

**NATURAL RESOURCES CONSERVATION SERVICE
CONSTRUCTION SPECIFICATION**

FOR

PUMPING PLANT

PHOTOVOLTAIC POWER SYSTEM

SCOPE

These construction specifications cover the components and installation of photovoltaic (PV) powered pumping plants.

DESIGN DOCUMENTATION

Design documentation from the contractor or equipment vendor(s) shall be submitted to NRCS for approval no less than 10 working days prior to the planned installation date. This shall consist of a site plan, site specific structural details, wire connection details, site specific computations, operation and maintenance plan, and equipment manufacturer's literature. Equipment manufacturer's literature shall include installation and operating instructions, wiring diagrams, schematics, spare parts lists, warranty documentation, maintenance requirements and any other information that is normally supplied with individual components.

COMPONENT SPECIFICATION

Individual components of this pumping plant shall be selected to perform in accordance with the **System Requirements** noted in this specification. The PV system shall conform to the most recent or currently adopted provisions of the National Electrical Code (NEC).

PV Modules. Modules shall have certification from ANSI, IEC, or be tested and listed by Underwriters Laboratories (UL), or another nationally recognized testing lab. Each module shall be labeled by the manufacturer with rated open-circuit voltage, power voltage, maximum permissible system voltage, power current, short-circuit current, and maximum power. Modules must be assembled with seals capable of remaining watertight over a temperature range of -20°F to +120°F. The modules must be certified to withstand winds of 80 mph, and the impact of one inch diameter hail at terminal velocity (80 mph, per American Society for Testing and Materials, ASTM E1038) without damage. The manufacturer shall warrant each module for a minimum period of ten years against power degradation in excess of 10% of the rated power. Module junction boxes shall be moisture resistant and shall have sufficient space for addition of bypass diodes. Boxes that accept conduit are preferred. Junction boxes should be mounted to the PV module frame and not to the PV module surface.

Mounting Structure. The PV array mount shall be constructed from materials protected from corrosion as suitable for the environment at the site. The mount shall have a tilt angle range of 20° to 60° from horizontal, as a minimum. The mounting structure must be capable of supporting the array under loads caused by 80 mph winds and ice loading of 1 inch thick minimum over all exposed surfaces.

Electronics. Electronic components shall be certified by ANSI, IEC, or UL listed, (or equivalent). PV systems shall be fused as required by NEC. A controller (of the type recommended by the pump manufacturer) that is capable of protecting the pump from common faults, including low water (dry running), overload, and electrical short circuits shall be provided.

Other electronic components specified in the design shall be installed in accordance with manufacturer's recommendations and NEC requirements. Electronic components shall be located in a weatherproof enclosure with strain relief entrances, and mounted at a level for convenient access on the PV array mounting structure.

Wiring. All wire material shall be copper. Module to module wiring shall be in conduit or be rated sunlight and weather resistant (USE, type TC or equivalent). In line splices are not permitted in the module wiring. Module wiring connectors must be crimp ring lugs and wiring terminals or compression terminal blocks. Wire nuts shall not be used. Each wire termination shall be adequately marked to identify the circuit conductor. The marking shall be consistent with the identification included on the wiring diagram.

A DC rated switch or circuit breaker shall be provided as a means for disconnecting the array from the system, per NEC requirements. The disconnecting device shall be located near the system controls and housed in a grounded weatherproof enclosure.

The electrical cable for submersible pumps shall be double insulated and shall be rated for submersible pump service. Portable systems shall employ a mechanical, weatherproof splice to connect the electrical drop cable to the pump motor. The drop cable for permanent systems shall employ a weatherproof splice made with crimp style butt connectors. In either case, the lead connected to the motor shall be factory installed and the lead connected to the drop cable shall be field installed. The splice shall be located above the static water level, or made waterproof.

Pump. Pumps, connectors, and fittings shall conform to all requirements of the design and manufacturer's specifications.

Protective Structures. Fencing, or other protective structures for the PV system, shall be provided to prevent damage by livestock. The enclosure must allow access to all system components for service and maintenance.

CONSTRUCTION AND INSTALLATION SPECIFICATION

All manufacturer's and testing lab installation instructions shall be followed during installation of the PV system and pump. All equipment shall be installed so as not to void manufacturer's warranties. All fasteners and hardware shall be torqued to the manufacturer's specifications. All electrical work shall conform to requirements in the current edition of the National Electrical Code (NEC). All plumbing work shall conform to the requirements of appropriate state and local regulations, and be performed in a workman like manner.

PV Array. The array shall be located as needed to receive the maximum amount of sunlight, with its orientation and tilt angle set as specified in the operation and maintenance plan. When the mounting structure is to be set in concrete, the concrete placement and setting time shall follow Reinforced Concrete Specification (Code 750) before the array is attached. The array shall be disabled until all electrical work has been completed.

Pumps. Pumps, screens, valves, etc. shall be assembled in accordance with the manufacturer's recommendations. Where flexible tubing is used for the discharge pipe inside a well, the pump should be attached to the top of the casing with a rope or cable of adequate strength to pull the pump from the well. Appropriate measures shall be provided to prevent the rope or cable from falling in the well casing.

Electronic Components and Wiring. Electronic components shall be installed in accordance with NEC requirements and manufacturer's recommendations. The negative PV conductor, the array mounting structure, and all other metal components of the system shall be grounded directly to earth. Where pumps are placed inside a well, the electrical drop cable should be fastened to the discharge pipe by wrapping with tape on intervals of ten feet.

TESTING AND ACCEPTANCE

The photovoltaic array and pumping plant shall be tested for proper operation. The test shall document the open circuit voltage, voltage to load, and water output in gallons per minute. For acceptance, the installed system must pump at the design flow rate for a period of no less than one hour, on a bright sunny day, or at any time the solar irradiance is 800 watts/m², or more.

SPECIFIC SYSTEM REQUIREMENTS

Pumping Plant Volume (gpm): _____

Pumping Plant Pressure (psi): _____

Photovoltaic Panel Array

1) Maximum Power (Watts): _____

2) Maximum System Voltage: _____

3) Power Voltage: _____

4) Power Current (Amps): _____

5) Open Circuit Voltage: _____

6) Short Circuit Current (Amps): _____

Voltage/Charging Controller: _____

Back-up Storage (Battery): _____

Additional Site Requirements: _____
