"A Test is Worth a Thousand Words"

Performance Driven Maintenance is the Solution

DOES YOUR BOILER EXPERIENCE ANY OF THE FOLLOWING?

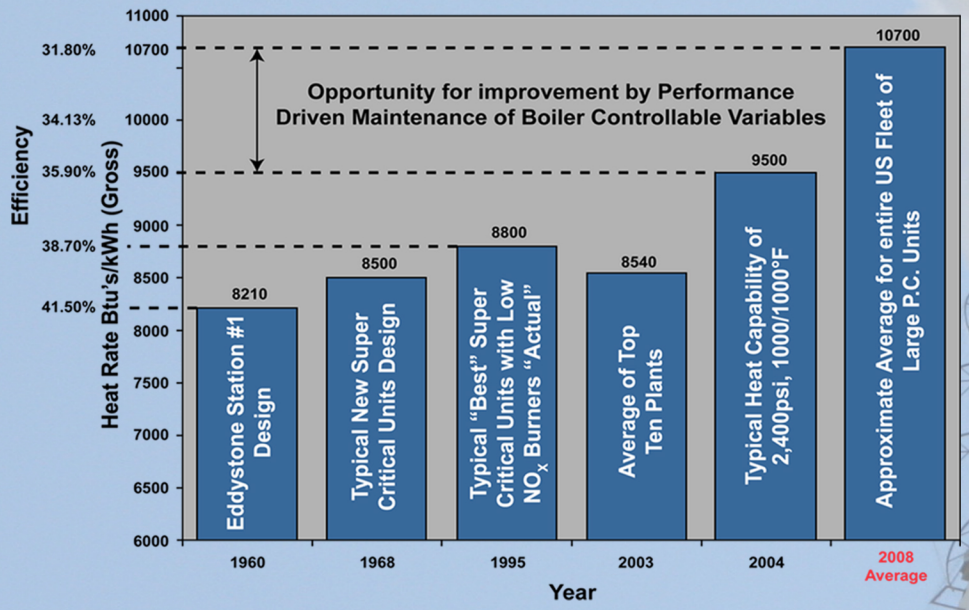
- Furnace Slagging/Fouling
- High Superheat/Reheat Sprays
- Airflow Management Issues
- High CO or NO_x Levels
- Over-firing SNCR/SCR Injection
- Poor Pulverizer Performance
- Fan Capacity Issues
- High LOI or Carbon in Ash
- Opacity Issues
- Reduced Availability & Reliability

STORM'S SOLUTION IS "PERFORMANCE DRIVEN MAINTENANCE"

In today's power market, it is becoming more and more challenging for boilers to operate as they were designed. Sometimes the equipment with the most use is not always the worst performer. While some equipment adheres to an overhaul schedule based on hours fairly regularly, it is not uncommon for boiler equipment (specifically pulverizers) to vary significantly based on the same hours of operation. That is why Storm recommends the performance driven maintenance approach.

Performance Driven Maintenance (PDM) is basing your outage focus on what is causing your unit's poor performance. Is your fineness on a particular mill poor? Then maybe you need to replace the worn out classifier blades. The concept is targeted to get the best bang for your buck. Everyone's budget is tight, so spend your money where it will make the biggest impact.

It is not uncommon for Storm to find 500 Btu/kWhr heat rate improvements by addressing performance driven maintenance. The following table shows how heat rate has increased since its original design and how PDM can improve this. We must first test to identify the opportunities that impact unit performance, reliability, heat rate and availability.



Heat Rate Improvement Opportunities from Design to Present

IN THIS ISSUE:

- Performance Driven Maintenance
- Four Step Process for Combustion Optimization
- Storm's 13 Essentials for Combustion Optimization

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Combustion Optimization

In many cases it is believed that a boiler is optimized until a forced outage occurs, CO/NO_x excursions, furnace slagging & fouling and high spray flows. It is common to find a boiler running at 3% excess oxygen at the economizer outlet and 0% at the furnace exit with CO greater than 4,000 PPM with slagging and excessive spray flows. It never fails that these issues are experienced when power demand and costs are high. So, how do we address these challenges?

Storm Technologies suggests a four step process for combustion optimization. We have a staff with many decades of experience and have been recommending this approach for nearly 20 years.

A Four Step Process

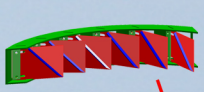
1. Conduct hands on testing with a proven CI Program
2. Conduct an ongoing "Performance Driven Maintenance" Program
3. Outage Planning based on the previous
4. Combine Teamwork with O&M to work together as the Performance Preservationists

Performance driven maintenance should be determined from testing efforts and preferably prior to an upcoming outage. Pulverizer performance and HVT testing will help determine which pulverizers and burners need more maintenance attention based on the test conclusions. Once the boilers pre-outage testing is completed and the opportunities are identified, a plan can be established for the outage.

