PRESENTER'S GUIDE

"ELECTRICAL SAFETY IN HAZMAT ENVIRONMENTS"

Training for the
OSHA HAZARDOUS WASTE OPERATIONS
and EMERGENCY RESPONSE (HAZWOPER) REGULATION

Quality Safety and Health Products, for Today... and Tomorrow

OUTLINE OF MAJOR PROGRAM POINTS

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The following outline summarizes the major points of information presented in the program. The outline can be used to review the program before conducting a classroom session, as well as in preparing to lead a class discussion about the program.

- **In a HAZMAT environment, everyday things such as electricity can become alien and dangerous.**

- **Normally an invisible part of daily life, electricity can:**
  - Ignite many hazardous materials.
  - Create fast-moving fires that are hard to control.
  - Make certain HAZMATs explode.

- **Ideally, electricity should be kept far away from HAZMAT substances at all times. Unfortunately, this is not always possible.**
  - Some manufacturing processes create flammable or explosive atmospheres in areas where electricity powers equipment or lights.
  - Also, hazardous materials emergencies often occur in electrified areas, such as when HAZMAT railroad tank cars crash into power lines.

- **In this program, you will learn general rules for staying safe around electrical power in HAZMAT environments, no matter what kind of conditions you encounter.**
  - We'll begin by considering worst-case scenarios, specifically, how electricity behaves when it's out of control.

- **Typically, uncontrolled electrical energy can produce three types of effects:**
  - Arcs.
  - Sparks.
  - High temperatures.

- **An "arc" is an electrical discharge crossing a gap between two points. These can occur in circuits that are:**
  - Overloaded.
  - Subject to voltage spikes.
  - Inadequately grounded.

- **Arcs produce heat that can ignite combustible materials. They also increase the risk of electrocution.**

- **"Sparks" are incandescent particles.**
  - They emit visible light as a result of being heated.

- **A malfunction that produces sparks is very serious.**
  - Sparks can indicate high-voltage arcing.
  - The higher the voltage, the greater the danger of fire, explosion or electrocution.
  - A spark can also be carried by air currents to other areas, causing fires a great distance away.

- **Because sparks glow due to heat, the more sparking occurs, the hotter the surrounding area becomes.**
  - This leads us to the next effect that uncontrolled electricity can have... high temperatures.

- **Electric lines that don't have enough insulation for the power they are carrying can radiate heat.**
  - The higher the voltage and the poorer the insulation, the greater the temperature.

- **While arcs and sparks produce high temperatures, an electrical line can also overheat without arcing or sparking. This can be caused by:**
  - Worn insulation.
  - Increasing the voltage of the line above the recommended safety limits.

- **Arcs, sparks and high-temperature electrical lines are particularly dangerous in locations that contain hazardous substances.**
  - Dealing with electricity in HAZMAT areas can lead to complex situations.
  - Fortunately, many of these issues are covered by the National Electrical Code (NEC).

- **The NEC is the primary source for electrical standards in the United States, and contains guidelines for electrical use in <u>all</u> environments where hazardous materials are located.**
  - The NEC divides hazardous materials areas into three classes, each with its own electrical specifications.

- **The three NEC HAZMAT area classes are:**
  - Class I: Where electricity could ignite airborne flammable gases and vapors, or cause them to explode.
  - Class II: Where airborne combustible dust is present.
  - Class III: Where ignitable materials are present, but are not airborne in sufficient quantities to catch fire.

- **Class I areas include:**
  - Refineries.
  - Chemical manufacturers.
  - Hospitals.

- **These sites contain flammable gases and vapors which can be ignited by unshielded electrical devices.**
  - In spite of these dangers, there are safe ways to work with electricity in these areas.

- **One of the most effective ways is through "engineering controls", which use technology to reduce workplace hazards.**

- **Since all electrical devices from large machinery to pocket flashlights contain circuitry, it is critical that you use approved equipment for the area you are working in.**

- **Electric devices with moving parts such as mechanical relays can produce arcs.**
  - This makes them unsuitable for Class I sites.
  - For this reason, Class I sites need to be equipped with "intrinsically safe" systems.

