



MARCH 2023

EV Grid to Charger

Industry segment update

ABB U.S. Electrification

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Document ID.:

Rev.:



Agenda

Designing G2C circuits

Installation considerations / qualifying questions

Trends

Utility Impact Examples

Q&A

Site Design Considerations

Site Design Philosophy

Dramatic Pivot

2017-2022 EV site desired functionality

- Remote metering for mains and in some cases feeders
- Remote open/reclose of mains/feeders
- Status of main/feeders
- SPD
- Space Heaters w/humidistat
- 12-16 week delivery standard, 4-6 week available

- 2023
- After Biden Infrastructure Bill
- NEVI – National Electric Vehicle Infrastructure
- Condo design philosophy, each power cabinet with safety switch - 6 handle rule

- Fast and inexpensive, modular construction, in customer inventory

NEC 2017 625.41 & 625.42 requirements

625.41 Overcurrent Protection. Overcurrent protection for feeders and branch circuits supplying equipment shall be sized for continuous duty and shall have a rating of not less than 125 percent of the maximum load of the equipment. Where non-continuous loads are supplied from the same feeder, the overcurrent device shall have a rating of not less than the sum of the noncontinuous loads plus 125 percent of the continuous loads.

625.42 Rating. The equipment shall have sufficient rating to supply the load served. Electric vehicle charging loads shall be considered to be continuous loads for the purposes of this article. Where an automatic load management system is used, the maximum equipment load on a service and feeder shall be the maximum load permitted by the automatic load management system.

ABB EV Charger Portfolio



Terra AC Destination	Terra DC Destination	Terra 24/54	Terra 94/124/184	Terra 360
3-22 kW	11-24kW	24-50 kW	94/124/184kW	360kW
1PH or 3PH input, 240VAC	19.5kW (peak)@ 208 VAC/1PH input 22.5kW (peak)@ 240 VAC 1PH or 3 PH input	480/277 VAC input	480/277 VAC input	480/277 VAC input
240VAC output	150-920 VDC output, current limited	150-920 VDC output, current limited	150-920 VDC output, current limited	150-920 VDC output, current limited
12-88A input	60A input	31/69A input	120/157/233A input	456A input
1.25 FLA for 80% rated feeder	1.25 FLA for 80% rated feeder	1.25 FLA for 80% rated feeder	1.25 FLA for 80% rated feeder	1.25 FLA for 80% rated feeder

4 kA withstand

65 kA withstand

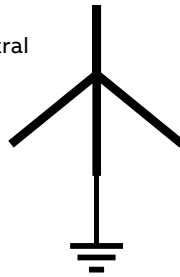
65 kA withstand

65 kA withstand

208/240 Facility Power Distribution Options

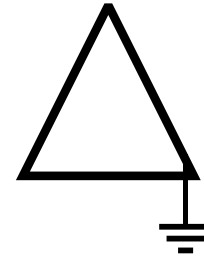
208/3/60

Wye configuration,
solidly grounded neutral

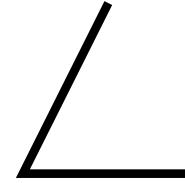


240/3/60

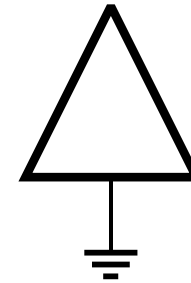
Delta configuration,
solidly corner grounded



