CHAPTER 14

Instrumentation, Control and Electrical Systems

INSTRUMENTATION, CONTROL AND ELECTRICAL SYSTEMS

14.1 General Requirements

14.1.1 Codes and Regulations

Sewage treatment systems are classified by reliability as noted in publication number EPA-430-99-74-001. Plant instrumentation, control and electrical systems shall be designed to comply with the applicable requirements of this standard. See Chapter 1, Section 1.3.11.

The design of the treatment facilities instrumentation, control and electrical systems shall conform to applicable codes and regulations including:

National Electric Code (NEC)
Occupational Safety and Health Act (OSHA)
State and Local Building Codes
National Electrical Safety Code (NESC)
Instrument Society of America (ISA)

14.1.2 Plan Requirements

The instrument and control plans shall include, as a minimum, the following drawings:

Instrumentation, control and systems legend and general notes

Process and instrumentation diagram (P&ID)

Process flow diagram (may be combined in P&ID)

Site plan

Plant power distribution plan (can be included in site plan)

Switching logic or schematic drawings

Complete electrical one-line diagram

Building lighting plans

Building power plans

Motor control diagram
Equipment and installations details as required

Instrument loop diagram

14.2 Instrumentation and Control Systems Requirements

14.2.1 General

An instrumentation and control system must be designed with both operational reliability (accurate and repeatable results) and maintainability if it is to properly serve its purpose.

14.2.2 Backup Equipment

Instrumentation whose failure could result in wastewater bypassing or a violation of the effluent limitations shall be provided with an installed backup sensor and readout. The backup equipment may be of a different type and located at a different point, provided that the same function is performed. No single failure shall result in disabling both sets of parallel instrumentation.

14.2.3 Automatic Control

Where system automation is employed, a manual intervention/override or backup shall be provided.

14.2.4 Calibration

Vital instrumentation and control equipment shall be designed to permit alignment and calibration without requiring bypassing of wastewater or a violation of the effluent limitations. Automated systems shall have provisions for operator verification of performance and all necessary systems calibration devices.

14.2.5 Test Circuits

Test circuits shall be provided to enable the alarms and annunciators to be tested and verified to be in working order.

14.2.6 Alarms and Annunciators

Alarms and annunciators shall be provided to monitor the condition of equipment whose failure could result in wastewater bypassing or a violation of the effluent limitations. Alarms and annunciators shall also be provided to monitor conditions which could result in damage to vital equipment or hazards to personnel.

The alarms shall sound in areas normally manned and also in areas near the equipment. The combination of alarms and annunciators shall be such that each announced condition is uniquely identified.

14.3 Electrical System Requirements

14.3.1 Electric Power Sources

14.3.1.1 Primary Power Source

Generally, the local electric utility will be the primary source of electrical power. Second source of electrical power may be on-site generation or a second connection to the electric utility. If the second source is a connection to the electric utility, it must be arranged that a failure of one source does not directly effect the other. See Chapter 1, Reliability Class.

14.3.1.2 Standby Power Source

All treatment facilities greater than 100,000 gpd (average design flow) shall be equipped with an emergency generator to provide an alternate power source when a second power source is not available. The capacity of the backup emergency generator system shall conform to the Reliability Classification together with critical lighting and ventilation. If a main pump station is on site (or near) and would result in zero flow reaching the plant during power outages, it shall have a second power feed or standby power.

14.3.2 Power Distribution Within the Plant

The electrical power distribution system within the plant should be planned and designed on the following basis:

Plant electrical loads (peak and average demand)

Maximum fault currents available

Proper protective device coordination and device fault current withstand and interrupt ratings

Plant physical size and distribution of electrical loads

Plant power factor correction requirements

Location of other plant utility systems and facilities

Reliability requirements

Voltage drop limitations

Planned future plant expansions

Feasibility and possible economic justification for electrical demand control system

Life-cycle cost of major electrical equipment

All codes and regulations, and good engineering practice

14.4 Miscellaneous Requirements

14.4.1 Fire and Flooding

Failure of electrical equipment from such causes as fire and flooding shall be minimized by provision of suitable equipment housing and location, as well as by proper equipment design.

14.4.2 Housing of Electrical Equipment

Where practicable, electrical equipment shall be located in a separate room having an adequately controlled environment.

14.4.3 Ventilation

Mechanical ventilation shall be provided as necessary to protect electrical equipment from excessive temperatures.

14.4.4 Spare Components

An adequate number of spare components shall be specified by the design engineer to permit in-plant repairs or modifications and adjustment. These components include starters, low voltage contactors, and buried conduit. Spare electrical components which are subject to wear, such as motor brushes and switches, should also be specified by the design engineer as appropriate to minimize downtime.

14.4.5 Lighting

Adequate lighting throughout the wastewater treatment facility shall be provided, particularly in areas of operation and maintenance activities. Adequate emergency lighting shall be provided in the event of power failure.