
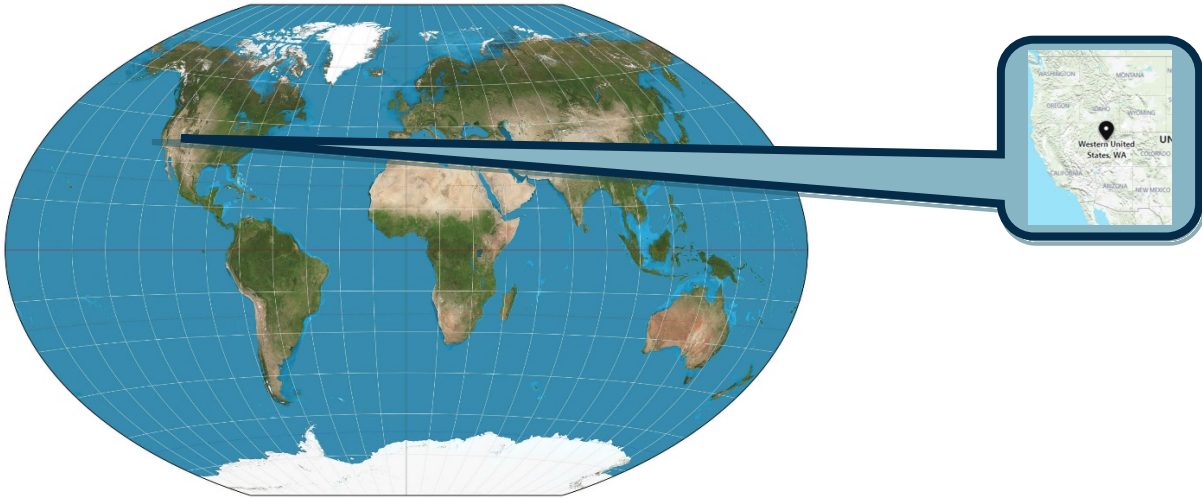


COMBINED CYCLE POWER PLANT
 Post Cleaning Summary

USA
 West

BACKGROUND:

- 2000 Commissioned
- Natural Gas
- Horizontal Gas Flow
- Base Load
- Ammonia Injection grid causes quick fouling
- Plant typically cleans every year
- 4 Modules Cleaned per unit
- PIC Conventional & PIC Deep Cleaning

HRSG	GT & Design	Output
<ul style="list-style-type: none"> • 2- Nooter/Eriksen • 24 wide 55 High 	<ul style="list-style-type: none"> • Two 501 F Gas Turbines • One Steam 	<ul style="list-style-type: none"> • 598 MW Total • 2 x 201 MW GTs • 196 ST MW Total

ASSESSMENT: HRSG fouling causing issues

- Decreased MW output from design
- Increased fuel cost
- Increased back pressure on gas turbines
- Decreased Heat Transfer
- Reduced Thermal Efficiency
- Increased Heat Rate

CLEANING RESULTS:



Comparison of Conventional (Partial) Cleaning vs. PIC Deep Cleaning:

