



BOILERS AND COMBUSTION CONTROL

Presented By:

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GovEnergy
www.govenergy.gov



University of Texas at Austin

- Utility Plant supports
 - 17 million square feet of facilities
 - 51,000 students
 - 25,000 faculty and staff
- Providing
 - 61 MW of power
 - 30,000 Tons of chilled water
 - 200,000 lbs per hour steam



Background

- Voluntary Emissions Reduction Permit (VERP) submitted in August of 2003
- Proposed reducing NOx by approximately 80%
- Accepted by the TCEQ in December of 2003
- Completion March 1, 2007



Background

- Issued Request for Qualifications (RFQ) in May of 2004
- Over 20 firms responded to RFQ
- Four firms, including Benz Air Engineering, interviewed





RFQ Submittals

Technology	Drawbacks
SCR	Expensive, requires ammonia or other chemical, stack modification
Low NOx Burners	Expensive, requires extensive boiler modification resulting in unknown characteristics.
Over-fired Air	Requires boiler modification, increases parasitic load





RFQ Submittals con't

Technology	Drawbacks
Water / Steam Injection	Water costs, reduced boiler capacity.
Induced Draft FGR	Could not guarantee reductions without water injection
Compu-NOx [®]	Unanimous Selection



Why Compu-NOx[®]?

- Lowest first cost by more than 50%
- Guaranteed lowest NOx emissions rate
- Improve turndown from 10 – 1 to 20 – 1
- Lowest operating cost (boiler operating costs reduced)
- Shortest down-time requirements



Why Compu-NOx[®]?

- In fact out of all 20+ RFQs received this was the only proposal that could claim an “Investment Pay Back”!*





Problem Description

- NOx emission mandates.
- Higher Fuel Costs
- Burner Replacement = Uncertainty
 - Unstable operation
 - Inefficient





Solution

Innovative boiler control system that matches combustion air, fuel, and flue gas recirculation to provide:

- NOx reduction to below mandated levels throughout boiler operating range
- Higher Efficiency for ROI

