The background of the slide features a photograph of an industrial facility, likely a power plant, with several tall smokestacks emitting thick plumes of white smoke. In the foreground, a row of dark green evergreen trees stands against the industrial backdrop. The sky is filled with soft, white clouds. The overall color palette is dominated by blues, greys, and greens, with a white diagonal stripe in the top left corner.

Dynamic Coal Flow Monitoring and Balancing System

Greener Environment with Optimised Combustion
from Coal Burning in Power Plants

NAVIGATING TOWARDS GREENER FUTURE

Navigating Towards Greener Future in Coal Combustion
through Dynamic Coal Flow Monitoring and Balancing System



RELIABILITY OF GENERATION DURING FLEXIBILIZATION

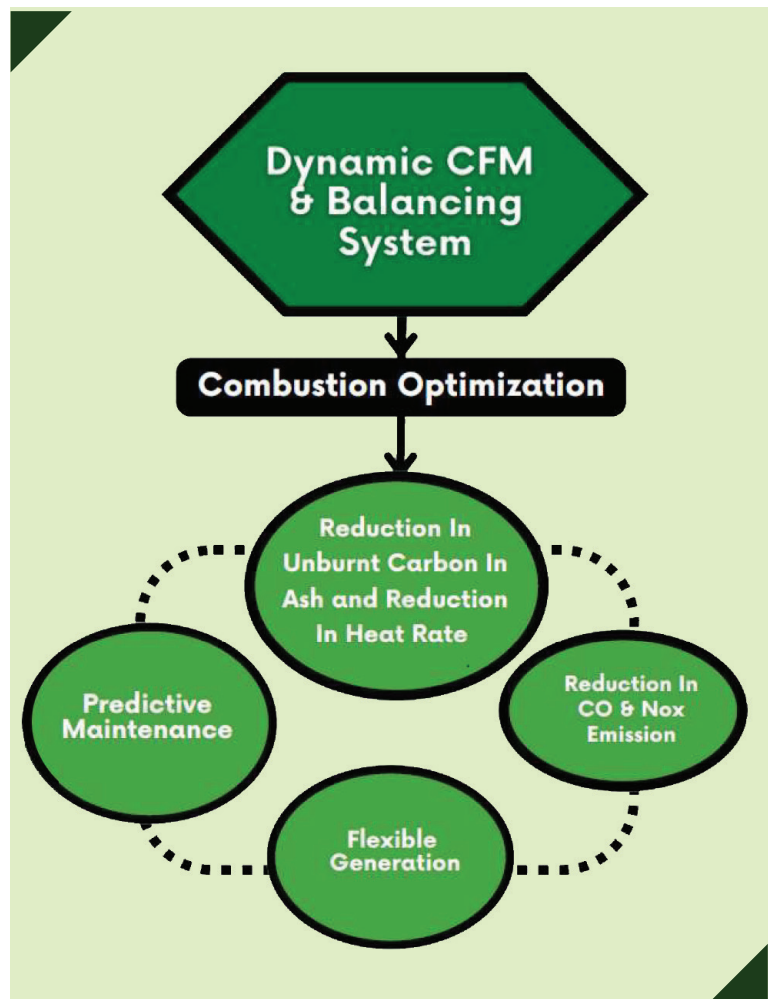
Evolve offers Technology to manage power plant operation to improve performance, reliability and safety during flexibilization operation.

Demand for reliable supply of electricity In sync with solar generation.

Coal based power plants at minimum load of 40 % at day time and full load at night is a challenging situation. Continuous ramp down and ramp up effects the boiler health.

In order to minimize the ramp up and ramp down shocks to boiler needs parameters to be digitally controlled:

1. Coal flow balancing
2. Reduction in fouling
3. Oxygen level control
4. Optimize combustion
5. Real time data analysis
6. Advanced monitoring and controls
7. Predictive maintenance



We at Evolve developed a software and hardware, so our customers better control the cost of operations and maintenance. Evolve software is real time analytic software that helps coal-based power plant personals to monitor and analysis the operational parameters so that coal flow imbalances are minimized.

