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Automation for Industrial Reverse Osmosis System Using SCADA Controller

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ABSTRACT: Reverse Osmosis (RO) is reliable, cost effective and energy efficient in producing pure water compared to other desalination process. The operation parameters includes pressure drop, flow rate, temperature and PH which can be automated and monitored during the process. RO are widely used in water treatment plants. It ensures safe, continuous, high quality of water to industries. This paper describes how the automation of industrial Reverse Osmosis system is done using PLC and SCADA.

KEYWORDS: Reverse osmosis; PLCs (Programmable Logic Controllers); SCADA; Automation.

I. INTRODUCTION

Reverse osmosis invented in 1959, is the new method of purification of water. This process removes dissolved organic and salt membranes. PLC's are used for variety of automated systems and processes. PLC system monitors the input by controlling the output to automate the machines. Inputs and outputs are in the form of digital and Analog or by both. Inputs includes AC, DC, Analog, thermocouple, RTD, frequency, transistor, and interrupt inputs. Output includes DC, AC, Relay.SCADA stands for Supervisory Control and Data Acquisition System. SCADA runs on DOS,VMS and UNIX.SCADA control performs monitoring, control for sites over longer distance of communication which including monitoring alarms and to process the data.Existing System : Here, the water is treated regularly and continuous process using PLC [1].

II. BLOCK DIAGRAM

Operations are shown in blocks.The Major Flow Lines shown with arrows giving direction to flow. The flow goes from left to right. Light streams such as gases towards top with heavy stream such as liquids and solids towards bottom. If line cross, then the horizontal line is continuous and the vertical line is broken (figure 1). From service tank, water is fed in to the tank. The anti scalent tank which removes the hardness of the Calcium and Magnesium of the water. Permacare 191 is the chemical used to remove the salinity in the water. Next the water is fed into SMBS(sodium metabisulphite) dosing tank. Here the chlorinated water may oxidize the membrane, to avoid that SMBS is used. HDPE(high density polyethylene) is a chemical reaction used for recycling. Finally, the water is fed in to acid dosing tank, the chlorine is dosed which acts as a bleaching detergent and used to pure the water. From service tank the water is moved to corresponding pump and drained to SSF(Slow Sand Filteration) outlet. From SSF outlet the water is moved to RO CIP(Chemical In Process) cartridge filter. It is used to remove bacterial impurities present in the water and make the water free ofparticulates. It moves to high pressure pump which supplies the pressure needed to push water through the membrane. Now from service water the water is moved to RO CIP tank then moves to the RO CIP pump then pump to RO CIP cartridge filter. Both the process is connected to energy recovery turbo charger which acts as an energy analysing tool which allows to calculate the energy level quickly and easily. Then, the water is moved to the filter which removes the impurities and thus finally pure water is obtained from RO product outlet.

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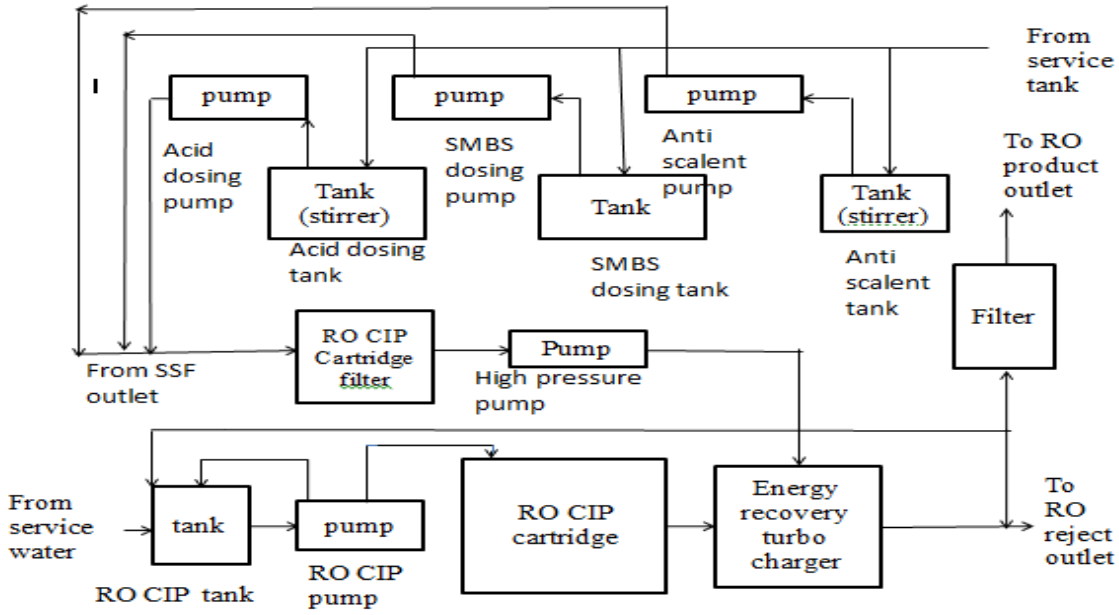

Figure 1: Reverse osmosis system

III. PIPING AND INSTRUMENTATION DIAGRAM

A piping and Instrumentation (P&ID) is a diagram used in the process industry which shows the piping of the process flow together with the installed equipment and instrumentation. It shows you the components needed to run, monitor and control specific processes. P&IDs communicate detailed information about operation, troubleshoot, and repair or modify a system (Figure 2).

