Retrofit Low Experience for Tangentially-Fired Boilers - 2002 Update

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NOx Reduction in Tangential Boilers

- **Overfire air appears to be the most effective way of reducing NOx emissions**
- **Separation distance between OFA and main combustion zone has a significant effect on the degree of NOx reduction achieved**
- **Flame holding devices can provide some modest reductions, however:**
  - ***Coal dependent***
  - ***High maintenance***

B&W's T-Fired low NOx Conversions

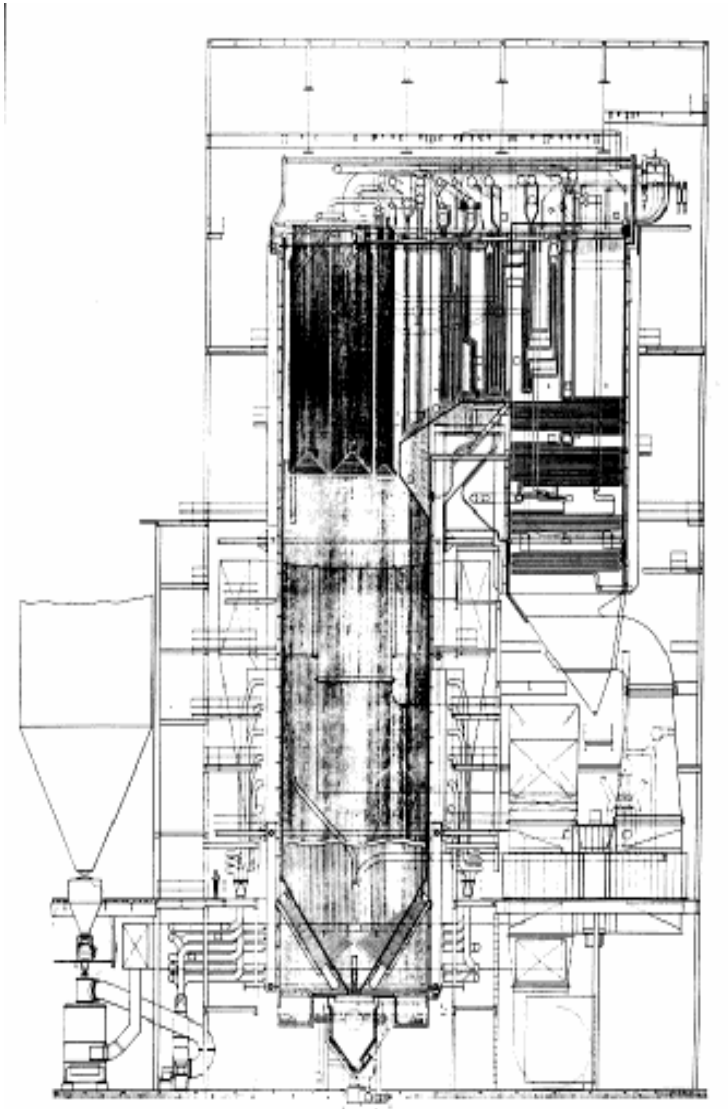
- Uses overfire air as the primary method for reducing NOx in tangential units
- Overfire air ports can be located in the corners or on the front and rear walls (interlaced)
- CFD modeling is used to assist in OFA port design, location, and performance predictions
- Over 7,000 MWe in NOx conversion over the past three years, representing 15 utility boilers
- Unit sizes from 130 MW to 850 MW
- Eight units in operation currently

B&W Low NOx Experience

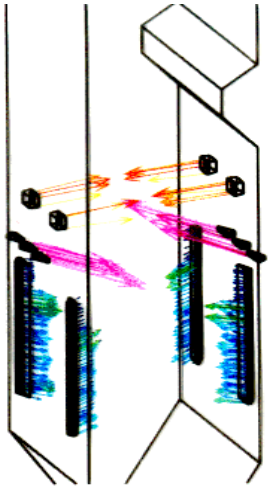
Plant	Size, MW	Type	Coal	Operation
A	730	Divided	E. Bit.	Yes
B	530	Divided	60/40	Yes
C	260	Twin	50/50	Yes
D	500	Divided	E. Bit.	Yes
E	450	Divided	80/20	Yes
F	730	Divided	E. Bit.	Yes
G	500	Divided	E. Bit.	Yes
H	140	Single	E. Bit.	Yes
I	885	Divided	PRB	Yes
J	850	Divided	E. Bit.	No
K	350	Divided	E. Bit.	Start-Up
L	140	Single	E. Bit.	No
M	550	Single	E. Bit.	No
N	885	Divided	PRB	No
O	350	Divided	E. Bit.	No
TOTAL	7700			

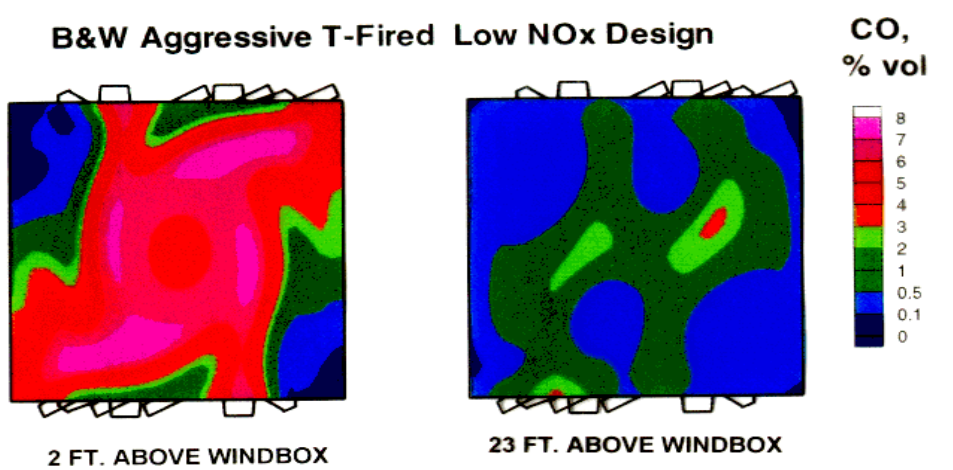
Plant A Unit Description

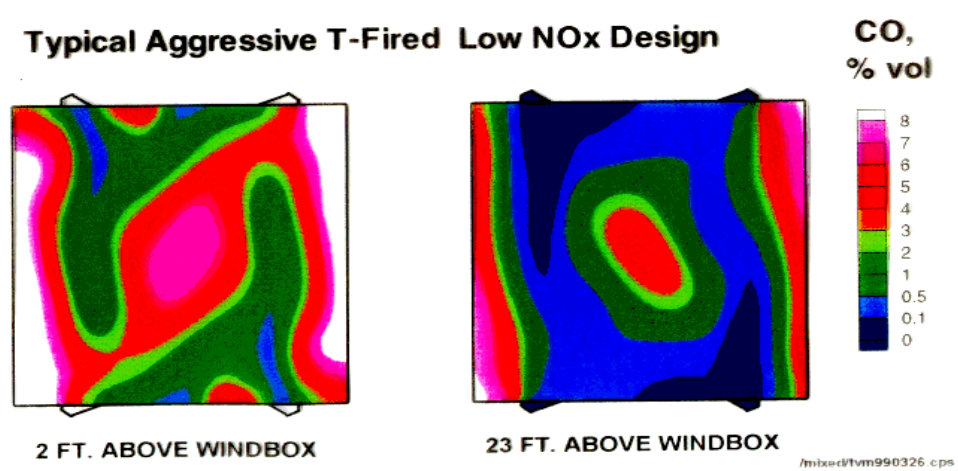
- 700 MW
- Supercritical operating pressure
- Six elevations of fuel admission
- Divided furnace
- OFA added in 1995 within the existing windbox
- Medium sulfur eastern bituminous coal



