Flame Interaction and Rollover Solutions in Ethylene Cracking Furnaces
Statement of Problem

• Cracking furnace must be retrofitted with new hearth burners to meet lower NO\textsubscript{x} requirements (150 mg/Nm³)
• Tight burner spacing
• Flame rollover is not acceptable
Application Description

- 2 Furnaces, 24 floor burners each, double fired
- RFG ~10% H₂ by volume
- Average firebox temperature: 1250°C
- Firebox dimensions: 10.21 x 2.8 x 9.93 m
- Induced draft
Technology Employed

- Zeeco “Enhanced-Jet” Ultra Low NO$_{x}$ Burner
- Secondary tips inspirate inert flue gas into flame
- Capable of sub 100 mg/NM$^3$ NO$_{x}$ emissions
Reducing NOx

Thermal NO\textsubscript{x} is the primary contributor to total NO\textsubscript{x}.

![Graph showing Thermal NOx vs Adiabatic Flame Temperature]
Burner Design

- Secondary tips fire into flue gas, inspirating flue gas into the flame
- Primary gas tips provide “fuel staging” and allow for tuning of heat flux profile
No Flame Rollover

- Inherent furnace currents tend to pull gasses towards tubes around 4 m above floor
- Fuel gas never crosses air stream so fuel gas is always between air and wall and cannot roll over
Heat flux profile can be “tuned”
Enhanced Jet Data

- 39 PPMV (79 mg/NM$^3$) NO$_x$
- Corrected to 3% O$_2$
- 1275°C Firebox
- 1065°C Floor Temp.
Enhanced Jet Video