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By: Richard F. Storm and Staff of Storm Technologies, Inc.

The "Storm" Total Combustion Optimization Approach

The Storm approach could be referred to as a "Comprehensive Approach to Combustion Optimization" or a "Common sense Approach to Combustion Optimization". Since the start of this company 12 years ago, we have hammered away at applying the Fundamentals, Getting the "inputs" Right, Furnace Performance Excellence and Pulverizer Optimizations.

Thankfully for the employees at Storm, the consistency of our approach and our grounding in the Fundamentals have paid off. We have worked with more and more of our long time customers and friends to apply these common sense approaches for GOOD RESULTS.

To those of you that have used our products and services, let me take this opportunity to say Thank You. To those of you that this newsletter is addressed to, that have not used our products and services for a year or so, let me suggest that you consider re-application of the storm approach, to "Total Combustion Optimization".

What are the benefits of the STORM approach?

A long time customer once said to me, "Storm, Back in 1983 when we had a slagging problem, you suggested that we apply the 10 Pre-Requisites of Optimum Combustion". Then, in 1986 when we wanted to begin a Heat-Rate Improvement Program - "You suggested the 10 Pre-Requisites of Optimum Combustion". "In 1992, when reducing NOx became a challenge, you suggested that we apply the 12 Essentials of Optimum Combustion". When reducing Flyash LOI and Waterwall wastage because of an issue in the Mid 90"s "you suggested the 13 Essentials of Optimum Combustion".

"Storm", my customer friend stated, "Do you know any other approaches? You keep Hammmering away at the fundamentals of the inputs; and the 10 Pre-Requisites, 12 Essentials and 13 Essentials. These are all the same list, just added on to over the years".

To this I replied, "Guilty". Yes, they keep on working; and yes we do know a few other things about Boilers, Boiler Maintenance, Inspections, Performance and (dare to say the word) Upgrades for performance improvement.

So, what are the benefits of the Storm Total Systems Approach to Combustion Optimization? Well, here is a partial list:

- NOx Optimization
- Reduced Slagging
- Reduced Waterwall Wastage
- Less "Popcorn Ash" to the SCR's
- Higher Load Factor
- Increased Load Capability
- Improved Heat Rate
- Increased Reliability
- More Efficient Application of Maintenance Resources and Budget
- Less Stack Opacity
- Better Flyash Quality
- Longer Superheater and Reheater tube metals life
- Less Air Heater Fouling
- Improved plant capacity factor
- Lower "Bus Bar" Generation Cost

Yes, I did say, this is a partial list. Seriously, getting the Fundamental "Right" does in fact pay large dividends. Very Large Dividends!

"Sometimes it Requires a Cultural Change"

Getting "Back to Basics" after so much has been written, published and talked about may seem trite? But it works! Some examples of competing (but sometimes complimentary) approaches are "Neural Networks", "Smart Soot blowing Systems", "Plug-in" or "Screw-In" low NOx burners, and the list goes on. Our "Culture" is grounded in the "Fundamentals". Many other approaches are good ideas, but often skip over the "Basics".

The Storm Approach to a total Combustion Optimization System:

1. Apply the 13 Essentials to the mills and combustion airflows.
2. Application of a High Momentum Overfire Air System for NOx, Flyash LOI, and Flue Gas Homogenization at the Superheater inlet.
3. Application of Venturis, Flow Nozzles and other necessary additions to measure and control the total airflow.
4. Apply the best testing and tuning techniques to calibrate the combustion airflows, and optimize the Pulverizers. Co-ordinate these optimizations with the plant DCS Control System, for new airflow characterizations, best load response, best Heat Rates, and best furnace conditions.
5. Apply a Performance Preservation Program.

Here is a "Real Culture Change"! Or is it? Really, we are just reinventing the tasks of the "Results Engineer" of yore. Some tried and proven techniques that have been tweaked to accommodate the average 30 year old coal fired boilers that we depend on today. Factors such as air in-leakage, overfire airflow measurement and control. Fuel switching and more, were not done in the 60's and 70's when many of the "Results Engineers'" of those days spent most of their time addressing Steam Cycle Performance, Pulverizer Performance and Representative Flyash LOI tracking.

Still good ideas to do. Some changes because of equipment age and new regulations on NOx, CO and Opacity. And, Some changes with updating of our test equipment and techniques. Heat-Rate improvements also seem to be coming back in vogue after years of emphasis on "Clean air Act" compliance emphasis.

Listed below are the 13 Essentials, and the 22 Operations and Maintenance Variables that are Controllable Heat Rate Factors. Applying these in a practical common sense manner, is what comprises "The Storm Approach to Total Combustion Optimization". Our list of customers that are rediscovering" the benefits is growing. For case studies and published technical papers, you may visit our website at www.stormeng.com. Storm Technologies, Inc. designs, manufacturers, and sells the equipment utilized to achieve "Excellence in Combustion Optimization". We pride ourselves in our mantra, "Service - Quality - Results". Especially Results.