CFD Modeling used for Plant A Design

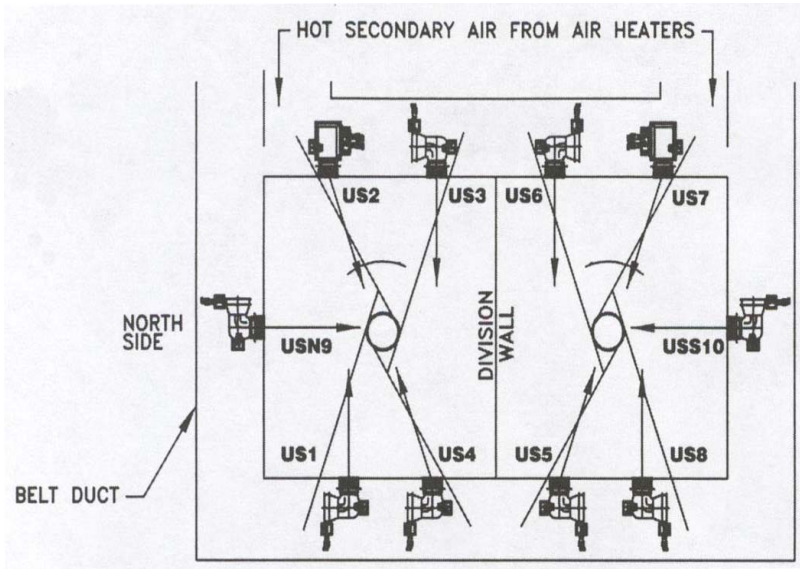




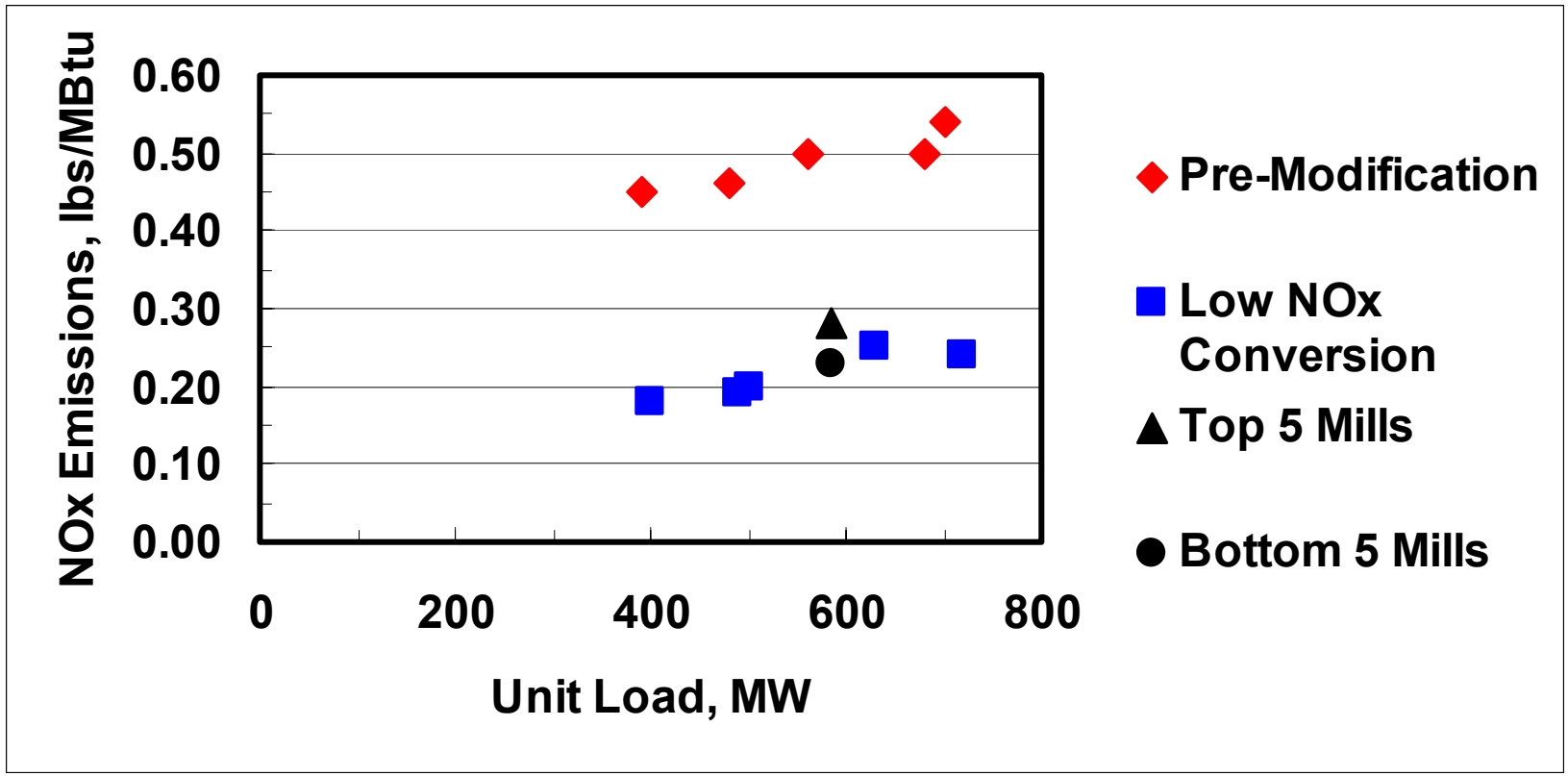


Benefits of Interlaced Design

- Better access around boiler
- No structural modifications
- Simpler pressure part opening
- Flexibility in controlling CO emissions
- Lower capital and installation cost

