

# Reinhold Environmental Ltd.

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2007 NOx Round Table & Expo  
Presentation

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*February 5-6, 2007 in Cincinnati, OH*



*A Catalytica Energy Systems Company*

**YEAR ROUND OPERATION – ARE YOU PREPARED?**

**Howard N. Franklin**

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# **Workshop Year Round Operation – Are You Prepared?**

**NOx Round Table**

**February 16, 2007**

**Cincinnati, OH**

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# Year Round Operation



- **Must Be Addressed ASAP**
  - **Regulations**
    - Impact on gas/catalyst system
    - Impact on reagent system
    - Other
      - Additional SCRs
      - NOx credits
      - Transportation
      - Labor
  - **Getting Ready**
    - Inspections/maintenance
    - Consolidation/holistic plan
    - Designate consistent team



Catalyst  
Engineer

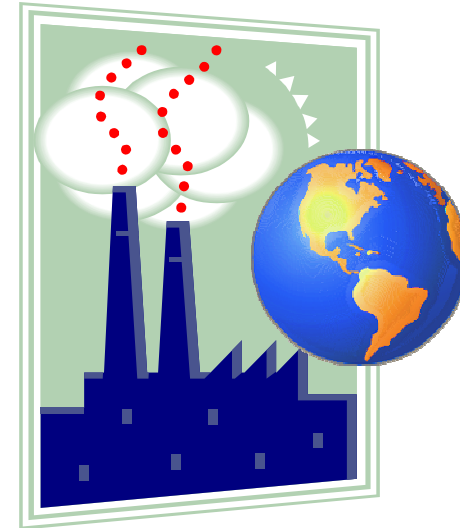
- **Informal - Sit Back and Relax**
  - What I came up with
  - What you can add
  - Questions we can discuss

**Learning Curve – People/Shifts**

# NOx Impact of CAIR Legislation



- **2003 NOx Baseline**
  - Annual NOx cap = NOx 3.2 million tons.
  - Ozone season cap = 1.05 million Tons
- **2009 NOx Cap**
  - Annual NOx
    - = NOx 1.52 million tons.
    - = 52% reduction (1.68 million tons)
  - Ozone Season
    - = 0.58 million tons
    - = 45% reduction (0.47 million tons)



- **2015 NOx Cap**
  - Annual NOx
    - = NOx 1.27 million tons.
    - = 60% reduction
  - Ozone Season
    - = 0.48 million tons
    - = 54% reduction

# Impact Upon Catalyst

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- **Current SCR Operation**
  - Approximately 103 GW with SCR having approximately 120,000 m<sup>3</sup> catalyst
  - Estimated catalyst replacement 5% today and 20-25% by 2008
- **2009 Estimate SCR Operational Hours will about Double**
  - Initial catalyst additions to meet new criteria – available?
    - Catalyst lead times increase
    - Impact of foreign market demand
  - Estimated catalyst annual replacement rate 20% - 30% beyond 2008
- **Add About 10 GW of SCR/Year**
  - Original needs 25,000 m<sup>3</sup>/year more catalyst
  - New needs another 12,000 m<sup>3</sup>/year
  - Add/Replace new another increase of 2,500 m<sup>3</sup>/year - additive

# Catalyst Self Audit



- ✓ Actual/Design Conditions
- ✓ Ko for your catalyst
- ✓ Keof – End of Life
- ✓ Margin Estimated for Guarantees
  - Activity or
  - Life
- ✓ SO<sub>2</sub> Oxidation with Margins
- ✓ Initial Catalyst Constituents
- ✓ Impact upon Mercury
- ✓ Arsenic/Calcium Guide

