



The STORM Approach to Reliability

Achieving high reliability of large utility power plants has become more important than ever. Countering the need to increase load factor and increase reliability are the pressures to:

- Increase load cycling and response times
- Achieving lower loads
- Increase time between major overhaul
- Use lower cost, poorer quality fuels with increased slagging and fouling tendencies
- Operate with less NOx emissions by reducing furnace oxygen, low NOx burners, and fuel staging

We suggest an approach, outlined in this newsletter, which has proven effectiveness for improvements in reliability.

Reliability Through Teamwork

Those familiar with Storm know that it all begins with applying the 13 Essentials. First, apply the 13 Essentials to the furnace inputs. The vast majority of forced boiler outages are caused, in our experience, by tube failures, slagging, fouling and burner overheating damage. Many of these root causes can be either predicted or prevented by an on-going effective boiler performance and reliability preservation program. The teamwork comes in when testing is used to drive pulverizer maintenance. Often, we visit plants that perform pulverizer maintenance based on operating hours, or fuel tons throughput. In our view, pulverizer maintenance should be driven by periodic tests of pulverizer performance. The important elements of pulverizer performance are fineness, fuel distribution, coal (pyrites) rejects, and primary airflow calibrations.

Optimizing pulverizer performance is a prerequisite for optimum furnace combustion. About three-fourths of the 13 Essentials are pulverizer, primary air and fuel line related. The pulverizers are truly the heart of a modern pulverized coal fueled boiler.

STORM's 13 Essentials

1. Furnace exit must be oxidizing, preferably an average of 3.0% with no single point below 2.0%.
2. Individual fuel lines balanced by "Clean Air" test to within $\pm 2\%$ deviation from the mean or better.
3. Fuel lines balanced by "Dirty Air" test, using a Dirty Air Velocity Probe, to $\pm 5\%$ deviation from the mean or better.
4. Fuel line flows balanced to $\pm 10\%$ deviation from the mean or better.
5. Fuel line fineness shall be 75% or more passing a 200 mesh screen. Particles remaining on 50 mesh shall be less than 0.1%.
6. Primary airflow shall be accurately measured & controlled to $\pm 3\%$ accuracy.
7. Overfire air shall be accurately measured & controlled to $\pm 3\%$ accuracy.
8. Primary air/fuel ratio shall be accurately controlled when above minimum line velocity.
9. Fuel line minimum velocities shall be 3,300 fpm or higher. (3,300 fpm allows for $\pm 10\%$ imbalance, 3,000 fpm absolute minimum)
10. Mechanical tolerances of burners and dampers shall be $\pm 1/4"$ or better.
11. Secondary air distribution to burners should be within $\pm 5\%$ to $\pm 10\%$ deviation from the mean.
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.

Boiler TUBE FAILURE Mechanisms which cause Forced Outages

1. Corrosion Fatigue*
2. Flyash Erosion*
3. Hydrogen Damage
4. Long Term Overheating (Creep)*
5. Short Term Overheating*
6. Sootblower Erosion*
7. Waterwall Fireside Corrosion*
8. Falling Slag Erosion*

