



Duquesne Light Company (DLC) Transmission Facility Interconnection Requirements

Revision 0

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Duquesne Light Company

Transmission Facility

Interconnection Requirements

1. INTRODUCTION

Duquesne Light Company (DLC) is a regulated electric utility operating an 817-square-mile area in southwestern Pennsylvania that includes the majority of Beaver and Allegheny Counties. Duquesne Light provides electric transmission and distribution services to approximately 600,000 customers within DLC's service territory. Duquesne Light's transmission system is comprised of over 600 circuit miles of overhead and underground transmission lines that interconnect to substations owned by DLC, DLC's neighboring Transmission Owners, and customers.

This document describes the processes and technical requirements for new or materially modified facility connections to the DLC transmission system. This document discusses the requirements for interconnecting generation facilities, transmission BES Facilities, and End-User facilities to DLC's 138 kV and 345 kV¹ transmission system. Note, DLC does not allow new interconnections to DLC's legacy 69 kV transmission system.

The DLC service territory is governed by the reliability standards established by the North American Electric Reliability Corporation (NERC), ReliabilityFirst Corporation (RF), and PJM Interconnections, LLC (PJM) organizations. As a member Transmission Owner (TO) of PJM, DLC adheres to the interconnection process established by the PJM Tariff and documented within the PJM Manual 14 series.

1.1. Document Overview

This document has been prepared by DLC to comply with NERC Reliability Standard FAC-001 Facility Interconnection Requirements to address interconnection requirements for generation facilities, transmission BES Facilities, and End-User facilities.

¹ Unless otherwise stated, all voltage values specified in this document shall be considered nominal values.

Section 2 of this document describes the procedures DLC follows to ensure all new interconnections and all material modifications of existing interconnections are studied. Section 2 also describes how DLC notifies the owners of systems that are affected by a new interconnection or a material modifica

tion to an existing interconnection on DLC’s system and how DLC confirms affected systems are within DLC’s Balancing Authority’s Metered Boundaries.

Section 3 of this document has been developed to provide topics Interconnection Customers (ICs) should consider when requesting an interconnection to DLC’s transmission system.

Sections 4 through 18 of this document contain technical requirements that may affect the design, operation, and/or maintenance of Interconnecting Facilities. Note, the technical requirements contained within this document are general and may not cover specific details for every case. The technical requirements normally applied may be altered by DLC to cover unanticipated technical problems that may occur despite the fact that the proposed installation is similar to a previously accepted installation. Since the technical requirements specified in this document are minimum DLC requirements, they must also meet national, state and local codes and regulations including all applicable NERC, RF, and PJM standards.

1.2. Definitions

Table 1 Table 1 defines terms that are used throughout the subsequent sections of this document.

Table 1: Defined Terms

Term	Definition
Attachment Facilities	As defined in the PJM Open Access Transmission Tariff as amended and supplemented.
BES Facility	As defined by the term Facility in the NERC Glossary of Terms as amended and supplemented.
Direct Connection Network Upgrades	As defined in the PJM Open Access Transmission Tariff as amended and supplemented.
End-User	A nonutility entity that consumes untransformed power from the DLC Transmission System.
Interconnection Customer (IC)	Any entity interconnected with or interconnecting to the DLC Transmission System.
Interconnection Facilities (IF)	Any facilities required for an entity to interconnect to the DLC Transmission System.
New Service Request Process	PJM’s process for interconnecting new generators or upgrading existing generators to the PJM system.
Point of Interconnection (POI)	The point where an Interconnection Customer’s equipment interconnects to the DLC system.

2. INTERCONNECTION STUDY PROCEDURES

NERC Reliability Standard FAC-001 requires Transmission Owners to address the following within the Transmission Owner's Facility interconnection requirements:

- Procedures for coordinated studies of new or materially modified existing interconnections and their impacts on affected system(s).
- Procedures for notifying those responsible for the reliability of affected system(s) of new or materially modified existing interconnections.
- Procedures for confirming with those responsible for the reliability of affected systems that new or materially modified BES Facilities are within a Balancing Authority (BA) Area's metered boundaries.

This document address each of these requirements.

2.1. Coordinated Studies

DLC supports the interconnection assessments performed by its Transmission Planner (TP) and Planning Coordinator (PC), PJM. PJM evaluates the reliability impact of:

- interconnecting new generation, transmission, or electricity End-User facilities,
- materially modified existing interconnections of generation, transmission, or electricity End-User facilities.

PJM administers the new or materially modified interconnection requests of generation facilities. The PJM interconnection process, as well as related processes for transmission expansion, is described in the PJM Manual 14 series which is available on PJM's website.

DLC coordinates with PJM to perform studies to determine the impact on the affected systems in accordance with NERC, RF, PJM, and DLC Transmission Planning Criteria. The DLC Transmission Planning Criteria is made publicly available on PJM's website.

The processes for new interconnections or materially modifying existing interconnections vary for generation facilities, transmission BES Facilities, and End-User facilities. The following subsections of this document explain the specific processes for these IF.

2.1.1. Generation Facilities

ICs must submit all interconnection requests for generation facilities to PJM via the New Services Requests process. *PJM Manual 14A: New Service Request Process* describes the New Services Requests process for the interconnection of generating facilities (including increases to the capacity of an existing generating unit or decommissioning of a generating unit) within the PJM RTO. Additionally, PJM Manual 14A guides ICs through the application, study, and agreement process.

