CHAPTER 19
DESIGN AND SAFETY

19-1. General.

The goal of any wastewater treatment system is to produce an acceptable effluent that meets all the applicable standards. This must also be accomplished at a reasonable cost. After the design has been completed, it is up to the operations and maintenance staff to assure that the system is:

— Operated properly;

— Continuously maintained;

— Run safely; and

— Monitored to continually plan for improvement in quality, cost savings and safety.

In a report to Congress, the EPA indicated that, throughout the country, wastewater effluent quality standards have not been met. In many instances, effluent requirements are not being met due to the following design deficiencies:

— Process control is too complex;

— Equipment operation and maintenance costs are excessive;

— Maintainability of equipment is not considered in the facility design;

— Emergency provisions are not included in the facility design;

— Ease of operator functions are not considered in the facility design; and

— Inadequate design of materials handling and storage.

Obviously all of these factors are critical in the design of a waste treatment facility. Therefore, it is the designer's responsibility to always be cognizant of these factors throughout the design phase of a project. In some cases, this may require early, detailed discussions with the operation and maintenance personnel. However, the benefits derived from these considerations could mean the difference between a non-compliance facility and a well-operated facility.

19-2. Specific design considerations.

Some particular areas of design where the factors noted above should be considered:

a. Equipment failures and contingencies. Provisions should be made for standby equipment or bypass piping for situations whenever process equipment failures are encountered. These conditions should also be planned for routine maintenance of process equipment.

b. Equipment maintainability. Provisions should be made for access, maintenance and removal of process equipment. Simple maintenance functions, such as the removal of pump motors, are often impossible due to inadequate access space.

c. Ease of equipment operation. All of the unit processes described in this manual have been evaluated for their ease of operation and consistency of treatment performance. Selection and design of process equip--ment should also consider these factors. For example, equipment that requires considerable operator attention should be less favored to simple, operator-free equipment.

d. Ease of operator functions. Stairs, walkways, manways and other structures should be included in the facility design to enhance the routine functions of the operator. Also, adequate lighting is essential for operator observations.

e. Safety of the operator. Design of the facility should meet all OSHA requirements and should never require the operator to risk safety for the sake of operating the system.

f. Materials handling and storage. Adequate space should be provided for storage of process chemicals, spare parts and machinery. Also, provision should be made for the handling and transportation of process materials, spare parts and maintenance equipment.

19-3. General safety considerations.

The designer must be aware of the occupational and public health hazards associated with plant operations and maintenance, and provide the safety features to control such hazards in accordance with existing criteria. These hazards include mechanical equipment; open pits and tanks; electrical components; toxic, infectious and flammable materials; and potential oxygen-deficient situations.

a. Safety features in plant design. The safety features listed below are minimum, general requirements and are not intended to be all-inclusive. For detailed requirements, refer to the applicable standards.

(1) Assure adequate ventilation in wet wells and dry wells. The chlorine storage area will be separated from the feed area and from the remaining plant areas. Mechanical exhaust ducts for chlorine storage rooms and the chlorination room will extend from near the floor level and exhaust outside the building. The design will allow for provisions of adequate make-up air. Design must conform to the requirements of chapter 17. Positive mechanical ventilation will be ample in grit and screening chambers as well as in the wet and dry wells. Fan capacities must be sufficient to effect a complete change of air every 2 to 5 minutes. Emergency generators with internal combustion engines will have their exhaust vented outside of the building to prevent carbon monoxide buildup during test or emergency use.

(2) Fencing and guard rails will be provided for open tanks, hatchways and other locations when needed. Stairs will be used for access to pump rooms in preference to vertical ladders. However, when vertical ladders cannot be avoided and their length exceeds 20 feet, they will be equipped with a ladder-climbing device, a hoop cage, or offset landings.

(3) All electrical wiring will be properly insulated and grounded. Explosion-proof equipment will be provided for enclosed or confined areas where explosive vapors, fumes or gases may accumulate; 110 volts or less for control circuits is desirable in such areas.

(4) Guards will be provided for all exposed, moving parts of pumps and equipment. Hoists and rails for removal of heavy equipment will also be provided for operation and maintenance purposes.

(5) The plant will be enclosed as necessary to protect the public and the facility.

(6) The public water supply must be protected to eliminate the possiblity of contamination by cross-connections with sewage or sludge piping. This will be achieved by a vertical, positive air gap of no less than 2 inches between the inlet and the outlet levels of a fixture. The water line utilized for plant washdown will be provided with a backflow-prevention device. Refer to AFM 85-21 for operation and maintenance of these devices at Air Force facilities.

(7) A potable, hot and cold water supply will be provided through a mixing faucet. Dressing room facilities will be provided except in the smallest plants.

(8) Signs will be provided designating hazardous areas and non-potable water taps.

(9) Flood lights will be provided for night-time inspection and maintenance.

(10) Crowding of equipment will be avoided around pumps, screens and vacuum filters. Valves and other operating devices must be readily accessible to avoid injury and encourage proper use so that spillage will be prevented.

(11) Sludge digestion tanks will be segregated from the rest of the plant and provided with liquid-level indicators or alarms.

(12) Good ventilation and a combustible-gas indicator will be provided for protection against any leakage in the gas-collection piping and appurtenances.

(13) A suitable facility for quick drenching or flushing of the eyes will be provided within the laboratory for immediate, emergency use.

(14) Piping and valves in the chlorine room will be color-coded with a primary color of brown and a secondary color of green.

b. Safety equipment. Facilities for the following safety equipment must be provided for at the plant:

— Safety harness with lifeline;

— First-aid kit;

— Fire extinguishers (type suitable for anticipated fires);

— A portable, combustible-gas indicator where sludge gas is collected;

— An oxygen deficiency indicator;

— Hydrogen sulfide and carbon monoxide indicators;

— A portable air blower;

— Two or more canister masks or demand-type, compressed-air masks certified by the National Institute for Occupational Safety and Health (NIOSH);

— A self-contained breathing apparatus;

— Miner's safety-cap lights.

c. Quick shower. A suitable facility for quick drenching or flushing of the eyes and body will be provided within the laboratory and other areas where chemicals are handled, stored or used except when water presence is a hazard with the chemical.