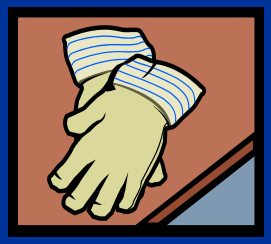
U.S.NRC
United States Nuclear Regulatory Commission
Protecting People and the Environment

HRTD
Human Resources
Training & Development

Chapter 9:

Industrial Safety



Objectives:

Identify, describe, and discuss general safety practices for hazards encountered at nuclear plants:

- **heat cramps/exhaustion/stroke**
- **noise**
- **electrical**
- **falls**
- **chemical**
- **oxygen-limited environments**

Discuss the information contained in Material Safety Data Sheets (MSDS) for use with chemicals.

Objectives:

Name basic industrial safety equipment and identify industrial safety items routinely required at nuclear power plants and fuel cycle facilities.

Discuss the NRC's Memorandum of Understanding (MOU) with OSHA.

Industrial Safety

Commercial reactor and fuel facilities have numerous safety hazards which are not radiological. These hazards can be real dangers to your health AND life.

The Non-Fatal Illness & Injury Rate measures the number of accidents resulting in days away from work.

It was 3.9 (per 200,000 person-hours) for general manufacturing, 3.0 for electrical utilities, and 0.6 for nuclear power (2009 BLS report).

Fatalities/Injuries at Power Generating Utilities

2009 occupational fatalities at work = 4340

- **Specifically, for all utilities:**
  - **Electrocution (0),**
  - **Vehicle operation (3),**
  - **Struck by an object (0), and**
  - **Falls (0).**

The greatest contributor to injuries continues to be strains and sprains, falls, being struck by objects, and overexertion.

Reference: Bureau of Labor Statistics, 2009

Emergencies in General

General Principles:

1) Assess the cause – don't become a victim! Considerations include: oxygen-limited environments, electrocution, heart attack, heat stroke, falls, diabetes, etc.

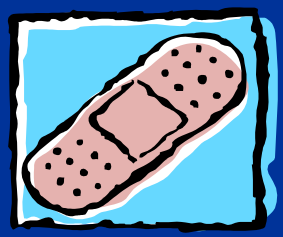
2) Call for help. Time is of the essence.

3) If needed, provide first aid only if you are qualified to provide it (e.g., CPR, use of AED units).

Medical Emergencies

Wounds: If you injure yourself, notify plant personnel immediately. For victims in contaminated areas, the precedence is to attend to the medical emergency over the concern for contamination.

Plants have arrangements with local hospitals to handle contaminated accident victims. If a victim in a contaminated area has to be taken to a hospital, an HP technician will typically be sent along to address the contamination concerns.



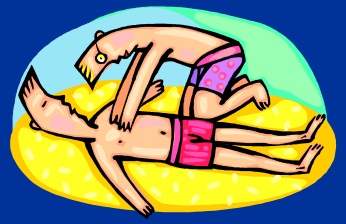
Reporting Problems/Emergencies

- Call the Control Room and provide the following information:
  - Who you are and the phone number,
  - Why you are calling,
  - Where you are, the location of the incident, the number of people involved,
  - What the incident involves – fire, medical, security,
  - When it occurred.

Responding to Problems/Emergencies

- Fires: Report the fire, standby in a safe location to warn others until the fire brigade arrives. Do not attempt to fight a fire unless it is small and clearly within your capability and training.

- Medical Emergencies: Report the injury/illness, provide the location and nature of the first aid emergency. Provide the victim's location. When your are assured of your own safety, render any first aid you are qualified to perform. Do not move an injured person unless directed by trained personnel. When the medical team arrives, offer assistance then stay clear of the area.



Heat Cramps

Heat cramps usually affect workers who sweat a lot during strenuous activity. This sweating depletes the body's salt and moisture levels. Low salt levels in muscles causes painful cramps. Heat cramps may also be a symptom of heat exhaustion.

Symptoms: Muscle pain/spasms usually in abdomen/arms/legs

First Aid: Stop all activity, and sit in a cool place.
Drink clear juice or a sports beverage.
Do not return to strenuous work for a few hours after cramps subside because further exertion may lead to heat exhaustion or heat stroke.
Seek medical attention if any of the following apply:

- The worker has heart problems.
- The worker is on a low-sodium diet.
- The cramps do not subside within one hour.

Heat Exhaustion

Heat exhaustion is the body's response to an excessive loss of the water and salt, usually through excessive sweating. Workers most prone to heat exhaustion are those that are elderly, have high blood pressure, and those working in a hot environment.

