REINHOLD ENVIRONMENTAL ®

2023 Reinhold/PCUG Round Table Presentation

Cohosted by Duke Energy and Vistra in The Westin Hotel, Cincinnati, OH on June 26-27, 2023

Considerations for New HRSG SCRs

ONE SOURCE. MANY SOLUTIONS.

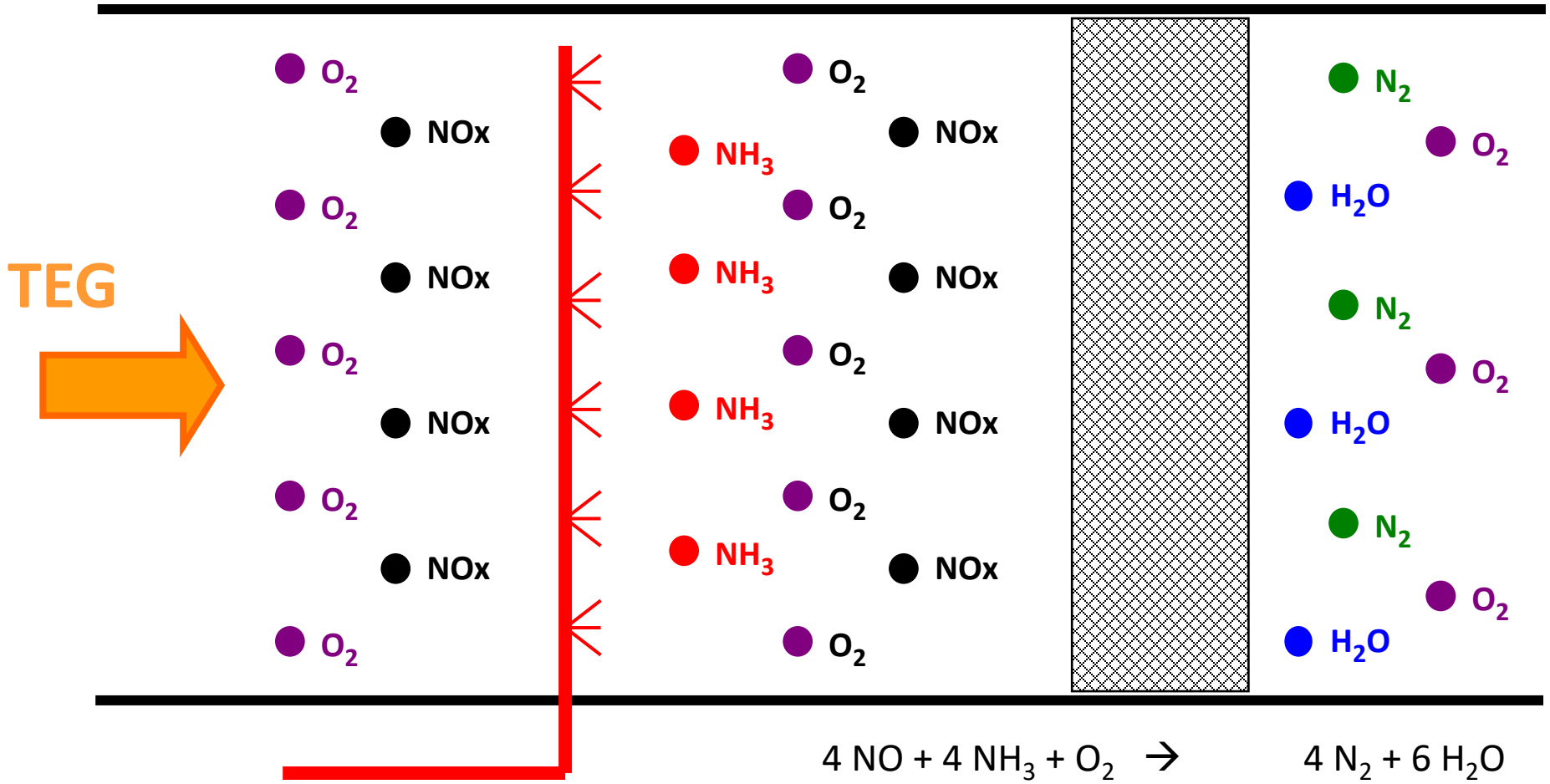
Babcock Power SERVICES
Babcock Power ENVIRONMENTAL
TEi
Riley Power
GSI
Boiler Tube Company of America
TEiC | CONSTRUCTION SERVICES
TEiC | HEAT EXCHANGER SERVICES
Struthers Wells
a TEi line of products