DLC coordinates with PJM on all interconnection studies pursuant to the process in PJM Manual 14A. The result of these studies will document any upgrades to DLC's Transmission System required to facilitate the request. After all applicable interconnection studies have been completed, PJM will draft the appropriate interconnection service or construction agreement to be executed by all applicable parties.

Existing ICs should also consult their Interconnection Service Agreement or Upgrade Construction Service Agreement when seeking to modify existing interconnections.

2.1.2. Transmission BES Facilities

Interconnection requests for new or material modifications to existing interconnections between DLC and another Transmission Owner (TO) require a PJM Baseline or Supplemental project. *PJM Manual 14B: PJM Regional Transmission Planning Process* discusses PJM's Regional Transmission Expansion Plan (RTEP) process, which includes the planning and execution of Baseline and Supplemental projects. During the RTEP process, PJM is responsible for studying the impacts of Baseline and Supplemental projects and coordinating with affected TOs. These studies, and any Transmission BES Facility upgrades identified as a result, are included in the PJM RTEP and made publicly available on the PJM website.

DLC considers any of the following changes to an existing interconnection between DLC and another Transmission Owner to be a material modification:

- A change in the BES Facility thermal rating by greater than 5%,
- A change in the BES Facility impedance by greater than 5%,
- A change in the nominal voltage of a BES Facility,
- A change in the protection coordination that would alter the way a facility would switch or respond to faults,
- A change in topology that would alter power flows on the BES.

2.1.3. End-User Facilities

ICs requesting new or modifications to existing End-User facilities interconnected to DLC's Transmission System must contact DLC's new business line at 412-393-4343 and complete an Electric Service Request Form. As part of the Electric Service Request Form, ICs must provide pertinent information (estimated peak loading, size of largest motor, requested voltage of interconnection, etc.) to DLC about the IC's planned End User facilities.

Once the Electric Service Request Form has been submitted to DLC, DLC personnel will meet with the IC and discuss the information provided on the Electric Service Request Form. After that discussion, DLC will perform a study to determine the impacts of the proposed interconnection to the DLC transmission system. The results of the DLC Impact Study will be documented in a report which will detail any new facilities that will be required to interconnect the IC's end user facilities

to DLC's transmission system in addition to any upgrades to DLC's transmission system that may be required to facilitate the new capacity addition. DLC will provide the report of the DLC Impact Study results to the IC. If the IC chooses to proceed with the new or modified interconnection after receipt of the study results, DLC will issue an Electric Service Agreement and submit a Baseline or Supplemental project, as applicable, in accordance with PJM's RTEP process as detailed in PJM Manual 14B.

DLC considers any of the following changes by an End-User to their facilities to be a material modification for which DLC requires an Electric Service Request Form to be submitted for review:

- Increases in demand of 5 MVA or more,
- Addition of equipment, such as (but not limited to) a large induction motor, that would significantly impact the composite load model used to represent a facility,
- Changes in protection schemes or settings,
- Any change to an End-User equipment configuration or operation that could result in a change in harmonic levels exported onto DLC's Transmission System,
- A change in End-User facility topology that may affect power flows on the BES,
- The installation of generation on the customer's system.

For End User interconnections, DLC will submit a Baseline or Supplemental project, as applicable, in accordance with PJM's RTEP process as detailed in PJM Manual 14B. As part of the RTEP process, PJM will study the proposed project as part of a "Do No Harm" study. DLC will notify those responsible for the reliability of any system that is determined to be affected by the project during the "Do No Harm" study.

2.2. Confirmation Affected Systems are within a Balancing Authority's Metered Boundaries

All new or materially modified facilities that seek interconnection to DLC's transmission system must go through the New Services Request process or RTEP process described in PJM Manuals 14A and 14B, respectively. PJM assesses facilities within its Balancing Authority Area's metered boundaries through the processes in these Manuals.

Per PJM Compliance Bulletin CB028, *NERC Standard FAC-001-3 – Facilities within the metered boundaries of a Balancing Authority*, a PJM issued Interconnection Service Agreement (ISA) or Upgrade Construction Service Agreement (UCSA) is FERC approved evidence that can be used by each IC as confirmation that their new or materially modified BES Facilities are within the PJM Balancing Authority Area's metered boundary.

2.3. Additional Reliability Studies

In order to ensure the reliability of the DLC transmission system, DLC may perform additional interconnection studies for ICs interconnecting inverter-based resources or harmonic-producing equipment. To facilitate these studies, ICs interconnecting inverter-based resources must provide EMT

modeling information to DLC consistent with Institute of Electrical and Electronics Engineers Standard (Std) 2800 upon request. Similarly, ICs interconnecting harmonic-producing loads must provide to DLC, upon request, a harmonic load model representing the 0th through 50th harmonics produced by the customer’s equipment for detailed studies. DLC reserves the right to identify, and require the IC to install and/or employ as applicable, equipment and/or operational procedures to mitigate any issues identified by these studies.

3. GENERAL CONSIDERATIONS

ICs and prospective ICs should read, understand, and consider the topics discussed within sections 3.1 through 3.33.3 when requesting an interconnection to DLC’s transmission system.

3.1. Generator and End-User Interconnection Facility Configurations

When requesting an interconnection to DLC’s transmission system for generation or End-User facilities, the IC should carefully consider the reliability that they will need for their service. DLC recommends redundancy when designing new IF for generators or End-Users to minimize the impact an outage will have on the IC. Figure 1 shows DLC’s recommended configuration for new IFs for generators and End-Users. In this configuration, the IC is fed by two independent transmission lines that allow for operational flexibility and redundancy.

