Reburning Projects in the Department of Energy's Clean Coal Technology Demonstration Program

NETL Conference on Reburning for NOx Control

Morgantown, WV

May 18, 2004

Al Mann and Tom Ruppel, Parsons Corporation
Tom Sarkus, National Energy Technology Laboratory

Clean Coal Technology Demonstration Program (CCTDP)

- Initiated in 1986
- 35 projects completed or still active
- Four reburning projects
  - All complete
  - Six locations

Location No. 1

- Gas reburning/sorbent injection
- Illinois Power (now Dynegy)
- Hennepin Station, Hennepin, IL

Hennepin Unit 1

- 80 MWe gross
- Tangentially Fired
- Gas Reburn - EER Technology
- Demonstration: 1/91-1/93; 24 months
- Reburn Fuel Heat Input: 18%
- NOx Emissions, lb/million Btu
  - Baseline 0.75
  - Controlled 0.25
  - Reduction 67% (average)

Location No. 2

- Gas reburning/sorbent injection
- City Water, Power & Light
- Lakeside Station, Springfield, IL

Lakeside Unit 7

- 40 MWe gross
- Cyclone-Fired
- Gas Reburn – EER Technology
- Demonstration: 5/93-10/94; 17 months
- Reburn Fuel Heat Input: 23%
- NOx Emissions, lb/million Btu
  - Baseline 0.97
  - Controlled 0.39
  - Reduction 60% (average)

Location No. 3

- Gas reburning/low-NOx burners
- Public Service of Colorado (now Xcel)
- Cherokee Station, Denver, CO

Cherokee Unit 3

- 172 MWe gross
- Wall-Fired
- Gas Reburn – EER Technology
- Demonstration: 11/92-1/95; 26 months
- Reburn Fuel Heat Input: 12.5%
- NOx Emissions, lb/million Btu
  - Baseline 0.73; 0.46 w/ LNB alone
  - Controlled 0.26
  - Reduction 44% w/ reburn; 64% overall

Location No. 4

- Coal reburning
- Wisconsin Power & Light (now Alliant)
- Nelson Dewey Station, Cassville, WI

Nelson Dewey Unit 2

- 110 MWe gross
- Cyclone-Fired
- Coal Reburn – B&W Technology
- Demonstration: 12/91-12/92; 12 months
- Reburn Fuel Heat Input: 25-30%
- NOx Emissions, lb/million Btu
  - Baseline 0.82
  - Controlled 0.39
  - Reduction 52%

Location No. 5

- Micronized coal reburning
- NYSEG
- Milliken Station (now AES Cayuga), Lansing, NY

Milliken Unit 1

- **148 MWe gross**
- **Tangentially Fired**
- **Micronized Coal Reburn – EER Technology**
  - DB Riley MPS 150 Mill – 72% through 325 mesh
- **Demonstration: 3/97-4/99; 25 months**
- **Reburn Fuel Heat Input: 14%**
- **NOx Reduction Since Inception: 3700 tons**
- **NOx Emissions, lb/million Btu**
  - **Baseline 0.35 w/ LNB alone**
  - **Controlled 0.25**
  - **Reduction 29% w/ reburn**

Location No. 6

- Micronized coal reburning
- Eastman Kodak Company
- Kodak Park, Rochester NY

Kodak Park Unit 15

- **60 MWe gross (equivalent)**
- **Cyclone-Fired**
- **Micronized Coal Reburn – EER Technology**
  - Fuller MicroMill – 80% through 325 mesh
- **Demonstration: 4/97-10/98; 18 months**
- **Reburn Fuel Heat Input: 17%**
- **High Unburned Carbon on Fly Ash**
- **NOx Reduction Since Inception: 9400 tons**
- **NOx Emissions, lb/million Btu**
  - **Baseline 1.36**
  - **Controlled 0.59**
  - **Reduction 57%**

Summary of CCTDP Reburning Projects

Technology	Location	Tech Pro-vider	Com-bustor	Size, MWe (gross)	Reburn Heat, %	Base-line NOx	Con-trolled NOx	NOx Red. %	Current Status of Reburning	Comments
Gas Reburning	Hennepin	EER	T-fired	80	18	0.75	0.25	67	Not operating	High price of natural gas. NOx reduction covered by other units.
Gas Reburning	Lakeside	EER	Cyclone	40	23	0.97	0.39	60	Not operating	High price of natural gas. NOx reduction covered by other units.
Reburning/Low NOx Burners (LNB)	Cherokee	EER	Wall-fired	172	12.5	0.73	0.26	64	Decommis-sioned	LNB plus OFA meets NOx emissions requirement
Coal Reburning	Nelson Dewey	B&W	Cyclone	110	25 - 30	0.82	0.39	52	Decommis-sioned	Overfire air (OFA) meets NOx emissions requirement
Micronized Coal Reburning/LNB	Milliken	EER	T-fired	148	14	0.35	0.25	29	Operating	LNB provides 39% NOx reduction. Total NOx reduction = 68%
Micronized Coal Reburning	Kodak Park	EER	Cyclone	60	17	1.36	0.59	57	Operating	Meets N.Y. State RACT requirement of 0.60 lb NOx/ million Btu

Summary of CCTDP Reburning Projects

- In all six cases, NOx reduction exceeded the project target goal of 50% (including reburning, LNB, and OFA)
- Substantial reductions in NOx emissions
- Wide range of coals
- Wide range of combustor types
- Minimal loss in thermal efficiency (~ 1%)

Reburning Costs

Capital, $/kW

- Gas: 15-20
- Coal: 50-60

Levelized, $/ton NOx

- Gas: 2100-2500 with gas at $5/million Btu
- Coal: 500-1000

Current Status of CCTDP Projects -- Gas Reburning

Discontinued at Hennepin, Lakeside, and Cherokee

- High price of natural gas
- Required NOx reductions at Hennepin and Lakeside covered by other units
- Required NOx reductions at Cherokee are met with LNB & OFA

Current Status of CCTDP Projects -- Coal Reburning

- Discontinued at Nelson Dewey
  - OFA meets emissions requirement
- Operating at Milliken and Kodak Park
  - Meeting current New York State NOx emissions limit of 0.60 lb/million Btu

CCTDP reburning projects were conducted in 1990s

- Modest NOx reductions (40-50%) required under CAAA Title IV (Acid Rain)
- Price differential between natural gas and coal < $2/million Btu

Current Environment for Reburning

- CAAA Title I (ozone transport) requires 85% NOx emissions reduction
- Post-combustion NOx control (SCR) probably required at many power plants
- Price differential between natural gas and coal
  ~ $4/million Btu
- Reburning viability needs to be evaluated on case-by-case basis

Future Prospects for Reburning

- Reburning has been used worldwide in commercial applications not funded by DOE – see Scorecard
- Reburning niche may be in combination with other technologies, i.e. both combustion modification and post-combustion
- One Power Plant Improvement Initiative (PPII) project involves Fuel Lean Gas Reburning (FLGR) coupled with SCR and SNCR
- Coal reburning incorporated in DOE's Low Emissions Boiler System (LEBS) project

Clean Coal Technology Compendium

For further information, visit the Clean Coal Technology Compendium:

www.netl.doe.gov

Links → Clean Coal Technology Compendium