BOROUGH OF EPHRATA
TECHNICAL REQUIREMENTS FOR CUSTOMER OWNED GENERATION – Revised December 8, 2014

General – The customer shall be in compliance with all applicable land use, zoning, planning, electric tariff rules and regulations and the applicable tariff classification and rates. The terms and conditions contained herein are in addition to, but do not modify nor negate, the terms of the tariff.

If generation is allowed by the Borough, a net meter and a customer generation meter shall be provided by the Borough for the installation. Customer shall bear responsibility for all equipment, metering equipment, wiring and installation in support of Borough requirements including reimbursement to the Borough of both net meter and customer generation meter costs. Meter locations shall be as approved by the Borough.

Each month the net meter and customer generation output meter shall be read by the Borough. The amount of kWhs to be billed for energy shall be the net amount of energy equal to the energy provided by the Borough minus energy returned to the Borough from the customer owned generation source. Billed energy shall not be less than zero in any month. Excess energy shall be recorded monthly and subject to annual true up as described below. Monthly distribution charges shall be based upon the sum of the net energy provided by the Borough (but not less than zero kWh) and the customer generation output in kWh. Monthly demand charges (if applicable) shall be as recorded by the net meter. All charges shall be determined as provided by ordinance or resolution of the Borough.

Installations in service prior to the date of these Technical Requirements shall not be subject to the requirement of a customer generation meter.

Annual True-up

The Borough shall reimburse customers for excess energy received by the Borough from the customer on an annual basis. The customer shall receive payment for the total excess energy up to the total amount of net energy provided by the Borough to the customer. Reimbursement to the customer shall be at the applicable Base Power Supply Cost in effect at the time of reimbursement or another established rate at the mutual agreement of the customer and the Borough. Installations in service prior to the date of these Technical Requirements that do not have a customer generation meter shall have applicable distribution charges deducted from any credit due to the customer.

I **Purpose** – The purpose of this document (relating to interconnection of on-site customer generation and parallel generation requirements) is to clearly state the terms and conditions that govern the interconnection and operation of on-site customer generation, in order to:

- **A.** establish technical requirements Which will promote the safe and reliable parallel operation of customer generation resources;
- **B.** enhance the reliability of electric service;

C. facilitate the implementation and use of distributed resources technologies;
D. enhance economic efficiency in the production and consumption of electricity and other energy; and
E. promote the use of distributed resources in order to provide electric system benefits during periods of capacity constraint.

II Applicability - Unless otherwise provided, these guidelines apply to all customer generation interconnected and operated in the Borough of Ephrata power delivery system. The interconnection and parallel operation of on-site customer generation operating above 100 kW shall be reviewed on an individual case basis.

III Definitions

A. **Account -** An account is one metered or un-metered rate or service classification which normally has one electric delivery point of service. Each account shall have only one electric service supplier providing full electric supply requirements for that account. A premises may have more than one account.

B. **Company** – Borough of Ephrata (Hereinafter called Borough).

C. **Consumption** – Electricity passing through the electric meter from the Borough's distribution system to the customer.

D. **Customer** – Any adult person, partnership, association, corporation, or other entity: (i) in Whose name a service account is listed, (ii) Who occupies or is the ratepayer for a premises, building, structure, etc., and (iii) Who is primarily responsible for payment of bills. A customer includes anyone taking Delivery Service or combined Electric Supply & Delivery Service from the Borough under one service classification for one account, premises or site. Multiple premises or sites under the same name are considered multiple Customers.

E. **Customer Generator Meter** – Electric Meter measuring how much electricity has been generated by customer owned and operated generation, Customer generation meter shall be paid for by customer, owned and operated by the Borough.

F. **Demand Charge** – Charge for the peak load that is drawn by a customer in any 15 minute period throughout the month as recorded by the Borough net meter. The measurement of demand is kilowatts (kW).

G. **Distribution Charge** - Charge for the use of local wires, transformers, substations, and other equipment used to deliver electricity to end-use consumers from the high voltage transmission lines. Each month, the distribution charge billing determinant shall equal all energy consumed by customer including the sum of energy purchased from the borough and energy supplied by customer generation.

H. **Distribution System** - Parts of the electric power system between the Borough point of power delivery and the consumers' service point of contact including distribution substations; primary distribution feeders; distribution transformers; secondary circuits, including the services to the consumer; and appropriate protective and control devices.

