



TABLE OF CONTENTS

TABLE OF CONTENTS	2
1 BACKGROUND AND PURPOSE.....	3
2 NET-METERING STATUS AND TIME-OF-USE PROGRAM.....	3
3 EXCLUSIONS	3
4 INTERCONNECTION REVIEWS	4
5 PPL EU ENERGY STORAGE CONFIGURATIONS.....	4
5.1 STANDBY (BACKUP) ENERGY STORAGE AS PERMITTED BY NEC 702 (1A).....	5
5.2 ENERGY STORAGE OPERATING IN PARALLEL WITHOUT GENERATION (1B)	6
5.3 ENERGY STORAGE OPERATING IN PARALLEL WITH GENERATION (1C).....	7
6 INADVERTENT EXPORT	7
7 DIAGRAMS	9
8 APPENDIX.....	12
8.1 ABBREVIATIONS.....	12
9 REVISION HISTORY	12



1 BACKGROUND AND PURPOSE

PPL Electric has developed guidelines and acceptable energy storage system (ESS) configurations to be installed in PPL Electric's service territory to ensure safe and reliable service for all distribution customers.

This document provides the guidelines for the interconnection of ESSs installed in various configurations on the distribution system:

- 1a) Provide standby (back-up power) during power outages
- 1b) Parallel operation with the utility without on-site generation
- 1c) Parallel operation with the utility in conjunction with on-site generation

This PPL Electric Energy Storage Interconnection Policy and Guidance Document will be modified as needed to reflect the Company's interconnection policies and standards, tariff rules as well as state and Pennsylvania's Public Utility Commission (PUC) regulations.

2 NET-METERING STATUS

At the time of the publication of this policy and guidance document, PPL Electric's Tariff and the Alternative Energy Portfolio Standards (AEPS) Act of 2004, as enforced by the Pennsylvania Public Utilities Commission (PUC), does not qualify ESSs for net-metering.

3 EXCLUSIONS

This document applies to energy storage interconnections in PPL Electric's service territory that operate within the jurisdiction of PPL Electric's tariff. This document does not apply to energy storage interconnections that are operating within a Wholesale Market Participation Agreement (WMPA) between PJM, PPL Electric, and the customer.



4 INTERCONNECTION REVIEWS

Customers must submit an interconnection application for their prospective generation and/or energy storage Distributed Energy Resource (DER). An interconnection application consists of an interconnection review to ensure system safety and reliability as well as compliance with technical and operational requirements. Customers that intend to install an ESS in parallel with the PPL Electric grid are required to sign an Interconnection Agreement (IA).

When an ESS is installed alongside a generation system within the same application, such as solar plus storage, they will be reviewed simultaneously. For inverter-based generation, the interconnection review will be based solely on the rated capacity of the inverter directly connected to the generation system, not the combined capacity of the inverter-based generation and the ESS. At the time of publication of this document, the storage nameplate capacity will not be considered during interconnection review as ESSs are ineligible for net-metering and are prohibited from exporting energy to the grid. The non-export operating mode is a requirement and settings shall be provided at the time of application for ESSs operating in parallel with the distribution system. Any subsequent changes to the ESS's operating mode shall be communicated to PPL Electric and is subject to utility approval.

New interconnection applications must be submitted to modify or retrofit existing ESSs.

5 PPL ELECTRIC ENERGY STORAGE CONFIGURATIONS

The following are the only Energy Storage System (ESS) configurations permitted by PPL Electric's Tariff:

- 1a) Standby (backup) ESS without Generation
- 1b) ESS Operating in Parallel without Generation
- 1c) ESS Operating in Parallel with Generation

An Interconnection Agreement (IA) is required for any ESSs that are interconnected with the utility grid. ESSs that have no electrical connection to a PPL Electric system do not require an interconnection agreement. Consult your local Authority Having Jurisdiction (AHJ) for more information.

