
# Facility Interconnection Connection Requirements

For Compliance with the following NERC Reliability Standards:
FAC-001-2, Requirement R1 and R3

**FAC-001-2 R1 & R3, Facility Connection Requirements**

Program Title

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**Revision History**

| Version | Date | Description |
|---|---|---|
| 0 | December 10, 2007 | Initial Development |
| 1 | February 13, 2008 | Revised to include information on procedures for coordinated joint studies of new facilities for Transmission and End-User facilities; and procedures for notification of new or modified Transmission Facilities |
| 2 | October 20, 2011 | Removed verbatim copy of language containing the text of standard as approved. Revised *Introduction* section to include document section numbers applicable to each type facility. Changed company name from E.ON U.S. to LG&E and KU, and updated references & links to supporting documents. Revised surge protection requirements and included in R2.1.4. Added signature page and revision block. |
| 3 | December 31, 2015 | Added paragraph to the *Introduction & Scope* section describing the LG&E and KU OATT and ITO functions. Added brief descriptions of the LG&E and KU OATT Part I, II, & III to the *Generator Facilities, Transmission Facilities, and End-User Facilities* sections. Made various changes in formatting to align with the requirements of version 2 of the standard (FAC-001-2), and LGE/KU's standard procedure template. |
| 4 | December 16, 2016 | Summary of Changes Resulting from this Annual Review: Complete Rewrite. |
| 5 | November 10, 2017 | Summary of Changes Resulting from this Annual Review: Added additional process to allow Ad Hoc Study Group member to perform their own test to determine if their system is affected by a GI request or TSR. |

## 1.0 Introduction & Scope

The purpose of this *FAC-001-2 Facility Connection Requirements* procedure (this "Procedure") is to document the minimum interconnection requirements for entities desiring to connect to the LG&E/KU Transmission System to ensure there are no adverse reliability impacts.

LG&E/KU reserves the right to take such actions as deemed necessary to ensure the reliability of the interconnected transmission system. All interconnections to LG&E/KU Transmission System are based on Good Utility Practice (GUP) and must be in compliance with FAC-001-2.

For purposes of this document, the LG&E/KU Transmission Owner will be referred to as the TO. The following defined terms will apply when determining interconnection requirements.

**Interconnection Customer / Interconnection Party** means any entity, including any affiliate of LG&E/KU, that proposes to interconnect with the TO's Transmission System.

**Interconnection Facilities** means the TO's Interconnection Facilities and the Interconnection Customer's Interconnection Facilities. Collectively, Interconnection Facilities include all facilities and equipment, either BES or non-BES, between the Interconnection Customer and TO that are necessary to physically and electrically interconnect the two. Interconnection Facilities shall not include Distribution Upgrades, Stand Alone Network Upgrades or Network Upgrades.

**Party** or **Parties** means the TO and Interconnection Customer being sometimes referred to singularly as "Party" or collectively as the "Parties."

## 2.0 Responsibilities and Procedures

***R1. Each Transmission Owner shall document Facility interconnection requirements, update them as needed, and make them available upon request. Each Transmission Owner's Facility interconnection requirements shall address interconnection requirements for:***

***1.1 generation Facilities;***

***1.2 transmission Facilities; and***

***1.3 end-user Facilities.***

This Procedure describes the requirements for new or materially modified generation Interconnection Facilities, transmission Interconnection Facilities, and end-user Interconnection Facilities. The interconnection requirements described in this Procedure may be amended from time-to-time to reflect changes and/or clarifications in planning, operating, or interconnection policies, but will be made available on LG&E/KU's OASIS. Importantly, this Procedure does not require Interconnection Customers to make changes to any *existing* Interconnection

Facility(ies) that predates the effective date of this Procedure, except with respect to material modifications to Interconnection Facility(ies).

In developing this Procedure, the TO addresses the following interconnection requirement topics, as set forth in the FAC-001-2 Application Guidelines: 1) Procedures for requesting a new Facility interconnection or material modification at an existing interconnection, 2) Data required to properly study the interconnection, 3) Voltage level and MW and MVAR capacity or demand at the point of interconnection (POI), 4) Breaker duty and surge protection, 5) System protection and coordination, 6) Metering and Telecommunications, 7) Grounding and safety issues, 8) Insulation and insulation coordination, 9) Voltage, Reactive Power (including specification for minimum static and dynamic reactive power requirements), and power factor control, 10) Power Quality Impacts, 11) Equipment ratings, 12) Synchronizing of Facilities, 13) Maintenance coordination, 14) Operational issues (abnormal frequency and voltages), 15) Inspection requirements for new or materially modified existing interconnections, 16) Communications and procedures during normal and emergency operating conditions, and 17[1]) Breaker layout and/or substation design.

[1] While this topic is not listed in the FAC-001-2 Application Guidelines, LG&E/KU felt it was important to address this as one of the minimum requirements for interconnection.

## Generation Facilities Interconnection Requirements

1. **Procedures for requesting a new Interconnection Facility(ies) or material modification at an existing Interconnection Facility(ies).**
   Interconnection Customer requesting a new facility or materially modified change to an existing facility should reference the LG&E/KU OATT, specifically Attachment M and Attachment N. Attachment M – Standard Large Generator Interconnection Procedures should be referenced for generating facilities larger than 20MW, and Attachment N – Small Generator Interconnection Procedures should be referenced for generating facilities no larger than 20MW.

   A material modification is any permanent change in the existing electrical or mechanical characteristics that may impact system stability, energy flow and/or short-circuit contribution.

2. **Data Required to properly study the interconnection**
   The data required to properly study an interconnection request is described in the LG&E/KU OATT, specifically Attachment M and Attachment N. Attachment M – Standard Large Generator Interconnection Procedures should be referenced for generating facilities larger than 20MW, and Attachment N – Small Generator Interconnection Procedures should be referenced for generating facilities no larger than 20MW.

3. **Voltage level and MW and MVAR capacity or demand at the point of interconnection**
   The data required to properly study an interconnection request is described in the LG&E/KU OATT, specifically Attachment M and Attachment N. Attachment M – Standard Large Generator Interconnection Procedures should be referenced for generating facilities larger than 20MW, and Attachment N – Small Generator Interconnection Procedures should be referenced for generating facilities no larger than 20MW. The voltage level, MW, MVAR capacity is also addressed in Attachment M and N.

4. **Breaker duty and surge protection**
   Fault current contributions resulting from a 3-phase, phase-phase, phase-ground, or double phase-ground fault on the system must be less than the fault duty capability of the fault interrupting devices required to clear the fault. A short circuit study is performed to determine if any fault interrupting devices need to be replaced as a result of not meeting the fault current requirements. Short circuit studies are performed by the Independent Transmission Organization (ITO) as part of the System Impact Study (SIS). The Interconnection Customer is responsible for ensuring that the fault interrupting devices owned by the Interconnection Customer meet the requirements determined by the SIS. The Interconnection Customer is responsible for notifying the ITO and TO of any changes in their facilities that may cause an increase in fault current contributions. Changes that result in an increase in fault current would be considered a materially modified change and portions of the SIS may be required to be reanalyzed.

All Interconnection Facility(ies) must be protected against voltage stresses caused by lightning, switching surges, and temporary over-voltages. Insulation strength must be determined by the expected voltage stresses on the installed equipment during operation. Conductor spacing, station shielding, surge arresters, spark gaps, circuit breaker pre-insertion resistors, etc., must be designed to provide proper insulation coordination with the insulation capabilities of installed equipment.

**5. System protection and coordination**

It is recognized that the application of specific relay equipment is not an exact science and will vary depending on available technology, existing facilities, system characteristics, and ultimate configuration at the POI. Selection, application, and operation of all Protection Systems must be based on GUP and meet all applicable industry standards.

The Interconnection Customer must provide, install, own, and maintain relays, circuit breakers and all other devices necessary to remove any fault current contribution from its system to any fault occurring on the LG&E/KU Transmission System not otherwise isolated by the TO's equipment, such that the removal of the fault must be coordinated with the protective requirements of the LG&E/KU Transmission System. The Interconnection Customer must be responsible for protection of its equipment from such conditions as negative sequence currents, over- or under-frequency, sudden load rejection, over- or undervoltage, generator loss-of-field, etc.

Each Party must be responsible for protecting its Interconnection Facility(ies) consistent with GUP. The Interconnection Customer must ensure their Protection Systems are designed in accordance with GUP, and properly coordinated with the LG&E/KU Transmission System.

Each Party's Protection System design must incorporate the necessary test switches to perform maintenance and testing activities while preventing inadvertent operations of other devices or schemes. Test switches must be placed such that they allow operation of all DC protective tripping circuits (including auxiliary and lockout relays) without the operation of breaker failure schemes and the unnecessary tripping of breakers, circuit switchers, or other interrupting devices.

Each Party must test, operate, and maintain Protection Systems that they own in accordance with GUP and all applicable requirements of the NERC PRC Reliability Standards.

Each Party must maintain and operate their respective Protection Systems so as to minimize, in accordance with GUP, the likelihood of disturbances originating in either system, which might cause impairment to the service of the other Party.