I. **Energy Charge** - a charge based on the electric energy (kWh) consumed. Each month, the energy charge billing determinant shall equal the net amount of energy, consumed by the customer, metered through the net meter. If the amount of energy billed is zero or less there shall be no energy charge. Additional charges including but not limited to customer charge, demand charge, PCA, distribution charge and other charges as adopted by Borough ordinance or resolution shall apply.

J. **On-Site Customer Generation** - An electrical generating unit of less than 100 kW, which may be connected to the Borough electric system. Installations up to and including 100 kW in size shall be allowed. Larger installations shall be evaluated for approval by the Borough on a case by case basis.

K. **Generator Owner** – The owner of the generating system that is interconnected to the Borough electric system.

L. **Grid** – The interconnected arrangement of lines and transformers that make up the Borough electric power system.

M. **IEEE Standard 929** – IEEE Standard entitled *Recommended Practice for Utility Interface of Photovoltaic (PV) Systems*, latest approved revision thereof.

N. **Interconnection** – The physical connection of customer generation to the Borough system in accordance with these guidelines so that parallel operation can occur.

O. **Interconnection Application** - The standard form of application or letter which must be submitted by the Generation Owner to the Borough for permission to interconnect with the Borough system.

P. **Inverter** – A static power converter with control, protection and filtering functions that converts Direct Current input to Alternating Current output. Inverters must be of the non-islanding type.

Q. **Island** – A portion of the utility system which contains both load and distributed generation and is isolated from the remainder of the utility system.

R. **Net Meter** – Electric meter capable of measuring the difference between the energy supplied by an electric utility and the energy generated by a customer-generator when any portion of the energy generated by the alternative energy generating system is used to offset part or all of the customer-generator's requirements for electricity. Net meter shall be paid for by customer, owned and operated by the Borough.

S. **Parallel Operation** – Any electrical connection between the Borough system and the Generator Owner's generating source.

T. **Point of Common Coupling** – The point where the electrical conductors of the Borough system are connected to the Customer's conductors and where any transfer of electric power between the Generator Owner and the Borough electric system takes place.

U. **Pre-Approved Equipment** – Specific generating and protective equipment system or systems that have been approved by the Borough as meeting the applicable parts of this document.

V. **Pre-Interconnection Study** – A study or studies which may be undertaken by the Borough in response to its receipt of a completed application for parallel operation with the Borough's system submitted on the Interconnected Application form prescribed by these guidelines. Pre-Interconnection Studies may include, but are not limited to service studies, coordination studies and facilities impact studies.

W. **Qualifying Facility (QF)** – An electric generation facility which is a qualifying facility under Subpart B, Section 201 of the Federal Energy Regulatory Commission's regulations per the Public Utility Regulatory Policies Act of 1978.

X. **Stabilized – The** Borough's system following a disturbance which returns to the normal range of voltage and frequency for at least 5 minutes or longer as coordinated with the Borough. The Borough may require a longer period upon a reasonable showing that the reconnection after 5 minutes will adversely affect the safety and reliability of the electric system.

Y. **Unit** – A distributed generation facility.

Z. **Utility System or Electric Distribution Facility** – Borough's distribution system operating to which the generation equipment is interconnected.

IV **Interconnection Application** – A proposed Generator Owner will make a formal application to the Borough for the interconnection of a generator to the Borough system. The customer shall submit documentation to the Borough stating the technical aspects of the installation, two clean copies of equipment catalog cuts and two copies of a one line diagram of the proposed installation and interconnection to the Borough system, accompanied by written representation by the customer that the installation will

be constructed and operated in full compliance with the Borough standards and requirements shall be included. For inverted installations, a statement that the inverter for the project is of the non-islanding type to prevent back feeds shall also be included.

V. Designation of Borough Contact Persons for Matters Relating to Distributed Generation Interconnection – The Borough Electric Division Superintendent will be the designated point of contact for all matters related to interconnected generation. The Borough Electric Division will maintain records concerning applications received for interconnection and parallel operation of distributed generation. Such records will include the date of receipt of each such application, documents generated in the course of processing such applications, correspondence regarding such applications and the final disposition of such application.

VI. Pre-Interconnection Studies – The Borough reserves the right to conduct a service study, coordination study, or facilities impact study prior to approval of a distributed generation unit. In instances where such studies are deemed necessary, the scope of such studies shall be based on the characteristics of the particular distributed generation unit to be interconnected and the proposed point of interconnection.

