



Transmission and End-User Facility Connection Requirements

(This document is not to be used for generator interconnections.)

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1.0 Purpose

The purpose of this guide is to outline the minimum requirements for safe and effective operation of both transmission and end-user facility interconnections to the CIPCO electric system. CIPCO and the customer shall use this guide when planning the inter-tie between facilities owned by CIPCO and the customer. This document is intended to be used for facility interconnections including both transmission interconnections and end-user interconnections. This document is not to be used for generation interconnections¹.

The information contained in this guide is not intended to capture each and every specific equipment and installation requirement. The minimal requirements specified in this document may need to be modified to meet the needs of unique installations. The intent of the requirements specified in this document are to address all types of interconnections. As such, not all of the requirements will necessarily apply to all types of interconnections. CIPCO reserves the right to determine which requirements apply to any specific requested interconnection.

¹ See CIPCO's Generation Interconnection Document

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2.0 Interconnection Guide

CIPCO permits other entities to connect to the CIPCO transmission system, providing it is done safely following proper requirements, criteria and good utility practices. CIPCO requires that certain protective devices, as outlined in this guide, shall be installed at locations where a customer desires to connect with CIPCO. The purpose of these devices is to separate interconnected facilities from the CIPCO electric system during abnormal operating conditions. This is done to protect the general public and CIPCO personnel from injury, and to prevent damage to CIPCO and customer-owned electrical equipment.

Other entities may connect with CIPCO, provided that the facilities meet the requirements outlined in this guide. The CIPCO approval process shall be followed for all interconnections with the CIPCO system. Employees of CIPCO shall report findings of any unapproved operation and/or connection to the CIPCO Engineering group. CIPCO's operations management team will then review the facilities and take any necessary action to assure safe operation. CIPCO reserves the right to open the inter-tie to any customer who violates any of these operating requirements.

2.1 Customer Owned Equipment

CIPCO shall not assume any responsibility for the protection of a customer's facilities, other than those interconnecting facilities as defined by an interconnection agreement of which CIPCO is a signatory. The customer shall be completely responsible for protecting its system from any abnormalities, including those created by the planned or unplanned operation of the CIPCO system.

2.2 Modeling Information

All customer facility equipment electrical characteristics and operating parameters will be provided to CIPCO for use in power flow studies, transient/voltage stability studies, short circuit studies, and relay setting calculations. This information includes, but is not limited to the following: voltage level, MW and MVAR capacity or demand at point of connection, system impedances, seasonal equipment ratings, annual load forecasts, operating practices/procedures, system protection requirements/settings, special protection systems, and other data requirements necessary for the safe and coordinated operation of the CIPCO electric system.

3.0 Definitions

3.1 Customer

The term “customer” refers to any entity requesting a transmission interconnection to the CIPCO electric system. Such entities include, but are not limited to, transmission owners, end-use customers including those of CIPCO’s distribution members, municipalities, loads of other electric utilities and other potential transmission users.

3.2 Emergency

The term “Emergency” means a condition or situation that in the reasonable good faith determination of the affected party based on Good Utility Practice contributes to an existing or imminent physical threat of danger to life or a significant threat to health, property or the environment.

4.0 Design Review Process

Notification of the intent to connect new facilities, or to modify existing facilities already connected to the CIPCO transmission system must be submitted to the CIPCO Engineering group so that the reliability impacts of the proposed facilities and their connections to the CIPCO system and neighboring systems can be assessed.

Transmission planning studies must be performed to determine the impact on the interconnected transmission system when connecting new and/or modified transmission or end-user facilities. Detailed information regarding the facilities to be modified or connected to the CIPCO system shall be submitted by the customer in sufficient detail to allow CIPCO to model, study, and assess the project requirements over the planning horizon. This submittal shall include the customer's proposed interconnection relay system, a project one-line drawing of the proposed installation, and any other relevant information deemed necessary by CIPCO to allow for a sufficient review of the proposed interconnection facilities impacts on existing and future systems.

