

Chapter 10 Pump Drive Selection

10-1. General

Several options are available to the designer when considering the selection of a pump drive for flood-protection pumping stations. The two factors that must be investigated when making this selection are reliability and cost. Alternative studies should be made considering these two factors. The two types of drives to be considered are electric motors and internal combustion engines. Gear drives are required as part of the drive system when using engines. Gear drives can also be used with electric motors permitting the use of a less expensive higher speed motor and allowing a greater variation of the pump speed than permitted with direct drive.

10-2. Reliability

The primary consideration in the selection of any pump drive is reliability under the worst conditions likely to prevail during the time the station will be required to operate. The reliability of the electrical power source should be determined from power company records of power outages in that area and their capability to repair any outages. Consideration of power from two different power grids within a company may be advisable for large pumping stations. The reliability of the various different types of equipment must also be studied. Electric motors and engines are usually very reliable while the necessary accessories to operate these units are less reliable. The complexity to operate and repair the piece of equipment by the operating personnel should also be considered. Equipment repair requiring specialized service personnel may require much greater time to put it back into service.

10-3. Cost Considerations

a. General. Unless reliability considerations are important enough to decide what type of drive to use, annual cost comparisons should be made of all systems under study. The annual costs should include the installed, operating, maintenance and replacement costs. After all costs have been established, a life-cycle cost analysis can be performed.

b. Installed costs. The installed costs include the construction costs of all the equipment and the electric power supply costs, which usually would include the cost of the substation plus the power line to the station.

These costs should be figured on an annualized basis using the number of years determined for the project life.

c. Operating costs. The operating costs would include the cost for energy and manpower expenses. To accurately estimate the total energy costs, an estimate of the amount of pumping required for each month of the year must be obtained. The source of pumping time should be obtained from hydrology period-of-record routing studies. The current price schedule for electric power from the supplying utility or the market price of engine fuel can be used to determine the costs for all stations except for large stations. For large stations, a study of future energy costs over the life of the project is justified. In determining the total cost of electricity, it is important to include both the cost for the energy used (kilowatt hours) plus any demand (capacity) charges. Demand charges by some power companies may be a major part of the energy costs.

d. Maintenance costs. Maintenance costs include manpower and materials for both preventative and major repairs. Unless the station has specialized equipment, these costs are usually estimated using the following percentages of the installed equipment costs:

<u>Station Size</u>	<u>Percentage (%)</u>
25 ℓ /s (1.0 cfs)	0.5
15 m^3 /s (530 cfs)	5.0

Percentages for intermediate station sizes are determined proportionally with the above values. The maintenance cost of unusual or specialized equipment would be determined separately and would be an additional amount.

e. Rehabilitation and replacement costs. Rehabilitation and replacement costs include those costs required to keep the station operable for the project life. For a normal 50-year station life, most of the equipment would be rehabilitated or replaced at least once, except for very large pumping stations. The periods between the rehabilitation/replacement could be shorter if the operating time were great. Major items such as pumps, drivers, and switchgear are figured to be rehabilitated or replaced once during the 50-year life. This major equipment rehabilitation or replacement is usually estimated to occur between 20 and 40 years after placing the station into operation. Rehabilitation costs for major equipment can be estimated to be 35 to 45 percent of replacement costs depending on the condition of the equipment. Other items of equipment may be replaced several times during the project life depending on their use or may require

EM 1110-2-3105
30 Mar 94

only partial replacement. It is most likely that equipment, except for the pump and motor, may not be replaced in kind. Therefore, the replacement cost should include all engineering and structural modification costs as well as the equipment costs. In any event, the equipment removal costs including the cost of all rental equipment plus the installation cost of all new equipment should be included.