Fundamentals of SO3 Conditioning

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Precipitators are Designed For:

- Volumetric flow rates, properties, and compositions of flue gases
- Environmental Limits

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- Particle composition
- Particle loadings
- Particle size distributions

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SO3 Conditioning

- Any changes in the design conditions can lead to Precipitator Performance that is not acceptable
- SO3 Conditioning is generally put into place to address changes in previously stated conditions

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- Required reductions in SO2 emissions have caused the burning of lower sulfur coals

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SO3 Conditioning

- Higher Resistivities are caused by lower SO3 concentration in the flue gas
- Only a small percentage of SO2 in the flue gas converts to SO3

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- Conversion of SO_2 to SO_3 depends in part on the ash composition and temperature profiles

- Concentrations of SO_3 in the flue gas are generally less than 50 ppm

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SO_3 Conditioning

- In some cases the available SO_3 is near zero due to low conversion rates from SO_2 to SO_3

- When this occurs SO_3 concentrations need to be boosted

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- One means of boosting SO3 concentrations in by flue gas conditioning

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Flue Gas Conditioning Reactions

- The object is to generate SO_3
  - $S + O_2$ yields SO_2
  - $SO_2 + \frac{1}{2} O_2$ yields SO_3
  - $SO_3 + H_2O$ yields H_2SO_4 which is combined with the flyash

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SO3 Conditioning

- Lowers Resistivity of Fly ash
- Improves precipitator performance for low sulfur coals
- Increases Power Levels
- Reduces Opacity

