SO_3 Mitigation Strategy Process

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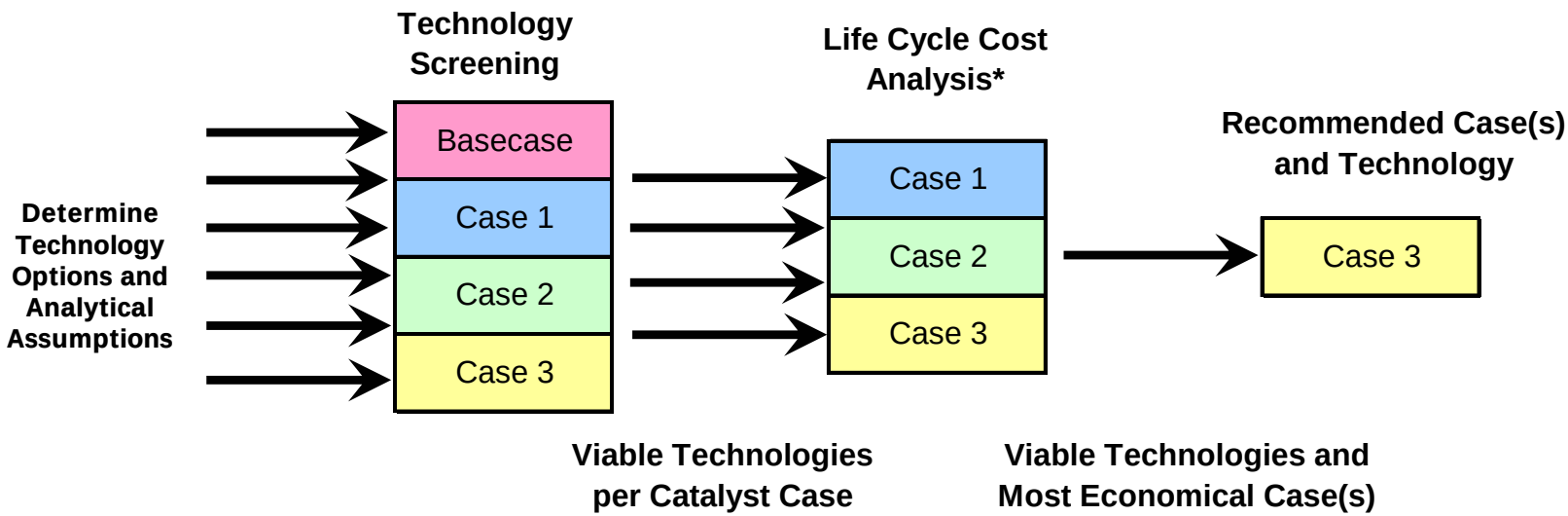
Presentation Agenda

- Why mitigate?
- Evaluation process overview
  - Viable technologies considered
  - Analytical assumptions
  - Technical and economic modeling
  - Risk management issues
- AEP's mitigation strategy decision
- Questions

Why Mitigate SO_3?

- EGUs not subject to specific regulatory emission limits on SO_3
- Potential of SO_3 to impact flue gas plume appearance, gaining attention of public and regulatory agencies
- Plume aesthetics are subjective, influenced by:
  - Ambient atmospheric conditions:
    - Temperature and relative humidity
    - Position of sun and cloud cover
  - Position of observer
- Proactive mitigation of SO_3 concentrations minimizes plume visibility and associated risks
- AEP desires to invest and improve environmental performance, leading development and application of innovative technologies