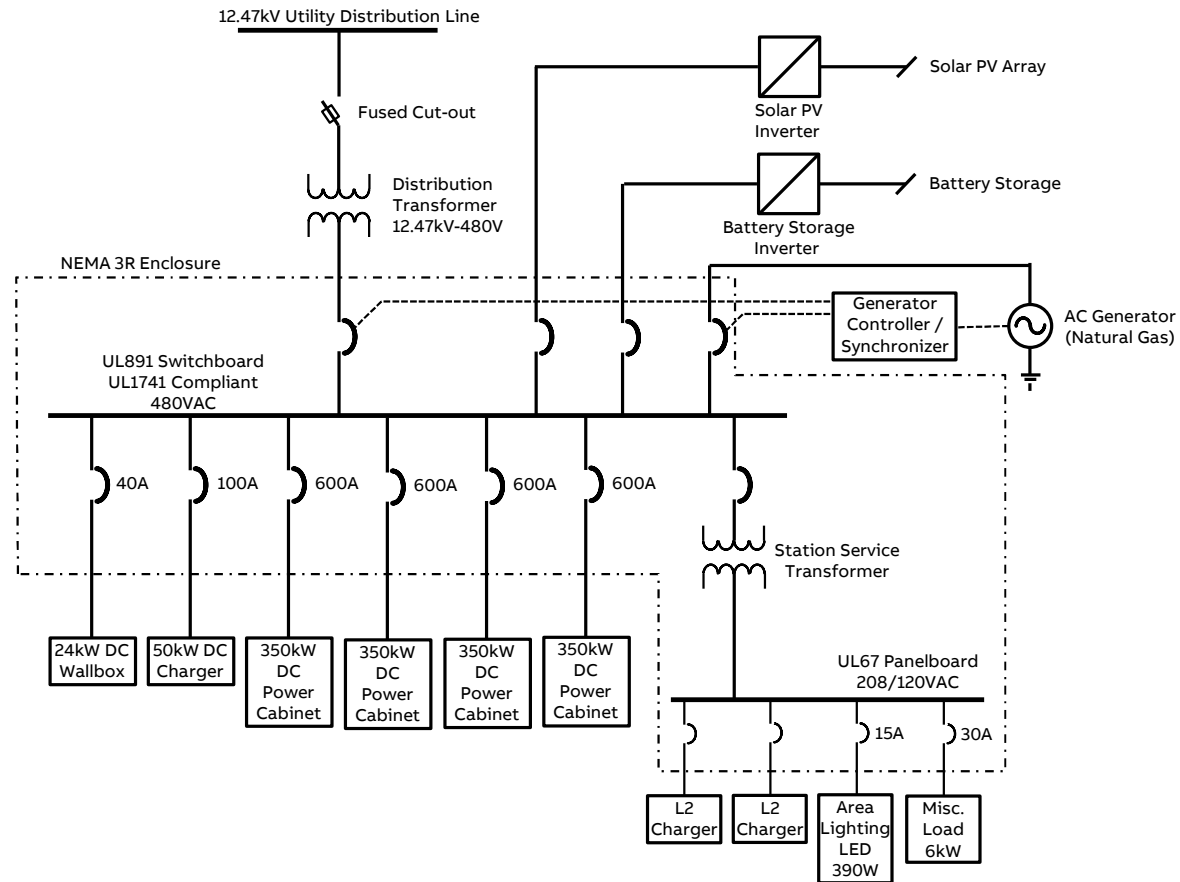
Open delta configuration,



Delta configuration, solidly
grounded center tap



Typical EVDC Charger power distribution topologies, Medium Voltage utility & multiple renewable sources for multiple dynamic 350kW & other loads.



Sizing & Configuration Power Distribution Equipment

Dramatic Pivot

- 100% mains standard – LSIG/RELT typically > 1000A (sum of charger loads)
- 80% feeders standard $3 \text{ phase (kW of charger X1000)} / (\text{RMS Vac input X 1.732}) \text{ X 1.1} = \text{charger input FLA X 1.25 for 80\% feeder MCCB}$ $350\text{kW @ 480} = 466 \text{ input A}$
- Beware of charger withstand ratings
- Typically NEMA 3 R type non-walk in outdoor installations. Shunt Trip on main for first responder safety.
- Sloped roof enclosure.
- Compartment space heaters, where necessary.
- Robust Type 2 SPD, where necessary.
- Brass mesh rodent screens to keep out wasps/rodents bugs/lizards & snakes
- Feeders to power cabinets required to have LOTO capability.
- To prevent vandalism all door located operator's devices (RELT switch and light) must be located internal to SWBD.
- 480Vac, 3 phase, 3 wire, solidly grounded wye service from utility

Utility configuration, short circuit levels, interrupting rating & application specific considerations

Utility compartment in switchboard may be required, utility specific.

ABB switchboard engineering has over 200 utility approved, utility compartment designs.

Utility may locate PT & CT in utility pad mounted transformer with EC supplied remote meter base.

Limit of direct reading meters is 400A.

Utility may require PT & CT mounted in EC supplied, utility approved enclosure.

NEMA standard for pad mount transformer is 5.75% +/- 7.5%.

Conservative rule of thumb is $20 \times \text{XFMR FLA} = \text{SCA}$

If three pole mounted transformers are used impedance can be 1.67% or 60X XFMR FLA!

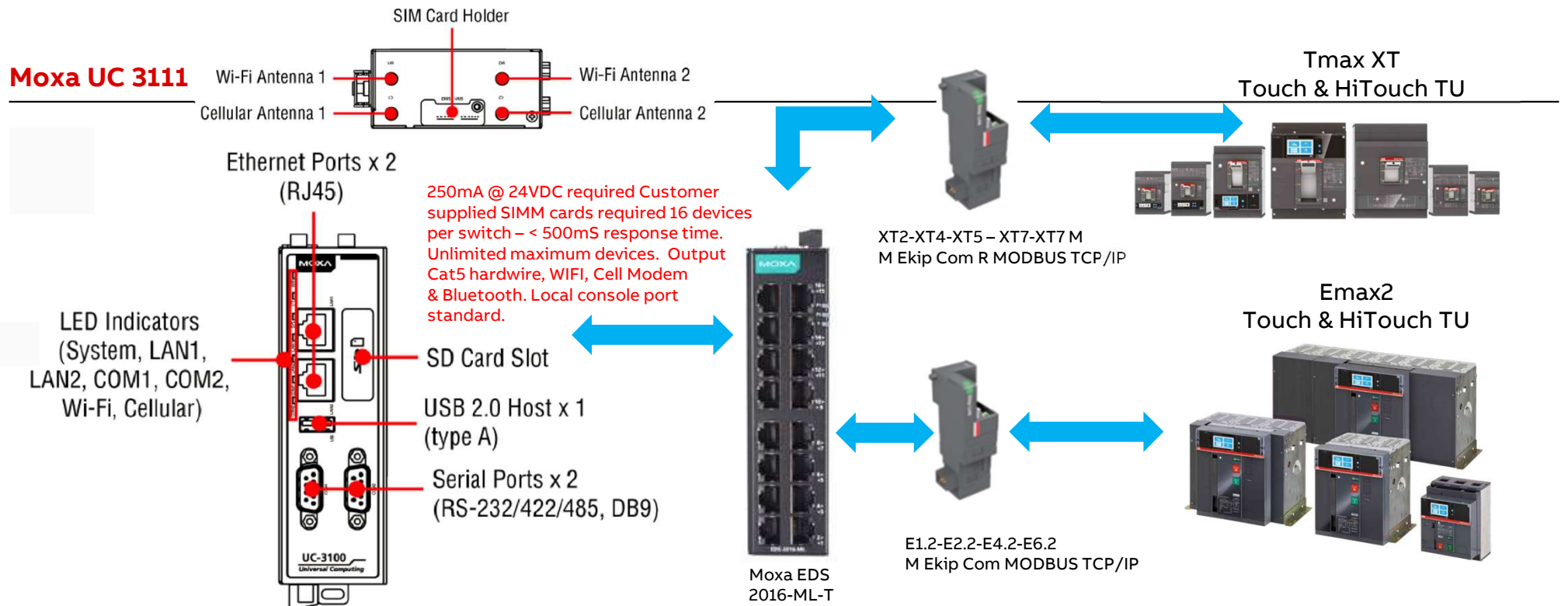
Utility in most cases will apply .4 X main breaker rating to size utility transformer

