

# SF6 Gas Decomposed!

## Best handling practices APC

- Billy J Lao  
General Manager  
DILO Direct,  
Odessa FL / Casa Grande AZ
- Neil Hutchins  
Senior Engineer Southern Company Services  
Substation Maintenance Support  
Support to Alabama Power Company



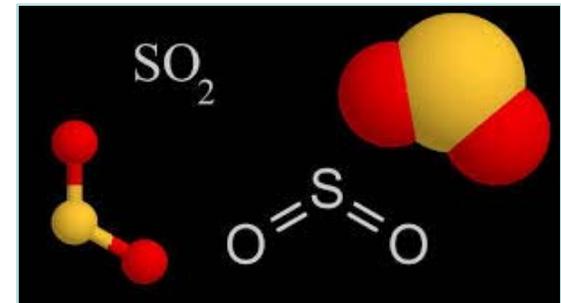
# Items to be discussed

- Sulfur Dioxide SO<sub>2</sub>
  - Description
  - Safety
  
- SO<sub>2</sub> – Contributing factors
  
- Best Practices AL Power / Southern Company
  
- Final Reporting practices AL Power / Southern Company

# Sulfur Dioxide (SO<sub>2</sub>)

## Chemical Formula

- SO<sub>2</sub>
  - Consists of 1 Sulfur and 2 Oxygen atoms (Dioxide)
  - Can be found in our atmosphere in low concentrations
  - It is a toxic gas with a pungent, irritating smell (rotten eggs)



## Safety

- SO<sub>2</sub>
  - Major pollutant and in case of exposure a potential health issue
  - Inhalation can contribute to increased respiratory symptoms and disease, difficulty in breathing, and premature death
    - NOTE: Those with asthma are likely to be more sensitive to SO<sub>2</sub> and may have stronger/ heightened negative reactions
  - SO<sub>2</sub> can be found as a powder in an area where it has formed, but may also be found in vapor space in GIE or in cylinders.
  - SO<sub>2</sub> is a reactive substance that can have a negative impact on materials such as metals (found in GIE) as well as other materials in GIE and gas handling equipment as it is highly corrosive and acidic.

SF<sub>6</sub>



# Sulfur Dioxide (SO<sub>2</sub>)

## Contaminants – SF<sub>6</sub> Decomp Byproducts

Chemical Name	Chemical Formula
<i>Gaseous Byproducts</i>	
Sulfur Dioxide	SO <sub>2</sub>
Thionyl Sulfide (sulfur tetrafluoride)	SOF <sub>2</sub> (SF <sub>4</sub> )
Hydrogen Fluoride	HF
Disulfur Decafluoride (sulfur pentafluoride)	S <sub>2</sub> F <sub>10</sub> (SF <sub>5</sub> )
Sulfuryl Fluoride	SO <sub>2</sub> F <sub>2</sub>
Sulfur Tetrafluoride Oxide	SOF <sub>4</sub> (SF <sub>4</sub> ) <sup>a</sup>
<sup>a</sup> SF <sub>4</sub> is readily hydrolyzed to SOF <sub>2</sub> .	
<i>Powder Byproducts</i>	
Tungsten, aluminum, copper fluorides	WF <sub>6</sub> , WO <sub>3</sub> , AlF <sub>3</sub> , CuF <sub>2</sub>

Excerpt: Nov 29, 2006 – EPA Conference – Presentation on SF<sub>6</sub> by-product handling – ICF International





