
# Creating a World of Possibilities

# An Overview of SCR Systems & Lessons Learned to Establish Long Term Reliability and Compliance


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For CEMTEK KVB-ENERTEC

DATE: September 12, 2018

INNOVA GLOBAL

# Presentation Outline

**Introduction**

**Company Overview**

**Critical Considerations for Emissions Control Systems**

**SCR Systems;**

**Design Process and Considerations, Flow Modeling**

**SCR and CO Catalyst**

**Ammonia Vaporization Skid Types, Ammonia Injection, Reactors**

**Reagents Including Aqueous, Anhydrous, Urea**

**Lessons Learned – Innovative Advances for Improved Controls**

INNOVA has proven experience working with EPC companies to provide cost savings and risk mitigation.

# INNOVA GLOBAL

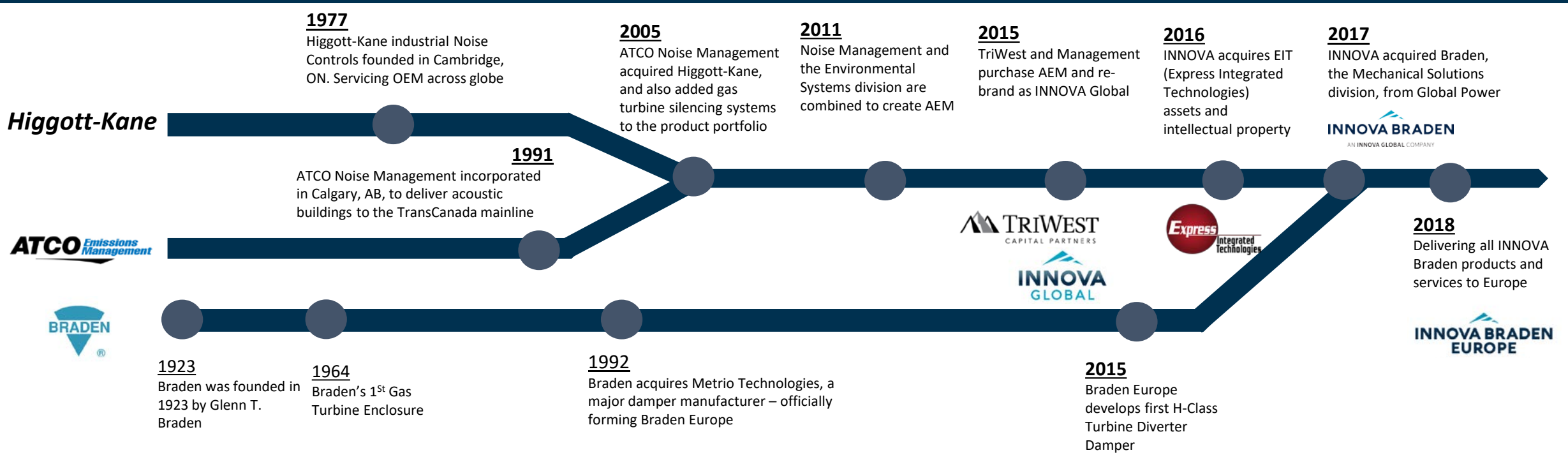
INNOVA Global is a leading supplier of specialized and balanced solutions for air and noise emissions control, acoustic consulting and mitigation, gas turbine auxiliary systems, heat recovery systems, oil and gas facilities as well as turnkey buildings. Backed by 40 years of innovation and a strong commitment to client excellence we deliver performance and efficiencies for our customers in the power generation, oil & gas, petrochemical and industrial sectors. With offices strategically located throughout the world we ensure global expertise combined with a local focus in everything we do.

INNOVA BRADEN EUROPE

AN INNOVA GLOBAL COMPANY

# HISTORY IN THE MAKING

- INNOVA Global is a new company comprised of companies with proud histories of servicing the energy industry around the world:  Braden, Express Integrated Technologies, Metrio Technologies, St George Steel, ATCO and Higgott-Kane
- In October, 2017 INNOVA acquired Braden from Global Power Equipment Group consisting of Braden Europe, Braden USA and Consolidated Fabricators



THE INNOVA GLOBAL

# FAMILY

INNOVA GLOBAL

**Operating Divisions**

- INNOVA NOISE MANAGEMENT SOLUTIONS — A DIVISION OF INNOVA GLOBAL
- INNOVA HEAT TRANSFER SOLUTIONS — A DIVISION OF INNOVA GLOBAL
- INNOVA OIL + GAS SOLUTIONS — A DIVISION OF INNOVA GLOBAL
- INNOVA BRADEN ENVIRONMENTAL SOLUTIONS — A DIVISION OF INNOVA GLOBAL
- INNOVA BRADEN RETROFIT SOLUTIONS — A DIVISION OF INNOVA GLOBAL

**Companies**

- INNOVA BRADEN — AN INNOVA GLOBAL COMPANY
- INNOVA BRADEN EUROPE — AN INNOVA GLOBAL COMPANY
- INNOVA ST. GEORGE STEEL — AN INNOVA GLOBAL COMPANY
- INNOVA CONSOLIDATED FABRICATORS — AN INNOVA GLOBAL COMPANY
- INNOVA GLOBAL SpA — AN INNOVA GLOBAL COMPANY
- INNOGLOBAL MEX — AN INNOVA GLOBAL COMPANY
- INNOGLOBAL PRO — AN INNOVA GLOBAL COMPANY
- INNOGLOBAL MAQ — AN INNOVA GLOBAL COMPANY

# INDUSTRIES

## WE PROUDLY SERVE

Power Generation

Oil and Gas

Mining

Petrochemical

Processing

Recycling

Transportation

Industrial

# Innova global Products

**Gas Turbine & Reciprocating Engine Systems**

**HRSGs, OTSGs, WHRUs & WHBs**

**Historical Only**

**Air Pollution Compliance**

**Noise Management**

**Turnkey Buildings**

**Gas Processing Components**

**Bypass Systems**

ENSURING THE HIGHEST QUALITY DELIVERABLES

# INNOVA WORLD CLASS CAPABILITIES

- Fully integrated engineering design with acoustical, structural, mechanical and chemical engineering
- In-house CFD, FEA analysis and acoustic mitigation software
- 3D Design Drafting with detailed drawings for fabrication
- INNOVA operated manufacturing facilities include:
  - 2 shops with 165,000 $ft^2$ in Monterrey, Mexico
  - 1 shop with 100,000 $ft^2$ in St. George, Utah, and
  - 1 shop with 50,000 $ft^2$ in Auburn, Massachusetts
- INNOVA also has more than 20 fabrication partners worldwide, including China, Thailand, Indonesia, South Korea, MENA, Turkey, Poland, Hungary, Macedonia, Europe, UK, Peru, Columbia and many more
- INNOVA is an approved OEM supplier to GE, Mitsubishi, Siemens and Solar Turbine
- INNOVA can install any of its products as required by our client
- INNOVA has more than 500 employees worldwide to support your company

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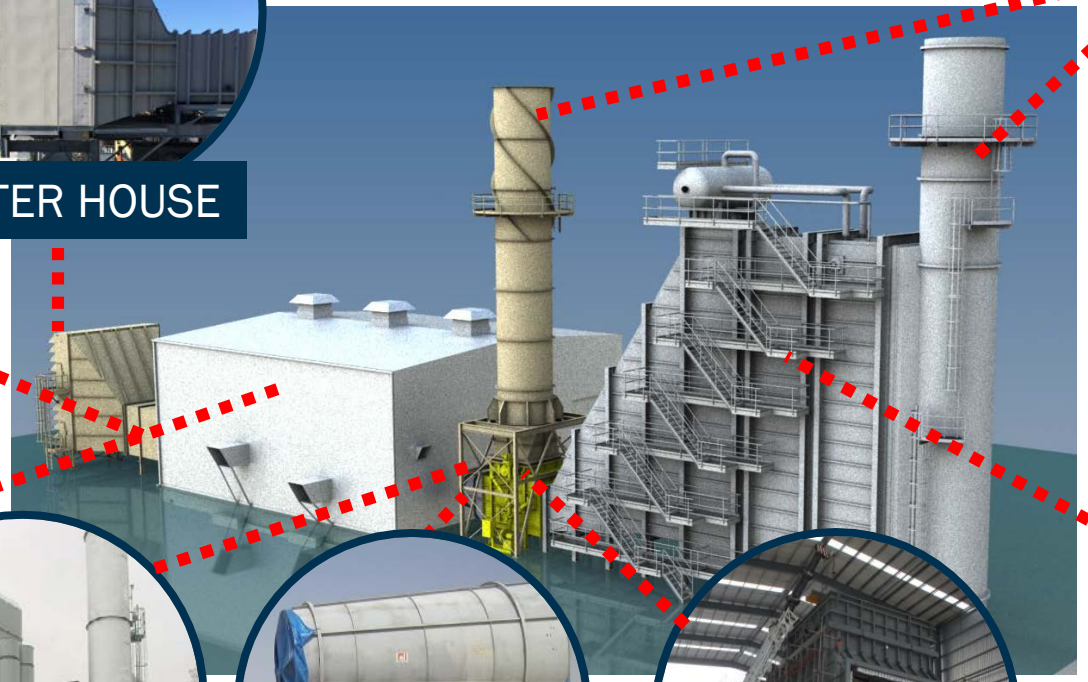
# GAS TURBINE

## PRODUCT PORTFOLIO

FILTER HOUSE

INLET SILENCING SYSTEM



EXHAUST SILENCING SYSTEMS

SCR & CO /SC/CC

ENCLOSURE

ANTI-ICING SYSTEM

DIFFUSER

DIVERTER DAMPER

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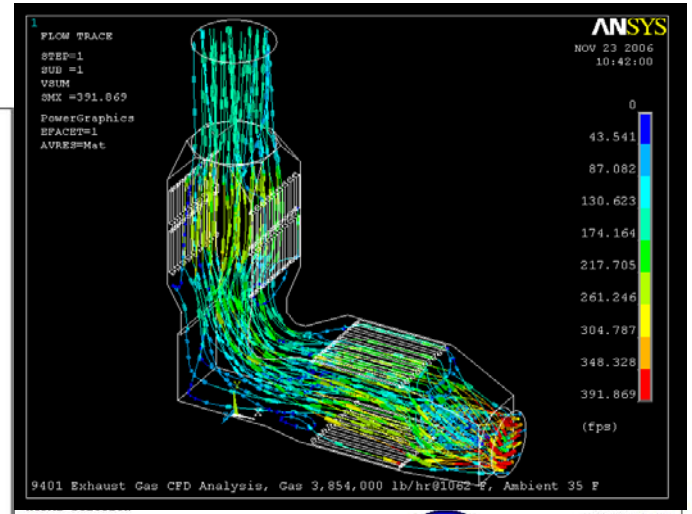
# ENGINEERING & DESIGN

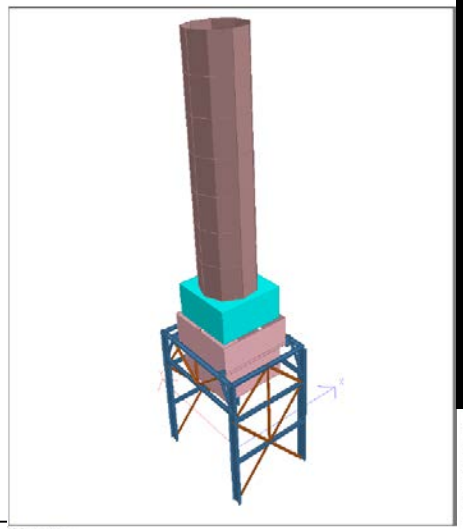
- **Core competencies in Mechanical, Structural, and Acoustical Engineering:**

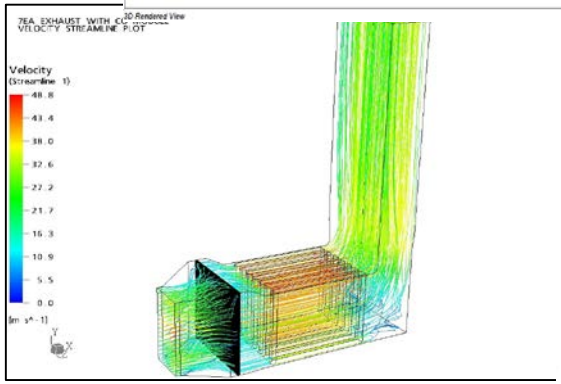
  - **Structural Framing & Mechanical Design**
  - **Stress & Fatigue Analysis**
  - **Software – STAAD, CFX, FEA, Inventor 3D, Vault PDM**
  - **PM – Primavera P6 Scheduling**