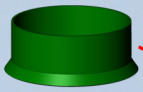
If you are familiar with Storm, you have seen our Thirteen Essentials for Optimum Combustion and or heard us talk of getting the fundamentals and inputs right! Nine of our thirteen essentials focus on the pulverizers and we believe that the key to combustion optimization begins at the pulverizers. The figure below illustrates our recommended approach and products for pulverizer performance and ultimately combustion optimization.

Fuel feed to the pulverizers should be smooth during load changes and measured & controlled as accurately as possible. Fuel feed quality and size should be consistent. Consistent raw coal sizing of feed to pulverizers are a good start (Max of 1"). Storm recommends that installation of STOCK® Coal Feeders.

Storm™ straight high spin classifier vanes with coarse particle guide for improved circulation, air/fuel distribution and coarse particle rejects.

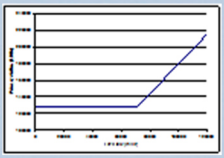


Extended outlet cylinder for improved homogenization and 50 mesh particle rejection.



Storm™ designed Primary Airflow Venturis for improved accuracy,desired to be accurately measured and controlled to ±3% accuracy.

Primary air/fuel ratio shall be correct & accurately maintained when



Journal spring pressures must be uniform for all three journals and at appropriate levels for fuel hardness and capacity.

Inverted cone with proper clearance to provide free flow of coarse particle rejects, yet restrict primary airflow from entering.

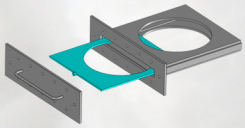
Neoprene seals at journal penetrations forminimal air in-leakage paths.

Journal to bull ring clearance 1/4" to 3/8" Max.

Maintain pyrite sweeps within 1/8" clearance.

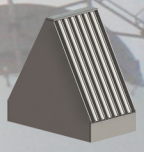
Orifices and housings for achieving optimum clean air system resistance

- Fuel lines balanced by "clean-air" tests +2% or better.
- Fuel lines balanced by "Dirty Air" test +5% or better.
- Fuel lines balanced by fuel flow +10% or better.
- Fuel line minimum line velocities shall be maintained.

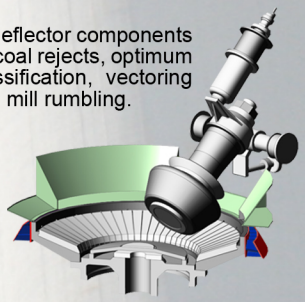


Fuel line fineness shall be 75% or greater passing a 200-mesh screen. 50 mesh particles shall be less than 0.1%.

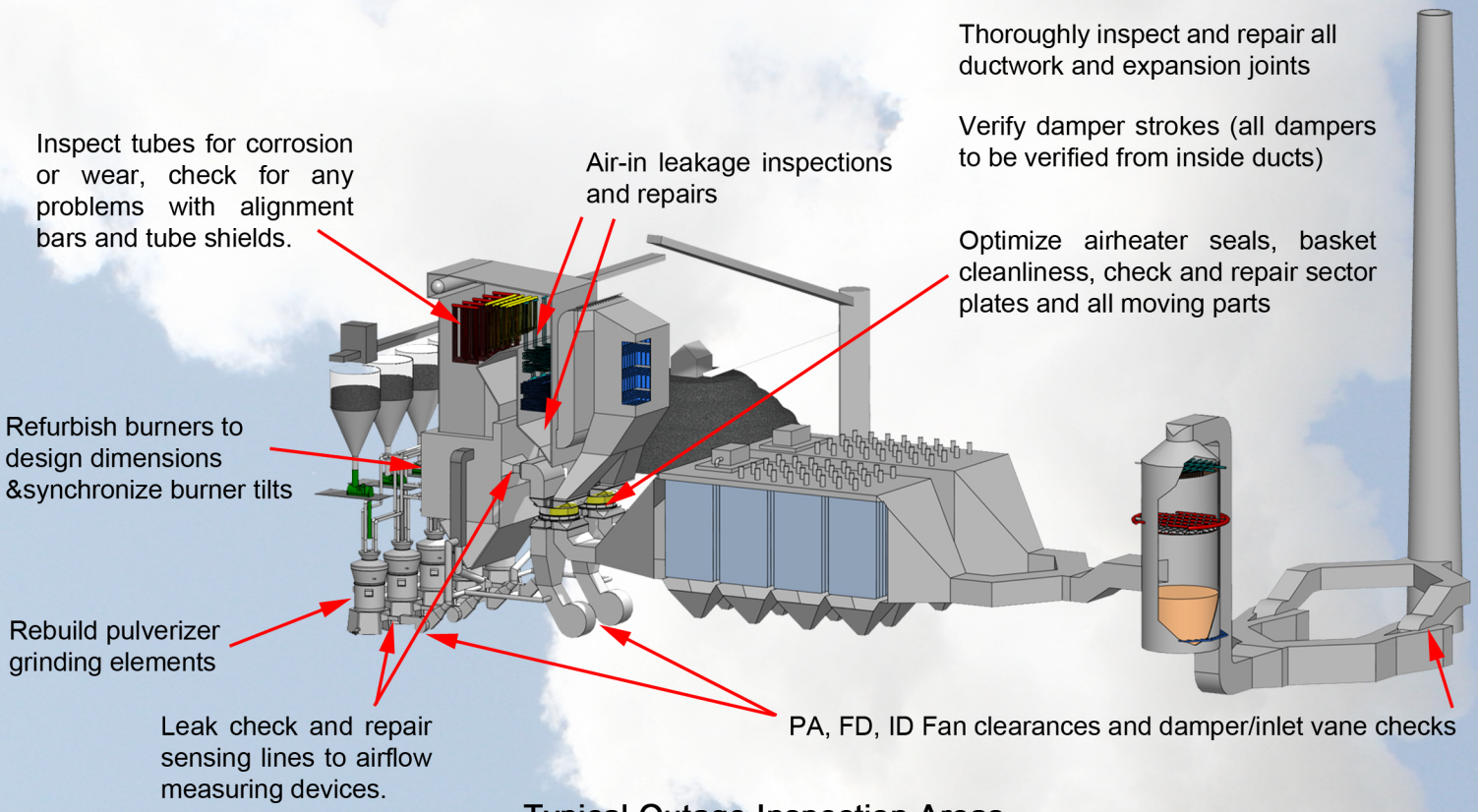
Storm™ fine cut riffles for improved fuel distribution (Fabricated from wear resistant Material and heavy duty for longevity)