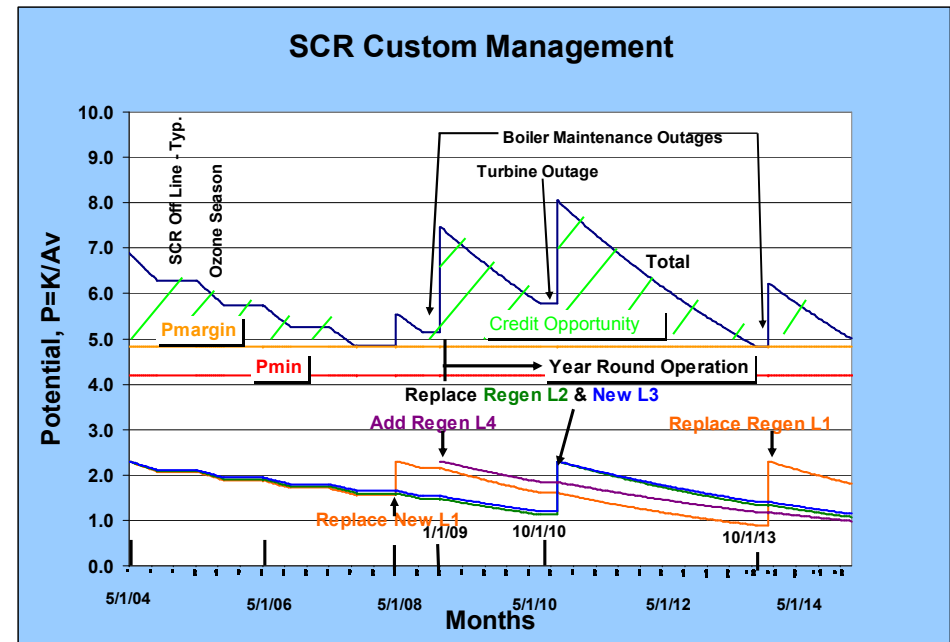


**Think Ahead  
Planning – Planning - Planning**

# Impact Upon Catalyst Management



- Catalyst Management Plan
  - New/regeneration lead times
    - Require earlier planning
    - Spare catalyst
  - Avoid unnecessary outages
    - Pluggage
    - Fuel
    - Deactivation
  - Test laboratory
    - Trusted
    - Certified
    - Independent
  - Increase number samples



**Think Ahead**  
**Planning – Planning - Planning**

# Impact Refurbishment Method



## Activity Table

<b>Layer</b>	<b>New</b>	<b>Depleted</b>	<b>Replace</b>	<b>Add</b>
<b>1</b>	100%	70%	100%	70%
<b>2</b>	100%	70%	70%	70%
<b>3</b>	100%	70%	70%	70%
<b>4</b>	Spare	Spare	Spare	100%
<b>Total</b>	<b>300%</b>	<b>210%</b>	<b>240%</b>	<b>310%</b>
<b>Time Left</b>	<b>3 years</b>	<b>0</b>	<b>~ 1 year</b>	<b>&gt; 3 years</b>

# Cycling Operation Considerations

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- **Low Load forms Ammonium BiSulfate (ABS)**
  - ✓ Minimum operating temperature – avoid ABS
  - ✓ Lower temps. vs operational times
  - ✓ Minimum  $\text{NH}_3$  injection temperature – minimize catalyst pluggage
  - ✓ Recovery temperature – decompose ABS
- **Economizer Bypass**
  - ✓ More use
  - ✓ Upgrade?
- **Off-Peak Operation**
  - ✓ Reduced flow: mal-distribution?
  - ✓ Catalyst pluggage – ash deposition?
  - ✓ Upgrade flow distribution system?