*Denotes: Those failure mechanisms that could be combustion side related



Figure 1: Tube Failure

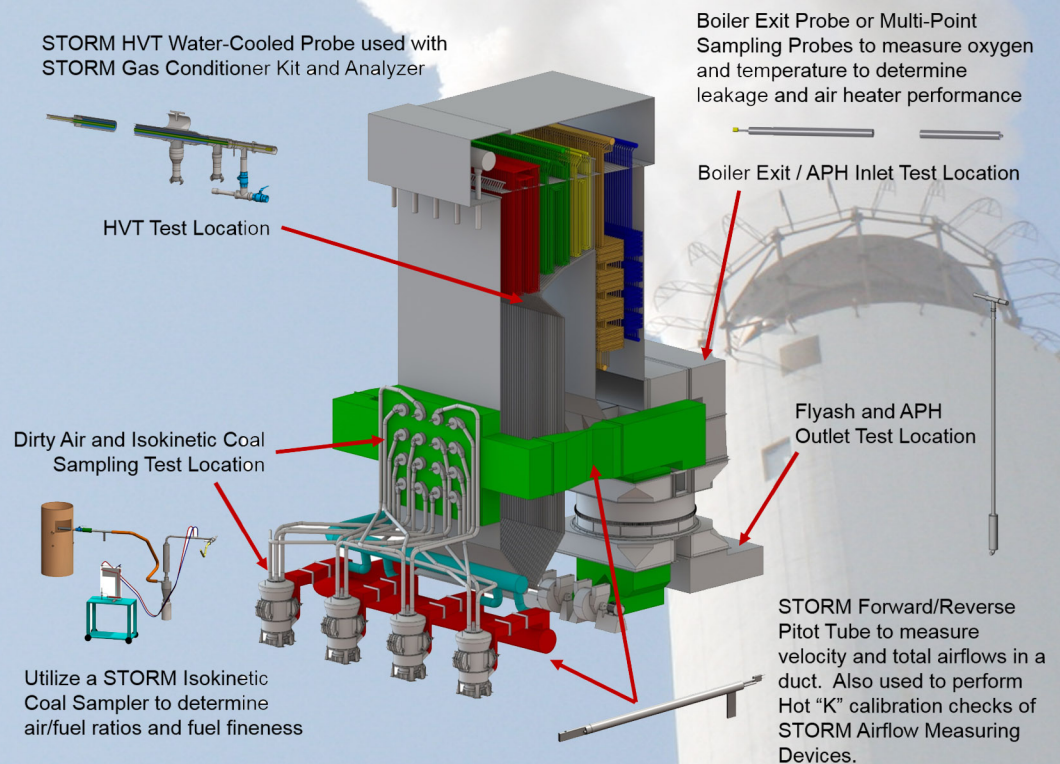
Pulverizer Performance and Tube Failures: Are They Related?

Yes, often these are. Poor fuel fineness is usually associated with poor fuel distribution. This combination can lead to fuel rich lanes of the products of combustion in the upper furnace. These actively burning lanes of fuel rich gases accelerate superheater slagging, and sometimes create localized temperatures over 2,500°F. This is conducive not only to slagging but also to high metal temperatures. Reliability becomes impaired as an adverse result of tube erosion from excessive sootblowing to remove the slag and/or from long term overheating. The root cause once again, combustion optimization.

Seven of the eight largest causes of tube leaks could be, and often are, related to fire side, combustion optimization.

Outage Work Planning by Completing a Comprehensive Diagnostic Test

Some of our customers have used the application of testing before the outage. Testing is now more common prior to outages due to those still adhering to MATS. This information is not always utilized to its full extent. As stated earlier, there are fewer outages, and there are less available budget funds for outage repairs. By completing a comprehensive diagnostic test before the outage, the “opportunities for improvement” can be identified and quantified. The figure below shows the test locations for a comprehensive diagnostic test on a typical coal fired boiler.

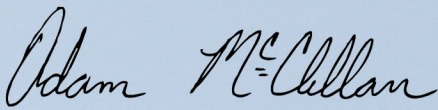


Where Does The Teamwork Come In?

Most power plants have leaner staffs now than in previous years. Most plants do not have a large group dedicated solely to testing and performance. It is hard to find the people to perform weekly pulverizer tests, daily flyash testing, and periodic airflow calibrations. One solution is to combine operations, maintenance, engineering and a special test contractor (like STORM). By this teamwork approach, predictive and preventive maintenance can be planned so that the boiler performance is preserved, and precious maintenance funds are used wisely. We know that this works, because we have participated at plants where it does. We have experience driven beliefs that this is the best approach to performance and reliability optimization. Perhaps hard to implement, but worth it considering the stakes and benefits pay back.

The STORM team has participated in a number of performance preservation and reliability improvement programs over the years. We have shown how the successful implementation of getting the furnace inputs right can improve unit heat rate, capacity factor and reliability. What we have recommended may not be the easiest, most sweat-free methods to achieving optimum performance, but they have been proven to be effective! If you would like to setup a performance preservation or reliability improvement program contact Storm and we will be glad to assist through planning, implementation or providing the needed equipment in order to get your facility started.

Yours very truly,



Adam McClellan, P.E.
Storm Technologies, Inc.

Disclaimer: These suggestions are offered in the spirit of sharing our favorable experiences over many years. Storm Technologies, Inc. does not accept responsibility for actions of others who may attempt to apply our suggestions without Storm Technologies' involvement.



