**	**Zone 1 – hot, dirty, exclusion; Zone 2 – warm, decontamination, contamination reduction; Zone 3 – cold, clean, support**	**As Low As Reasonably Achievable**	**85 dB**
Activity 13, FS 3	Activity 14, FS 1	Activity 15, FS 7	Activity 7, FS 6	Activity 18, FS 15

Q&As for HAZWOPER Jeopardy IV

10	20	30	40	50
As a First Responder, Awareness Level what should your response be to an emergency situation?	Who is the person authorized to make key decisions during emergencies and control all response activity?	**DAILY DOULBLE** Name the four heat-related illnesses.	Name the two signal words used in the GHS 2012 HazComm Standard.	Name the seven Safety Systems beginning with the most effective and ending with the least effective.
Sound the alarm and get out Activity 23, FS 3	**Incident Commander** Activity 23, FS 3	**Heat rash, Heat cramps, Heat exhaustion, Heat stroke** Activity 20, FS 8	**Warning and Danger** Activity 8, FS 7	**Design,** **Mitigation,** **Maintenance and Inspection,** **Warning Devices,** **Training,** **Procedures,** **PPE** Activity 4, USW Safety Systems Chart

Q&As for HAZWOPER Jeopardy V

10	20	30	40	50
What resource we studied about this week has a Chemical, Synonym and Trade Name Index?	List three of the six health and safety issues that wearing PPE can cause.	Why is air monitoring conducted?	Name three of the six causes of MSDs.	What two levels of PPE are appropriate for oxygen deficient atmospheres?
NIOSH Pocket Guide	**Limited agility and dexterity, heat stress, limited vision, claustrophobia, limited hearing**	**To determine the appropriate level of employee protection needed on site.**	**Force, Repetition, Posture, Vibration, Temperature, Contact stress**	**Level A and Level B**
Activity 5, FS 2	Activity 13, FS 9	Activity 26, FS 1	Activity 21, FS 11	Activity 22, FS 6

Final Jeopardy:

Question: Name the five levels of emergency responders according to OSHA.

Answer: First Responder, Awareness Level
First Responder, Operations Level
Hazardous Materials (HAZMAT) Technician
HAZMAT Specialist
On-scene Incident Commander (IC)
(Activity 23, FS 2)

Activity 33: Strengthening the Health and Safety Committee

- This Activity should take about 45 minutes.
- Review purpose with class participants.
- **Task 1 answer: Answers will vary with class participants.**
- **Task 2 answer: Information from Factsheets 4 and 5 should be included in the answers.**
- **Task 3 answers: Answers will vary with class participants.**
- **Activity 33: Strengthening the Health and Safety Committee Review Questions**

1. Where does a health and safety committee need to be rooted? **On the shop floor**
2. Where should the union committee have representatives from? **All major departments, shifts and work groups**
3. The deep dark hole, the fix-it committee and the employer dominated committee are all examples of what? **Common pitfalls to effective health and safety committees.**
4. In order to have a successful health and safety committee **must** reach out to the _____. **Membership**

Notes: _____