As soon as feasible, CIPCO will coordinate the study with MAPP and MISO and/or others as appropriate. All parties that are likely to have an interest in or be impacted by the study will be notified and invited to participate in the study process. CIPCO may perform these studies with input from the stakeholders or it may retain an outside consultant to perform the studies. The results of these analyses will be used to determine whether modifications to either the existing or future systems of CIPCO or others or modifications to the customer's proposed facilities are necessary to maintain the reliability of the transmission system. If adverse impacts are found, additional studies may be needed to determine the extent of system modifications or reinforcements necessary to allow the interconnection to take place.

The unique requirements of each interconnection will dictate the items to be submitted and evaluated during the design review and study process. Items to be submitted and/or evaluated in these processes include, but are not limited to, the following:

- Voltage and MW and MVAR capacity or demand at the point of connection
- Breaker duty and surge protection
- System protection and coordination
- Metering and telecommunications
- Grounding and safety issues
- Insulation and insulation coordination
- Voltage, reactive power, and power factor control
- Power quality impacts

- Equipment ratings
- Synchronization of facilities
- Maintenance coordination
- Operational issues (abnormal frequency and voltages)
- Inspection requirements for existing or new facilities
- Communications and procedures during normal and emergency operating conditions

The customer should begin its detailed design only after the CIPCO review of the initial application and one-line drawing. CIPCO will commit to an installation time frame only after sufficient design information has been furnished to assure the agreed upon requirements are being met. The customer must consider the time constraints of CIPCO when scheduling the project. The customer shall allow a reasonable amount of time after acceptance of the one-line and relay system design for any modifications to CIPCO facilities.

After the project is determined to be feasible, a joint meeting may need to be held between the customer and CIPCO to discuss the financial aspects of the installation. A separate meeting may take place to organize the stages of installation. Should the customer, at any time, determine that the project is not feasible after submitting their application; the customer shall verify cancellation of the application in writing.

5.0 General Operating Requirements

Prior to commencing operation, the customer shall obtain approvals from CIPCO for the facility requirements and operating procedures for the customer's interconnection. The customer is responsible for specifying appropriate equipment so that the customer's facilities are compatible with the CIPCO electric system. The customer, in satisfying these requirements, is also responsible for meeting any applicable federal, state and local codes.

The specific CIPCO operating requirements for all customers with interconnected facilities include the following:

5.1 Voltage Range

The customer shall operate their facilities to maintain the same voltage level as the CIPCO system at the point of interconnection. The customer shall maintain operation of the customer's facilities within the guidelines of the CIPCO Planning Criteria.

5.2 Voltage Fluctuations

The customer shall not cause excessive voltage flicker on the source substation bus or transmission system at any time. Acceptability will be determined based on the magnitude of the voltage fluctuation and the frequency of occurrence. Regardless of the frequency of occurrence, customer switched loads and capacitor banks shall not result in a voltage step change greater than 3%.

5.3 Harmonics

The customer's equipment shall not introduce excessive distortion to the CIPCO sinusoidal voltage or current waveforms. Guideline values for total harmonic distortion shall be at or below values published in the most current version of ANSI/IEEE 519, "Recommended Practices and Requirements for Harmonic Control in Electrical Power Systems."

5.4 System Protection

The customer is responsible for providing adequate protection of CIPCO facilities for any conditions that might arise while interconnected. The customer is also responsible for providing adequate protection to its

facilities under any CIPCO operating condition. Conditions may include but are not limited to:

- single phasing of supply
- system faults
- equipment failures
- abnormal voltage or frequency
- lightning and switching surges
- excessive harmonic voltages
- excessive negative sequence voltages
- separation from CIPCO supply (islanding)

The customer shall cooperate with CIPCO in the analysis of disturbances to either the customer's facility or CIPCO's electric system by gathering and providing access to any information relating to a disturbance, including information from oscillographs, protective relay targets and reports, breaker operations and sequence of events recorders.

