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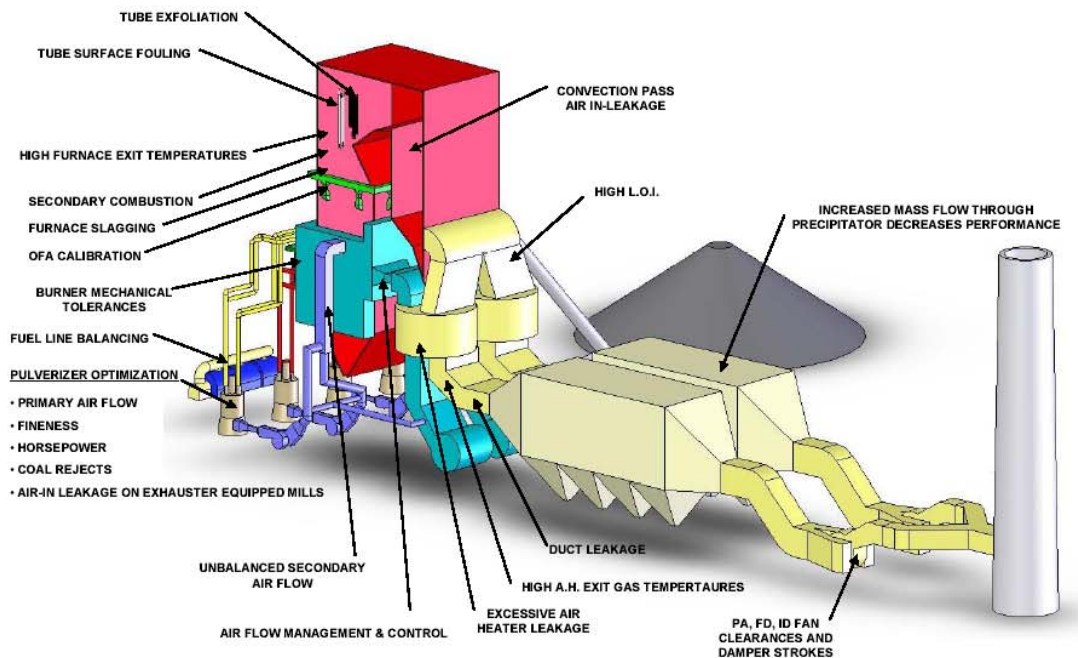
**Achieving the Best Possible Performance from Large Pulverized Coal Fueled Utility Boilers per \$ of O&M**

Applying the 13 Essentials has served our company and our customers well. As one football coach explaining his success put it, "Hit-Block-Run, Hit-Block-Run, practice, practice, practice". Always apply the Fundamentals first.

So it is with Combustion and Performance Optimization on a large pulverized coal fired boiler. First, apply the Fundamentals. Now, as simple as the 13 Essentials are, I have to admit that getting these right does in fact require a great deal of effort and commitment by all involved. For this edition of our newsletter, I thought it would be useful to review the most common "Opportunities" for improvement.

**OPPORTUNITIES FOR IMPROVEMENT**

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



It has been our experience that two basic root causes of non-optimized combustion are prevalent in the US Pulverized Coal Plant Fleet. Before getting into the two root causes

of non-optimized combustion, let's answer the question: Why Optimize Combustion? There are at least 15 reasons to optimize combustion, and by the Storm Approach, that means getting the furnace inputs right!

- Improve fuels flexibility
- Reduce slagging
- Reduce fouling (and popcorn ash to SCR's)
- Improve heat rate
- Reduce flyash unburned carbon
- Reduce bottom ash carbon content
- Reduce de-superheating spray water flows to the superheater
- Reduce waterwall wastage (fire side corrosion)
- Reduce "Hot Tubes" with metal temperatures above limits (reliability)
- Increase capacity factor due to fan limitations from too much air in-leakage or too high of draft loss from fouling
- Reduce NO<sub>x</sub>
- Improve flame stability with low volatile fuels (such as petroleum coke)
- Improve reliability due to large slag falls and pressure part damage
- Lower production cost
- Reduce "GHG" (Greenhouse Gas Emissions)

The last decade of operations has focused on reducing NO<sub>x</sub>, almost at any cost, and often at the sacrifice of what is known to be the "Best" for Combustion and Performance Improvement. Now that low NO<sub>x</sub> combustion is pretty well standard for all large boilers, the "new issue" is "Greenhouse Gas" emissions.

