# South Orange County Wastewater Authority

## Successes, Opportunities, & Lessons Learned: Digested Gas ICE Cogeneration System

- Introduction to SOCWA
- Project Background
- Planning & Design
- Construction
- Lessons Learned

SOCWA
South Orange County Wastewater Authority

CWEA

# South Orange County Wastewater Authority

- Located in south Orange County, California
- Joint Powers Authority
  - 10 Member Agencies
  - Formed in 2001
- Approx. 500,000 residents served
- Three wastewater treatment plants
- Two ocean outfalls


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# South Orange County Wastewater Authority

- Member Agencies
  - City of Laguna Beach
  - City of San Clemente
  - City of San Juan Capistrano
  - El Toro Water District (WD)
  - Moulton Niguel WD
  - South Coast WD
  - Santa Margarita WD
  - Irvine Ranch WD
  - Trabuco Canyon WD
  - Emerald Bay Service District

# Regional Treatment Plant

- Built in 1982
- Design Capacity:
  - 12 MGD Liquid
  - 20 MGD Solids
- Tertiary Capacity: 9 MGD
- Conventional Activated Sludge
- Approximately 1/3rd of solids are brought onsite for processing
- Located in a small valley with seasonal temperatures ranging from 30F to 100F+

# JB Latham Treatment Plant

- Built in 1964
- Design Capacity: 13 MGD
- Tertiary Capacity: None
- Conventional Activated Sludge
- Located in a marine environment

# Project Drivers

- SOCWA faced multiple challenges related to Cogen aging assets
- State incentives for self generation (SGIP)
- Impending regulations
  - South Coast Air Quality Management District (AQMD)
  - Rule 1110.2 reduced emissions limits for ICE engines

| Component | Nitrogen Oxides(1) | VOCs(2) | Carbon Monoxide(1) |
|---|---|---|---|
| Previous | 45 | 250 | 2,000 |
| Proposed | 11 | 30 | 250 |

(1) Parts per million by volume corrected for 15% oxygen
(2) Parts per million by volume, measured as carbon, corrected for 15% oxygen

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# Site Conditions at Project Begining

| Criteria | Unit | Regional TP | JB Latham TP |
|---|---|---|---|
| Liquid Capacity | mgd | 13 | 12 |
| Solids Capacity | mgd | 20 | 12 |
| Cogen Units | ea | 3 | 1 |
| Cogen Horsepower | HP | 457 | 636 |
| Generator Size | kW | 400 | N/A |
| Blower Size | sfcm | N/A | 11,000 |
| Biogas Production | scfm | 216 | 115 |
| Gas Treatment | -- | None | None |
| Emissions Controls | -- | None | None |

# Regional Treatment Plant

# JB Latham Treatment Plant

# New System Design Criteria

| Criteria | Unit | Regional TP | JB Latham TP |
|---|---|---|---|
| Biogas Production | scfm | 216 | 115 |
| Cogen Units | ea | 1 | 1 |
| Generator Size | kW | 800 | 633 |
| Gas Treatment | -- | H2S & Siloxane Removal | H2S & Siloxane Removal |
| Emissions Controls | -- | OC(1), SCR(2) & CEMS(3) | OC(1), SCR(2) |
| Boiler Size | BTU | 4,000,000 | N/A |
| Blower Units | ea | N/A | 3 |
| Blower Capacity | scfm | N/A | 6,500 |

(1) Oxidation Catalyst
(2) Selective Catalytic Reduction
(3) Continuous Emissions Monitoring