A) **Completion of Pre-interconnection Study** – Upon completion of the interconnection study, the Borough will notify the Generator Owner that the application has been approved or indicate in sufficient detail why the application cannot be approved.

B) **Pre-interconnection Study Fee** – The Borough will do a pre-interconnection study without charge up to the typical and customary cost that the Borough would expend for study work of similar type of customer interconnection. If the cost to the Borough is expected to exceed this typical and customary amount, or if multiple submittals by the Generator Owner are necessary, the Borough will advise the Generator Owner of the expected cost of such study work by the Borough before such work begins. The Generator Owner will be responsible for payment of all costs above the typical and customary amount.

VII Interconnection of Distributed Generation – Where generation is capable of exporting power to Borough system, the interconnection study may result in more stringent interconnection requirements.

VIII Pre-approval of Generation units, Devices and Systems – Upon approval by the Borough that certain generating unit's protective devices and/or system(s) meet the standards set out in these guidelines, such approval shall be made available to the appropriate manufacturer upon written request. For subsequent applications using some or all of the identical generating unit's protective devices and/or systems, the applicant may submit a copy of the approval with the application as proof that its equipment has already been approved for use on the Borough's system. Use of pre-approved equipment will not eliminate any applicable requirement for a pre-interconnection study to determine the suitability of the equipment for each application, given the unique

arrangements and characteristics of both the Generator Owner and Borough systems at the point of the interconnection.

IX Connection Approval – The Generator Owner can connect their generation to the Borough system only after the Interconnection Application has been approved and the Generation Owner has received approval notification.

X Interconnected Generation Site Warning Label – The Generator Owner will install a warning label in a conspicuous place on their electric meter or meter box to notify Borough personnel that there is a generator source installed on the load side of the meter. The warning label shall not be placed in a location that would interfere with the ability of Borough personnel to read the electric meter. The warning label must be placed before the generation can be interconnected.

XI Disconnection and Reconnection. – The Borough may disconnect a service with a distributed generation unit under the following conditions:

A. **Application Termination** – Upon termination of the approved Interconnection Application

B. **Non Compliance** – For non-compliance with the technical guidelines specified in this document or other requirement contained in the applicable Customer Tariff, provided that the Borough has given notice to the Generator Owner and provided the Generator Owner reasonable time (consistent with the condition) to correct such non-compliance. The Borough will reconnect the service only upon receipt of certification from the Generator Owner and verification by the Borough that the unit is in compliance.

C. **In Case of a system emergency or outage of the Borough Electrical Sources** – The Generator Owner's generation equipment must be installed and configured so that parallel operation must automatically cease immediately and automatically during outages or loss of the Borough electric source in accordance with these guidelines. The Generation Owner must also cease parallel operation upon notification by the Borough of a system emergency, abnormal condition or in cases where such operation is determined to be unsafe, interferes with the supply of service to other customers or interferes with the Borough's system maintenance or operation. In addition, the Borough may disconnect the generator from the Borough system for system emergencies without notice.

D. **For Routine Maintenance and Repairs** – The Borough may disconnect a Customer/Generation Owner for routine maintenance and repairs on the Borough system.

The Borough will reconnect the Customer/Generation Owner as quickly as possible following any such service interruption.

XII **Termination** – The Generation Owner may terminate the approved Interconnection Application upon thirty (30) days written notice to the Borough. The Borough may terminate the Interconnection Application for cause. The Generator Owner must give the Borough notice that it intends to permanently shut down his generation.

XIII **Privileged Communications Concerning Proposed Distributed Generation Projects** – In the course of processing applications for parallel operation and in the conduct of pre-interconnection studies, the Generation Owner shall provide the Borough with detailed information concerning the proposed distributed generation project and note as privileged, on each applicable sheet and information considered privileged. If any submitted information is requested by a third party, notice shall be given by the Borough to the Generator Owner. It shall be the responsibility of the generation owner to legally challenge the release of this information.

XIV **Technical Guidelines for Parallel Operation of On-site Distributed Generation Units** – This subsection describes minimum requirements and procedures for safe and effective connection and operation of distributed generation. A Generator Owner may operate 60 Hertz, three phase or single phase generating equipment, Whether a QF or non-QF, in parallel with the Borough's system pursuant to an approved Interconnection application provided that the equipment and Generator Owner meet or exceed the requirements of these guidelines and that the Borough has approved the Generator Owner's application to interconnect. This subsection describes typical interconnection requirements. Certain specific interconnection locations and conditions may require the installations of additional protective settings or hardware, especially when exporting power to the system. If the Borough, in the Borough's sole opinion, concludes that an application for parallel operation requires additional protective settings or hardware, the Borough shall make those requirements known after all pertinent studies are completed.