As a general design philosophy, the Protection System must be able to:

- Reliably and securely respond to all types of electrical faults (3-phase, phase-phase, phase-ground, and double phase-ground)

- Properly respond to abnormal system conditions of voltage, current, power swings, and/or frequency to ensure system stability and reliability are not jeopardized.
- Provide for high speed isolation of only the faulted parts of the system during normal clearing
- Provide for backup protection in the event of a Protection System component failure or a failure of the breaker to interrupt such that fault clearing still meets the system performance requirements of the NERC Reliability Standards and LG&E/KU Transmission Planning Guidelines
- Prohibit any automatic reclosing attempts by a generator breaker following a protective relay trip. Lines directly connecting a generator to the transmission system shall not use automatic reclosing.
- Properly coordinate with all other protection systems
- Allow for loadability in accordance with NERC PRC-023 Reliability Standard

Prior to the in-service date, each Party or its agent must perform a complete calibration test and functional trip test of the Protection System. Also, at routine maintenance intervals suggested by GUP, NERC reliability standards, and/or the respective owner's Protection System maintenance program, each Party must test its Protection System. These tests do not require the tripping of any element in-service. These test do, however, require that all protective relays and lockout contacts be activated.

## 6. Metering and Telecommunications

Designated metering points must be at the POI, and any other points determined necessary to provide proper billing, balancing, and scheduling services. All energy delivered to, or flowing through, a designated metering point must be in the form of three-phase, sixty (60) hertz alternating current at nominal system voltage.

All power and energy measurements used for billing, balancing, and scheduling purposes must be derived from full 3-element revenue quality meters which have an accuracy rating of 0.2% or better, in accordance with the latest applicable standards of the American National Standard for Electric Meters (ANSI C12.1 and ANSI C12.20).

Suitable and reliable metering equipment must be installed at each designated metering point and must include potential transformers, current transformers, meters, test switches, data acquisition equipment, communication equipment, and other equipment as may be needed.

The metering equipment must be located at the POI. If the location of the instrument transformers is not at the POI due to physical limitations (as agreed to by the TO), meters must have the capability to adjust for losses from the designated metering point to the instrument transformer location.

Current and potential inputs to meters must be from instrument transformers rated for metering accuracy. All instrument transformer ratings, characteristics, materials, construction, and tests must be in full compliance with the latest applicable standards of the American National Standards for Instrument Transformers (ANSI C57.13). Minimum capacity and accuracy requirements must be as follows:

- Capacity – Instrument transformers must have adequate capacity to serve all connected metering and non-metering burden without exceeding the limits of accuracy as defined by ANSI C57.13. All current transformers must have a minimum thermal rating factor (RF) of 1.5.
- Accuracy – Minimum accuracy class requirements when feeding meters used for billing, balancing, and scheduling purposes must be 0.3% for Potential Transformers (PT) and 0.3% for Current Transformers (CT). However, when two CTs are connected in parallel on the secondary side (as in a double-breaker or breaker-and-a-half scheme), the minimum accuracy class must be 0.15% for each CT. Also, when paralleled, the following requirements must apply.
    - CTs must have the same ratio
    - CT secondary wires must be paralleled at the meter, to reduce the total burden
    - CT secondary wiring must have a single ground point, located at the meter

When necessary, space for LG&E/KU metering equipment must be provided by the Interconnection Customer and must be accessible to LG&E/KU at all times. All meters must be sealed, and such seals may be broken only by its owner on such occasions when the meters are to be inspected, tested, calibrated, or adjusted. Each Party must comply with any reasonable request of the other Party concerning: (a) the testing, calibration, and sealing of meters, (b) the presence of a representative of the other Party when the seals are broken and tests are made, and (c) other matters affecting measurements for billing, balancing, or scheduling.

The following table illustrates the meter configuration requirements for each meter and each type of interconnection.

| | Meter 1 (Class 20) | | | | Meter 2 (Class 20) | | |
|---|---|---|---|---|---|---|---|
| Configurations | MWh | MVarh | MW | MVAR | MW | MVAR | MW (Backup) |
| Generation Only > 20MW **OR** Generation exceeds POI load | X | X | N/A | N/A | X | X | N/A |
| Generation Only < 20MW | X | X | X | X | N/A | N/A | N/A |
| Generation w/ACE control (e.g., pseudo-tie) | X | X | X | X | N/A | N/A | X |

The TO requires certain telemetered data which is monitored by the Transmission Control Center (TCC). This information includes:

- Generator breaker status and/or breaker status from the high side of the GSU transformer for each unit.
- Automatic Voltage Regulation (AVR) Status as required by VAR-002 NERC Reliability Standard.
- Net MW, MVAR, MWh, and MVarh output for each unit.

**Disturbance Monitoring Equipment (DME)**

DMEs must be installed on the transmission side of the GI. LG&E/KU must have access to the data from the DMEs when there is a disturbance near the GI.

## 7. Grounding and safety issues

Grounding and safety considerations should be consistent with GUP. Proper clearances must be provided to ensure a safe work environment for qualified personnel.

A perimeter fence or barrier must be provided as required by the National Electric Safety Code (NESC) standards for the safety of the general public.

A substation ground grid must be designed and constructed to limit the step and touch potential during maximum available phase-to-ground faults. The ground grid design must be in accordance with IEEE Standard 80 "Guide for Safety in AC Substation Grounding." All equipment and perimeter fence must be solidly connected to the ground grid.

## 8. Insulation and insulation coordination

This is addressed in the Breaker Duty and Surge Protection section above.

## 9. Voltage, Reactive Power (including specification for minimum static and dynamic reactive power requirements), and power factor control

Voltage, Reactive Power (including specification for minimum static and dynamic reactive power requirements), and power factor control is described in the LG&E/KU OATT, specifically Attachment M and Attachment N. Attachment M – Standard Large Generator Interconnection Procedures should be referenced for generating facilities larger than 20MW, and Attachment N – Small Generator Interconnection Procedures should be referenced for generating facilities no larger than 20MW.

Upon execution of the signed Standard Large Generator Interconnection Agreement (LGIA) or Small Generator Interconnection Agreement (SGIA), the TO will update the "VAR-001 Voltage and Reactive Power Schedule" document with any required changes as a result of the new or materially modified generator. The Interconnection Customer must comply with the "VAR-001 Voltage and Reactive Power Schedule" and VAR-002 generation procedures during all hours that the generating unit is connected to the TO's Transmission System.

After interconnection is complete, the Interconnection Customer must perform the reactive power testing required by the NERC MOD-024 and MOD-025 Reliability Standards and must supply those MOD-024 and MOD-025 test results to the LG&E/KU Planning Coordinator ("PC") and Transmission Planner at NERC.PlanningCoordinator@lge-ku.com.

## 10. Power Quality Impacts

Power quality impacts are described in the LG&E/KU OATT, specifically Attachment M and Attachment N. Attachment M – Standard Large Generator Interconnection Procedures should be referenced for generating facilities larger than 20MW, and Attachment N – Small Generator Interconnection Procedures should be referenced for generating facilities no larger than 20MW.

## 11. Equipment ratings

After interconnection is complete, the Interconnection Customer must comply with the NERC MOD-032 data request when the LG&E/KU PC requests data and meet the schedule for submitting the requested data. This data request includes Interconnection Facility(ies)'s Ratings.

The Interconnection Customer must comply with the NERC FAC-008 Reliability Standard and must maintain up to date documentation for determining the Interconnection Facility(ies)'s Ratings of its solely and jointly owned Interconnection Facility(ies). Upon request by the LG&E/KU BA, TO, TP and/or PC, the Interconnection Customer must provide to the requesting entity a copy of the Interconnection Customer's documentation for determining the Facility Ratings of its solely and/or jointly owned Interconnection Facility(ies). If the Interconnection Customer makes revisions to its documentation for determining the Facility Ratings of its solely and jointly owned Interconnection Facility(ies), the revised documentation must be supplied to the TO.

## 12. Synchronizing of Facilities

An Interconnection Customer must design, construct, and operate its facility(ies) in a manner that supports synchronization of facilities. Connection to the LG&E/KU Transmission System will be at the nominal system voltage level of 69kV, 138kV, 161kV, 345kV, or 500kV. Each of these systems is operated as a solidly grounded system.

The actual connection voltage and equivalent phase designation will depend on the location of the Interconnection Facility(ies). Phase designations are always A, B, and C. Using a 1-2-3 phase designation and rotation as a reference, the equivalent phase rotation on the LG&E Transmission system is C-B-A and the equivalent phase rotation on the KU Transmission system is B-C-A. The Interconnection Customer will be responsible for ensuring that all interface connections are coordinated with the LG&E/KU Transmission system.

The Interconnection Customer must provide the necessary facilities for proper synchronization of its system with the LG&E/KU Transmission System such that synchronism can be accomplished without causing undesirable currents, surges, or voltage dips on the LG&E/KU Transmission System. Control systems utilized in closing a circuit breaker that ties a generator to the LG&E/KU Transmission System must prohibit any attempt to close the circuit breaker when the generator is not in synchronism with the LG&E/KU Transmission System. The Interconnection Customer must never attempt to parallel its system with the LG&E/KU Transmission System when the synchronizing facilities are malfunctioning or inoperative. Manual synchronizing without relay supervision is not permitted.

## 13. Maintenance coordination

Maintenance of the Interconnection Facility(ies) must be performed at a level that ensures the reliability and continuity of service of the interconnected systems. Configuration of equipment at the Interconnection Facility(ies) should be such that scheduled and forced outages at or beyond the POI will not have adverse impacts on the reliability of the LG&E/KU Transmission System. If an outage on a Party's Interconnection Facility(ies) or Network Upgrades adversely affects the other Party's operations or facilities, the Party that owns or controls the facility that is out of service must use reasonable efforts to promptly restore such Interconnection Facility(ies) to a normal operating condition consistent with the nature of the outage. The Party that owns or controls the Interconnection Facility(ies) that is out of service must provide the other Party, to the extent such information is known, information on the nature of the emergency condition, an estimated time of restoration, and any corrective actions required. Initial verbal notice must be followed up as soon as practicable with written notice explaining the nature of the outage. Relevant maintenance records should be maintained.

