DCS Based Effluent Treatment Plant

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Abstract - Industries are rapidly increasing and so it creates a large amount of pollution and the areas near it are highly affected. As most of industries are growing in domestic domains, public suffer from highly toxic gases, unhygienic and dirty water. To prevent those kind of waste, effluent treatment plants are incorporated in such industrial areas. Most of the previously used ETPs are manually operated which increases the labor cost and it may also result in to more number of errors and so this proposed work will be a step towards eliminating such problems by involving automation in this field which reduces both labor cost, error, and it also gives economic benefits to the industry. This paper illustrates the methodology and need of automation involved in effluent treatment plant.

Index Terms - DCS; Effluent Treatment Plant; nV Engineering tool; SCADA

I. INTRODUCTION

The population as well as pollution are rapidly increasing in developing country like India. Population grows with rising standard of living and in turn more amount of wastewater is generated. Water is considered as most important natural resource and is a basic requirement for every living organism. Water is not only used for drinking, but it is also used for household and industrial purposes. Though water is available in abundance in nature, yet most of it is contaminated, and so it needs to be treated so that it can be recycled and reused. For the treatment of contaminated water Effluent Treatment Plant is used which cleans the effluents form the industry, polluted water from lakes, rivers etc. so that it can be further used. The level of treatment of such effluents varies with different types of industries and becomes complex for larger industries.

There are number of ways to treat the industrial waste, one can use manual mode for small industries and one can use the automatic mode for large industries like textile industry or food industry or yeast industry. For effluent treatment plant, the effluents are collected and processes like primary filtration, mixing, neutralization by acid or alkali chemical coagulation, settling and separation of sludge, pressure filtration and discharging are taken place. Each process is done according to the content of the waste present in the industries. This paper includes why DCS is preferred over PLC, how automation is done in this field and its real time communication through SCADA.

II. LITERATURE SURVEY

Kim and Skrentner (1993) found many of the application contained some automation. According to the survey, it was found that about 75 percent industries are using single-loop controller technology.

The Red River Army Depot, TX, water treatment plant was automated filter backwashing by using programmable logic controllers (PLCs). High-lift pumping was operated in manual mode whose operation is insufficient for large industries. Individual chemical feed loops were used in some industries.

In some plants, the automatic loops are no longer used because of the extensive maintenance required to keep control valves and Ph probes operating. The previous plants did not have fully centralized monitoring of the plant nor were they controlled sitting in the remote place.

III. BACKGROUND

DCS referred as Distributed Control System; it is a computerized, programmed control system for a operation or plant with a great number of complex control loops, are divided into various divisions throughout the system, with a central operator. The DCS approach increases reliability and diminishes the installation cost by placing the control functions near process plant which also facilitates remote monitoring and supervision. The control of various parameters can also be done through Programmable Logic Controller instead of using Distributed Control System, but DCS is mainly preferred as it can handle more number of analog and digital I/O's compared to PLC.

SCADA refers for Supervisory Control & Data Acquisition; it is used in order to gather and analyze the actual-time data to keep a record, monitor and control the parameters remotely. It also has the facility to generate trend, reports and to identify various alarms conditions based on its predefined set points. OPC DA is used as the communication protocol for communication of DCS with SCADA in this paper.

OPC DA stands for OPC Data Access. OPC also specifies how real-time data can be interchanged between a data source and a data sink. For example PLC and HMI, SCADA and PLC, SCADA and DCS etc. There are different versions available each higher version with more number of specifications.