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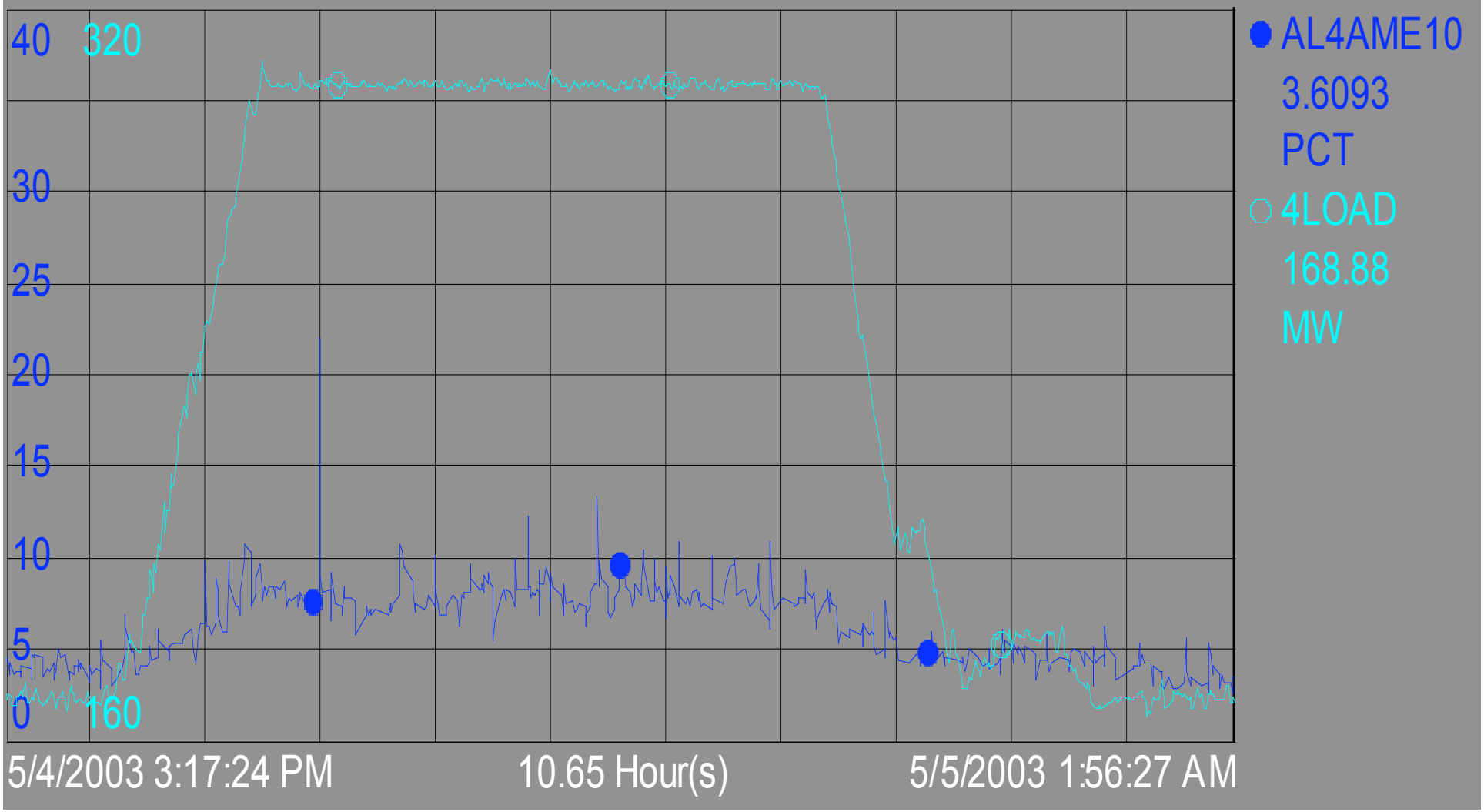
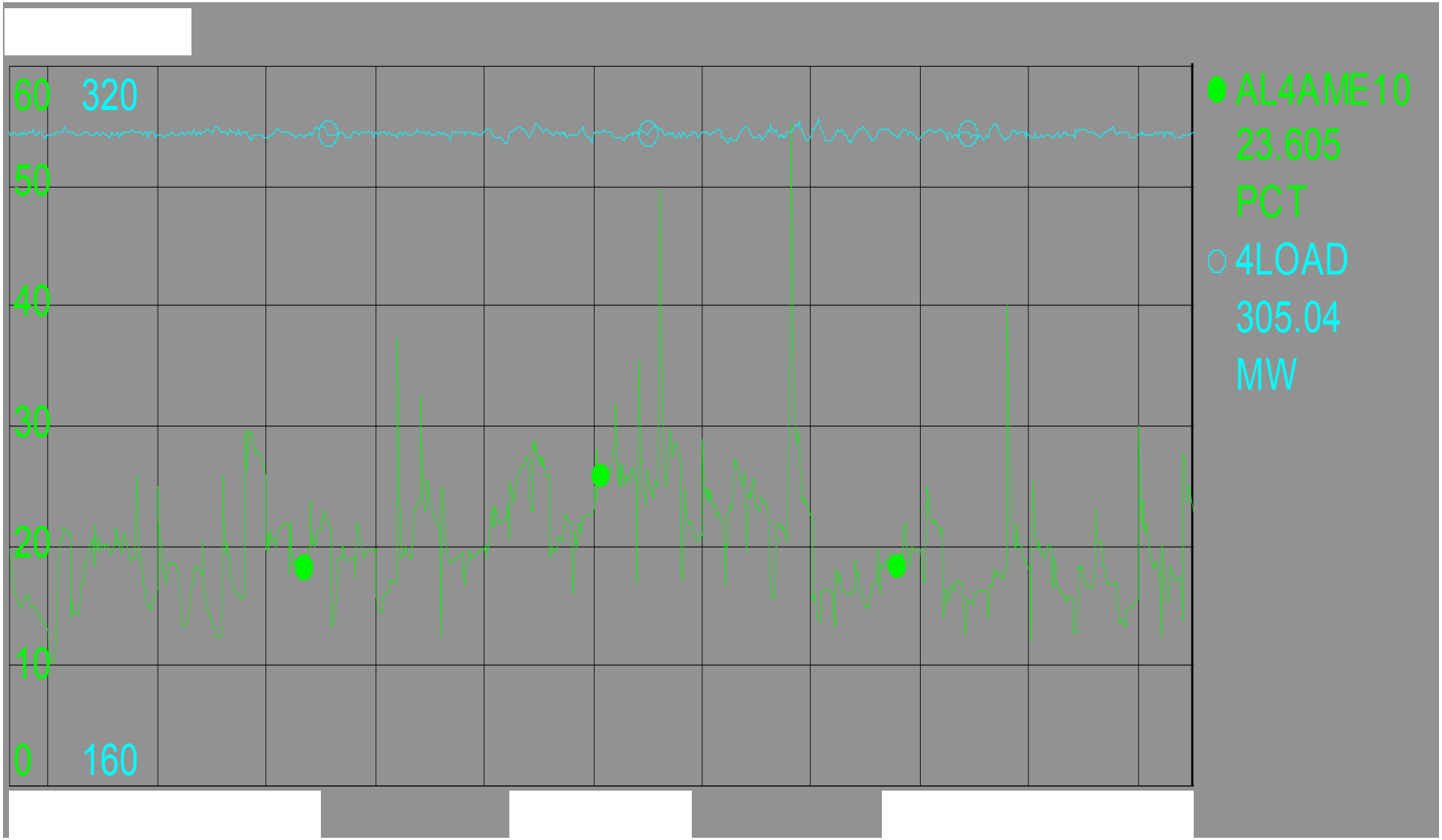
Opacity Due to SO3 Injection