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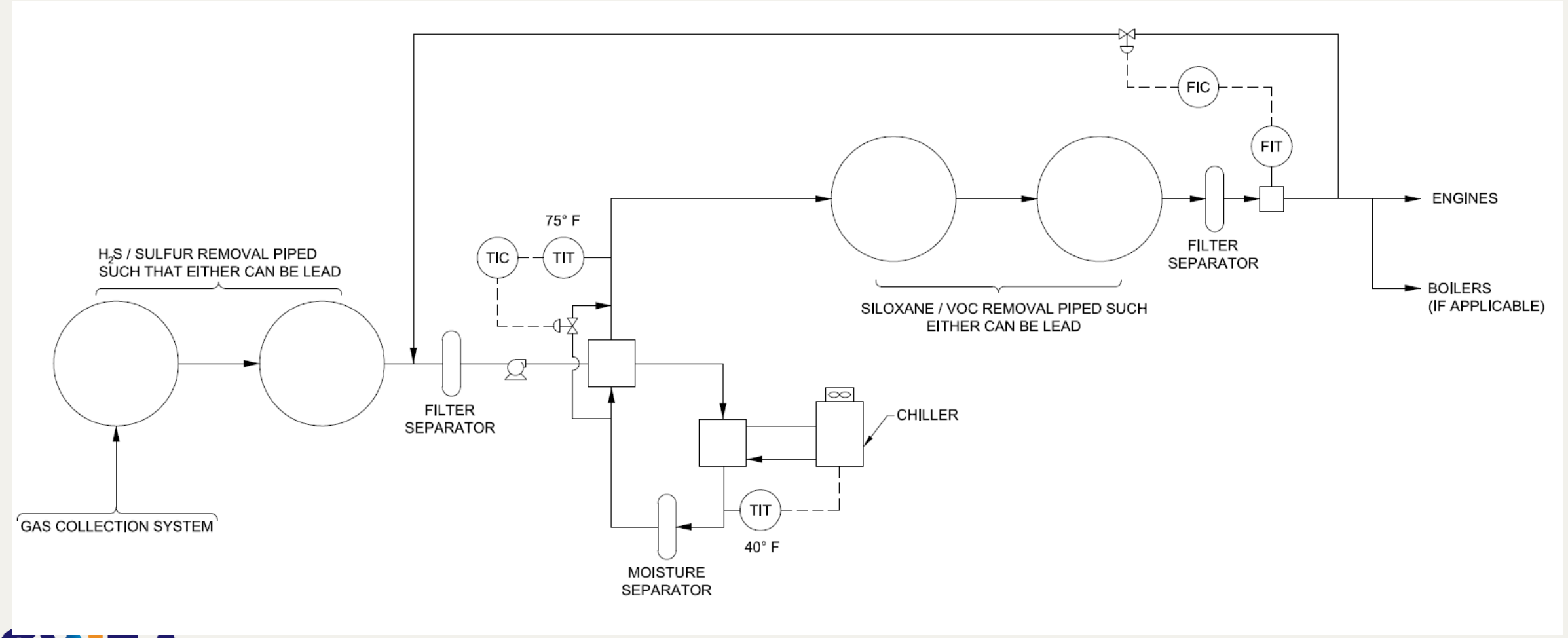
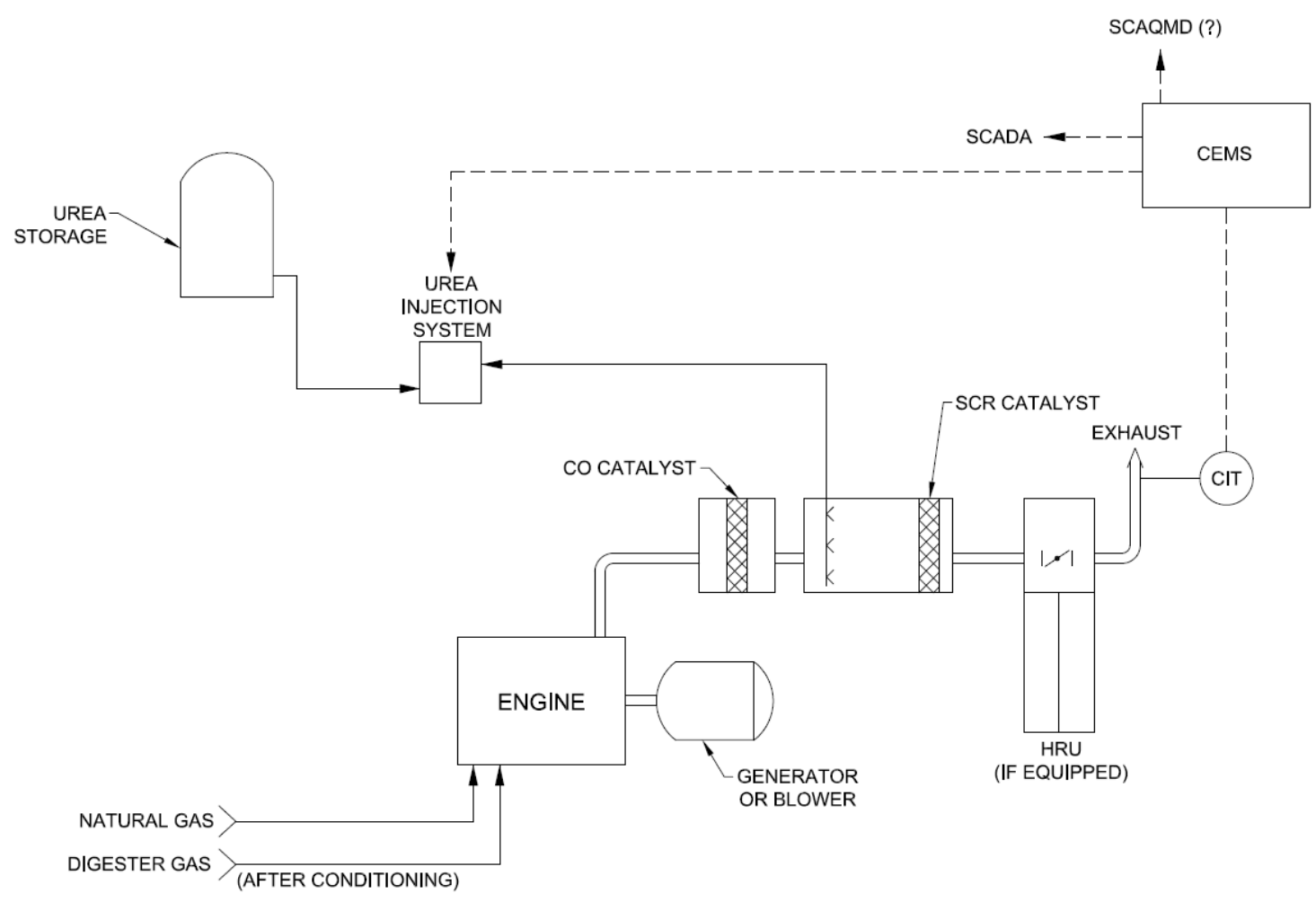
# Gas Conditioning System



# Engine Emissions Controls



# Construction

- Regional TP Cogen System Construction Cost: $8.6M
  - Includes complete switchgear and utility transformer replacement
- JB Latham TP Cogen System Construction Cost: $6.0M
  - New Aeration System: $3.8M
  - New Power Building: $2.6M
  - Other Improvements: $1.6M
  - Total Project: $14.0M

# Regional Treatment Plant

- Jenbacher Cogeneration System Installed in 2018
  - Rated Capcity:
    - 1,175 BHP
    - 848 kW
    - Max Biogas Fuel Flow: 13,053 scfhr
- Current digester gas flows are supplying about 85% of the engine's capacity

# JB Latham Treatment Plant

- Jenbacher Cogeneration System Installed in 2017
  - Rated Capcity:
    - 881 BHP
    - 633 kW
    - Max Biogas Fuel Flow: 10,342 scfhr
- Current digester gas flows are supplying about 70% of the engine's capacity

