CHAPTER VII

PUMPING FACILITIES

A. GENERAL REQUIREMENTS – Pumping facilities shall be designed to maintain the sanitary quality of pumped water and in such quantities and pressures as necessary. They should not be vulnerable to interruption caused by natural or man-made disturbances. Every effort shall be made to insure the safe and satisfactory operation of the water supply pumping facilities. Additional specific requirements applicable to well pumps and well house pumping installations are provided in Chapter IV.

B. PUMPING STATIONS

1. LOCATION – Pump station site considerations should include its location relative to the water resource and point of delivery, availability of utilities and land for future needs, and its sanitary protection. Pump stations shall be located above ground, graded to carry surface water away from the station, and protected from vandalism and unauthorized entry. Station accessibility shall be provided for ease of needed service.

2. FACILITIES

   a. Floor elevation must be at least 1 ft. (0.3 m) above the 100-year flood elevation or protected to that elevation. In addition, the elevation of the floor is to be at least 6 inches (15.2 cm) above finished grade. When locating a pump station below ground level cannot be avoided, totally enclosed pumps and motors will be required.

   b. Provide adequate interior space as needed for the installation of additional units and for the safe servicing of all equipment.

   c. Building must be of durable construction, fire and weather resistant and have outward opening doors.

   d. Means for disinfecting all facilities must be provided.

   e. Floors must drain without impairing the quality of water being handled. All floors shall slope toward a suitable drain at 1/8 inch/foot (1.0 cm/m).

   f. Provide suitable outlet for drainage from pump glands without discharging onto the floor.

3. SPACE REQUIREMENTS – In planning pump stations, sufficient floor space should be provided for pumps, suction and discharge pipe headers, re-chlorination equipment, proportioning flow controls, and electrical switch-gear. Access to pumps and motors and space for equipment needed for installation, removal, and servicing of pumps and auxiliaries should also be considered.

4. EQUIPMENT SERVICING – Pump stations shall be provided with crane-ways, hoist beams, eyebolts, or other adequate facilities for servicing or removal of pumps, motors, or other heavy equipment; openings in floors, roofs or elsewhere as needed for removal of heavy or bulky equipment; and a convenient tool board, or other facilities as needed, for proper maintenance of the equipment.

5. SANITARY AND OTHER CONVENIENCES – Except for small automatic stations or where such facilities are otherwise available, all pumping stations should be provided with potable water, lavatory, and toilet facilities. Plumbing should be so installed as to prevent contamination of a PWSS.

6. STAIRWAYS AND LADDERS – Stairways or ladders shall be provided between all floors and in pits or compartments which must be entered from another level, and they shall have handrails on both sides and treads of non-slip material. Stairs are preferred in areas where there is frequent traffic or where supplies are transported by hand. They should have risers not exceeding 9 inches (22.9 cm) and treads wide enough for safety.

7. HEATING – Provisions shall be made for adequate heating for the comfort of the operator and the safe and efficient operation of the equipment. Pump houses not occupied by personnel should be sufficiently heated to prevent freezing water or chemical solutions in equipment or treatment processes.

8. VENTILATION – Adequate ventilation shall be provided for all pumping stations. Forced ventilation of at least six changes of air per hour shall be provided for all rooms, compartments, pits, or other enclosures below grade level, and for any area where an unsafe atmosphere may develop or where excessive heat may build up.

9. DEHUMIDIFICATION – Dehumidification should be provided in areas where excess moisture could cause safety hazards or damage to equipment.

10. LIGHTING – Pump stations shall be adequately lighted. All electrical work should conform to the requirements of State and local codes.

11. SUCTION WELLS – Wells shall be watertight, have sloped floors to permit removal of water and entrained solids, and be covered or otherwise protected against contamination.

C. PUMPS

1. TYPES – Single and multistage centrifugal pumps are almost universally used for water booster service facilities or high service pump stations. Well pumps include deep well vertical turbine, submersible, propeller and mixed flow, jet, air lift, rotary, or reciprocating pumps.

2. SELECTION CRITERIA

   a. CAPACITY – Capacity requirements are determined by the peak hourly demand on the system served by the pump station, and the range of present and future operating conditions anticipated. A pump should be selected which will operate alone or in parallel with other pump units when required, and at maximum operating efficiency over the range of head and flow conditions.

   b. CHARACTERISTIC CURVES – Each centrifugal pump has its own characteristic curves and the pump must fit into the system and be able to operate within its head and flow constraints. If pumps cannot be found to fit the requirements at a constant motor speed, then pumps with variable-speed drives are advisable.

      It is good practice to select a pump with an impeller that is smaller in diameter than the maximum impeller size for that pump so that a larger impeller can be installed when water demands increase. It may also be desirable to oversize the motor in the original installation as a provision for the future use of a larger impeller.

   c. EFFICIENCY – Do not select a pump on the basis of a very high efficiency at a single design or specification point. Rather the selection should be made on the best average efficiency over the entire range of conditions under which the pump will operate including parallel operation with other pump units.

   d. SPEED – The speed should be selected so as not to exceed that which the pump type can handle. Upper limits of speed with respect to capacity, head, and suction conditions should not be exceeded in order to avoid cavitation.

3. NUMBER OF PUMPS – At least two pumping units shall be provided for water booster service facilities or high service pump stations. With any pump out of service, the remaining pump or pumps shall be capable of meeting the peak demand of the system against the required distribution system pressure without dangerous overloading.

4. DESIRABLE OPERATING CONDITIONS – The NPSH of proposed pump installation should be greater than the required NPSH of the pump under all operating

conditions. Suction lift should be avoided if possible or be within allowable limits, preferably less than 15 ft. (4.6 m). Provisions should be made for pump priming should suction lift be necessary.