Figure 1: Interconnection Configuration with Redundancy

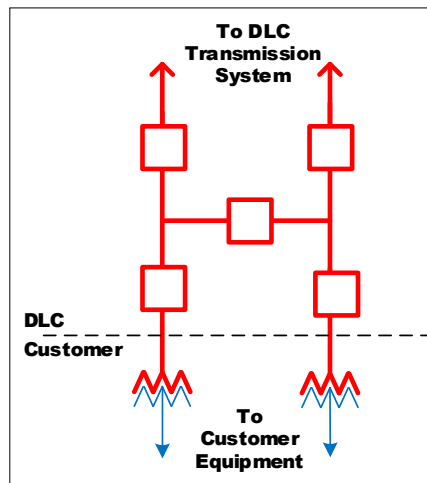
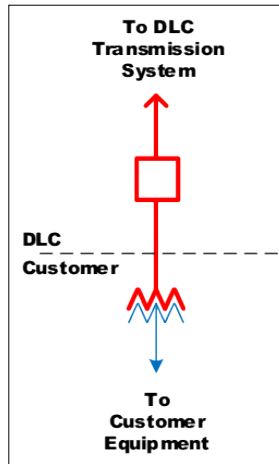


Figure 2 shows DLC’s recommended configuration for new IFs for generator and End-User ICs that wish to forego redundancy. Note that DLC no longer permits the tapping of DLC-owned transmission lines for new load and generation interconnections.

Figure 2: Interconnection Configuration without Redundancy



Generators interconnecting to the DLC transmission system shall utilize step-up transformers with a high-side grounded-wye/low-side delta winding configuration as shown in Figure 3. End-Users interconnecting to the DLC transmission system shall utilize transformers with a high-side delta/low-side grounded-wye winding configuration as shown in Figure 4. DLC may, on a case-by-case basis, permit the installation of transformers with differing winding configurations if DLC determines, in its sole discretion, that the proposed winding configuration will not adversely affect the interconnection or the DLC transmission system.

Figure 3: Typical Generator Step-Up Transformer Winding Configuration

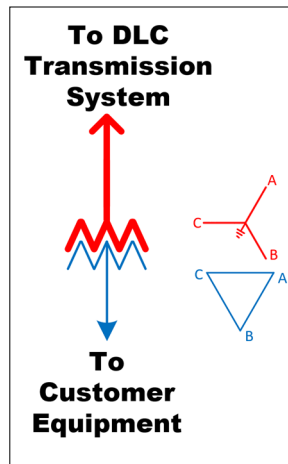
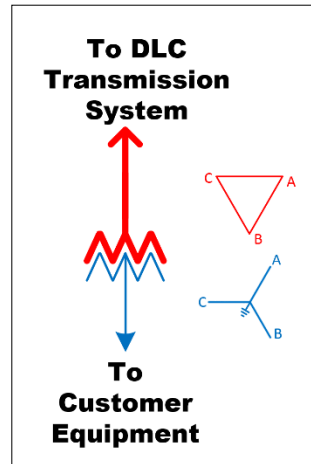


Figure 4: Typical End-User Transformer Winding Configuration



3.2. Option to Build

The PJM Open Access Transmission Tariff (OATT) allows for ICs going through the New Service Request process to have the option, under certain circumstances, to assume the responsibility for the design, procurement and construction of Transmission Owner Attachment Facilities and Direct Connection Network Upgrades. *PJM Manual 14A: New Service Request Process* and *PJM Manual 14C: Generation & Transmission Interconnection Facility Construction* provide more details on this “Option to Build.”

If exercising the Option to Build, the IC must select contractors to perform such work from DLC’s “List of Approved Contractors and Vendors”. Similarly, all equipment installed by the IC while exercising the Option to Build must be from the vendors/manufacturers on DLC’s “List of Approved Contractors and Vendors”. DLC’s “List of Approved Contractors and Vendors” is available on PJM’s website. If a contractor or vendor/manufacture desired to be used by the IC is not on the “List of Approved Contractors or Vendors,” the IC must request DLC to evaluate the contractor or vendor/manufacture for acceptability by emailing DLC at Standards@duqlight.com.

3.3. Indemnification

The IC shall indemnify and hold DLC harmless for all damages, injuries and fatalities to DLC or others arising out of the IC’s use, ownership, or operation of its facilities, and caused in whole or in part by the IC’s equipment failure or negligence. The IC is solely responsible for providing adequate protection for its facilities operating in parallel with DLC’s system and shall release DLC from any liability for damages or injury to its facilities arising out of such parallel operation, unless caused solely by DLC’s negligence.

4. SAFETY REQUIREMENTS

All work performed by the IC on DLC’s transmission system shall be in accordance with all applicable safety practices and OSHA requirements. Furthermore, all facilities interconnecting to DLC’s system must comply with the applicable codes and standards found in Section 4.1 of this document and must have an isolation device compliant with the applicable requirements of Section 4.2 of this document. Failure to meet these requirements may result in serious harm to the public and/or DLC personnel.

