Monitoring of Thermal Power Plant Using PLC and SCADA

SHUBHA KULKARNI[1], SOWMYARANI MALSA[2], NIDHISHREE D[3], PATIL ARCHANA[4], SHRUTI [5]
[1,2,3,4,5] *Dept. of Electrical & Electronics Engineering, GNDEC, BIDAR*

Abstract -- Over the years the demand for high quality, greater efficiency and automated machines has increased in this globalised world. This paper summarize the various stages of operations involved in the conversion of a manually operated boiler towards a fully automated boiler The automation is further enhanced by constant monitoring of boiler using SCADA screen which is connected to the PLC by means of communication cable. In order to automate a power plant and minimize human intervention, there is a need to develop a SCADA system that monitors the plant and helps reduce the errors caused by humans. In this project SCADA system is used in monitoring the boiler parameter likes temperature, pressure, flow, level. Sensors are used to monitor the parameter and the sensed signals are processed by PLC and monitor with SCADA the signals are compared with the reference parameter and the respective valves of the parameter are adjusted with the monitoring and logic control system. We are generating 4MW and 6MW with the help the help of PS1 and PS2 respectively.

Indexed Terms -- Supervisory Control and Data Acquisition (SCADA), Programmable Logic Controller (PLC), Inputs/Outputs tags, Programming Interface, Alarms.

I. INTRODUCTION

Now a day's the demand for higher reliability and efficiency is increasing in thermal power plant. Power plant requires continuous inspection & monitoring after regular intervals. There may be chances of errors while measuring at various stages by human workers. Thus to increase reliability the automation is needed so that overall efficiency of power plant gets improved. The automation is developed by using PLC (Programmable Logic Controller) and SCADA (Supervisory Control and Data Acquisition system) which reduces the errors caused by human workers. PLC is programmable logic control. It is used for implementing various function such as sequencing, timing, counting, logic, arithmetic control through analog and digital input output modules. In order to store the program in PLC it must be interfaced to computer via interfacing unit. The programmed can be implemented through various languages. In this paper ladder logic is used for programming. SCADA system is used to supervise a complete process. The output of different sensors is given to the PLC which takes necessary action to control the parameter. SCADA and PLC are interfaced by using communication cable. The alarm system is also provided to inform the operator. SCADA is used to monitor water level, temperature, pressure using different sensors and corresponding output is given to the PLC, for controlling these parameters. The sensors used are pressure sensor, temperature sensor, and water flow level sensor. The pressure is measured and control at turbine too.

Boiler is one of the most important units in thermal power plant. Boilers are used to generate the steam at a pressure of 66Kg/cm^2 and 900^{o}C, this steam is used to rotate the Turbine at speed of 7700 RPM. Turbine is coupled with generator via a reduction gearbox. Gearbox is used to reduce the speed from 7700 to 1500 RPM. Once the generator rotates at its rated speed, with excitation it starts generating the Power. This power will be supplied to plants for their production and for self-consumption.

II. BLOCK DIAGRAM

Boiler unit is the heart of thermal power plant. Human intervention is difficult because of high boiler temperature. Hence we control the boiler using automation (PLC and SCADA). The process flows as per figure 1.

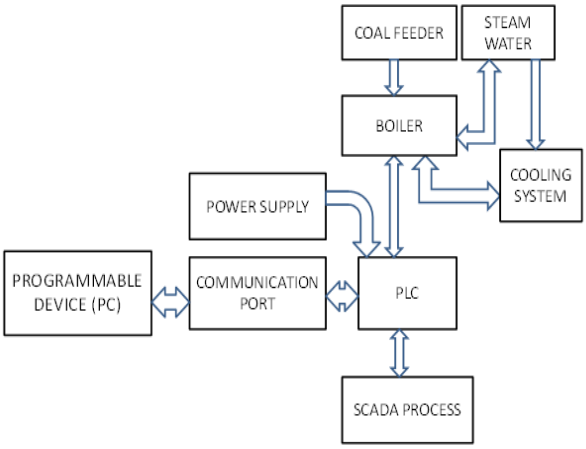


Fig. 1: - Automation of Thermal Power Plant.

