REINHOLD ENVIRONMENTAL ®

2025 Reinhold/PCUG Round Table Presentation

Hosted by AEP and Buckeye Power

in The Hilton Columbus Polaris Hotel, Columbus, OH

on June 23-24, 2025

SCR & LPA Screen Efficiency

APS Four Corners Case Study

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Andrew Kline - IGS Director of Technical Sales

Overview

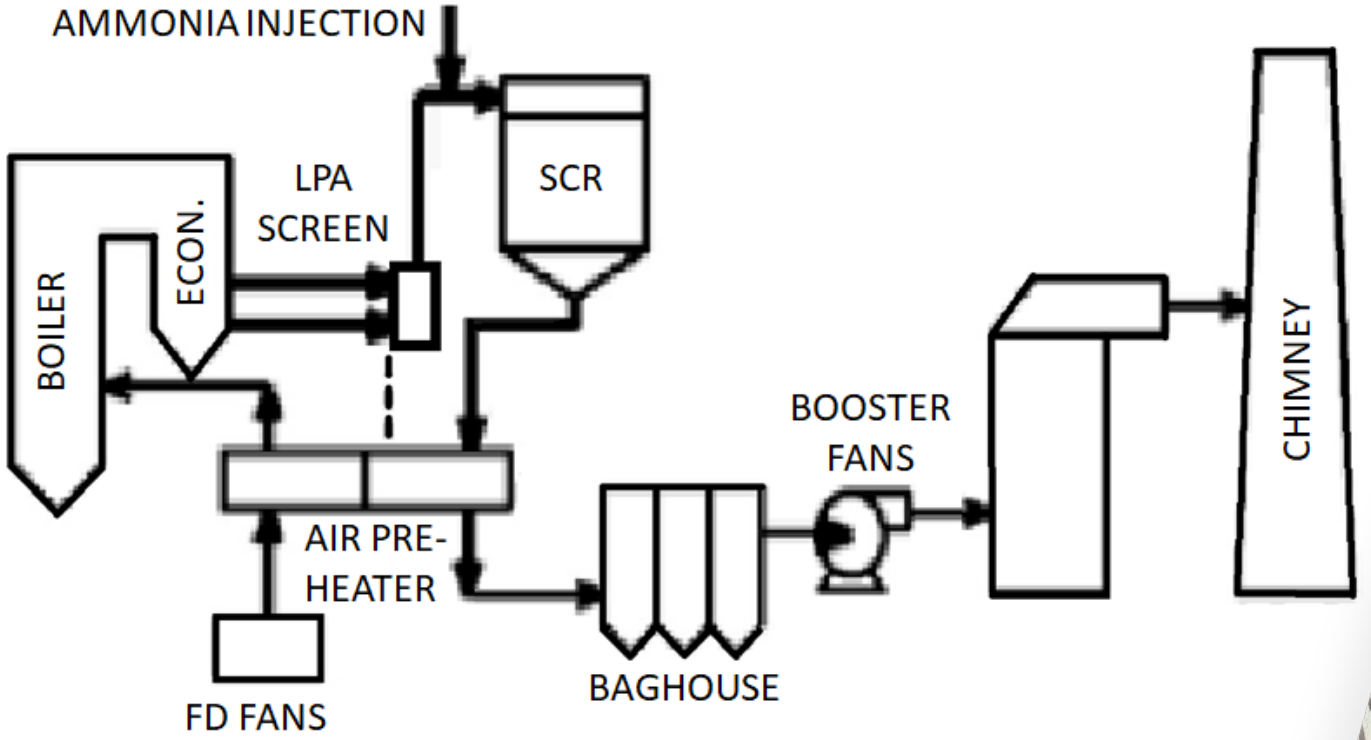
- Operational Background and Overview
- Diagnosing the Problem
  - LPA Screen Plugging
  - Air Cannon Failures at SCR
  - SCR Performance
- IGS Corrective Actions and Implementation
- Results to Date
- Conclusion

