REINHOLD ENVIRONMENTAL Ltd.

2011 NOx-Combustion Round Table & Expo Presentation

February 7-8, 2011, in Birmingham, AL / Hosted by Southern Company

Demonstrated Commercial Operation of ULTRA™ Urea Conversion Process for SCR Reagent Feed System

NOx Roundtable 2011
February 8, 2011
Birmingham, AL

Amy Strauss, P.E.
Senior Engineer
City Utilities of Springfield , MO
Southwest Power Station

Dale Pfaff
Midwest Regional Sales Manager
Fuel Tech, Inc.

CITY UTILITIES
Bringing Power Home.

Agenda

CITY UTILITIES
Bringing Power Home.

- Fuel Tech – Company Information
- Fuel Tech ULTRA™ System
  - Process Description
  - Process Modeling
- City Utilities of Springfield Unit 1
  - Unit Description
  - Urea Reagent Technology Selection
    - Urea vs. NH_3
    - Safety Issues
  - System Scope
  - Operational History
    - Maintenance and Operational Costs
- Start up of CUS Southwest Unit 2
- Fuel Tech Commercial Experience
- Summary

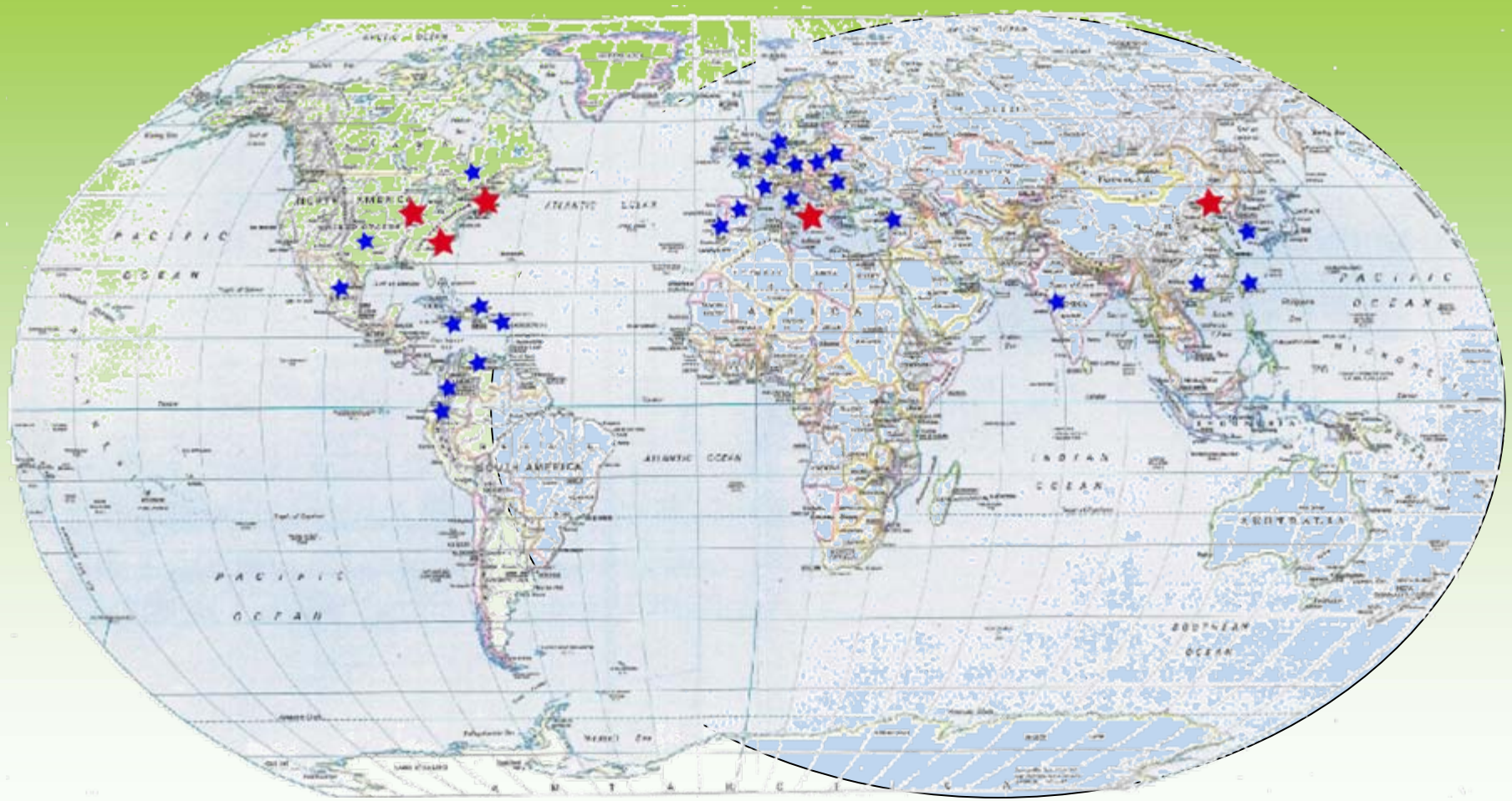
FUEL TECH
Technologies to enable clean efficient energy™

Fuel Tech Overview

- **FUEL CHEM® Technology**
  - Boiler Efficiency and Availability Improvements
  - Slag and Corrosion Reduction
  - Controls SO_3 Emissions and Addresses Related Issues
- **Innovative Approaches to Enable Clean Efficient Energy**
  - NO_X Reduction Technologies include Combustion Modifications, SNCR, ASCR, RRI, ULTRA
  - Field Optimization Services
  - Flue Gas Conditioning Systems for Particulate Control – Outside US and Canada
  - Sorbent Injection for SO_2 Control
- **Flow Modeling and SCR Catalyst Management Services**
  - Computational Flow Dynamics and Physical Flow Modeling for Power Plant Systems
  - SCR System Optimization and Catalyst Management Services
- **Technology solutions based on Advanced Engineering Computer Visualization and Modeling**
- **Strong Balance Sheet (Stock Symbol: NASDAQ – FTEK)**

Fuel Tech's Global Presence

CITY UTILITIES
Bringing Power Home.



Office Locations: Warrenville, IL; Stamford, CT; Durham, NC; Milan, Italy; Beijing, China

Countries where Fuel Tech does business: USA, Belgium, Canada, China, Columbia, Czech Republic, Denmark, Dominican Republic, Ecuador, France, Germany, India, Italy, Jamaica, Mexico, Poland, Portugal, Puerto Rico, Romania, South Korea, Spain, Taiwan, Turkey, United Kingdom, Venezuela

FUEL TECH
Technologies to enable clean efficient energy™

ULTRA™ Technology Overview

CITY UTILITIES
Bringing Power Home.