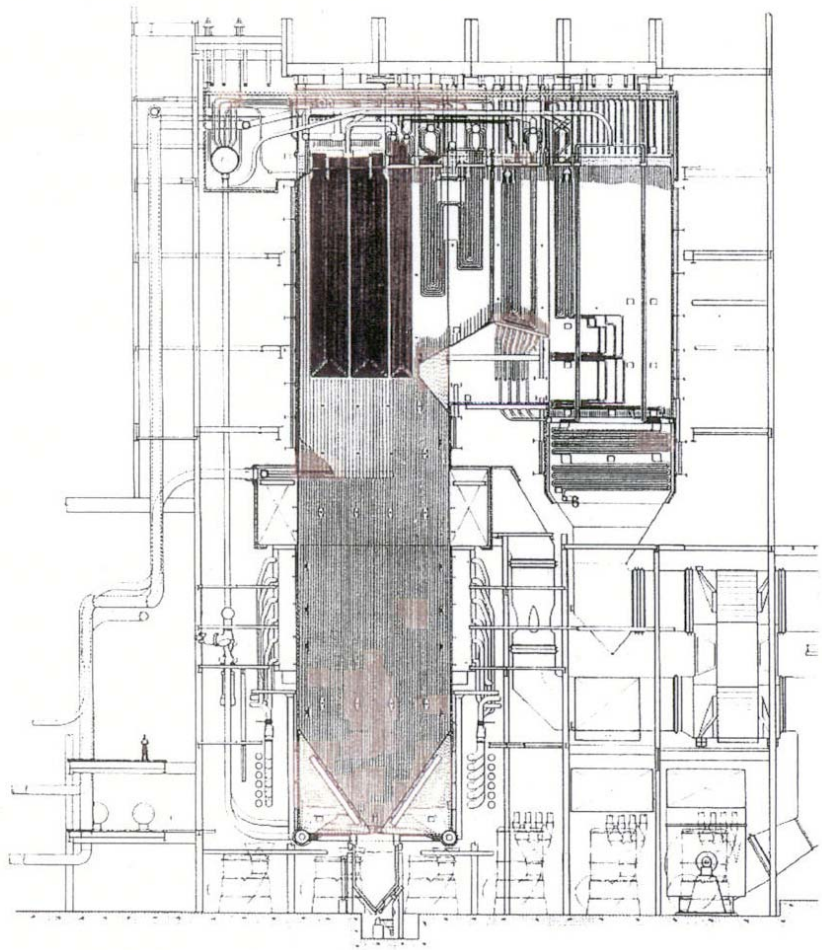


Plant A Detailed Results

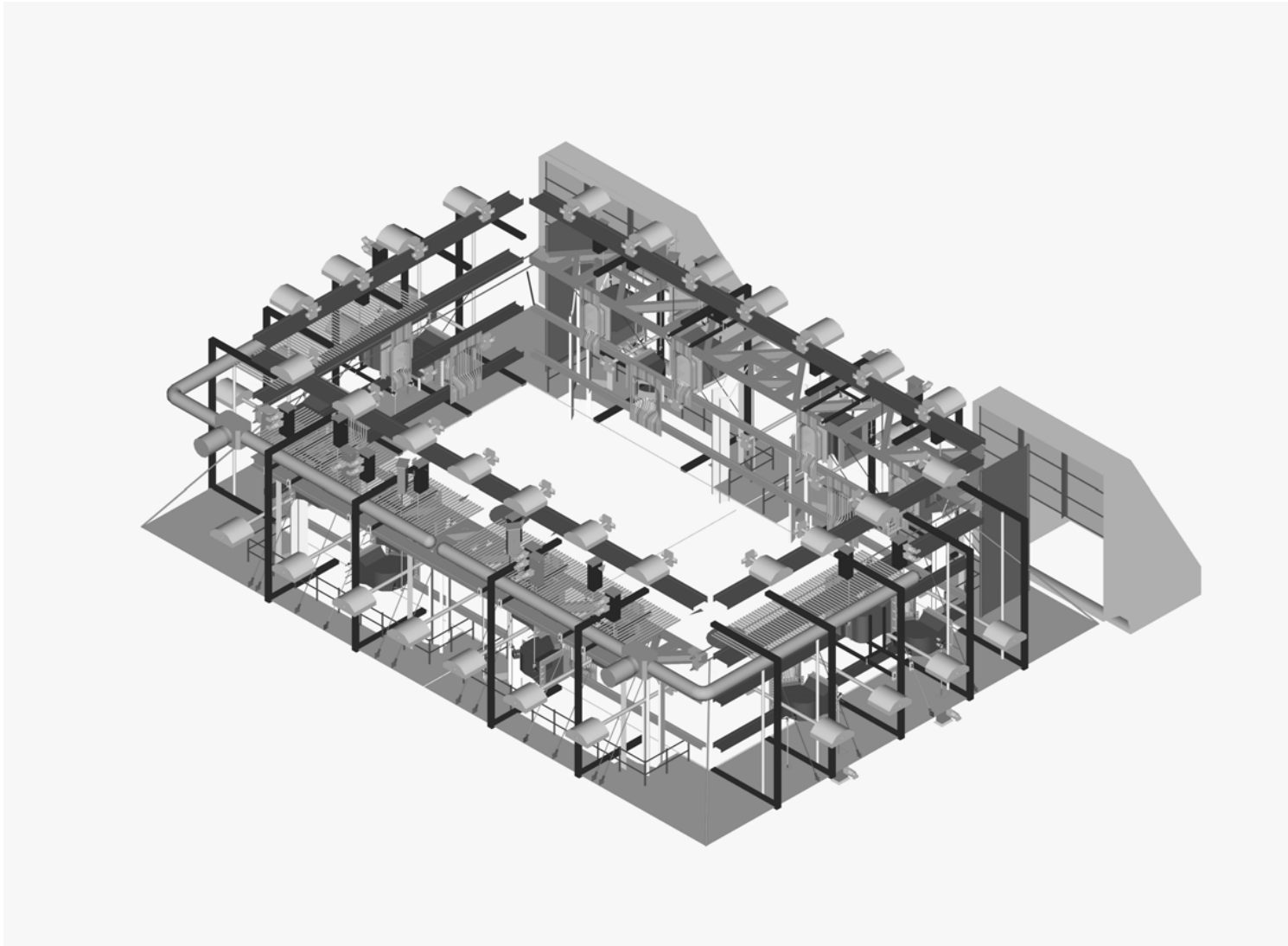


Plant B

- 520 MW
- Subcritical pressure
- Divided furnace
- Six elevation of fuel
- Fuel is a 60% PRB and 40% eastern bituminous
- Baseline NOx at 0.4 to 0.5 lbs/MBtu

