

Control of Effluent Disposal Pumps by Using Wireless Communication between Two Programmable Logic Controllers

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Abstract: Control and Instrumentation in any process industry can be compared to the nervous system in the human being. In industries and process plants, instrumentation makes use of various measuring components designed to suit the process. Generally in power plants to discharge effluent water, a separate arrangement known as EDP/H (effluent disposal pump house) is installed and the communication from EDP pump house to control room for commands and feedbacks are hardwired, when the input is given to the PLC (programmable logic controllers) like pump on/off then only the pumps are operated. Sometimes, there will be possibility of breakdown of the wire, to recover these breakings and to establish the proper communication between the wires again, junction boxes are used. It is a very lengthy, difficult and expensive process to lay fresh cables and whenever these cables are immersed in water due to rains and drains overflow, then the control system is getting disturbed because of short-circuit. To overcome this problem, wireless communication is established between the EDP/H and control room through PLC to PLC wireless communication. The current paper deals with the "wireless communication for control of effluent disposal pumps using plc".

Keywords: PLC, Viper SC 400 wireless router, Allen Bradely PLC, Effluent, RSLOGIX500 software.

1. Introduction

Effluent is an out flowing of water or gas from a natural body of water, or from a human-made structure. Effluent, in engineering is the stream exiting in a chemical reactor. Effluent is defined by the United States Environmental Protection Agency as "wastewater - treated or untreated - that flows out of a treatment plant, sewer, or industrial outfall". Generally effluent refers to wastes discharged into surface waters. The Compact Oxford English Dictionary defines effluent [1] as "liquid waste or sewage discharged into the river or the sea". The below Figure 1 shows effluent disposal pump house system. The ash water from the plant will be coming to the effluent sump. In the effluent sump the water will be purified and then it will be flowing in to the three effluent disposal pumps. The three effluent disposal pumps are used to dispose the water into sea. Continuous running of these pumps is important to prevent the overflow of EDP sump.

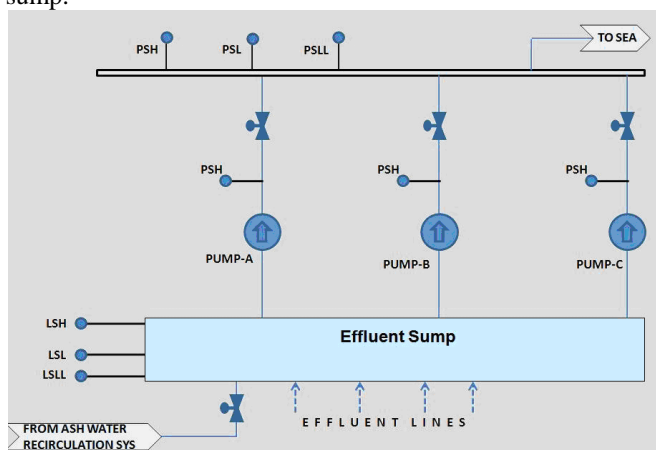


Figure 1: Effluent Disposal Pump House System

Effluent in the artificial sense is considered as water pollution [2], such as the outflow from a sewage treatment facility or the waste water discharge from industrial facilities. An effluent sump pump for instance, pumps waste from toilets installed below a main sewage line. In the context of waste water treatment plants, effluent that has been treated is known as secondary effluent, or treated effluent. This cleaner effluent is then used to feed the bacteria in biofilters. In the context of a thermal power station, the output of the cooling system may be referred as the effluent cooling water (sea water), which is noticeably warmer than the environment.

Effluent only refers to liquid discharge. To discharge this effluent water, a separate arrangement known as EDP/H (effluent disposal pump house) is installed and the communication from EDP house to control room for commands and feedbacks are hardwired. By using wired communication, there is possibility to break down the wire and also possibility to earthing and short-circuits so, to overcome this problem wireless communication is used. Wireless communication is established between the EDP/H and control room through plc to plc wireless communication. In wireless communication, it is feasible, reliable and smooth running. By using wireless the cost is also reduced. The comparison between wired and wireless is shown in the Table no 1.