SCR Added and began Operating:
March 2018

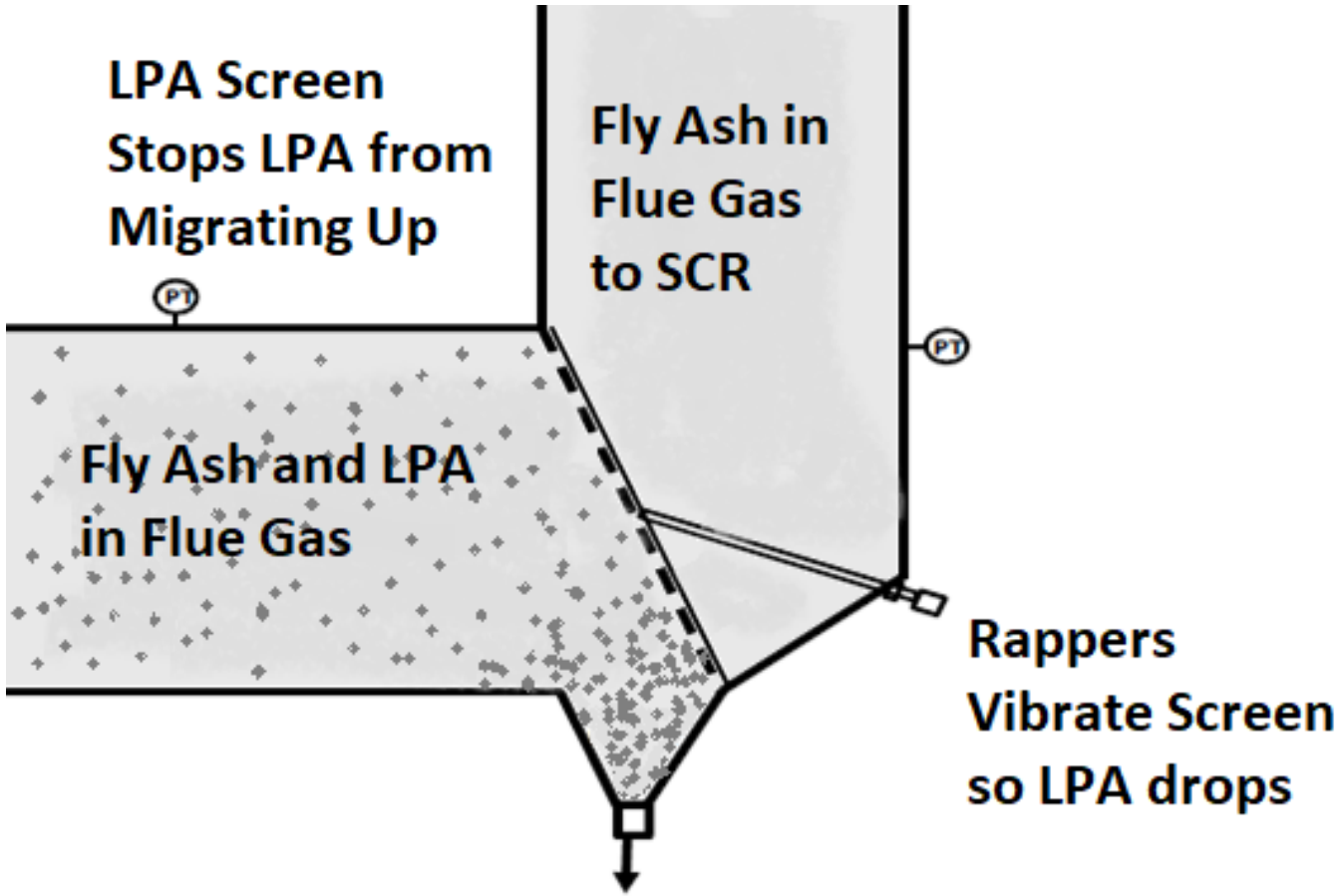
Expected Shutdown:
2031

Operation Unit 4 & 5:
750 MW Each

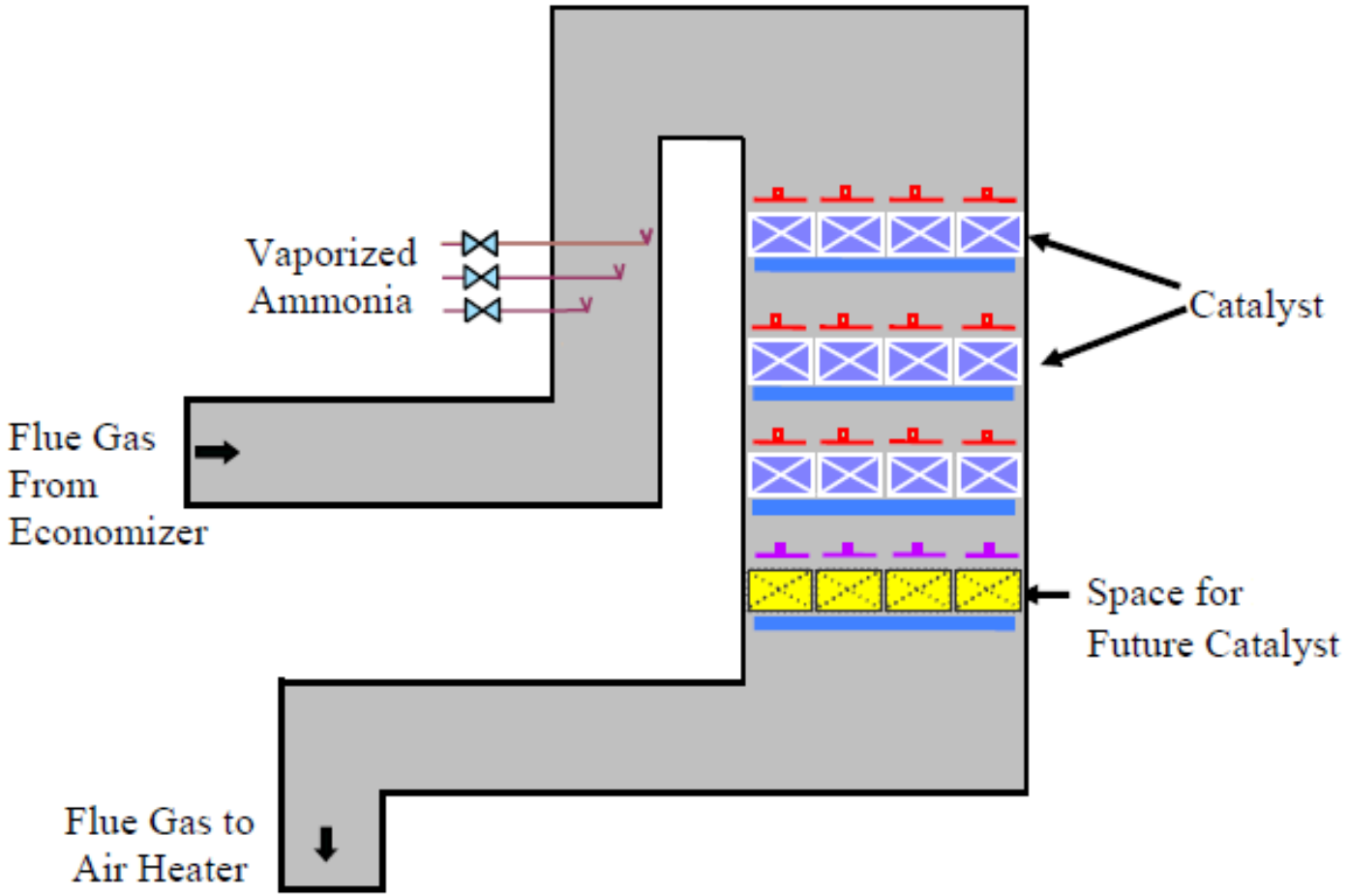
General Arrangement
APS Four Corners



LPA System at Four Corners



SCR System at Four Corners



Operational Background

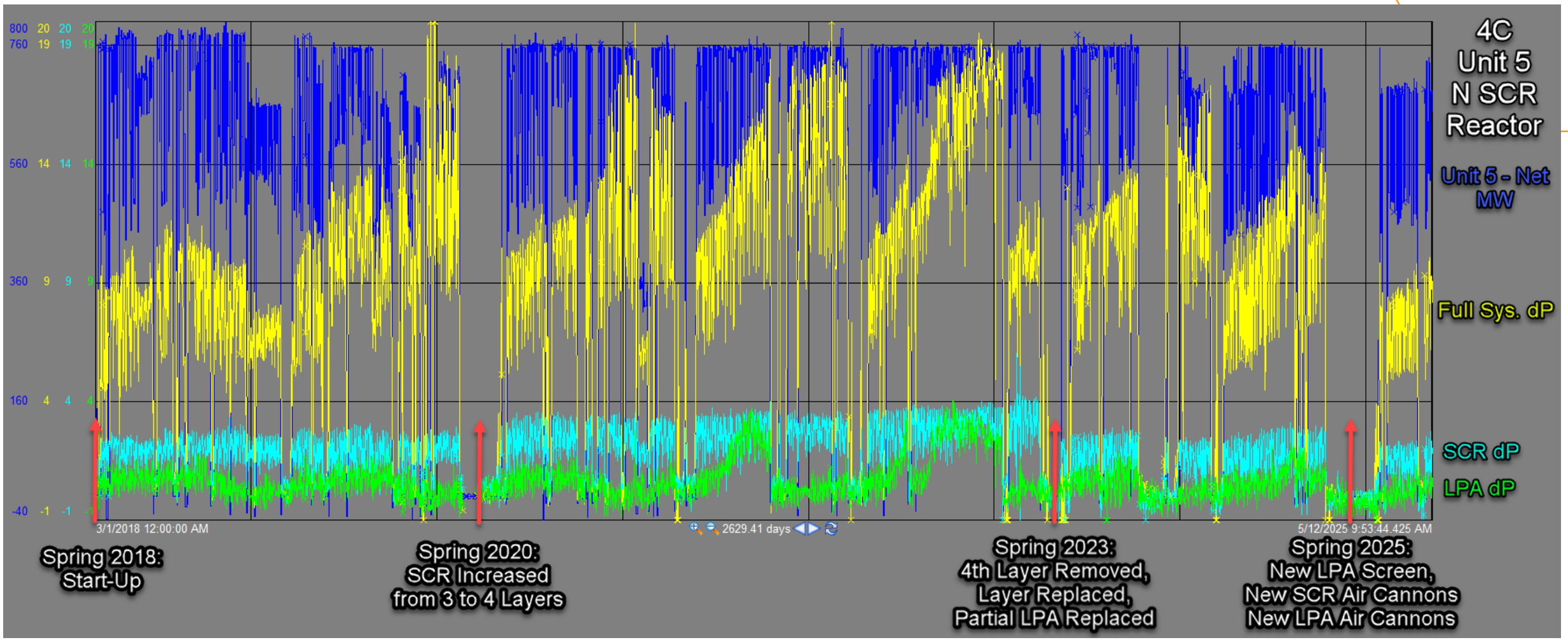
- Normal Operation 2018-2019
  - System Back Pressure Reached 12 in H_2O
- Spring 2019 – Screw Conveyor at LPA Screens taken out of service due to continued maintenance issues
  - System Back Pressure Reached 20 in H2O
    - Booster Fans started to max out, MW's Lost
  - LPA Screen Back Pressure started to reach 3 in H_2O
  - Increased Flue Gas Velocities Caused Premature LPA Screen Erosion

Operational Background

- Spring 2020 (U5), 2021 (U4) – 3 Layer SCR increased to 4 Layers
  - Corrosion in Air Preheater
  - System Back Pressure Reached 20 in H_2O Faster
    - Booster Fans continued to max out, MW's Lost
- July 2022 - Jessica Hernandez joined APS
  - Worked with Bruce Salisbury and Coy Cody to understand system challenges and history

Operational Background

- Spring 2023 – Reduced SCR to 3 Layers
  - Improvements achieved at SCR and Preheater
- Spring 2025 – New LPA Screen, New LPA Air Cannons, New SCR Air Cannons, improvements to Preheater
  - System Back Pressure expected to stay below 14 in H_2O
  - LPA Screen Back Pressure expected to stay under 1 in H_2O
  - Booster Fans continued to operate optimally