Each configuration is further elaborated in the following sections. Illustrations of the various configurations are shown in Section 7. The customer may have additional features at their facility that are not reflected in the diagrams, but the distinguishing operational features of any ESS installed by a customer shall be consistent with one of the following configurations. The functionality required for each configuration may be controlled by the inverter or control system programming. All configurations require that the customer/contractor utilize all necessary equipment and control system settings to ensure that



the ESS does not export to the grid. Verifiable proof of equipment installation and control system settings are required to ensure compliance with non-export of the ESS to the grid¹.

5.1 STANDBY (BACKUP) ENERGY STORAGE AS PERMITTED BY NEC 702 (1A)

Energy storage systems installed in this configuration with the grid do not need an interconnection agreement. This configuration is intended to supply power, automatically or manually, to the customer's facility in the event of a loss of power from the utility. This configuration does not qualify for net-metering and exporting energy to the grid using the ESS is strictly prohibited. This configuration can be charged by on-site generation or from the utility but may only discharge power to the customer's facility when electrically isolated from the PPL Electric grid. This configuration is typically used to power critical load panel(s), normally powered from the main panel, which can instead be powered by the standby (backup) ESS when there is a loss of power from the utility.

This configuration requires that the customer/contractor install an automatic or manual open transition (break-before-make) switch. This device will ensure that the ESS is able to be charged while connected to the utility and can only be discharged when a loss of power from the utility is detected.

An automatic transition switch is usually preferred to enable the automatic operation of the ESS when a loss of power from the utility is detected. National Electric Code (NEC) Article 702 addresses the transition device requirements for optional standby (backup) systems which this configuration must comply with. Manual Interlock kits and closed transition (make-before-break) switches are prohibited from being used for standby ESS applications. [PPL EU approved open transition automatic switches](#) can be found on the REMSI website. If a switch that does not appear on this list is to be used, the customer/contractor must provide the switch's model specification sheet for review and approval when submitting the interconnection application. Manual open transition switches are approved for use by PPL EU; however, an approved list of models is not maintained.

If the conditions for this energy storage configuration are met, PPL Electric recommends the following:

- Provide PPL EU with a one-line diagram
- Provide PPL EU with Electrical Inspection Cut-in Card indicating approval

To ensure the safety and reliability of the distribution system, PPL EU reserves the right to conduct an inspection to verify compliance. PPL Electric reserves the right to verify non-export status of ESSs by any means available to the utility.

¹ Verifiable proof should be provided when the interconnection application is submitted for review and approval. Verifiable proof can be in the form of one-line diagrams, equipment specification sheets and inverter operating mode and settings.



5.2 ENERGY STORAGE OPERATING IN PARALLEL WITHOUT GENERATION (1B)

This configuration allows the ESS to operate in parallel with the utility as a demand side management (DSM) resource but does not allow the ESS to export energy to the grid. This configuration does not qualify for net-metering and exporting energy to the grid using the ESS is strictly prohibited. Subject to the Inadvertent provisions below, the customer must provide the control system settings as part of the interconnection application to ensure that the ESS does not export to the grid. This configuration may be charged from the utility and discharged to power the customer's facility while operating in parallel with the utility.

This configuration requires that the customer/contractor utilize all necessary equipment and control system settings to ensure that the ESS does not export to the grid. All inverters and ESSs must be Institute of Electrical and Electronics Engineers (IEEE) 1547 and Underwriters Laboratory (UL) 1741 SA certified as applicable.

To ensure safe interruption of the ESS, an AC disconnect switch must be installed between the load side of the utility billing meter and the ESS inverter to facilitate the immediate isolation of the system from the electric grid during emergencies.

If the conditions for this energy storage configuration are met, the following items must be provided to PPL EU prior to operating the system:

- Verifiable proof of equipment or control system settings to prevent net metering ineligible export from ESSs
- Approved Electrical Inspection Cut-in Card
- Signed Interconnection Agreement and Certificate of Completion

To ensure the safety and reliability of the distribution system, PPL EU reserves the right to conduct an inspection to verify compliance. PPL Electric reserves the right to verify non-export status of ESSs by any means available to the utility.