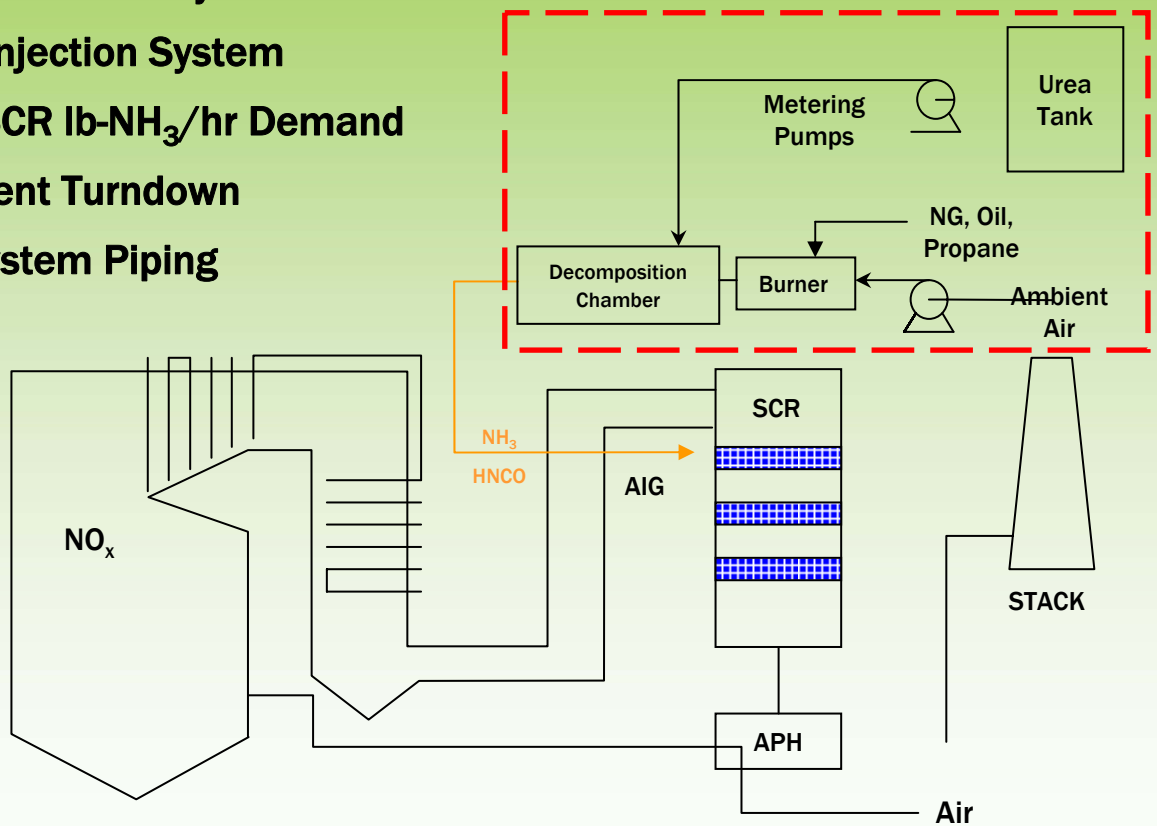
- Safe and Effective Alternative to Ammonia for SCR
- Responsive System to Load Demands
- Simple…Simple….Simple
- Avoid Ammonia Storage and Handling Safety Issues
  - Homeland Security Chemical of Interest for Anti-Terrorism
  - DOT and DOT Restrictions
  - Increase in Rail Tariffs due to Risk and Tanker Tracking Requirements
- Levelized Annual Costs Advantage vs. Aqueous Ammonia Systems
- ULTRA™ Experience
  - Small Gas Turbine/HRSG Installations
  - Coal Fired Boilers through 700 MW
  - Contracts Totaling Over 6,600 MW of combined experience
  - Installations in the US, China, Europe

FUEL TECH
Technologies to enable clean efficient energy™

ULTRA™ Systems
On-site Conversion of Urea

CITY UTILITIES
Bringing Power Home.

- **Safe Urea Reagent used for SCR Systems**
- **Proven & Simple Urea Injection System**
- **Urea Flow Dictated by SCR lb-NH_3/hr Demand**
- **Rapid Response, Excellent Turndown**
- **Negligible NH_3 in the System Piping**



FUEL TECH
Technologies to enable clean efficient energy™

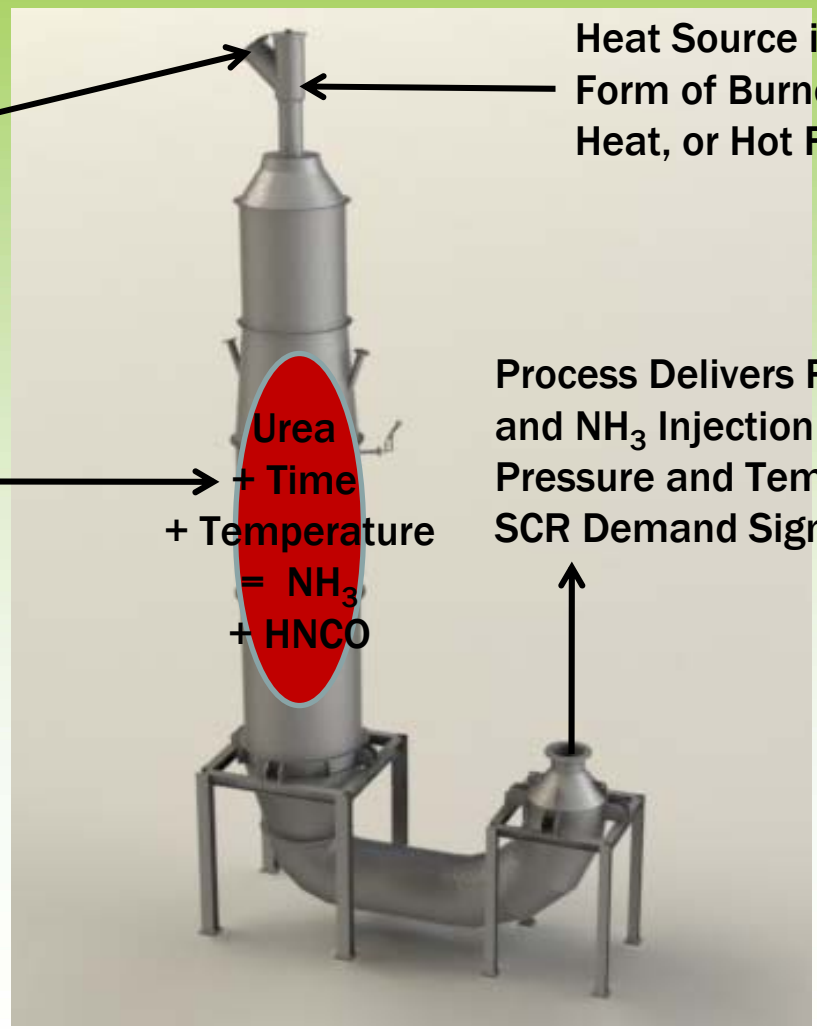
Thermal Decomposition of Urea

CITY UTILITIES
Bringing Power Home.

