TRANSMISSION

FACILITIES INTERCONNECTION

REQUIREMENTS

Corresponds to

NERC Standard FAC-001

Developed By
CPP Engineering Department

December 21, 2018

Version 4

INDEX

CPP Transmission Facilities Interconnection Requirements

ATTACHMENTS, TABLES, FIGURES & APPENDIXES

CPP TRANSMISSION FACILITIES CONNECTION REQUIREMENTS

Preface

This document contains the facility connection requirements which will facilitate the safe, efficient and reliable integration of any electrical transmission, generation, and end-user facility into the Cleveland Public Power (CPP) Transmission System. For the application of this document, the following definitions apply:

Transmission Connection –

An electrical connection between the CPP Transmission System and another networked transmission system such as the facilities of an adjacent transmission owner or a load serving entity.

Generation Connection –

An electrical connection between the CPP Transmission System and a generation facility. This does not include behind-the-meter generation.

End-User Connection (Load Customer)–

An electrical connection between the CPP Transmission System and end-user facilities, i.e., load customer. These facilities are not a networked transmission system and might include behind-the-meter generation.

The requirements specified in this document are intended to ensure a compatibility of electrical designs and equipment and, thereby, contribute to the uniformity of service to all parties connected to the CPP Transmission System. This document provides a written summary of the CPP plans to achieve the required system performance throughout the planning horizon by establishing interconnection requirements for new and materially changed transmission, generation, and end-user facilities connected to the CPP Transmission System.

In all cases, the CPP standards are consistent with the requirements for Facility Interconnections as specified by the applicable NERC Reliability Standards, Reliability First (RF) reliability principles and standards, guides, procedures, and reference documents, PJM documents and manuals and applicable regional transmission organization (RTO) tariffs and agreements.

ReliabilityFirst is the successor organization to three former NERC Regional Reliability Councils: the Mid-Atlantic Area Council (MAAC), the East Central Area Coordination Agreement (ECAR), and the Mid-American Interconnected Network (MAIN) organizations. The requirements included in this document

apply to all CPP facilities included in the applicable PJM Open Access Transmission Tariff.

All transmission and generation Interconnection Customers connecting to the CPP Transmission System must agree to comply with the applicable PJM documents and manuals and applicable NERC and RF standards as noted above.

Any party seeking to modify or establish a new connection to the CPP transmission system should use this document when planning an installation, but should be aware that it may not cover all details in specific cases. Its purpose is to provide a general reference for typical situations that can be utilized when evaluating any potential modification to the CPP transmission system. As such, the CPP requirements presented in this document should be considered as the minimum acceptable requirements. Additional provisions may be necessary as a result of the findings of CPP studies performed, or other regional requirements or agreements, which are more restrictive.
The planning and implementation of new or modified transmission, generation, and end-user facilities connected to the CPP Transmission System are coordinated with the interconnected transmission system through the Regional Transmission Expansion Plan (RTEP), and the updated Multi-Regional Modeling Working Group Process (MMWG) base cases. The customer must confirm with PJM for all new or materially modified transmission Facilities are within the PJM Authority Area's metered boundaries. The RTEP processes are documented on the PJM web site at www.pjm.com.

Initial Load Studies (ILS) and Detailed Load Studies (DLS) that will be performed by CPP in association with any proposed new or modified transmission system connection will only evaluate its impact on the CPP transmission system. These studies are performed for end-user connections and in some instances for transmission connections. CPP will notify adjacent transmission owners, transmission customers, RTOs or others that may be impacted by the proposed new or modified transmission, generation or end-user facilities as required by any existing tariff, interconnection agreement and the PJM processes. This will be done as soon as feasible. CPP will share its study results and data with the impacted parties as appropriate within its established code of conduct. All Studies will also include estimates for permits. Any impacted party, at its discretion, may perform an independent evaluation of the impact of the proposed project. As a prerequisite to construction, the customer planning the new or modified connection to the CPP system must resolve all disputed issues with any intervening party.
The processing of transmission system load connection requests or preliminary reviews of transmission connection requests includes an evaluation to determine if an Initial Load Study (ILS) and/or a Detailed Load Study (DLS) is required to

analyze the impact of the proposed load connection facilities on the transmission system.