Continuous pumping is preferable to frequent stopping and starting. The selected pump capacity should minimize the number of on-off cycles. The minimum period of operation should not be less than 15 minutes.

5. PUMP SUCTION AND PRIMING – Provisions to prime pumps are necessary when suction lift is required. Priming water shall not be of lesser sanitary quality than that of the water being pumped. Means shall be provided to prevent back siphonage. Centrifugal pumps may be provided with an air, steam, or water operated ejector connected to the top of the pump case. When an air-operated ejector is used, the screened intake should draw clean air from a point at least 10 ft. (3.0 m) above the ground or other source of contamination, unless the air intake is fitted with an approved filtering apparatus. Vacuum priming may be used.

   The suction piping should be as short and direct as possible and sized such that the maximum flow velocity is less than 4 ft/sec (1.2 m/s). The suction pipe should be larger than the discharge pipe. Pipe bends that unevenly distribute flow across the suction of multiple pumps should not be used. Suction piping should slope upward from the source to the pump and be airtight.

6. DRIVES – Pumps may be driven by electric motors, steam turbines, or diesel, gas, or gasoline engines. Drives may be direct or by power transmission. Properly designed belt or chain drives are acceptable. Right angle gear drives are useful, particularly for connecting power from two sources such as an electric motor drive and a standby engine drive, so that either can be selected through a clutch arrangement.

7. POWER REQUIREMENTS – Power units shall be sized to operate without overload under all possible combinations of flow and head from zero to maximum flow at any head from zero to shut-off head.

8. WELL PUMP SELECTION AND INSTALLATION – Some factors to be considered in selecting a pump for a particular well installation are: capacity, depth of well, pumping level, inside diameter of well, condition of bore, abrasive properties of water (e.g., sand), total head, type of power available, and costs.

9. BOOSTER OR HIGH SERVICE PUMPS – Booster or high service pumps may be used to increase pressures in parts of a water distribution system by taking suction from a main or reservoir in one part of the system at low pressure and discharging it into another part of the system, a storage reservoir, or elevated tank at a higher pressure. When discharging into a reservoir or tank, constant speed centrifugal pumps may be used. Individual home booster pumps shall not be allowed for any individual service from the PWS main.

Booster or high service pumps shall be located or controlled so that they will not produce negative pressure in their suction lines. The intake pressure must be at least 20 psi (140 kPa) when the pump is in normal operation. The automatic cutoff pressure must be at least 10 psi (70 kPa) in the suction line. The automatic or remote control devices shall have a range between the start and cutoff pressure that will prevent excessive cycling, and they should be readily accessible for servicing and repairs. A bypass is required and disinfection facilities may be required.

D. APPURTENANCES

1. VALVES – Pumps should be adequately valved to permit operation, maintenance, removal and repair of the equipment while the rest of the system remains in operation. If foot valves are necessary they should have a net valve area of at least two-and-one-half times the area of the suction pipe, and they should be screened. Each pump should have a positive acting check valve on the discharge side between the pump and shutoff valve.

2. PIPING – In general piping should:

   a. Be designed so that the friction losses will be minimized;

   b. Not be subject to contamination;

   c. Be sloped in one direction to drains;

   d. Have adequate cleanouts;

   e. Have watertight joints;

   f. Be protected against surge or water hammer by:

      1) Slow valve closure;

      2) Surge tank with free water surface;

      3) Air chamber;

      4) Surge suppressor;

      5) Surge relief valve; and

      6) Pump reversal.

g. Be such that each pump has an individual suction line or the lines should be manifolded so that they will insure similar hydraulic and operating conditions; and

h. Be arranged for minimum interruption of service due to any one piping break.

3. GAUGES AND METERS – Each booster or high service pump should have a standard pressure gauge on its discharge line, a compound gauge on its suction line, and recording gauges. Each pump or group of pumps should have means for measuring the discharge. All booster or high service pumping stations should have indicating, totalizing, and recording meters for the total water pumped.

4. WATER SEALS – Water seals should not be supplied with water of a lesser sanitary quality than that of the water being pumped. Where pumps are sealed with potable water and are pumping water of lesser sanitary quality, the seal should be provided with a break tank open to atmospheric pressure and have an air gap, between feeder line and the spill line of the tank, of at least 6 inches (15.2 cm) or two pipe diameters, whichever is greater.

5. CONTROLS – Pumps, their prime movers and accessories should be controlled in such a manner that they will operate at rated capacity without dangerous overload. Where two or more pumps are installed, provision should be made for proper alternation. Provision should be made to prevent operation of the pump during the backspin cycle. Electrical controls should be located above grade. Equipment shall be provided or other arrangements made to prevent surge pressures from activating controls that switch pumps on or activate other equipment outside the normal design cycle of operation.

6. AUTOMATIC AND REMOTE CONTROLLED STATIONS – All automatic stations should be provided with automatic signaling apparatus which report when the station is out of service. All remote controlled stations should be electrically operated and controlled, and have signaling apparatus of proven performance. Installation of electrical equipment shall conform to state and local codes.

7. STANDBY POWER – To ensure continuous service when the primary power has been interrupted, a power supply from at least two independent sources or a standby/auxiliary source shall be provided. Fuel storage facilities and fuel lines must be designed to protect the water supply from contamination when standby power is provided by on-site generators or engines. Preferred fuels are natural or bottled gas.

8. WATER PRELUBRICATION – When automatic prelubrication of pump bearings is necessary and an auxiliary power supply is provided, the prelubrication line shall be fitted with a bypass valve to bypass around the automatic control so that the bearings can, if necessary, be lubricated manually before the pump is started. Alternatively, the prelubrication controls shall be wired to the auxiliary power supply.