Charger AIC rating is an often-overlooked issue.

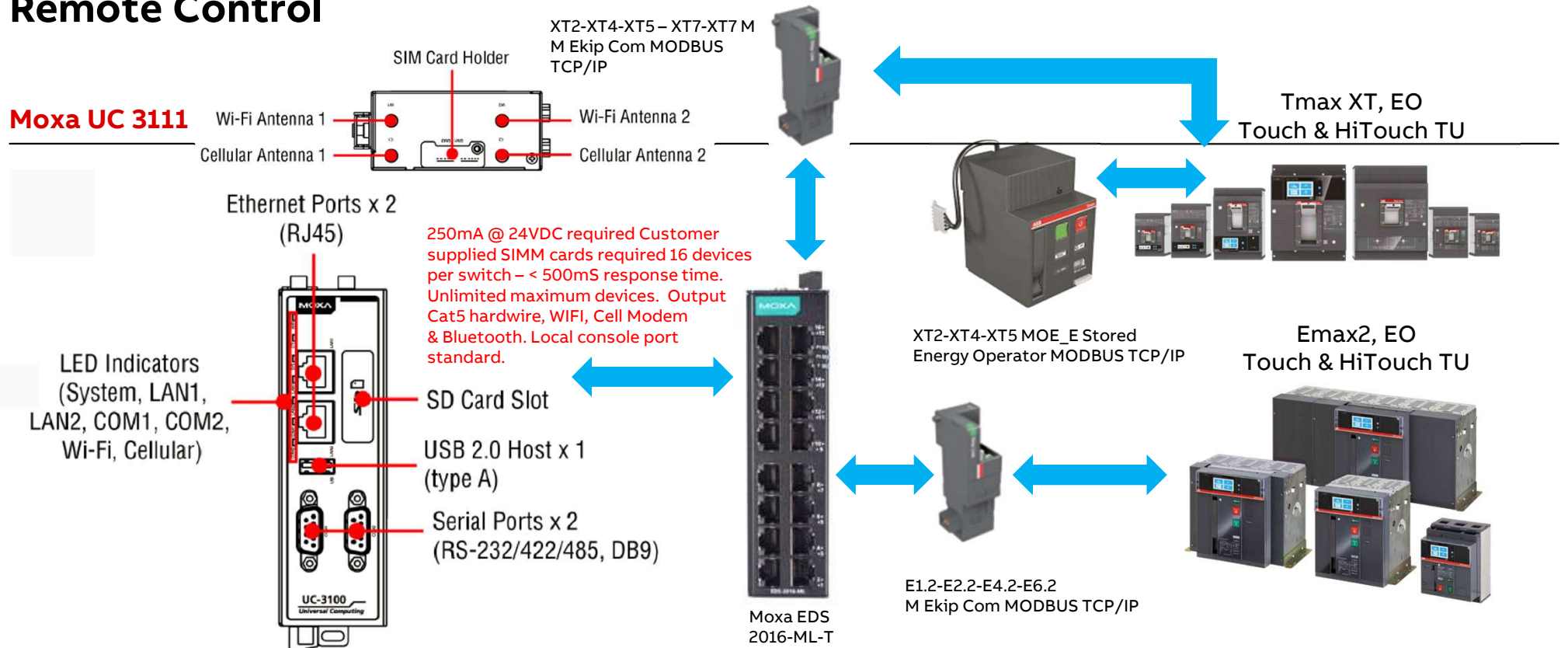
Typically, largest utility transformer is 2500 kVA – 3008 A continuous, 65kA max

Beware of overhead clearance in parking decks.

