Exelon-East Interconnection Guidelines

(For Generators at Transmission Level)

December 2025

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INTRODUCTION

This document provides guidance applicable to generator interconnection customers or Project Developers ("PD") planning to operate generators interconnected to the Exelon transmission system. This guideline is intended to provide standards that apply to various aspects of PD interface with Exelon. It contains technical standards regarding generator interconnection, relay & protection, SCADA, communication, and metering. It also contains protocols that address generator interconnection arrangements, real estate transactions, facility energization, and post-energization interface associated with such generator interconnections.

This guideline is posted on the PJM website at http://www.pjm.com/planning under each operating company's technical standards. This guideline is also available on the Exelon website at http://www.exeloncorp.com/

Definitions

Exelon

This document pertains to all Exelon East companies. References of "Exelon" can be interpreted to mean the local Exelon utility. This includes Atlantic City Electric (ACE), Baltimore Gas and Electric (BGE), Delmarva Power (DPL), Philadelphia Electric Company (PECO) and Potomac Electric Power Company (PEPCO). ComEd has individual standards that should be referenced for any projects within the ComEd territory.

Project Developer (PD)

An entity that enters the PJM process to interconnect a new generation facility to or to increase the capacity of an existing generation facility interconnected with the Exelon transmission system.

PJM Interconnection, L.L.C. (PJM)

PJM is the Regional Transmission Organization (RTO) that is responsible for planning and operating the Exelon transmission system for the purpose of providing non-discriminatory access to PDs for movement of wholesale energy. PJM manages the generator interconnection process and energy market.

Generation Interconnection Agreement (GIA)

A three-party interconnection agreement between Exelon, PJM and the Project Developer that sets forth the interconnection project details, required upgrades to be constructed by the Transmission Owner with high level scope and cost, along with details of the Capacity Injection Rights (CIR's). The GIA also contains construction schedules and responsibilities to complete the generator interconnection. The GIA replaces both the Interconnection Service Agreement (ISA) and Interconnection Construction Service Agreement (ICSA) from the old process.

Interconnection Agreement (IA)

A two-party agreement between Exelon and the Project Developer, typically used with non-FERC jurisdictional projects. Similar to the GIA, this agreement contains the project details including high level scope and cost along with the construction schedule and responsibilities.

Wholesale Market Participation Agreement (WMPA)

A three-party agreement between Exelon, the PD and PJM when the generator interconnection is non-FERC jurisdictional. This document establishes the capacity rights of the PD in the PJM market. A two-party Interconnection Agreement between Exelon and the Project Developer must be executed prior to the WMPA being signed.

Interconnection Program Managers

An Exelon work group that interfaces with PJM, PD and Exelon internal groups to facilitate generator interconnections.

Transmission System Operation (TSO)

An Exelon work group that operates the electrical grid as the designated authority.

Large Customer Services (LCS)

An Exelon work group that interfaces with large scale commercial PD at various levels during and after generator interconnections.

Project Management (PM):

An Exelon work group that is typically responsible for managing the facilities studies, design, and construction of the generator interconnections.

1) EXELON TECHNICAL STANDARDS

The Exelon East companies' electric transmission systems consist of 500kV, 230kV, 138kV and 69kV lines and substations. The following technical standards will apply to generator interconnections at all transmission voltage levels.

Generator Interconnections at Transmission Voltage Level

The Exelon transmission system is vital to maintaining system integrity and network reliability of the bulk power system. The generator interconnection to a transmission line bisects that line into two segments. In certain parts of our territories, multiple generators are located within a short distance of each other. The connection of several generators to a single transmission line at relatively short intervals would result in repeated segmentation of that line, causing undue fragmentation.

Excessive segmentation of transmission lines degrades system integrity and network reliability. A line with excessive segmentation presents various challenges including difficulty in outage planning, communications, increased maintenance costs and increased loss of system continuity.

To reduce transmission line segmentation, generators located in proximity to one another should interconnect to a common substation typically known as 'Generation Hub'. The following guidelines should be followed in this regard:

a) A PD shall not bisect a transmission line less than two (2) miles from an existing or proposed substation. Instead, the PD should interconnect to the existing or proposed substation. In this situation, a proposed substation is defined as a substation with an executed GIA.

b) A PD can bisect a transmission line less than two (2) miles from an existing substation if the existing substation cannot be expanded to interconnect the PD due to physical limitations.

Excessive segmentation will be determined in the PJM Phase 1 System Analysis.

All new transmission substations shall be designed to a minimum of a four-breaker ring bus designed to be expandable to a breaker-and-a-half configuration. This arrangement is required to have an appropriate level of reliability and maintenance flexibility. Design requirements should be verified by the PD by referencing the latest Exelon Standards design manual available on the PJM website.

A new PD may interconnect to an existing substation, an existing nuclear station or may choose to connect to a radial distribution line. Details of these three options are described below:

i) Generator Interconnection to an Existing Substation

Some of the existing Exelon transmission substations are designed with ring-bus or

straight-bus configuration. To interconnect a new generator, the existing substation should be converted into the standard breaker-and-a-half configuration and create a line position for the generator lead line.

