REINHOLD ENVIRONMENTAL ®

2023 Reinhold/PCUG Round Table Presentation

Cohosted by Duke Energy and Vistra in The Westin Hotel, Cincinnati, OH on June 26-27, 2023

Southern Company Co-Firing Experience 2023 Reinhold Conference

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Co-Firing Unit Information

Manufacturer: Combustion Engineering

Type: Supercritical, combined circulation (forced circulation), divided furnace cell, pulverized furnace, radiant reheat

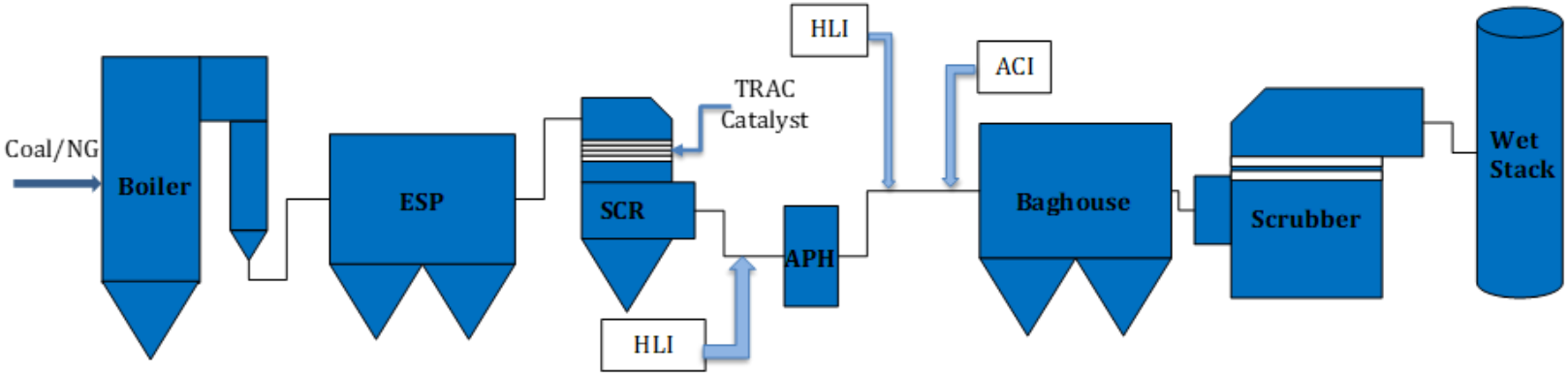
Seven (7) elevations of coal firing nozzles located in each of the eight (8) tilting tangential windboxes in the furnace corners; Center water wall; Fifty-six (56) coal firing nozzles in the furnace

Initial Start-up: June 1974

Nameplate Rating, MWe: 880

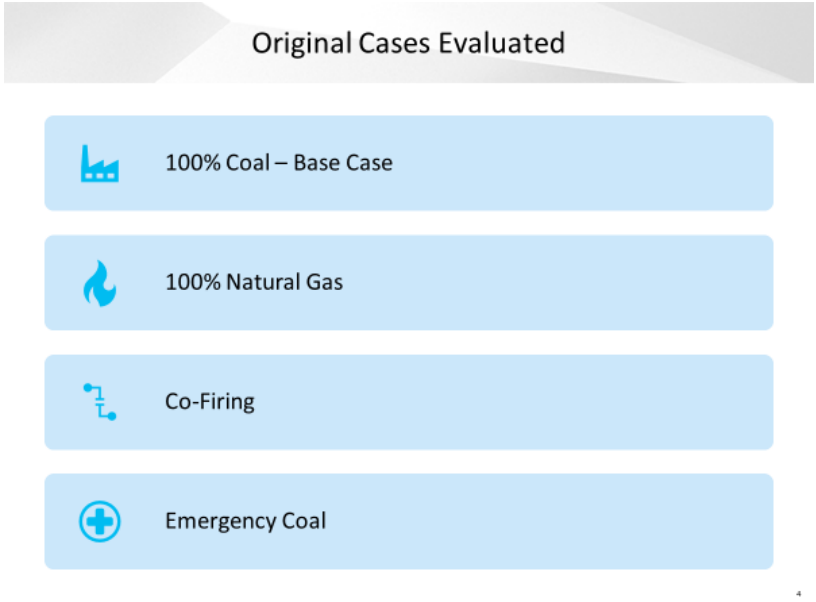
- Later converted to balanced draft operation
- 2015 three (3) elevations of natural gas firing equipment added
- GE supplied separate overfire air (SOFA) system for in furnace NOx Emissions control

