ENGINEERING & CONSTRUCTION SVCS PROCEDURE: ECS 20202 902 PV FACILITIES

TITLE: Parallel Operations & Interconnection of Photovoltaic (PV) Facilities

CREATION DATE: May 29, 2002 REVISED DATE: January 4, 2007

POLICY STATEMENT: It is the policy of JEA to support programs which enhance the quality of life, protect the environment, and provide significant value to the City of Jacksonville and the communities we serve. This will establish clearly defined technical and safety standards necessary for a customer's Photovoltaic (PV) system to interconnect with JEA. All interconnections are to comply with the applicable statutes, ordinances, codes, rules, and regulations of all governmental units, bodies, and agencies.

ASSIGNMENT OF RESPONSIBILITY: The Vice President – Engineering and Construction Services, through his/her designee, the Director – Standards & Utility Services is responsible for the maintenance of this procedure. It is the responsibility of the customer requesting the interconnection to provide for the design and installation of an adequate protection and control system to meet the following items:

- The requirements of this procedure
- All applicable electrical and safety standards and codes
- The criteria of all licensing authorities

DEFINITIONS:

- **PHOTOVOLTAIC CELLS** – Semiconductor devices that convert sunlight into direct current (DC) electricity.
- **INVERTER** – Converts direct current (DC) power to alternating current (AC) power.
- **UTILITY INTERACTIVE or GRID CONNECTED** – Electric generating system which operates in parallel with the electric utility.
- **ISLANDING** – A condition in which a portion of a utility network that contains both load and generation remains energized while isolated from the remainder of the utility grid.
- **POWER QUALITY** – The measurement and characteristics of voltage and current with respect to instantaneous and steady state values or fluctuations thereof.
- **RELIABILITY** – The availability of electrical service that has acceptable power quality characteristics.

SCOPE: This procedure includes the minimum engineering, operating, and protective requirements for safe and reliable operation of both JEA's system and the customer's system. These standards provide a uniform policy to be used, but JEA reserves the right to review each interconnection separately for specific needs according to the particular set of conditions and situation involved in each case.

PROCEDURE:

I. Requirements

A. These standards include such items as follow:

1. Personnel safety
2. Protection and Operation
3. Power Quality

B. If an installation fails to meet any requirements herein specified, JEA may disconnect or refuse to connect the installation. JEA reserves the right to alter the requirements herein specified by special agreement if conditions change and a subsequent technical study indicates that the safe and acceptable operation of its distribution system and service to other customers may be compromised.

C. A customer shall not operate photovoltaic electrical generating equipment in parallel with JEA's electric system without the prior written consent of JEA and without full compliance with this procedure.

II. Personnel Safety

A. **General** - The foremost concern is safety. It must be recognized that JEA's electrical system and the customer's electrical system will interact through interconnection of the customer's photovoltaic facility.

1. Adequate protection and safe operational procedures must be achieved by the joint interconnection system. The customer shall be required to furnish, install, repair, operate, and maintain in good order, and be solely responsible for the safe operation of the generation and associated interconnection systems to be operated in parallel with JEA's electrical system.

2. The customer shall permit JEA's employees to enter upon its property at any reasonable time for the purpose of inspecting and/or testing the customer's equipment, facilities, or apparatus. Such inspections shall not relieve the customer from the obligation to maintain the equipment in safe and satisfactory operating condition.

3. JEA's approval of isolating devices used by the customer will be required in order to ensure that such devices will comply with JEA's switching and tagging procedure for safe working clearances.

B. **Disconnect Switch** - A manual disconnecting switch, of the visible load break type, shall be required to provide a separation point between the customer's photovoltaic facility and JEA's electrical system. This switch will be furnished and installed by the customer, in a visible location accessible to JEA personnel at all times. The switch will be installed as close to the meter as practical and be capable of being locked in the open position with a JEA padlock. The switch shall meet all applicable local and national electrical codes for the installed PV system. The switch shall be permanently labeled with three inch high letters clearly stating "JEA P.V. DISCONNECT". If the switch is mounted out of sight of the meter, instructions must be posted at the meter clearly stating the location of the disconnect switch. In the event of a system emergency JEA reserves the right to open the switch thereby isolating the customer's electrical system without prior notice to the customer. Any of the following conditions shall be cause for ***disconnection:***

1. JEA's system emergencies and/or maintenance requirements
2. Hazardous conditions existing on the customer's generating or protective equipment, as determined by JEA
3. Adverse effects of customer's generation to JEA's other electric customers and/or system, as determined by JEA
4. Failure of customer to comply with any existing or future regulations, rules, order, or decisions of any governmental or regulatory authority having jurisdiction over the customer's electric generating equipment or the operation of such equipment.

