REINHOLD ENVIRONMENTAL ®

2025 Reinhold/PCUG Round Table Presentation

Hosted by AEP and Buckeye Power

in The Hilton Columbus Polaris Hotel, Columbus, OH

on June 23-24, 2025

Gas Co-Firing O&M – Good and the Bad

2025 Reinhold Environmental Round Table Conference – 6/23/25

Agenda

Introduction

Panelist

Design Considerations

Operational Experience

Gas Co-Firing O&M – Good and the Bad

Introduction

Duke Energy Gas Co-firing Summary

	Cliffside 5	Cliffside 6	Belews Creek 1 & 2	Marshall 1 & 2	Marshall 3 & 4
Boiler OEM	CE	Hitachi	B&W	CE	CE
Boiler Style	4 corner Sub-Critical	Wall Fired Super-Critical	Wall Fired Super-Critical	8 corner Sub-Critical	8 corner Super-Critical
Commercial	1972	2012	1975	1965 & 1966	1969 & 1970
Capacity MWg	600	905	1170	400	700
AQCS Equipment	SCR, ESP, WFGD	SCR, SDA, FF, WFGD	SCR, ESP, WFGD	SNCR, ESP, WFGD	SCR (3) SNCR (4), ESP, WFGD
# Coal Burners	24	30	80	40	48
Co-fire Ratio	10-40%	100%	50%	10-40%	50%
# Gas Burners	8	30	32	16	16
On site CapEx	$54M		$117M	$101M	
Pipeline	Dominion (7 mile 16-inch)		PNG (10-mile 24-inch)	PNG (20 miles 20-inch)	

Duke Energy Co-Firing Program Results

- All converted units achieved burner design output, boiler steam temperatures, and emissions targets.
- Lower min loads and higher ramp rates achieved.

Site	Unit Output (MWg)	% Gas	CO Target (lb/mmbtu)	CO Result (lb/mmbtu)	NOx Target (lb/mmbtu) @ SCR Inlet	NOx Result (lb/mmbtu) @ SCR Inlet	VOC Target (lb/mmbtu)	VOC Result (lb/mmbtu)	Coal Ramp Rate (MW/min)	Co-Fire Ramp Rate Result (MW/min)	Coal Min Load (MW)	Co-Fire Min Load (MW)
Cliffside 5	600	40%	0.08	0.015	0.25	0.164	N/A	N/A	8	10	150	100
Cliffside 6	905	100%	0.037	0.03	0.25	0.109	0.0023	0.0019	8	15	350	250
Belews 1 / 2	1170 585	50% 100%	1.05 0.04	0.002 / 0.069 0.001 / 0.002	0.517 0.4	0.499 / 0.498 0.40 / 0.398	0.004 0.0025	0 / 0.0002 0.0004 / 0.0002	6	25	300	300
Marshall 3 / 4	700 385	50% 100%	0.07 0.08	0.0096 / 0.087 0.0073 / 0.0042	0.32 0.24	0.19 / 0.176 0.161 / 0.148	0.0025 0.0055	0.0008 / 0.0009 0.001 / 0.0011	5	20	280	150
Marshall 1 / 2	400 160	40% 100%	0.06 0.08	0.0037	0.29 0.22	0.24 / 0.204 0.167 / 0.088	0.0025	0 / 0.0006 0 / 0	4	8	150	70

