NATURAL RESOURCES CONSERVATION SERVICE

INTERIM CONSERVATION PRACTICE STANDARD

CONNECTICUT

RENEWABLE ENERGY SYSTEM

(No.)

CODE 716

DEFINITION

System to utilize renewable energy resources that meet some or all on-farm energy needs.

PURPOSE

Develop a renewable energy system to off-set non-renewable energy sources as part of a conservation management system.

CONDITIONS WHERE PRACTICE APPLIES

This practice applies to agricultural operations where a feasibility study indicates that on-farm energy needs can be fully or partially met by use of renewable energy sources that include bioenergy, geothermal, hydropower, solar, and wind.

This practice does not apply to:

- anaerobic digesters;
- heat pumps (air-to-air, ground-coupled, or water-source);
- geothermal electric generation systems; and
- production of energy crops.

CRITERIA

General Criteria Applicable to All Purposes

Laws and Regulations. All Federal, state, and local laws, rules, and regulations, including local inland wetland agency regulations, governing the construction and use of this practice as well as setbacks from wells, surface water and property boundaries shall be followed. Planned work shall comply with all federal, state, and local laws and permit conditions and requirements. **The landowner shall obtain all necessary permits prior to construction or any land clearing activities.**

Separation Distances. Separation distances from residences and buildings, property lines, surface water bodies including wetlands, private wells or springs, and/or public wells shall be determined on a case by case basis in consultation with appropriate state or local regulatory agencies.

Proposed renewable energy system must have performed successfully in similar situations and locations as demonstrated by independent, verifiable sources.

Secure written approval from the local electric utility for all grid-connected systems.

Plan, design, and construct renewable energy system facilities and processes to meet all federal, state, and local laws and regulations.

Include a method for disposal and / or utilization of process by-products that will not result in a degradation of environmental resources.

Design renewable energy systems capacity based on available resources, operating conditions, and on-farm energy needs. Evaluate the resource characteristics in terms of how well the renewable resource matches the on-farm needs for annual, seasonal, and daily cycles.

Design renewable energy systems or devices per manufacturer's recommendations; generally-accepted good engineering practices; and/or actual operating experience.

Address safety concerns for each component within the process.

Additional Criteria Applicable to Bioenergy.

Design, operate, and maintain combustion systems according to *CIGR Handbook of Agricultural Engineering, Volume V: Energy and Biomass Engineering* (1999) as appropriate.

Design storage of feedstock, byproducts, or waste materials according to NRCS Conservation Practice Standard, Waste Storage Facility (313) as appropriate.

Additional Criteria Applicable to Geothermal.

Design, operate, and maintain geothermal systems according to *Direct Utilization of Geothermal Energy: A Technical Handbook* (1979) as appropriate.

Additional Criteria Applicable to Hydropower.

Design, operate, and maintain hydropower systems according to *Microhydropower Handbook* (1983) Sections 4 and 5 as appropriate.

Additional Criteria Applicable to Solar Photovoltaic (PV).

PV modules must have as a minimum, a manufacturer's warranty against power degradation in excess of 10% of the rated power for no less than ten years after installation. PV modules shall be listed by Underwriters Laboratories (UL) or another nationally recognized testing laboratory.

Size pump, PV, and battery systems based on peak demand and existing or planned available water storage according to manufacturer's recommendations. Size the PV system to operate the pump at the design flow rate with the appropriate service factor considering a minimum panel degradation of 10 years. Fixed arrays shall be oriented to produce maximum energy during the critical water demand period.

Additional Criteria Applicable to Solar Thermal (Hot Water & Space Heating).

Provide a mechanism to protect the system from freezing.

Additional Criteria Applicable to Windmills.

Size unit according to pumping lift distances and flow capacities as specified by the manufacturer. Base mill diameter on the stroke length and the average wind speed. Size tower in proportion to the mill diameter with adequate height for efficient and safe operation.

Additional Criteria Applicable to Wind Turbines.

All towers (or other structures to which turbines will be mounted) shall be of sufficient height that the sweep of the blades is a minimum of 30 feet above and 100 feet away from any obstacle, or as recommended by the manufacturer.

All lighting shall meet the minimum Federal Aviation Administration regulations.

CONSIDERATIONS

General Considerations Applicable to All Systems

Consider performance of an energy audit prior to investment in a renewable energy system. Renewable energy systems may not provide the fastest payback to an energy investment. An appropriate feasibility review supports the landowner's evaluation. An audit which evaluates energy use for the agricultural operation and actions planned or taken to reduce energy use and improve energy efficiency will generally result in a more appropriately sized renewable energy system. An energy audit provides more flexibility for the landowner and may increase the cost-effectiveness of renewable energy system investments.

To determine feasibility of a renewable energy system, evaluate the following items, as applicable:

- costs, responsibilities, and conditions for a net-metering agreement;
- expected service life of the proposed system;
- project costs, maintenance expenses, and overall economic viability;
- aesthetic concerns;
- ambient noise level of the system; and
- placement In lightning prone areas best practices are to locate the system away from high points in the topography, install lightning rods adjacent to the system, and include lightning surge protection in the system specifications.

The efficiency of any power generating units, type of power utilized, quantity of power produced, quality of buildings or structures, automation features and other accessories installed shall be in keeping with the economic and environmental value of the renewable energy system to accomplish the conservation objectives.