Process Flow Diagram



Original Scenarios and Concepts Considered

- Maintaining Coal Firing Capability
- Environmental Equipment Remaining In-Service (SCR, ESP, Baghouse, Injection Systems, Scrubber, Wet/Dry Stack)
- Existing unit natural gas co-firing capabilities existing optimum firing levels
- How to best maintain coal handling and environmental (baghouse/scrubber) equipment during extended downtime



- Maximum load dictated by maximum achievable heat input and turbine efficiency; limited by burner design/location
- Coal minimum load dictated by back-end flue gas temperatures (MIT, acid dew point)
- Co-firing introduces other challenges due to high moisture

To Date Co-Firing Experience

Operating Scenarios

1. 100% Coal – Base Case
2. 100% Natural Gas
3. Co-Firing – Variable Runtimes/% Mixes
4. Upcoming – 100% Coal on Days/100% NG on Nights (Daily Swings)

Systems/Parameters Considered

1. Baghouse
2. Activated Carbon Injection
3. Hydrated Lime Injection
4. Oxidation Air Blowers
5. Draw Off
6. ESP
7. SCR
8. Mist Eliminator Washes/Controls
9. Anti-Foaming System (At this time always in service)
10. pH
11. ORP
12. Density
13. Temperatures (Baghouse Inlet/Scrubber Inlet)

100% Coal – Base Case

Baghouse	In Service
ACI	In Service (lbs/hr starting point set)
HLI	In Service (lbs/hr starting point set)
Ox Air	2 Blowers In Service
Draw Off	Set in Automatic Control based on Density
ESP	In Service (Tuned for Baghouse Efficiency with Ash out of ESP set based on ACI/HLI Injection Rates)
SCR	In Service
ME Wash	In Service (Automatic Control/Timer for Min/Density Dependent)
Other	Normal (pH/ORP/Density daily testing)

100% Natural Gas

Baghouse	Out of Service
ACI	Out of Service
HLI	Out of Service
Ox Air	1 Blower In Service
Draw Off	1 Valve 15-20% Open Continuous Drawoff; 1 Valve in Auto Control with Set Submergence Level
ESP	In Service (Tuned for Baghouse Efficiency with Ash out of ESP set based on ACI/HLI Injection Rates)
SCR	In Service (Min NH3 Flow with Min Temperature Set)
ME Wash	Minimum of Once Per 24 Hours/Trending and Monitoring DP Across MEs
Other	Increased Temperatures at Scrubber Inlet Monitored

Co-Firing

Baghouse	In Service (Set Times Between Ash Pulls)
ACI	In Service (lbs/hr starting point set)
HLI	In Service (lbs/hr starting point set)
Ox Air	1 Blower In Service
Draw Off	1 Valve 15-20% Open Continuous Drawoff; 1 Valve in Auto Control with Set Submergence Level
ESP	In Service (Tuned for Baghouse Efficiency with Ash out of ESP set based on ACI/HLI Injection Rates)
SCR	In Service (Set MIT)
ME Wash	In Service (Automatic Control/Timer for Min at Least Once per 24 Hours/Density Dependent)
Other	Normal (pH/ORP/Density Daily Testing to Ensure in Right Direction but May Not Build to Normal Levels Depending on Length of Run)

100% Coal During Day/100% Natural Gas During Evening

*Testing Required for Validation

Baghouse	In Service; Using Coal Burning for Pulling Times as Starting Point
ACI **HLI**	In Service (lbs/hr starting point set) for Coal Burn/Out of Service for NG Burn with Blowers Maintain Running
Ox Air *	1 Blower In Service Minimum (ORP Dependent)
Draw Off*	Set in Automatic Control based on Submergence Level; A Valve in Auto Control with Set Starting Point; Monitor ORP to Adjust Drawoff As Needed
ESP	In Service (Tuned for Baghouse Efficiency with Ash out of ESP set based on ACI/HLI Injection Rates); Set for Coal Burn Operations as Starting Point
SCR*	In Service; Set MIT for Coal Burn and Set MIT for NG Burn; Will Take Time to Reach MIT; Operator to Manually Load Up for Temps
ME Wash	In Service (Automatic Control/Timer for Min of Once Per 24 Hours and Monitoring DP/Do Not Expect Density to Build Up To Normal Operations)
Other*	100% Gas Burns Take Limestone Pumps Out of Service with Flushing Pump/Lines for 20 Minutes as a Starting Point and Swapping Pumps Each Time

Gas Conversion Modifications

Gas Conversion Scope of Work Includes the Following:

- Two additional elevations of burners
- One elevation of ignitors
- Relocation the existing burners/ignitors
- Additional piping
- Additional valving
- Wind box modifications
- Additional emissions controls
- Ductwork modifications
- Additional rear reheat tube surface area

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