An ILS is an assessment by CPP of the capability of the existing system to accommodate the request for the new or modified connection facilities. An ILS typically includes but is not limited to the following:

Load flow analysis
Short circuit level at point of interconnection
Consideration of special circumstances (PQ issues, i.e., power quality)
Identification of direct connection requirements
Identification of network upgrades needed
Consideration of multiple connection alternatives
Operational limitations
Written report of results

A DLS is an engineering study conducted by CPP. A DLS typically includes but is not limited to the following:

Consideration of one ILS connection alternative
Estimates of costs associated with direct connect and System upgrades
Specification of protection requirements
Specification of metering requirements
Operational limitations
Stability analysis as required
Written report results

The applicability of each main section of this document to transmission, generation, and end-user facilities is identified in the title of each of the main sections.

CPP TRANSMISSION FACILITIES INTERCONNECTION REQUIREMENTS

1. Service Application (Transmission, Generation, and End-User)

1.1 General

When information on the location and size of any new or modified load connection proposal has been determined, the transmission customer must complete the appropriate application and submit it with any required deposit to the specified CPP agent.

CPP will coordinate any resulting system upgrades required by the load interconnection with PJM as applicable.
Applications for generation or transmission interconnection service is available electronically from the PJM website (www.pjm.com) as appropriate.

2. Load Connection Requirements (End-User)

2.1 General

All connections to the CPP Transmission System must be designed such that, under normal operating conditions, faults at the Interconnecting Party's facility will be cleared by a dedicated interrupting device(s) and will not result in an outage of any CPP transmission line, bus, or transformer.

2.2 Tap Connection Definition and Requirements

A connection to the CPP Transmission System that requires only the Connecting Party's load to pass through the interconnecting facilities under any condition is considered a tap connection.

The attached *Figure 1* illustrates a typical tap supply configuration, for CPP transmission supply voltages at 138 kV, and some of the basic connection requirements. As indicated, line switches will be required at the tap point to allow for sectionalizing the line without supply interruption to the customer. CPP may require , in a case by case review, that motor operated mechanisms and SCADA control be installed with the switches in order to minimize the time required for restoration in the event of permanent line faults on the

tapped transmission line. CPP requires both mechanisms for all BES facilities.

2.3 Looped Connection Definition and Requirements

A connection to the CPP Transmission System that requires CPP transmission line load (through flow) to pass through the connecting facilities under any condition is considered a looped connection. Loop connected facilities have the potential to significantly affect the reliability and loadability of the CPP Transmission System and therefore should be avoided when possible. If the Looped Connection is permitted by CPP the facilities must be designed and built in either a breaker and a half or a ring bus configuration. In such an even the Connecting Party shall be responsible for determining its' NERC compliance requirements, if any.

Figure 2 illustrates a typical loop supply configuration and some of the basic connection requirements.

For looped supply configurations, a grounded wye high side transformer winding configuration may be acceptable (system study required) in addition to either a delta or ungrounded wye high side winding configurations for connecting substation transformers.

3. Network Connection Definition and Requirements (Transmission)

A connection to the CPP Transmission System that allows bi-directional energy and/or fault current flow between otherwise independent transmission systems is considered a network connection. Check with PJM tariffs and documentation for further clarification.

4. Voltage Levels, System Capacity, and Operational Issues (Transmission, Generation, and End-User)

The Interconnecting Party's facility will be supplied from CPP's 138 kV transmission system, which is designed to operate between the following percentages of nominal voltage under normal and single transmission element outage conditions.

138 kV (90.0%-105%)

.

Under certain emergency conditions involving multiple system contingencies, the transmission system may operate for a period of time outside of this range. The Interconnecting Party is responsible for providing any voltage sensing relaying required to protect its facility during abnormal voltage operation. In addition, immediate action may be required to disconnect load from the CPP transmission system should voltage fall below the minimum percentage of nominal value listed above. The Interconnecting Party will be given advance notice of such action, to the extent possible, and will be expected to disconnect from the transmission system upon CPP request until the initiating condition has been corrected.

The MW and MVAR capacity or demand at the point of connection is limited by the capabilities of the CPP Transmission System. Analysis and documentation of these capabilities are provided through the connection processes referenced in the preface of this document. Operational issues associated with the proposed facilities will be analyzed and documented through the connection processes referenced in the preface of this document.

