# Simulation of Boiler Control using PLC & SCADA

**Shital S. Chopade, Pradhuman Verma, Prashant Verma**

***Abstract— The purpose of this paper is to present a programmable logic controller (PLC) control system that is applied to the water tube boiler which will increase high quality and greater efficiency.***

***This system monitors boiler`s temperature and pressure and volume via different sensors which provide input to PLC. The output of PLC controls the boiler temperature and pressure and gives out the user required volume of steam.***

***All pressure and temperature variations are shown on SCADA screen and are controlled through SCADA. Different automated check valves are used to release pressure and to inform the concerned authority through alarm in case of an emergency.***

***Keywords (PLC) SCADA.***

## I. INTRODUCTION

Over the years the demand for high quality, greater efficiency and automated machines has increased in the industrial sector of power plants. Power plants require continuous monitoring and inspection at frequent intervals. There are possibilities of errors at measuring and various stages involved with human workers and also the lack of few features of microcontrollers. Thus this paper takes a sincere attempt to explain the advantages the companies will face by implementing automation into them.

The boiler control which is the most important part of any power plant, and its automation is the precise effort of this paper.

In order to automate a power plant and minimize human intervention, there is a need to develop a **SCADA (Supervisory Control and Data Acquisition)** system that monitors the plant and helps reduce the errors caused by humans. While the SCADA is used to monitor the system, **PLC (Programmable Logic Controller)** is also used for the internal storage of instruction for the implementing function such as logic, sequencing, timing, counting and arithmetic to control through digital or analog input/ output modules various types of machines processes. Systems are used to monitor and control a plant or equipment in industries such as telecommunications, water and waste control, energy, oil and gas refining and transportation

**Present System:**

Previous days, Steam was apply to the boiler process is not periodically. It provides uncontrolled steam to the boiler for heating. Therefore, wastage of steam is more.

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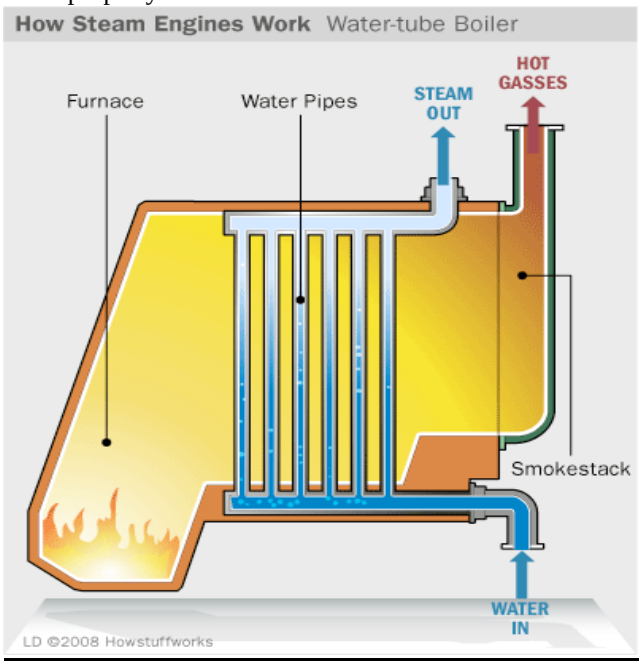
**Proposed System:**

So far, the steam generator is controlled only by manually. Now the process is fully automatic and analysis of status obtained in SCADA. Applying Steam is controlled by PLC. So, efficiency of heating the boiler by use of steam is to be high.

### *Boiler*

Boiler is defined as a closed vessel in which steam is produced from water by the combustion of fuel. Generally, in boilers steam is produced by the interaction of hot flue gases with water pipes which is coming out from the fuel mainly coal or coke. In boilers, chemical energy of stored fuel is converted into the heat energy and this heat energy is absorbed by the water which convert them into a steam.

Due to poorly understand the working principles; boilers have many serious injuries and destruction of property. It is critical for the safe operation of the boiler and the steam turbine. Too low a level may overheat boiler tubes and damage them. Too high a level may interfere with separating moisture from steam and transfers moisture into the turbine, which reduces the boiler efficiency. Various controlling mechanism are used to control the boiler system so that it works properly.




### *Applications of Boiler*

Boilers have many applications which are as follows:

- These can be used in stationary applications to provide heat, hot water and steam for domestic use in many industries.
- These can be used in mobile applications to provide steam for locomotion in applications such as trains, ships, and boats.