# Lessoned Learned

## Gas Treatment

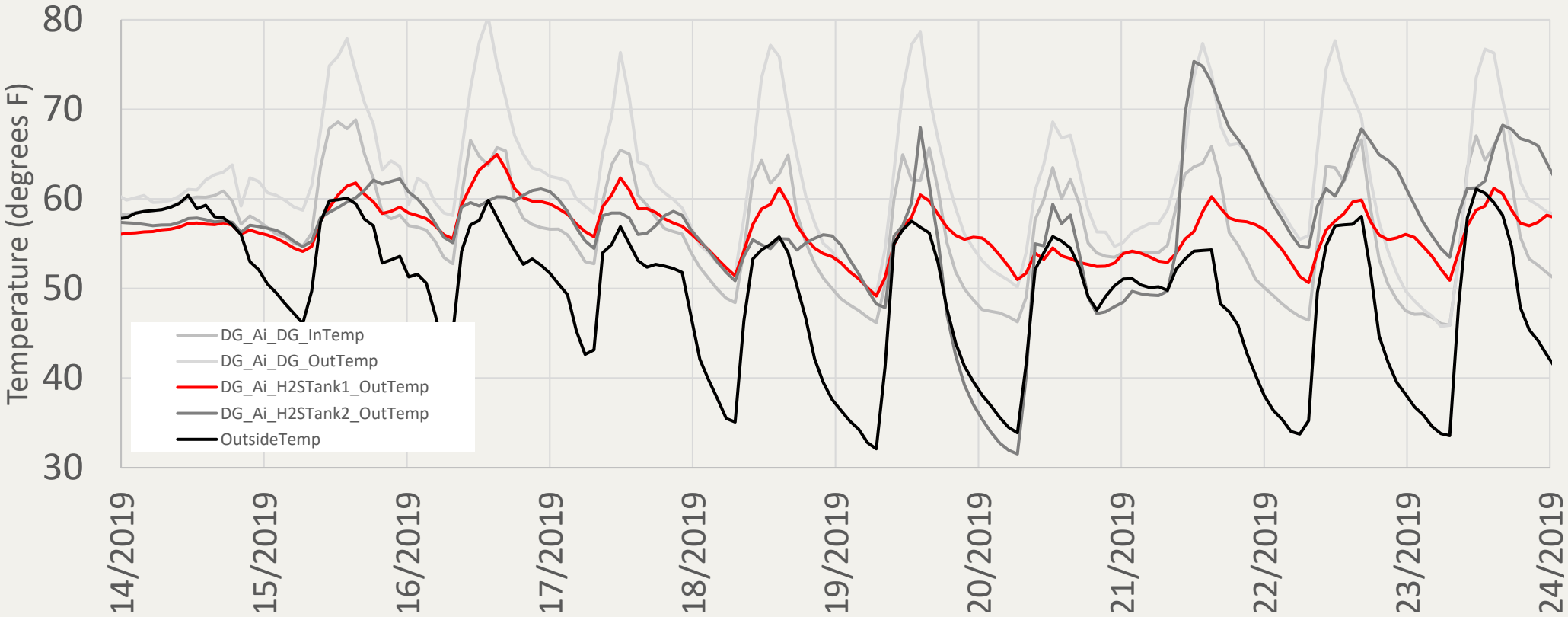
# Lessoned Learned

## Gas Treatment

- Media Concerns
  - Originally planned to use Iron Sponge
    - Can spontaneously combust under certain circumstances
    - Requires significant storage and handling prior to disposal
    - Requires chemical dosing (soda ash) and pH monitoring
  - JBL Switched from Iron Sponge to a plant-based carbon for H2S removal
    - Currently no issues and no breakthrough after over 24-months of operation
  - RTP installed SulfaTreat as an Alternative
    - Worked well initially, but doesn't perform well in colder temperatures
    - Replaced with plant-based carbon with breakthrough after one to two months