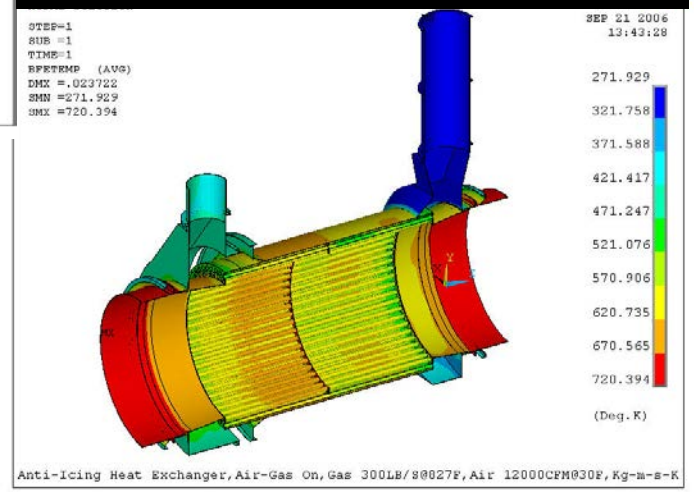
  - **Heat Transfer**
  - **Fluid Flow (including CFD Analysis)**
  - **Building HVAC Design**

  - **Industrial Noise Control Design**
  - **Environmental Noise Modeling (Cadna/A)**
  - **Noise & Vibration Measurement**
  - **Indoor Noise Modeling (Odeon)**



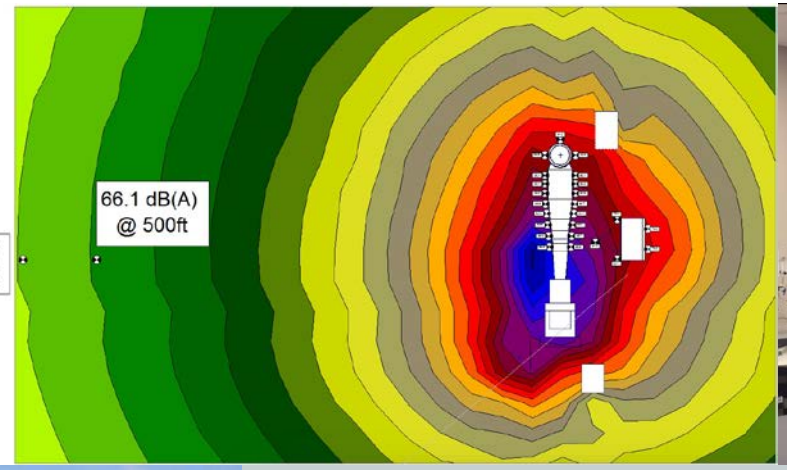


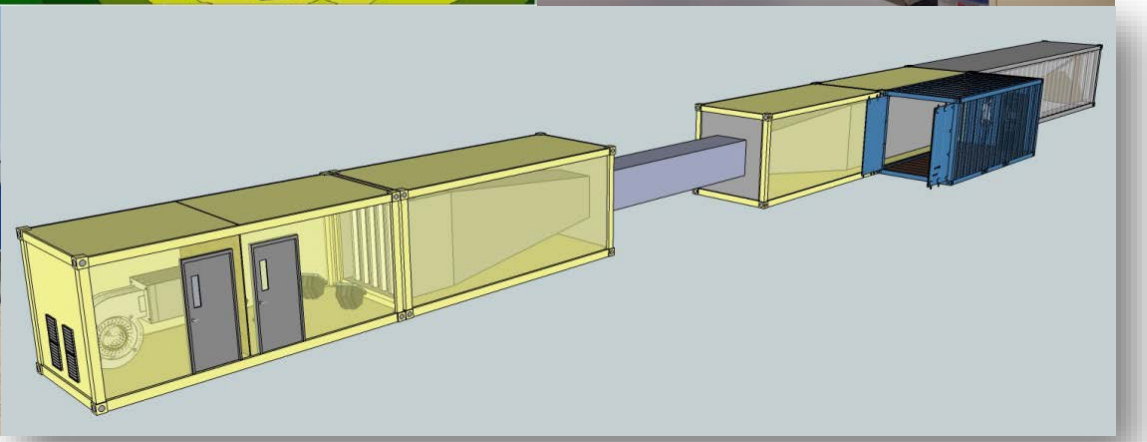



# ACOUSTINC ENGINEERING

## Acoustic Analysis

- **Anechoic test chamber**
- **In-house lab for acoustic materials testing**



# INNOVA SCR/CO PARTIAL REFERENCE LIST

| GT Size | # | GT Size | # |
|---|---|---|---|
| GE LM2500 | 1 | PW FT8-TP | 2 |
| GE LM6000 | 165 | ST Taurus60 | 2 |
| GE LMS100 | 48 | ST Mars100 | 2 |
| GE FrFA.04 | 1 | ST Mars130 | 1 |
| GE FrEA&6B | 3 | ST Titan250 | 7 |
| W501AA | 6 | SEI Trent60 | 7 |
| ABB GT10B2 | 1 | SEI RB211 | 1 |
| Does not include competitor's repaired SCR systems, reciprocating engine or industrial ECS. | | | |

**248 SCR & CO Emission Control Systems**

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GLOBAL
Environmental Solutions

# SELECTIVE CATALYTIC REDUCTION (SCR) SYSTEMS

5 x LM6000 SCR systems in operation

- Unique patented ammonia injection grid achieving higher NH3 mixing
- Superior sealing to prevent bypass around catalysts
- Modular construction

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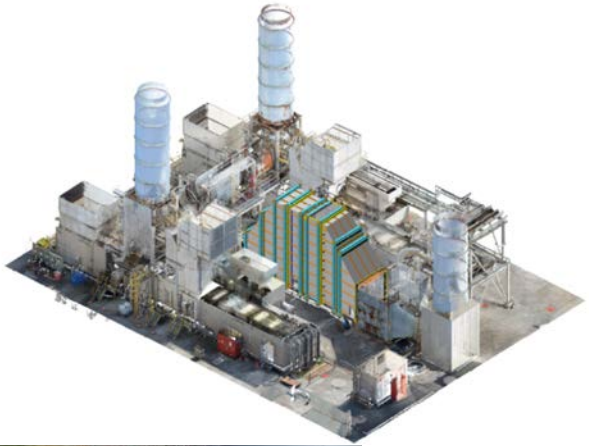
# SPIRIT ENERGY

## BARROW IN FURNESS, UK





INNOVA designed and fabricated the entire system in the UK to minimize risk for this project. INNOVA's hot catalyst system scope consisted of:

- CFD and Physical Flow Modelling
- CO Reduction System
- Ammonia Vaporization System
- NOx Reduction System
- CEMs Monitoring Probes
- CEMs Analyzer System
- Urea Forwarding Skid
- Site Demolition and Installation
- Commissioning

POWER SECTOR

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SCR SYSTEMS
INNOVA
GLOBAL
Environmental Solutions

# REGULATORY DRIVERS AFFECTING REFINERIES

## REGULATION XX (RECLAIM)

**PROPOSED AMENDED REGULATION XX – REGIONAL CLEAN AIR INCENTIVES MARKET (RECLAIM): PROPOSED AMENDED RULE 2001 – APPLICABILITY, AND PROPOSED AMENDED RULE 2002 – ALLOCATIONS FOR OXIDES OF NITROGEN (NOX) AND OXIDES OF SULFUR (SOX)**

As RECLAIM facilities transition to command and control, they will be subject to Regulation XIII –New Source Review (NSR) requirements

Command and control transition rules need to meet BARCT and include

*Rules; 1109.1-Refinery Equipment-Blrs, Htrs, FCCU, GTs SC/CC, ICE, Incinerator & Calciner, SRU/TGI

Rule 1146, 1146.1, 1146.2 Control of NOx Emissions from Boilers, Steam Generators, Process Heaters, Water Heaters

Rule 1118.1 – Control of Emissions from Non-Refinery Flares

Rule 1110.2 – Emissions from Gaseous- and Liquid-Fueled Engines

Rule 1134 – Emissions of Oxides of Nitrogen from Stationary Gas Turbines

Rule 1147 – NOx Reductions from Miscellaneous Sources

**Levels of up to 95% reduction under evaluation, adoption all rule amendments target end of 2018/1st Qtr. 2019**

**AB 617** Political deal for AB 398. Components-increased monitoring, stricter penalties for violations
Will change reporting requirements, may require third-party verification.
Expedited schedules for implementation of (BARCT) limits not later than December 31, 2023."

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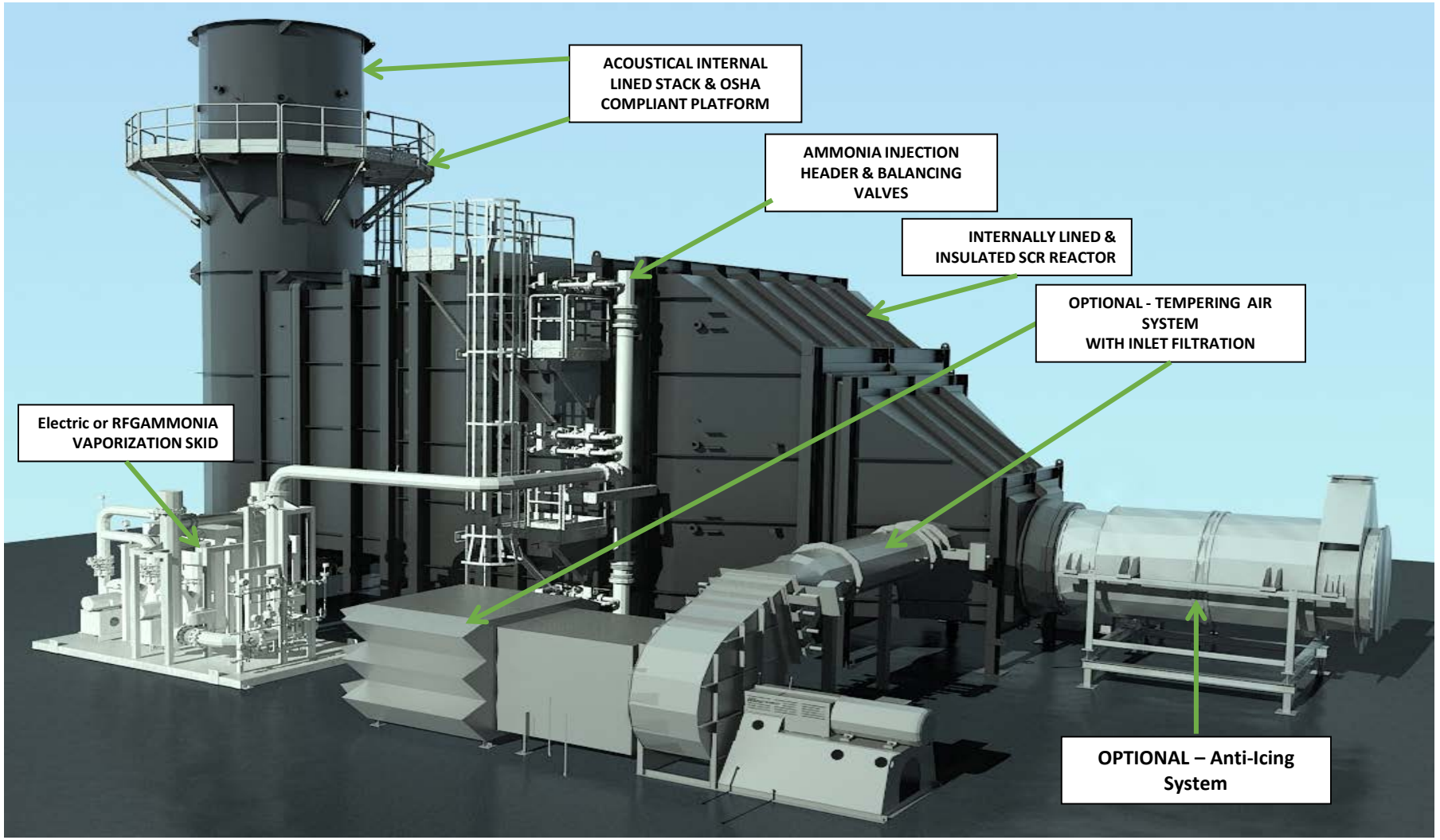
# ELEMENTS OF SCR CATALYST SYSTEM

