

Steam Boiler Automation Using Programmable Logic Controller

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ABSTRACT: This Project represents the automation of steam boiler using PLC. Steam is one of the utility factor for Titan used for cooking application as well as for the effluent evaporation. Steam boilers are used in the production of steam used in Effluent treatment plant (ETP) and in canteen. The main aim of this project is to automate coil type steam generator. In Effluent Treatment Plant (ETP) 600Kg steam boiler is used to generate steam at the pressure of 10Kg/cm² for the effluent evaporation. The boiler operation is carried out manually with the control panel and it's running for about 12Hrs per day. The proposed project is to create a control system of boiler with PLC based controls. PLC Ladder Program is written for the steam boiler logics and it is simulated and tested.

KEYWORDS---LDO, BDS, NO, NC, ETP

I. INTRODUCTION

Nowadays, every new industry before stepping into the production line, never gives up thinking about ways of automating it's production process, so as to reduce its overall expenditure in terms of wages, wastage of material due to inaccurate manual work and to reduce the overall time taken for production. This is where the job of PLCs come into picture. The main theme behind using a PLC is reduction of cost as well as complexity of incorporating huge number of electrical devices, easier error detection, optimization of overall production time and above all automation. As we know that the boiler is very important part in industry and it require continuous inspection with specific time interval. Earlier days this inspection and monitoring is done with human workers. There are number of possibilities of errors with human workers while measuring particular values in boiler operation process. So, a reliable monitoring system is required to avoid these errors and maximize profit. Boiler automation includes the monitoring of temperature, pressure and water level using different sensors. In case of emergency different automated check valves are used to release pressure, steam and inform the concerned authority through alarm. This project which includes applications of PLC, reflects the true and exact nature of operation of a boiler used in an industry where steam energy is greatly required for other useful operations to take effect and also to design of a PLC controlled boiler for production of steam with temperature, pressure & level as control parameters.

II. EXISTING METHOD

A. MANUAL OPERATION OF BOILER CONTROL

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, we take 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 our work. In order to automate a power plant and minimize human intervention, there is a need to develop PLC (Programmable Logic

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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.

B. DRAWBACK OF CONVENTIONAL SYSTEM

- Conventional equipment systems are prone to errors due to the involvement of humans in the data collection and processing using complicated mathematical expressions.
- Thus, what we require is a system that collects raw data, processes it and presents it in values which can be verified and compared with the standard values.
- In the coding process of this implementation with micro-controller, it requires a fast and efficient processing which on the other part depends on the length and sub-routines of the coding process.

III. PROPOSED METHOD**A. AUTOMATED BOILER OPERATION**

The main aim of our project is to automate the manually operated steam boiler. The steam boiler is one of the most utility factor for all industrial plants. In Titan steam boiler, which is running at the pressure of 10Kg/cm² which is used in effluent treatment plant (ETP) with the capacity of 600Kg. this boiler is operated manually using the control panel. While controlling the boiler manually various factors needs to be considered which are very sensitive to be operated and often leads to serious problems. To avoid this, we propose an automated boiler that is operated and controlled using PLC (Programmable Logic Controller). By automating the boiler operation, we could minimize the human intervention and errors made by them during operation. Frequent examination of controls by the workers is greatly reduced. This satisfies the high quality and greater efficiency of steam boiler which is essential part of plant functioning.

B. ADVANTAGES

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

IV. PLC TECHNIQUE

A programmable logic controller (PLC), also referred to as a programmable controller, is the name given to a type of computer commonly used in commercial and industrial control applications. PLCs differ from office computers in the types of tasks that they perform and the hardware and software they require performing these tasks. While the specific applications vary widely, all PLCs monitor inputs and other variable values, make decisions based on a stored program, and control outputs to automate a process or machine.

A. BASIC SCAN

Once the program is in the CPU – the PLC is then set to run, and the PLC executes the application program repeatedly. In addition to executing the program, the CPU regularly reads the status of the input devices, and sends data to the output devices. The Input system senses the status of the real- world inputs (a switch, a level, etc.), translates them to values that can be used by the CPU, and writes those values to the Input table. The application program is executed, and writes values to the Output table. The Output system then converts the output value to a real- world change (motor turns on, valve opens, etc.) This process of reading inputs, executing

logic, and writing outputs is called the PLC Scan or Sweep. The CPU continuously Reads Inputs, Solves Logic, and Writes to the outputs (there are other tasks the CPU does – which will be discussed later). It is important to understand the scan because it may dictate how a programmer structures logic.

