Dominion Energy Virginia / North Carolina

Interconnection Parameters for Net Metering Distributed Energy Resources

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2.0	12/12/2023	Midsize NEM Disclaimer
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1 Scope

The scope of the Net Metering Interconnection Parameters for Distributed Energy Resources Guide (Guide) is to provide technical background and guidance concerning the interconnection of Net Metering Distributed Energy Resources (DER). The primary purpose of a Net Metering DER is to offset customer energy usage with the energy generated by a renewable fuel source. With Net Metering DERs,[1] it is expected that some amount of energy may flow onto Dominion Energy Virginia / North Carolina's electric distribution system, referred to in this guide as the Electric Power System (EPS), especially during light loading conditions. This guide provides a high-level overview of the interconnection study parameters to form the basis of the engineering review of Net Metering DERs.

The interconnection parameters described in the Guide are based, as applicable, on Good Utility Practice, industry standards, the North Carolina Utilities Commission (NCUC) Interconnection Rules and Procedures associated with Net Metering, and the Virginia State Corporation Commission's Regulations Governing Net Energy Metering, which define and establish standardized interconnection and operating requirements for the safe and reliable operation of the EPS and Net Metering DERs.

Any output capacity discussed in this Guide will be stated as kW or MW.

Estimated costs for typical Net Metering DER upgrades are attached as Appendix C.

1.1 Disclaimer:

The information contained within this Guide, including any standards, guidelines, criteria, or requirements referenced therein or included in the Appendices, is intended to be used for information purposes only, is provided "as is" without representation or warranty of any kind, expressed or implied, and is subject to change.

Dominion Energy is not responsible for the user's reliance on this Guide, or for any erroneous or misleading material. Dominion Energy may revise or withdraw this Guide at any time at its discretion without notice. It is the user's responsibility to ensure that it complies with all of Dominion Energy's current interconnection and operating requirements. To the extent that the information in this Guide is inconsistent with the Dominion Energy tariffs or agreements, the Dominion Energy tariffs or agreements, as applicable, shall control. Finally, this Guide is non-binding and confers no rights.

[1] In this Guide, the term "Net Metering DERs" is used synonymously with "Generating Facility" or "Generator" as those terms are defined in 20 VAC 5-315-20.

1.2 Inverter Derating Policy for Net Metering Generators

Inverter Derating Policy for Net Metering Generators

The Utility will determine the generator's AC capacity solely based on the inverters' nameplate ratings. Nameplate ratings include the nominal voltage, current, maximum active power, apparent power, and reactive power, at which the inverter is capable of sustained operation. De-rating of inverters below nameplate capacity will not be accepted as a method to reduce the generator's AC capacity. The capacity is defined as the total of all inverters' maximum AC active power output.
The Utility will not recognize any customer-imposed limitations, including but not limited to:

- Power control devices
- Software or firmware settings
- Other software-based operational restrictions such as curtailment schedules and export limits.

Such limitations cannot be guaranteed to remain in place throughout the system's lifespan and may be altered without Utility oversight. Designing protection based on these limitations could adversely affect the safety and reliability of the Utility's Electric Power System (EPS). Therefore, all interconnection requirements and studies will be based on the maximum AC active power output.

2 Net Metering DER Study (Review) Parameters

Dominion Energy's Net Metering DER General Study Parameters are applicable to Net Metering DERs 3 MW and below and may consist of an in-depth review by Dominion Energy's engineering team based on the size. The in-depth review is driven by the fact that a Net Metering DER's annual generation may exceed its annual usage by up to 150%. The in-depth review is preceded by a Net Metering review (screening) performed for all Net Metering DER applications regardless of size immediately following submittal of the application and is based on the conditions of interconnection, as defined in Chapter 315, the Regulations Governing Net Energy Metering - 20VAC5-315-40, and any other requirements as specified in Dominion Energy's **Blue Book**. Additionally, the service transformer supplying the customer will be assessed to ensure that the proposed project size does not exceed the transformer's nameplate rating. Furthermore, given the export capability of Net Metering DERs, any distribution operating device located upline from Net Metering DER 1,000 kW and above will typically be required to have 3 phase tripping / operating capability, which may involve some equipment upgrades or replacements.

The DER General Study Parameter sections in this Guide provide a detailed description of the following:

- Dominion Energy's Net Metering DER Interconnection Study (review) process for projects 250 kW and below. (see section 2.2)

- Dominion Energy's Net Metering DER Interconnection Study (review) process in general for projects 250 kW and above but less than 1,000 kW. (see section 2.3)
- Dominion Energy's Net Metering DER Interconnection Study process in general for projects 1,000 kW and above but less than or equal to 3,000 kW. (see section 2.4)
- Net Metering DER Interconnection Study Parameters in general and the applicability of IEEE Std. 1547-2018 requirements and certification to UL 1741 Edition 3 (see section 2.6)
- Dominion Energy's approach to Net Metering DER grid support and ride-through capabilities (see section 2.6.1 and 2.6.2 respectively)
- Net Metering DER Impact limitations in general and the criteria that guide them, such as Power Quality Requirements, Rapid Voltage Change (RVC), Transformer Inrush requirements, and Harmonics. This section also discusses Transformer and circuit loading limitations and other criteria applicable to Net Metering DER Interconnections. (see sections 2.7.1, 2.7.2, 2.7.3 and associated subsections)
- Equipment reviews performed throughout the DER study process (see section 2.7.4)

The Net Metering DER General Interconnection Parameters section in this Guide provides a detailed description of the physical interconnection of the Net Metering DER with Dominion Energy's EPS. The section focuses on the POI and associated attachment facilities, and includes the following:

- Dominion Energy's DER Interconnection Generator Step-up Transformer Requirements (see section 3.1)
- Interconnection parameters for Net Metering DER for 250 kW and below. (see section 3.2)
- Interconnection parameters for Net Metering DER 250 kW and above but less than 1,000 kW (see section 3.3)
- Interconnection parameters for Net Metering DER 1,000 kW and above but less than or equal to 3,000 kW (see section 3.4)

2.1 The Net Metering DER Study (Review) Generally

Any DER that will operate in parallel with the EPS is required to meet applicable standards for interconnection and be certified to applicable testing standard(s). These standards include, but are not limited to, IEEE Std. 1547 and UL 1741 standard. Section 4 of this Guide includes a non-exhaustive list of applicable guides, codes and standards, state jurisdictional rules, and procedures applicable to the interconnection of DER.

For any DER connecting to Dominion Energy's EPS, regardless of its technology, the determination of whether the DER can safely and reliably operate in parallel with the EPS depends on several criteria applied at different phases of the DER interconnection review and studies. These include the impact of

DER on transformer and circuit loading and/or capacity, on conductor thermal rating, on voltage profile or power quality, on protective device coordination, and other criteria as described in the sections 2.2 through 2.7 (including subsections) below.

In the preliminary review phase of Net Metering DERs of size 1,000 kW and above, but less than or equal to 3,000 kW, the loading limit associated with a generator interconnection will be determined in the preliminary review. The loading limit is dependent upon the size of the DER, the rating and capability of the applicable distribution facilities, and associated control equipment. Applicable distribution facilities include but are not limited to the following devices: substation transformer, load tap changer, circuit conductor, substation and/or line regulator(s), distribution pole/pad-mounted transformer(s), breaker(s), line recloser(s), and fuse(s). Please refer to sections 2.7.2 and 2.7.3 for additional information on loading limit calculation.

During the study phase of Net Metering DERs of size 1,000 kW and above, but less than or equal to 3,000 kW, Dominion Energy performs voltage studies on all proposed DER sites using a power systems simulation platform called Synergi Electric. Existing circuit models for Dominion Energy's EPS are used and the proposed DER sites are added to the model. Power flow studies are performed, and the DER power output is varied from full output to no output to evaluate the worst-case voltage flicker. All proposed DER interconnections are currently studied at a fixed power factor, typically unity (1.0 PF), which is considered the base-case scenario for all DER regardless of the technology and/or the reactive or voltage support capability.

The sections below provide additional guidance on the general parameters considered by Dominion Energy during the Net Metering DER interconnection study (review) process. While the below sections provide guidance on the parameters that have the most impact on the outcome of the study process, they do not constitute an exhaustive list of all applicable study parameters.

2.2 Net Metering DER <250 kW Study (review) process.

For Net Metering DER < 250 kW, Dominion Energy does not perform voltage studies on the proposed DER sites. However, the Net Metering DER will need to satisfy the eligibility criteria as described in the State of Virginia Chapter 315, Regulations Governing Net Energy Metering, Condition of interconnection (20VAC5-315-40) and any applicable requirements. Additional requirements for interconnection for sites <250kW can be found in Dominion Energy's **Blue Book**, under the Customer Generation section.

Please note that if the 250 kW threshold of total DER on a Distribution line section is reached or exceeded due to **existing or aggregate generation**, the interconnection may be subject to other requirements

typically applicable to Net Metering DERs ≥ 250 kW and < 1,000 kW or Net Metering DER ≥1,000 kW and ≤3,000 kW. See Section 2.3 or 2.4 below for more information.

2.3 Net Metering DER ≥ 250 kW and < 1,000 kW Study (review) process.

For Net Metering DER ≥ 250 kW and < 1,000 kW, Dominion Energy does not perform voltage studies on the proposed DER sites. However, the Net Metering DER will need to satisfy the eligibility criteria as described in the State of Virginia Chapter 315 - Regulations Governing Net Energy Metering - Condition of interconnection (20VAC5-315-40), and any applicable requirements. Furthermore, a Net Metering DER ≥ 250 kW and < 1,000 kW, is considered as a significant size that can impact Safety and Reliability of the Power System, including protection. As a result, the associated **load-to-generation ratio** will be reviewed to determine if any other system protection upgrades are needed. Load-to-generation ratio is defined as the ratio between the day-time light load and the total aggregate generation on the distribution line segment. Additional information on requirements for interconnection can be found in Dominion Energy's Blue Book, under the Customer Generation section.

Please note that if the 1,000 kW threshold of total DER on a Distribution line section is reached or exceeded due to existing or aggregate generation, the interconnection may be subject to other requirements typically applicable to Net Metering DER ≥1,000 kW and ≤3,000 kW. See section 2.4 below for more information.

2.4 Net Metering DER ≥1,000 kW and ≤3,000 kW Study process.

For Net Metering DER ≥1,000 kW and ≤3,000 kW, Dominion Energy performs voltage studies on all proposed DER sites using a power systems simulation platform called Synergi Electric. Existing circuit models for Dominion Energy's EPS are used and the proposed DER site are added to the model. Power flow studies are performed, and the DER power output is varied from full output to no output to evaluate the worst-case voltage flicker. All proposed DER interconnections are currently studied at a fixed power factor, typically unity (1.0 PF), which is considered the base-case scenario for all DER regardless of the technology and/or the reactive or voltage support capability. Furthermore, a Net Metering DER ≥1,000 kW and ≤3,000 kW is considered as a significant size that can impact Safety and Reliability of the Power System, including protection. As a result, the associated load-to-generation ratio will be reviewed to determine if any other system protection upgrades are needed. Load-to-generation ratio is defined as the ratio between the day-time light load and the total aggregate generation on the distribution line segment. Additional information on power quality, transformer inrush, Rapid Voltage Change (RVC) and harmonics requirements are provided in the subsections below.

