

REINHOLD ENVIRONMENTAL[®]



2024 Reinhold/PCUG Round Table Presentation

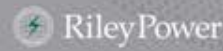
Hosted by LG&E/KU and Co-hosted by Southern Co. and TVA
in The Marriott Resort Lexington Griffin Gate Hotel, Lexington,
KY on June 24-25, 2024

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Technical Considerations for Simple Cycle Hot SCRs

Michael Allen - 2024 Reinhold Roundtable



BabcockPower

ONE SOURCE. MANY SOLUTIONS.

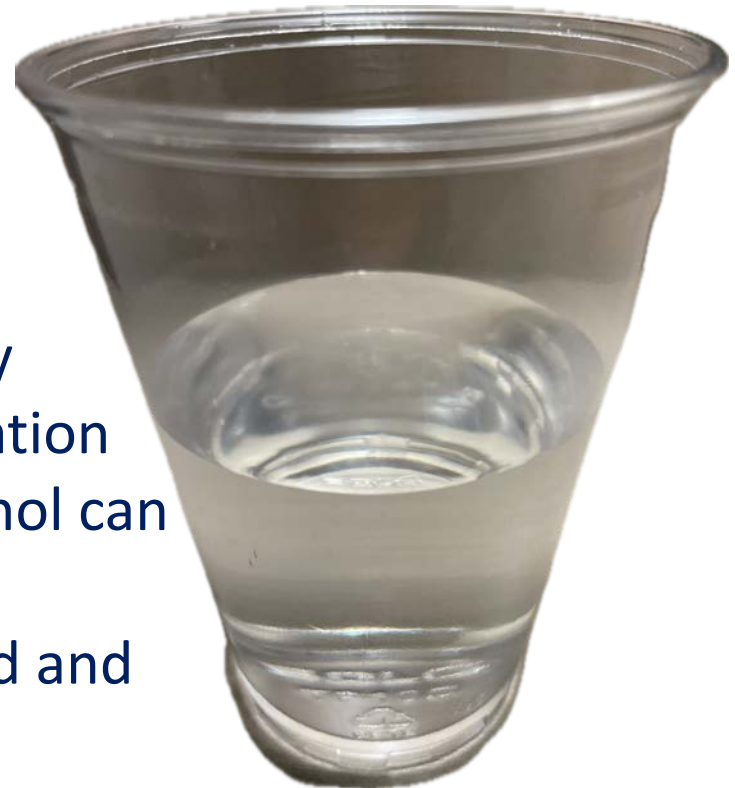
Areas of Discussion

- Safety Moment – Hydration
- The Problem – Why Hot SCRs Are Needed
- The Solution – How Hot SCRs Work
- The Capabilities – Key Hot SCR Technical Details
- The Considerations – Hot SCR Design Decisions
- Summary & Question Time – My Email: mallen@vogtpower.com



