

Bulletin 84-1-11
Interconnection of electric power production sources
Rules 2-010, 64-078, 64-110, 84-004, 84-008, 84-018, 84-022 and 84-030

Issued May 2018
 Supersedes Bulletin 84-1-10

Scope

- 1) Requirements for customer owned generating systems
- 2) Single-phase inverters connected to three-phase system
- 3) Neutral conductor requirements for connection to a supply authority
- 4) “Utility-interconnected” requirements for connection to a supply authority

(1) Requirements for customer owned generating systems

Customer owned (non-utility) generating systems are subject to inspection in accordance with the Ontario Electrical Safety Code (OESC). This Bulletin provides additional information and clarification to the requirements of Section 84, Interconnection of electric power production sources.

Additional information can also be found in:

- (1) ESA-SPEC-004 Electrical guidelines for inverter-based micro-generating facility (10 kW and smaller);
- (2) ESA-SPEC-005 Process Guideline for the Installation of Parallel Generating Systems greater than 10 kW;
- (3) CSA standard C22.2 No. 257 Interconnecting inverter-based micro-distributed resource to distribution systems;
- (4) CSA standard C22.3 No. 9 Interconnection of distributed resources and electricity supply systems; and
- (5) ESA Bulletin 64-1-* “Connection of utility-interactive inverters on the load side of service disconnecting means”.

General

Rule 84-002 requires that a supply authority be consulted as part of planning an interconnected generation system.

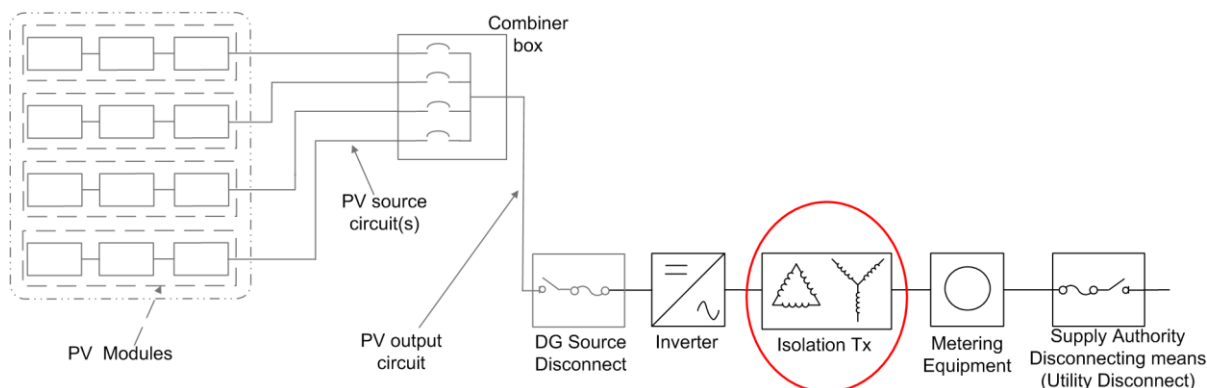
Protection and Control

Protection and control of customer owned generating systems is required in accordance with Section 84.

For electrical power production sources installations utilizing inverter technology and directly connected to the supply authority, an inverter that is approved and marked “UTILITY INTERCONNECTED” is acceptable as meeting the protection and control requirements of Section 84.

Where inverters are connected to the supply authority system through a customer-owned isolation transformer, the designer/installer shall provide proof to the area electrical inspector that the inverter will shut down upon loss of any one phase on the supply authority side of the isolation transformer, Rules 84-008 and 64-078. The secondary of the isolation transformer often continues to deliver similar operating voltage in an open delta configuration. An example of one of the configurations where the inverter may not shut down upon loss of any one phase on the supply authority side is WYE-DELTA, with the delta facing the inverter, as shown in Diagram B1 (may not be limited to only that configuration).

Diagram B1 – Solar PV system connected to a supply authority via an isolation Tx



The Electrical Safety Authority (ESA) strongly recommends designers of interconnected generation systems utilizing an isolation transformer consult with a transformer manufacturer and review the supply authority and customer configurations/requirements prior to specifying the transformer for a project.

For generating systems based on non-inverter technology or utilizing an approved stand-alone inverter, the protection and control required by Section 84 shall be coordinated with and acceptable to the supply authority, prior to connection authorization from ESA. The owner or owner's agent shall provide verification to ESA that the installed protection and control is acceptable to the supply authority.

For this reason, the supply authority (i.e. Local Distribution Company) must be involved with customer owned, electric power production installations.

Temporary connections may be authorized to permit calibration and coordination prior to generation.

Plan Review

Electrical work on any electrical installation shall not commence until plans have been submitted and examined by the inspection department where the electrical installation involves any installation involving consumer-owned, electric-power-generating equipment with a rating in excess of 10 kW (Micro size), as defined by the OEB, and operating in parallel with a supply authority system.

(2) Single-phase inverters connected to three-phase system

Question 1

Are single-phase inverters, for solar and other interactive renewable energy systems, permitted to be connected to a three-phase system?