Michael Allen – 30th Reinhold Round Table & Expo

Areas of Discussion

- The Basics
- Retrofit Considerations
- New Unit Considerations
- Multi Pollutant Catalysts
- Simple Cycle SCRs
- HRSG Types
- Summary

The Basics – SCR Reaction Mechanism



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

$NO + NO_2 + 2\ NH_3 \rightarrow 2\ N_2 + 3\ H_2O$

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

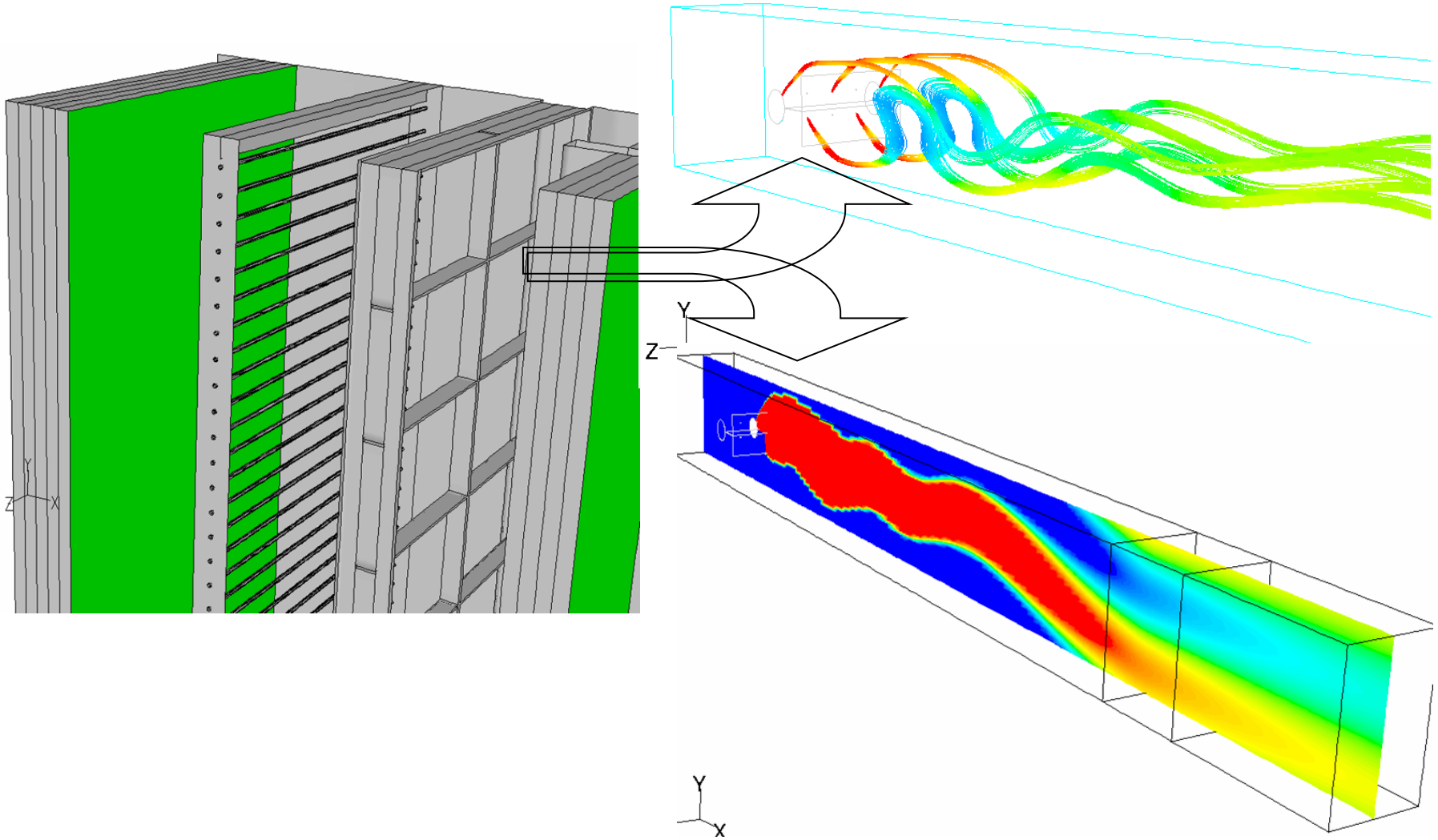
The Basics – Ammonia Flow Control Unit (AFCU)

- AFCU skid vaporizes ammonia using either recirculated flue gas or an electric heater unit
- Recirculated flue gas extracts warm flue gas from a location upstream of the SCR catalyst via a blower
- Electric heater units heat outside air to a specific temperature
- Fans transport air/gas to the aqueous NH3 vaporizer.