4C
Unit 5
N SCR
Reactor
Unit 5 - Net MW
Full Sys. dP
SCR dP
LPA dP
800 20 20
760 19 19
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160 4 4
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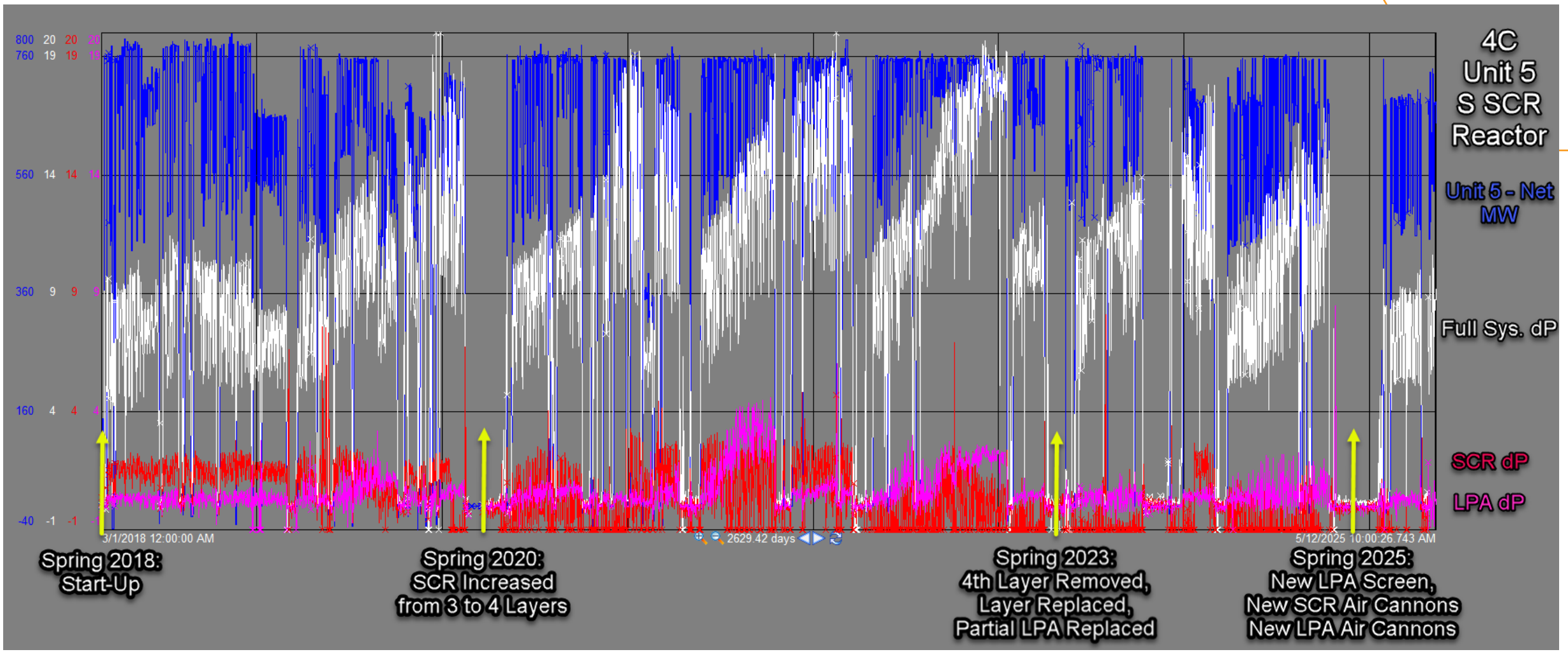
3/1/2018 12:00:00 AM
2629.41 days
5/12/2025 9:53:44.425 AM
Spring 2018:
Start-Up
Spring 2020:
SCR Increased
from 3 to 4 Layers
Spring 2023:
4th Layer Removed,
Layer Replaced,
Partial LPA Replaced
Spring 2025:
New LPA Screen,
New SCR Air Cannons
New LPA Air Cannons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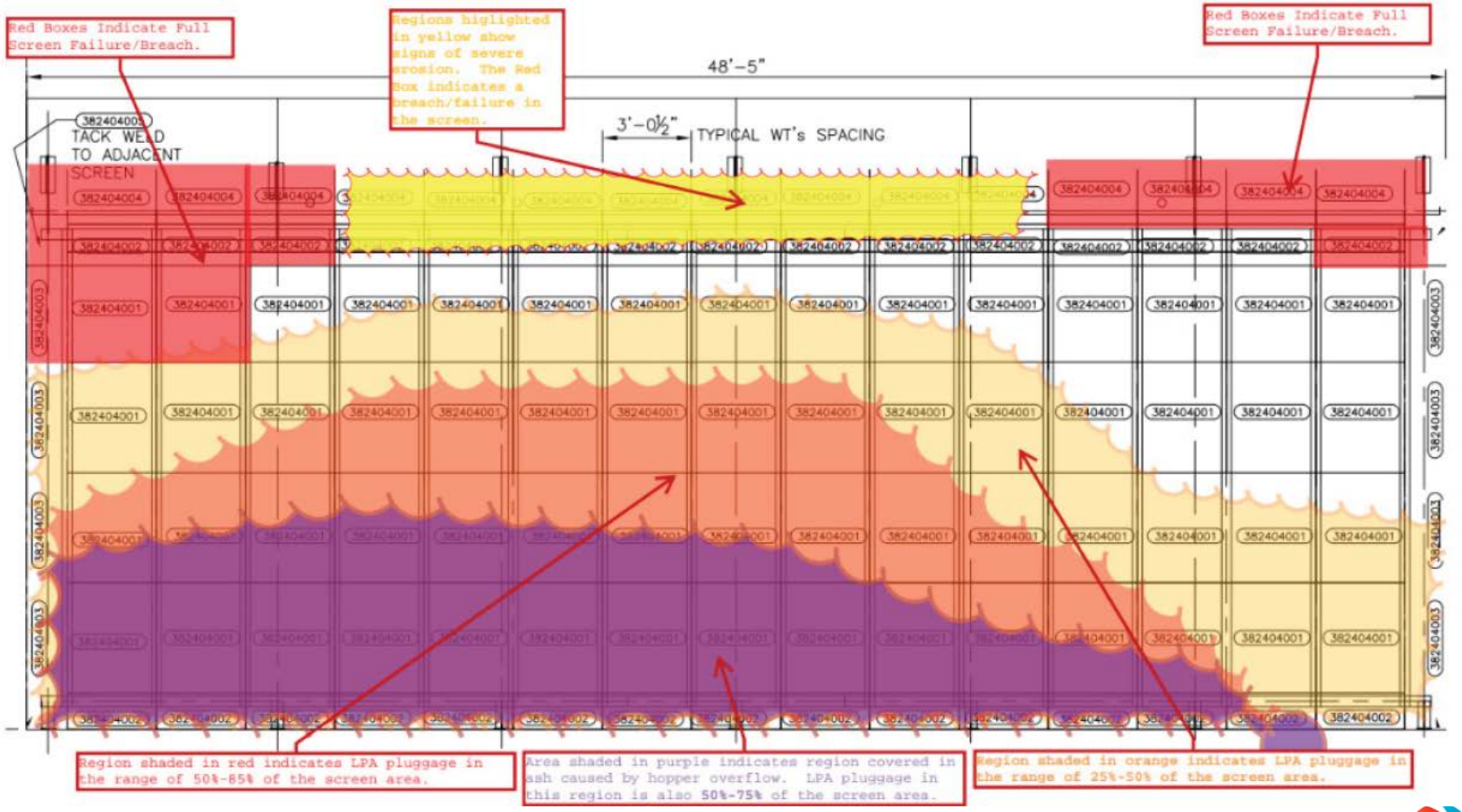
New LPA Screen,
New SCR Air Cannons
New LPA Air Cannons

LPA Screen Operational Issues

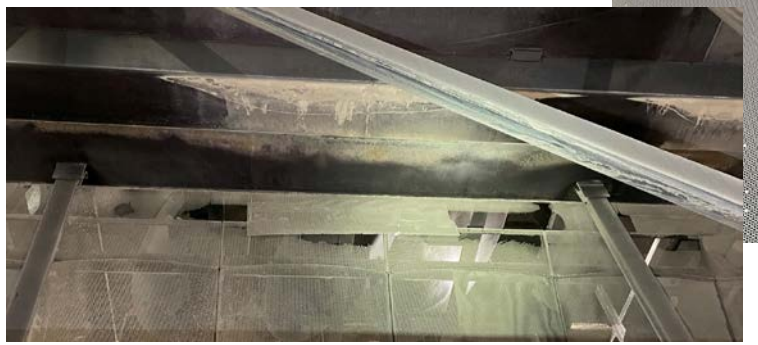
- Screw Conveyor was inoperable due to continued maintenance issues
- Ash Piled at Screw Conveyor Blocking >50% of the screen
- LPA at Four Corners exhibited characteristics of slag and ash LPA types with a porous, sintered matrix surrounded by fly ash agglomerates.
  - I.E Very Erosive
- Reduced LPA Screen surface area due to plugging