Provide for disposal of components that have reached the end of their planned life.

Provide appropriate backup sources based on the risk associated with the inoperability of the planned renewable energy system, including possible threats to public safety. Backup sources may include the electric utility, stand-alone generating equipment, battery storage or similar provisions.

The design of the power plant and associated housing, if required, shall consider accessibility for equipment, maintenance and repairs, and the need for protecting equipment from the elements (e.g., wind, hail, and lightning) and vandalism.

Sites near or within wetlands may require special design considerations.

Additional Considerations Applicable to Bioenergy.

Refer to American Society of Agricultural and Biological Engineers (ASABE) S593 for general bioenergy terminology. Biomass energy feedstocks may include sources such as crops (both agricultural and silvicultural), crop residues, animal manures, and other organic materials. Biopower generation systems may include biological and thermochemical conversion platforms. Examples include biogas production, thermochemical conversion, and direct combustion such as burning wood chips and/or other waste wood.

Evaluate, as applicable, potential odor concerns on-farm and to adjacent properties.

Additional Considerations Applicable to Solar PV.

When applicable, evaluate the use of solar trackers to improve annual system efficiency. PV Watts, a web-based tool, can be used to evaluate PV system performance.

Evaluate and mitigate any impact on hydrology (runoff, groundwater recharge, etc.) by solar PV placement on sites that were previously non-impervious.

A photovoltaic panel may be partitioned into smaller subpanels with nonpolarizing, white borders to reduce the attractiveness of solar panels to polarotactic insects. Polarotactic insects use polarized light as a behavioral cue and are subject to interpret PV panels as bodies of water.

Additional Considerations Applicable to Solar Thermal.

Where applicable, evaluate the performance and cost/benefit of the use of:

- a solar PV module to power the circulating pump to improve overall system efficiency; and
- evacuated tube collectors instead of flat plate collectors, since the former maintain efficiency over a wider range of ambient temperatures and heating requirements.

Additional Considerations Applicable to Wind Turbine.

Structural elements or mechanisms may be required to reduce wildlife impact on sites frequented by federally listed threatened and endangered species of birds and bats, in known migration pathways, areas where birds and/or bats are highly concentrated, and areas that have landscape features known to attract large numbers of raptors.

Wind speed profiles at the proposed site should be confirmed with anemometer data or by an equally objective and verifiable source for minimum of one year.

PLANS AND SPECIFICATIONS

Plans and specifications for constructing renewable energy systems shall comply with this standard and describe the requirements to properly install the practice to achieve its intended purposes.

Plans and specifications shall include the following in the design report supplied to the owner:

- a site plan;
- objectives for, and anticipated performance of, the proposed system;
- detailed drawings;

- site specific construction specifications for each system which includes manufacturer's and engineer's recommendations for mounting and installing the system components.

To the extent practical, specifications shall conform to NRCS National Engineering Handbook Part 642.

AS-BUILT DRAWINGS

As-built drawings shall be prepared showing all pertinent elements and elevations as actually installed. As-built data and drawings will be provided to the owner/operator, regulatory state agency and participating partners upon construction completion.

OPERATION AND MAINTENANCE

An Operation and Maintenance (O&M) Plan shall be prepared for, reviewed with, and signed by the landowner or operator responsible for the application of this practice.

The plan shall provide specific instruction for operating and maintaining facilities to ensure proper function. All component manufacturers' instructions appropriate for the specific equipment installed at the site shall be attached to the plan upon completion of the job.

The plan shall include the provision to address the following, as a minimum:

- Inspection and testing of all system components and appurtenances;
- Proper start-up procedures for the operation of the system;
- Routine maintenance of all mechanical components;
- Periodic removal of fire hazard material from around the site;
- Routinely test and inspect all automation components of the system to assure they function as designed;
- Periodic inspection of all safety features to ensure they are in place and functional;
- Emergency shutdown procedures;
- Procedures to insure proper training of operators; and
- Specific adjustments to the system appropriate to seasonal and daily changes in the renewable resource and other system operating conditions.

REFERENCES

American Society of Agricultural and Biological Engineers. 2006. Terminology and Definitions for Biomass Production Harvesting and Collection, Storage, Processing Conversion and Utilization. ANSI/ASABE S593 (May 2006). ASABE, St. Joseph, MI.

Anderson, D.N. and J.W. Lund. (eds.) 1979. Direct utilization of geothermal energy: A technical handbook, Spec. Rep. 7, Geothermal Resources Council, Davis, CA.

Kitani, O., T. Jungbluth, R.M. Pearl and D. Ramdani.(eds.) 1999. CIGR handbook of agricultural engineering, Volume V: Energy and biomass engineering. ASAE, St. Joseph, MI: American Society of Agricultural Engineers.

McKinney, J.D., B. Bradley, J. Dodds, T.B. McLaughlin, C.L. Miller, G.L. Sommers, and B.N. Rinehart. 1983. Microhydropower handbook*,* Vols. 1 *& 2*. U.S. Department of Energy, Idaho Falls, ID.

Wright, M. 1998. Nature of geothermal resources. *In* John W. Lund (ed.) Geothermal direct-use engineering and sign guidebook, Geo-Heat Center, Klamath Falls, OR.