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Boiler Management System

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Abstract: **The boiler is a closed container that generates steam through combustion and transfers heat to water. Heat transfer to a process is accomplished using steam that is under pressure. As a cheap means of delivering heat to the process, water is used. As water is heated to a point where steam is produced, the volume of the steam increases and the pressure inside the chamber rises, creating a very dangerous force. Because of this, the boiler is hazardous machinery that needs to be handled carefully and leaks to be continually checked for. Evaporation is the term for the process by which a liquid is heated to a gaseous state. Any surface of the boiler can be used as a heating surface; water is on one side and hot combustion gases are on the other. The components of a boiler that aid in turning a liquid into steam are called heating surfaces. In a boiler, the amount of heating surface is measured in square metres. A boiler's efficiency increases with the size of its heating surface. By this project, we are controlling the factors such as pressure, temperature, level, and flow through a small-scale DCS. We are using our experience to create a smaller model of the boiler management system. To maintain the pressure inside the boiler, we are also introducing some additional safety precautions. To do this, we are employing valves like PRVs (pressure releasing valve).**

Index Terms **- Boiler, evaporation, DCS, PLC, SCADA**

1. INTRODUCTION

A boiler is a power generator that produces steam that is pumped to a generator attached to a turbine to produce electricity. A boiler incorporates two fundamental systems. The steam water system, commonly known as the boiler's waterside, is the initial system. The fuel air-flow gas system, often known as the boiler's fireside, is the other boiler system. The gasoline and oxygen needed to burn the fuel are the system's inputs. The wind-box is another name for the fuel and air chamber. The byproducts are ash, flue gas, and steam.

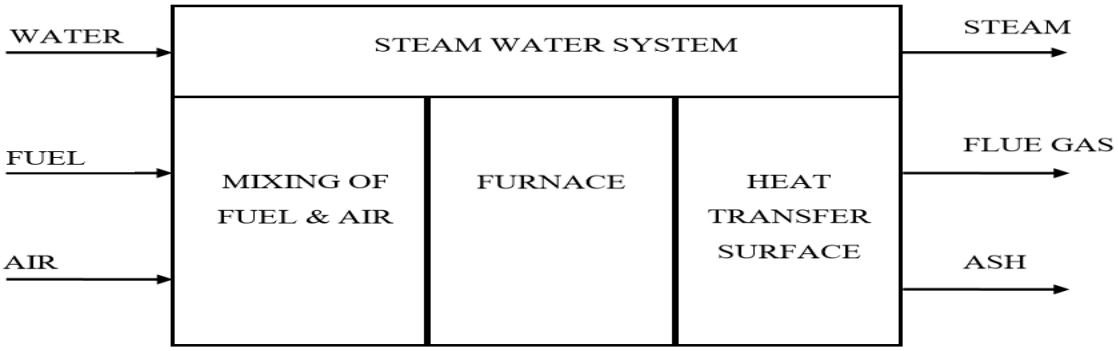

Fig. 1.1 . block diagram

Our project involves the implementation of a scale model of the boiler management system, and it involves the control of parameters like pressure, temperature, level, and flow using a scale model of the DCS. To maintain the pressure inside the boiler, we are also using certain additional safety precautions, such as PRV valves (pressure releasing valve).

Damage or maintenance work on the boilers will have a significant impact on how much power is produced and how industrial processes operate. As we all know, accidents are never desired, whether they include a boiler or not. Accidents involving boilers may result in property loss or production loss. Sometimes there may also be a loss of life

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or harm to nearby innocent bystanders. Boiler accidents have a significant potential for catastrophe due to their powerful explosives. High-pressure boilers of the modern era come with an automatic control system. Control equipment could malfunction at any time, making safety measures and the control role more crucial. Condition monitoring must be carried out with care for the boiler's potentially dangerous effects and their effects to prevent or reduce downtime.

Boiler systems are an integral part of many major industries. Our automated boiler system includes 4 control parameters Temperature Pressure, Flow, Level. Controlling of these parameters is done using: PLC and SCADA. Industrial boilers have many physical variables to be monitored and controlled. Several accidents occur due to the decrease or increase of variable levels beyond the SETPOINT.

Previous works are manually controlled by using relays that were performed for a long number of years. But the main disadvantages are the wastage of manpower and accidents due to carelessness and also not efficient. The control system switched to Logic Controllers which deals with more I/O's but without a human-machine interface (HMI)

2. Boiler system

Boilers are fuel-burning instruments that produce either hot water or steam that gets circulated through pipe for heating process. A boiler is a generating unit that generates steam which is pumped to the generator connected with a turbine to generate electric power. The boiler system is made of

- Feed water system
- Steam system
- Fuel system

The feed the water system provides water to the boiler and regulates it automatically to meet the steam demand. The water supplied tothe boiler that is converted to steam is called feed water. The sources of feed water are:

- Condensate or condensed steam returned from the processes
- Makeup water is the raw water which must come from outside the boiler room and plant processes.