However, if the existing substation cannot be converted into the standard breaker-and-a-half configuration due to physical limitations, then the generator is allowed to connect to an existing substation by connecting to an available bus position in the existing configuration. If no bus position is available, Exelon will investigate expansion of the existing substation if it does not violate Exelon design standards and practices. Consideration must be given to the arrangement of lines and generators for reliability and bus loading concerns. Additional details on this scenario can be found under Section 5 of this document in "Real Estate Requirements" as well as in the "Exelon Utilities Transmission Bus Configuration Design Philosophy" manual.

In either case, the dead-end structure for the generator lead at the first structure outside the Exelon substation will serve as the point-of-change in ownership between Exelon and the PD.

ii) Generator Interconnection to an Existing Nuclear Station

For a Project Developer connecting at an existing nuclear station, the substation will require additional coordination with the Exelon Transmission Planning department and will be noted in the Facility Study.

iii) Generator Interconnection on a Radial Distribution Line

Exelon has many transmission level radial lines feeding stepdown distribution transformers. Sometimes, a new PD selects a radial line for generator interconnection. The following guidelines are provided to address this scenario.

Exelon specifies that any generator interconnection must have two outlet lines. This arrangement ensures that a maintenance outage on one line does not necessitate taking the generator offline. To meet this requirement, a new generator interconnection needs to bisect at least two (2) radial lines. If there is only one radial line available, the generator cannot interconnect unless a new transmission line is built to provide a second outlet for its generation, or the radial line is converted into a network line.

2) INTERCONNECTION FACILITIES

The interconnection facilities include all facilities built to interconnect a PD generating facility to the Exelon transmission network. In most cases, this would include a PD collector substation, generator lead line, and an interconnection substation. The collector substation and generator lead line are PD-owned interconnection facilities. The interconnection substation is an Exelon-owned interconnection facility. Additionally, network upgrades may be necessary to maintain system adequacy with injection of PD generation into the electric power system.

The PD is responsible for all costs to engineer, design, procure, construct and commission all the interconnection facilities and network upgrades. After successful completion of a generator interconnection, Exelon shall own and be responsible to operate and maintain the interconnection substation. The following sections provide guidance on building interconnection facilities and network upgrades.

2.1) Point-of-Interface between Exelon and PD Interconnection Facilities

For each interconnection, a dead-end structure is installed immediately outside the boundary of the Exelon interconnection substation at a location determined by Exelon. This dead-end structure, provided by the Project Developer, is used to connect the generator lead line from the PD substation and serves as the point-of-interface or the Point of Change in Ownership between the PD-owned interconnection facilities and Exelon-owned interconnection facilities, except for Fiber Optic cables.

Unless otherwise specified, the PD shall own and be responsible to maintain the dead-end structure, support structure, incoming insulators (including any jumpers), incoming generator lead line (wire) and all associated hardware. Exelon will own the insulators and associated hardware nearest to Exelon's interconnection facility. The generator lead line shall enter the substation yard terminating at the dead-end structure. The method of connection (overhead or underground) will be determined by Exelon during the facility study. The PD cannot install any part of its generator lead underground inside the interconnection substation boundary.

Regarding the Fiber Optic cable, the Fiber Distribution Panel (FDP) should be considered the fiber optic point of interconnection. This item shall be located on a structure constructed and owned by the Project Developer, located adjacent to the Exelon owned substation, as approved by Exelon. Exelon must have the ability to always access this interconnection point. Exact specifications for this structure and its location shall be coordinated with Exelon's Telecom engineering department during the 60% design phase of the project.

The PD shall own and be responsible for maintaining the Fiber Optic cables from the PD collector substation to the fiber optic point of interconnection. Exelon shall own and be responsible for maintaining the Fiber Optic cables from the Exelon interconnection substation to the fiber optic point of interconnection. The Exelon telecom network shall not extend into the customer owned site nor vice versa.

2.2) Exelon-Owned Interconnection Facilities

Exelon, as a Transmission Owner, will agree to the following split of responsibilities with the PD for Exelon-owned interconnection facilities and network upgrades.

2.2.1) Option to Build on Greenfield Site

a) The PD may elect to build interconnection facilities on greenfield sites such as new substations and transmission lines as stated in the PJM Tarriff. Under this option, the PD will engineer, design, procure, construct and commission greenfield interconnection facilities that will be owned by Exelon. The PD shall hire Exelon approved contractors and vendors and use Exelon standards/specifications with Exelon oversight and approval.

b) Exelon shall specify the protection system design and provide all settings for protective systems that protect Exelon equipment.

c) Exelon shall engineer, design, procure, construct and commission the line attachments (tie-in work) to the Exelon-owned interconnection facilities on greenfield sites.

d) The PD shall coordinate the schedule for its work with Exelon to ensure that its requests for oversight/approval are matched with Exelon resources.