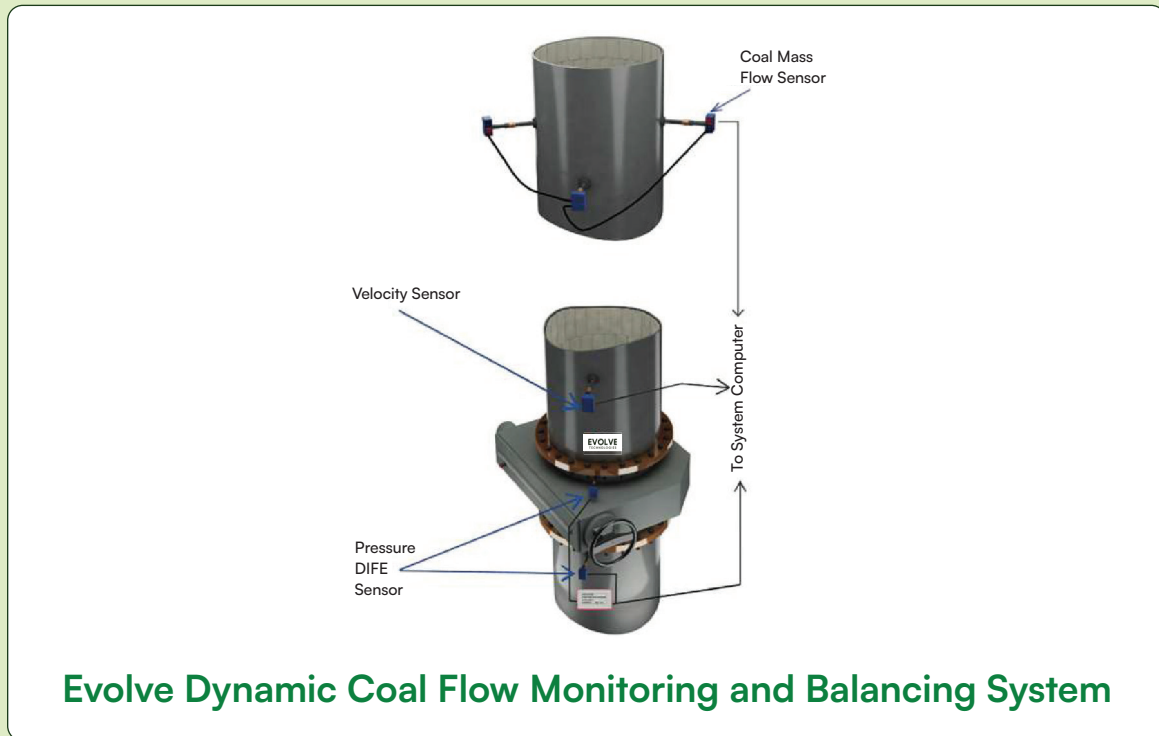
It is presumed that all the pipes originating through the mill of carry almost equal coal flow. But microwave sensors provided data narrates a different story. The highest coal carrying pipe is carrying 33% (shortest length) of the total coal transported while the longest length pipe carries just 15% of the total coal flow. In case of 40% minimum total feeding of coal to the mill is maintained 20 MT/ hr. therefore mass flow in pipe 1 is 5.8 mt/hr. Pipe 2 is 6.6 mt/hr. pipe 3 is 4.6 mt/hr. and pipe 4 carrying 3 Mt/hr. primary air and secondary air combines to provide enough combustion air for complete combustion.

If combustion air is sufficient to provide complete combustion to 6.6 MT / hr for pipe 2 then it will be hugely excess for 3 MT /hr flow of pipe 4. The resultant would be that due to excess air for pipe 4 flame will be extinguish or vary inconsistent.

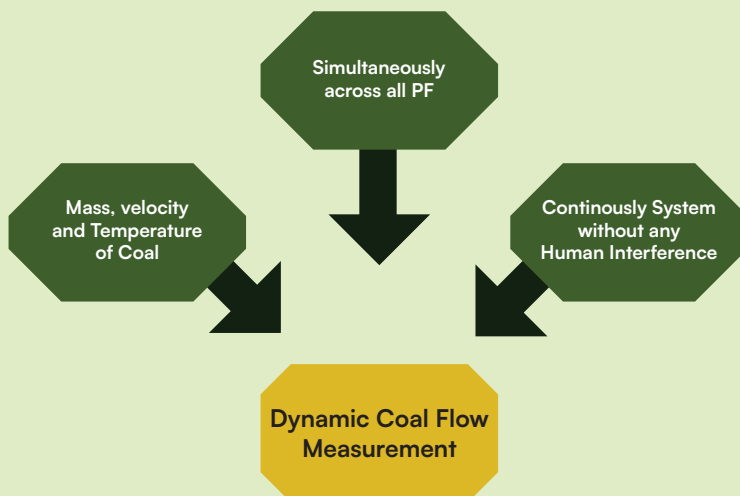
To overcome such situations, it is advisable to balance the coal flow. Our flow monitoring software for steam generators develop to meet requirements of flexibilization.

GREEN COAL POWER GENERATION-

Evolve Dynamic Coal Flow Monitoring and Balancing System



The flow distribution between the coal pipes is achieved as the coal air mixture leaves from the pulverizer through a number of outlet pipes, each of which carries coal into one individual burner. The number of outlet pipes on a typical mill varies between 2 and 8. The distribution of primary air throughout the piping network is controlled by flow resistances of the various coal pipes. Because of differences in pipe lengths and numbers and types of elbows in each burner line, different coal pipes from a pulverizer has different flowresistances.



EVOLVE'S DYNAMIC COAL FLOW MONITORING AND BALANCING SYSTEM IS CAPABLE OF CONTINUOUSLY MEASURING COAL FLOW IN REAL TIME CONDITIONS USING MICROWAVE BASED SENSORS AND BASED ON OUTPUT OF COAL FLOW SYSTEM, COAL FLOW VALVES ARE USED FOR BALANCING THE COAL FLOWS AND VELOCITY.

PROJECTED IMPROVEMENTS

The system will benefit in the following areas:

01

FLEXIBILISATION

Rapid ramping of generation as per grid demand, down upto 40% technical minimum. NTPC has targeted readiness of plants to operate at 40% technical minimum.

Siemens has carried out Minimum Load Pilot Test at Unit-6 of NTPC Dadri TPS - 500 MW consisting of 6 Mills (Make : BHEL).

Finding of this report suggest that one of the most limiting factors preventing the minimum load being reduced further is "Flame intensity / combustion optimization at low load if specific coal is less than 0.6". Report also suggests that main challenges at low load is combustion behavior, Mill operation behavior and Mill operation data like coal mass flow patterns in pipes, coal/air temperature to burner.

