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INTRODUCTION - This handbook has been compiled by the Consolidated Edison Company of New York, Inc. (Con Edison) to serve as a guideline for small and independent power producers with a capacity up to 20 MW for interconnecting their generation with the Con Edison Electrical Distribution System. The handbook contains information concerning the interconnection and operating process from the planning stages through the generation system’s operating life. This guide facilitates the requirements of the New York State Standardized Interconnection Requirements (SIR) for generators of 2 MW or less\(^1\). It also covers generating units larger than 2 MW and up to 20 MW. The information found herein is intended for both new installations of generating equipment and for cases where existing systems are being upgraded or modified. Because some systems can have specific requirements not outlined in the SIR, Con Edison will supplement, on an individual basis, the requirements of this handbook per the allowances of the SIR and needs of the customer. Throughout this handbook the Consolidated Edison Company will be referred to as the Company and the owner or operator of on-site generation or the small independent power producer will be referred to as the Customer. This document is for generating equipment connected only at the distribution system and customer facility levels. Requirements for dispersed generation installations connected to the Company transmission system are covered in a separate handbook. This document does not cover emergency generation equipment that is not at any time operated in parallel with the Company power system.

This specification may not apply to interconnections made to the system for generation that intends to make wholesale sales. For such interconnection, customer and the Company may have to comply with the requirements set forth in NEW YORK ISO Open Access Transmission Tariff (“OATT”), attachment Z.

The provisions of this handbook are applicable to the following forms of generation:

1.1 **Net Metered Generation Sources** (“Net Metered Class”):
Residential customers using solar electric power generation

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\(^1\) The currently applicable SIR is available on the Consolidated Edison website as an addendum to the Company’s schedule for electricity, P.S.C No. 9 Electricity.
equipment (Single Phase, 600 V or Less) with a rated capacity of 10 kW or less, wind power generators or Farm power generators up to 25 kW or less located at the customer’s primary residence and non-residential customers having farm waste generating equipment with a rated capacity of not more than 400 kW or Farm wind power generators up to 125 kW that are connected to the company distribution system.

The generating equipment must be designed, installed, interconnected, tested, and operated in accordance with applicable government, industry, and company standards. Solar electric, farm waste generators and wind power generators within the rating limits specified above, connected in parallel with the distribution system and net metered, must comply with the standards contained in the New York State Standardized Interconnection Requirements and Application Process (“SIR”) adopted by the Public Service Commission in effect at the time of application for service. The SIR is set out in Addendum-SIR to the Company’s Schedule for Electricity Service (the “Full-service Tariff”), P.S.C. No. 9 – Electricity.

Tariff provisions governing net-metered electric generators in this class are contained in Rider R – Net Metering for Customer-Generators. Note that the Company reserves the right to exclude a power producing facility from connection to the Company’s secondary network systems when the Company deems it necessary to protect its system, facilities, or other customers.

1.2 New York SIR Dispersed Generation 2 MW or Less (“2MW and Under Class”)

Customers with private generation facilities with a total nameplate rating of 2 MW or less and connected in parallel with the distribution system must comply with the SIR in effect at the time of application. The SIR includes information about applying for service, and about design, interconnection, installation, testing and operating requirements. Tariff provisions regarding use of on-site generation are contained in General Rule III-13 (D) (E) and (F) of the Full-service Tariff. Provisions regarding interconnection of these types of generators for standby service are contained in Service Classification (SC) 14-RA – Standby Service of the Retail Access Rate Schedule, P.S.C. No. 2 – Retail Access (the “Retail Access Schedule”). Provisions regarding interconnection of these types of generators for buyback service are contained in Service
Classification 11 of the Full Service Tariff.

1.3 Dispersed Generation Larger than 2 MW and up to 20 MW ("Over 2MW Class")

Customers with private generation facilities with a total nameplate rating greater than 2 MW (note: the upper limit of capacity typically allowed is 10 MW on a distribution feeder and 20 MW on a network), and are connected in parallel with the distribution system must comply with the requirements set forth in this manual. This manual includes information about applying for service, and about design, interconnection, installation, testing and operating requirements. Tariff provisions regarding use of on-site generation are contained in General Rule III-13 (D) (E) and (F) of the Full-service Tariff. Tariff provisions regarding interconnection of these types of generators for standby service are contained in Service Classification No. 14-RA – Standby Service of the Retail Access Schedule. Provisions regarding interconnection of these types of generators for buyback service are contained in Service Classification 11 of the Full Service Tariff.

All generating interfacing equipment in the three classes above must be designed, installed, interconnected, tested, and operated in accordance with applicable government, industry, and company standards. Any generation interfacing equipment interconnected to the system and falling within the Net Metered or 2 MW and Under Classes must comply with the process and standards contained in the SIR. The SIR does not apply to units larger than 2 MW.

Applicants planning generation rated at 15 kW or smaller will be required to complete the application form in Appendix B. Applicants planning generation rated between 15 kW and up to 2 MW will be required to complete the application form in Appendix C and the "Addendum to Application for Service" (Form 1 in Appendix A). Applicants planning generation greater than 2 MW up to 20 MW will be required to submit the "Addendum to Application for Service" and Forms 2-6 as applicable to the specific type of generation technology and as described in Appendix (A) – Documentation Requirements.

The information contained herein is general and not intended to cover all details and aspects of a particular case. The Company should be consulted on the current applicability of any item.

Any information contained in this handbook is subject to change without
notice, and customers shall verify current applicability of information through written inquiry to the Company.

2.0 POLICY ON DISPERSED GENERATION - It is the policy of the Company to permit operation of on-site generating equipment in parallel with the Company’s electric system if the required protection requirements are satisfied and the appropriate approvals are obtained. This can be done whenever there is no adverse affect on the Company’s other customers, equipment, or personnel, while maintaining the quality of service.

On-site generation may be operated in parallel with the Company’s system or isolated from the Company system by means of a transfer switch (break-before-make). To maintain reliability of service on the system, generation operated in parallel is subject to equipment and operating requirements not applicable to generation operated in isolation.

All customers planning to connect generation to the system must complete the application and approval process outlined in this document. For net metered generation and generation of 2 MW and under, the process is set out in the SIR. For units larger than 2 MW and up to 5 MW, the Company will follow the SIR timing requirements for the approval process. Per the steps outlined in the SIR (see SIR Application process steps 1-11 later in this manual), Con Edison may identify that a detailed Coordinated Electric System Interconnection Review (CESIR) is required for some generation systems. This may be needed to determine the impact of the customer’s generation on the Company system and any necessary upgrades or changes to the Company system needed to allow for satisfactory interconnection performance. The company will notify the customer regarding the estimated CESIR cost prior to initiating it and will proceed with the study only upon the customer’s agreement to pay the costs as and to the extent required by the SIR. The CESIR may identify specific Company system modifications and the costs of such modifications needed for successful interconnection. The customer is responsible for the cost of any additions and reinforcements to the Company’s distribution systems that are required for the Company to permit parallel operations in accordance with the SIR. Based on the CESIR, the customer will be given a cost estimate of such modifications and must promptly inform the Company of its decision whether to proceed. The specific costs for which the customer is responsible and the timing of payment are described in the Tariff.

2.1 PROTECTION RESPONSIBILITY - The Company is not responsible for protection of the customer’s generator(s), or of any other portion of the customer’s electrical equipment. See Full-service Tariff, General Rule III-14(C) and (D). The customer is
solely responsible for protecting his equipment in such a manner that faults or other disturbances on the Company’s electrical power system do not cause damage to the customer’s equipment. The Company does not warrant the adequacy, safety or other characteristics of any structures, equipment, wires, pipes, appliances or devices owned, installed or maintained by others.

All protection equipment required to protect and coordinate with the Company’s distribution system will be specified by the Company and based upon any needs determined by any applicable CESIR.

3.0 TARIFF PROVISIONS AND INTERCONNECTION COSTS
Customers with onsite generation take standby service under SC 14-RA of the Retail Access Schedule, except for: (1) customers billed under Rider R; (2) customers whose on-site generation equipment has a total nameplate rating equal to no more than 15 percent of the maximum potential on-site demand; and (3) customers who would otherwise take service under SC 1, 2, 7 or the energy-only rate of SC 12. Customers taking delivery service under SC 14-RA may elect to purchase supply from the Company. Certain customers may elect to take service under SC11 – Buy Back Service, whereby power and energy is sold to the Company, to the extent permitted under that SC. A brief description of the applicability of each of the above service classifications is provided below.

3.1 STANDBY SERVICE (SC 14-RA) - Standby service is available to replace and/or supplement the power and energy ordinarily generated by means of a private generating facility on customer premises (except where service is provided under Rider R). Standby Service is also available for station use by a customer that is a wholesale generator. Subject to the provisions of this operating procedure and SC-14-RA, the generator may be operated either in parallel with the Company’s service or isolated from the Company system by means of a double-throw transfer switch. Rate options are as follows:

3.1.1 Exemption from standby service rates and phase-in of standby service rates – Certain customers taking service under SC 14-RA will be billed at their otherwise applicable rate, as described in Special Provision D of SC 14-RA; other customers may be eligible for exemption provided that any prerequisites for such billing are met as described in Special Provision P of SC 14-RA. These customers are still required to pay any applicable interconnection costs, as set forth in the tariff.
Customers exempt from standby rates as specified in SC-14RA including designated technologies such as Fuel Cells, Photovoltaic, etc.

**Designated Technologies** are generators based on renewable energy sources (fuel cell, wind, solar thermal, photovoltaic, biomass, tidal, geothermal, and methane waste), and certain cogeneration technologies (“Combined Heat and Power”) that meet minimum efficiency criteria. (See SC 14-RA, Common Provisions, Definitions, Leaf No. 142, and Special Provision P, Leaf No. 180). Eligible “Combined Heat and Power generators under 1 MW” must have at least 60% overall annual efficiency (combined usable electrical and usable thermal output) and with at least 20% of the heat produced from the electrical generation process recovered for practical use. In addition, each such plant must meet a NOx emission limit for CHP plants of 4.4 lbs/MWh or such other limit established for stationary combustion installations by the State Department of Environmental Conservation.

**3.1.2 NEGOTIATED RATE OPTION** – Certain customers taking service under SC 14-RA may enter into an agreement for standby service at negotiated rates.

**3.2 BUY-BACK SERVICE (SC 11)** – Under SC 11, the Company may purchase capacity and energy from a “Qualifying Facility” which meets the requirements for qualification under Part 292 of Title 18 of the Code of Federal Regulations or as defined in Section 2 of New York Public Service Law (See also SC 11, leaf 307, special provision E for specific details of this service classification). In addition, under Rule III-13F, distributed generators are permitted to export power (1) when the generating equipment is operated at the direction of the NYISO under NYISO SCR procedures or EDRP procedures, or (2) at the direction of the Company under Rider O or U. While these distributed generators are not SC 11 facilities, they are required to comply with the provisions of SC 11.

The amount of purchased power and energy may be limited by the Company, where technical considerations dictate that such actions are necessary. Buy-Back service is not available for secondary network service interconnections.
3.3 OTHER SERVICE CLASSIFICATIONS - There may be situations where the Company’s service must be rendered under more than one service classification. For example, a customer may wish to sell power to the Company under Service Classification No.11 and also require Standby Service from the Company. Buy-back Service and Standby Service must each be contracted for separately and will be metered separately. Alternatively, a customer may choose to segregate a portion of the total service requirements so that such portion is served exclusively under an appropriate firm service classification.

3.4 CUSTOMER INTERCONNECTION COSTS – Customers with generation facilities shall be subject to charges for interconnection costs incurred by the Company and directly related to the installation of the facility deemed necessary by the Company to permit interconnected operations with a customer, as provided in the Retail Access Schedule and the SIR. These costs may include the reasonable costs of connection, initial engineering evaluations, switching, metering, transmission, distribution, safety provisions, engineering and administrative costs.

3.5 PENALTY FOR INTERCONNECTING WITHOUT COMPANY AUTHORIZATION

A Customer who interconnects a distributed generation unit without the Company’s authorization will be: (1) liable and responsible for all damages (including any and all third party damages) and expenses (including all legal fees) that result; (2) responsible for all of the Company’s incurred expenses to ensure the safety and reliability of the electric system caused by the unauthorized interconnection of the Customer’s distributed generation unit; and (3) subject to a contract demand surcharge equal to twice the amount of the charge for Contract Demand that would otherwise be applicable under standby service rates in accordance with General Rule III-13 (D) of the Full Service Tariff.

4.0 THE ELECTRICAL DISTRIBUTION SYSTEM - The distribution system supplies power to the Company’s low voltage network customers and radial customers from area substations at the 4kV, 13kV, 27kV and 33kV primary service voltage levels. The majority of customers receive Low Tension (low voltage) service directly at the distribution system secondary voltage levels of 120/208V; 120/240V or 265/460V, while a small
percentage of High Tension (high voltage) customers receive power at primary service voltage levels. The two major types of distribution systems in Con Edison’s system are the radial and network designs. Radial systems have a single high voltage feeder feeding energy from the substation to numerous distribution transformers tapped along it. The distribution transformers step the voltage down from primary voltage to low voltage service and serve anywhere from 1-16 customers each. Networks have multiple primary feeders feeding several parallel network transformers that feed energy into a low voltage grid (grid network type) or local building bus (spot network) where the customer is connected. Thousands of low voltage customers are served off of each low voltage grid network connection. Almost all customer generation will be connecting to one of these types of distribution systems.

For most interconnections, the voltage level, system configuration, and design requirements of the generator will be dictated by the type of distribution system to which it is connected (network or radial), the customer’s service voltage level, the distributed generation equipment rating and type, and the electrical characteristics of the distribution system connection point and generator. There are many different voltage levels on the system (See Table 1).

From a reliability standpoint, service in each area is categorized by the Company relative to the number of allowable coincidental primary feeder failures without interrupting the customer. These failures are defined as CONTINGENCIES. A FIRST contingency service area is one in which only one incoming feeder can be out of service at a given time. In a SECOND contingency area, two feeders can be out of service coincidentally without affecting service. Therefore, to ensure service, a minimum of two (2) incoming feeders are required for a first contingency area and a minimum of three (3) incoming feeders are required for a second contingency area. The contingency level at the point of generation interconnection will have an influence on the generator design since for the generator impact studies it may be necessary to model system performance in each of the different contingency modes. Network systems will have the highest contingency and are usually the most complex in which to interconnect, while radial systems the lowest contingency and in many cases easier to interconnect with.

5.0 OVERVIEW OF ISSUES RELATED TO INTERCONNECTION

Customer generation connected to the distribution system can cause a variety of system impacts including steady state and transient voltage changes, harmonic distortion, and increased fault current levels.
Generation systems of 2 MW or less, which individually on higher capacity feeders may not cause very serious impacts, can, on weaker circuits, in aggregation or in special cases (such as lightly loaded networks), significantly impact the Company’s distribution system. A CESIR in some cases is needed to identify the severity of system impacts and the upgrades needed to prevent problems. For larger customer generation units in the range of over 2 MW to 20MW, there is generally needed a time for a significant CESIR no matter where on the system the customer is connecting. In general, dispersed generation connected to the distribution system shall be limited to a maximum of 10 MW on a distribution feeder and 20 MW per network substation. This is an upper limit that represents the maximum possible under ideal situations and assumes that at area substations there are no additional limitations as indicated by site-specific system studies (e.g., available short circuit current contributions, minimum network loading in light loading seasons, voltage regulator interactions, etc.)

There are a wide range of issues associated with the interconnection of distributed generation to the power system. Among these are:

- Impact on step voltage regulation equipment
- Increased fault duty on Company circuit breakers
- Interference with the operation of protection systems
- Harmonic distortion contributions
- Voltage flicker
- Ground fault overvoltages
- Islanding
- System restoration
- Power system stability
- System reinforcement
- Metering

It is important to scrutinize the interconnection of customer generation to the power distribution system so that any negative impacts can be avoided and assure that the customer generation will have only a positive or, at least, neutral impact on the system performance. It is the intent of any Company study in accordance with SIR requirements when applicable to avoid negative power system impacts by identifying the particular type of impact that will occur and determining the required equipment upgrades that can be installed to mitigate the issue(s).

Anywhere within the Company’s service territory that the customer plans to interconnect generation, they will be interfacing to one of two main types of distribution systems. These will be either radial systems or network systems. Most of the Company’s customers in the urbanized
boroughs of New York City are fed by low voltage network distribution system designs and some of the suburban areas (especially to the north) are fed by radial distribution system designs. The interface voltage levels will be either low voltage or medium voltage depending on the location on the Company’s system and size of the generator.

Connecting customer generation to the low voltage network poses some issues for the Company. The generation can cause the power flow on network feeders to shift (reverse) causing network protectors within the network grid to trip open. No synchronous generators are permitted for interconnection to the company’s secondary voltage grid networks. Small induction and inverter based generators may be allowed on the secondary voltage grid networks on a case-by-case basis. Connection of generators on the spot networks are only permitted if the secondary bus is energized by more than 50% of the installed network protectors as required by IEEE Std. 1547-2003.

Dispersed generation ranging in size from 5 to 10 MW, and installed on non-network systems should be connected to dedicated radial distribution feeders since the light load condition on the existing feeders may not meet the acceptable norm to avoid islanding (i.e., one third of the feeder’s all time light load be greater than the dispersed generation MW rating).

Because of the severe safety and potential equipment damage issues associated with feeding power into a deenergized distribution system, a major design consideration of any customer generator installation is that THE GENERATOR SHALL NOT ENERGIZE A DEENERGIZED COMPANY CIRCUIT. The protection system shall be designed with interlocks and proper protective functions to ensure that there is proper voltage, frequency and phase angle conditions between the Company’s system before the generator is permitted to parallel.