2.2.2) Work within an Energized Substation

a) Exelon, having overall responsibility for maintaining reliability of the transmission system, and to avoid the possibility of any negative impact on system reliability and stability, will not mutually agree to allow a PD to construct and commission the interconnection facilities and network upgrades within energized substations. Please refer to the PJM Open Access Transmission Tariff for further information regarding Option-to-Build options and rights.

b) Exelon shall specify the protection system design and provide all settings for protective systems that protect Exelon equipment.

c) The PD shall coordinate the schedule for its work with Exelon to ensure that its requests for oversight/approval are matched with Exelon resources.

In exercising Option-to-Build for Exelon-owned interconnection facilities, the PD must adhere to Good Utility Practices, the National Electrical Code, the National Electrical Safety Code, North America Electric Reliability Corporation, Reliability First Corporation, PJM standards, Exelon standards, Exelon planning criteria and guidelines, and all applicable laws and regulations.

Before proceeding with construction under the Option-to-Build, the PD must furnish final design documents to Exelon for review and acceptance. The PD design documents (electrical prints, relay settings, etc.) will be reviewed by Exelon. Additional engineering meetings may be necessary to discuss these documents. If changes are necessary, the PD shall incorporate all changes and corrections and resubmit corrected prints to Exelon for review and approval before proceeding.

Project delays due to untimely submittal of complete design documents are the responsibility of the PD. These documents must be of good engineering quality and include the following:

- One-line diagram showing the connections between the generator(s) and the Exelon system.
- Three-line diagrams showing current and potential circuits for protective relays.
- Relay tripping and control schematic diagrams.
- Instruction books for relays.

Unless otherwise stated, Exelon requires the PD to provide four (4) hard copies of the completed construction package (including all drawings and prints) prior to the start of construction.

2.2.3) Exelon-Approved Contractors & Vendors

The PD is required to utilize Exelon-approved contractors and vendors to build Exelon-owned interconnection facilities.

- A list of Exelon-approved contractors and vendors is posted on PJM website.
- Project Developers should confirm that the chosen contractor is in good standing with Exelon prior to the start of design.
- PJM rules allow the PD to propose new contactors and vendors that have not been Exelon-approved. Exelon should evaluate the proposed contractors and vendors using the same process as any new contractor Exelon would consider for work on its system.

2.3) PD-Owned Interconnection Facilities

The Project Developer is responsible for engineering, designing, procuring, constructing, commissioning, operating and maintaining PD-owned interconnection facilities in accordance with Good Utility Practices, the National Electrical Code, the National Electrical Safety Code, North America Electric Reliability Corporation, Reliability First Corporation, PJM standards and all applicable laws and regulations. This includes installing, setting, and maintaining all protective devices necessary to protect the PD interconnection facilities.

The PD is responsible for coordinating with Exelon during the engineering, design, and construction phases of its equipment to ensure coordination of protective relay devices.

Exelon functional relay requirements will be provided to the PD during the detailed design phase of the project. The information for the specific project will indicate the protective functions for which the PD is to provide relays and related equipment. The PD will indicate the specific relay type(s) and range proposed for each function. The PD must also provide proposed current and potential transformer ratios, connections, and locations as related to the electrical one-line diagram.

The PD is responsible for installing reactive compensation, if needed, at its collector substation to maintain ± 0.95 power factor at the point-of-interface between PD and Exelon interconnection facilities.

The PD is responsible for coordinating the design of its own generator step-up electrical facility with PJM and Exelon.

Within one (1) month following the commercial operation of generating unit(s), PD must provide Exelon with certified documentation demonstrating that "as-built" Customer Facility and PD-owned interconnection facilities are in accordance with applicable PJM studies and agreements.

3) REAL ESTATE REQUIREMENTS

There are two scenarios with respect to real estate assets and rights necessary for completion of the interconnection and subsequent operation of PD's project as described below:

A generator interconnecting by building a new substation at a new site

Consistent with the PJM Tariff, a Project Developer can choose a location to interconnect. Under this scenario, the PD is responsible to purchase or otherwise obtain all necessary and appropriate (i) real property rights (whether in the form of fee simple ownership, a perpetual easement, a perpetual license or other perpetual right) as determined by Exelon and (ii) permits and approvals from all applicable governmental authorities and property owners (collectively, the "Property Rights and Permits"), to install the following facilities:

- An appropriately located parcel(s) of land that is approximately five (5) acres in size for 69kV or 138kV interconnection and eight (8) acres in size for 230kV or 500kV interconnection for the location, construction and operation of the Exelon interconnection substation (the "Interconnection Substation"), together with additional fee simple access from the public right-of-way to the Interconnection Substation, the design and width of which to be approved by Exelon in its sole discretion;
- A line section to tie-in the transmission line to the Interconnection Substation (the "Line Section"); and.
- Transmission line (generator lead) to interconnect PD's collector substation to the Interconnection Substation.