We in the coal fired power generation sector are targeted as being the largest single source of man made GHG's. It does not matter that these are perhaps only 3-4% of the total GHG's and that water vapor and solar activity are likely to be of far more influence in Global Warming. The fact is that it is simply the Right Thing to do. That is to maximize the efficiency of combustion, while at the same time reducing NO<sub>x</sub>. I have written much on "Stealth Heat Rate Penalties" and will be pleased to direct you to presentations, newsletters and articles that we have published on Improving Heat Rates by Optimizing Combustion. These are proven. Electric Generation in the USA will Remain COAL based for many years! There is One **HERE AND NOW** way to reduce Greenhouse gases. That is to improve Heat Rates. Boiler Combustion Optimization is the largest opportunity to do so.

### Two Common Opportunities

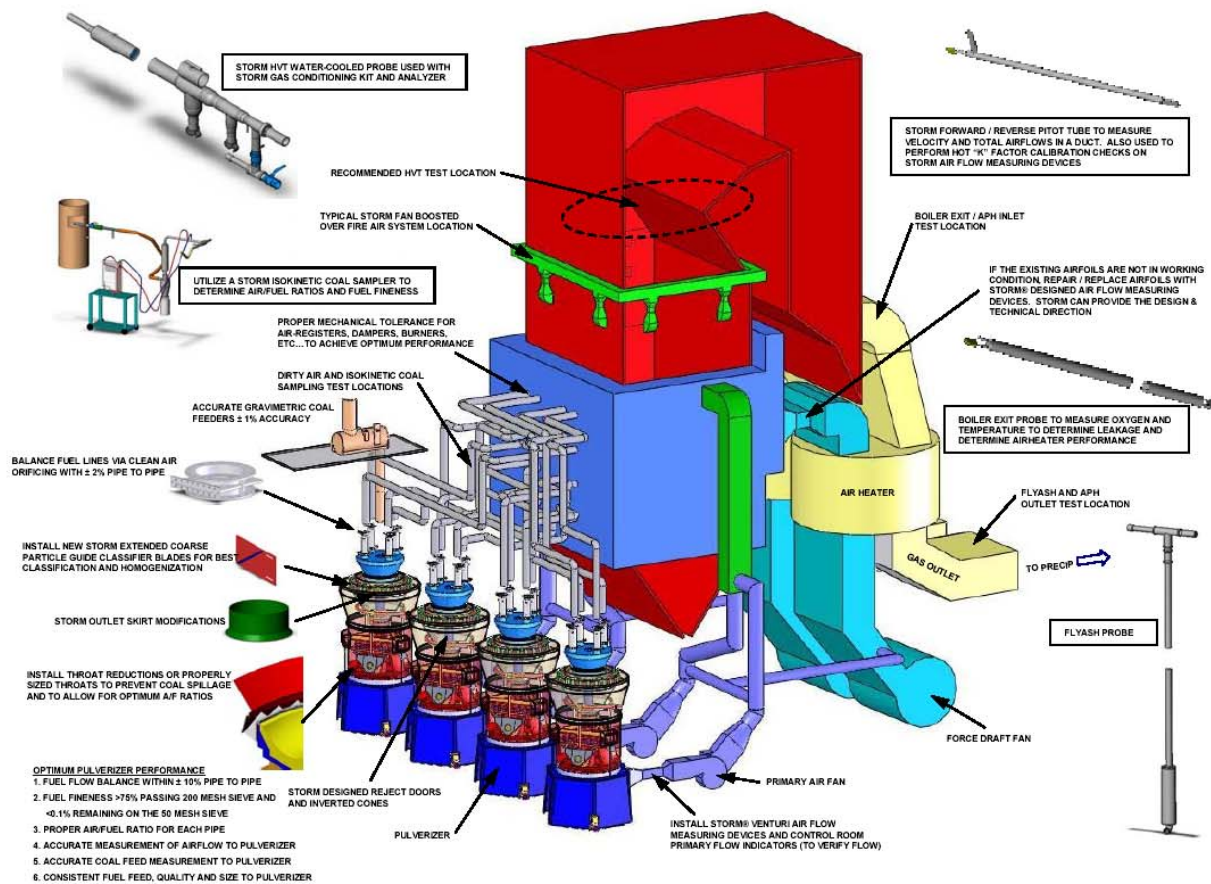
I said at the start that I was going to outline which of the 13 Essentials provides the most benefit per \$ invested. Here they are:

1. Air In-leakage and Air Flow Measurement and Control.
2. Pulverizer Performance – including fineness, fuel distribution and primary airflow characterization.