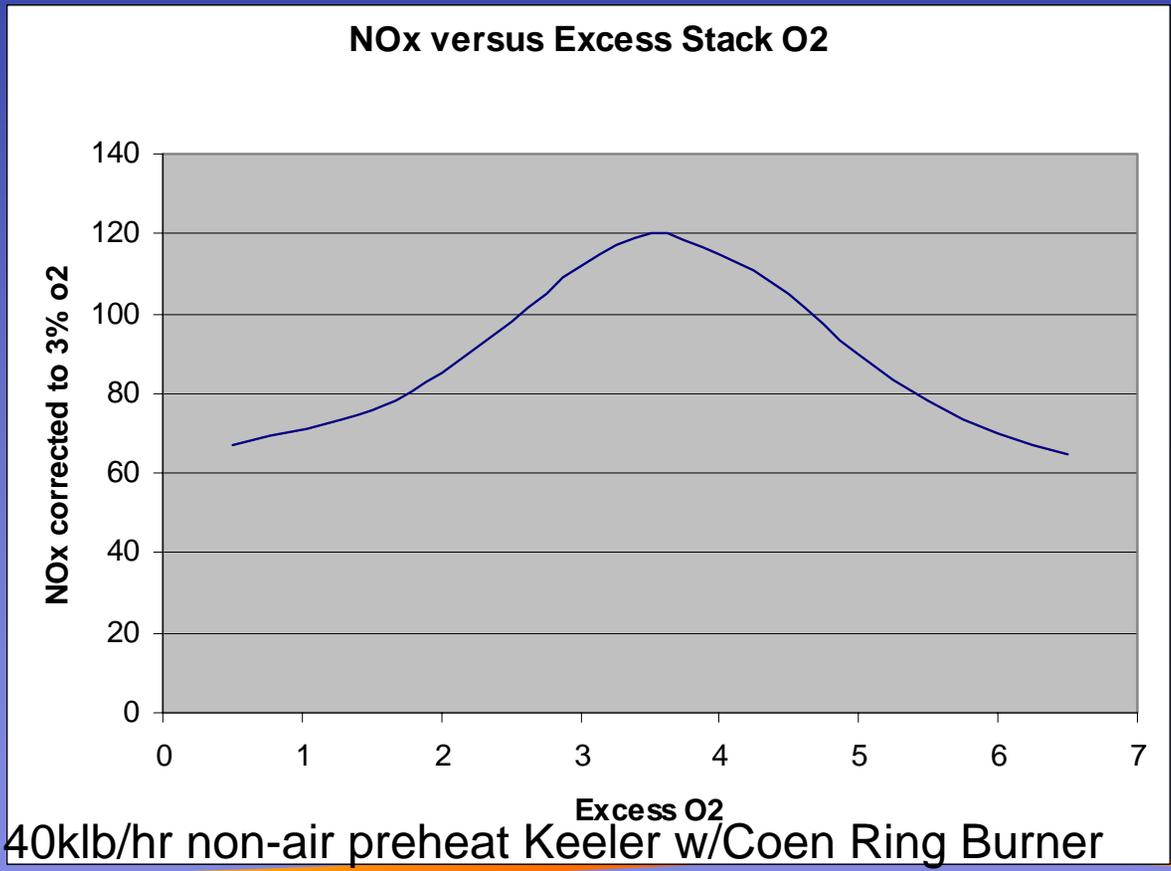
Combustion and Thermal NOx



Heat



NOx versus Excess Oxygen





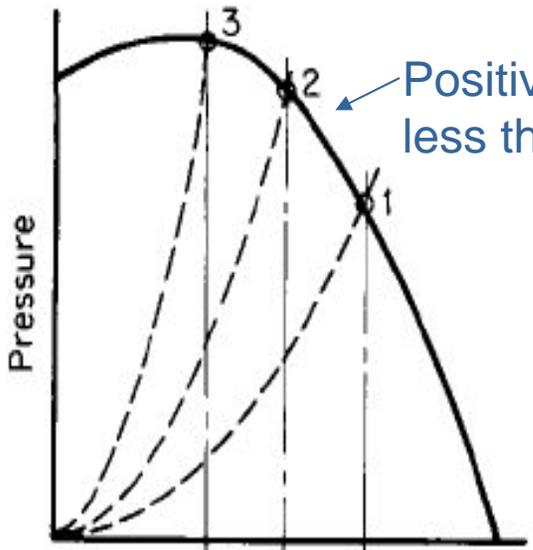
Standard Boiler Operation

- Fixed speed fan controlled by dampers
- Inaccurate control means high excess air delivered to combustion section of boiler (typically 14-16%).
- High temperatures and abundant oxygen radicals in flame promote NO_x formation.
- Flame instabilities at lower loads due to inability to control air flow from fixed speed fans.

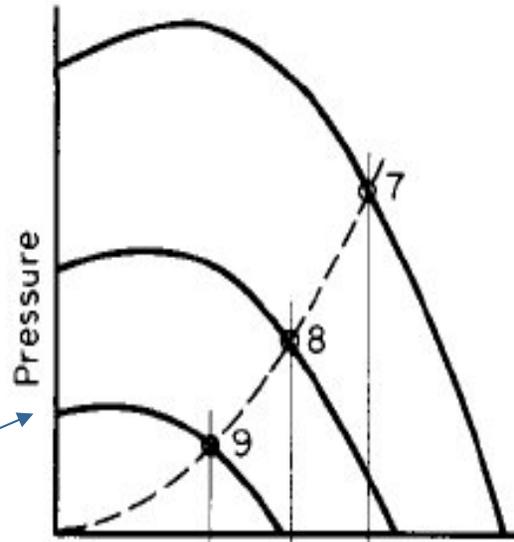
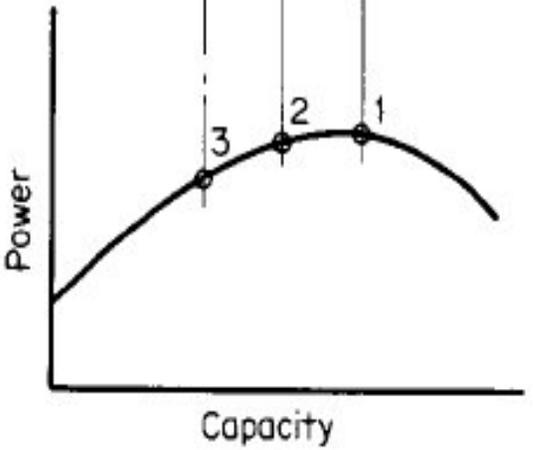