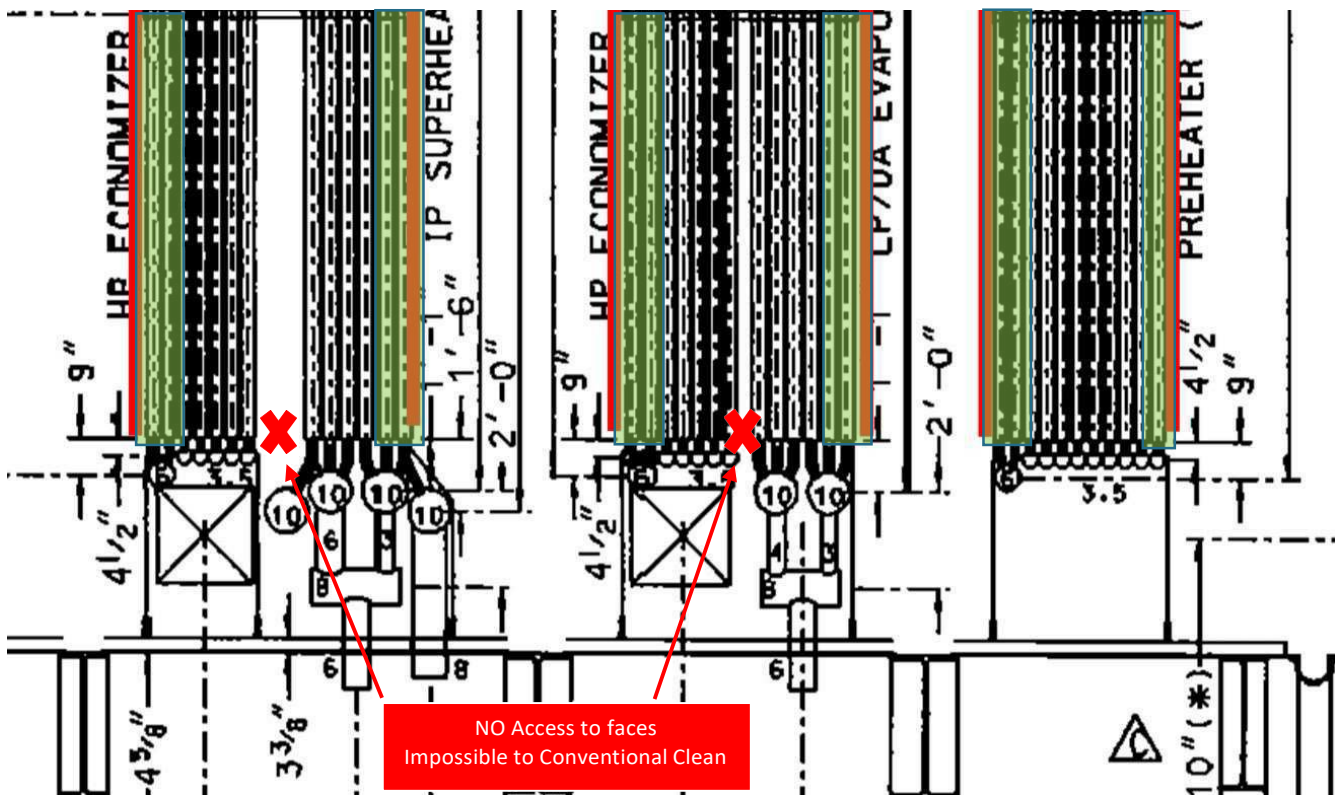
This plant gets severe fouling from the AIG that is necessary at this location. PIC has cleaned this plant once a year for many years and the plant was satisfied with the results of high pressure Conventional Cleaning. After skipping a year of cleaning and then Conventional Cleaning, the amount of back pressure increased even higher than expected.

After convincing the plant to Deep Clean the plant will now only deep clean for all future cleanings. Though all data was not shared with PIC a comparison of the surface areas cleaned with Traditional Surface Cleaning and PIC Deep Cleaning make it obvious that PIC Deep Cleaning is the best option for this plant.

Green areas represent tube surfaces cleaned

PIC Conventional Cleaning (24 Bar / 350 PSI):

Conventional cleaning only cleans the surface of the first rows and lower than 24 Bar pressure cleans even less