# Lessoned Learned

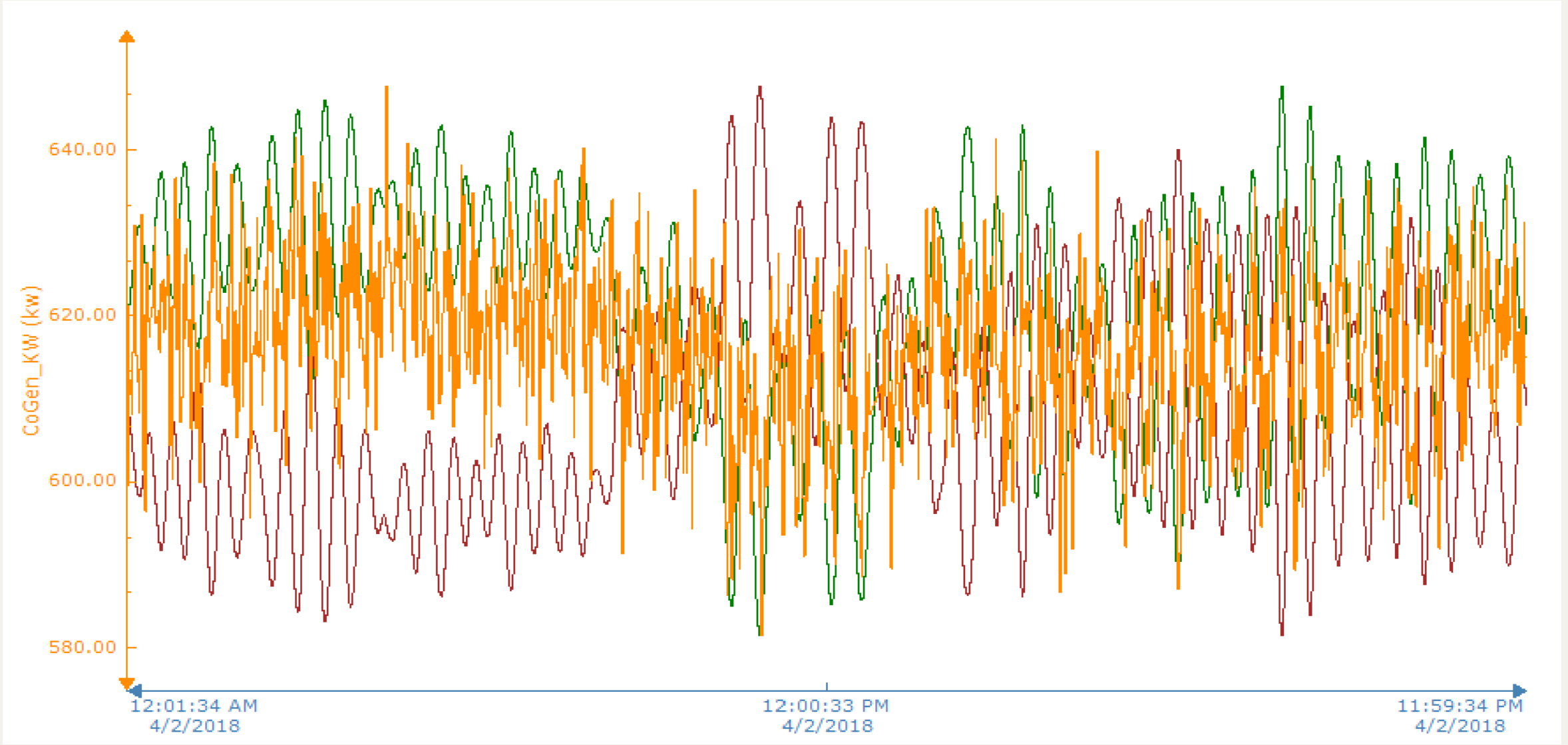
## Gas Treatment



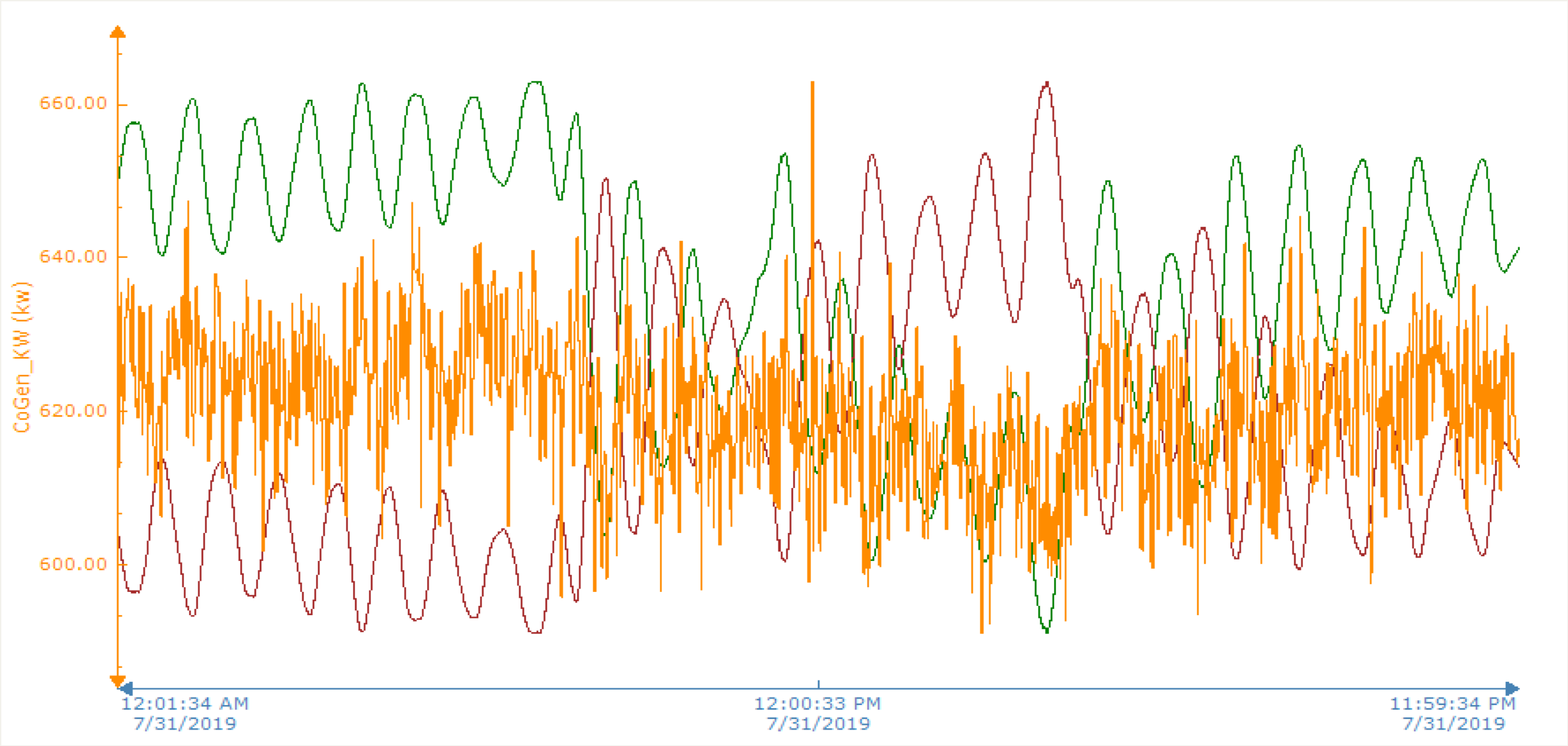
# Gas Treatment

- Expected gas flows during design vs reality after construction
  - AQMD permit requires operating at full load
  - Natural gas blending required to run at full load
- Controlling pressures and flows
  - The gas blower would draw down pressure to a vacuum where the controlling pressure transmitter is located
  - Reprogrammed controls to use the average dome pressure from online digesters to control flow digester gas flow
- Lesson Learned: Be willing to be flexible and come up with solutions outside of the original project

# Gas Treatment – Gas Controls Before



# Gas Treatment – Gas Controls After



# Engines

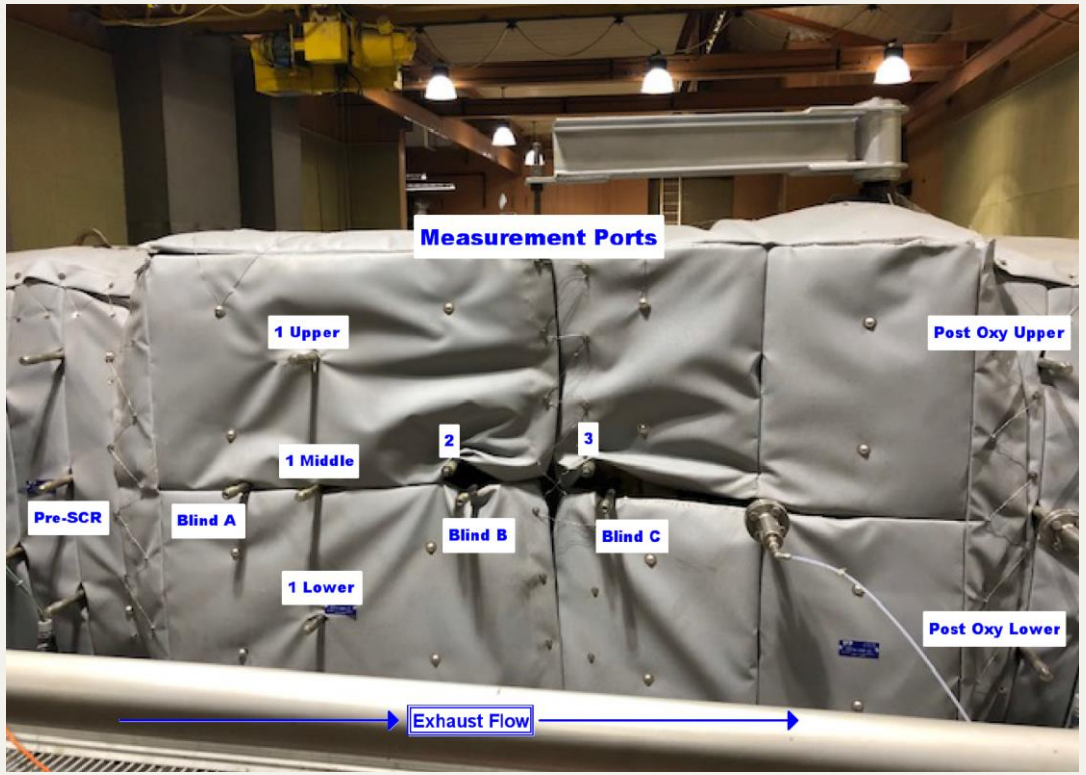
- Jenbacher Leanox Control System
  - Monitors multiple parameters to control NOx emissions
  - Initially power output swings of +/-100 kW
  - Currently better controlled but still being worked on
  - Blending less than 5% natural gas can cause stability issues
- Limited local access to control and maintenance parameters