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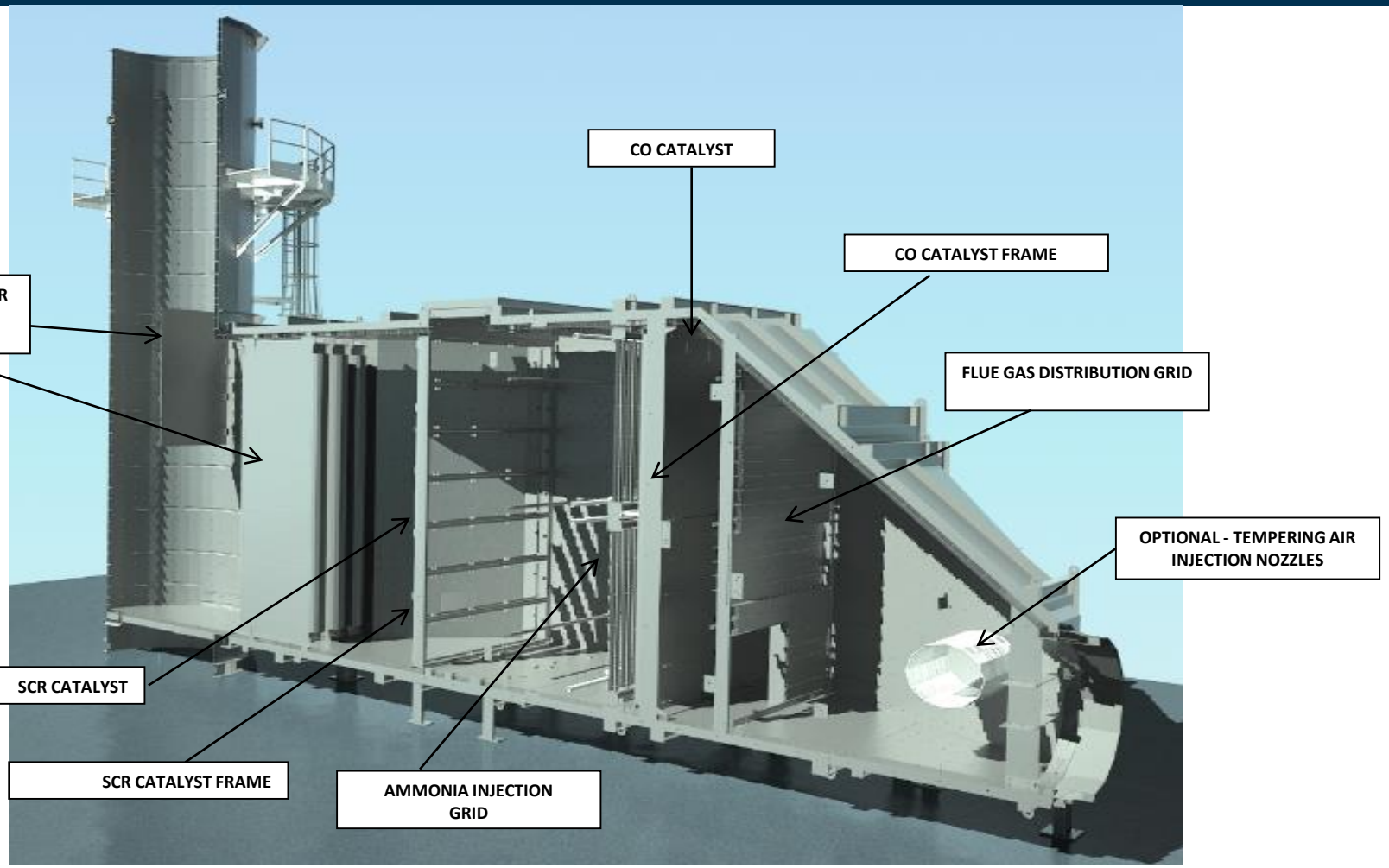
# INTERNAL ELEMENTS OF CATALYST SYSTEM

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# SCR DESIGN CONSIDERATIONS

- **Emissions requirements**
  - **NOx**
  - **CO**
  - **Ammonia Slip**
  - **Particulates**
  - **VOC**
- **Exhaust gas flow distribution**
- **Exhaust temperature**
- **Catalyst life requirements**
- **Exhaust gas composition**
- **Turbine operating conditions**
- **CO Catalyst oxidation effect**
- **Ammonia oxidation effect**

1. Design life – 25 years, 30 years - except catalyst
   - Typical Catalyst life: 1,000 to 40,000 hour
2. Typical operating conditions – 40% load to 100% load
   - Lower load ranges incorporate enhanced system designs
3. Starts per year can various up to multiple starts per day
4. Continuous operational temperature of CO and NOx catalysts
   - 800 F design
   - 850 F design
   - 900 F design
5. Stack emissions requirements, PM 2.5, PM10, NOx, CO, NH3, etc
6. Acoustic requirements
   - Balance the impact of tempering air system (if applicable), duct break-out and stack top

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# KEY CONSIDERATIONS

## FOR GAS FIRED CATALYST SYSTEMS

| | |
|---|---|
| Service life in hours/years 1,000 to 40,000 | Ammonia slip at end of catalyst life |
| Flue gas bulk exhaust temperature | Working catalyst temperature |
| Flue gas exhaust $NO_X$ levels min. & max. | Reactor duct configuration aspect ratio |
| Required $NO_X$ removal ppm and total % | Flue gas flow uniform distribution |
| Maximum pressure loss allowance | Mean flue gas temp. distribution |
| Total exhaust stream volumetric flow rate | $NH_3/NO_X$ cross section distribution |

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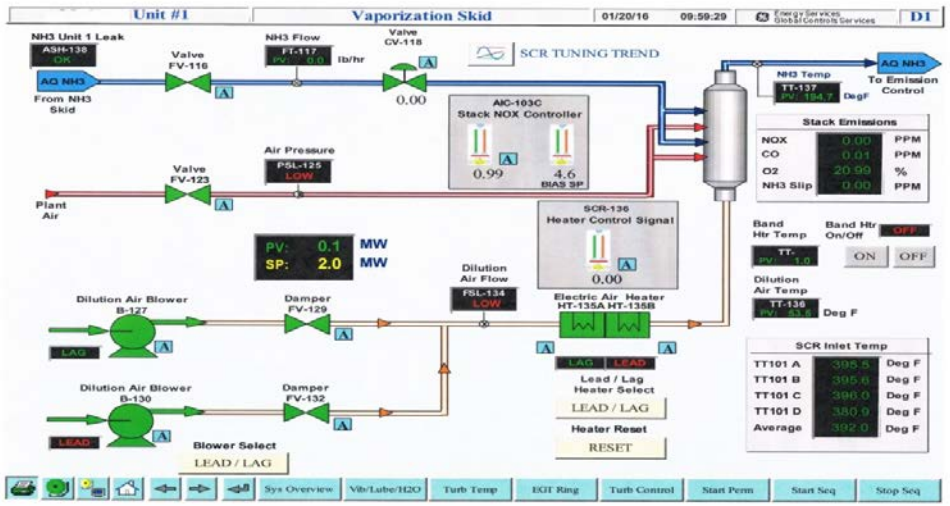
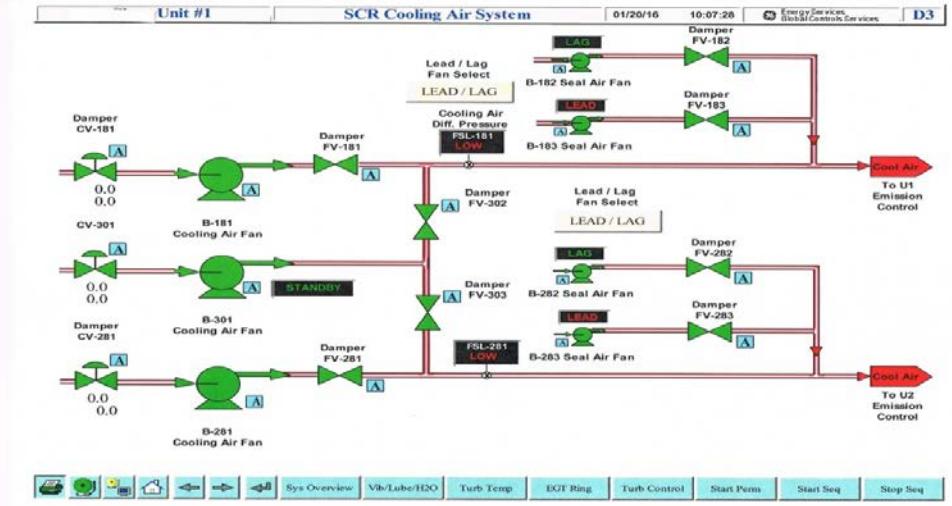
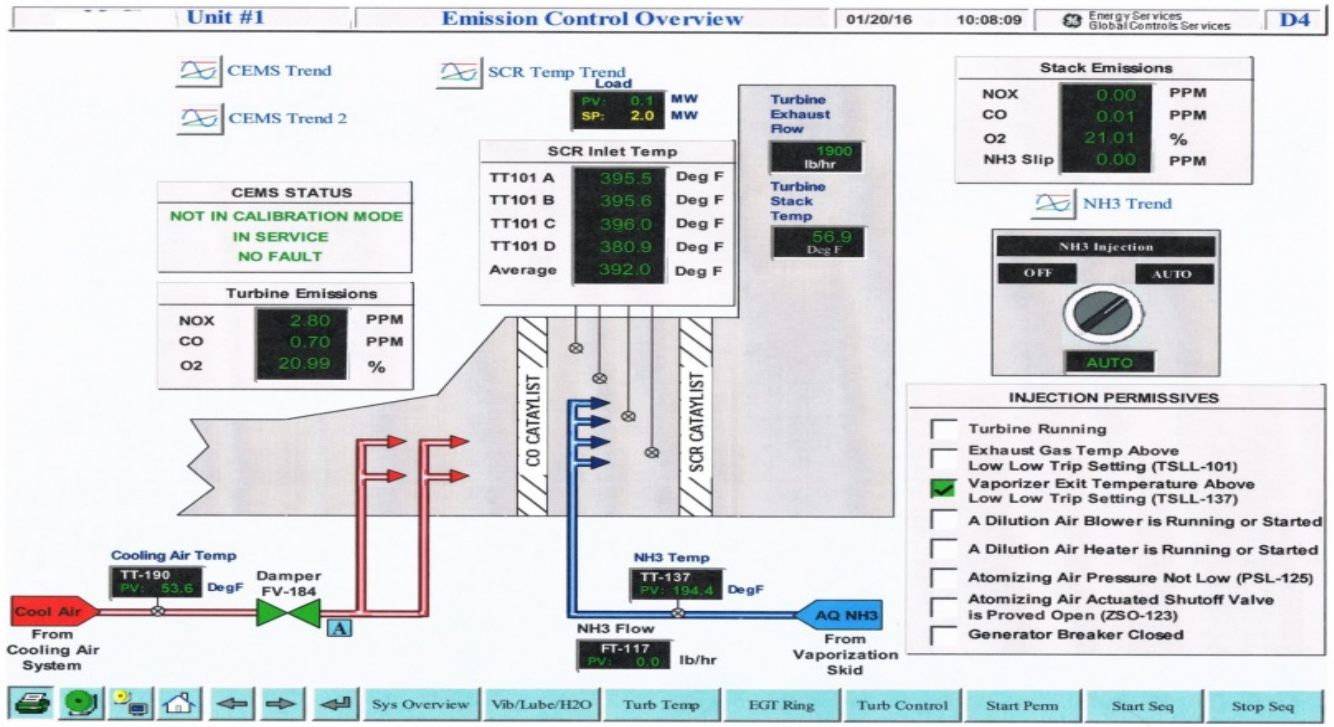
# PLC Stand Alone or DCS Integrated Control Systems

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# TYPICAL NEW AND RETROFIT

## CATALYST SYSTEMS FOR GAS TURBINES, BOILERS, PROCESS HEATERS

Reactor & Ductwork Design Considerations:

- Seismic and wind loads
- Thermal growth
- Catalyst support
  - Differential growth and loading
- Accessibility (Internal/external components)
- Thermal insulation
- Extent of prefabrication
- Constructability

Catalyst system considerations include:

- Catalyst module support
- Module material construction
- Sealing and retention
- Catalyst sample cassettes/coupons
- Catalyst deactivation
- Flue gas flow and distribution
- Catalyst cleaning

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# Maintenance Concerns for Emission Control Systems

| | |
|---|---|
| Service life year/hours<br>(Campaign life customer requirement) | Periodic sampling to validate activity, ammonia quality/concentrate |
| Maintain safe exhaust gas temperature to avoid ABS formation | Fine tune injection start cycle for NH3 optimization-system calibrations |
| Check flue gas exhaust $NO_X$ levels are within contract design limits | Verify equipment operations and CEMS for consistent reliable performance |
| Verify required $NO_X$ removal is across design turndown | NH3 skid maintenance, calibration and sealing systems are intact |
| Ensure pressure loss allowances are consistent over time | Annual catalyst cleaning at outage if inspection warrants |
| $NH_3/NO_X$ distribution as catalyst ages | AIG Inspection, rebalance grid<br>Check sealing systems |

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# SCR REACTIONS & CATALYST DESIGNS

**The primary reactions for NOx**

$4\ NH_3 + 4\ NO + O_2 \rightarrow 4\ N_2 + 6\ H_2O$

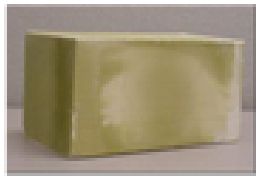
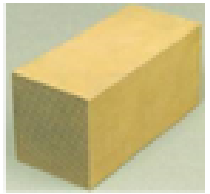
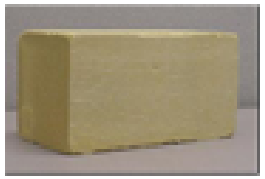
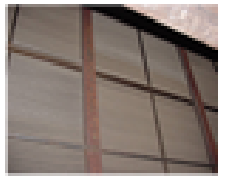
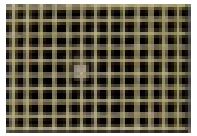
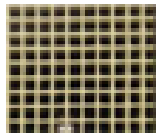
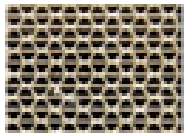
$8\ NH_3 + 6\ NO_2 \rightarrow 7\ N_2 + 12\ H_2O$

Secondary reactions –

$2\ NH_3 + SO_3 + H_2O \rightarrow (NH_4)_2(SO_4)$

$NH_3 + SO_3 + H_2O \rightarrow NH_4HSO_4$

- **Can be poisoned/deactivated**
  - **Sodium**
  - **Potassium**
  - **Arsenic**
  - **Chromium**
  - **Plugging**
  - **Sintering**

| | Washcoated | Extruded | Fiberglass Support | Plate Catalyst |
|---|---|---|---|---|
| Catalyst Element |  |  |  |  |
| Channel Geometry |  |  |  |  |
| Manufacturers | Engelhard<br>Johnson Matthey | Cormetech<br>Argillion<br>Ceram<br>SK<br>KWH | Haldor Topsoe<br>Hitz | Hitachi<br>Argillion |




**High Temperature -** decreases available surface area by thermal sintering of ceramic material & amalgamation of active sites

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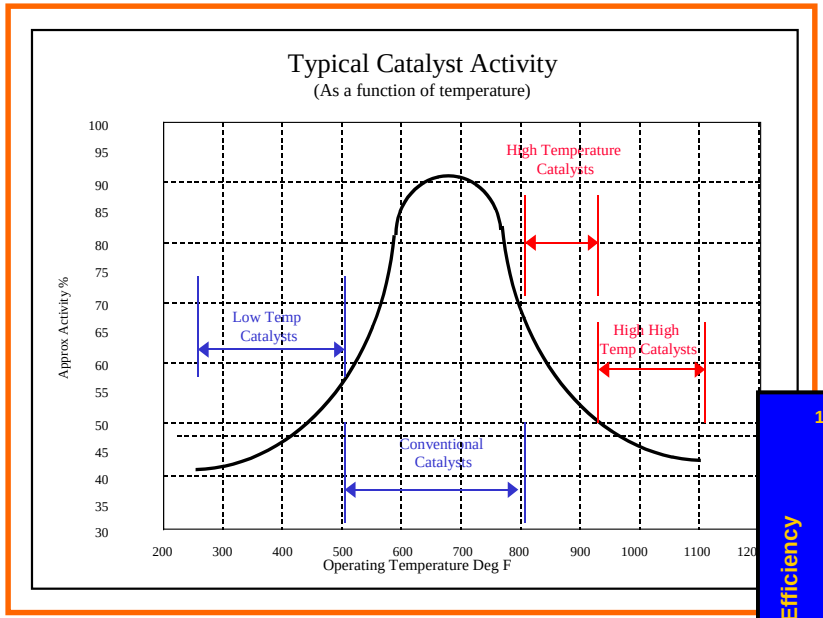
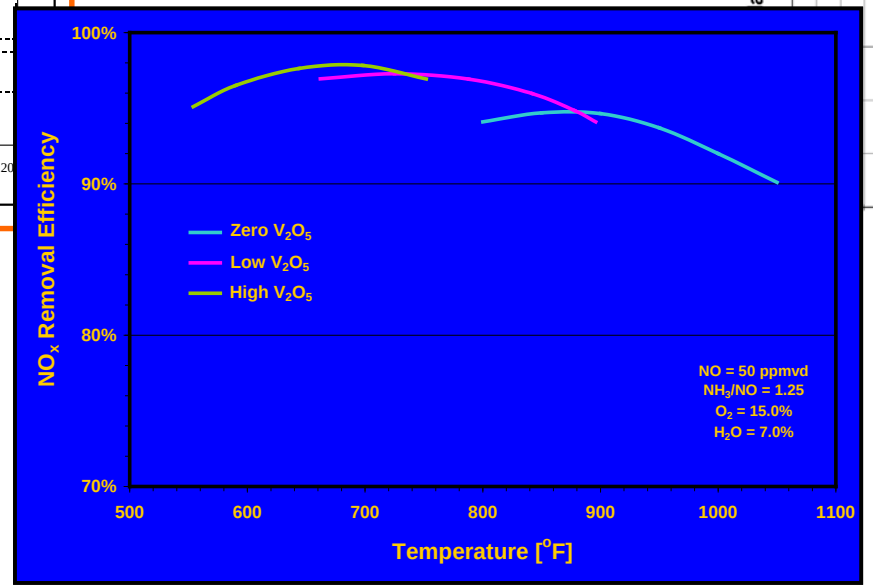
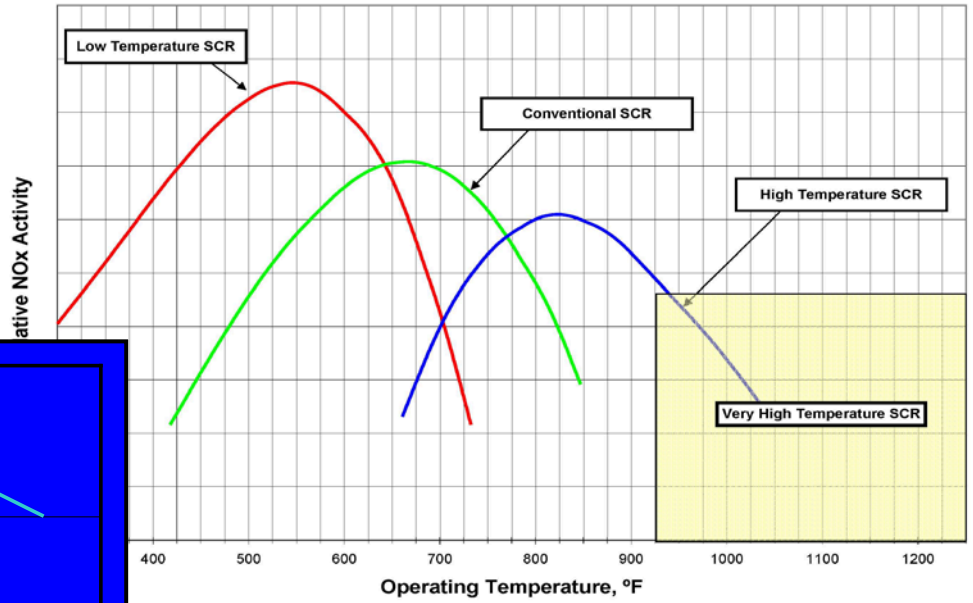
# TYPICAL SCR CATALYST CURVES FROM VARIOUS MANUFACTURERS




High Temperature decreases available surface area by thermal sintering of substrate material & amalgamation of active sites

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# CO Catalyst Types & Reactions

**The primary reaction for CO**

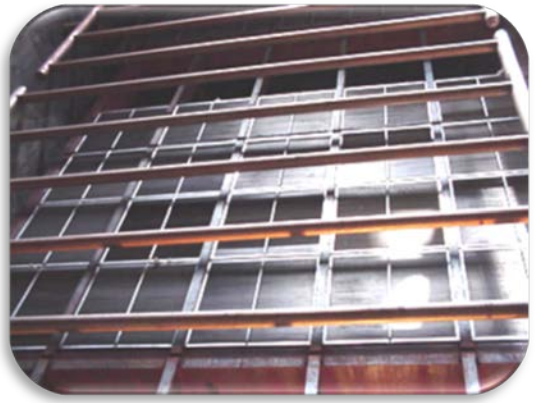
$CO + ½ O_2 \rightarrow CO_2$

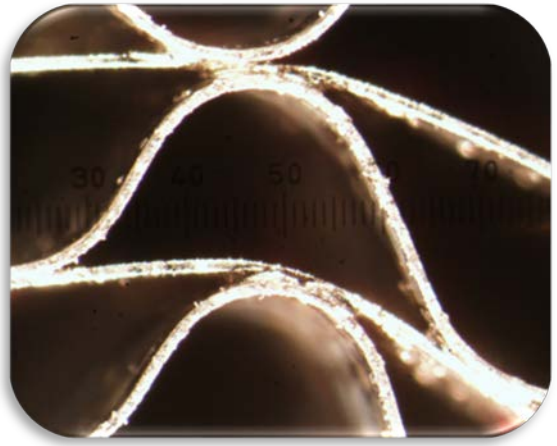
Secondary reactions –

$NO + ½ O_2 \rightarrow NO_2$

$SO_2 + ½ O_2 \rightarrow SO_3$

$CH_4 + 2O_2 \rightarrow CO_2 + 2H_2O$





**Promotes good Mass Transfer**

**CO Catalysts**

- **Metal Foil vs Ceramic Honeycomb**
- **PGM loading in wash coat slurry**
- **Straight Channel vs Herringbone**
- **Modular construction**
- **Smaller pitch than SCR catalyst**
- **Reaction improves with heat**
- **Can affect NOx concentrations**