02

EMISSION CONTROL

Combustion optimization techniques results in NOx reduction. Although NOx emissions from boilers are influenced by many factors. The most significant factor is flame temperature and excess primary air velocity. NOx is formed by reaction of nitrogen and oxygen present in air at flame temperature of more than 1700 deg C (Fusion temp of ash). This high temperature results in increase in NOx and ash slagging on boiler tube.

03

HEAT RATE IMPROVEMENT AND REDUCTION IN UNBURNT ASH

As against designed efficiency of 39% Indian projects operate between 28-32% efficiency. Prime objective of Dynamic Coal Flow Monitoring and Balancing System is to maintain Air to Fuel ratio for optimized combustion. Reduction in Fly ash and bottom ash unburnt and reduction in super heater temperature and reduced slagging. The most frequent cause of extreme fuel imbalances is poor tuning of mass flow and velocity in coal pipes. Slagging leads to poor heat absorption by boiler tubes that lowers boiler efficiency. High Velocity of more than 27m/s and high volume of coal in burner results in high flame temperature (Fusion Temperature).

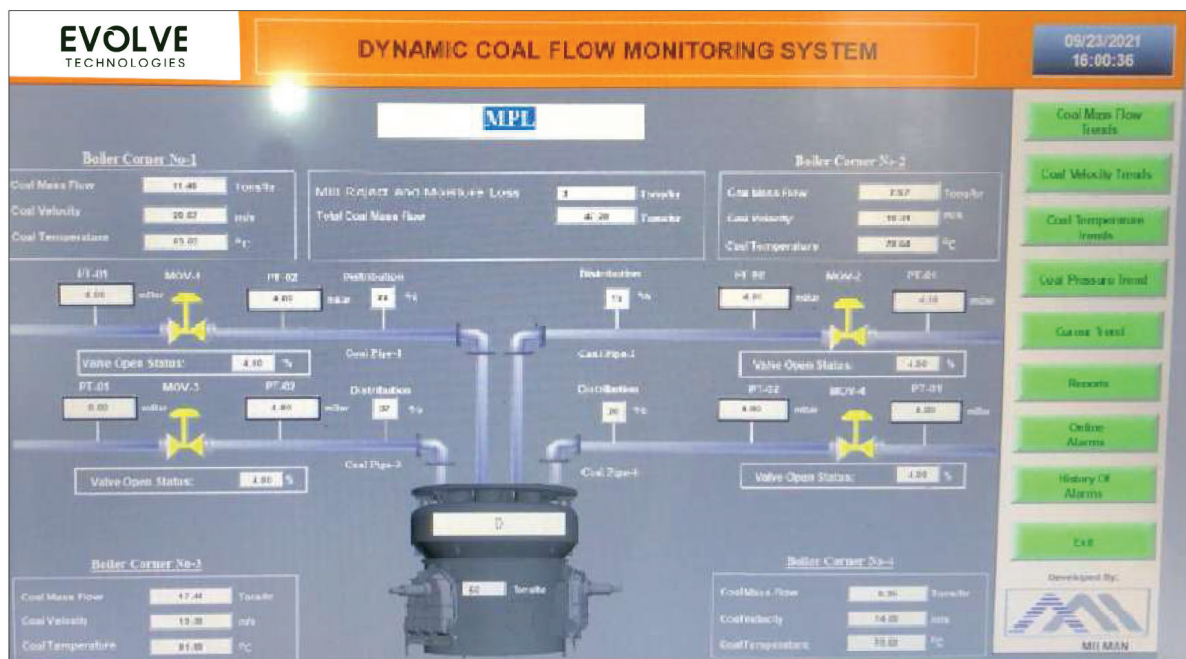
THE SYSTEM

Evolve has adopted a novel approach

“Unless we can measure continuously, we cannot improve.”

Evolve Dynamic Coal Flow Monitoring and Manipulation System is an engineered system specifically designed to meet the requirements of Indian Power Plants operating at high ash content. With German collaboration - MIC Worldwide, Evolve has developed a package for real time measurement of important Coal flow parameters. These include :

1. Coal Mass Flow in each pipe
2. Coal Roping Area identification
3. Coal Temperature in each pipe
4. Coal Velocity in each pipe
5. Coal Flow Balancing with Coal Flow Valves



Coal Flow Monitoring

Evolve Dynamic Coal Flow Software is user friendly software, which has been designed keeping in view the parameters which would be most useful from operations and maintenance point of view. Software has evolved over the years after feedback from plants as well as understanding coal flow application and find tuning from time to time