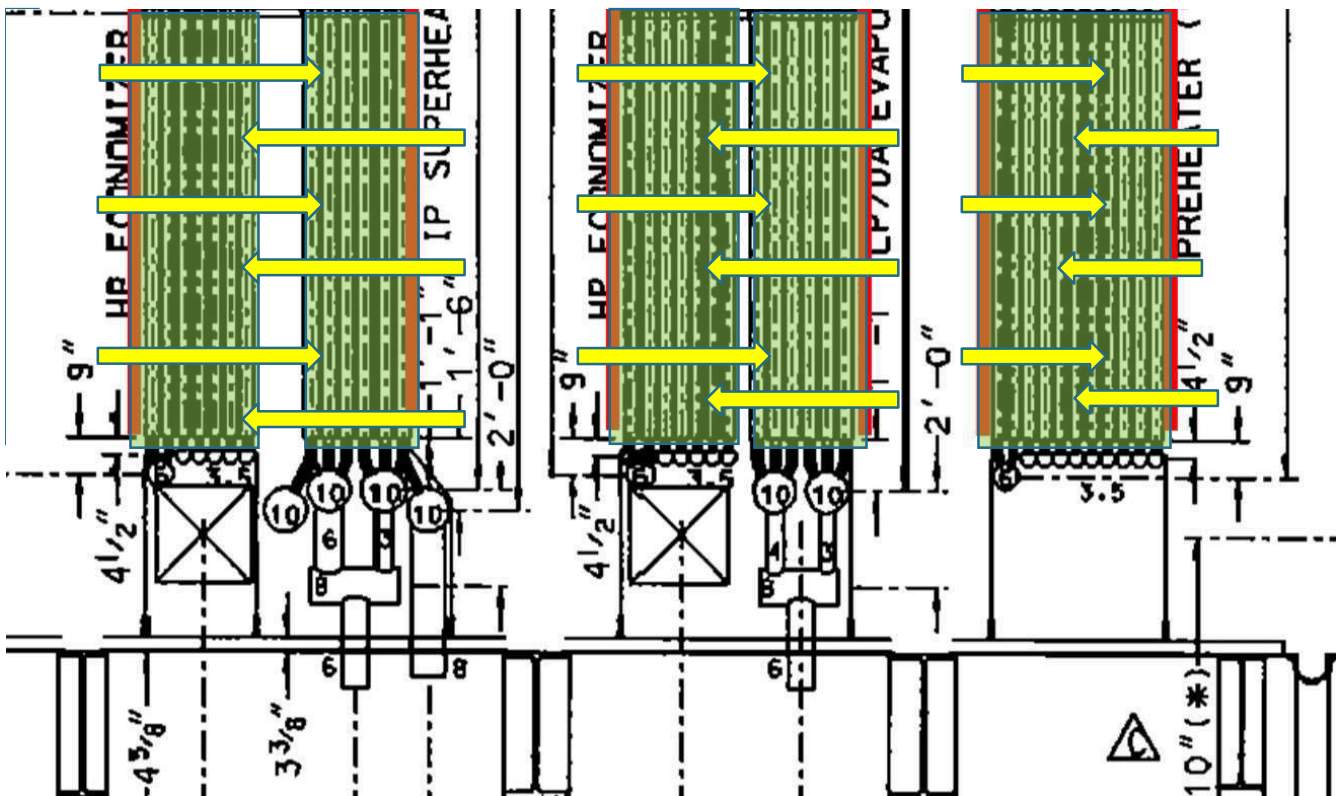
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- “partial” or “surface” cleaning reached debris approximately 2 tubes deep
- This type of cleaning only work effectively for small modules (4-6 tubes) at 24 Bar (350 PSI)
- The amount of cleaning with this method was only 20-25 % of the surface area
- The largest module was 14 rows deep
- Spaces between the modules made it impossible to surface clean where there was no access

PIC Deep Cleaning (24 Bar / 350 PSI)



PIC Deep Cleaning tools reach through modules to clean all faces and overlap to fully cleaning