4.1. Codes and Standards

All interconnecting facilities must comply with the requirements of the current National Electrical Code (NFPA-70/ANSI, as amended and supplemented), National Electrical Safety Code (ANSI C2, as amended and supplemented), all other applicable national, state, and local codes and ordinances, and the DLC Electric Service Installation Rules available on DLC’s website.

4.2. Disconnect and Isolation Devices

For generation and End-User facilities, all IFs shall have a readily accessible, lockable, visible-break isolation device. This device shall be located at the point of interconnection and shall be accessible without notice by DLC personnel, where applicable. It shall be mechanically interlocked in a manner that ensures continuous current has been interrupted allowing the visible break device to be operated. One visible disconnect point, clearly identified for utility access, for each point-of-interconnection shall be installed.

In the event an IC elects to provide DLC access to an isolation device that is contained in a building or area that may be unoccupied and locked or not otherwise readily accessible to DLC, the Interconnection Customer shall provide ready access to the isolation device through a means specified by DLC (e.g., lockbox, electronic card reader, etc.). The Interconnection Customer must locate the access controller in a location that is readily accessible by DLC and the Interconnection Customer shall permit DLC to affix a placard in a location of DLC’s choosing that provides clear instructions to DLC operating personnel on access to the isolation device.

5. MVA CAPACITY AT POINT OF INTERCONNECTION

DLC will make every effort to accommodate the required injection at the requested point of interconnection. The study process will determine the feasibility of the request and identify any subsequent upgrades. DLC’s available transmission voltages and their typical MVA ratings are shown below.

System Voltage (kV)	Typical Rating (MVA)
138	222.7
345	1,244.2

Refer to section 11 of this document for DLC’s voltage, reactive power, and power factor control requirements.

6. CIRCUIT BREAKER DUTY AND SURGE PROTECTION

The following subsections of this document provide requirements for short-circuit current ratings and surge protection.

6.1. System Short Circuit Duty

DLC will provide the maximum three-phase and line-to-ground fault currents (magnitude and X/R) at the proposed interconnection location. The minimum interrupting rating of all equipment at DLC substations is as follows:

System Voltage (kV)	Rated Short-Circuit Current (kA)
138	63
345	50

6.2. Surge Protection

DLC will install surge arresters on DLC-owned lines as necessary. The IC is responsible for installing surge arresters to protect the IC’s equipment such as on the high- and low-voltage terminals of power transformers.

The following table lists the DLC standard for surge arresters used in substations:

Arrester Type	System Voltage	Duty Cycle Voltage	TOV (Note 1)	MCOV	Maximum discharge voltage at 10kA for 8/20 μ s waveshape:	Minimum Energy Capability	Minimum pressure relief current rating	Mounting Bolt Circle*	Fault Current Withstand	Leakage Distance
Station	138 kV	108 kV	129.6 kV	88 kV	303 kV max	9.0 kJ/kV	60 kA or greater	8.75 in	60 kA	108" min
Station	345 kV	276 kV	331.2 kV	220 kV	670 kV max	7.0 kJ/kV	80 kA or greater	10 in	80 kA	276" min

- 1) Temporary over voltage (TOV) capability shall be equal to or greater than 1.2 per unit arrester duty cycle rating for a time equal to or greater than 1.0 seconds at no prior energy.
- 2) Arresters shall be of adequate rigidity to withstand forces imposed by winds of up to 76 mph without damage and ice up to one (1) inch thick.
- 3) Each arrester shall be sealed to permanently prevent the entrance of moisture.
- 4) The base and top shall have three (3) holes at 120 degrees mounting for 1/2 inch minimum bolts on a ___ inch bolt circle.*
- 5) Arrester line terminal pads shall have four 9/16 inch holes drilled on 1-3/4 inch centers in accordance with NEMA LA-1 standard. The ground terminal pads shall have two 9/16 inch holes drilled on 1-3/4 inch centers.
- 6) Maximum discharge voltage based on the higher of published values in present supplier documentation or typical characteristics based on Table 1 in IEEE Std C62.22-2009.

7. SYSTEM PROTECTION AND COORDINATION

DLC’s requirements for the protection and coordination of IF are as follows:

- DLC will specify and install the equipment required to protect the DLC system, equipment, personnel, and customers (“Protection Equipment”). DLC will own, operate, and maintain the

Protection Equipment specified inclusive of a DC source to provide power to DLC's Protection Equipment.

- The IC is responsible for installing, owning, operating, and maintaining the equipment required to protect the IC's equipment and personnel. When designing this equipment, the IC should consult DLC to ensure coordination between DLC's Protection Equipment and the IC's.
- All protective relays shall be of the multifunction, programmable, micro-processor based type and meet or exceed ANSI/IEEE Std C37.90, "Relays and Relay Systems Associated with Electric Power Apparatus." Relays shall be designed for operation in a nominal 125 VDC system (140 VDC Float), which provides the power source for the relay as well as all control power for operating and tripping devices. Transmission breakers require independent redundant trip circuit and protection (i.e., two relays (Primary and Secondary), two trip coils, two of all ancillary components and independent wiring and cabling).
- All protective relays, switches, wiring and cabling, and current transformers shall be designed to operate continuously at the circuit breaker's continuous ratings as shown in Section 13 of this document.
- All requirements of the *PJM Manual 07: PJM Protection Standards* shall be followed.
- IC Protection System settings that are designed to operate for faults on the BES shall be provided to DLC for review and approval in accordance with NERC Standard PRC-027. IC Protection System settings shall operate in the intended sequence for faults on BES.
- DLC Protection System settings that are protecting the interconnecting facility will be provided to the IC for their review in accordance with NERC Standard PRC-027.
- DLC may require the installation of DLC-owned protective relays on the customer's property. In these instances, the IC is required to provide two AC sources that can be utilized to charge DLC's DC source. DLC will communicate this requirement to the IC as part of the design of DLC's facilities.

