STORM TECHNOLOGIES, INC. March 2015

Cycling of Large Utility Boilers, Some Thoughts to Consider

As we approach Spring, two operations and maintenance challenges come to mind as a result of reduced electricity demand during mild weather.

1. It is outage season and time to perform internal inspections for reliability and MATS reasons.
2. Cycling operation of large utility boilers that were designed for "Base Load" operations.

Here are nine common challenges that we have seen many operations and maintenance teams struggle with:

1. Combustion airflow too high at startup (wrongly interpreted NFPA Code requirement of 25% minimum airflow). Combustion airflow for modern low NOx burner equipped boilers has several paths. As in the example illustration below, only about 60-70% of the air for combustion is admitted through the windbox. Nearly all of the true excess air is added above the burner belt. Therefore at high loads airflow management is important for low NOx firing. At low loads, accurate and reliable measurement and control is absolutely mandatory for acceptable combustion within the furnace.

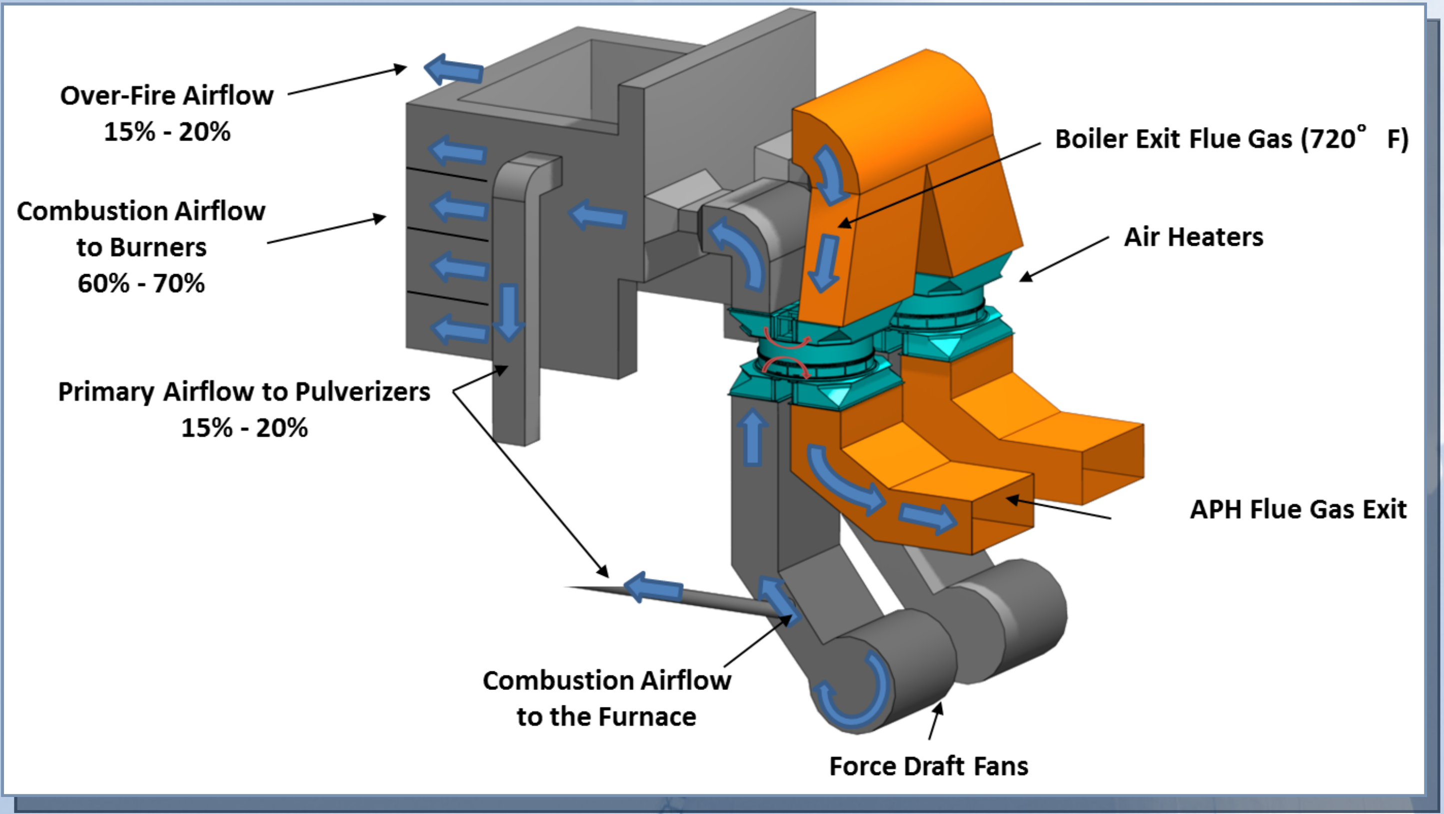


Figure 1. Boiler airflow path with typical values

2. Combustion airflow to out of service burners, starving those firing oil through warm-up guns and causing ESP oil film coating or opacity issues.