Because of the potential interference with reclosing on radial and auto-loops feeders and/or restoration operations on the utility system, AUTOMATIC RECLOSING OF THE CUSTOMER’S INTERTIE CIRCUIT BREAKER IS NOT TO BE PERMITTED. The only exceptions that allow a unit to automatically reconnect are certain inverter–based generation systems and small generators 15 kW or less as discussed later in Section I-6.3.

The Company’s distribution substations are subject to fault duty limitations. Adding generation to the distribution system increases the amount of fault current imposed on the substations. The Company will assign a Fault Current Margin (FCM) Queue Position for completed Project Applications associated with synchronous generators in the Load.
Area. FCM is available for allocation in a Load Area until such time as the Available Fault Current is equal to 100% of the rated fault interrupting capability of the circuit breakers at the associated area substation unless engineering, reliability or other pertinent issues preclude the interconnection of additional parallel synchronous distributed generation without mitigation.

No queue will be established for applications for parallel synchronous distributed generation without fault mitigation in Load Areas where the Company has determined that there is no FCM. See Con Edison DG Website (http://m020-w5.coned.com/dg/default.asp) for the procedure details.

Exceeding the fault duties at the substations as a result of dispersed generation will not be permitted and alternate methods of interconnection must be explored where this limit has been reached.

Multiple service facilities may be supplied to the Customer from a multibank transformer installation. These service installations, or takeoffs, may be either cable with limiters or bus detail with fuses. To assure that the reliability and proper protection are maintained in these service facilities, the Customer is not permitted to:

a) Parallel secondary takeoffs from a common facility.
b) Parallel secondary facilities supplied from separate locations.
c) Exceed the ampacity rating of any service facility.
d) Create an unbalanced loading condition in excess of 5% between phases of a service.

6.0 GENERAL DESIGN AND OPERATING REQUIREMENTS – From the perspective of interconnection, there are three main types of customer generation systems that interface to the power system. These include:

- Induction Generators
- Static Power Converters
- Synchronous Generators

Each type has its own specific characteristics regarding synchronization equipment, protective functions, starting practices, and electrical operating behavior. Whether the generation is less than 2 MW and covered under the SIR guidelines or larger than 2 MW and covered under other requirements, there are specific common interface requirements that will always apply. There may also be additional specific requirements that may be identified as part of any CESIR that is performed for a specific location.
These specific requirements are discussed later in this manual (see Sections III, IV and V).

6.1 COMMON PROTECTION REQUIREMENTS
The customer shall provide appropriate protection and control equipment for the generator. The customer’s equipment shall be capable of automatically disconnecting the generation upon detection of an islanding condition and upon detection of a utility system fault.

The generator’s protection and control scheme shall be designed to ensure that the generation remains in operation when the frequency and voltage of the utility system are within the specified limits. Upon request from the Company, the customer shall provide documentation detailing compliance with the specified operating ranges as mandated by the SIR or as dictated by any required CESIR.

The generator will have, as a minimum, an automatic disconnect device(s) sized to meet all applicable local, state, and federal codes and operated by over and under voltage, and over and under frequency protection. For three phase installations, the over and under voltage protection shall be included for each phase and the over and under frequency protection shall be on at least one phase. All phases of the generator or inverter interface shall disconnect or cease export of power when directed by the protective devices. Voltage protection shall be wired according to the type of distribution system ground. The Company will notify the customer on the appropriate sensing arrangement based on the configuration of the Company system at the point of common coupling\(^2\). More detailed discussion of the protection requirements specific to each generator type can be found in Sections III, IV and V.

6.2 RESPONSE TO ABNORMAL VOLTAGE AND FREQUENCY CONDITIONS
The default voltage operating range for generators shall be from 88%-110% of nominal voltage magnitude. The protective device shall automatically initiate a disconnect sequence from the utility system as detailed in IEEE Std.1547 (see Table 1 in that standard). Clearing time is defined as the time the operating range is initially violated until the customer’s generator ceases to energize the PCC

\(^2\) For four wire multi-grounded neutral distribution systems, the phase to neutral (ground) voltage is desired. For ungrounded systems, the phase to phase voltage is desired. The Customer’s interface transformer will also impact the needed arrangement – see SIR document and IEEE 1547-2003 for more details.
(this includes detection time for the relay function, any intentional delay times, and any delays caused by clearing devices such as circuit breaker travel times).

The default frequency operating range for generators shall be from 59.3 Hz to 60.5 Hz. The protective device shall automatically initiate a disconnect sequence from the utility system as detailed in IEEE Std. 1547 (see Table 2 in that standard). Clearing time is defined as the time the operating range is initially violated until the customer’s generator ceases to energize the PCC (this includes detection time for the relay function, any intentional delay times, and any delays caused by clearing devices such as circuit breaker travel times).

IEEE Std. 1547-2003 Tables 1 and 2 provide “default” clearing times. Note that the default times of those settings are for generators of 30 kW or less. Above 30 kW rating, as described in the footnotes of those tables, the times and settings may be altered as needed by the Company to coordinate with power system requirements.

6.3 RECONNECTION AFTER RESTORATION OF NORMAL VOLTAGE AND FREQUENCY CONDITIONS -
For customer DG facilities 15 kW or less, if the generation facility is disconnected as a result of abnormal voltage and/or frequency conditions, then the customer’s generator shall remain disconnected until the Company distribution system voltage and frequency conditions have returned to within acceptable limits for a minimum of five (5) minutes. This reconnect capability does not apply to systems greater than 15 kW rating that do not use an inverter based interface. For systems greater than 15 kW, this automatic reclosing philosophy may suffice and will be determined by the company. If the Company determines that a facility must receive permission to reconnect, then any automatic reclosing functions must be disabled and verified to be disabled during the generation system verification testing.

6.4 CODES, STANDARD AND CERTIFICATIONS - All equipment used by the customer shall be designed, manufactured, installed and tested in accordance with the latest applicable industry standards, including ANSI, IEEE, NEC, NESC, OSHA, UL, NEMA and any applicable local or city rules, regulations or ordinance codes, unless otherwise specified.

Electrical inspections must be performed by the Company and by a
recognized inspection agency, such as the N.Y. Board of Fire Underwriters, the City of New York or local municipality before parallel operation will be permitted.

The interconnection of the customer’s facilities with the Company’s electric distribution system shall also comply with the Company’s applicable criteria, guides and procedures for such interconnections.

The application and design requirements of high tension distributed generation customers are also subject to the provision of Specification EO-2022. Furthermore, the generating facilities that are large enough to fall under the New York Power Pool's (NYPP) and the Northeast Power Coordinating Council's (NPCC) Operating and Planning Guidelines, must be in compliance with those requirements.

In order for inverter equipment to be certified as acceptable for interconnection to the utility system without additional protective devices, the interface equipment must be equipped with the minimum protection functions (outlined later in this manual for each type of interface) and tested in compliance with Underwriter’s Laboratories most current applicable version of UL-1741, “Inverters, Converters and Controllers for Use in Independent Power Systems.”

Equipment rated less than 1000 volts shall be tested in accordance with the Guide on Surge Testing for Equipment Connected to Low Voltage AC Power Circuits, ANSI/IEEE C62.45, to confirm that the surge withstand rating is capability is satisfied for the product’s surge level rating as defined in Recommended Practice on Surge Voltages in Low Voltage AC Power Circuits, ANSI/IEEE C62.41.2

Equipment rated greater than 1000 volts shall be tested in accordance with manufacturer or system integrator’s designated applicable standards. For equipment signal and control circuits use Standard Surge Withstand Capability (SWC) Tests for Protective Relays and Relay Systems, IEEE C37.90.1.

The acceptance criteria for both of these testing protocols shall be as detailed in IEEE C37.90.1. If during the performance of any of the tests prescribed above, the equipment ceases to export power and in the judgment of the independent testing laboratory fails in a safe manner, this will be considered an acceptable result for the purposes of these requirements.
Utility grade relays need not be certified per the requirement of this section, but are covered under other requirements discussed later in this manual.

6.5 **DESIGN CLASSIFICATION** - Interconnected customer generation is classified with respect to the following:

a) Generator rating  
b) Rate classification  
c) Interconnection type

Examples of the various customer generation design classifications are shown in Table 2.

Where multiple generators are connected to the Company's distribution system through a single service point, the appropriate classification will be based on the aggregate ratings of the generators.

It should be understood that these classifications have been established for convenience and design requirements and are based on urban/suburban circuits with normal load density. The final decision concerning the requirements for each installation will be made depending upon the customer load magnitude, the magnitude of other load connected to that circuit/system, the available short circuit contribution and other system parameters.

6.6 **DISCONNECT SWITCH DEVICES** – The customer shall provide a lockable means of isolating its generator(s) from the Company’s distribution system. This disconnect device (or combination of devices) must maintain a visible open working clearance for maintenance or repair as stipulated by the Company’s work rules.

The disconnect switch shall be clearly marked “Generator Disconnect Switch” with permanent 3/8” letters or larger. The disconnect switch shall be located within 10 feet of the utility’s external electric service meter. If such location is not possible, the customer will propose and the Company will approve of an alternate location.

An emergency shutdown switch which would remove the facility generation from the system is recommended to be accessible to Company personnel and located near the disconnect switch. The opening of this switch shall trip the intertie or generator circuit
breaker. Breaker position indication shall be provided at the switch.

For service at 600V or below (Low Tension service), the customer shall furnish and install a lockable manual disconnect switch. The switch shall be installed in the interconnection circuit or in the generator leads to isolate the generator when out of service.

Disconnect switches must be rated for the voltage and current requirements of the particular installation. In addition, the basic insulation level (BIL) of the disconnect switch shall be such that it will coordinate with that of the Company's equipment. Disconnect switching devices shall meet all applicable UL, ANSI, and IEEE standards and shall meet all applicable local, city, state and federal codes.

Disconnect switches must be visible, load break, gang-operated and must be lockable in both the open and closed positions with a standard Company padlock. The disconnect switch must be key interlocked with its associated circuit breaker. The disconnect switch must be lockable in the open position with a standard utility padlock with a 3/8" shank.

For installations above 600V or with a full load output greater than 960A, a draw-out type circuit breaker with the provision for padlocking at the draw-out position can be considered a disconnect switch for the purposes of this requirement.

Customers supplied from the Company's medium voltage (i.e., from 4 kV to 33 kV) distribution system must provide a means of applying grounds on Company feeders. Grounding requirements are detailed in the Company's high-tension specifications.

6.7 GROUNDING - The customer shall utilize a grounding interface to the Company's system that is compatible with and appropriate for the grounding needs of the Company's distribution system. Proper grounding is critical because without a proper grounding approach, dangerous or damaging conditions could arise in the operation of the generator that could cause problems for the distribution system and connected loads. Grounding influences the nature of ground fault overvoltages, harmonics, fault level contributions, and the potential for ferroresonance.

In order to assess the generator's grounding as it appears to the Company's distribution system the generator grounding design
must include details describing the neutral grounding arrangement of the generator and the winding configuration/grounding arrangement of any interface transformers. In cases where the customer wishes to use its existing step-down transformer that has been serving their load as the interface to the Company distribution system, it is important to recognize that an existing transformer that is perfectly suitable for serving load at a site may not always be satisfactory to serve as a generator interface transformer because it may not provide proper grounding with respect to the company distribution system. The installation of a generator at a customer site may necessitate changing out the existing transformer with a new transformer that has appropriate grounding or adding a second transformer that is meant just for the generator.

Another important consideration is that the generator installation, depending on where it ties into the customer's system, will need to provide grounding that complies with all applicable requirements of the National Electrical Safety Code (NESC), National Electric Code (NEC) and the Company. The proper method of generator system grounding to be used with a particular power system interconnection point is unique for each installation. Table 3 indicates the Company's distribution system grounding methods.

6.8 DEDICATED TRANSFORMER – The Company reserves the right to require the customer generating facility to connect to the Company distribution system through a dedicated transformer. The transformer shall either be provided by the Company at the customer's expense, or purchased from the Company by the customer, or purchased from a third party and conform to the Company's specifications. The transformer may be needed to insure conformance with utility safe work practices, to enhance service restoration operations or to prevent detrimental effects to other utility customers. The transformer that is part of the normal electrical service connection of a customer's facility may meet this requirement if there are no other customers supplied from it. A dedicated transformer is not required if the installation is designed and coordinated with the Company to protect the Company distribution system and its customers adequately from potential detrimental net effects caused by the operation of the generator.

If the Company determines the need for a dedicated transformer, it shall notify the customer in writing of the requirements. The notice shall include a description of the specific aspects of the utility system that necessitate the addition, the conditions under which the dedicated transformer is expected to enhance safety or prevent
detrimental effects, and the expected response of a normal, shared transformer installation to such conditions. A CESIR may be necessary in some cases to determine the need for a dedicated transformer.

Cost allocation rules for the dedicated transformer are set forth in the Company's tariff and the SIR.

6.9 LIGHTNING PROTECTION - Underground cables and electrical apparatus supplied from overhead primary circuits, operating at 4kV, 13kV, 27kV and 33kV shall be protected against lightning. The customer shall equip the riser pole and, if necessary to provide proper insulation coordination margins, other points of the cable with a properly rated metal oxide surge arrester. The arrester rating will depend on the specific system voltage level and system grounding arrangement. Methods for selecting appropriate surge arrester ratings and locations can be found in IEEE Standard C62.22-1997. Use of short arrester lead length practices and cable riser pole and end-point (open point) arresters to prevent reflections per the recommendations of IEEE C62.22 are critical to maintain adequate protective margin.

Surge protection at the terminals of the generator windings for all appropriate surge modes is recommended (regardless of whether or not the system is fed by overhead lines). Rotating machines are best protected with a combination of metal oxide surge arresters and wavefront sloping capacitors located at their terminals. Information on the use of sloping capacitors and rotating machine (motor) surge protection that can be applied to distributed generation scale generators can be found in IEEE Standard 141-Electric Power Distribution for Industrial Plants.

It is recommended that inverters have surge protection at their terminals. Photovoltaic system inverters are especially vulnerable to surges due to the exposed dc input leads attached to roof-top or field mounted solar PV modules and connection of the inverter to the ac system. This arrangement can allow large surge potentials to develop between the dc and ac ports during nearby lightning strikes thereby imposing extremely high surge voltages on internal inverter electronics. It is recommended that surge protection for PV inverters take into consideration these potentials and use ground reference equalization of all port surge arresters to mitigate the threat.

All power generation equipment shall meet the applicable surge
voltage withstand and isolation ratings discussed earlier in this manual. Specifically, these include Surge Withstand Capability Test for equipment greater than 1000 V rating (see IEEE C37.90.1) and the Surge Withstand Capability (based on Category) defined in IEEE C62.41.2 and C62.41.45.

6.10 HARMONIC REQUIREMENTS - The maximum total and individual harmonic distortion for voltage and current injected by the customer’s equipment and loads at the point of common coupling (PCC) shall meet IEEE Std.519 and IEEE Std.1547 guidelines. A facility causing harmonic interference is subject to being disconnected from the Company system until the condition has been corrected.

For non-certified equipment installations, the customer is required to measure harmonics before and after the interconnection is established. The customer shall submit the results of these tests to the Company for review. If necessary, the customer will be required to make all corrections to avoid harmonic problems.

6.11 VOLTAGE REGULATION AND VOLTAGE FLICKER
Parallel operation of customer generation has an influence on the distribution system voltage levels by changing the current levels on the system. The amount of influence depends on the size and nature of the customer’s generation system as well as how it is operated and the characteristics of the distribution system. The Company has two main voltage regulation concerns:

- Avoiding objectionable voltage flicker
- Maintaining the steady state distribution system voltage within the proper operating limits.

Voltage Flicker: Voltage flicker is a sudden change in voltage (that occurs in seconds or fractions of a second) that can cause objectionable changes in the visible output of lighting systems. Sudden changes in the state of a power generator can cause flicker. Examples include starting/stopping of generators, output-steps, periodic oscillations in output caused by generator prime move governor hunting and misfiring, fluctuation of wind and PV system outputs, and many other factors. The Company requires that any customer energy producing equipment connected to the system must not (at the PCC) exceed the limits of voltage flicker as defined by the maximum permissible voltage fluctuation shown for the borderline of visibility curve in IEEE Std. 519-1992 and, where applicable, the Con Edison flicker specification (see Graph 1).
requirement is necessary to minimize complaints by other customers.

**Steady State Voltage Regulation:** Steady state voltage is the voltage of the power system over a sustained period of time usually defined as anywhere from about 1 to 3 minutes or longer in duration. The operation of the generator should not cause the Company’s distribution system voltage to go outside of the steady state voltage limits. ANSI Std.C84.1-1995 defines the steady state voltage limits for AC power systems in North America. In addition, the Public Utilities Commission establishes service voltage limits for the Company. The Company shall require that the customer generator be operated in a manner that does not cause the voltage regulation to go outside the applicable limits. In addition, operation of the generator shall not cause undo hunting and interference with the normal operation of the Company’s voltage regulation equipment.

6.12 RELIABILITY AND POWER QUALITY – The customer generation shall in no way degrade the reliability or power quality of the distribution system.

6.13 POWER FACTOR
If the average power factor of the customer (including the effects of the generator current), as measured at the PCC is less than 0.9, then the method of power factor correction necessitated by the installation of the generator, if any, will be negotiated with the utility as a commercial item. For Reactive Power (VAR) requirements, the customers shall refer to the applicable Company’s rate “Service Classification” under the Special Provisions section to determine the kilovar charges. For a more detailed discussion of power factor requirements see also the specific generator requirements in Sections III, IV and V of this specification.

6.14 ISLANDING – Under no circumstances will a customer generator be allowed to sustain an island condition with any part of the Company distribution system beyond the PCC. The customer generator must be equipped with protection to sense a possible island and disengage from the Company distribution system within a time frame required by IEEE Std.1547.