D. **Responsibility and Liability** - JEA shall be responsible for JEA owned facilities. The customer shall likewise be responsible for the customer's entire system, ensuring adequate safeguards for other customers, JEA personnel and equipment, and for the protection of its own generating system.

The customer shall indemnify and hold JEA harmless from any and all claims, demands, costs, or expenses for loss, damage, or injury to persons or property (including the customer's photovoltaic system and JEA's system) caused by, arising out of, or resulting from:

1. Any act or omission by the customer, or customer's contractors, agents, servants, and employees in connection with the installation or operation of the customer's photovoltaic facility or the operation thereof in connection with JEA's system
2. Any defect in, failure of, or fault related to the customer's photovoltaic facility
3. Customer's negligence or negligence of customer's contractors, agents, servants, and employees
4. Any other event or act that is the result of, or proximately caused by the customer or the customer's facilities

III. Protection and Operation

A. **General** - The protection and operation of the interconnection between the customer's photovoltaic facility and JEA's distribution system depends on the size, type, and location of the facility within JEA's system. It will be the responsibility of the customer to provide all devices necessary to protect the customer's equipment from damage by any abnormal conditions and operations which occur on JEA's system that result in interruptions and restorations of service by JEA's equipment and personnel.

It is the customers' responsibility to protect the photovoltaic facility and associated equipment from the following conditions and events:

1. Overvoltage or undervoltage
2. Overfrequency or underfrequency
3. Overload
4. Short circuits (including ground fault)
5. Open circuits
6. Phase unbalance and reversal
7. Reverse power flow conditions
8. Reclose attempt by JEA
9. Any attempt by the Customer to synchronize with JEA's system

10. Any other injurious electrical conditions that may arise on JEA's system

JEA reserves the right to perform such tests as it deems necessary to ensure safe and efficient protection and operation of the customer's facilities.

B. **Loss of Source -** The customer shall provide approved protective equipment necessary to immediately, completely, and automatically disconnect the photovoltaic system from JEA's system in the event of a fault on JEA's system, a fault of the customer's system, or loss of source on JEA's system. The photovoltaic system shall incorporate an anti-islanding inverter that will cease to energize the utility line in ten cycles or less, unless otherwise specified by JEA. Energization shall remain disabled until continuous normal voltage and frequency have been maintained by the utility for a minimum of 5 minutes, at which time the inverter is allowed to automatically reconnect the photovoltaic system to the utility.

C. **Coordination and Synchronization** - The customer shall be responsible for coordination and synchronization of the customer's equipment with JEA's electrical system, and assumes all responsibility for damage that may occur from improper coordination or synchronization of the photovoltaic facility with JEA's system. Details of synchronization can be found in the Power Quality section of this procedure.

D. **Electrical Characteristics** - Single-phase interconnections with JEA are permitted at power levels up to 15 kW. For power levels exceeding 15 kW, a three-phase balanced interconnection will normally be required. The Customer shall interconnect with JEA at the voltage of the available distribution line of JEA for the locality of the interconnection, and shall utilize one of the standard connections (single-phase or three-phase, wye-delta).

JEA reserves the right to require a separate transformation and/or service for a customer's photovoltaic facility, at the customer's expense. The customer shall bond all neutral(s) of the PV system to the main service panel neutral, and shall install a separate driven ground to 25 ohms or less and bond this ground to the ground located in the main service panel (Not applicable on delta interconnections).

E. **Exceptions** – Photovoltaic facilities having capacity ratings that can perform as follows will require more complex interconnection facilities as deemed necessary by JEA:

1. Produce power in excess of 1/2 of the minimum electrical load requirements of the interconnected distribution circuit
2. Produce power flows approaching or exceeding the thermal capacity of the connected JEA distribution line or transformers
3. Adversely affect the operation of JEA or other customer's voltage, frequency or overcurrent control and protection devices
4. Adversely affect the quality of service to other customers
5. Interconnect at voltage levels greater than distribution voltages

IV. Power Quality

A. General - It is the policy of JEA to allow only those interconnections which can be achieved without reducing the power quality and reliability of service to other customers and to disconnect such interconnections should unforeseen difficulties arise which impair the Power Quality or Reliability.