If the Interconnection Facility(ies) are black start resources and are documented as black start resources in the LG&E/KU BA's EOP-005 plan, those units must be tested per EOP-005 TO requirements.

## 14. Operational issues (abnormal frequency and voltages)

Operational issues (abnormal frequency and voltages) are described in the LG&E/KU OATT, specifically Attachment M and Attachment N. Attachment M – Standard Large Generator Interconnection Procedures should be referenced for generating facilities larger than 20MW, and Attachment N – Small Generator Interconnection Procedures should be referenced for generating facilities no larger than 20MW.

**15. Inspection requirements for new or materially modified existing interconnections**

Inspection requirements for new or materially modified existing interconnections are described in the LG&E/KU OATT, specifically Attachment M and Attachment N. Attachment M – Standard Large Generator Interconnection Procedures should be referenced for generating facilities larger than 20MW, and Attachment N – Small Generator Interconnection Procedures should be referenced for generating facilities no larger than 20MW.

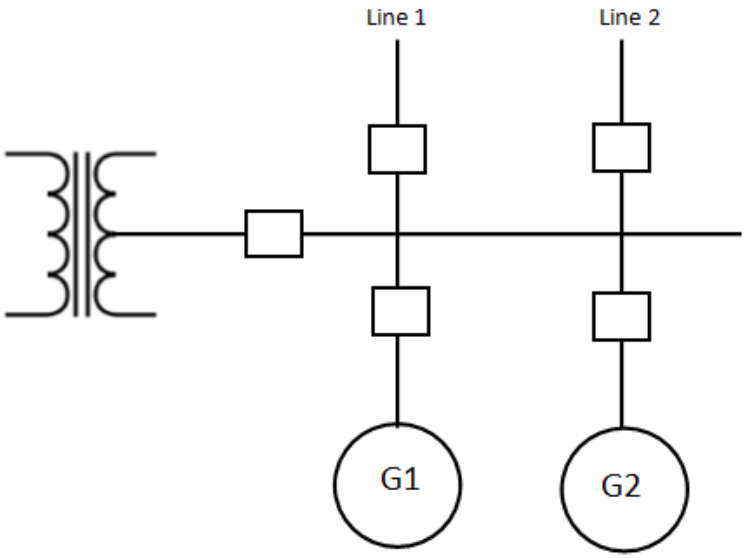
**16. Communications and procedures during normal and emergency operating conditions**

Each Party must provide to the other Party all information that may reasonably be required by the other Party to comply with applicable laws and regulations and applicable Reliability Standards.

**17. Breaker layout and/or substation design**

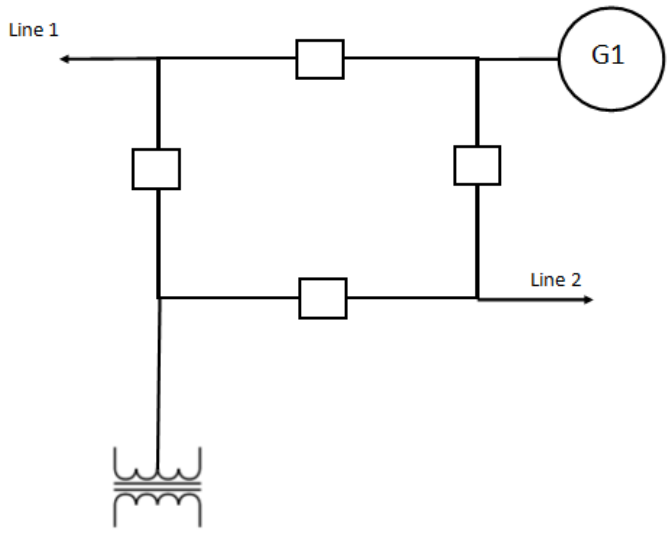
Specific breaker layouts for Interconnection Facility(ies) are required.

The straight bus configuration may be used if a bus failure, meeting the TPL-001-4 P2 planning event, satisfies the performance requirements of the TPL-001-4 P2 planning event and LG&E/KU's Planning Guidelines. An example of the straight bus configuration is shown below.



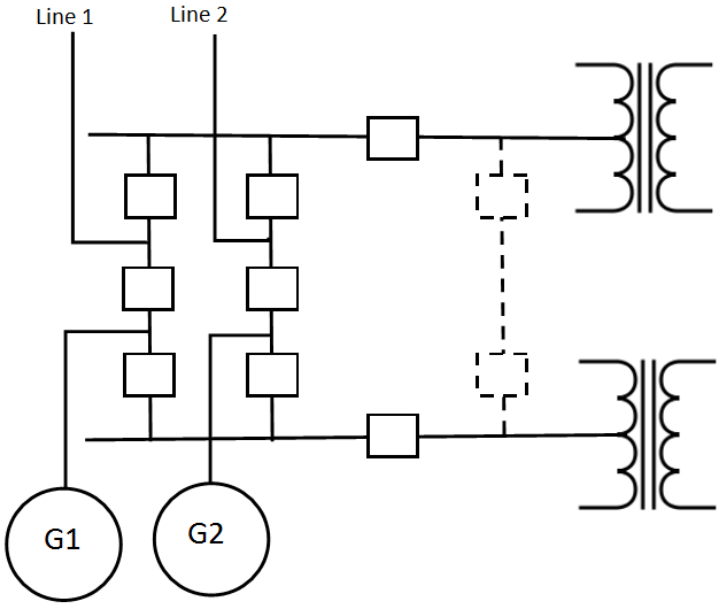
In the event that a bus failure for TPL-001-4 P2 planning event, does not satisfy the performance requirements of the TPL-001-4 P2 planning event and LG&E/KU's Planning Guidelines, a more reliable configuration should be used, particularly a ring bus or a breaker and a half layout as prescribed below:

- For an Interconnection Facility(ies) that is comprised of less than five elements (including lines, transformers, and generators of the same voltage class), the breaker layout must be a ring bus. An example of the ring bus configuration is shown below.




- For Interconnection Facility(ies) with five or more elements (including lines, transformers, and generators of the same voltage class), the breaker layout must be a breaker and a half configuration.

  In certain instances, TPL-001-4 studies may indicate the need for a bus tie with either a single or double breaker configuration. The breaker and a half layout is shown below; the bus tie is shown in the diagram below as a dotted line.


Line 1
Line 2
G1
G2

## Transmission Facilities Interconnection Requirements

### 1. Procedures for requesting a new Interconnection Facility(ies) or material modification at an existing Interconnection Facility(ies).

LG&E/KU defines Transmission Facility Interconnections as a tie line between two separate entities that are interconnected at 69 kV and above.

LG&E/KU considers Interconnection Facility(ies) to be materially modified if it meets one of the following:

- Change in operating voltage,
- Reduction in rating of the solely or jointly owned equipment that results in a reduction in rating of the Interconnection Facility(ies),
- Any additions or removals of equipment that results in changes in the system driving point impedance at the Interconnection Facility(ies).

For new or materially modified Interconnections Facility(ies), the interconnecting party must contact the LG&E/KU PC at NERC.PlanningCoordinator@lge-ku.com.

The planners between the interconnecting entities will study the benefits and impacts of the new or materially modified Interconnection Facility(ies). Studies will be based on NERC TPL-001-4 Reliability Standard and planning guidelines and requirements of those involved in the Interconnection Facility(ies). There are no timeline requirements to complete the studies for the Interconnection Facility(ies). Any impacts found on neighboring affected systems will be communicated to the neighboring system, and there could be corrective action plans required of the interconnecting party. The transmission planners must notify and work with the affected system to ensure that there are no impacts that are not mitigated. If the affected system identifies a constraint that requires a Corrective Acton Plan (CAP) as required by TPL-001-4 and / or applicable planning criteria that cannot be mitigated, the Interconnection Facility(ies) will not be constructed.

The results of this process will form the basis for an Interconnection Agreement between interconnecting companies.

### 2. Data Required to properly study the Interconnection Facility(ies)

The following data is required to be shared in order to properly study the Interconnection Facility(ies):

- Appropriate non-disclosure agreements (NDA) so that the data and models can be shared,
- Models as agreed upon by the transmission planners,
- Information including modeling data for the Interconnection Facility(ies) and any new facilities planned as a result of the Interconnection Facility(ies), including:
  - Operating voltage of the Interconnection Facility(ies),
  - Impedances for the new Interconnection Facility(ies),

- Seasonal normal and emergency ratings for the new Interconnection Facility(ies),
- Short circuit model changes as a result of the Interconnection Facility(ies) and other facilities,
- Stability model changes as a result of the Interconnection Facility(ies) and other facilities.

- Confirmed Transmission Service Requests (TSRs) included in the models and other expected transfers that do not have a confirmed firm TSR.
- Other data as deemed necessary by either party.

**3. Voltage level and MW and MVAR capacity or demand at the point of interconnection (POI)**

This is addressed in the "Data required to properly study the Interconnection Facilities" section above.

**4. Breaker duty and surge protection**

Fault current contributions resulting from a 3-phase, phase-phase, phase-ground, or double phase-ground fault on the system must be less than the fault duty capability of the fault interrupting devices required to clear the fault. A short circuit study is performed to determine if any fault interrupting devices need to be replaced as a result of not meeting the fault current requirements. The Interconnection Party is responsible for ensuring that the fault interrupting devices owned by the Interconnection Party meet the requirements determined by the short circuit study. Changes in interconnection systems can change fault currents and may require upgrades to the facilities. Interconnection Party is responsible for notifying the LGE/KU TO of any changes in their facilities that may cause an increase in fault current contributions.