Throat and deflector components for reduced coal rejects, optimum primary classification, vectoring and reduced mill rumbling.



The following figure shows typical outage inspection areas and if the test results identify air in-leakage in certain areas they can be targeted and planned for the outage.



Typical Outage Inspection Areas

As previously discussed, we feel that there are up to approximately 500 Btu/kWhr of heat rate opportunities on the table and by identifying these opportunities and embracing Storm's Thirteen Essentials for Optimum Combustion, it is possible to gain these in a short period of time. Upon completion of the outage and recommendations based on the pre-outage testing it would be recommended to complete post outage testing to review the performance and provide additional recommendations for performance preservation.

Storm has been successful with testing and tuning to reduce CO, NO_x and carbon in ash (LOI) by tuning the burners, pulverizers and applying our Thirteen Essentials for Optimum Combustion (provided on next page). Storm approach is unique where we are not just probe pushers we provide solutions to plant challenges and we believe in our mantra SERVICE, QUALITY, RESULTS. Please let us know if you have any questions and for planning of pre-outage testing so that you can be prepared for the fall and spring outages to improve unit performance and heat rate. We look forward to working with you and your team in the near future and appreciate the opportunities provided to us in the past and future.

Sincerely,

Danny Storm

Danny Storm
President/Senior Consultant

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Service - Quality - Results

Thirteen Essentials of Optimum Combustion for Low NO_x Burners

1. Furnace exit must be oxidizing preferably, 3%.
2. Fuel lines balanced to each burner by "Clean Air" test ±2% or better.
3. Fuel lines balanced by "Dirty Air" test, using a Dirty Air Velocity Probe, to ±5% or better.
4. Fuel lines balanced in fuel flow to ±10% or better.
5. Fuel line fineness shall be 75% or more passing a 200 mesh screen. 50 mesh particles shall be less than 0.1%.
6. Primary airflow shall be accurately measured & controlled to ±3% accuracy.
7. Overfire air shall be accurately measured & controlled to ±3% accuracy.
8. Primary air/fuel ratio shall be accurately controlled when above minimum.
9. Fuel line minimum velocities shall be 3,300 fpm.
10. Mechanical tolerances of burners and dampers shall be ±1/4" or better.
11. Secondary air distribution to burners should be within ±5% to ±10%.
12. Fuel feed to the pulverizers should be smooth during load changes and measured and controlled as accurately as possible. Load cell equipped gravimetric feeders are preferred.
13. Fuel feed quality and size should be consistent. Consistent raw coal sizing of feed to pulverizers is a good start.

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- Service/Quality/Results
- NOX Emissions Tuning and Control
- Secondary Air Balancing
- Combustion Improvement Programs
- Air Heater Leakage and Performance
- Failure Analysis
- Full Service Fabrication and Machining
- Consulting
- Short Courses
- Outstanding Fabrication Quality
- Complete Annual Service Contracts
- Fuel Change Evaluations
- Comprehensive Boiler Inspections
- Boiler Surface Area Evaluations
- Technical Direction of Outage Repairs
- Air In-Leakage
- Specialized Testing Equipment
- Testing and Corrective Plans of Action
- Airflow Measurement Devices
- Pulverizer Capacity and Fineness
- Flyash Carbon Reduction Programs
- Immediate Technical Responses