2.5 Net Metering DERs Energy Storage System (ESS) Review Parameters.

This Section 2.5 provides interconnection review parameters for Energy Storage Systems (ESS) used in conjunction with Net Metering.

An ESS is a particular type of DER that has the ability not only to store energy from the EPS but also to inject its stored energy into the EPS. This makes it both a load and a generation source. Any energy storage used in conjunction with Net Metering must be installed in such a way that prevents charging from the grid or discharging to the grid.

2.5.1 Loading and Discharging Restrictions

When the ESS is utilized in a Net Metering DER system, it is required per the Net Metering Interconnection rules and procedures not to charge using the Dominion Energy's EPS or back-feed into the EPS. Back-feeding into the EPS may be allowed if ESS is solely charged from the PV.

If the ESS owner / operator desires to utilize the ESS as both a load (importing power from Dominion Energy's EPS) and a generator (back-feeding or exporting into Dominion Energy's EPS), this may impact eligibility under the Chapter 315 terms and conditions, and may implicate Chapter 314 of the regulations.

2.5.2 ESS Parameters Review

All ESS project customers are required to provide a set of relevant ESS study parameters as listed below. These parameters should be provided for each proposed ESS application along with the operating mode and configuration of the ESS.

2.5.2.1 Point of electrical connection Identification

The point of electrical connection should be provided.

2.5.2.2 ESS Inverter Specification

The ESS customer shall provide the ESS inverter specifications and certifications. As discussed in section 2.1 of this Guide, any DER equipment paralleling with the EPS which in this case is an ESS inverter, regardless of configuration, shall be certified to the UL 1741 standard.

2.5.2.3 ESS configuration and Operating Sequence Specifications

The ESS customer shall provide the ESS system's specifications, including but not limited to the operating manual, control and wiring diagrams, and a detailed sequence of operations. Additionally, as the ESS system associated with the Net Metering DER is typically not permitted to both charge from and discharge (back-feed) into the Dominion Energy's EPS, proof along with certification from a qualified installer or technician that the ESS has been properly installed and set up, per the manufacturer's specifications as to prevent charging from or back-feeding into the Dominion Energy's EPS will be required.

2.6 Net Metering DER Interconnection as it applies to IEEE Std. 1547-2018

A Net Metering DER is a "generating facility" or "generator," which is defined in the applicable regulations as "***an electrical generating facility consisting of one or more renewable fuel generators***" (see 20VAC5-315-20). Renewable fueled generators are mostly inverter based, a generation technology that has the capability of providing several smart functionalities.

2.6.1 Grid Support Capability Requirements

Dominion Energy defines grid support as DER equipment capabilities and functionalities required by IEEE Std. 1547-2018 for purposes of maintaining reliable operation of the EPS and responding to the variability of electric power supply and demand. These capabilities include real and reactive power support. Dominion Energy acknowledges the capability of most DER to provide grid support within their design specification(s) and limitation(s). Although inverter-based DER may be capable of providing a higher level of grid support using smart inverter functionalities, Dominion Energy is responsible for ensuring that EPS voltage remains within the ranges allowed by the respective state jurisdiction. Accordingly, Dominion Energy designs its EPS without creating a dependency on DER grid support functions for normal day to day operations of the EPS for reliability purposes, so that the safety and reliability of the EPS is not ceded to a third party. Dominion Energy has established the following standard to ensure that result: DER interconnection related upgrade(s) or infrastructure solutions shall initially be established to mitigate any voltage, thermal, power quality, and other safety related issues, at the DER customer's expense, before any DER is requested to provide grid support functionalities. Dominion Energy will use grid support functionalities for future operational issues, including but not limited to adverse operating conditions, after all infrastructure solutions and associated mitigation tools have been exhausted.

2.6.2 Ride-through Capability Requirements

Although Dominion Energy supports the IEEE 1547-2018 ride-through capability requirements for DER, Dominion Energy is not requiring the application or utilization of ride-through functionalities at this time. Table 4 below outlines current Dominion Energy requirements associated with DER Voltage ride-through. Please note any requirements within the table may be subject to change at Dominion Energy's discretion.

Voltage Range (p.u.)	Operating Mode	Clearing time (s)
1.20 – 1.10	Momentary Cessation	2
1.10 – 0.88	Continuous Operation	∞
0.88 – 0.50	Mandatory Operation	2
0.50 – 0.00	Momentary Cessation	0.16

***Table 4*: Dominion Energy Voltage Ride-Through Requirements**
(Source: IEEE Std. 1547a-2020, Category III)

2.7 Other Net Metering DER Interconnection Study (Review) Parameters

For Net Metering DER that go through the full study process, additional interconnection study (review) parameters associated with Power Quality such as Rapid Voltage Change (RVC), flicker, harmonics typically will apply. Those parameters are described in the subsections below.

2.7.1 Power quality requirements

The goal of the DER interconnection study process is to ensure that any DER connecting to the EPS does not impact the power quality of Dominion Energy's system. Important power quality criteria evaluated during the DER interconnection study process include the following:

- Ensuring that voltage dip/rise or the Delta change in voltage does not exceed 3% of nominal voltage due.
- Ensuring that harmonic distortion levels do not exceed limits as defined in IEEE Std. 519-2014 and IEEE Std. 1547-2018.
- Ensuring simulated flicker on power system is maintained within the requirements defined in IEEE Std. 1547-2018.