IV. PROPOSED ARCHITECTURE

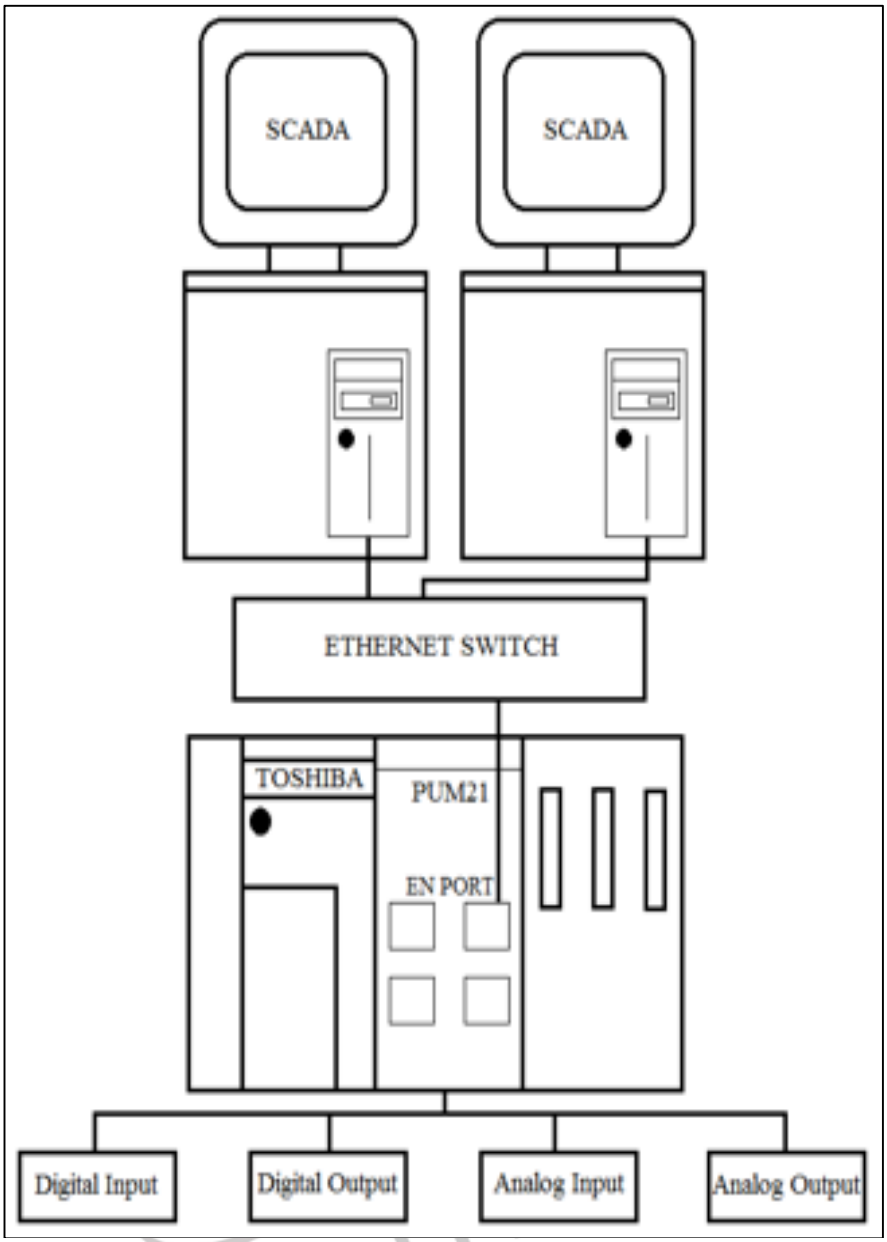

Figure 1:General Architecture

The architecture of the effluent treatment plant consist of various blocks like
1) The operating desk
2) Ethernet Switch
3) DCS
4) I/O Bus

The operating desk at the field is used for controlling as well as monitoring the various parameters, it contains the logic where the operator can make changes as per the requirements and the operator also has the facility to view the parameters through the SCADA screen. The operator desk will have each and every software that is used for the process.

The Ethernet Switch works as a main station which connects others computers, DCS and many other devices. The switch can also be wired to the router and modem to access the Internet. The port size depends upon the number of devices included in the system. The Ethernet Switch used here has two port facility one is RJ45 and FO port. Each of them are used as per the necessity. The Ethernet Switch used here is NETGEAR GSM7224 and its connections are shown in the figure it also has a power supply port.

Type 2 light DCS of Toshiba with PUM21 processor connected to the SA911 TCNET I/O adapter connected to the number of nodes. The number of modules reliable on the number of analog & digital I/Os. It consist of sixteen channel each analog input nodes whereas eight channel of each analog output nodes. The total amount of analog input nodes are ten and analog output nodes are six. Similarly each digital input and output nodes are of thirty-two channel, the total number of digital input nodes used are thirty-eight and digital output nodes are ten.