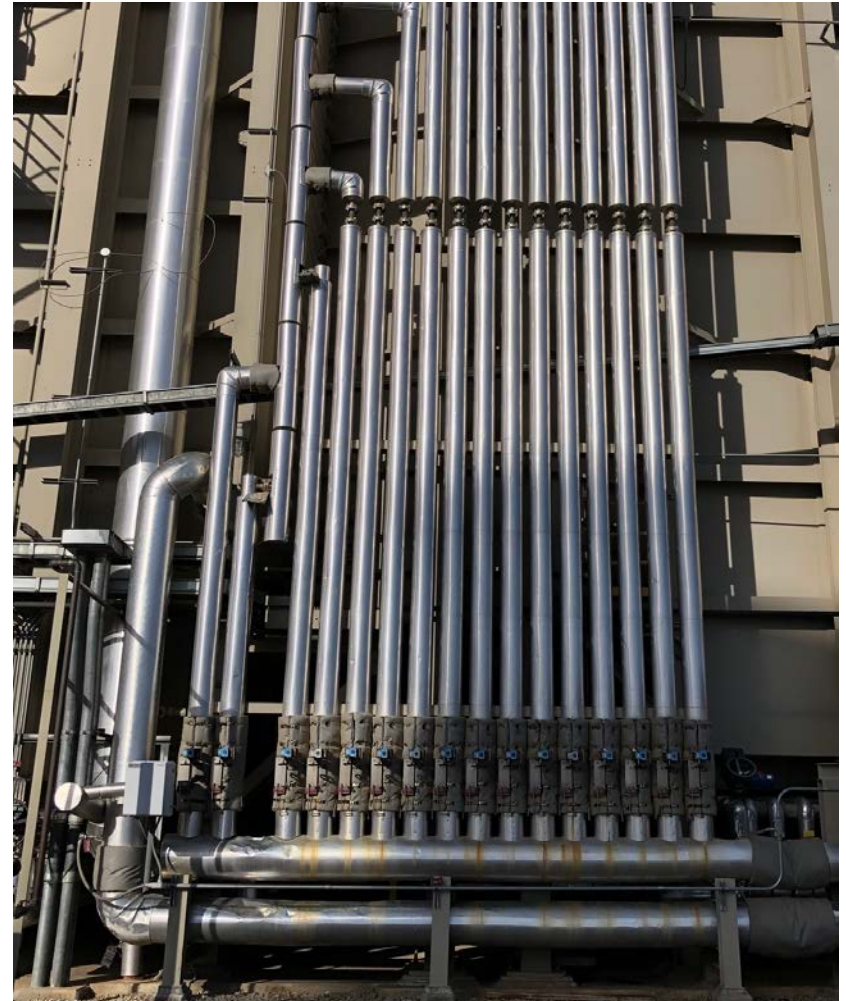
Safety Moment - Hydration

- Average water content by age:
 - Newborns: 70%
 - Men age 51+: 56%
 - Women age 51+: 47%
- 75% of Americans are dehydrated, Conferences take us out of our daily routines, which can lead to dehydration
- Energy drinks, soft drinks, and alcohol can increase dehydration
- Proper hydration can improve mood and mental focus
- If you feel thirsty, you are probably already dehydrated



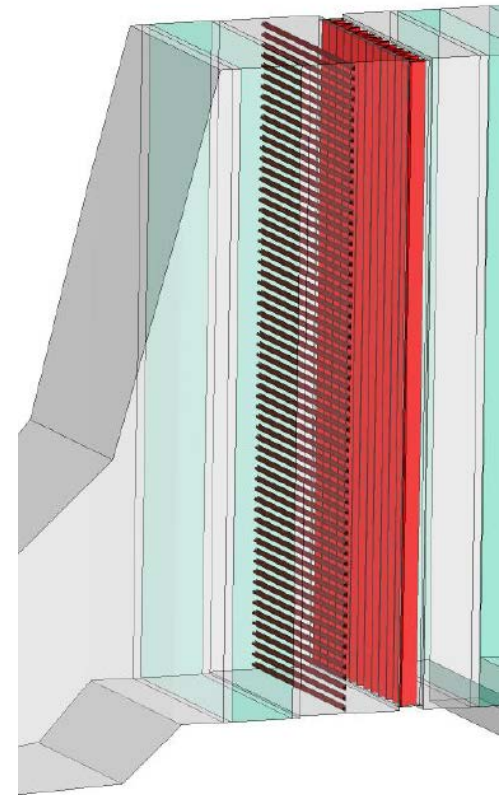
The Problem – Grid Level

- Power generation is increasingly intermittent
- Time to grid is essential
- Steam turbine heat soak takes a long time
- Rapid load changes can be difficult for steam systems
- NOx and CO regulations are increasingly stringent



The Problem – System Level

- Gas turbine exhaust gas is HOT
- SCR catalysts can sinter permanently when overheated
- High temperature catalysts are expensive
- Ammonia oxidizes to NO_x at high temps
- Good distribution of exhaust gas velocity, temperature, and ammonia is essential
- Distribution can change with gas turbine load and ambient temperature
- Big fans are expensive and energy intensive
- Silencer designs must account for higher gas velocities than are typical for HRSGs



The Other Solution – Aeroderivatives

- Some gas turbines produce exhaust temperatures below 1,000°F
- At these temperatures tempering air is not required
- Removing tempering air reduces complexity
- However, these aeroderivative gas turbines are much smaller
- Multiple aero gas turbines are required to equal the output of an F or H class gas turbine



The Solution – Concept

- Smooth: Address gas turbine swirl to provide the target flow distribution
- Cool: Inject tempering air to reduce the gas mix temperature to levels acceptable to the SCR catalyst
- Reduce: Inject ammonia and reduce the NO_x levels to the target values in the SCR, then use silencer baffles to reduce the noise to acceptable levels



The Solution – VPI Design

- Distribution grid
- Tempering air system
- Mixing and expansion
- CO catalyst
- Ammonia injection grid
- SCR catalyst
- Silencer