8. METERING AND TELECOMMUNICATIONS

The following subsections of this document provide DLC's metering and telecommunications requirements for IF.

8.1. Revenue Metering

All revenue metering equipment must adhere to the requirements of DLC's Tariff and, for ICs participating in the PJM wholesale market, PJM's Manuals and OATT.

8.1.1. Transmission BES Facilities

When a new interconnection between a TO and DLC is requested, the requesting TO shall install, own, operate, test, and maintain the revenue metering equipment unless otherwise agreed to by DLC. The revenue metering equipment shall be compensated for losses between the meter location and the POI.

8.1.2. End-User Facilities

The IC shall furnish and install the following equipment for the Company's metering system:

- Foundations and structures for mounting the metering current and voltage instrument transformers and mounting the metering transformer test switch enclosure.
- A rigid, galvanized steel, underground conduit system, 1.5 inch diameter with pull line, from the substation yard test switch enclosure(s) to DLC weatherproof meter enclosure mounted at a mutually agreed on location.
- Access to 120 volt AC via a standard duplex outlet in close proximity to DLC metering equipment to facilitate testing etc.
- Revenue metering enclosure

DLC will provide the following metering equipment and/or service:

- Revenue accuracy instrument current (CT) and voltage (VT) transformers, three (3) of each.
- DLC will provide the customer with outline drawings of the revenue metering transformers, unless structure designs are provided by DLC.
- Metering transformer test switch enclosure(s) on the instrument transformer structure(s) in the substation yard.
- Secondary wiring and conduit to connect the metering instrument transformers to the substation yard test switch enclosure.
- Secondary wiring from the test switch enclosure to the revenue meter enclosure.
- DLC will pull and terminate all required metering secondary wires and cables.

The mutually agreed upon location of the meter equipment enclosure shall be within 150 cable feet of the substation yard metering instrument transformer test switch enclosure(s).

If changes are made in/at the IC premises which render the existing meter equipment location unsafe, unsuitable, or inadequate, the IC shall be required to provide a suitable alternative location for this metering equipment. If relocation of the meter equipment is necessary, the IC will be billed an appropriate service charge for this work.

The IC is not permitted to install meters or instruments in the metering transformer secondary circuits. Metering data pulses and/or interval time pulses can/shall be provided to the customer from DLC metering equipment for load control and/or monitoring systems at the customer's request. A designated fee is charged for this service.

8.1.3. Generating Facilities

Any metering necessitated by the IC shall be installed at the IC's expense in accordance with FERC, state, local regulatory, PJM, and DLC requirements.

The type, size, and location of metering equipment will be determined and specified by DLC. At DLC's discretion the IC can be required to install and maintain a dedicated communications link, compatible with DLC's equipment, to telemeter the instantaneous MW output and hourly MWH output simultaneously to DLC's Operation Center. Installations where net power flow across the interconnection can be very small compared to the maximum power flow require special consideration. It is not possible to accurately meter loads, which are small in relation to current transformer CT ratios involved. DLC reserves the right to require that the generation and load(s) be separated and metered individually. A generating facility used for net metering shall be equipped with a single bi-directional meter that can measure and record the flow of electricity in both directions at the same rate. A dual meter arrangement may be substituted for a single bi-directional meter at DLC's discretion.

If the IC's existing electric metering equipment does not meet the requirements in this document, DLC shall install new metering equipment for the IC at DLC's discretion. Any subsequent metering equipment change necessitated by the IC shall be paid for by the IC. The IC has the option of utilizing a qualified meter service provider to install metering equipment for the measurement of generation at the IC's expense.

Additional metering equipment for the purpose of qualifying alternative energy credits owned by the IC shall be paid for by the IC. DLC shall take title to the alternative energy credits produced by the IC and pay for and install the necessary metering equipment, should the IC expressly reject title to the credits.

IC requests for virtual meter aggregation shall be provided by DLC at the IC's expense. The IC shall be responsible only for any incremental expense entailed in processing their account on a virtual meter aggregation basis.

8.2. Telecommunications and SCADA

Telecommunications circuits, which must be reliable and secure, should be tested regularly and monitored online, with special attention given to emergency channels. In addition, the IC shall follow the telecommunications requirements outlined in PJM Manuals.

8.2.1. Transmission BES Facilities

When a new interconnection between a TO and DLC is requested, DLC and the TO shall collaborate to determine an appropriate communication channel between the two companies' equipment.

8.2.2. End-User Facilities

Installation of communications facilities and services (internet service, leased telephone circuits, fiber optics, etc.), communications facility operation and maintenance, and other ongoing costs are the responsibility of the IC. The IC shall install and maintain satisfactory operating communications between its facilities and DLC's Operations Center or the IC's designated representative DLC's Operations Center. The IC shall also:

- Provide standard voice line and dedicated voice line at its facility control room via the public telephone system.
- Provide and maintain backup communication links with the transmission system operator for use during abnormal conditions.
- Provide the dedicated data circuit(s) necessary to provide data to PJM and DLC as necessary to conform with applicable standards.
- Provide remote monitoring and control of the interconnecting facility through the DLC supervisory control and data acquisition system (SCADA). DLC shall specify the manufacturer, type, and model number of the SCADA equipment to be installed.
- Install fiber-optic communications between the IF and DLC's existing fiber-optic infrastructure. DLC shall specify the fiber-optic communications as part of the design of the IF.

