McDermott Technology, Inc.

Cost-Effective Control of NO_X with Integrated Ultralow-NO_X PC Burner and SNCR

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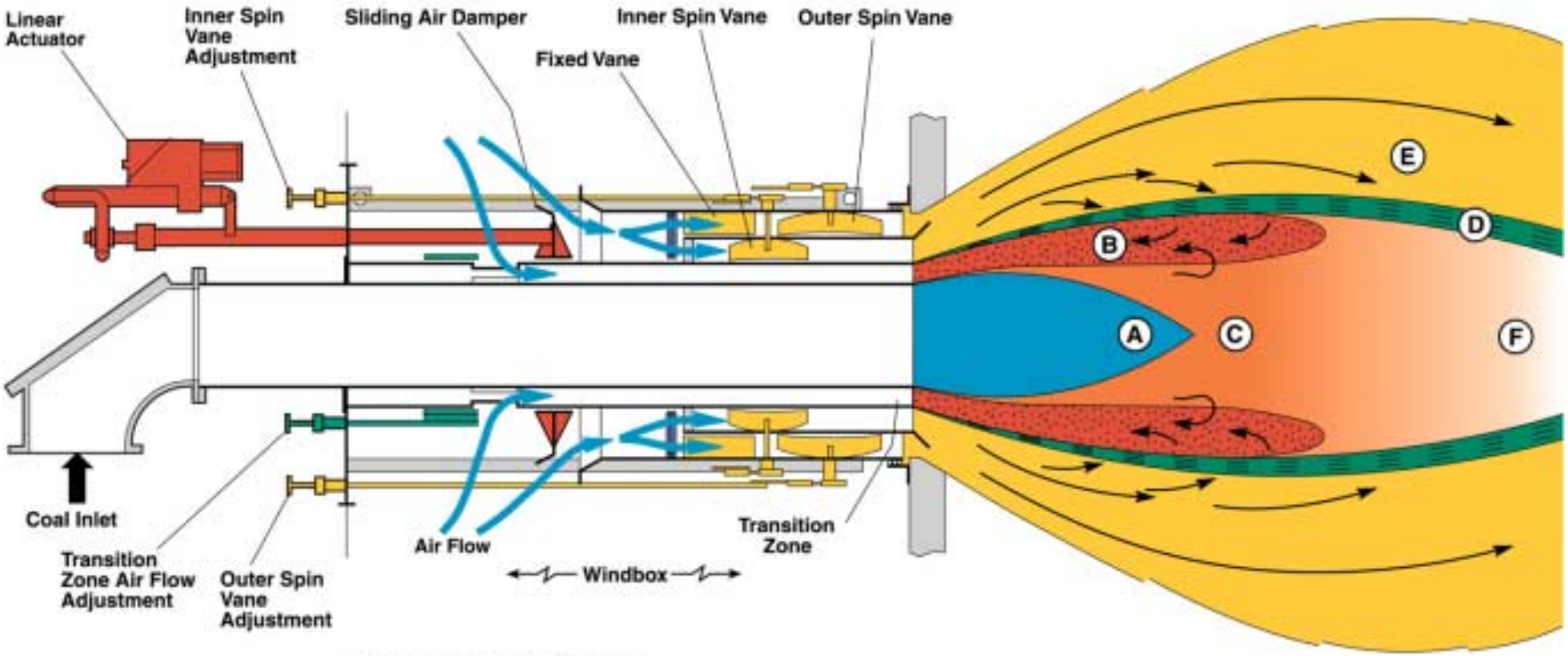
Introduction

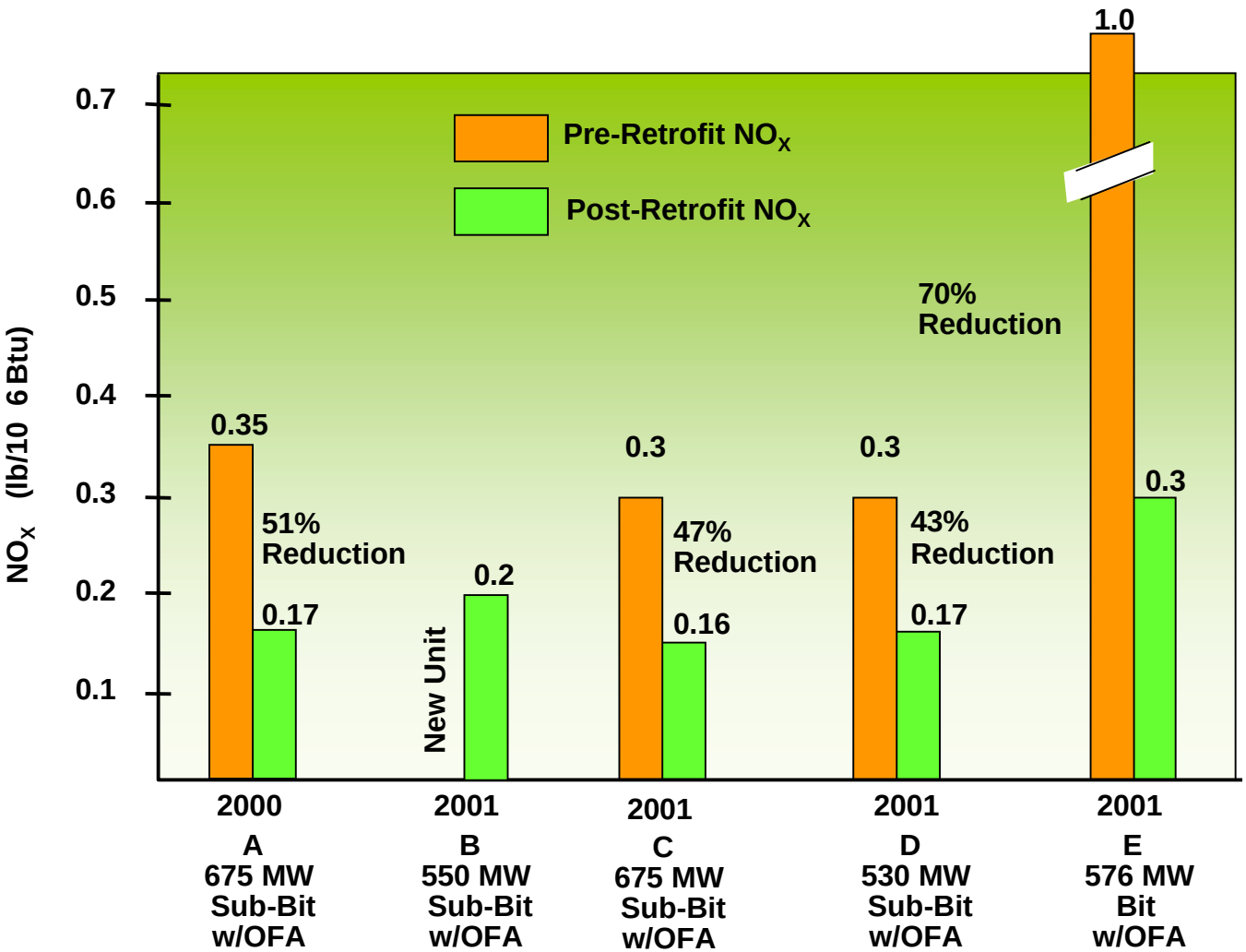
- Coal-burning power plants subject to various NO_X regulations
  - Title IV (acid rain legislation) — 0.46 lb / 10^6 Btu for wall-fired boilers, low-NO_X burners
  - Title I (Ozone Transport) — 0.15 lb / 10^6 Btu requires SCR
- Ultra low-NO_X with SNCR can be developed to meet OTR NO_X regulation level