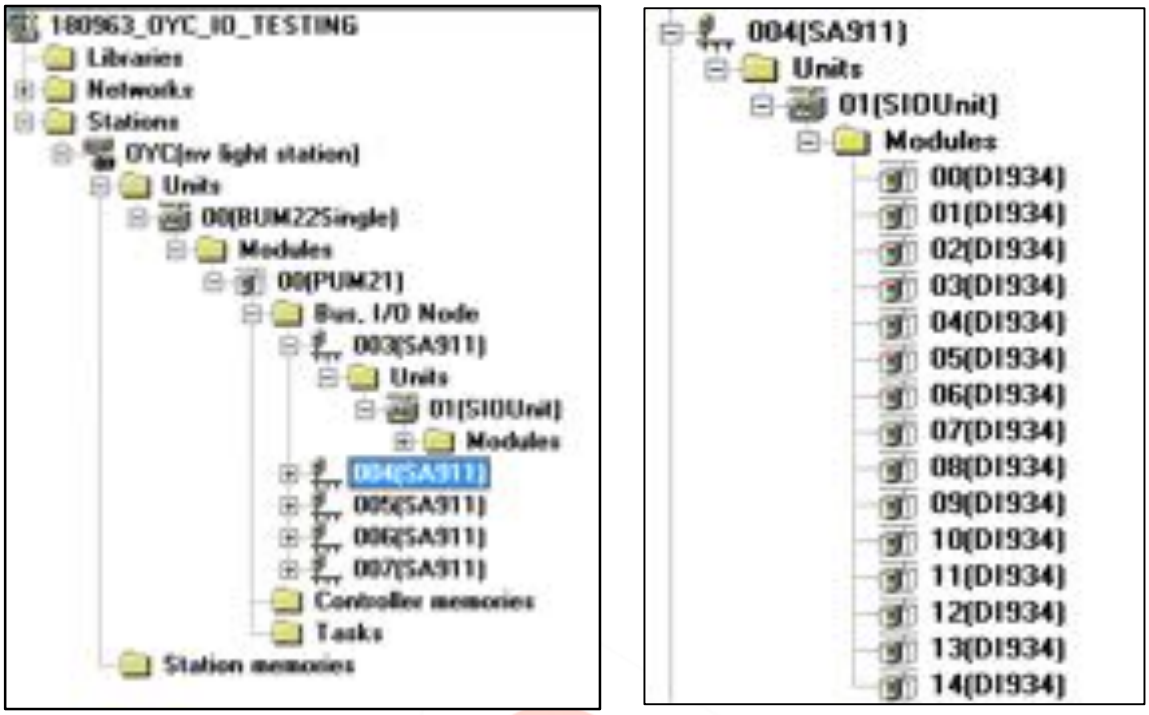

Figure 2: Product Tree

V. IMPLEMENTATION

The first step to implement this plant is to identify process I/Os, then assign each parameter with proper tag name and accordingly give a unique address to each of them.

Pre-define the dosing concentration of various chemicals involved in the process, define the higher and lower limit for the level switches and define the conditions which motor/pump/blower will work for how many hours, which one will go in standby/duty mode, give the conditions when will the equipment work in remote/local/auto/manual mode. According to conditions above, the whole process need to be implemented through programming in DCS and SCADA. Hence a communication medium is set between PLC and SCADA so that real time data can be fetched easily and can be seen in SCADA screen.

Let us consider a simple process and take one interlock for it.

All drives related to DAF-2 system should be kept in remote auto mode through HMI/PLC including dosing pumps.

Whenever DAF-2 Feed pumps (P-03 A/B) starts automatically in auto mode or remote manual mode; DAF-2 Recycle Pump (P-06 A/B), Air Compressor (AC-01 A/B), Spiral scoop & Carriage system drive (SM-02), HCl dosing pump-1 (P-32 A/B), PAC Dosing Pump-2 (P-38 A/B), will start automatically if all these drives are kept in remote auto mode through PLC.