5.3 ENERGY STORAGE OPERATING IN PARALLEL WITH GENERATION (1C)

This configuration allows the combined generation and ESSs to operate in parallel with the utility as a DSM resource but does not allow the ESS to export energy to the grid. This design provides for the following:

- Allows the ESS to be charged by either the utility or the generator
- Allows the ESS to be discharged while operating in parallel with the utility.
- Applies only to systems that combine both generation and energy storage.
 - Types of generation include standby generation (i.e., backup diesel), self-generation² and net-metered generation³ such as solar photovoltaic.

Energy exported from the ESS does not qualify for net-metering and exporting energy to the grid using the ESS is strictly prohibited. PPL EU requires the customer/contractor to utilize all necessary equipment and control system settings to ensure that the ESS does not export to the grid.

Subject to the Inadvertent Export provisions below, the customer must provide the control system settings as part of the interconnection review.

All inverters and ESSs must adhere to the most recent versions of IEEE 1547 and UL 1741 as applicable.

To ensure safe interruption of the ESS, an AC disconnect switch must be installed in between the load side utility meter and the DER/ESS inverter to facilitate the immediate isolation of the ESS and/or DER from the electric grid in case of emergencies.

If the conditions for this energy storage configuration are met, the following items must be provided to PPL EU prior to operating the system:

- Verifiable proof of equipment or control system settings to prevent net metering ineligible export from ESSs
- Approved Electrical Inspection Cut-in Card
- Signed Interconnection Agreement and Certificate of Completion

To ensure the safety and reliability of the distribution system, PPL Electric reserves the right to conduct an inspection to verify compliance at any time. PPL Electric reserves the right to verify non-export status of ESSs by any means available to the utility.

² Self-generation is generation supplying some or all of the customer's demand from onsite generation with no intent to export or to be compensated for export.

³ Net-metered generation is generation at the customer's facility that is permitted to export to the grid and to be compensated for that export energy. Net-metered generation includes renewable generation that has been approved for net-metering.