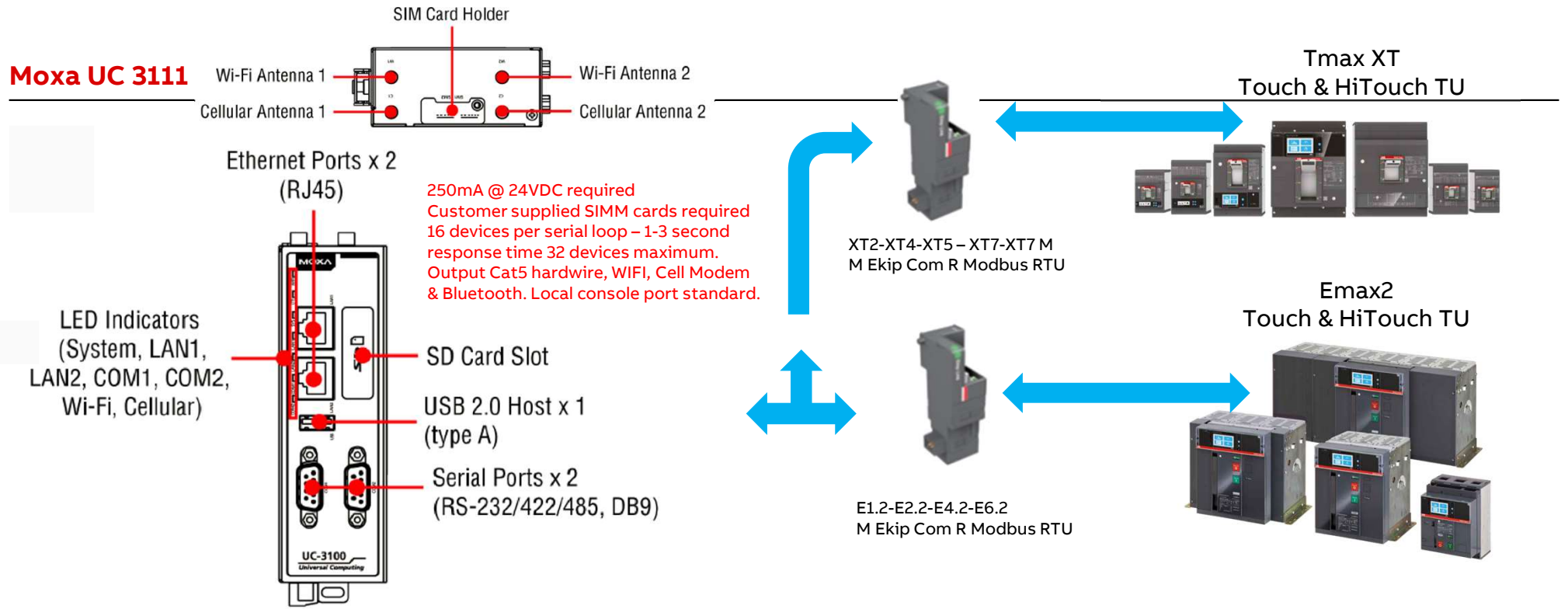
Comms Topology MODBUS TCP/IP input from Devices, Data Acquisition Only



Comms Topology MODBUS TCP/IP input from Devices, Data Acquisition & Remote Control



Comms Topology Modbus RTU input from Devices, Data Acquisition Only



Switchboard safety considerations and applicable UL & IEEE standards and NEC Articles

Typically NEMA 3 R type non-walk in outdoor installations. Shunt Trip on main for first responder safety.

UL 891 - Switchboard construction standard.

UL489 - ICCB & MCCB standard

UL 1741- Multiple source switchboard construction and operation standard

IEEE 519 – Harmonic contribution content standard

NEC Article 625.41 Overcurrent Protection – continuous duty, NEC Article 625.42 Service Equipment rating & load control, & NEC Article 625.43 Charger LOTO provision

NEC Article 626 (2017/2020 NEC Cycles) Service Diversity for Truck and Bus installations

NEC Article 240.86 A & B – Series Ratings

NEC Article 240.87 - Arc flash energy reduction

NEC Article 230.95-Service main GF protection

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Trends

Trends

- Medium Voltage distribution
- Complex utility coordination
- Microgrids with alternative energy sources
- Load control by network – crucial for brownfield condo/office/apartment garages.
- Bidirectional operation
- Utilities in play as operators
- Unique vehicle applications
- Utilities forced to dramatically reduce kWh billing rate to dedicated EV sites.

— Utility Impact Examples

PECO (Philadelphia Electric Company)

peco
AN EXELON COMPANY

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Documents & Guides

New Business
1-800-454-4100

View the Requirements for Service

Builders Handbook

For underground electric and gas installations for new homes in the PECO service area, please consult the Builder's Handbook to understand the general process for working with PECO to complete your project.

[Download Handbook \(pdf\)](#)

[Padmount Transformers Location Guidelines](#)

Blue Book

Revision	Section	Section Description (pdf)
05/2018	Section A	Forward
05/2018	Section B	Table of Contents
05/2018	Section C	Internet Updates
05/2018	Section 1	Introduction
05/2018	Section 2	Definitions
05/2018	Section 3	Services Available
05/2018	Section 4	General Requirements
05/2018	Section 5	Customer's Use of Service
05/2018	Section 6	Secondary Service Under 600 Volts
05/2018	Section 7	Services Over 600 Volts
05/2018	Section 8	Metering
05/2018	Section 9	Electric Inspection Agencies
05/2018	Section 10	Acceptable Equipment
05/2018	Section 11	Cable Specifications
05/2018	Section 12	Illustrations

PECO "Blue Book"

<https://www.peco.com/MyAccount/MyService/Pages/Guidelines.aspx>

Blue Book

For information on electric service requirements, refer to the PECO Electric Service Requirements Manual, or the "Blue Book."

