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Soot Blower Control Using Plc & Scada

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Abstract - **The efficiency of boilers in thermal power plants is greatly affected by the cleanliness of their heat exchanger surfaces. Soot blowers are essential for ensuring efficient heat transfer by eliminating soot deposits that build up gradually. Traditional soot blowing techniques, like manual and time-based operations, frequently lead to high energy usage and unsatisfactory cleaning outcomes. This paper delves into the development and execution of an automated soot blower control system, utilizing programmable logic controllers (PLC) and supervisory control and data acquisition (SCADA) to tackle the challenges at hand. The suggested system maximizes cleaning cycles by continuously monitoring and controlling the process, thereby reducing steam wastage and energy losses. The findings indicate that the implementation of PLC-SCADA-based automation significantly boosts cleaning efficiency, enhances boiler performance, and guarantees system reliability, making it an essential advancement for contemporary power plant operations.**

KEYWORDS- Soot Blower, Programmable Logic Controller (PLC), Supervisory Control and Data Acquisition (SCADA),Efficiency, Boiler, heat.

I. INTRODUCTION

In power plants that generate electricity using thermal energy, the efficiency of boilers is of utmost importance in determining the overall energy output. A major obstacle in ensuring boiler efficiency is the building up of soot and ash on heat exchange surfaces, which hampers heat transfer efficiency and leads to higher fuel consumption. To tackle this issue, soot blowers are utilized to eliminate these deposits and restore the machine's efficiency. Historically, the process of soot blowing has been carried out either manually or on a predetermined schedule.

Unfortunately, this method frequently leads to uneven cleaning, operational inefficiencies, extended periods of downtime, and higher maintenance expenses. The emergence of automation presents a hopeful solution to these limitations. The automated soot blower control system is a cutting-edge technological advancement that improves boiler efficiency by automating the removal of soot. Through real-time monitoring, the system identifies the most effective soot blowing schedule, guaranteeing efficient cleaning and enhanced heat transfer. This not only minimizes fuel usage but also decreases downtime and improves operational safety. Additionally, the system seamlessly integrates with existing plant control systems, resulting in streamlined operations and minimizing the need for manual intervention. This automated approach not only enhances reliability and safety but also promotes sustainable energy production by reducing energy losses and minimizing resource wastage.
The main objective of this paper is to examine the design, methodology, and implementation of the automated soot blower control system, emphasizing its significance in enhancing boiler efficiency, minimizing operational expenses, and promoting the sustainability of power generation facilities.

II. LITERATURE SURVEY

The efficiency of boilers in industrial applications is significantly affected by soot deposition on heat exchange surfaces. The accumulation of soot reduces heat transfer efficiency, increases fuel consumption, and leads to higher operational costs. To address these challenges, researchers have explored automation techniques using Programmable Logic Controllers (PLC) and Supervisory Control and Data Acquisition (SCADA) systems for effective soot blower control. Several studies have been conducted to optimize the soot blowing process, aiming to enhance boiler performance, reduce maintenance efforts, and improve energy efficiency. This section reviews key research contributions in the domain of soot blower control using PLC and SCADA.

Boiler Efficiency Analysis using Direct Method by Sunit Shah & D. M. Adhyaru (2011): In this study, the authors propose a method for automating soot blowing in boilers using a Programmable Logic Controller (PLC). The research highlights the significance of monitoring critical parameters such as thermal efficiency and heat rate in steam generators. These parameters are essential for assessing the overall performance of the boiler and are influenced by various factors, including boiler design, control strategies, fuel quality, and operating conditions. The paper emphasizes the need for efficiency optimization to enhance the operational performance of boilers.

Control of Boiler Operation using PLC-SCADA by K.Z.Gouri Shankar (2008): This paper discusses the transition from a manually operated boiler to a fully automated system using PLC-SCADA. The study highlights the increasing demand for high-quality, efficient, and automated machinery in a globalized world. The research primarily focuses on the control of key parameters, including level, pressure, and flow, at various stages of the boiler plant. By implementing automation, the study aims to enhance operational efficiency and reliability in boiler systems.

Effect Of Smart Soot Blowing System In Boiler Furnace On Cycle Efficiency And Cost Saving by Raj Kumar B and Dr. N. S. Venkatesh Gupta (2013): This study addresses the issues related to soot and slag deposition on furnace walls, which diminish heat flux. The authors propose an Intellectual Soot Blowing system aimed at efficiently and economically removing soot from furnace walls. The implementation of this system demonstrated significant improvements in cycle efficiency and cost savings.

Design of Boilers Soot Blower Control System for Power Station Using Programmable Logic Controller by Ibrahim Mohammed Elfatih

Mohammed Mohi Eldin (2012): This thesis discusses the design of a soot blower control system using PLCs for a 30 Megawatt unit at Khartoum North Power Station. The existing system, composed of relays and contactors, faced issues like unreliability and high maintenance costs. The proposed PLC-based system aims to reduce spare parts usage, decrease maintenance time, and provide automatic operation, enabling operators to monitor and control all stages of the soot blowing process.