Figure 2. Warm up guns and ignitors with insufficient air for complete combustion; approximately 40% stack opacity.

The problem here is too much combustion airflow being diverted to the windbox at elevations where the oil is not being added, and oil not atomized adequately to sustain a clean sharp flame.

3. Airheater cold end temperatures which increase deposition and risk of fire hazard from oil mist collection.

4. Startup overheating damage to the reheater or superheater when the first pulverizer is started. High total airflow at startup can create objectionably high flue gas temperatures at the startup of the first pulverizer and on through the first 25% of unit load increase. The mismatch of high airflow can cause overheating of the superheater metals and temperature excursions to the steam turbine.

5. Burner component metals overheating due to burners out of service and absence of cooling at low load operations. The maximum metal overheating damage to burners, in our experience, has been when burners are out of service.

Figure 3. Heat damaged burner nozzle

6. Electrostatic precipitator fouling with oil soot or condensed vapor, sharp, clean oil startup burners are not optional.

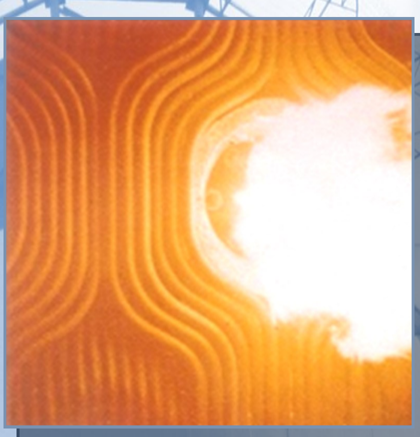


Figure 4. View of ignitor during startup

7. Airheater fires from dirty oil ignitor mist carryover. If you see one, you will never want to see another. These are extremely destructive and dangerous.

8. Environmental issues, opacity, CO, NOx

9. Water chemistry, dissolved oxygen, contaminant, suspended solids that collect in the boiler water walls. Waterwall samples for deposit loading are a good idea.

Are any of the above a concern for you? Well, they are for many plants that I have had experience with over the last few decades. As the "Must Run" renewable power, nuclear and low cost natural gas, combined cycle plants operate more and more, 500-700 MW coal plants are being asked to cycle operations during the mild weather. When two shift operation of a large coal unit is experienced, the risk of experiencing or exacerbating one or more of the nine issues listed above becomes a reality. How can you avoid these problems? First, let's take a couple of examples.

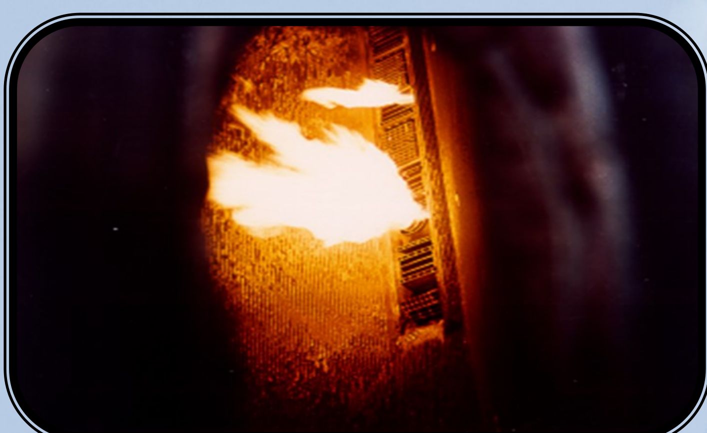


Figure 5. Flame observed after 1—2 auxiliary compartment opened to provide more combustion air. This resulted in less than 10% opacity.

NFPA # 85 Code specifies that the boiler shall have a minimum total combustion airflow of 25% of full load airflow at all times. In our experience, it is common for this to be misinterpreted that if 25% is good and required, then 30-40% is better. This is not the case. Higher than needed combustion airflow at startup wastes ignition fuel, can contribute to high temperatures into the superheater and reheater upon the start of the first coal mill and can carry oil mist into the air heaters and electrostatic precipitator which creates other problems.

We have seen the diesel oil consumption at startup of a 360 MW unit be reduced from 30,000 + gallons to less than 15,000 gallons. Also, reductions in oil fired mist carryover by optimizing the oil igniter combustion performance. Figure 5 is a picture of a 600 MW Corner-Fired Boiler with optimized air damper settings. The preceding Figure 2 is with non-optimum combustion airflow's.

It is critical during start-ups to have sharp and clean oil fires to reduce the amount of oil deposits in the air heater and precipitator, thus reducing the risks of fires and poor precipitator performance following a start-up. As in Figures 4 & 5.