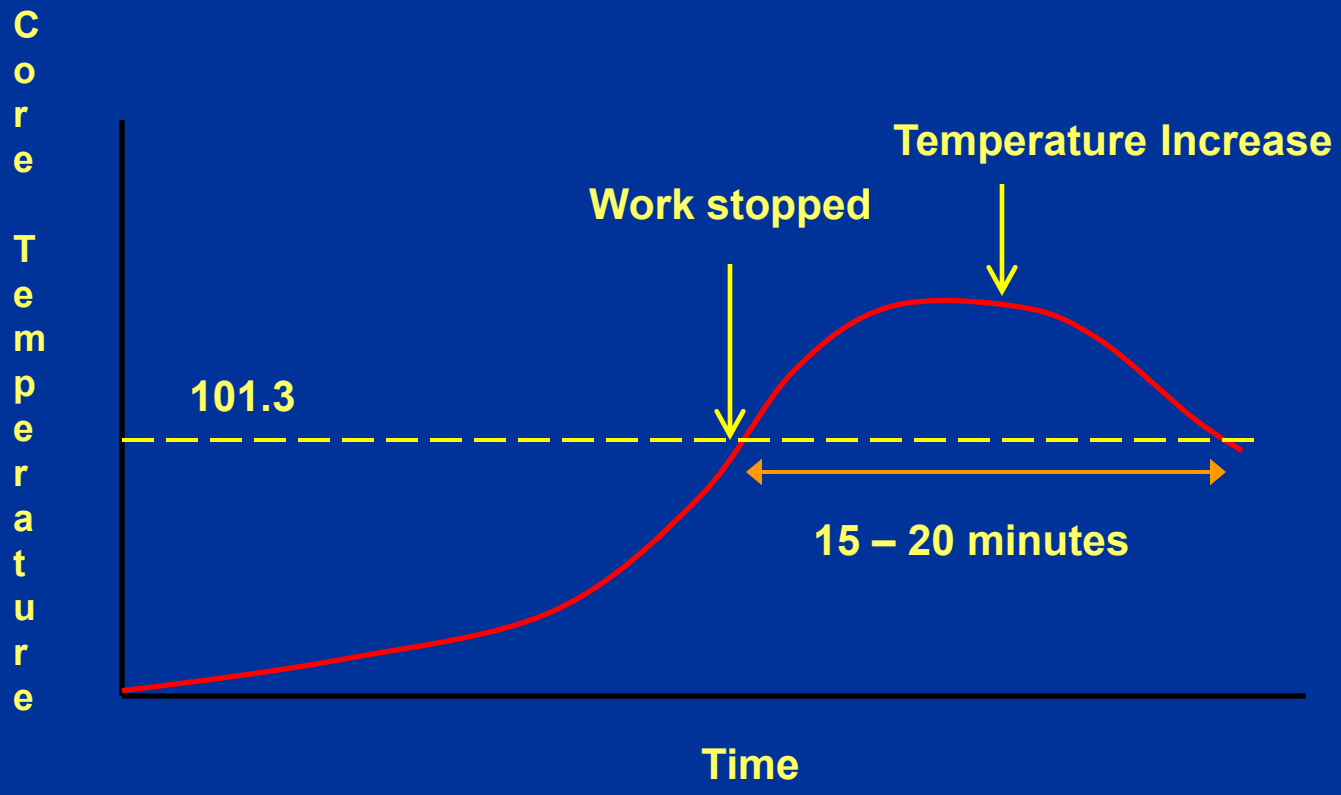
Symptoms:	**Heavy sweating; weakness/fatigue; dizziness; confusion; nausea; clammy, moist skin pale/flushed complexion; muscle cramps; slightly elevated body temperature**
First Aid:	**Move them to cool, shaded or air-conditioned area. Drink plenty of water/cool, nonalcoholic beverages. Have them take a cool shower, bath, or sponge bath.**

Heat Stroke

Heat stroke is the most serious heat-related disorder. It occurs when the body is unable to control its temperature: your temperature rises rapidly, the sweating mechanism fails, and the body is unable to cool down. When heat stroke occurs, body temperature can rise to 106°F, or higher, within 10-15 minutes. Heat stroke can cause death or permanent harm if emergency treatment is not given.

Symptoms:	**Hot, dry skin; profuse sweating; hallucinations; chills; headache high body temperature; confusion/dizziness; slurred speech**
First Aid:	**Call 911 and notify their supervisor. Move the sick worker to a cool shaded area. Cool the worker: soak clothes w/ water, spray/sponge/shower them w/ water, fan their body DO NOT GIVE THEM WATER TO DRINK!**

EPRI Study of Body Core Temperature of Males on Treadmill Wearing Protective Clothing



Males age 25-40, 150-170 lbs. Exercised for 45 min. or until temperature reached 101.3 degrees.

Core temperature monitored by internal probe that transmits data.

Heat Stress OE

A Resident Inspector (RI) and a licensee team were performing a containment walkdown prior to a refueling outage (RFO) when the containment access hatch malfunctioned and the team was unable to leave containment. The health physics technician with the team was trained to recognize the signs and symptoms of heat stress, as well as how to respond. The HP tech took appropriate actions to minimize the effects of heat stress on the team until they were able to leave containment (this included removing their anti-C's, and getting to a cooler area in containment). A special inspection team was chartered to review the event, and IOEB posted a COMM on this event.

Operating Experience

During another RFO at a different site, an RI was present on site to perform a mode 3 containment walkdown. The RI was accompanying a licensee team. The team ascended one SG platform (40' vertical climb), descended and then were preparing to ascend another platform. Prior to ascending, it was noted that the RI did not look well, but when questioned, he stated that he was fine. Upon reaching the platform, the RI lost consciousness. Licensee staff caught the inspector, preventing a 40' fall to the next level below. The licensee took appropriate action to cool down the RI, who was able to descend, with assistance, and leave containment. Emergency treatment was tended outside containment. The RI's vital signs were determined to be stable. He was given water and told to seek further medical evaluation. The RI was allowed to go home after site personnel verified he had recovered sufficiently.