Compu-NOx Design

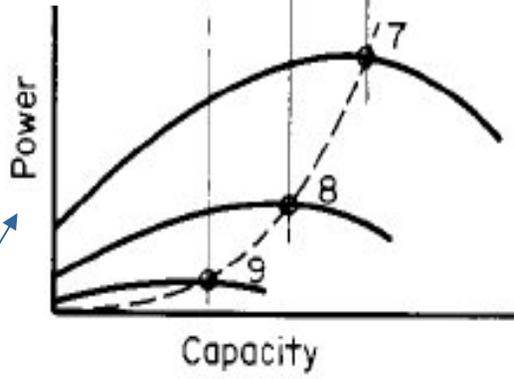
- Near Stoichiometric Combustion.
- Little FGR needed for high NOx reduction.
- Air, fuel, and flue gas recirculation flows are metered throughout the boiler's operating range – from hot standby to full load conditions.



Positive slope characteristic at loads less than 50%. Impossible to control!



Stable Operating Point throughout the load. Repeatable Control throughout the load with Unlimited Turndown.



Cubic Reduction in Power

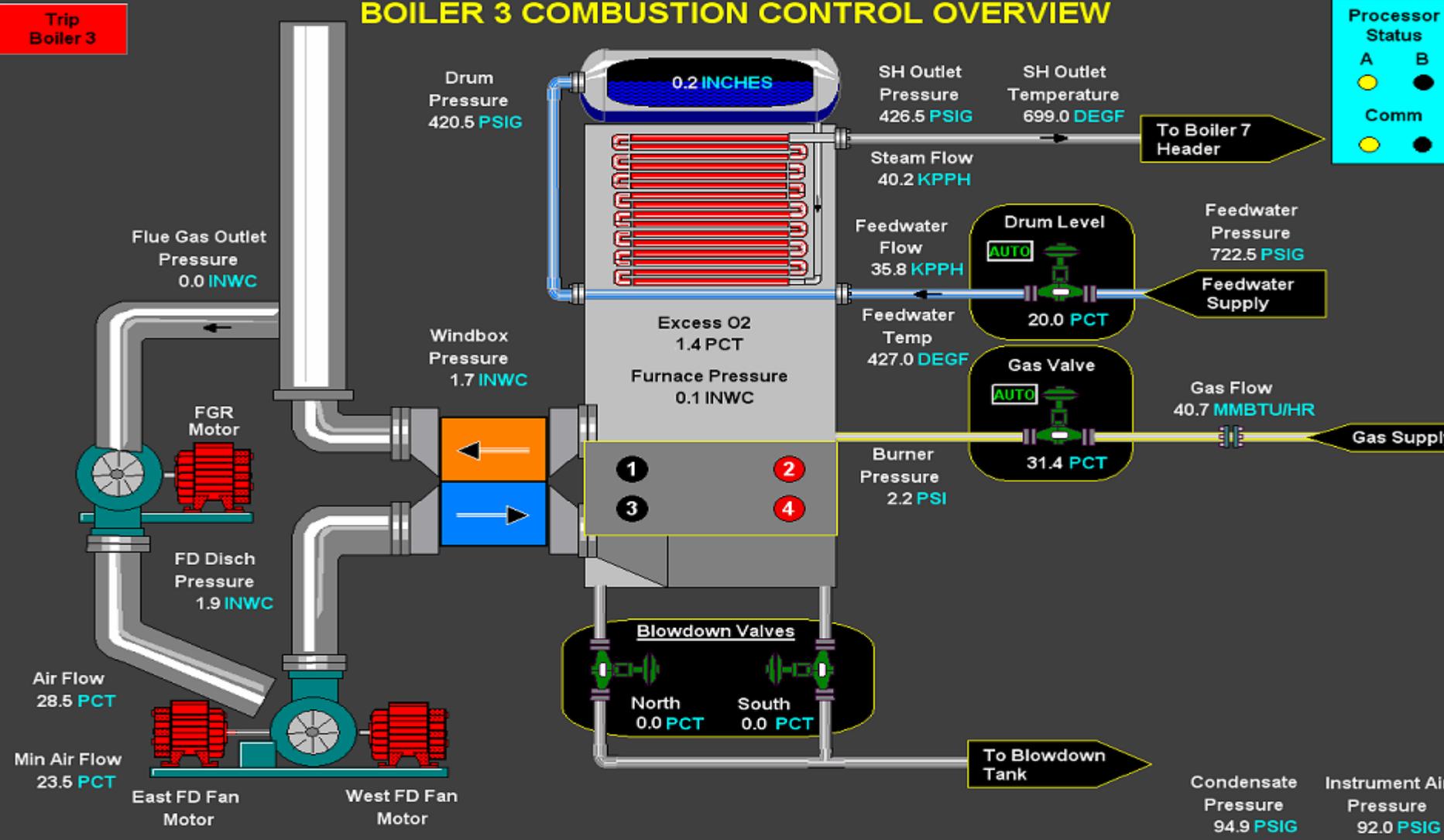
Damper Control

VFD Control

Compu-NOx Advantages

- Utilizes existing boiler burners and fans
- Can be integrated into existing plant operating networks
- >100 to one boiler turn-down.
- VFD Combined with Proper PLC Control = Control of Air and Flue gas
- Cubic Reduction of Horsepower
 - 600hp fan will consume 75hp at 50% load---
 - 0.6hp at 10% load!

BOILER 3 COMBUSTION CONTROL OVERVIEW



Processor Status

A B

Comm

Boiler 7 CCS Overview	Suppress CCS Alarms	Show Fuel Oil	FD/FGR/AIR Details	Boiler 3 Trends	Boiler 3 Alarm Setpoints	Boiler 3 Transmitters	Boiler 3 BMS Overview
LOCAL ACK	ALM SUM	Alm: 0, Sup:					ALL ACK



Boiler #3 – University of Texas