The Basics – CFD Modeling

CFD modeling will:

- Verify the gas distribution
- Check the AIG location
- Optimize the grid design
- Verify the target ammonia distribution



The Basics – NOx Levels

Typical Gas Turbine NOx Emissions:

- Natural Gas: 25 - 40 ppmvdc
- Diesel: 40-60 ppmvdc

Typical Stack Emissions:

- New Plants: 2.0 ppmvdc
- Existing Plants: 5-15 ppmvdc

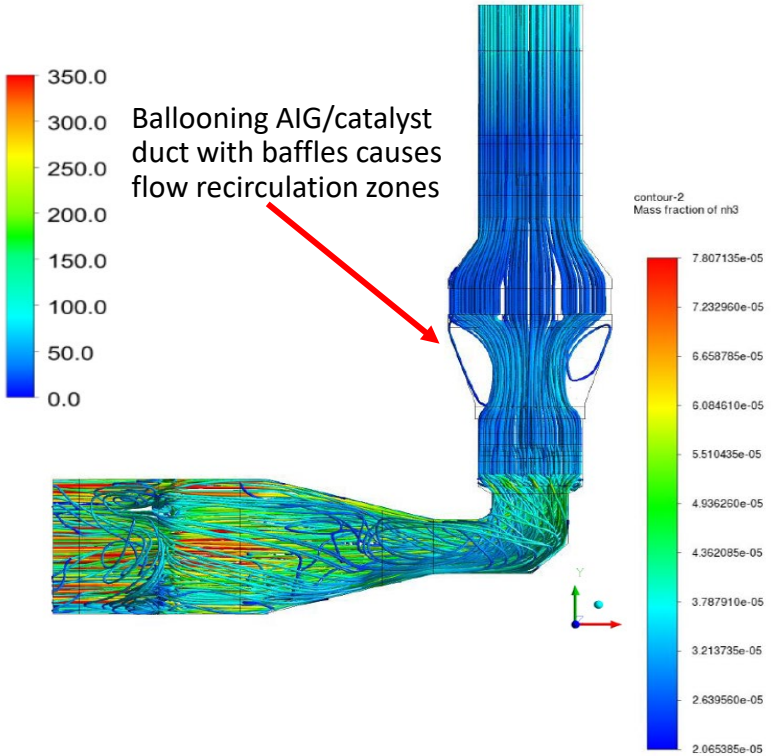
Typical Reduction Levels: 90-95%

Typical Design Life: 40,000 hours or 5 years

Typical Type: 19% Aqueous

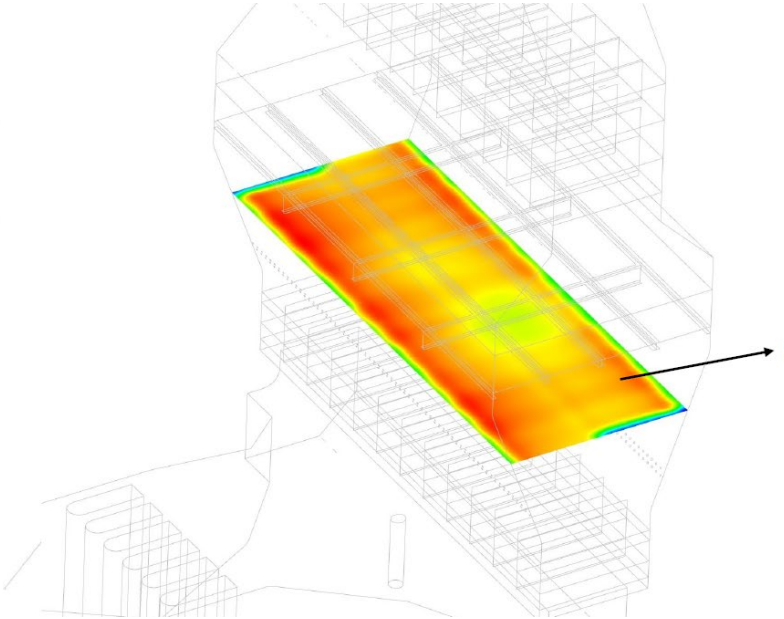
Retrofit Considerations - Space