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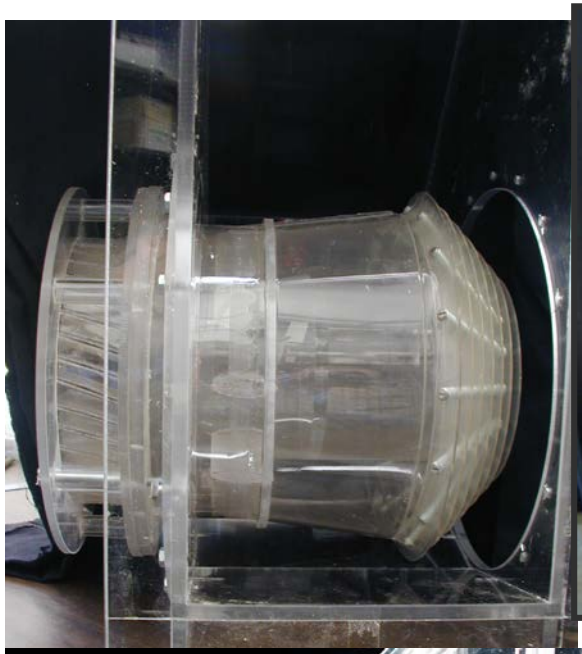
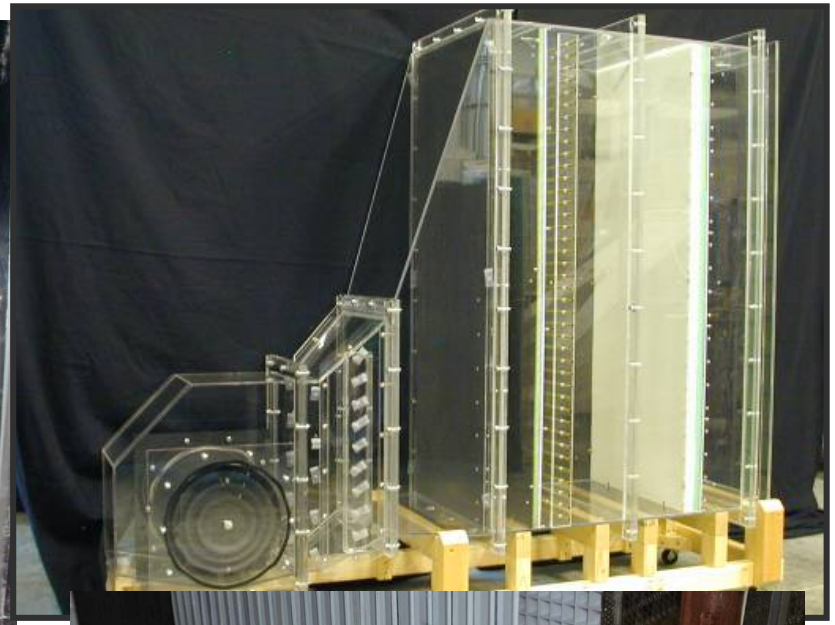
# SCALE COLD FLOW MODEL – VALIDATES DESIGN





Develops flow distribution devices and injection ports to;

a) Validates velocity, ammonia and temperature distributions through catalyst:

b) Used in conjunction for CFD Modeling

c) Incorporate all devices within flow field that affects flue gas and ammonia distribution

- Typical Boundaries: Turbine Diffuser or Process Equipment Exhaust Outlet through Stack Outlet.
- CFD and CFM results, validates ammonia injection design, ammonia mixing devices, tempering air distribution through injection ports, turning vanes, perforated plates and flow straightening devices.

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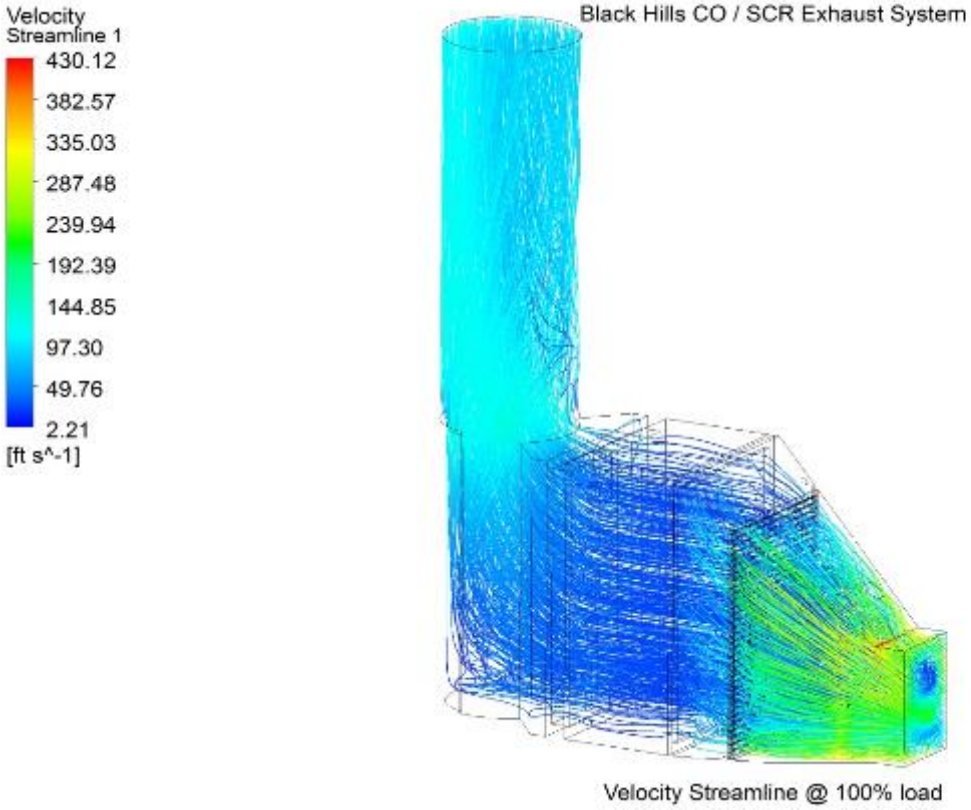
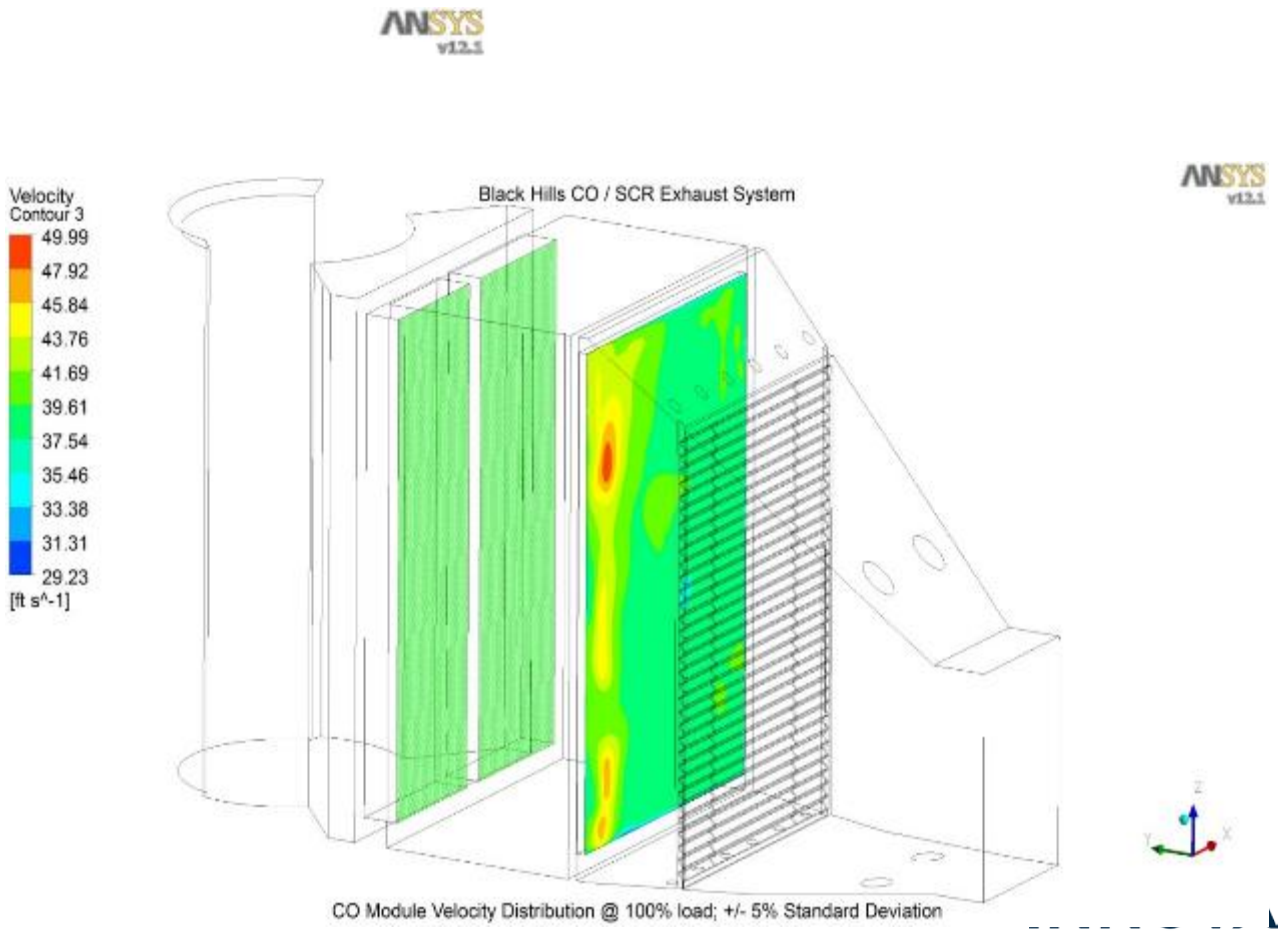
# FLOW MODELLING & DISTRIBUTION




Velocity Streamline @ 100% load




CO Module Velocity Distribution @ 100% load; +/- 5% Standard Deviation

GLOBAL

# FLOW MODELLING PARAMETERS DISTRIBUTION GRID

**SCR Catalyst**

- Flue Gas Velocity Maldistribution: 15% RMS
- Flue Gas Temperature Maldistribution: + / - 25 ‘F
- NH3 to NOx Molar Ratio Maldistribution: 10% RMS

**CO Catalyst**

- CO Distribution Required: 10% RMS
- Velocity Distribution Required: 15% RMS

Formed 409 SS Distribution grid with built in access door
Grid is one of the first modelling output deliverables
Establishes flow field for other downstream components

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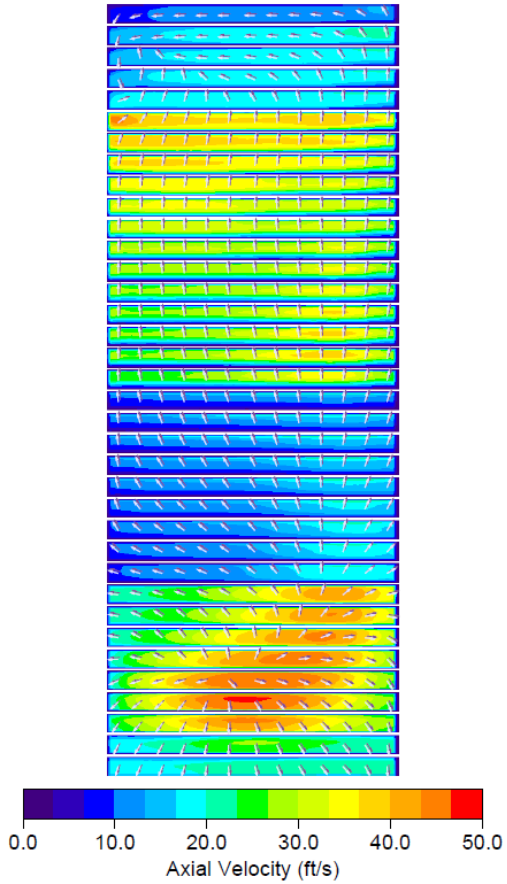
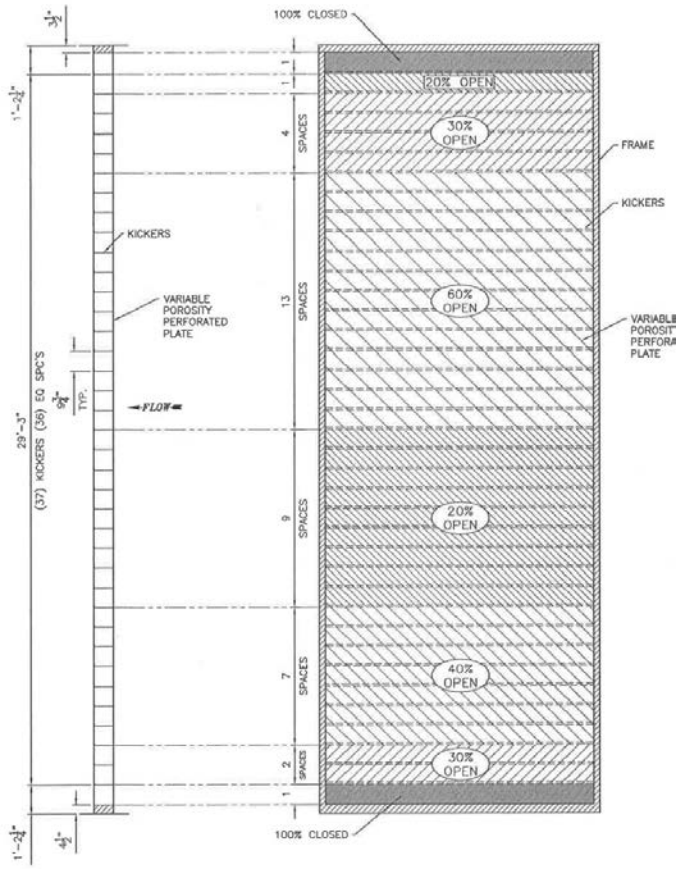
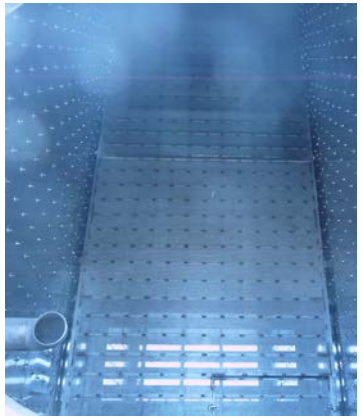
PERFORATED PLATE & AMMONIA INJECTION

