Ontario Energy Board | Commission de l'énergie de l'Ontario

EMAIL & WEB POSTING

DATE: November 26, 2020

TO: **All Licensed Electricity Distributors**
All Other Interested Parties

RE: **EB-2019-0207 Guidance - Protection Philosophy for DER Connections**

This letter provides information for distributors to aid discussions with prospective distributed energy resource (DER) proponents in relation to a sample protection philosophy for use with connection projects intended for self-supply that use non-exporting, inverter-based technologies.

In August 2019, the Ontario Energy Board (OEB) initiated a review of its requirements in regard to the connection of DERs by licensed electricity distributors (DER Connections Review[1]). The purpose of this initiative has been to identify any barriers to the connection of DERs, and where appropriate to standardize and improve the connection process. OEB staff convened a Working Group to identify changes that could quickly improve the consistency and clarity of the process and lower costs for both the proponents and the industry. The Working Group's membership represents a broad range of distributors, consumer groups, firms that are working on DER projects, and groups advocating for generation technologies and environmental concerns.

The Working Group identified a concern with the lack of clear technical requirements for connections which can lead to insufficient information from proponents in a connection application submitted to a distributor. The Distribution System Code (Code) specifies the responsibilities of licensed distributors regarding connection of generators. Section 6.2.11 of the Code specifies that a distributor shall require a person, upon making an application for the connection of a generation facility to the distributor's distribution system, to provide the following information: a preliminary design of the proposed interface protection; and all necessary technical information required by the distributor to complete the connection impact assessment. The Working Group suggested that project proponents would be able to submit better applications if there were a common

1 EB-2019-0207: DER Connections Review

understanding of the requirements that may be necessary for the protection interface between the proposed DER and the distribution system.

The Working Group adapted a protection philosophy that was provided in the 2019 Ontario Energy Association report entitled “Report of the OEA Interconnection Working Group” to illustrate an example of good utility practice regarding the kinds of protection interface distributors typically require. The result of the Working Groups’ effort, in Attachment A, is a sample protection philosophy that may be shared with a customer or contractors working on their behalf seeking connection for a non-exporting, inverter-based DER for load displacement. This sample protection philosophy is not a substitute for the technical requirements outlined in Appendix F.2 of the Code, but rather an aid to improve information being submitted for the connection assessment process described in Appendix F.1 of the Code.

The purpose of this letter is to make available to distributors the protection philosophy developed by the Working Group so that it can be shared with customers and DER proponents as a reference to aid in improving the quality of their connection applications. OEB staff believes that the protection philosophy can be of assistance to those distributors that have had few or no connections of DERs to their system. Based on the input from the Working Group, the use of a common approach like this will likely reduce costs for both distributors and their customers and facilitate responses to DER connection inquiries from customers.

OEB staff expects that the work of the Working Group in reviewing technical and process requirements will continue over the next several months and may lead to further information or guidance for distributors and DER providers. However, given the Working Group’s view that there is value to the sector in making this sample protection philosophy available, OEB staff is providing it to the sector. As additional technical matters are addressed and recommendations made by the Working Group, OEB staff may issue guidance to the industry.

Any enquiries regarding this letter should be directed to the OEB’s Industry Relations email address at industry.relations@oeb.ca.

Yours truly,

Original Signed By

Brian Hewson,
Vice President, Consumer Protection & Industry Performance

Attachment

ATTACHMENT

Sample Protection Philosophy for Non-exporting Inverter-based Sources

Ontario Energy Board | Commission de l'énergie de l'Ontario

Protection for Distributed Energy Resource Proponents Applying for Connection

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This document is a summary of a sample protection philosophy for non-exporting, inverter-based (NE/I) connections including storage, solar, and wind. The OEB intends it as a guide for proponents regarding the kinds of protections, and particularly the categories of protections, that distributors will require for connection.

This is one example of a protection philosophy that would meeting the interconnection standards[1]. Other philosophies may also meet the standards. It provides guidance to a distributed energy resource (DER) proponent on good utility practice as it relates to protection requirements of non-exporting, inverter-based (NE/I) DERs. To form a protection scheme, all the elements for each category within any given protection philosophy are requirements.

This document is not an approval for connection. This information should help proponents file better and more complete applications for connection. A proponent will need to submit detailed protection settings after the utility has completed the impact assessment of the submitted connection application.

The standards and certification testing referenced in this document should be read as referring to the current versions of these standards at time of reading.