5. Load Power Factor Requirements (Load Customer Only)

Customers connected directly to the transmission systems should plan and design their systems to operate at close to unity power factor to minimize the reactive power burden on the transmission systems. The CPP requirement for close to unity power factor is that the power factor at the point of interconnection shall be controlled to be within the range of 0.97 lagging to 0.99 leading.

Shunt capacitors are frequently used as a means to control the power factor of an Interconnecting Party's facility. However, there are several areas that should be addressed in applying capacitors to avoid potential problems. These problems can include, but are not limited to, transient voltages due to capacitor switching and voltage amplification due to resonance conditions. The services of a qualified consultant should be obtained to review the specific application and provide recommendations in regard to control of these phenomena.

6. Frequency Range (Transmission, Generation, and End-User)

The CPP Transmission System typically operates at a nominal 60 Hz with a variation of ± 0.05 Hz. Under certain emergency conditions, the transmission system may operate for a period of time outside of this range. The Interconnecting Party is responsible for providing any frequency sensing relaying required to protect its facilities during abnormal frequency operation.

7. Power Quality (Transmission, Generation, and End-User)

7.1 Harmonics and Flicker

Certain electrical equipment located at an Interconnecting Party facility (arc furnaces, cycloconverters, inverters, etc.) may generate flicker and harmonics that can negatively impact the utility power system.

The Interconnected facility shall comply with harmonic voltage and current limits specified in the most recent revision of IEEE Standard 519, "IEEE Recommended Practices and Requirements for Harmonic Control in Electrical Power Systems".

Flicker shall be measured as described in the most recent version of IEEE Std 1453, "IEEE Recommended Practice for Measurement and Limits of Voltage Fluctuations and Associated Light Flicker on AC Power Systems". Pst is a measure of short-term perception of flicker obtained for a ten-minute interval. Plt is a measure of long-term perception of flicker obtained for a two-hour period calculated from 12 consecutive Pst values. The connected facility shall be designed and operated such that Pst does not exceed 0.8 and Plt does not exceed 0.6 for 1% of the time (99% probability level) using a minimum assessment period of one week.

Voltage flicker for infrequent events such as large motor starting will be evaluated based upon the resulting percent voltage dip per event (see Annex A of IEEE Std. 1453-2004 or the most recent revision).

CPP may initially, or in the future, require the installation of a harmonic and/or flicker monitoring system in order to permit ongoing assessment of compliance. PJM's rules require that CPP

would need to show that the Interconnection Customer equipment has changed for PJM to be responsible at a later date.

7.2 Sensitive Electrical Equipment

Certain electrical equipment may be sensitive to normally occurring electric interference from nearby connected loads in the Interconnecting Party's facility or from other customers connected to the power system. If sensitive electrical equipment is to be supplied directly from the electric power system, it is recommended that the equipment grounding requirements and power supply requirements be examined by the Interconnecting Party or its consultant prior to installation. Attention should be given to equipment tolerance to various forms of electric interference, including voltage sags and surges, momentary outages, transients, harmonics, or other electrical noise. When electrical disturbances to sensitive electrical equipment such as computer, electronics, controls, and communication equipment cannot be tolerated, the Interconnecting Party shall furnish additional equipment as may be necessary to prevent equipment malfunctions. The supplier of such sensitive electrical equipment should be consulted regarding the power supply requirements or the remedial measures to be taken to alleviate potential misoperation of the equipment. A power quality consultant can also perform a site survey of the electric power supply environment and furnish recommendations to provide the acceptable level of reliability.

8. Interconnecting Party Substation Equipment Requirements (Transmission, Generation, and End-User)

8.1 Size and Pull-Off Tension of Line Conductors and Overhead Ground Wire

The sizes and approximate pull-off or dead-end tension for each phase conductor and ground wire will be provided by CPP for design of the takeoff structure. The exact pull-off tensions will be determined after the substation plans are finalized.

The line terminal connectors furnished by the Interconnecting Party to bolt to the air switch terminal pad shall be compression

type. The ground wire shall be grounded to the steel structure and the station ground grid by the Interconnecting Party.

If the incoming high voltage lines will cross railroad tracks, such as a siding or main line, to reach the substation, it may be necessary to increase the tensions or provide additional height on the substation structure to meet railroad crossing requirements.

The point of attachment of the line entrance conductors shall be of sufficient height to provide the basic vertical clearance requirements for lines crossing over public streets, alleys, or roads in urban or rural districts, as outlined in the National Electrical Safety Code, latest revision.

