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# Environmental and Safety Concerns with $SF_6$ Gas

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# $SF_6$ Gas – Sulfur Hexafluoride Pure State

- Odorless, colorless, tasteless, non-flammable, non-corrosive and non-toxic
- It is also and asphyxiant
  - Must vent and test atmosphere
  - Heavier than air
  - Will displace air

# $SF_6$ Gas – Sulfur Hexafluoride Contaminated State

- Toxic decomposition byproducts
  - $SF_4$, $S_2F_2$, $SOF_2$, $SO_2F_2$, $SO_2$, HF and hydrofluoric acid
  - "Rotten egg" odor
  - Do not inhale
- The amount of decomposition byproducts depends on voltage, number of operations, type of operation
- Solid decomposition byproducts-metal fluorides
- Under normal operation, the amount is small
- Considered contaminated if $SO_2$ concentration greater than 3 ppm. Must avoid direct contact

# $SF_6$ Gas – Sulfur Hexafluoride Contaminated State

- Health Affects
  - Skin Irritation
  - Mucous membrane irritation
  - Upper respiratory tract infection
  - Cramps and itching
  - Exposure to elevated concentrations may result in asphyxiation and possible death
  - If metal fluorides contact skin or eyes, flood with water for 20 minutes and immediately seek medical attention

# $SF_6$ Gas – Sulfur Hexafluoride Contaminated State

- Personal Protective Equipment (PPE)
  - Disposable Polycoated Saranex or Sontara coveralls
  - Disposable nitrile gloves
  - Disposable rubber boots
  - Plastic bags for disposal
  - Supplied air respirator system for initial opening and cleaning
    - Respiratory protection may be downgraded after initial cleaning

# Identification of Equipment


SF6 EQUIPMENT ELECTRICAL ARCING MAY RELEASE HAZARDOUS BY-PRODUCTS

- Equipment containing $SF_6$
  - On access covers
  - Adjacent to sampling valves
  - On compartments containing $SF_6$
  - On circuit breaker and transformer control cabinets
  - Cable manholes associated with feeders with $SF_6$ terminations

# Working on $SF_6$ Equipment


SF6 Gas shall NOT be vented into the atmosphere. A SF6 Gas Reclaimer Cart shall be used to reclaim SF6 gas.

- Prior to any work
  - Gas is to be tested-if greater than 3ppm considered contaminated
- If Not Contaminated
  - Evacuate $SF_6$ using a reclaimer cart and filter
  - Introduce Grade D breathable air into equipment
  - If cannot enter, atmospheric air can be introduced by means of a blower and opening access points, no Chem Lab testing required
  - If making bodily entry, breathing air to be tested and certified to be 19.5 to 23% oxygen.

# Working on $SF_6$ Equipment

- If Contaminated
  - Create a hot and cool zone
  - Evacuate $SF_6$ using a reclaimer cart and filter
  - Introduce Grade D breathable air into equipment
  - Personnel shall not enter until testing indicates 19.5-23% oxygen and less than 3 ppm $SO_2$ with all results recorded
  - Before contacting internal parts a check for metal fluorides shall be conducted
    - Prior to inspection, must be suited up and use supplied breathable air
    - If residue observed, shall be cleaned using approved vacuum with HEPA filter and cleaned with Precision solvent
    - A portable eyewash shall be available

# Evacuation Procedure

- Isolate from system
- Test for $SO_2$
- Connect filter and evacuate to 500 microns
- Break vacuum with tested Grade D breathable air to atmospheric pressure
- Retest for $SO_2$ and continue evacuation until less than 3 ppm of $SO_2$
- If two evacuation attempts fail to reduce $SO_2$ atmospheric air can be used in place of Grade D breathable air
- Once $SO_2$ less than 3 ppm, evacuate refill with Grade D breathable air prior to entry

# Evacuation Procedure

- After acceptable levels of $SO_2$ and oxygen at atmospheric pressure are confirmed, entry by personnel with appropriate PPE and supplied air
- Inspect for metal fluorides
- Vacuum all metal fluorides using HEPA vacuum and wipe down all surfaces with Precision. Purge with forced air for 5 minutes to ventilate solvent vapors. If burn through failure, purge for 2 hours
- Once equipment is purged, respirator protection is no longer required
- All toxic residue, rags and disposable clothing shall be placed in plastic bags and placed in a DOT approved drum for solid waste and placarded appropriately.

# When Things Go Wrong

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# In Summary

- All working around $SF_6$ equipment need to be aware of the risks and dangers of pure and contaminated gas.
- Need to have procedures in place in the event of incident
- Need to have personnel trained
- Need to have PPE available

# Questions?