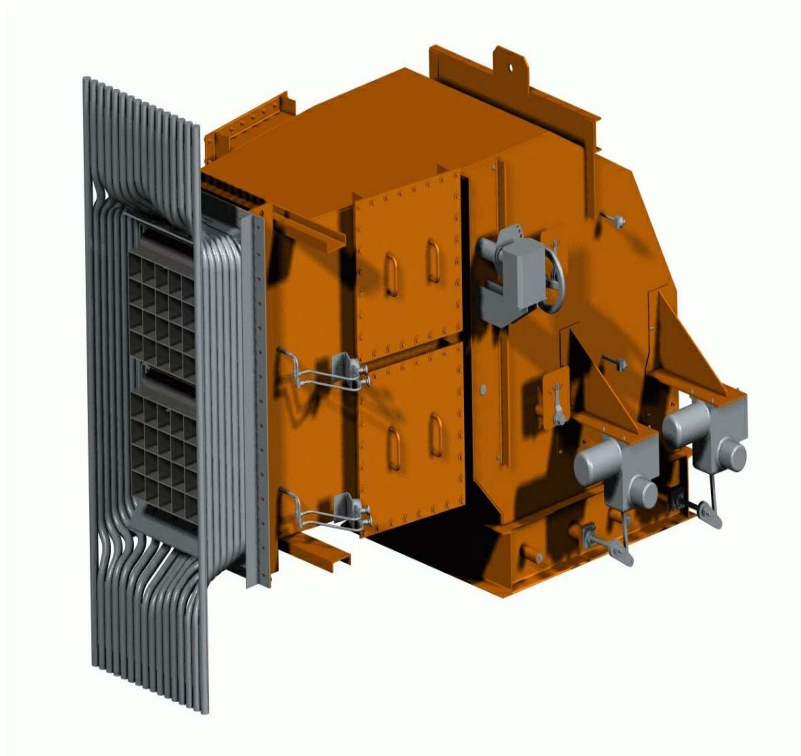


Plant B OFA Port Arrangement

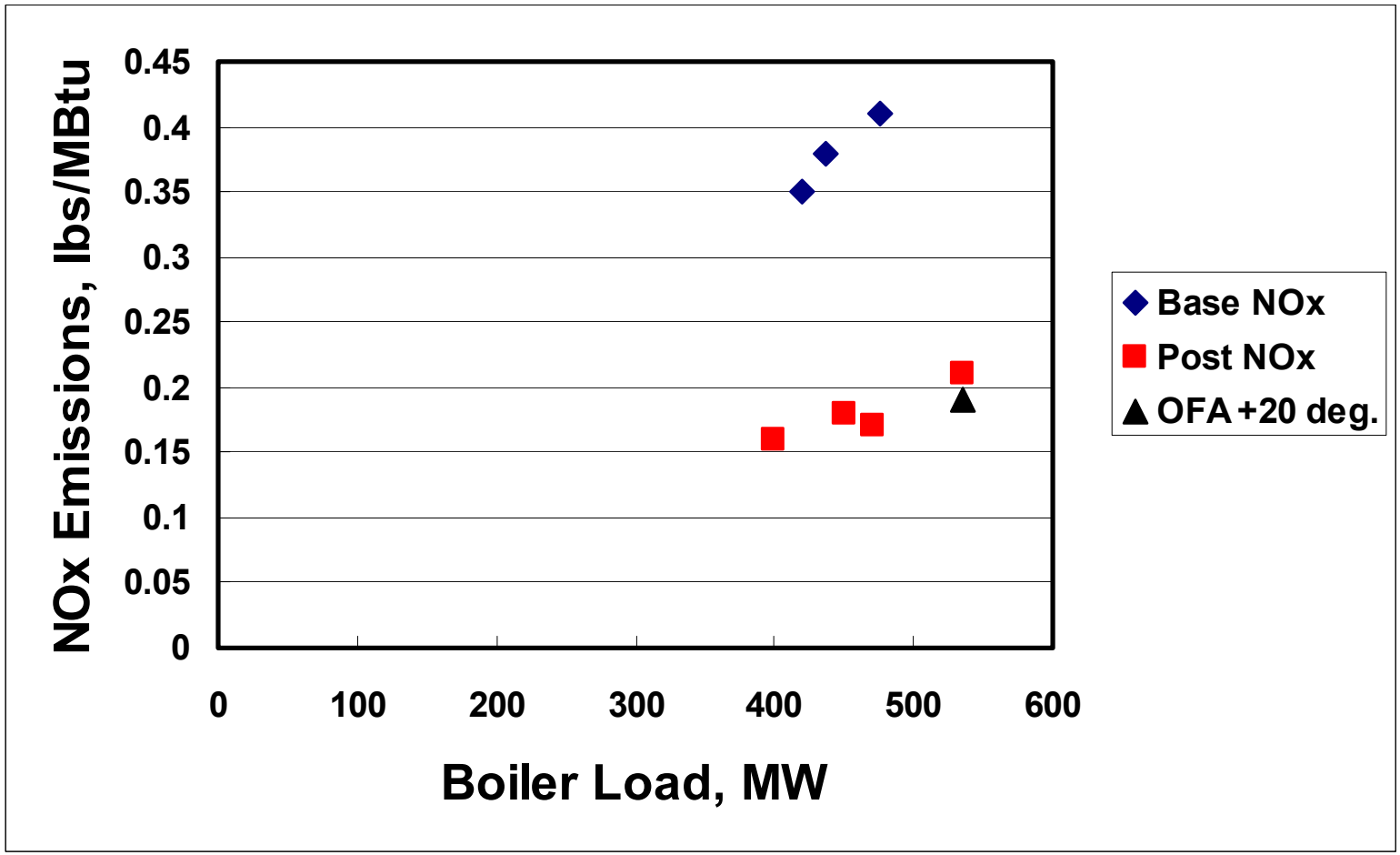


Plant B Overfire Air Port

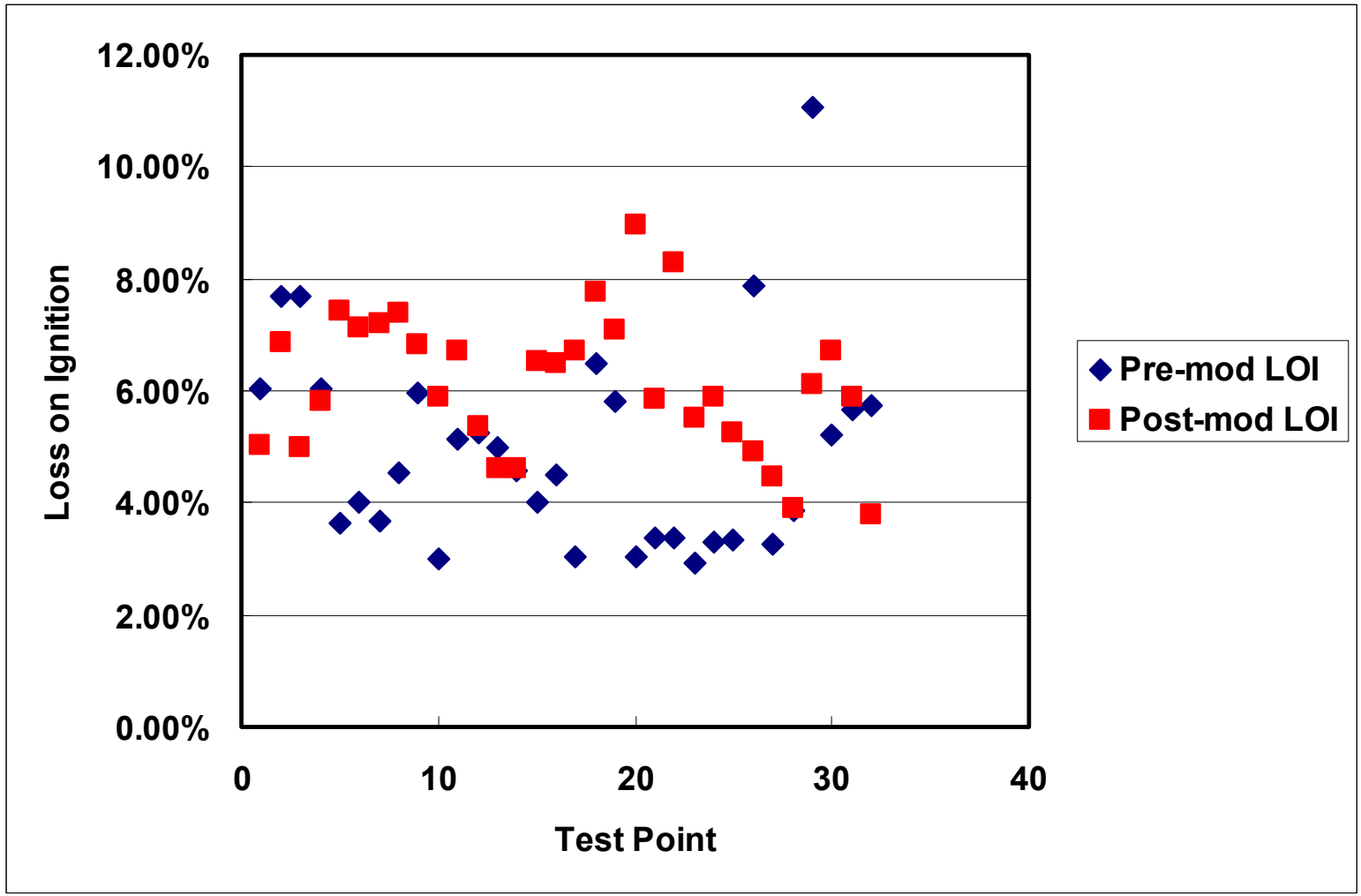
- Interlaced design
- Pitot tubes for air flow indication and balancing
- Thermocouples for temperature indication
- Manual tilting
- Plates for cooling the waterwall tube bends



