Effect Of Smart Soot Blowing System In Boiler Furnace On Cycle Efficiency And Cost Saving

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Abstract

This project deals with the problems associated with soot or slag deposition on the furnace walls, which reduces the heat flux. Attempts have been made in order to blow off the soot on furnace walls efficiently and economically, which lead to the invention of a new system called Intellectual Soot Blowing. Changes in fundamental boiler operating parameters can cause major changes in boiler operation. It is found that substantial financial improvement could be made by the implementation of slag control system even though boiler slag system error occurs. The project includes comparative analysis of THR, UHR &Cycle efficiency prior and after installation of SWBS where there is a drastic change in investment for slag removal in the plant which in turn boots the cycle efficiency, which is a needed parameter. In the Automated Recovery Boiler Soot blower Control System package, the soot blowers are controlled by two redundant PLCs and monitored from the DCS operator interface and a redundant plasma, touch-screen operator interface terminal via six separate display screens, Soot blowing Control, Manual Mode Blower.

Keywords – *Soot blower, Boiler Efficiency, Recovery Boiler, PLC, DCS, and HMI*

"1. Introduction"

Power plants must balance the need for maximum heat transfer with minimum operating costs. As a boiler
accumulates excess soot, boiler walls and heat exchanger surfaces become clogged and inhibit heat transfer. While the common solution is soot blowing, a fixed soot blowing schedule often fails to clean surfaces when heat transfer rates are degrading, or wastes steam by blowing soot before it is necessary. This approach to soot blowing wastes resources and creates significant costs. By operating in either Steam Mode Automatic or Continuous Mode, the soot blower optimization, utilizes strategic soot blowing sequences, ensuring that a plant only blows soot when it is needed, and only in the necessary locations. Automated and/or smart soot blowing delivers up to a 0.5% heat rate improvement, minimizes soot accumulation, improves heat transfer rates, improves overall boiler efficiency, balances blowing sequences, avoids unnecessary steam usage, avoids opacity spikes, extends plant equipment life, and avoids forced outages due to soot accumulation

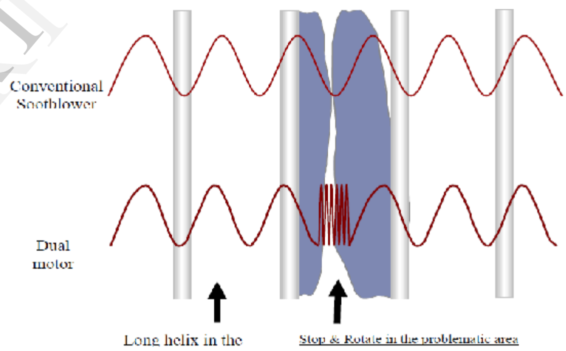

Fig.1:Camparision between Conventional and SMART soot blower

"2.Methodology"

The wall blowers are scanned starting from 1 in sequence from the top most elevation as in the existing SBC. To operate wall blowers, logics have been built so as to cover a wide range of SH spray flow. The term frequently referred here described in detail:

Method 1

SH spray water flow alone is used as index for operating the wall blowers.

Method 2

SH spray water flow and heat flux reduction are used as a index for operating the wall blowers. This method is same as method 1 logics except the operation of wall blower is skipped where there is no reduction in absorbed heat flux.

2.1 Cycle completed

Scanning of 56 blowers starting from 1 is incremented after completing one scanning and resets during clicking the STOP or during the completion of last cycle. A counter is provided in the MMIC screen in method 2.

2.2 Response time

A small time delay is given to reflect the heat flux gain/SH spray reduction after wall blowing at the end of complete scanning of that wall. The user can vary this time through setting option. Response time gets reset after the preset time.

2.3 Cycle time

This timer is started at the time of starting the cycle. The user can vary this time through settings option. It get reset either during clicking the stop or starting the cycle again.

2.4 Blower operation time

To monitor the blower operation after giving the START command, time delay is given which is called as "Blower operation time". The user can vary this time through settings option. It gets reset after preset time.

2.4 Warm-up time

This timer is started after opening the soot blower main steam valve. It essentially gives time to heat steam line and purge out the condensed moisture. The user can vary this time through settings option. It gets reset after preset time.

2.5. Wall time

If the SH spray flow is continuously within high and low set points, a timer starts to count and when the count reaches the preset values, that section of wall blowers are commanded to operate as per logic. The user can vary this time through settings option .It gets reset after preset time.

2.6. Low spray time

If the SH spray flow is consistenting lower than the set point a timer starts to count and when the count reaches the preset values, an alarm is given to the operator. The user can vary this time through settings option. It gets reset after preset time.

2.7. Reach low spray time

Even after scanning all 56 blowers, still the SH spray flow has not reached the low set point, and then this time is compared with "Reach flow spray time". If it is less than the preset value an alarm signal is generated called "spray flow low not reached in time".