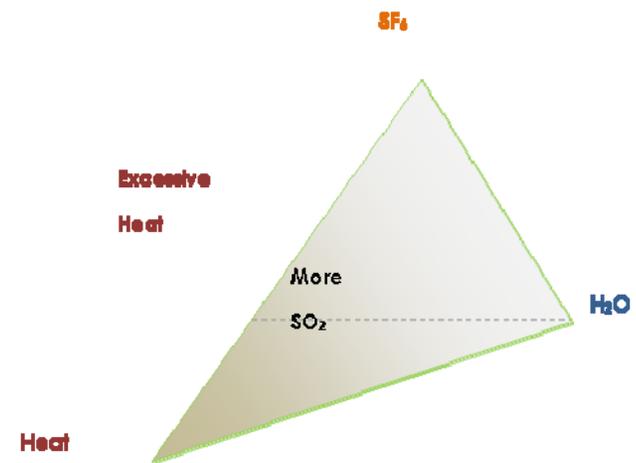
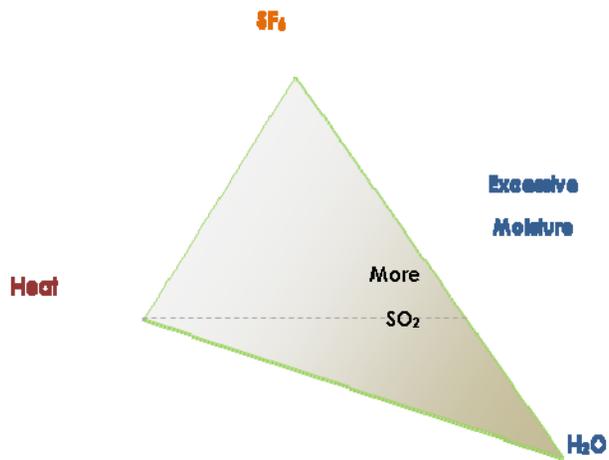
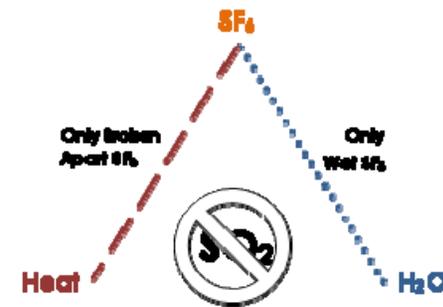
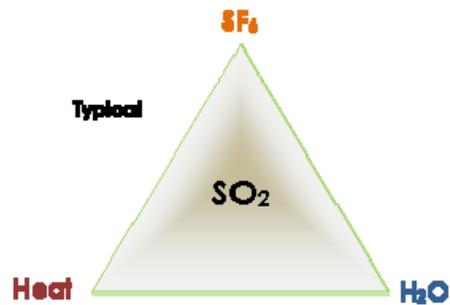
# Sulfur Dioxide (SO<sub>2</sub>) contributing factors

## Arc Byproducts

- Formed by the bonding of split atoms from SF<sub>6</sub>, trace gases (i.e. moisture vapor) and metal oxides (erosion byproducts) after an event causing the SF<sub>6</sub> molecules to separate when exposed to heat > 385 F (normal operation or a fault)
  
- Highly corrosive
  - Can shorten maintenance intervals
  - Can cause equipment failure in high enough concentrations
  
- Very acidic in nature
  - Can pose a severe health risk
  
- Created from electric discharges
  - Partial discharges (normal conditions & abnormal conditions)
  - Switching arcs (normal operation)
  - Failure arcs (i.e. GIE dielectric failure)
  - etc.

# Sulfur Dioxide (SO<sub>2</sub>) contributing factors

## Primary Contaminants





# U.S. EPA's 2017 Workshop on SF6 Emission Reduction Strategies

APC SF6 Best Practices

January 24, 2017

Neil Hutchins  
Southern Company Services  
Support to Alabama Power Company



# U.S. EPA's 2017 Workshop on SF6 Emission Reduction Strategies



- Neil Hutchins,
- Senior Engineer Southern Company Services Substation Maintenance Support
  
- Over 18 Years of experience in Transmission/Substation Maintenance
- Provide Support to Alabama Power Company on SF6 equipment,
  - Purchase SF6 Breakers, 15 kV to 500 kV
  - Manage Alabama Power Company spare SF6 breaker fleet
  - Provide support to Alabama Power Company's Substation Maintenance groups, Substation support group, Substation Construction, Safety and Training organizations
- Advisor to Southern Company Major Equipment Committee
- IEEE Senior Member
- Member of IEEE/PES Switchgear Committee
- Member of IEEE Alternative Gases to SF6 Task Force
- Member EPRI Substation Task Force

# Alabama Power Company / Southern Company SF6 Best Practices



- Plan
  - What (Event/operation)
  - Who (Personnel required)
  - When
  - Communication (Information, Location, impacts, etc)
  - Impact to employees, system, public, customers, etc.
- Training
  - Procedure and Guidelines
    - Equipment
    - SF 6 Gas
    - Hazards
    - Respirator
    - Compliance
- Practice