Plant B Detailed Results

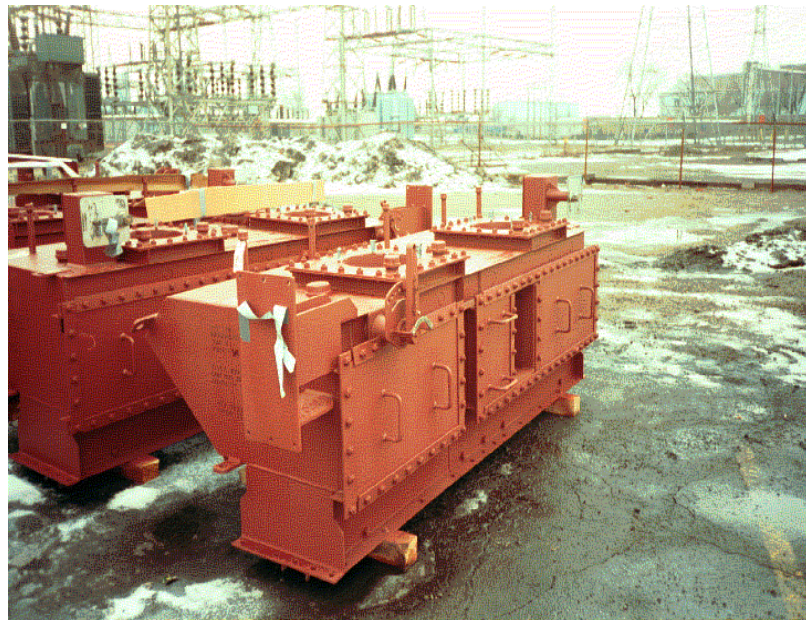


Plant B LOI Long-Term Data



Plant C Main Combustion Equipment

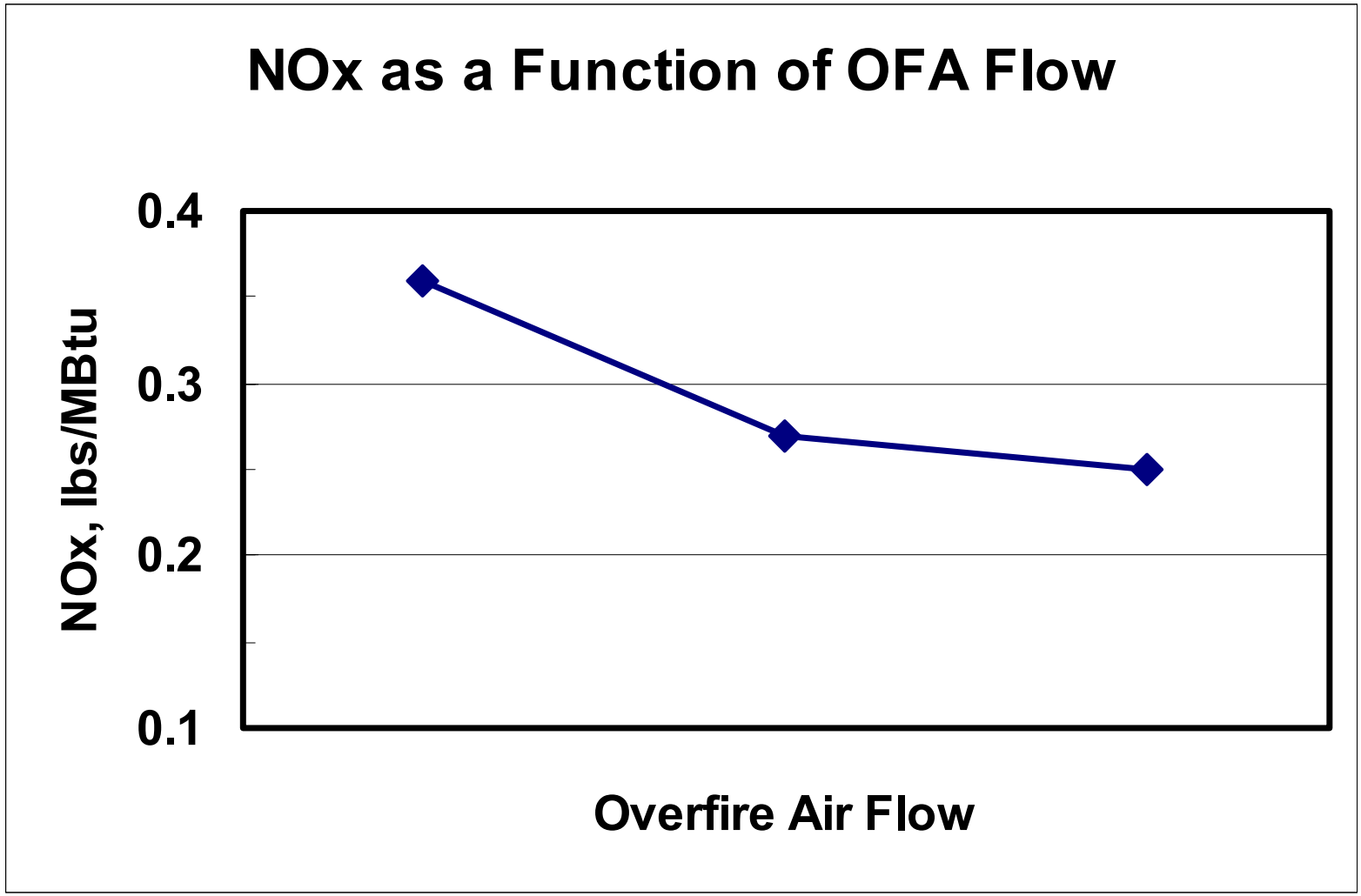
- Supplied complete replacement of corner windboxes
- Re-designed all internal components
- Re-designed tilting mechanism
- Re-designed secondary air dampers



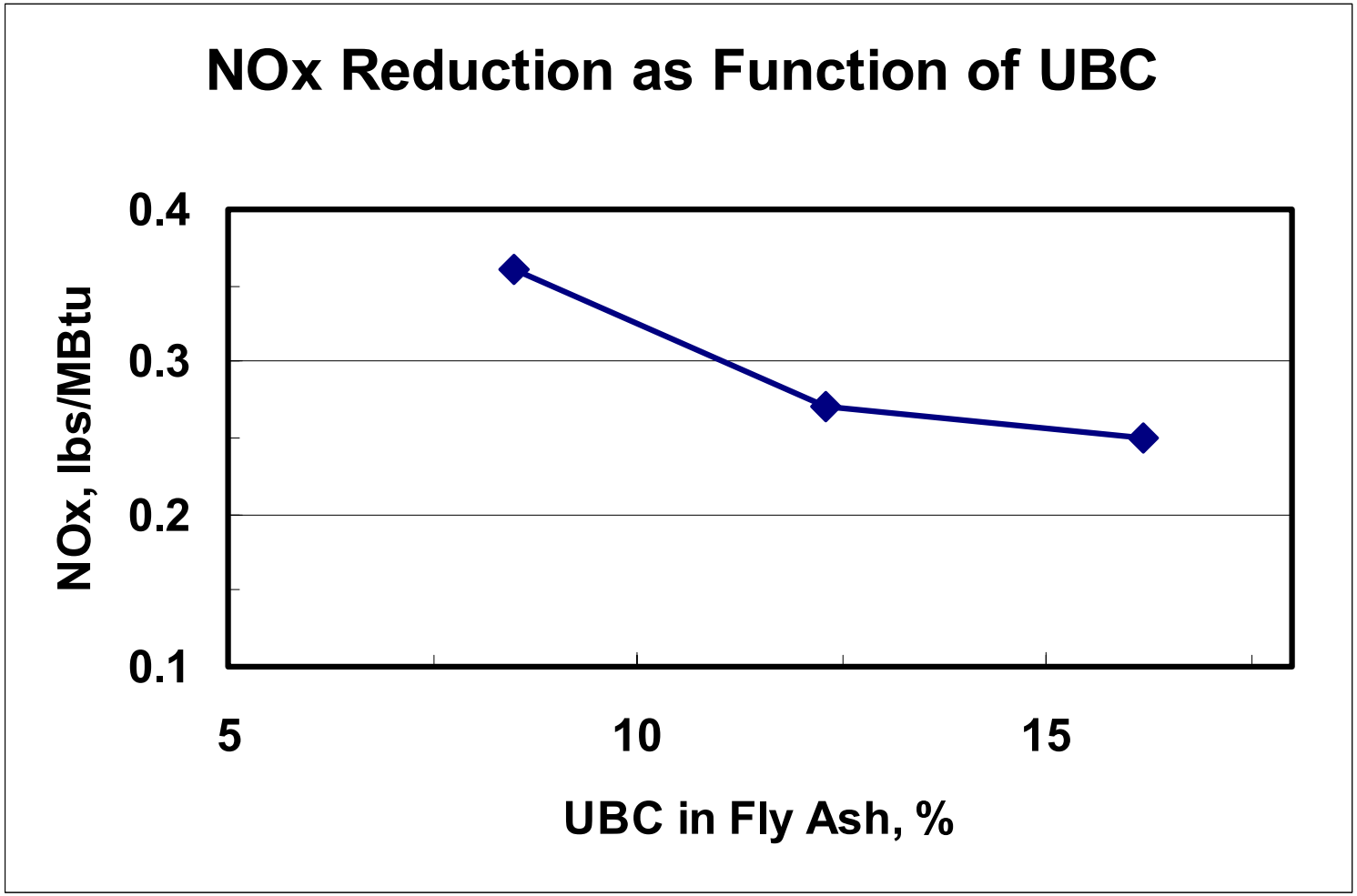
Plant C Overfire Air Port

- Located at the corners of the furnace
- Equipped with pitot tubes for air flow control indication
- Thermocouples installed for temperature indication
- Manual tilting