2.7.1.1 Net Metering DER system's RVC and transformer inrush requirements

IEEE Std. 1547-2018 requires DER not to cause voltages to exceed 3% of nominal and 3% per second averaged over a period of one second when the Point of Interconnection (POI) is at medium voltage. Medium voltage is typically defined as voltage above or equal to 1 kV but less than or equal to 35 kV.

For a POI at low voltage, which is defined as voltages 1000 V and less per IEEE C62.41.2, IEEE Std. 1547-2018 requires DER not to cause voltages to exceed 5% of nominal and 5% per second averaged over a period of one second.

An excessive amount of RVC, even if it is infrequent, can have negative impact on power quality. For example, Dominion Energy customers with voltage sensitive processes or equipment have in the past experienced significant disruption due to RVC. Thus, Dominion Energy requires RVC to be limited to specific levels as described above and as established in the IEEE Std. 1547-2018.

2.7.1.2 Harmonics requirements

Dominion Energy has identified several areas of concern related to harmonics for DER such as harmonic contributions. Harmonics can be generated by several components of DER, including soft start units,

power electronics, transformer energization, and saturation. The following subsections describe the harmonic study process and some mitigation solutions utilized when harmonic issues are identified.

2.7.1.2.1 Harmonics study process

Presently, Dominion Energy installs a power quality (PQ) meter or device at the POI to monitor harmonics for all DERs 250 kW and above while also providing visibility. For DERs 1,000 kW and above, PQ meters are typically placed at the POI before the DER is energized to record "background" harmonics. This allows Dominion Energy to study the harmonics that are contributed by the DER prior to energization and once energized.

All equipment that can produce harmonics should meet regulations limiting Total Harmonic Distortion (THD) to limits as defined in the latest revision of IEEE 519. If the power quality meters discussed above reveal significant issues at a DER site, the DER customer must mitigate the harmonics issues.

2.7.2 Transformer Loading Limit requirements

Reverse flow on a substation transformer will be limited to the base or Oil Natural Air Natural (ONAN) rating of the transformer. When evaluating the maximum aggregated DER on a distribution transformer, Dominion Energy considers a light load factor in addition to the ONAN rating of the transformer. The light load factor is defined as either the actual transformer light load, which is limited to daytime light load for PV only DER system, or 10% of the transformer top nameplate rating, whichever is the smallest. Ultimately, the maximum aggregate generation connected on a substation transformer will be limited to the summation of the transformer base rating and a light load factor, if any. This also ensures the maximum DER sites can be safely connected the circuit. Table 1 provides guidelines for a typical distribution transformer maximum allowable reverse flow and total allowable aggregate DER with respect to the transformer nameplate rating.

Transformer Nameplate Rating (MVA)	Maximum Reverse Flow ONAN (MVA)	Maximum Allowed Aggregate DER ONAN + LLF** (MVA)
6.5 *	3.9	4.6
6.5/7*	4.2	4.9
6/8/10	6.0	7.0
7.2/9.3/12	7.2	8.4
8.4/10.2/14	8.4	9.8
12/16/20	12.0	14.0
13.4/17.9/22.4	13.4	15.7
20.1/26.8/33.6	20.2	23.5
24/40	24.0	28.0
27/ 36/45	27.0	31.5
30/40/50	30.0	35.0
33.6/44.8/56	33.6	39.2
45/60/75	45.0	52.5
50.4/67/ 84	50.4	58.8

* Reverse Flow Rating for non-standard transformer is the lower of the ONAN rating or the base impeadance test rating.

** LLF = Light load factor and is assumed, for reference purpose, to be equal to 10% of the top nameplate rating of the transformer.

Highlighted - Standard Purchase Size

***Table 1** : Transformer Chart - DER Limits*

2.7.2.1 Service Transformer Requirements

For NEM DERs being installed behind a Dominion Energy service transformer, the total AC inverter (MVA) nameplate capacity cannot exceed the MVA rating of the service transformer. If this capacity is exceeded, the service transformer will need to be upgraded at the developer's expense to the next largest size needed to handle the reverse power flow.

2.7.3 Circuit Loading Limit requirements

Dominion Energy has developed circuit loading limit criteria corresponding to the rating of largest conductors used in its system. The circuit loading requirements are described in sections 2.7.3.1 and 2.7.3.2 below.

2.7.3.1 Thermal Limit/ Physical Circuit Capacity

Dominion Energy standard 477 AAC wire size has a maximum rating of 644 A. However, given the limitation of other components such as disconnects and bushings, Dominion Energy established the standard circuit maximum ampere rating of 600 amps to be conservative. Table 2 below provides guidance on some typical circuit thermal limits, which have different megawatt (MW) equivalents depending on the distribution circuit operating voltage.