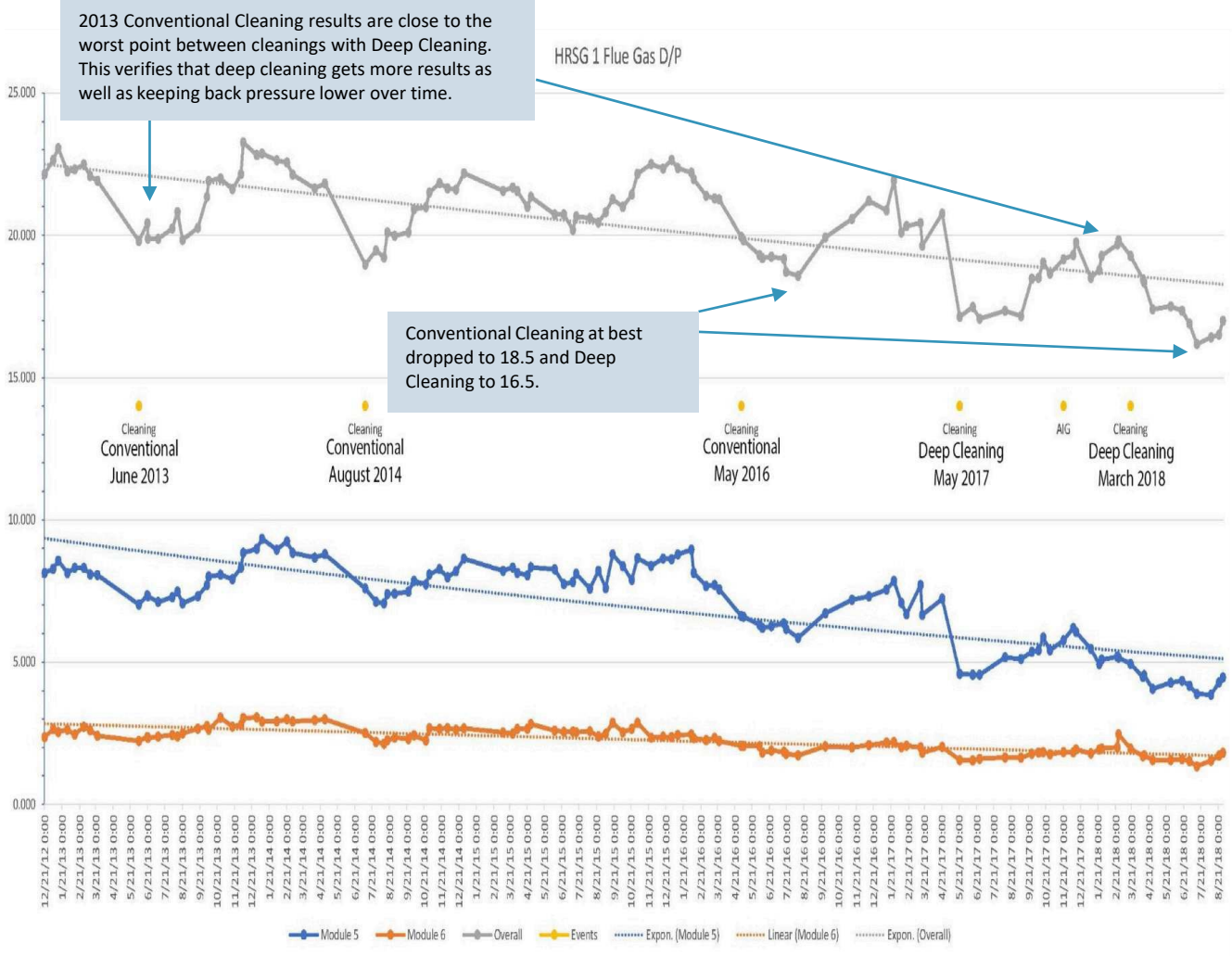
- PIC Deep Cleaning reached debris throughout the modules in all directions
- The amount of cleaning with this method cleaned 95 % of the surface area
- The largest module was 14 rows deep
- Spaces between were reached with special tools and all faces were cleaned even though there was limited access