# Emissions Controls

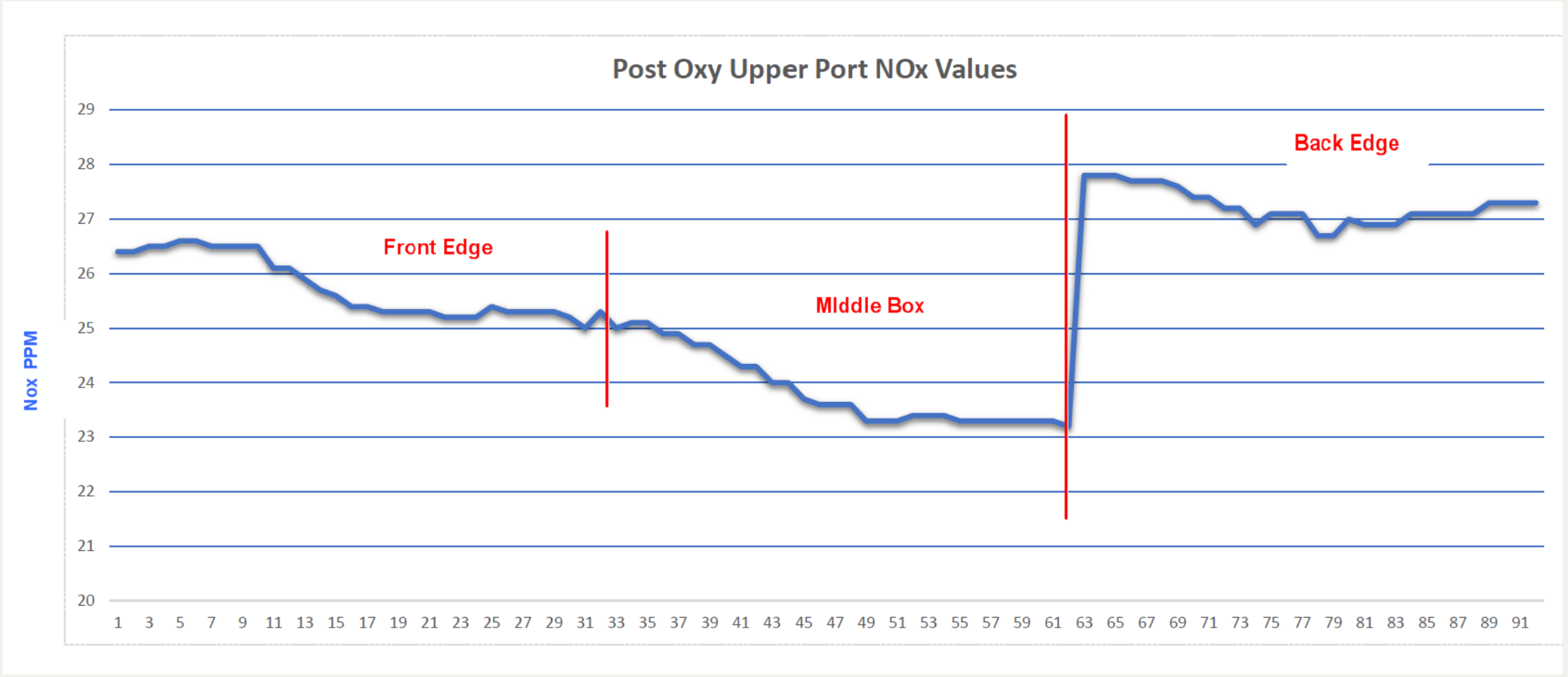
- NOx emissions limited to 11 ppm
- CO emissions limited to 250 ppm
- Selective Catalytic Reduction used to control NOx
  - Metal catalyst with urea (ammonia) injection
- Additional catalyst to reduce CO emissions

# Emissions Controls

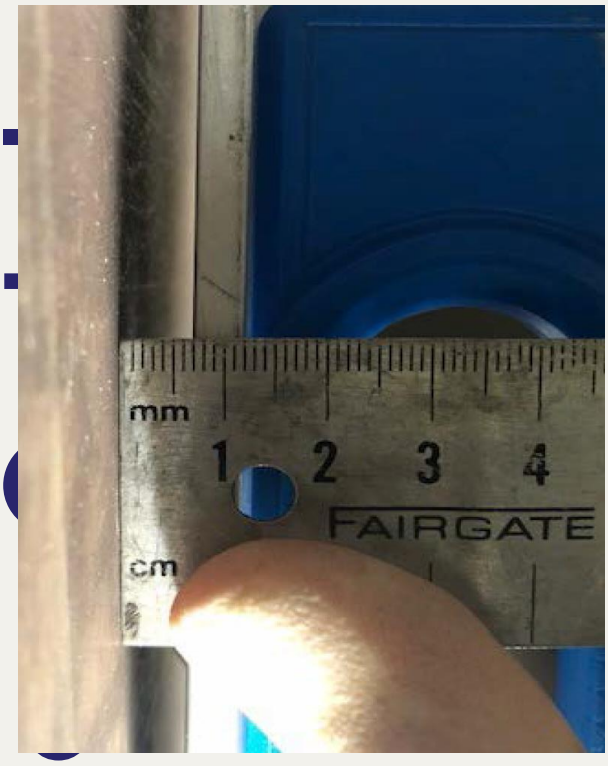
- SCR Sizing allowed for one additional row of catalyst for each system
  - Both system are now utilizing this additional space with no further room for expansion
- Installation of probes helped determine the issue with bypass at RTP



# Emissions Controls




mm
1 2 3 4 5 6
FAIRGATE
cm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cm