Approval to connect to the Borough system indicates only that the minimum Borough electrical requirements for a safe proper interconnection have been satisfied. Such approval does not imply that the Generator Owner's facility meets all land use, zoning, planning or federal, state and local standards or regulations.

A) General Interconnection and Protection Requirements.

1) The Generator Owner's generation and interconnection installation must meet all Borough land use, zoning, planning and applicable national, state, and local construction and safety codes.

2) The Generator Owner's generator shall be equipped with protective hardware and software designed to prevent the generator from energizing the Borough's de-energized circuits. The Generator Owner's generator must automatically disconnect from the Borough's system if the Grid source is lost, irrespectively of connect loads or other generators.

3) The generator shall be equipped with the necessary protective hardware and software designed to prevent sustained parallel operation of the generating equipment with the Borough system unless the system service voltage and frequency are within acceptable magnitudes.

4) Pre-approved equipment for the project site, approved by the Borough, shall be accepted as part of an interconnection proposal without the need to re-review the equipment itself. However, the application, design and setting of pre-approved units and/or equipment must be reviewed and coordinated according to the unique needs of the specific location of the proposed installation.

5) The Generator Owner will be responsible for protecting its own generating and interconnection equipment in such a manner so that Borough system outages, short circuits, single phasing conditions or other disturbances including zero sequence currents and ferroresonant over-voltages do not damage the Generator Owner's generating equipment. The protective equipment shall also prevent excessive or unnecessary tripping that would adversely affect the Borough's service reliability to other Generator Owners and Customers.

6) The generator and interface protection schemes shall be continuously monitored and functioning and the generator shall immediately disconnect from the Borough's system for any condition that would make the protection scheme inoperable.

7) The operating power required for the protection and control schemes for the generator and the control power used to disconnect the generator from the Borough must not be dependent on local Borough power.

8) Where multiple generators are connected to the system through a single point of common coupling, the sum of the ratings of the generators will be used to determine the applicability of these guidelines. Protection scheme performance with one or more units off line will have to be considered.

9) Applicable circuit breakers or other interrupting devices at the Generator Owner's facility must be capable of interrupting the maximum available fault current at the site, including any contribution from the Owner's generator(s).

10) The Generator Owner will furnish and install a manual disconnect device Which, When opened, will have the effect of isolating the generator from the Borough's system. The disconnect device shall have a visual break (a disconnect switch, a draw-out breaker, fuse block, etc. as appropriate to the voltage level), and shall be accessible to the Borough's personnel, and shall be capable of being locked in the open position via a Borough padlock. The Borough shall use reasonable efforts to utilize padlocks of a size consistent with typical manufacture's specifications. The Generator

Owner shall follow the Borough's switching, clearance and tagging procedures.

11) The design, procurement, installation, and maintenance of the equipment at the Generator Owner's site is the responsibility of the Generator Owner and at the Generator Owner's expense. Customer shall provide and install Borough approved meter bases for both Borough Net meter and Borough customer generation meter. Customer shall reimburse Borough for cost of customer generation net meter.

12) Any necessary enhancements or improvements needed within the Borough's system and/or at the Customer sites to accommodate the parallel interconnection of the Generator Owner's generation will be at the Generator Owner's expense.

13) The Generator Owner has full responsibility and liability for the safe and proper operation of their equipment and the power originating from their generator. The Generator Owner is also responsible for synchronizing their generator(s) with the Borough's system and maintaining a synchronous operation.

14) The Generator Owner must immediately cease parallel operation upon notification by the Borough if such operation is determined to be unsafe, interferes with the supply of service to other customers, or interferes with the Borough's system maintenance or operation.

15) The Borough reserves the right to specify the type of transformer connection (e.g. delta-delta, wye-delta, wye-wye) that will be employed for all multiphase interface transformers consistent, Where reasonable, with the Generator Owner's power system.

B) Prevention of Generator Owner Generation Interference with the Borough System. To eliminate undesirable interference caused by operation of the Generator Owner's generating equipment, the Generator Owner's generator shall meet the following criteria:

1) Voltage – The generating equipment will be operated in such a manner that the voltage levels on the Borough's system are in the same range as if the generating equipment were not connected to the Borough's system. The Generator Owner shall provide an automatic method of initiating a disconnect sequence of his generating equipment from the Borough system with set points noted in the table below.