5.5 Power Factor

The End-User Interconnection Customers shall maintain a minimum power factor, measured at the point of interconnection, of 98% at the transmission connection point. Failure of the End-User Customer to maintain a power factor within this range may result in rate penalties to the Customer.

Transmission Interconnection Customers are responsible for reliable operation that does not place an undue burden on the CIPCO electric system. Power factor requirements for Transmission Interconnection Customers will be 98% unless determined in the sole opinion of CIPCO through detailed studies or other means, to be otherwise.

5.6 Synchronizing

The customer shall be solely responsible for synchronizing their facilities with the CIPCO system. CIPCO will have the right to review, approve and inspect the method of synchronization. Automatic synchronizing settings will not be changed following installation unless mutually agreed to by both parties. The customer must install proper sensing devices to sense a de-energized circuit to assure that a de-energized circuit of CIPCO is not energized by the customer.

5.7 Reclosing

CIPCO utilizes automatic circuit breaker reclosing on transmission circuits. Upon request, these reclosing times for the CIPCO source breaker(s) will be given to the customer. It is the customer's responsibility to design and maintain their system to properly isolate upon loss of the CIPCO supply before any reclosing operation occurs.

5.8 Interrupting Device

To properly isolate customer facilities from the CIPCO system, customers with three-phase service shall provide a three-phase interrupting device with appropriate protective relays. These devices shall also be capable of interrupting the maximum available fault current at that location. Three-phase devices shall interrupt all three phases simultaneously, and shall have a separate tripping control source independent of the AC source (i.e., tripping control fed from a DC battery and charger).

The interrupting device shall be located within the customer's facility in accordance with applicable codes. If specific site issues require that the interrupting device be located within a CIPCO facility, any wiring, installation, testing and maintenance of this device shall be accomplished by CIPCO personnel at the customer's expense.

5.9 Transformer

CIPCO may require, at the customer's expense, a dedicated transformer or transformers to serve the customer's facilities. Since transformer connections and configuration can significantly impact CIPCO electric system operation, CIPCO shall review and approve the configuration of any customer-owned interconnection transformer(s). This includes, but is not limited to, transformer connection configuration (delta, wye) and grounding method (solid ground, ungrounded, impedance grounded...). It is the customer's responsibility to receive written approval from CIPCO prior to purchasing any interconnection transformer(s).

5.10 Disconnection Means

The customer shall provide a disconnecting device for use by CIPCO as a means of electrically isolating the CIPCO system from the interconnecting facilities and to establish working clearances for maintenance and repair work in accordance with CIPCO safety rules. This disconnecting device may be located at the point of interconnection between the customer and CIPCO's electric system. Depending on system configuration and application, CIPCO may require that the disconnecting device have load break capability.

The disconnecting device shall be physically located for ease of access by CIPCO personnel. Access shall be available at all times for CIPCO personnel. The type of disconnecting device must allow for visual indication of the contact's position. A circuit breaker alone is not sufficient, as it does not allow visual indication of contact position. The disconnecting device's operating handle shall be lockable only in the open position with a standard CIPCO padlock. All devices and their locations are subject to approval by CIPCO.

CIPCO reserves the right to open the disconnecting device and lock it in the open position. Conditions in which this may occur include but are not limited to:

- CIPCO personnel and/or public safety is threatened,
- Repair or maintenance of CIPCO facilities,
- Inspection of customer's facilities and protective equipment reveals a hazardous situation,
- Lack of customer maintenance or maintenance records,
- Interconnecting facilities interfere with other CIPCO customers and/or the CIPCO electric system as outlined in these requirements.

5.11 Communications

The customer shall employ qualified operators for the interconnected facilities and for coordinating operations with CIPCO. The customer shall provide CIPCO with contact numbers for the interconnected facilities, with at least one contact number designated as available 24 hours a day. The customer shall notify CIPCO of any operational constraint, including production schedule estimates (as applicable).