8.2.3. Generating Facilities

Installation of communications facilities and services (internet service, leased telephone circuits, fiber optics, etc.), communications facility operation and maintenance, and other ongoing costs are the responsibility of the IC.

At DLC's discretion, the IC may be required to install and maintain a dedicated communications link and devices, compatible with DLC's equipment, to provide telemetry (i.e. SCADA) to DLC's Operation Center. If requested by DLC, the required telemetry is as follows: circuit breaker status, voltage, amperage, MW, MVAR, MWH, and frequency.

The preferred communications protocol for SCADA communications is DNP 3.0 over TCP/IP.

All SCADA equipment installations shall comply with the current NERC Cyber Security standards, where appropriate.

9. GROUNDING AND SAFETY ISSUES

The following subsections of this document detail DLC’s grounding and safety requirements for interconnections to the DLC system. DLC reserves the right to assert location-specific requirements on a case-by-case basis.

9.1. Grounding

The grounding system shall be designed in accordance with the current National Electrical Safety Code with guidance provided by IEEE Std 80 “IEEE Guide for Safety in AC Substation Grounding,” as amended and supplemented, to establish safe step and touch potentials. For the area within the customer substation containing DLC equipment, the grounding system shall be designed and installed in accordance with the *DLC Engineering Design Manual: Grounding System Guide and Instructions for Design and Installation at Power Stations, Substations, and Customer Stations*. At its discretion, DLC will design the grounding system and perform soil resistivity testing for the portion of the IC’s substation that will contain DLC-owned equipment. The IC shall be responsible for installing and testing the grounding system per the DLC requirements.

The IC is responsible for the design and installation of the complete and integrated protective grounding system. A drawing showing the installation of the proposed grounding system with soil resistivity tests and calculations (IEEE Std 80) must be submitted to DLC prior to installation for review and comment. This drawing shall include the following pertinent information:

- Size and type of grounding conductors
- Resistivity of soil (earth) at substation site utilizing Wenner’s four-pin method (IEEE Std 81)
- Location and burial depth of grounding conductors
- Design resistance
- Location and length of ground rods
- Method of bonding grounding conductor to ground rods, intersecting underground conductors, underground conductor taps, fence posts, gates, structures, electrical outdoor equipment, control room equipment, control room doors, louvers, cable trays, and control cable shields.

The substation yard within the customer’s fence and an apron area extending three (3) feet beyond the customer’s fence around the complete perimeter of the fence including any gate swing, shall be covered with a minimum of four (4) inches of washed 2B limestone to reduce touch and step potentials and maintain the grounding system integrity by controlling vegetation.

The IC shall arrange and pay for an inspection of the grounding system by a qualified inspection agency. The ground impedance of the completed grounding system shall be tested prior to connection of DLC transmission conductors and shield wire(s). Certified test results of the value of resistance in ohms, using IEEE 80 std Fall-of-Potential Method are to be submitted to DLC for review and approval. Also,

a ground continuity test shall be performed to ensure that all ground risers are connected to the entire grid.

9.2. Site Conditions, Security, and Access

The IC shall designate a location on its site for facilities necessary to serve the IC. DLC has the sole discretion to determine whether such site is suitable for construction of its facilities and reserves the right to require the IC to remediate issues with its designated site or identify a suitable alternative site.

At DLC’s discretion, the IC shall either construct a free-standing control house or provide a completely segregated area within the customer building for a control room (“control area”). This control area will be limited to DLC access only. DLC reserves the right to install security measures, such as card reader access or security camera systems, to secure the control area.

The IC shall provide DLC with access to the site 24 hours a day, 7 days a week. DLC will comply with an IC’s reasonable safety requirements for site access.

9.3. Station Fencing

A substation fence shall be installed by the IC to limit the likelihood of entrance by unauthorized people and the general public. DLC will determine fence specifications based on site conditions. All fences shall conform to DLC standards.

9.4. Disconnecting Devices and Grounding Switches

Disconnect switches shall be installed to establish visible open breaks for clearance points for personnel to work between. Ownership of disconnect switches shall be determined on a case-by-case basis during the design of the facilities. All incoming lines shall have a disconnect associated with them which are typically be owned by DLC. Breakers shall have a visible open break on either side.

For 345 kV lines and busses disconnects, grounding switches shall be installed.

9.5. Mechanical Keyed Interlocks

Breakers shall have a mechanical key interlock for DLC use. DLC shall specify the manufacturer and model of the key release unit installed in the breaker during the design phase of the project.

10. SPACING, MINIMUM CLEARANCE, AND INSULATION COORDINATION

Electrical clearances of the substation equipment shall, at a minimum, be designed to the National Electrical Safety Code (NESC) and National Electrical Code (NEC) requirements based on the equipment Basic Impulse Level (BIL) for voltages less than 345 kV. For 345 kV the clearance shall be designed based on a switching surge factor of 2.74 per unit (p.u.) (810 kV). The following table lists the DLC BIL requirements.