	12.5 kV	13.2 kV	23 kV	34.5 kV
MW	Amps	Amps	Amps	Amps
1	46	44	25	17
2	92	87	50	33
3	139	131	75	50
4	185	175	100	67
5	231	219	126	84
6	277	262	151	100
7	323	306	176	117
10	462	437	251	167
12	554	525	301	201
13	600	569	326	218
13.7		600	344	230
15			377	251
20			502	335
24			600	400
28				469
30				502
32				536
36				600

***Table 2** : Amps per circuit voltage and equivalent MW*

2.7.4 Equipment Reviews

As part of the interconnection study for a DER, Dominion Energy will assess the loading limit associated with interconnecting a generator. If Dominion Energy determines that any of the limits described in previous sections (i.e. sections 2.4, 2.5.1, and 2.5.2) are exceeded, the following upgrade requirements may apply prior to the interconnection of the DER. Those requirements include but are not limited to:

- Primary or secondary conductor upgrade
- Substation Transformer upgrade to the next size up that will accommodate the addition of the DER
- Service Transformer upgrade to the next size up that will accommodate the addition of the DER
- Substation regulator and/or associated control upgrade
- Line regulator and/or associated control upgrade
- Addition of new express feeder
- Addition and/or upgrade of line recloser(s)
- Addition or removal of line fuse(s)
- Protection and coordination reviews
- Other equipment upgrades due to fault duty

3 Net Metering DER General Interconnection Parameters

Dominion Energy has two typical Net Metering DER connections depending on the size of the DER. These typical connections are DER less than 1MW in size and DER of size 1 MW and above. The connections and typical equipment installation configurations are discussed in sections 3.2 and 3.3 below and are applicable to all DER technologies. Appendix A provides additional information on the typical layout of associated DER interconnection or attachment facilities.

3.1 Net Metering DER Interconnection Generator Step-up Transformer Requirements

The following generator step-up (GSU) transformer requirements apply to all DER paralleling with the Dominion Energy EPS regardless of their applicable interconnection parameters. Any Dominion Energy supplied GSU transformer for use with the interconnection of a DER will have a Wye-ground / Wye-ground winding configuration. If a DER customer elects to have Dominion Energy supply the GSU transformer, steps must be taken to ensure that the DER protection system associated with inverters handles that type of configuration. For any GSU transformer supplied by the DER customer, Dominion Energy will require a GSU that has either a Wye-ground / Wye-ground or Wye-ground/Wye (DER Side) winding configuration.

3.2 Interconnection Parameters for Net Metering DER < 250 kW

For an interconnection of a Net Metering DER less than 250 kW, a bi-directional meter and a Company accessible, lockable load breaking disconnect will be required prior to the interconnection. Additional requirements for interconnection can be found in Dominion Energy's **Blue Book**. Details on the interconnection parameters for DER < 250 kW are provided in Figure 1 below.

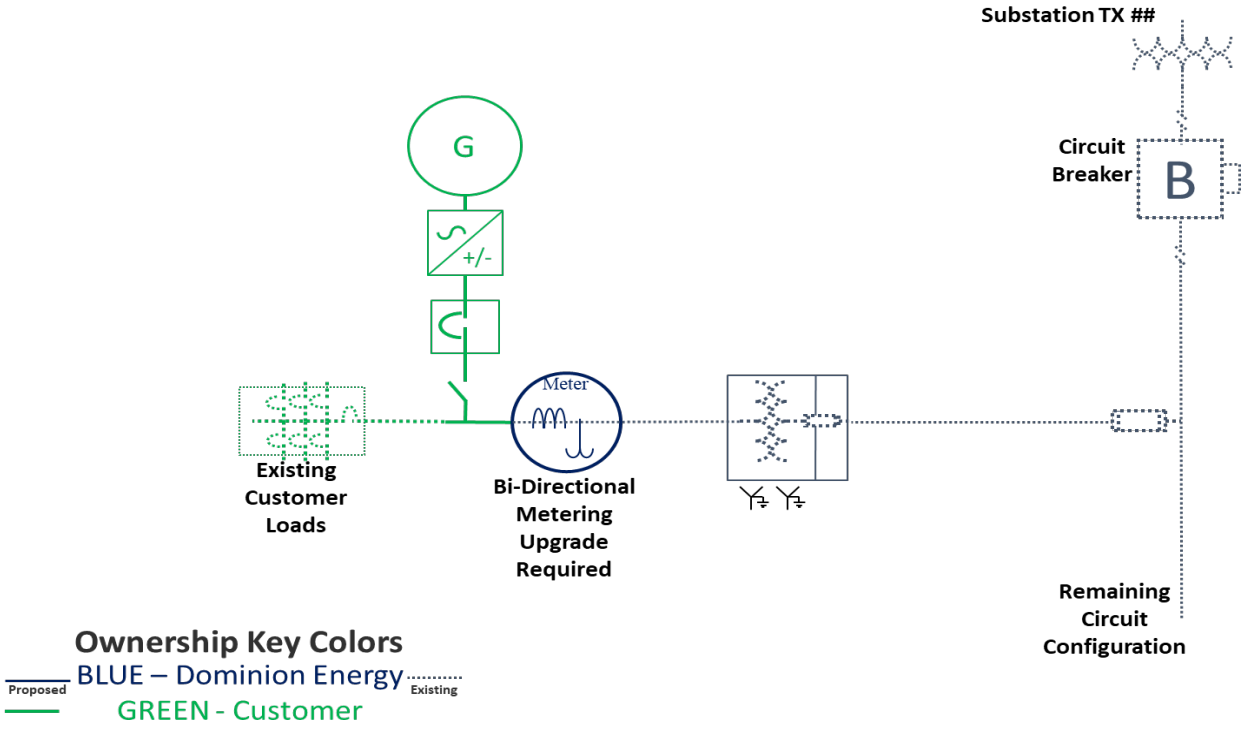


***Figure 1*: Typical Layout for Net Metering DER < 250 kW**

3.3 Interconnection Parameters for Net Metering DER ≥250 kW and < 1,000 kW

The subsections below describe 2 different interconnection configurations for DER less than 1 MW and equal or above 250 kW.

