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Online fault detection system for cooling tower in power plant by using PLC-SCADA

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ABSTRACT

This paper provides a big approach for power plant automation system of Fault Detection in cooling towers on the basis of PLC and SCADA. The techniques and program which are used in this paper are helpful to detect the fault occurs inside the cooling tower of the thermal power plant. A cooling tower is also used for removing the heat from the condensate water which is flowing through the pipes of the tower so that it is called a heat removal system. Water to be cooled and then returned for use in recirculation through the system in the cooling tower. The New fault detection and fault finding system based on upcoming data from the detection sensors which are used for fault detection. In this system, a combination of PLC internal program and visualization of fault on SCADA window gives easy fault finding and clearing process. In this paper, there are two software used for finding the faulty condition (PLC - Allen Bradley- RS Logix 500 and SCADA- Wonderware Intouch) RS Logix 500 uses ladder logic for finding the faults and Wonderware Intouch used to show faulty condition on the windows. This paper includes three types of failure of fault detection in cooling tower which are major caused in steam power plant during operation. In this whole process, SCADA is used for online visualization of the faulty condition.

Keywords— *Fault detection, Control, Information analysis, Cooling tower*

1. INTRODUCTION

Cooling Towers plays an important role in power plant and mostly concerned with heat Cooling towers are a very important part of many thermal power plants. The first task of a cooling tower is to take out the heat coming from the power plant into the atmosphere. A part of the cooling water takes out the Latent Heat from the water which reduces its temperature. The normal cooling tower temperature from the incoming water is up to 3 °C more than the ambient wet-bulb temperature. In this paper on the basis of PLC internal program logic in Allen Bradley PLC, all the faults related to the cooling tower can be detected. In the old days, the microcontroller is used to detect the faulty condition but with some limitation. After the invitation of PLC, there is no limitation on the detection system. PLC uses a bit of logic operation to detect the fault. [07]. Relays are used to start and stop the operation of the operating condition. Sensors are attached to the cooling towers which detect the normal and abnormal condition. On a basic level, electromechanical relays function by magnetically opening or closing their electrical contacts when the coil of the relay is energized. A PLC (Programmable Logic Controllers) is the combination of small microcontrollers which is used to take action on a large platform. It generally monitors the abnormal and normal condition and takes proper action on the operating condition. Most of the logic operation is based on the Boolean expression whereas some models depend on instruction like timers and some continuous control. [03].

SCADA is generally used for an online line or real-time visualization of the overall plant from a remote location. There is four main functions of the SCADA which are Data Acquisition, Networked Data Communication, Data Presentation, Control Data acquisition is nothing but the collection of data which involves some conversion like analog to digital. Network data communication transmit the data to a request data spontaneously. In data presentation, the gathered data is processed and presented for system operators to make perfect response and control decisions. Control directly affects the output of the system.

2. FAULT OCCURS IN BOILERS

2.1 Evaporation Fault

In a cooling tower, hot water is distributed over the medium which flows down and is cooled due to evaporation with the incoming air. Fans are used to create required air to take out the heat. Evaporation fault generally depends on the ambient temperature and Relative humidity. Evaporation loss is the water quantity evaporated for cooling duty.

2.2 Drift Fault

It is very important to take the drift problem in the account of cooling towers. The normal range for the end-user specification is 0.02% drift loss. Droplets of water left on the top of the tower which creates a drift and thus causes a fault. Generally, an impressive eliminator can reduce drift loss to a range of 0.002–0.2% of the water circulation rate.

2.3 Blowdown

Blowdown is nothing but a water discharge to the bottom of the tower to remove high mineral content system water, impurities, and sediment. The water which is evaporated from the surface of the cooling tower leaves behind the salts, which after some time increasers the level of TDS. This requires to be blowdown occasionally. [04]