Equipment	Basic Lightning Impulse Insulation Level (BIL)	
	138 kV	345 kV
Bus insulators	650	1300
Disconnect switches	650	1300
Circuit Breakers	650	1300
Power transformer Bushing	650	1050
Current transformers	650	1300
Potential transformers	650	1300

11. VOLTAGE, REACTIVE POWER, AND POWER FACTOR CONTROL

The interconnection shall not result in any voltage conditions that violate NERC, PJM, or DLC reliability criteria. DLC’s transmission system is operated within a voltage range of 0.95 p.u. and 1.05 p.u. except in the case that specific equipment is identified as more restrictive.

Generating facilities shall meet the voltage, reactive power, and power factor control requirements outlined in *PJM Manual 14G: Generation Interconnection Requests* and be operated in accordance with *PJM Manual 14D: Generator Operational Requirements*.

End-User facilities shall operate close to unity power factor to minimize the reactive power burden on the DLC Transmission System. DLC requires these facilities to operate at power factors between 0.95 lagging and 0.95 leading. DLC reserves the right to waive these requirements or assert location-specific requirements on a case-by-case basis.

12. POWER QUALITY IMPACTS

The interconnection of any generator, transmission owner, or End-User facility to the DLC system should not negatively impact the power quality of other users. DLC sets maximum limits on allowable voltage and current distortion at user facilities.

12.1. Harmonics

Customer connections shall be assessed at the POI with an appropriate instrument that is capable of measurements in accordance with IEC 61000-4-7 and IEC 61000-4-30, Class A. For inverter-based generation ICs, harmonic distortion levels at the POI shall meet the applicable limits contained within or referenced by the latest revision of IEEE Std 2800. For all other ICs, harmonic distortion levels at the POI shall meet the applicable limits contained within or referenced by the latest revision of IEEE Std 519.

12.2. Flicker

DLC sets voltage flicker limitations for interconnection customers in accordance with recommendations from IEEE Std 1453. The following table, based on Table 2 of IEEE Standard 1453, sets individual flicker emission value limits for users.

Flicker Emission Value	95 th Percentile Flicker Limit		
	P _{95%}		
	≤ 1kV	≤ 35kV	> 35kV
P _{st}	0.6	0.9	0.8
P _{lt}	0.5	0.7	0.6

Unless specified otherwise by DLC, measurements to evaluate adherence with this requirement will be performed at the POI, using an IEC 61000-4-15 compliant flickermeter. If it is not practical to obtain measurements at the POI, they may be taken at the closest available location and the corresponding Flicker emission at the POI will then be calculated from those measurements, following IEEE Std 1453 recommendations. The monitoring period will be of sufficient duration to characterize the nature of the customer's load profile, which is typically approximately 168 hours.

12.3. No Waiver

Any instance in which DLC does not strictly enforce any applicable power quality requirement does not constitute or imply a waiver of such requirement. At all times, DLC reserves all rights to strictly enforce power quality requirements.

13. EQUIPMENT RATINGS

All substation equipment installed by the IC shall have interrupting, peak current, and continuous ratings no less than those in the table below.

System Voltage (kV)	Rated Maximum Voltage (kV)	Rated Continuous Current (A)	Rated Short-Circuit and Short-Time Current (kA)	Rated Interrupting Time (ms)	Maximum Permissible Tripping Time Delay (s)	Rated Closing and Latching Current (kA)
138	145	3000	63	50	1	164
345	362	3000	50	33	1	130

14. SYNCHRONIZING OF FACILITIES

14.1. Generation Facilities

The IC shall assume all responsibility for properly synchronizing its generation with the DLC system. DLC requires, at a minimum, a synchro-check relay and synchroscope to provide proper synchronization with its system. Reclosing of generation facilities is generally not permitted.

14.2. Transmission BES Facilities

Transmission interconnections between areas controlled by different Independent System Operators (ISO) and between the facilities of different TOs require synchro-check relays and synchrosopes at the points of interconnection. Reclosing angles will be determined by DLC in coordination with PJM.

14.3. End-User Facilities (with Generation)

End-User facilities with generation capability that can run synchronized with the DLC system shall be equipped with the synchronizing capabilities as described in Section 14.1, regardless of the facility's power export potential. This type of facility shall also be equipped with reverse power relays, over/under voltage relays, over/under frequency relays that will trip the generation clear of the DLC system under abnormal conditions or during inadvertent power export.

14.4. End-User Facilities (without Generation)

Synchronizing of facilities typically does not apply to end users without any generation. However, facilities with large induction and/or synchronous motors may cause potential system disturbances if the transmission supply source is equipped with reclosing capability. In this case, the reclosing circuits shall be supervised by a synchro-check relay. If the End-User facility is supplied from two or more lines, synchronizing equipment will facilitate faster restoration during system emergencies and may be considered. DLC reserves the right to require voltage and/or frequency protection on a case-by-case basis.

15. FACILITY MAINTENANCE AND COORDINATION

Each interconnected party should maintain, or initiate the maintenance of, its facilities in a safe and reliable manner in accordance with all applicable standards, rules, procedures, protocols, all applicable laws and regulations, and good utility practice. In addition to the electrical system maintenance, the IC is responsible for maintaining general substation property. This maintenance includes, but is not limited to fencing, foundations, grounding, UG conduit, structural steel, control house, control house HVAC, lighting, yard rock covering, access roadway(s) to the substation and vegetation management within and adjacent to the substation outer fence.