All Interconnection Facility(ies) must be protected from lightning, switching surges, and temporary over-voltages. Insulation strength must be determined by the expected voltage stresses on the installed equipment during operation. Conductor spacing, station shielding, surge arresters, spark gaps, circuit breaker pre-insertion resistors, etc., must be designed to provide proper insulation coordination with the withstand capabilities of installed equipment.

**5. System protection and coordination**

It is recognized that the application of specific relay equipment is not an exact science and will vary depending on available technology, existing facilities, system characteristics, and ultimate configuration at the POI. Selection, application, and operation of all Protection Systems must be based on GUP and meet all applicable industry standards.

The TO reserves the right to add or delete protective equipment, as may be applicable, in order to avoid adverse impacts on the LG&E/KU Transmission System, and to refuse to operate in parallel with a party that, in the opinion of the Company's engineering staff, is not (or cannot) operate in a manner that ensures safe and reliable interconnected operation.

Interconnection Party must install, operate, and maintain Protection Systems required as a part of its Interconnection Facility(ies) as a result of interconnecting with the LG&E/KU Transmission System.

TO must install any Protection Systems required as part of its Interconnection Facility(ies) as a result of interconnecting with the Interconnection Party system.

In compliance with GUP, Interconnection Party must provide, install, own, and maintain relays, circuit breakers and all other devices necessary to remove any fault current contribution from the Interconnection Party's system to any fault occurring on the LG&E/KU Transmission System not otherwise isolated by the TO's equipment, such that the removal of the fault must be coordinated with the protective requirements of the LG&E/KU Transmission System. Interconnection Party must be responsible for protection of the Interconnection Party's equipment from such conditions as negative sequence currents, over- or under-frequency, sudden load rejection, over- or undervoltage, generator loss-of-field, etc.

Each Party must be responsible for protecting its facilities consistent with GUP. The Interconnection Party must ensure their Protection Systems are designed in accordance with GUP, and properly coordinated with the LG&E/KU Transmission System.

Each Party's Protection System design must incorporate the necessary test switches to perform maintenance and testing activities while preventing inadvertent operations of other devices or schemes. Test switches must be placed such that they allow operation of all DC protective tripping circuits (including auxiliary and lockout relays) without the operation of breaker failure schemes and the unnecessary tripping of breakers, circuit switchers, or other interrupting devices.

Each Party must test, operate, and maintain Protection Systems in accordance with GUP and all applicable requirements of the NERC PRC Reliability Standards.

Each Party must maintain and operate their respective system so as to minimize, in accordance with GUP, the likelihood of disturbances originating in either system, which might cause impairment to the service of the other Party.

As a general design philosophy, the Protection System must be able to:

- Reliably and securely respond to all types of electrical faults (3-phase, phase-phase, phase-ground, and double phase-ground)
- Properly respond to abnormal system conditions of voltage, current, power swings, and/or frequency to ensure system stability and reliability are not jeopardized.
- Provide for high speed isolation of only the faulted parts of the system during normal clearing
- Provide for backup protection in the event of a Protection System component failure or a failure of the breaker to interrupt such that fault clearing still meets the system performance requirements of the NERC Reliability Standards and LG&E/KU Transmission Planning Guidelines

- Allow for high-speed restoration through auto-reclosing following temporary line faults. For interconnecting tie lines and lines exiting a generator bus, the auto-reclose function must be supervised by sync-check. Lines directly connecting a generator to the transmission system must not use automatic reclosing.
- Properly coordinate with all other Protection Systems
- Allow for loadability in accordance with NERC PRC-023 Reliability Standard

Prior to the in-service date, each Party or its agent must perform a complete calibration test and functional trip test of the Protection Systems. Also, at routine maintenance intervals suggested by GUP, NERC reliability standards, and/or the respective owner's Protection System maintenance program, each Party must test its Protection Systems. These tests do not require the tripping of any element in-service. These tests do, however, require that all protective relays and lockout contacts be activated.

## 6. Metering and Telecommunications

Designated metering points must be at the POI.

All energy delivered to, or flowing through, a designated metering point must be in the form of three-phase, sixty (60) hertz alternating current at nominal system voltage.

All power and energy measurements used for billing, balancing, and scheduling purposes must be derived from full 3-element revenue quality meters which have an accuracy rating of 0.2% or better, in accordance with the latest applicable standards of the American National Standard for Electric Meters (ANSI C12.1 and ANSI C12.20).

Suitable and reliable metering equipment must be installed at each designated metering point and must include potential transformers, current transformers, meters, test switches, data acquisition equipment, communication equipment, and other equipment as may be needed.

If the location of the instrument transformers is not at the POI due to physical limitations (as agreed to by the TO), meters must have the capability to adjust for losses from the designated metering point to the instrument transformer location.

Current and potential inputs to meters must be from instrument transformers rated for metering accuracy. All instrument transformer ratings, characteristics, materials, construction, and tests must be in full compliance with the latest applicable standards of the American National Standards for Instrument Transformers (ANSI C57.13). Minimum capacity and accuracy requirements must be as follows:

- Capacity – Instrument transformers must have adequate capacity to serve all connected metering and non-metering burden without exceeding the limits of accuracy as defined by ANSI C57.13. All current transformers must have a minimum thermal rating factor (RF) of 1.5.
- Accuracy – Minimum accuracy class requirements when feeding meters used for billing, balancing, and scheduling purposes must be 0.3% for Potential Transformers (PT) and 0.3% for Current Transformers (CT). However, when two CTs are connected in parallel on the secondary side (as in a double-breaker or breaker-and-a-

half scheme), the minimum accuracy class must be 0.15% for each CT. Also, when paralleled, the following requirements must apply.

- CTs must have the same ratio
- CT secondary wires must be paralleled at the meter, to reduce the total burden
- CT secondary wiring must have a single ground point, located at the meter

All meters must be sealed, and such seals may be broken only by its owner on such occasions when the meters are to be inspected, tested, calibrated, or adjusted. Each Party must comply with any reasonable request of the other Party concerning: (a) the testing, calibration, and sealing of meters, (b) the presence of a representative of the other Party when the seals are broken and tests are made, and (c) other matters affecting measurements for billing, balancing, or scheduling.

Each Party must comply with the applicable Regional Reliability Organization requirements. Unless otherwise agreed by the Parties, TO must install metering equipment at the POI prior to the energization date of the tie line and must own, operate, test and maintain such metering equipment. Real and reactive power flows to and from the tie line and breaker status on each end of the tie line must be provided. The following table illustrates the data required for each meter and each type of interconnection.

| | Meter 1 (Class 20) | | | | | | Meter 2 (Class 20) |
|---|---|---|---|---|---|---|---|
| Configurations | MWh | MVarh | MW | MVAR | kV | Amp | MW (Backup) |
| Trans - Trans | X | X | X | X | X | X | X |

**Check Meters**

Interconnection Party may install and operate, on its premises and on its side of the tie line, one or more check meters to check TO's meters. Such check meters must be for check purposes only and must not be used for the measurement of power flows for purposes of this interconnection tie line, except as described in the "testing of metering equipment" section below. The check meters must be subject at all reasonable times to inspection and examination by TO or its designee. The installation, operation and maintenance of check meters must be performed entirely by Interconnection Party in accordance with GUP.

**Standards.**

The TO must install, calibrate, and test revenue quality metering equipment in accordance with applicable ANSI standards.

**Testing of Metering Equipment.**

The TO must inspect and test all TO-owned metering equipment upon installation and at least once every two (2) years thereafter. If requested to do so by Interconnection Party, TO must inspect or test metering equipment more frequently than every two (2) years. TO must

give reasonable notice of the time when any inspection or test must take place, and Interconnection Party may have representatives present at the test or inspection. If at any time metering equipment is found to be inaccurate or defective, it must be adjusted, repaired or replaced. If metering equipment fails to register, or if the measurement made by metering equipment during a test varies by more than two percent from the measurement made by the standard meter used in the test, TO must adjust the measurements by correcting all measurements for the period during which metering equipment was in error by using Interconnection Party's check meters, if installed. If no such check meters are installed or if the period cannot be reasonably ascertained, the adjustment must be for the period immediately preceding the test of the metering equipment equal to one-half the time from the date of the last previous test of the metering equipment.

**Metering Data**

The metered data must be telemetered to one or more locations designated by TO and one or more locations designated by Interconnection Party. Such telemetered data must be used, under normal operating conditions, as the official measurement of the amount of power flowing into and out of the Interconnection.

**Remote Terminal Unit**

Prior to the energization date of the tie line, a Remote Terminal Unit (RTU), or equivalent data collection and transfer equipment acceptable to the Parties, must be installed to gather accumulated and instantaneous data to be telemetered to the location(s) designated by TO through use of a dedicated point-to-point data circuit(s). The communication protocol for the data circuit(s) must be specified by TO. Instantaneous bi-directional analog real power and reactive power flow information must be telemetered directly to the location(s) specified by TO. Each Party will promptly advise the other Party if it detects or otherwise learns of any metering, telemetry or communications equipment errors or malfunctions that require the attention and/or correction by the other Party. The Party owning such equipment must correct such error or malfunction as soon as reasonably feasible.

## 7. Grounding and safety issues

Grounding and safety considerations should be consistent with GUP. Proper clearances must be provided to ensure a safe work environment for qualified personnel.

A perimeter fence or barrier must be provided as required by the NESC standards for the safety of the general public.

A substation ground grid must be designed and constructed to limit the step and touch potential during maximum available phase-to-ground faults. The ground grid design must be in accordance with IEEE Standard 80 "Guide for Safety in AC Substation Grounding". All equipment and perimeter fence must be solidly connected to the ground grid.

## 8. Insulation and insulation coordination

This is addressed in the "Breaker Duty and Surge Protection" section above.