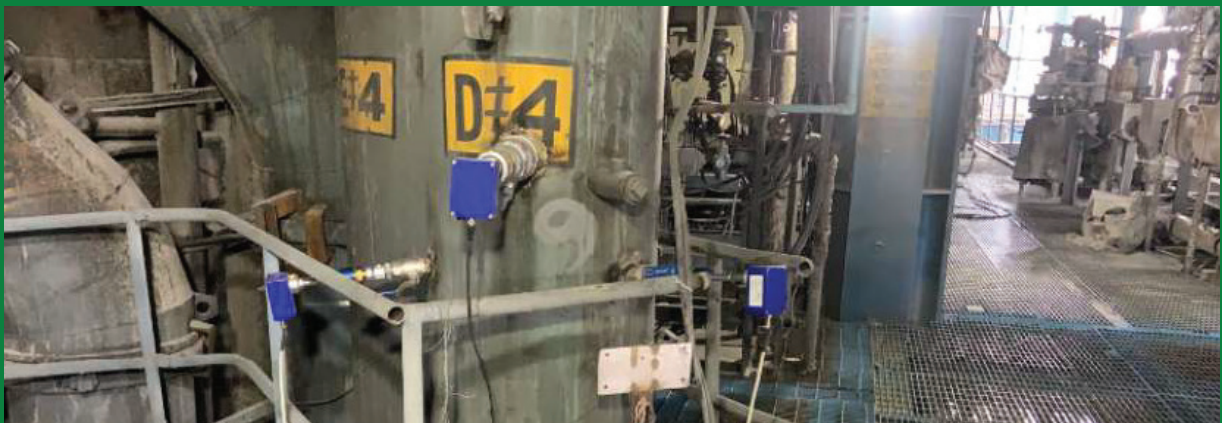
PLACEMENT OF MICROWAVE BASED MASS FLOW SENSORS

Three microwave based mass flow sensors are installed in each coal pipe 120 degree apart as shown below. Mass flow sensors are placed in vertical section of the coal pipe, as close to the burner as possible. These sensors are responsible for measuring mass flow in each pipe and for indicating the areas of coal roping within the pipe.



PLACEMENT OF ELECTROSTATIC BASED VELOCITY SENSORS

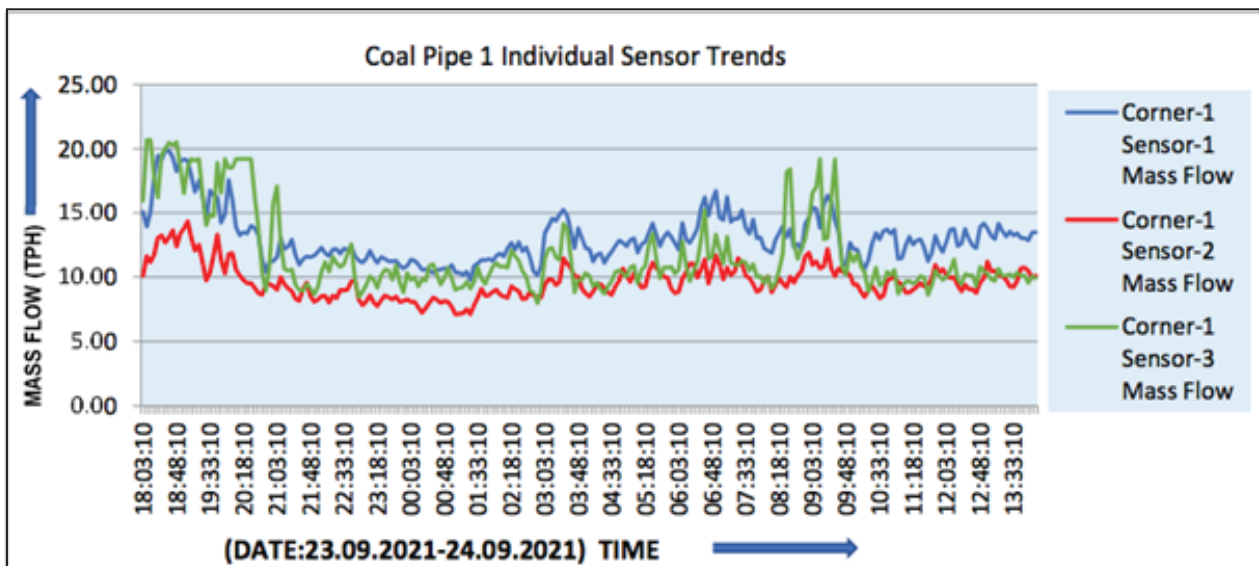
Velocity sensor is installed 500 mm above the mass flow sensors. This is electrostatic sensor which measures the velocity of coal particles and temperature of coal particles within coal pipe.



PLACEMENT OF COAL FLOW VALVES IN PIPELINE

Coal Flow valves are recommended for installation on mill outlet in order to Dynamically adjust the cross-sectional area of area pipe, thereby controlling the pipeline resistance and coal distribution from coal mill to coal pipe.





NEED FOR CONTINUOUS MONITORING SYSTEM FOR EFFICIENT OPERATION

Graph represents coal mass flow of 1 coal pipe in 3 sections of same plane for a duration of almost 20 hours with constant feeder loading. It can be noticed that Mass flow is changing from 8-9 TPH to 20 TPH in this duration.

One section of pipe represented by Sensor-1 has very high coal flow as compared with other two sensors Manual equipment currently deployed, Dirty Pitot Tube can be measuring at any point in this pipe as there can be no knowledge of coal flow characteristics. Any point reading cannot be considered representative of the coal flow in the pipe.

The coal flow in coal pipes is a Dynamic 2 phase system. Coal flow conditions in coal pipes are continuously changing based on various parameters like moisture in coal, temperature, velocity, coal type, coal classification, coal density and many more. It extremely difficult to simulate / predict the actual pattern of flow in pipes. It varies not only from mill to mill but from pipe to pipe under various conditions.