It should be noted that in all cases, Exelon requires the transfer of fee simple ownership of land for the Interconnection Substation together with fee simple access from the public right-of-way to the Interconnection Substation. The PD shall transfer all the Property Rights and Permits to Exelon, at no cost or expense to Exelon, pursuant to documentation that is acceptable to Exelon together with all the Property Transfer Documents described below. In the rare circumstances that fee simple ownership is not possible due to extenuating circumstances such as conflicting federal regulations, Exelon will review proposed parcels on a case-by-case basis and will decide, in its sole discretion, if the proposed parcel and rights alternative to fee simple are acceptable.

When Exelon will be the constructing party of the Interconnection Substation, the transference of the Property Rights and Permits should occur prior to the start of below grade construction. In the event of Option to Build where the PD is the constructing party of the Interconnection Substation, the transference of the Property Rights and Permits must occur prior to energization.

A generator interconnecting to an existing substation

Based on the recent FERC ruling, if additional land is needed to expand an existing Exelon-owned and operated substation, the TO is responsible for this property acquisition at the expense of the Project Developer. An estimate for the cost and duration of this acquisition will be provided by the TO in the Phase 2 Facility Study report.

However, the PD is responsible to purchase property or otherwise obtain all Property Rights and Permits to install the transmission line (generator lead) to interconnect PD's collector substation to the existing Exelon substation.

Real Estate Transaction Details

The form of transfer documents and the type of real estate transactions will be determined by the type of facility or the required Property Rights and Permits that need to be transferred to Exelon. This transaction may include:

- Conveyance of fee simple ownership in some or all the real property to Exelon.
- For Interconnection Substation: Conveyance of fee simple property and/or perpetual easements (exclusive and nonexclusive) required for all equipment and facilities associated with the substation and transmission lines including, but not limited to, access, drainage, fiber, and such other overhead and underground facilities as Exelon may reasonably require for the construction, use, maintenance and operation of the generation hub or the Interconnection Substation.
- For facilities other than substation: Conveyance of perpetual transmission, fiber, and facilities easements (exclusive and nonexclusive) for the purposes of interconnecting the interconnection substation with the Exelon transmission system, including such overhead and underground electrical, fiber, and related communications, transmission and distribution facilities.

In each of the three transaction scenarios outlined above, or any combination thereof, the PD will be responsible for executing and delivering all documentation requested by Exelon or required by any third party title insurer, surveyor or property owner to transfer the Property Rights and Permits, which may include, without limitation, special warranty deeds, easements, purchase and sale agreements containing representations and warranties acceptable to Exelon, assignments, bills of sale, affidavits, certifications, statements, certifications as to value of improvements, surveys, title policies, and releases, and such other documentation necessary to obtain a title policy in favor of Exelon covering the property rights and interests conveyed (the "Transfer Documents").

To facilitate transfer of property rights and permits, Exelon will provide the form of real property transfer agreement that will incorporate terms and conditions that reflect Exelon's standard business practices, together with engineering review of proposed PD facilities that involve Exelon real estate and/or right of way.

Project Developer's Responsibilities

It is PD's responsibility to purchase property, acquire rights and obtain any required permits or zoning for the transmission, distribution and or communication facilities required to interconnect its generation. In addition, the PD will grant to Exelon such rights and interests as may be reasonably necessary to interconnect the generation facilities and associated network upgrades to the Exelon system.

It is imperative, when the PD is required by the scope of a project to provide information, that the deliverables itemized below be received by Exelon as soon as possible. This will facilitate a timely review and will allow Exelon to address the real estate aspects of the project in a timely manner.

The PD is responsible for providing the following:

The following current information covering all interests and rights to be conveyed to Exelon:

- Exelon-approved detailed civil engineering drawings showing the proposed site plan, layout, drainage, access and facilities.
- A title commitment covering all real estate assets to be conveyed to Exelon (whether by deed, easement, assignment or otherwise) (the "Real Property") issued by a title company reasonably acceptable to Exelon (the "Title Commitment").
- Copies of all documents referenced in all the exceptions listed in the Title Commitment.
- Copies of all documents creating the Property Rights and Permits.
- ALTA/ACSM Land Title Survey of the Real Property.
- Topographic survey at a contour interval appropriate to the relief and size of the Real Property.
- Phase I Environmental Assessment Report (Phase 2 if appropriate or necessary as determined by Exelon) and any other environmental reports, notifications and documents associated with or related to the Real Property.
- Wetland Delineation reports for all of the Real Property.
- Annexation Agreement(s), zoning changes or other governmental agreements or approvals entered into or proposed with respect to the Real Property.
- All jurisdictional permits, such as special use and building permits, that have been issued for the project or copies of pending applications that relate to or affect the Real Property.
- At the closing of the conveyance transaction, all original warranties and plans shall be delivered to Exelon.
- A statement of value of all improvements that have been or will be

constructed on the Real Property.

- An asset map row for the improvements.
- All of the documentation required by the real property transfer agreement.
- Such other information and documentation as Exelon may reasonably require.

Additional information may also be required, depending on project requirements. Requests for such information will be transmitted to the PD during project development and in connection with Exelon's review of the foregoing documents and materials.