LARGE ELECTRIC UTILITY BOILER COMBUSTION AND PERFORMANCE OPTIMIZATION SEMINAR

JULY 21-23 , 2020

HILTON HEAD MARRIOTT RESORT & SPA
HILTON HEAD ISLAND, SC

Course Topics:

- Basic Steam Generation
- Evolution of Steam Generators
- Boiler Fundamentals & Design
- Water & Steam Properties
- Basic Thermodynamics
- Boiler Reliability
- The Fundamentals of Combustion
- Typical Plant Performance Challenges
- Comprehensive Diagnostic Testing
- Heat Rate Awareness
- Applying the Essentials
- Coal Quality Fundamentals
- Coal Pulverizers
- Boiler Design
- Fuel / Ash Properties
- The Solid Fuel Injection Systems Approach to Air & Fuel Flow Management
- Low NOx Firing Systems
- Biomass Combustion
- Case Studies
- Circulating Fluidized Bed Boilers
- Oil & Gas Firing
- Energy, Economics and the Environment

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FIELD SERVICES

- Services for Coal (PC, CFB & Cyclone), Oil, Biomass, and Gas Fired Systems
- ASME PTC (4.0 & 4.3) Testing Capabilities
- Complete Annual Service Contracts
- Comprehensive Boiler Inspections
- Technical Direction of Outage Repairs
- Complete Testing Programs
- Specialized Testing Equipment
- Airflow Measurement and Control Devices (Design, Fabrication and Calibration)
- Flyash Carbon Reduction Programs
- NOx Emissions Tuning and Control
- Combustion Improvement Programs for:
 - Pulverizers
 - Burners
 - Fans
- Fuel Change Evaluations
- Boiler Surface Area Evaluations
- Performance Testing and Corrective Plans of Action
- Air In-Leakage Measurement and Inspections
- Pulverizer Capacity and Fineness Improvements
- Fuel Line Balancing Improvements
- Secondary Air Balancing
- Air Heater Leakage and Performance Testing
- Heat Rate Improvements Through Boiler
- Optimization Programs
- Failure Analysis
- Consulting
- Immediate Technical Responses

OUR SERVICES

FIELD SERVICE TESTING

Our field services team specializes in Combustion Optimization programs through application of the fundamentals. Our programs have a very unique method of using specialized testing equipment to determine improvements of nearly any steam generator.

ENGINEERED SOLUTIONS

Our team is accustomed to taking a project from a concept to an engineered solution, including FEA and CFD analysis, in a timely and accurate manner in order to meet our customers stringent schedule needs. Each customized project is directed towards STORM's primary intention of being customer and RESULTS driven.

LAB SERVICES

STORM can provide a complete package of testing analysis for weekly or monthly monitoring. By providing regular monitoring services, results are achieved in performance and reliability of the boiler.

FABRICATION

STORM can manufacture much of its engineered solutions and optimization components it recommends to our customers. Working with Fabricated Solutions, a division of Storm Technologies, we can expedite fabrication while maintaining quality to meet our customer's needs.

SHORT COURSES

Our Large Electric Utility Boiler Combustion and Performance Optimization Course is a one of a kind course that has been presented to thousands of people worldwide. The course is a combination of combustion fundamentals and the STORM methodology.

FABRICATION

- Airflow Management Systems
- Overfire Air Systems
- Ductwork
- Control & Shutoff Dampers
- Metal Expansion Joints
- Ceramic Tiling & Duct Lining
- Pulverizer Optimization Components
- Classifier Blades
- Outlet Cylinders
- Reject Doors
- Rotating Throats & Deflectors
- Fuel Line Orifice Housings
- Burner Spinner Spreaders
- Chordal Thermocouples
- Oil Atomizer Tips
- Serpentine Straps
- Specialized Testing Equipment
 - Dirty Air Probes
 - Isokinetic Coal Sampling Kits
 - Fuel Line Dustless Connectors
 - Static/Temperature Probes
 - Boiler Exit Probes
 - Multipoint Probes / Bubblers
 - Automated Boiler Exit Sampling Systems
 - Forward / Reverse Pitot Tubes
 - Isokinetic Flyash Sampler Kits
 - In-Situ Flyash Samplet Kits
 - High Velocity Thermocouple (HVT) kits