Well, yes these really are more than two of the 13 Essentials (more like about 10 of them). But, from a basic opportunities standpoint these are extremely common. By applying the Storm Approach to Combustion Optimization, the “15 Opportunities” outlined in the foregoing can be cost effectively improved. This can be accomplished by a true partnering approach and using Storm Techniques, Storm Field Personnel and Storm Performance Improvement Components, it is a Fact!

## How to Apply the Fundamentals

Step 1: have Storm Technologies, Inc. conduct a Comprehensive Diagnostic Test.

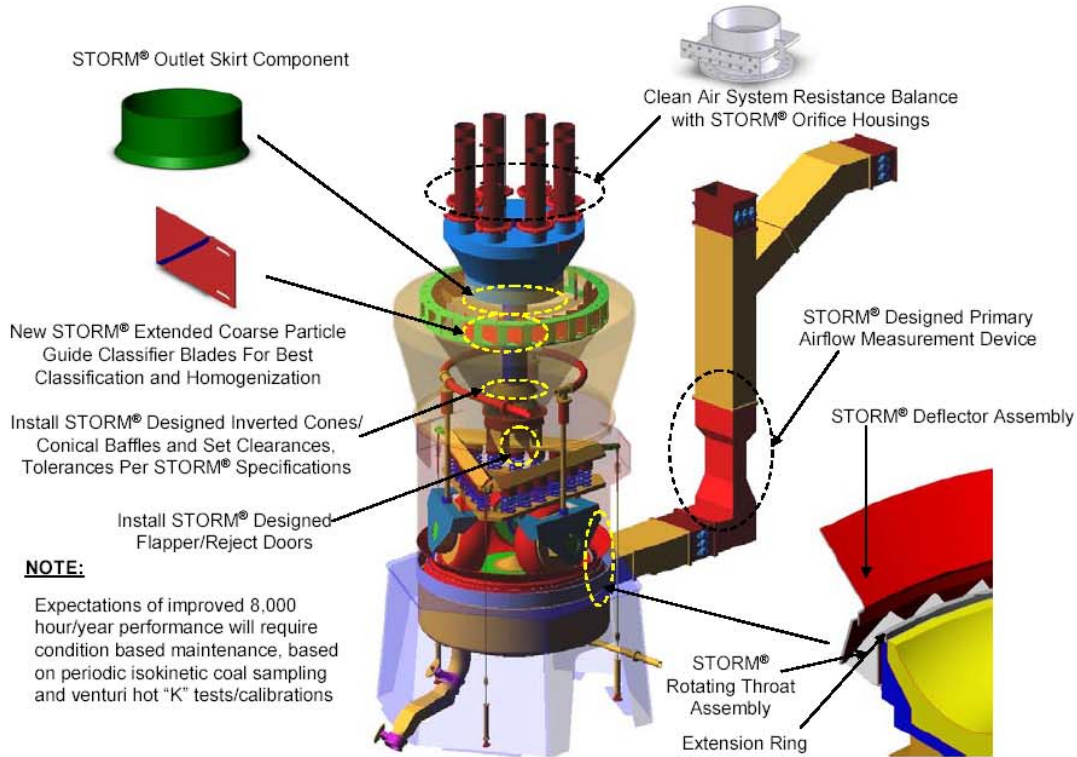


The purpose of this is to ascertain and identify what the opportunities are and to quantify them as to how much opportunity they represent. Examples: Coal fineness, coal distribution, air in-leakage, high primary airflows, airflow imbalances, etc.



Step 2: Apply “Performance Driven Maintenance”, such as correct pulverizer fineness, install accurate airflow measuring elements, repair air in-leakage and balance fuel lines.

### STORM RECOMMENDED PULVERIZER MODIFICATIONS



Step 3: “Tune the Boiler” to achieve the Best NO<sub>x</sub>, Best furnace performance and achieve load dispatch rate of change requirements.

Step4: Apply “Performance Preservation” by periodic testing of fuel fineness, airflows, furnace performance, representative flyash sampling and airflow calibrations.