Exelon's Responsibilities

The following are the main points of contact within Exelon that a PD will coordinate with to successfully execute the above stated requirements.

Project Management

The Exelon Project Manager leads Exelon's real estate process. Exelon Project Management and Engineering, in conjunction with the PD, will develop designs that define the real estate needs. Exelon's Real Estate Department group supports that plan execution. The Exelon Project Manager responsibilities include activities such as:

- Allow a minimum of 6 months for site evaluation, document preparation and to perform due diligence. More time in advance may be required depending on the real estate being managed.
- Periodic meetings commensurate with the size of the acquisition need to take place. These may be weekly depending on the upcoming project milestones.
- Establish the date(s) for closing the real estate transaction(s) to meet the overall project schedule.
- Define the scope of the real estate activities required for the project.
- Monitor the status of real estate activities to ensure that the process is moving forward and will meet the closing date(s).
- Provide guidance on technical/operational matters that must be addressed during the real estate process.
- Coordinate with internal departments, such as Environmental Services, to ensure that appropriate Exelon processes and requirements are being met (which may include the review and approval of environmental permits).
- Provide PJM with required communications prior to land conveyance.
- Create an Exelon Project ID for the land transfer and give Exelon's Plant Accounting department the equipment and property valuation letter to add these assets to Exelon's records.
- Conduct a Final Acceptance walk-down with Exelon team. This includes any

other properties or easements acquired by the project under the PJM Option to Build (microwave repeater sites, fiber easements, aux power or transmission line easements, etc.).

Real Estate

The Real Estate Department, in conjunction with legal counsel, executes the tasks involved in the real estate portion of the project with activities such as:

- Leading the real estate calls to ensure that progress is being made and that issues are being managed.
- Monitoring and guiding completion of customer due diligence requirements (examples of these are zoning, permits etc.).
- Negotiating mutually acceptable terms and conditions in the real estate documents required for the project.
- Coordinating the process for securing internal approval of customer facilities to be located on property in which Exelon has an interest.
- Guiding customer rights acquisition on behalf of Exelon.
- Conducting a formal real estate closing to accomplish transfer of property ownership.
- Creating and updating a real estate closing checklist, which may differ for each project, to monitor the status of all required documents and deliverables related to the project.

4) RELAY & PROTECTION REQUIREMENTS

General Need for System Protection in the Presence of Parallel Generation

The components of the transmission system are subject to a variety of natural and man-made hazards; among these are lightning, wind, wildlife, and vandalism. Damaged or short-circuited equipment should be switched out of service as soon as possible to minimize safety hazards, to avoid minimize equipment damage, and to maintain system stability. Generation operated in parallel with the transmission system provides an additional source of energy that must also be disconnected in case of an emergency. It is essential that a suitable system of protection be used to minimize these hazards and to prevent the reduction of quality of service to other transmission customers.

General Effects of Interconnected Generation on System Protection Requirements

The addition of PD's generation shall not introduce a hazard or adversely affect the quality of service to Exelon customers. Protective equipment must be added to standard Exelon facilities to provide adequate protection of the transmission system. Exelon's protection system designs and requirements are based on years of system operating experience and analysis of events both internal and external to Exelon as well as requirements from the various regulatory organizations. Requirements for additional protective equipment due to interconnected operation will vary depending on the size of the PD's generation and on the nature of the Exelon local system.

Interconnection Overview

Details of designs intended for generation interconnections on the Exelon system can be found below. As a rule, generation that is less than 20 MVA may be connected to the distribution system. Generation from 20 to 300 MVA is usually connected to the 138 kV system, but can be connected to 69kV in certain situations, and generation more than 300 MVA is connected to the 230 kV system.

Protective relaying for new interconnections must meet Exelon's current standards based on voltage level. Transmission lines help maintain regional stability and reliable power flow. Equipment at 230kV and above follows stricter requirements than equipment at 138kV or below, though some high load 138kV areas adopt higher standards. In all scenarios effective protection is essential. Requirements for different voltage levels are listed for common setups and may be refined during engineering.

Detailed protection requirements for adding generation to an Exelon transmission line with existing generation must be made on a case-by-case basis. Adding generation to the transmission line may require additional protection at other existing installations.

Protection Requirements of 230kV and above Interconnections

When connecting to an existing station, the interconnection configuration will typically follow the configuration at that station with new breaker/breakers or bus position as required. These designs may vary and PD's should reference the "Exelon Utilities Transmission Bus Configuration Design Philosophy" found on the PJM site.

In some cases, system conditions may require that a generator be connected to an existing line by splitting the line. Three terminal lines are not allowed by Exelon at any voltage level and typically, a 4-breaker ring configuration is used when splitting a 230kV line.

For some PD generation installations, the most appropriate interconnection point to the Exelon system would be directly into the bus at an existing Exelon substation. If the Exelon substation had a ring bus configuration, the PD interconnection point would have to maintain the integrity of the substation design. This would require the addition of at least one new circuit breaker at the substation. The effect on the substation protection would depend on the site specifics. Protection also would have to be installed on the line to the generator. Additional information on substation requirements can be found in the "Exelon Utilities Transmission Bus Configuration Design Philosophy" posted on the PJM website.