Boiler Control System input and output devices are connected to the PLC. SCADA Unit also connected to PLC, SCADA unit displayed all input and output signals. 24V Power Supply unit is connected to the PLC. SCADA System monitors the Boiler Temperature, Pressure, Steam Flow and Water level. parameters. PLC gets the signals from particular sensor after that automatically rectify and switch on that particular parameter. A 230V AC supply is given to programmable device. As SCADA is designed in computer by INTOUCH WANDERWARE 9.5 software with all required parameters controlled in SCADA program.

The ladder diagram is designed in computer by ALLEN BARDLEY SLC 500 software and it is dumped in PLC with help of communication cable RS232. A 24V DC supply is feed to PLC. Thus PLC and SCADA are interlinked by giving the same I/O address. The PLC and SCADA are connected to every unit of thermal power plant to control and monitor the process. When we press the auto start button as shown in figure 2, the Boiler Fed Pump (BFP), Forced Draft Fan (FD), Induced Draft Fan (ID) and Ventilator Valve (V_5).When the boiler water level reaches to 940 ltr/hr, the gas flow valve (V_7) and diesel valve (V_8) will open. When the boiler temperature reaches to 750^0C, the diesel valve (V_8) will close and coal valve (V_2) will open. The process starts by dumping the coal in coal chamber. When coals are reached to certain level, the sensors senses and coal conveyor motor is on, thus with help of conveyor belt the coal is feed into boiler.

The first conversion of energy takes place in boiler. Coal is burnt in boiler furnace to produce heat and steam. This steam is preheated and superheated to gain high pressure and temperature steam. Then steam is piped to turbine. The high pressure steam impinges and expands across a numbers of sets of blades in turbine. Thus due to high pressure, the turbine rotates the generator rotor to produce electricity based on Faraday's principle of electromagnetic induction. The left low pressure, low temperature steam is then condensed and pumped back into boiler to repeat the cycle.

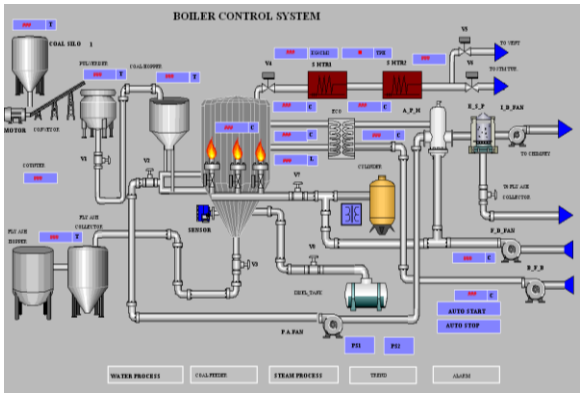


Fig. 2: - Process Window

III. CRITICAL CONTROL PARAMETERS IN BOILER

In this System PLC and SCADA interfaced to the Boiler System and maintain the following factors at particular level**.**

a) Level Control:

In Boiler System water is important for steam generation, if the boiler water is going to below the 60 %, sensor sense the level and gives the signal to PLC. After receiving the signal feed water pump automatically switched on.

b) Pressure Control:
In this system maintain the turbine inlet pressure at 66 Kg/cm^2. If the pressure level will increase that particular level, PLC gets signal from pressure switch and Coal feeding will reduce. If the pressure Level decreased that particular level, PLC gets signal from pressure switch and Coal Feeding will increase.

c) Flow Control:
In Boiler System, Power Generation is depended to the steam flow. In this System steam flow is 40 tph, as per requirement steam flow will control at particular level.

d) Temperature Control:
In System we have maintained the turbine inlet steam temperature at 485°C. If the steam temperature increased above the rated value, PLC gets signal from thermo couple and after Cold water will spray that particular steam pipe line. If the steam temperature decreased that particular level, PLC gets signal from thermo couple Coal Feeding increased.

IV. PROCEDURE DURING BLACK OUT

Emergency oil pump will get started after black out. If emergency oil pump is not started ensure oil flow from the over head oil from the sight glass. Check whether emergency Diesel Generator (DG) has been started in auto, if not started start from local panel.

If emergency DG has been started, start the main oil pump, jacking oil pump & turning gear from control room.

If the baring gear is not started, hand bearing of turbine is to be done in duration of 10mins. Close the stop valve of both the boiler's manually. Open the casing drains of turbine.