**9. Voltage, Reactive Power (including specification for minimum static and dynamic reactive power requirements), and power factor control**

This section is not pertinent to Transmission-to-Transmission interconnections.

**10. Power Quality Impacts**

The Interconnection Party must design, install, operate, and maintain its facilities so as to reasonably minimize the likelihood of a disturbance (or abnormal operating condition) adversely affecting or impairing the LG&E/KU Transmission System. The phase voltages on the Interconnection Party's system must be balanced. The waveform must be sinusoidal and free from distortion and excessive harmonics. No Party's facilities shall cause excessive voltage flicker nor introduce excessive distortion to the sinusoidal voltage or current waves as defined by ANSI Standard C84.1-1989, in accordance with IEEE Standard 519, or any applicable superseding electric industry standard.

**11. Equipment ratings**

Equipment provided by the Interconnection Party must meet all applicable ANSI and IEEE standards. The equipment must be designed and installed for operation, without damage, within the full ranges of normal system voltages, frequency, and expected switching surges.

The Interconnection Party must comply with the NERC FAC-008 Reliability Standard and must maintain up to date documentation for determining the Facility Ratings of its Interconnection Facility(ies). Upon request by the LG&E/KU BA, TO, TP and/or PC, the Interconnection Party must provide documentation for determining the Facility Ratings of its Interconnection Facility(ies).

Post interconnection, if/when there is a temporary or permanent Rating reduction for the Interconnection Party's Interconnection Facility(ies), the Interconnection Party must notify the LG&E/KU BA, without intentional delay, of the Rating reduction. If there is a permanent Rating increase of the Interconnection Party's Interconnection Facility(ies), that increase will be communicated to the LG&E/KU PC during the next annual tie-line Rating coordination. No action will be taken by the LG&E/KU BA, TO, TP and/or PC for temporary Rating increases for the Interconnection Facility(ies).

**12. Synchronizing of Facilities**

An Interconnection Party must design, construct, and operate its facility(ies) in a manner that supports synchronization of facilities. Connection to the LG&E/KU Transmission System will be at the nominal system voltage level of 69kV, 138kV, 161kV, 345kV, or 500kV. Each of these systems is operated as a solidly grounded system.

The actual connection voltage and equivalent phase designation will depend on the location of the Interconnection Facility(ies). Phase designations are always A, B, and C. Using a 1-2-3 phase designation and rotation as a reference, the equivalent phase rotation on the LG&E Transmission system is C-B-A and the equivalent phase rotation on the KU Transmission system is B-C-A. The Interconnection Party will be responsible for ensuring that all interface connections are coordinated with the LG&E/KU Transmission System.

If generation resources are part of the Interconnection Party's system, the Interconnection Party must provide the necessary facilities for proper synchronization of its system with the LG&E/KU Transmission System such that synchronism can be accomplished without causing undesirable currents, surges, or voltage dips on the LG&E/KU Transmission System. The Interconnection Party must never attempt to parallel its system with the LG&E/KU Transmission System when the synchronizing facilities are malfunctioning or inoperative. Manual synchronizing without relay supervision is not permitted.

**13. Maintenance coordination**

Maintenance of the Interconnection Facility(ies) must be performed at a level that ensures the reliability and continuity of service of the interconnected systems. Configuration of equipment at the Interconnection Facility(ies) should be such that scheduled and forced outages at or beyond the POI will not have adverse impacts on the reliability of the LG&E/KU Transmission System. Relevant maintenance records should be maintained. If an outage on a Party's Interconnection Facility(ies) or Network Upgrades adversely affects the other Party's operations or facilities, the Party that owns or controls the facility that is out of service must use reasonable efforts to promptly restore such facility(ies) to a normal operating condition consistent with the nature of the outage. The Party that owns or controls the facility that is out of service must provide the other Party, to the extent such information is known, information on the nature of the emergency condition, an estimated time of restoration, and any corrective actions required. Initial verbal notice must be followed up as soon as practicable with written notice explaining the nature of the outage.

**14. Operational issues (abnormal frequency and voltages)**

This section is not pertinent to Transmission-to-Transmission interconnections.

**15. Inspection requirements for new or materially modified existing interconnections**

**Pre-Energization Testing and Modifications.**

Prior to the energization of the tie line, TO must test TO's Interconnection Facility(ies) and Network Upgrades and Interconnection Party must test its portion of the Interconnection Facility(ies) to ensure their safe and reliable operation. Each Party must make any modifications to its facilities that are found to be necessary as a result of such testing.

**Post- Energization of Tie Line Testing and Modifications.**

Each Party must perform routine inspection and testing of its facilities and equipment in accordance with GUP as may be necessary to ensure the continued interconnection tie line in a safe and reliable manner. Each Party has the right, upon advance written notice, to require reasonable additional testing of the other Party's facilities as may be in accordance with GUP.

**Right to Observe Testing**

Each Party must notify the other Party in advance of its performance of tests of its Interconnection Facility(ies). The other Party has the right to observe such testing.

**Right to Inspect**

Each Party has the right, but no obligation to: (i) observe the other Party's tests and/or inspection of any of its Protection Systems and other protective equipment; (ii) review the settings of the other Party's Protection Systems and other protective equipment; and (iii) review the other Party's maintenance records relative to the Interconnection Facility(ies), the Protection Systems and other protective equipment. A Party may exercise these rights from time to time as it deems necessary upon reasonable notice to the other Party. The exercise or nonexercise by a Party of any such rights must not be construed as an endorsement or confirmation of any element or condition of the Interconnection Facility(ies) or the Protection Systems or other protective equipment or the operation thereof, or as a warranty as to the fitness, safety, desirability, or reliability of same. Any information that a Party obtains through the exercise of any of its rights must be deemed to be confidential information.

## 16. Communications and procedures during normal and emergency operating conditions

**Outage Authority and Coordination.**
Each Party may in accordance with GUP in coordination with the other Party remove from service any of its respective Interconnection Facility(ies) or Network Upgrades that may impact the other Party's facilities as necessary to perform maintenance or testing or to install or replace equipment. Absent an emergency condition, the Party scheduling a removal of such facility(ies) from service will use reasonable efforts to schedule such removal on a date and time mutually acceptable to the Parties and the Reliability Coordinators. In all circumstances, any Party planning to remove such facility(ies) from service must use reasonable efforts to minimize the effect on the other Party of such removal.

## 17. Breaker layout and/or substation design

An interconnection can be requested within a new or existing substation. It can also be an interconnection outside of any substations. The exact layout of the interconnection will be based on studies using TPL-001-4 and the transmission planners planning criteria / guidelines.

The Interconnection Party must submit initial and final specifications for the Interconnection Facility(ies), including Protection Systems, to the TO for review and comment. TO must review such specifications to ensure that the Interconnection Facility(ies) are compatible with the technical specifications, operational control, and safety requirements of TO.

Interconnection Party must make such changes to the Interconnection Facility(ies) as may reasonably be required by TO. The Interconnection Facility(ies) must be designed and constructed in accordance with GUP.

TO's review of Interconnection Party's final specifications must not be construed as confirming, endorsing, or providing a warranty as to the design, fitness, safety, durability or reliability of the interconnecting tie line, or the Interconnection Facility(ies).

The timing and duration of this review process must be based on the work scope and incorporated in the overall project schedule to meet the required in-service date.

Within one hundred twenty (120) calendar days after the date of energizing the tie line, unless the Parties agree on another mutually acceptable deadline, Interconnection Party must deliver to TO "as-built" drawings, information and documents for the Interconnection Facility(ies), such as: a one-line diagram of the Interconnection Facility(ies), a relay functional diagram, 3-Line AC and DC schematic diagrams for all facilities associated with Interconnection Party's Interconnection Facility(ies). TO's Interconnection Facility(ies) must be designed and constructed in accordance with GUP. Upon request, within one hundred twenty (120) calendar days after the energization date of the tie line, unless the Parties agree on another mutually acceptable deadline, TO must deliver to Interconnection Party the following "as-built" drawings, information and documents for TO's Interconnection Facility(ies). The Interconnection Party will be responsible for operating their owned portion of the tie line and the TO will be responsible for operating the TO's portion of the tie line.

## End-User Facilities Interconnection Requirements

1. **Procedures for requesting a new Interconnection Facility(ies) or material modification at an existing Interconnection Facility(ies).**

   **End-User Facilities** – Facilities that serve either *Network Native Load* or *Network Load*, which are defined as follows:

   - **Network Load** – Includes all end-use customers taking transmission service directly from the TO and not served by the LG&E/KU LSE. The Network Load customer is considered the Interconnection Customer or Network Customer.
   - **Network Native Load** – Includes all end-use customers that the LG&E/KU Load-Serving Entity (LSE) is obligated to serve. Network Native Load customers take service at Transmission level voltages or at Distribution (primary or secondary) level voltages. For Network Native Load, the LG&E/KU LSE is considered the Interconnection Customer.

   When the Interconnection Customer desires to add a new delivery point or increase load to an existing delivery point, the Interconnection Customer to the ITO per the directions in the OATT and the OATT Business Practices as posted on OASIS. The TSR request is followed by a NITS Application that can be found on OASIS or through this link.

   https://www.oasis.oati.com/LGEE/LGEEdocs/LGEE_Network_Service_Application_07172015.xls

   The ITO will perform a (SIS) and the results will be shared with the Interconnection Customer at the completion of the study. If constraints are identified, or if direct assignment facilities are required to accommodate the new request, the SIS will be followed by a Facilities Study (FS). The TSR may be accepted upon completion of conditions identified in the SIS and FS studies.