6.15 METERING REQUIREMENTS – The need for additional revenue metering for non-net metered customers will be reviewed on a case-by-case basis and shall be consistent with the requirements of
the Public Service Commission.

Net metered customers shall be afforded the option of selecting a "standard meter" that can run in reverse, single meter with bidirectional capability (i.e., an input and output register) or two meters measuring consumption and generator output separately. (Only non-demand time-of-day customers may elect a bidirectional meter.) For photovoltaic net metered time-of-day residential customers, the second meter can be either a time-of-day or non-time-of-day meter.

It is important to recognize that a standard meter running in reverse does not meet accuracy standards under Public Service Law and accordingly, in any billing dispute dependent on those meter accuracy standards, the customer will be unable to rely upon net meter readings as a basis for claims against the Company. A customer selecting the standard meter option before September 30, 2005 agrees to waive in writing any billing complaint that is unresolvable because of the inaccuracy inherent in running such meters in reverse. Customers choosing the alternate option will have their billing disputes resolved on the usual standards for evaluating customer complaints.

The two meter (or bi-directional meter) option is required for time of use metering. The customer is responsible for the cost of the second time of use meter installed at the generator site. (An existing Rider R customer electing to use a bidirectional meter is responsible for the incremental cost.)

For larger generator installations, the metering becomes more complex and may require equipment such as medium voltage PTs and CTs, fusing, support poles, various equipments housings, etc. As is necessary, the Company will prepare detailed metering schemes for each customer. The customer shall furnish, install and maintain mounting facilities for the Company’s meters, metering transformers and meter devices, and provide suitable space and enclosures for such facilities. The customer shall furnish, install and maintain all wiring and miscellaneous equipment for revenue meters, metering transformers and meter devices (but not the meters, metering transformers and the meter devices themselves). If needed, the customer shall install and connect revenue metering transformers for the initial installation and upon subsequent alterations to the primary cable or bus connections. The customer shall furnish and install meter wiring between metering transformers and the revenue meters, but the Company will make the final connections to the
meters. The customer shall also furnish, install and maintain all wiring and miscellaneous equipment for demand metering devices and/or additional devices required in addition to watt-hour meters.

Meters and protective devices installed by the customer for customer use shall not be connected to the secondaries of the Company’s current or voltage transformers (potential transformers). For services connected to the Company’s distribution system primary, metering transformers shall be connected on the incoming line side of the customer’s instrument transformers and energy consuming devices. In cases where the customer’s meter location requires devices to be installed on the incoming side of the metering transformers, the installation of such devices shall be approved by the Company. Examples of such devices include neon indicators, phasing facilities or potential transformers for automatic circuit breaker operations. Details of requirements for high-tension connected equipment can be found in Company specification EO-2022.

No customer equipment shall be installed in revenue metering compartments.

Some high tension (high voltage) customers will have meters and metering equipment installed on the low tension (low voltage) side of the incoming transformers. Those meters will be compensated for transformer losses.

In addition to transformer losses, in some cases the meters will have to be compensated for transformer vault lighting, transformer heaters, etc., which are required components of the service installation.

6.16 UTILITY GRADE RELAYS - A controller may be certified in certain small generator applications (such as in the case of a net metered inverter that passes UL 1741) or they may need to be based upon utility grade relays (such as with a 1.5 MW rotating machine).

Utility grade relays must comply with, as a minimum, the most current version of the following standards:

- ANSI/IEEE C37.90 Usual Service Conditions-Ratings (Current, Voltage, etc.)
- ANSI/IEEE C37.90.1 Surge Withstand Capability Fast Transient Test
- IEEE C37.90.2 Radio Frequency Interference
IEEE C37.98 Seismic Testing (Fragility) of Protective and Auxiliary relays

ANSI C37.2 Electric Power System device Function Numbers

IEC 255-21-1 Vibration

IEC 255-22-2 Electrostatic Discharge

IEC 255-5 Insulation (Impulse Voltage Withstand)

6.17 VERIFICATION TESTING - All interface equipment except for single phase inverters and inverter systems rated at 15 kW and less must include a detailed verification test procedure submitted to the Company for approval. The verification test procedure must establish that the protection settings meet Company requirements. The verification testing shall be site-specific and is conducted periodically to assure continued acceptable performance.

Upon initial parallel operation of a generating system, or any time interface hardware is changed, the verification test must be performed. The customer is responsible for the testing and a qualified individual must perform verification testing in accordance with the manufacturer’s published test procedure. Qualified individuals include professional engineers, factory-trained and certified technicians, and licensed electricians with experience in testing protective equipment. The Company reserves the right to witness verification testing or require written certification that the testing was successfully performed.

Verification testing shall be performed at least once every four years. All verification tests prescribed by the manufacturer shall be performed. If wires must be removed to perform certain tests, each wire and terminal must be clearly marked and permanently marked. To facilitate ease and accuracy of testing, it is recommended that the customer shall furnish, install and maintain suitable test facilities for relays, microprocessors, etc. Such facilities shall include test studs, links, adequate ac and dc power sources, etc. The customer (generator owner) shall maintain verification test reports for inspection by the Company. Testing of all protective devices must be performed by qualified personnel before the final functional testing of the interconnection scheme. All testing results must be
submitted to the Company for approval.

Single phase inverter systems rated at 15kW and below shall be verified upon initial parallel operation and once per year as follows: the owner or his agent or customer shall operate the load break disconnect switch and verify the power producing facility automatically disconnects and does not reconnect for five minutes after the switch is closed. The owner shall maintain a log of these operations for inspection by the Company. Any system that depends upon a battery for trip power shall be checked and logged once per month for proper voltage. Once every four (4) years the battery must be either replaced or a discharge test performed.

For any generation system other than certified single-phase inverters rated at 15 kW and below, verification testing shall be performed by means of a calibrated and certified test set prior to initial energization and every 48 months thereafter (or in shorter intervals if recommended by the equipment manufacturer). The most recent certified relay-test reports shall be kept at the location and be made available for Company inspection. The Company reserves the right to inspect the facility and witness the test itself. The customer shall notify the Company at least ten business days in advance of the relay-test to give the Company the opportunity to determine whether Company personnel should be present during the test.

The test procedures for power generation equipment protected by discrete and multifunction microprocessor based relays must at least demonstrate that:

- All relays operate from every possible source of trip signal or voltage.
- All relays trip the desired breaker.
- The generator will isolate for a complete loss of Company supply.
- The ratio and polarity of relay and instrument transformers are proper.
- The phase angle characteristics of directional and other relays are correct.
- Relays have been tested at pick-up and at three multiples of 29
minimum pick-up (three, five and eight times).

- The protective devices must also be bench tested and verified field tested to meet the tolerances in Table 4.

- Microprocessors shall have a test switch or other means for connection to test sets.

Submitted documentation of the relay and operational testing shall include graphic or digital recordings of actual current and voltage levels obtained during the test(s). A protective device maintenance and operation log shall be kept at the customer’s premises and be made available for Company inspection. These test procedures must include relay settings, continuity of relay circuits, breaker close and trip coils (ac and dc circuits), insulation impedances of protective circuits and current and voltage transformers.

The customer’s periodic inspection of ac and dc control power for circuit breakers, reference single-line diagrams, relay protection diagrams and coordination test data must also accompany test reports.

The Company shall be notified at least ten (10) business days prior to the operational tests. After the successful completion of the operational tests, final approval will be based on review of the test results submitted by the customer.

**6.18 MAINTENANCE OF CUSTOMER’S EQUIPMENT AND CABLE**

The customer shall perform periodic maintenance on circuit breakers, relays, transformers, generators, inverters, batteries, and other equipment to meet the Company’s specifications unless the manufacturer recommends a more frequent schedule for maintenance.

In general, low tension customers shall follow the manufacturer’s recommendations and maintenance cycles and high tension customers shall comply with the Company’s Specification EO-4035 “Operation and Maintenance of Equipment on High Tension customer’s Premises.” Failure by the customer to perform periodic maintenance as required by the SIR and contractual agreements with the Company will result in a discontinuance of service until this requirement is satisfied.

The customer shall provide written notification to the Company in the event the individual or firm responsible for maintenance of on-
site generating equipment, breakers and/or relays is being replaced. Such written notification shall be given within seven business days and include the name, address and telephone number of the new individual or firm.

In the event it is necessary for the customer to disconnect Company service, the customer shall notify the Company’s District Operator of the planned disconnection at least seven business days in advance of the disconnection.

When connections of new customers or other work such as routine maintenance will interrupt service to a customer, the Company will contact the customer to arrange a mutually agreeable time, if possible, for such Company work to be performed. When interruption is required, service will be restored as quickly as possible.

The Company occasionally applies a high-potential proof test to check the condition of its feeders. That portion of the service equipment on the supply side of the first disconnecting device on the customer’s premises will be included in those high-potential proof tests.

6.19 MAINTENANCE OF COMPANY’S EQUIPMENT AND CABLE - Before work is to be performed on a Company feeder (normally done while the feeder is de-energized), an authorized Company representative will lock open (with Company padlock) the intertie circuit breakers or disconnect switches for all on-site generating customers receiving service from that feeder.

6.20 DISCONNECTING SERVICE - When requested by the Company, the customer shall discontinue parallel operation:

- To eliminate conditions that constitute a potential hazard to utility personnel or the general public
- Pre-emergency or emergency conditions on the utility system
- A hazardous condition is revealed by a utility inspection
- Protective device tampering
- Parallel operation prior to utility approval to interconnect

6.21 SYSTEM OPERATION DOCUMENTATION - The customer shall maintain an operating log at his facilities indicating changes in operating status (available or unavailable), maintenance outages, trip indications, manual events and other unusual conditions found
during routine inspections. In the log, all relay targets are to be registered whenever a breaker operation occurs. At a minimum, this log shall include time, date, relay type, circuit number, phase, model number and description of disturbance. The Company shall have the right to review these logs, especially in analyzing system disturbances.

The customer shall keep a set of updated drawings, which includes a one-line circuit diagram and system wiring diagrams of the installation’s electrical facilities. These drawings shall be made available during the Company’s periodic inspection.

6.22 CIRCUIT BREAKER AND SWITCHING OPERATIONS - The customer’s interconnection tie and/or generator circuit breaker(s) shall open to separate the Company’s and customer’s facilities, for faults on either the Company’s incoming supply feeder(s), low-voltage service or the customer’s equipment.

The circuit breakers shall also be opened automatically when the Company’s incoming feeder(s) or low voltage service(s) is de-energized for scheduled work.

The intertie circuit breaker shall be closed manually and only after the Company’s operating authority has determined that the situation which caused the breaker to open no longer requires the breaker to remain open. The operating authority shall make such determination promptly after the customer notifies the operating authority that the breaker is ready for closing.

If a customer is serviced at primary voltage, the customer shall promptly notify the Company of any circumstances endangering Company service. The customer shall also notify the Company of any automatic operation of the intertie circuit breaker(s) or any other main protective device at the customer’s installation. The customer shall inform the Company of the exact time of operation, breaker position (open or close), relay targets and condition of breaker control power. The equipment on the customer’s premises causing the above operation shall not be reenergized until it is isolated, repaired or replaced, and until the Company has determined that the condition that caused such operation has been corrected. The Company shall make such determination promptly after the customer notifies the Company that the equipment is ready to be reenergized.

6.23 MAINTENANCE OF GROUNDS - FOR THE PROTECTION OF
PERSONNEL, ONLY AUTHORIZED COMPANY PERSONNEL SHALL GROUND OR REMOVE GROUNDS FROM INCOMING COMPANY PRIMARY FEEDER (S). If grounding of the Company feeder(s) is required, the customer shall contact the Company’s District Operator. All other switching within the customer’s premises shall be performed by qualified employees of the customer. The customer shall notify the Company’s District Operator at least fifteen business days before customer switching is planned so that the Company can determine whether its personnel are required to supervise the switching activities. A shorter notice period will be acceptable where such switching is necessary to restore service to the customer.

6.24 TELEPHONE COMMUNICATIONS - The Company shall be provided with a 24-hour direct telephone access to the customer’s facility for communications regarding emergency operation of Company primary feeders and customer-owned equipment that is energized directly from these feeders.

Each customer shall have provision for a telephone service between the Company and the customer or the customer’s generating facility. All other communications shall be between the customer and the customer Project Manager (CPM), unless otherwise designated.

6.25 COMPANY ACCESS, INSPECTION, AND SYSTEM EMERGENCIES - Company access to the customer’s interconnection equipment and the generator circuit breaker will be required for maintenance of Company equipment, routine inspection, and in emergency situations. In cases other than emergencies, reasonable advance notice of the need for access will be given to the customer. Only Company personnel bearing Company identification cards and authorized representatives of the customer should be permitted access to vaults, rooms, manholes or enclosures containing on-site generating and/or interconnection equipment.

a) Company Access - The Company will require access to customer premises to maintain splices connecting the Company and customer’s cables, and to maintain meters, metering devices, and current and voltage transformers used for metering.

b) Inspection - Where there is parallel operation, the Company
or its authorized representative will periodically inspect, at reasonable intervals, the customer's generator operation, equipment, testing procedures, measurement records and maintenance and operating logs. Customers failing to follow the Company-approved relay testing procedures, or properly keep records of operations, maintenance schedule and test results, will be required to cease parallel operation or to take Company service through isolated (non-parallel) operation.

c) System Emergencies - In case of emergency, where service is in imminent danger of interruption, or where there exists a condition which imminently endangers life, property or the Company service; the Company may disconnect and lock open the interconnection circuit breakers or the customer's on-site generating equipment. Where possible the customer shall be given advance notice of such disconnections under these emergency circumstances. Service shall be restored to the customer as soon as system conditions permit.
II - CUSTOMER INTERFACE PROCEDURES

1.0 INTRODUCTION

1.1 Application Process Overview – This section outlines the procedure for a customer to receive approval to interconnect power generation facilities to the Company’s power distribution system. The described process is intended for the following types of generation:

1. Interconnection of new distributed generation facilities with a nameplate rating of 2 MW or less (as aggregated on the customer side of the point of common coupling), that fall under the SIR process and;

2. Review of any modifications affecting the interface at the point of common coupling (PCC) of existing customer distributed generation facilities that have a nameplate rating of 2 MW or less as aggregated on the customer side of the point of common coupling, that fall under the SIR process and that have been interconnected to the Company distribution system and where an existing contract between the customer and the Company is in place and;

3. New distributed generation or modifications to existing distributed generation over 2 MW and up to 20 MW as aggregated on the customer side of the point of common coupling. Generation in this size range does not fall under the Public Service Commission’s mandated SIR guidelines. However, for larger customer generation (over 2 and up to 5 MW connected to the distribution system), the Company will follow the approval process time line set forth in the SIR. In all other cases, the Company will, where possible, use a similar application and approval process as outlined in this Section for SIR type generation. However, the time frames of the application process and level of requirements may be extended compared to those units under the SIR guidelines due to the larger size of these generators and resulting increase in complexity of interconnection issues.

This application process and its requirements do not apply to generation equipment that will never be allowed to operate in parallel with the Company distribution system. As an example, this includes emergency standby generators with break-before-make
transfer switch and any other generation sources that operate independently of any connection to the distribution system and have no provision for such connection (even for a short period of time). As stated above, this application process is mandated by the Public Service Commission for customer generation equipment up to 2 MW that will be connected to the Company distribution system on a full or part time basis.

The application process is an 11 step procedure that has been developed by the New York State Public Service Commission with input from New York State electric utilities, distributed generator equipment vendors, system integrators, and other stakeholders with the intention of providing a standardized interconnection process for customer based distributed generation facilities. The goals of the process are to allow generators to be interconnected in a timely, safe and operationally effective basis, and where possible, to reduce the cost and complexity of interconnection to both the customer and the Company.

The time required to complete the 11 step process will depend on the characteristics of the generator, the size class (as specified above), its intended operating modes, and the characteristics of the Company distribution system at the point of interconnection. It is the Company’s objective that the process should be completed in a timely manner that affords the lowest cost to the customer as allowed by the need to preserve safety, reliability, power quality and operational efficiency of the Company distribution system. The generator will be given approval to connect only after the generator interface design has the necessary protection and design features per the SIR requirements or Company requirements where applicable and the Company’s review shows that any safety, reliability, and power quality issues have been addressed through added protection equipment and/or distribution system upgrades.

The application process and attendant services are offered by the Company on a non-discriminatory basis to any customer. As part of the process, the Company may identify the need for detailed engineering studies (CESIR), distribution system upgrades and additional protection requirements (beyond the base SIR). As allowed by the Public Service Commission, the costs of the detailed study and upgrades are the responsibility of the customer (because these are costs the Company would not have incurred but for the interconnection of the generator.) The application process is structured to allow the customer to see each cost in advance so that they may choose whether or not to continue moving forward.
with the process prior to committing to these costs. This avoids unnecessary expenditure of resources by either party and is for the benefit of both the customer and the Company.

The application process will be monitored by Staff of the Department of Public Service to ensure that the Company and customer complete the process within the guidelines identified in the SIR. The Company will keep a log of all applications, milestones met, and justifications for application specific requirements. As stated earlier, the customer will be responsible for payment of application fees and Company costs related to studies and upgrades as described in the 11 step process.

1.2 Application Process Steps – The application process consists of the following 11 steps as documented in the SIR. The process is reproduced here in this manual, with additional comments and clarification that are applicable to Con Edison (the “Company”).

- **Step 1 – Initial Customer Contact**: Customer contacts the Company to enquire about potential generation interconnection project and/or express intent to submit application for interconnection. A meeting is set to meet with customer and review the details of the propose project (see step two). The Company’s Energy Services Department is responsible for the Company interface coordination of the project from the start of preliminary discussions to the commencement of interconnected operations.