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05/2018	Section 12	Illustrations

PECO Service Drop Details

<u>Phases</u>	<u>Nominal Voltage</u>	<u>Wires</u>	<u>Comments</u>
3	208Y/120	4	<p>Intended for exclusive supply to a building or group of contiguous buildings. Available where accessible to grounded three-phase primary.</p> <p>Transformers and secondary will be installed on the Customer's premises at a suitable location provided by the owner. (The Company at its discretion may provide service from aerial distribution facilities located along public highways when no suitable transformer location is available on the premises <u>and</u> demand does not exceed 100 kVA.)</p> <p>Service capacity at this secondary voltage is limited to 750 kVA. If capacity exceeds this limit for transformers located inside the building, then the customer must take Standard High-Tension Service (see section 3.5 below). If capacity exceeds this limit but remains at or below 1,500 kVA for transformers located outside the building, then the customer can request either a 480Y/277v service, provided a padmounted transformer can be installed outside the building, or a Standard High-Tension Service (see section 3.5 below).</p> <p>See Fig 8.08</p>
3	480Y/277	4	<p>Intended for exclusive supply to a building or group of contiguous buildings. Available where accessible to grounded three-phase primary.</p> <p>Transformers and secondary will be installed on the Customer's premises at a suitable location provided by the owner.</p> <p>Service capacity at this secondary voltage is limited to 750 kVA for transformers located inside the building and to 1500 kVA for transformers located outside the building. If capacity exceeds these limits, then the customer must take Standard High-Tension Service (see section 3.5 below).</p> <p>See Fig. 8.21, 8.22, 8.23</p>

100 kVA = 278 FLA @ 208V

750 kVA = 2,084 FLA @ 208V

750 kVA = 903 FLA @ 480V

1,500 kVA = 1,806 FLA @ 480V

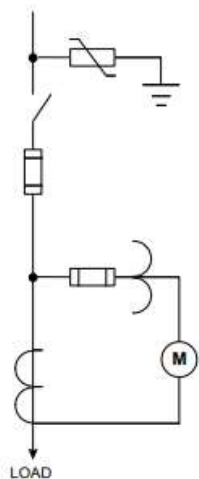
PECO Service Drop Details

3.5 STANDARD HIGH TENSION SERVICES

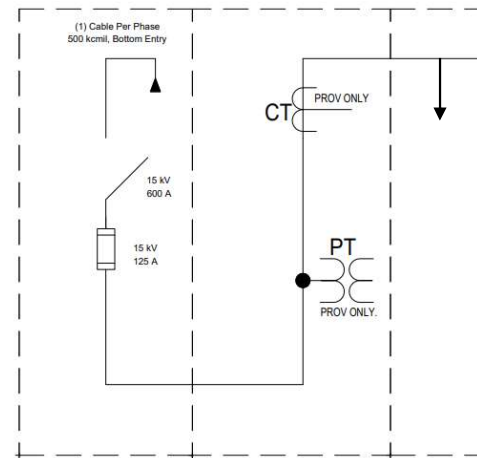
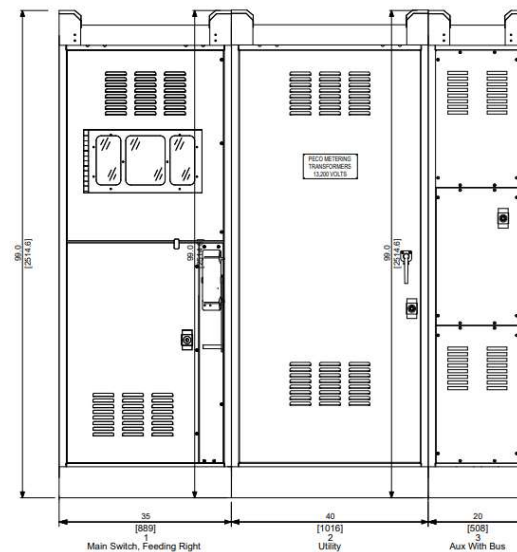
All standard high-tension service available from the Company is three-phase primary. Where two or more standard voltages are present in a given area, the Company will select the voltage at which the required service can be supplied most economically.

NOTE: Customers requiring service with nominal voltages of 208Y/120v or 480Y/277v, who require transformation in excess of the secondary service limits specified above in Section 3.4, must take Standard High-Tension Service.