LPA Screen Operational Issues

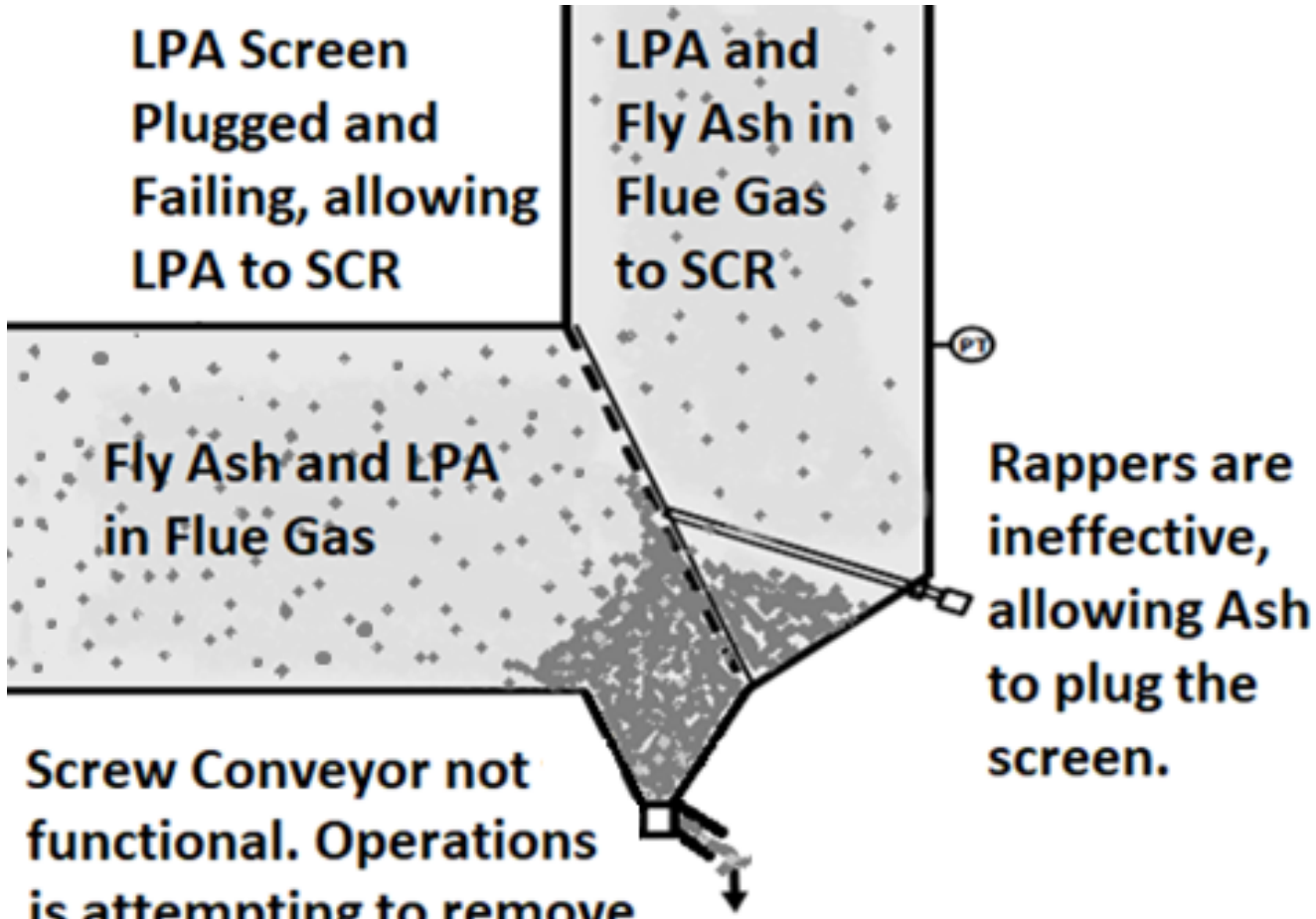


LPA Screen Operational Issues

- Ash Piling Increased velocities through the screen, significantly decreasing screen life
  - Holes developed – they were incorrectly repaired or not repaire
  - LPA broke through to SCR, Preheater, Baghouse, etc.
- Rappers were ineffective in clearing screen due to flow disruptions



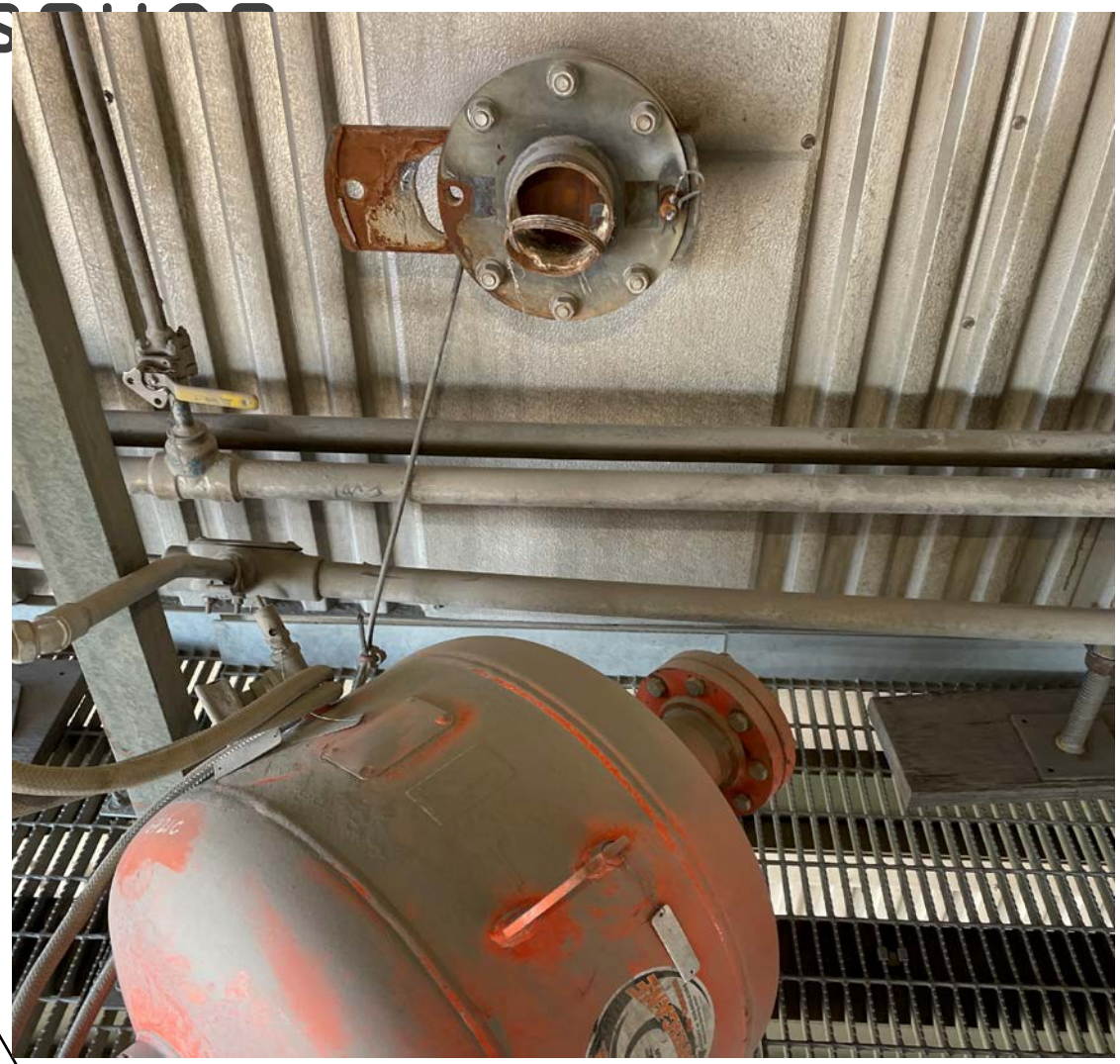
LPA Screen Operational Issues



SCR Air Cannon Operational Issues

- Four Corners has a positive pressure system
  - Ash back flowed into Air Cannons
- Air Cannons Corroded
  - MI NDA determined end of life of Air Cannons would be 2028
  - Maintaining system required inspection on all 64 pressure Vessels and replacing pressure reliefs per ASME Code
- Thermal Safety Sheilds (Gate Valves) Failed causing Safety Issues
  - Sch. 40 Pipe was threaded, creating a thin area. Corrosion caused failure
  - Air Cannons were shooting off the unit – MAJOR safety concern.

SCR Air Cannon Operational Issues



Corrosion from Positive Pressure System

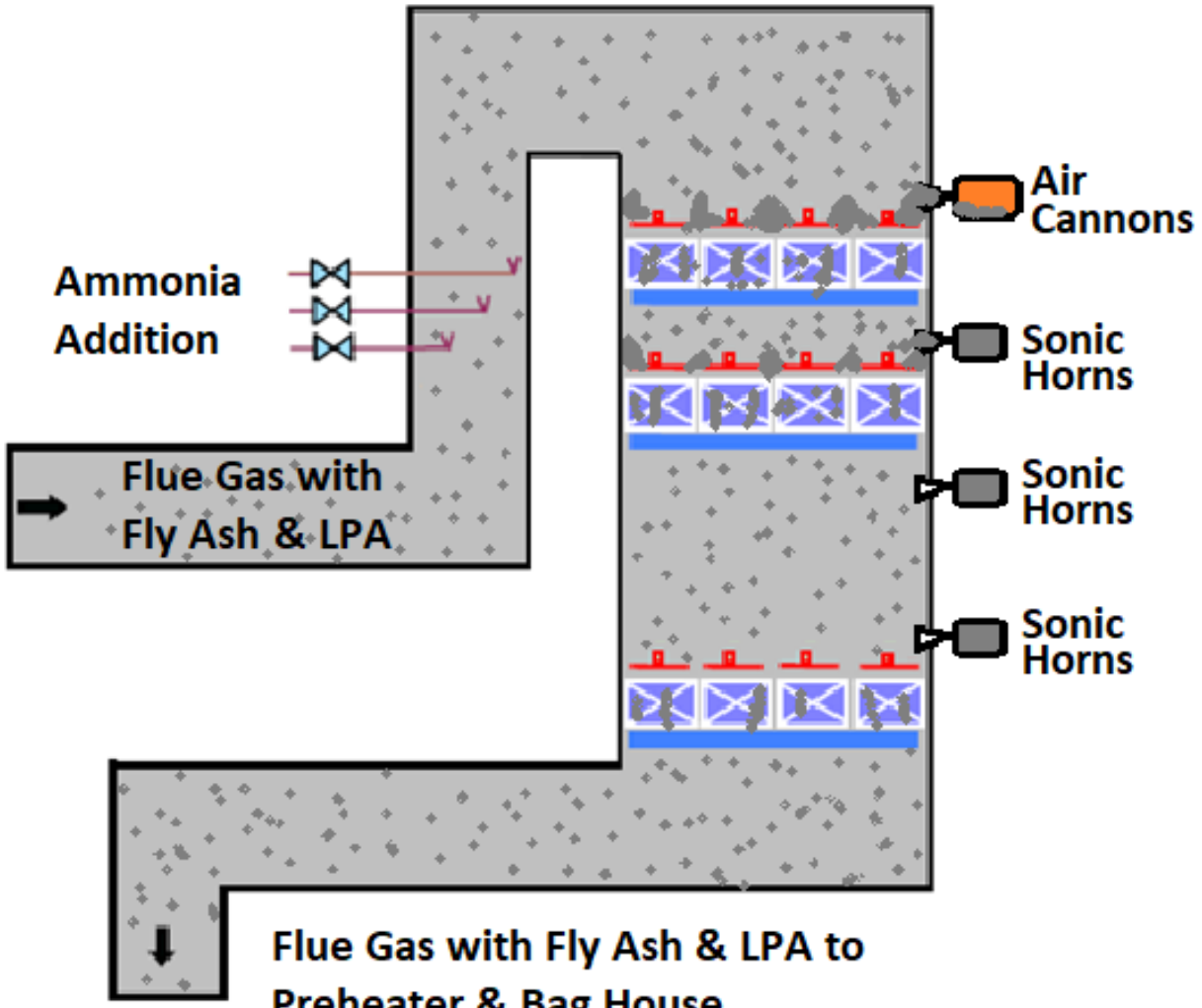
SCR Air Cannon Operational Issues

Corrosion from Positive Pressure System

SCR Performance Issues

- Ash Piles on all layers of the catalyst
  - Unit 5 had a maintenance event where steam penetrated the SCR causing significant issues. Unit 4 is not as severe.
- Air Cannons and Sonic Horns were plugged and not operating
- SCR Catalyst Screens damaged from narrowed Air Cannon shots.
- LPA breakthrough visible on all layers. Reducing the life of the SCR from 5-7 years per layer to 3-5 years.