- **Step 2 – Customer Enquiry is Reviewed by the Company to Determine Nature of the Project**: Technical staff from the Company will meet with the customer (by phone or in person) to discuss the scope of the proposed project and to determine what specific information may be required by the customer to proceed with the formal application. The Company will make available to the customer the documents that are needed to process the application (depending on the project these could include the application form, contract, technical requirements, specifications, listing of qualified type tested equipment/systems, application fee information, applicable rate schedules, and metering requirements.) For generator projects falling under SIR guidelines, all information needed by the customer will be provided within three (3) business days following the initial customer Contact unless the customer indicates otherwise. A specific person or persons representing the Company will be assigned as the point of contact for the
customer to coordinate with regarding the generation project. In these discussions, the Company will explain the interconnection procedure and may also discuss the preliminary technical feasibility of the proposed interconnection. If the customer desires to isolate its generation, and operate in a manner that will at no time operate in parallel with the utility system and will not require Company Back-Up Service on an outage by the on-site generation, approval of the installation by the Company is not required.

- **Step 3 – Customer Files Formal Application:** The customer submits the formal application to the Company. The submittal must include the completed standard application form, and for systems with a contractual total aggregate nameplate rating exceeding 15 kW, a non-refundable $350 application fee. For net-metered classified customer generators, see Step 6. If the customer proceeds with the project to completion, the application fee will be applied as a payment for the Company’s total cost for interconnection, including the cost of processing the application. Within five (5) business days of receiving the application, the Company will notify the applicant of receipt and if the application has been completed adequately. It is in the best interest of the applicant to provide the Company with all pertinent technical information as early as possible in the process. If the required documentation is presented in this step, the Company will be able to perform the required reviews and allow the process to proceed as expeditiously as possible. The specific application form(s) to be filed are a function of the type of generation that is being interconnected to the Company distribution system and are as follows:
### Application Forms to Use in Step 3

<table>
<thead>
<tr>
<th>Type of Generation</th>
<th>Use Appendix B Application</th>
<th>Use Appendix C Application</th>
<th>Use Addendum to Application for Service (Form 1)</th>
<th>See Appendix A and Detailed Company Forms as Applicable (Forms 2-6)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Less than or Equal to 15 kW</td>
<td>✔</td>
<td></td>
<td>✔ *</td>
<td></td>
</tr>
<tr>
<td>Greater than 15 kW and up to 2 MW</td>
<td></td>
<td>✔</td>
<td>✔</td>
<td></td>
</tr>
<tr>
<td>Greater than 2 MW up to 20 MW</td>
<td></td>
<td></td>
<td>✔</td>
<td>✔</td>
</tr>
</tbody>
</table>

* Customers not under Rider R shall fill out Form 1 in addition to Appendix B

- **Step 4 – Company Conducts a Preliminary Review and Develops a Cost Estimate for the Coordinated Electric System Interconnection Review (CESIR):** The Company conducts a preliminary review of the proposed system interconnection. Upon completion of the preliminary review, the Company will inform the applicant as to whether the proposed interconnection is viable or not, and provide the customer with an estimate of costs associated with the completion of the Coordinated Electric System Interconnection Review (CESIR). The preliminary review shall be completed and a written response detailing the outcome of the preliminary review shall be sent to the customer within five (5) business days of the completion of Step 3. For aggregate systems above 300 kW and up to 2 MW, and interconnections to network systems, the preliminary review shall be sent to the customer within fifteen (15) business days of the completion of Step 3. The Company’s response to the customer’s application to interconnect aggregate systems above 300 kW and up to 2 MW, or proposing to interconnect to network systems, will include preliminary comments on requirements for protective relaying, metering and telemetry. For systems of 15 kW or less, no costs will be charged to the customer for completion of the preliminary review or CESIR. For systems larger than 2 MW, the response time of the Company may be longer than 15 days due to the added complexity of the
system impacts associated with larger installations.

- **Step 5 – Customer Commits to the Completion of the CESIR:**
  In order for the Company to complete the CESIR, certain data is needed from the customer. The Company will need the following information completed in order to proceed with the CESIR:

  - a complete and detailed interconnection design package
  - the name and phone number of the individual(s) responsible for addressing technical and contractual questions regarding the proposed system, and
  - if applicable, advanced payment for completion of the CESIR

The complete detailed interconnection design package shall include:

1. Electrical Schematic drawing(s) reflecting the complete proposed system design which are easily interpreted and of a quality necessary for a full interconnection. The drawings shall show all electrical components proposed for the installation and their connections to the existing on site electrical system from the generator to the point of common coupling (PCC)

2. A complete listing of all interconnection devices proposed for use at the PCC. A set of specifications for this equipment shall be provided by the applicant upon request from the utility.

3. The written verification test procedure provided by the equipment manufacturer, when such a procedure is required by the SIR guidelines.

For aggregate customer generation systems above 300 kW and up to 2 MW, as well as those units above 2 MW, and interconnections to network systems, the complete detailed interconnection design package shall include, where applicable, three copies of a proposed single line diagram of the generation system showing the interconnection of major electrical components within the system including:
1. All key pieces of equipment from the generator(s) to the point of common coupling (generator, switchgear, grounding equipment, protective relay functions, PT and CT connections, interface transformer, overcurrent devices, lightning arresters, cable types and impedances, etc.)

2. The number and individual ratings, % impedance of each generator comprising the aggregate rating of the system

3. The type of generator (inverter, synchronous or induction)

4. The type and power rating of energy source (solar PV, wind, internal combustion engine, combustion turbine, fuel cell, etc.)

5. Where applicable, the general high voltage bus configuration and relay functions

6. The proposed generator step-up transformer MVA ratings, winding arrangement, % impedance, tap settings and voltage rating

7. Details on the type of proposed grounding for the generator (include generator and transformer winding arrangement and any grounding impedances that are proposed)

8. Include details of any planned telemetric controls

In addition to the above information to be contained in the design package, the customer shall also provide a list of the proposed relay functions to be used with a table of their planned settings and the intended purpose of each function. The PT and CT ratio and connection schemes for these relay function signals must be provided where applicable. The customer shall provide a discussion of the intended modes of operation of the generation plant (i.e. peak shaving, cogeneration, backup power, export, etc.) and details on the expected power factor of the proposed generator and, when applicable, a plan for maintaining adequate power factor within the required SIR limits. The method of dynamic control for regulation of VARs and power output of the generating unit will be provided as part of the design package. Combined Heat and Power (CHP) customer’s requesting Designated Technology status must also submit documentation illustrating their ability to meet both the efficiency and emission requirements.
The Company will provide information to the customer regarding the location and arrangement for metering equipment and this shall be included on the customer's design package drawings when submitted for acceptance.

The design package data will be used by the Company to perform Electrical studies to demonstrate that the design is within acceptable limits, inclusive and limited to the following: system fault, relay coordination, flicker, voltage drop, and harmonics.

Prior to the customer’s submittal of detailed drawings, the Company will provide equivalent system impedances and fault levels at the point of interconnection so that the customer can perform its own preliminary relay coordination study taking into account the Company’s system. This data may be needed by the customer so that it can select the proper ratings of interconnection switchgear and determine appropriate relay pickup settings.

Operating instructions will be prepared by the customer for parallel operation detailing both normal and emergency startup and shutdown procedures and shall be attached to the design package forms by the customer or his authorized representative. The customer’s operating personnel shall receive the necessary training in the operating procedures before parallel operation begins.

- **Step 6 – Company Completes the CESIR**

The Company will complete the CESIR:

1. A review of the impacts of the customer’s generator to the utility system
2. A review of the proposed system’s compliance with the applicable criteria set forth below

A CESIR will be performed by the Company to determine if the proposed generation on the circuit results in any relay coordination, fault current, and/or voltage regulation problems. A full CESIR may not be needed if the aggregate generation is less than 50 kW on a single-phase branch circuit of a radial distribution circuit or 150 kW on a three-phase feeder circuit.

The CESIR shall be completed within four (4) weeks (20 business days) of receipt of the information set forth in Step 5 for systems of 300 kW or less and within 12 weeks (60 business days) for systems
larger than 300 kW and up to 2 MW. For systems larger than 2 MW, the increased complexity of the CESIR may require more than 12 weeks (60 days). For systems utilizing type-tested equipment, the time required to complete the CESIR may be reduced.

Upon completion of the CESIR, the Company will provide the customer, in writing, the following:

1. Expected distribution system impacts, if any

2. Notification of whether the proposed system meets the applicable criteria considered in the CESIR process

3. If applicable, a description of where the proposed system is not in compliance with these requirements

4. Subject to subsections (a) through (d) below, a good faith, detailed estimate of the total cost of completion of the interconnection of the proposed system and/or a statement of cost responsibility for a dedicated transformer(s):
   
   (a) with respect to an applicant that is **not** to be net-metered, an estimate shall be provided and shall include the costs associated with any required modifications to the utility system, administration, metering, and on-site verification testing;
   
   (b) with respect to an applicant that is **to be net-metered** and that is either a Farm Wind or Residential Wind applicant intending to install wind electric generating equipment with a rated capacity of more than 10 kW, an estimate shall be provided and (i) shall include the costs associated with any required modifications to the utility system, administration, metering, and on-site verification testing, and such applicant shall be informed that it is responsible for one-half of such costs, and (ii) shall include the applicant's responsibility for the actual cost of installing any dedicated transformer(s) up to the maximum set forth in subsection (e) below;
   
   (c) with respect to an applicant that **is to be net-metered** (but not a Farm Wind or Residential Wind applicant covered in subsection (b) above), such applicant shall have no responsibility for the interconnection costs described in subsection (b)(i) above, and a statement shall be provided showing the applicant's responsibility for the actual cost of installing any dedicated transformer(s) up to the maximum set forth in subsection (e) below;
(d) with respect to an applicant that is to be net-metered, if the Company determines that it is necessary to install a dedicated transformer(s) to protect the safety and adequacy of electric service provided to other customers, the applicant shall be informed of its responsibility for the actual costs for installing the dedicated transformer(s). The following table reflects the maximum responsibility each designated applicant shall have with respect to the actual cost of the dedicated transformer(s):
Maximum Expense for Dedicated Transformer for Net Metered Customers are as shown in the table below:

<table>
<thead>
<tr>
<th>Generator Type</th>
<th>Generator Size</th>
<th>Maximum Transformer Responsibility</th>
</tr>
</thead>
<tbody>
<tr>
<td>Residential Solar</td>
<td>Up to 10 kW</td>
<td>$350</td>
</tr>
<tr>
<td>Residential Wind or Farm Wind</td>
<td>Up to 25 kW</td>
<td>$750</td>
</tr>
<tr>
<td>Farm Wind</td>
<td>26 kW up to 125 kW</td>
<td>$1,000</td>
</tr>
<tr>
<td>Farm Waste</td>
<td>Up to 400 kW</td>
<td>$3,000</td>
</tr>
</tbody>
</table>

Special rules may be applied to a customer that has both Solar and Wind power generators at the same site. The tariff shall be consulted for such “Hybrid” installations.

- **Step 7 – Customer Commits to Company Construction of Power Distribution System Modifications and Construction of its own Plant based on the “Final” Company Approved Design**

The customer will:

- Execute a standardized contract for interconnection
- Provide the Company with an advance payment for the Company’s estimated costs as identified in Step 6, except for net metering applicants (estimated costs will be reconciled with actual costs in Step 11)
- Where applicable, the customer may also need an addendum agreement with the Company to cover maintenance and operational issues.

As a prerequisite of the customer’s generation plant construction process, the customer shall submit to the Company the final set of protection design drawings, detailed specifications, and descriptions of all protection devices and accessories the customer intends to purchase and install. This submission is essentially a revised specification of the original design package submitted in Step 6 (revisions, if any, are due to additional protection requirements or design changes that might be required by the Company based on the review of original design package submitted in Step 6.) The final package used for the actual plant construction shall include a full set of wiring.
and schematic diagrams, marked “FINAL” and sealed by a New York State licensed Professional Engineer. (Note: The final design would be the same as the original design if the Company required no changes in the design.) The Company will approve and grant permission for interconnection when the customer’s final plans meet the Company requirements.

If it is necessary during the final stages of planning leading up to construction or during construction itself to alter the “Final Design,” the customer shall provide advance written notice to the Company of any proposed change in electrical equipment associated with the interconnection, and the Company shall promptly inform the customer whether the contemplated changes are acceptable and consistent with the goal of conducting a safe, reliable and efficient interconnection.

- **Step 8 – Project Construction**

  The customer will build the facility in accordance with the Company-accepted design. The Company shall have the option to inspect construction work to ensure the installation will be compatible with the Company’s requirements. Prior to generation plant operation, the customer’s installation shall be inspected by the Company to verify compliance with the Company’s “Final” detailed specification and with the customer's “Final” Company-approved drawings and details of the interconnection. Such inspections shall be conducted at a mutually agreeable time.

  The Company will commence construction/installation of system modifications and metering requirements as identified in Step 6. The Company required system modifications will vary in their construction time depending on the extent of work and equipment required. The schedule for this work will be discussed with the customer during Step 6 and on a reasonable efforts basis be coordinated with the needs of the customer installation.

- **Step 9 – The Customer Generation Facility is Tested in Accordance with Standardized Interconnection Requirements:**

  Verification testing will be performed in accordance with the written test provided in Step 5 and any site-specific requirements identified by the Company in Step 6. The final testing will be conducted at a mutually agreeable time and the Company shall be given the opportunity to witness the tests.
Single-phase inverter-based systems rated at 15 kW or less will be allowed to interconnect to the utility system prior to the verification test for a period not to exceed two hours, for the sole purpose of assuring proper operation of the installed system.

• Step 10 – Interconnection and Operation
The customer’s system will be allowed to commence parallel operation upon satisfactory completion of the tests in Step 9. In addition, the applicant must have complied with and must continue to comply with the contractual and technical requirements. These contractual requirements also include an addendum contract worked out with the customer to allow for suitable periodic testing and maintenance of the interconnection hardware.

• Step 11 – Final Acceptance and Company Cost Reconciliation
Within 60 days after interconnection, the utility will review the results of its onsite verification and issue to the customer a formal letter of acceptance for interconnection. At this time, the Company will also reconcile its actual interconnection costs related to the project against the application fee and advance payments made by the customer. The customer will receive either a bill for any balance due or a reimbursement for overpayment as determined by the Company’s reconciliation, except that a net metering applicant may not be charged in excess of the cost of installing any dedicated transformer. The customer may contest the reconciliation with the Company and if the applicant is not satisfied, a formal complaint may be filed with the Commission.

1.3 AMENDMENT TO APPLICATION FOR ON-SITE GENERATION
An amendment to the customer’s interconnection application may be needed as a result of and issues arising from the CESIR or other site specific requirements either of a design or operating nature. The amendment will cover various issues related to the maintenance and operation of the system. The Company and customer will work together to achieve a suitable amended contract that is satisfactory to both parties.

2.0 INTERCONNECTION CHARGES
Customers shall be subject to charges for interconnection costs. To permit interconnected operations with a customer, the
Company may incur costs which are in excess of those would have incurred had the customer taken firm service. These excess costs, called interconnection costs, are directly related to the installation of facilities the Company deem necessary for interconnection. They include initial engineering evaluations, purchase and installation of additional switching, transmission and distribution equipment at Company’s facilities, safety provisions, engineering and administration. These costs shall be paid in full by the customer prior to commencement of service.

3.0 SUMMARY

The above procedure is summarized as follows:

- **Step 1 – Initial Customer Contact**
- **Step 2 – Customer Enquiry is Reviewed by the Company to Determine Nature of the Project**
- **Step 3 – Customer Files Formal Application with Fee**
- **Step 4 – Company Conducts a Preliminary Review and Develops a Cost Estimate for the Coordinated Electric System Interconnection Review (CESIR)**
- **Step 5 – Customer Commits to the Completion of the CESIR**
- **Step 6 – Company Completes the CESIR**
- **Step 7 – Customer Commits to Company Construction of Power Distribution System Modifications and Construction of its own Plant based on the “Final” Company Approved Design**
- **Step 8 – Project Construction**
- **Step 9 – The Customer Generation Facility is Tested in Accordance with Standardized Interconnection Requirements:**
- **Step 10 – Interconnection and Operation**
- **Step 11 – Final Acceptance and Company Cost Reconciliation**

In addition to the above, the customer, depending on the type of generator
installation will need to agree to an amended standard contract covering certain maintenance and operational issues associated with the system.
III. INDUCTION GENERATOR – TECHNICAL REQUIREMENTS

1.0 INTRODUCTION – An induction generator operates on principles identical to an ac induction motor, except that in normal operation it has a speed of rotation slightly greater than the synchronous speed of the 60 Hz power system. The induction generator, because it has “slip” in relation to the 60 Hz utility system voltage, is often referred to as an “Asynchronous” generator because it is never quite synchronized with the utility (Company’s) distribution system. Induction generators do not have an exciter and they can not normally sustain a stable island on their own so they are not used for generator plants that must provide power on a stand alone basis. They are, however, commonly used in power plants that only need to operate in parallel with another source (such as the utility system). In general, induction generators have unique characteristics as follows:

- Induction generators operate in an asynchronous fashion with respect to the utility system voltage so when first connecting to the Company’s distribution system it does not require precise alignment of frequency and phase angle. However, speed matching to near synchronous speed may still be required for some cases.

- The design of the induction generator (its lack of an exciter) makes it less likely to pose an islanding risk to the Company’s system than a synchronous generator. On the other hand, self-excitation still can occur in some special cases (causing ferroresonance) so the threat of islanding is not entirely removed and must be addressed as part of any induction generator interface design package.

- Induction generators gather the excitation current they need from the utility system (Company’s system) thereby consuming considerable reactive power from the system. This causes voltage drop and increased losses on the distribution system. In situations where system losses and voltage drop are significant, the induction generator may need provisions to correct its power factor to near unity.

