

CP&L Experience with Mobotec ROFA/Rotamix NOx Reduction Technologies

2002 DOE LOI Conference

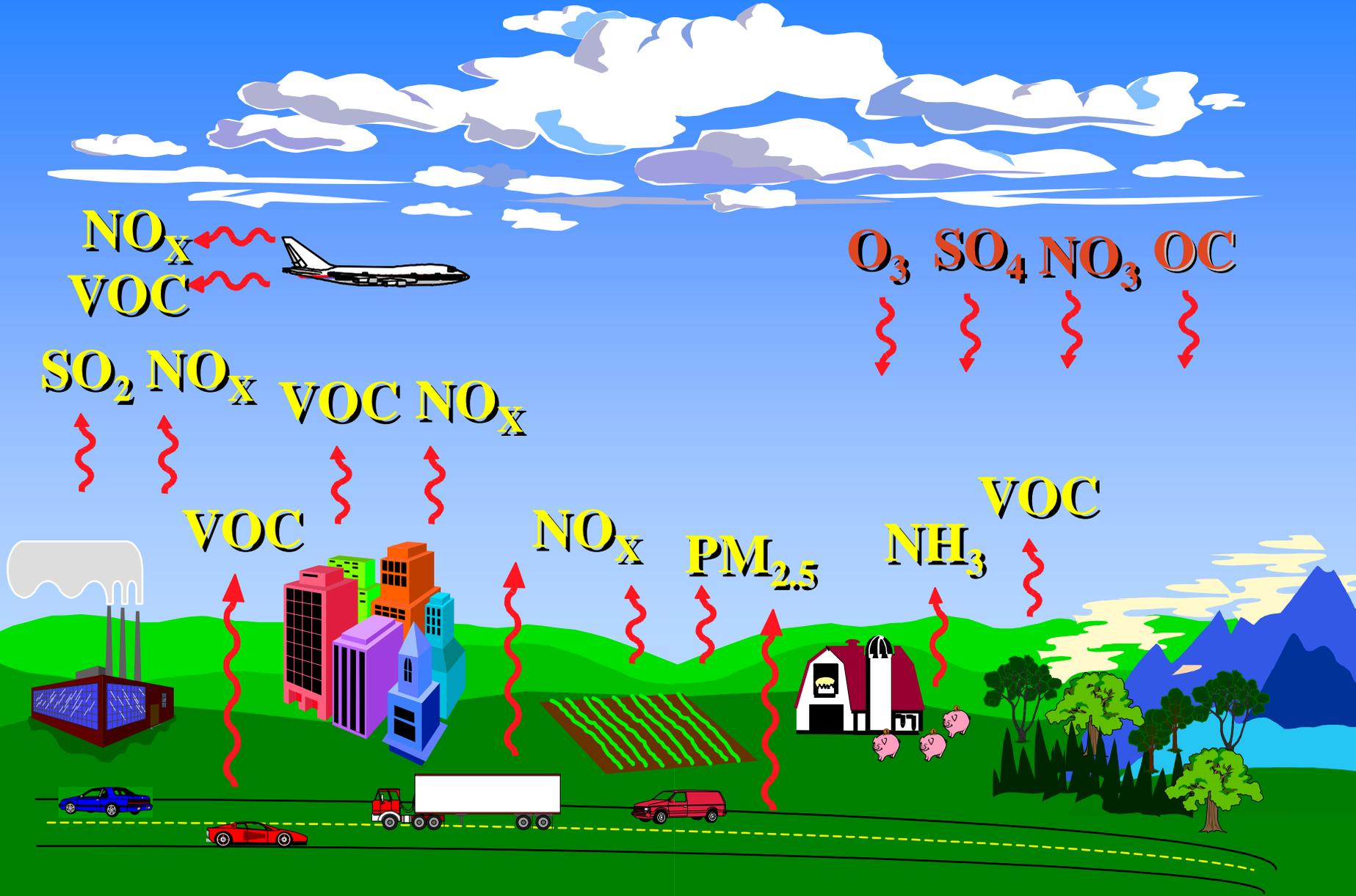
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CP&L
A Progress Energy Company

Air Pollutant Formation



NOx Reduction Options

- Change fuels
 - Natural gas vs. coal
- Reduce NOx formed during combustion
 - Low NOx burners
 - Underfire air
 - Overfire air
- Remove NOx after it is produced
 - Selective non-catalytic reduction(SNCR)
 - Selective catalytic reduction(SCR)

Evolution of CP&L NOx Control Technology Installations

- 1993 - 1999 Traditional approach (LNB/OFA)
- 1997 - 1999 WIR installations
- 1999 - 2000 1st ROFA installation
- 1999 - 2000 AEFLGR installation
- 2000 - 2001 1st ROFA/Rotamix installation
- 1998 - 2001 1st SCR installation