Best Practices: Working in Heat

Workers should avoid exposure to extreme heat, sun exposure, and high humidity when possible. When these exposures cannot be avoided, workers should take the following steps to prevent heat stress:

- Wear light-colored/loose-fitting/breathable clothing (cotton.)
- Avoid non-breathing synthetic clothing.
- Gradually build up to heavy work.
- Schedule heavy work during the coolest parts of day.
- Take more breaks in extreme heat and humidity.
- Ice vests/packs may be available for wear.
- Take breaks in the shade or a cool area when possible.
- Drink water frequently, and enough to prevent thirst.
- Avoid drinks with caffeine/alcohol/large amounts of sugar.
- Protective clothing/PPE may increase the risk of heat stress.
- Monitor your physical condition and that of your coworkers.

Noise Hazards

Most licensee facilities will contain large numbers of operating machinery. These will tend to create a noisy environment that can have deleterious effects on your hearing if you do not take precautions.

OSHA noise limits vary based on exposure time, but generally are limited to ~ 90dB (continuous exposure above which will cause permanent hearing damage).

Examples of noise levels:

Telephone dial tone: 80 dB
Truck traffic: 90 dB
Jet engine @ 100': 140 dB

Hearing Protection

Check the signs at each entrance to a space/room.

Some areas will require DOUBLE protection if certain equipment is running (e.g., diesel rooms).

If entering a contaminated area, check BEFORE you dress out whether you will need hearing protection.

Electrical Hazards

Licensee facilities will also contain large numbers of components that need electricity to run.

Many plants will have high voltage power lines that reach 500,000 volts. Remember, however, it is the AMPERAGE that kills you: lower voltage sources can still provide lethal shocks.

Special equipment/clothing is available for workers that need to work around energized equipment. For most NRC personnel, you should never be in close enough proximity of open, energized equipment where you need the gear.

Electrical Hazards

When dealing with electrical items, TREAT ALL COMPONENTS AS ENERGIZED.

Even if you are just an observer, maintain a safe distance from the job.

According to OSHA, a person is killed every day in the US from injuries suffered due to arc flashes.

Falls

You will generally encounter multiple levels at all facilities you visit, as well as environments with wet or slick surfaces, ladders, scaffolding, etc.

In the US, the greatest contributor to injuries resulting in days away from work remains some type of fall.

Slips and falls do not always require large heights to cause injury. Most facilities are constructed of iron and concrete, so in any type of fall, your body will generally lose.

Fall Protection

Check with safety personnel at each licensee facility for rules about climbing, etc.

Generally, if you are on a walking/working surface with an unprotected edge greater than 6’ above a lower level, you must wear some type of fall restraint/ harness or there must be a protective device in place.

“Falls” also include falling objects: the best protection against this is your hardhat.

Chemicals

Power plants will use large varieties of chemicals in their day-to-day operations. Some of these will be stored in very small quantities; some will be stored in large tanks containing thousands of gallons.

These chemicals can produce a variety of personnel dangers:

- Toxicity/Asphyxiation
- Chemical Burns
- Carcinogenic effect
- Cryogenic injuries (frostbite)
- Blindness

Materials Safety Data Sheet - MSDS

OSHA requires that employers provide information to employees about the hazardous chemicals to which they are exposed, by means of a hazard communication program, labels and other forms of warning, material safety data sheets (MSDS), and information and training. (29CFR1910.1200(b)(1)).

The MSDS tells you about the physical and chemical hazards of exposure to the chemical(s), safe handling and information on providing emergency and first aid for exposure to the chemical.

MATERIAL SAFETY DATA SHEET
FOR ODORIZED PROPANE

1. Chemical Product and Company Identification

Product Name: Odorized Commercial Propane

Chemical Name: Propane

Chemical Family: Paraffinic Hydrocarbon

Formula: C3H8

Synonyms: Dimethylmethane, LP-Gas, Liquefied Petroleum Gas (LPG), Propane, Propyl Hydride

Name & Address:	Transportation Emergency Number:	Emergency Number:
BLUE STAR GAS 880 N. Wright Rd. Santa Rosa, Ca. 95407	**P.E.R.S.** 1-800-728-2482	***707-546-1400*** For Routine Info, Call: *707-546-1400*

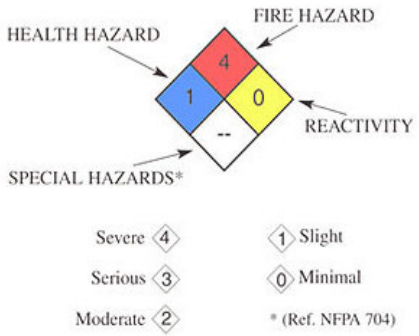
2. Composition/Information on Ingredients

INGREDIENT NAME /CAS NUMBER	PERCENTAGE	OSHA PEL	ACGIH TLV
Propane/74-98-6	87.5-100	1,000 ppm	Simple asphyxiant
Ethane/74-84-0	0-5.0		Simple asphyxiant
Propylene/115-07-1	0-10.0		Simple asphyxiant
Butanes/various	0-2.5		Simple asphyxiant
Ethyl Mercaptan/75-08-1	16-25 ppm	0.5 ppm	0.5 ppm

3. Hazards Identification

EMERGENCY OVERVIEW

DANGER! Flammable liquefied gas under pressure. Keep away from heat, sparks, flame, and all other ignition sources. Vapor replaces oxygen available for breathing and may cause suffocation in confined spaces. Use only with adequate ventilation. Odor may not provide adequate warning of potentially hazardous concentrations. Vapor is heavier than air. Liquid can cause freeze burn similar to frostbite. Do not get liquid in eyes, on skin, or on clothing. Avoid breathing of vapor. Keep container valve closed when not in use.



