September 2005 Volume No. 9

STORM TECHNOLOGIES, INC.
411 North Depot Street PO Box 429
www.stormeng.com
Albemarle, NC 28002
Phone: (704) 983-2040, Fax: (704) 982-9657

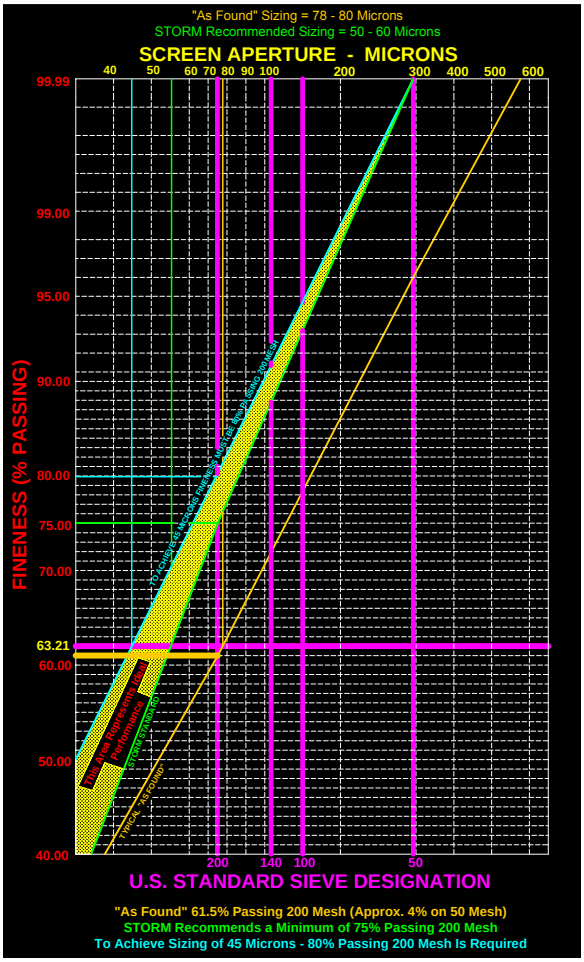
"Condition Based Maintenance" And "Performance Preservation"

What do these have in common and how can STORM Help?

Previous Newsletters and reports by Storm Technologies, Inc. have used the term, **"Performance Driven Maintenance"**. By this we have meant pulverizer and boiler performance planning by diagnostic testing to identify opportunities for improvement as well as maintaining performance preservation after the outage. Not only effective in getting ***RESULTS***, but it is also cost effective. The following page graphically indicates areas of opportunities and here are some specifics:

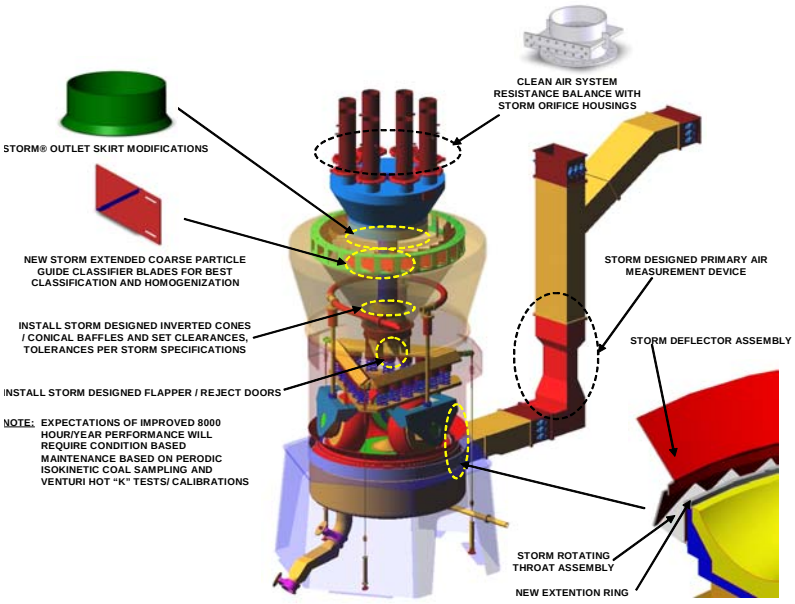
Pulverizer fineness and fuel distribution:

According to many of our tests, on average, fineness is abysmally poor. Often worse than 60% passing a 200 mesh sieve and whole numbers remaining on a 50 mesh sieve. Fuel balance, which usually correlates with fineness, is often ±25% or worse, burner to burner. Airflow measurements from the primary air measurement elements are often inaccurate by more than 10% & primary airflows are often ≥30% above optimum required airflow. This incorrect indication compounds dry gas losses, high de-superheater spray flows, slagging/fouling, and increased NO_x. The following figure indicates "As Found" fineness and Recommended, which indicates the large difference in micron sizing, which impacts the time for "carbon burn-out" due to the particle sizing as well as improving fuel distribution to each burner line with the improved fineness.



As explained in our "Thirteen Essentials for Optimum Combustion with Low NOx Burners", the majority of the essentials (9 of 13) deal with pulverizer performance, thus Storm feels that a **"Performance Driven Maintenance Plan"** is critical to address combustion optimization starting with the pulverizers, burners and airflow management to maintain **"Performance Preservation"**.

STORM RECOMMENDED PULVERIZER MODIFICATIONS



The previous depicts a typical program to improve pulverizer performance by addressing "Performance Driven" variables to improve distribution and fineness of the pulverizers.

Continued on Back

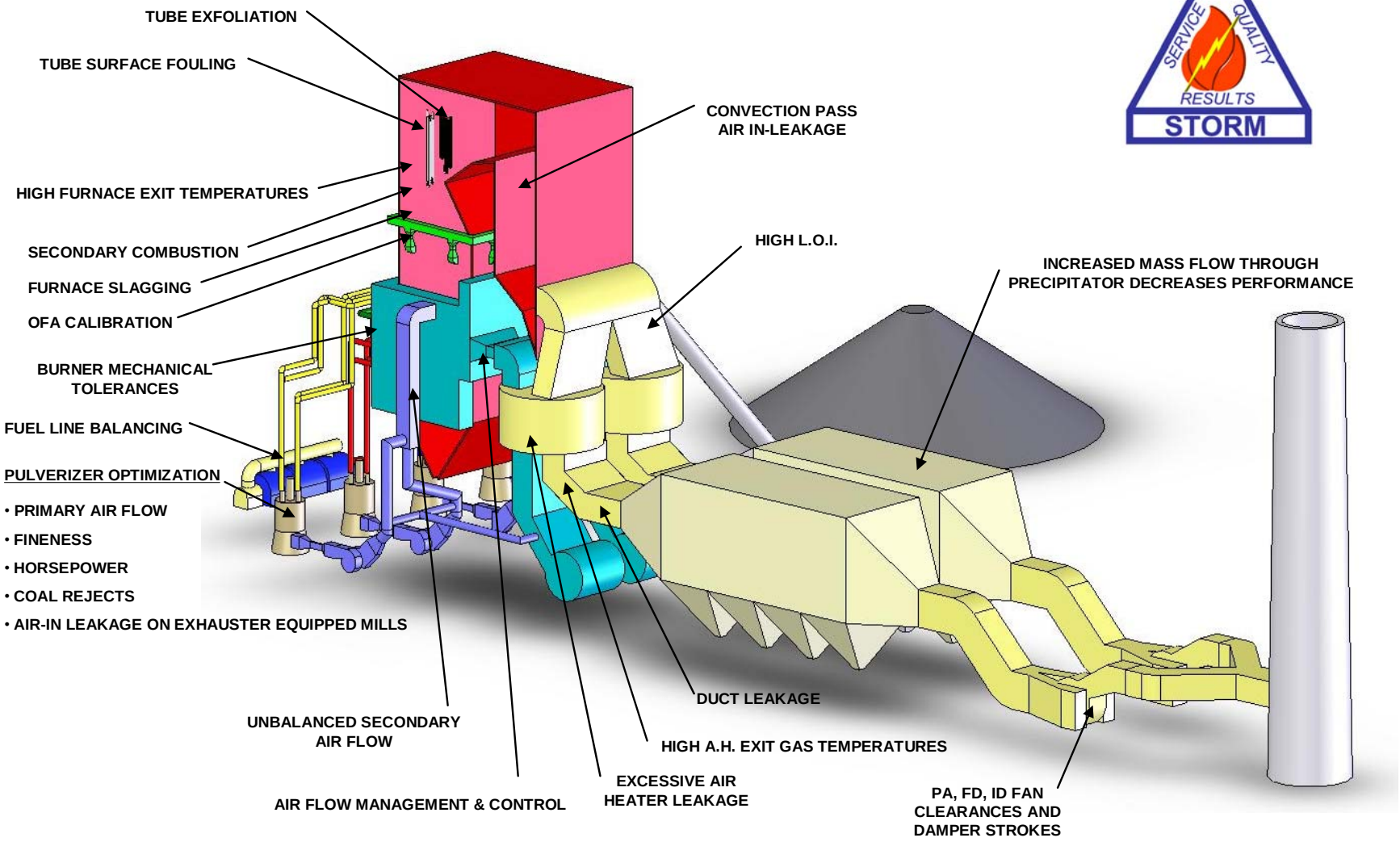
STORM TECHNOLOGIES, Inc.