Panel Chair – Chad Donner – Duke Energy

Ann Palmer – Southern Company

John Brotherton – Duke Energy

Randy Bullock – Southern Company

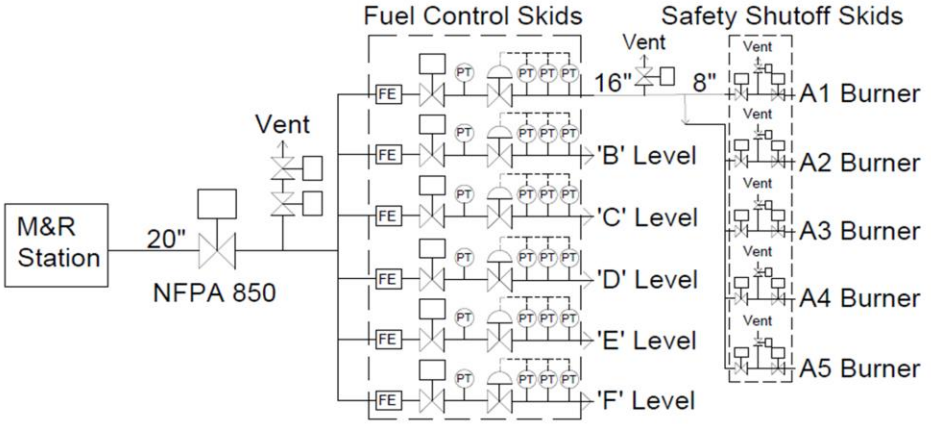
Joe Bittinger – American Electric Power

Panelist

Design Consideration Questions

Design Configuration Questions – Firing System

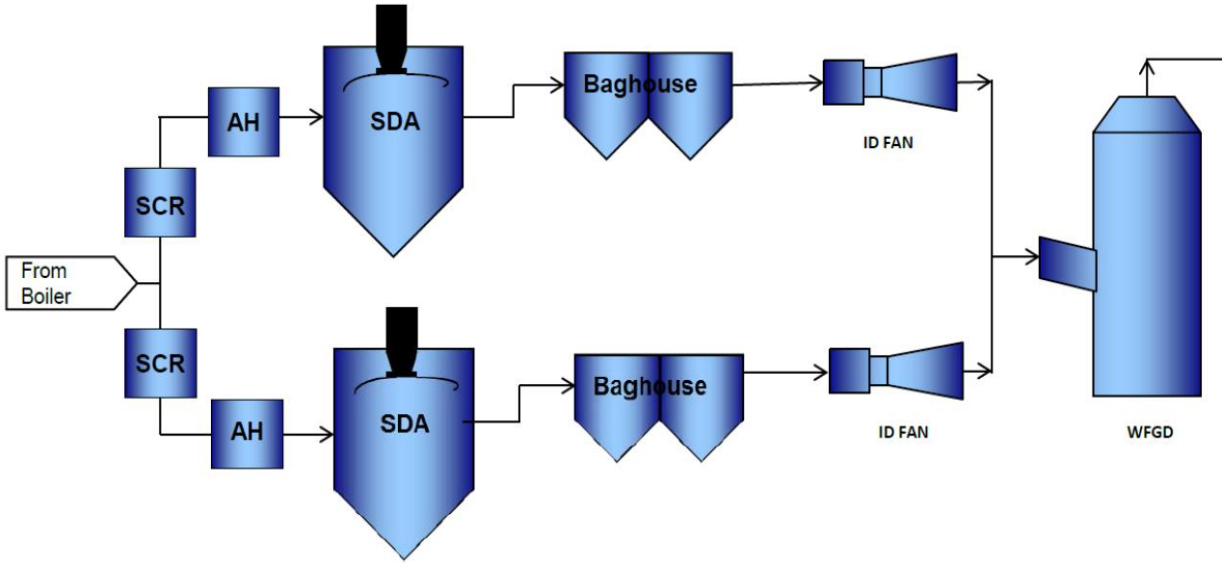
- Gas heating vs. insulation?
- Fuel control skids - Level or boiler control?
- Burners – New vs retrofit?
- Igniters – HESI vs separate igniter train?
- Burner cooling – Passive vs. active?
- Interferences – 3D laser scan; boiler growth; vents
- Controls – Gas controls, boiler controls mods, implosion protection



Design Configuration Questions – Auxiliary Systems

- Gas leak detection - Area vs. point or both?
- N2 purge systems - Sweep vs. pressure?
  - NFPA 85 – Purge into & out of service
- CO monitoring?
- Scanner cooling air improvements?
- Boiler area ventilation – HCA NFPA 70 / NFPA 497