POTENTIAL HEALTH EFFECTS INFORMATION

ROUTES OF EXPOSURE:

Inhalation: Asphyxiant. It should be noted that before suffocation could occur, the lower flammability limit of propane in air would be exceeded, possibly causing both an oxygen-deficient and explosive atmosphere. Exposure to concentrations >10% may cause dizziness. Exposure to atmospheres containing 8%-10% or less oxygen will bring about unconsciousness without warning, and so quickly that the individuals cannot help or protect themselves. Lack of sufficient oxygen may cause serious injury or death.

MATERIAL SAFETY DATA SHEET

MANUFACTURER: Owens-Corning Fiberglas Corp.
Fiberglas Tower
Toledo, Ohio 43659

HEALTH INFORMATION PHONE & EMERGENCY PHONE:
8:00 AM-5:00 PM (EST); (419)-248-8234
Emergencies only, after 5:00 PM (EST); (419)-248-5339

PRODUCT DIVISION: Trumbull Asphalt Division

TECHNICAL PRODUCT INFORMATION PHONE:
8:00 AM-5:00 PM (EST); (708)-594-6977

DATE PREPARED: February 28, 1991
SUPERSEDES MSDS DATED: April 4, 1986

What chemicals are in the product?

SECTION I - COMPONENT DATA

HAZARDOUS INGREDIENTS:

COMMON NAME	CHEMICAL NAME	CAS NUMBER	% COMPOSITION	OSHA-PEL	ACGIH-TLV	OTHER
Petroleum Asphalt	Petroleum Asphalt	8052-42-4	100	None Established	5 mg/m³ 8-hr TWA (asphalt fumes)	NIOSH, 5 mg/m³ Ceiling Limit
Hydrogen Sulfide	Hydrogen sulfide	7783-06-4	Contaminant	10 ppm 8-hr TWA	10 ppm 8-hr TWA	NIOSH, 10 ppm 10 minute max.

What is the maximum amount of each chemical you can legally be exposed to? (This is also called the "permissible exposure limit" or PEL.)

SECTION II

INHALATION: Move individual to fresh air ... oxygen. If not breathing, administer ... minister

SKIN CONTACT: If hot material strikes the skin, immediately drench or immerse the area in water to assist cooling. If available, apply iced water or ice packs to the burned area. (Do not used iced water or cold packs if the burned area covers more than 10% of the body, as this may contribute to shock.) Do not try to remove asphalt from a burn after it has ... attention. Medical personnel can soften and remove cooled asphalt with petroleum jelly. For contact ... clean exposed skin with waterless hand cleaner, then wash with mild soap and water. If irritation ... attention.

... flush eyes with running water for at least 15 minutes. Seek medical attention immediately.

Is the product a fire or explosion hazard?

SECTION III - FIRE AND EXPLOSION DATA

FLASH POINT (°F): 400+ for asphalt — METHOD USED: Cleveland Open Cup

AUTO IGNITION TEMPERATURE (°F): Unknown. — FLAMMABILITY LIMITS (%): LEL: Not Determined UEL: Not Determined

How does it enter your body?

... bon dioxide, dry chemical.

SECTION IV - HEALTH HAZARD DATA

PRIMARY ROUTES OF EXPOSURE: Inhalation, skin contact, and eye contact.

HEALTH HAZARDS (including acute and chronic effects and symptoms of overexposure):

ACUTE: Inhalation: Heated product may release asphalt fumes which may cause nose, throat, mucous membrane irritation, nauses, headaches, or dizziness. See Section VII for health hazards of hydrogen sulfide in confined

How can it affect your health in the short term and long term?

... ith the cold product may result in dryness, and irritation. Contact ... nal burns. Long term skin exposure to asphalt fumes can increase ... kin discoloration.

CHRONIC: Prolonged or repeated skin contact with this product may result in irritation and dermatitis. (See Carcinogenicity below.)

Oxygen-Limited Environments

Oxygen-limited environments, generally called confined spaces (CS), can be immediately dangerous to life and health (IDLH).

Most facilities require specialized training before allowing an individual to access a CS.

OSHA requirements contain specific rules for marking the CS, accessing the CS, and special training for attendants at the CS entrance, as well as rescuers.

Confined Spaces

Confined space entries still result in fatalities in the US each year.

In 1988, a US PWR experienced a fatality in a CS when a worker entered in an attempt to rescue a diver that was overcome by a lack of oxygen.

General Safety Equipment

Safety Equipment includes:

Use of Personal Protective Equipment (PPE): Hardhats, eye protection, ear protection, and safety shoes/sturdy shoes (leather or rubber that covers your entire foot and sole - no pointed heels, moccasins, athletic shoes or sandals.)

Be attentive to safety equipment requirements.

Identify policies for use of safety equipment when entering contaminated areas - are hard hats worn in contaminated areas? If so, where are the hard hats kept?

PPE

Hard hats: generally, licensees will provide a hardhat for your use.

Safety glasses: generally, licensees will provide NON-prescription glasses for your use. If you need prescription safety glasses, the NRC may provide these (see note from Admin). Contacts are generally allowed.

Safety shoes: If you visit facilities regularly, the NRC may provide these (see note from Admin). Contact the site Resident Inspectors office for local requirements.

PPE

Hearing Protection: Generally, facilities will provide any required hearing protection.

Gloves: Depending on your activities, you may need to wear leather or rubber gloves. These would generally be provided to you by the licensee.