   Requests by existing (or new) customers to add a new load delivery point may be made by making a placeholder TSR on the OASIS to establish priority in the TSR Queue, then submitting an updated (or new) application per the OATT to the ITO. The only 10 year load forecast that needs to be submitted in the updated application will be for the new load request and any delivery points impacted by this request. Example, some existing loads may be reduced when the new delivery point is constructed, so a revised load forecast for the reduced load(s) will be required at the same time as the load forecast for the new delivery point.

2. **Data Required to properly study the interconnection**
   The data required to properly study an Interconnection Facility(ies) is described in the LG&E/KU's OATT Business Practices document posted on OASIS.

3. **Voltage level and MW and MVAR capacity or demand at the point of interconnection (POI)**
   Voltage level and MW and MVAR demand is data required to properly study an Interconnection Facility(ies) and is described in the LG&E/KU OATT Business Practices document posted on OASIS.

4. **Breaker duty and surge protection**
   Fault current contributions resulting from a 3-phase, phase-phase, phase-ground, or double phase-ground fault on the system must be less than the fault duty capability of the fault interrupting devices required to clear the fault. The TO will provide fault current information to the Interconnection Customer upon request. The Interconnection Customer is responsible for ensuring that the fault interrupting devices owned by the Interconnection Customer meet the maximum available short circuit current. The Interconnection Customer is responsible for notifying the TO of any changes in their facilities that may cause an increase in fault current contributions.

   All Interconnection Facility(ies) must be protected from lightning, switching surges, and temporary over-voltages. Insulation strength must be determined by the expected voltage stresses on the installed equipment during operation. Conductor spacing, station shielding, surge arresters, spark gaps, circuit breaker pre-insertion resistors, etc., must be designed to provide proper insulation coordination with the withstand capabilities of installed equipment.

5. **System protection and coordination**
   It is recognized that the application of specific relay equipment is not an exact science and will vary depending on available technology, existing facilities, system characteristics, and ultimate configuration at the POI. Selection, application, and operation of all Protection Systems must be based on GUP and meet all applicable industry standards.

   LG&E/KU Transmission reserves the right to add or delete protective equipment, as may be applicable, in order to avoid adverse impacts on the LG&E/KU Transmission System, and to refuse to operate parallel with a customer that, in the opinion of the Company's engineering staff, is not (or cannot) operate in a manner that ensures safe and reliable interconnected operation.

   Interconnection Customer must install, operate, and maintain Protection Systems required as a part of its Interconnection Facility(ies) as a result of interconnecting with the LG&E/KU Transmission System.

   TO must install any Protection Systems required as part of its Interconnection Facility(ies) as a result of interconnecting with the Interconnection Customer system.

   In compliance with GUP, Interconnection Customer must provide, install, own, and maintain relays, circuit breakers and all other devices necessary to remove any fault contribution from the Interconnection Customer system to any short circuit occurring on the LG&E/KU Transmission System not otherwise isolated by the TO's equipment, such that the removal of the fault contribution must be coordinated with the protective requirements of the LG&E/KU

Transmission System. Interconnection Customer must be responsible for protection of its equipment from such conditions as negative sequence currents, over- or under-frequency, sudden load rejection, over- or undervoltage, generator loss-of-field, etc.

Each Party must be responsible for protecting its facilities consistent with GUP. The Interconnection Customer must ensure their Protection Systems are designed in accordance with GUP, and properly coordinated with the LG&E/KU Transmission System.

Each Party's Protection System design must incorporate the necessary test switches to perform maintenance and testing activities while preventing inadvertent operations of other devices or schemes. Test switches must be placed such that they allow operation of all DC protective tripping circuits (including auxiliary and lockout relays) without the operation of breaker failure schemes and the unnecessary tripping of breakers, circuit switchers, or other interrupting devices.

Each Party must test, operate, and maintain Protection Systems in accordance with GUP and all applicable requirements of the NERC PRC Reliability Standards.

Each Party must maintain and operate their respective system so as to minimize, in accordance with GUP, the likelihood of disturbances originating in either system, which might cause impairment to the service of the other Party.

As a general design philosophy, the protection system must be able to:

- Reliably and securely respond to all types of electrical faults (3-phase, phase-phase, phase-ground, and double phase-ground)
- Properly respond to abnormal system conditions of voltage, current, power swings, and/or frequency to ensure system stability and reliability are not jeopardized.
- Provide for high speed isolation of only the faulted parts of the system during normal clearing
- Provide for backup protection in the event of a Protection System component failure or a failure of the breaker to interrupt such that fault clearing still meets the system performance requirements of the NERC Reliability Standards and LG&E/KU Transmission Planning Guidelines
- Allow for high-speed restoration through auto-reclosing following temporary line faults. For lines exiting a generator bus, the auto-reclose function must be supervised by sync-check. Lines directly connecting a generator to the transmission system must not use automatic reclosing.
- Properly coordinate with all other Protection Systems
- Allow for loadability in accordance with NERC PRC-023 Reliability Standard

Prior to the in-service Date, each Party or its agent must perform a complete calibration test and functional trip test of the Protection Systems. Also, at routine maintenance intervals suggested by GUP, NERC reliability standards, and/or the respective owner's Protection System maintenance program, each Party must test its Protection Systems. These tests do not require the tripping of any element in-service. These test do, however, require that all protective relays and lockout contacts be activated.

## 6. Metering and Telecommunications

### *6.1 Requirements for End-User (Network Load) Interconnections*

Designated metering points must be at the POI, and any other points determined necessary to provide proper billing, balancing, and scheduling services. If the location of the instrument transformers is not at the POI due to physical limitations (as agreed to by the TO), meters must have the capability to adjust for losses from the designated metering point to the instrument transformer location.

All energy delivered to, or flowing through, a designated metering point must be in the form of three-phase, sixty (60) hertz alternating current at nominal system voltage.

All power and energy measurements used for billing, balancing, and scheduling purposes must be derived from full 3-element revenue quality meters which have an accuracy rating of 0.2% or better, in accordance with the latest applicable standards of the American National Standard for Electric Meters (ANSI C12.1 and ANSI C12.20).

Suitable and reliable metering equipment must be installed at each designated metering point and must include potential transformers, current transformers, meters, test switches, data acquisition equipment, communication equipment, and other equipment as may be needed.

Current and potential inputs to meters must be from instrument transformers rated for metering accuracy. All instrument transformer ratings, characteristics, materials, construction, and tests must be in full compliance with the latest applicable standards of the American National Standards for Instrument Transformers (ANSI C57.13). Minimum capacity and accuracy requirements must be as follows:

- Capacity – Instrument transformers must have adequate capacity to serve all connected metering and non-metering burden without exceeding the limits of accuracy as defined by ANSI C57.13. All current transformers must have a minimum thermal rating factor (RF) of 1.5.

- Accuracy – Minimum accuracy class requirements when feeding meters used for billing, balancing, and scheduling purposes must be 0.3% for Potential Transformers (PT) and 0.3% for Current Transformers (CT). However, when two CTs are connected in parallel on the secondary side (as in a double-breaker or breaker-and-a-half scheme), the minimum accuracy class must be 0.15% for each CT. Also, when paralleled, the following requirements must apply.

- CTs must have the same ratio
- CT secondary wires must be paralleled at the meter, to reduce the total burden
- CT secondary wiring must have a single ground point, located at the meter

All meters must be sealed, and such seals may be broken only by its owner on such occasions when the meters are to be inspected, tested, calibrated, or adjusted. Each Party must comply with any reasonable request of the other Party concerning: (a) the testing, calibration, and sealing of meters, (b) the presence of a representative of the other Party when the seals are broken and tests are made, and (c) other matters affecting measurements for billing, balancing, or scheduling.

In addition to the metering requirements outlined in this document, the Interconnection Customer must adhere to the requirements described in the LG&E/KU OATT Attachment G – Network Operating Agreement.

The following table illustrates the number of meters (designated as Meter 1 and Meter 2) and data required from each meter for each type of interconnection.

| | Meter 1 (Class 20) | | | | Meter 2 (Class 20) | | |
|---|---|---|---|---|---|---|---|
| Configurations | MWh | MVarh | MW | MVAR | MW | MVAR | MW (Backup) |
| POI Load < 10MW | X | X | X | X | N/A | N/A | N/A |
| POI Load > 10MW | X | X | N/A | N/A | X | X | N/A |
| POI Load w/ACE control (e.g., pseudo-tie) > 10MW | X | X | X | X | N/A | N/A | X |

**Metering Data for Network Load**

The metered data must be telemetered to one or more locations designated by TO and one or more locations designated by Interconnection Customer. Such telemetered data must be used, under normal operating conditions, as the official measurement of the amount of power flowing into the Interconnection.

**Required Telemetry at End User Facilities for Network Load**

The Network Customer will be responsible for the purchase, installation, operation, maintenance, repair, and replacement of all data acquisition equipment, metering equipment, communication equipment, and any other associated equipment and software, which may be required by the TO for the Network Customer to operate in accordance with the metering requirements of the NOA (Network Operating Agreement). Such equipment must conform to GUP and the standards and practices of the TO's Control Area. Prior to installation of new or replacement equipment, the TO and the Network Customer must, and the TO may, review the equipment and software required by this section to ensure conformance with such standards or practices.

The TO, using reasonable discretion, must select the real time telemetry and data to be received by the TO and the Network Customer as deemed necessary for reliability, security, economics, and/or monitoring of system operations. This telemetry includes, but is not limited to, loads, line flows, voltages, generator output, and breaker status at any of the Network Customer's transmission facilities. The Network Customer must consult with the Balancing Authority regarding the necessary data and telemetry needed for reliability, security, economics, and/or monitoring of system operations.

The TO and Network Customer must be responsible for implementing any computer modifications or changes required to their own computer system(s) as necessary to implement this section.