- Personal Protective Equipment
  - Tyvek Disposable coveralls with protective shoe covers
  - Complete Rain Suit (Switching)
  - Nitrile gloves
  - Duct Tape
  - Full-face respirator with AG/OV/P100 cartridge
  - SCBA with auxiliary, if personnel entering area/space
- Personnel and Equipment Decon
  - Defined Area for Personnel Decon
  - Distilled Water
  - Baking Soda
  - Pump up sprayer(s) with Baking soda and distilled water mix
  - HEPA Vacuum with non metallic attachments
  - SF6 Cylinder(s) empty (Under Vacuum)
  - SF6 Recovery and Testing Equipment
  - Denatured alcohol
  - Atmosphere/air monitor

## Alabama Power Company / Southern Company SF6 Best Practices



- Clean-up Supplies
  - Distilled Water
  - Baking Soda
  - Pump up sprayer with Baking soda, distilled water mix and food coloring
  - Trash Bags
  - Rags
  - Paper Towels
  - HEPA Vacuum with non metallic attachments
  
- Wind Sock (Monitor direction of the wind)
- Weather Forecast and impacts
- Barricade tape
- Clear assignment of duties
- Disposal Plan
- First Aid Kit
- AED
- Medical Plan (Paramedics, Hospital and location, etc)
- Identify Onsite and Offsite support



- Alarms
- Relay event records analysis
  - SF6 Gas Quality analysis
  - Breaker Information

# Alabama Power Company / Southern Company SF6 Best Practices Crew members in PPE



Alabama Power Company / Southern Company SF6 Best Practices  
View of Phase 2 Tank with Stationary Interrupter Assembly removed



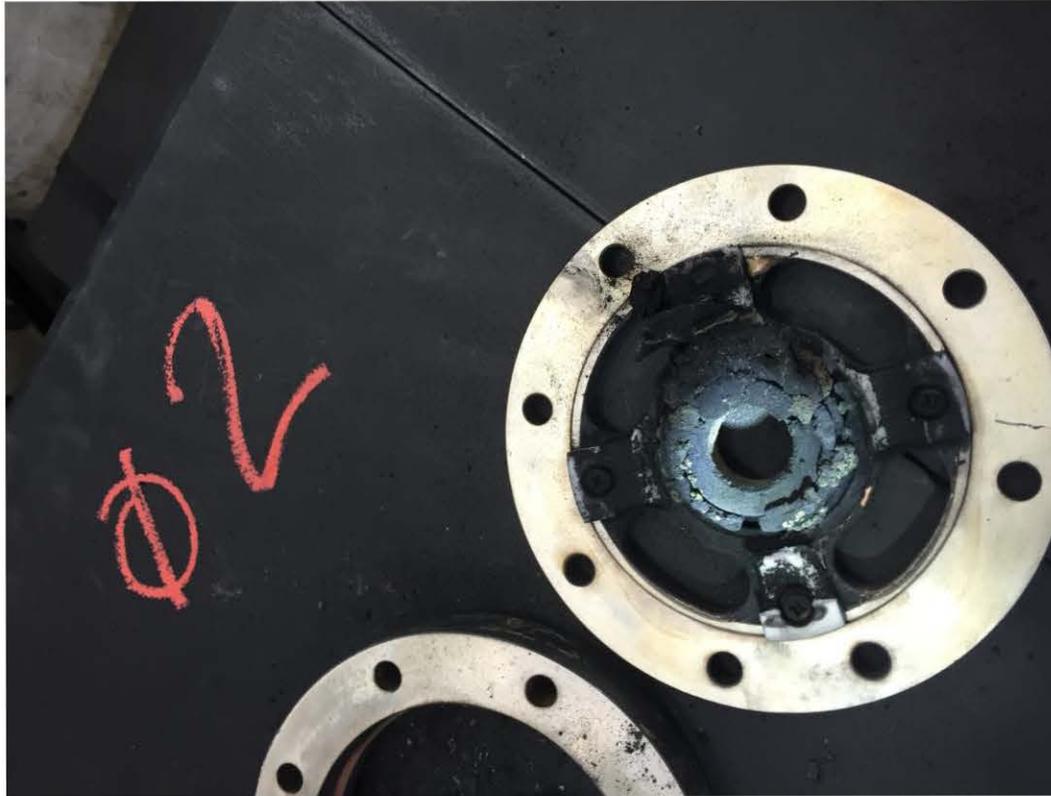
Alabama Power Company / Southern Company SF6 Best Practices  
Bushings connection moving side on interrupter for Phase 2



# Alabama Power Company / Southern Company SF6 Best Practices Stationary Arcing and Main Contact Assembly for Phase 2



## Moving Arcing Contacts for Phase 2





• **QUESTIONS ?????**



Alabama Power