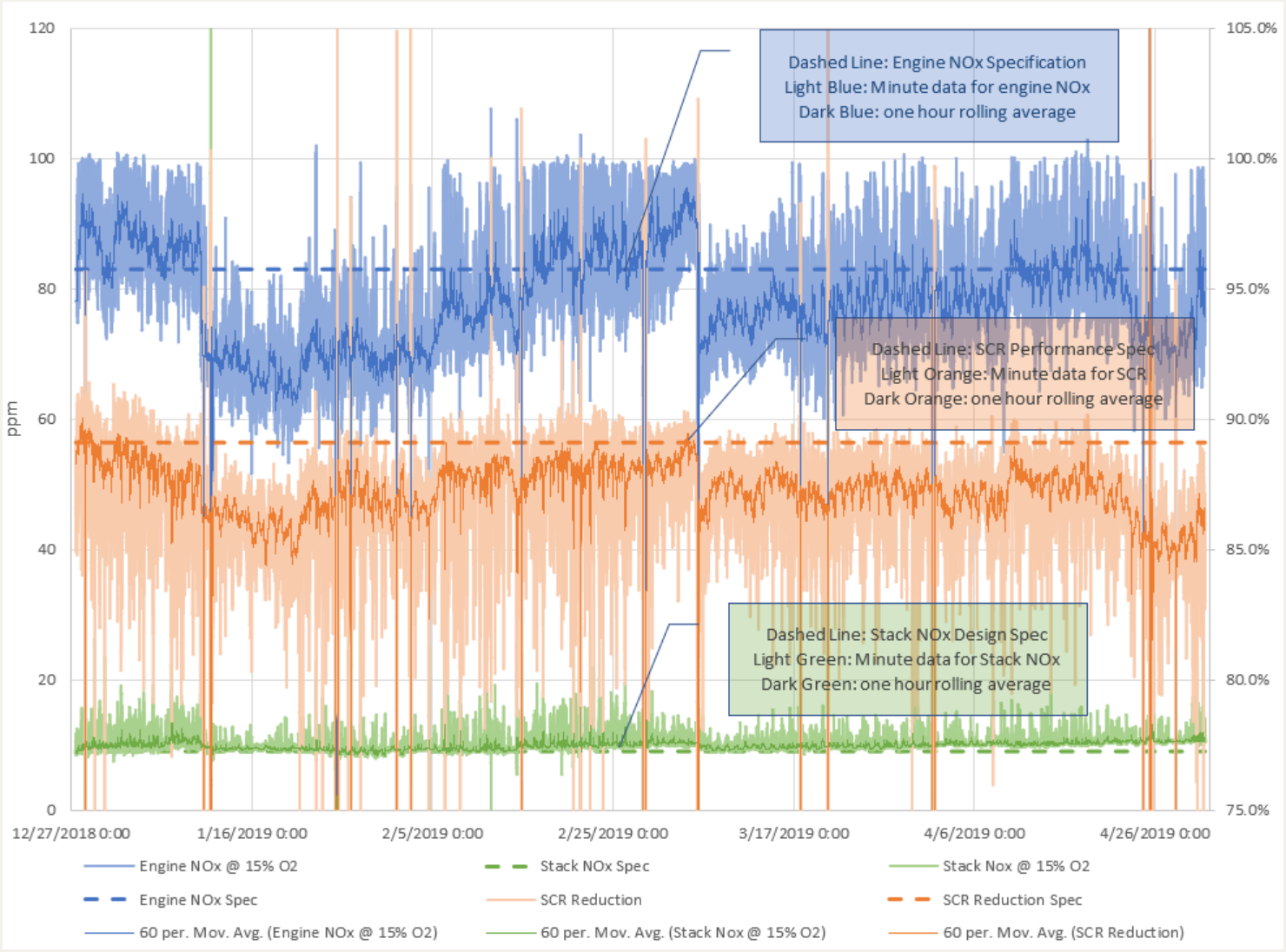
# Emissions Controls

- Continuous Emissions Monitoring System (CEMS)
  - Computer that logs minute-by-minute emissions data
  - Data is compiled and submitted to AQMD twice per year
  - CEMS is only required at the RTP due to the engine size
  - CEMS has provided a much more detail view of both the engine and SCR performance
  - Data has helped determine where emissions issues are coming from (engine vs SCR)

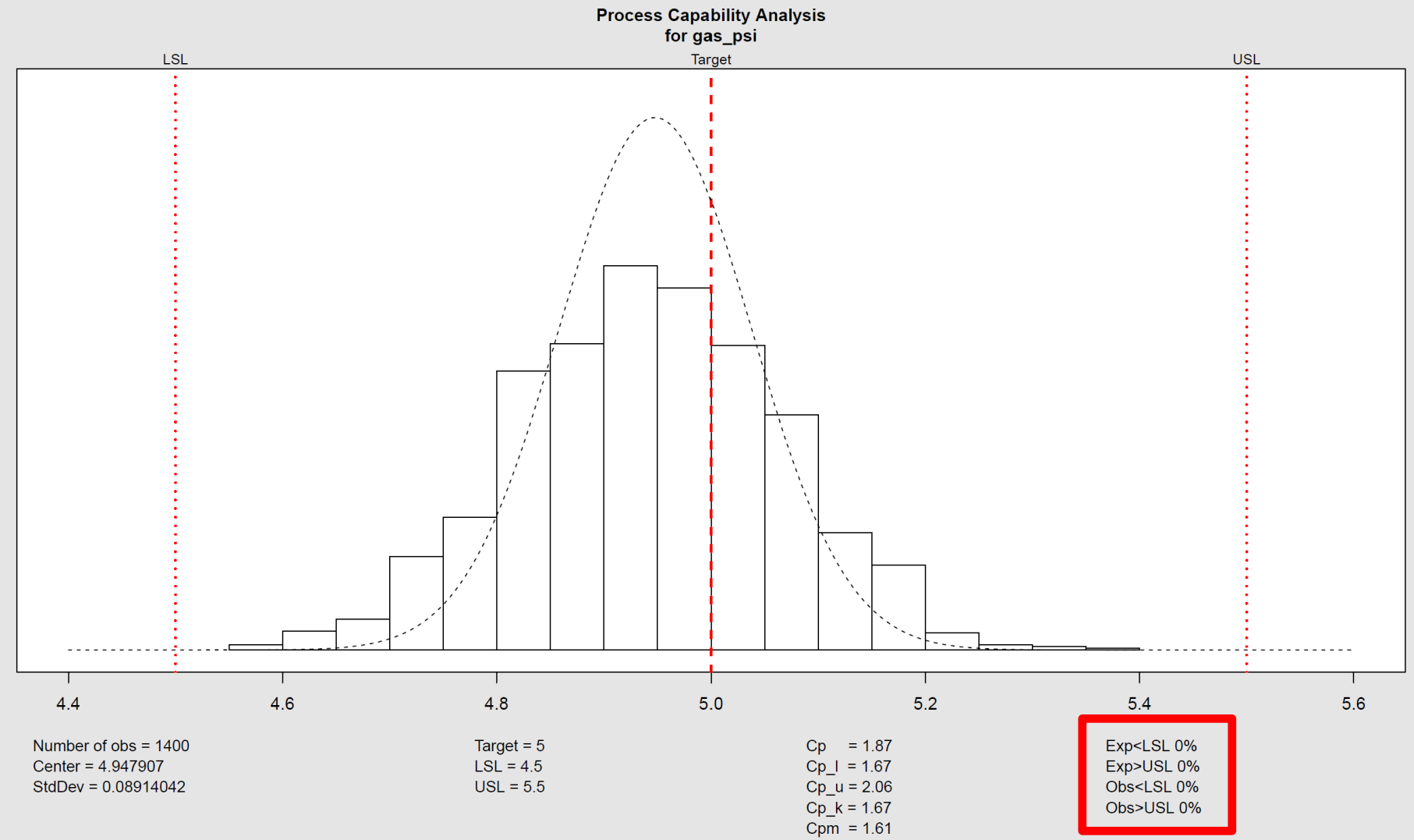
# Using the CEMS Data to Determine the Source of Issues