8.2 Short Circuit Data & Interrupting Device Ratings

CPP will provide the following anticipated near-term short circuit data for a specific point of connection:

- 3 Phase Fault in AMPS or MVA
- Single Line-Ground Fault in AMPS*
- System Impedance on 100 MVA Base as Z1%, Z0%

*Note: CPP Transmission System phase to ground fault values are calculated assuming transformers with either a wye-ungrounded or delta connected high side. For wye-grounded transformers, the transformer contribution to the total fault current will have to be taken into account.

Substation equipment shall have interrupting and momentary ratings adequate for the short circuit conditions provided. Fault interrupting devices shall have the open-close duty cycle ratings necessary to accommodate their required open-close sequences.

While CPP will endeavor, where possible, to anticipate future system changes which may affect the provided values, it does not assume responsibility or liability with respect to such protective devices, nor guarantee their continuing adequacy against increased interrupting capacity requirements resulting from system changes. Connected parties are responsible for periodic review of existing and future fault conditions and for any future equipment

upgrades/replacements that are required. PJM and CPP would also analyze these situations if there is appropriate data to do so and work with generation owners to update their systems.

All gas insulated interrupting devices within the Connecting Party's facility having a direct connection to a CPP transmission line shall be equipped with a low gas pressure alarming/tripping/lockout scheme (as appropriate for the particular device) in order to minimize the possibility of a transmission fault resulting from a of loss of insulating gas.

8.3 Other Design Criteria

8.3.1 Equipment Basic Insulation Levels

The minimum required Basic Insulation Levels (BIL) are listed in Table 1. Substations in areas with significant airborne pollution may require a higher insulation level.

8.3.2 Transformer Surge Protection (Lightning Arresters)

Metal oxide arresters are preferred for transformer protection. Minimum arrester ratings are listed in Table 1.

Arresters protecting transformers are generally mounted on the transformer. When the arresters will not be mounted next to the terminals of the equipment to be protected, the voltage at the protected insulation will usually be higher than at the arrester terminals. MOV arrester application guide, IEEE Std C62.22, should be consulted to determine the maximum acceptable separation distance between the arresters and the protected equipment.

Consult manufacturer's catalog for details concerning arrester protective characteristics, ratings, and application.

8.3.3 Ratings of Current Carrying Equipment

For tap supply configurations, the Interconnecting Party's high voltage bus and associated equipment, such as switches, connectors, and other conductors shall have a minimum continuous current

carrying rating and a momentary asymmetrical current rating as listed in Table 1. Minimum current ratings will be provided by CPP for looped or network supply configurations.

8.3.4 Electrical Clearances (Outdoor)

Electrical substation design clearances are listed in the attached Table 1. These design clearances shall be used for electrical facilities up to and including any interrupting device connected directly to a CPP transmission line and for all facilities that are part of the CPP transmission current path.

The safety clearances from live parts to all permanent support surfaces for workers shall be no less than the minimum listed in Table 1 and shall be applied throughout the entire substation.

The minimum vertical clearance of the conductors above ground and the vertical and horizontal clearance of conductors passing by but not attached to a building or wall shall be in accordance with the National Electrical Safety Code or applicable state and local codes.

8.3.5 Insulators for Station

The required station post insulator types are listed in Table 1. Substations in areas with significant airborne pollution may require a higher insulation level. Higher strength insulators are available and shall be used as needed to meet bus momentary short circuit withstand values.

8.3.6 Horn Gap Switch(es) and Disconnect Switch(es)

A gang operated horn gap switch shall be installed on each transmission line supply entrance to the Interconnecting Party's facility at a location which is accessible by CPP personnel 24 hours a day. The switch shall be lockable in the open position with a CPP padlock in order to provide for a visible electric isolation of the Interconnecting Party's facility and shall be identified with a CPP designated equipment number.

A ground mat of 4' x 6' dimension shall be provided beneath the air switch operating handle and located so that the switchman will remain on the mat while operating the switch. The mat shall be connected electrically directly to the grounding point of the switch handle and from there to the station ground grid.