Additional Eye Protection: In certain cases, you may need goggles or face-shields, in addition to standard safety glasses. These will generally be provided to you.

Fall Protection: Generally provided.

Arc Flash Gear: Generally provided.

Safety Glasses & Shoes

The Admin Service Center places orders to obtain protective shoes and glasses for employees who are subjected to safety hazards.

To request eyeglasses or shoes -

Please forward an email through your supervisor for approval to ASC or send an approved NRC Form 30 to O2-A11.

Please include the reason that the safety equipment is needed.

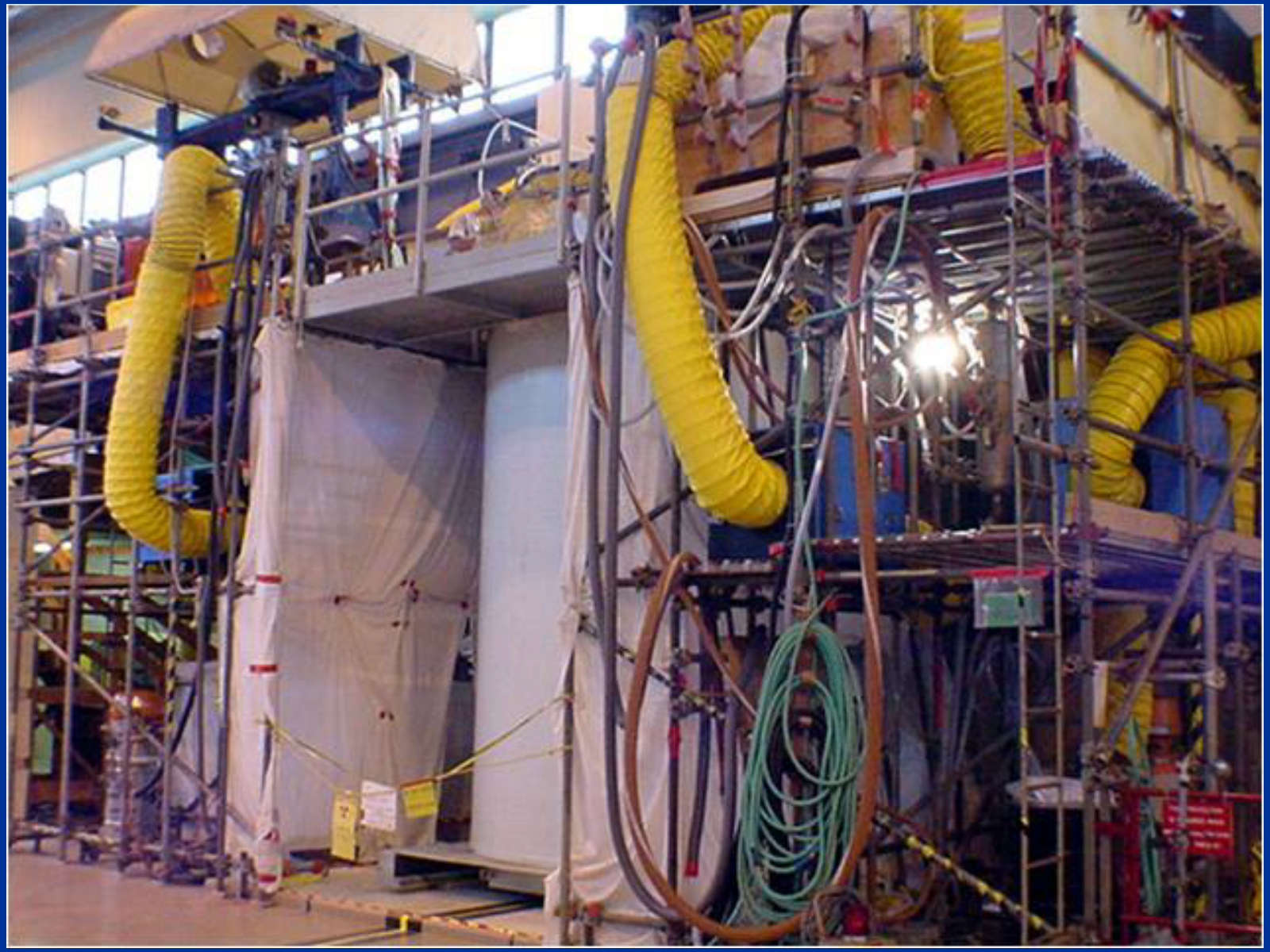
Contact: **Tojuana Fortune Grasty**
Admin Services Specialist
301-415-4272
ASC@nrc.gov

The NRC - OSHA MOU

The NRC has a memorandum of understanding (MOU) with OSHA on occupational safety at licensee facilities. The MOU (IN 88-100) describes areas of responsibility between NRC & OSHA.

According to the MOU, NRC personnel may identify safety concerns within the OSHA responsibility areas or may take complaints from employees about OSHA-covered conditions. They may bring these matters to the attention of licensee management, or elevate OSHA safety issues to the attention of the NRC Regional management when appropriate.

What do I need to watch out for?