Low NO_x DRB-4Z™ Burner Combustion Zones



A. Oxygen lean devolitilization
B. Recirculation of products
C. NOx reduction zone
D. High temperature flame sheet
E. Controlled mixing of secondary combustion air
F. Burnout zone

B&W Low NO_X Burner Experience

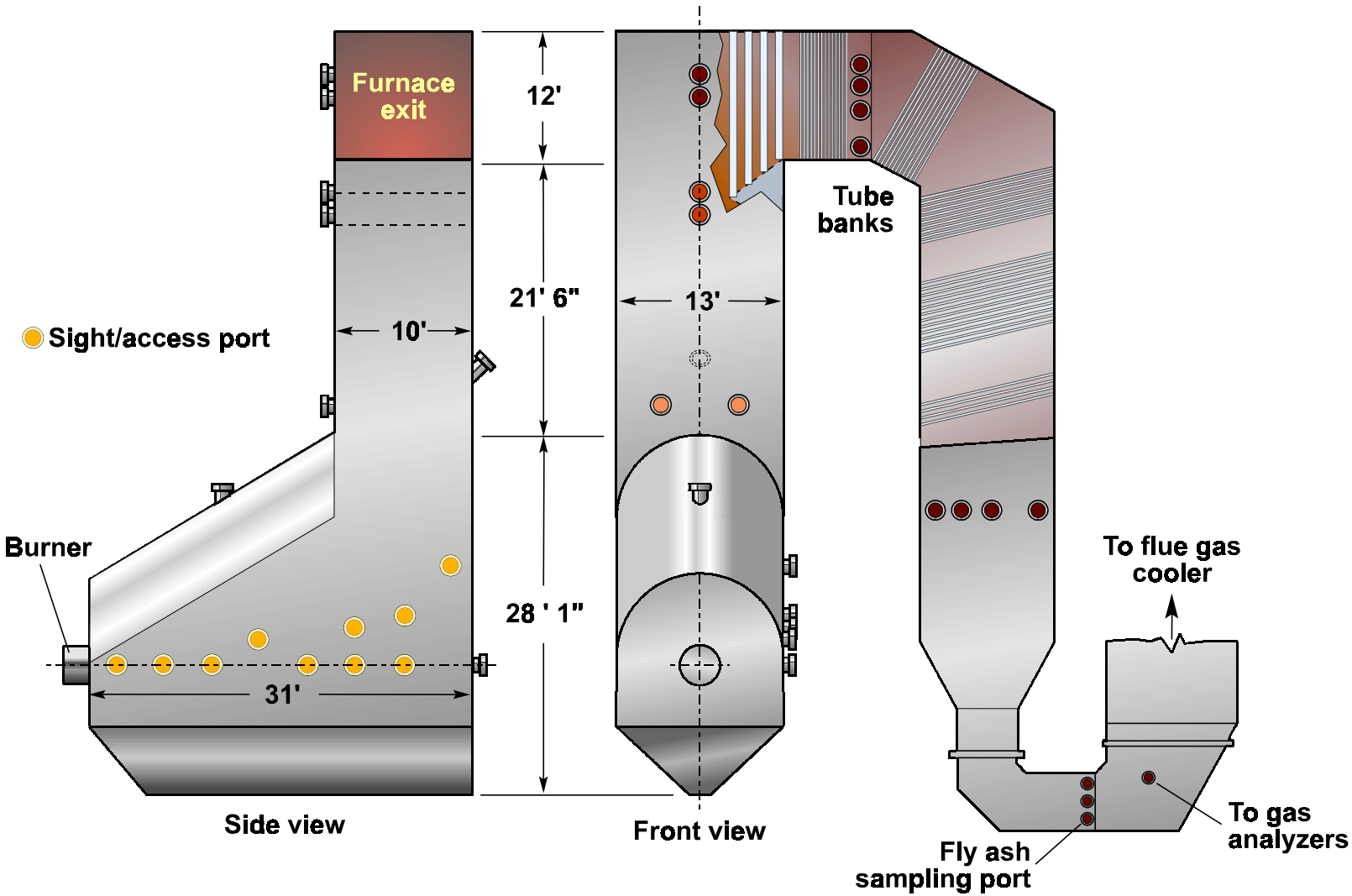


DRB-4Z™ Burner LOI Results

Objectives

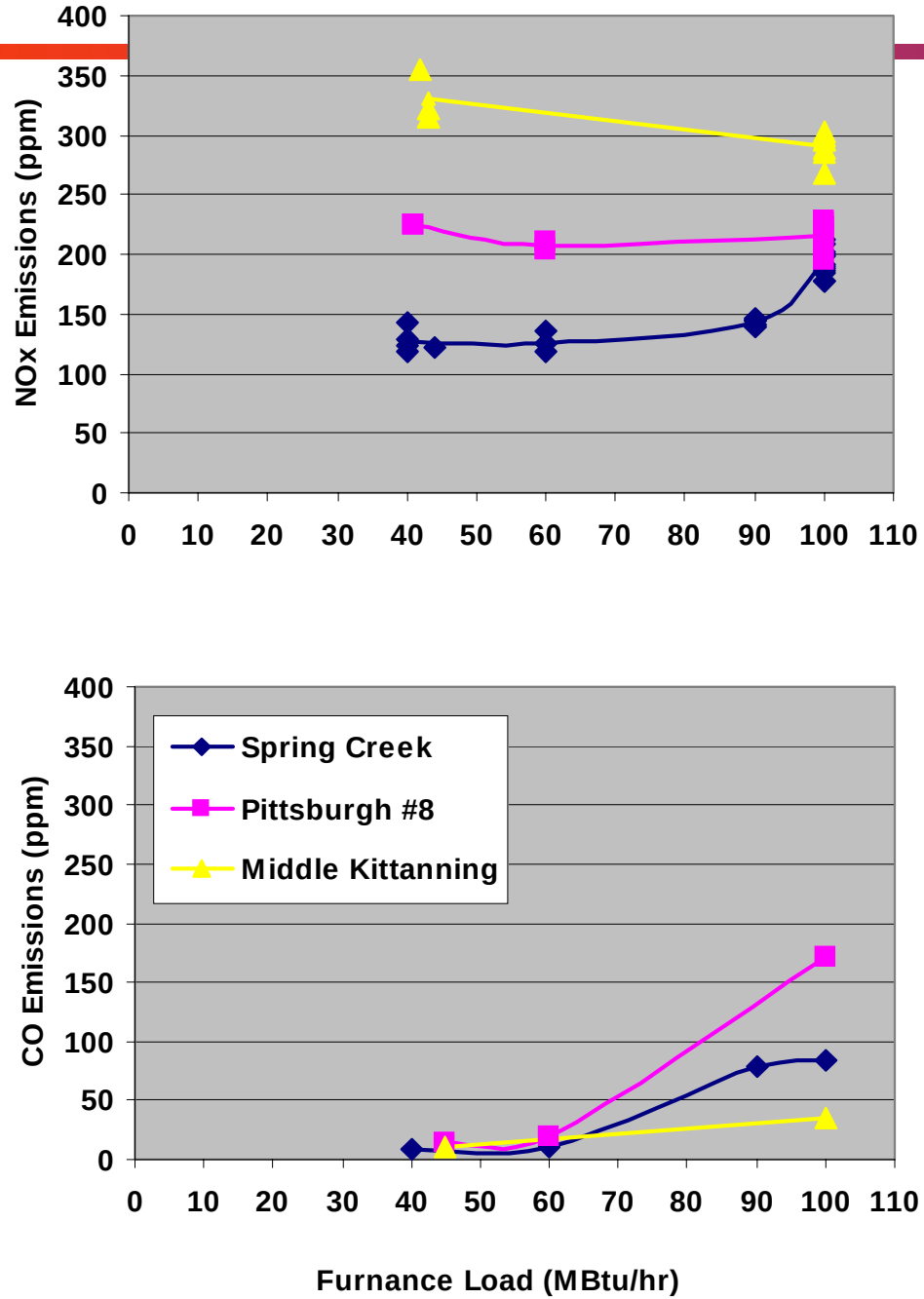
- To develop cost-effective NO_X reduction technology ready for commercial deployment by 2002-2004 capable of:
  - Meeting 0.15 NO_X lb / 10^6 Btu emission level in field
    - Nominal 25% NO_X reduction by SNCR
  - Achieving levelized cost saving of 25% over SCR technology
  - Negligible impact on balance-of-plant issues
  - Maintain performance over wide range of coals