Sample Protection Philosophy for Non-exporting Inverter-based Sources

The protection system of the connection will be designed to:

- Detect internal faults with the generator facility, downstream of the Point of Common Coupling (PCC), and automatically disconnect the NE/I source
- Detect external faults on the utility feeder and automatically disconnect the NE/I source
- Detect islanding conditions and disconnect the NE/I source
- Detect export of power from the NE/I source to the utility feeder and automatically disconnect the NE/I source

[1] The contents of this document, although intended as guidance, conform to the interconnection and approval requirements prevalent at the time of its issuance. At all times, the current versions of relevant codes and standards govern.

Internal Faults Within the Generator Facility

The following protections are in place to protect against internal faults resulting from the NE/I source:

- **Multi-Function Relay-**At the PCC, a multi-function relay will be installed to monitor internal faults resulting from the NE/I source. The 52 Trip Breaker will trip if it detects the following:
  - 25 - Synchronization Check
  - 27 - Undervoltage
  - 59 - Overvoltage
  - 81O/U - Under and Over Frequency
  - ID -Active Anti-Islanding

- **Inverter Breakers** - Each inverter is equipped with an AC breaker at the output of the inverter providing additional overcurrent protection

- **Facility Overcurrent Protection** - All circuits within the facility are protected from both phase-to-phase and phase-to-ground faults by appropriate overcurrent protection devices. Fuses are sized to clear under fault conditions within the generator facility

External Phase and Ground Faults in the Distribution System

The following protections are in place to protect against external faults resulting from the utility feeder:

- **Multi-Function Relay** - At the main utility service, prior to the first facility load, a multi-function relay will be installed to monitor faults from the utility feeder. The 52 Trip Breaker at the NE/I source PCC will trip under the following faults:
  - 27 - Undervoltage
  - 32R- Reverse Power
  - 50/51- Overcurrent
  - 59 - Overvoltage
  - 81O/U - Under and Over Frequency
  - 67 - Directional
- **Inverter Protection:** The inverters proposed for this project are certified to UL 1741, IEEE 1547, CSA C22.2 107.1-01 standards[2] and will behave accordingly.

2 All references to standards or testing certifications should be read as the most current version.

Anti-Islanding

- The Energy Resource Facility will operate in a grid following mode and will not operate islanded.
- **Anti-Islanding Inverters** -The NE/I source inverters contain both passive and active anti- islanding protection as required by IEEE 1547 and UL1741 SA. If the utility normal power supply is interrupted, the inverters detect the loss of power and disconnect.

Reverse Power

- **Reverse Power Protection** - In addition to the multi-function relay at the utility supply monitoring reverse power (32R), the load is continually monitored to ensure the NE/I source discharge is below the consumption of the facility. This additionally protects against power injection to the utility grid.

Directional Overcurrent

- **Directional overcurrent protection** - Directional overcurrent relays are normally used on incoming line circuit breakers on buses which have two or more sources. They are connected to trip an incoming line breaker for fault current flow back into the source, so that a fault on one source is not fed by the other sources.

Special Comment Regarding Inverter Based Generation

The inverters specified for this project have a limited fault current contribution.

- Because inverters are current-limited devices, unlike rotating generators, the fault current is very close to the maximum output current, limiting the fault current in the system to 120% -140% of FLA.

Table 1: Protection Summary Matrix

Description	IEEE Device	Internal Faults	External Faults	Anti-Islanding	Reverse Power
Over-Voltage	59	**X**	**X**	**X**	
Under-Voltage	27	**X**	**X**	**X**	
Over-Frequency	81O	**X**	**X**	**X**	
Under-Frequency	81U	**X**	**X**	**X**	
Instantaneous Over-Current Phase	50	**X**	**X**		
Timed Over-Current Phase	51	**X**	**X**		
Reverse Power	32R			**X**	**X**
Directional	67	**X**	**X**		
Active Anti-Islanding	IEEE 1547			**X**	

Table 2: Protection Elements

Protection Element Function	Device#	Feeder Protection Relay/Shunt Trip	IEEE 1741 SA Inverter
Over-Voltage	59	X	Y
Under-Voltage	27	X	Y
Over-Frequency	81O	X	Y
Under-Frequency	81U	X	Y
Synchronization Check	25	X	Y
Reverse Power	32R	X	
Overcurrent	50/51	X	Y
Directional	67	X	
Active Anti-islanding	ID		X

X = Primary Y = Secondary