Redundancy of protection is required by Exelon standards, NERC Planning Standards, PJM Standards, and/or RFC Standards which specify that no single protection system component failure can cause a fault to remain on the system. Protective relaying systems on the 230 kV and above system shall include two complete schemes, each including primary and back-up protection. Independent current transformers, potential transformer secondaries, and DC source (separate batteries are required at 230kV) will feed each system. The relaying schemes will be complementary in terms of their principle of measurement rather than redundant and be of varying construction to minimize the chance of a common mode failure. The standard medium of system protection communication on the Exelon transmission system is fiber optic-based equipment. Any other technologies must be reviewed and approved by Exelon prior to the start of customer design work.

Protection Requirements of 138kV and below Interconnections

When connecting to an existing station, the interconnection configuration will typically follow the configuration at that station with a new breaker or bus position. In some cases, system conditions may require that a generator be connected to an existing line by splitting the line. Large generators connected to the 69kV or 138kV transmission systems may require the use of a ring bus. All substation layouts should be designed in a way that makes them expandable.

Adding a fourth source to a three-terminal line or a third source to a two-terminal line limits the effectiveness of protective relay schemes and reduces system reliability. This type of configuration can limit the amount of power that can be supplied by the weakest source to the line, cause compromises and degradation of line protection, and limit transmission availability to the PD. Thus, Exelon does not allow three terminal line

configurations for generator interconnections, and the line must be broken into two lines. A four-breaker ring bus substation will be installed if connection to an existing Exelon substation is not feasible. New line protection packages are needed for the two new lines created by splitting the existing Exelon line and for the line to the generator.

For some PD generation installations, the most appropriate interconnection point to the Exelon system would be directly into the bus at an existing Exelon substation. If the Exelon substation is a ring bus configuration, the PD interconnection point would have to maintain the integrity of the substation design. This would require the addition of at least one new circuit breaker at the substation. The effect on the substation protection would depend on the site specifics. Protection also would have to be installed on the line to the generator.

Redundancy of protection is required per Exelon standards, NERC Planning Standards, PJM Standards, and/or RFC Standards which specify that no single protection system component failure can cause a fault to remain on the system.

Review and Approval of PD Protection System Designs

Exelon will review and approve the design of all customer-owned protection systems that are identified in the 230kV and above and 138kV and below one-line diagrams and minimum design requirement drawings above. Exelon approval is required prior to the start of detailed customer design work.

Exelon will review and approve the settings of protective relays for any intertie tap lines, GSUs, and for any generator setting that must coordinate with the Exelon Transmission System. Exelon approval is required prior to energization of PD equipment.

Testing of PD Protection System Designs

Exelon will witness customer testing of any PD protection system where the design is required to be reviewed and approved including proper application and testing of relay settings required for coordination with the Exelon transmission system. Exelon's approval of all testing is required prior to energization of PD equipment.

Exelon requires a high current test (also known as a through-fault test) for any bus or GSU transformer differential schemes prior to energization of these schemes. Exelon will witness this test. Exelon review and approval of the results of this test is required prior to energization of PD equipment. This test is typically performed just prior to livening.

A witness test list will be provided for a given site and will be the ultimate governing document on what is required. An Exelon tester's time is generally scheduled at least 8 weeks in advance by the Regional Work Management department. These individuals are not scheduled for work until completed and approved prints, and other required documentation, are in hand. PD representatives shall work with Exelon Work Management to schedule tester's time for witness testing and review of testing documentation. Four (4) sets of approved blueprints (as built) must be provided to the Exelon testing department. The project delays may be caused by untimely submittal of

approved blueprints by the PD.

Reclosing of Exelon Supply Lines

Most faults on overhead lines are transient. That is, if the line is de-energized promptly, it can be reclosed and returned to service. Examples of such transient faults include momentary tree contact due to wind, and insulator flashover due to lightning. Automatic reclosing of overhead lines is standard industry practice to improve the reliability of supply. In many cases, the line can be de-energized and reclosed within one second, with minimal disruption of service to the PD.

Effects of Interconnected Generation on Automatic Reclosing

Automatic reclosing on Exelon transmission lines can harm generators connected to the T&D system, especially if the line is reclosed while generation remains online. Both synchronous and induction generators risk damage due to loss of synchronism or improper speeds during reconnection. Exelon retains automatic reclosing to maintain service reliability but will try to reclose from non-generating terminals and use delayed reclosing on 230kV and above. For voltages 138kV and below, high-speed reclosing ensures reliability for distribution, though some rare cases may require direct generator tripping during faults.

Possible Reclosing Scenarios and PD Responsibilities

The PD is responsible for protecting the generating facility's equipment so that automatic or manual reclosing, faults, or other disturbances on the Exelon System do not cause damage to the equipment.