- **Patented Technology for On-site Urea Conversion Process that Relies on the Controlled Injection and Thermal Decomposition of Urea to NH_3 and HNCO**

Carrier Medium: Ambient Air, Clean Flue Gas

Heat Source in the Form of Burner, Electric Heat, or Hot Flue Gas

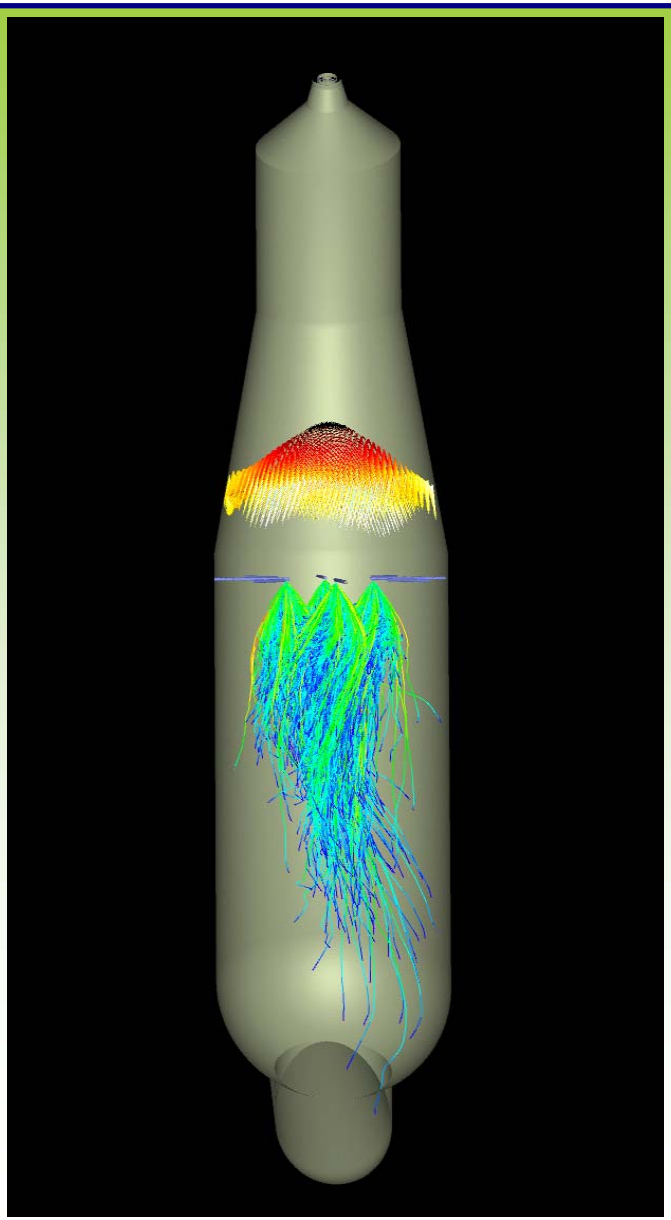


Injection of Aqueous Urea in Temperature and Time Dependent Chamber – Fast Load Following Capabilities

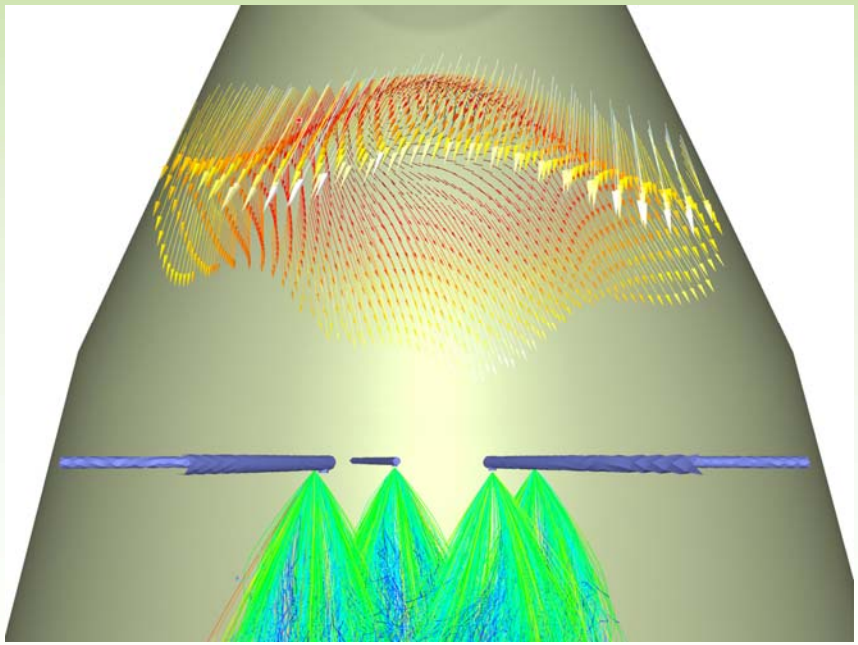
Process Delivers Reagent to Static Mixer and NH_3 Injection Grid (AIG) at Required Pressure and Temperature Based on SCR Demand Signal

FUEL TECH
Technologies to enable clean efficient energy™

Process Modeling



- **Computational Fluid Dynamics (CFD) Modeling of Decomposition Chamber**
- **Modeling of Temperature, Residence Time, and Droplet Dispersion**
- **Evaluation of Urea Injection Strategies**



FUEL TECH

Technologies to enable clean efficient energy™

CITY UTILITIES OF SPRINGFIELD (CUS), MO

Southwest Power Station Unit 1 ULTRA™ System

CUS Unit 1 – Operating Parameters

- **The City Utilities of Springfield, MO - Southwest Power Station; One (1) Operational Generating Unit (Unit 1), and One (1) New Generating Unit (Unit 2)**

