NATURAL RESOURCES CONSERVATION SERVICE

CONSERVATION PRACTICE STANDARD

PUMPING PLANT

(No.)

CODE 533

DEFINITION

A facility that delivers water at a designed pressure and flow rate. Includes the required pump(s), associated power unit(s), plumbing, appurtenances, and may include on-site fuel or energy source(s), and protective structures.

PURPOSE

This practice may be applied as a part of a resource management system to achieve one or more of the following:

- Delivery of water for irrigation, watering facilities, wetlands, or fire protection
- Removal of excessive subsurface or surface water
- Provide efficient use of water on irrigated land
- Transfer of animal waste as part of a manure transfer system
- Improvement of energy use efficiency
- Improvement of air quality

CONDITIONS WHERE PRACTICE APPLIES

This practice applies where conservation objectives require the addition of energy to pressurize and transfer water to maintain critical water levels in soils, wetlands, or reservoirs; transfer wastewater; or remove surface runoff or groundwater.

CRITERIA

General Criteria Applicable to All Purposes

Federal, State, and Local Laws. All planned activities shall comply with all federal, state, and local laws and regulations.

Cultural Resources. Ground disturbing activities have the potential to affect significant cultural resources. Complete a cultural resources review prior to ground disturbing activities to assure that existing cultural resources will not be adversely impacted.

Pump requirements. Ensure design flow rate, range of operating heads, and pump type meets the requirements of the application.

Base selection of pump materials on the physical and chemical qualities of the material being pumped and manufacturer's recommendations.

Power units. Select pump power units based on the availability and cost of power, operating conditions, need for automation, and other site specific objectives. Ensure power units match the pump requirements and be capable of operating efficiently and effectively within the planned range of conditions. Size the power unit to meet the horsepower requirements of the pump, including efficiency, service factor, and environmental conditions.

Electric power units may include line power, photovoltaic panels, and wind or water powered turbines.

Ensure electrical wiring meets the requirements of the National Electrical Code.

Variable Frequency Drives. The owner must notify the electric power provider that a Variable Frequency Drive will be installed prior to installation, and be responsible for following requirements of the electric power provider.

Protect the Variable Frequency Drive against overheating.

Ensure the Variable Frequency Drive control panel provides the read out display of flow rate or pressure.

Photovoltaic panels. Size the photovoltaic array based on average data for the location and the time of year pumping occurs, according to manufacturer's recommendations. Ensure the photovoltaic array provides the power necessary to operate the pump at the design flow rate, with the appropriate service factor considering a minimum panel degradation of 10 years. Orient fixed arrays to receive maximum sunlight. Base panel tilt angle on the location latitude and time of year for power requirements. Mount panels securely to resist movement by environmental factors.

Windmills. Size pumping units according to pumping lifts and capacities, as specified by the manufacturer. Base the diameter of the mill on the stroke length and the average wind speed. Proportion towers to the mill diameter, with adequate height for efficient and safe operation.

Water powered pumps (hydraulic rams). Size pumping units according to flow rate, lift, fall, and efficiency. Return bypass water to the stream or storage facility, without erosion or impairment to water quality.

Suction and discharge pipes. To prevent cavitation, design suction and discharge pipes to account for suction lift, net positive suction head, pipe diameter and length, minor losses, temperature, and altitude. Base the size of suction and discharge pipes on hydraulic analysis, operating costs, and compatibility with other system components.

Include appurtenances such as gate valves, check valves, pressure reducing valves, pressure gages, pipe connections, and other protective devices, to meet the requirements of the application.

Install screens, filters, trash racks, or other devices as needed to prevent the intake of sand, gravel, debris, or other objectionable material into the pump. Design intake screens according to applicable Federal and State guidelines, to avoid entrainment or trapping of aquatic organisms.

Include backflow prevention devices according to Federal, State, and Local laws, to prevent contamination of water sources connected to the pumping plant.

Buildings and accessories. Securely mount pumps on a solid foundation such as pilings or concrete. Design foundations to safely support the loads imposed by the pumping plant and appurtenances. Use sheet piling or other measures, as required, to prevent piping beneath the foundation.