# CFD MODELLING & PHYSICAL FLOW TESTING

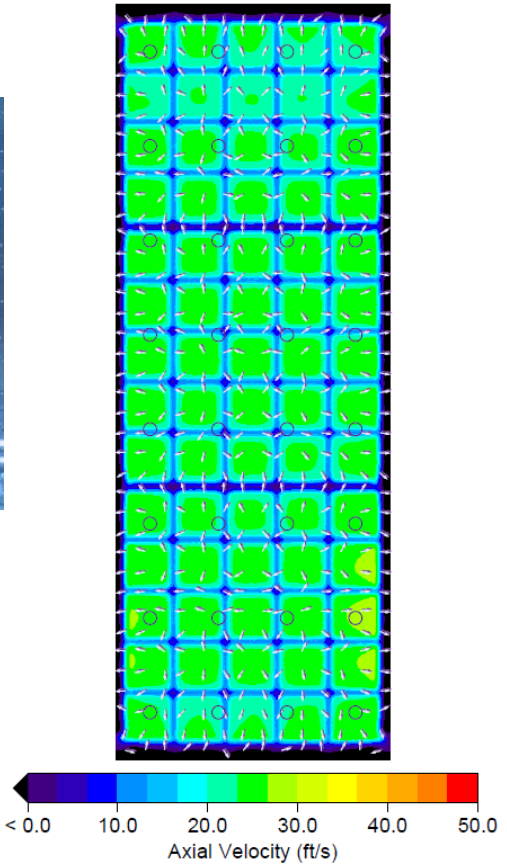
Distribution Grid Perforated Plates - Flow In To Page

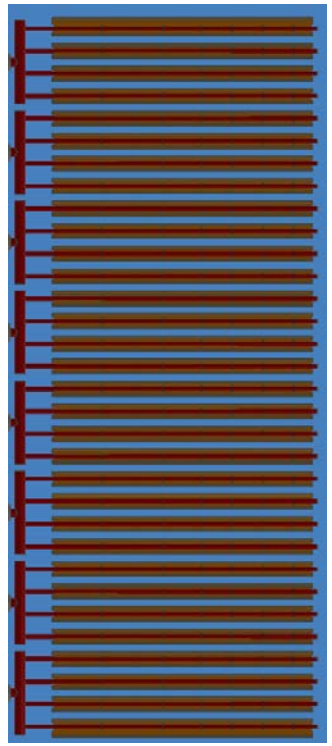


12" Upstream AIG - Flow In To Page



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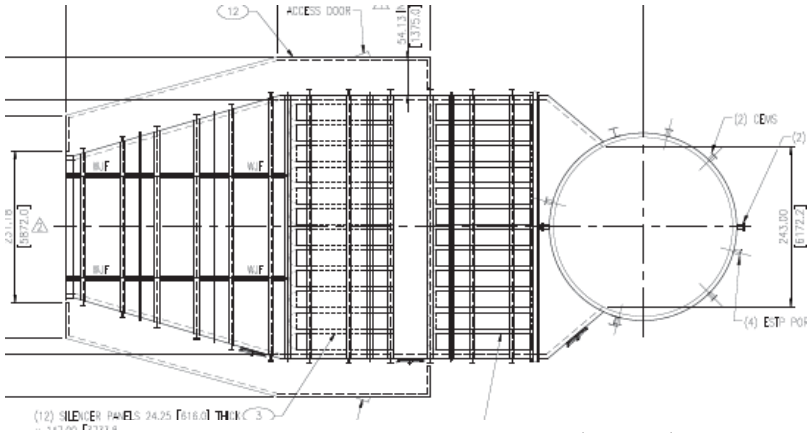
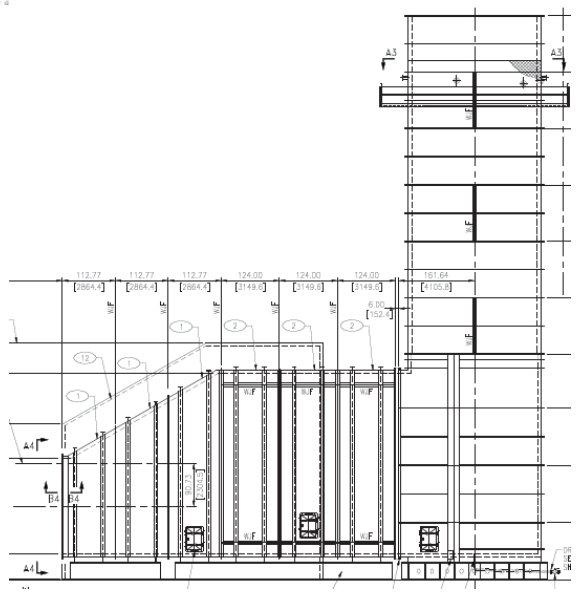
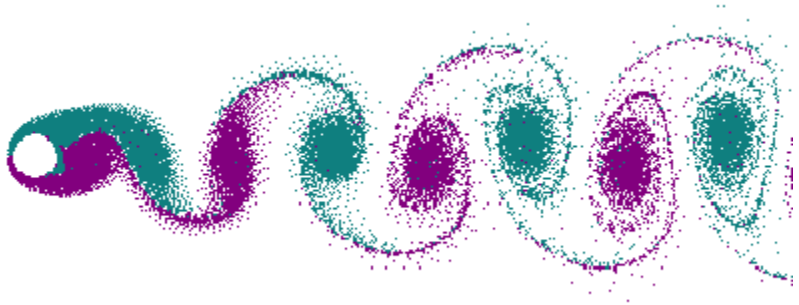
# HORIZONTAL SILENCING & STRAKES

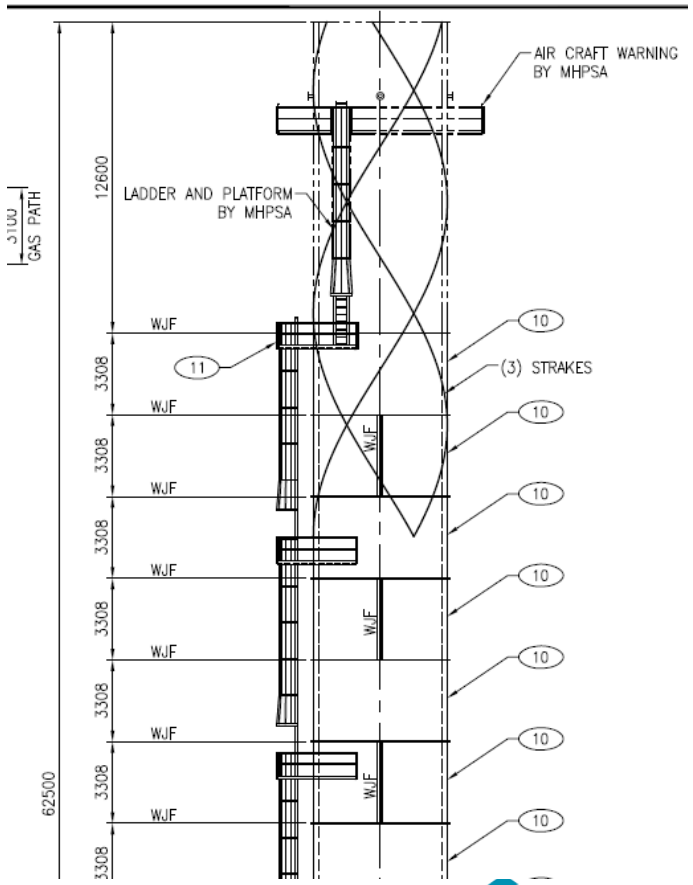




Strakes:

- Introduce turbulence
- Counteract the effects of vortex shedding

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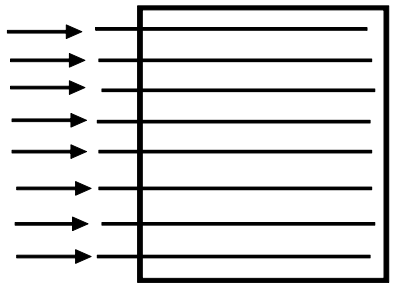
# NH3 Injection Grid Base Designs – AIG Tuning Impacts

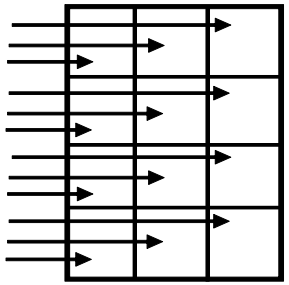
- **No Adjustments:** Some systems have no AIG adjustment valves – ***bad idea!***
  No flexibility to account for 1) duct velocity gradients, 2) duct NOx gradients, or 3) lance-to-lance ammonia flow gradients

- **1-D:** Most systems have one-dimensional adjustability

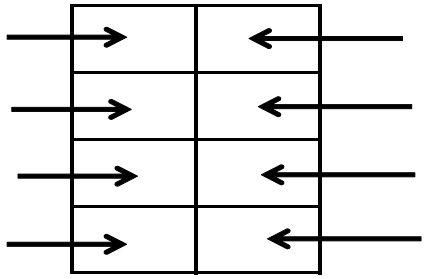


*Information courtesy of FERCo*

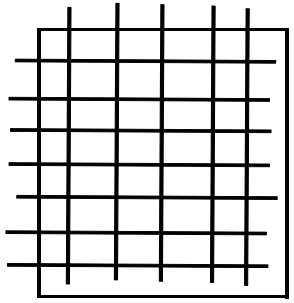
- **Multi-Zone**: Ideal design: multiple zone adjustability



3 Zones Horizontally



2 Zones Horizontally



Horizontal and Vertival Lances

***Multiple zone tuning capability allows for optimized performance with ability to favorably bias ammonia gas to minimize slip, extend catalyst life and reduce operating costs.***

***Two dimensional individual lance biasing while offering greater flexibility can be timely and complicate tuning process***

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# SCR REAGENT INJECTION SKID TYPES


Design and Build to Specifications - In house manufacturing
Multiple reagents applied across industry & location
Systems can use electric, hot flue gas or steam as heating medium

1. Aqueous 19% or 29% - generally used throughout industry
2. Anhydrous most cost effective, highest safety requirements
3. Urea 30 to 50% - most expensive, minimal safety requirements
4. Hot recirculated flue gas - lowest power consumption