- 1950's vintage Babcock & Wilcox Boiler
- 500F Combustion Air Temperature.
 - Competing proposals required eliminating air preheat.
- 4 ring burners (original) and rated for 150,000 lbm/hr
- Compu-NOx installed 2005.
- NOx reduced from 220ppm to 18ppm - Natural Gas
- NOx reduced from 320ppm to 28ppm - #2 Oil
- Boiler efficiency increased from 76% to 85%
- Ability to bank boiler results in \$6000.00/day savings
- Simple payback in 2.2 months

Overview and Data Courtesy of The University of Texas at Austin



Conclusions

- Both Emissions reduction and efficiency gains can be achieved through proper boiler control.
- Existing equipment can be utilized to achieve significant value to operating plants.

With proper control “A good burner is a low NOx burner”



Guaranteed Results?

- Both boilers surpassed the VERP required reductions both on natural gas and fuel oil
 - Boiler 3 - 184 ppm to 22.2 ppm
 - Boiler 7 – 296 ppm to 27.5 ppm
- Efficiency improvements of between 5 and 10% depending on load
- Turndown better than 20 to 1



Guaranteed Results?

- Savings from reduction in HP
 - ~\$100,000 annually
- Savings from increased boiler efficiency (lower excess air)
 - ~850,000 annually
- Less than a 2 year payback!!!