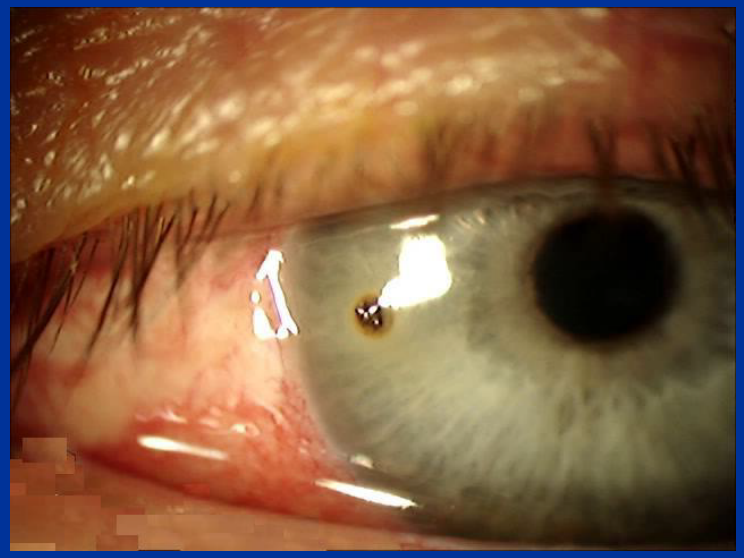
What do I need to watch out for?

What do I need to watch out for?

What do I need to watch out for?

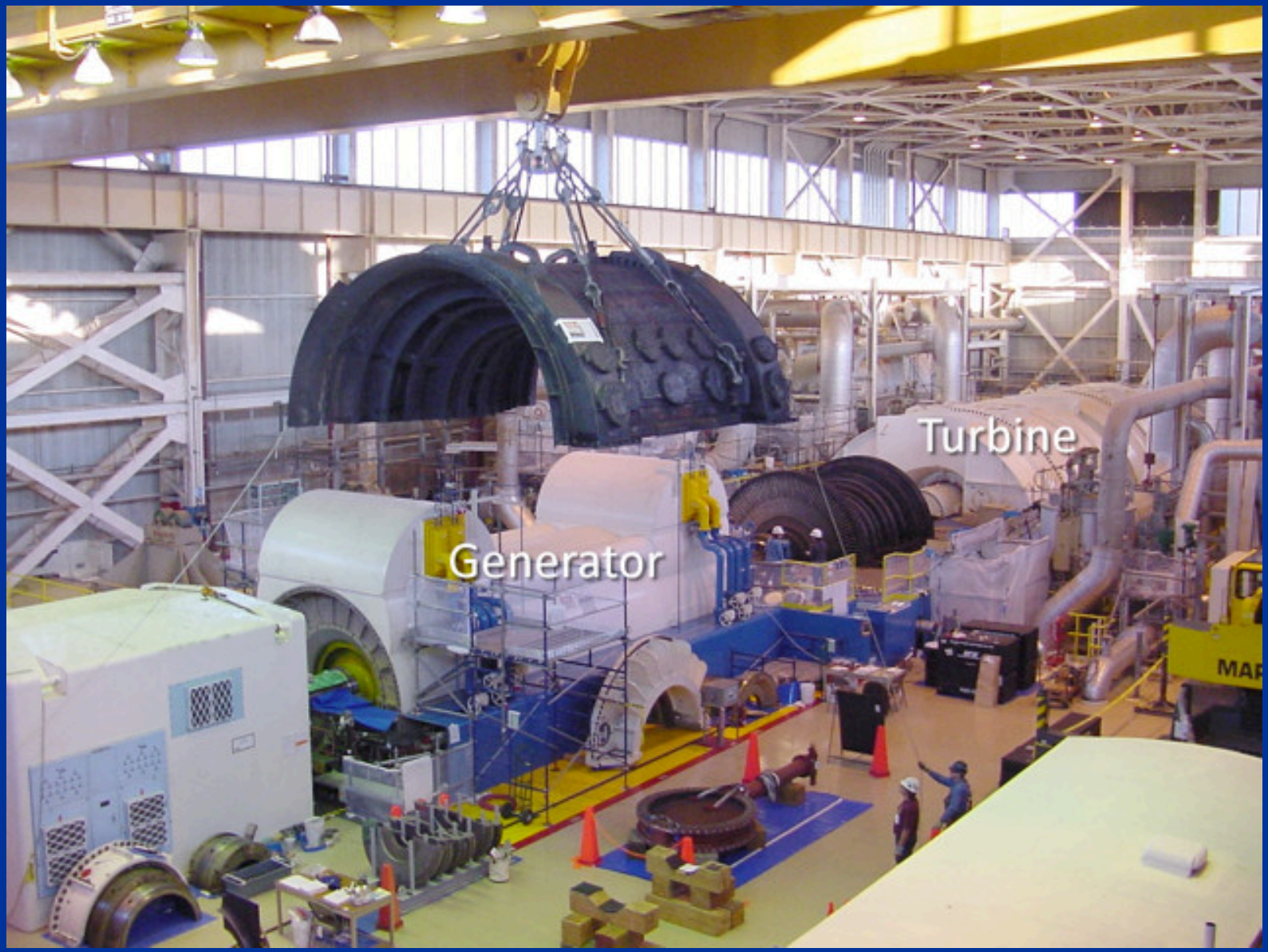
What do I need to watch out for?

What do I need to watch out for?