"Performance Driven Approach" to Identify the Following Opportunities By Proper, Complete and Accurate Testing by STORM Method

OPPORTUNITIES FOR IMPROVEMENT

AT LEAST SOME OF THESE ARE TYPICAL OF MOST P.C. UTILITY BOILERS

Identified by Storm Technologies, Inc.



Air In-Leakage and Furnace Exit Gas temperatures:

Furnace excess oxygen levels are often far lower than indicated, due to tramp air in-leakage. Of course, not a problem on pressurized furnaces, but most utility boiler furnaces are balanced draft. We authored an article in the June 2005 issue of "Power" magazine which outlines the impact of "Stealth" heat rate factors. Well, many of the same factors that are applicable for "Best Heat Rate" are also applicable for the best "Reliability" and highest "Capacity" factor. Also, fuels flexibility, slagging, fouling, SCR performance, and NO_x performance. I admit it, I am a supporter of getting the inputs to the furnace right, and if this is done, benefits show up in reliability, capacity, heat-rate, NO_x, flyash LOI, and allow for fuel flexibility. So what is the Storm Technologies, Inc. approach to ***"Condition Based Maintenance"***? Let us explain: Here is an outline for a ***"Performance Preservation"*** program: Take a look at this, & note how useful this can be to consider as part of a "Condition Based Maintenance Program". The following Page includes an overview of a "Typical Unit" and recommended test locations and equipment to be combined with "Performance Driven Maintenance".

Note: ***The following list is a partial list and should be reviewed and modified for plant specific equipment (i.e. types of burners, pulverizers, boiler, equipment, etc….). Similarly, NO_x season operations may vary from non-NO_x season settings for Unit Optimization and/or NO_x control:***

Optimum Combustion Performance Preservation Outline

Performance preservation requires the combined efforts of operations, maintenance, & test personnel.

Each Shift or Daily

- Check fuel and ash analyses
- Excess oxygen on curve, airflow on curve
- Wind-box to furnace ΔP is optimum
- Feeders balanced
- Damper strokes proper
- Steam temperatures at 1005/1005°F
- Spray flows normal
- Soot blower steam temperatures, pressures, and condensate drains
- Air heater temperature checks
- Review NO_x & boiler settings for consistent NO_x levels for given oxygen set point
- Raw coal sizing
- Burner tilt angles, and similarity of angles (corner fired boilers)
- Air registers and air slides, impeller settings (wall fired boilers)
- Pulverizer coal reject quantity
- Pulverizer outlet temperatures
- Pulverizer drive motor power or amps
- Visual appearance of coal flames
- Nose arch and super-heater area for slag appearance
- Verify oxygen balance (i.e. I.D. and F.D. fan amps) and tune accordingly.
- Super-heater inlet for flame carryover by visual appearance
- Lower furnace for possible slag bridging, bright appearance.
- Review lower ash hopper for areas of air in-leakage to impact NO_x & Performance
- APH inlet duct hoppers hot, & not plugged
- Normal operational checks

Weekly Performance Tests

- Flyash sampling (representative sample)
- Coal fineness (Storm method)
- Oxygen analyzer calibrations
- Damper stroke verifications
- Steam temp.'s & spray-flow measurements
- Furnace exit excess oxygen measurement
- Air heater leakage
- Soot-blowing steam pressures, temp.'s and thermal drains
- Super-heater/re-heater tube metal temp.'s
- Normal plant results tests