- Induction generators can not sustain an appreciable fault current for a fault at their terminals for a long time due to the collapse of excitation source voltage during the fault. However,
they will inject a large amount of current for a short transient period of time and this can impact the power system.

Because of the characteristics of the induction generator described above, its protection and interface is somewhat different than that of the synchronous generator.

2.0 INDUCTION GENERATOR STARTING
Induction generators may be connected to the distribution system and brought from a standstill up to synchronous speed (just as an induction motor is) if it can be demonstrated that the initial voltage drop measured at the point of common coupling is acceptable based on current inrush limits. The same requirements also apply to induction generators connected at or near synchronous speed using a speed matching relay approach because a voltage dip is present due to an inrush of magnetizing current even when the unit is connected at or near synchronous speed (albeit of shorter duration than starting from a standstill condition).

In order to assess voltage flicker, the expected number of starts per hour and maximum starting kVA draw data will need to be delivered to the utility company to verify that the voltage dip due to starting is within the acceptable flicker limits according to IEEE 519-1992 and, where applicable the Con Edison flicker curve requirements (see Graph 1).

Starting or rapid load fluctuations on induction generators can adversely impact the Company’s distribution system voltage and cause noticeable voltage quality problems for customers on the circuit. Corrective step-switched capacitors or other techniques may be needed to mitigate the voltage flicker and regulation issues that arise. These measures can, in turn, cause ferroresonance, which is a serious form of over-voltage condition that can damage equipment and loads on the system. If the customer’s design includes additional capacitors installed on the customer side of the PCC, the Company will review these measures and may require the customer to install additional equipment to reduce the risk of ferroresonance. Customers, who provide capacitor banks to minimize the voltage drop on the bus during starting of the generator, shall provide a way to automatically disconnect them from the generator terminals after the start up. The customer shall perform and submit studies to demonstrate the impact of the capacitors on the system.

3.0 INDUCTION GENERATOR POWER FACTOR
Induction generators, unless corrected with capacitors, operate at relatively poor power factor due to the reactive excitation current drawn from the Company’s power system. For induction generators falling within
the 0 to 2 MW SIR guidelines, if the average power factor of the customer (including the effects of the generator current), as measured at the PCC is less than 0.9, then the method of power factor correction necessitated by the installation of the generator, if any, will be negotiated with the utility as a commercial item. For Reactive Power (VAR) requirements, the customers shall refer to the applicable Company’s rate “Service Classification” under the Special Provisions section to determine the kilovar charges. For induction generators larger than 2 MW, the Company will negotiate with the customer the reactive requirements of the machine and expected power factor performance. Regardless of generator size, use of power factor correction capacitors must be approved by the utility to insure that issues related to self-excitation and ferroresonance are addressed.

4.0 INDUCTION GENERATOR PROTECTION
The customer is responsible for tripping their generator intertie breaker and/or contactor and isolating their generator from the Company’s distribution system in the event of an electric fault and/or abnormal voltage/frequency condition. The protective relaying requirements for a particular facility will depend on the type and size of the facility, voltage level of the interconnection, location on the distribution circuit, fault levels, and many other factors. IEEE Standard 1547-2003 has specific tables with recommended default values for the trip settings of distributed generators.

4.1 MINIMUM PROTECTIVE DEVICES - The absolute minimum protective relays that the Company will require for induction generators for any size generator will never be less than the relays mentioned below, and on a case by case basis it may be necessary for the utility to require additional protection.

a) Utility grade undervoltage relays (device 27) shall be connected phase to ground on each phase. These relays disconnect the customer from the Company’s distribution system during faults or when the Company feeder is out of service. The default trip settings should conform to IEEE Standard 1547-2003 Table 1. However, for generation greater than 30 kW the Company may require different settings on a case-by-case basis as needed.

b) Utility grade overvoltage relays (device 59) shall be connected phase to ground on each phase. The default trip settings should conform to IEEE Standard 1547-2003 Table 1. However, for generation greater than 30 kW the Company may require different settings on a case-by-case basis as needed.
c) Utility grade over- and under-frequency protection (devices 81/0 and 81/U) are used to trip the generator or intertie breaker upon detecting a frequency deviation outside of reasonable operating conditions. The default trip settings should conform to IEEE Standard 1547-2003 Table 2. However, for generation greater than 30 kW the Company may require different settings on a case-by-case basis as needed.

The above functions are the minimum Company required relaying functions per the SIR table of minimum requirements and per the context of IEEE 1547-2003. However, it should be recognized that the customer may be required, based on the outcome of a Coordinated Electric System Interconnection Review (CESIR) or general technical review, to use protection settings other than the default settings described above, and add additional protection to facilitate proper operation of the Company’s low voltage network system or radial distribution feeders depending on where the system is interconnected. Additional protection could take the form of phase and ground fault overcurrent relays, ground fault over-voltage relays, directional power and/or overcurrent relays, transfer trips, speed matching controls, lock-out functions, etc.

It is important to recognize that the protection functions mentioned above are specified by the Company with the objective to protect the Company’s electrical distribution system as well as its other customers from the effects of the customer’s generator. The customer’s generator may need voltage and current unbalance relays and various types of generator over-current relays to prevent overheating of the generator windings during unbalance and fault conditions. Certain forms of generator grounding may also be needed to reduce the level of ground fault current so that generator windings don’t see excessive damaging forces during faults. DC backup power may be required for relay tripping functions depending on the size and criticality of the function.

To insure that both the utility system and the generator are protected, the customer has the responsibility to install the Company designated relays and also work with the generator manufacturer or system integrator to use relays and grounding practices that are coordinated to protect the generator itself from damage during faults and other anomalies. Damage that occurs to a customer generator as a result of failure to use appropriate
protection and design practices is not the responsibility of the Company.

4.2 GRADE OF RELAYS FOR INDUCTION GENERATORS
As mentioned in the Section I of this manual, only relays that are type tested by a certified lab or the Company or utility grade will be accepted for protection of the interconnection and the generator. Relays may be single function or multifunction packages, and they can be mechanical, solid state or microprocessor based types as long as they satisfy the utility grade or type tested specifications. Modern microprocessor multifunction relays designed for generator protection that satisfy the required utility grade specifications have recently become much more cost effective (compared to earlier products of a decade ago) and are available from a variety of equipment vendors.

5.0 INDUCTION GENERATOR GROUNDING

The appropriate grounding scheme to use for the induction generator is a function of the type of distribution system to which it is connected and other factors specific to each site. The four main concerns of the Company regarding the type of induction generator grounding to utilize are ground-fault overvoltages, ferroresonance, harmonics, and ground-fault current contribution/detection issues. There is a widely held misconception in the industry that because the induction generator does not normally self excite, that the effects of ground fault overvoltages can be ignored since they would disappear quickly (transient decay). However, partial excitation can still exist on some phases during ground faults and because an induction generator might self excite due to capacitors and because even without self excitation, the transient decay period of its output can cause damage in just a few cycles, the grounding of induction generators and its potential impact must still be treated almost similar to a synchronous generator. This means the Company may need to specify effective or solid grounding for an induction generator whenever there is a concern about ground fault overvoltages on a four wire multi-grounded neutral distribution system. When interconnecting to ungrounded or uni-grounded distribution systems an ungrounded or impedance grounded interface to the Company distribution system at the PCC will usually be specified. The final determination as to which ground configuration is most appropriate will be done on a case-by-case basis. It is important to recognize that the type of grounding referred to in this section is the grounding with respect to the utility distribution system which is a function of not just the generator grounding itself, but also the configuration of the interface transformer winding configuration and its ground connection.
6.0 COMMON DESIGN REQUIREMENTS
Many design requirements that the customer must satisfy are common to all of the generator types (that is SPC, induction, and synchronous generator types). The common requirements include the disconnect switch, certification standards, power quality standards, IEEE 1547 voltage response tables, etc. See section-I of this manual for a discussion of the common requirements.

7.0 TYPICAL INTERCONNECTION DRAWINGS – Drawings No. 1 and 2, at the end of this manual represent typical interconnection design for induction generators and are presented as illustrative examples. Each project may have different requirements.
IV. STATIC POWER CONVERTER- TECHNICAL REQUIREMENTS

1.0 INTRODUCTION - The static power converter (SPC), also commonly referred to as an inverter, provides the interface between direct current (dc) energy sources or variable high frequency sources and the 60 Hz power distribution system. Examples of generation systems employing SPC units include photovoltaic arrays, fuel cells, battery storage systems, some microturbines, and some wind turbines. Unlike an induction or synchronous generator that uses rotating coils and magnetic fields to convert mechanical into electrical energy, the SPC converts one form of electricity into another (i.e. dc to ac) and is typically controlled and protected by its internal microprocessor-based controller. The internal controller detects abnormal voltage, current and frequency conditions and quickly disables the injection of power into the system if limits are exceeded. It also controls synchronization and start-up procedures. While most small certified SPC units designed for grid parallel operation can rely totally upon their internal protection functions, larger and special feature SPC units may also require external protection/control functions.

When applying SPC units to the Company’s distribution system there are some big differences compared to rotating machines. These include:

- SPC have no moving or rotating parts and utilize the on/off switching of solid state transistors to “synthesize” a 60 Hz ac waveform from the energy source.

- Due to the fast switching response of transistors, an SPC is usually able to stop producing energy much faster than a typical rotating machine (once the controller protection scheme identifies the need to interrupt flow of energy)

- The fault level contribution of SPC units are not usually as large as those from the same size (rating) induction or synchronous rotating type generator reducing the impact on Company equipment

SPC units use embedded microprocessor controllers that control the switching and waveform synthesis, and also have embedded protection functions such as under/over voltage and under/over frequency. SPC also often employ an “active” anti-islanding capability (if they are listed per UL 1741 as a non-
islanding inverter). This is a level of protection beyond that found in ordinary voltage and frequency based passive islanding protection. A “certified” SPC per UL1741 can eliminate the need for external utility grade relays for smaller systems.

Because the use of SPC for DG is an emerging commercial technology, and is still going through a maturation process, the local, state and national regulations related to this are still evolving. Currently the IEEE 929-2000 for PV inverters, IEEE-1547-2003, and UL-1741 standards serve as the national foundation for the most pertinent interconnection requirements for SPC units. The Company approach for interconnecting SPC (inverters) is consistent with these standards where they are applicable and consistent with the requirements of the SIR.

2.0 SPC Startup and Synchronization

Modern SPC units which are designed for grid-parallel operation operate as grid interactive synchronous sources and will synchronize their output with the utility system voltage to achieve proper and safe parallel operation. For most small SPC, such as UL 1741 certified PV inverters and fuel cell inverters, all of the start-up, control and synchronization logic and functions are built into the device. At the instant the SPC is physically connected to the grid, its voltage sensing and controller circuitry starts tracking the utility distribution voltage, phase angle and frequency. The transistors of the SPC are then triggered to begin switching to create a source current injection into the system that is synchronized with the utility system. As part of the start up process, many photovoltaic and other types of SPC units include a soft start-up feature that gradually ramps up to full output over several seconds following the moment of initial connection. This helps reduce voltage flicker compared to the approach of suddenly stepping to full output. The Company desires this type of soft start feature for SPC units and may not require it if the CESIR shows the resulting flicker of a full step start is not an issue.

Some sophisticated SPC units operate in parallel with the utility system during normal conditions and as a secondary function can serve as stand-alone power for customer load when the utility distribution system is disabled. If the customer generator is to employ this type of “Advanced” SPC configuration, it must be configured with the appropriate protection and synchronization equipment to transition to/from grid parallel operation in a safe and proper fashion. It must not energize any part of the utility system beyond the PCC when the voltage or frequency conditions are out of range. When the utility service is restored to within normal range it must
use a Company approved method to resynchronize with the system prior to re-connecting.

3.0 POWER FACTOR
Essentially all modern SPC are self commutating and pulse width modulated (PWM) devices which makes it possible for them to easily operate at a very high power factor when at full load (almost always in the vicinity of 1). Modern self commutating and pulse width modulated SPC should have no problem meeting the SIR requirement of an average 0.9 power factor at the PCC as long as the loads at the customer's facility do not cause poor power factor. The normal mode of operation that the customer is required to maintain is to operate the SPC as an essentially fixed power factor source close to unity. However, a benefit of some modern SPC designs is that some units can regulate the phase angle providing either leading or lagging VARs for voltage regulation purposes. In most cases, the Company does not allow this type of regulation to occur on the system by customer generation but under some scenarios it can be of benefit to the system and may be allowed pending review by the Company. For SPC falling within the 0 to 2 MW SIR guidelines, if the average power factor of the customer (including the effects of the generator current), as measured at the PCC is less than 0.9, then the method of power factor correction necessitated by the installation of the generator, if any, will be negotiated with the utility as a commercial item. For SPC larger than 2 MW, the Company will negotiate with the customer the reactive requirements of the machine and expected power factor performance.

4.0 HARMONICS
Modern units generally use Pulse Width Modulation (PWM) with high switching frequency and this has been shown to produce an extremely high quality waveform within IEEE 519-1992 requirements – especially good in the lower order harmonics. Despite meeting this standard, in rare cases, higher frequency harmonics and noise that arise from inverters (SPC), can on occasion cause interference with other devices or power line carrier systems. While generally this is extremely rare, the Company reserves the right to require that the customer should take corrective action or disable the system in the event of a noise problem after the system becomes operational. The Company requires that all inverters meet IEEE 519-1992 and IEEE 1547-2003 Harmonic limit requirements.

5.0 STATIC POWER CONVERTER PROTECTIVE FUNCTIONS
The customer is responsible for tripping the Static Power Converter intertie breaker and/or contactor and isolating his generator from the Company’s distribution system in the event of an electric fault or abnormal
voltage/frequency condition. The protective relaying requirements for a particular SPC facility will depend on the type and size of the facility, voltage level of the interconnection, location on the distribution circuit, fault levels, and many other factors. IEEE Standard 1547-2003 has specific tables with recommended default values for the trip settings of distributed generators. New York State also has specific requirements under the net metering law that applies to net metered PV inverter systems.

5.1 MINIMUM PROTECTIVE DEVICES

The absolute minimum protective functions that the Company will require for Static Power Converters 20 MVA and less will never be less than the functions mentioned below, and for non-net metered systems on a case by case basis it may be necessary for the utility to require additional protection. These functions could be by means of a utility grade relay controlling an interrupting device or, where applicable, by an imbedded relay function within the SPC controller if the SPC is certified. Minimum requirements are defined as follows:

a) Net Metered PV system SPC units and SPC under 15 kW rating

These systems shall use an SPC that is certified under the most current approved version of UL1741 requirements and/or that is type tested and approved by NYS PSC for parallel interconnection with the utility system. This means that the unit has suitable under/over voltage and frequency relaying functions, active (dynamic) anti-islanding, and the other necessary requirements outlined under the net metering requirements and UL1741.

b) Non-net metered SPC Units or Units Greater than 15 kW

These units shall employ the minimum required protection functions consisting of type tested and/or certified equipment under the most current version of UL 1741, and/or where appropriate, utility grade relays as specified by the Company. These functions shall include:

1. Undervoltage function (device 27) shall be performed phase to ground on each phase. These relays disconnect the customer from the Company’s distribution system during faults or when the Company feeder is out of service. The default trip settings should conform to IEEE Standard 1547-2003 Table 1. However, for generation greater than 30 kW the Company may require different settings.
on a case-by-case basis as needed.

2. Overvoltage function (device 59) shall be performed phase to ground on each phase. The default trip settings should conform to IEEE Standard 1547-2003 Table 1. However, for generation greater than 30 kW the Company may require different settings on a case-by-case basis as needed.

3. Utility grade over- and under-frequency protection (devices 81/0 and 81/U) are used to trip the generator or intertie breaker upon detecting a frequency deviation outside of reasonable operating conditions. The default trip settings should conform to IEEE Standard 1547-2003 Table 2. However, for generation greater than 30 kW the Company may require different settings on a case-by-case basis as needed.

The above functions are the minimum relaying functions per the SIR table of minimum requirements and per the context of IEEE 1547-2003. However, it should be recognized that the customer may be required, based on the outcome of a Coordinated Electric System Interconnection Review (CESIR) or general technical review, to add additional protection to facilitate proper operation of the Company’s low voltage network system or radial distribution feeders depending on where the system is interconnected. Additional and external protection could take the form of phase and ground fault overcurrent relays, ground fault over-voltage relays, directional power and/or overcurrent relays, transfer trips, speed matching controls, lock-out functions, etc.

5.2 STATIC POWER CONVERTERS WITH STAND ALONE CAPABILITY
As mentioned earlier, some SPC units designed for grid parallel operation also have stand-alone capabilities, meaning that they can operate independently of the Company’s distribution system. This type of arrangement is useful when the customer desires to serve just the customer load for power quality and reliability purposes if there should be a utility system power outage or abnormal voltage condition. Since under no circumstances is the customer allowed to energize the Company distribution system beyond the PCC when voltage and frequency conditions are out of range, the SPC
schemes with this type of stand-alone capability must have a suitable arrangement of switchgear and protective relays to isolate their island from the Company’s distribution system when the voltage and frequency goes outside the IEEE 1547-2003 limits (see Tables 1-2 in that standard). The intertie breakers and/or switchgear for this island shall be controlled by an appropriate scheme of relay functions that provide the necessary reliability, and control functions to detect abnormal utility conditions at the PCC, separate from the system and maintain a proper island for the customer, and resynchronize and connect to the system after utility service is restored to the normal range. Depending on the type of equipment that is employed (size rating, voltage level etc.) the Company may require utility grade relays, dc backup power for the tripping functions, and various alarms. Re-connecting back into the system may not be allowed until the Company’s district operator has approved for a manual reconnection.