3. BLOCK DIAGRAM OF CONTROL SYSTEM

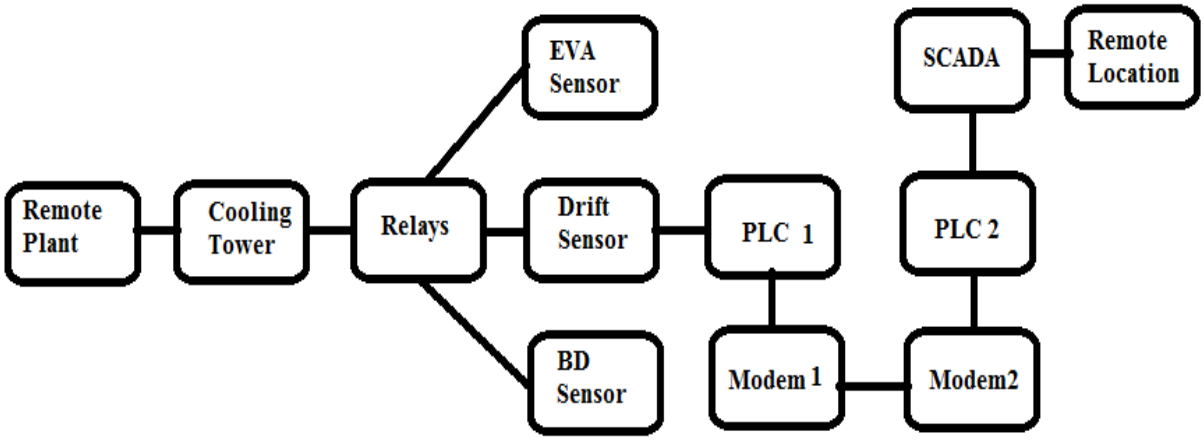

Fig. 1: Control system for cooling tower

Cooling Tower is an important part of the power plant which is generally used for removing the heat from the water coming from the steam boiler. Relays are attached to the cooling tower for switching operation and controlling of operating condition. There are three sensors are used in this paper namely as EVA sensor, Drift sensor, and BD sensor. EVA sensor detects the fault of Evaporation while the drift sensor is used to detect the faults of drift and BD sensor detects the fault of Blowdown [06]. When Fault is detected the faulty signal is given to the relays on which it takes an on-off switching operation. All the signal coming from the sensors is given to the PLC 1, where PLC 1 take proper action on the basis of PLC internal logic Program. After that PLC signal is given to modem 1 for network communication with the remote location to show the faulty condition on the SCADA windows. Modem 2 is used to communicate with modem 1 for incoming signals. Modem 2 gives the working signals or faulty signals to the PLC 2 where PLC 2 control the process of fault clearing. SCADA is used for the overall visualization of working condition as shown in figure 1. [05][07]

4. BASIC PROCEDURE FOR FAULT DETECTION SYSTEM

- Start RS Logix 500 pro. Crate a particular new file with a particular processor as shown in figure 2.

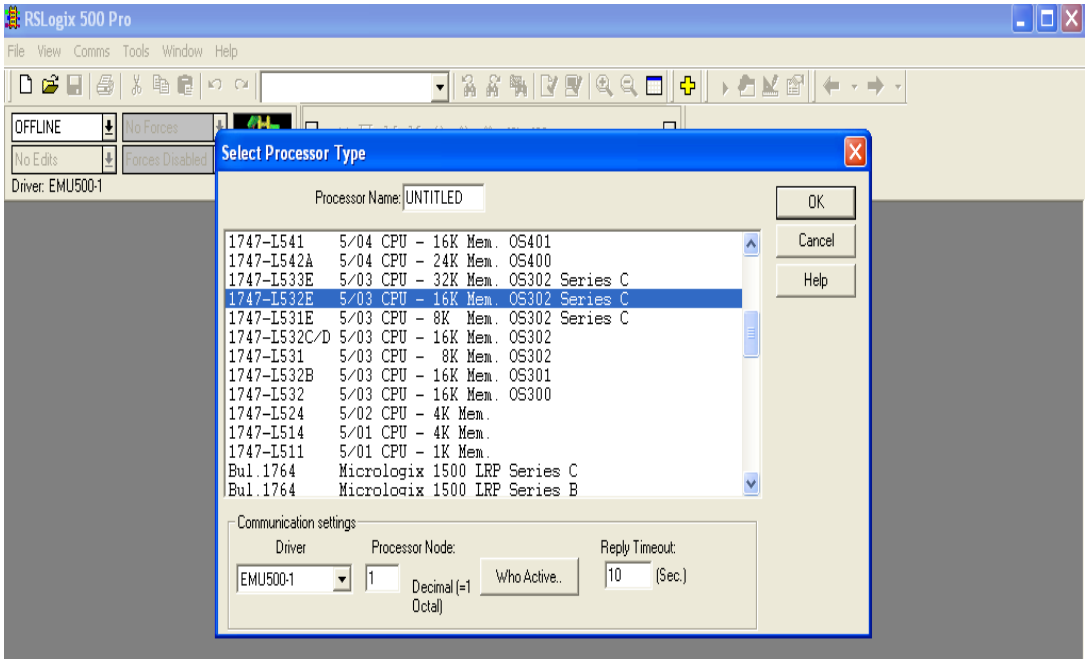

Fig. 2: Starting of program

- Create a SCADA window with a particular name and attach the wizard according to the process as shown in figure 3.