Manual techniques like Dirty Pitot Tube test assumes that coal flow in each pipe and at all time intervals is homogeneous. Hence, 1 or 2 readings in each pipe are considered to be representation of that pipe for entire duration. Coal flow cannot be conclusively by measured by any point analysis. It is only the study of trends which can prove useful for analysis of coal flow parameters. This necessitates the use of Dynamic and real time system for Coal Flow Monitoring.

Expected Benefits



Flame Stability At Low Loads



Heat Rate Improvement

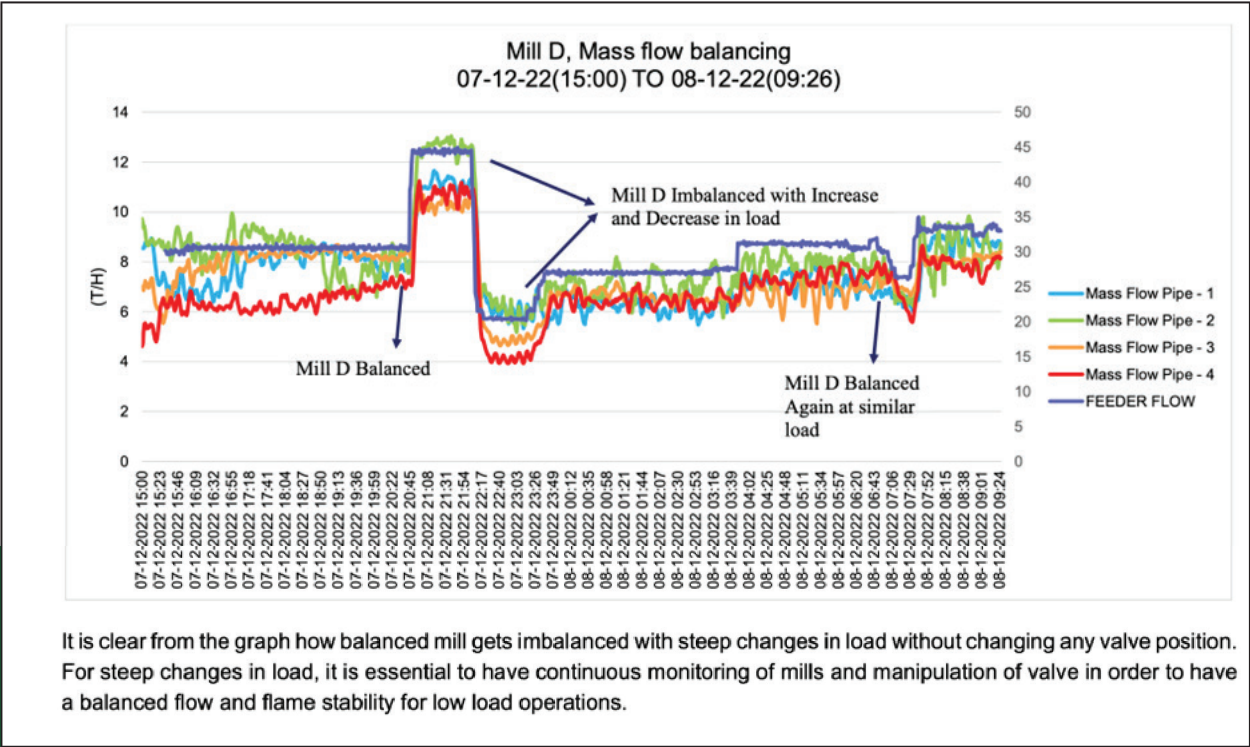


Reduction In Unburnt Ash

NEED FOR CONTINUOUS MONITORING SYSTEM FOR FLEXIBILIZATION

Balanced coal flow is the requirement of power station as per recommendation of all OEMs. Traditionally, fixed orifices installed within the pipes are used to balance the clean air flows. While this can be an effective way of balancing air flow, evidence from field measurements suggests primary air flow balancing has little effect on distribution of coal flows between the coal pipes. Instead, the coal flow distribution among the outlet pipes is a dynamic phenomenon and is strongly influenced by factors such as mill loading, moisture in coal and coal type.

In order to study the impact of coal flow balancing with changing mill loads Evolve has carried out a test in 250 MW corner fired boiler in India.



It is evident from the graph that balanced coal flows in the mill gets imbalanced with steep changes in load without any change in valve position. For steep changes in load, it is essential to have continuous monitoring for mills and manipulation of valves in order to have a balanced flow and flame stability for low load operations. These findings are in sync with test runs low load carried out by Task Force at various plants where lack of flame stability at low loads was found to be one of the most limiting factors in flexing the thermal units.

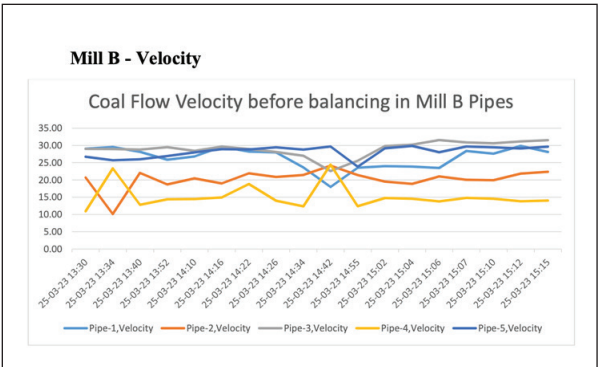
REAL TIME DATA OF DEMONSTRATIONS AT POWER PLANTS:

Evolve has carried out multiple measurement and balancing assignments in India. To name few Power Plants:

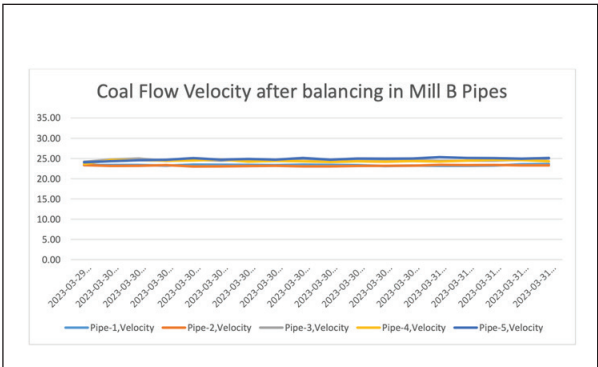
- 2X600 MW LANCO ANPARA (Wall Fired Boiler)
- 2X250 MW DSPM CSPGCL - Korba (Corner Fired Boiler)
- 2X500 MW DVC - Andal (Corner Fired Boiler)
- 2X500 MW TATA - Maithan (Corner Fired Boiler)

COAL VELOCITY BALANCING IN WALL FIRED BOILER

Velocity (Pre Balancing)

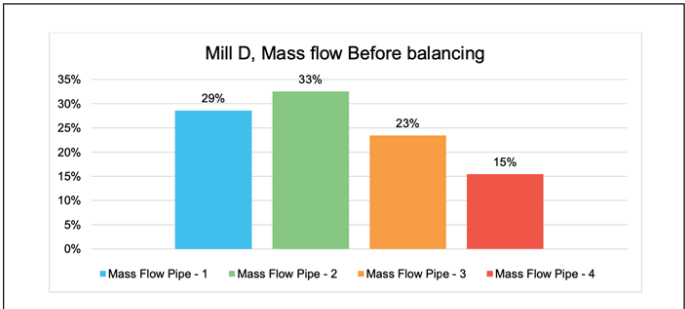


Velocity (Post Balancing)

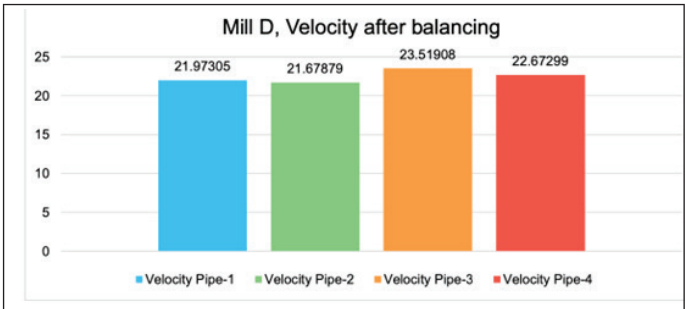
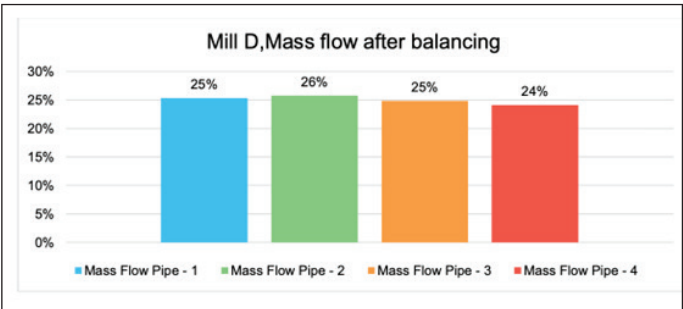


MASS FLOW BALANCING BY BMW COAL FLOW VALVES

Before commencing the test, Coal Flow Valve setting was kept at the equivalent setting of BHEL recommended fixed orifice ID.
At original fixed orifice settings, mass flow distribution obtained is as under:



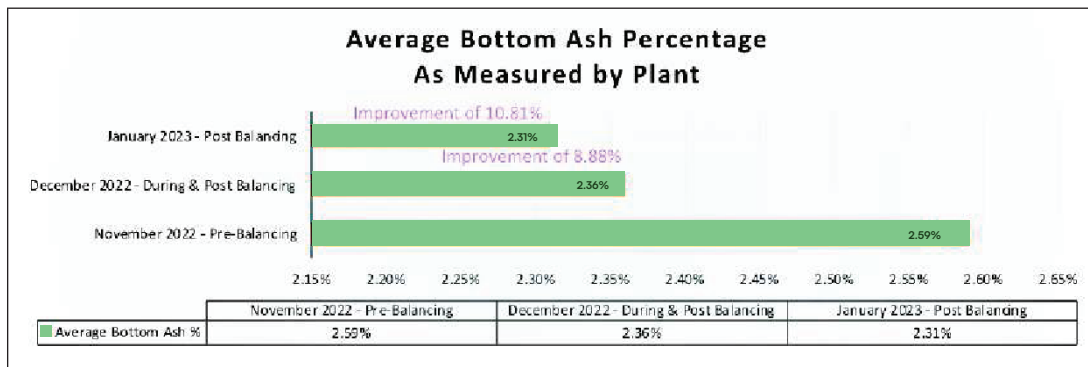
MASS FLOW BALANCING BY BMW COAL FLOW VALVES