Let us know when we may assist you and your team.

Sincerely,

Richard F. (Dick) Storm

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Thirteen Essentials of Optimum Combustion for Low NOx Burners

- Furnace exit must be oxidizing preferably, 3%
- Fuel lines balanced to each burner by "Clean Air" test ±2% or better
- Fuel lines balanced by "Dirty Air" test, using a Dirty Air Velocity Probe, to ±5% or better
- Fuel lines balanced in fuel flow to ±10% or better
- Fuel line fineness shall be 75% or more passing a 200 mesh screen 50 mesh articles shall be less than 0.1%
- Primary airflow shall be accurately measured & controlled to ±3% accuracy
- Overfire air shall be accurately measured & controlled to ±3% accuracy
- Primary air/fuel ratio shall be accurately controlled when above minimum.
- Fuel line minimum velocities shall be 3,300 fpm
- Mechanical tolerances of burners and dampers shall be ±1/4" or better.
- Secondary air distribution to burners should be within ±5% to ±10%
- 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
- Fuel feed quality and size should be consistent. Consistent raw coal sizing of feed to pulverizers is a good start

A Few Words on the 13 Essentials

These have expanded from the 10 pre-requisites for optimum combustion, first promoted in the 1980's. The point is, they are simple, have been around a long time, and they make a great "punch list" for resolving slagging, LOI, and NOx issues in large P.C.-fired utility boilers.

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Twenty-Two Operations and Maintenance Controllable Heat Rate Factors

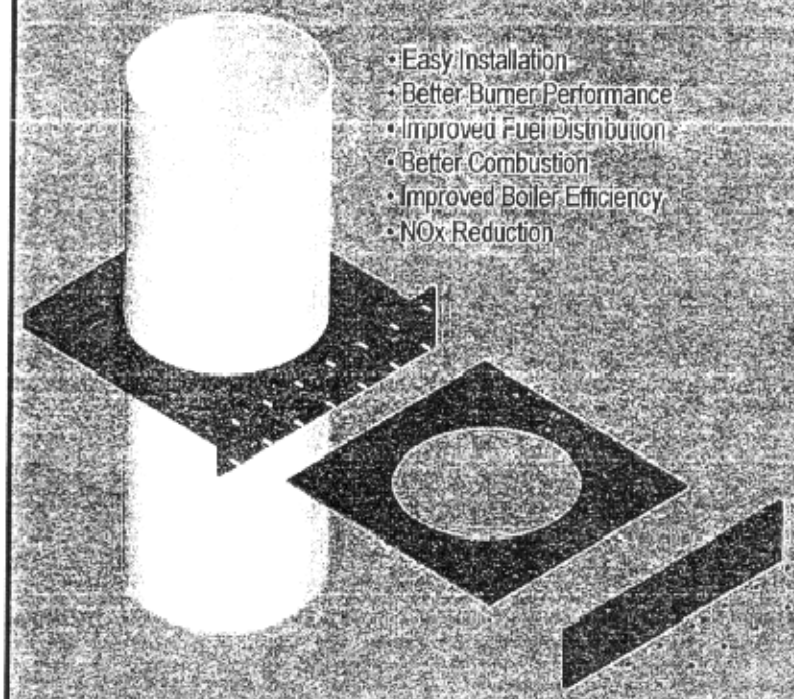
Flyash LOI
Bottom ash carbon content
Boiler and ductwork air in-leakage
More precise primary airflow measurement and control, by reducing tempering air
Reducing pulverizer air in-leakage on suction fired mills
Pulverizer throat size and geometry optimization to reduce coal rejects and compliment operation at lower primary airflows
Secondary airflow measurement and control for more precise control of furnace stoichiometry, especially important for low NOx operation
Reduction of extremely high upper furnace exit (FEGT) peak temperatures, which contribute to "Popcorn Ash" carryover to the SCR's and APH's, High spray water flows, Boiler slagging and fouling, and high draft losses due to fouling. The high draft losses cause increased in-leakage, increased fan auxiliary power wastage and increased associated losses with the high spray water flows
High de-superheating spray water flow to the superheater
High de-superheating spray water flow to the reheater
High air heater leakage (note: Ljungstrom regenerative airheaters should and can be less than 9% leakage)
Auxiliary power consumption/optimization i.e., fan clearances, duct leakage, fueling primary air system optimization, etc
Superheater outlet temperature
Reheater outlet temperature
Airheater outlet temperature
Airheater exit gas temperature, corrected to a "no leakage" basis and brought to the optimum level
Burner "inputs" turning for lowest possible excess oxygen at the boiler outlet and satisfactory NOx and LOI. Applying the "Thirteen Essentials"
Boiler exit (economizer exit) gas temperatures ideally between 650°F to 750°F, with zero air in-leakage (no dilution!)
Cycle losses due to valve leak through – i.e. spray water valves, reheater drains to the condenser, superheater and re-heater drains and vents, and especially any low point drains to the condenser or to the hot well
"Soot blowing" Optimization – or smart soot blowing based on excellence in power plant operation. (Remember, soot blowing medium is a heat rate cost, whether compressed air or steam) Feed water heater level controls and steam cycle attention to detail. Steam purity and the costly impact of turbine deposits on heat rate and capacity.

