CHAPTER 6

OPERATING EFFICIENCIES

6-1. General. Water pumping stations will normally operate automatically to satisfy the hydraulic requirements of the system. Supervisory or remote control of electric motors will be provided on the larger installations to reduce operator time and to provide a means for optimal control of energy costs, and to allow for energy conservation measures. For optimal control of energy costs, particularly for larger pump stations, the control system will allow the operators to schedule pump operations so that station electrical consumption is minimized at the same time adequate storage for fire protection and system pressures are maintained. Energy costs comprise the major component of the operating costs of water supply systems. The largest quantity of energy is usually consumed by treated water pumping stations. The overall operating cost associated with a particular pump station will be dependent upon the following factors: the pumps, the distribution system, the pump drivers, and the governing energy rate schedule. The design analysis for the distribution system and pump station and the cost evaluation will consider these factors.

6-2. Pump Operations. Three different problem areas are usually encountered in any attempt to improve pump operations of an existing pump station: inefficient pumps, inefficient pump combinations, and inefficient pump scheduling. The efficiency of a single pump is the ratio of water horsepower produced by the pump to the input horsepower, usually electrical. This efficiency should be measured at several flow rates. It is not always physically practical to measure flow rates after pumps are installed in existing installations. However, if this information can be obtained and the pump is shown to satisfy its original performance specification, there is still no assurance that it will operate efficiently in the system. The efficiency of a pump running alone can be much different than when running in conjunction with other pumps. With multiple pump operation the actual flow produced will depend upon the head differences between the suction header and discharge header. The relationship between these heads and the flow rate is referred to as the system head curve and is a function of tank water level on each size of the pump, pipe carrying capacity near the pump, location of water users with respect to the pump, and which other pumps are operating. Depending on the system head encountered by a pump, the pump may perform over a wide range of efficiencies.

6-3. Pump Scheduling. Pump scheduling for optimum energy costs for large pump stations with elevated storage can be established by use of computer programs where accurate input data reflecting existing system operations can be obtained. The total energy consumption charges associated with a pump operation can be decreased by improving the efficiency of individual pumps or combination of pumps. However, such measures have little impact on reducing the costs associated with time of day energy rate schedules. The primary way to minimize the cost associated with variable electric rate schedules is through use of off-peak pumping strategies. This policy should be implemented if energy savings exceed the cost of additional storage capacities. The key to implementation of an off-peak pumping schedule is the availability of equalizing storage and the development of an optimal pump operating policy. A pump operating policy is a schedule of water levels that should be maintained and a series of rules that dictate when different pumps should be operated in response to different system conditions. The pump operating policy might consider time of year as well as time of day. As an example, no pumping when the ambient temperature falls below a preset temperature during cold months during the period when electricity usage is the highest. An optimal pump operating policy is that policy which will satisfy all constraints at a minimum cost.

6-4. Ease of Operation and Maintainability. The design of pumping equipment and drives will be evaluated based on several factors: amount of operator attention, frequency of routine maintenance and adjustment, energy savings, and availability of parts and service. Proper alignment of pump and driver, as well as support of suction and discharge piping will help prevent some noises and vibration. Noise is minimized by choosing pumps to operate near the point of best efficiency and proper suction conditions. Increased vibration affects the life of bearings, stuffing boxes, and mechanical seals. Partially closed valves will not only increase noise, but will increase radial thrust and resultant stresses in shafts and bearings of centrifugal pumps.