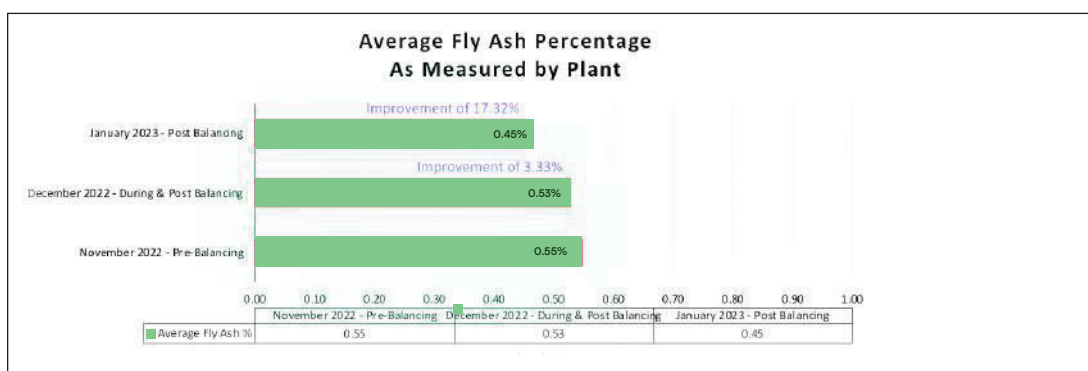
REDUCTION IN UNBURNT CARBON AND ASH

PLANT-1 : CORNER FIRED BOILER - 250 MW

Improvement
of 10.81%

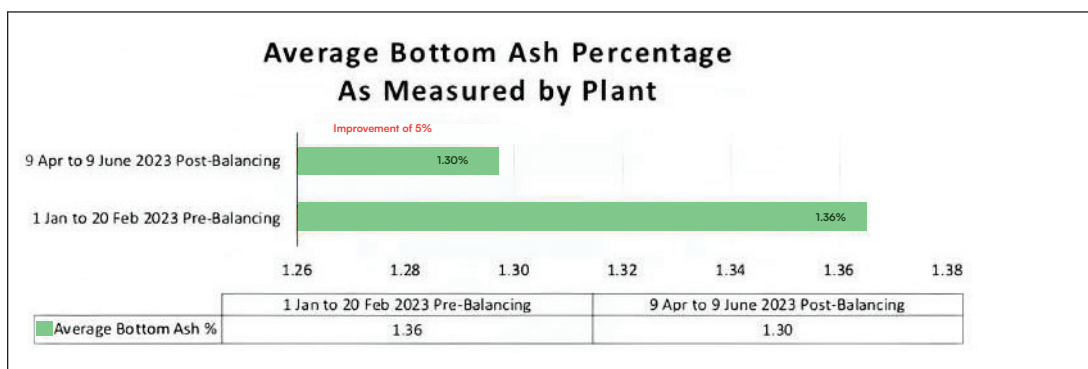


Improvement
of 17.32%

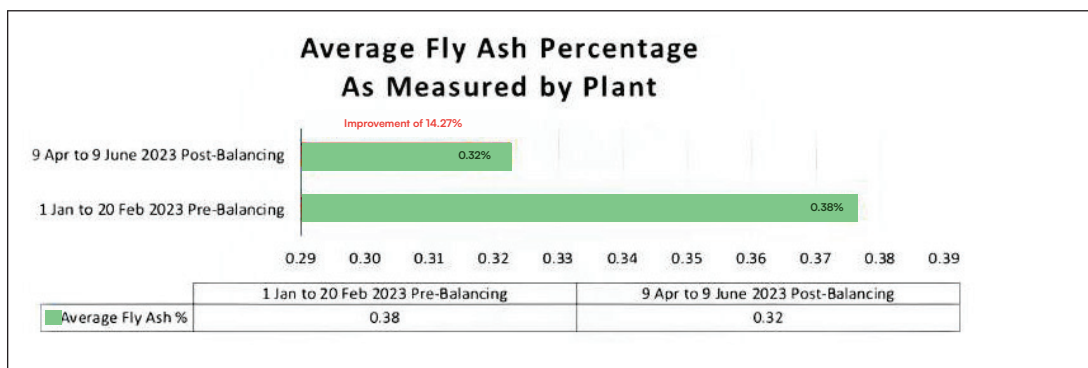


PLANT-2 : WALL FIRED BOILER - 600 MW

Improvement
of 5%



Improvement
of 14.27%





SYSTEM HIGHLIGHTS

- Evolve Dynamic Coal Flow Monitoring System is a Make in India initiative
- It's an import substitute fully developed and indigenised by MSME
- Stable flame at flexible operations
- Balancing Valves is Patented Technology with more than 1,000 installations in India
- Dynamic Coal Flow Monitoring and Balancing is a proven technology under Indian conditions with the quantified benefits
- Excellent ROI of 8 months to 1.5 Years depending on plant to plant and operations
- Mass Flow Balancing and Coal Velocity Balancing has potential to improve following plant operation parameters :
 - i. Unburnt Carbon Percentage in Bottom Ash.
 - ii. Unburnt Carbon Percentage in Fly Ash.
 - iii. Gross Heat Rate
 - iv. Super Heater Inlet and Outlet Temperature differences
 - v. Oxygen Level Differences in LHS and RHS of furnace
 - vi. NOx Reduction
- Dynamic Coal Flow Monitoring and Balancing System is a very important tool for flexing the Thermal Power Fleet, where fast ramping is requirement