2.8. SH Spray flow high

Even after scanning all 56 blowers, still the SH spray flow is above the set high point, an alarm signal is generated, "spray flow remaining high''

3.Experimental setup:

Fig.2: Experimental set up of temperature Probe.

Fig.3: view of soot blower inside furnace

4. Results and Discussions:

Parameters	Before SMART Soot Blowing	After SMART Soot blowing
Turbine heat rate(thr	2223.89KJ/KWH	2216.97KCal/KWH
Unit heat rate(uhr)	2607.14Kcal/KWH	2580.57Kcal/KWH
Cycle efficiency	32.98%	33.325%

Table.3 : Experimental results

Description	Unit	Conventional	Smart
Average RH Spray	T/hr	16	7
Difference in RH spray	T/hr	9	
RH steam flow at MCR	T/hr	630	630
Reduction in RH spray	%	1.42857	
Heat rate change for 1% change in RH spray	%	0.2	
Reduction in Heat Rate	%	0.28571	
Heat Savings: MCR Heat input for 210MW turbine: 486 Millions Kcals/hour **X**0.0028571	Kcals	1388571.43	
Calorific value of Coal	Kcal/ Kg	4200	4200
Coal quantity Saved(1388571.43/4200000)	T/hr	0.3306122	
Coal saved/year(0.3306122*24*333)		2642.253	
Cost of coal saved @Rs.1600/ton	Rs	4227604.9	

Table no.3.1: Savings over reheat reduction

Description	Conventional	Smart
Number wall blowers/year	55944	17664
Reduction in wall blowing/year	38280	
% of Reduction in Blowing /year	68.425	
AS firm spends for replacing tubes per annum	2.5lakhs	
Therefore the savings due to reduction in wall blowing is (2.5*0.68425)	1.711 lakhs	

Table.3.2: Savings over water tubes

Description	Rs.In Lakhs
Make up water saving	11.25
Fuel saving	6.989
Savings due to reduction in RH spray	42.276
Savings due to reduction in Replacement of water tubes	1.711
Total Amount saved/annum	62.226

Table.3.3: Experimental results saving by induction of SMART soot blowing system

"6. Conclusion"

Change over to smart wall blowing system is likely to bring savings of around Rs.60 to 70 lakhs/boiler/annum due to reduced reheater spray and reduced steam off for wall blowing .On implementation in all units.

The trial of a localized slag control system has highlighted many potential areas where boiler efficiency can be improved. Although the analysis of trial data is not yet complete many areas of interests have been observed.

Changes in fundamental boiler operating parameters can cause major changes in boiler operation .These changes have proven to be much greater than has always been assumed and as such have proved to be in some instances, the cause of many boiler problems.

The assumption that boiler slagging is random in nature is not strictly true, as it was noted that some areas showed definite slagging patterns. Sometimes these patterns lead detrimental conditions being established and the potential for localized problem, such as tube damage, is increases. A control system using heat flux sensors can identify problem areas and in many cases can reduce, or remove, the cause.

The risk of potential slag brides and slag related waterside tube erosion can be reduced by using a sensor based system to monitor and control slagging.

It was found that substantial financial improvement could be made by the implementation of a slag control system even though the trial boiler slag controls system even though the trial related problems.

Systems using global variables and fixed algorithms to control boiler heat transfer cannot do so accurately due to the much localized nature of the slagging proceed and the tendency for conditions to change quickly and without any external signs.

The analysis has also proved that the cycle efficiency has been driven up to a considerable extent when compared to the conventional value.

"7.References"

[1] "Steam/its generation and use"; Babcock & Wilcox; 3rd Printing; ©1978; Library of Congress Catalog
No. 77-90791

[2] Diamond Power International, Inc.; P.O. Box 415, Lancaster, Ohio 43130; (740) 687-6500; Fax: (740)
687-4229;

[3]http://ebiz.diamondpower.com/DP/Framesets/RecoverySet.html

[4] IK-525R Recovery Sootblower; Sootblower Controls Systems; Product Listing BOS® for Windows
"Clyde Bergemann Sootblowers"; Clyde Bergemann;

[5] Ma F. and Hanna M.A

[6] An Introduction to Measurements using Strain Gages,
Karl Hoffmann, 1998

[7] "Slag Monitoring at Georgia Power Plant Bowen"
IJPGC2003-40148, Charlie Breeding and Chris Bentley

[8] "Slag and Deposit Monitoring at TVA Cumberland"
PWR2004-52042, Charlie Breeding, Rabon Johnson, and BenZimmerman

Books:

[9] **DOMKUNDWAR,** *Power plant Engineering.* (The Danbad Co; 1988)

[10] **R.S Kurmi,** *Thermal Power Engineering.* (The CHAND Pvt Ltd, 2011)