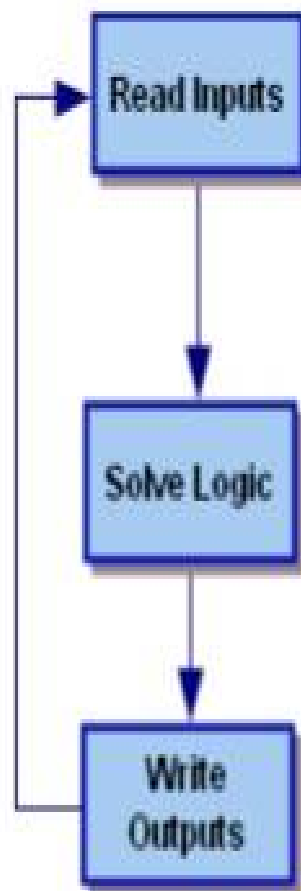


Figure 1 Basic scan

B. MEMORY

The control program application program is stored in memory. As the PLC executes logic, it may also read and store values to memory. The values may also be used and referenced by the application program.

V. PLC COMPONENTS

Programmable controllers have grown throughout industrial control applications because of the ease they bring to creating a controller: ease of programming, ease of wiring, ease of installation, and ease of changing. PLCs span a wide range of sizes, but all contain six basic components:

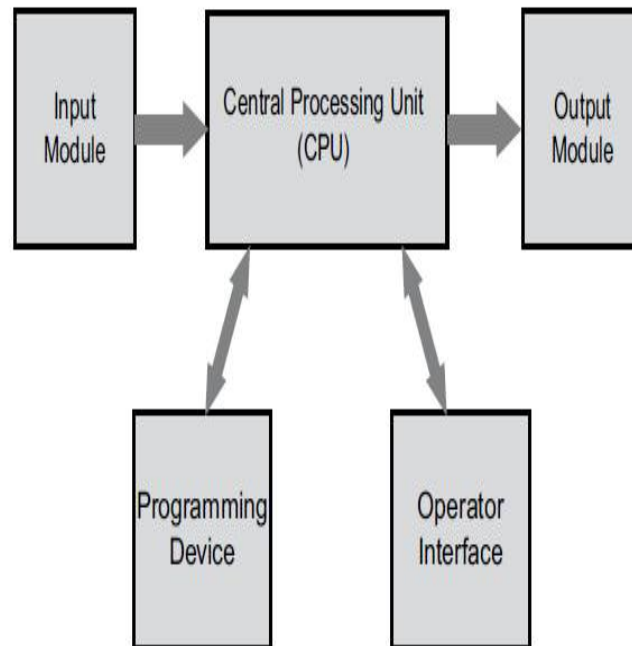


Figure 2 PLC Components

- Processor or Central Processing Unit (CPU).
- Rack or Mounting.
- Input Assembly.
- Output Assembly.
- Power Supply.
- Programming Unit, Device, or PC/Software.

A. RAKE ASSEMBLY

Most medium to large PLC systems are assembled such that the individual Power Supply are modules that are held together within a rack. In smaller PLC systems, all of these components may be contained in a single housing or brick these smaller systems are sometimes referred to as bricks or shoebox PLCs.

B. POWER SUPPLY

The power supply provides power for the PLC system. The power supply provides internal DC current to operate the processor logic circuitry and input/output assemblies. Common power levels used are 24V DC or 120 VAC.

C. PROCESSOR

The processor, central processing unit, or CPU is the brain of the PLC. The size and type of CPU will determine things like: the programming functions available, size of the application logic available, amount of memory available, and processing speed.

A. INPUT/OUTPUT ASSEMBLY

Inputs carry signals from the process into the controller; they can be input switches, pressure sensors, operator inputs, etc. These are like the senses and sensors of the PLC. Outputs are the devices that the PLC uses to send changes out to the world. These are the actuator the PLC can change to adjust or control the process – motors, lights, relays, pumps, etc. Many types of inputs and outputs can be connected to a PLC, and they can all be divided into two large groups – analog and digital. Digital inputs and outputs are those that operate due to a discrete or binary change – on/off, yes/no. Analog inputs and outputs change continuously over a variable range – pressure, temperature, and potentiometer.