Similarly, whenever DAF-2 Feed pumps stops automatically in auto mode or remote manual mode; DAF-2 Recycle Pump (P-06 A/B), Air Compressor (AC-01 A/B), Spiral scoop & Carriage system drive (SM-02), HCl dosing pump-1 (P-32 A/B), PAC Dosing Pump-1 (P-38 A/B) will stop automatically if all these drives are kept in remote auto mode through PLC.

Train Selection for Tanks is to be provided on PLC/HMI screen to select the operating tank out of two tanks T-03/T-04. Level switch of the selected tank shall be active when operator select tank for operation.

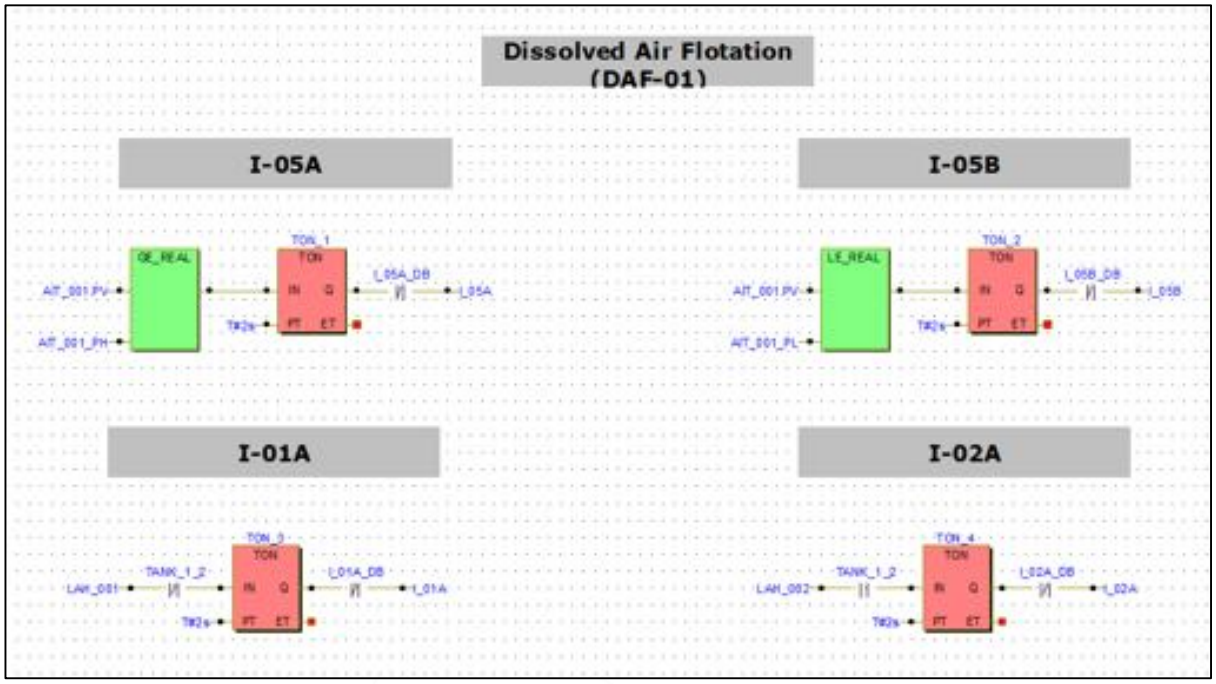

Figure 3: Interlock system

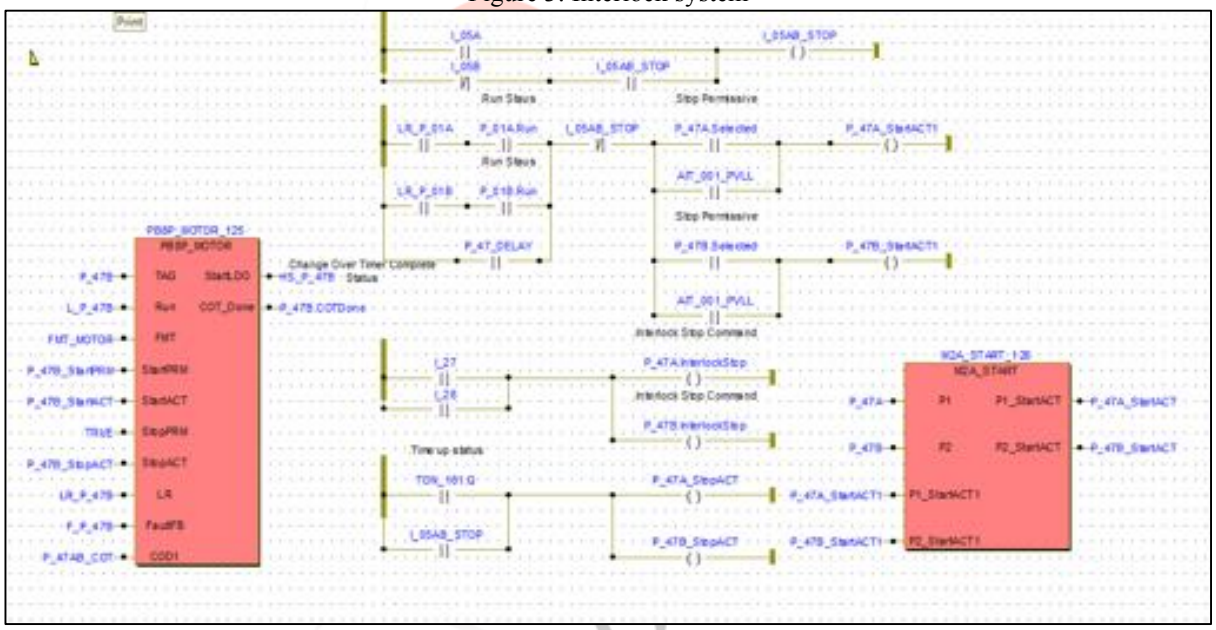

Figure 4: Ladder Logic

VI. RESULT

The objective of the paper is to understand the ETP control philosophy and developing logic and DCS panel engineering for those I/O simulations. Figure 5 shows the panel for DCS in which MCBs, POWER SUPPLYs, ETHERNET SWITCH, TERMINAL BLOCKs, PUM12 and digital modules are mounted according to panel standards. The cost required for implementation of this proposed scheme is much less in comparison to manual mode of operation. The man power are considered the major contributors for the cost which is thus eliminated, and the entire process can be seen through SCADA. The real time data can hence be acquired through SCADA which can be controlled as well as monitored. Some screens are shown below.