5.3 USE OF UTILITY GRADE RELAYS TO SERVE AS BACKUP OVER IMBEDDED SPC PROTECTION FUNCTIONS

The Company does not require utility grade backup relays for less than 30 kW SPC systems that use the appropriate certified and/or type tested equipment. As SPC units become larger however, the need for utility grade backup relays becomes more critical. For larger SPC the Company may require a set of backup utility grade relays and switchgear to isolate the customer’s generation system even though the SPC has its own internal functions. The exact threshold where this becomes critical depends on the application and will be determined on a case-by-case basis.

5.4 TRANSFER TRIP

In some cases the Company may require some sort of transfer trip to provide more reliable islanding protection than is afforded by local voltage and frequency windowing relay functions alone (For example, DG connected directly to high tension feeders.) While an SPC unit with active-anti-islanding is unlikely to island with the utility system given its local protection functions, one that has the capability to serve the local customer as a stand-alone unit during a utility system interruption would need the active islanding protection disabled and thus must rely only upon passive voltage and frequency protection functions. In certain cases larger units in this class might need a transfer trip function.
6.0 SPC GROUNDING

The appropriate grounding scheme to use for the SPC interfaced generator is a function of the type of distribution system to which it is connected and other factors specific to each site. The main concerns of the Company regarding the type of SPC grounding to utilize are ground-fault overvoltages, ferroresonance, harmonics, dc-current injection, and ground-fault current contributions/detection issues. The Company may need to specify effective or solid grounding for an SPC generator whenever there is a concern about ground fault overvoltages on a four wire multi-grounded neutral distribution system. When interconnecting to ungrounded or uni-grounded distribution systems an ungrounded or impedance grounded interface to the Company distribution system at the PCC will usually be specified. The final determination as to which ground configuration is most appropriate will be done on a case-by-case basis. It is important to recognize that the type of grounding referred to in this section is the grounding with respect to the utility distribution system which is a function of not just the generator grounding itself, but also the configuration of the interface transformer winding configuration and its ground connection.

7.0 COMMON DESIGN REQUIREMENTS

Many design requirements that the customer must satisfy are common to all of the generator types (that is SPC, induction, and synchronous generator types). The common requirements include the disconnect switch, certification standards, power quality standards, voltage response tables, etc. See section-I of this manual for a complete discussion of the common requirements.

8.0 TYPICAL INTERCONNECTION DRAWINGS – Drawings 3 and 4 are interconnection drawings of typical SPC arrangements for electrical capacity of 500 kW or less. For larger units, additional requirements may be specified by the company. The relay devices, except for the reverse power relays, are functional representations of the package protection of the unit. These drawings are presented as illustrative examples and each project may have different or additional requirements.
V. SYNCHRONOUS GENERATORS-
TECHNICAL REQUIREMENTS

1.0 INTRODUCTION –
Synchronous generators are rotating energy conversion machines capable of operating as stand alone power sources (running independently of any other source). They also can operate in parallel with other sources (such as a utility distribution system) if they are properly synchronized to those sources and have appropriate protection/controls. In general, synchronous generators have the following characteristics from an interconnection standpoint:

- The integral exciter and exciter controls of a synchronous generator allow it to operate as a stand alone source. This is particularly useful for customers that desire DG installations that can serve the dual function of stand alone (standby) power unit and also grid parallel operation. Extra care in the anti-island protection is required with these units.

- Synchronous generators can adjust their excitation levels to vary the reactive output of the machine. A high level of excitation can make the unit produce reactive power for the utility system (appear capacitive). A low level can make the unit consume reactive power from the system (appear inductive). The power factor can be adjusted anywhere from substantially leading (capacitive) through unity to substantially lagging (inductive) making this technology very versatile for voltage regulation and VAR support applications for both the customer and the utility system.

- Synchronous generators, unlike induction generators, must be precisely synchronized with the utility system at the instant of connection and during operation. This means matching the frequency, phase angle and voltage magnitude within certain tight tolerances at the instant of interconnection of the customer’s tie breaker in order to avoid damage to or problems with the generator or utility system equipment. The unit’s speed must be controlled in appropriate fashion once it is connected so that it does not slip out of synchronism. If the unit slips out of synchronism and is not immediately separated from the system equipment damage or power quality problems could occur.

- Synchronous generators, due to their exciters can sustain fault currents for much longer than an induction generator (assuming the
exciter energy source is separately derived). This makes fault protection more critical on a synchronous unit than on an induction unit.

2.0 SYNCHRONOUS GENERATOR STARTING AND SYNCHRONIZING

The frequency, phase angle and voltage magnitude difference between the generator and the Company’s distribution system at the moment of connection must be no more than allowed in IEEE 1547-2003 (see Table 5 in that document). This is a requirement of the Company because failure to connect within the indicated tolerances could cause a significant voltage and current perturbation on the Company’s distribution system that could impact the power quality of other customers. In extreme cases, where the tolerances are widely violated, distribution system outages could be triggered, damage to Company equipment could occur and/or the customer generator could be severely damaged.

The prime mover (turbine or internal combustion engine) for the synchronous machine needs to be started and the generator needs to be brought up to synchronous speed prior to completing the synchronizing process described in the paragraph above. To do this, the prime mover may use the generator (acting temporarily as a motor) or other motorized auxiliary equipment to start the prime mover and get the unit up to synchronous speed. However, the Company requires that any starting equipment deriving its starting power from the utility system must not cause voltage flicker or voltage regulation problems on the Company distribution system. As part of the design review, the starting process is assessed to make sure that it does not cause unacceptable voltage flicker on the Company system. In order to assess voltage flicker from starting a synchronous generator, if the starting method draws power from the utility system, then the customer shall submit the expected number of starts per hour and the maximum starting kVA draw data to the utility to verify that the voltage dip due to starting is below the visible flicker limit as defined by IEEE 519-1992 and, where applicable, the Con Edison flicker specification (See Graph 1)

No synchronizing across Company distribution system equipment is allowed. This includes network protectors, switches and other devices. Interlocks with upstream disconnect switching devices may be required.

3.0 SYNCHRONOUS GENERATOR OUTPUT FLUCTUATIONS

While the machine is running and connected to the power distribution system, the output power must not be allowed to fluctuate in a manner
that causes objectionable voltage flicker or voltage regulation problems on the Company’s distribution system. The customer shall maintain and operate the generation facility such that any intentional and/or unintentional power output fluctuations do not cause flicker that exceeds the visible flicker limit as defined by IEEE 519-1992 and, where applicable, the Con Edison flicker requirements (see Graph 1).

4.0 SYNCHRONOUS GENERATOR POWER FACTOR AND REACTIVE POWER CONTROL MODE

The synchronous generator output, due to its exciter controls, can be adjusted to near unity power factor and can even provide reactive support if needed. For synchronous generators falling within the 0 to 2 MW SIR guidelines, if the average power factor of the customer (including the effects of the generator current), as measured at the PCC is less than 0.9, then the method of power factor correction necessitated by the installation of the generator, if any, will be negotiated with the utility as a commercial item. For Reactive Power (VAR) requirements, the customers shall refer to the applicable Company’s rate “Service Classification” under the Special Provisions section to determine the kilovar charges. For generators larger than 2 MW, the Company will negotiate with the customer the reactive requirements of the machine and expected power factor performance.

Unless otherwise required by the Company, the synchronous generator will operate in a “voltage following” mode where it operates at near unity power factor and it will not directly attempt to regulate the voltage by adjusting the VAR output (either leading or lagging).

If the customer does not wish to use a voltage following approach and instead wants to use reactive-current based regulation either to help reduce the customer reactive demand or improve voltage regulation, then the control scheme, generator reactive current capability ratings and settings will be reviewed by the Company to insure that they are compatible with the Company distribution system at the point of connection. The Company will grant permission for this approach if it is feasible at the site where it is applied. Use of this method will be approved only if it can be shown that the settings will not cause voltage regulator hunting effects, degradation of voltage conditions on the feeder, and nuisance trips of the generator due to reactive current overloads. Voltage regulation schemes using the reactive current regulating capabilities of synchronous generators can be helpful to both the customer and the Company.

5.0 SYNCHRONOUS GENERATOR PROTECTION

The customer is responsible for tripping the generator intertie breaker and
or contactor and isolating the generator from the Company’s distribution system in the event of an electric fault and/or abnormal voltage/frequency condition. The protective relaying requirements for a particular facility will depend on the type and size of the facility, voltage level of the interconnection, location on the distribution circuit, faults levels, and many other factors. IEEE Standard 1547-2003 has specific tables with recommended default values for the trip settings of distributed generators.

5.1 MINIMUM PROTECTIVE DEVICES - The absolute minimum protective relays that the Company will require for Synchronous generators will never be less than the relays mentioned below, and on a case by case basis it may be necessary for the Company to require additional protection. Synchronous generators need more protection than induction generators and this is reflected in the minimum requirements below:

a) Utility grade undervoltage relays (device 27) shall be connected phase to ground on each phase. These relays disconnect the customer from the Company’s distribution system during faults or when the Company feeder is out of service. The default trip time settings should conform to IEEE Standard 1547-2003 Table 1. However, for generation greater than 30 kW the Company may require different settings on a case-by-case basis as needed.

b) Utility grade overvoltage relays (device 59) shall be connected phase to ground on each phase. The default trip time settings should conform to IEEE Standard 1547-2003 Table 1. However, for generation greater than 30 kW the Company may require different settings on a case-by-case basis as needed.

c) Utility grade over- and under-frequency protection (devices 81/0 and 81/U) are used to trip the generator or intertie breaker upon detecting a frequency deviation outside of reasonable operating conditions. The default trip time settings should conform to IEEE Standard 1547-2003 Table 2. However, for generation greater than 30 kW the Company may require different settings on a case-by-case basis as needed.

d) Utility grade synchronism-check relay (device 25C) operates when the customer generator and the Company’s distribution system is within the desired limits of frequency, phase angle and voltage. IEEE 1547-2003 Table 5 has specific settings
that the Company may require. The Company also may require other settings on a case-by-case basis as needed.

e) Ground fault detection. Use either a utility grade non-directional ground overcurrent relay (device 51N) for wye-connected systems or a utility grade zero sequence overvoltage relay (device 59N) for delta-connected systems. This detects Company system ground faults and trips the generator offline.

f) Utility grade phase overcurrent relays. Three phase-overcurrent relays (device 50/51) or Three-phase, voltage-controlled/restraint overcurrent relays (device 50V/51V) trips on a desired value of overcurrent flowing out of the customer’s generator that is coordinated with thermal damage characteristics of the machine windings.

The above functions are the minimum Company required relaying functions for a synchronous generator per the SIR minimum requirements and per the context of IEEE 1547-2003. However, it should be recognized that the customer may be required, based on the outcome of a Coordinated Electric System Interconnection Review (CESIR) or general technical review, to add additional protection to facilitate proper operation of the Company’s low voltage network system or radial distribution feeders depending on where the system is interconnected. Additional protection could take the form of directional power and/or overcurrent relays (device 32 or 67), transfer trips, lock-out functions (device 86), backup relays, etc. The protection scheme could also require a dc battery relay tripping source with appropriate alarm and/or protection should it fail.

It is important to recognize that the protection functions mentioned above are specified by the Company with the objective to protect the Company’s electrical distribution system as well as its other customers from the effects of the customer’s generator. However, the customer should be aware that their generator may itself also be damaged by voltage or current anomalies and the customer may need additional protection beyond what is specified by the Company to protect their own generator plant. For example, unbalanced voltage (device 47) and current relays (device 46) would have little impact on the protection of the Company distribution system, but could be crucial to the generator to protect it from overheating in an unbalanced voltage or current condition.
To insure that both the utility system and the generator are protected, the customer has the responsibility to install the Company designated relays and also work with the generator manufacturer or system integrator to use relays and grounding practices that are coordinated to protect the generator itself from damage during faults and other anomalies. Damage that occurs to a customer generator as a result of failure to use appropriate protection and design practices is not the responsibility of the Company.

5.2 PROTECTION OF SYNCHRONOUS GENERATORS TRANSITIONING FROM GRID PARALLEL TO STAND ALONE OPERATION
Customers that want to transition their generation system from grid-parallel to standalone operation for power quality and reliability purposes when the Company supplied power is unavailable at the PCC can do this with a synchronous generator if the appropriate protection and isolation is provided. This type of operation is allowed as long as the customer generator does not energize any portion of the Company’s system beyond the PCC during the system outage or abnormal voltage conditions. This type of arrangement requires the customer to have anti-islanding protection by monitoring the intertie point (PCC) with appropriate relaying functions that will operate an isolation device (tie circuit breaker) at the PCC. The islanding protection would consist of voltage and frequency window relays per IEEE 1547-2003 Tables 1 and 2 trip settings or other modified settings if required by the Company.

5.3 GRADE OF RELAYS FOR SYNCHRONOUS GENERATORS
Only relays that are certified (type tested) or utility grade will be accepted for protection of the interconnection and the generator. Relays may be single function or multifunction packages, and they can be mechanical, solid state or microprocessor based types as long as they satisfy the utility grade or type tested (certification) specifications. Modern microprocessor multifunction relays designed for generator protection that satisfy the required utility grade specifications have recently become much more cost effective (compared to earlier products of a decade ago) and are available from a variety of vendors.

5.4 TRANSFER TRIP
The Company may require a transfer trip to provide more reliable
islanding protection than is afforded by local voltage and frequency windowing relays alone. Islanding cannot be allowed under any circumstances on the Company’s system and the Company must use extra caution in the design of the interconnection for these generators.

6.0 SYNCHRONOUS GENERATOR GROUNDING

The appropriate grounding scheme to use for the synchronous generator is a function of the type of distribution system to which it is connected and other factors specific to each site. The four main concerns of the Company regarding the type of synchronous generator grounding are ground-fault overvoltages, ferroresonance, harmonics, and ground-fault current contribution/detection issues. The Company may need to specify effective or solid grounding whenever there is a concern about ground fault overvoltages on a four wire multi-grounded neutral distribution system. Ungrounded or impedance grounded installations might be specified in other circumstances (such as when interconnecting to ungrounded or uni-grounded distribution systems). The final determination as to which ground configuration is most appropriate must be done on a case-by-case basis.

7.0 SYNCHRONOUS GENERATOR HARMONICS

The company requires that the customer maintain harmonic distortion levels at the PCC in accordance to IEEE 519-1992 and IEEE 1547-2003 (see Table 3 in that document). While synchronous generators are relatively distortion free from a positive sequence voltage perspective, the characteristics of these machines can create zero sequence harmonic voltages that appear in the zero sequence path (neutral). They can also exacerbate certain harmonics that are created by load currents. These harmonics can occasionally be problematic depending on the machine design and loads at the customer facility. With certain transformer arrangements, some harmonic distortion can find its way from the customer to the utility system and vice versa. As part of any CESIR design package review, practices will be recommended by the Company that have shown the best results in mitigating harmonics in a particularly situation. These include specifying a generator winding arrangement with a 2/3 pitch (as opposed to a full pitch where the magnetic field poles span a rotational distance equal to that of the stator winding area), providing special grounding to limit the flow of zero sequence harmonics, the use of interface transformers with windings that block the flow of harmonics, and harmonic filters. Some of the solutions that are appropriate also must be balanced against the grounding needs of the generator and so must be addressed on a case-by-case basis.
8.0 STABILITY OF SYNCHRONOUS GENERATORS - In order to assure continued operation of the dispersed generation source and minimize impacts to existing customers during system disturbances, the stability of the customer’s generator may need to be investigated for larger units in this class or aggregations of many smaller units.

Instability occurs when systems are subject to disturbances. While all generator types can have stability issues, rotating synchronous generators, in particular, owing to their electromechanical nature and the characteristics of synchronizing torques/inertia effects are the most likely of the three types of units to experience stability related issues. Stability problems can cause loss of synchronism (forcing the generator to trip offline) or build up of rotor oscillations that lead to power quality and/or reliability problems. Examples of contributing factors to the problem are:

a) Load swings
b) Switching operations
c) Short circuits
d) Loss of utility supply
e) Motor starting
f) Hunting of synchronous machines
g) Periodic pulsation applied to synchronous systems

Power system stability studies are essential for planning and designing a dispersed generation installation. The method of determining the stability limits of a system is elaborate and must take into account all the factors affecting the problem including the characteristics of all machines, exciting systems, governors, inherent regulation, grounding and circuit breaker response time. The Company may require a stability study part of a CESIR.

9.0 COMMON DESIGN REQUIREMENTS
Many design requirements that the customer must satisfy are common to all of the generator types (that is SPC, induction, and synchronous generator types). The common requirement include the disconnect switch, certification standards, power quality standards, voltage response tables, etc. See section 1 of this manual for a complete discussion of the common requirements.