5.12 Routine Maintenance and Emergency Repairs

CIPCO performs routine maintenance and inspections of its, substation and transmission facilities. The coordination of the maintenance of these facilities takes into account numerous factors, including but not limited to the capability to serve load, safety, customer requirements and economics. CIPCO will use reasonable efforts to schedule planned inspection and maintenance to mutually agreed to times that are designated to have minimal disruption on the operation of the interconnected facilities.

CIPCO performs most routine maintenance during normal working hours. The customer may request that this maintenance occur outside of normal working hours or meet an expedited schedule. The customer agrees to

reimburse CIPCO for any incremental costs for meeting special schedule requirements.

Under Emergency conditions the interconnected facilities may be adjusted to a safe operating level, including disconnection. CIPCO will take all prudent measures to return the electric delivery system to a normal operating state. CIPCO will not reimburse the customer for any costs associated with an unexpected shutdown during Emergency conditions.

5.13 Performance Criteria

All applicable performance requirements must be met for an interconnection. These requirements include, but are not necessarily limited to, CIPCO Planning Criteria, NERC Planning and Operating Standards, Mid-Continent Area Power Pool Guides, and Midwest Reliability Organization Guides. System performance will be assessed through transmission system power flow, stability, and short circuit analysis.

6.0 Protection Requirements

CIPCO requires adequate interconnection protection to separate interconnected facilities from the CIPCO electric system. The purpose of this equipment is to detect customer energization of a CIPCO circuit that has been deenergized or detect a fault or abnormal condition on the CIPCO electric system that requires separation of the customer's facilities.

6.1 Customer Protective Equipment

The customer shall provide all required interconnection protective equipment to achieve the purposes of Section 5.0. This equipment shall be approved by CIPCO and provide the protective functions specified within this guide. This equipment shall be located within the customer's facility. If specific site issues require the equipment to be located within a CIPCO facility, any wiring, installation, testing and maintenance of this equipment shall be accomplished by CIPCO personnel at the customer's expense.

Note that while the general purpose protection of the interconnection between CIPCO and the customer is provided for within this Section 6.0, it is the responsibility of the customer to provide protection for their own equipment. These protection requirements are only guidelines; final requirements will be established during the engineering process.

6.2 Ownership of Facilities

CIPCO may, at its sole discretion, assume ownership of all interconnection facilities greater than 100 kV. For interconnections at voltages less than 100 kV, CIPCO ownership will generally start at, but not include, the transformer high-side disconnect switch unless otherwise agreed to by CIPCO.

6.3 Requirements for Interconnection

Output contacts of any Customer protective equipment relays installed shall directly energize the trip coil of the customer's breaker or an intermediate auxiliary tripping relay which directly energizes the breaker trip coil. The relaying system shall have a reliable source of power independent from the AC system (DC battery and charger) to assure proper operation of the protection scheme. The protective relays shall be utility grade devices as defined in ANSI/IEEE Standard C37.90, "Relays and Relay Systems Associated with Electric Power Apparatus."

All relays shall have appropriate test switches (ABB type FT-1 preferred) to allow testing the operation of the relay without unwiring or disassembling the relay. Relay settings shall be reviewed and approved by the CIPCO System Protection Department. The relays shall be grouped in dedicated panels or cabinets accessible to CIPCO personnel.

Voltage transformers installed on the primary side of the transformer connected phase to ground are required for some of the protective functions. A primary fused cutout and secondary fused safety switch are required to prevent accidental backfeed from wound-potential transformers. Current transformers shall have shorting terminal blocks as necessary for metering and relaying.

CIPCO may require a communications channel be installed as part of the relay protection scheme. This communications channel may be a leased telephone circuit, power line carrier, CIPCO owned pilot wire, microwave, or other means determined and/or approved by CIPCO. This communication circuit and associated communication equipment, at both the customer and CIPCO facilities, shall be installed at the customer's expense.