SCR Performance Issues



SCR Performance Issues

Unit 4 1st Layer Plugging

SCR Performance Issues

Unit 4 2nd Layer Plugging

SCR Performance Issues

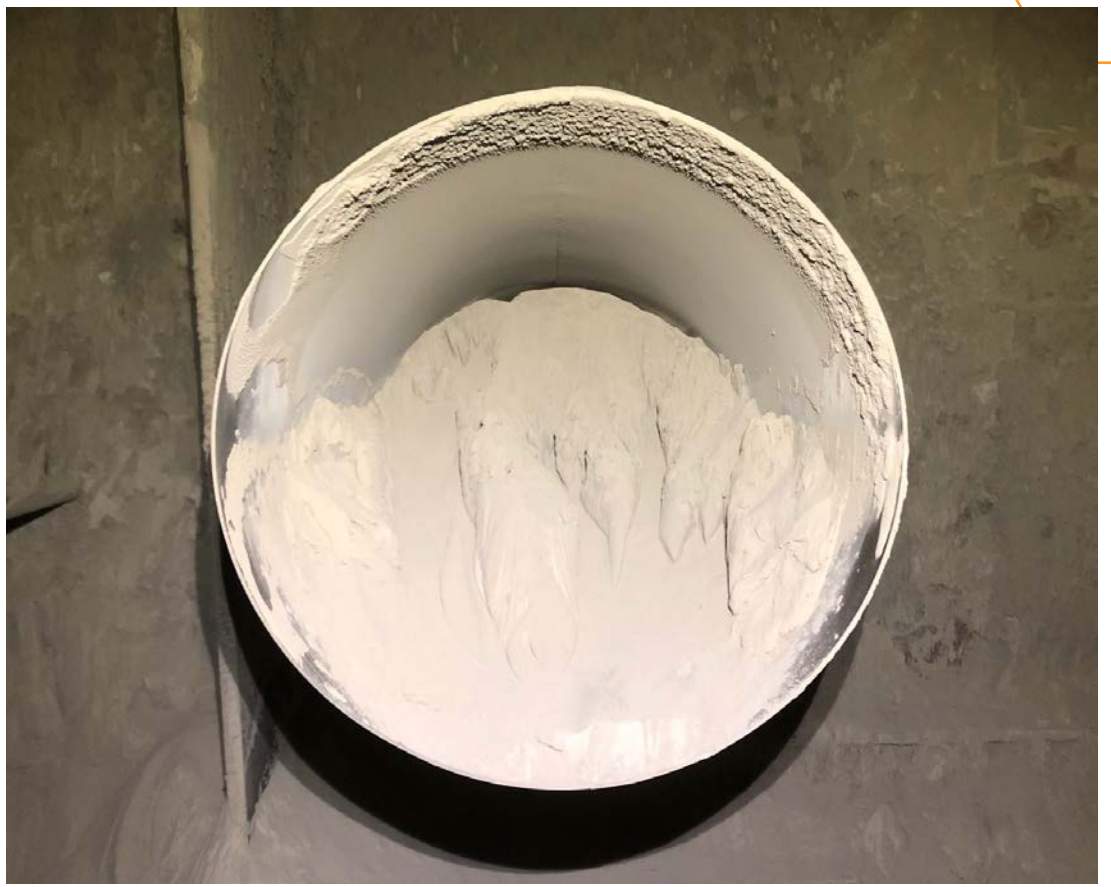
Unit 5 1st Layer Plugging

SCR Performance Issues

Unit 5 2nd Layer Plugging

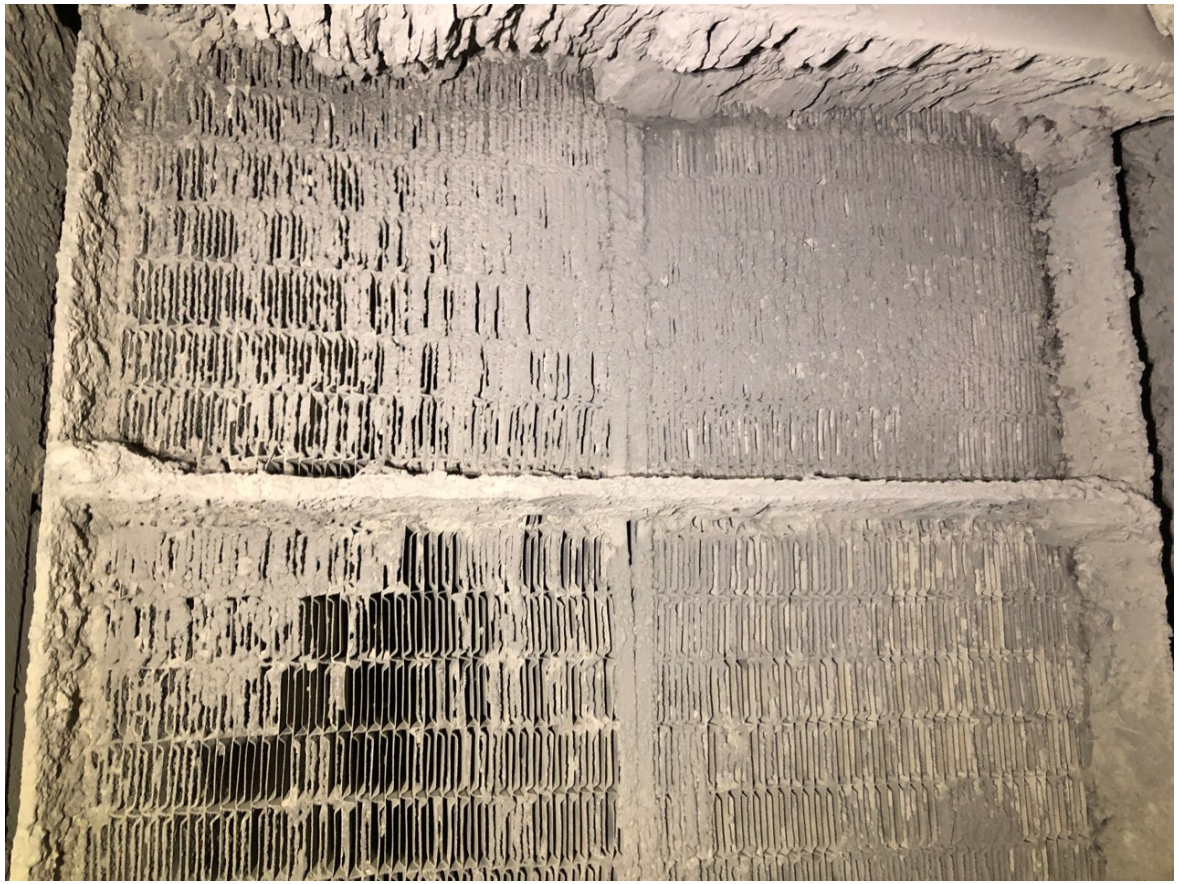
SCR Performance Issues

LPA Breakthrough

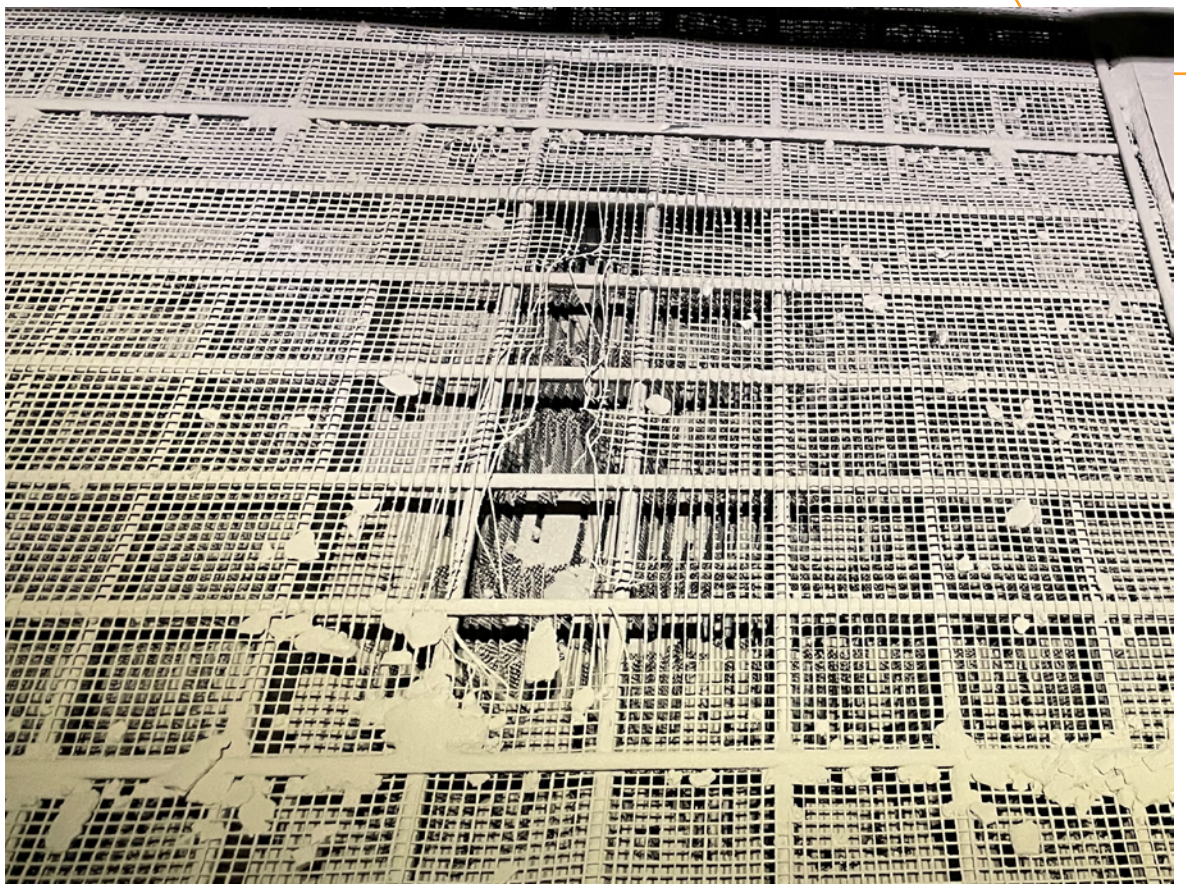


Plugged Sonic Horn

SCR Performance Issues



LPA Underside of Unit 5 SCR – Steam Event



SCR Screen Failure

SCR Performance Issues

Unit 5 – Uneven Corrosion

SCR Performance Issues

Unit 4 – Uneven Corrosion

Other System Issues

- LPA Breakthrough also impacted the duct, baghouse, and preheater
- Operating 3 Layers vs. 4 Layers reduces SO_3 by 25%, or an expected 228 Tons per year
  - Operational issues progressed further after 4th layer installed
  - Higher SO_3 concentration raises the Acid Dew Point(ADP), causing sulfuric acid damage to downstream equipment.
  - Acid condensation produces “sticky” surfaces resulting in ash accumulation, specifically in the preheater