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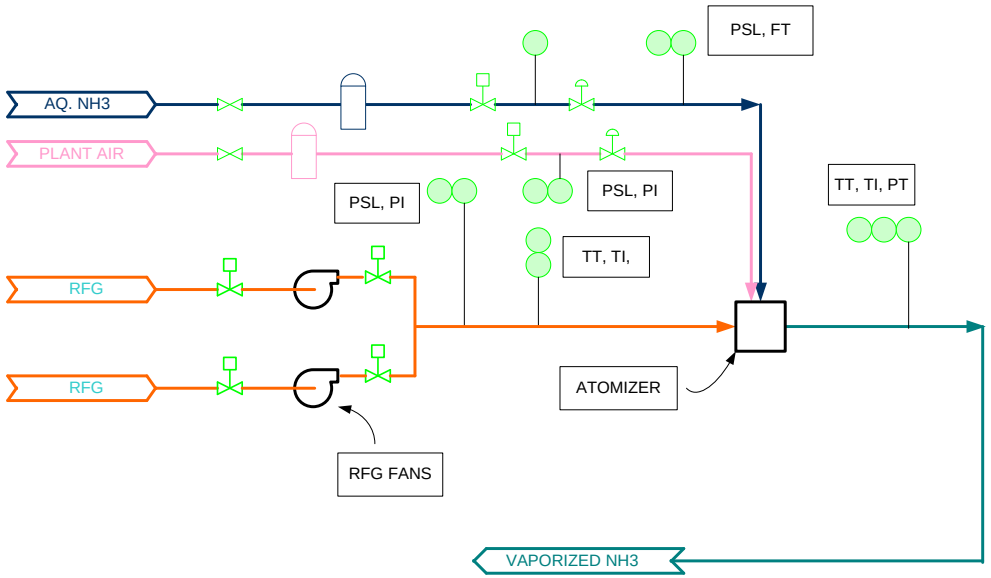
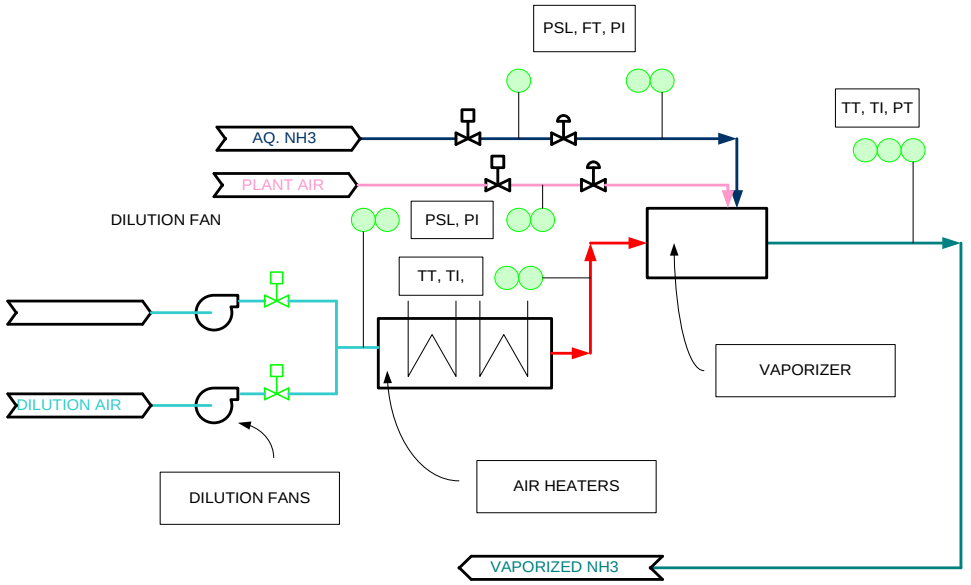
# SCHEMATICS – COMMON SCR REAGENT SKIDS

## Hot Flue Gas Vaporizing




## Hot Ambient Air Vaporizing




Ammonia vaporization/mixing skid components include:

- Vaporizer and electric or hot flue gas heating
- Piping, valves filters, drains, controls and skid
- Control logic - Programmable Logic Controller (PLC) or DCS.
- Safety considerations

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# AMMONIA VAPORIZATION SKID


**2 x 100% Electric Heaters**

**2 x 100% Blowers**

**Vaporizer**

**Ammonia Train**

Innova ammonia system in operation

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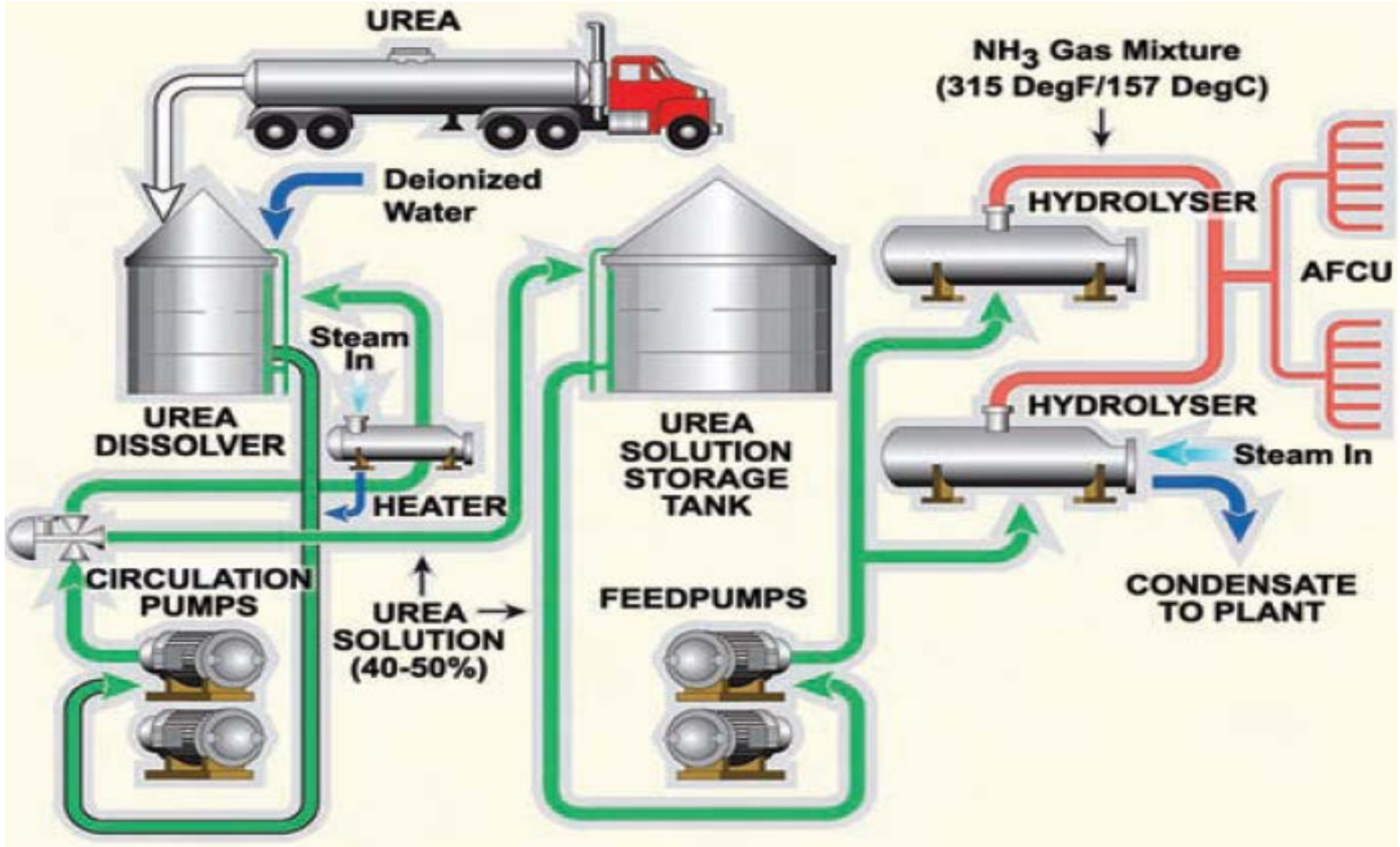
# Urea Conversion System – U2A
# Stable Storage – Mostly Costly Reagent System

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# LESSONS LEARNED - FLUE GAS SEALING SYSTEMS PARAMOUNT TO CATALYST LONG LIFE

Seal failed before at ~ 40K Hours not found till after warranty- Unit failed RATA and experienced excessive ammonia consumption.


Engineered seal using fabricated U channel stuffing box with receiver on catalyst module forms stuffing box that is packed with loose insulation. Seal system operating up to 14 years on original catalyst load without failure to achieve design limits.

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# COMPETITOR'S FAILED SCR CATALYST SYSTEM CAUSE-OVERHEATING & INSTALLATION ERRORS

- Catalyst failure resulting from overheating of the catalyst – thermal sintering
- Insufficient tempering air fan sizing determined to be cause of failure
- Catalyst seal failures occurred as a result of thermal sintering-catalyst block shrinkage
- Thermal sintering resulting in separation of active catalytic material from ceramic substrate
- Unit failed to achieve NOx reduction performance and system was abandoned in place

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# Failed Rival Integrator's Ammonia Injection Grid System Designed Without Balancing Valves

- NO BALANCING VALVES, SCAFFOLD ACCESS ONLY, NO AIG ADJUSTMENT
- FAILED PERFORMANCE, REQUIRED AN ORIFICE TO BE INSTALLED AT EACH DRILLING +1700
- PROJECT CORRECTION TOOK SEVERAL YEARS TO REMEDY BY OUTSIDE CONSULTING AND COST WELL BEYOND ALLOCATED BUDGET

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# GOOD AND BAD LINER SYSTEMS

**RIGHT - Solid Liner Plate System**
**Welded Stud Anchoring**

**WRONG - Expanded Metal Liner**
**Wire Welded Retainers**

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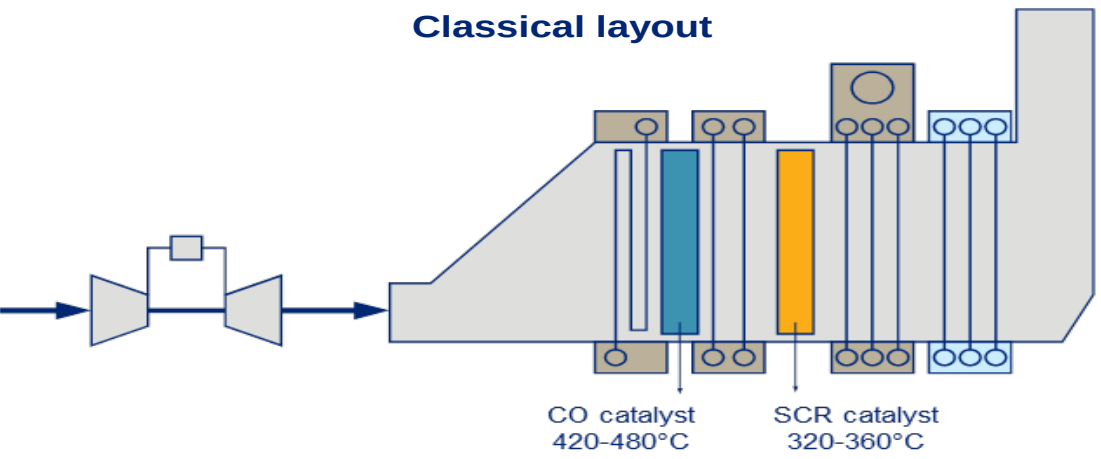
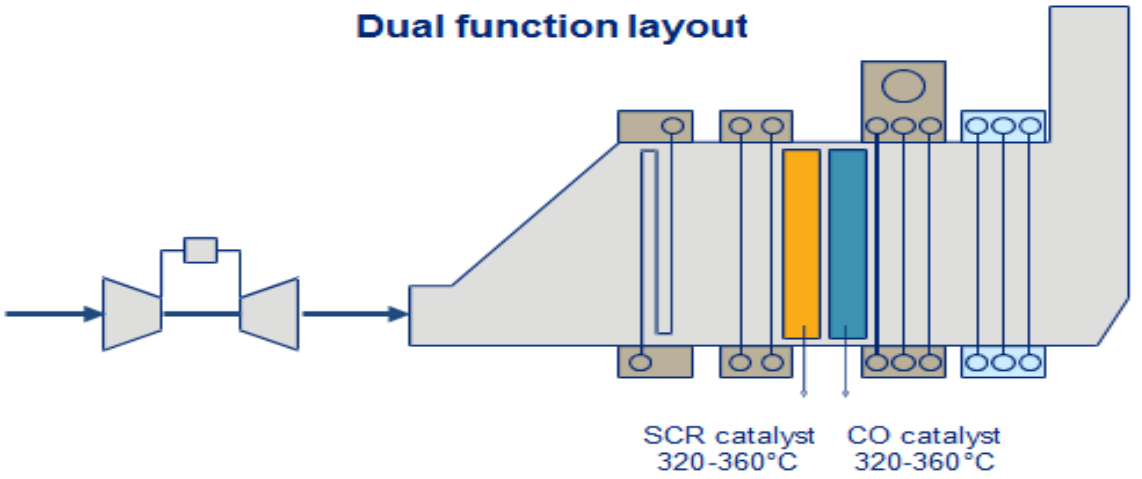
# Innovations - Comparison – Location of the CO Catalyst




| Classical Layout | Dual Function Layout |
|---|---|
| Lower CO-catalyst volumes | Lower specific pressure drop |
| Higher HC oxidation | Lower $SO_2$ oxidation |
| Can't be exposed to $NH_3$ | Not impacted by $SO_2$ |
| Very high $SO_2$ oxidation | Easier installation |
| CO catalyst impacted by $SO_2$ | Liquid ammonia injection |