- **Also known as "non-incendiary systems", these are electronic circuits that carry out the same function as their mechanical counterparts... but without producing sparks.**

- **Devices with these features are always marked with a label that identifies them as being "intrinsically safe".**
  - If a piece of equipment is not marked "intrinsically safe", it should not be used in a Class I site.

- **The only drawback to intrinsically safe systems is that they must be designed for specific atmospheres.**
  - This is because different substances have different flashpoints.
  - An intrinsically safe electrical system that is safe in one HAZMAT environment might not be safe in another.
  - Due to the broad range of chemicals used by industry, the NEC has not specified a "lowest common denominator" intrinsically safe system for use in <u>all</u> hazardous environments.

- **Other engineering controls include specialized enclosures that can actually suppress explosions.**
  - If something inside one of these containers explodes, the damage would be contained, and the outside air will not be heated to the point that it ignites.
  - These explosion-proof cases are not necessarily gas-tight or vapor-tight, but they are flame-tight, which means that fire cannot escape from them.

- **Other engineering controls isolate machinery from Class I hazardous atmospheres to prevent fires and explosions from occurring. These controls fall into three broad categories:**
  - Hermetic seals made of metal or plastic.
  - Encapsulating seals of tar, wax or epoxy.
  - Oil immersion, which uses a layer of oil as a barrier against flammable or explosive atmospheres.

- **As important as engineering controls are in Class I environments, they are only one part of the safety picture. "Work practices" are equally important.**
  - Together with engineering controls, they form a total system of preventive measures.

- **Work practices are administrative methods for isolating workers from hazardous materials.**
  - While engineering controls deal with technology, work practices involve operating procedures.

- **In Class I environments, the two most common work practices are:**
  - Purging.
  - Inerting.

- **Both of these remove flammable or explosive gases from the local atmosphere.**

- **Purging uses non-flammable gases called "purgatives" to flush flammable atmospheres from enclosed spaces.**
  - The amounts of purgatives that are required vary with the molecular weights of the substances being removed.
  - Carbon dioxide and nitrogen are commonly used as purgatives, because they are inert and react with very few other chemicals.
  - The National Electrical Board and OSHA also permit the use of positive-pressure air as a purgative, provided that safeguards are taken against ventilation failure.

- **Purging can sometimes cause problems, however.**
  - In some cases, purged flammable gases or vapors can ignite after they are vented to the outside air.
  - So it is critical that these gases are vented safely away from ignition sources.

- **The other common Class I work practice, "inerting", consists of adding a nonflammable gas to the atmosphere in order to displace oxygen.**
  - The object is to reduce the percentage of oxygen in the atmosphere to the point that it is too low to support burning.
  - The precise amount of oxygen reduction that is necessary depends on the substances that are involved.
  - For chemical-specific information on effective oxygen-reduction levels, consult the SDS for the substance in question.

- **However, inerting may cause problems in confined spaces because it can remove so much oxygen that the air becomes unbreathable.**
  - This condition is called an "oxygen-deficient" atmosphere.

- **Before anyone enters an inerted space, it must be tested to see if it can support life. If it can't, the entrant must wear:**
  - An OSHA-approved, supplied-air respirator (SAR).
  - A harness.
  - A lifeline.

- **Entrants must be monitored at all times by an attendant outside of the confined space.**
  - A rescue team must also be available in case of an emergency.

- **While Class I sites are complex work environments that present many hazards, Class II areas pose different risks.**
  - In Class II sites, airborne combustible dust is the primary threat.

- **This is why electrical equipment that is used in Class II areas must be both:**
  - Dust-tight.
  - Resistant to overheating when covered with dust.

- **Devices that meet both of these criteria are referred to as "dust-ignition-proof".**
  - Hermetic sealing, encapsulation and oil immersion can all be used to keep machines free of ignitable dust.

- **Work practices can also prevent electrical accidents in Class II environments.**
  - Of these procedures, the most common is pressurization.
  - Similar to purging, this uses a pressurized inert gas or clean air to periodically blow dust out of the area.
  - Unlike purging, however, pressurization cannot bring an area to a safe level once dust is inside...it is a preventive measure only.