3.3.1 Net Metering DER ⩾250 kW and < 1,000 kW (with no DTT required)

For the interconnection of a Net Metering DER 250 kW and above but less than 1,000 kW that do not require Direct Transfer Trip (DTT), the same requirements as described in section 3.2 apply along with a PQ device prior to interconnection. The Dominion Energy owned PQ device will have shunt trip capability of the customer owned breaker and will be located at the load side of the disconnect switch. The PQ

device is meant to provide visibility of the Net Metering DER to Dominion Energy's Regional Operation Center (ROC) by providing real time status of the generation through constant polling. Further details on the interconnection parameters for DER ≥250 kW and < 1,000 kW are provided in Figure 2 below.

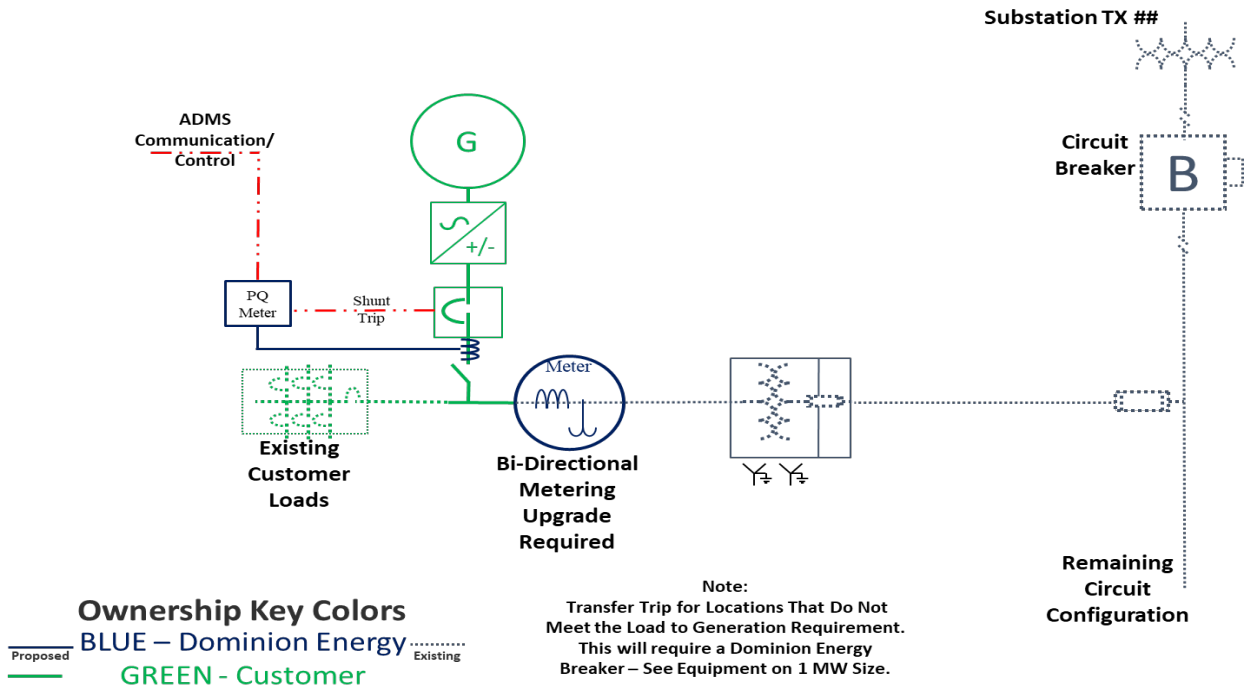


***Figure 2**: Typical Layout for Net Metering DER ≥250 kW and < 1,000 kW (No DTT required)*

3.3.2 Net Metering DER ≥ 250 kW and < 1,000 kW (with DTT required)

For the interconnection of a Net Metering DER 250 kW and above but less than 1,000 kW that require Direct Transfer Trip (DTT), the same requirements as described in section 3.2 apply along with a Customer owned low voltage breaker and a Dominion Energy owned PQ device prior to interconnection. The Dominion Energy owned PQ device will have shunt trip capability and will be located at the load side of the disconnect switch. The PQ device is meant to bring visibility of the Net Metering DER to Dominion Energy's ROC by providing real time status of the generation through constant polling as well as control capability of the low voltage breaker. Further details on the interconnection parameters for DER ≥250 kW and < 1,000 kW that require DTT are provided in Figure 3 below.