Table 1: Comparison between Wired and Wireless Communication

Parameters	Wired communication	Wireless communication
Distance (4km approx)	Through cables	Through vipersc400 wireless router
Cost	>Rs.50,000/-	Rs.50,000/- (approx)

2. Hardware Description

The main components are:

1. Wireless router viper sc 400.
2. Allen Bradely plc SLC 500 processor
3. Rslogix 500 software

1. Wireless router viper SC 400:

The Viper SC+ provides any IP-enabled device with connectivity to transmit data. This DSP (digital signal processing) based radio was designed for industrial applications, utilizing 136-174 MHz, 215-240 MHz, 406.1125-511.975 MHz, 880-902 MHz, and 928-960 MHz frequencies. Operational as a wideband IP modem or router, Viper SC + [3] is optimized for use in smart grid distribution automation, and SCADA (supervisory control and data acquisition) applications. Connect an ethernet cable into the LAN (local area network) port of the Viper SC+ and plug the other end into the ethernet port of your personnel computer.

2. Allen Bradely PLC SLC 500 processor:

The Allen-Bradley SLC 500[4] is a small chassis-based family of programmable controllers, discrete, analog, and specialty Input/output (I/O), and peripheral devices. With multiple processor choices, numerous power supply options and extensive I/O capacity, the SLC 500 family provides a powerful solution for mid-range stand-alone or distributed industrial control. The SLC 500 family delivers power and it has flexibility with a wide range of communication configurations, features, and memory options. The RSLogix 500 ladder logic programming package provides flexible editors, point-and-click I/O configuration, and a powerful database editor, as well as diagnostic and troubleshooting tools to help in saving time. In Figure 2 the connection of SLC 500 processor with personnel computer (PC) through the data switch is shown.

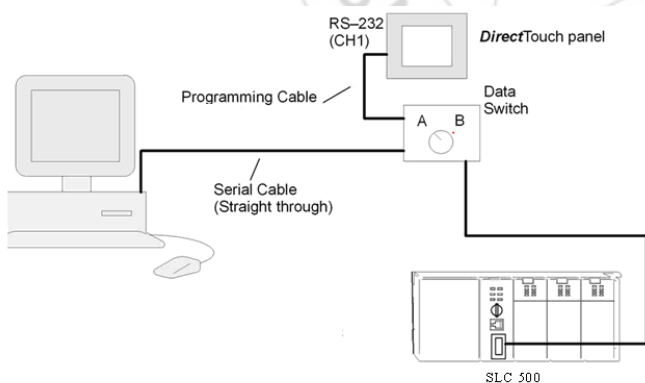


Figure 2: Connection of SLC 500 with PC

3. Rslogix 500 software:

The RS logic 500 software serves the SLC 500 family, as well as micrologix PLC's. The RSLOGIX 5 is used for PLC 5 systems. It is almost identical to RSLOGIX 500. RSLogix 500 [4] software is a 32-bit Windows ladder logic programming package for the SLC 500 and MicroLogix processors. RSLogix 500 is compatible with SLC 500 and MicroLogix programs created with any Rockwell Software programming packages.

RSLogix 500 software includes:

- 1) SLC libraries for storing and retrieving portions of ladder logic for use across any Rockwell Software SLC programming software products.
- 2) Free-form of ladder editor that concentrate on the application of logic instead of syntax.
- 3) Powerful project verifier that will build a list of errors which helps to navigate the corrections.
- 4) Compare utility that will graphically view project differences
- 5) An address wizard that makes entering addresses easier and reduces keying errors.
- 6) A custom data monitor to view separate data elements together and observe interactions.

SLC 500 Specifications:

- 1) Supported Platform
- 2) Any computer running Windows 98/NT/2000/XP operating system WinCE
- 3) Intelligent Instrumentation EDAS CE and LAN point CE
- 4) Supported serial communication ports: 1 – 32
- 5) Supported protocol: Allen-Bradley DF1 full-duplex.
- 6) Supports multiple, multi-thread user applications simultaneously

In Figure 3 and Figure 4 there are five rungs which contain input MOV block, MSG block and output. These are used as main elements in this ladder logic for EDP pump house and control room. The MOV command is an output instruction that moves a copy of a value from a source to a desired destination. This instruction is placed on the right side of the rung, and is carried out on each scan providing the rung conditions are true. The MSG command is used to pass the information from EDP to control room. The Figure 3 indicates processor 1 i.e., EDP house and Figure 4 indicates processor 2 i.e., control room. The signal from the processor 1 through router will move to control block and from the control block it is received by the processor 2 and finally by this signal the pumps are operated