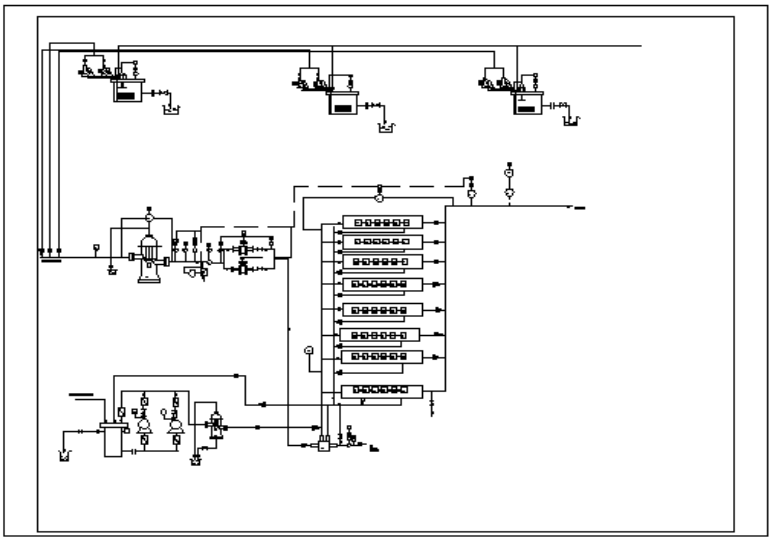

Figure 2: Piping and Diagram Instrumentation Diagram

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III.DATA SHEETS

Document Containing specifications and information of an instrument or device.the general information of instruments such as tag number identification,service description,location,P&ID number or drawing number reference,process data,calibrated range,material,performance details, hazardous certification and accessories required.

IV.INSTRUMENTATION INDEX SHEET

Document containing is a list of instrument devices within a plant include tag number of all physical instruments (e.g. field instrument, physical alarm and indicator) and pseudo instruments which commonly named “soft tag” (e.g. DCS indication, alarm, and controller). Created at the beginning of project and considered as a live document which should be kept updated even though the plant has been operated. In instrument index document, the following information should be stated but not limited to Tag number, Loop Number, Type of Instrument, Location, Service description, P&ID Number, Line number or equipment number, I/O Type Control System,Range or set point along Engineering,Applicable reference Document (Instrument Data Sheet Number, Hook-up Drawing Number, Instrument Layout Number, Loop Drawing Number),Package Number, Manufacturer, Model Number.

V.INPUT AND OUTPUT LIST

Input/Output list is a document containing list of instrumentation devices which serve as an input or output of control system. Therefore, only the tag number that physically has a cable which connects to the control system appears on I/O list.When there are more than one control system in a plant (let say PCS and SIS), the I/O list shall clearly indicates which instruments is assigned to which control system or may separate them to different section in the document**.**

VI.HOOK UP DIAGRAM

Hook-up drawing is a detailed drawing showing typical installation of instrument in a correct manner so that instrument operates properly. Hook-up drawing indicates tubing slopes, position of instrument in reference to process tapping point, scope break between instruments versus piping. Hook-up drawing also gives information the requirement of bulk material for each installation. It also details its specification (size, type and material) and the quantity.

VII.PLC (Programmable Logic Controller)

A programmable logic controller, PLC is a digital computer used for Automation. PLC’S are designed for multiple arrangements of digital and analog inputs and outputs. PLC is an example of a real time system since output results must response to input conditions within a limited time.in this paper we are simulating the process in PLC.

VIII.RESULT AND DISCUSSION

SCADA is a system for remote monitoring and controlling.it is used for large and whole processes. SCADA system may allow operators to change the set point and enable alarm conditions such as temperature, flow can be displayed and recorded.

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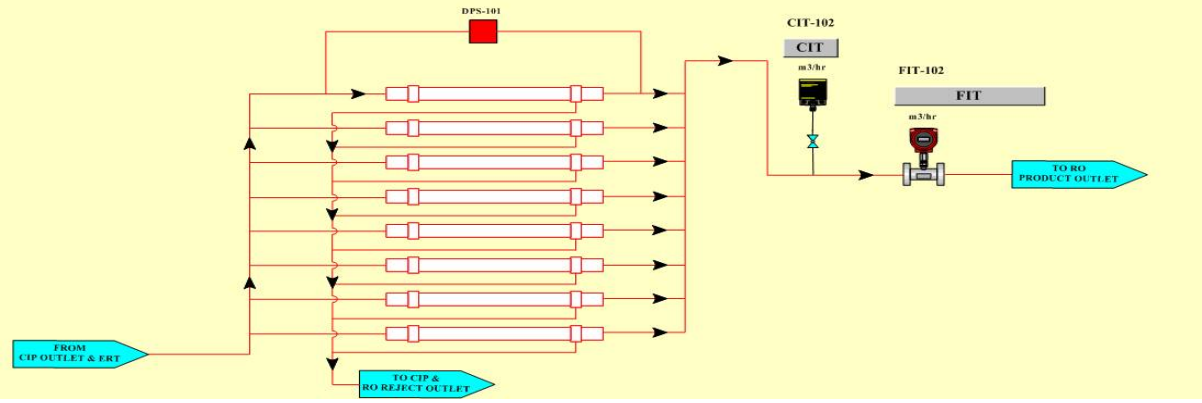