Retrofit Considerations - Mixing

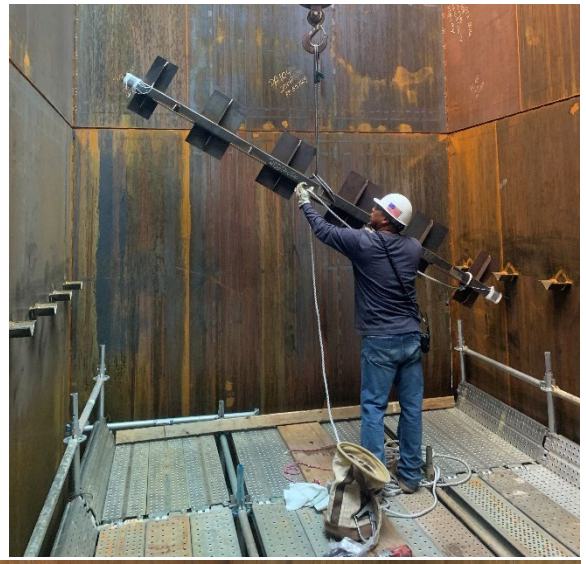


BEFORE MIXING DESIGN

AFTER MIXING DESIGN



INSTALLING



INSTALLED

Other Retrofit Considerations

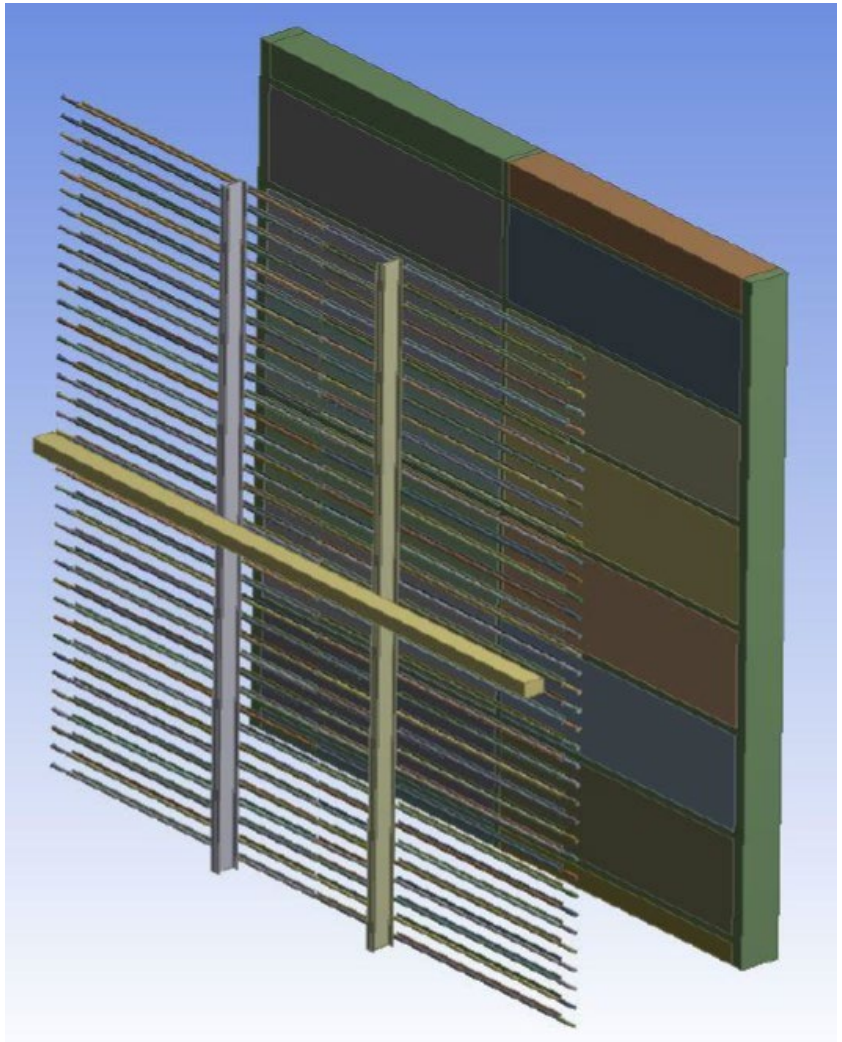
Things to consider when adding an SCR to an existing unit:

- Structural Supports
- Catalyst Temperature
- Operating Load Range
- Tuning/Balancing
- Replacement Access
- Design Life
- Catalyst Type
- Future Upgrades

New Unit Considerations – High Efficiency Designs

Vogt has supplied multiple new HRSGs capable of 95% NOx reduction (40 ppmvdc to 2 ppmvdc). This is accomplished with:

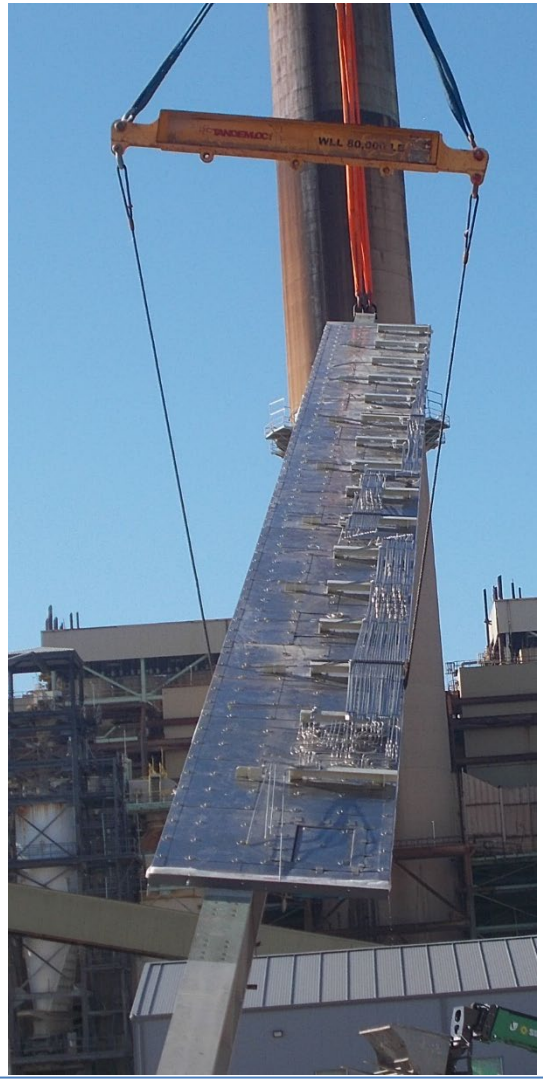
- AIG lances entering from both sides of the unit to improve ammonia distribution.
- Effective ammonia heating and vaporization to minimize heat transfer across the lances.
- Sufficient duct length between the AIG and the SCR to allow for mixing across the load range.
- Detailed CFD to optimize hole location and maximize ammonia distribution.
- Pillows and baffles installed around the SCR frame to reduce bypass around SCR catalyst.



New Unit Considerations – Ammonia Test Grids

An ammonia test grid:

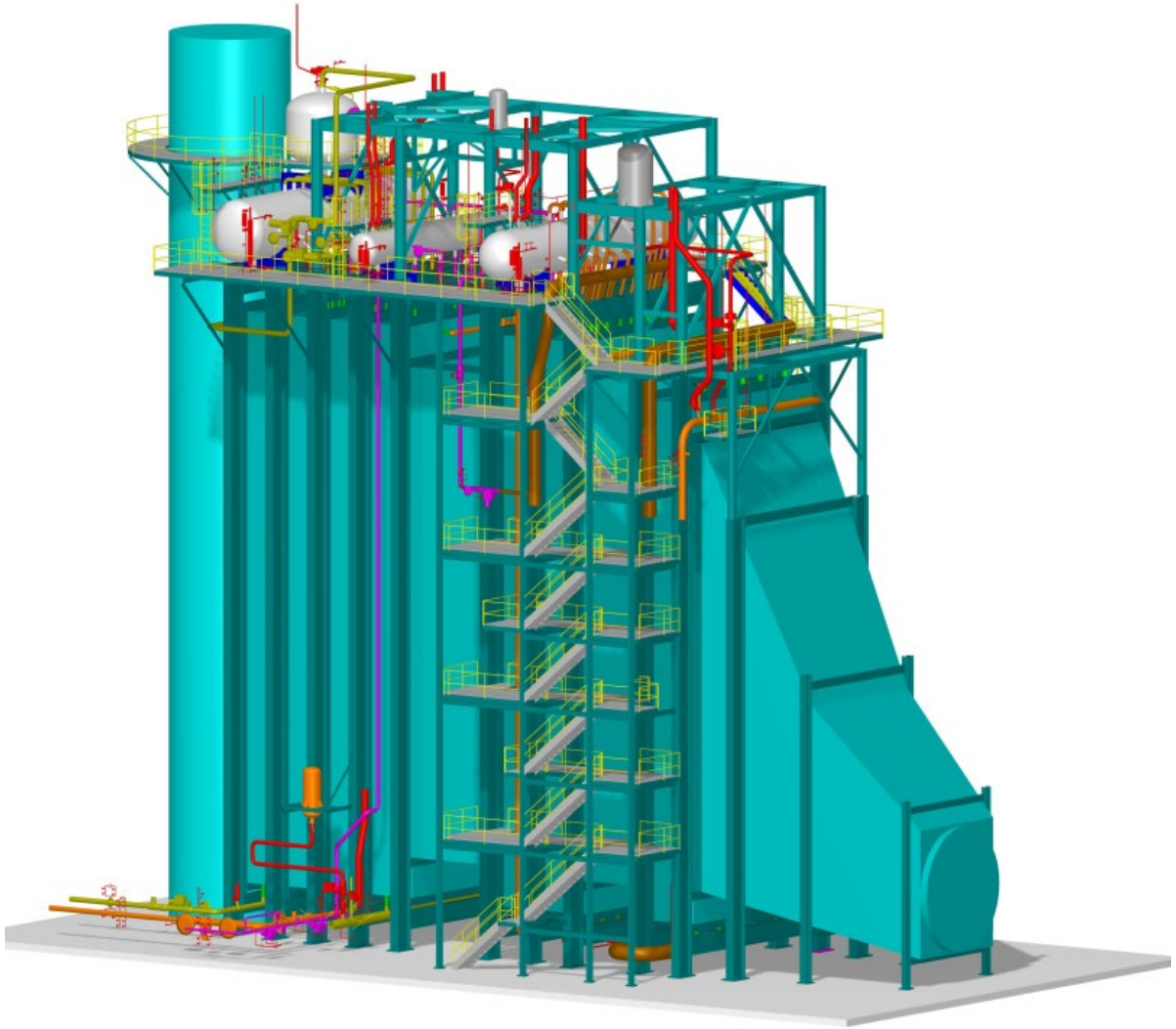
- Is installed on the downstream side of the SCR catalyst.
- Measures outlet NOx and allows for better tuning of AIG.
- Can be shop installed on duct sidewalls
- Can include shop installed on trays to be bolted on SCR frame.
- Only field work required is fit up between sidewall and trays.
- A majority of new units are installed without an ammonia test grid.



Other New Unit Considerations

Things to consider when designing the SCR for a new HRSG:

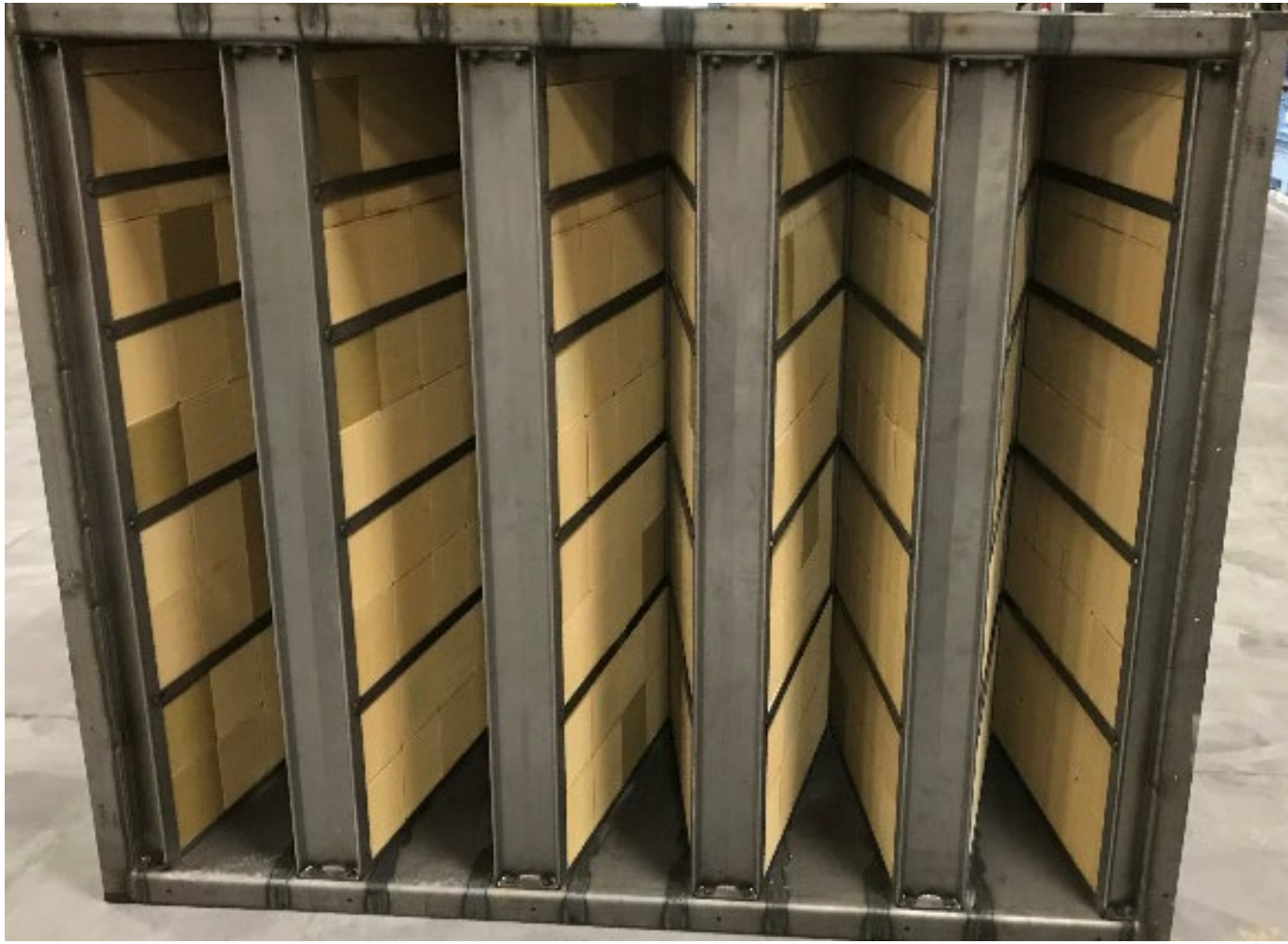
- Fuel Type and Corresponding Emissions
- Space for Added Capacity
- Catalyst Temperature
- Operating Load Range
- Tuning/Balancing
- Replacement Access
- Design Life
- Future Upgrades