These horn gap switches shall be three pole, single throw, gang operated. Disconnect switches may be single pole, single throw, hook-stick operated or three pole, single throw, gang operated. Characteristics for all horn gap switches and disconnect switches including voltage and BIL ratings, clearances and pole spacing shall be as given in Table 1. Substations in areas with significant airborne pollution may require a higher BIL level. There shall be no braids in the current carrying parts of the switch. Gang operated switches shall be complete with a horizontal, rotating-type operating handle. A grounding device is to be furnished for the operating shaft and shall consist of a tin coated, flexible copper braid, located as close as possible to the operating handle. The braid shall have a cross sectional area equivalent to 4/0 copper cable, or greater. The braid shall be secured to the shaft by means of a galvanized steel U-bolt clamp and associated cradle-type galvanized steel hardware. The opposite end of the braid shall have two (2) 9/16 inch holes at 1-3/4 inch spacing. Both ends of the braid shall be stiffened and protected by a ferrule or additional tinning.

All switches are to be manufactured and tested in accordance with the latest revision of IEEE Std C37.30, ANSI C37.32, and IEEE Std C37.34.

8.3.7 Substation Fence Safety Clearances

The fence safety clearances in the Interconnecting Party substation shall comply with Section 11 of IEEE Std C2, "National Electrical Safety Code."

8.3.8 Grounding System Design and Test

The grounding system shall be designed in accordance with IEEE Std 80 - latest revision, "IEEE Guide for Safety in AC Substation Grounding." The grounding system design and construction shall be verified by tests in accordance with IEEE Std 81, "IEEE Guide

for Measuring Earth Resistivity, Ground Impedance, and Surface Potentials of a Ground System."

Ground fault currents from CPP sources are referenced in Section 8.2, Short Circuit Data & Interrupting Device Ratings. Interconnecting Party equipment ground sources can contribute significant fault current independent of the ground fault values in Section 8.2. These ground sources shall be considered in the design of the grounding system.

If the substation structure is to be wood-pole type construction, the transmission line overhead ground wire, all switch bases, fuse bases, and other non-current carrying metal parts shall be grounded.

9. System Protection (Transmission, Generation, and End-User)

9.1 CPP Transmission System Protection

CPP will provide functional specifications and relay settings for all protective relays, including the protection and control equipment required for synchronizing of power systems at the Interconnecting Party's facility that have a potential impact on the reliability of the CPP Transmission System. The criteria for these functional specifications and settings will be based upon requirements set forth in the CPP transmission protective relay philosophy. CPP also reserves the right to specify the type and manufacturer for these protective relays. The specific recommendations and requirements for protection will be made by CPP based on the individual substation location, voltage and configuration.

Those protective relays required by CPP and any auxiliary-tripping relay associated with those relays shall be utility-grade devices. Utility grade relays are defined as follows:

1. Meet IEEE Std C37.90, "Relays and Relay Systems Associated with Electric Power Apparatus."
2. Have relay test facilities to allow testing without unwiring or disassembling the relay.
3. Have appropriate test plugs/switches for testing the operation of the relay.
4. Have targets to indicate relay operation.

The relaying system shall have a reliable source of power independent from the ac system or immune to ac system disturbances or loss (e.g., dc battery and charger) to assure proper operation of the protection scheme.

CPP will provide short circuit data for the specific point of connection for additional CPP transmission facility outage contingencies as requested by the connecting party for use during the completion of power system studies.

CPP will review settings for the Connecting Party's internal relays in order to establish coordination between the facility protective equipment and the CPP Transmission System relays.

9.2 Connecting Party Protection

It is the Interconnecting Party's responsibility to assure protection, coordination and equipment adequacy within their facility for conditions including but not limited to:

1. Single phasing of supply
2. System faults
3. Equipment failures
4. Deviations from nominal voltage or frequency
5. Lightning and switching surges
6. Harmonic voltages
7. Negative sequence voltages
8. Separation from CPP supply
9. Synchronizing generation
10. Synchronizing facilities between independent transmission system and CPP Transmission System

It is the Interconnecting Party's responsibility to determine that their internal protective equipment coordinates with the required CPP protective equipment and is adequate to meet all applicable standards to which the party may be subject.

CPP further reserves the right to modify relay settings when deemed necessary to avoid safety hazards to utility personnel or the public and to prevent any disturbance, impairment, or interference with CPP's ability to serve other customers. CPP will ensure they coordinate any relay changes with the connecting party as appropriate.

9.3 Automatic Underfrequency and Undervoltage Load Shedding

CPP applies automatic underfrequency load shedding relaying in compliance with the applicable ReliabilityFirst Reliability Council agreements.

