SAFE SRU
Start up & Shut downs

Why control your SRU shut downs & start-ups?

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SULFUR UNIT S/D & S/U
Near Misses, Mistakes and Mishaps

► Incorrect metering of the main combustion air resulted in severely sub-stoichiometric conditions for 24 hours causing the entire Wasteheat boiler and first condenser to fill up with soot. $1,000,000 repair.

► Complete destruction of Wasteheat boiler due to uncontrollable sulfur fire. $500,000 repair.

► Complete destruction of internals and catalyst in the first converter. $500,000 repair.

► Filling the entire SRU with only fuel gas to ‘snuff’ out sulfur fires.

► Damage to refractory due to condensed water in the steam line dumped into the reaction furnace.

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Safe SRU Shutdown and Startup

**Agenda**

► When to shutdown SRU’s
► Types of Shutdowns
► What do we need to accomplish
► SRU Shutdown Procedure
► Safety Concerns / What not to do

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**When To Shutdown SRU’s**

► **For Turnaround:**
  - Inspection/Repair:
    - Burners, refractory, tube sheets, ferrules, coalescer pads, corrosion, eductors, rundown lines, diffuser plates
  - Maintenance:
    - Orifice meters, RF opticals, flame scanners, tg analyzer, seal pots, pressure transmitters, purge air lines, etc.

► **Due To Unscheduled or Emergency Shutdown:**
  - Essential to avoid:
    - Catastrophic failure of equipment/vessels
    - Emissions violations
    - Loss of acid gas feed stream or combustion air

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**Types of SRU Shutdowns**

► **Scheduled Shutdown:**
  - Turnarounds
    - Typically every 2-4 yrs & for 10-30 days
    - Scheduled Shutdown begins with fuel gas
    - Ends with cool down with inert gas steam or N2.

► **Unscheduled or Emergency Shutdown:**
  - Includes immediate removal of acid gas & combustion air to the reaction furnace.
  - Can be down for just a couple of hours
  - Will need fuel gas to keep it warm if down longer
  - Better to allow unit to cool naturally after fuel gas sweep than on “hot stand-by”

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Shutdown Logic

The Following are some of the conditions that will initiate a Shutdown:

- Acid gas K.O. Drum High-High Level
- SWS Drum High-High Level
- Acid Gas or Combustion air Low-Low Flow
- Claus WHB Steam Drum Low-Low Level
- Claus WHB outlet High-High temperature
- Condenser Low-Low Level (if applicable)
- Condenser outlet High-High temperature
- Reaction furnace high-High pressure
- Reaction furnace High-High temperature
- Flame detection (dual voting 2 of 2 flame failure)
- High-High Converter Bed Temperatures
- Incinerator Shutdown (optional)
- DCS manual operator initiated shutdown switch
- Local Panel operator initiated shutdown switch
- Local (ESD) operator initiated shutdown switch
- Plant ESD in control room

What Do We Need To Accomplish?

► Sulfur Removal:
  - All sulfur vapors & All sulfur bearing compounds must be removed from the SRU.

► Fuel Gas Combustion:
  - Deficiency in combustion air will cause Soot formation—coats the tubes & the catalyst
  - Excess combustion air conditions will result in sulfur fires & risks destroying converter internals

► SRU Cool Down:
  - With either air or N₂.
  - N₂ is preferable for tight schedules.

Safe SRU Shutdown Procedure

Procedure for a Safe and Expedient Claus Plant Shutdown:

Fuel Gas Sweep
  - Firing reaction furnace & reheaters with fuel gas
  - Need minimum 24 hrs to sweep all S vapors out of the train!
  - Set stoichiometry at 95-99%
    - Avoids sooting up the beds, avoids sulfur fires, safeguards vessels & catalyst
  - Steam Line must be connected to the reaction furnace
    - Necessary to temper the fuel gas burn
    - Necessary as heat from fuel gas will destroy the reaction furnace!
    - Tie in via main acid gas line if possible
  - Overall, want high mass flow rate during fuel gas sweep
    - Shortens the time of the sweep
Safe SRU Shutdown Procedure

Procedure for a Safe and Expedient Claus Plant Shutdown:

► Block in and blind the acid gas line to the SRU
► Establish a fuel gas fire in the reaction furnace
► Combustion air flow must be controlled—main or trim air lines
► Fuel gas should be fired at 95 to 99 percent stoichiometry
  ▪ This will prevent sooting, equipment and catalyst damage due to sulfur fires
► Add inert gas (steam) immediately to control temperature of reaction
  ▪ Must not exceed 1350 °C (refractory/fire brick limitations)
► Continuous sampling of gas from waste heat boiler or condenser.
  ▪ Establishes burn stoichiometry to keep within limits

Safe SRU Shutdown Procedure

► Examples of Stoichiometry:

► Diagrams A, B and C represent Gas Chromatograms showing different scenarios of fuel gas burn.

Diagram A: Stoichiometric Fuel Gas Burn
Safety Concerns / What not to do

To ensure both personnel and equipment safety during shutdown and startup procedures, following should be noted:

- Possibility of Explosion
  - NEVER light up without air purge of at least one minute!
  - Avoid damage to furnace refractory and firebrick above 1350 °C
- Avoid Refractory shock & failure
  - DO NOT fire or cool down at more than 50 °C per hour
- Avoid Sooting and Sulfur Fires
  - Firing below 95% stoichiometry will cause sooting
  - Firing above 100% stoichiometry could result in S fires & damaged internals.
Safety Concerns / What not to do

To ensure both personnel and equipment safety during shutdown and startup procedures, following should be noted:

► Control the Fuel Gas Sweep
  - ALWAYS use O₂ measurement & gas sampling
► Sulfur fires in the converter above 700 °C
  - can result in damage to metallurgy
► Sulfur fires in the converter above 900 °C
  - Risks fusing the alumina catalyst & complete loss of catalyst
► Steam supply
  - Steam to condensers & converters should be available to snuff any sulfur fires, particularly in coalescing/mesh pads
  - BUT—remove the steam if bed temp < 150 °C to avoid water condensation.

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