The required protective functions are dependent on the type interconnection transformer connection utilized for a particular installation.

CIPCO may require a line breaker at each line terminal where customer is connected at 100 kV or above. A ring bus will be required for any interconnections connected to the CIPCO 345 kV system regardless of size.

A ring bus may also be required at sites below 345 kV for the following reasons:

1. If, due to projected power flows, CIPCO cannot switch out its interconnecting line sections for maintenance without requiring an outage of the Customer.
2. If the three-terminal line created by the interconnection will result in over tripping of adjacent lines.

CIPCO will not allow a ring bus with more than 5 breakers. Addition of the sixth breaker will require a breaker-and-a-half design.

7.0 Commission, Testing, and Maintenance Requirements

Once the customer's equipment has been installed and functionally tested by the customer, CIPCO shall witness final operational tests of the interconnection relay system. These tests will consist of verifying the relays have the correct voltages and currents, as well as function in the manner intended. CIPCO shall not be responsible for verifying any control or signal wiring not directly related to the interconnection relay. The customer is responsible for all relay settings, testing and calculations needed for protection of its equipment.

CIPCO reserves the right to verify on demand the calibration of all protective equipment including relays, interrupting devices, etc., at the inter-tie connection. Verification may include the tripping of the inter-tie interrupting device by the protective relays. After proper operation of the equipment is demonstrated, CIPCO may request that a protective seal be placed on relaying equipment to prevent unauthorized tampering.

For installations where the relays and inter-tie interrupting device(s) are not installed within a CIPCO facility, the customer shall be responsible for the maintenance and testing of this equipment. The customer shall not exceed CIPCO recommended maintenance intervals. Provisions shall be made for CIPCO to have access to this equipment for inspection, testing and control. Maintenance documentation and test reports shall be furnished to CIPCO.

For installations where the relays and inter-tie interrupting device(s) are installed within a CIPCO facility, CIPCO shall maintain this equipment and bill the customer for maintenance cost. CIPCO has the option of using its own personnel or contracting this maintenance work to others.

The customer has sole responsibility for the routine maintenance of their facilities and protective equipment. The customer is encouraged to contact the CIPCO Engineering Department for recommendations for maintenance practices and testing intervals of their protective equipment. Complete maintenance records shall be maintained by the customer and be made available upon request for CIPCO review. Failure of the customer to provide proper routine maintenance may result in decreased system reliability to the CIPCO system and may result in disconnection at CIPCO's sole discretion.

8.0 Metering and Telemetry Requirements

The customer shall allow CIPCO to install on the Customer premises the equipment necessary to measure loads or any part thereof, and to collect and obtain any other data necessary to determine operating characteristics of such installation. Metering is to be installed according to applicable tariff and/or contract.

CIPCO will furnish meters and instrument transformers. The customer shall furnish meter sockets and a suitable metering mounting location. The customer shall be responsible for the labor/contractor cost of the installation and the associated material costs of the metering equipment.

CIPCO shall determine, on a case by case basis, if the interconnected facilities necessitate the continuous telemetry of status, voltage, and power quantities to the applicable System Operations Center. Specific telemetry requirements may be necessary. If deemed necessary, the customer shall furnish and install at its expense the communication channel and the necessary CIPCO approved telemetering equipment and associated devices.

9.0 Costs Incurred

The customer shall agree to install, operate and maintain its interconnected facilities without cost to CIPCO. It shall also be the customer's responsibility to install, operate and maintain its system safely.

The customer shall be responsible for any costs required to upgrade the CIPCO electric delivery system to permit interconnected operation. This may include, but is not limited to, upgrade of transformer insulation levels, installation of upgraded lightning arresters, line upgrades, and/or the replacement of circuit breakers due to increased fault current levels. It shall also include all engineering costs associated with equipment additions and/or replacements. Any equipment to be installed on CIPCO property shall be accomplished by CIPCO personnel, or personnel under contract to CIPCO, at the customer's expense.