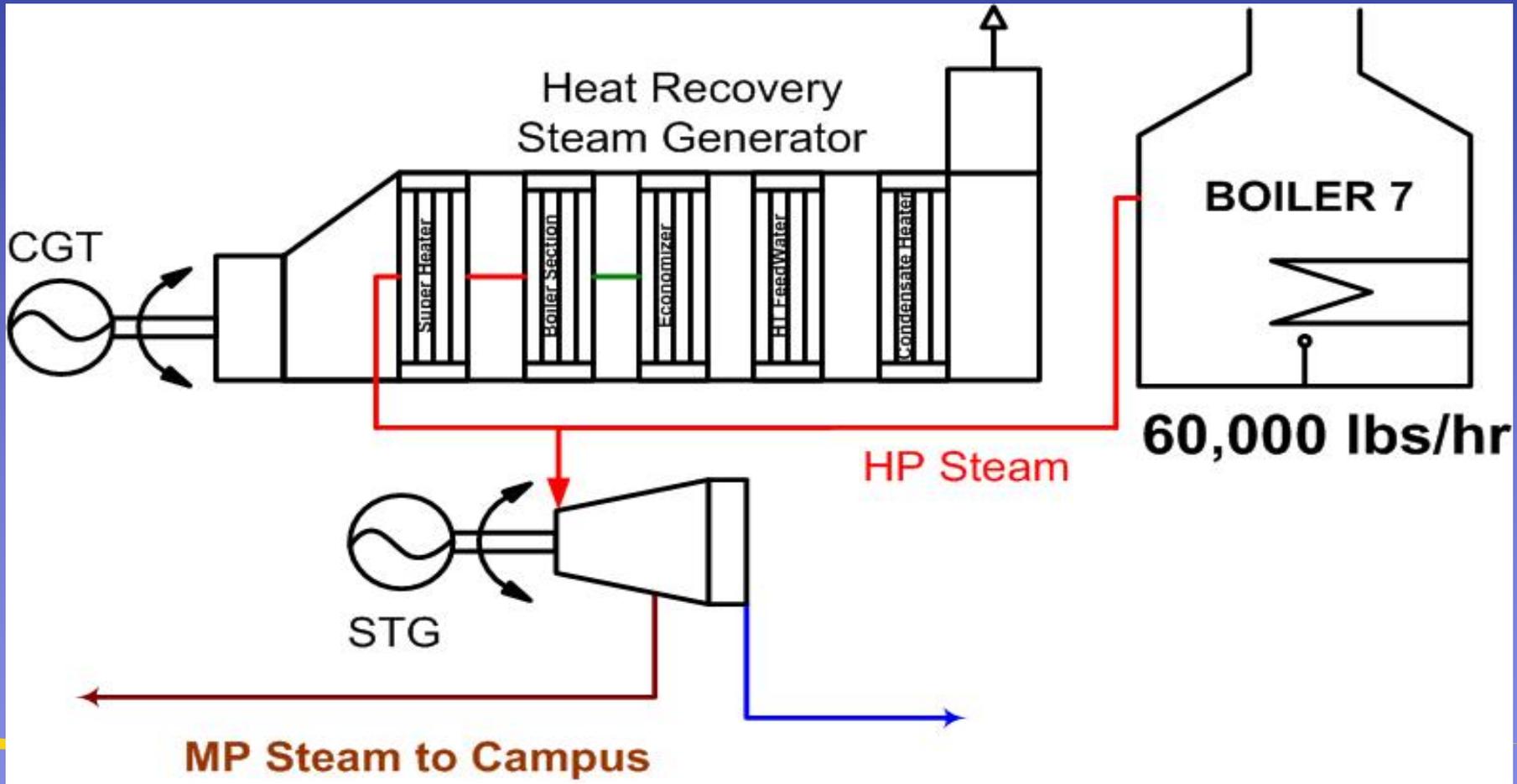


Unexpected Results!