ROFA (Rotating Opposed Fire Air) Technology

- Developed in Sweden by Dr. Göran Moberg
- Wall-fired or tangentially-fired furnace
- Utilizes high velocity overfire air
- 17 installations in Sweden burning a variety of fuels
- NOx reductions > 50%
- Additional NOx reductions with ammonia injection(Rotamix)

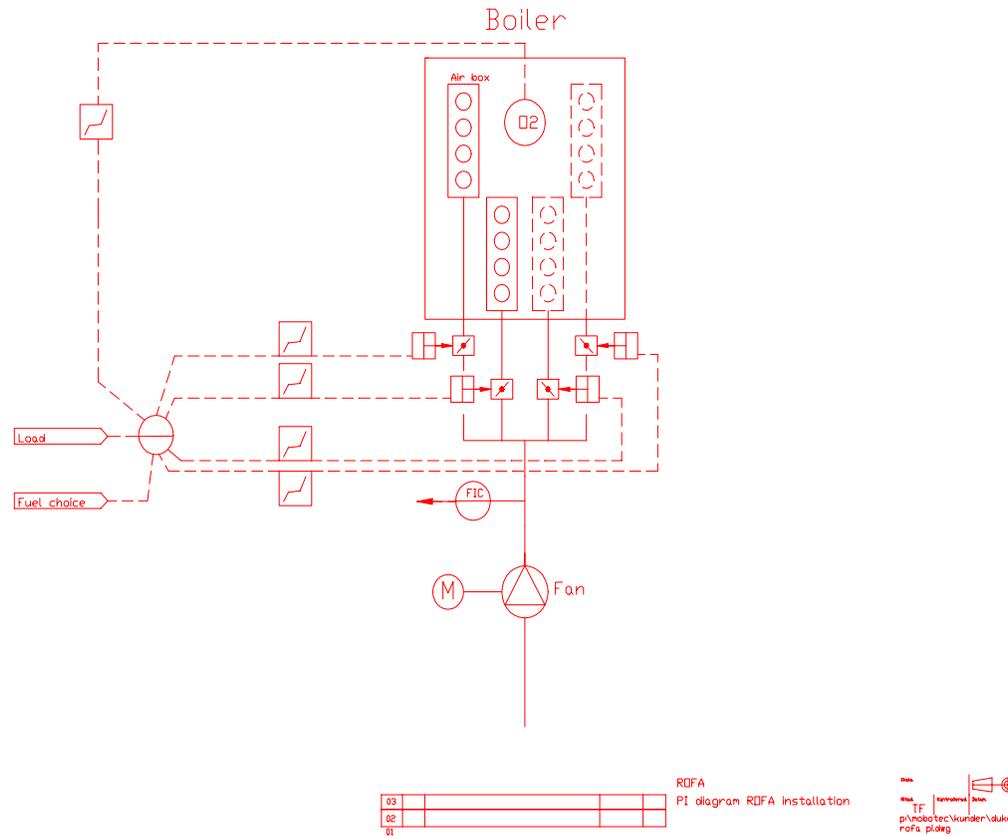
Cape Fear Unit 5

- CE Tangentially fired boiler
- Natural Circulation
- Operational in 1956
- Four corner design
- 154 MW
- No NOx Controls
- Uncontrolled NOx is .62#/MMBtu

CF 5 ROFA Design

- High velocity overfire air
 - ▶ 20% of secondary air redistributed above the burners
 - ▶ Air velocity boosted with a 1100 HP fan
 - ▶ Six ROFA injection boxes
- No changes to burners
- Installed June 2000 on Cape Fear 5
 - ▶ 1st pulverized coal fired installation in the world
 - ▶ 1st US installation