10.0 TYPICAL INTERCONNECTION DRAWINGS – Drawings No. 5, 6, 7, 8 and 9, at the end of this manual, represent typical interconnection design for various types synchronous generators. Each project may have different requirements. These drawings are presented as illustrative examples and each project may have different or additional requirements.
This revision includes the wind power requirement, queuing procedure, etc. as highlighted in Gray.
# Table 1

## DISTRIBUTION SYSTEM SERVICES

<table>
<thead>
<tr>
<th>Service District</th>
<th>Service Type (%)</th>
<th>Predominant Service Voltages</th>
<th>Predominant Distribution System Configurations</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Underground</td>
<td>Overhead</td>
<td>Primary Voltage</td>
</tr>
<tr>
<td>Bronx</td>
<td>88</td>
<td>12</td>
<td>27kV 13kV 4kV</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>120/208V</td>
</tr>
<tr>
<td>Brooklyn</td>
<td>91</td>
<td>9</td>
<td>27kV 4kV</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>120/208V</td>
</tr>
<tr>
<td>Manhattan</td>
<td>100</td>
<td>0</td>
<td>13kV</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>120/208V</td>
</tr>
<tr>
<td>Queens</td>
<td>86</td>
<td>14</td>
<td>27kV 4kV</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>120/208V</td>
</tr>
<tr>
<td>Staten Island</td>
<td>49</td>
<td>51</td>
<td>33kV 13kV 4kV</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>120/208V 120/240V</td>
</tr>
<tr>
<td>Westchester</td>
<td>56</td>
<td>44</td>
<td>13kV 4kV</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>120/208V 120/240V</td>
</tr>
</tbody>
</table>
### Table 2

#### EXAMPLES OF DISPERSED GENERATION CLASSIFICATIONS

<table>
<thead>
<tr>
<th>Drawing No.</th>
<th>Generation Type</th>
<th>Service Classification</th>
<th>Interconnection Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>No.1</td>
<td>Induction</td>
<td>Standby</td>
<td>LT- Preferred Arrangement</td>
</tr>
<tr>
<td>No.2</td>
<td>Induction</td>
<td>Standby</td>
<td>LT- Alternate Arrangement</td>
</tr>
<tr>
<td>No.3</td>
<td>Converter</td>
<td>Standby</td>
<td>SPC-Parallel</td>
</tr>
<tr>
<td>No.4</td>
<td>Converter</td>
<td>Standby</td>
<td>SPC- Stand Alone</td>
</tr>
<tr>
<td>No.5</td>
<td>Synchronous</td>
<td>Standby</td>
<td>LT- Non Isolated Operation-Preferred</td>
</tr>
<tr>
<td>No.6</td>
<td>Synchronous</td>
<td>Standby</td>
<td>LT- Non Isolated Operation-Alternate</td>
</tr>
<tr>
<td>No.7</td>
<td>Synchronous</td>
<td>Standby</td>
<td>LT- with Stand Alone Capability</td>
</tr>
<tr>
<td>No.8</td>
<td>Synchronous</td>
<td>Buy Back</td>
<td>HV-Single Feeder (13, 27 and 33 kV)</td>
</tr>
<tr>
<td>No.9</td>
<td>Synchronous</td>
<td>Buy Back</td>
<td>HV-Single Feeder (13, 27 and 33 kV)</td>
</tr>
</tbody>
</table>
### TABLE 3

**COMPANY’S SYSTEM GROUNDING METHODS**

<table>
<thead>
<tr>
<th>System Nominal Voltage *</th>
<th>Phase / #Wire</th>
<th>Transformer Connection Primary / Secondary</th>
<th>Grounding Method</th>
</tr>
</thead>
<tbody>
<tr>
<td>120 / 208 208Y / 120</td>
<td>3 Phase / 4 Wire</td>
<td>Delta / Wye-Ground</td>
<td>Multi-grounded Solid Neutral</td>
</tr>
<tr>
<td>265 / 460 480Y / 277</td>
<td>3 Phase / 4 Wire</td>
<td>Delta / Wye-Ground</td>
<td>Multi-grounded Solid Neutral</td>
</tr>
<tr>
<td>2,400 / 4,160 4,160Y / 2,400</td>
<td>3 Phase / 4 Wire</td>
<td>Wye-Ground / Wye-Ground</td>
<td>Multi-grounded Solid Neutral</td>
</tr>
<tr>
<td>13,800</td>
<td>3 Phase / 4 Wire</td>
<td>Delta / Wye **</td>
<td>Unigrounded</td>
</tr>
<tr>
<td>27,000</td>
<td>3 Phase / 4 Wire</td>
<td>Delta / Wye **</td>
<td>Unigrounded</td>
</tr>
<tr>
<td>33,000</td>
<td>3 Phase / 4 Wire</td>
<td>Delta / Wye **</td>
<td>Unigrounded</td>
</tr>
</tbody>
</table>

* Refers to transformer secondary side  
** Transformer Wye Neutral grounded via reactor
### TABLE 4

**TOLERANCES**

<table>
<thead>
<tr>
<th>Test Parameter</th>
<th>Tolerance of Specified Settings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Current</td>
<td>± 5%</td>
</tr>
<tr>
<td>Voltage</td>
<td>± 5%</td>
</tr>
<tr>
<td>Time</td>
<td>± 5%</td>
</tr>
<tr>
<td>Frequency</td>
<td>± 0.05 HZ</td>
</tr>
<tr>
<td>Phase Angle</td>
<td>± 3 Degrees</td>
</tr>
</tbody>
</table>
NOTES:
1. These limits are for 120-volt circuits during normal operating conditions. They also apply to services supplied by closely associated transformers (three or more banks) under first contingency only. For first contingency elsewhere within the network area, multiply Chart values by a factor of 1.5. Flicker limits for 265 volt applications are obtained when multiplying the Chart values by a factor of 2.2.

2. **Group I Limits** apply, in general, to residences, small apartment houses, small stores and industrial establishments, as follows:
   (a) A 6-volt flicker is permissible for infrequently started appliances if the service supplies more than one customer.
   (b) An 8-volt flicker is permissible during the start-up of air conditions or other infrequently started appliances, provided the service supplies only one customer.
   (c) A 9-volt flicker is permissible for fire pumps and other occasionally started equipment, and also for apparatus started not more often than once in two hours, if little or no lighting is involved.

3. **Group II Limits** apply to services supplying extensive amount of lighting load and affecting relatively large groups of people such as office buildings, hotels, theaters, large stores, large apartment buildings, etc. Group II Limits should also be used for equivalent 120 volt flicker on 2.4 and 4 kV primary feeders.
Appendix A

DOCUMENTATION REQUIREMENTS

Prior to equipment installation, the customer shall submit the equipment and generating system description per the attached Application for Dispersed Generation Operation forms to the Company for approval. All pertinent forms shall be completed, signed and sealed by the Customer or their representative as approved by the Company. The required information is necessary for the Company to properly review the project.

1.0 APPLICATION REQUIREMENTS

When a customer expresses a definite commitment to install a generator for the purpose of parallel interconnection operation with the Company’s utility service, he shall prepare a request using the “APPLICATION FOR DISPERSED GENERATION OPERATION” and forward it to the Manager, Cogeneration Projects Group of the Distribution Engineering Department.

1.1 One-Line Diagram

The one-line diagram shall be prepared by a licensed Professional Engineer with experience in this discipline.

The one-line diagram shall be submitted for each application for parallel operation with the Company system. The drawing(s) shall show existing and proposed facilities at the customer’s location. For the initial submittals a distinction shall be made between existing facilities, modifications to existing facilities and new equipment. The drawing(s) shall show as a minimum, the items indicated below. A separate one-line diagram is required for each location. “Typical” drawings or manufacturers’ catalog cuts are not acceptable for a one-line diagram.

Drawing content on the initial submittal should include as much of the following information as possible:

1.1.1 All buses, cables, breakers, fuses, transformers, etc. All equipment must be uniquely identified.

1.1.2 Equipment Ratings.

a) Generator

- Capacity
- Voltage
- Power Factor
• Type (Synchronous, Induction)
• Manufacturer
• Winding Connection (Delta, Wye)
• Grounding Equipment Ratings
• Subtransient Reactance

b) Bus Work

• Voltage
• Ampacity
• Manufacturer/Model

c) Circuit Breakers

• Continuous Current Ratings
• Short Circuit Interrupting Ratings
• Close and Latch Current Ratings
• Manufacturer/Model

c) Fuses

• Current Ratings
• Manufacturer/Model
• Indicate if Current Limiting

e) Disconnect/Ground Switches

• Current Ratings
• Indicate if Lockable
• Manufacturer/Model

f) Transformers

• Capacity Ratings
• Cooling/Temperature Ratings
• Voltage Ratings
• Voltage Taps
• Impedance
• BIL
• Winding Connection (Nameplate)
• Grounding Facilities and Ratings

1.1.3 Monthly Load Data (without Generation – Last 3 Years)
- Maximum Facility Demand (from billings last – 3 years)
- Contract Demands
- Minimum Facility Monthly Demand (from billings – last 3 years)
- Facility Minimum Daily Demand

1.1.4 Protective Relaying & Metering

- ANSI Relay Designation
- \( ct \) & \( vt \) Ratios and Accuracy Class
- Relay Breaker Tripping
- Relay Function Description
- Relay Manufacturer & Model
- Relay Set Points

1.1.5 Generator Leads

- Impedance
- Type of Circuits
- Number of Circuits

1.2 Generation Data

A customer shall fill out and submit the data forms applicable to the type(s) of generation for the project. Induction Generator, Synchronous Generator and Inverter data sheets are included in this handbook.

The customer shall provide the reactive power requirements of the induction generator over its entire operating range.

The appropriate form(s) shall be completed for every unit proposed for interconnection, even if they have the same characteristics. The applicable form should contain as much information as possible. This will greatly reduce unnecessary delays to obtain missing data.

2.3 Short-Circuit and Relay Coordination Study

The Customer shall supply a short-circuit and relay coordination study for the facility in addition to the information required on the attached “Protective Equipment - Data & Test Record” form. It is recognized that the data required in this section may not be available at the time of the application, but it is the Customer’s responsibility to make it available for
The study should include:

1.3.1 Short-circuit current calculations for a relay study. Short-circuit currents to predict the operation of various overcurrent protective devices.

1.3.2 Relay current-tap and time-dial setting

- Relays on transformer feeders
- Relays on single motor feeders
- Relays on incoming lines and feeders with miscellaneous load
- Residually-connected ground-fault relays
- Ground-fault relays in series with generator or transformer neutral
- Intertie relays

1.3.3 Graphical Proof of Device Coordination

a) Coordination of relays and other devices in series including:

- Time-delay relays
- Fundamental rules for coordination of Time-delay relays
- Time-delay direct-acting circuit breaker trips and fuses
- Instantaneous devices (relays and direct-acting trips) and consider the following,

1. Effect of fault current decay due to generator-current decrement on relay performance.

2. Effect of current transformer saturation on relay behavior.
b) Coordination of Overcurrent Devices

- Coordination of primary fuses and secondary feeder circuit breakers.
- Coordination of primary fuses and transformer main secondary circuit breakers.
- Generator coordination - Utility and load circuit breakers.

1.3.4 Effect of Wye-Delta and Delta-Wye connected transformers on overcurrent protective device coordination.

A relay test report form (Protective Equipment - Data & Test Record - Form 6) is attached and shall be used for submitting data information for each relay installed on the Customer system or supplied by the Customer.

1.4 Generation Load Data

- Daily, monthly, seasonal, shoulder and annual load profiles showing highest 30 minute maximum demand (kW)
- Scheduled maintenance periods
- List of equipment with ratings to be switched to Company supply during downtime. Show estimated highest 30 minute maximum demand (kW)
- Contract Demand _______ kW

1.5 Load to be Supplied by Company

- List of equipment with ratings
  Highest maximum 30 minute demand (kW)
- Contract Demand __________ kW
- Estimated daily, monthly, seasonal, shoulder and annual load profiles showing highest 30 minute maximum demand (kW)

2.0 ATTACHMENTS

The following attachments are part of this appendix:

Forms:

No. 1 – Application for Dispersed Generation Operation
No. 2 – Induction Generation Data
No. 3 – Synchronous Generator Data
No. 4 – Excitation System Data
No. 5 – Inverter Data
No. 6 – Protective Equipment Data & Test Record

Drawings:

No. 1 - Low-Tension Induction Generators - Preferred Arrangement
No. 2 - Low-Tension Induction Generators - Alternate Arrangement
No. 3 - Static Power Converter - Parallel Operation
No. 4 - Static Power Converter - With Stand Alone Capability
No. 5 - Low-Tension Synchronous Generators, Non-Isolated Operation - Preferred Arrangement
No. 6 - Low-Tension Synchronous Generators, Non-Isolated Operation - Alternate Arrangement
No. 7 - Low-Tension Synchronous Generators with Stand Alone Capability
No. 8* - High Voltage (13 kV, 27 kV and 33 kV) Single Feeder Buy Back Service
No. 9* - High Voltage (13 kV, 27 kV and 33 kV) Single Feeder Supplementary Service

NOTE: (*) This interconnection scheme could be upgraded to provide second contingency restoration capability either manual or automatic (break-before make) transfer switching to an alternate Company supply or emergency generator. In this case, appropriate interlocks must be installed to preclude:

a) Tying two systems out-of-phase with each other; and
b) Inadvertent energization of the Company’s high tension feeder.
ADDENDUM TO APPLICATION FOR SERVICE

FOR APPLICANTS REQUESTING DISPERSED GENERATION OPERATION AND ELECTRIC STANDBY SERVICE AND/OR BUY-BACK SERVICE

Application is made hereunder to CONSOLIDATED EDISON COMPANY OF NEW YORK, INC. ("Con Edison" or the "Company") for use of an on-site generation facility under the terms of the applicable rate schedule(s) for: (a) delivery of delivery and supply of electricity by the Company under Service Classification No. ("SC") 14-RA-Standby Service, and/or (b) purchase of electricity under SC 11-Buy-back Service. The applicant agrees to pay for such service at the rates and charges, and under the terms and conditions, specified in the Company's rate schedule(s) as these may be amended from time to time. The terms and conditions of SC 14-RA and SC 11 can be viewed at www.coned.com/committees.

An applicant requesting electricity service under SC 14-RA and/or SC 11 must complete this form in addition to the Application for Service. This form is not applicable to applicants for service under Rider R. Net Metering for Customer Generators. An applicant for Dispersed Generation of 2 MW or less connected in parallel to Con Edison's Distribution System must comply with New York State Standardized Interconnection Requirements ("SIR") set out in Addendum-SIR to Con Edison's Schedule for Electricity Service and complete the application contained therein in addition to this application. (See www.coned.com/documents/dcs/EO/Addendum-SIR.PDF.) Other customers must comply with the Company's design requirements and operating rules and procedures.

This application shall not be modified or affected by any promise, agreement, or representation, orally or in writing, by any agent or employee of the Company.

Section 1.

Date Application Filed__/__/____

Mo. Day Yr.

Account Name

Service Address

Borough/Municipality Zip

Expected date that service will be completed

Expected date service will be energized

Will this project be operated in parallel with Con Edison’s system? □ YES □ NO

If YES, what is the expected date of first parallel operation?

Section 2.

1. Type of Service Requested: (Please check)

☐ Standby (SC 14-RA)  ☐ Buy-back (SC 11)

Section 3. If you are requesting Standby Service (SC 14-RA)

Billing

A. Exemption from SC 14-RA Rates

Certain customers, based on their generator's capacity, receive service under SC 14-RA, but are billed under the SC that would otherwise be applicable if they did not have a generating facility on the premises.

If applicable to your service, please check the box that applies:

☐ Your generation equipment has a nameplate rating equal to no more than 15% of the maximum potential demand from all sources.

☐ You would otherwise be billed under a non-demand-metered SC (SC 1, SC 2 or SC 7).
B. Optional Exemption from SC 14-RA Rates

Certain customers who receive service under SC 14-RA have the option to be billed either under SC 14-RA rates or under the SC that would otherwise be applicable if they did not have a generating facility on the premises.

If you are requesting to be billed at the SC that would otherwise be applicable to your service, please check the box that applies:

- Your contract demand is less than 50 kW.
- Your generator uses a designated technology, as described in Section 4, and commences operation between 7/29/03 and 5/31/09.

C. Phase-in or Immediate Billing of SC 14-RA Rates

Certain customers have the option to be billed immediately under SC 14-RA rates or to have such billing phased-in until the billing period ending on or before 1/31/11.

If you are requesting to have SC 14-RA billing phased-in, please check the box that applies:

- Your generator uses a designated technology, as described in Section 4, and commences operation between 7/29/03 and 1/31/11.
- You received service under SC 3 – Back-up Service or SC 10 – Supplementary Service as of 1/31/03.
- You commenced construction of, or executed binding financial commitments for construction of, an on-site generation facility as of 1/31/00.
- You are named in the 3/31/03 Joint Proposal in Public Service Commission Case 02-E-0781 as: (a) a recipient of a New York State Energy Research and Development Authority ("NYSERDA") feasibility study award, and the generator commences operation by 5/31/09, or (b) a recipient of a New York State Energy Research and Development Authority ("NYSERDA") on-site generation project award.

D. Full Billing at SC 14-RA Rates

If you did not check off boxes in A, B or C, billing will commence at full standby service rates.

Section 4. If using a Designated Technology(ies)

A customer who exclusively uses one or more of the following technologies or fuels may request an exemption from, or phase-in to, standby service rates. If you are requesting a phase-in or exemption for this reason, please check the box(es) that applies:

- Fuel Cells
- Wind
- Solar Thermal
- Photovoltaics
- Sustainably-Managed Biomass
- Tidal
- Geothermal
- Methane Waste
- Combined Heat and Power (CHP), as described in Section 8, of 1 MW or less

Section 5.

Electric Delivery Service

What type of SC 14-RA delivery service are you requesting?

- Electricity Delivery and Supply Service from Con Edison
- Electricity Delivery Service only from Con Edison

If you are requesting Electric Delivery Service only, will you purchase electricity supply from an ESCO?

- YES
- NO

If NO, will you be a Direct Customer?  YES  NO

(To be a Direct Customer, your aggregate load must be 1 MW or more.)
Contract Demand

SC 14-RA Contract Demand (Low Tension) ___ kiloWatts (kW) or (High Tension) ___ kiloWatts (kW)

(If Contract Demand is not provided by the SC 14-RA applicant, it will be determined by Con Edison.)

REMARKS: ____________________________

Section 6.

If Buy-Back Service (SC 11) is requested:

Type of Facility

Is this facility a "Co-generation Facility," "Alternate Energy Production Facility," or "Small Hydro Facility," as defined in Section 2 of the New York Public Service Law?

☐ YES  ☐ NO

Is this facility a "Qualifying Facility" under Part 292 of Title 18 of the Code of Federal Regulations?

☐ YES  ☐ NO

Documentation attached?