Figure 3:SCADA process for RO section

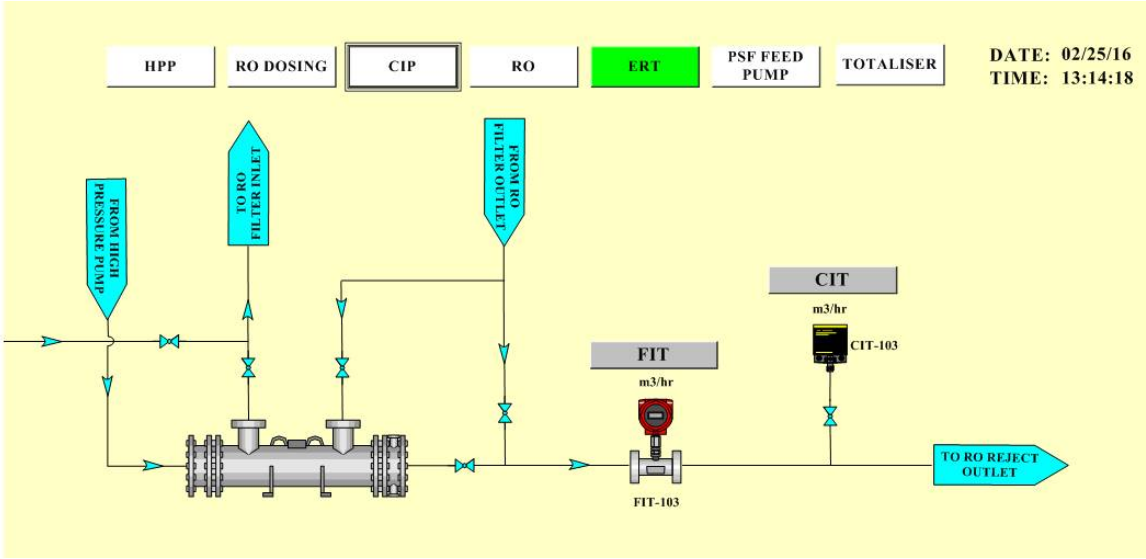

Figure 4:SCADA Process For Energy Recovery Turbocharger(ERT)

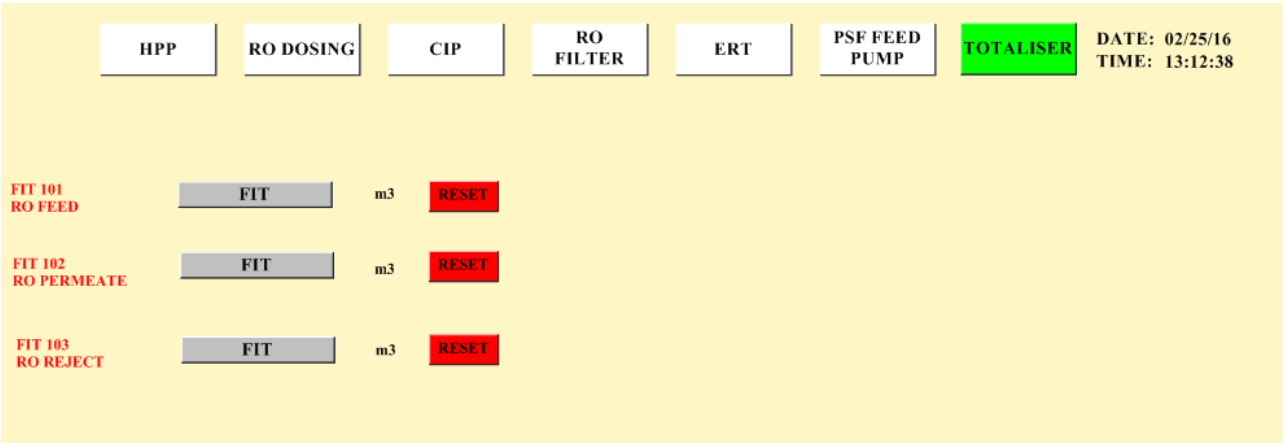

Figure 5: SCADA Process For Totaliser

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IX. CONCLUSION

The conclusion from this process is by using piping diagram the design is developed. Then, PLC program is written to automate the RO system using SCADA controller .thus, automation of RO system by using SCADA controller process is done and pure water is obtained.

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