- Steam boilers are used as generators to produce electricity in the energy business. These are also used in agriculture as well for soil steaming.
- These can be used in heating systems or for cement production.
- These can be used in textile industries for bleaching and many other industries like sugar mills and chemical industries

## CONTROL PARAMETERS IN BOILER

### *A. Level Control*

Steam Drum level, De-aerator level and hot well level

### *B. Pressure Control*

Force draft pressure, Induced draft pressure, Steam drum pressure, Deaerator pressure, Turbine inlet steam pressure, balanced draft pressure

### *C. Flow Control*

Air flow, Steam flow, Water flow

### *D. Temperature Control*

Deaerator temperature, Steam drum temperature, Underbed boiler temperature, Turbine inlet steam temperature, Flue gas temperature.

## BOILER OPERATION

Water plays a major part in the generation of steam. Inlet water to the steam drum should be in purified form, for that, PH value of the water should be maintained, and stored in de-aerator tank. Feed water pump is switched ON by using feed water pump switch. The water from the de-aerator tank is allowed to pass through two parallel pipes. In one pump the flow rate is maintained at 130% and in another it is 5%. Thus the failure of any one pipe does not affect the boiler operation. The water is passed through economizer, thus the heat in the outgoing gases is recovered, by transferring its heat to the water. Then the heated water is made to flow through steam and water drum. In this, water should be maintained at least at 50%. For sensing water level we use PID controller in AB PLC. When the level is lesser than or greater than 50%, PID controller senses the level change and sends the appropriate control signal to the feed water valve 1 or valve 2. Thus, in spite of any changes in disturbance variable, the water level can be maintained at 50% by proper turning of PID controller.

Water in the water drum is maintained at more than 75%. This water is circulated back to steam and water drum, due to difference in temperature, high amount of steam is generated.

The generated steam temperature may be greater or lesser than the desired temperature. So depending on the situation the generated steam is then passed through primary heater followed by secondary heater. The secondary temperature is monitored.

Here we consider three main cases:

1. If the secondary heated temperature is greater than the desired temperature then by using PID controller, approximate control signal is sent to the control valve 3 of the super heater tank, to reduce the temperature, by spraying chilled water from de-aerator tank.

2. If the output of the secondary heated temperature is lesser than the desired, using a PID controller approximate control signal is sent to bunker valve to control fuel flow.

3. If the output of the secondary heated temperature equals the desired temperature, no control action is needed, the stem is taken out.

## AUTOMATION

Delegation of Human Control to technical Equipment aimed towards achieving.

***Advantages***

Higher productivity, Superior quality of end product, Efficient usage of raw materials and energy, Improved safety in working condition.

♦ Reduced space requirements, energy saving, less maintenance and hence greater reliability.

Implementation of changes in the control logic as well as reducing the project lead- time was not possible.

***Programmable Logic Controller*** In this, instead of achieving desired control and automation through physical wiring of control devices, it is achieving through program say software.

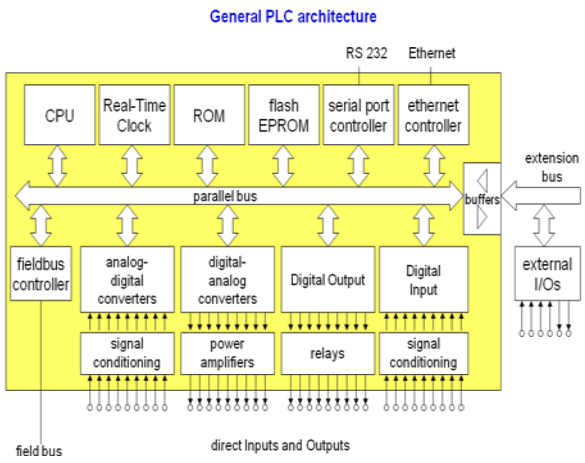
## ALLEN BRADLEY PLC

Programmable Logic Controller or PLC is an intelligent system of modules, which was introduced in the control, & instrumentation industry for replacing relay based logic [4]. Over a period of time, better I/O handling capabilities and more programming elements have been added along with improvement in communication.

### *PLC Working*

At the beginning of each cycle the CPU brings in all the field input signals from the input signals from the module and store into internal memory as process of input signal. This internal memory of CPU is called as process input image (PII).

User program (Application) will be available in CPU program memory. Once PII is read, CPU pointer moves in ladder program from left to right and from top to bottom. CPU takes status of input from PII and processes all the rungs in the user program. The result of user program scan is stored in the internal memory of CPU. This internal memory is called process output image or PIQ. At the end of the program run i.e., at the end of scanning cycle, the CPU transfers the signal states in the process image output to the output module and further to the field control.