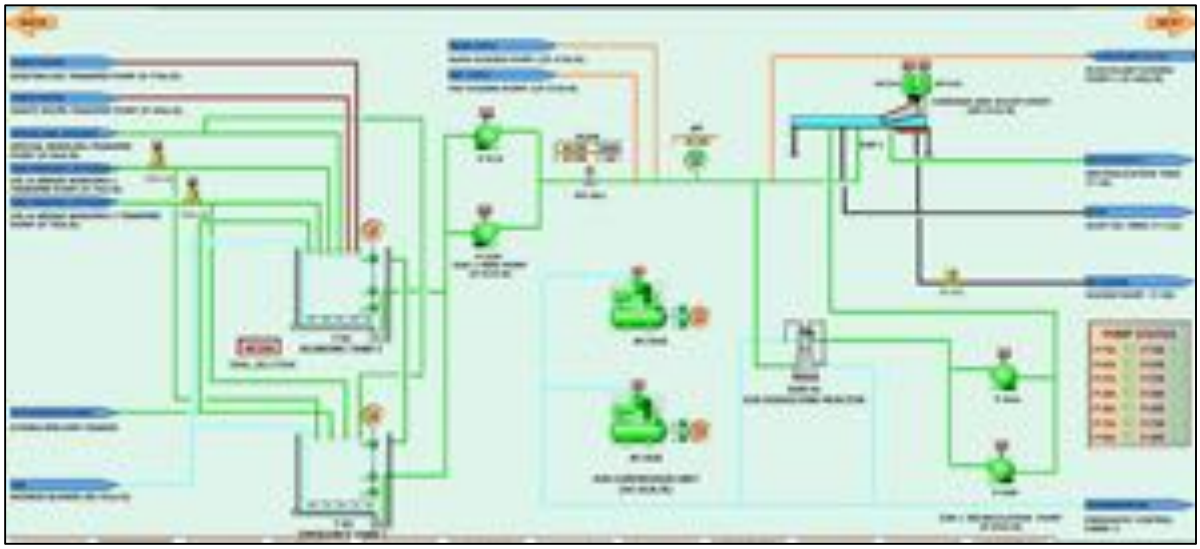

Figure 5: DAF Process

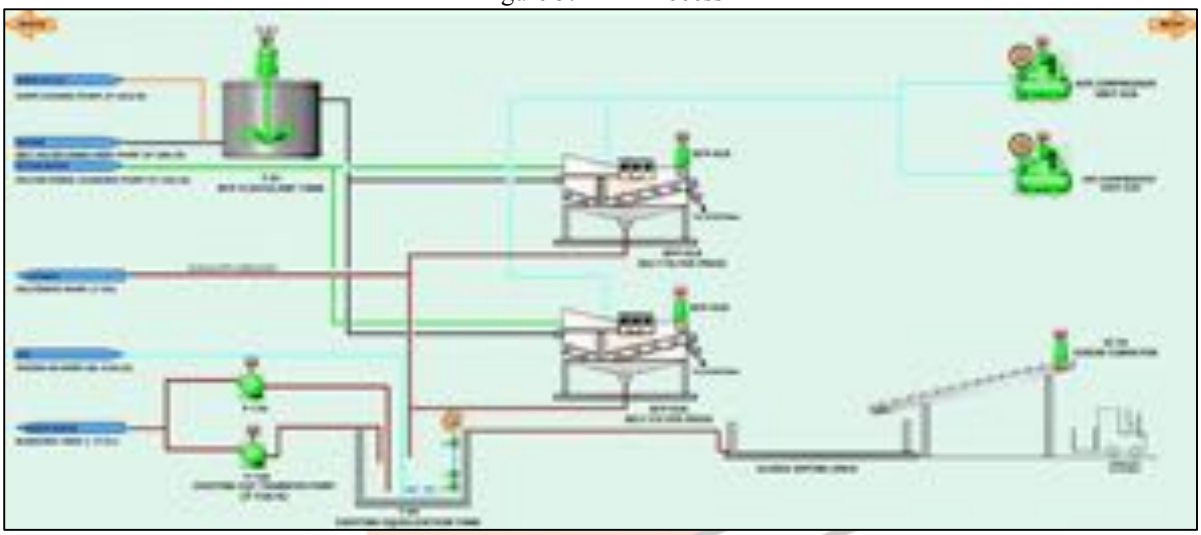

Figure 6: Belt Filter Process

VII. CONCLUSION

The conventional ETP systems monitors and controls the treatment process manually but the efficiency of operation is less and also there is considerable delay between action and reaction. Thus there is need to have an efficient and effective system development which is resulted in more efficient and faster system.

By implementing automation in this field, the operator can access the whole plant remotely and can monitor and control any critical parameter, it also makes the system faster in comparison to manual mode of operation and no personal attention is needed to take corrective action. Instead of being manually supervised plant operation engineers and automation professionals now enjoy a new tool that offers greater efficiency, thus making system more productive, while monitoring real-time data, alarm, reports and historical information on day to day basis.

Since the observing and controlling of the plant process is performed with the use of computer, no additional manpower is required for system operation and supervision. By using DCS, SCADA the data exchange is easily accomplished through wired/wireless network and stored in soft format, so the expenditure of paperwork is considerably low.

VIII. FUTURE SCOPE

As the country is going towards digitization this new approach in the industry will be used and will be beneficial for many growing and manufacturing industries. The Groov Epic which will be used has plenty of applications, it can be used instead of controller and it has a graphical screen inbuilt similar to the HMI screen where we can view or manage the parameters.Software such as groov Manage, groov View, PAC Control, Ignition Edge, Sparkplug MQTT and Node-RED can be utilized and each of them are user-friendly software's. Using the IIOT platform will also give a secure network.

IX. ACKNOWLEDGMENT

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