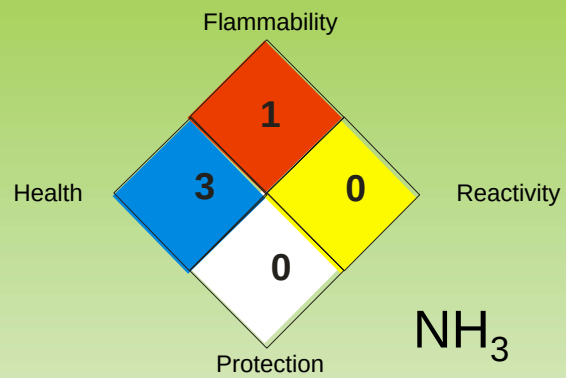
- **Unit 1 - 203 MW Riley Turbo Fired Unit Utilizing PRB coal**
  - **Retrofitted with an SCR System for NO_x Control.**
  - **NO_xOUT ULTRA™ Urea based NH_3 generation sized to provide 240 PPH SCR Reagent**

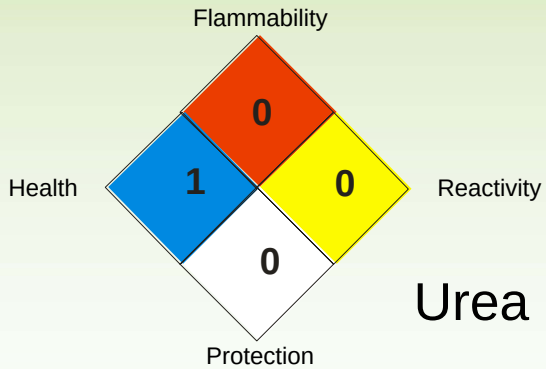
- **SCR NO_x Reduction of 80% to 0.08 lb/MMBTU**

- **CUS Unit 1 SCR and reagent system placed into commercial operation in January 2009.**

Reagent Alternatives for SCR Systems

- **Anhydrous Ammonia**
  - **Highest Risk Reagent**
  - **Decrease in US Ammonia Production**
- **Aqueous Ammonia**
  - **19% Concentration**
  - **29% Concentration - limited availability**
- **Urea for On-Site Ammonia Generation**
  - **Significant Safety Advantages**
  - **Worldwide Availability of Urea**
  - **Equivalent SCR Performance**





Urea Technology Selection

CITY UTILITIES
Bringing Power Home.

- **Safety Considerations Eliminated NH_3 Systems**
  - City of Republic High School Located Within NH_3 Toxic Release Zone
  - Growth of City of Springfield Around Plant
  - NH_3 Truck Traffic Near the City of Springfield
- **Engineered Evaluation Comparing Urea Systems**
  - Fuel Tech ULTRA System Most Cost Effective Compared to Other Urea Conversion Processes
  - Site Visits of Existing ULTRA Systems Confirmed Simplicity and Reliability
- **Evaluation Determined 50% Aqueous Urea was Most Cost Effective Based on Usage Rates**
  - Dry Urea and On-Site Solutionizing vs. Aqueous Urea Delivery Evaluated
  - Formaldehyde Free Urea NOT Required

FUEL TECH
Technologies to enable clean efficient energy™

Urea vs. Ammonia

CITY UTILITIES
Bringing Power Home.

- **Safety Considerations**
  - **Safety can be Engineered into the Design, but Considerations may Drive the Decision**
- **Natural Gas Pricing**
  - **Elevated Price of NG in North America is Forcing the Shutdown of NH_3 Productions and an Increase in Dry Urea Imports**
  - **LNG is an Alternative but Supply Insufficient to Cover Demand**
- **On-site Ammonia Storage**
  - **DHS has Promulgated Final Rule for On-site Storage of Chemicals – Unsure How this Will Impact Anhydrous NH_3 Storage for SCRs**
- **Transportation**
  - **"Chain of Custody" Regulations for TIH* Rail Shipments Driving Transportation Costs Considerably Higher, Some Carriers May Opt and are Currently Being Forced to Reroute Shipments to Avoid HTUAs**

* The TSA component of the DHS is about to implement a series of federal regulations affecting the transportation of Toxic Inhalation Hazard (TIH) materials such as Chlorine and Anhydrous Ammonia – will require "documented chain of command handoffs" along distribution zone.

FUEL TECH
Technologies to enable clean efficient energy™

Anhydrous Ammonia

Safety Considerations

- **Ammonia Storage**
  - **Department of Homeland Security (DHS) has indentified ammonia as a chemical of interest for anti-terrorism standards**
- **Transportation**
  - **Rail carrier risks and freight rate increases to handle anhydrous ammonia**
  - **Department of Transportation Restrictions**
  - **State and local restrictions on shipping and routing**
- **Safety Risks**
  - ***EPA Worst Case Release Analysis*** **– Toxic Endpoint for 60,000 Gallon Release Covers a Radius of 7 to 10 Miles[1]**

1 http://yosemite.epa.gov/oswer/ceppoweb.nsf/vwResourcesByFilename/backup.pdf/$File/backup.pdf