☐ YES  ☐ NO

Type of Documentation ____________________________

Contract Demand

SC 11 Contract Demand _____________ kiloWatts (kW)

REMARKS: ____________________________

Section 7.  (Not required if submitting a New York State Standardized Interconnection Requirements "SIR" Application)

Type of Generator/System:

☐ Induction Generator  kWAR Requirements ____

☐ Inverter System

☐ Synchronous

Maximum Capacity _________ kW

Power Factor: Generation _________% Generation and Load _________% (at interconnection point)

Engines:

Fuel (primary) _________ Fuel (alternate) _________ BTU/Hr Input _________ BTU/Hr Output _________

Therm/HR _________, Therm/HR _________

Please check this box if you would like information on Con Edison's gas service options for Dispersed Generation where Con Edison's gas delivery service is available.

☐

REMARKS: ____________________________

Section 8.

Electrical Contractor/Design Information

Responsible Electrical Contractor/Firm ____________________________

Address ____________________________ Telephone ____________________________

Name of Engineer or Licensed Electrician ____________________________

The following must be submitted to Con Edison for its approval prior to the purchase of any equipment. Please check off the following boxes, as applicable:
Section 9.

Combined Heat and Power Qualifying Requirements

An applicant seeking to qualify the generator as a Designated Technology Customer - Combined Heat and Power (CHP) installation must submit a project analysis undertaken by a licensed Professional Engineer (PE) that documents that the installation meets all of the requirements set forth below. The project analysis must be submitted with the applicant's design information as set forth in Section 8 of this application or contained in the "SIR."

- The annual overall efficiency is no less than 60% based on the higher heat value (HHV) of the fuel input.
- The usable thermal energy component absorbs a minimum of 20% of the CHP facility's total usable annual energy output.
- The CHP installation does not exceed 1 MW of capacity and serves no more than 100% of the customer's maximum potential demand.
- NOx emissions do not exceed 4.4 lbs/MWh. This standard is effective until the New York State Department of Environmental Conservation adopts a new emissions standard concerning stationary combustion installations, at which time such new standard will apply.

PE Seal here

Professional Engineer Information:
Please affix seal in circle

Name (Print) ______________________________________
License No. ____________________________________
Signed _________________________________________
Date ___________________________________________

Consolidated Edison, at its discretion, may request a new project analysis or an update of an existing project analysis periodically, but no more than once a year.

Section 10. TO THE BEST OF MY KNOWLEDGE THE INFORMATION PROVIDED HEREIN IS ACCURATE AND NO ATTEMPT HAS BEEN MADE TO MISREPRESENT THE FACTS.

ADDITIONAL APPLICATION SUBMITTED BY:

Name of Applicant ______________________________
(Please print)
Full Signature __________________________________
Telephone # ( ) ________________________________

Affiliation to person responsible for account (Check one)

- Owner
- Partner
- Same
- Corporate Officer
- Agent
- Other
(Specify)
## Application and Design

### Manual No. 4

**Field Manual No. 16, Sect. 4**

**March 2006**

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### For Company Use Only

<table>
<thead>
<tr>
<th>Related Electric Service(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Is there a related electric service supplied from the same service facilities as this account?</td>
</tr>
</tbody>
</table>

If YES, provide account number(s) and describe: ____________________________

---

### Interconnection Charge

<table>
<thead>
<tr>
<th>Interconnection Charge</th>
<th>THIS SERVICE</th>
<th>FIRM SERVICE</th>
<th>CHARGE (NET)</th>
</tr>
</thead>
<tbody>
<tr>
<td>For SIR Applicants</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Estimated Interconnection Cost</td>
<td>$___________</td>
<td>$___________</td>
<td>$___________</td>
</tr>
<tr>
<td>Actual Interconnection Cost</td>
<td>$___________</td>
<td>$___________</td>
<td>$___________</td>
</tr>
<tr>
<td>For all other Applicants</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Interconnection Costs</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>$___________</td>
<td>$___________</td>
<td>$___________</td>
</tr>
</tbody>
</table>

*If payment will be made in installments (Not applicable to SIR Applicants), what is the initial payment amount? _______ (minimum 25%) Over how many years will the balance, plus interest, be paid? ☐ one year ☐ two years ☐ three years ☐ four years ☐ five years (5-year maximum)*

**AMOUNT PAID**: $___________  **DATE**: **Month** / **Day** / **Year**

### Annual O&M Charge

| Amount to be Paid Monthly | $___________ |

### Security Deposit

| Security Deposit | $___________ |

### Application Fee

| Application Fee | $350. SIR Application Fee when the aggregate nameplate rating exceeds 15 KW |

### Rate and Documentation Review

**Qualifying Exemptions:**

- ☐ On-Site generation serving 15% of total load or less
- ☐ Customer with Contract Demand of less than 50 kW
- ☐ Customer with Designated Technology commencing service 7/29/03-5/31/06
- ☐ Customer billed under a non-demand metered SC (SC1, SC2 or SC7)

**Qualifying Phase-in:**

- ☐ Designated Technologies Customer
- ☐ Existing Customer as per SC 14-RA

### Documentation Submitted:

- ☐ Agent Letter of Authorization
- ☐ Qualifying Facility Status Documentation (SC 11)
- ☐ Designated Technology Documentation (SC 14-RA)
- ☐ One-line Installation Diagram
- ☐ Protection Schematics
- ☐ Generator Control Description
- ☐ Other ____________________________

### Rate Determination

**Special Billing Indicator**: __________

**Customer Service Class**: __________

**Contract Demand**: _______ kW  **Established by**: ☐ Customer ☐ Company

**Authorized by**: __________  **Employee #**: __________  **Date**: __________

### Interconnection Determination

**Authorized by**: __________  **Employee #**: __________  **Date**: __________

**Application taken by**: __________  **Employee #**: __________  **Date**: __________

**Application approved by**: __________  **Employee #**: __________  **Date**: __________

---

**GA 6067-4R 6/06**

**Page 5 of 5**

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INDUCTION GENERATOR DATA

Location: ________________________________

Manufacturer ___________________________ Unit No. ________________________________
Serial No. ________________________________ Type ________________________________

RATED OUTPUT

________________________ kVA Locked Rotor _____________________________ Amp
________________________ kW
________________________ kV Magnetizing Inrush
________________________ Amp Current if Energized
________________________ HP at Synchronous Speed __________________________ Amp
________________________ PF Synchronous Speed __________________________ RPM
Efficiency __________________________ %
Frequency __________________________ Hz

Rotor Reactance (Xr): ________________ p.u.* Stator Reactance (Xs): ________________ p.u.*
Magnetizing Reactance (Xm): ________________ p.u.* Short-Circuit Reactance (Xd*): ________________ p.u.*

Generator and Turbine Inertia WR² ________________ lb. ft.²
Inertia Constant on Machine Base Hc ________________ MW Sec/MVA
Exciting Current: ______________________________ Amp

Reactance Power Required: (a) __________________________ kVAR @ No Load
(b) __________________________ kVAR @ Rated Load

Frequency of Starts: __________________________ Per Minuto __________________________ Per Hour

* Per Unit Based on Own kVA Rating
SYNCHRONOUS GENERATOR DATA

Location: ________________________

Manufacturer ____________________ Unit No. ______________________

Serial No. ________________________ Type _________________________

RATED OUTPUT

___________________ kVA  Number of Phases _______________________

___________________ kW  Damper (Amortisseur) Winding ____________

___________________ kV  Winding Connection _______________________

___________________ Hz  Neutral Grounded? _______________________

___________________ RPM  Gnd Resistance _________________________ ohms

___________________ Amp  Type _________________________________

___________________ PF  _________________________________

___________________ % Eff. _________________________________

IN PER UNIT ON RATED MACHINE kVA AND kV

Direct Axis Unsaturated Synchronous Reactance  Xd ____________

Quadrature Axis Unsaturated Synchronous Reactance  Xq ____________

Direct Axis Transient Reactance at Rated Current  X'di ____________

Direct Axis Transient Reactance at Rated Voltage  X'dv ____________

Quadrature Axis Transient Reactance at Rated Current (where applicable)  X'qi ____________
SYNCHRONOUS GENERATOR DATA - Cont'd

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<tr>
<th>Parameter</th>
<th>Unit</th>
<th>Value</th>
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<tr>
<td>Directed Axis Subtransient Reactance at Rated Current</td>
<td>X&quot;di</td>
<td>______________</td>
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<tr>
<td>Quadrature Axis Subtransient Reactance at Rated Current</td>
<td>X&quot;qi</td>
<td>______________</td>
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<tr>
<td>Direct Axis Subtransient Reactance at Rated Voltage</td>
<td>X&quot;dv</td>
<td>______________</td>
</tr>
<tr>
<td>Quadrature Axis Subtransient Reactance at Rated Voltage</td>
<td>X&quot;qv</td>
<td>______________</td>
</tr>
<tr>
<td>Negative Sequence Reactance</td>
<td>X_2</td>
<td>______________</td>
</tr>
<tr>
<td>Zero Sequence Reactance</td>
<td>X_0</td>
<td>______________</td>
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<tr>
<td>Stator Leakage Reactance at Rated Voltage</td>
<td>Xlv</td>
<td>______________</td>
</tr>
<tr>
<td>Stator Leakage Reactance at Rated Current</td>
<td>Xli</td>
<td>______________</td>
</tr>
<tr>
<td>Potier Reactance</td>
<td>X_p</td>
<td>______________</td>
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<tr>
<td>Positive Sequence Resistance</td>
<td>R_1</td>
<td>_____ @ ______°C</td>
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<td>Zero Sequence Resistance</td>
<td>R_0</td>
<td>_____ @ ______°C</td>
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<td>Negative Sequence Resistance</td>
<td>R_2</td>
<td>_____ @ ______°C</td>
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<tr>
<td>Direct-Axis Transient Open-Circuit Time Constant</td>
<td>Td'o</td>
<td>_____ Sec. @ ______°C</td>
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<tr>
<td>Direct-Axis Subtransient Open-Circuit Time Constant</td>
<td>Td'v</td>
<td>_____ Sec. @ ______°C</td>
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<tr>
<td>Quadrature-Axis Transient Open-Circuit Time Constant</td>
<td>Tq'o</td>
<td>_____ Sec. @ ______°C</td>
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<tr>
<td>Quadrature-Axis Subtransient Open-Circuit Time Constant</td>
<td>Tq'v</td>
<td>_____ Sec. @ ______°C</td>
</tr>
<tr>
<td>Short-Circuit Time Constant of Armature Winding</td>
<td>Ta</td>
<td>_____ Sec. @ ______°C</td>
</tr>
<tr>
<td>Generator &amp; Turbine Inertia</td>
<td>WR^2</td>
<td>_____ Lb. ft.²</td>
</tr>
<tr>
<td>Inertia Constant on Machine Base</td>
<td>H_c</td>
<td>_____ MW Sec/MVA</td>
</tr>
<tr>
<td>Saturation Curve No. on Open Circuit</td>
<td></td>
<td>______________</td>
</tr>
<tr>
<td>Saturation Curve No. for Rated Stator Current at 0 PF lag</td>
<td></td>
<td>______________</td>
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<tr>
<td>&quot;V&quot; Curve No.</td>
<td></td>
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FORM - 3
EXCITATION SYSTEM DATA

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<th>Station</th>
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<th>2.</th>
<th>3.</th>
<th>4.</th>
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<th>Voltage Response</th>
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<th>Mfr./Exciter Type</th>
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<th>Mfr./Regulator Type</th>
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<tr>
<th>Saturation Curve No. on Open Circuit</th>
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</table>

<table>
<thead>
<tr>
<th>Saturation Curve No. for Rated Armature Current</th>
<th></th>
</tr>
</thead>
</table>
INVERTER DATA

Manufacturer

Reference Number, Type or Style

Type:
Line - Commutated
Self - Commutated
Serial Number
Nameplate Rating

Harmonic Characteristics:

% Total Harmonic Voltage Distortion*
% Total Harmonic Current Distortion*

* Estimated (or measured) percent distortion of the fundamental (60 Hz) waveform at the interconnection point. Also submit any certified test reports or manufacturer’s data.
## Protective Equipment - Data & Test Record

<table>
<thead>
<tr>
<th>LOCATION</th>
<th>VOLTAGE</th>
<th>C.T. Ratio</th>
<th>P.T. Ratio</th>
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### Specific Settings

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<tr>
<th>Relay</th>
<th>Secondary</th>
<th>Average Left Settings</th>
<th>Remarks</th>
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<tbody>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Time</th>
<th>Amp</th>
<th>Volts</th>
<th>Ohms</th>
<th>Date</th>
<th>Time</th>
</tr>
</thead>
</table>

**Additional Specifications**

---

**Form - 6**

---

SYSTEM PROTECTION ENGINEER

SHEET NO.

ITEM NO.

TECH. SERVICES & DIV. DEPT.

COPIES TO

ENG. FILE

COPIES TO

SEE ATTACHED ENG. FILE

Note: This form is intended for use in documenting protective equipment data and test record details. It includes spaces for location, voltage, C.T. and P.T. ratios, specific settings, and additional specifications.
Appendix B – Application for Generation 15 kW and Less
(APPENDIX  B to SIR)

NEW YORK STATE STANDARIZED APPLICATION
FOR SINGLE PHASE ATTACHMENT OF PARALLEL
GENERATION EQUIPMENT 15 KW OR SMALLER
TO THE ELECTRIC SYSTEM OF

Utility: _______________________________________

Customer:
Name: ______________________ Phone: (___)__________
Address:_________________________ Municipality: ________________

Consulting Engineer or Contractor:
Name: ______________________ Phone: (___)__________
Address:_________________________

Estimated In-Service Date: ______________________

Existing Electric Service:
Capacity: __________ Amperes   Voltage: __________ Volts
Service Character: ( )Single Phase ( )Three Phase

Location of Protective Interface Equipment on Property:
(include address if different from customer address)
_________________________________________________________

Energy Producing Equipment/Inverter Information:
Manufacturer: _________________________________
Model No. ________________  Version No. ________________
( )Synchronous  ( )Induction  ( )Inverter  ( )Other_________
Rating: __________kW          Rating: __________kVA
Generator Connection: ( )Delta  ( )Wye  ( )Wye Grounded
Interconnection Voltage: __________Volts
System Type Tested (Total System): ( )Yes ( )No; attach product literature
Equipment Type Tested (i.e. Inverter, Protection System):
( )Yes ( )No; attach product literature
One Line Diagram attached: ( )Yes
Installation Test Plan attached: ( )Yes

Signature:

________________________________    ________________  ________
CUSTOMER SIGNATURE          TITLE      DATE
Appendix C – Application for Generation 15 kW up to 2 MW
(APPE NIX C to SIR)

Page 1 of 2

NEW YORK STATE STANDARDIZED APPLICATION
FOR ATTACHMENT OF PARALLEL GENERATION
EQUIPMENT 2 MW OR SMALLER
TO THE ELECTRIC SYSTEM OF

Utility: ________________________________

Customer:
Name: _____________________________ Phone: (___)__________
Address:_____________________________ Municipality: ________________

Consulting Engineer or Contractor:
Name: _____________________________ Phone: (___)__________
Address:_____________________________

Estimated In-Service Date: ________________________________

Existing Electric Service:
Capacity: ___________ Amperes  Voltage: ___________ Volts
Service Character: ( )Single Phase  ( )Three Phase
Secondary 3 Phase Transformer Connection ( )Wye  ( )Delta

Location of Protective Interface Equipment on Property:
(include address if different from customer address)

Energy Producing Equipment/Inverter Information:
Manufacturer: ______________________________
Model No. __________________ Version No. ______________
( )Synchronous  ( )Induction  ( )Inverter  ( )Other_________
Rating: ___________ kW  Rating: ___________ kVA
Rated Output: ____ VA  Rated Voltage: ____ Volts
Rate Frequency: ___ Hertz  Rated Speed: ___ RPM
Efficiency: ____%  Power Factor: ___%
Rated Current: ____ Amps  Locked Rotor Current: ____ Amps
Synchronous Speed: ___ RPM  Winding Connection:
Min. Operating Freq./Time:
Generator Connection: ( )Delta  ( )Wye  ( )Wye Grounded
System Type Tested (Total System): ( )Yes  ( )No; attach product literature
Equipment Type Tested (i.e. Inverter, Protection System):
( )Yes  ( )No; attach product literature
One Line Diagram attached: ( )Yes
Installation Test Plan attached: ( )Yes
Appendix C to SIR Page 2 of 2

For Synchronous Machines:
Submit copies of the Saturation Curve and the Vee Curve
( ) Salient ( ) Non-Salient
Torque: _______ lb-ft   Rated RPM: _______
Field Amperes: _______ at rated generator voltage and current
   and _______% PF over-excite
Type of Exciter: ____________________________________________
Output Power of Exciter: ____________________________________
Type of Voltage Regulator: __________________________________
Direct-axis Synchronous Reactance (X_d) _______ ohms
Direct-axis Transient Reactance (X'_d) _______ ohms
Direct-axis Sub-transient Reactance (X''_d) _______ ohms

For Induction Machines:
Rotor Resistance (R_s) _____ ohms   Exciting Current _____ Amps
Rotor Reactance (X_s) _____ ohms   Reactive Power Required:
Magnetizing Reactance (X_m) _____ ohms   _____ VARs (No Load)
Stator Resistance (R_s) _____ ohms   _____ VARs (Full Load)
Stator Reactance (X_s) _____ ohms
Short Circuit Reactance (X''_d) _____ ohms Phases:
Frame Size: ____________ Design Letter: _____   ( ) Single
Temp. Rise: ____________ °C.   ( ) Three-Phase

For Inverters:
Manufacturer: ____________ Model:
Type: _______ ( ) Forced Commutated ( ) Line Commutated
Rated Output: _____ Amps   _____ Volts
Efficiency: _______%

Signature:

__________________________   __________________   ____________
CUSTOMER SIGNATURE         TITLE                DATE