The steam the system collects and controls the steam produced in the boiler. Steam is directed through a piping system. Throughout the system, the pressure of the steam is controlled using valves and measured with steam pressure gauges. All the equipment used to provide fuel to generate the necessary heat is term as fuel system. The equipment required in the fuel system varies on the type of fuel used in the system

3. Model Description

Project is about the realization of boiler working and also controlling by using plc and monitoring. At first, the system senses level using a DP transmitter and temperature using an RTD. Flow and level is modified and monitored using the SCADA. The program will be executed according to the instructions in the Unity Pro software. Output signals can be used to control the Feed-water control valve and the indirect water heater tank.

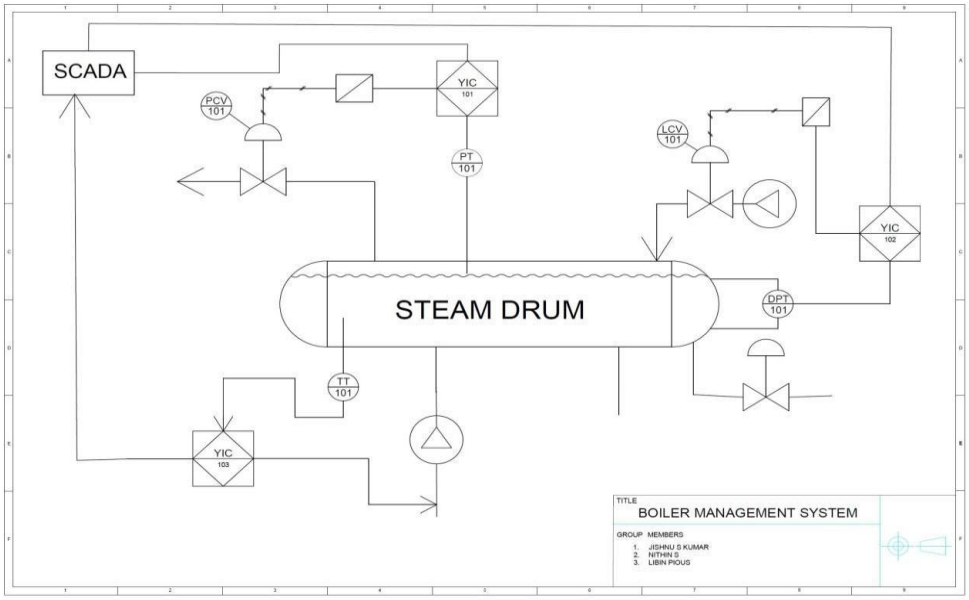

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Fig. 3.1 P&ID Diagram

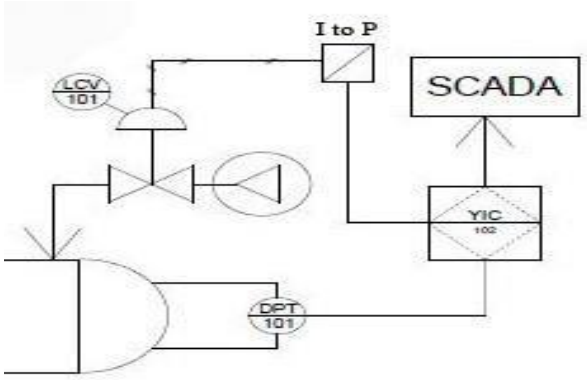
At first the de-mineralized water allowed to falls into the Steam drum and the flow is controlled by a controlled valve. Before entering into the tank, the water is preheated. The water is entered into the tank through the inlet valve, The level is measured with a differential pressure transmitter which is calibrated in terms of level. As the level of water is increasing the outlet valve opens and the inlet valve becomes close. When the level has maintained the heating, process takes place by external heating circuit, thus the temperature of the water increases. This temperature can be controlled and monitored by Temperature Transmitter. As the temperature increases, the pressure is built up inside the tank and this pressure is measured by Pressure transmitter and controlled by using a control valve. These valves are controlled by using plc.

4. Process Description

Level Control

The differential pressure transmitter is used to measure the level of water inside the drum, here we calculate the pressure difference in low level and High level and calibrated in terms of level and the output is fed to the plc. The Plc compares it with the set-point and takes the corresponding control signal. The output of the plc signal is converted to a Pneumatic signal by I/P converter and the converted signal controls the pneumatic valve. The set-point can be modified through the SCADA system. There will be two possible conditions for controlling the level

1. As the level increases the outlet valve opens and the inlet valve closes, thus the level will be maintained.
2. As the level decreases the outlet valve closes and the inlet valve opens, thus the level will rise again.