Where buildings are necessary to protect the pumping plant, include provisions for adequate ventilation and accessibility for equipment maintenance, repairs, or removal.

Design suction bays or sumps to prevent the introduction of air at the intake.

Ensure the discharge bay or the connection to the distribution system meets all hydraulic and structural requirements.

Design structures and equipment to provide adequate safety features to protect operators, workers, and the public from potential injury. Require drive shaft covers on all exposed rotating shafts.

Additional Criteria Applicable to Providing the Efficient Use of Water on Irrigated Land

Include provisions for the connection of flow and pressure measurement devices in power plant system design.

Additional Criteria Applicable to the Improvement of Energy Use Efficiency

For fossil fuel or electrical grid power sources, ensure pumping plant installations meet or exceed the Nebraska Pumping Plant Performance Criteria. Refer to the NRCS National Engineering Handbook, Part 652, National Irrigation Guide, Table 12-2.

Additional Criteria Applicable to the Improvement of Air Quality

Ensure replacement pumping plants have lower total emissions of oxides of nitrogen and fine particulate matter, compared to the unit being replaced.

For new, replacement, or retrofitted pumping equipment, utilize a non-combustion power source, or cleaner-burning technologies or fuels.

CONSIDERATIONS

When planning this practice, the following should be considered as applicable:

- The removal of surface water by a pumping plant can affect downstream flows or aquifer recharge volumes. Consider potential the long term impacts downstream of the pumping plant.

- If using a pumping plant to remove surface water or ground water flowing into a wetland, consider the potential impacts on existing wetland hydrology.
- The operation and maintenance of a pumping plant can involve the use of fuels and lubricants that when spilled may adversely affect surface or ground water quality. Consider measures to protect the environment from potential spills. In some cases, secondary containment of spilled fuel may be required by Federal and State laws or regulations.
- Pumping plants are often constructed in flood-prone areas or can be subject to other unexpected natural events. Consider how the pumping plant may be protected from extreme natural events and the consequences of damage or failure.
- Include protective sensors to detect low or stopped flow, or pressures that are too high or too low.
- The visual appearance of buildings or structures associated with the pumping plant should be compatible with the surrounding environment.
- When installing new or replacing existing combustion equipment, non-combustion and renewable energy sources, such as solar, wind, and water, should be considered.

PLANS AND SPECIFICATIONS

Ensure plans and specifications for constructing pumping plants are in accordance with this standard and describe the requirements for properly installing the practice to achieve its intended purpose. As a minimum, include the following in the plans and specifications:

- A plan view showing the location of the pumping plant in relationship to other structures or natural features.
- Detail drawings of the pumping plant and appurtenances, such as piping, inlet and outlet connections, mounting, foundations, and other structural components.
- Written specifications that describe the site specific details of installation.

OPERATION AND MAINTENANCE

Prepare an Operation and Maintenance plan specific to the pumping plant being installed for use by the owner and responsible operator. Provide specific instructions for operating and maintaining facilities to ensure the pumping plant functions properly as designed. As a minimum, address the following in the plan:

- Inspection or testing of all pumping plant components and appurtenances.
- Proper start-up and shut-down procedures for the operation of the pumping plant.
- Routine maintenance of all mechanical components (power unit, pump, drive train, etc.) in accordance with the manufacturer's recommendations.
- Procedures to protect the system from damage due to freezing temperatures.
- When applicable, procedures to frequently check the power unit, fuel storage facilities, and fuel lines, for leaks and repair as needed.
- Periodic checks and removal of debris as necessary from trash racks and structures, to assure adequate flow capacity reaching the pumping plant intake.
- Periodic removal of sediment in suction bays, to maintain design capacity and efficiency.
- Inspection and maintenance of anti-siphon devices, if applicable.
- Routine test and inspection of all automated components of the pumping plant, to assure the proper functioning as designed.
- Inspection and maintenance of secondary containment facilities, if applicable.
- Periodic inspection of all safety features, to ensure proper placement and function.
- Prior to retrofitting any electrically powered equipment, electrical service must be disconnected and the absence of stray electrical current verified.

REFERENCES

NRCS National Engineering Handbook,
Part 652, National Irrigation Guide