IOSR Journal of Electronics & Communication Engineering (IOSR-JECE)
ISSN : 2278-2834, ISBN : 2278-8735, PP : 36-38
www.iosrjournals.org

Automation in drinking water supply distributed system and testing of water

Mr. Prashant palkar[1] , Prof. (Dr.) Shrinivas Patil[2] Prof. Mrs. Pooja Belagali[3], Mr. Ashish Chougule[4]

[1,2,3]*(Electronics Engineering dept. Dr. J. J. Magadum college of Engg. Jaysingpur, India)*
[2]*(Electronics and Tele. Engg. Dept. DKTE'S TEI, Ichalkaraji, India)*

ABSTRACT : *Now a day's there is a rapid development in urban residential area, whereas in case of water distribution system they are using traditional method, which is not atomized. Along with this another problem in the water supply system is that public is using suction pumps to suck the water directly from the home street pipeline. The best way to improve the water distribution system is by using industrial PLC and PC system, which includes all network components like flow sensor, GSM modules, pH sensor etc. The water theft can be best monitored by the flow variations given by the flow sensors mounted on the channels. The system includes Remote Terminal Units (RTU), flow transducers and actuators distributed on a wide geographical area, control and power panels for the pump stations etc. The reliable instrumentation connected to PLC or RTU assure real time monitoring of the main technological parameters of large water distribution networks. The data acquired of SCADA system (Supervisory Control and Data Acquisition) represent the support for optimization of the process and data- driven Decision Support System (DSS).*

I. INTRODUCTION

In traditional drinking water supply system is facing many problems related to filtration, pumping of water, distribution of water and testing of water. Conventional water supply department comprises three different sections for water supply. First is the pumping station, which does the sucking of water from water source. The second section is a filtration department in which measurement of pH and chlorine is done. Third section is the distribution section through which water is distributed in all the municipal wards. Currently these three sections are working independently. The major problems in water supply system are, leakage or wastage of water and the majority public is using suction motors to suck water from main supply connection, which results decrease in water pressure.

To overcome above said problems an automated system has been proposed which enhances the water distribution, reduces wastage of water as well as identify the theft of water.

The water supply system is a part of the urban infrastructure which must assure the continuity of the water distribution, water quality control and the monitoring. The use of water diversity increases because of restriction imposed by the water availability, hydrological conditions, storage capability of tank, control and process parameters [1]. The system includes pumping stations, filtering treatment utilities, storage tanks, piping distribution network and central dispatching unit. The complete SCADA system structure includes one or more central main-station (PC based) that communicates with more PLC's implemented into the pumping stations or RTUs located in control panels throughout the network. The PLC(s) handle the direct control of the technological process whereas the central dispatching unit user interfaces SCADA. The treatment of data is implemented by the central station. The reduction of the operating cost as well as reduction in the water losses is now possible by the implementation of an intelligent control system. This offers the support for the optimization of the functional exploitation strategy and the optimization of equipment use. The global online supervision of the water distribution network is realized by the central dispatching operator as well as the remote control of the actuators installed into the most important points of the system. According to the requirements of the water flow condition, the pressure and flow transducers areinstalled in booster stations or measuring points throughout the network. These electronic devices are connected to the RTUs which transmit the data to the central dispatching station in order to offer dynamic behavior. The RTUs provide the data acquisition facility for different sensors (specific for water pressure, flow, level or chemical component concentration) using digital and analog modules; which insure the preliminary signal treatment and wireless data communication to the dispatching unit. The SCADA system implemented to the central dispatching unit manages the data communication [2] with all the RTUs and PLCs, which store the received data from measuring points and the pumping station. It offers advanced analysis functions as well as the remote control of the major technological parameters.

II. METHEDOLOGY

The proposed automated urban water supply system consists of PLC, pH sensors, chlorine measurement system, and sensors for water theft detection, GSM module, SCADA system and motor driver.

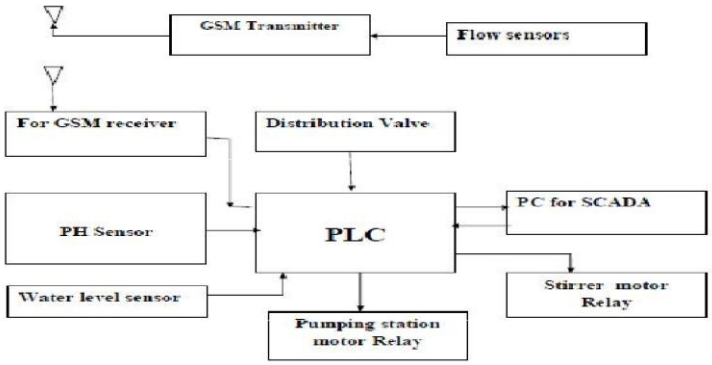

Fig. 1 System Block Diagram

Programmable Logic Controller is the heart of automated water supply system. PLC has been help in controlling pump station motor contactors, stirrer motors, distributed valves as well as measure pH of the water. PLC programming is done using Ladder Diagram Language. Ladder diagram is specialized schematic language commonly used to document industrial control logic systems. It is called "ladder" diagram because it resembles a ladder with two vertical rails (supply power) and as many "rungs" (horizontal lines) as there are control circuits to represent.