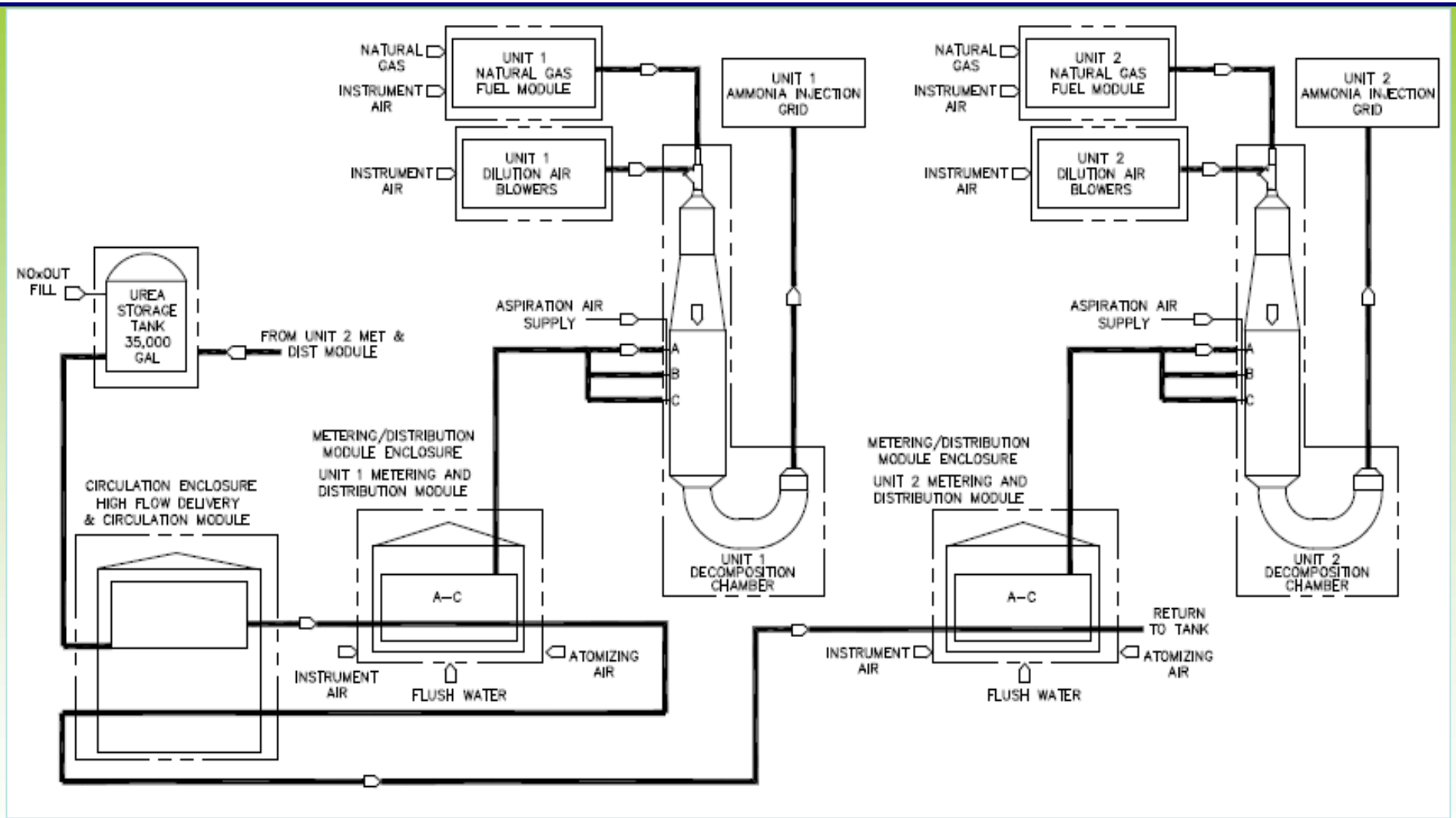
Aqueous Ammonia

Safety Considerations

- **Ammonia Storage**
  - Containment for possible liquid leaks/spills
- **Transportation**
  - 29% Aqueous ammonia is restricted by Department of Transportation in many areas
  - State and local restrictions on shipping and routing
- **Safety Risks**
  - Increased transportation risk due to more shipments of dilute chemical
  - 1.2 mile toxic radius for 60,000 gallon spill
  - Much higher unloading frequency at plant site raises potential incident probability

System Configuration

CITY UTILITIES
Bringing Power Home.



FUEL TECH
Technologies to enable clean efficient energy™

System Configuration

- One (1) 35,000 Gallon FRP Reagent Storage Tank, Common to Both Units, Heat Traced and Insulated
- One (1) Circulation Module with Redundant Pumps Housed in an Enclosure, Common to Both Units
- Per Unit Basis
  - One (1) Metering and Distribution Module Housed in Enclosure
  - One (1) Natural Gas Flow Control Module
  - One (1) Dilution Air Blower with Redundant Fans
  - One (1) Decomposition Chamber with Natural Gas Burner and Injection Lances

ULTRA™ System Arrangement

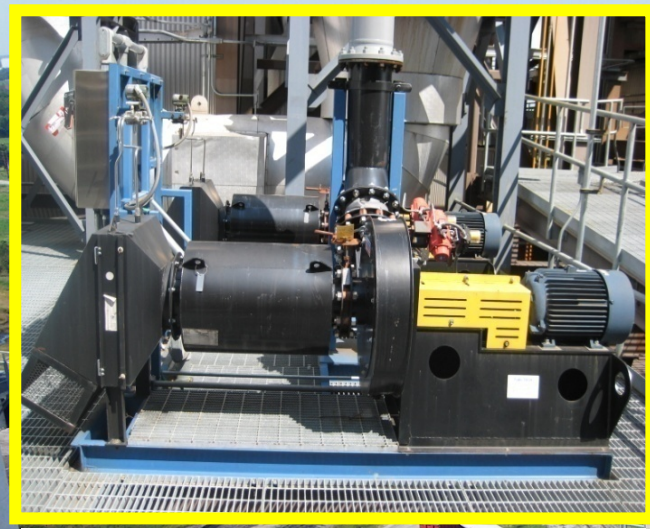
CITY UTILITIES
Bringing Power Home.

Urea Storage Tank and Circulation Building

FUEL TECH
Technologies to enable clean efficient energy™

ULTRA™ System Arrangement

CITY UTILITIES
Bringing Power Home.