For each interconnected facility, the IC shall provide DLC personnel access to areas under the IC's control as reasonably necessary to permit DLC to perform its obligations such as operation and maintenance.

DLC and the IC shall coordinate the planning and scheduling of preventative and corrective maintenance to the IC's facilities, IF, or the DLC Transmission System. The IC should review applicable interconnection agreements for specifics on the coordination of maintenance activities. Note, when any 100kV and above facility is or will be out of service, PJM must be notified as outlined in *PJM Manual 3: Transmission Operations*.

Unless otherwise agreed upon by DLC and the IC, the IC shall be responsible for the maintenance, replacement, and eventual removal of any equipment owned by the IC. Any new equipment installed by

the IC shall meet the applicable requirements of the then-effective DLC Transmission Facility Interconnection Requirements. Whenever an Interconnection Facility is replaced (including but not limited to, for example, when the Interconnection Facility has reached the end of its operational life as DLC shall determine), the IC shall conform all of its facilities to the applicable requirements of the then-effective DLC Transmission Facility Interconnection Requirements.

16. OPERATIONAL ISSUES

The criteria for acceptable transmission system performance for normal system conditions can be found in the *PJM Manual 3: Transmission Operations*, which discusses specific transmission conditions and procedures for the management of transmission facilities within the PJM Control Area. During emergency operating conditions, PJM may implement emergency operating procedures and corrective control strategies.

Operation of the interconnected electric system and all interconnected individual facilities during emergency or abnormal operating conditions shall be governed by the policies, procedures and communication protocols as described in *PJM Manual 13: Emergency Operations*. Generally, PJM shall communicate Emergency Operational Directives through the DLC Operations Center, which in turn shall communicate all necessary instructions to the interconnected facilities. Emergency conditions include: an abnormal electrical system condition requiring manual or automatic action, a fuel shortage, or a condition that requires implementation of emergency procedures as defined in the PJM Manuals. Refer to *PJM Manual 12: Balancing Operations* for corrective control strategies, such as customer load shedding for resolving undervoltages or underfrequency.

17. INSPECTION REQUIREMENTS

17.1. Prior to Energization

It is the responsibility of the interconnected customer to:

- Have the protective and safety equipment tested by a qualified testing agency and inspected by a qualified inspection agency. Documentation of the test results shall be submitted to DLC for review.
- Arrange and pay for an inspection of the station and interconnection facilities by a qualified inspection agency. Documentation of the Certification of Completion shall be furnished to DLC.

DLC has the right to:

- Inspect structural and electrical work to determine compliance with DLC requirements.
- Witness or perform acceptance testing prior to the interconnected facility being permitted to operate on the DLC system.

If DLC identifies any defects in the IF or failures of the IF to comply with applicable standards, DLC shall notify the IC of any identified defects or failures within 20 days after DLC's receipt of the results

of such inspection or testing. The IC shall take appropriate actions to correct any such defects or failures at its sole cost and expense, and shall obtain DLC's acceptance of the corrections prior to facility interconnection, which acceptance shall not be unreasonably delayed, withheld or conditioned.

17.2. Post Energization

Each IC shall perform routine inspection and testing of each of its interconnected facilities and equipment as may be necessary to ensure the continued interconnection of its facility with the transmission system in a safe and reliable manner. Applicable testing and/or inspection results must be provided to DLC upon written request. On providing advance written notice, DLC may request reasonable additional testing of the IF for good cause.

18. COMMUNICATIONS PROCEDURES

The Interconnection Customer shall install and maintain satisfactory operating communications with the DLC Operations Center.

The primary point of communications between the interconnected transmission facility operator and DLC shall be through DLC's Operation Center. The facility operator shall provide DLC's Operation Center the phone numbers of critical operations personnel, such as Operating Engineers and Shift Supervisors. These are the personnel that must quickly and accurately respond to operations directives given by PJM and transmitted by DLC. A list of all responsible operations and engineering personnel and their 24-hour access phone numbers shall also be provided and updated as soon as organizational changes are made. The DLC Operations Center 24-hour access phone numbers and email addresses shall be provided as part of the facility interconnection agreement.

All communications and procedures during normal operations and emergency operating conditions shall follow the requirements outlined in:

- *PJM Manual 01: Control Center and Data Exchange Requirements*
- *PJM Manual 03: Transmission Operations*
- *PJM Manual 13: Emergency Operations*

19. REFERENCES

The following items referenced in this document are publicly available:

- [Duquesne Light Company Electric Service Installation Rules](#)
- [Duquesne Light Company Approved Transmission Contractors and Vendors](#)
- [NERC Glossary of Terms](#)
- [PJM Compliance Bulletin CB028, NERC Standard FAC-001-3 – Facilities within the metered boundaries of a Balancing Authority](#)

- [PJM Open Access Transmission Tariff](#)
- [Various PJM Manuals](#)

The following items referenced in this document either need to be purchased or require a subscription to access:

- National Electrical Code
- National Electrical Safety Code
- Various IEEE Standards

20. DOCUMENT APPROVAL

Prepared By	Approved By	Approval Signature	Date
J. Hitt	J. Harchick	<i>Jason A Harchick</i>	06/06/2023

21. REVISION HISTORY

Version	Prepared By	Summary of Changes	Date
0	Jason Hitt	Initial creation of the document based on DLC's previous FAC-001 Interconnection Requirements for Generation Facilities, Transmission Facilities, and End-User Facilities dated 12/30/2015.	06/06/2023