CEDF Furnace Schematic



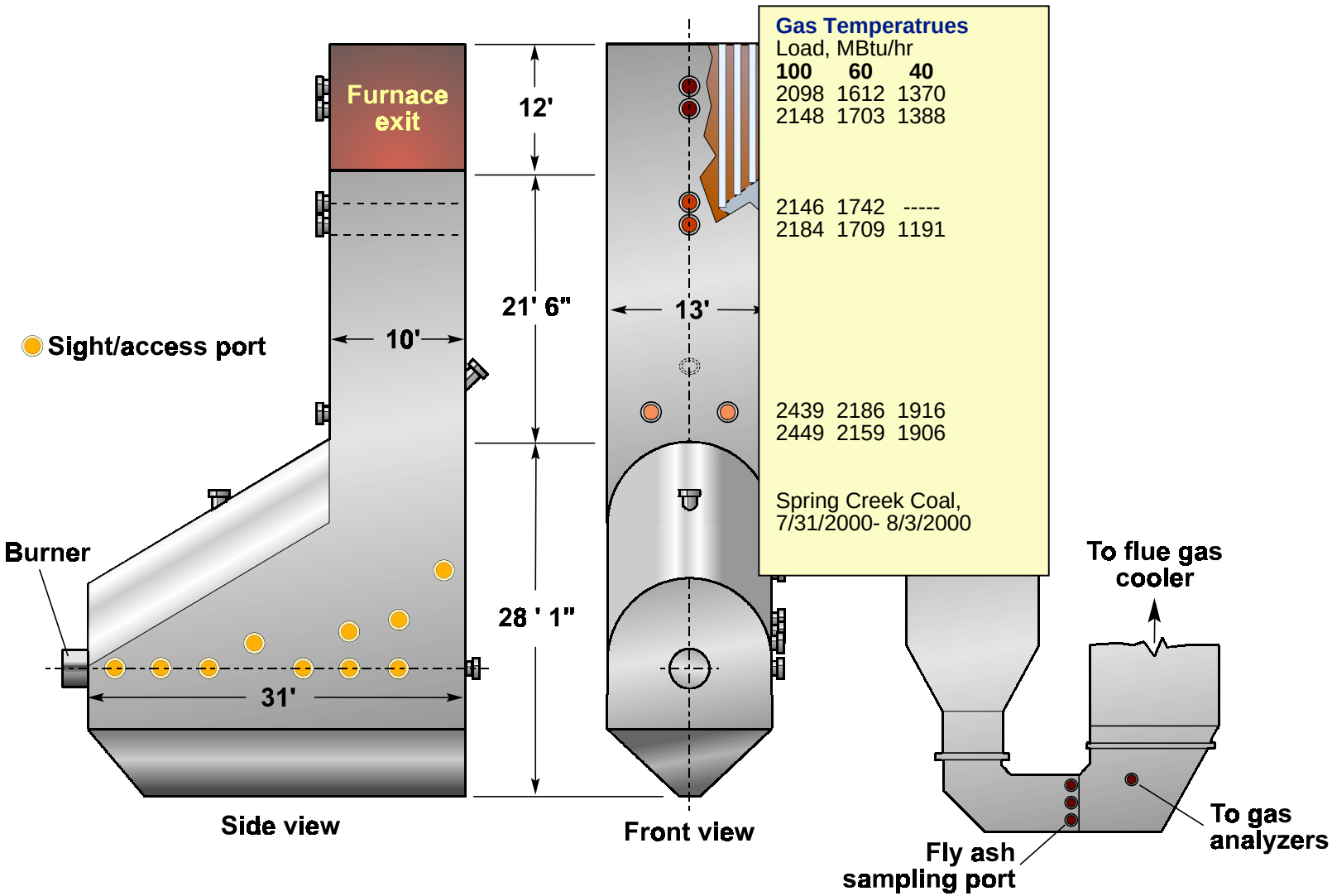
Coal Analyses

	Western Subbituminous	High-Volatile Bituminous	Medium-Volatile Bituminous
	Spring Creek	*Pittsburgh #8*	*Middle Kittanning*
Fixed Carbon (%)	39.10	44.00	47.31
Volatile Matter (%)	31.05	36.82	19.89
Moisture (%)	26.21	12.87	9.55
Ash (%)	3.64	6.31	23.25
Fixed Carbon/Volatile Matter	1.26	1.20	2.38
Nitrogen (%)	0.64	1.12	0.96
Sulfur (%)	0.23	3.10	1.20
Heating Value (Btu/lb)	9110	11733	10054