Without SO3 Injection



SO3 Operation

- When determining a set point, start at a low injection rate and slowly increase until the results are obtained

- Common rates of injection are 3 ppm to 12 ppm

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- The installation of SCRs will increase SO3 in the flue gas and require readjustment (or elimination) of SO2 system injection rates

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Methods of Generating SO3

- Sulfur burning system- Molten Sulfur
- Granular Sulfur system
- Liquid SO2 system

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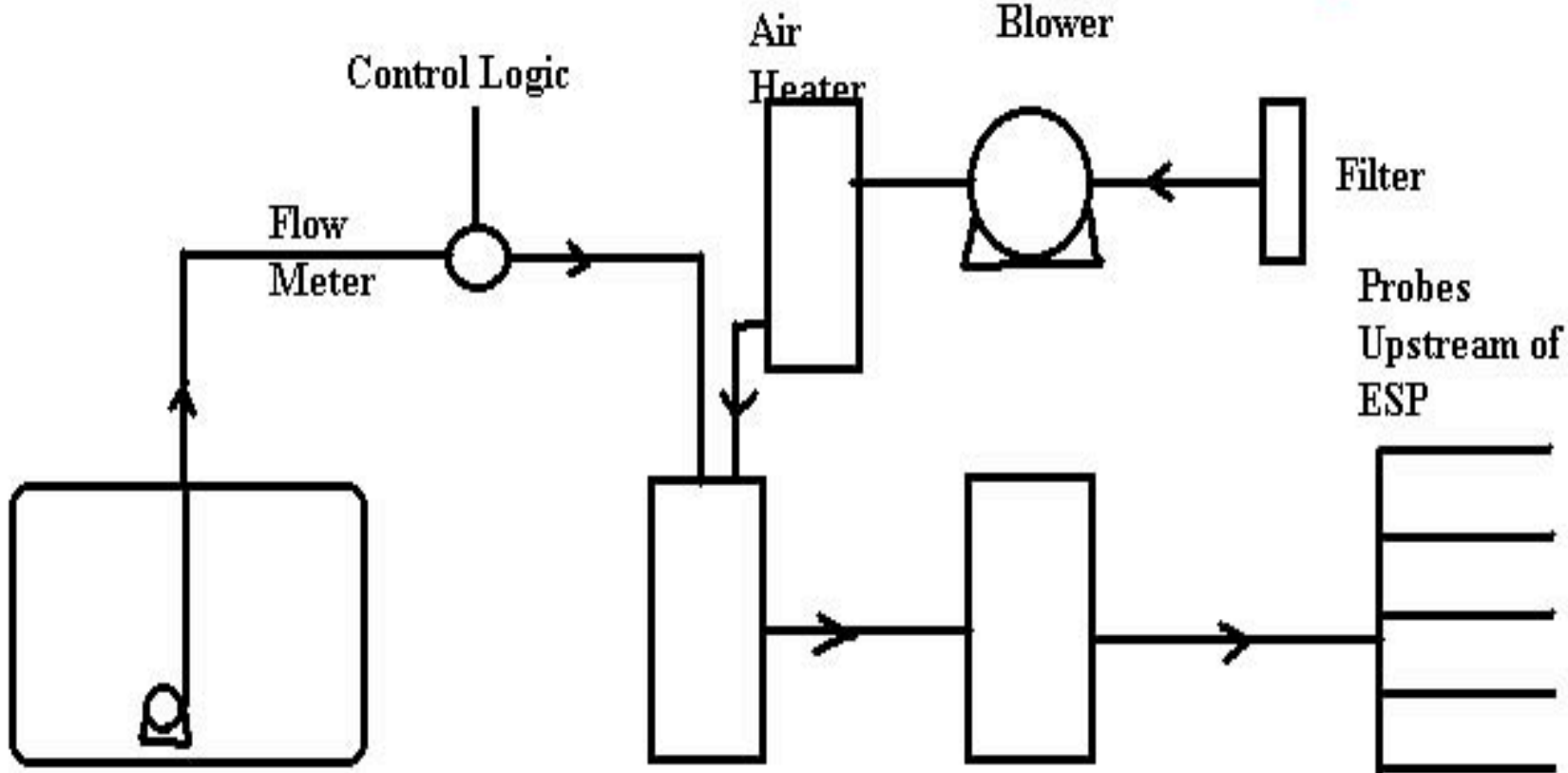
Molten Sulfur Flue Gas Conditioning