PLC Based Automatic Soot Blower Control System in Boiler by N. Kavitha et al. (2017): This paper presents a method for automating soot blowing in boilers using a Programmable Logic Controller (PLC). The system monitors process variables, estimates the fouling status of heat exchange surfaces, evaluates economic impact, and triggers the soot blowing sequence. The automation aims to optimize the soot blowing cycle, thereby enhancing boiler efficiency.

ARM7 Based Automatic Soot Blower Control System by Savita Sonoli at el. (2014): This paper introduces an embedded-based industrial automation technique for efficient operation of soot blowers using the ARM7 platform. The system controls the soot blower based on stack temperature, aiming to improve boiler efficiency. The performance of the designed system was tested in the laboratory, showing an error margin of ±1.

BLOCK DIAGRAM

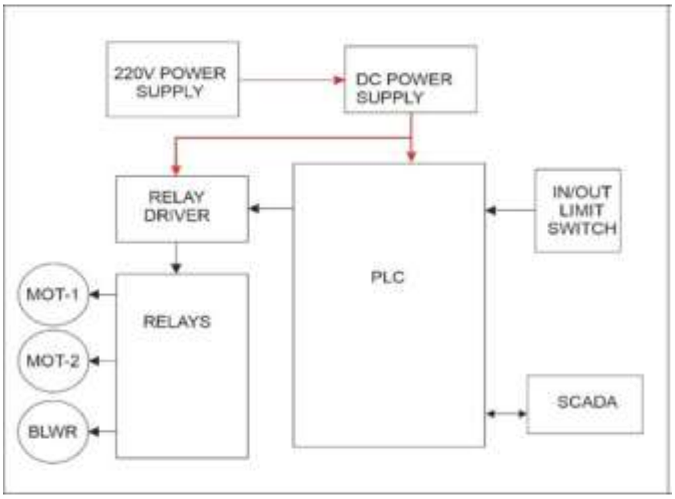


Fig 1: Block Diagram of Soot Blower Control Using PLC & SCADA

III. METHODOLOGY

This research concentrates on the development and execution of an automated soot blower control system for thermal power plants, utilizing a programmable logic controller (PLC)-based supervisory control and data acquisition (SCADA) framework. The system streamlines the soot blowing process, guaranteeing effective cleaning and maintaining a safe working environment. The procedure is outlined below:

1: System architecture. The system is built with the following components and functionalities .Power supply: supplies the necessary power to the plc, motors, and related components. Switching Mechanisms .Home switch: identifies the initial position of the blower (when it is pulled back). End switch: identifies the maximum safe distance at which the blower can be inserted into the boiler. Outputs-The rotary motor is responsible for controlling the rotation of the blower, allowing it to move in both clockwise and counter clockwise directions for efficient cleaning. The transverse motor is responsible for moving the blower in and out of the boiler. The blower motor is responsible for creating air pressure at 2.3 kilograms to eliminate soot and ash deposits. PLC and SCADA integration: The plc carries out the ladder logic for managing the entire process, using input signals and pre-programmed instructions. The SCADA system offers a live interface for monitoring and managing the process, allowing operators to oversee operations effectively.

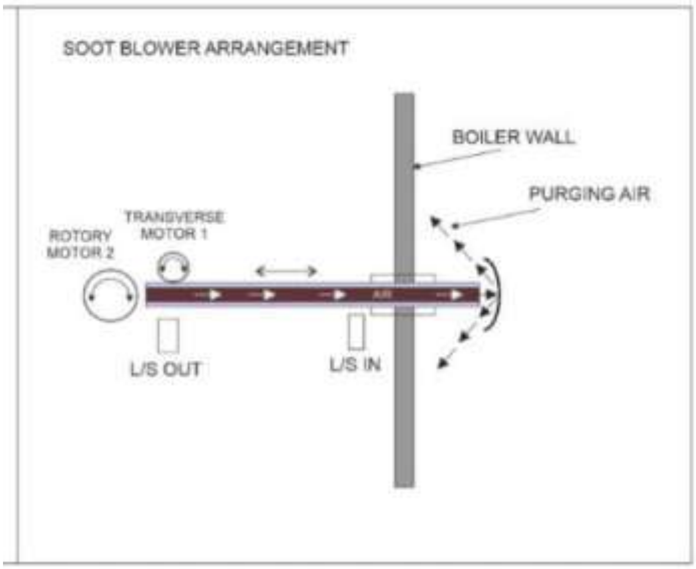
2: Code for Regulating the System. The control logic is designed using plc ladder logic to automate the soot blower process.