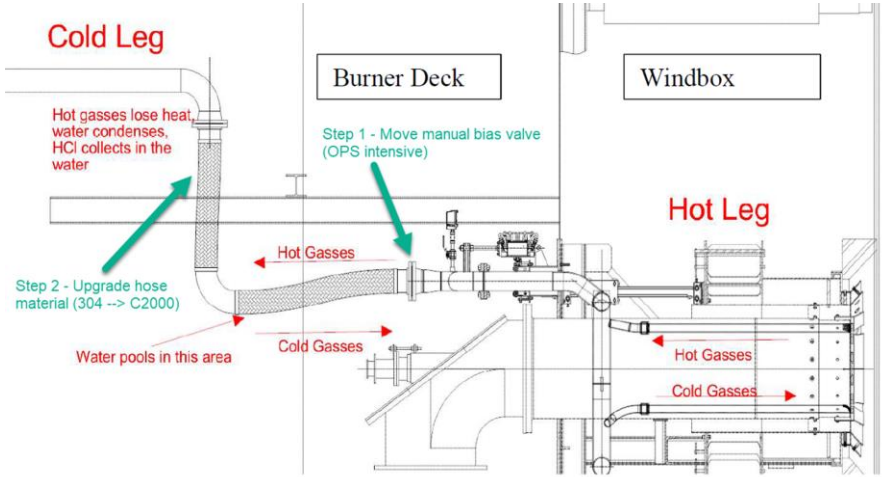
- SCR
  - Low load operation / cutoff
  - NH3 injection turndown
  - Dilution air supply
  - MoT
- ESP
  - SO3 injection turndown
  - Field operation / cutoff
- SDA-Baghouse
  - Slurry feed control
  - Baghouse bypass
- WFGD
  - Slurry temperature
  - Purge control
  - Hg re-emission control

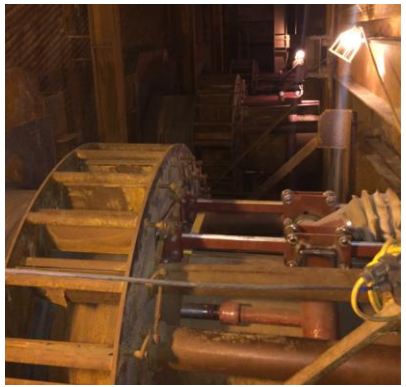


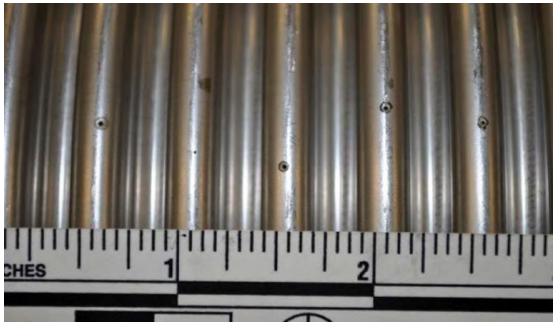
Operational Experience Questions

Operational Experience Questions – Burners / Flex Hoses

- Scanner issues
  - Flame discrimination?
  - Overheating / line of sight?
- Burner Overheating
  - Windbox combustion?
- Flex hose corrosion?
- Burner operation
  - Bring all burners up/down together?
  - Maintain mill group control?







Operational Experience Questions – AQCS Equipment

- Reduced MOT on SCR Operation to 485F → Generation Flexibility Benefit?
- Suspected SDA Approach Temp Issues w/ Change to Higher Moisture Fuel → SDA Buildup and Baghouse Bag Life Issues?
- Higher WFGD pH on gas operation → Benefit?
- Calcium carbonate formation & plating → Purge More Frequently?
- Hg Re-Emission → Purge More Frequently?
- Ramp Rate Issues w/ WFGD While Co-Firing → Periods of Higher SO2 Emissions Until Reagent Feed Catches Up?
- Wastewater Nitrate Issues with Gas → Purge More Frequently?
- Steady O&M Culture Shift with "Easy" Gas → Coal Equipment is Treated as Secondary and not Maintained as Essential to Operation "Operational Amnesia"?
- Gas Dispatch Philosophy → Fuel Flexibility Opportunity?

Questions?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