

Chapter 16 Control Equipment

16-1. Control Rooms and Consoles

In larger pumping stations, the complexity of the pumping system and the trend toward reducing the number of operating personnel will usually require the formation of a centralized monitoring and control room. Controls, alarms, and devices to indicate system status should be grouped on a control console so that one operator can conveniently initiate control sequences and observe the system response (Plate 20). Care should be taken to include a monitoring capability for all essential pumping system parameters. Some alarms that may be required include motor and pump bearing temperatures, motor winding temperature, motor trip and lockout relays, motor or gear cooling water failure, excessive pump discharge piping pressures or flow rates, lubrication system failures, abnormal water levels, trashrake malfunction, etc. A graphic display is an effective means of grouping alarm and status information.

16-2. Programmable Controllers

A programmable controller (PLC) should be considered for usage when the controls or monitoring requirements of the station become complex. When appropriately applied, this device provides the processing power and flexibility necessary to efficiently control a complicated system.

a. Advantages. Advantages of the programmable controller include:

- (1) The flexibility to reprogram or modify the control sequence.
- (2) The ability to manipulate, compare, or perform arithmetic functions on data stored at various memory locations.
- (3) A high degree of reliability when operated within their ratings.
- (4) The ability to accept a wide variety of input and output devices.
- (5) The capability to force inputs and outputs "on" or "off" to aid in troubleshooting.

b. Operator interfaces. Operator interfaces can range from simple pushbuttons and indicating lights to personal computers (PCs). The PC offers increased computing power, data logging, and graphics capabilities.

c. Cautions.

(1) Personnel. Some caution should be exercised, however, in applying PLCs and PCs to pump station applications. Most pumping stations are operated and maintained by local interests. The local levee or sewer district may not have the experience or expertise to maintain the PLC system. An evaluation should be made of the availability of qualified repair services and the competency level of the anticipated operating and maintenance personnel.

(2) Environment. Also, while PLCs are rugged devices which can normally be applied to pumping station environments with little concern for exceeding their environmental ratings, the designer should evaluate the need for any special provisions to ensure that the PLC will be operated within its temperature and humidity ratings. If the use of a PC is desired, it should be an industrially hardened version and should be kept in a conditioned environment.

d. Temperature and humidity ratings. Typical ambient operational temperature ratings are 0 to 60 degrees centigrade and -40 to 85 degrees centigrade during storage. Typical humidity ratings are from 5 to 95 percent without condensation. Operation or storage in ambients exceeding these values is not recommended without special consultation with the manufacturer.

e. Interposing relays. The output contacts of programmable controllers have limited current carrying capacity. Electrical devices which require significant amounts of current for operation, such as large solenoid devices, may require the addition of interposing relays to the system. However, to minimize complexity, the use of interposing relays should be avoided wherever possible.

16-3. Water Level Sensors

a. General. A variety of sensors are available for use in sensing water levels, including float-actuated mercury switches, float-actuated angle encoders, bubbler systems, bulb-type floats, etc. The use of float-actuated mercury switches is discouraged due to environmental

concerns. A comparison should be made of the particular pumping station requirements in relation to the various level sensor capabilities before deciding upon the system to be employed. In more sophisticated stations, it may be desirable to utilize an angle encoder. With its associated electronic packages, very accurate level comparisons and alarm functions are possible. Also, its output may be convenient for inputting to programmable controllers or computers. The selection of a sophisticated water level sensing system, however, must always be made with consideration of the quality of maintenance and repair services available to the station after construction.

b. Bubbler systems. Bubbler systems when used are usually of the air-purged type. The nitrogen gas purged type is usually employed at remote sensing areas where power to run the air compressor of an air-purged system is difficult to obtain. The air-purged system operates by purging air into a channel, sump, etc., through a tube and measuring the back pressure which varies in proportion to the variation in liquid level. A linear variable differential transformer is usually used to convert pressure readings to low voltage or current signals. When used in sufficient number, this system may be cheaper than an equivalent float-actuated system. However, it is more complex and is subject to clogging in highly siltatious waters.

c. Angle encoders. The transducer should be of the electromagnetic resolver type and nonvolatile. Each shaft position should be a unique output that varies as a function of the angular rotation of the shaft. If power is lost,

the correct output should immediately be restored upon restoration of power. Units are available in single or multiturn construction.

16-4. Elapsed Time Meters and Alternators

To ensure even wear on pumping units as well as reducing the frequency of motor starting, it is recommended that elapsed time meters and alternators (where pumps are started automatically) be installed to provide a record of pump usage.

16-5. Timing Relays

Several timing relays are commonly employed in pump control circuits. If siphon breakers are required, an on-delay timer delays closing of the siphon breaker solenoids until the siphon system is fully primed. This feature reduces motor horsepower requirements to establish prime. The other is an off-delay timer which prevents the motor from being restarted until any reverse spinning of the pump has stopped.

16-6. Miscellaneous Circuits

The miscellaneous small power circuits commonly required in installations for the control transformers, potential transformers, lighting transformers, and control power should either be protected by standard circuit breakers or fuses of adequate rating.