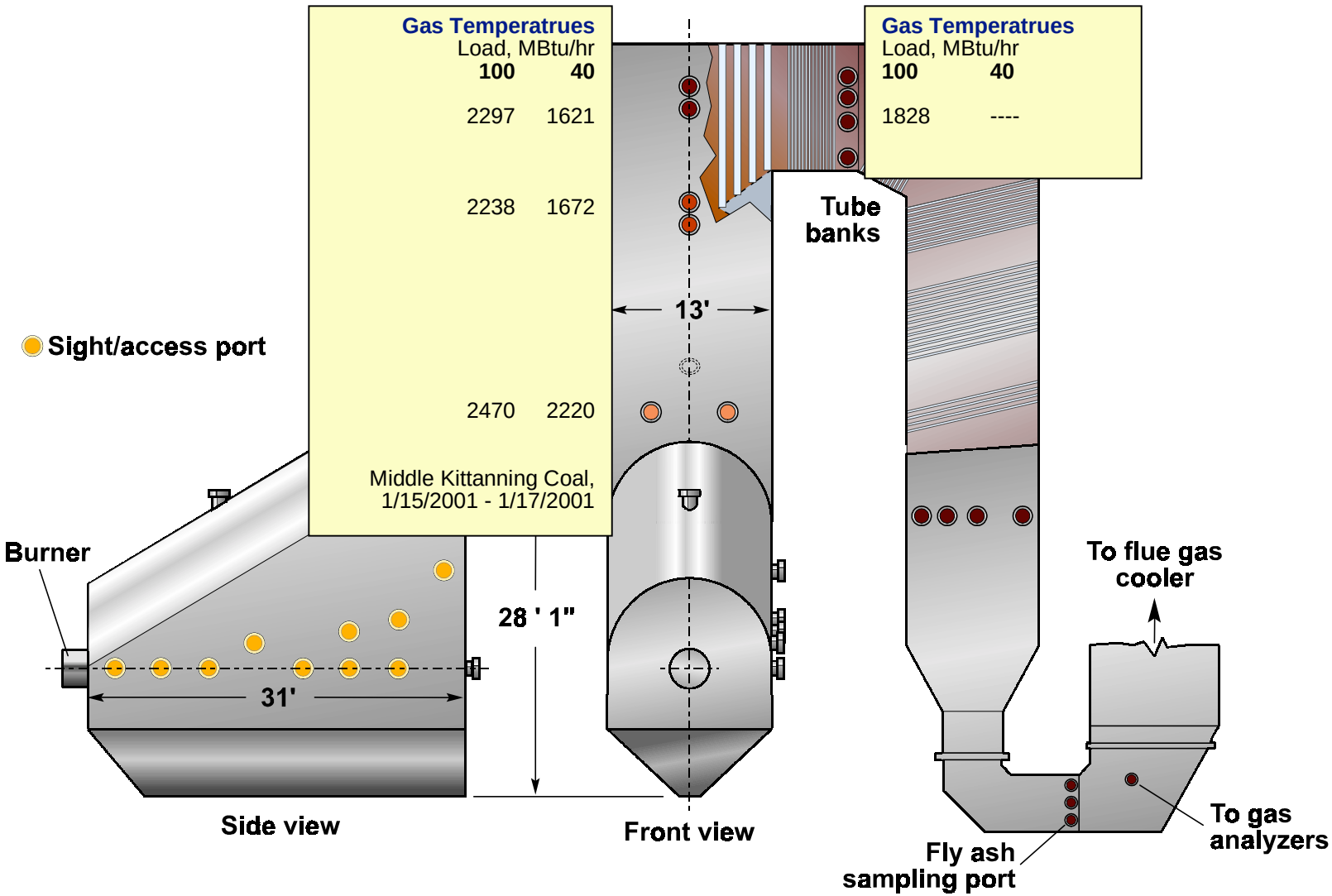


Effect of Furnace Load on NO_X and CO Emission, Firing Baseline Plug-In DRB-4Z™ Burner with Test Coals