***6.2 Requirements for End-User (Network Native Load) Interconnections***

For Network Native Load, the LG&E/KU Load Serving Entity (LSE), as the Interconnection Customer, must provide for the following:

Remote Control, Indication, and Data Acquisition:

a. The Interconnection Customer will be responsible for the purchase, installation, operation, maintenance, repair, and replacement of all data acquisition equipment, metering equipment, communication equipment, and any other associated equipment and software, which may be required by the TO for the Interconnection Customer to operate in accordance with the network operating agreement. Such equipment must conform to GUP and the standards and practices of the TO's Control Area. Prior to installation of new or replacement equipment, the TO and the Interconnection Customer must, and the TO may, review the equipment and software required by this section to ensure conformance with such standards or practices.

b. The TO, using reasonable discretion, must select the real time telemetry and data to be received by the TO as deemed necessary for reliability, security, economics, and/or monitoring of system operations. This telemetry includes, but is not limited to, loads, line flows, voltages, equipment alarms, and breaker status at the Interconnection Facility(ies).

**Required Telemetry at End User Facilities for Network Native Load**

Please note the following in reference to required telemetry at an Interconnection Facility(ies):

- If required for purposes of state estimation, for sending data to the RC, or known operational needs, PTs and associated telemetry may be required to provide bus voltages, MW, and MVAr flows. LG&E/KU TCC should be consulted for these decisions.

## 7. Grounding and safety issues

Grounding and safety considerations should be consistent with GUP. Proper clearances must be provided to ensure a safe work environment for qualified personnel. A perimeter fence or barrier must be provided as required by the NESC standards for the safety of the general public.

A substation ground grid must be designed and constructed to limit the step and touch potential during maximum available phase-to-ground faults. The ground grid design must be in accordance with IEEE Standard 80 "Guide for Safety in AC Substation Grounding". All equipment and perimeter fence must be solidly connected to the ground grid.

8. **Insulation and insulation coordination**
   This is addressed in the "Breaker Duty and Surge Protection" section above.

9. **Voltage, Reactive Power (including specification for minimum static and dynamic reactive power requirements), and power factor control**
   The LG&E/KU PC requires a load forecast which includes power factor data at each delivery point. This data is requested by the LG&E/KU PC and supplied by the Interconnection Customer per a schedule in a MOD-032 annual data request.

10. **Power Quality Impacts**
    The Interconnection Customer must design, install, operate, and maintain its facilities so as to reasonably minimize the likelihood of a disturbance (or abnormal operating condition) adversely affecting or impairing the LG&E/KU Transmission System. The phase voltages on the Interconnection Customer's system must be balanced. The waveform must be sinusoidal and free from distortion and excessive harmonics. No Party's facilities shall cause excessive voltage flicker nor introduce excessive distortion to the sinusoidal voltage or current waves as defined by ANSI Standard C84.1-1989, in accordance with IEEE Standard 519, or any applicable superseding electric industry standard. If a new or material modified load causes power quality issues, the Interconnection Customer will need to mitigate the power quality violations.

11. **Equipment ratings**

    Equipment provided by the Interconnection Customer must meet all applicable ANSI and IEEE standards. The equipment must be designed and installed for operation, without damage, within the full ranges of normal system voltages, frequency, and expected switching surges.

12. **Synchronizing of Facilities**
    The design, construction, and operation of the Interconnection Facility(ies) must coordinate with the LG&E/KU Transmission System. Connection to the LG&E/KU Transmission System will be at the nominal system voltage level of 69kV, 138kV, 161kV, 345kV, or 500kV. Each of these systems is operated as a solidly grounded system.

    The actual connection voltage and equivalent phase designation will depend on the location of the Interconnection Facility(ies). Phase designations are always A, B, and C. Using a 1-2-3 phase designation and rotation as a reference, the equivalent phase rotation on the LG&E Transmission System is C-B-A and the equivalent phase rotation on the KU Transmission System is B-C-A. The Interconnection Customer will be responsible for ensuring that all interface connections are coordinated with the LG&E/KU Transmission System.

If generation resources are part of the Interconnection Customer's system, the Interconnection Customer must provide the necessary facilities for proper synchronization of its system with the LG&E/KU Transmission System such that synchronism can be accomplished without causing undesirable currents, surges, or voltage dips on the LG&E/KU Transmission System. The Interconnection Customer must never attempt to parallel its system with the LG&E/KU Transmission System when the synchronizing facilities are malfunctioning or inoperative. Manual synchronizing without relay supervision is not permitted.

**13. Maintenance coordination**

Maintenance of the Interconnection Facility(ies) must be performed at a level that ensures the reliability and continuity of service of the interconnected systems. Configuration of equipment at the Interconnection Facility(ies) should be such that scheduled and forced outages at or beyond the POI will not have adverse impacts on the reliability of the LG&E/KU Transmission System. Relevant maintenance records should be maintained.

**14. Operational issues (abnormal frequency and voltages)**

Under Frequency Load Shed (UFLS) is described in the LG&E/KU OATT, specifically Attachment G – Network Operating Agreement.

**15. Inspection requirements for new or materially modified existing interconnections**

**Prior to Connecting End User Facilities**

Prior to connection, TO must test its Interconnection Facility(ies) and Network Upgrades and Interconnection Customer must test its portion of the Interconnection Facility(ies) to ensure their safe and reliable operation. Each Party must make any modifications to its facilities that are found to be necessary as a result of such testing.

**Post Connection of End User Facilities**

Each Party must perform routine inspection and testing of its facilities and equipment in accordance with GUP as may be necessary to ensure the Interconnection Facility(ies) operate in a safe and reliable manner.

Interconnection Customer must operate, maintain and control its portion of the Interconnection Facility(ies) in a safe and reliable manner and in accordance the NITS agreement.

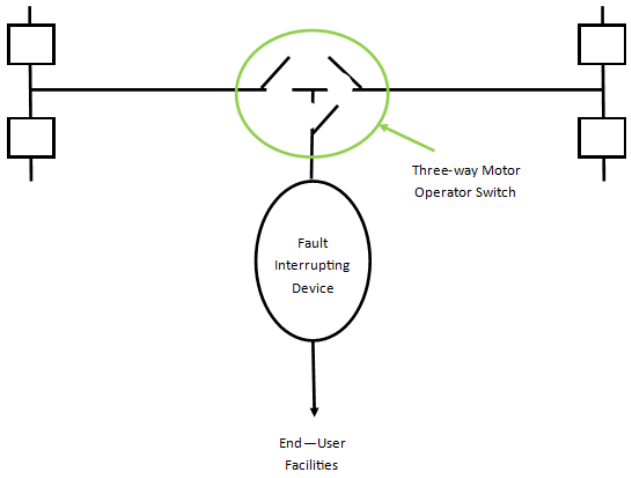
**16. Communications and procedures during normal and emergency operating conditions**

Each Party must provide to the other Party all information that may reasonably be required by the other Party to comply with applicable laws and regulations and applicable Reliability Standards.

**17. Breaker layout and/or substation design**

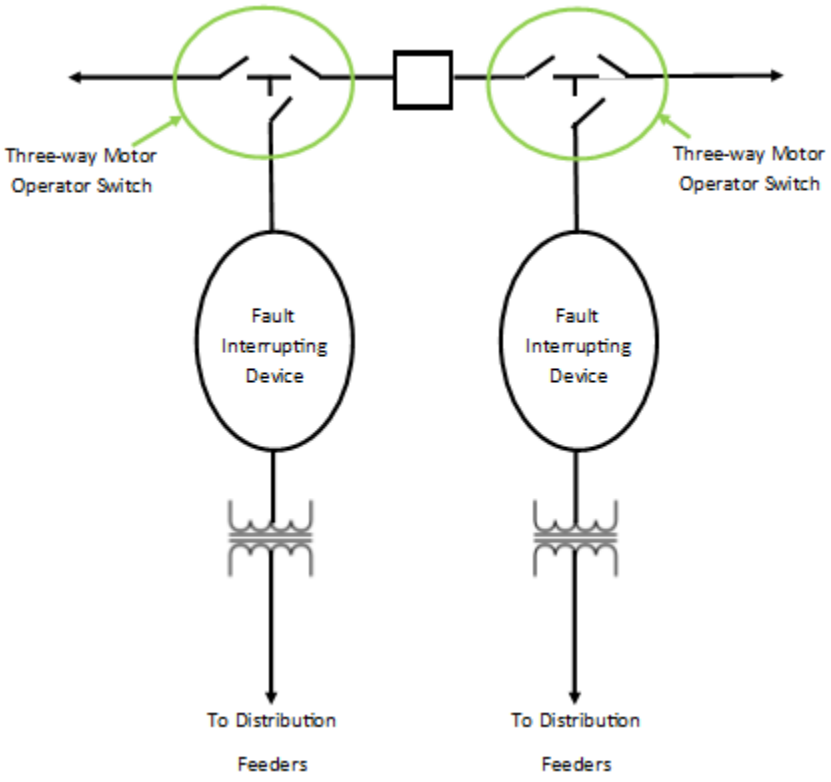
The Interconnection Facility(ies) must have a fault interrupting device such as a circuit switcher or circuit breaker that will disconnect the Interconnection Facility(ies) from the Transmission System for a fault on the Interconnection Facility(ies). At the tap point, there must be a minimum of a motor operated three-way switch. The minimum requirements for loads served at 161 through 69 kV is shown in Figure 1 below. This requirement includes a fault interrupting device on the high side of the distribution transformer and three-way motor operator switch at the tap.

**Figure 1**




The more reliable breaker layouts shown in Figures 2, 3 and 4 can be used if requested by the Interconnection Customer. The breaker layout shown in Figure 2 is only an option for non-BES lines desiring higher reliability.