# Measurements - Anticipation



- NH<sub>3</sub> Consumption
- NH<sub>3</sub> Slip
  - ✓ Correlate wet with NH<sub>3</sub> in ash
  - Avoid bottom, eco. and hot ESP ash
  - ✓ Update for fuel switching/blending
- Catalyst Layers'  $\Delta P$ 
  - ✓ Track over time
  - Signals pluggage
- Air Preheater  $\Delta P$ 
  - ✓ Track over time
  - ✓ Upgrade air preheater?
    - ABS formation/pluggage
- ✓ Archive Fuel Samples
- ✓ Record AIG valve positions

**-Build In Cautions –  
- Avoid Stops -**



# Ammonia Consumption - Estimates



- 2003 NH<sub>3</sub> Usage
    - Basis: 0.35 lb/MMBTU → 0.15 lb/MMBTU:
    - Presents 7.5 – 4.3 = 3.2 million tons NO<sub>x</sub> [High]
    - 4.3 millions tons/year (17/46) = 1.6 NH<sub>3</sub> million tons/year
  - 2009 Estimate NH<sub>3</sub> Increased Usage
    - About double – Say 1.6 to 2.4 millions tons/year
  - Current U.S. NH<sub>3</sub> Consumption = 18.7 million tons/year total\*
    - Will use ~8% – 12.8% more NH<sub>3</sub> in 2009
    - Supply probably not a problem
- \*The Fertilizer Institute, Wash. D.C.

**NH<sub>3</sub> Supply Should Be Adequate**

# Ammonia On Site



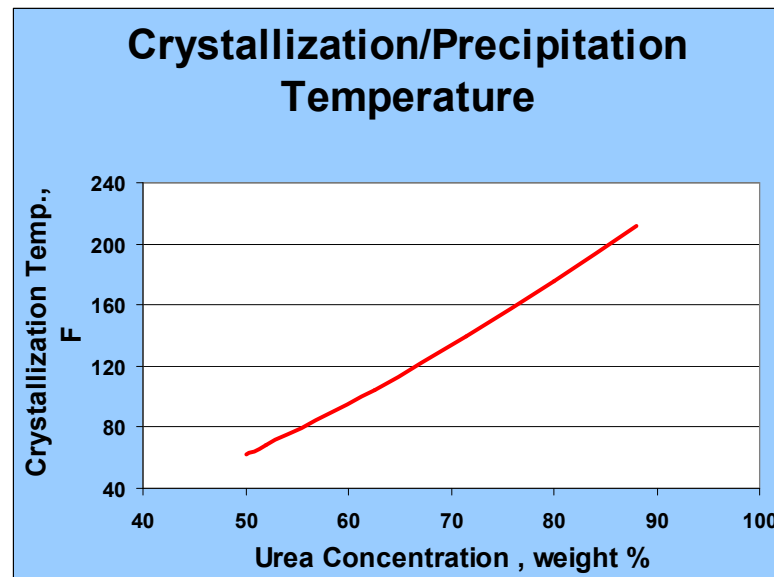
- **Added Consumption Requires Increased**

- Delivery to site
- Site storage
- Vaporization
- Increased maintenance

- **Winter Operation Impacts**

- Anhydrous - low
- Aqueous - condensation
- Urea – crystallization
  - Insulate piping
  - Trace heating

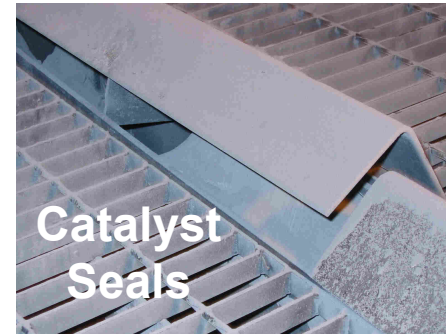
- **Supply Reliability**



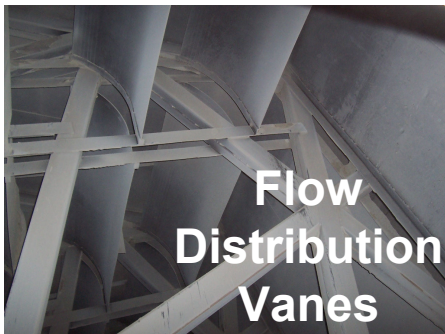
# Auxiliaries



- Bypass Systems
  - ✓ Economizer
  - ✓ SCR – secure for safety
- Inspect Duct Work
  - ✓ Insulation/expansion joints
  - ✓ Ammonia system/AIG
  - ✓ Catalyst seals
  - ✓ Flow distribution devices
- LPA Screens and LPA Removal