- **If dust gets inside the area, it must be removed through manual means, using a broom or a non-sparking shovel.**
  - Never use a vacuum cleaner (it's motor might produce a spark that could ignite flammable or explosive materials).

- **Be careful! Removing dust could also cause some of it to become airborne in the process, making the atmosphere more hazardous.**
  - If this occurs, electrical power sources will need to be switched off and the dust removed by high-volume fans.

- **Purging and inerting are used infrequently in Class II environments, since both can stir up even more dust, and cause it to become airborne.**
  - If these methods <u>are</u> used, the air pressure must be kept low, to prevent the dust from being stirred up.

- **So far, we've looked at site classes that involve significant amounts of airborne contaminants. Class III sites are different.**
  - At these locations, the air doesn't contain ignitable materials in sufficient quantities to catch fire.
  - In these areas, the concern is flammable deposits that may build up on floors, counters and equipment.
  - This is why high surface temperatures are the primary concern in Class III areas.

- **Keeping machine temperatures down can be achieved in several ways:**
  - The equipment room can be kept cool and well-ventilated (this also reduces dust in the area).
  - Machinery can be insulated and be run within safe operating temperatures.

- **No matter what measures are used, however, fan-cooled motors should not be installed in Class III areas.**
  - Combustible fibers could clog the fan, shutting it down.
  - This could cause the motor to overheat, resulting in a fire or an explosion.

- **Although the three classes of HAZMAT areas that we've been discussing are different in many ways, they do have some things in common:**
  - No matter what class a HAZMAT environment belongs to, all of its wiring and electrical equipment must be installed in accordance with the National Electrical Code.
  - Electrical equipment used in these locations must also be approved by Underwriter's Laboratories (UL), or another testing organization recognized by federal authorities.

- **Most of the time, following safety regulations, observing safe work practices and using appropriate engineering controls can keep accidents from occurring.**
  - There are times, however, when you may encounter accidents involving electricity and hazardous materials that have already occurred.
  - These situations must be brought under control quickly.

- **We've seen how hazardous materials can react to electricity in various ways.**
  - Some catch fire or explode easily.
  - Many are excellent conductors, increasing the danger of electrocution.

- **But even if released chemicals do not react to electricity, uncontrolled electrical sources at the site are dangerous in themselves.**
  - This is why one of the primary objectives in an emergency is to immediately cut the power.

- **You may be able to do this by switching off circuit-breakers, but not if the breakers are located in a flammable atmosphere!**
  - In these circumstances, an arc could occur, igniting the air.
  - If you have any doubts about the local atmosphere, get out fast and have the power shut off remotely, by the electric company.
  - Until the electricity is turned off, no one... not even responders... should enter the site.

- **Everyone must be kept a safe distance from the area until the power shut-off is confirmed by someone in authority, such as the Incident Commander.**
  - A "table of initial isolation and protective action distances" can be found in the Emergency Response Guidebook.

- **When first responders <u>are</u> allowed in an electrical hazard area, they must use monitoring and sampling equipment that is designed to prevent ignition.**
  - These devices guard against ignition by using technologies such as intrinsically safe systems and hermetic seals.

- **As we've seen, the presence of electricity at a HAZMAT site makes the area even more dangerous.**
  - But by following proper procedures, you <u>can</u> stay safe in these situations.

*** * *SUMMARY* * ***

- **Uncontrolled electrical energy can produce three major effects, all of which can heat materials above their flashpoints:**
  - Arcs.
  - Sparks.
  - High temperatures.

- **The National Electrical Code (NEC) divides HAZMAT areas into three classes:**
  - Class I (containing flammable gases and vapors).
  - Class II (airborne combustible dust is present).
  - Class III (ignitable materials are present in small quantities).

- **Electrical hazards in these areas can often be managed through engineering controls and work practices.**

- **One of the primary objectives in a HAZMAT emergency is to cut the power immediately.**

- **Until someone in authority confirms that the power is shut off, everyone... including first responders... must stay a safe distance from a HAZMAT area.**

- **In a HAZMAT environment, everyday things like electricity can become alien and dangerous... but that doesn't mean they are uncontrollable.**

- **Know the safety rules, follow them without exception, stay on your toes... and you will stay alive!**