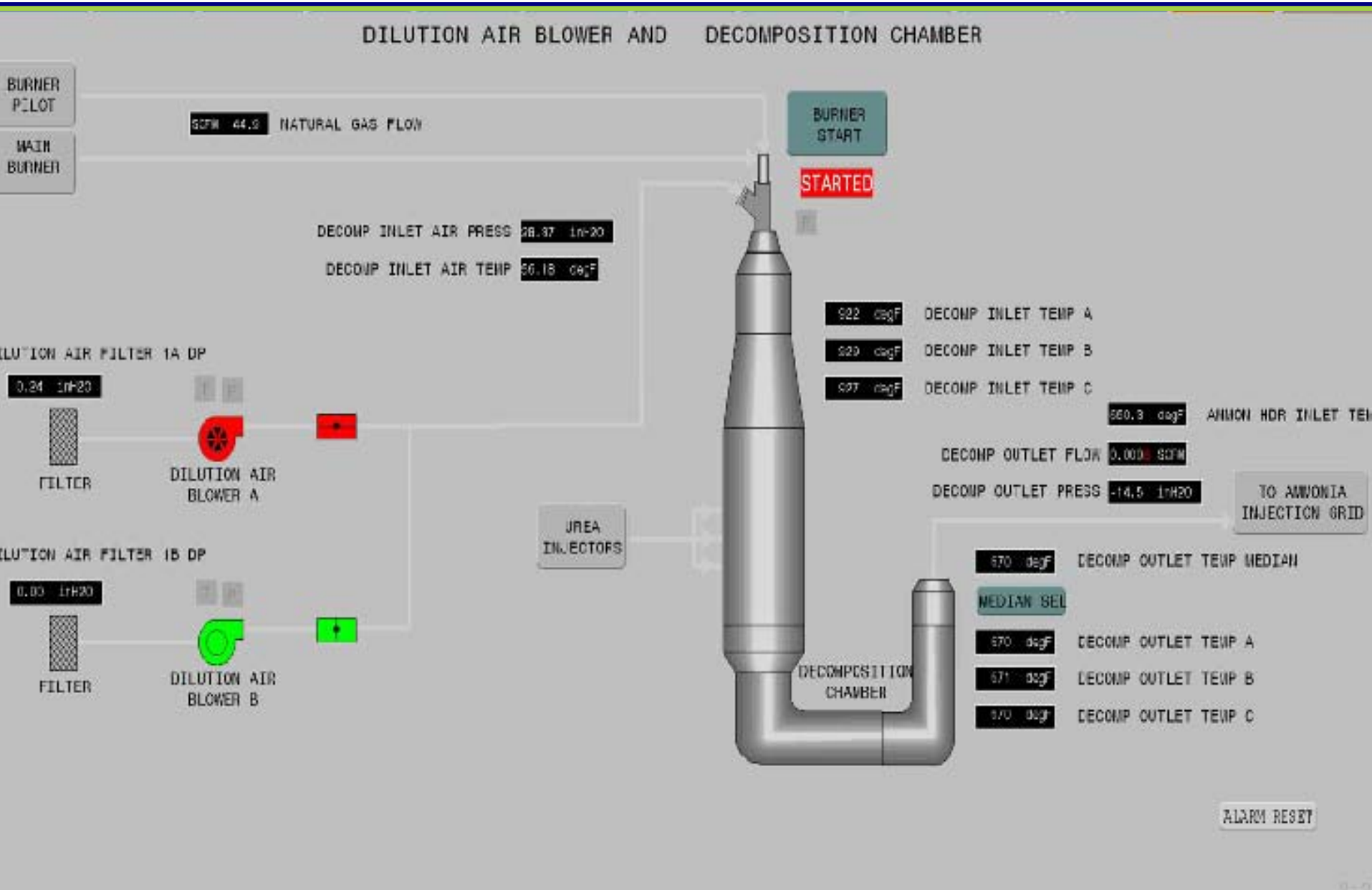


Dilution Air Fan Module

Decomposition Chamber

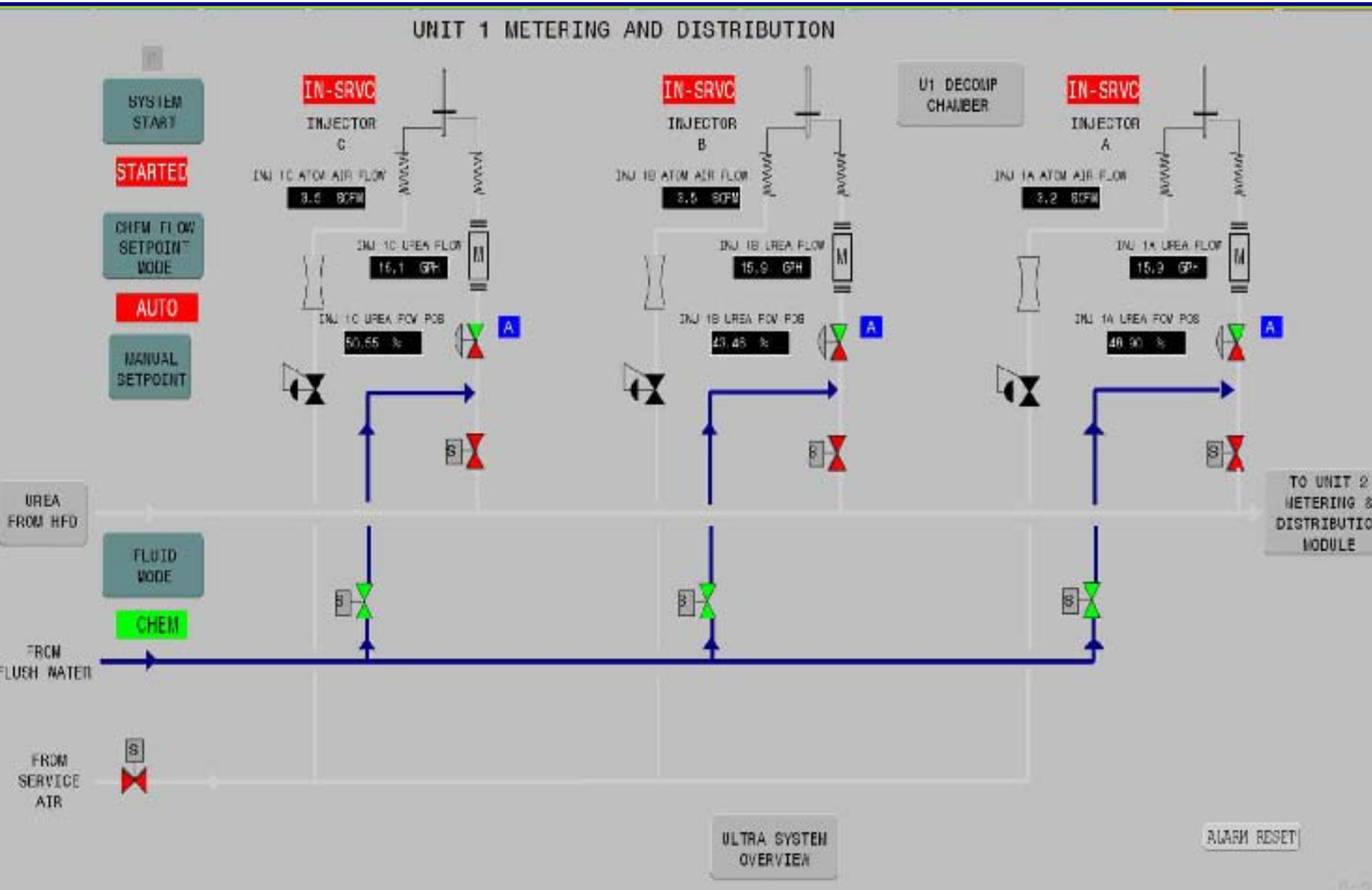
Unit 1 DCS Screen No. 1

CITY UTILITIES
Bringing Power Home.