V. SCADA

In this project we are using INTOUCH WANDERWARE 9.5 SCADA Software. SCADA INTOUCH is a software application program for process control, collection of data in real time from remote locations in order to control equipment and conditions. SCADA is used in power plants, oil and gas refining, waste control telecommunications and transportation. The hardware collects and feeds the data into a computer that has SCADA software installed. The computer then further processes this data and presents it in a timely manner. By using in touch, we can generate powerful applications, which can deed the key features of Microsoft windows, graphics, networking and more. INTOUCH can also lengthen by adding custom active wizards, generic objects and creating INTOUCH quick script extensions.

All the INTOUCH quick scripts are event driven. The event can be a data change, condition, mouse click, timer, and so on. The order of processing is application specific.

Script Type	**Description**
Application	Linked to the entire application
Window	Linked to a specific window

VI. PLC

A PLC Allen Bradley SLC 500 is a solid state device designed to perform the logic functions, previously accomplished by components such as electromechanical relays, drum switches, mechanical timers/counters etc, for the control and operation of manufacturing process equipment and machinery. The requirement of highly specialized, high speed manufacturing process created a demand for smaller, faster acting, more reliable, low power consuming, expandable eliminating much of the hard wiring control devices called PLC's.

The Allen Bradley RSLogix family of compatible ladder logic programming packages helps you maximize performance, save project development time, and improve productivity.

VII. RESULTS AND ANALYSIS

CASE 1: When PS1 and PS2 are off 2MW power is generated. The water level, pressure, water flow and temperature graphs are shown below.

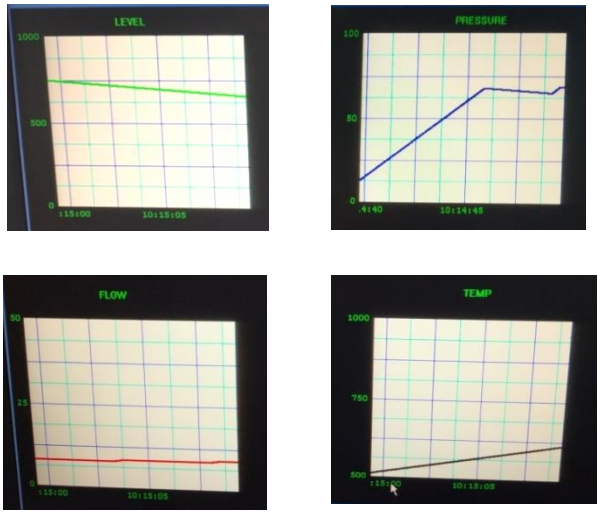
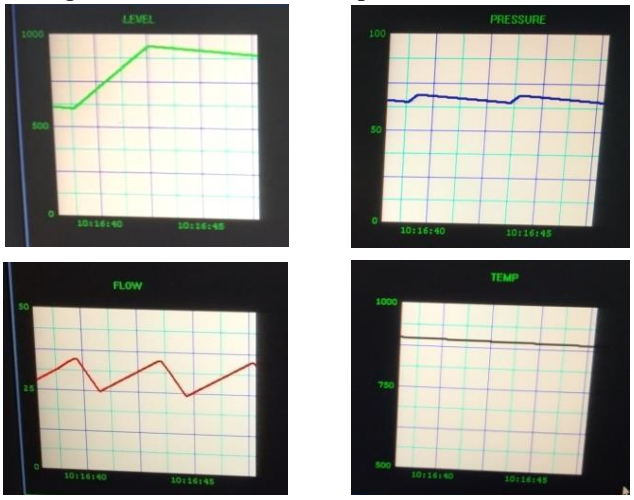


Fig. 3: - Water level, Steam pressure, Flow and Temperature (PS1 and PS2 off).

CASE 2: When PS1 and PS2 are on 4MW and 6MW power is generated respectively. The water level, pressure, water flow and temperature graphs are shown below.

Fig 4: - Water level, Steam pressure, Flow and Temperature (PS1 and PS2 on).



VIII. CONCLUSION

The most important and complicated part of any power plant is the boiler control. Several techniques can be implemented to monitor and control the boiler in power plant. The method that has to be used on various objectives like superior quality, increased efficiency, high profit and other such points depending upon the purpose of the company that implies it.

This paper focused on the continuous changes that are relentlessly taking place in the contemporary scenario of the industrial segment. The paper has furnished itself to study the integral parts of the entire process involved, their implementation and parameters control. In this project the PS1 and PS2 are used to generate 4MW and 6MW of power respectively.

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