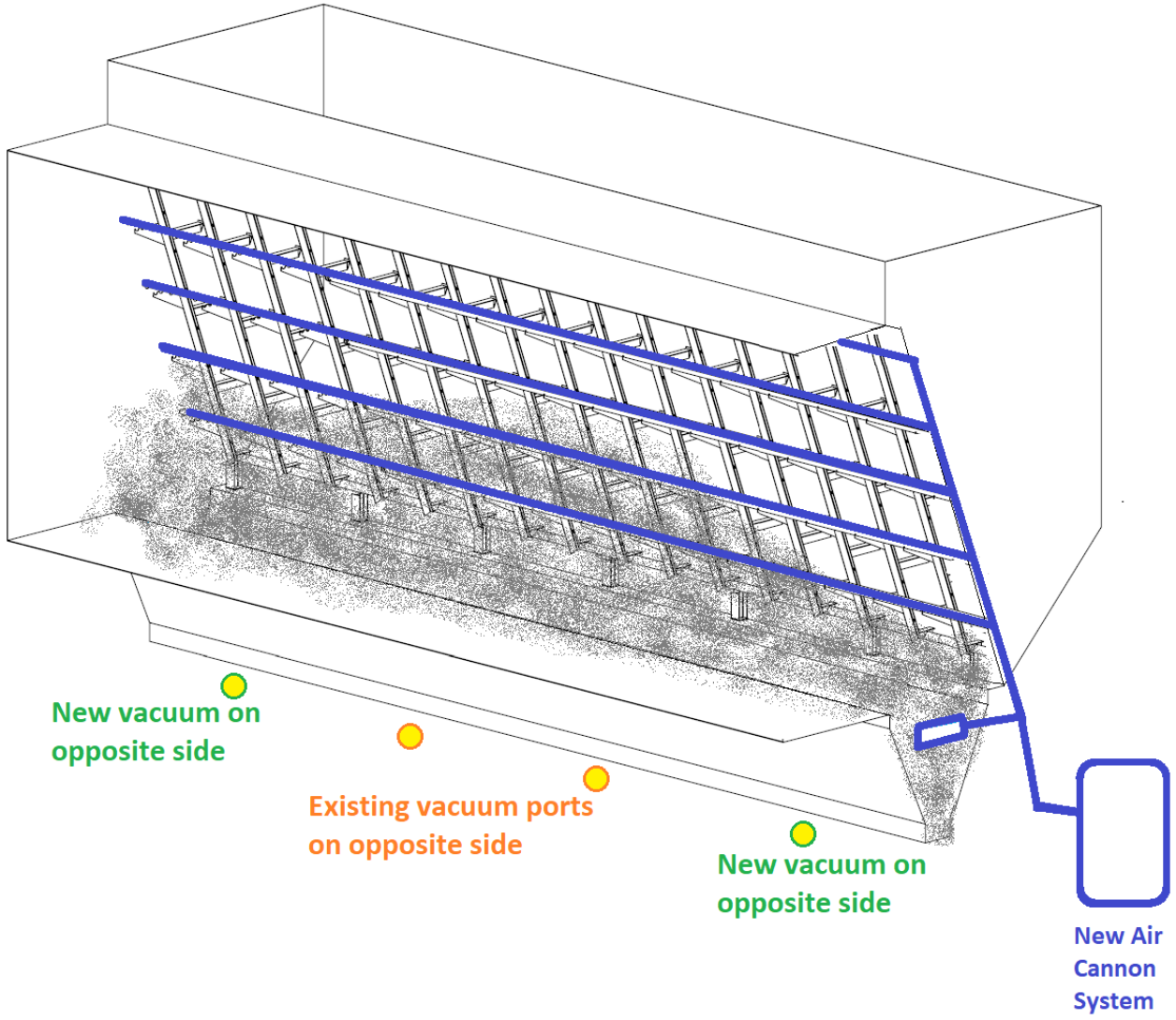
IGS Solutions - LPA Screen

- LPA Screens Completely Replaced
- Upgraded Two-Stage Coating to Allow for Easy Inspection
- LPA Screen Air Cannons Installed to Replace Rappers

IGS Solutions - LPA Screen

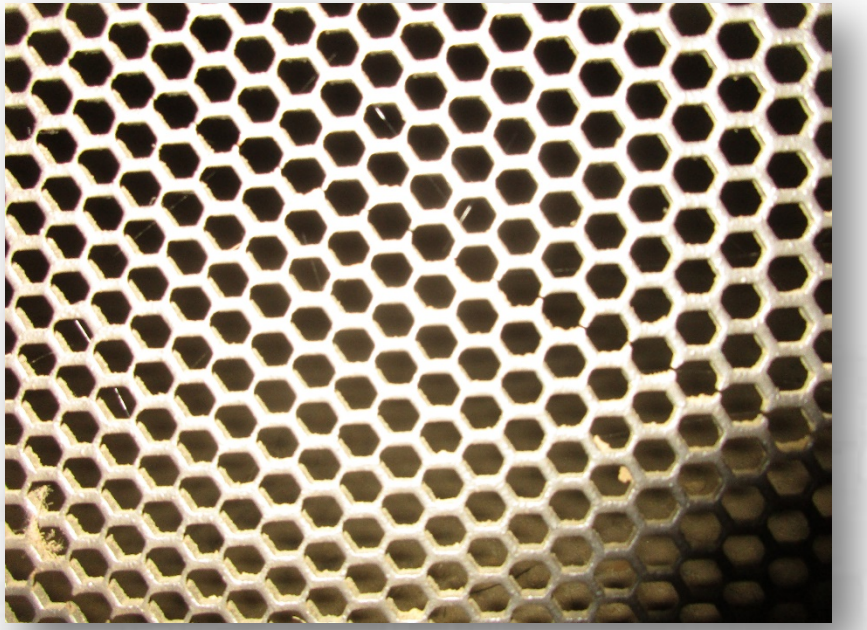
- APS decided to install vacuum ports in leu of replacing/repairing the Screw Conveyor
- Air cannon cleaning system will help keep ash fluidized, helping to reduce ash piling
- APS and IGS decided to add a large cannon nozzle in the hopper to break Ash Bridging to improve vacuum effectiveness
- Air cannon monitoring system installed

IGS Solutions - LPA Screen



LPA Screen Maintenance is Critical – Yet Often Overlooked!

LPA SCREENS ARE LIKE BRAKE PADS, YOU NEED TO CHANGE THEM BEFORE THEY FAIL!!!



- ***Early Signs of Failure, Plan for Change!***

Failure Imminent, Change Now!

Severe Failure

Regular Qualified Inspection is Critical to Protect the SCR Between Outages

Two-Stage Coating Makes Insection Quick and Easy!