For CPP, which is within the PJM RTO, PJM Manual 37, Attachment A: PJM Reliability Plan, Section F – Emergency Operations, Item 4 will be applicable.

All Wholesale Interconnecting Parties within the PJM RTO portion of the CPP system shall have an automatic underfrequency load shedding plan in effect that meets PJM Manual 37 requirements and ReliabilityFirst Reliability Council agreements.

Retail Interconnecting Parties within the PJM RTO portion of the CPP system shall install automatic underfrequency load shedding schemes as identified by CPP.

CPP is required by NERC and ReliabilityFirst to apply automatic undervoltage load shedding relaying as needed to prevent cascading transmission system outages. The specific locations where undervoltage load shedding relaying must be installed and the amounts of load to be shed are determined by special system studies. Wholesale and Retail Interconnecting Parties will be required to install undervoltage load shedding schemes as identified by CPP through these special studies.

10. Remote Relay Access (Transmission, Generation, and End-User)

10.1 Loop or Network Connected Substations

All digital relays which have the capability of recording system disturbance information and that are used for protection of CPP transmission facilities shall be provided with the equipment necessary to allow CPP to remotely retrieve this data

10.2 Tap Connected Substations

Although not normally required at tap connected facilities, CPP may at its option require remote relay access at a specific facility.

11. SCADA Requirements (Transmission, Generation, and End-User)

11.1 Loop and Network Connected Substations

Loop and network connected facilities shall be equipped with a Supervisory Control and Data Acquisition (SCADA) Remote Terminal Unit (RTU) and shall be connected via an appropriate, Interconnecting Party supplied, dedicated communications channel to the CPP's Transmission System Control Center in Cleveland, Ohio. The RTU shall provide CPP with at least the information and control capabilities listed below. Facilities with unusual or non-conforming load characteristics may be required to provide additional information and control capabilities beyond those listed.

11.1.1 Control

The RTU shall provide CPP with control of all circuit interrupting devices that are directly in the CPP transmission path.

11.1.2 Position Indication

The RTU shall provide CPP position indication of all transmission voltage circuit interrupting devices and motor operated disconnect devices.

11.1.3 Alarms

The RTU shall provide CPP equipment alarm information for each circuit interrupting device and associated protective relaying in the transmission path. Indication of protective relay operation alarms for relaying other than the transmission line relaying that operates a circuit interrupting device in the transmission path will also be provided. (These might include breaker failure or bus differential relaying).

11.1.4 Operational Metering

The RTU shall provide CPP instantaneous bi-directional real and reactive power metering (MW and MVAR) and voltage for all CPP transmission lines connected to the facility, as well as ampere metering of each circuit breaker in the transmission path. These quantities may be measured using relay accuracy class instrument transformers and meters/transducers.

11.1.5 Revenue Metering

The RTU shall provide CPP access to the revenue metering quantities specified in Section 12 using DNP 3.0 communications protocol.

11.2 Tap Connected Substations

CPP may require tap-connected facilities with unusual or non-conforming load characteristics to install a SCADA RTU. Tap connected transmission load facilities do not normally require a SCADA RTU. If an RTU is required, CPP will specify the information and control capabilities to be provided.

12. Revenue Metering Requirements (Transmission, Generation, and End-User)

CPP approved revenue class metering equipment shall be installed to meter the aggregated load of the connected facility consisting of instantaneous bi-directional real and reactive power metering (MW and MVAR) and integrated hourly real and reactive energy metering (MWH and MVARH). The revenue meters shall be connected to current transformers (CT's) having IEEE Std C57.13 minimum metering accuracy rating of 0.3% at a burden designation of B-1.8. The voltage transformers (VT's) or coupling capacitor voltage transformers (CCVT's) must have IEEE Std C57.13 minimum metering accuracy rating of 0.3% at a burden designation of Y. VT's are preferred for revenue metering. CCVT's should only be used where there is a VT located within the same facility against which the CCVT can be periodically tested and calibrated. In cases where power flow varies significantly, extended range or high accuracy CTs may be required. In extreme cases, additional metering equipment may be required to properly measure energy delivered or received.