Generating Systems with Inverters Up to 25 kW	Generating Systems with Inverters Greater than 25 kW	Non-Inverter or Rotating Machine Generating Systems
• Trip in 0.1 second for V<50% • Trip in 2 second for 50%≤V<88% • Trip in 2 seconds for 106%<V<137% • Trip in 0.03 second for 137%≤V (Above times and voltages taken directly from IEEE 929)	• Trip in 0.1 Second for V <50% • Trip within 0.1 to 30 seconds for 50%≤V<88% • Trip within 0.1 to 30 seconds for 106%<V<137% • Trip in 0.03 second for 137%≤V (Specific voltage and time delay set points will be determined for each installation.)	• Trip in 0.1 second for V≥115% • Trip within 0.1 to 30 seconds for V>110% or V<90% (Specific voltage and time delay set points will be determined for each installation.)

Note: Trip time refers to the time between when the abnormal voltage condition occurs and the generator being disconnected from the Borough system.

On three phase generator installations, full three phase voltage sensing shall be employed. Voltages must be sensed on the high side of any interface transformer if the transformer high voltage winding is ungrounded.

The Generator Owner may reconnect to the grid when the system voltage returns to normal range and is stabilized as defined in Section III, Definitions.

2) **Flicker** – The Generator equipment or operation of equipment shall not cause voltage flicker on the Borough's system or to any other Borough customer. This flicker shall not exceed the "Borderline of Irritation" curve, as defined in IEEE Std 519-1992, *Recommended Practices and Requirements for Harmonic Control in Electric Power Systems*. Lower levels of flicker may be required in areas where equipment such as computers and instrumentation are impacted.

3) **Frequency** – The operating frequency of the generating equipment shall not deviate more than the values noted in the table below.

Generating Systems with Inverters Up to 25 kW	Generating Systems with Inverters Greater than 25 kW	Non-Inverter or Rotating Machine Generating Systems
• Trip in 0.1 second for F<59.3 Hz • Trip in 0.1 second for F>60.5 Hz. (Set points taken from IEEE 929)	• Trip in 0.1 second for F<59.3 Hz • Trip in 0.1 second for F>60.5 Hz. (Other frequency and time delay set points may be necessary for a specific installation.)	• Trip in 0.1 second for F<59.3 Hz • Trip in 0.1 second for F>60.5 Hz. (Other frequency and time delay set points may be necessary for a specific installation.)

Note: Trip time refers to the time between when the abnormal frequency condition occurs and the generator being disconnected from Borough.

The Generator Owner may reconnect when the system frequency returns to normal range and is stabilized as defined in Section III, Definitions.

4) **Harmonics** – Non-linear circuit elements such as inverter can produce harmonics. Per IEEE Std 519, *Recommended Practices and Requirements for Harmonic Control in Electric Power Systems*, the total harmonic distortion (THD) voltage shall not exceed 5% of the fundamental 60 Hz frequency nor 3% of the fundamental for any individual harmonic as measured at the location Where the customer interfaces with the Borough's system (Point of Common Coupling). In addition, the level of harmonic current that the customer is allowed to inject into the Borough's system shall not exceed that specified in IEEE Std 519. Furthermore, any communication notch shall be limited as defined by IEEE Std 519. The preceding requirements apply to all types of generation systems.

   The Generator Owner is responsible for the installation of any necessary controls or hardware to limit the voltage and current harmonics generated by his equipment to defined levels.

5) **Power Factor** – The generator must not adversely impact the power factor of the Generator Owner site. Inverters shall be designed to operate close to unity power factor. The operating power factor of the generator shall be contained within the limits defined in the table below.

Generating Systems with Inverters Up to 25 kW	Generating Systems with Inverters Greater than 25 kW	Non-Inverter or Rotating Machine Generating Systems
0.985 Lagging or Leading When output exceeds 10% of inverter rating.	0.985 Lagging or Leading When output exceeds 10% of inverter rating.	0.985 Lagging or Leading

However, to the extent that a Generator Owner's power factor at the Point of Common Coupling falls below 0.985 lagging, the Generator Owner must obtain, install and maintain, at his expense, corrective apparatus that compensates for the drop in power factor caused by the installation of the generator.