Answer 1

No, unless the following are satisfied (as per Rule 64-110):

- The inverters used are certified as "UTILITY INTERCONNECTED" and approved for use in three-phase systems;
- The single-phase inverters are connected to provide three-phase balanced output;
- The installation complies with requirements of Rules 84-008 and 84-018;
- Confirmation that the installation is acceptable to the supply authority, and
- The installation meets the inverter manufacturer's requirements.

Where permitted to be connected by the supply authority, the three-phase configured system shall be considered one generation source for the purpose of applying Rules 84-008 and 84-018, and shall meet the following requirements:

- Confirmation that Rule 84-008 is satisfied, by providing loss of supply authority voltage sensing (phase loss sensing) on all phases, such that upon loss of supply authority voltage on any one phase, the production source automatically disconnects all inverters simultaneously from the supply authority system; and
- Confirmation that Rule 84-018 is satisfied, by providing loss of voltage sensing (phase loss sensing) on all phases, such that upon loss of voltage in one or more of the electric power production source phases, the production source automatically disconnects all inverters simultaneously from the interconnected system.

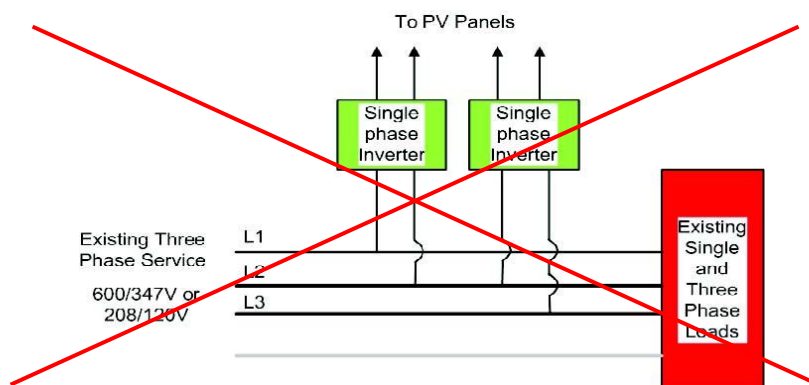
Question 2

Are one or two single-phase inverters certified as "UTILITY INTERCONNECTED" permitted to be connected to a three-phase supply authority system?

Answer 2

No. Rule 64-110 does not permit one or two single-phase inverters to be connected to three-phase system as the connection will not result in a three-phase balanced output. Diagram B2 provides an example where the installation of single phase inverters may not result in a balanced three phase output.

Diagram B2 – Single-phase inverters connected to a three-phase supply authority system



(3) Neutral conductor requirements for connection to a supply authority

Question 3

For an electrical power production source (generator) connected to a supply authority incorporating a neutral (grounded circuit conductor), does the OESC require a neutral output from the generating system to be connected to the supply authority system neutral?

Answer 3

No, unless:

- The generator used requires a neutral reference from the supply authority (Rule 2-034); or
- The supply authority specifies a neutral output (Rule 84-002).

Question 4

Where a transformer is used to change the voltage of the electrical power production source to match that of the supply authority, does the OESC require transformer output to have a neutral point for connection to the supply authority system neutral? (i.e.: 208 V solar inverter system connected to 347/600 V supply authority).

Answer 4

No, unless the supply authority requires a neutral output.

Rationale

Although the supply authority connected electrical power production source may also feed neutral connected loads within the facility, or load share, and a neutral connection to the revenue meter may also be required by the supply authority for metering purposes, the OESC does not mandate a neutral output.

Some supply authorities specify a neutral output from the interconnected electrical power production source which would require compliance based on Rule 84-002.

Some grid tie inverters require a neutral reference from the supply authority; this would require compliance based on Rule 2-034.

Some grid tie inverters can be configured to operate with or without a neutral output, (i.e. L1 and L2 only). Others, such as three-phase grid tie inverters, may require a neutral reference.

Supply authorities may also require a neutral output from the interconnected electrical power production source for metering purposes or for voltage stability.

(4) “Utility-interconnected” requirements for connection to a supply authority

Some products can operate in parallel with the LDC and are programmable to back-feed the supply authority. When these products are part of energy storage systems, they may be part of a system that is certified to the CAN/UL/ANSI/UL 9540 Energy Storage Systems and Equipment standard. The applicable requirements for supply authority interconnection are required as per CSA standard C22.2 No. 107.1 and UL standard UL 1741.

These products may not be, or do not include “transfer devices” that electrically isolate the system from the supply authority. Devices that operate in parallel with the supply authority are required to meet the applicable standards’ requirements for supply authority interconnection and be marked as “Utility Interconnected” or equivalent.

As part of the business process at ESA, inspectors are required to send a connection authorization to the supply authority indicating interconnected electrical power production sources with or without energy storage such as batteries.

Examples of systems that may operate in parallel with the supply authority:

1. Self-contained energy storage systems, see Photos B1

Photo B1 - Example of self-contained energy storage system and nameplate



2. Residential co-generation systems, see Photos B2

Photo B2 - Example of residential co-generation system and nameplate label



Supply authority interconnected installations are required to meet all Section 84 requirements including:
- Installation of a disconnecting means (Rule 84-022);

- Installation of a warning notice that indicate more than one source and diagram of the interconnected system (Rule 84-030).