Multi Pollutant Catalysts

Multi Pollutant Catalysts, also known as Dual Catalysts have:

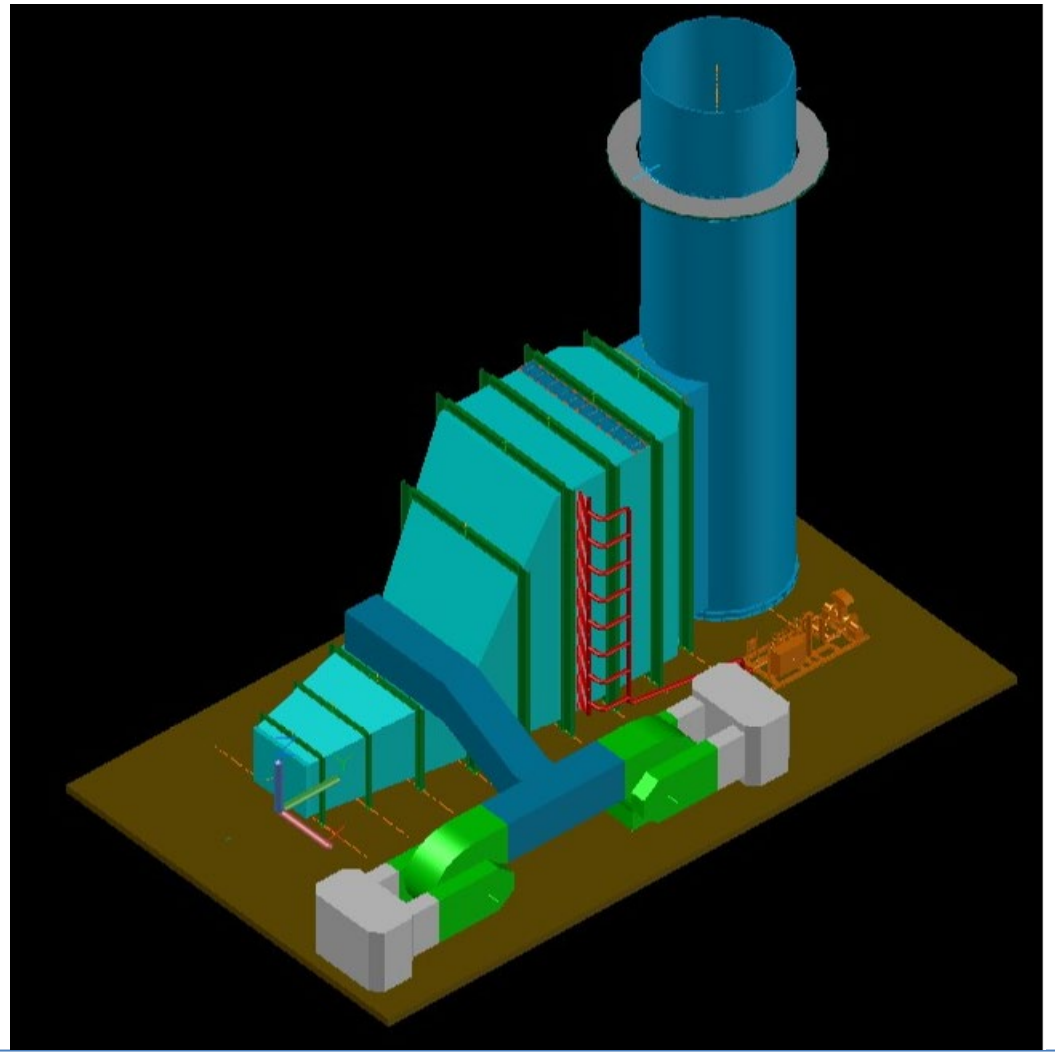
- A single substrate that can reduce both NOx and CO.
- Better resistance to sulfur poisoning at low temperatures compared to traditional CO catalysts.
- Lower space, complexity and backpressure requirements compared to a CO + SCR solution.
- A short (but quickly growing) experience list.