TABLE 10.23 P
13 KV SERVICE ASSEMBLIES
FUSED SINGLE SERVICE WITH PRIMARY METERING



HAVE TO PROVIDE A PECO APPROVED HV SWITCH AND YOUR OWN TRANSFORMER FROM 13.2KV TO LV AND YOUR OWN LV DISTRIBUTION EQUIPMENT (SWBD)



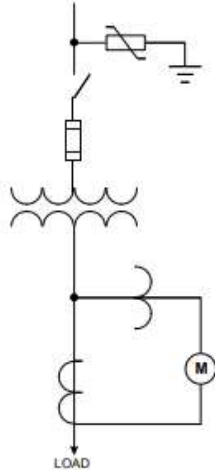
PECO Service Drop Details

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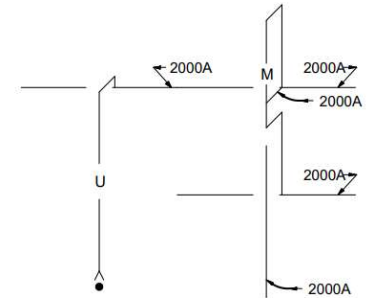
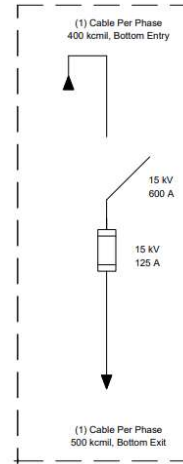
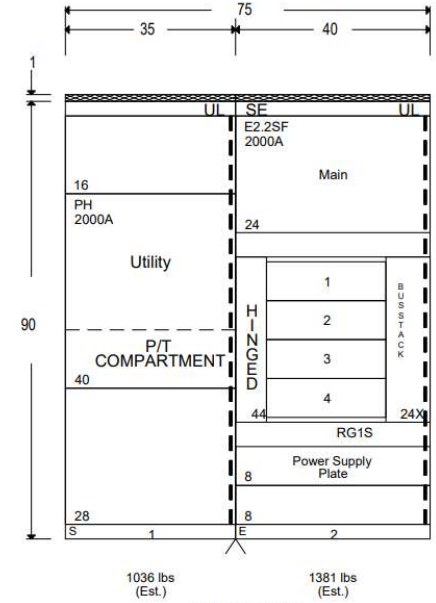
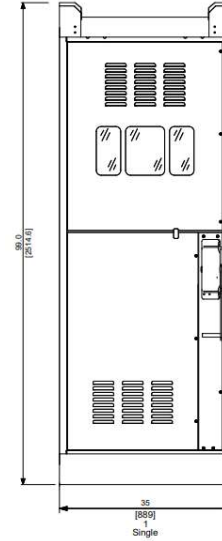
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TABLE 10.23 S
13 KV SERVICE ASSEMBLIES
FUSED, SINGLE SERVICE, WITHOUT PRIMARY METERING
(METERED SECONDARY, COMPENSATED)



HAVE TO PROVIDE A PECO APPROVED HV SWITCH AND YOUR OWN TRANSFORMER FROM 13.2KV TO LV AND YOUR OWN LV PECO APPROVED DISTRIBUTION EQUIPMENT (SWBD) ALSO HAVE TO PROVIDE A TRANSFORMER DATA SHEET FOR METER PROGRAMMING



PECO Service Drop Details

**TRY TO KEEP WITHIN THE
"ESTABLISHED" LIMITS**

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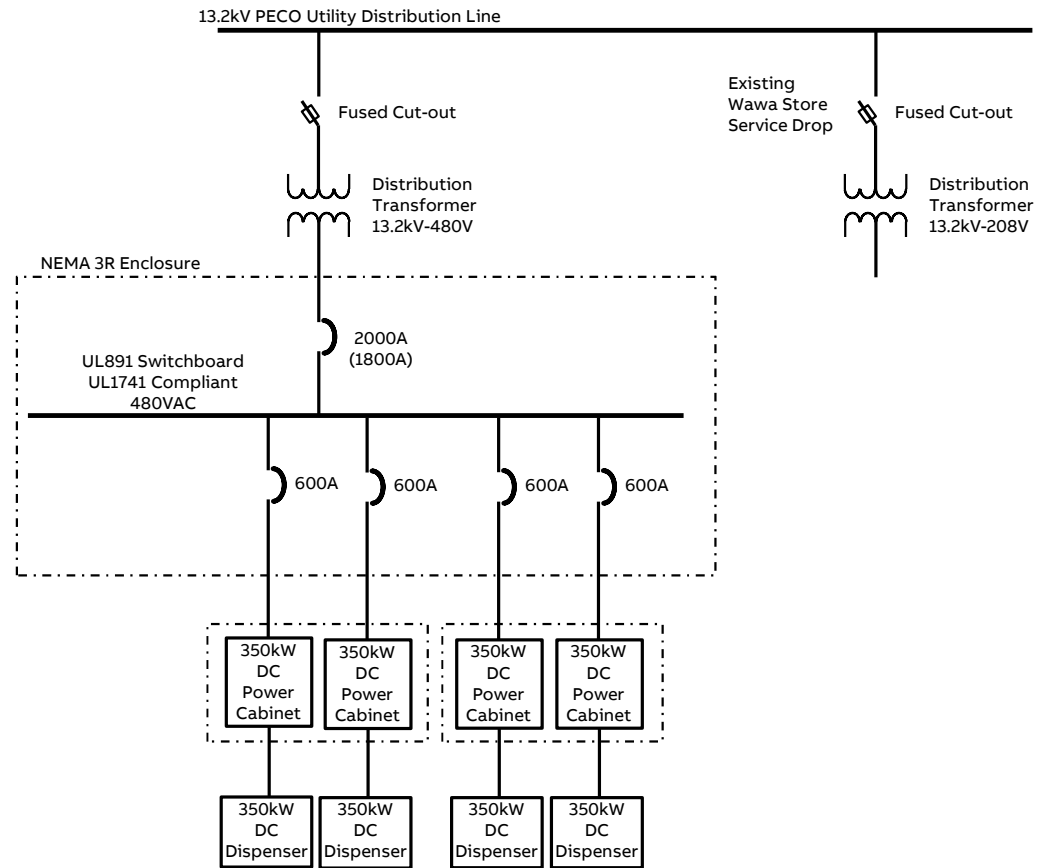
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1,500 kVA = 1,806 FLA @ 480V

