Grounding and Bonding Against Static Electricity

Jon Koppari, CSP, MS
Occupational Safety and Health Instructor
OSHA Training Institute
Objectives

• Identify Sources of Ignition.
• Identify Hazards associated with static electricity.
• Explain difference between grounding and bonding.
• Explain best practice techniques for grounding and bonding.
• Explain how to plan for overhead power line hazards
Sources of Ignition

- Hydrogen Sulfide H2S
- Methane
- Hydrocarbons
- Natural Gas
- Lightning
- Flashlights
- Electrical
- ????????
Static Electricity

• An imbalance of electric charges within or on the surface of a material.
• Created whenever two surfaces contact and separate.
• When the positive and negative charges are equal on both sides of the material.
(a) Charge accumulation on low conductivity liquids

(b) Charge accumulation on an insulated conductor

(c) Charge accumulation on a person on an insulating floor or wearing insulating footwear

(d) Charge accumulation on insulating solids (e.g., rubbing an insulating pipe)
Static Electricity

• Other Examples
  – Belts and pulleys
  – Tires and the road
  – Fluid flow through a pipe
  – Agitation and mixing of fluids
  – Splash filling of flammable liquids
Static Electricity

For static electricity to be a hazard, four conditions must be met:

- There must be a means for a static charge to develop.
- Enough energy must build up to cause ignition.
- There must be a discharge of this energy (a spark).
- The spark must occur in an ignitable vapor or dust mixture.
Hazards of Static Electricity

- **BURNS (Electrical)**
- **ELECTROCUTIONS**
- **SHOCK and FALL**
- **ARC BLAST – ARC FLASH (Thermal)**
- **FIRE**
- **EXPLOSIONS**
Grounding and Bonding

- Listed Safety Can
- Drum Containing Class I Flammable Liquid
- Bonding
- Grounding
Grounding and Bonding

• Bonding equalizes the potential charges, but does not eliminate the static charge.
• Grounding directly connects to earth through a ground rod, copper pipe or building steel. This allows for the static charge to be drained away.
Grounding and Bonding Techniques
Where to Ground and Bond

• Rig substructure, derrick mast and other equipment.
• A tank truck when loading and unloading hydrocarbons.
• Frak tanks during flow back
• blending, pumping and sand transfer equipment.
• Electrical panels, MCC, Switchboards, equipment and motors (Equipment Grounding Conductor).
• Mixing stations.
• Portable generators.
• ?????????
Grounding and Bonding Techniques

Connectors for bonding and grounding, such as copper wire and clamps, must provide a good conductive path. To ensure this:

- Must be permanent, effective and continuous.
- Remove all dirt, paint, rust, or corrosion from areas where connections are to be made.
- Use connectors that are strong enough for the job.
- Use flexible connectors where there is vibration or continuous movement.
- Connect **metal to metal**.
- Protect ground clamps, and fittings and connectors from physical damage.
**Grounding and Bonding Techniques**

- **Ground Rod Electrode Installation**
  - **Section 250.53(G)**
  - **A**: 8 ft Minimum
  - **B**: 45°
  - **C**: 2½ ft Minimum
  - **Clamps must be suitable for direct burial [250.70]**.

- **Rock Bottom**

- **The upper end of the ground rod must be flush with or underground unless protected against physical damage.**
Grounding and Bonding Techniques

**Sphere of Influence**

- Grass
- Dirt
- Copper Driven Rod

10 ft.
Grounding and Bonding Techniques
Grounding Techniques
Grounding Techniques

Buried Copper Plate

Electrolytic Electrode

- Moisture from air coming in
- Augered hole
- Wire
- Copper Pipe
- Bentonite Clay
- Salt solution leaking out
Grounding Techniques

• Grounds must not be connected to:
  – Electrical conduit systems
  – Plastic pipes
  – Gas or steam pipes
  – Dry pipe sprinkler systems
  – Lightning rods
  – Metal storage racks
  – Building support beams
Planning for Power Line Hazards

To help plan for and eliminate power line contacts, follow this process:

**Survey:** Locate the power lines on the job site.

**Identify:** Determine which activities and equipment will be at risk of contacting a power line.

**Eliminate:** by having the utility company de-energize and visibly ground the line or have them move the line a safe distance away.

**Control:** if the power line cannot be de-energized or moved, then take precautionary measures and have a written plan.
Planning for Power Line Hazards
Planning for Power Line Hazards
Ground the Equipment that will be working near or under the power lines
Have utility move power lines beyond the safe working distance.
Planning for Power Line Hazards
Resources

• NFPA 77 Recommended Practice on Static Electricity

• API RP 54 Occupational Safety for Oil and Gas Well Drilling and Service Operations

• API RP 2003 Protection Against Ignitions Arising Out of Static, Lightning and Stray Currents

• NEC NFPA 70 National Electrical Code Article 250
Any Questions