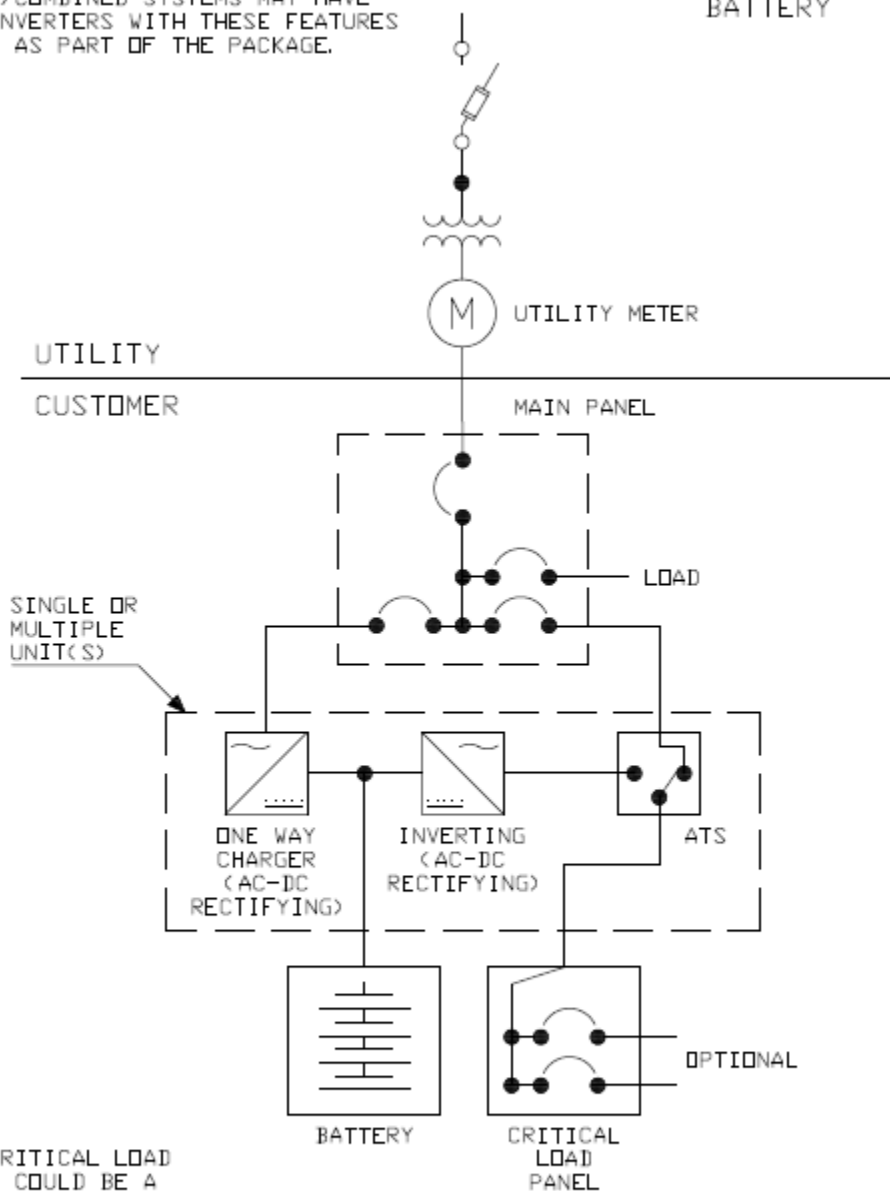
6 INADVERTENT EXPORT

The customer is responsible for ensuring that the ESS is inhibited from exporting energy to the grid. Inadvertent export is defined as the unauthorized export of real power to the grid from an export ineligible power source, such as an ESS, operating in parallel with the utility. The customer/contractor is required to use any combination of equipment and control system settings such as transfer relays, energy management systems or any other customer facility hardware or software to prevent the ESS from exporting to the grid.

7 DIAGRAMS

FIGURE ILLUSTRATES REPRESENTATIVE ENERGY STORAGE CONFIGURATIONS. PACKAGED/COMBINED SYSTEMS MAY HAVE HYBRID INVERTERS WITH THESE FEATURES PROVIDED AS PART OF THE PACKAGE.