Temperature / Gas Species Mapping



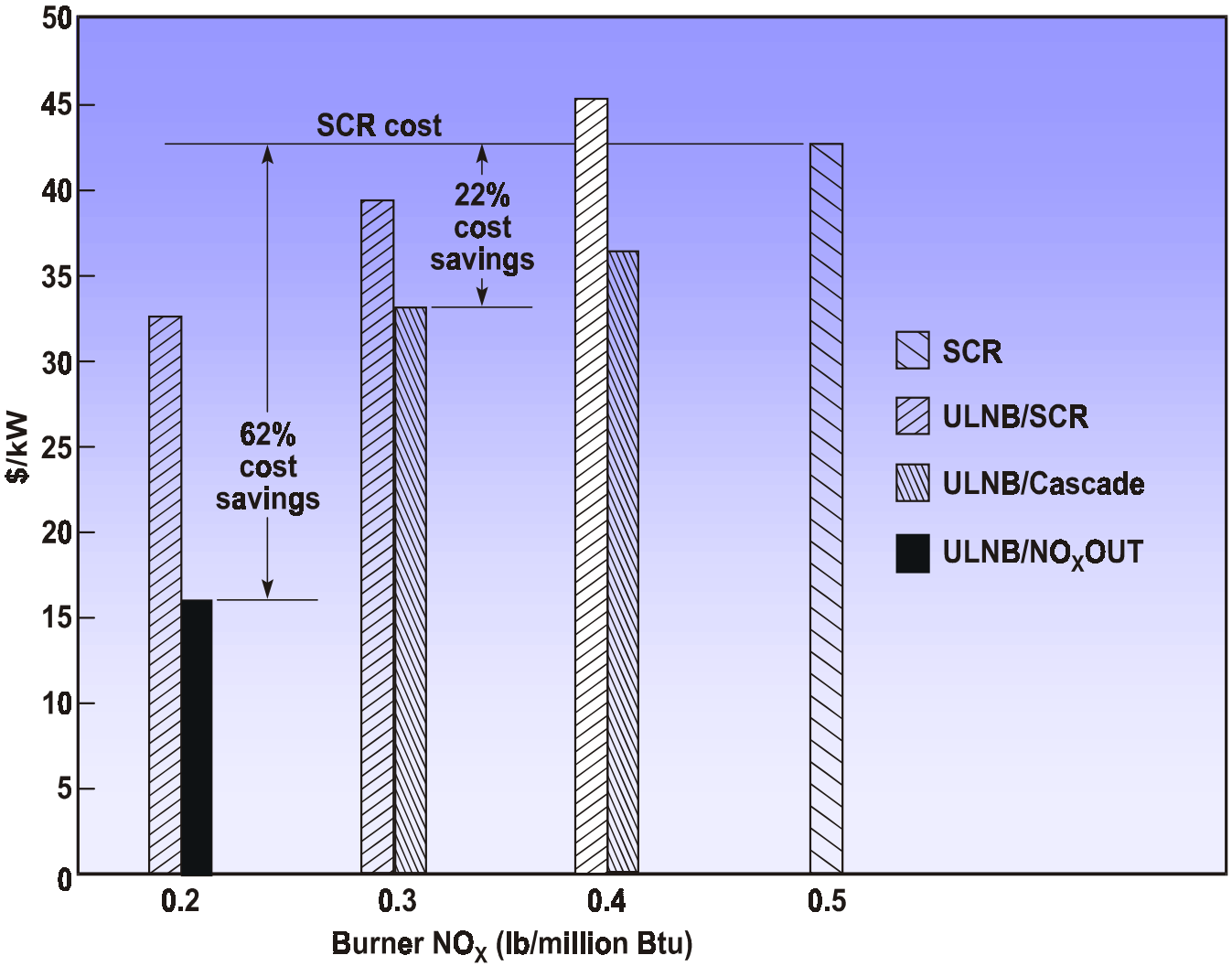
Temperature / Gas Species Mapping



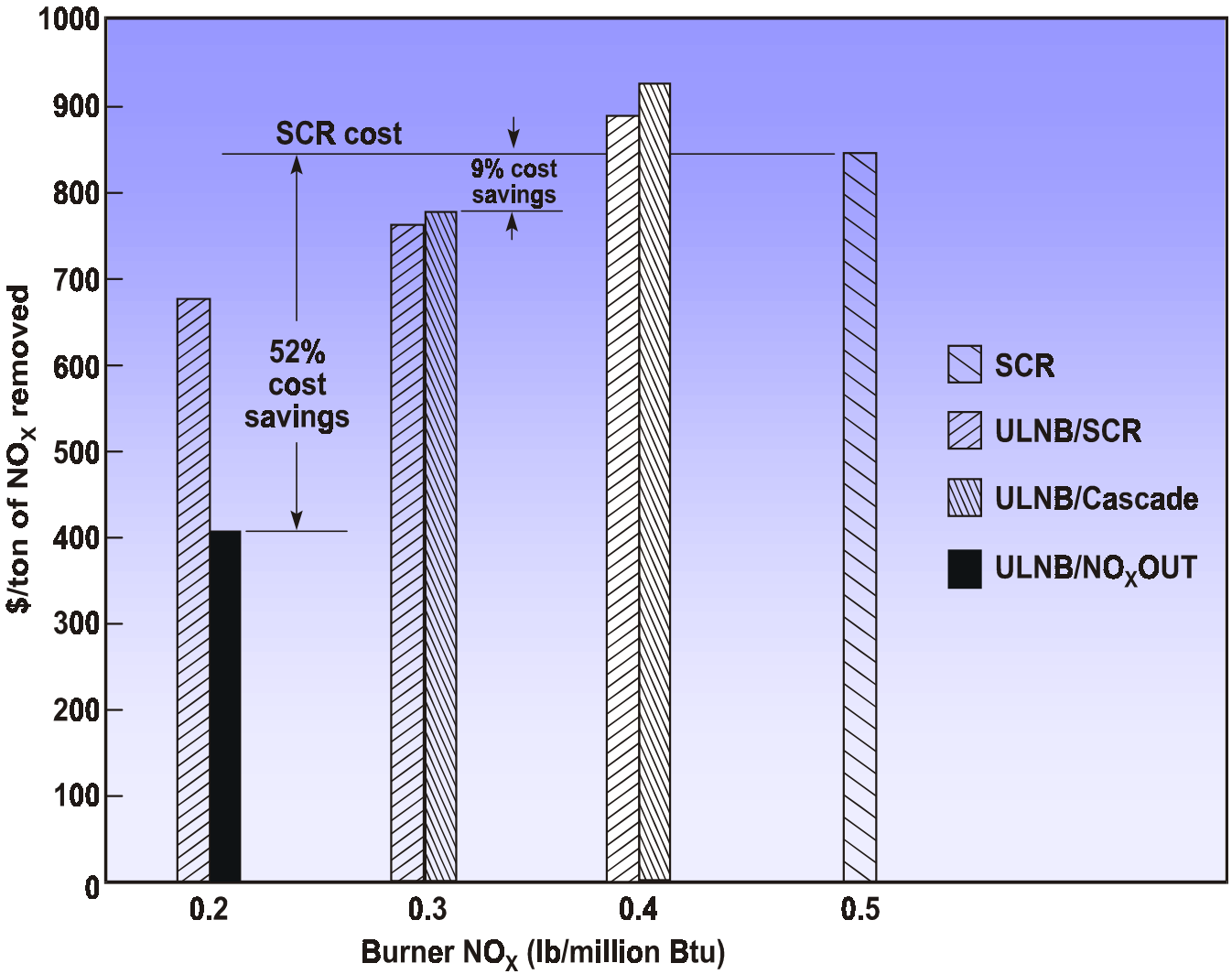
Conclusions

- Substantial NO_X has been reduced
- Side effects seem manageable
- Additional NO_X reduction can be achieved with air staging and SNCR