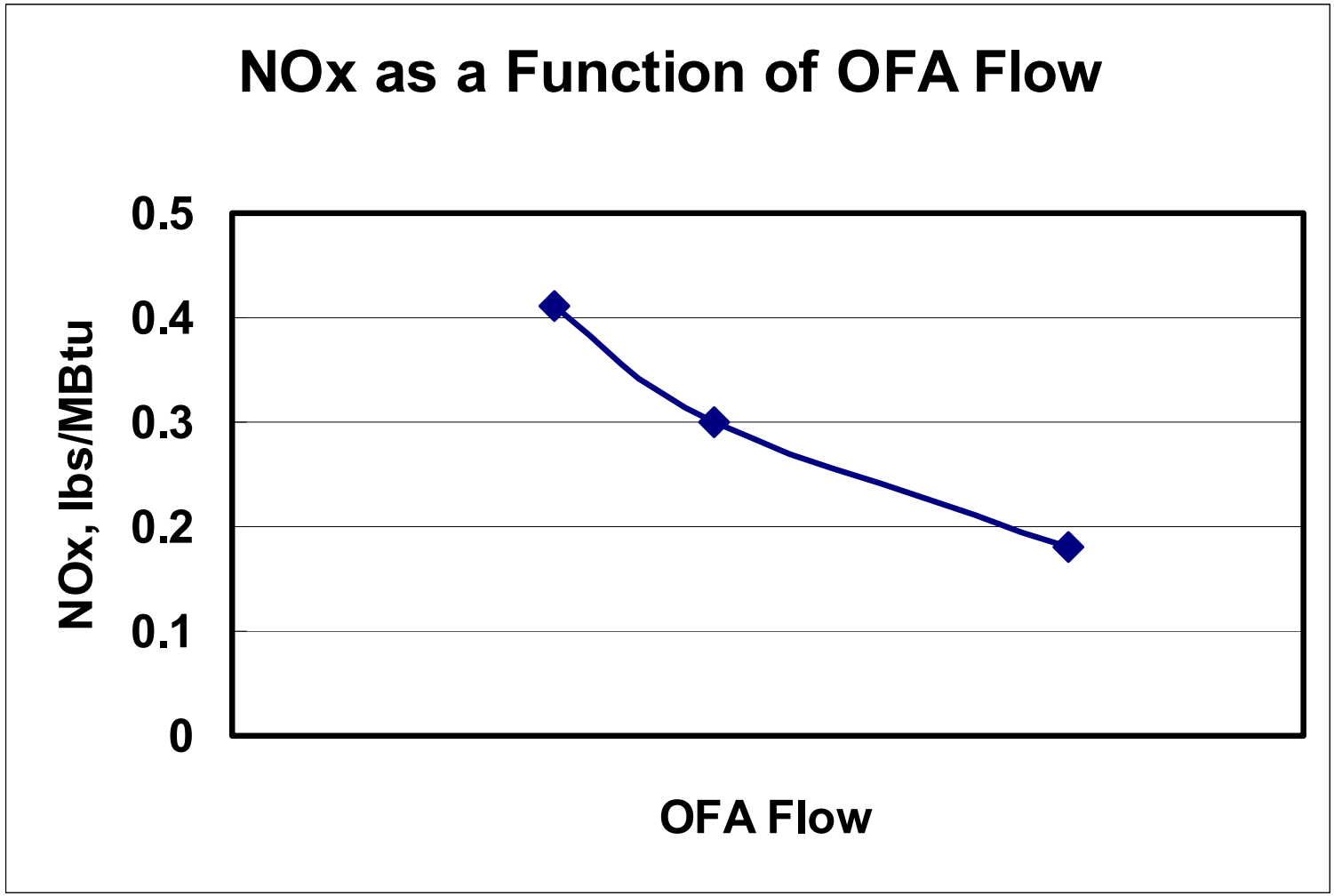
NOx Results - Plant G



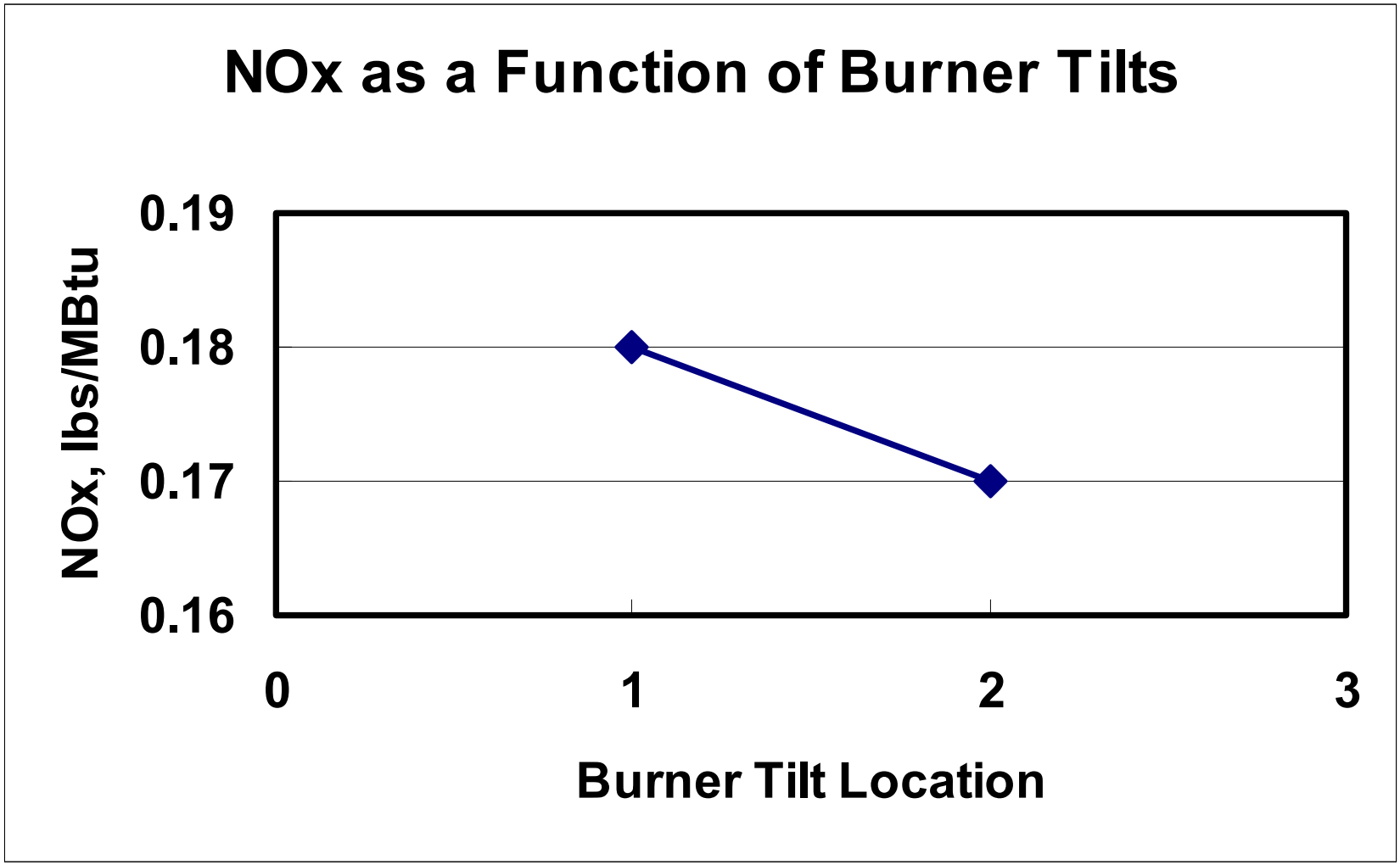
UBC Results - Plant G



NOx Results Plant H

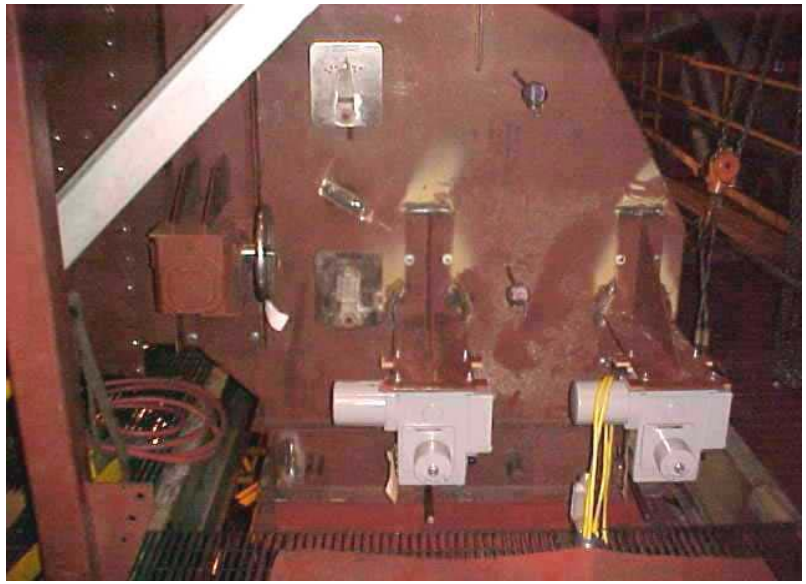


Tilt Effect - Plant H