Example of an EVDC Charger power distribution topology with PECO (Philadelphia Electric Company) at a Wawa convenience store in Glen Mills, PA



Example of an EVDC Charger power distribution topology with PECO (Philadelphia Electric Company) at a Wawa convenience store in Glen Mills, PA



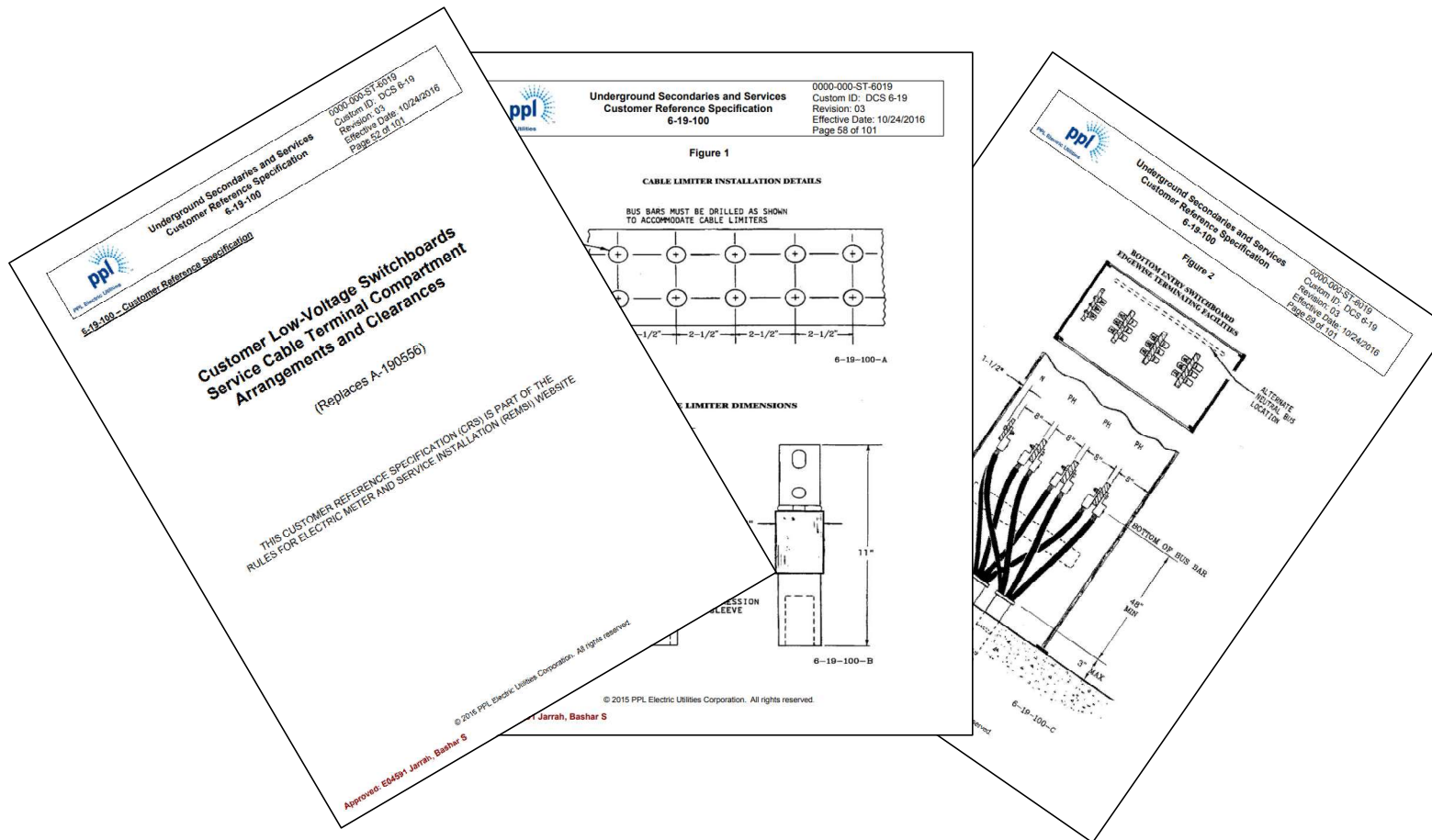
PECO (Philadelphia Electric Company)

The screenshot shows the PECO website's navigation and content. The top navigation bar includes the PECO logo, navigation links (Smell Natural Gas?, Outage, Pay Bill, Moving, Español, 中文, Contact Us), a search bar, and user options (Sign In, Register). Below this is a secondary navigation bar with links for My Account, Outages, Ways to Save, Smart Energy, Safety & Community, and Marketplace. The main content area is titled 'My Green Power Connection' and includes a breadcrumb trail: Home > Smart Energy: My Green Power Connection. The page features three main sections: 'Solar for Home & Business' with a description and a 'LAUNCH OUR Solar Calculator' button, 'Developers & Contractors' with a description and a 'Learn about our solar calculator! (PDF)' link, and 'FAQs' with a description. A sidebar on the left contains a menu with categories like Smart Grid & Smart Meter, Innovation & Technology, My Green Power Connection (highlighted), Solar for Home & Business, Developers & Contractors, and FAQs.