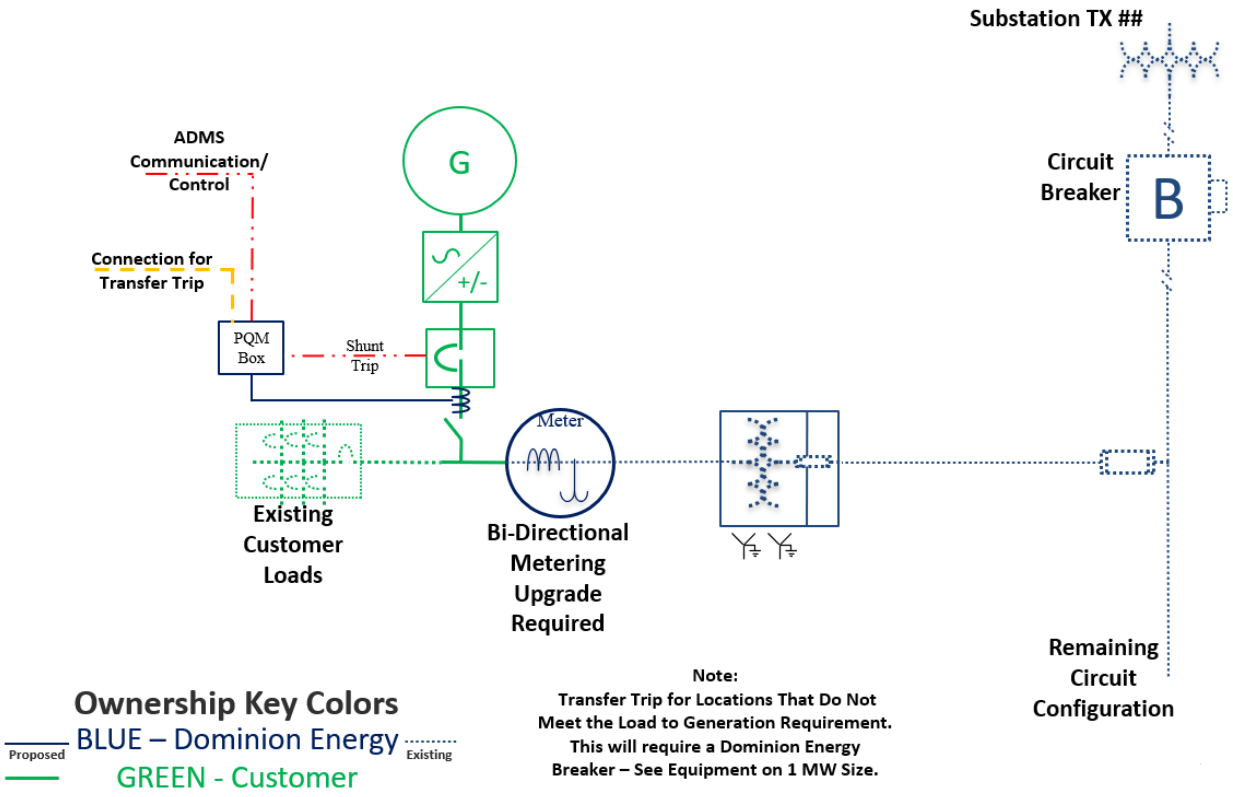


***Figure 3**: Typical Layout for Net Metering DER ≥250 kW and < 1,000 kW (DTT Required)*

3.4 Interconnection Parameters for Net Metering DER ≥1,000 kW and ≤3,000 kW

The following subsections describe the typical interconnection configurations for Net Metering DER ≥1,000 kW and ≤3,000 kW.

3.4.1 Net Metering DER ⩾1,000 kW and ⩽3,000 kW (Existing Service Transformer)

For the interconnection of a Net Metering DER 1,000 kW and above but not exceeding 3,000 kW that is connecting at the low voltage side of an existing service transformer, a customer owned low voltage breaker and a Dominion owned PQ device will be required prior to interconnection. The Dominion Energy owned PQ device will have shunt trip capability and will be located at the load side of the disconnect switch. The PQ device is meant to bring visibility of the Net Metering DER to Dominion Energy's ROC by providing real time status of the generation through constant polling as well as control capability of the

low voltage breaker. Further details on the parameters of the external power supply are provided in Figure 4 below.