ROFA System P&ID



Cape Fear 5 ROFA Fan



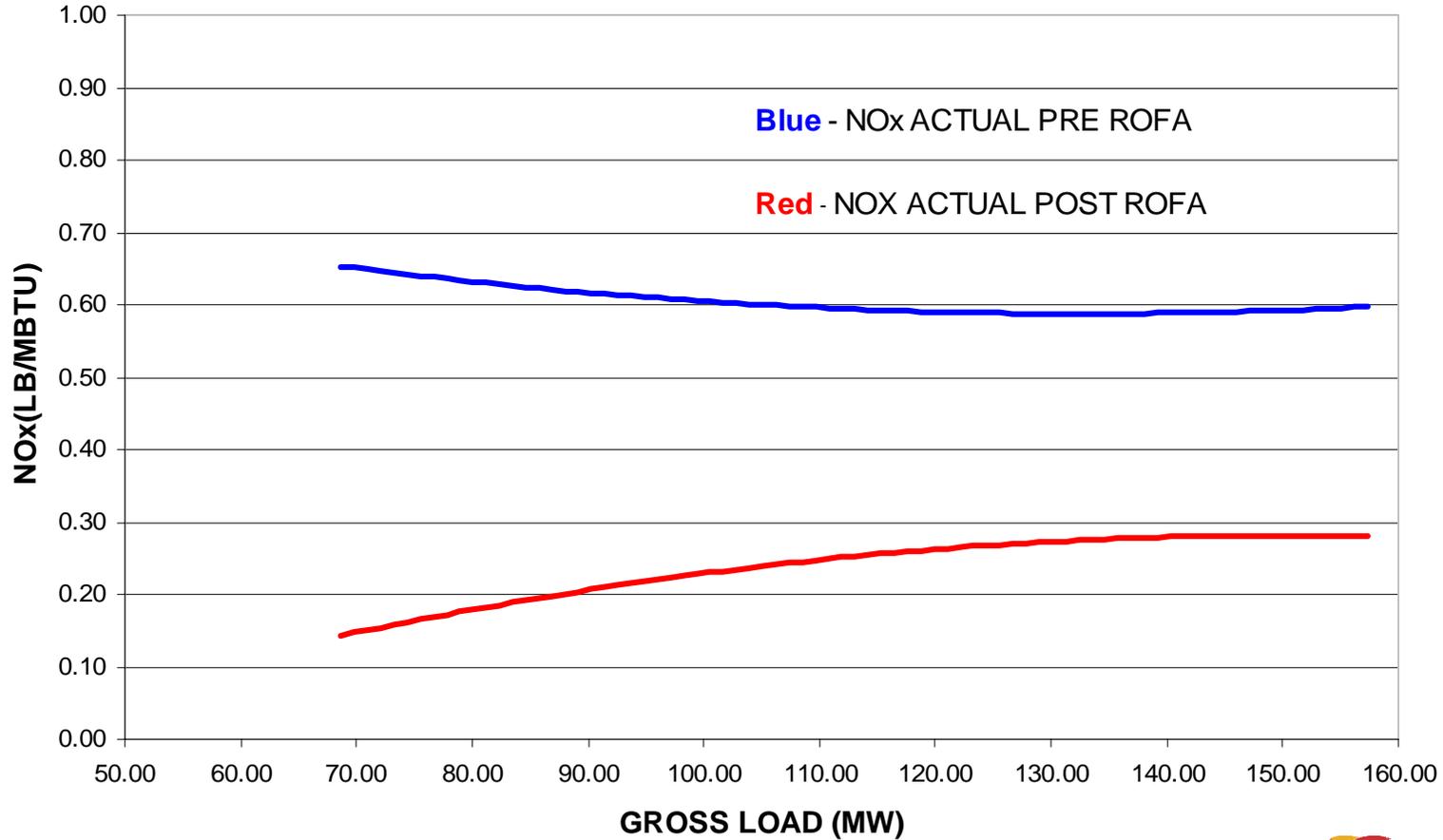
ROFA Boxes 4 and 6



CF 5 ROFA Results

- 15 day outage
- 55% NOx reduction to .28 lb/mbtu at full load
- Minimum load NOx < .20 lb/mbtu
- 12 ppm CO
- LOI's increased from 3% to 5%
- Uniform temperatures across furnace
- \$300/ton NOx removed
- 50% lower NOx removal cost than LNB/OFA

Cape Fear 5 NOx vs. Load



ROFA Advantages/Disadvantages

- Advantages

- ▶ Significant NOx reductions
- ▶ No CO increase
- ▶ “Invisible” to Operations Personnel
- ▶ Potential to avoid SCR’s

- Disadvantages

- ▶ Auxiliary power increase
- ▶ Station electrical capacity may need to be upgraded

Rotamix Technology

- Developed in Sweden by Dr. Göran Moberg
- Wall-fired or tangentially-fired furnace
- Utilizes ammonia injection in addition to high velocity overfire air
- Additional NO_x reductions > 50%