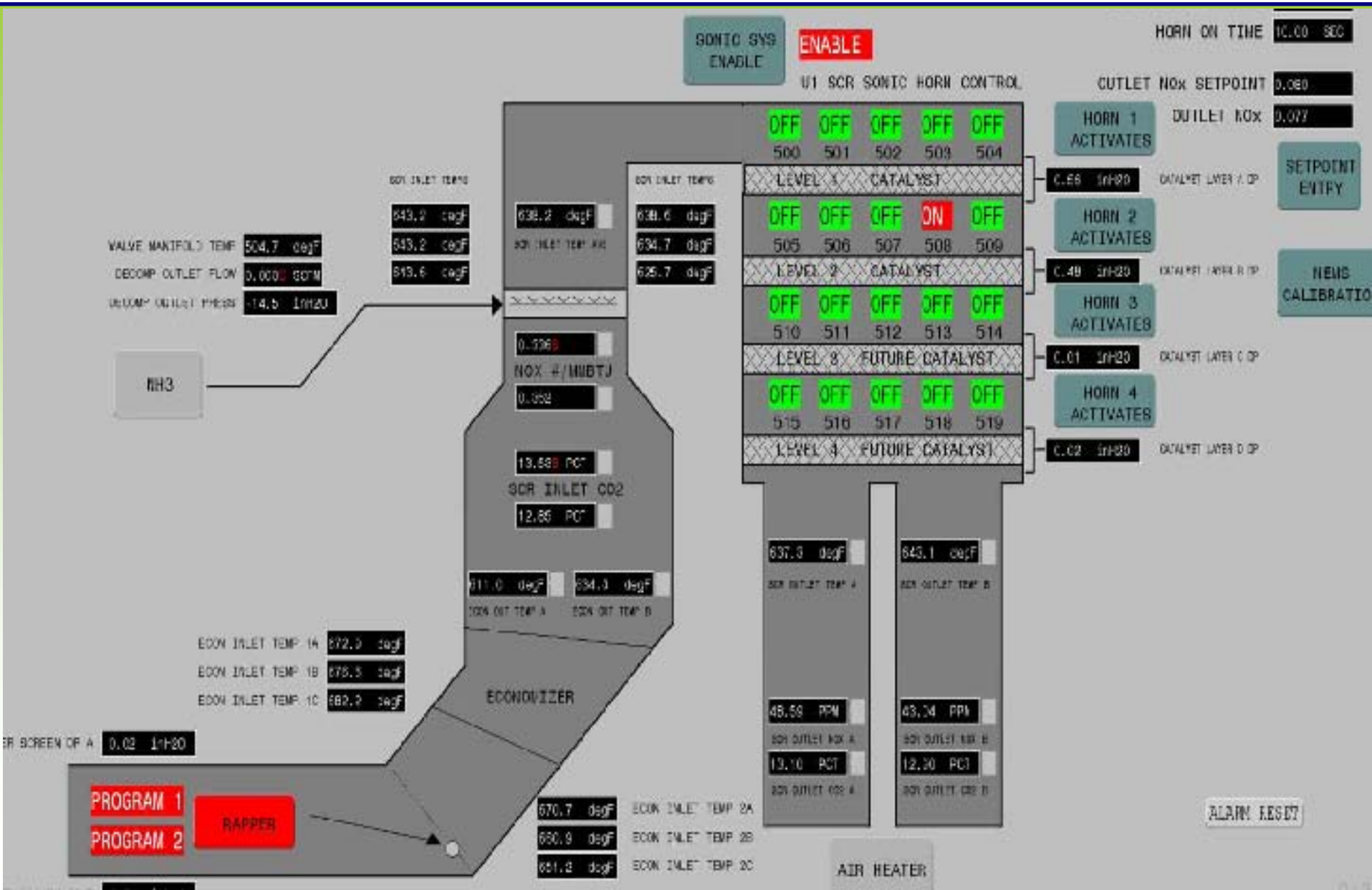
Unit 1 DCS Screen No. 2

CITY UTILITIES
Bringing Power Home.



Unit 1 DCS Screen No. 3

CITY UTILITIES
Bringing Power Home.



Operational History

CITY UTILITIES
Bringing Power Home.

- ULTRA System in Service for Two (2) Years, Since January 2009
- ULTRA/SCR System Availability in 2010 = 97.7%
  - System not Operating During Shutdown and Startup Procedures
- Unit 1 Capacity Factor for 2010 = 88.6%
- Operating Costs (Monthly Average)
  - Average Urea Costs = $0.35/MWn
  - Average Natural Gas Costs = $0.09/MWn
- Maintenance Costs – Labor (Average)
  - Routine Inspection/Maintenance: ULTRA System Maintenance Labor = One (1) Person, Eight (8) Hours Per Week
  - Preventative Maintenance: Two (2) Person, Eight (8) Hours Each Per Quarter
- Maintenance Costs – Materials (Average)
  - Materials (i.e. gauges, injection tips) = $5,000/Year (New).
  - Expected to Rise to ~ $10,000/Year Over Time

FUEL TECH
Technologies to enable clean efficient energy™

Operational/Equipment Issues and Lessons Learned

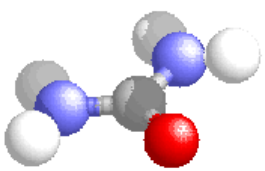
CITY UTILITIES
Bringing Power Home.

- **Burner Light Off Issues on Decomposition Chamber**
  - **Natural Gas Flow and Pressure Problems**
    - **Re-Drilled Orifice on Burner – Corrected Problem**
    - **Unit 2 Started Up With No Problems**
- **One Time - AIG Pluggage**
  - **Temperature Related Urea Reformation**
    - **Replace Some Plugged Pipe – Reinsulated AIG Piping and Installed Temperature Indication/Permissive**
    - **Problem Solved**
    - **No Issues on Unit 2**
- **Temperature at AIG Must Be Maintained Above 375°F @ Farthest Point**
- **Optimization of Injection and Decomposition Chamber**
  - **Atomization Air Pressure**
  - **Tip Selection**
  - **Total Air Flow**
  - **Flush Cycle Time**

FUEL TECH
Technologies to enable clean efficient energy™

Liquid Urea Properties – NH_2CONH_2

at 60°F	NOxOUT LT		NOxOUT A		Urea Liquor	
Urea Concentration	**32.5%**	**40.0%**	**50.0%**	**60.0%**	**70.0%**	**85.0%**
Specific Gravity	1.0897	1.1113	1.1400	1.1688	1.1976	1.2407
Pounds per Gallon	9.085	9.265	9.505	9.643	9.767	9.970
Crystallization Temperature (°F)	11.3	33	62	96	135	195
Boiling Point (°F)		220	225	231	240	
Biuret	0.14	0.17	0.21	0.3 to 0.4	0.3 to 0.4	0.36
pH	7.0 to 10.0	7.0 to 10.0	7.0 to 10.0	7.0 to 10.0	7.0 to 10.0	7.0 to 10.0
lb-NH3/gallon	1.67	2.10	2.70	3.28	3.88	4.81



Urea Quality

CITY UTILITIES
Bringing Power Home.