Twenty-two O&M controllable Heat Rate Factors. It has been my experience that the average power plant has at least 75% of these as "opportunities" for improvement.

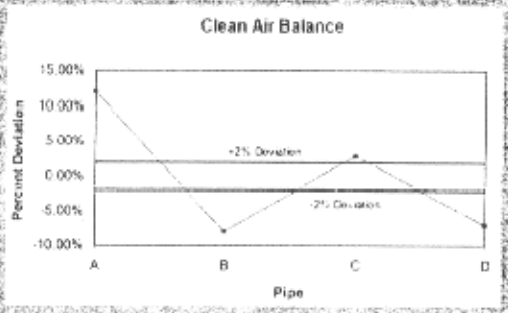
Let STORM® prepare you for the Fall Outage!

STORM® FUEL LINE ORIFICE/ISOLATION HOUSING

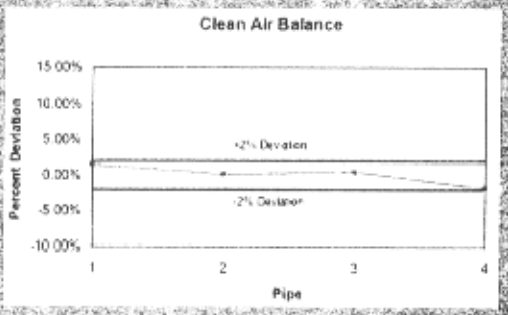
- Easy Installation
- Better Burner Performance
- Improved Fuel Distribution
- Better Combustion
- Improved Boiler Efficiency
- NOx Reduction

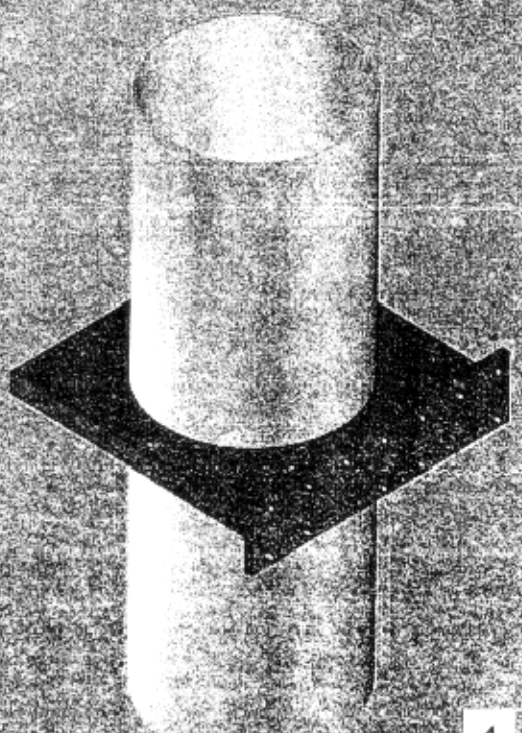


As Found Fuel Line Balance



Fuel Line Balance After Installing Properly Sized Orifice Plates





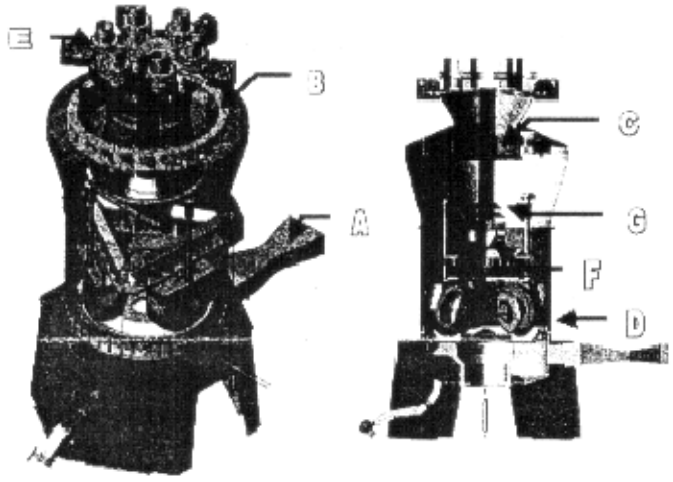
Fuel line balancing via square edge orifices is the first step in balancing fuel to individual burners. Air is the medium which carries fuel to the burners. Properly balanced fuel lines, by clean air balancing, benefits burner performance, fuel distribution, combustion, boiler efficiency, and NOx reduction.