The Capabilities – Key Technical Details

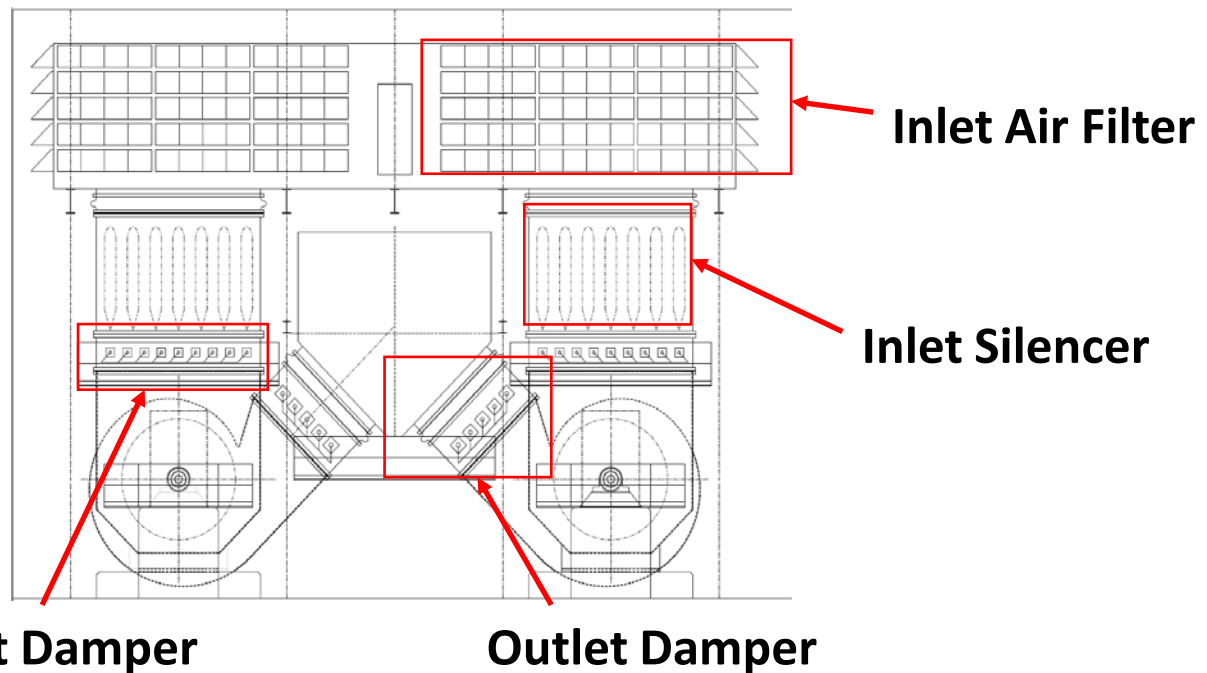
These are typical values for the current applications:

- Up to 95% NO_x reduction with ≤ 2 ppm ammonia slip
- < 5 minutes startup time
- 8 – 12 inwc gas turbine backpressure
- > 36 month catalyst life
- 25 year design life



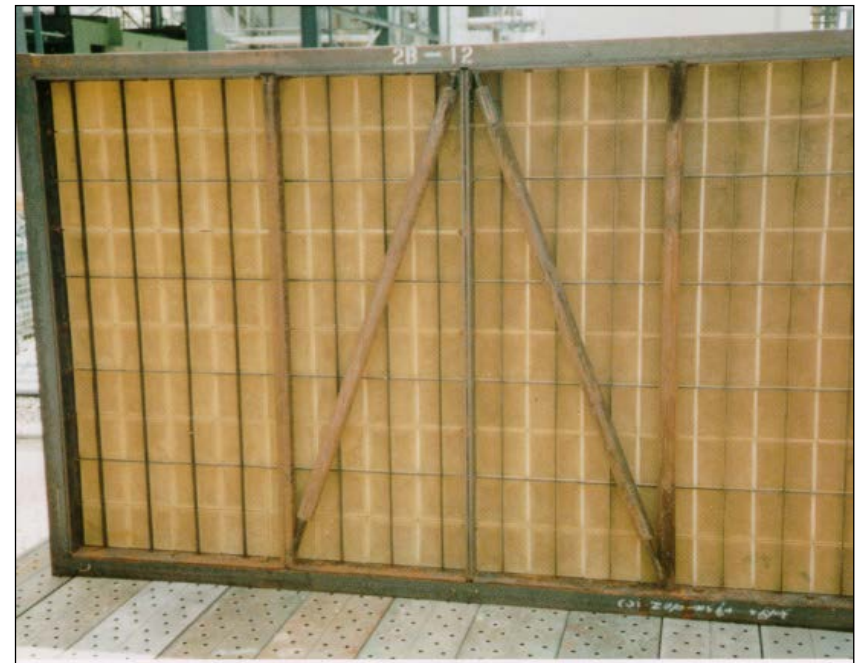
The Considerations – Fans

- Redundancy (2x100%, 2x50%, Spare Parts)
- Operating Range (Current conditions, future upgrades, turndown capabilities)
- Ambient temperature range
- Isolation
- Filtration



The Considerations – Catalyst Systems

- Multipollutant vs Separate CO and SCR
- Additional capacity
- Design life
- Design temperature
- Ammonia injection grid design
- Tuning provisions



The Considerations – Execution

- Documentation
- Project Schedule
- Catalyst monitoring and replacement schedule
- Future upgrades or retrofits

Conclusion

- Hot SCR deployment is expected to increase significantly over the next few years
- Effective coordination of multiple systems is required to achieve the desired results
- Awareness of the major tradeoffs associated with Hot SCR design can help reduce design time and cost



Questions?

Thank you!