*Information courtesy of Umicore*

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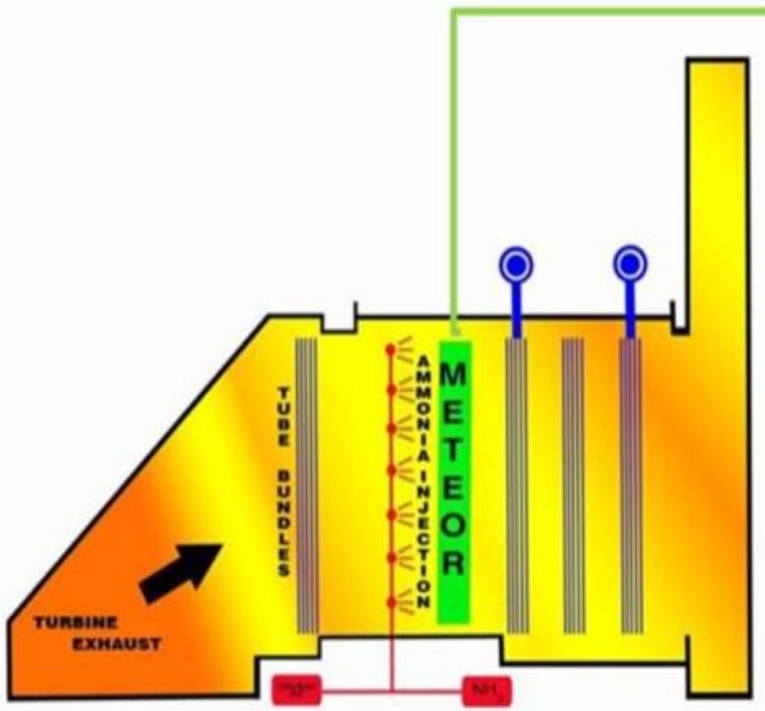
# Single Zone Catalyst Reactor for Combined or Simple Cycle

→ AIG → METEOR™

CORMETECH METEOR™




**Oxidizing Function:**

CO oxidation to $CO_2$

VOC oxidation to $CO_2$ and $H_2O$

**Reduction Function:**

$4NO + 4NH_3 + O_2 \rightarrow 4N_2 + 6H_2O$

$2NO + 2NO_2 + 4NH_3 \rightarrow 4N_2 + 6H_2O$

$6NO_2 + 8NH_3 \rightarrow 7N_2 + 12H_2O$

- Homogeneously extruded honeycomb catalyst (1 layer)
- **SCR** functionality
  → $V_2O_5$-$WO_3/TiO_2$
- **Oxidation** functionality
  → PGM (Pd and/or Pt)

- **Simplicity of** *one catalyst layer vs. two*
  - Smaller footprint in HRSG
  - Lower pressure drop
  - Lower capital and O&M costs
- **Flexibility**
  - applicable to new units, retrofits, and replacements
- **Lower $SO_2$ oxidation rate**
  - Potential for reduced backend fouling
- **Highly resistant to sulfur,** compounds in the flue gas
  - Broader load flexibility from reduced sensitivity to sulfur fouling agents when operating at low temperature
- **Lower Pressure Drop**
  - improved power output
  - reduced fuel costs

***Information courtesy of Cormetech***

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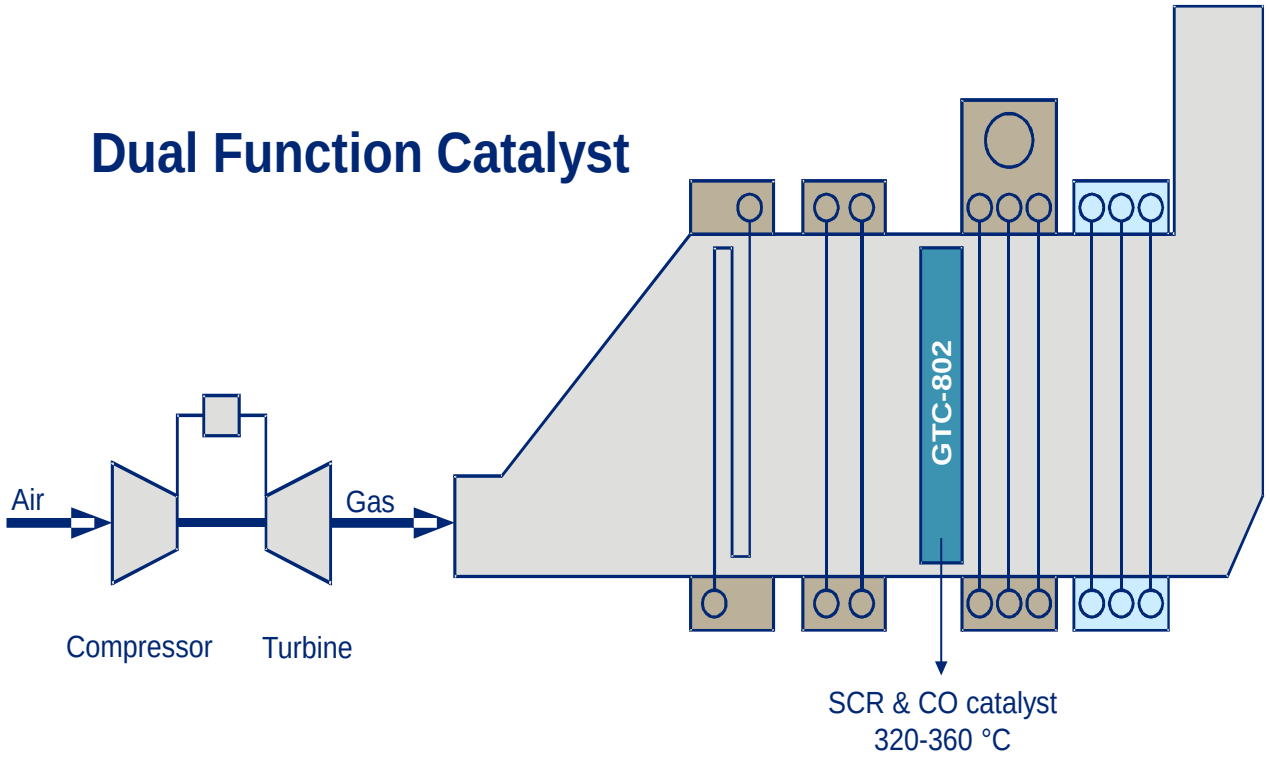
# Performance Advantages
# Dual Function Catalyst In HRSG

## Optimized

**Dual Function Arrangement**

- Lowest specific system pressure drop
- Lowest $SO_2$ oxidation
- Lowest NO oxidation
- Easiest installation
- Lower $NH_3$ slip
- Can utilize frameless module design
- Liquid ammonia injection




***Information courtesy of Umicore Catalyst***

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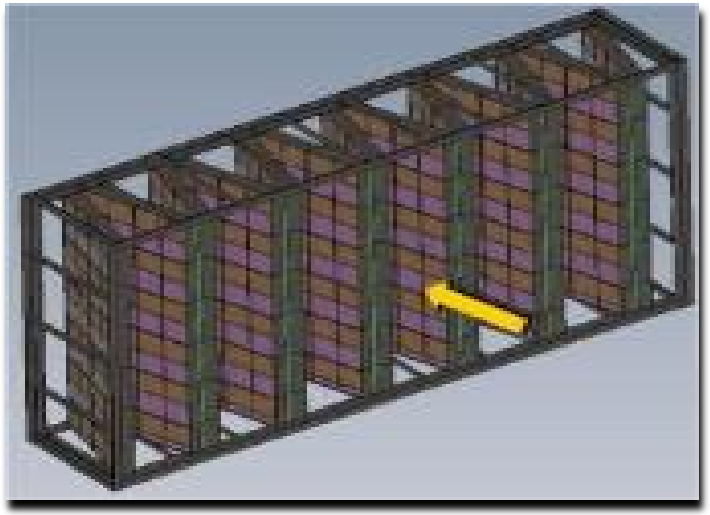
# Example of Advanced Catalyst Configuration, Geometry, Performance

CORMETECH ELITE™ Platform

**Combines three new tools**

**Pleated Module**



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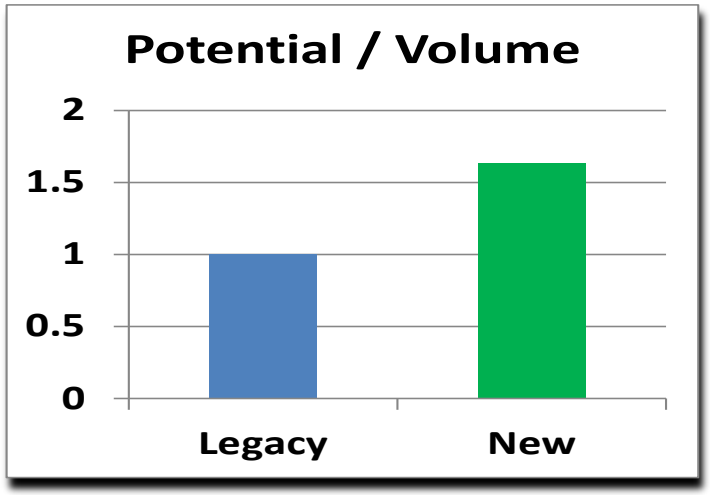
**Advanced Catalyst Potential**
**60% Higher**




Patent Pending

+

**Integrated Seal**

## Result:

- **Step-change** reduction in pressure drop: **60–75% Lower!**
- **Vastly improved** emission control solution capability for NOx, CO, $NH_3$ slip
- **Innovative** seal to prevent need for maintenance

***Information courtesy of Cormetech***

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# NRG Marsh Landing, MID  McClure, SMUD McClellan FERC Reference Plants – Frame Peaking Turbines

- **Advanced Technology Designed SCR Systems – All California Based**
- MLGS Largest simple cycle peaking plant in US – Antioch CA
- McClellan first successful high temperature catalyst system without tempering Air – Modesto CA
- McClure first plant to operate with dual fuel capability natural gas and ULSD – Sacramento CA
- All gas turbines are FERC reference plants validating SCR for frame class peaking gas turbines

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# TYPICAL NEW AND RETROFIT

## INNOVA CATALYST SYSTEMS FOR GAS TURBINES

Standard with Tempering Air

Basin Electric – LM6000 PC

Scope: Design, Fabrication

Operating Conditions –100% load
NOx Emissions – 25ppm/25ppm
CO Emissions – 125 ppm/Design - 76 ppm

Stack emission requirements
NOx Emissions – 2.5 ppm/2.5ppm
CO Emissions – 4 ppm/Design - 4ppm
NH3 Slip – 5 ppm/Design 5ppm

Standard Non Tempered Air

Point Comfort Texas
LM6000

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# OUR EXPERIENCE

- More than a 1,000 gas turbine air and flue gas handling systems operating around the globe.
- Over 240 SCR systems in power and refinery, oil & gas and petrochemical industries.
- Engineering experience on all types of SCR systems for turbines and process operations.
- Specialty work in retrofit projects including catalyst replacement, SCR system upgrades for tempering air, ammonia vaporization, ammonia injection grids.
- Highly experienced in specialty manufacturing for refinery and process industries subject to severe environmental conditions in remote locations.
- Multiple product divisions involved in air and sound pollution control systems for a variety of gas and oil based combustion systems related to refining, oilfield and power application.

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# INNOVA GLOBAL PARTNERSHIP

INNOVA GLOBAL exists to help Industrial companies be compliant with local environmental standards and improve operations –by being cleaner, quieter and more efficient.

➢INNOVA GLOBAL is an established SCR designer providing advanced emission controls for gas and oil fired systems, the technology is time tested ensuring reliable, continuous operation.

➢INNOVA GLOBAL supplies SCRs, Gas/Fluid Process Systems, HRSGs and Acoustical control systems in power, petrochemical and refining throughout the world. Our products have stood the test of time for more than 40 years.

➢INNOVA GLOBAL is a team consisting of highly experienced professionals in their respective fields, utilizing the most sophisticated technologies for the development, design, manufacture and supply of equipment; providing in-depth studies, field services or complete turnkey supply and installation of our products.

➢INNOVA GLOBAL is a team player working together with customers to achieve our collective goals, going above and beyond client expectations.

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# INNOVATION