Stirrer motor is used for oxidation purpose at the filtration tank. These motors are turned on and off using PLC according to the purification of water. The PLC take output from pH and chorine sensor; value displayed on SCADA.

III. PUMPING STATION AND DISTRIBUTION AUTOMATION SYSTEM

The technological equipment installed in the pumping stations are controlled by a PLC based equipment which acquires all the hydraulic parameters (pressure, flow, reservoirs water level, free and residual chlorine , pH) and the electrical parameters for all the electric drives[1].

The pumping functioning module implemented in the PLC includes a schedule optimization tool based on the following criteria:

- The hourly electrical energy tariffs,
- The water demand dynamic and constraints, inflows,
- Statistical records regarding the water demand,
- Maintenance planning related to the market demand.
- In the system have three different sensors. It used for tank level detection; one is at bottom of tank, second will be positioned at middle position of tank and third will be kept at the top of tank. If water level detector detects a level at low or mid level thus PLC will turn on pump station motor. We consider water supply department has two motors in pump station, one is for regular use and another is for emergency purpose which is shown in figure 2. Using proposed system both the motors will be included in the system and controlled as per need using PLC. Current status of the entire sensor will be displayed on PC. SCADA software will used to developed graphical user interface.

The optimization module facilitates the move to the preventive or predictive exploitation of the water resources and storage capacities based on intelligent control algorithms. They represent the support for electrical energy cost optimization by real time monitoring the pumping schedule and the on/off electric drive transient load reducing, maintenance planning based on the functional wear and loading.

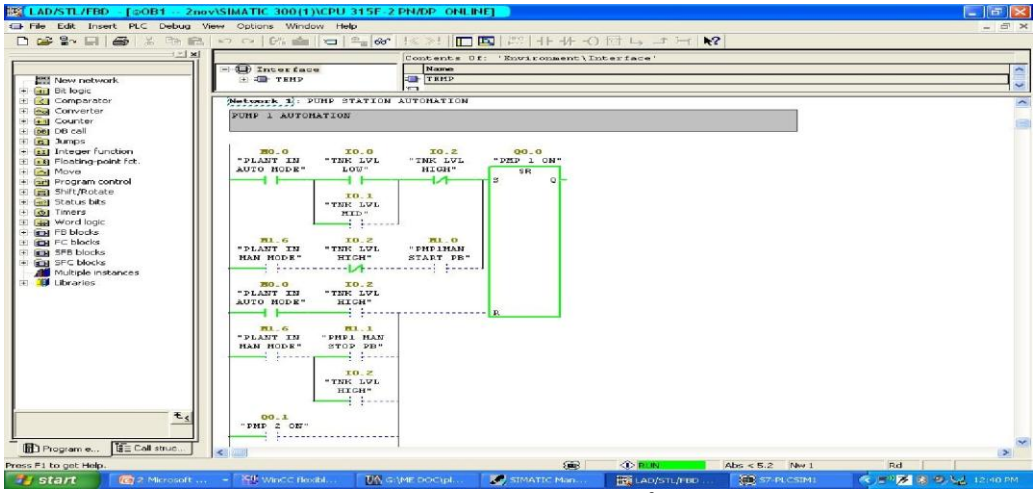

Fig. 2 Program in somatic manager for pump station

Conventional water distribution system comprises mechanical valves to distribute water. Since process is controlled manually, it requires more time and man power, with significant amount of wastage of water. Solenoid controlled valves will be incorporated to avoid wastage of water. Selection of solenoid valve depends upon size of water supply pipe and pressure of the water.

VI. SCADA COMMUNICATION

The data acquired from the remote site panels RTU pole mounted to avoid vandalism, from the pumping stations PLCs and the water reservoirs are transmitted to the dispatching unit computer installed in the water distribution company's headquarter. The computer software system integrates an SCADA application program specifically developed for water distribution management. The dispatching unit SCADA system elaborates daily,monthly, yearly diagrams, tables and reports related to the operator requested parameters. The system stores the acquired data in a specific database for later use analysis and retrieving [2].

V. CONCLUSION

The automation implemented in water distribution system ensures to avoid wastage of water and reduces time. Due to SCADA it is possible to monitor and control whole system from head quarters. Distributed system is intelligences it monitoring all time without man power. Automation system having following benefits:

- Continuous water distribution according to water level.
- The real time alarms created in SCADA when any equipment fail in distributed or pump station.
- Database elaborate daily, monthly and yearly report in Central PC.
- Measurement data reliability by the global monitoring of the network in the central dispatching unit.
- Automated measurement of pH and chlorine and display in SCADA due to this quality of water Provide to consumer.

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