Each Three Months

- Leak checks of airflow measuring elements
- Hot "K" calibrations of airflow measuring elements (primary and secondary)
- Furnace excess oxygen traverse by HVT probe to check oxygen and stratifications
- Measure oxygen rise from furnace to stack

Each Outage

- Rebuild pulverizer grinding elements
- Refurbish burners to design dimensions and tilt strokes
- Verify damper strokes
- Leak check and repair sensing lines to airflow measuring devices
- Inspect, repair and functionally check all dampers from inside ductwork
- Set APH seals, clean baskets, check and repair sector plates and all moving parts
- Inspect and repair all primary and secondary dampers and ductwork
- Thoroughly inspect and repair all ductwork and expansion joints

NOTE:

The Previous Outline Discussed is a Intensive Testing Program That Should be Conducted per Storm Technologies, Inc. Equipment and Procedures for Optimum Results and Unit Reliability to Identify Areas for Opportunity Covered by the "Conditioned Based Maintenance".

In Summary:

The previous information and outline recommended for "Performance Preservation" indicated the importance of proper testing and tuning of the unit to identify areas of opportunities for improvements. These areas should be addressed in the "Conditioned Based Maintenance Program", thus you can see the importance of how proper testing and tuning can identify these opportunities to improve and/or "Preserve" performance optimization.
Often proper testing is over-looked and/or improperly completed to provide an accurate and though test. The testing is not easy, however the payback is much better with "Heat-Rate" and unit Reliability factors during peak months. In today's operation we have NO_x seasons, poor and varying fuel qualities, which tend to push the limits of the boiler (i.e. reducing atmospheres, slagging, high spray-flows, high carbon in ash or LOI, poor fineness and capacity, etc.……). With these conditions present, it makes this "**Performance Driven Maintenance"** program ***CRITICAL*** to unit operations to provide optimum combustion, reduced NO_x emissions, improved heat-rate and reliability, etc…

How can "Performance Driven Maintenance" and/or "Conditioned Based Maintenance" be completed?

Simple! Good, complete, proper & accurate TESTING combined with a Good Maintenance plan addressing the test conclusions and findings. The following provides a concept indicating areas of opportunities for performance and reliability improvements. This plan should address the fundamentals by working towards Storm Technologies, Inc. **"Thirteen Essentials for Optimum Combustions with Low NO_x Burners"**. In case review is needed; these essentials are as follows and the opportunities are indicated previously in the graphics within this newsletter:

Storm Technologies, Inc.

"Thirteen Essentials of Optimum Combustion for Low NO_x Burners"

Fuel Preparation

1. Fuel feed quality and size shall be consistent (< ¾" – 1" raw coal size).
2. Fuel feed shall be measured and controlled as accurately as possible. Load cell, microprocessor equipped, gravimetric feeders are preferred.
3. Fuel line fineness shall be 75% or more passing a 200 mesh screen, and 50 mesh particles shall be less than 0.1%.

Distribution to Burners

4. Primary airflow shall be accurately measured and controlled to ±3% accuracy.
5. Primary air to fuel ratio shall be accurately controlled when above minimum.
6. Fuel line minimum velocities shall be maintained.
7. Fuel lines shall be balanced by "Clean Air" test to within 2% of average.
8. Fuel lines shall be balanced by "Dirty Air" test to within 5% of average.
9. Fuel lines shall be balanced in fuel flow to within 10% of average.
10. Secondary air distribution to burners shall be within 5-10% of average.