- Detailed logging of emissions data from the CEMS allowed us to see both the performance of the engine and the SCR in great detail
- Using the R Project for Statistical Computing
  - Open source and free
- Process Capability Analysis
  - Useful for any repetitive process that has defined upper and/or lower limits

# RTP Cogen - Emissions Data Graph



# Statistical Analysis – Who's Fault Is it?



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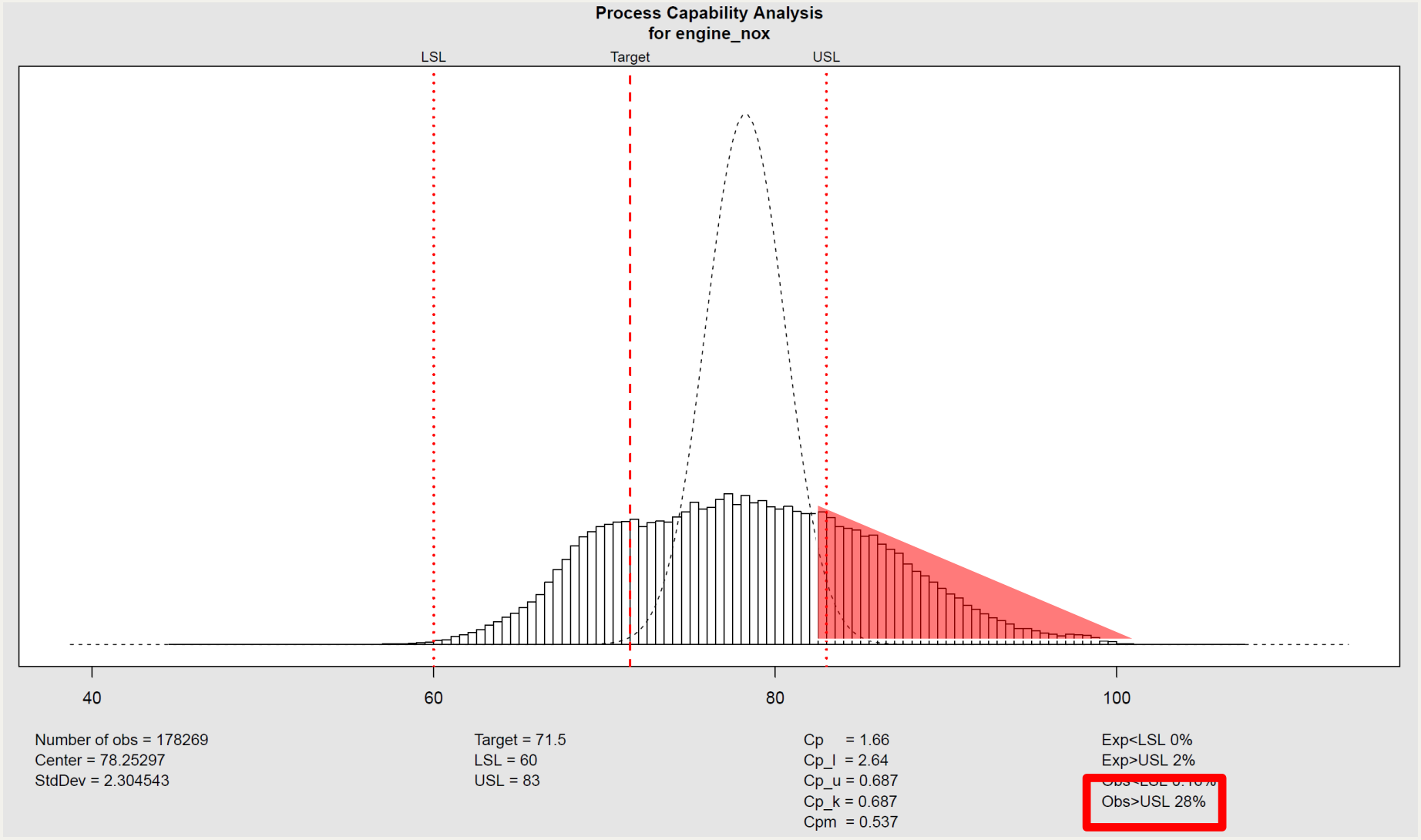

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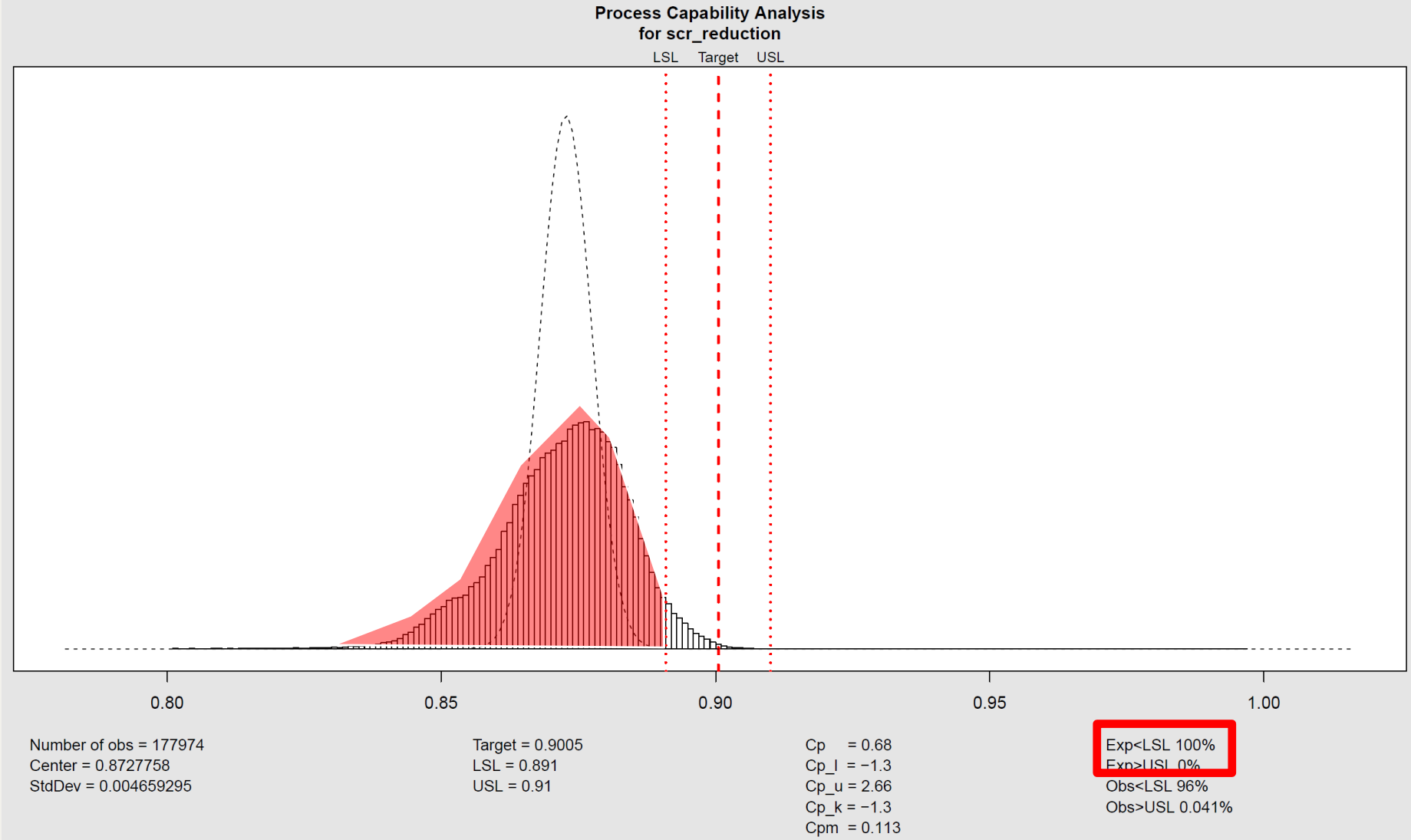