## SCADA

Stands for Supervisory Control And Data Acquisition. As the name indicates, it is not a full control system, but rather focuses on the supervisory level. As such, it is a purely software package that is positioned on top of hardware to which it is interfaced, in general via Programmable Logic Controllers (PLCs), or other commercial hardware modules. SCADA systems are used not only in most industrial processes: e.g. steel making, power generation (conventional and nuclear) and distribution, chemistry, but also in some experimental facilities such as nuclear fusion. The size of such plants range from a few 1000 to several 10 thousands input/output (I/O) channels.

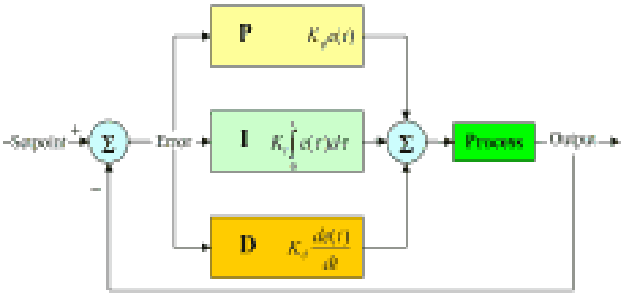
However, SCADA systems evolve rapidly and are now penetrating the market of plants with a number of I/O channels of several 100 K: we know of two cases of near to 1 M I/O channels currently under development. SCADA systems used to run on DOS, VMS and UNIX; in recent years all SCADA vendors have moved to NT. One product was found that also runs under Linux.

### *PID Controller*

A Proportional-Integral-Derivative (PID) controller is a general feedback control loop mechanism widely used in industrial process control systems. A PID controller corrects the error between a measured process variable and the desired set point by calculating the value of error. The corrective action can adjust the process rapidly to keep the error minimal

The PID controller separately calculate the three parameters i.e. the proportional, the integral, the derivative values. The proportional value determines the reaction to the current error. The integral value determines the reaction based on the sum of recent errors as past error. The derivative value determines the reaction based on the rate at which the error has been changing as a future error. By tuning these three constants in the PID controller algorithm, the controller can provide control action designed for specific process control requirements

Some applications may require only one or two parameters of the PID controller to provide the appropriate control on system. A PID controller will be called a PI, PD, P or I controller in the absence of the respective control actions. This is achieved by setting the gain of undesired control outputs to zero. PI controllers are very common, since derivative action is very sensitive to measurement noise and the absence of an integral value may prevent the system from reaching its target value due to control action.




## APPLICTIONS

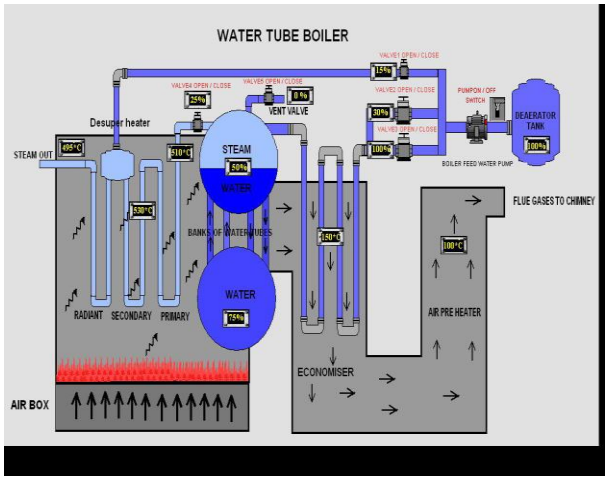
- Water and Wastewater
- Power
- Oil and Gas
- Research facilities
- Transportation
- Security systems
- Siren systems
- Energy saving
- Economical

## FUTURE SCOPE

- The future work deals with the purification of water to the boiler and the air circulation for the boiler to burn the fuel using same automation technique.
- Continuous monitoring and inspection of boiler parameters can also be done using internet sitting at home

## CONCLUSION

- The most important aspect of any power plant is the boiler control. Several techniques can be implemented but, the method that has to be used relies on varied objectives like superior quality, increased efficiency, high profit depending upon the purpose of the company that implies it
- The ceaseless changes that are relentlessly taking place in the contemporary scenario of the industrial segment. Emphasis has been given to the automation process that is now rapidly taking its place in all the power plants across the globe.
- The Paper has furnished itself to study the integral parts of the entire process involved, their implementation and the problems that may show up have also been given their due importance

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