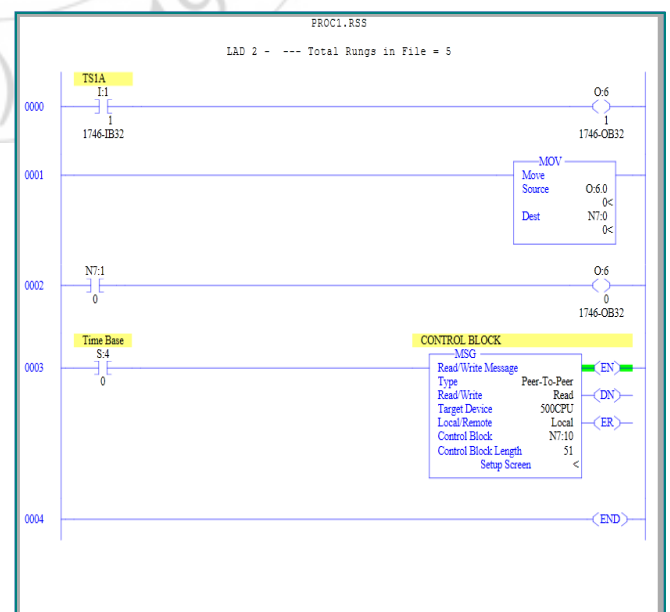


Figure 3: Ladder logic diagram for remote PLC of EDP house

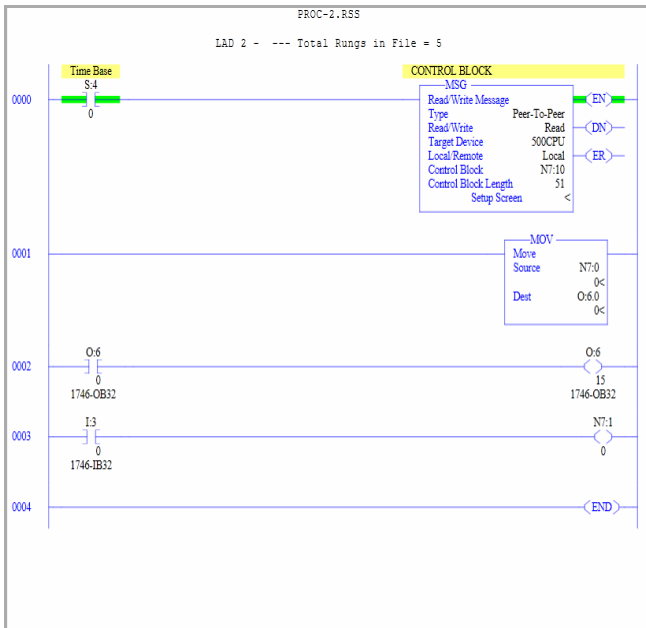


Figure 4: Ladder logic diagram for communicating PLC in EDP of control room

3. Result

The communication is established between two processors of the control system and minimum transmission is achieved. By using RS Logix SLC 500 software, the pump on/off commands and feedbacks are operated. The alarm which is indicated in the Figure 5 shows the pump on/off conditions. When the water overflows the alarm is indicated.

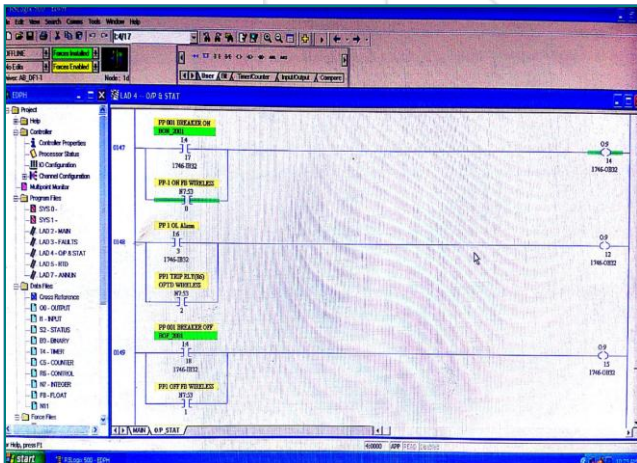


Figure 5: Operational indications of EDP house and control room monitor

4. Conclusion

The difficulties faced with cable cutting, pumps resulting outages of the Effluent Disposal pumps can be solved in a smart and economy way. The benefit of this paper is to show, how wireless communication can aid in continuous, reliable and smooth running of Effluent Disposal pumps. The exact status of starting or stopping of the pumps were not reliable but in this scheme it is possible to know the exact status. The operation of the pump is smooth and consistent. There is no

outage of the pumps due to cable cut and earthing faults at cable joints.

References

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- [3] www.calamp.com/viper_sc_reference_manual_viper_sc_user_manual.pdf
- [4] http://allen-bradely.rockwell.com/programabel_controller/
- [5] PLC programming for Industrial Automation by Kelvin Collins.