#1A
STANDBY
BATTERY

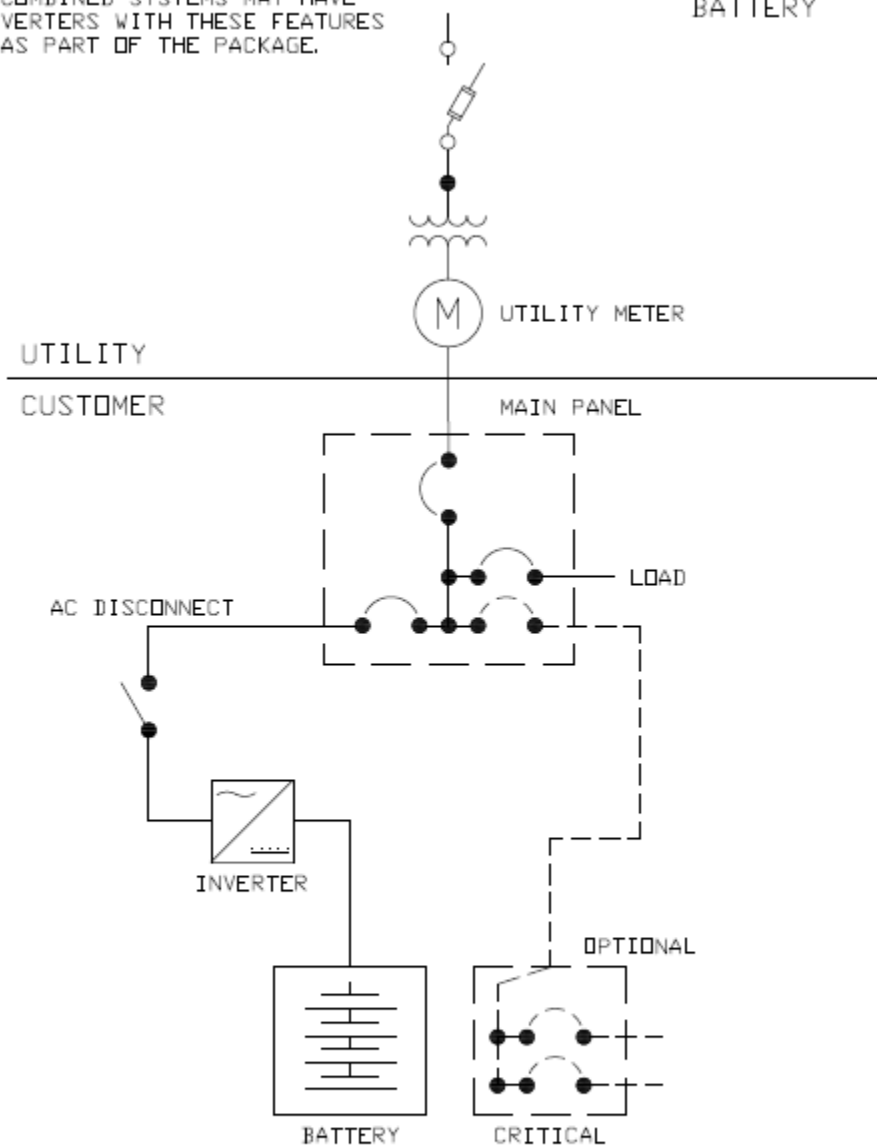


NOTES:

1. THE CRITICAL LOAD PANEL COULD BE A SEPARATE LOAD PANEL AS SHOWN IN THE DIAGRAM OR COULD BE THE ENTIRE MAIN PANEL
2. BATTERY NOT ALLOWED TO PARALLEL WITH OR EXPORT TO GRID

FIGURE ILLUSTRATES REPRESENTATIVE ENERGY STORAGE CONFIGURATIONS. PACKAGED/COMBINED SYSTEMS MAY HAVE HYBRID INVERTERS WITH THESE FEATURES PROVIDED AS PART OF THE PACKAGE.