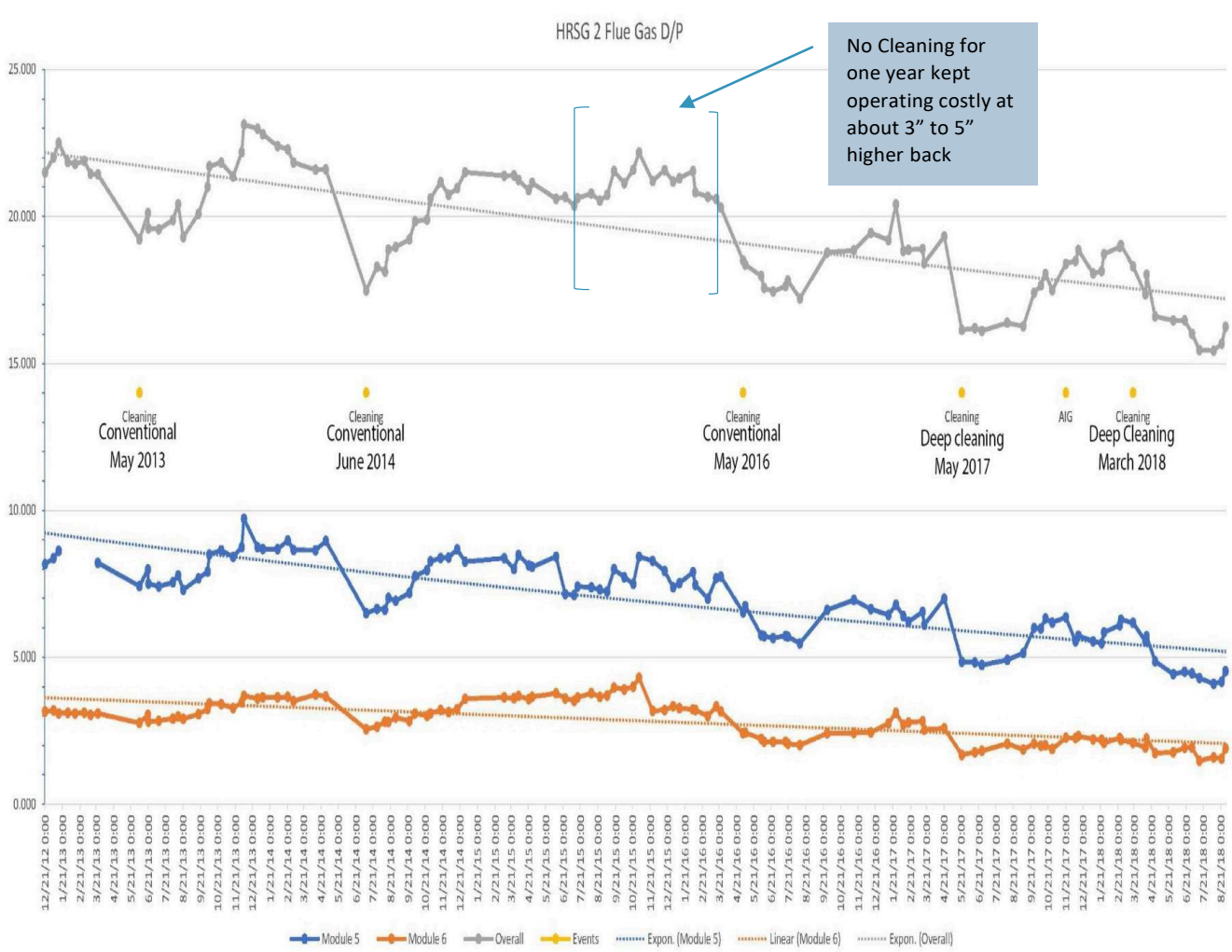
Debris Removed

- PIC Deep Cleaning removed approximately 4x the amount of debris than Conventional Cleaning
- This plant has very quick debris build up due to the ammonia injection grid.

GT Back Pressure (Differential Pressure) over 5 Years

Both HRSGs cleaned showed similar results that HRSG cleaning is beneficial as soon as the HRSG is fouled. The Data also shows the additional benefits of PIC Deep Cleaning.





Summary:

- PIC Deep Cleaning annually was a better investment for the plant than Conventional Cleaning
- This plant can be used as an example for any plant that needs to be cleaned and is deciding on using Conventional Cleaning or PIC Deep Cleaning
- The cost of additional fuel and loss output from 2013 to 2017 was much greater than the additional cost of PIC Deep Cleaning.

“Over the past 5 years, we hired a handful of different companies to perform gas-side tube cleaning of our HRSGs. We tried CO₂ blasting and chemical cleaning”.

“Where others had failed before, Precision Iceblast succeeded”.

Greg Cvetnich Technical Coordinator