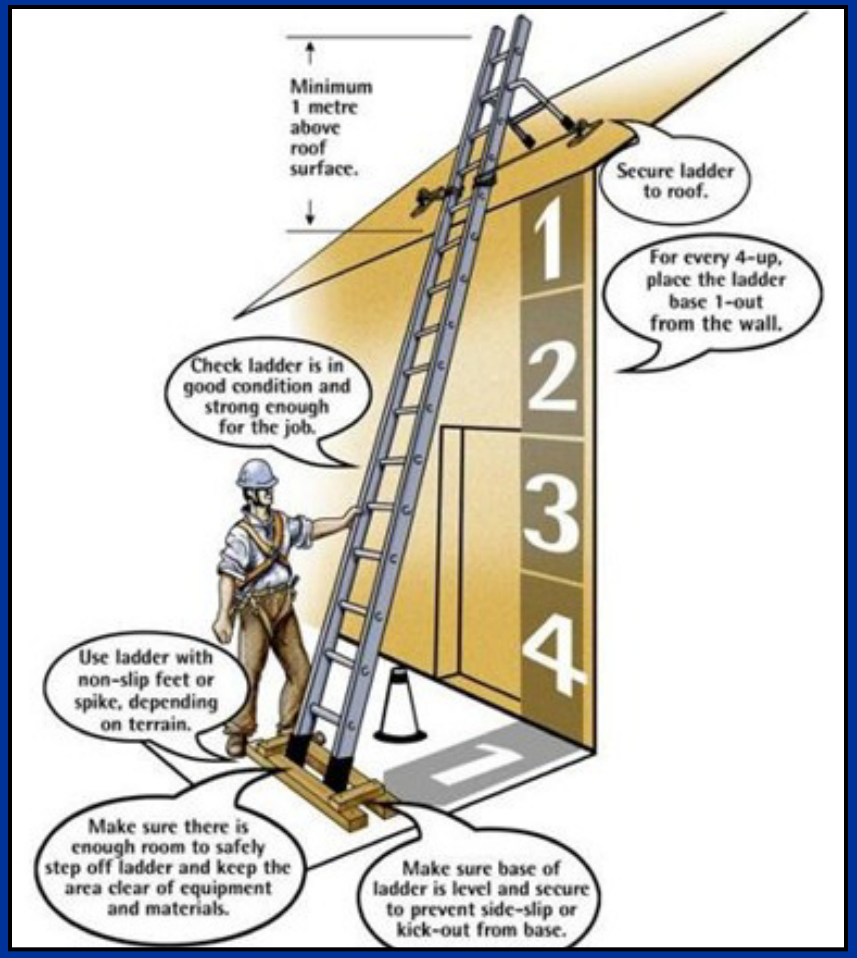


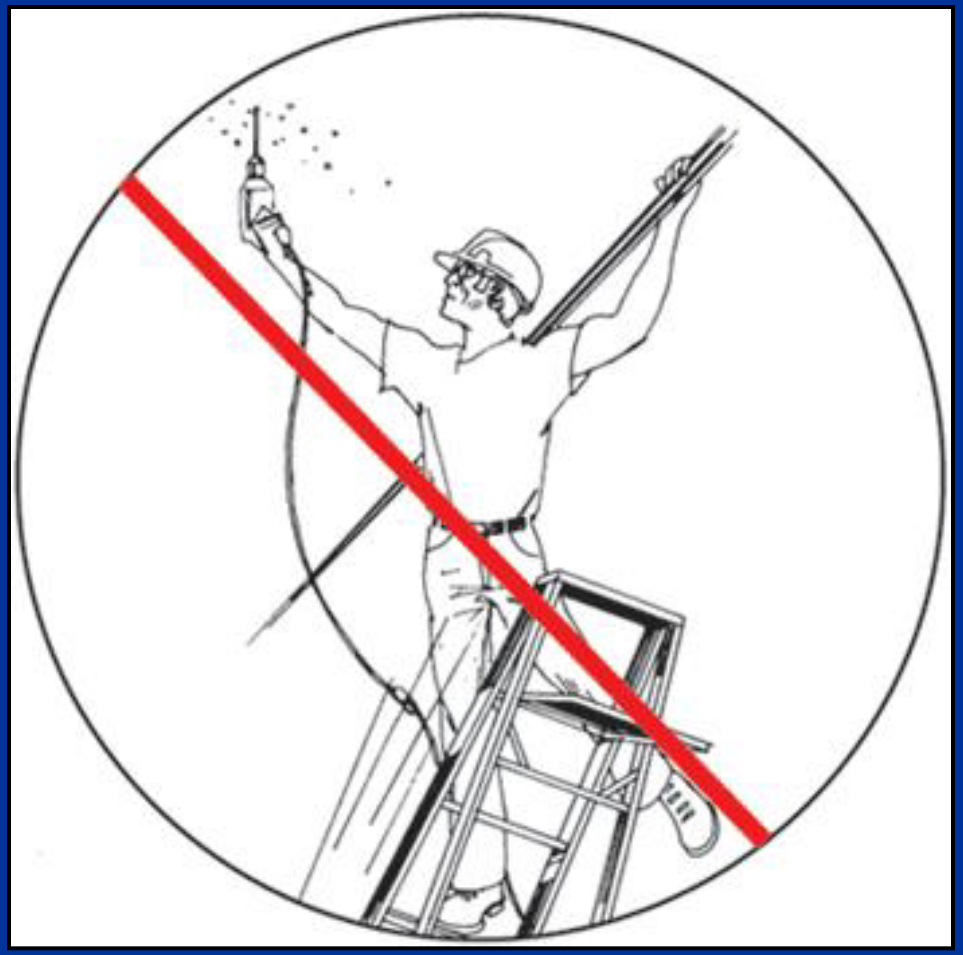
What do I need to watch out for?