6) **Current** – In some cases, directional over-current protection may be required to limit fault current flowing onto the Grid in the event of a line fault. DC inverters that are incapable of producing fault current do not require directional over-current protection.

   Inverter systems shall not inject DC current greater than 0.5% of rated inverter output in the AC interface point under either normal or abnormal conditions.

7) **Fault and Line Clearing** – The Generator Owner shall automatically disconnect from the Borough's system during electrical faults on the Borough's electrical system and upon loss of the Borough's electric source. The Generator Owner may reconnect when the system voltage and frequency return to normal range and is stabilized as defined in Section III, Definitions. Detection of the loss of the Borough's primary electric system, Where the Generator Owner is operating in an island with other customer load, becomes increasingly difficult as the level of dispersed generation on a feeder approaches the connected load. For generating units 25 kW and below, the over/under voltage and over/under frequency settings described previously along with the anti-islanding provisions of IEEE 929/UL 1746 inverters, shall be sufficient to satisfy this provision. For units greater than 25 kW the voltage and frequency set-points are to be adjustable, with the actual setting determined by the Borough based on the electrical characteristics of the generator and the Borough's electrical system. In addition, additional protection such as power directional or directional over current functions may be required. For units 500 kW or larger, a direct tripping scheme to trip the generator upon loss of the Borough feeder may be required by the Borough. This decision will be based on the saturation of distributed generation on a particular feeder circuit and in those cases where under voltage or under frequency sensing may not adequately detect loss of the Borough source.

8) **Automatic Reclosing** – The Generator Owner is responsible for protecting his equipment from the effects of switching or automatic reclosing of the Borough's feeder circuit.

C) Control, Protection and Safety Equipment Requirements Specific to Generators of 25 kW[1] or less.

All Generator Owners 10 kW or less can be single phase. Customer owned generators greater than 10 kW must be evaluated by the Borough to determine if it can be single phase. The following table describes necessary control, protection and

safety equipment specific to generator of 25 kW or less connected to Secondary or Primary Voltage Systems:

Control, Protection and Safety Equipment for Generators of 25 kW[1] or Less Connected to Secondary or Primary System

Generator Size 25 kW or less

Generator Disconnect Device
Over-Current Trip
Over-Voltage Trip
Under Voltage Trip
Over/Under Frequency Trip
Synchronizing Check[2] **Manual or Automatic**

Notes:
1. Exporting to the Borough system many require additional operational/protection devices.
2. For synchronous and other type of generators with stand-alone capability.

D) Control, Protection and Safety Requirement Specific to Three Phase Synchronous Generators, Induction Generators, and Inverter Systems.

Generators greater than 25 kW must be three phase machines connected to three phase circuits.

1) **Three Phase Synchronous Generators.** Generator circuit breakers shall be three phase devices with electronic or electromechanical control. The Generation Owner is solely responsible for properly synchronizing his generator with the Borough's system. For a synchronous generator, the excitation system response ratio shall not be less than 0.5 (five-tenth). The generator's excitation system(s) shall confirm, as near as reasonably achievable, to the field voltage vs. time criteria specified in American National Standards Institute Standard C50.13-1989 in order to permit adequate field forcing during transient conditions.

2) **Three Phase Induction Generators and Inverter Systems.** Induction generation may be connected and brought up to synchronous speed (as an induction motor) if it can be demonstrated that the initial voltage drop measured on the Borough's side at the point of common coupling is within the visible flicker limits stated in Section XIV.B.2. Otherwise, the Generator Owner may be required to install hardware or other techniques to bring voltage fluctuations to acceptable levels. Line-commutated inverters do not require synchronizing equipment. Self-commutated inverters whether of the utility-interactive type or stand-alone type shall be used in parallel with the Borough system only with synchronizing equipment.

Control, Protection and Safety Equipment[1] Less than 1 MW Three Phase Connected to Primary System

Generator Disconnect Device[2]
Over-Voltage Trip
Under Voltage Trip
Over-Current Trip
Over/Under Frequency Trip
Ground Over-Voltage Trip[3]
OR
Ground Over-Current Trip[3]
Synchronizing Check[4] **Manual or Automatic**
Power Direction[5]
Transfer Trip/Reclose Blocking[6]

Notes:
1. Exporting to the Borough's system may require additional operating/protection devices and will require coordination of operations with the Borough.
2. For installations of 25 kW or less, the Generation Owner may elect to have the meter act as the disconnect device with the approval of the Borough.
3. Selection depends on grounding system, if required, by the Borough.
4. For synchronous and other types of generators with stand-alone capability.
5. Required only if generator size is greater than Generator Owner's minimum load and thus capable of exporting. The relay will operate if the power flow from the generator into the Grid exceeds a predetermined level. A time delay will have to be incorporated into this relay to prevent it from operating during synchronous swings.
6. May be required as part of any necessary transfer tripping/reclose blocking protection scheme.

