

PLC AND SCADA BASED AUTOMATION OF ELEVATED SERVICE RESERVOIR

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ABSTRACT

The world has been revolutionized with the introduction of automation in almost all productivity, decreasing costs of manufacturing, improving quality and more importantly upgrading of working condition of the human labour. As we all know that water is very fragile natural resource which is very essential for every individual. So it's become very mandatory to handle water properly in sophisticated way. Earlier water was supplied in metropolitan area's was not so automated. So it becomes unprecised and water was not managed properly as per the requirement of various zones as they were mostly manually operated which results wastage of water. With the help of Programmable Logic Control (PLC) we have developed automatic control of Elevated Service Reservoir (ESR) which was previously done manually which leads to wastage of water in great extent. It not only controls but also it monitors whole process with the help of Supervisory Control and Data Acquisition (SCADA)

KEYWORDS: Automation, ESR, PLC, SCADA

INTRODUCTION

The concept of automation is evolving rapidly. This is so, because of implementation of automation technique within the plant. Automation is nothing but automatic operation of a particular process, by programmed devices such as robot, PLC, etc. which takes and executes the decision without human intervention. To accomplish these activities automation system relies on the use of self-correcting control system that employs feedback. As computers can store, select, record and present data systematically, these are widely use to direct automated system. Another application is its use in launching aiming and guidance of military rockets. Automation is also been applied to information handling, resulting in the solution of many engineering problems.

The ESR is the basic structure of the water supply to the city. At present due to lack of development the working of ESR is done manually. With the usage of various automation devices like level transmitters, flow transmitters etc. We can increase the development level and reduce the energy consumption of the present system.

At present the level is measured by using level gauge. Which is also has very less accuracy and precision. Thus it can be replaced by ultrasonic level transmitter and thus the level in ESR can be perfectly measured.

There is no any device to measure the flow, pH, turbidity, pressure of incoming water to ESR. Thus the Electromagnetic flow transmitters, pH sensor, turbidity sensor, differential pressure (DP) cell are used in system respectively.

PROJECT DESIGN

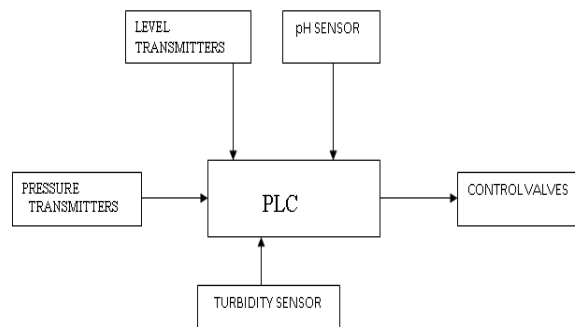


Figure 1: Block Diagram

Level Transmitter

The level transmitter used is of ultrasonic type manufactured by Forbes Marshall. This type of level transmitter works on the principle of the transmitting and receiving the ultrasonic waves and is used to measure the level of water in ESR which is also represented on SCADA.

Pressure Transmitter

The pressure transmitter used is DP cell manufactured by SIEMENS. This DP cell works on the principle of pressure difference on both side of transmitter and thus the pressure of incoming flow is measured.

pH Sensor

The measurement of pH is the most important aspect concern with water. pH of water is should be neutrally 7. Hence for the range of pH of the water in the system should be in between 6.5 to 7.5. Or else water will be very harmful for the citizens for drinking purpose. Hence this pH sensor measures the pH and indicates the value on SCADA.

Flow Transmitter

Flow of incoming water to the ESR is measured with electromagnetic flow transmitter manufactured by Khrono Marshal. According to the given set point of the flow will be compared with the flow measured with the transmitter and also will be displayed on the SCADA.

Turbidity Sensor

Measurement of turbidity in ESR is very essential. Using turbidity sensor turbidity can be measured in ESR. Hence the measured turbidity is also displayed on SCADA.

PLC

The father of the system is PLC manufactured by Mitsubishi. The PLC accepts the input from the Flow Transmitters, pressure transmitters, level transmitters, pH sensors, Turbidity sensor and compares it with the benchmarks already fed into the PLC. The error between the actual reading and the benchmark will modulate the final control element to reduce this error to zero. The PLC will function according to the logic or ladder program fed into it by the user using Codeys software linked with PLC. Data base will be also generated or the analysis purpose. Last but not the least, PLC is also programed to send message if the problem occurs when the system is in progress.

Control Valves

The final control element of the system is globe valve with linear characteristic and having motorized controlled actuators. The input to the control valve is given from the PLC. Now the motorized actuators are driven by Variable Frequency Drive (VFD). According to the ladder program the valve will throttle and allow the water to flow. And also the valve used is of fail to close type as if any error or problem occurs then the valve should immediately shutoff.

GSM System

Global System for Mobile communication (GSM) system is used in project for the sending the message to the engineer on the field to the occurrence of error or problem in the system. The program for the same is also fed into the PLC.