When automatic reclosing may result in equipment damage or a safety hazard, either to the Exelon System or the PD facilities, Exelon and/or PJM may require that additional protective equipment be installed. This will usually consist of communication and/or control equipment to disconnect the PD's generator (or to confirm that it is disconnected) before the Exelon transmission line is reclosed.

5) SCADA REQUIREMENTS

Some generators will require continuous telemetry to Exelon's and PJM's operation facilities. These will typically be large generators, generators involved in wholesale transactions or generators that are dispatchable by PJM. Telemetry may be required for one or more of the following reasons:

i) System Control. PJM has an obligation to maintain frequency and generation/load balance within its service territory. Changes in the status of large amounts of generation, without real-time telemetry, are detrimental to system control.

ii) Transmission System Operation. The status of large generators significantly impact operating decisions. Operators need to know the status of these large generators before performing routine or emergency switching.

iii) Public Safety. Generators can potentially keep a portion of the electrical grid energized while isolated from the Exelon System. It is critical to detect these situations as soon as they occur so that corrective action can be taken, since the safety of the public and of Exelon workers is at stake.

Generators that meet the following criteria require implementation of telemetry to Exelon's and PJM's control center. Required telemetry is listed below each criterion. If more than one criterion applies to a generator, the telemetry requirements of each criterion must be met.

If the PD is involved in a Power Purchase Agreement (PPA) or participating in the PJM capacity markets which contain unit specific performance or a unit specific payment structure, the following applies:

- Continuous telemetry required.
- Instantaneous revenue grade MW and MVAR; and cumulative revenue grade MWhr and MVARhr at the generator's step-up transformer high side (or equivalent net output) for each unit.
- Instantaneous revenue grade MW and MVAR; and cumulative revenue grade MWhr and MVARhr at all points of interconnection with Exelon and all points of service from Exelon.

If multiple PD's generators over a large area with an aggregate generation greater than 40 MW are being centrally controlled, the following applies:

- Continuous telemetry required.
- Aggregate instantaneous MW of all generators.

General Design Requirements

There are two concerns with telemetry at PD sites:

- The normal requirements for substation remote supervision and operation
- The unique requirements for PD service, as emphasized in this document.

PJM Requirements

When telemetry is required, as described earlier in this document, the following design will be used.

Exelon SCADA Engineering will specify the SCADA system required. SCADA technology is constantly evolving, so specific devices are not referenced in this document. But the system will typically provide the following five basic functions:

1. Monitor status, control, and metering of the Exelon substation and any Exelon equipment.
    a) One or more input/output modules/cards to accommodate any hard-wired alarms, status, and controls
    b) Serial and/or IP data connections to protective IEDs, equipment monitors, revenue meters, etc.
2. Provide substation information to the Exelon SCADA system
    a) A serial or IP data connection to the Exelon SCADA system from the SCADA data concentrator
    b) The data connection can be via a telco circuit, a fiber optic cable, or a radio pathway as specified by Exelon based on availability at the site and ability to meet all Exelon SCADA and security requirements.
3. Provide substation information to onsite personnel

    If required, a utility-grade computer unit is typically used to act as a substation HMI. The computer will have a serial or IP connection to the SCADA data concentrator to acquire the substation data.
4. Provide Exelon substation information to the PD
    a) Current practice is to establish a DNP 3.0 serial connection between the Exelon data concentrator and the PD control system. The PD will act as the DNP master and poll the Exelon system for any desired information.
    b) For larger installations, a fiber optic cable is typically installed between the Exelon and PD facilities. This DNP connection is most easily accomplished by using a pair of fibers in this cable.
    c) The Exelon system will be programmed to only provide information relevant to the PD connection. This data typically includes the revenue metering data, as well as status of equipment relating to the PD connection/tap on the Exelon system.

5. Provide Exelon SCADA system with PD substation information

   a) Current practice is to establish a 2nd DNP 3.0 serial connection between Exelon and the PD. Exelon will now act as the DNP master and poll the PD on this 2nd DNP connection to gather information about the PD facility.

   b) Like with the first DNP connection, for larger installations a fiber optic cable is typically installed between the Exelon and PD facilities. This DNP connection is most easily accomplished by using a pair of fibers in this cable.

   c) For generator facilities, additional SCADA information may be requested by Exelon to be transmitted through PJM's ICCP link.

6) COMMUNICATION REQUIREMENTS

Communications will be required for Relay Protection schemes, SCADA, telemetry, voice/data, Revenue Metering, and other Substation services. The Substation is a harsh environment that will require extraordinary means of construction to provide safe, dependable, and reliable service for all required connections.

Relay Requirements

Communications for Relay schemes need to be provided with equipment that meets the same IEEE C.37.90 requirements as the Relays themselves. The type of Communications equipment utilized will vary based on the Transmission voltage level that is being protected. The standard medium of system protection communication on the Exelon transmission system is fiber optic-based equipment. Any other technologies must be reviewed and approved by Exelon prior to the start of customer design work. This review will occur at the same time as the Relay schemes are reviewed.