IGS Solutions - SCR Air Cannon Upgrades

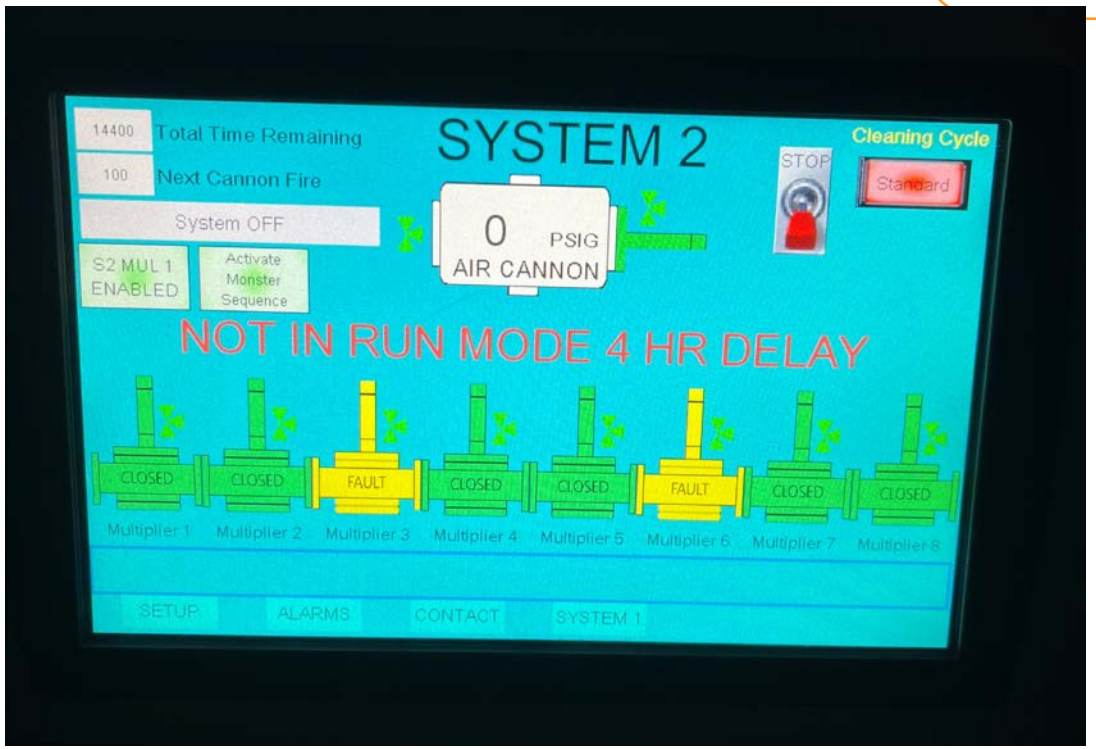
- Air Cannon Upgraded from 4” to 8” increasing power
- Nozzles Upgraded from 4” to 6” increasing blast coverage and depth

IGS Solutions - SCR Air Cannon Upgrades

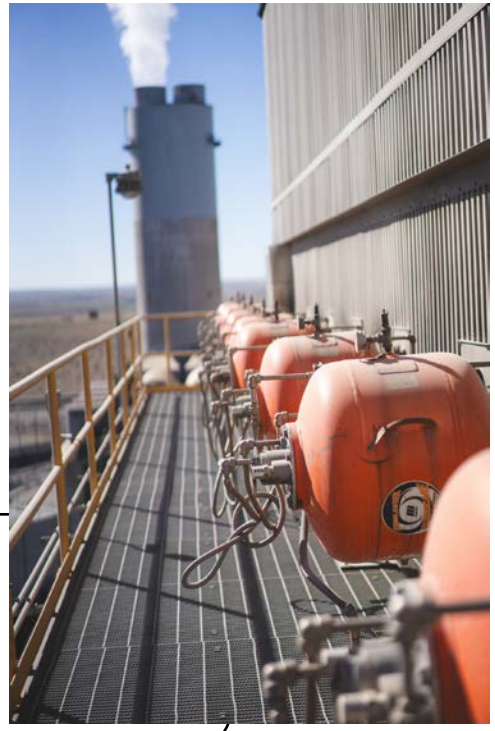
- Multiplier Design - Reduced the ASME Pressure Vessels from 32 per unit to 4 per unit
- Protection from Positive Pressure
  - Multipliers add layer of protection between the process and air cannon internals
  - A vertical discharge section adds distance and elevation preventing corrosive media from reaching multiplier
  - Discharge piping and nozzle material upgraded to stainless

IGS Solutions - SCR Air Cannon Upgrades

- Air Cannon Monitoring System Installed
  - Real time feedback to DCS
  - Reduces need for physical inspection
  - Can Alert DCS of a system malfunction and allow for a quick repair



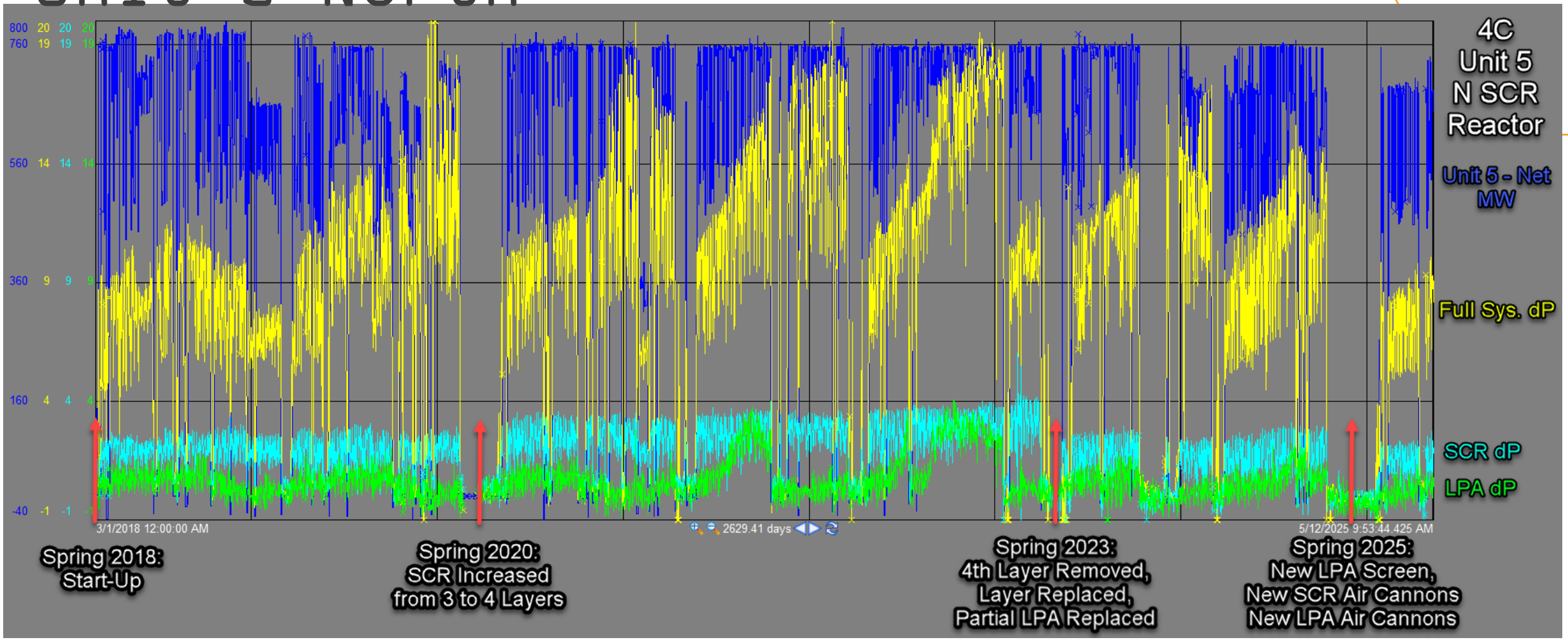
Before & After - SCR



Results

- Inspections have not been conducted post LPA System upgrade
- Inspections of the SCR show less Ash Piling
- After 140 days of Operation on Unit 5 and 90 days on Unit 4:
  - **30-60% less Pressure Drop through out the full system**
  - Projected to reach 14 in H_2O at most, reduction of 6 in H_2O