Initialization: As soon as the system is turned on, the plc verifies the condition of the home switch. If the home switch is turned on, it indicates that the blower is in its starting position. Operation of the soot blower-The transverse motor is initiated by the plc to insert the blower into the boiler until the end switch is activated. When the end switch is turned on, the transverse motor ceases its movement, and the rotary motor starts functioning. The rotary motor spins the blower in a clockwise direction for a specific amount of time. Following the clockwise rotation, it changes direction and rotates counter clockwise for the same amount of time. During rotation, the blower motor is engaged to produce air pressure of 1.2 kg, guaranteeing comprehensive cleaning of the heat exchanger surfaces.

Completion and retraction: Once the cleaning cycle is finished, the transverse motor is reactivated to retract the blower back to its original position until the home switch is activated. After the home switch is turned on, the process halts, and the system returns to its normal state.

Monitoring and safety: The entire process is closely monitored using the SCADA system, which provides real-time data, such as the position of the blower, motor status, and air pressure. Safety interlocks are designed to disable motor operations if the limit switches malfunction or if unforeseen circumstances arise. Above figure shows the Soot blower arrangement in power plant. Until now it is operated manually but the problem arises when these blower remains in boiler for longer a time. Due to the high temperature of boiler it affects the Blower. Then we need to cool the boiler for maintenance which takes a huge time and also affects the heat transfer of boiler.

RESULT



The comparison between manual and automated soot blowing systems reveals substantial enhancements in efficiency, cost reduction, and system dependability with automation. By implementing automated soot blowing, the frequency and intensity of operations are optimized, resulting in a 20-30% increase in efficiency compared to manual methods. Moreover, automation minimizes the consumption of steam by 25-40%, resulting in direct savings on operational expenses. The system's dependability is improved by minimizing the need for manual intervention, which helps to minimize the chances of human error and ensures more consistent performance. Additionally, combining the automated system with SCADA allows for improved data logging and trend analysis, which in turn supports predictive maintenance and minimizes the chances of unforeseen breakdowns. Real-time monitoring of system performance enables operators to detect potential problems early on, preventing them from worsening and ensuring smoother and more efficient operations.

This study's results validate that automated soot blowing offers numerous benefits compared to manual methods. By fine-tuning the soot blowing cycles, the efficiency of heat transfer is enhanced, resulting in lower fuel consumption. The decrease in steam wastage greatly decreases operational expenses, making automation a financially viable option. Moreover, the improved system reliability reduces the occurrence of downtime and operational interruptions. The integration of SCADA enhances predictive maintenance capabilities, enabling proactive interventions that prevent significant system failures. In conclusion, the findings suggest that adopting an automated soot blowing system offers substantial technical and economic advantages. This progress not only improves the efficiency of power plants but also promotes sustainability and cost-effectiveness in their operations.

IV. CONCLUSIONS

The adoption of PLC-SCADA-based soot blower control has shown substantial enhancements in the efficiency, dependability, and energy conservation of boiler operations. By reducing unnecessary soot blowing and maximizing steam utilization, automation improves the overall efficiency and productivity of power plants and industrial boilers. By incorporating real-time monitoring through SCADA, the soot blowing process can be continuously supervised, data acquired, and controlled in a dynamic and adaptive manner, resulting in a more efficient and intelligent operation. The conventional soot blowing techniques, which required manual operation or fixed-time intervals, frequently resulted in the unnecessary release of steam and inconsistent cleaning outcomes. In contrast, PLC-SCADA automation ensures that soot removal happens only when needed, reducing maintenance needs and enhancing overall boiler performance. Additionally, the capability of PLC'S to connect with sophisticated sensors enables accurate monitoring of soot buildup, triggering cleaning procedures only when predetermined limits are reached. By adopting a focused strategy, this approach optimizes resource utilization while safeguarding the structural integrity of boiler tubes, thereby prolonging their operational lifespan. The advanced monitoring features of SCADA enhance system reliability by offering operators real-time data, historical trend analysis, and predictive maintenance insights. These features minimize the chances of unforeseen breakdowns and improve the overall efficiency of the boiler system over time. In the future, progress in artificial intelligence and machine learning may lead to even more precise and efficient automation of soot blowers. Predictive analytics can facilitate more precise predictions of soot accumulation patterns, enabling the system to dynamically modify cleaning schedules to ensure optimal performance. The integration of IOT-based monitoring will enable remote access and cloud-based data logging, enhancing operational visibility and decision-making capabilities. Moreover, as SCADA systems become more interconnected, it is crucial to implement robust cybersecurity measures to safeguard them from potential cyber threats. In summary, the combination of plc and SCADA in soot blower control systems signifies a notable progress in boiler maintenance and the optimization of efficiency. By utilizing automation, real-time monitoring, and intelligent decision-making, these systems not only decrease operational expenses but also enhance energy efficiency and sustainability. As advancements in artificial intelligence (AI) and internet of things (IOT) integration progress, soot blower automation will continue to evolve, becoming an essential element in contemporary industrial processes.

V. Acknowledge

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