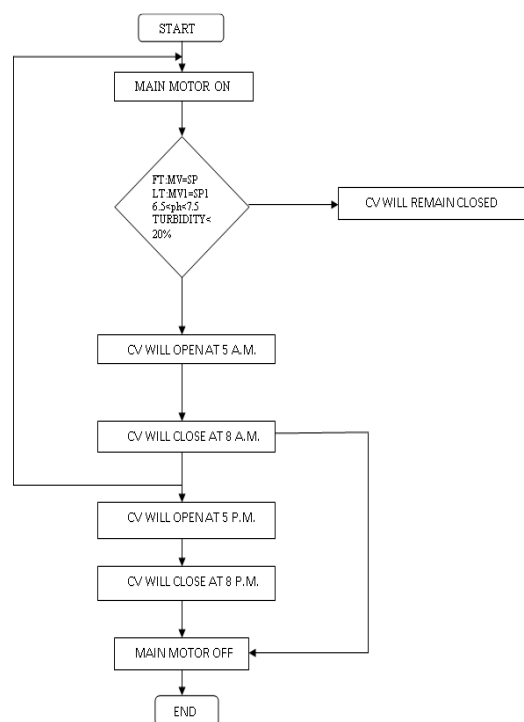


Figure 2: Flow Chart

The above shown flow chart is the logic of ladder program used to design the system and automate the structure. Hence according to this logic the PLC is programmed and the system is turned towards automation.

WORKING OF SYSTEM

The present system is being replaced with the automation devices such as Level transmitter, Flow transmitter, Pressure transmitters etc. linked with PLC loaded with the logic using ladder diagram. Ultrasonic level transmitter output of 4mA to 20mA is fed to PLC and is calibrated to distance of 0 m to 4m of height. Similarly flow transmitter, pressure, pH sensor and turbidity sensor outputs are fed to PLC.

Now according to logic of PLC, the output control valve will open from morning 5am to 8am and evening 5pm to 8pm. As the water supply timing to the citizen is the same but the valve will open only after verifying some conditions of the transmitters.

The conditions of the transmitters and sensors are as follows:

Level Transmitter

Level in the ESR should be more than 3.5meters. If it is less than 3.5m, the valve will remain to close position.

Pressure Transmitter

Benchmark of 2.5kg/cm^2 is given to the pressure transmitter. If the pressure is less than its benchmark than it indicates that there is either leakage in the pipeline or there is less amount of water in the main sump tank from where the water is supplied to all ESR's.

Flow Transmitter

Flow transmitter measure the flow of the incoming water. It just measures the flow and according to bench mark it adjusts the control valve to the input side of ESR.

pH Sensor

pH is the most important aspect in this automation system. pH sensor measures the pH of water which should be maintained to 7. The system is programed in such a way that if the pH of system exceeds to 7.5 or falls down to less than 6.5 then the control valve at output of ESR remains closed. The water is not supplied to the city. As the acidic or basic pH water is not supposed to be used for drinking, thus the pH sensor is used here.

Turbidity Sensor

According to the bench mark given to the turbidity sensor the turbidity in the system is controlled. If the turbidity exceeds to its bench mark then the alum is added in the same proportion to the ESR tank. And in this manner the turbidity is controlled.

Thus thing in consideration all above conditions, the logic is been developed in the ladder diagram and the system is automated. The whole system is linked with the SCADA. All values of benchmark and the actual values are displayed on the SCADA screen and the system can be analyzed from the SCADA room.

GSM system is one more advantage in this respective automation and plays very important role. The instant messages are delivered to the field engineer and the certain actions can be taken by him.

In all the time consumed for the manual operation of the system will be reduced, the manual energy will get reduced due to automation and the big issue on the fore head of corruption in the water supply section will be reduced.

RESULTS

The experimental results are taken on the ESR at the PCMC water supply station, Pune. The results were firmly taken at plant after commissioning of the process. The results taken with respect to level of the tank, input pressure of the water to the inlet of the tank, pH of water in the tank and flow of water to ESR. The results taken as follows:

Table 1

| Time | Level | Pressure | pH | Flow | Control valve %opening |
|---------|-------|------------------------|-----|----------|------------------------|
| 5 am | 3.8 m | 2.5 kg/cm ² | 6.8 | 2500 LPH | 100% OPEN |
| 6:30 am | 3.5 m | 2.5 kg/cm ² | 6.8 | 2448 LPH | 100% OPEN |
| 7:30 am | 3.6 m | 2.5 kg/cm ² | 6.9 | 2420 LPH | 100% OPEN |
| 9 am | 4 m | 2.5 kg/cm ² | 6.7 | 0 LPH | 0% OPEN |

CONCLUSIONS

In this paper we have presented a PLC-SCADA based automation of Elevated Service Reservoir. The trend in automated water treatment plants is to use SCADA systems based on PLCs, advanced communication systems, and PC-based software. PLC has been widely used and played an important role in the automation industry today. Due to advantages of low cost and high reliability, many automation machine manufactures still prefer to use PLC at the time being. The SCADA provides multipurpose utility management and operating flexibility for the monitoring system. The whole system is useful for reducing the wastage of water and delivering water efficiently to the citizens.

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