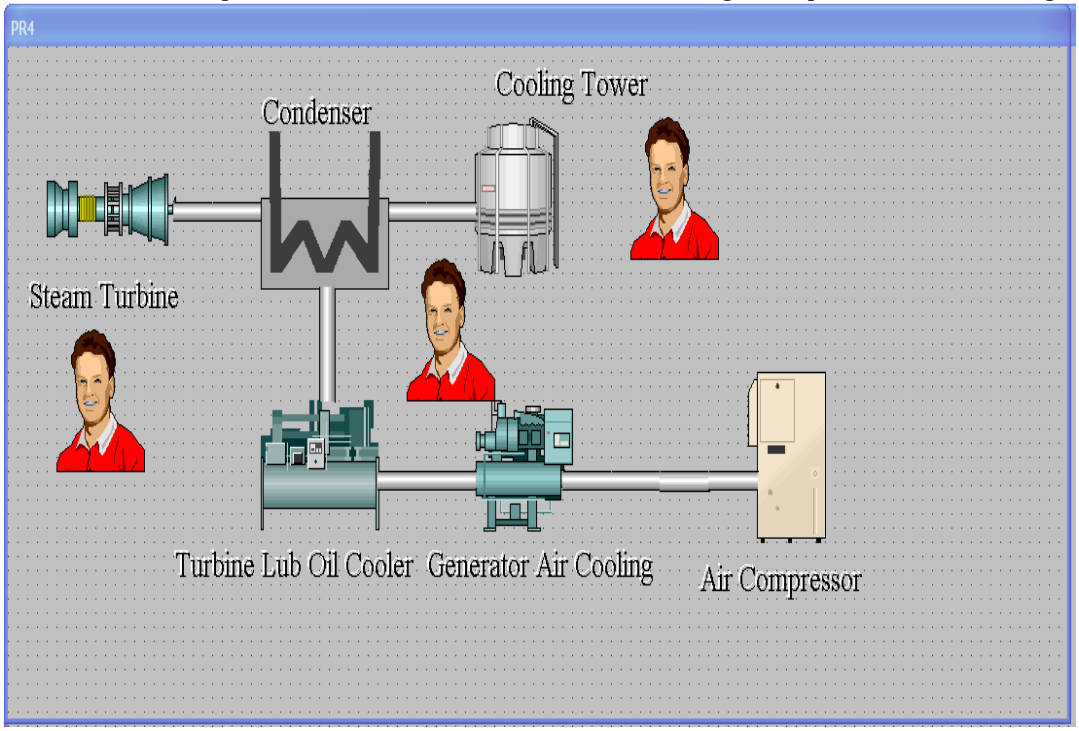

Fig. 3: Representation of power plant

5. PLC INTERNAL PROGRAM

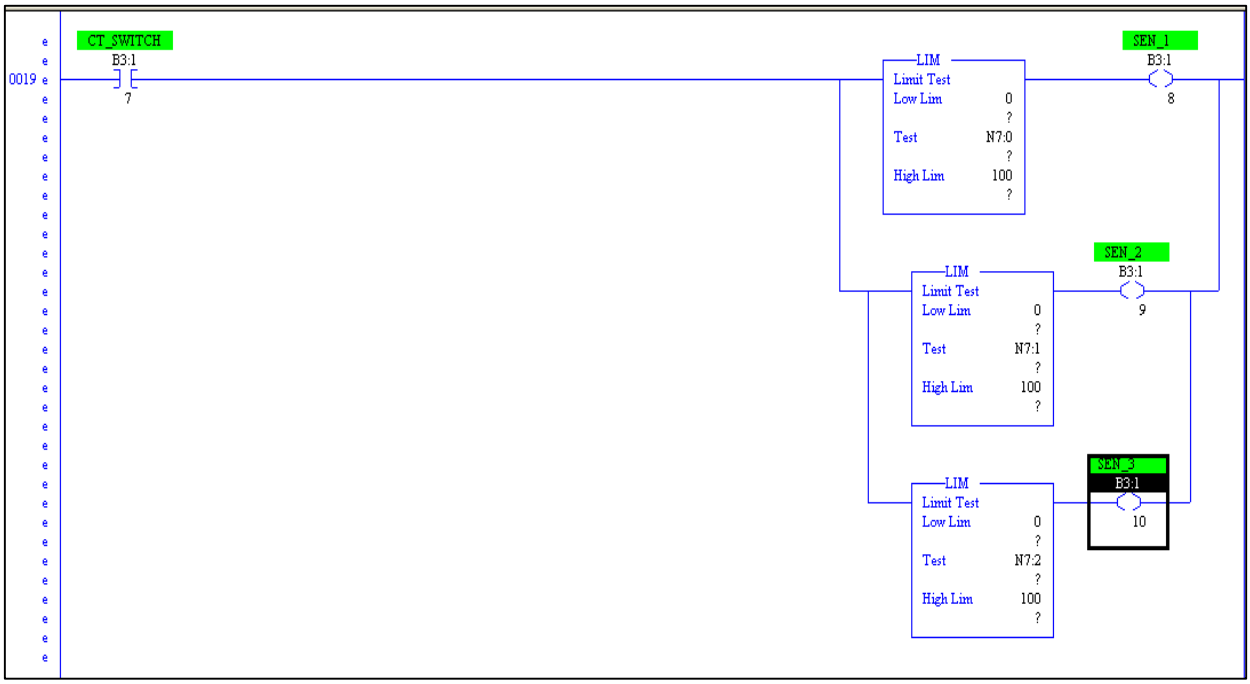

Fig. 4: PLC internal logic program

In PLC logic, fault conditions are detected by sensors which causes a fault such as cooling tower internal faults. There are usually three types of faults which are detected by Boil Sen 1, Sen 2 and Boil Sen 3 in a ladder logic program Sen 1 is used to detect the Evaporation fault which generally depends on the limit instructions interger denoted by N7: 0 while Sen 2 is used to detect the Drift fault which depends on the limit instructions interger denoted by N7: 1 Sen 3 is used to detect the Blowdown fault which depends on the limit instructions interger denoted by N7: 3. If any fault occurs on the system sensor bit get enabled and alarm condition can be seen on the SCADA screen. If the limit of any fault increases beyond the certain