- ✓ SCR Cleaning Devices
  - Sootblowers
  - Acoustic horns
- ✓ Instrument service/maintenance

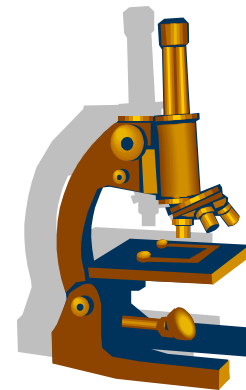


**Auxiliaries Now Operate Year-Round**

# Fuels



- Seasonal Variations?
- Impact on Quality
  - Ash
    - Quantity
    - LPA
  - Arsenic: As/Ca
  - Calcium: CaO
  - Silica: SiO<sub>2</sub>
  - Phosphorous
  - Alkali metals: Na and K
  - Iron: Fe
  - SO<sub>3</sub>
- Pluggage
- Catalyst Reuse



# Other Impacts

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- Adding FGD?
  - Switch to higher sulfur fuels
  - Higher SO<sub>3</sub>
  - Air Preheater
- Year Round Mercury Oxidation
- Coal Blending
  - Ash fusion temperature
  - Pet Coke
    - Increased SO<sub>2</sub>
    - Vanadium
  - PRB
    - Decreased As/Ca ratio
    - Reduced chloride level
- Biomass/Waste
- Other

**Manage Impacts on SCRs**

# Change in Management Strategy



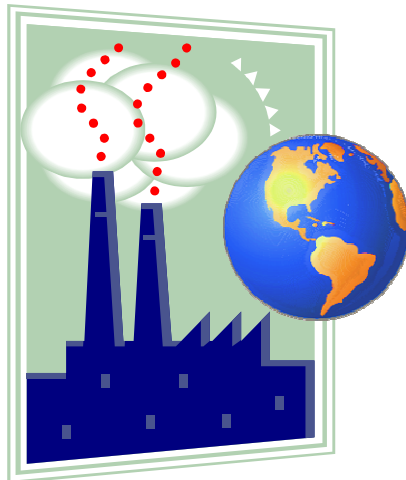
- Catalyst Availability/Cost
- Labor Availability/Cost
  - Most upgrades
    - Fall 2008 outage, or
    - Spring 2009 outage
  - Labor costs –replace/add
    - Higher contractor prices
    - Lower productivity
  - Plan early
    - Earlier or later outages
    - Spare catalyst
- Third Party Availability/Cost
  - Inspections
  - Testing
  - Tuning
  - Flow distribution
- Truck Availability/Cost
  - Thousands of modules
    - Drivers
    - Proper trucks

**Think Ahead**

# Change in Management Strategy



- **Constant Operation**
  - Can not ride out problems
  - More maintenance/compressed
- **What if SCR Goes Off-Line?**
  - NOx credit strategy
    - Seller
    - Buyer
    - Neutral



## Anticipation/Closer Tracking

- **Proactive Planning**
  - More catalyst
  - Sampling/rapid testing
  - Activity
  - Poison accumulation
  - Longer lead times
- **Have more SCR spare parts**
  - Catalyst
  - Meters
  - Valves
  - Others
  - Consistency

# Risks



- 12 from 5 Month Operation
  - More usage – higher risk of unavailability
  - Higher reliability required
  - Compressed off-line time
- Outage Duration
  - New?
  - Regenerate?
  - Rejuvenate?
  - Back-up catalyst?
- Labor Availability/Specialized Contractors
- Long Term Agreements?
  - Guaranteed response/certainty
  - Firm pricing in an escalating market



The Clock is Ticking

**End**

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## Discussion



[http://www.scr-tech.com/tech\\_papers.htm](http://www.scr-tech.com/tech_papers.htm)