- After control modifications boilers were much more responsive
- Although 20 to 1 turndown possible, water treatment issues surfaced
- Discovered it was possible to “Bank” either boiler
- This allowed a new operating condition

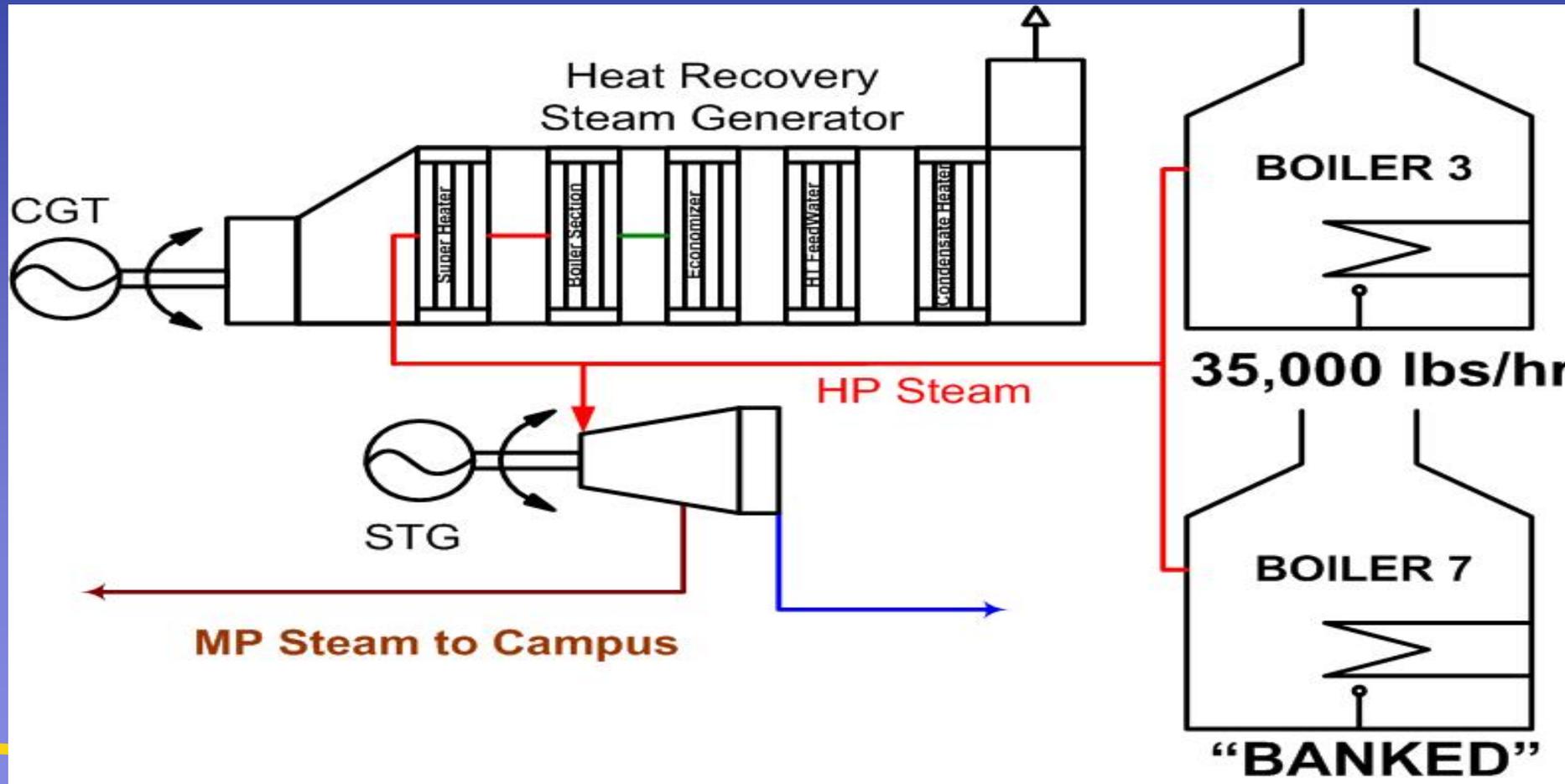


Original Plan





New Plan





Actual Results

- Savings from reduction in HP slightly higher ~\$110,000 per year
- Savings from “Banking” boiler
 - *Over \$2 million annually*



Summary

- Exceeded required NOx reductions
- Significantly reduced operating costs





Would you like to know more about this session?

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- Don't forget to fill out and drop off your session evaluations.



For More Information

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