Simple Cycle SCRs

There is increasing interest in providing emissions compliance for peakers and other simple cycle gas turbine installations. This is accomplished with Simple Cycle SCRs, also known as Hot SCRs. These systems:

- Reduce the turbine exhaust temperature with tempering air fans to a range where typical SCRs can safely operate.
- Inject ammonia and reduce NOx like a typical HRSG, but in a more compact area.
- Can deliver emission compliant operation in situations where intermittent operation and large load swings are needed.



HRSG Design Types

SI – Shop Installed

FI – Field Installed

- The supply schedule for new HRSGs depends on their design type.
- Logistics are a major consideration in the preferred design type.
- If needed, the design and sales phase can be completed in a matter of weeks.

	MAIN STEEL	CASING	GAS BAFFLES	INTERNAL PIPING	PIPE SEALS	Lifting Lugs	Handling Lugs	Approx. Hydro / Mths	Approx.Dir. Mhrs (scale)
V-One	SI	SI	SI	SI	SI	SI	SI	4 / 6	1
V-Max	SI	SI	SI	SI	SI	SI	SI	10 / 11	5
V-Flex	FI	SI	SI	SI	SI	SI	SI	11 / 12	6
V-Lite	FI	FI	FI	FI	FI	Fixture Required (3 cranes?)	Fixture Required	12 / 13	7
LOOSE HARP	FI	FI	FI	FI	FI	Fixture Required	Fixture Required	13 / 14	9

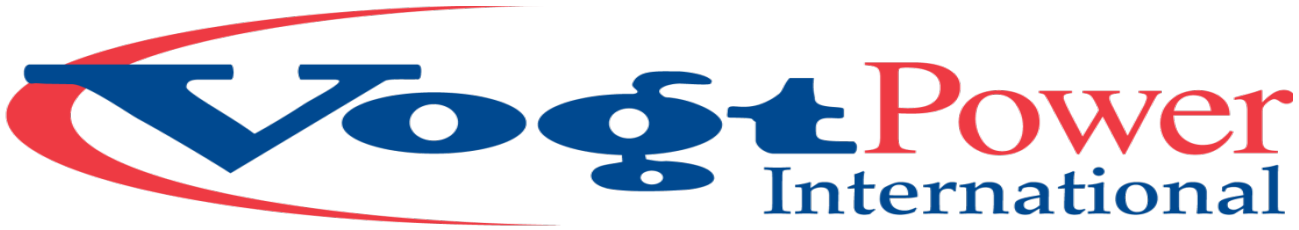
- V-One Estimate - Basis - 1 wide x 3 deep x 2 pressure level

- All other Estimates - Basis - 2 wide x 5 deep x 3 pressure level

(Durations and man hour estimates are typical examples)

Summary

- The SCR market for HRSGs is well established with many proven solutions for typical applications.
- Considering a few key areas of the design early in the project can greatly increase the likelihood of a successful outcome.
- Newer applications such as Multi Pollutant Catalysts and Simple Cycle SCRs provide more flexibility to the industry.
- Vogt and the other companies in the Babcock Power family have the broad experience to help you navigate this changing regulatory environment. Our goal is complete customer satisfaction through teamwork and understanding.



Thank you for your time!