VI. LADDER LOGIC

A program consists of instructions that accomplish specific tasks. The degree of complexity of a PLC program depends upon the complexity of the application, the number and type of input and output devices, and the types of instructions used. Ladder logic is one programming language used with PLCs. Ladder logic incorporates programming functions that are graphically displayed to resemble symbols used in hard-wired control diagrams. The left vertical line of a ladder logic diagram represents the power or energized conductor. The output coil instruction represents the neutral or return path of the circuit. The right vertical line, which represents the return path on a hard-wired control line diagram, is omitted. Ladder logic diagrams are read from left-to-right and top-to-bottom. Rungs are sometimes referred to as networks.

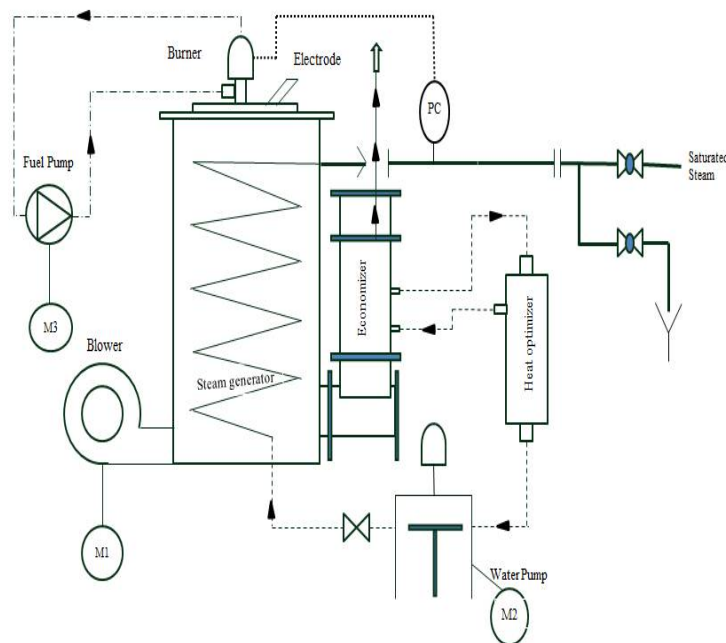


Figure 3 Ladder logic diagram

Statement list (STL)-instructions include an operation and an operand. The operation to be performed is shown on the left. The operand, the item to be operated on, is shown on the right. Function block diagrams (FBD)-include rectangular functions with inputs shown on the left side of the rectangle and outputs shown on the right side.

VII.HARDWAREDESIGN

The boiler operates on 415V, 50Hz, 3 phases, 4 wire electrical supply. The control circuit voltage is 230V. Earthing connections are provided on the control panel box. 3 phase supply is given to blower motor, water pump motor, to fuel pump motor through contactors. The motor contactors are provided with terminal overload relays. One phase supply is connected to the control circuit through control fuse F1. Neutral is connected to the N. Control circuit thus works on 230V AC supply. When the FILL switch is put on, coil is energized, contacts close and water pump motor starts. The burner solenoid coil circuit is energized 6-10 second after FIRE switch is put on. Photo resistor circuit is checked 10-15 seconds after the solenoid coil is energized. If the safety contacts are open the unit goes into electrical lock-out giving alarm. If any safety trips while the unit is running, the unit goes into electrical lock-out giving alarm.

When FIRE switch is put on, supply reaches coil and the motor starts. After filling up the boiler coil with water the FIRE switch may be put on. Supply reaches terminal coil of the sequence controller. When flame is established, the photo resistor senses the light and its electrical resistance reduces. Ignition stops and the firing sequence is over. When all safeties remain in health condition, firing continuous until the terminal L1 receives supply.

VIII. CONCLUSION

The most important aspect of any power plant is the boiler control. Several techniques can be implemented to control the boiler in power plant. The method that has to be used relies on various objectives like superior quality, increased efficiency, high profit and other such points depending upon the purpose of the company that implies it. With the prime objective of catering to these necessities and the needs of the industrial sector, significance has been given here to automation. Emphasis has been given to the automation process that is now rapidly taking its place in all the power plants across the globe. We have furnished it 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. 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.

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