B. The customer's photovoltaic system must be of sound engineering design and quality workmanship, shall have safe and reliable operating characteristics, shall meet all

applicable codes, and shall be approved by all Governmental authorities having jurisdiction. JEA reserves the right to perform such tests as it deems necessary to ensure the quality of the customer's PV service.

C. The characteristics of the customer's photovoltaic system shall meet the following minimum guidelines in addition to all requirements of the JEA Rules and Regulations:

1. Operate at a power factor > .85 (lagging or leading) when output is > l0% of rating.

2. Operate in the frequency range of 59.3 - 60.5 Hz.

3. Have a total harmonic current distortion less than 5% of the fundamental frequency current at rated inverter output

4. All inverter(s) shall be listed and in compliance with *Underwriters Laboratories* (UL) 1741, *Inverters, Converters, and Controllers for Use in Independent Power Systems.*

5. Photovoltaic modules and panels shall be in compliance with:

   a. *Underwriters Laboratories* (UL) 1703, *Standard for Safety: Flat-Plate Photovoltaic Modules and Panels.*
   b. *IEEE Standard* 1262-1995, *IEEE Recommended Practice for Qualification of Photovoltaic (PV) Modules.*

6. PV system installation shall be completed by a qualified state licensed contractor. In addition, the system shall be in compliance with:

   a. *IEEE Standard* 929-2000, *Recommended Practice for Utility Interface of Photovoltaic Systems.*
   b. *National Electrical Code* (NEC) *Article* 690, *Solar Photovoltaic Systems.*
   c. All other relevant articles of the latest edition of the *National Electrical Code.*
   d. All local building and electrical codes.

V. Metering for Photovoltaic (PV) SYSTEMS

JEA does not require metering of the energy deliveries from the PV system. If the customer desires to meter the system, the meter shall be furnished and installed by the customer.

VI. Cost Responsibility

The customer is required to bear all costs associated with the protective devices, transformers, lines, services, switches, and associated equipment and devices beyond that which would be required to provide normal service to the customer if no interconnection of the customer's photovoltaic system were involved. The costs shall be paid in advance by the customer to JEA for all material and labor that is required. JEA shall supply the customer with a written cost estimate of all its required materials and labor prior to any work being done. JEA shall also provide project timing and feasibility information to the customer.

VII. Implementation

A. **Application for Interconnection** - Formal application for interconnection shall be made by the customer prior to the installation of any photovoltaic related equipment. This application shall be accompanied by, but not limited to, the following:

1. Physical layout drawings, including dimensions
2. All associated equipment specifications and characteristics including, but not limited to, technical parameters, ratings, basic impulse levels, electrical main one-line diagrams, schematic diagrams, system protection, related system interconnection diagrams
3. Power requirements in watts Operating/instruction manuals
4. Proposed metering and disconnect switch locations with a description of the access to be provided to JEA during all hours of the year
5. Electrical system interface drawing to include a one line diagram of the JEA/customer interface, identification of JEA circuits serving the facility, site plan with location of the JEA PV disconnect switch and metering cabinets, and customer disconnect switch.

Any subsequent change in the system must also be submitted to JEA for review and written approval prior to actual modification. The above mentioned review, recommendations and approval by JEA do not relieve the customer from the complete responsibility for the adequate engineering design, construction, and operation of the customer's equipment and for any liability for injuries to property or persons associated with any failure to perform in a proper and safe manner for any reason.

B. **Initial Interconnection** - The customer shall give JEA forty-eight hours notice to provide JEA an opportunity to witness the initial interconnection of the photovoltaic system with JEA's system. At the first opportunity to JEA, the Customer shall demonstrate the operation of the inverter, the interconnecting equipment and it's protective and control schemes.

VIII. Terms of Service

Generation Capability - It shall be the customer's responsibility to inform JEA of any change in their electric generating capability.

SIGNED: /s/ Kris K. Rosenhauer
Director, Standards & Utility Services

EFFECTIVE DATE: JANUARY 4, 2007