**Figure 2**




The minimum requirements for loads served at 345 or 500 kV, are shown in Figures 3 and 4Figure 3 shows one distribution transformer while Figure 4 shows two distribution transformers.

**Figure 3**

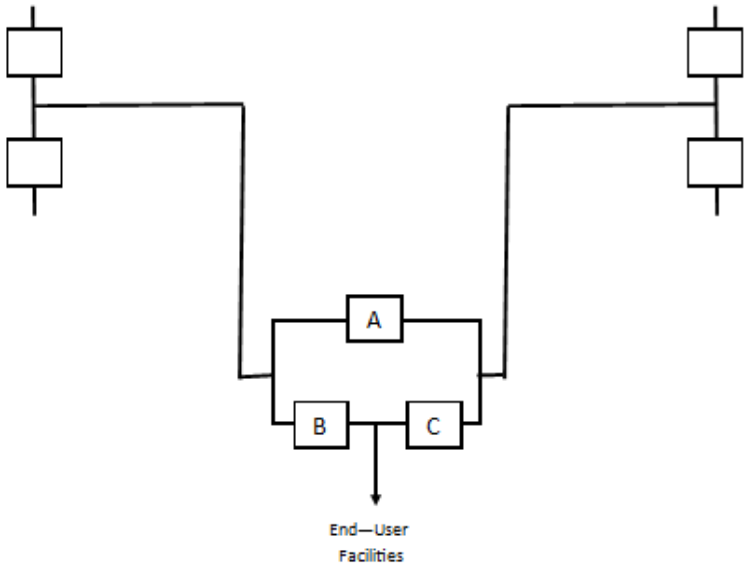
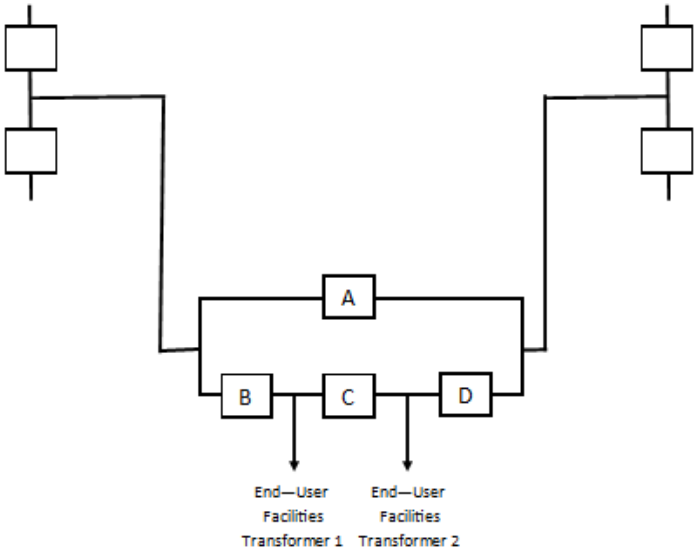

A
B
C
End—User
Facilities

**Figure 4**


A
B
C
D
End—User
Facilities
Transformer 1
End—User
Facilities
Transformer 2

In the examples shown in Figures 3 through 4, if the Interconnection Customer chooses the added reliability, the TO will perform studies to determine if breaker A is required.

Interconnection Customer shall submit initial and final specifications for the Interconnection Facility(ies), including Protection Systems, to TO for review and comment. TO must review such specifications to ensure that the Interconnection Facility(ies) are compatible with the technical specifications, operational control, and safety requirements of TO. All specifications provided hereunder must be deemed confidential.

Interconnection Customer must make such changes to the Interconnection Facility(ies) as may reasonably be required by TO, in accordance with GUP, to ensure that the Interconnection Facility(ies) are compatible with the technical specifications, operational control, and safety requirements of TO. The Interconnection Facility(ies) must be designed and constructed in accordance with GUP.

TO's review of Interconnection Customer's final specifications will not be construed as confirming, endorsing, or providing a warranty as to the design, fitness, safety, durability or reliability of the Interconnection Facility(ies).

The timing and duration of this review process must be based on the work scope and incorporated in the overall project schedule to meet the required in-service date.

Within one hundred twenty (120) calendar days after connection of the Interconnection Facility(ies), unless the Parties agree on another mutually acceptable deadline, Interconnection Customer must deliver to TO "as-built" drawings, information and documents for the Interconnection Facility(ies), such as: a one-line diagram of the Interconnection Facility(ies), a relay functional diagram, 3-Line AC and DC schematic diagrams for all facilities associated with Interconnection Customer's Interconnection Facility(ies). TO's Interconnection Facility(ies) must be designed and constructed in accordance with GUP. Upon request, within one hundred twenty (120) calendar days after the connection of the Interconnection Facility(ies), unless the Parties agree on another mutually acceptable deadline, TO must deliver to Interconnection Customer the "as-built" drawings, information and documents for TO's Interconnection Facility(ies).

PPL companies

***R3. Each Transmission Owner shall address the following items in its Facility interconnection requirements:***

***3.1 Procedures for coordinated studies of new or materially modified existing interconnections and their impacts on affected system(s).***

***3.2 Procedures for notifying those responsible for the reliability of affected system(s) of new or materially modified existing interconnections.***

## Generator Interconnections

When a new or materially modified generator is being studied by the ITO, an Ad Hoc Study Group is formed. The Ad Hoc Study group members consist of transmission planners from each of the neighboring transmission systems. During the generator interconnection studies, the Ad Hoc Study group reviews the models, study scope, and input files etc. prior to the performance of the ITO's SIS. The neighboring transmission systems' participation in the Ad Hoc Study group is the forum to ensure that the generator interconnection studies are coordinated with the neighboring transmission system.

As part of the ITO study for a generator interconnection SIS, neighbor utility facilities are included in the contingency list which are analyzed. The neighbor utility facilities are also monitored against the performance requirements of TPL-001-4 during the contingency analysis. When the performance requirements are not met on the neighbor utility system, that neighbor utility is identified as an affected system. The affected system constraint is included in the SIS that is posted. The affected system is notified by the ITO of the constraint. If the affected system determines that the interconnection causes a valid constraint, the interconnection customer may be required to have an affected system study as determined and performed by the affected system. The GI interconnection is not approved until the affected system has put in writing to the ITO, that they are satisfied that the constraint has been mitigated by the interconnection customer.

The Ad Hoc Study Group members may perform their own test to determine if their system is affected by the GI request. The preliminary results, including the details of the transmission constraint(s), must be communicated to the ITO within 30 calendar days of the initial Ad Hoc Study Group meeting for inclusion into the final ITO study report. If there are impacts to third party Transmission Systems, the customer must coordinate with the impacted third party system owner to remedy. The impacted third-party should work with the customer to provide appropriate data regarding the impact. The GI request will not be finalized until resolution of third party impacts.

## Transmission to Transmission Interconnections

When a new or materially modified Interconnection Facility or tie line is being studied by the transmission planners, an Ad Hoc Study Group is formed using members of the existing Ad

Hoc Study group. The Ad Hoc Study group members consist of transmission planners from each of the neighboring transmission systems. During the Interconnection Facility interconnection studies, the Ad Hoc Study group reviews the models, study scope, and input files etc. prior to the study. The neighboring transmission systems' participation in the Ad Hoc Study group is the forum to ensure that the interconnection studies are coordinated with the neighboring transmission system.

As part of the studies performed, neighbor utility facilities are included in the contingency list. The neighbor utility facilities are also monitored against the performance requirements of TPL-001-4 in the studies. When the performance requirements are not met on the neighbor utility system, that neighbor utility is identified as an affected system. The affected system constraint is included in the study report that is shared with the Ad Hoc Group. The transmission planners notify the affected system of the constraint. If the affected system determines that the interconnection causes a valid constraint, the interconnection customer may be required to have an affected system study as determined and performed by the affected system. The Interconnection Facility interconnection is not approved until the affected system has put in writing to the planners that they are satisfied that the constraint has been mitigated by the interconnection customer.

**End-User Interconnections**

When a new or materially modified End-User Interconnection Facility is being studied by the ITO, an Ad Hoc Study Group is formed. The Ad Hoc Study group members consist of transmission planners from each of the neighbor transmission systems. During the End-User interconnection studies, the Ad Hoc Study group reviews the models, study scope, and input files etc. prior to the performance of the ITO's SIS. The neighboring transmission systems' participation in the Ad Hoc Study group is the forum to ensure that the End-User interconnection studies are coordinated with the neighbor transmission system.

As part of the ITO study for an End-User SIS, neighbor utility facilities are included in the contingency list which are analyzed. The neighbor utility facilities are also monitored against the performance requirements of TPL-001-4 during the contingency analysis. When the performance requirements are not met on the neighbor utility system, that neighbor is identified as an affected system. The affected system constraint is included in the SIS that is posted. The affected system is notified by the ITO of the constraint. If the affected system determines that the interconnection causes a valid constraint, the interconnection customer may be required to have an affected system study as determined and performed by the affected system. The End-User interconnection is not approved until the affected system has put in writing to the ITO, that they are satisfied that the constraint has been mitigated by the interconnection customer.

The Ad Hoc Study Group members may perform their own test to determine if their system is affected by the TSR request. The preliminary results, including the details of the transmission constraint(s), must be communicated to the ITO within 30 calendar days of the initial Ad Hoc Study Group meeting for inclusion into the final ITO study report. If there are impacts to third party Transmission Systems, the customer must coordinate with the impacted third party system owner to remedy. The impacted third-party should work with

the customer to provide appropriate data regarding the impact. The TSR request will not be confirmed until resolution of third party impacts.