Four steps to “Excellence in Operations and Maintenance” simply the Right thing to do for many Reasons. Not the least of which is meeting the plant goals of capacity, lowest production cost kW/\$, fuels flexibility, reliability and minimum NO<sub>x</sub>. Many of our publications are posted on our web page, which you may find at [www.stormeng.com](http://www.stormeng.com). Of course, feel free to call for further information on how combining your resources with Storm’s can yield RESULTS.

Yours Very Truly,

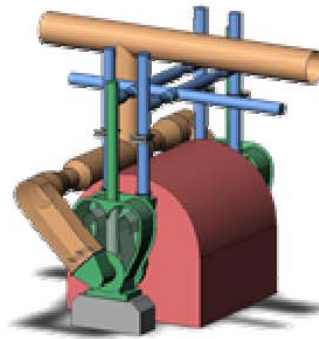
Richard F. Storm  
Senior Consultant

## STORM<sup>®</sup> Summary of Achieving

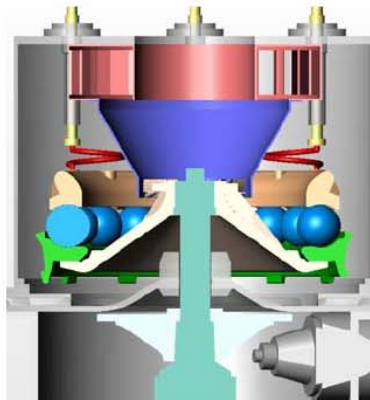
- Pipe to pipe clean air balance within  $\pm 2\%$  of the mean pipe velocity.
- Pipe to pipe fuel balance within  $\pm 10\%$  of the pulverizer's mean pipe fuel flow.
- Pipe to pipe dirty air velocity balance within  $\pm 5\%$  of the pulverizer's mean pipe dirty air velocity.
- Air to fuel ratio of 1.8 pounds of air per pound of fuel on MPS, EL, and Bowl pulverizers.
- Minimum coal fineness level of 75% passing 200 mesh and less than 0.1% remaining on 50 mesh.
- Pulverizer to pulverizer mass air and fuel balance within  $\pm 5\%$ .
- Pulverizer outlet temperature of 155°F or higher. (Except on high-moisture Western fuels, then 135°F minimum.)
- Minimum fuel line velocity of 3,300 Fpm.
- Achieve Optimum vane wheel throat velocities (vertical spindle mills) to minimize or eliminate coal rejects, while allowing acceptable air-fuel ratios to be attained.
- Optimum mechanical tolerances. (i.e. *spring pressures, grinding element condition, ball sizes, etc.*)



**Bowl Mill**



**Ball Tube Mill**



**EL Pulverizer**



**MPS Pulverizer**

Note: STORM<sup>®</sup> is neither a manufacturer or affiliated with the original OEM of the pulverizer systems above.

# STORM<sup>®</sup> Pulverizer

## Benefits of STORM<sup>®</sup> Classifier Components

- Reduce 50 Mesh (Coarse particle) bypass.
- Reducing the intensity of "oxidizing" and "reducing" atmospheres within the furnace cavity.
- Installation of STORM<sup>®</sup> classifier blades will create improved swirl, homogenization and fuel distribution. (These must be properly designed and tuned upon installation. Also, the primary airflow ramp and throat configuration must be compatible).



**NOTE:** STORM<sup>®</sup> provides different variations of classifiers for all static centrifugal classifiers.



## Benefits & Purpose of a STORM<sup>®</sup> Design Rotating Throat and Deflector

- Reduced or eliminated coal rejects, improved vectoring for improved grinding and improved primary airflow controllability.
- Increased pulverizer & furnace residence time.
- Improved coal fineness.
- Capability to reduce air/fuel ratios.
- Reduced FEGT's with improved combustion lower in the furnace.
- Reduced available "free" oxygen in the high temperature flame core.
- Excessive amounts of primary airflow tend to force ignition points away from the burner as a result of higher burner nozzle velocities, thus allowing infusion of oxygen "rich" air into the flame core and increasing NO<sub>x</sub> exponentially.
- Reduce pulverizer vibration & rumbling.
- Deflector sets an open area to maintain an acceptable velocity to keep coal particles in suspension and prevent coal spillage.