SO3 Equipment- Molten System

- Sulfur Storage Tank
  - Insulated steel tank for storing liquid molten sulfur.
  - Tank is heated by circulating steam at about 50 psi through coils inside the tank.
  - The sulfur is kept at about 280 degrees F

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SO3 Equipment- Molten System

- Sulfur Pumps
  - Variable speed, submerged sulfur gear pumps
  - Older systems used positive displacement pumps
  - Mass flow elements measure sulfur flow

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SO3 Equipment- Molten System

- Sulfur Burning System
  - Most widely used
  - Most economical operating cost

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- Higher Initial cost
- Use on units larger than 300 mW
- Sulfur feedstock
- More reliable with submersible pumps

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SO3 Equipment- Granular

- Economical on smaller units
- Uses sulfur pellets that are stored in a bin
- Compressed air and auger are used to move the sulfur pellets

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- Burner is used to melt the sulfur pellets
- SO_2 gas is created
- Catalyst bed converts SO_2 to SO_3

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Granular Sulfur Conditioning System

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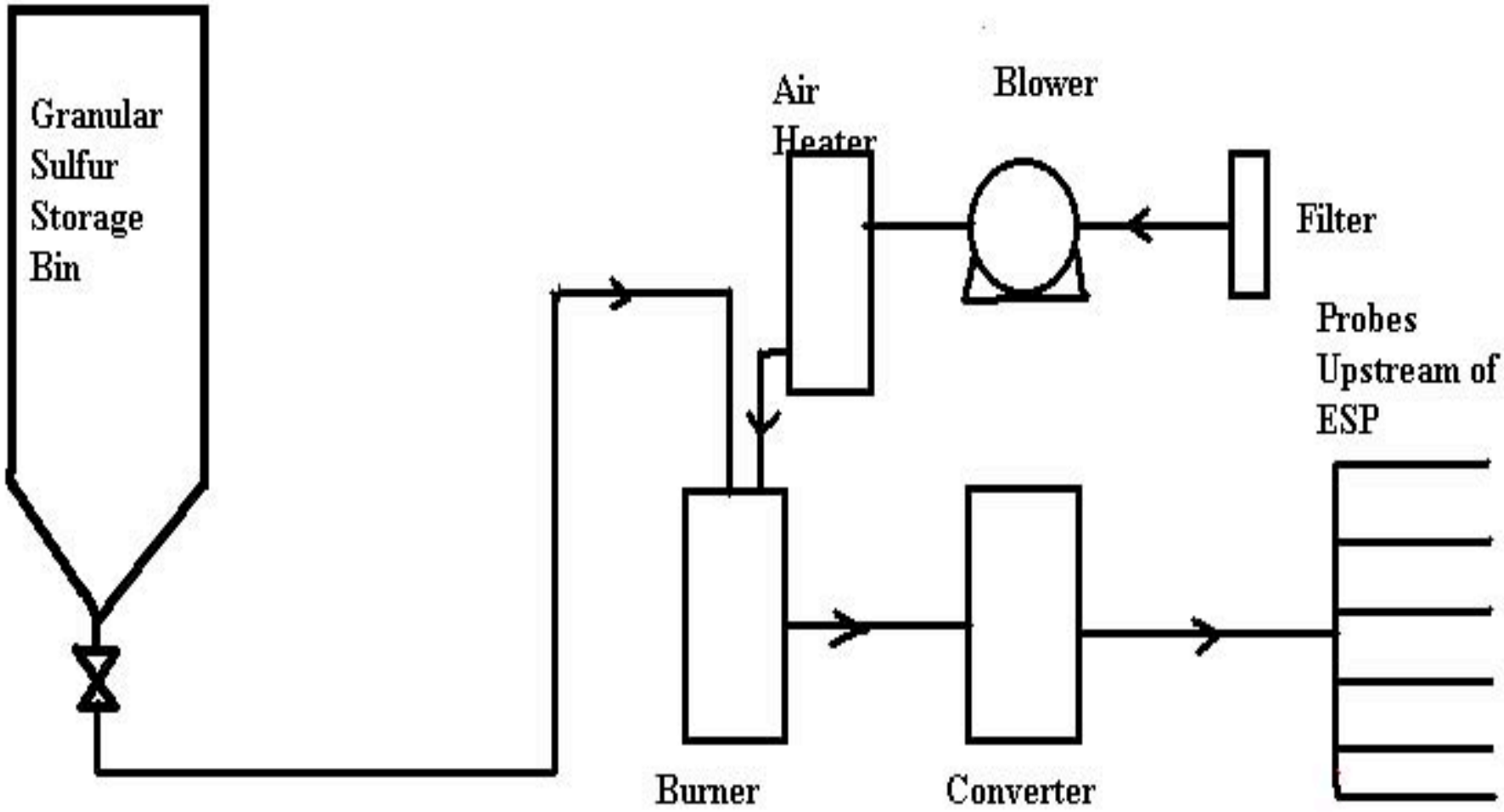