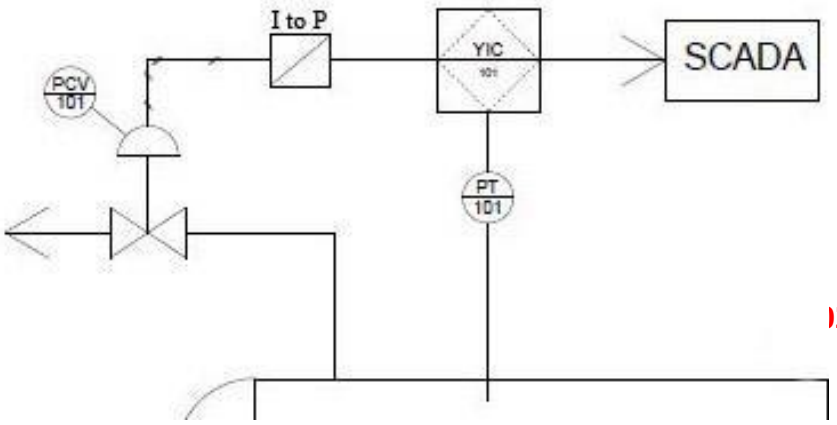


Pressure Control

Fig. 4.1 level control

Here we use a pressure transmitter to measure pressure and the output is fed to the plc. The Plc compares it with the set-point and takes corresponding control. The output of the plc signal is converted to a Pneumatic signal by I/P converter and the converted signal controls the pneumatic valve. The set-point can be modified through the SCADA system. There will be two possible conditions for controlling the pressure

1. As the pressure increases the control valve opens, thus the pressure will be released.
2. As the pressure decreases the control valve close, thus the pressure will build up inside the drum.



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Temperature Control

Fig. 4.2 Pressure Control

Here we use temperature transmitter to measure the temperature inside the drum and the output is fed to the plc. The Plc compares it with the set-point and takes the corresponding control signal. The output of the plc signal is converted to Pneumatic signal by I/P converter and the converted signal controls the pneumatic valve. The set-point can be modified through the SCADA system. There will be two possible conditions for controlling the pressure

1. As the temperature increases the control valve closes, thus the temperature inside the drum will decreases.
2. As the temperature decreases the control valve opens, thus the temperature inside the drum will increases.

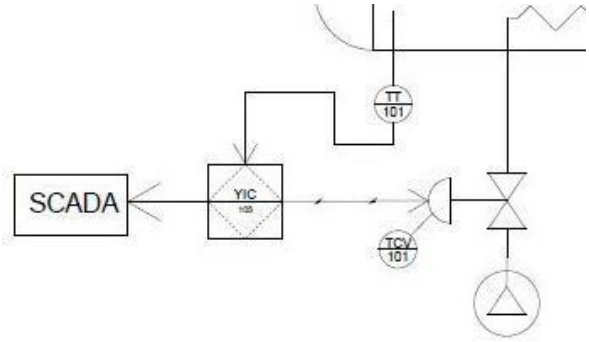

Fig. 4.3 Temperature Control

5 Result

The result that we obtained after completing the project is that we were able to control all the physical parameters like temperature, pressure, level, and boiler operation and efficiency were able to increase. The software that we were used in controlling these parameterswas unity pro. The completed working model of the whole set up is also shown in fig

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In this model controlling and measurement of various boiler parameters like temperature, pressure, and level were made. The safety system requirements and proper boiler designs as well as simulation software to get the highest efficiency of the control system.

6 Conclusion

Steam is produced by the boiler and utilised for heating, energy production, and other domestic purposes. The act of operating a boiler is fraught with dangers that can result in boiler explosions, operator injuries, and fatalities. To prevent any risks affecting the operation process, boiler P&ID designs could be improved. Boiler P&ID would incorporate additional safety measures and sensors that make boiler operation significantly safer by preventing any potentially dangerous situations by adhering to safety control methods. According to recent findings, system efficiency has increased from 70% to 89%. In order to execute safety control requirements for BMS systems, all control measures and boiler designs are based on many standards, including NFPA-85, ASME, and ISA-77, which were recently released. Moreover, the operating process is smoother and easier to control with higher efficiency when the boiler component sizes and arrangements are appropriate. Boiler safety greatly depends on the proper selection of safety gear and boiler parts. Equipment selection must take risk minimization into account.

We were able to implement a basic industrial boiler and get it to run thanks to the project we completed for our B. Tech degree. Several boiler characteristics, including temperature, pressure, and level, were controlled and measured in this model. The programme that we have employed for this function is the UTILITY PRO. With SCADA's assistance, it was possible to read the outputs from the various sensors. In the SCADA, all controlling was done.

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