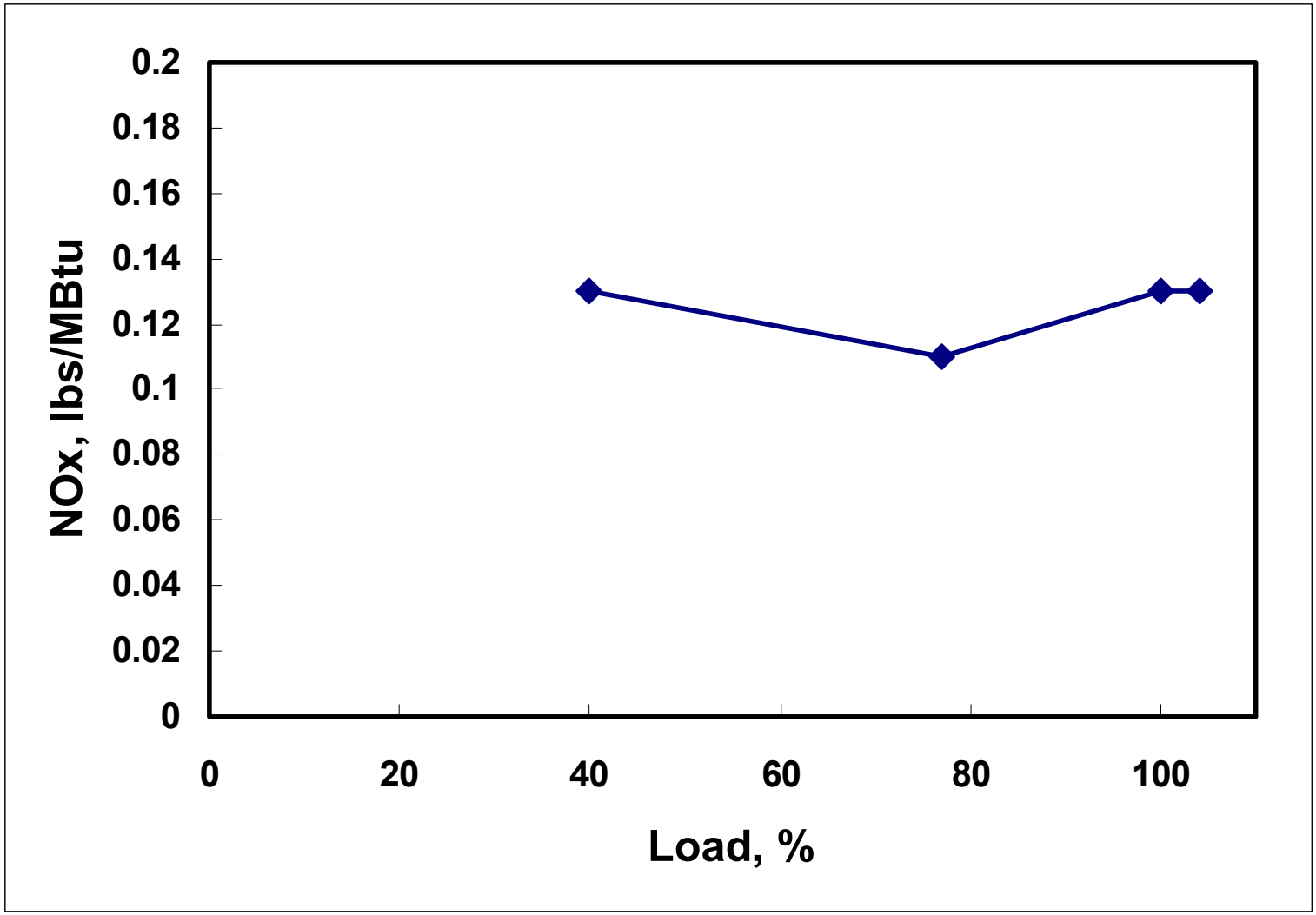
Plant I Retrofit

- 880 MW generating capacity
- Divided furnace
- 100’ x 50’ plan area
- Eight (8) interlaced OFA ports located above main combustion zone
- Nine elevations of coal injectors