Liquid SO2 System

- Higher operating cost
- Safety issues from liquid Sulfur dioxide
- Moderate initial equipment cost

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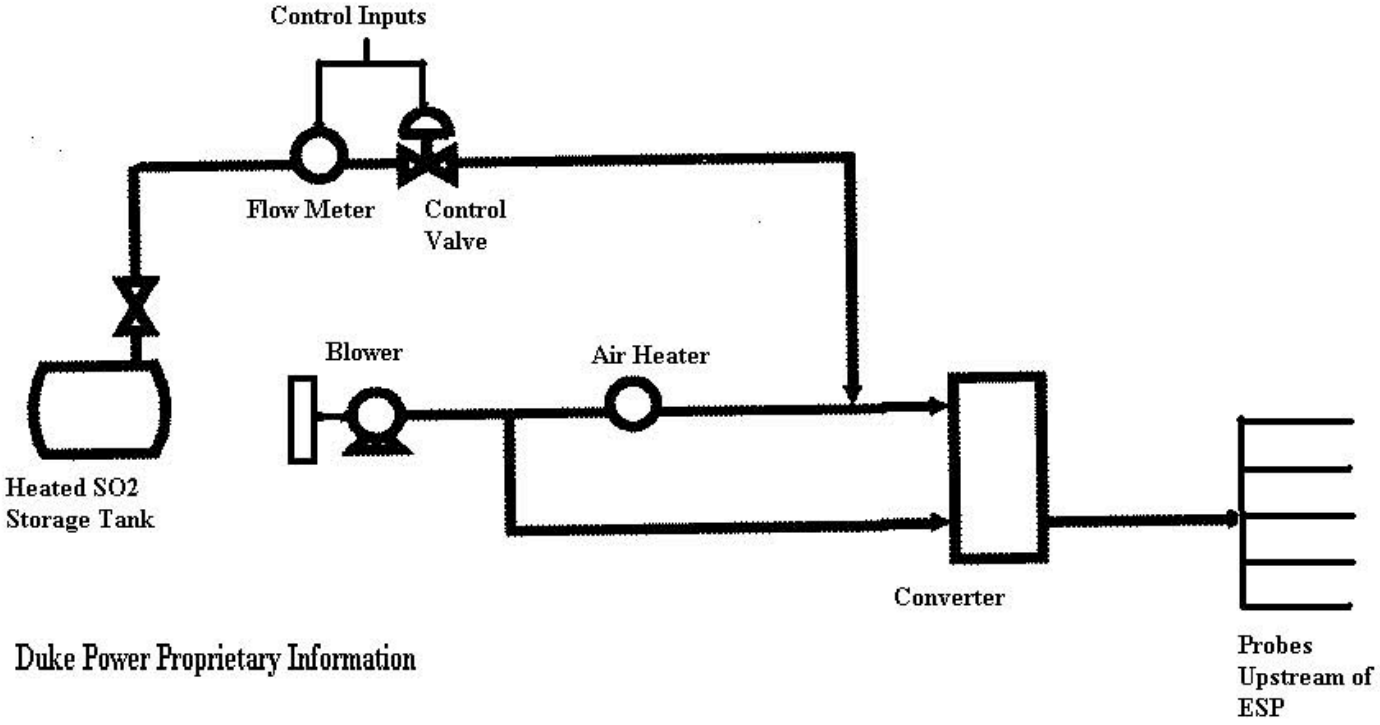
Liquid SO2 Flue Gas Conditioning