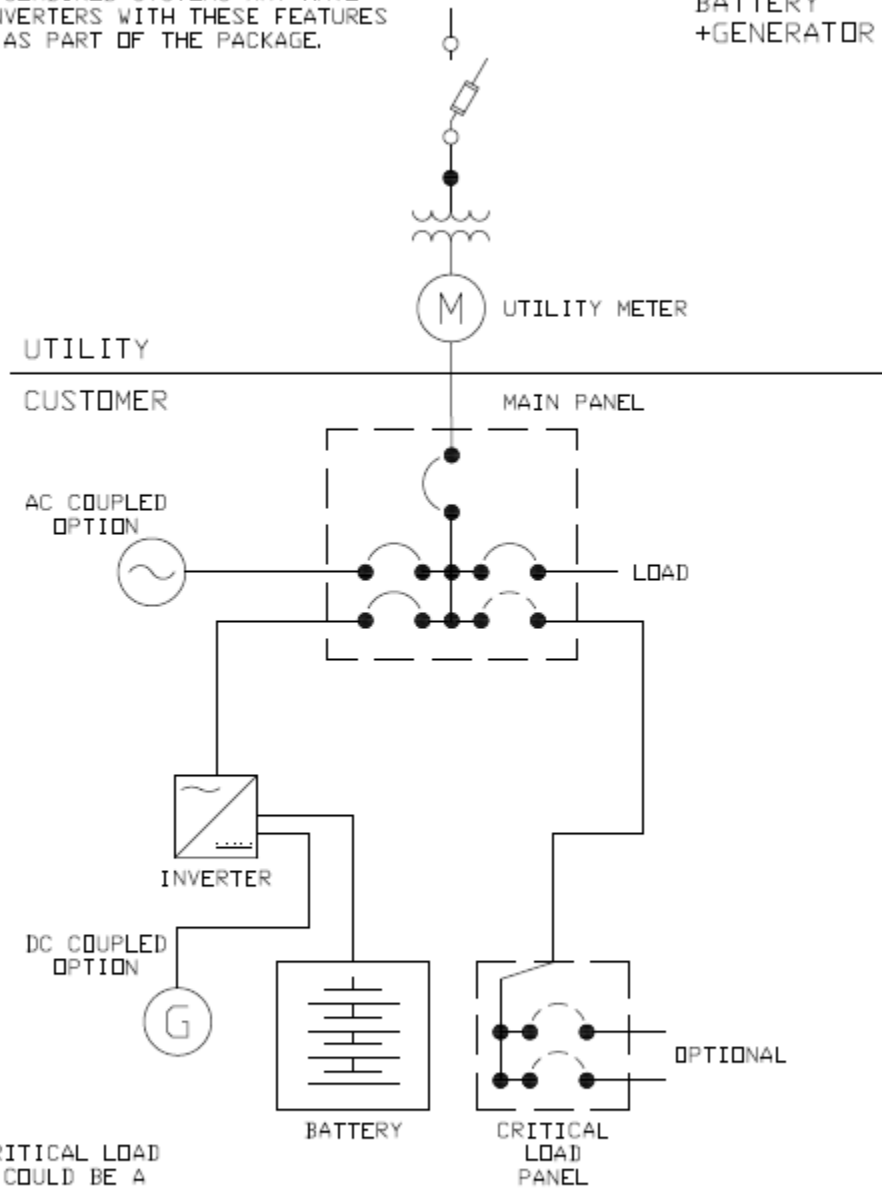
#1B
PARALLEL
BATTERY



- NOTES:
1. THE CRITICAL LOAD PANEL COULD BE A SEPARATE LOAD PANEL AS SHOWN IN THE DIAGRAM OR COULD BE THE ENTIRE MAIN PANEL
 2. BATTERY NOT ALLOWED TO PARALLEL WITH OR EXPORT TO GRID

FIGURE ILLUSTRATES REPRESENTATIVE ENERGY STORAGE CONFIGURATIONS. PACKAGED/COMBINED SYSTEMS MAY HAVE HYBRID INVERTERS WITH THESE FEATURES PROVIDED AS PART OF THE PACKAGE.

#1C
PARALLEL
BATTERY
+GENERATOR



- NOTES:
1. THE CRITICAL LOAD PANEL COULD BE A SEPARATE LOAD PANEL AS SHOWN IN THE DIAGRAM OR COULD BE THE ENTIRE MAIN PANEL
 2. BATTERY NOT ALLOWED TO PARALLEL WITH OR EXPORT TO GRID



8 APPENDIX

8.1 ABBREVIATIONS

The following defined acronyms and abbreviations are used in this document:

AHJ	Authority Having Jurisdiction
DER	Distributed Energy Resource
DSM	Demand-side Management
EDC	Electric Distribution Company
ESS	Energy Storage System
IEEE	Institute of Electrical and Electronics Engineers
IA	Interconnection Agreement
NEC	National Electric Code
PA PUC	Pennsylvania Public Utility Commission
PPL EU	PPL Electric Utilities
PUC	Public Utility Commission
REMSI	Rules for Electric Meter and Service Installations
TOU	Time-of-Use
UL	Underwriters Laboratory
WMPA	Wholesale Market Participation Agreement

9 REVISION HISTORY

Revision 0 01/01/2022	Initial Procedure Release
Prepared by:	Mohamad A. Kanbari Senior Engineer, Distribution Interconnection & Tariff Rules
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