IJCRT.ORG ISSN : 2320-2882

INTERNATIONAL JOURNAL OF CREATIVE RESEARCH THOUGHTS (IJCRT)

An International Open Access, Peer-reviewed, Refereed Journal

BOILER MANAGEMENT SYSTEM

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Abstract: **The boiler is an closed vessel that is used for generating steam by combustion and transferring of heat to the water. Steam under pressure is used for transferring the heat to a process. Water is used as the affordable medium for transferring heat to the process. When water is boiled into steam its volume increases and pressure builds up inside the chamber thus producing a force that is extremely dangerous. This causes the boiler to be dangerous equipment that needs to be continuously monitored for leakages and should be handled carefully. Liquid when heated up to the gaseous state this process is called evaporation. The heating surface can be any part of the boiler; hot gases of combustion are on one side and water on the other. Heating Surfaces are the Boiler parts which helps in converting the medium to steam The amount of heating surface of in a boiler is expressed in square meters. The larger the heating surface a boiler has, the more efficient it becomes by using our knowledge, we are implementing a miniature model of the boiler management system and through this project, we are controlling the parameters like pressure, temperature, level, and flow through a miniature model of DCS. Here we are also implementing some additional safety measures to maintain the pressure inside the boiler for this we are using valves like PRV (pressure releasing valve).**

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

1. INTRODUCTION

A boiler is a generating unit that generates steam which is pumped to the generator connected with the turbine to generate electric power. A boiler is incorporate with two basic systems. The first system is the steam water system also named as the waterside of the boiler. The other boiler system is the fuel air-flow gas system, also referred to as the fireside of the boiler. The inputs to the system are the fuel and air required to burn the fuel. The fuel and air chamber are also referred to as the wind-box. The outputs are the steam, flue gas, and ash.

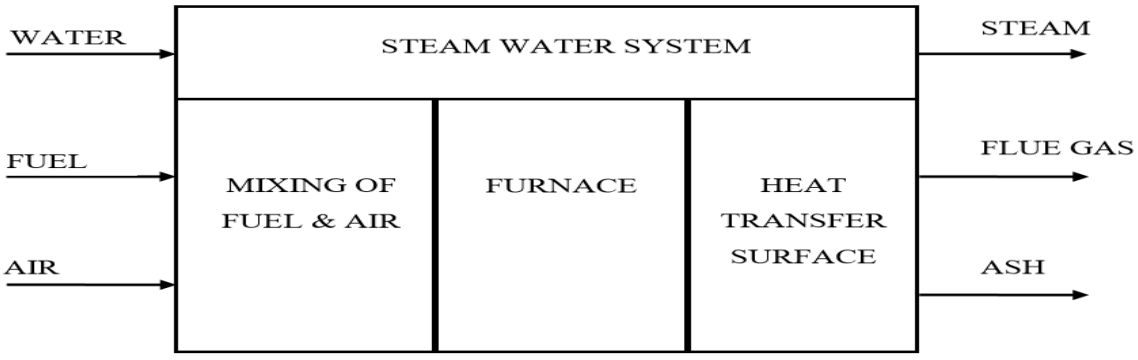

Fig. 1.1 . block diagram

In our project, we are implementing a miniature model of the boiler management system and through this project, we are controlling the parameters like pressure, temperature, level, flow through a miniature model of DCS. Here we are also implementing some additional safety measures to maintain the pressure inside the boiler for this we are using valves like PRV (pressure releasing valve).

If any damage or maintenance's work in the boilers it will seriously affect the production of power and industrial process. As we know that not only a boiler accident but any other accident is undesirables. Boiler accidents may involve loss of property/loss of production. Sometimes they may be an injury to the innocent persons in the vicinity or loss of life also. Boiler accidents are highly catastrophic in nature because of high explosive power. Modern high-pressure boilers are equipped with an auto control system. At any time, the control devices may fail so that safety devices and control role may become more important. By taking into consideration the dangerous effect of the boiler and its consequences condition monitory should be done to preventer minimize downtime of industry and save the life of the employees.

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 to the 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.

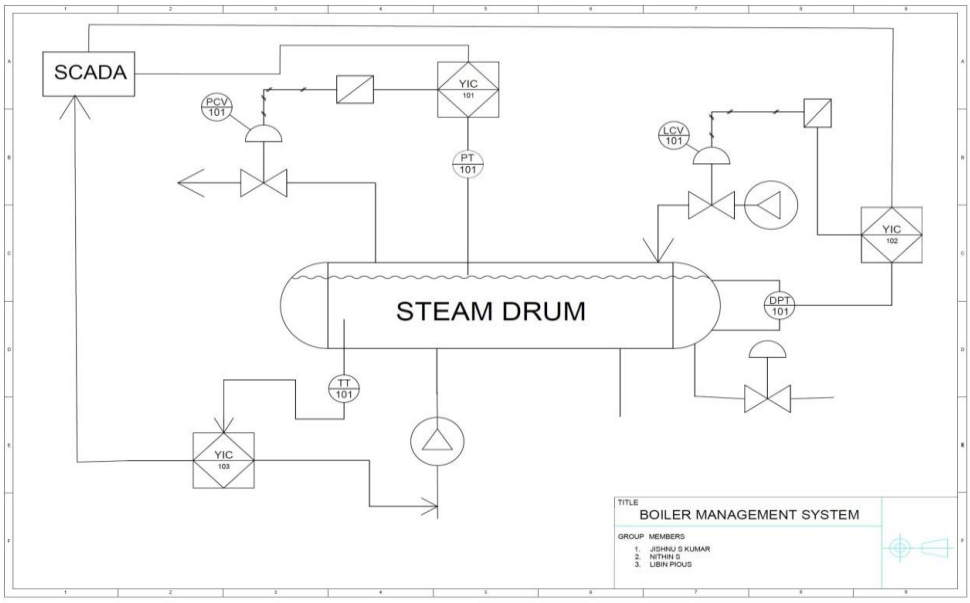

Fig. 3.1 P&ID Diagram

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

4.1 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.