The Hybrid

- Cliffside Unit 5 has a hybrid Granular Feed and Molten SO3 system

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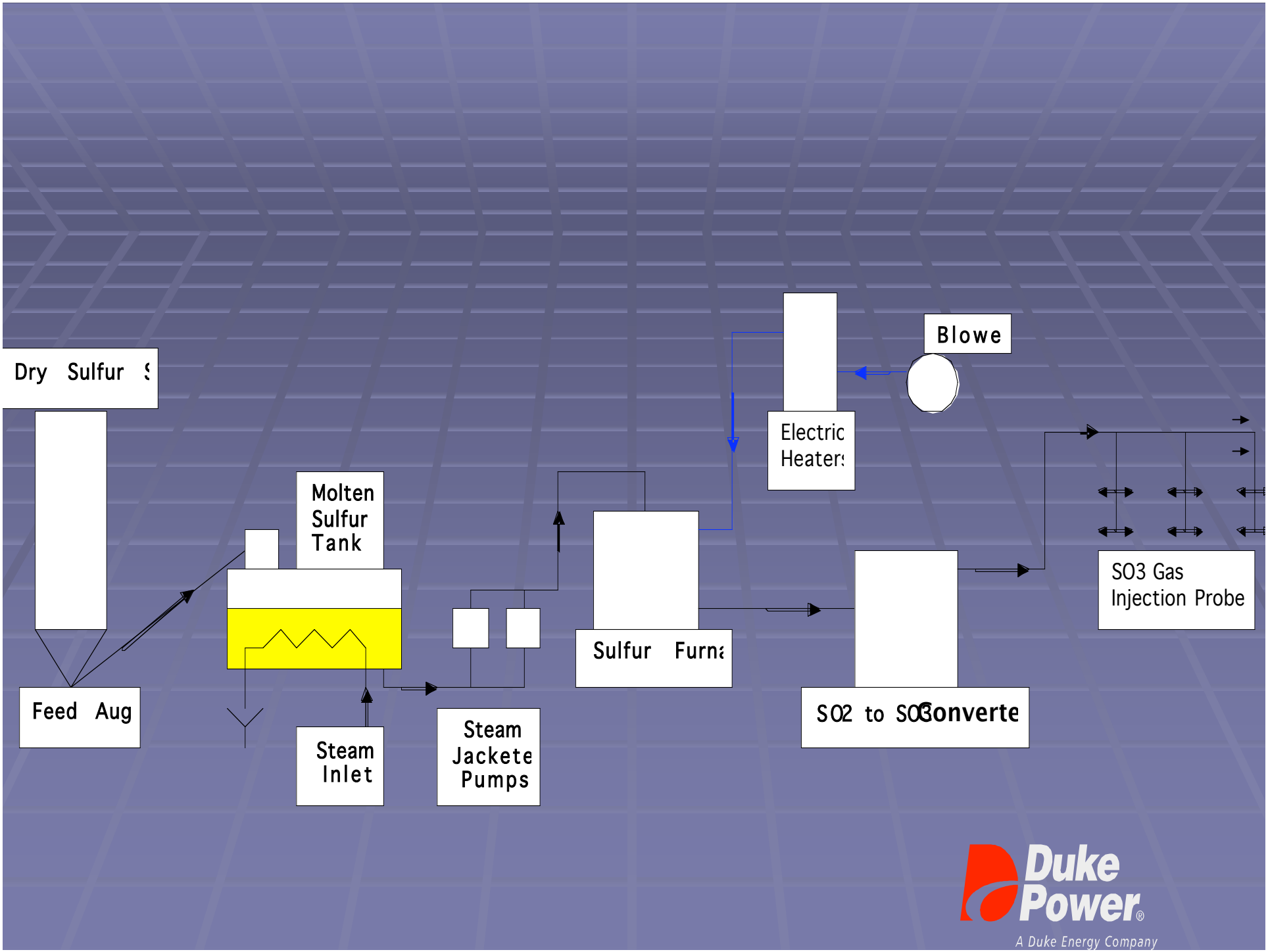
Dry Sulfur
Feed Aug
Molten Sulfur Tank
Steam Inlet
Steam Jackete Pumps
Sulfur Furna
Electric Heater
Blowe
SO2 to SO3 Converte
SO3 Gas Injection Probe
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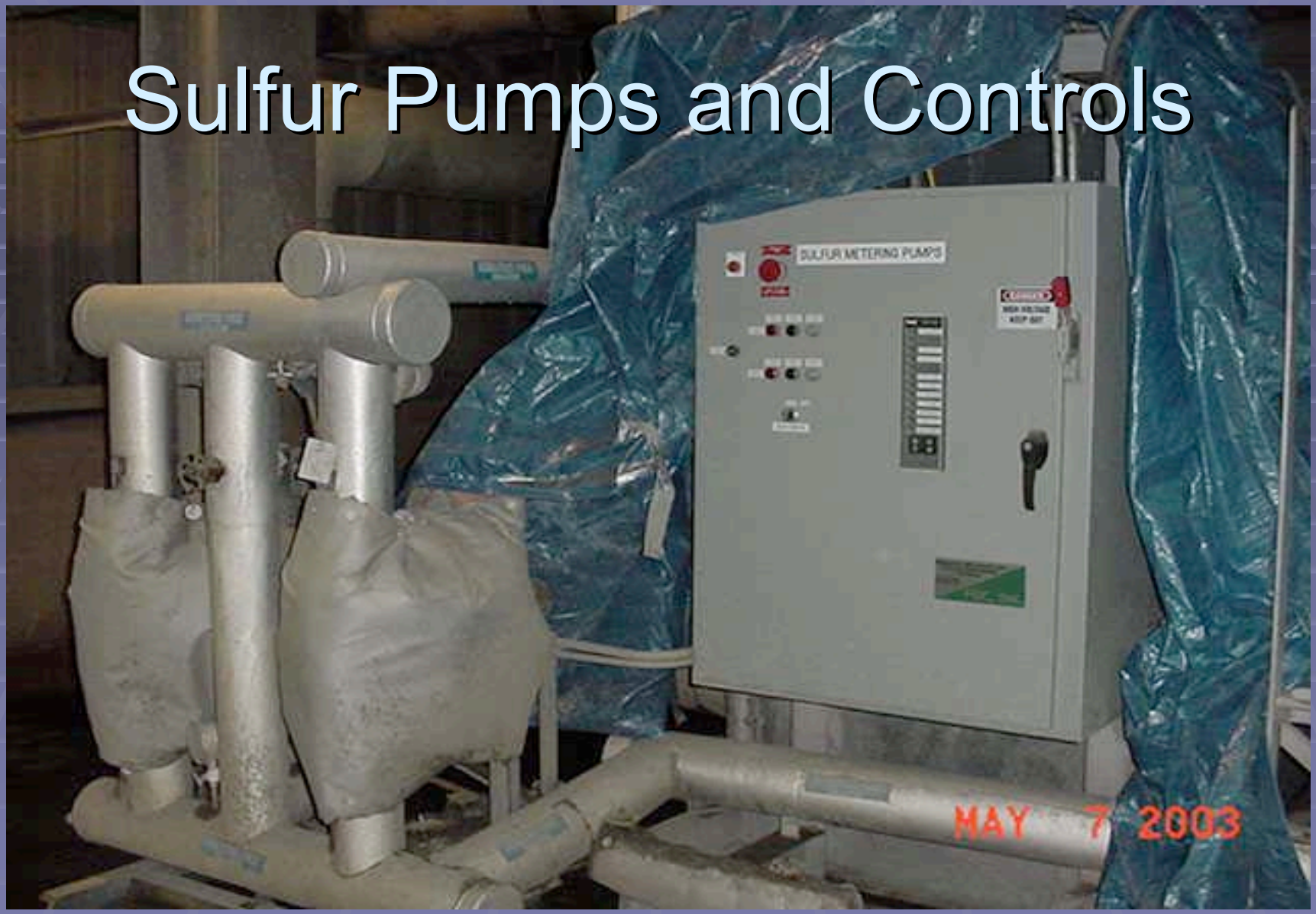
Dry Sulfur Storage

Sulfur Pumps and Controls



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Sulfur Dry Feed Mechanism

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Molten Sulfur Tank

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Steam Jacked Pipe and Tank

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Thank-you