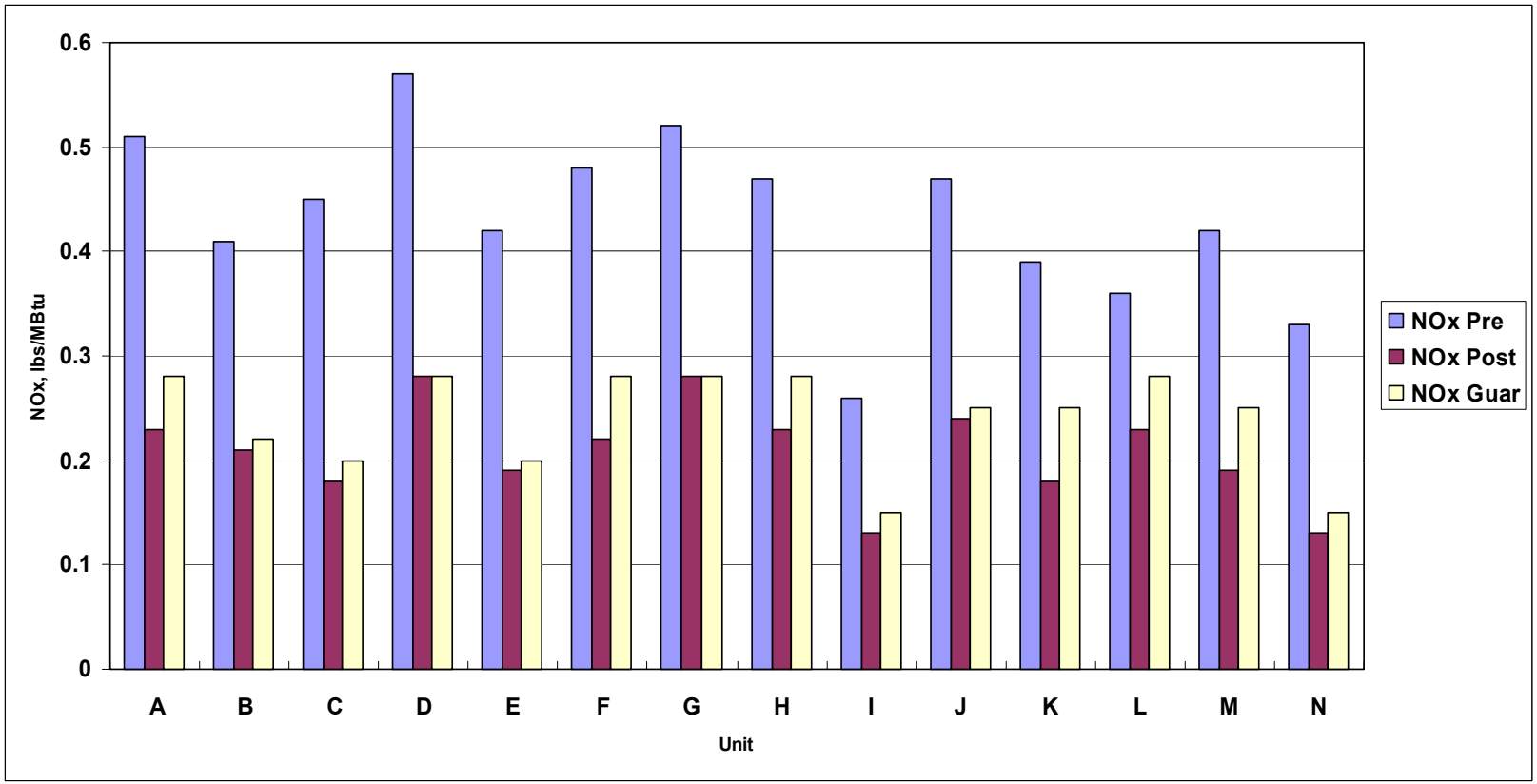


Plant I OFA Ports

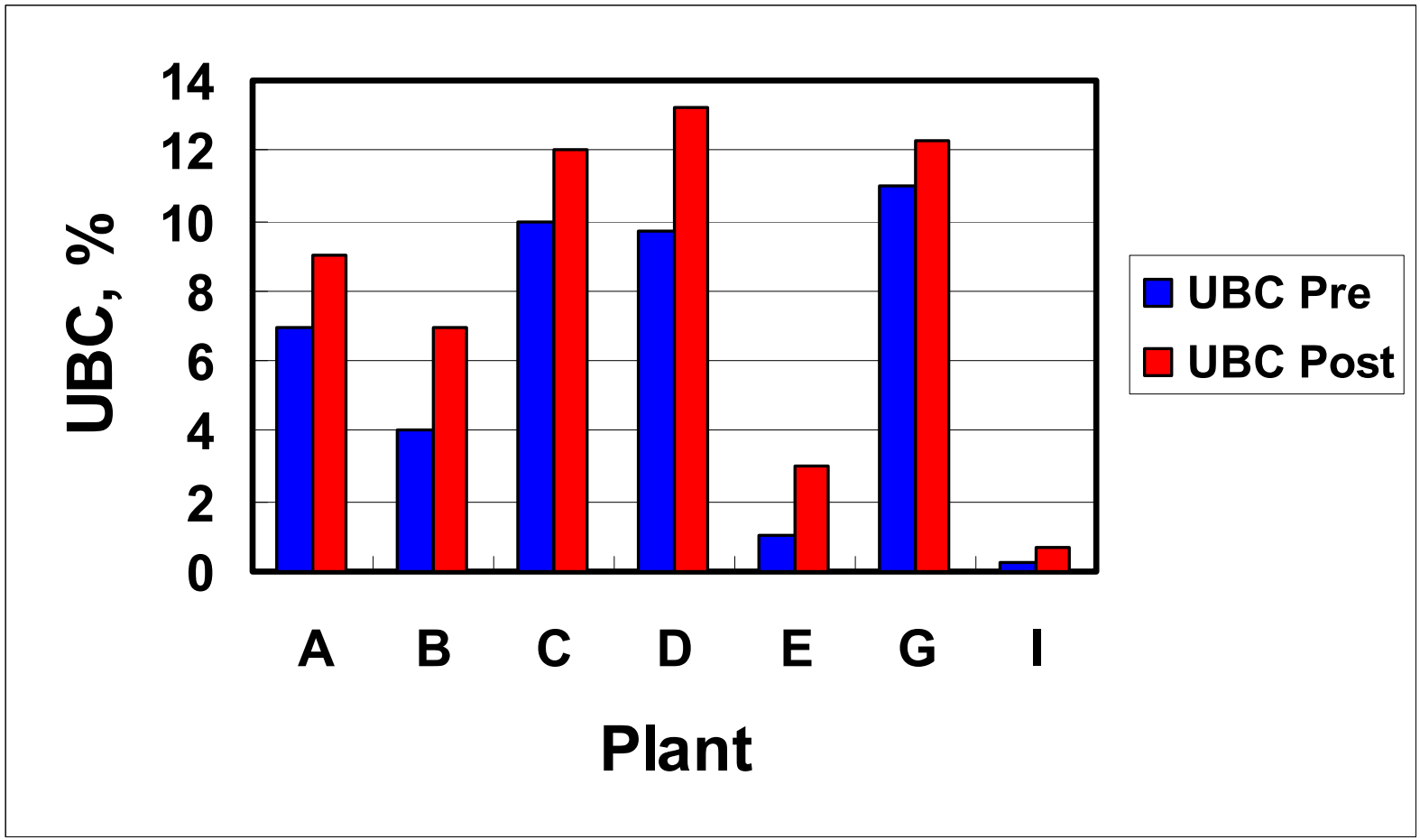
Results with PRB Coal (Plant I)



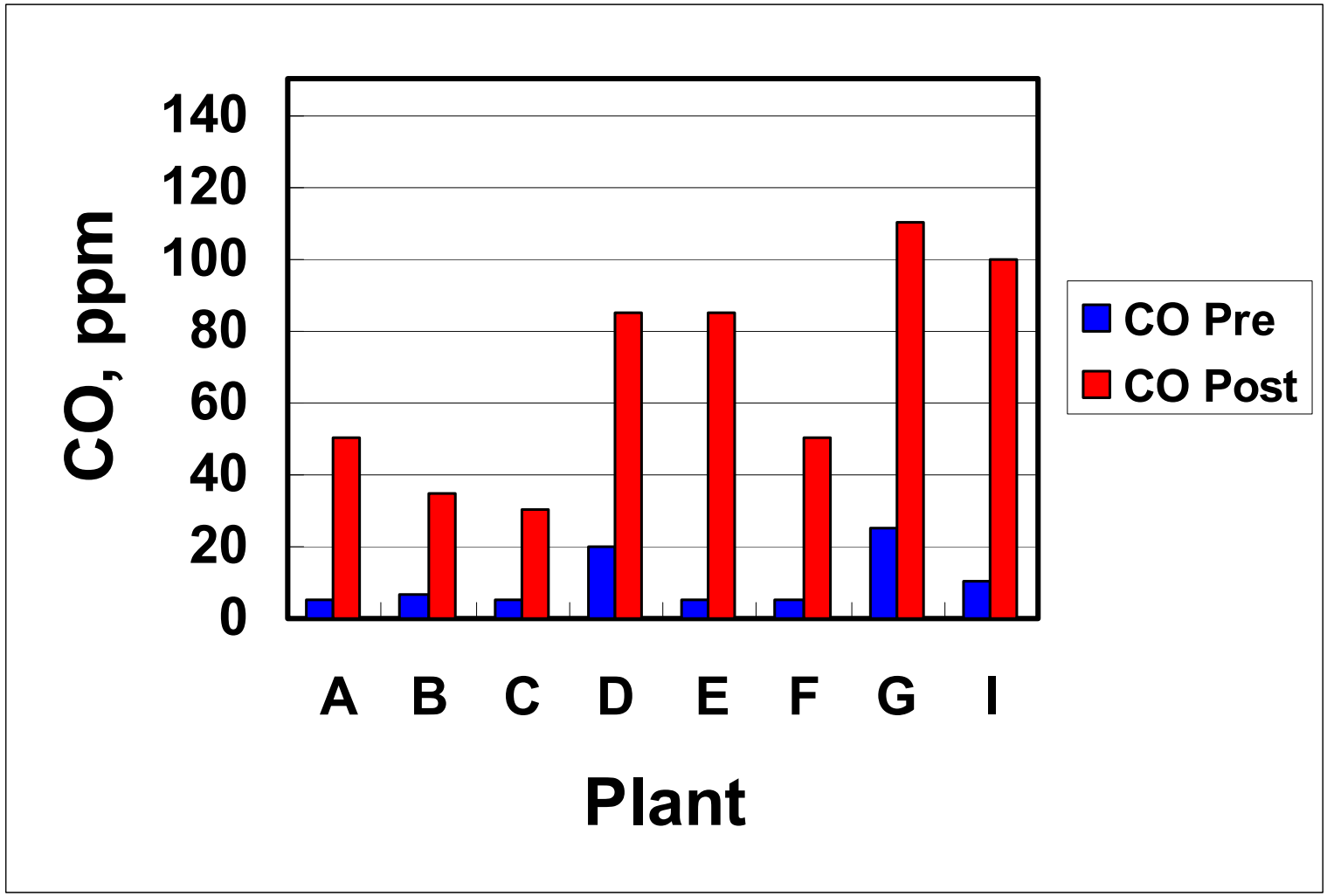
Summary of NOx Emissions Results



Summary of UBC Results



Summary of CO Emissions



Summary

- Overfire air addition is the dominant technique in reducing NOx emissions
- Interlaced or corner introduction of OFA have similar effect on NOx reduction
- Interlaced is less expensive
- NOx reductions of over 50% achieved
- NOx levels less than 0.15 with PRB coal
- UBC levels increase 35% to 50% depending on degree of staging and coal