Unit 5 North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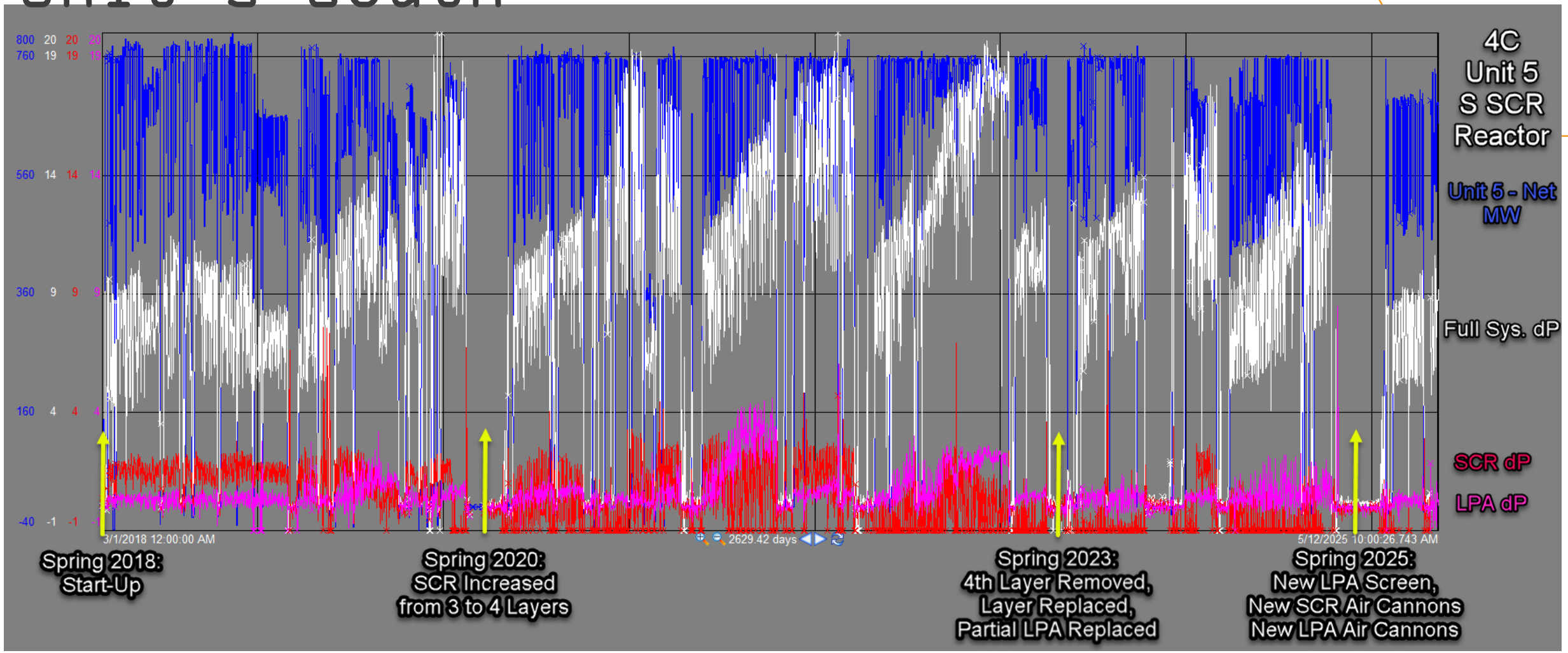
Unit 5 South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760 19 19 19
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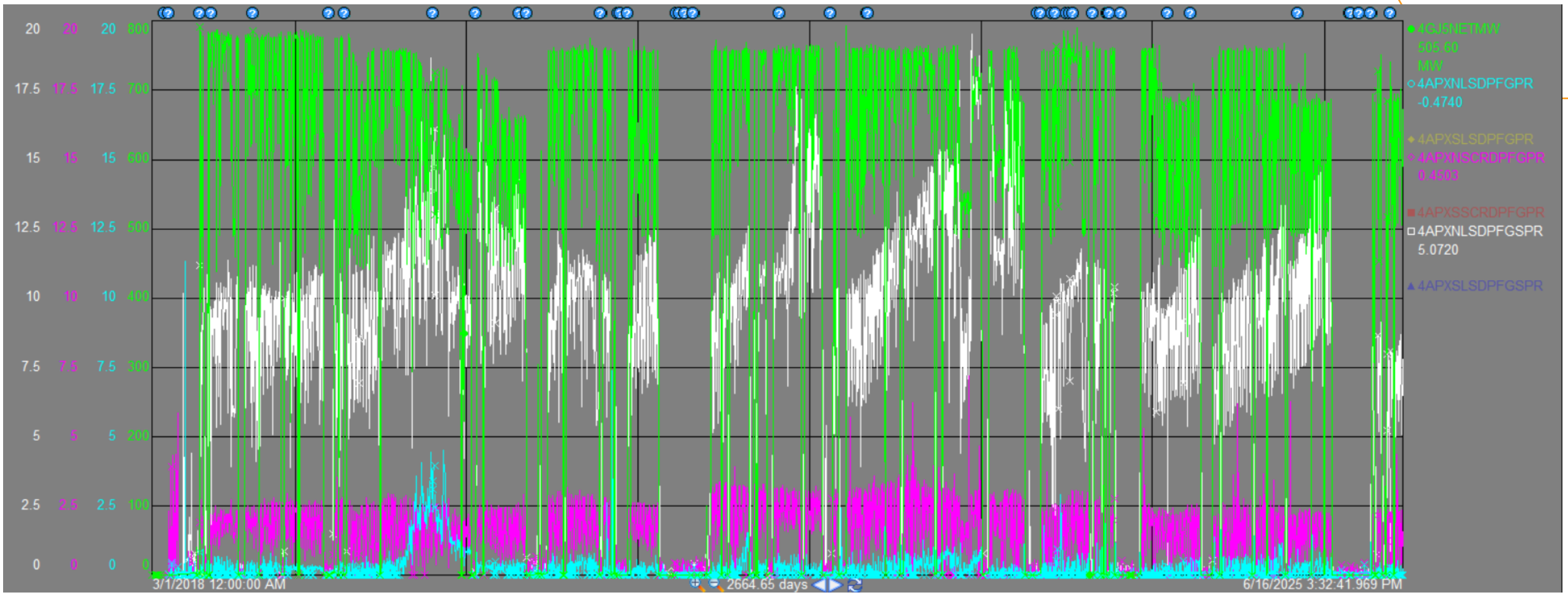
Unit 4 North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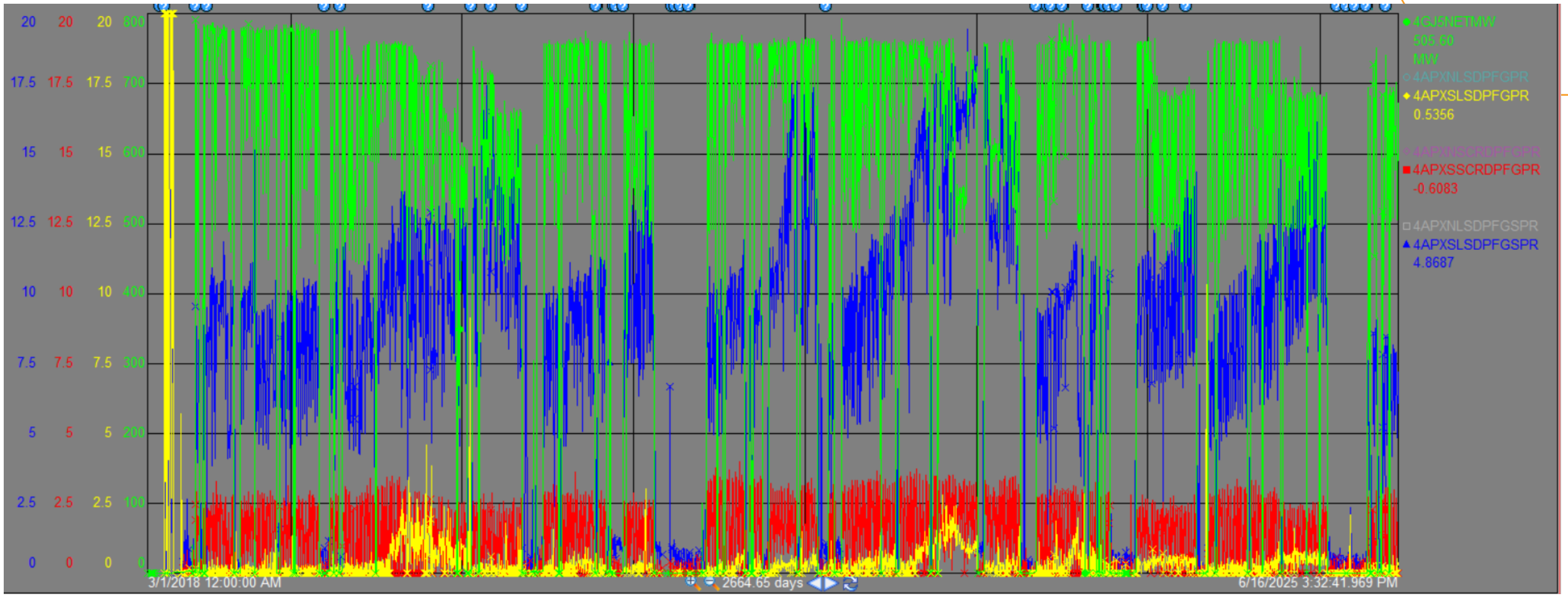
Unit 4 South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Results

- Restored Production & Eliminated DeRates
- Reduced ID Fan Loading
- Reduced Maintenance on Booster Fans, Bag House, & SCR
- Reduced Damage to Preheater
- Reduced SCR Layer Replacements Projects by 1 or 2 before end of life.
  - Reducing waste and Capital $$ needed

Conclusions

- System Performance & Reliability Improved
- MW Production Restored
- Safety Improved, Maintenance Reduced

Special Thanks to:

- Dracyon – Jeff Shelton and his team for support during the projects
- Ceram – Jared Koliha and his team for Project Assistance
- Environex – Andy Toback and his team for their support in reviewing Catalyst Samples and estimating remaining life
- APS Team Members – Bruce Salisbury (Engineer, Retired), Coy Cody (Engineer, left APS)

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Thank you

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