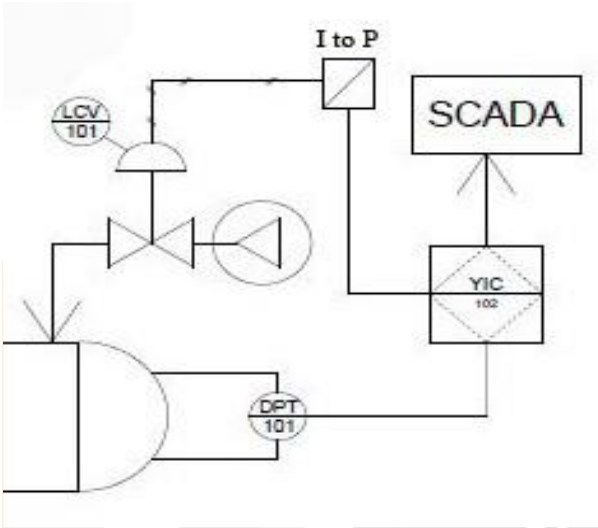

Fig. 4.1 level control

4.2 Pressure 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.

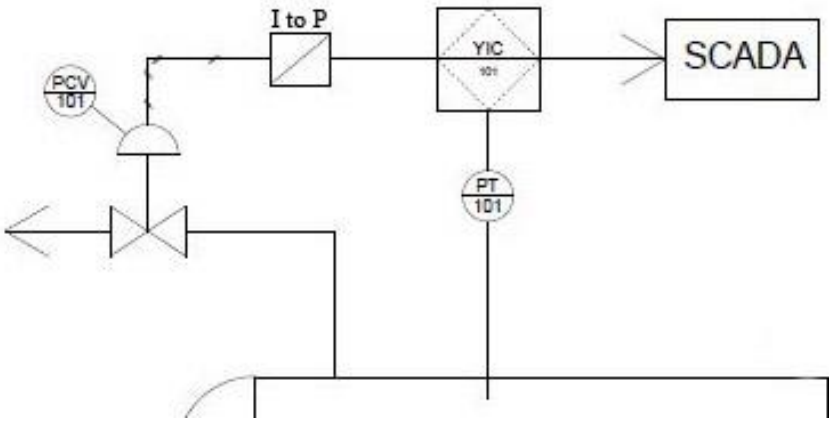

Fig. 4.2 Pressure Control

4.3 Temperature 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.

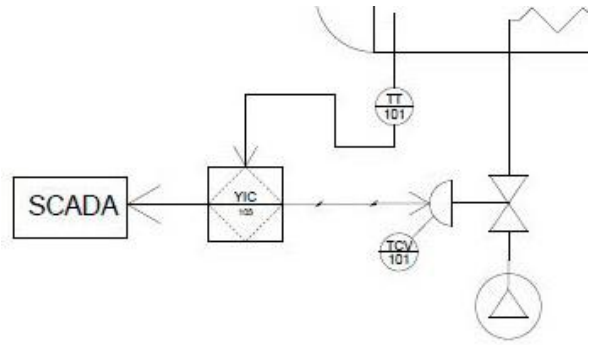

Fig. 4.3 Temperature Control

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 parameters was unity pro. The completed working model of the whole set up is also shown in fig

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

The boiler is used to produce steam for generating electricity, heat, and personal uses. Many hazards are affecting the boiler operation process causing boiler implosions, operator injures, and loss of life. An improvement of boiler P&ID designs could be done to avoid any hazards affecting the operation process. By following safety control measures, boiler P&ID would include extra safety measures and sensors that make boiler operation much safer by avoiding any hazardous situation. Current results improves the system efficiency from 70% to 89%. All control measures and boiler designs are based on several standards such as NFPA-85, ASME, and ISA-77 published recently in order to implement safety control requirements for BMS systems. Moreover, with a proper arrangement and sizing of the boiler components operation process becomes smoother and easy to be controlled with higher efficiency. The correct selection of safety equipment and boiler components has very important role in boiler safety. Equipment selection has to be made in accordance with risk reduction.

From our project that we had done as part of our B. tech course, we were able to implement a simple industrial Boiler and it's working. In this model controlling and measurement of various boiler parameters like temperature, pressure, and level were made. For this purpose, the software that we have used is the UTILITY PRO. Outputs from the different sensors were able to read out with the help of SCADA. All the controlling was done in the SCADA

7. ACKNOWLEDGMENT

We would like to extend our sincere gratitude to all the faculty members of the Department of Applied Electronics and Instrumentation Engineering, Adi Shankara Institute of Engineering and Technology, Kalady, Ernakulam.

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