What do I need to watch out for?



What do I need to watch out for?





READ ALL SIGNS!!!

Review

- The NRC has a "memorandum of understanding," MOU, with OSHA regarding industrial safety.
- Licensees are required to have "material safety data sheets," (MSDS's) for all hazardous chemicals – these provide information on safe handling/first aid for chemical exposures.
- Hazards at plants include: electrical – treat all components as energized; chemical – MSDS's are required; physical - falls, wear appropriate shoes, use hand rails, hard hats, and eye protection, oxygen limited environments – make sure an assessment has been conducted; burns – be alert for hot surfaces and steam; noise - use hearing protection.
- You should treat ALL electrical equipment or components as if they are energized.

Review

- For medical emergencies – report the incident, don't become a victim.
- The special medical emergencies are heat exhaustion – being overheated and, heat stroke – a life threatening medical emergency.
- Medical emergencies take priority over any contamination concerns.
- The number one cause of injuries at nuclear facilities is some type of fall.
- Entry into confined spaces will require some type of specific licensee training.

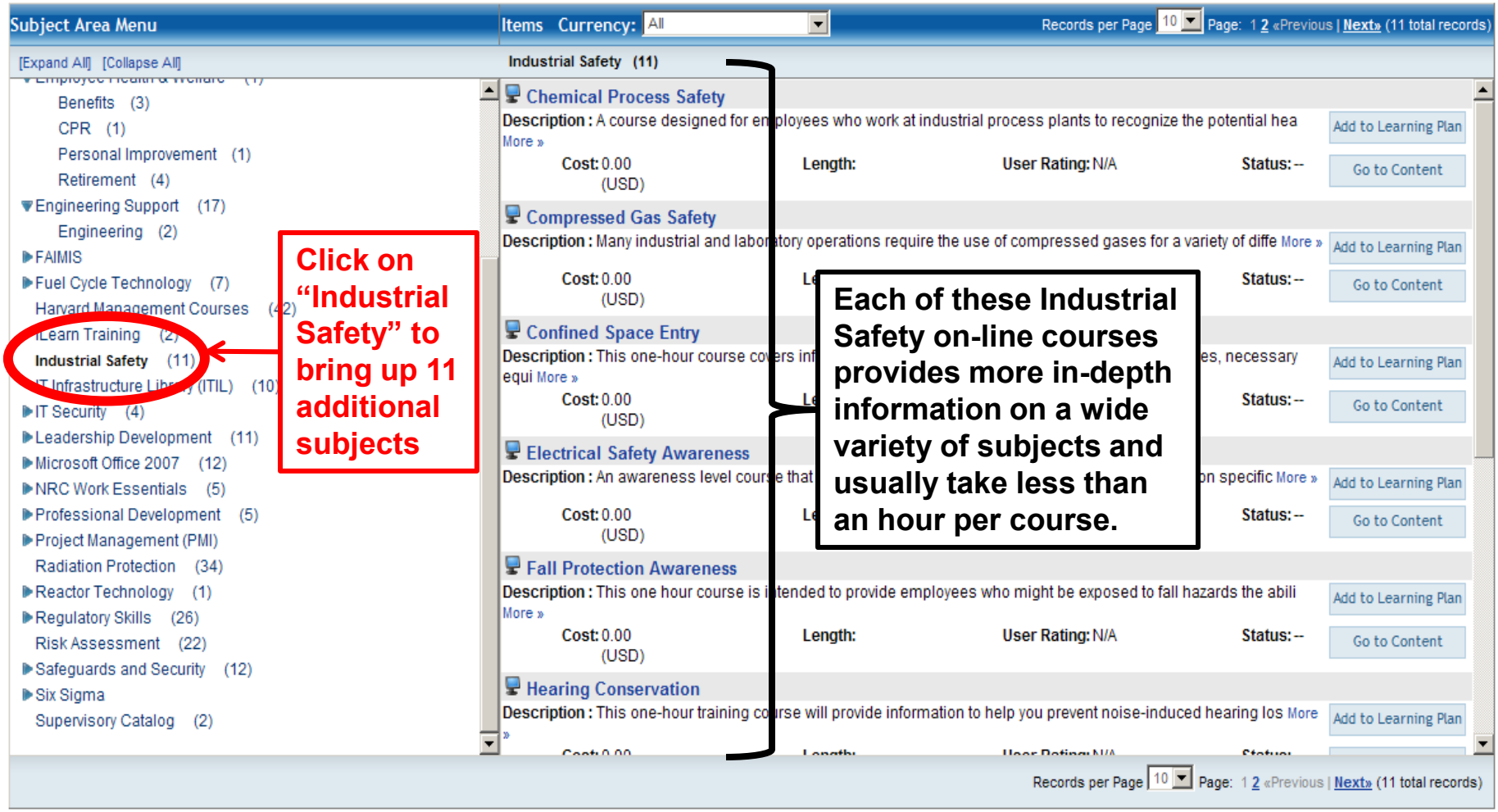
Need more Industrial Safety training?

Personal | Learning | Catalog | Reports

Sign into iLearn and click on "Browse Catalog"

Browse Catalog

This page is used to browse the catalog by Subject Area. You can click the Expand icon next to any subject area title to view the Subject Areas nested beneath it.



Click on "Industrial Safety" to bring up 11 additional subjects

Each of these Industrial Safety on-line courses provides more in-depth information on a wide variety of subjects and usually take less than an hour per course.