E) Requirements Specific to Generators paralleling for 0.1 second or less (Closed Transition Switching)

The table below shows the protective functions required by this requirement for generators less than 1 MW which parallel with the Borough's system for 0.1 second or less such as during source or load transfers.

Control, Protection and Safety Equipment
Generators Connected to Secondary or primary System Voltage

For 0.1 Second or Less
(Closed Transition Switching)

Generator Size
Up to 1 MW

Over-Voltage Trip
Under Voltage Trip
Synchronizing Check[1] **Manual or Automatic**
Excessive Closed Time Trip[2]

Notes:
1. For synchronous and other types of generators with stand-alone capability.
2. Scheme will trip generator if closed transition parallel mode remains in effect longer than 0.1 second.

F) **Inverter Type** – DC Generation installations using inverters for interconnection with the Borough must use non-islanding type inverters as defined in IEEE 929, *IEEE Recommended Practices for Utility Interface of Photovoltaic (PV) Systems* (including Annex B, D, E & G) and UL Subject 1741, May 1999, *Standard for Static Inverters and Charge Controllers for use in Photovoltaic Power Systems.*

G) **Inspection and Start-Up Testing** – the Generator Owner shall provide the Borough with reasonable prior notice at least 3 weeks before the initial energizing and start-up testing of the Generator Owner's generating equipment and the Borough, at its discretion, shall witness the testing of any equipment and protective systems associated with the interconnection. The Generator Owner shall revise and re-submit the application information for any proposed modification that may affect the safe and reliable operation of the Borough's system. The generator may be reconnected to the Borough's system only after the modified application has been reviewed, testing has been confirmed and the Borough has given approval to reconnect.

H) **Site Testing and Commissioning** – Testing of protection systems shall include procedures to functionally test all protective elements of the installation up to and including tripping of the generator and interconnection point. Testing and testing intervals shall be in accordance with manufacturers' and industry recommendations. Testing will verify all protective set points and relay/breaker trip timing. The Borough may witness the testing of installed switchgear, protection systems, and generator. The Generator Owner is responsible for all maintenance of the generator, control and protective equipment. The Generator Owner will maintain records of such maintenance activities which the Borough may review at reasonable times. For generation systems greater than 500 kW, a log of generator operations may be required in order to determine its output and run times for system planning purposes.

I) **Metering** – Metering requirements will be reviewed on each specific installation.

J) **Dedicated Transformer** – A dedicated transformer will be required Where the Generator facility is served from the same transformer secondary as another Borough customer and inverter-based technology not meeting IEEE 929-1999 and IEEE 519-1992 specifications is used. In addition, a dedicated transformer or other current-limiting device is needed for any type of generator installation where the increase in available short circuit current could adversely impact other Borough customers on the same secondary circuit.

K) Suggested References

The following references can supply technical support and insight into the safe, reliable interconnection of distributed generation with the Borough electric system. These references shall be reviewed by those individuals or firms contemplating parallel operation of generation with the Borough.

IEEE C37.95-1989 – *IEEE Guide for Protective Relaying of Utility-Consumer Interconnections*

IEEE Std 1001(1988) – *IEEE Guide for Interfacing Dispersed Storage and Generation Facilities with Electric Utility Systems*

IEEE Std 929 – *IEEE Recommended Practices for Utility Interface of Photovoltaic (PV) Systems*

IEEE Std 1021 (1988) – *IEEE Recommended Practices for Utility Interconnection of Small Wind Energy Conversion Systems*

IEEE Std 519 -1992 – *IEEE Recommended Practices and Requirements for Harmonic Control In Electrical Power Systems*

L) Applicable Standards

All installations, and specifically generation installations, shall meet all requirements, including but not limited to safety and performance, of the current edition of the National Electrical Code, applicable Institute of Electrical and Electronic Engineers' (IEEE) standards, Underwriters Laboratories and the Borough's specific requirements.