The instrument transformers used for revenue metering shall be installed on the transmission voltage side of the Interconnecting Party's step-down transformer, on the load side of the fault-interrupting device, and within the local zone of fault protection of the connecting facility. Under special circumstances and with written approval from CPP, revenue metering may be located on the secondary side of the step-down transformer and adjusted for transformer losses (compensated metering). Approval of compensated metering requires that the Interconnecting Party provide power transformer test data indicating transformer load and no-load losses, exciting current and impedance. This data shall be certified accurate to within 1%. If the transformer is equipped with a no-load tap changer, the test data shall be provided for all available taps. The Interconnecting Party must also demonstrate that accurate transformer loss compensation will be programmed into the revenue metering. Compensated metering may be used with load tap changing (LTC) transformers if the transformer self-cooled rating is less than or equal to 25MVA and the forced-cooled rating is less than or equal to 35MVA. Compensated metering may not be used at facilities exporting power.

The meters, test switches and any other secondary devices that could have any impact on the performance of the metering facilities shall be sealed at all times and the seals shall be broken only when tests, adjustments, and/or repairs are required and after both parties have been informed. Communication equipment shall be provided to allow CPP to remotely retrieve revenue metering data via Interconnecting Party supplied access to the public phone system. CPP shall set the password and any other security requirements for remotely accessing the revenue meters so as to ensure the security of the meters and the meter data.

13. Communications (Transmission, Generation, and End-User)

13.1 Normal Voice Communications

When required by CPP, the Interconnecting Party shall provide a dedicated voice communication circuit to the CPP Transmission System Control Center (SCC). Such a dedicated voice communication circuit would originate from the Interconnecting Party's 24 hour manned operations office and would be typically required for:

- Generation Facilities – Synchronization and operation of generation in excess of 2.5 MW supplying to the CPP system,

- Transmission Substations – Connected transmission facilities only supplying customer load.

All other normal voice communication concerning facility operations shall be conducted through the public telephone network to the SCC phone number(s) issued by CPP.

13.2 Emergency Voice Communications

Voice communications in the event of a transmission facility emergency shall use the dedicated voice circuits, if available, or public telephone network and phone number(s) designated for emergency use.

It is the Interconnecting Party's responsibility to take prudent steps when an area or system wide capacity emergency is declared. Load reductions shall be implemented by reducing non-essential loads. This type of reduction is usually conveyed through the local media. Contractual load reductions should already be in effect.

The Interconnecting Party is responsible for providing the assigned CPP System Control Center a "Customer Contact List." This generally is a listing of two or more people, their title, their business and home phone numbers. Any special information such as Police and Fire phone numbers as well as Substation phone numbers should be attached. Interconnecting Parties are provided an unlisted phone
number to be used for emergency or routine operations. Operational emergencies (equipment) warrant a direct call either way. The SCC Dispatcher will advise the designated CPP customer representative of problems that need to be handled directly with the customer.

System capacity emergencies are communicated through the local media except for contractual customers. Contractual customers are notified electronically in the event of an "Emergency Interruption."

14. Generation Connection Requirements (Generation and End-User)

Generation facilities directly or indirectly connected to and operated in synchronism with the CPP Transmission System will have additional

requirements beyond those specified up to this point. Those requirements are described in this section.

14.1 Connection Configurations

New generation connected at transmission voltage levels, 100kV and higher, will require detailed system studies to determine the feasibility of the proposed connection point and the specific connection requirements. The figures referenced in Section 14.5 show typical connections for generation owner substations and associated generation. Refer to Attachment C for additional information about the configuration of the connected facilities.

14.2 Design Requirements

The generation owner is responsible for specifying appropriate equipment and facilities such that the parallel generation is compatible with the CPP Transmission System. The generation owner is also responsible for meeting any applicable federal, state, and local codes. The minimum CPP Transmission System connection design requirements for parallel generation are as follows.

14.2.1 Reactive Power

The Facility's minimum requirement shall be the provision of a reactive power capability sufficient to maintain a composite power delivery for the Facility at the Interconnection Point at a power factor that meets PJM requirements. CPP will coordinate with the Interconnecting Party to identify the optimal generator step-up transformer tap to make such a capability available when demanded.

Induction generators and other generators with no inherent VAR (reactive power) control capability, or those that have a restricted VAR capability less than the defined requirements, must provide supplementary reactive support equivalent to that provided by a similar-sized synchronous generator. It must be capable of providing reactive output anywhere within the power factor range that meets PJM requirements Non-synchronous will be required to meet PJM requirements.