By reducing the total airflow to the boiler and changing the secondary air damper adjustments, to force more combustion air to the igniters that are in service, then improved combustion can be achieved. By implementing these kind of minor adjustments, not only can startup fuel be conserved but also better operations experienced. Faster, safer startup's and with fewer emissions too.

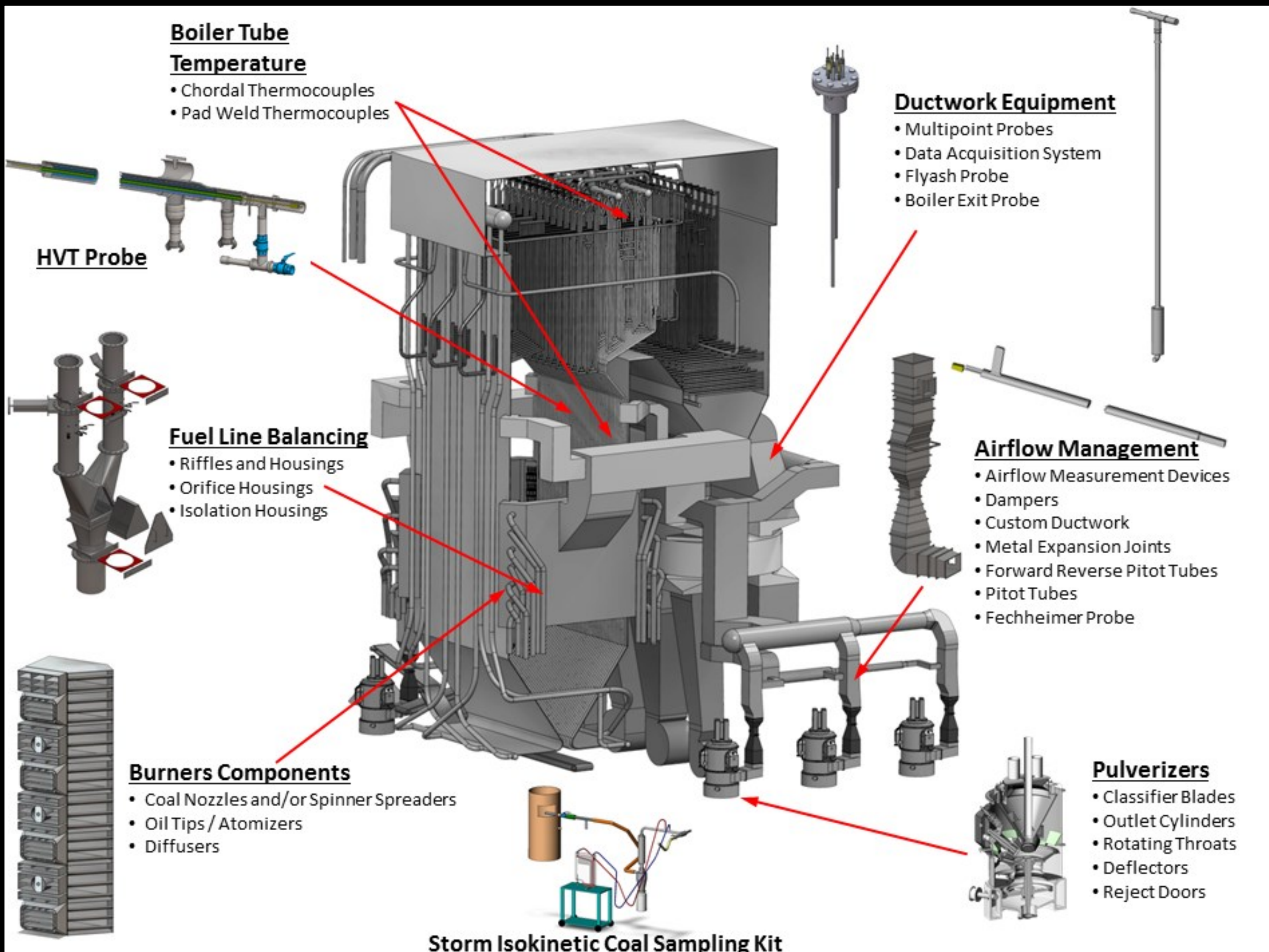
Applying the Fundamentals has always been important. If you wish to discuss any plant challenges with a senior Storm Technologies Engineer, kindly send us an email or give us a call.

Yours very truly,

Richard F. Storm

Richard F. (Dick) Storm

Senior Consultant



STORM TECHNOLOGIES, INC

SERVICE, QUALITY, RESULTS

SERVICE QUALITY RESULTS STORM

411 N. Depot St.
Albemarle, NC 28002
704.983.2040
www.stormeng.com

Specialized Testing Equipment • Airflow Measurement, Control and Improvements • Combustion & Boiler Performance Improvements • Outage Technical Direction • Heat Rate Programs • Mill Optimization • Environmental Performance Issues • Fuel Changes & Evaluations • Boiler Design Evaluations • Training • Fabrication & Machining