limit which is above 100 then the fault is detected. The fault is cleared by using timer instruction required for repairing the faults. All three faults are shown on the SCADA screen by using alarm animation. [01][02]

6. RESULT

All the visualization of the power plant is shown in SCADA software. Generally, SCADA consists of accessing of data feature and controlling process. There are three Lights are shown in the SCADA screen for detecting faults inside the Cooling. Light 1 represent Evaporation Fault, light 2 represent Drift Fault and light 3 represent Blowdown fault.

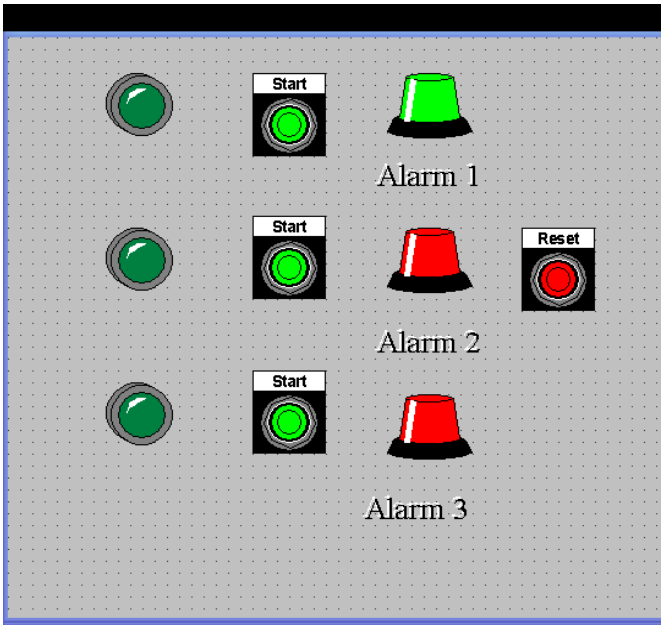

Fig. 5: Alarm condition

7. CONCLUSION

A fault detection system with the help of PLC SCADA has been studied for power plant fault clearing process. Various simulations are carried out to analyze and detect the fault to improve the performance of the system.

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