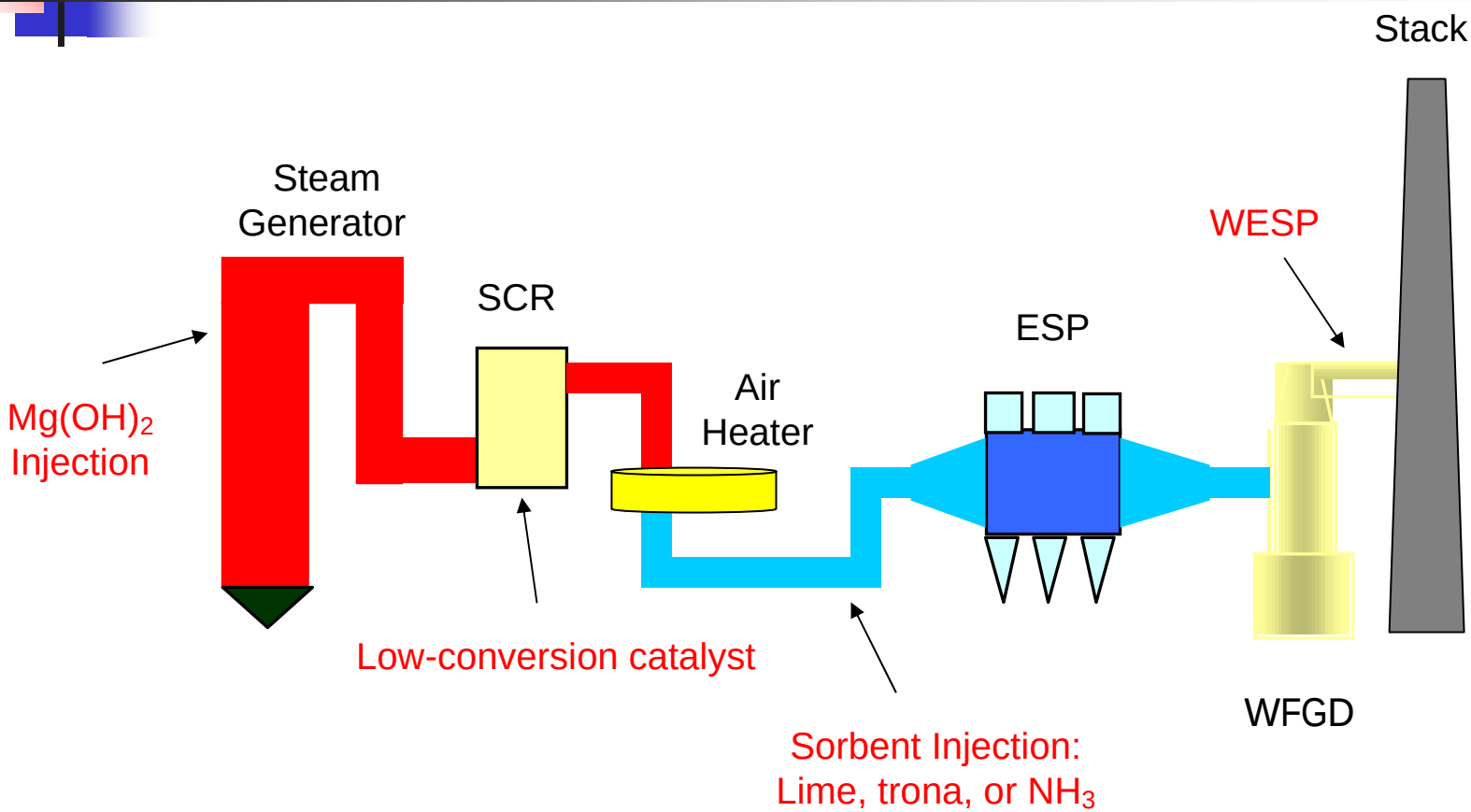
Evaluation Process Overview



*Includes catalyst replacement cost, NO_X removal performance, and SO_3 mitigation cost

"Cases" represent different SCR catalyst management plan cases

Viable SO_3 Mitigation Technologies Considered



Unit Specific Analytical Assumptions

- Fuel basis – SO_2 content
- Unit configuration:
  - Furnace size and type
  - Emission control equipment
- SO_2 to SO_3 conversion:
  - Furnace
  - SCR catalyst:
    - Maximum
    - Average
    - “Steady state”

Unit Specific Analytical Assumptions - Cont'd

- H_2SO_4 capture:
  - Air heater
  - FGD absorber
- Technology capital and O&M costs:
  - Consultant estimates and existing technology installations – costs scaled on MW basis where appropriate
  - SCR catalyst management:
    - Base case – existing catalyst management plan
    - Supplementary cases – accelerated replacement of 1-4 catalyst layers with low-conversion type
  - Sorbents – based on forward price curves

Technology Screening Model

- Based on a calculator that determines optimum hourly operating cost for each mitigation technology or combination of technologies
- Inputs:
  - Worst and baseline scenario analytical assumptions
  - Catalyst management cases with annual and highest theoretical SO_2 to SO_3 conversion rates
- Outputs:
  - Mitigation technologies or combinations of technologies that can meet range of acceptable SO_3 concentrations
  - Annual O&M cost inputs to economic model for screened technologies

Economic Evaluation Model

- Spread-option model - dispatches unit against forward price of power based on variable costs
- Inputs:
  - Forward price curves – power, fuel, SO_2, NO_X
  - Capital costs for technology and catalyst management
  - Annual O&M costs for operating units, retrofits, and mitigation technologies
- Output – ranked ordering of net present values for screened mitigation technologies.

Risk Management Issues

- Corrosion of ductwork from SO_3 condensation:
  - Higher potential with higher SO_2 content coal
  - Air heaters and ductwork (prior to dry sorbent injection) – inject magnesium hydroxide in boiler or maintain elevated bulk gas temperature, incurring heat rate penalty
- Sorbents:
  - Volatility of pricing going forward
  - Logistics – supply infrastructure sufficient to meet demand
  - Alternatives – continue to test new formulations to address potential site-specific constraints with specific sorbents

Strategy Determination

- Strategic scenarios:
  - Greater certainty with technical issues/O&M costs – results in lower initial costs with less flexibility (lower option value)
  - Less certainty with technical issues/O&M costs – results in higher initial costs to gain long-term flexibility (higher option value)

Strategy Determination (Cont'd)

- Given uncertainty with respect to:
  - Application and implementation of technologies to units ranging from 200-1300MW capacity with the following site-specific constraints:
    - Furnace configuration – open pass boilers
    - Air heater location in flue gas stream – hot ESP applications
    - Duct configurations – long runs from multiple retrofitting
    - ESP size – wide-range of SCA ratings
  - Future fuel selection
  - Long-term sorbent pricing

Strategy Determination (Cont'd)

- Decision was to engineer capability at units to inject magnesium hydroxide into furnace as well as dry sorbent (e.g. trona or hydrated lime) between air heater and ESP
- As uncertainties are resolved through operation of initial installations, revisit analysis and refine strategy to lower life-cycle costs in subsequent installations.

Questions?

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