# Statistical Analysis

- Lessoned Learned: Data used and presented in an understandable and meaningful way can greatly impact the decision-making process.

# Electrical Output and Future Concerns

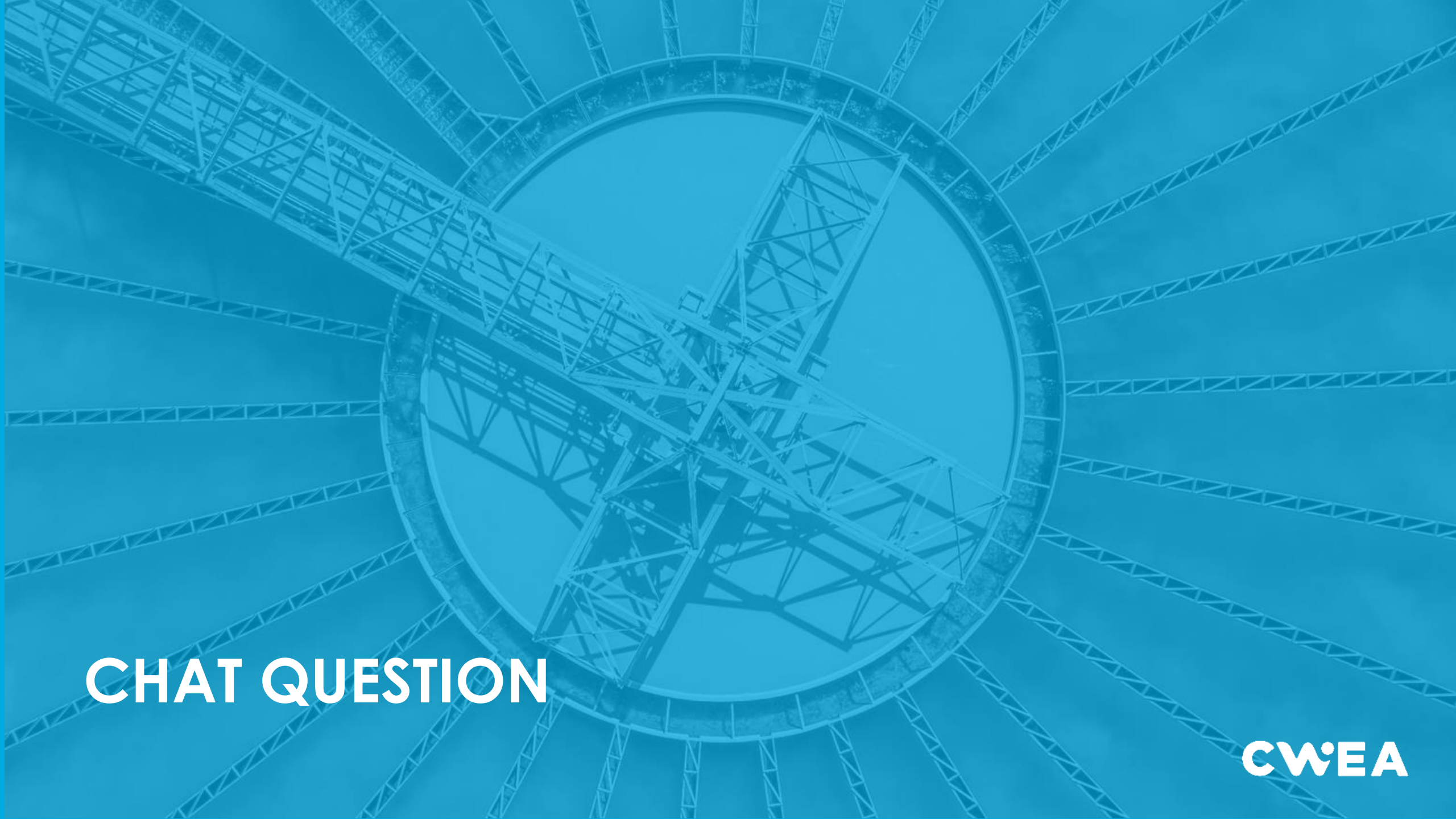
- The AQMD permit requires that we be a net importer of electricity at each facility
  - As plants get more efficient in the coming years, we will push close to zero import of electricity
- Both plant utility providers, Southern California Edison and San Diego Gas and Electric, have steep demand charges based on 15-minute averages
  - Shutting the engine off for even a short period of time can result in additional charges of up to $20,000/mo depending on several factors
- Redundancy or planning to offset these charges may not have a long-term impact

# Current Status

- Regional Treatment Plant
  - Digester Gas Conditioning System is still having fast breakthrough
  - Engine and SCR emissions are within design parameters
  - Electrical output still fluctuating, and control programs are still being adjusted

# Current Status

- JBL Treatment Plant
  - Digester Gas Conditioning System is working well and within design parameters
  - Engine and SCR emissions well within specifications and easily controlled
  - Electrical output still fluctuating, and control programs are still being adjusted



# CHAT QUESTION

# QUESTIONS & ANSWERS

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