TESTIMONIALS



CHHATTISGARH STATE POWER GENERATION COMPANY LIMITED

Performance report of "Variable orifices & coal flow monitoring system"

With reference to above subject, an order for supply of "Variable orifices measurement of online coal flow" for XRP-883 coal mills of DSPM TPS Korba East placed on M/s Evolve Technologies Hathras, vide P.O. No. under ref (3). The above order has been completely executed and the material was received on td. 30.06.2022. These Orifices have been installed in mills 1A, 1B, 1C & 1D of U#1 during AOH in AUG-22. Also, the balancing of coal pipes were carried out in all 4 mills in Nov-22. The following observations were found after balancing of coal pipes:

Improvement in GUHR as compared to pre-balancing.

- 1 Reduction in Unburnt carbon in Bottom Ash as compared to pre-balancing.
- 2 Reduction in Unburnt Carbon in Fly Ash as compared to pre-balancing.
- 3 Reduction in NOx values of flue gases at exit



MAITHON POWER LIMITED

M/s Evolve Technologies had installed Variable Orifices and Coal Flow Monitoring System in Mill D of Unit 2. Evolve Coal Flow Monitoring & Balancing tests were conducted between 23rd to 25th of September'2021. The system has effectively demonstrated its capability to measure coal mass flow and other coal pipe parameters in each pipe dynamically and accurately. The data provided by system is almost correlating with DCS data and physical condition of coal piping. They have also been able to balance the coal mass flow in all the 4 PF pipes of Mill 2-D by manipulating their Variable Orifices, within 5% of the Mean Average Coal Flow. The diagnostic ability of the system is expected to enable in plant operations for improving combustion and controlling NOx emissions.



HINDUSTAN POWER PROJECTS PRIVATE LTD

Certified that M/s. Evolve Technologies Had supplied ceramic variable Orifices in unit 1 & 2 of MB power, Annupur, via order No. #LITL/MB ATPP/MECH/PCP/PO/4960000899 in 2015. These orifices have crossed the 25,000 running hours & are still running successfully. Therefore wear & erosion resistance is satisfactory. Further, manipulation of variable orifices was smooth whenever it was required during mill operation to adjust the area of flow. Hence, overall performance of variable orifices is satisfactory after 25,000 running hours. Also, the quality of ceramic tile fixing of variable orifices is good.

BMW
Steels Ltd

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Amal
Amal Kumar
10.07.2022

Maithon



Letter No: MPL/COMS/FY2021-22/25

Date: 29/10/2021

To Whomsoever It May Concern


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The diagnostic ability of the system is expected to enable in plant operations for improving combustion and controlling NOx emissions.

With Best Regards,

For, Maithon Power Ltd


S H Pandey
(Chief O&M, Services)

A Joint Venture of TATA POWER & DVC
Registered Office : Corporate Center, 54, Sant Tukaram Road, Camara Bunder, Mumbai 400 009, Tel: 91 22 67171232.
Works : Village Dambhut, P.O. Barbindia, P.S. Nirsak, District Chhindwad 482 205, Jharkhand
Tel: +91 6540 278001/50 Fax: +91 6540 278040 +91 6860075658
Corporate Identity Number (CIN) : U74899MH2000PLC267297, Website Address : www.tatapower.com/mpl

DSPM

CHHATTISGARH STATE POWER GENERATION COMPANY LIMITED
(Chhattisgarh Government Undertaking)
(A Successor Company of CSEB)
OFFICE OF THE SUPERINTENDING ENGINEER (Boiler)
Dr. SPM TPS, KORBA EAST, DISTT: KORBA, PIN: 495677 (C.G.)

No. 25-07/SE/BLR/DSPM TPS 3034

Korba Dtd 15/01/23


To,
M/s BMW Steels
Navipur Road
Hathras- 204101
E-mail kolkata@bmwsteels.com

Sub:- Performance report of "Variable orifices & coal flow monitoring system".

Ref:- 1. Tender No. - 03-03/TN-423/DP-529/21-22.
2. your E-mail dtd. 27.07.2023.
3. SAP Contract no. : 5500098527 dtd. 27.05.2022.

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2. Reduction in Unburnt carbon in Bottom Ash as compared to pre-balancing
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4. Reduction in NOx values of flue gases at exit.



SUPERINTENDING ENGINEER (BOILER)
DSPM TPS, CSPGCL, KORBA EAST

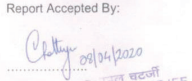
DVC Andal

BMW-MIC system has showed its capability to measure the mass flows in each pipe dynamically & accurately. This diagnostic ability of this system will help in improving combustion and thus reduce unburnt carbon in ash and CO & NOx emissions.

Report Verified By:

Archil Chatterjee
(BMW Steels Ltd.)

Measurements Verified By:

(DVC Andal)

Report Accepted By:

(DVC Andal) PAL CHATTERJEE
SUPERINTENDING ENGINEER (Mech)
Dr. SPM TPS, KORBA EAST
C.V.C., D.S.T.P.S., ANDAL

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EVOLVE

TECHNOLOGIES

“We Promise to deliver low NOX and low CO Emission along
with higher combustion efficiency.”



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CORPORATE OFFICE

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Dehradun, Uttarakhand, 248001