QUALITY SPECIFICATIONS – UREA				
	NOxOUT® A	NOxOUT® HP	UNSTABILIZED UREA	NOxOUT® LT
Description	Modified 50% Aqueous Solution of Urea	Modified 50% Aqueous Solution of Urea	50% Aqueous Solution of Urea	Modified 32.5% Aqueous Solution of Urea
Density (g/ml @ 25° C)	1.13 - 1.15	1.13 - 1.15	1.13 - 1.15	1.085 - 1.105
pH	7.0 - 10.8	7.0 - 10.8	7.0 - 10.8	5.0 - 10.8
Appearance	Light Yellow, Clear to Slightly Hazy	Light Yellow, Clear to Slightly Hazy	Light Yellow, Clear to Slightly Hazy	Light Yellow, Clear to Slightly Hazy
Salt Out Freeze Point	64°F (18°C)	64°F (18°C)	64°F (18°C)	40°F (4°C)
Foam (after bottle is shaken)	Foam Lasts > 15 seconds	Foam Lasts > 15 seconds	Not Applicable	Foam Lasts > 15 seconds
Free NH3	< 5000 ppm	< 5000 ppm	< 5000 ppm	< 3000 ppm
Biuret Content	< 5000 ppm	< 5000 ppm	< 5000 ppm	< 3000 ppm
Organic Phosphate	55 - 85 ppm as PO4	22 - 40 ppm as PO4	Not Applicable	55 - 85 ppm as PO4
Orthophosphate	< 6 ppm as PO4	< 6 ppm as PO4	< 2 ppm as PO4	< 6 ppm as PO4
Suspended Solids	< 10 ppm	< 10 ppm	< 10 ppm	< 10 ppm
Urea Makeup Water	Total Hardness as CaCO3 ≤ 300 ppm	Total Hardness as CaCO3 ≤ 150 ppm	Total Hardness as CaCO3 ≤ 20 ppm	Total Hardness as CaCO3 ≤ 300 ppm

QUALITY SPECIFICATIONS – DILUTION WATER				
	NOxOUT® A	NOxOUT® HP	UNSTABILIZED UREA	NOxOUT® LT
	Dilution Water Analysis	Dilution Water Analysis	Dilution Water Analysis	Dilution Water Analysis
Total Hardness as CaCO3 (ppm)	<450	<150	<20	<450
"M" Alkalinity as CaCO3 (ppm)	<300	<100	<100	<300
Conductivity (µmho)	<2500	<1000	<1000	<2500
Silica as SiO2 (ppm)	<60	<60	<60	<60
Iron as Fe (ppm)	<1.0	<1.0	<1.0	<1.0
Manganese as Mn (ppm)	<0.3	<0.3	<0.3	<0.3
Phosphate as P (ppm)	<1.0	<1.0	<1.0	<1.0
Sulfate as SO4 (ppm)	<200	<200	<200	<200
Turbidity (NTU)	< 10	< 10	< 10	< 10
pH	<8.3	<8.3	<8.3	<8.3

FUEL TECH
Technologies to enable clean efficient energy™

CUS Unit 2 ULTRA Startup

CITY UTILITIES
Bringing Power Home.

- Unit 2 - New Generating Unit
- 300 MW Foster Wheeler Opposed Wall Fired Unit Utilizing PRB coal
  - SCR System for NO_x Control.
  - NO_xOUT ULTRA™ Urea based NH_3 generation sized to provide 225 PPH SCR Reagent
- SCR NO_x Reduction of 72% to 0.07 lb/MMBTU
- CUS Unit 2 SCR and Reagent System Placed into Commercial Operation in January 2011.

FUEL TECH
Technologies to enable clean efficient energy™

ULTRA™ Experience

CITY UTILITIES
Bringing Power Home.

Customer Name	Location of Installation	Capacity	SCR Reagent Demand	Installed
Peerless Manufacturing	MATEP -Boston, MA,	2 × 15 MW	15 lb/hr	2002
Northern Indiana Public Service	Michigan City Unit 12	520 MW	1200 lb/hr	2003
Northern Indiana Public Service	Bailey Unit 8	360MW	1100 lb/hr	2004
Northern Indiana Public Service	Schafer Unit 14	520 MW	1200 lb/hr	2004
Huaneng Beijing Co-Generation Co Ltd.	Gaobeidian Power Plant - Beijing, China	4 × 830 tph Steam	330 lb/hr	2007
Huaneng Beijing Co-Generation Co Ltd.	Shijingshan Power Plant - Beijing, China	4 × 200 MW	400 lb/hr	2007
University of California	Irvine, CA	14 MW	11 lb/hr	2007
City Utilities -Springfield	Southwest Station Units 1 & 2	203 MW, 300 MW	240 lb/hr	2008
D B Doosan Babcock	CLP Power -Castle Peak Units 1-4	4 680 MW	175 kg/h	2008
Northern Indiana Public Service	Bailey Unit 7	175 MW	720 lb/hr	2008
University of Texas	Austin, TX	32.5 MW	25 lb/hr	2008
Kansas City Power & Light	Sibley Unit 3	420 MW	1110 lb/hr	2009
Pensotti Idrotermici Sices	Parma, Italy	245 kNm^3/h	50 lb/hr	2007
Speic	Brest, France	2 x 9 t/h	500 lb/hr	2005
Qinling	China	2 x 660 MW	350 lb/hr	2009
Rentech Boiler Systems	Sinclair, WY	150 KPPH Steam	150 lb/hr	2010
EDF	Martinique, France - Fort De France	2 x 45 MW	300 lb/hr	2010
AZA	Brescia, Italy	275 kNm3/h	70 lb/hr	2010

FUEL TECH
Technologies to enable clean efficient energy™

CUS ULTRA™ Summary

CITY UTILITIES
Bringing Power Home.

- **ULTRA System on Unit 1 Operating Successfully for Two (2) Years**
- **Unit 2 ULTRA System Operational**
- **System Chosen Based on Safe Reagent Supply**
  - **Economical Compared to Other Urea Conversion Technologies**
- **Reliable Equipment with Commonality for Two (2) Units**
- **High System Availability**
- **Ability to Follow NH_3 Demand Signal for Repeatable and Reliable NO_x Reductions**

FUEL TECH
Technologies to enable clean efficient energy™

Contact Information

- **Ms. Amy Strauss, P.E.**

  Senior Engineer
  City Utilities of Springfield, MO
  P: (417) 831-8779
  amy.strauss@cityutilities.net

- **Mr. Dale Pfaff**

  Midwest Regional Manager
  Fuel Tech, Inc.
  P: (847) 504-6650
  dpfaff@ftek.com