All EV charger applications and load additions go through the PECO Green Power Connection team. This team was formed to handle solar and distributed generation applications but have evolved to include EV chargers.

[My Green Power Connection | PECO - An Exelon Company](#)

PPL (Pennsylvania Power Light)




PPL Customer Reference Specification

CRS 6-19-100

https://www.pplelectric.com/-/media/PPElectric/At-Your-Service/Docs/REMSI/CRS/crs-6-19-100.ashx?sc_lang=en&hash=5F254D92ADA1D7B480F6580438D9AE87

PPL Service Drop Details


Underground Secondaries and Services
 Customer Reference Specification
 6-19-100

0000-000-ST-6019
 Custom ID: DCS 6-19
 Revision: 03
 Effective Date: 10/24/2016
 Page 52 of 101

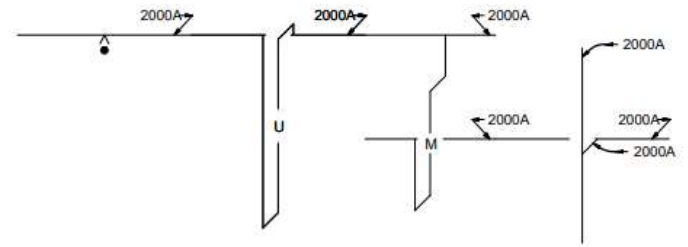
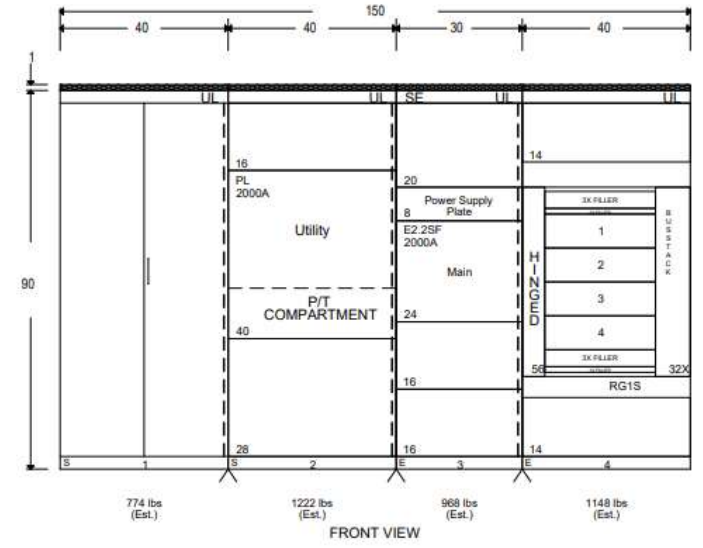
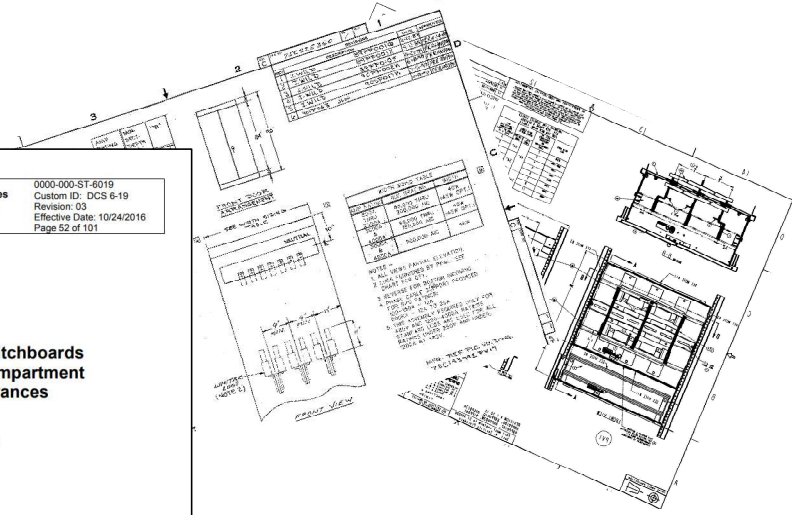
8-19-100 – Customer Reference Specification

**Customer Low-Voltage Switchboards
 Service Cable Terminal Compartment
 Arrangements and Clearances**

(Replaces A-190556)

THIS CUSTOMER REFERENCE SPECIFICATION (CRS) IS PART OF THE
 RULES FOR ELECTRIC METER AND SERVICE INSTALLATION (REMS) WEBSITE

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 Approved: E04591 Jarrah, Bashar S



*HAVE TO PROVIDE A PPL APPROVED
 INCOMING CABLE LIMITER LUG
 SECTION ALONG WITH A SEPARATE
 SECTION FOR THE PPL UTILITY
 METERING COMPARTMENT.*

*TYPICALLY, THIS ADDS 80" TO THE
 WIDTH OF THE LINEUP*

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Questions?

ABB