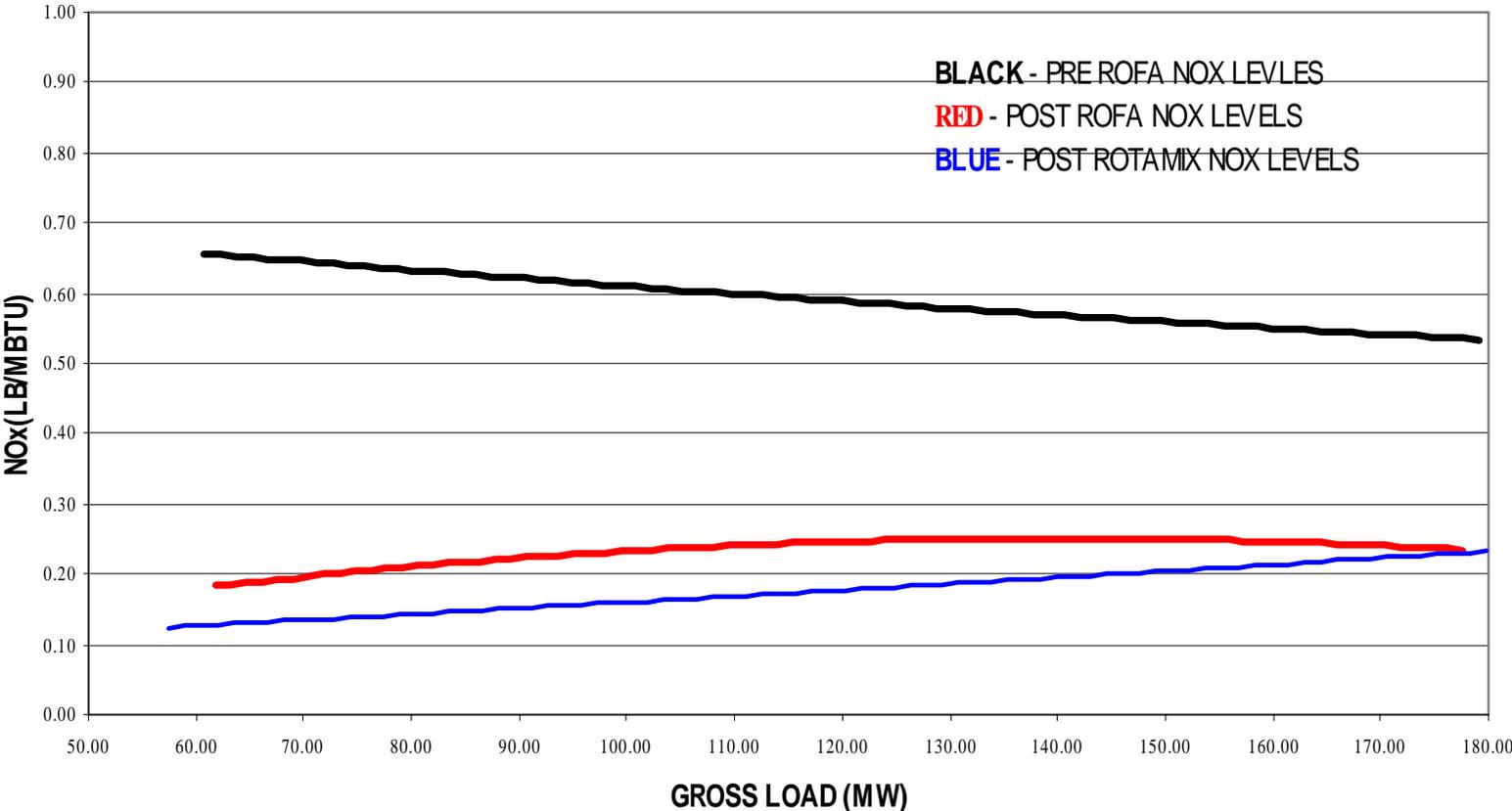
Cape Fear Unit 6

- CE Tangentially fired boiler
- Pulverized Coal - Eastern Bituminous
- Controlled Circulation
- Operational in 1958
- Eight corner design with division wall
- 175 MW
- No NOx Controls
- Uncontrolled NOx is .63#/MMBtu

CF 6 ROFA/Rotamix Design

- Aqueous ammonia SNCR
- High velocity overfire air carries ammonia and dilution water into the boiler
- No changes to burners
- Eight Rotamix boxes / 14 ROFA boxes
 - ▶ Five different elevations
 - ▶ Two 700 HP fans
- Installed June 2001 on Cape Fear 6
 - ▶ 1st pulverized coal fired installation in the world
 - ▶ 1st US installation

Cape Fear 6 NOx vs. Load



CF 6 ROFA/Rotamix Results

- 71% NOx reduction to .18 lb/mbtu at full load
- Ammonia slip controlled to 5 ppm at Economizer Outlet
- Uniform temperatures across furnace
- \$1,000/ton NOx removed(seasonal cost)
- 60% lower NOx removal cost than an SCR
- 70% lower capital cost than an SCR

Cape Fear 6 ROFA/Rotamix Installation



Upper Rotamix Boxes



Lower ROFA/Rotamix Boxes



Ammonia Storage

- 20,000 gallon storage tank
- 19% Aqueous Ammonia Solution

Ammonia Storage Tank and Pumps



Cape Fear Unit 5 Rotamix

- Added Rotamix on Unit 5 in 2002
- System operational April 2002

Summary

- Alternative NOx reduction technologies
 - ▶ Flexible NOx compliance strategy
 - ▶ Capital cost savings of \$50MM over conventional technologies
 - ▶ Low cost options for other utilities and industry
 - ▶ Older plants remain competitive