Combustion

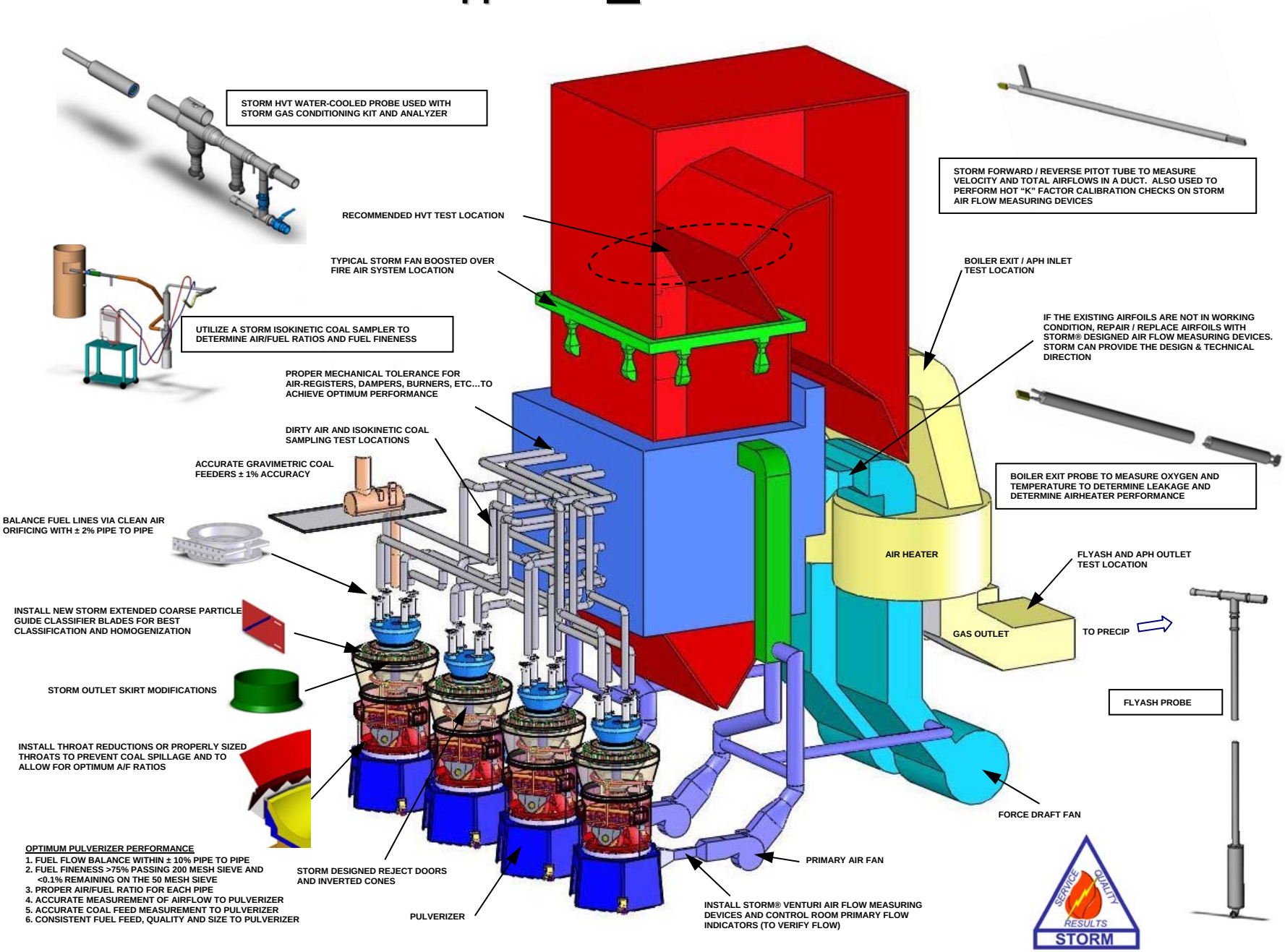
11. Over-fire air shall be accurately measured and controlled to ±3% accuracy.
12. Furnace exit shall be oxidizing, preferably 3%.
13. Mechanical tolerances of burners and dampers shall be ±1/4".

Call Storm Technologies, Inc. to perform these Task's at hand. STORM is Trained, Energetic, Focused, and Capable of interpolating the data from a Pre-Outage test program to make recommendations, provide outage direction of recommendations and Post Outage Testing and Tuning. This "Performance Driven" and "Conditioned Based Maintenance" approach will quantify existing performance and post outage results.