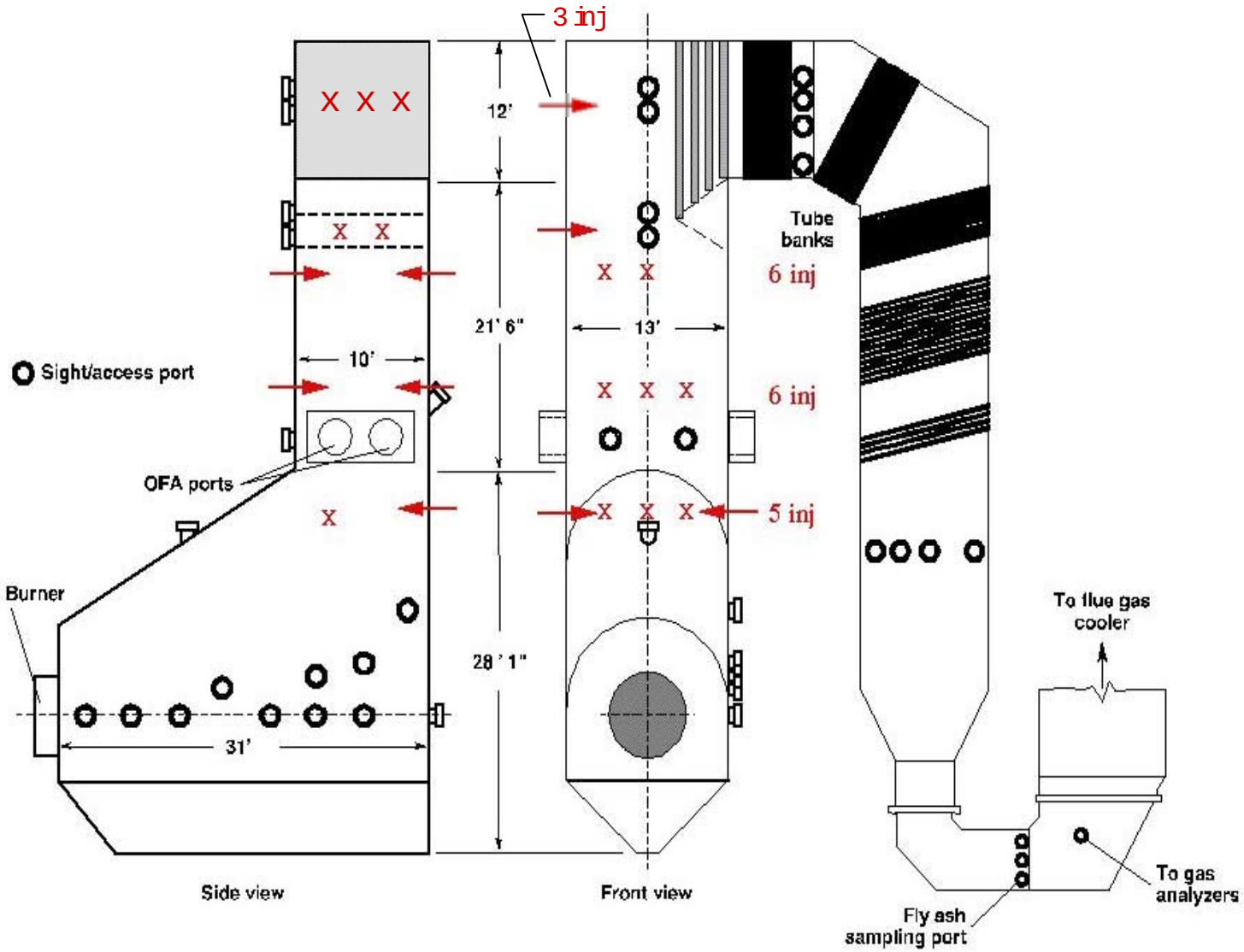
Capital Cost



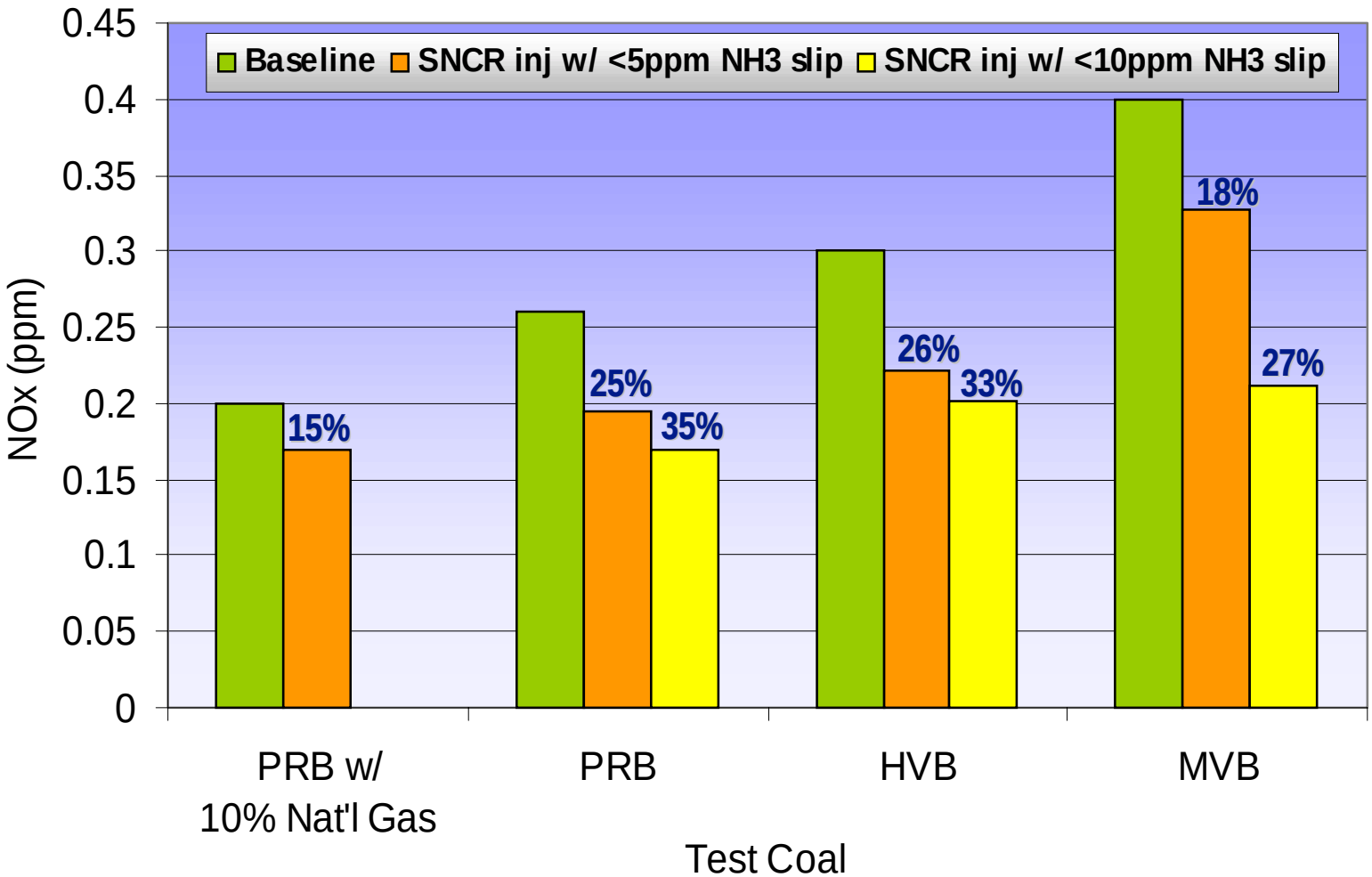
Levelized Cost



SNCR Injection Locations



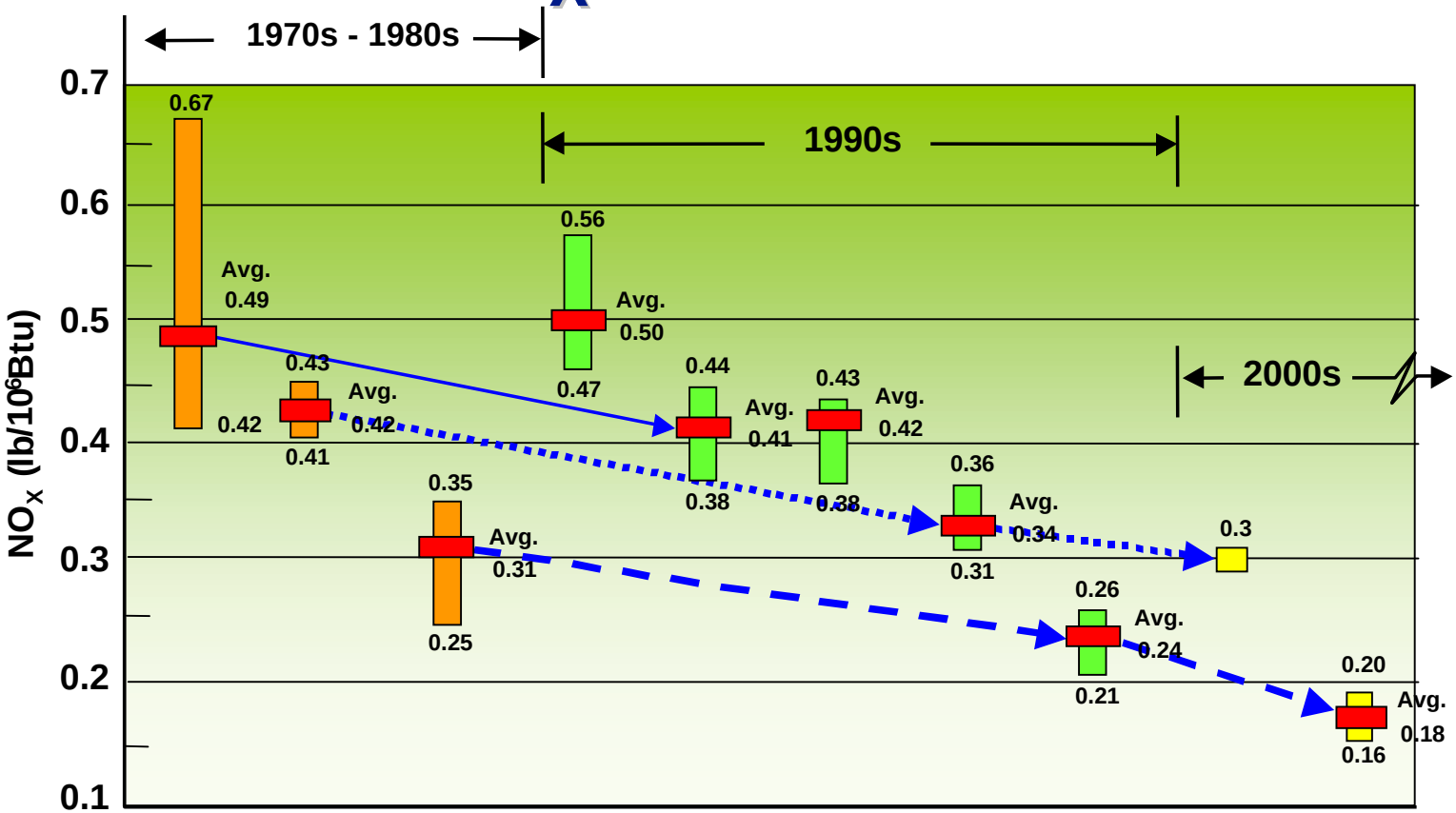
Effect of SNCR Injection on NO_x Emissions for Plug-In DRB-4Z™ Burner Firing Test Coals at 10^6 Btu / hr



Project Participants

- The Babcock & Wilcox Company (B&W)
  - Leading designer, developer, manufacturer of coal-fired power plants.
- Fuel Tech
  - Provider of urea-based SNCR technology
- McDermott Technology, Inc. (MTI)
  - R&D affiliate of (B&W) and other McDermott companies

B&W Low-NO_X Burner Advancements



	Bit	Bit	Sub-Bit	Bit	Bit	Bit	Bit	Sub-Bit	Bit	Sub-Bit
	DRB	DRB + OFA	DRB	DRB-XCL	DRB-XCL	DRB-XCL + OFA	DRB-XCL + OFA	DRB-XCL + OFA	DRB-4Z + OFA	DRB-4Z + OFA
	9 Units (opposed)	2 Units (opposed)	14 Units (opposed)	5 Units (Single)	5 Units (Opposed)	5 Units (Single)	7 Units (Opposed)	5 Units (Opposed)	1 Units (opposed)	4 Units (opposed)
Avg. MW	713	480	564	155	335	169	556	550	480	564

Approach

- An integrated system consisting of:
  - Ultralow-NO_X pulverized-coal burner
    - To reduce NO_X with combustion modification technique, usually most cost competitive
  - SNCR technology
    - To trim NO_X to compliance level
- B&W's DRB-4Z™ Ultralow-NO_X burner and Fuel Tech's NOxOUT® were evaluated in B&W's 10^6 Btu / hr clean-environment development facility

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