SCADA/Telemetry/Revenue Metering Requirements

Communications for SCADA/Telemetry/Revenue Metering have slightly less stringent requirements unless they are using the same equipment that the Relay schemes are using. These communications can be made on fiber optic equipment. Normal communication methods involve cellular communication either private Verizon network (ION-RV55) or AMI (Network/Access Point). Any other technologies must be reviewed and approved by Exelon prior to the start of customer design work.

Other Voice/Data Requirements

Communication for other voice/data services, including cellular lines, Fire Protection, LAN/Internet, etc. also do not have the same stringent requirements as the Relay schemes, unless they are using the same equipment. Any communications provided by leased lines from the phone company will require the same GPR studies as described above in the SCADA Requirements. These communications can be provided over fiber optic-based equipment, with one exception:

- The primary Fire Protection circuit, if required, cannot be provided over a "private network" (i.e., an Exelon based fiber optic system) per NFPA72. However, if Fire Protection is not required, and is simply being added because it's preferred, then this channel can be through SCADA or some other communication means, as approved by Exelon

Any other technologies must be reviewed and approved by Exelon prior to the start of customer design work.

7) METERING REQUIREMENTS

The following equipment shall be in place, tested and operational before a PD comes online.

Revenue Meter

The Revenue Meter measures the wholesale energy output (Hourly net MWH and Hourly net MVARH) of a generator. The Revenue Meter readings provide the basis for financial settlement in PJM market.

A revenue metering point will need to be established at or near the Point of Change of Ownership. Project Developer will purchase and install all metering instrument transformers along with any other required telemetry equipment. The Project Developer will be responsible for constructing a metering structure per Exelon's specifications.

The Exelon supplied meters will be considered the official meters and must be the source for reporting generation output to PJM. The revenue meter will be installed by Exelon at or near the Point of Change in Ownership structure. This location must be approved by Exelon prior to installation. Exelon would be responsible for operating, maintaining, inspecting, and testing all metering equipment upon installation and at least once every two (2) years thereafter. The PD would inspect the testing.

It is PD's responsibility to send the data that PJM requires directly to PJM. The PD will grant permission for PJM to send Exelon the following telemetry that Project Developer sends to PJM: real time MW, MVAR, volts, amperes, generator status, and interval MWH and MVARH.

AMI Meter at Transmission Level

The AMI Meter measures retail energy consumption by the PD at transmission level. The AMI Meter is installed at the Interconnection Substation on Exelon's side of Point of Change of Ownership.

Exelon owns the AMI Meter and is responsible for operating, maintaining, inspecting, and testing all metering equipment upon installation and at least once every two years thereafter. There are several options for the PD to obtain retail energy:

- PD can choose the Exelon for retail energy. If so, Exelon bills the PD through a bundled service under the applicable tariff rates.
- PD can choose another Retail Energy Supplier (RES) associated with the energy portion of their bill. If so, Exelon would continue to bill the PD unbundled Retail Delivery service under the applicable tariff rates with RES being passed through to the customer based on the negotiated third-party rates.

- PD can choose to self-supply retail energy. If so, Exelon would continue to bill PD based on the applicable rates and any net-negative usage.

Retail Meter at Distribution Level

The Retail Meter measures the retail energy consumption by the PD at distribution level. The Retail Meter is installed at the PD facility at the distribution voltage level. If PD facility is located within the Exelon Distribution Service Territory, the local Exelon utility would own and maintain the distribution Retail Meter and bill the PD using the following options for purchasing retail energy:

- The PD can choose Exelon for distribution of retail energy. If so, Exelon bills PD through a bundled service under the applicable tariff rates.
- The PD can choose another Retail Energy Supplier (RES) associated with the energy portion of their bill. If so, Exelon would continue to bill PD unbundled Retail Delivery service under the applicable tariff rates with RES being passed through to the customer based on the negotiated third-party rates.

If PD facility is not located within the Exelon Distribution Service Area, the PD should work with the electric utility of that area for retail energy at distribution level and install a separate meter.

Real Time Power Meter

The PD is responsible for installing a Real Time Power Meter at the high side of its generator transformer to measure real time MW, MVAR and voltage. The PD is responsible for transmitting real time data for its generator to PJM, including but not limited to the following:

- Instantaneous net MW for the generator.
- Instantaneous net MVAR for the generator
- Instantaneous Voltage value.

Additionally, the PD is responsible for transmitting the status of transmission level circuit breakers and Motor Operated Disconnects (MODs) to PJM in real time.

Tie-Line Meter

External Tie Lines are circuits that connect the PJM Balancing Authority area with an external Balancing Authority area. Internal Tie Lines are circuits that connect the control zones within the PJM Balancing Authority area.

It is PJM protocol to install metering at each end of the External and Internal Tie-Lines, one serving as primary Tie-Line meter and the other serving as secondary or back-up Tie-Line meter.

In situations where a PD cuts in the Tie Line to get interconnected, PD is required to install a Tie-Line meter at the line terminal connecting the non-Exelon

substation. The Tie-Line meter will be designated as ‘primary’ or ‘secondary’ depending on the designation of Tie-Line meter located at the non-Exelon substation.