Balancing system resistance of fuel lines by the clean air method is the first phase of a comprehensive fuel and air balancing program. It is important to remember that clean air balancing is an important factor in optimizing pulverizer fuel and air balance, and we have made it easier. The STORM® designed orifice housing allows quick and easy installation changes for square edge orifices. The orifice plate easily slides in and out of the housing, making orifice changes very simple.

If you have a question about the STORM® designed Orifice/Isolation Box or any other products or sevices, feel free to contact us.

STORM® Pulverizer Improvement Parts

The Coal Pulverizers are the heart of a pulverized coal fueled power plant! There are at least 22 controllable heat rate factors on a typical pulverized coal fueled plant. About half of them are controllable at the pulverizers by pulverizer associated equipment.



Typical STORM changes with a Performance Improvement Kit are:

A – Airflow Measuring Venturi for improved measurement accuracy

B – High Spin Classifier Vanes for improved circulation and air/fuel distribution

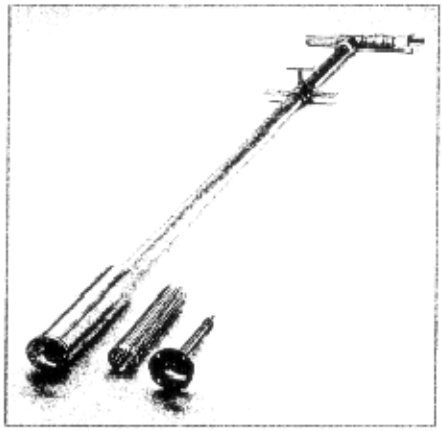
C – Modified outlet cylinder for improved homogenization & 50 mesh particle rejection

D – Improved Throat & Deflector modification and design for vectoring and reduced mill rumbling

E – Orifices and housings for achieving optimum clean air system resistance

F – Modified flapper doors for improved closure and elimination of large particle bypass

Featured Equipment!

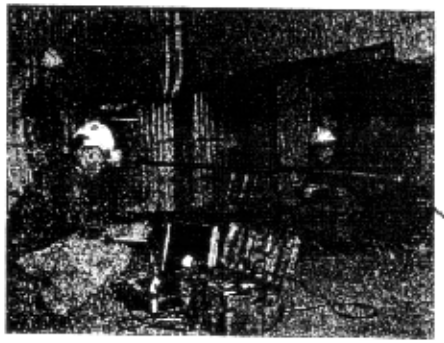


Storm In-Situ Flyash Sampling Kit

Includes:

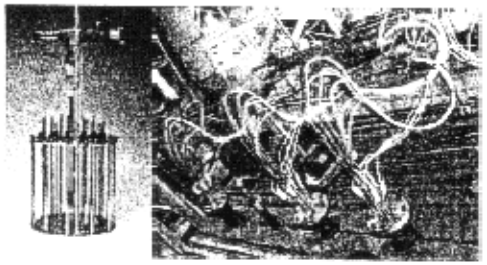
Sample canister, nozzle tip, perforated cylinder, 50 filters, aspirator assembly, optional pipe length, required air connection fitting and procedures.

Unit Price: **$1,850.00**



Picture No. 1

Storm Designed FBOFA

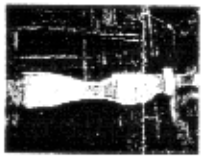


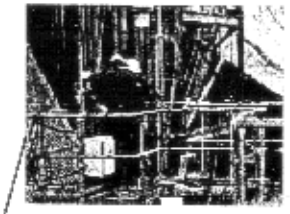
Picture No. 9

Picture No. 4

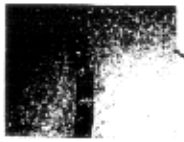
Picture No. 2

Picture No. 5



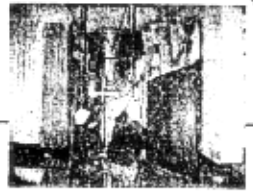


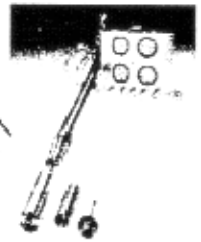
Picture No. 8



Picture No. 3

Picture No. 6





Picture No. 7

Pic # 1 – water cooled HVT probe. Pic # 2 – Classifier Blades Pic # 3 – Rotating throats & Deflector. Pic # 4 - Orifice Housings/plates for clean air balancing. Pic # 5 – Primary Airflow Venturi. Pic # 6 – Secondary Airflow Venturi. Pic # 7&8 Near Isokinetic and Isokinetic Flyash Probes. Pic # 9 – Multi point bubbler and probes with thermocouple data acquisition system.