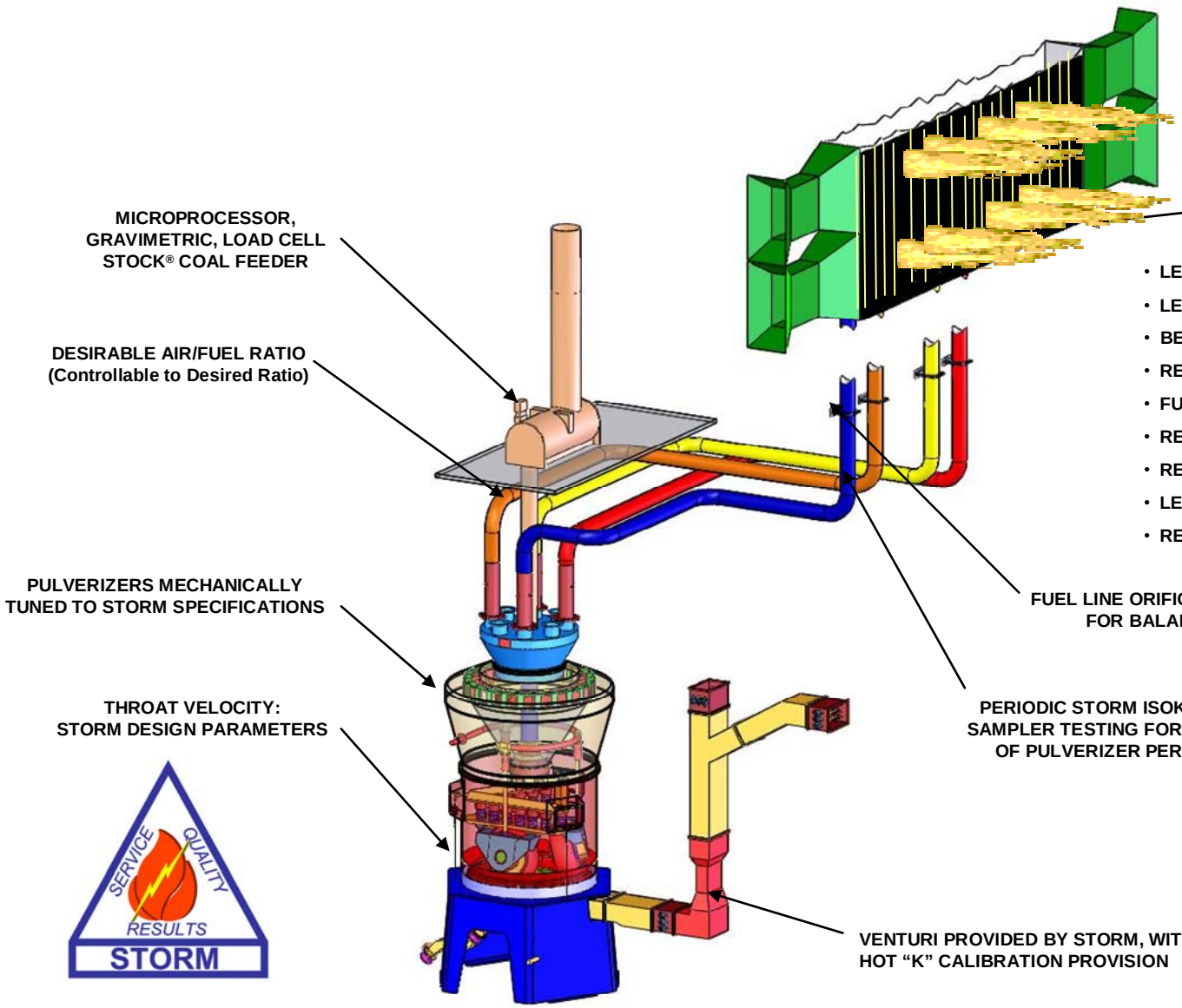
STORM TECHNOLOGIES, INC
411 Depot Street, PO Box 429 Albemarle, NC 28001
Phone: (704) 983-2040 Fax: (704) 982-9657

STORM TECHNOLOGIES, Inc.

"Performance Driven Approach IS Conditioned Based Maintenance"



THE STORM SOLID FUEL INJECTION SYSTEM APPROACH TO FURANCE COMBUSTION EFFICACY



EXCELLENCE IN PULVERIZER PERFORMANCE AND FUEL LINE BALANCING RESULTS IN UNIFORM FLAMES HERE FOR THE ADVANTAGES OF:

- LESS SLAGGING
- LESS FOULING
- BETTER FLYASH LOI
- REDUCED DRY GAS LOSS
- FUEL FLEXIBILITY
- REDUCED "POP CORN" ASH TO SCR
- REDUCED "FEGT"
- LESS DE-SUPERHEATING SPRAY-FLOWS
- REDUCED SOOTBLOWING