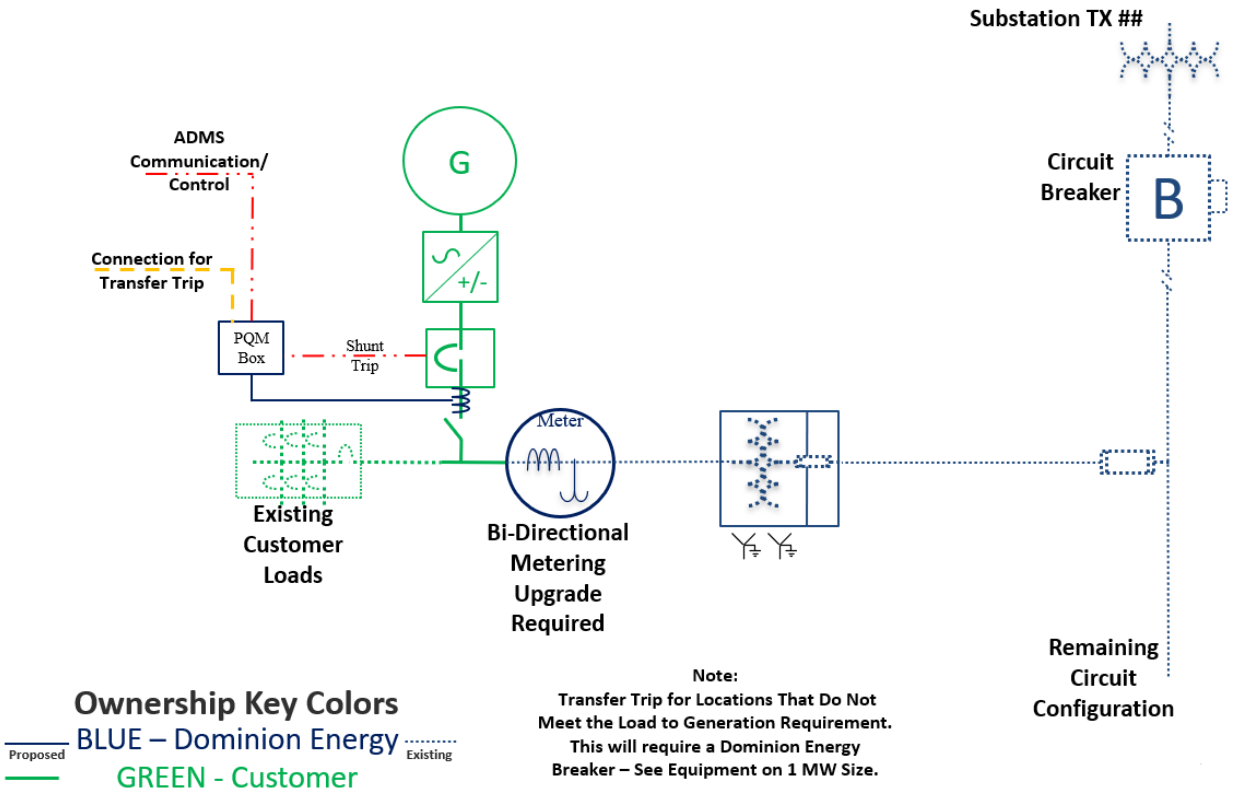


***Figure 4**: Typical Layout for Net Metering DER ≥1,000 kW and ≤3,000 kW (Existing Service Transformer)*

3.4.2 Net Metering DER ≥1,000 kW and ≤3,000 kW (Dominion Energy owned Transformer)

For the interconnection of a Net Metering DER 1,000 kW and above but not exceeding 3,000 kW that is connecting at the low voltage side of a Dominion Energy owned transformer, a recloser with a SEL-651R controller will be required at the medium voltage (primary) side of the transformer (i.e., typically 34.5 kV). Also, a Dominion Energy owned PQ device will be required at the low voltage side prior to interconnection. The PQ device will provide Dominion Energy's ROC real time status of the generation through constant polling as well as control capability of the POI recloser. The typical winding configuration of a Dominion Energy owned distribution transformer will be Wye-ground / Wye-ground. Further details on the

parameters of the external power supply are provided in Figure 5 below. Please note that facilities charges totalization/aggregation will typically apply.

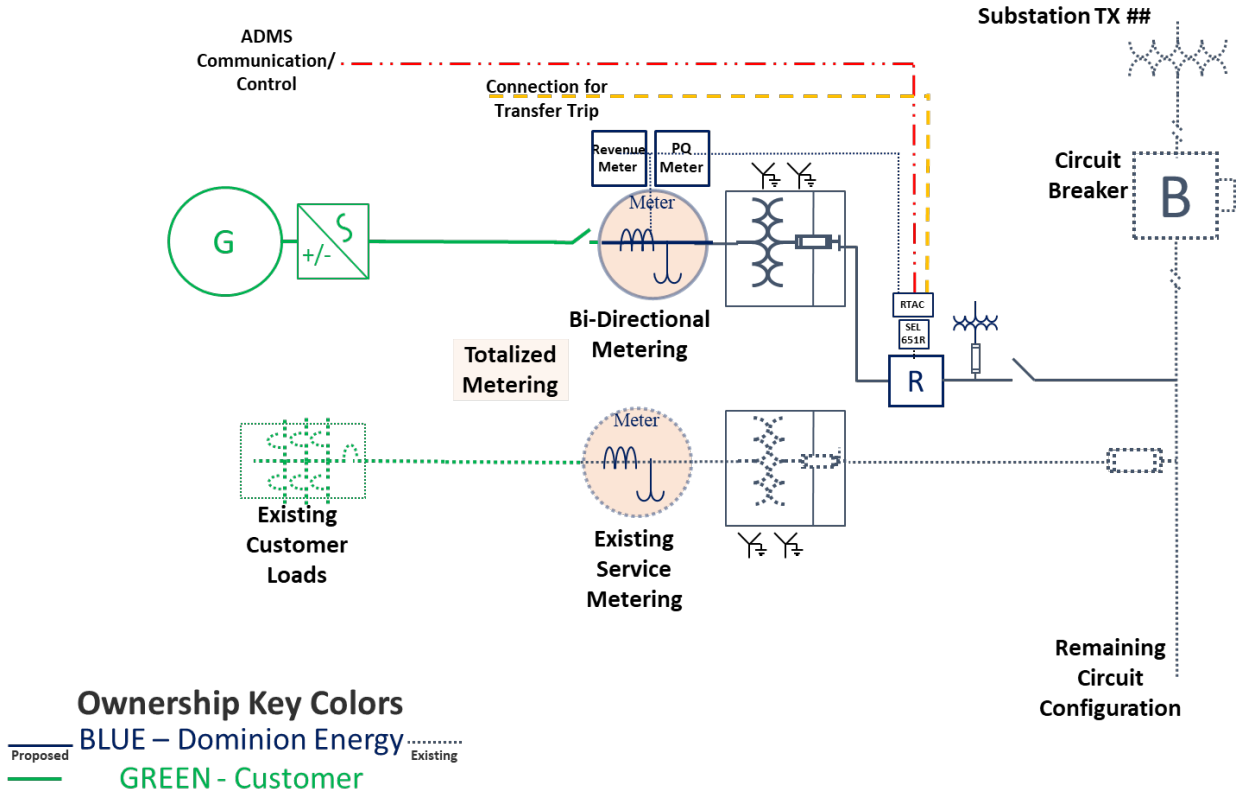


***Figure 5**: Typical Layout for Net Metering DER ≥1,000 kW and ≤3,000 kW (Dominion Energy owned Transformer)*

3.4.3 External power supply for Net Metering DER ≥1,000 kW and ≤3,000 kW (Dominion Energy owned Transformer)

For interconnection of Net Metering DER 1,000 kW and above but not exceeding 3,000 kW, with Dominion Energy owned transformer, the customer has the option of obtaining an external power supply up-line from the POI to the DER site for service power needs. This could be an alternate power supply to the site for emergency/auxiliary load. Further details on the parameters of the external power supply are provided in Figure 6 below. Please note that facilities charges for totalization/aggregation costs will typically apply.

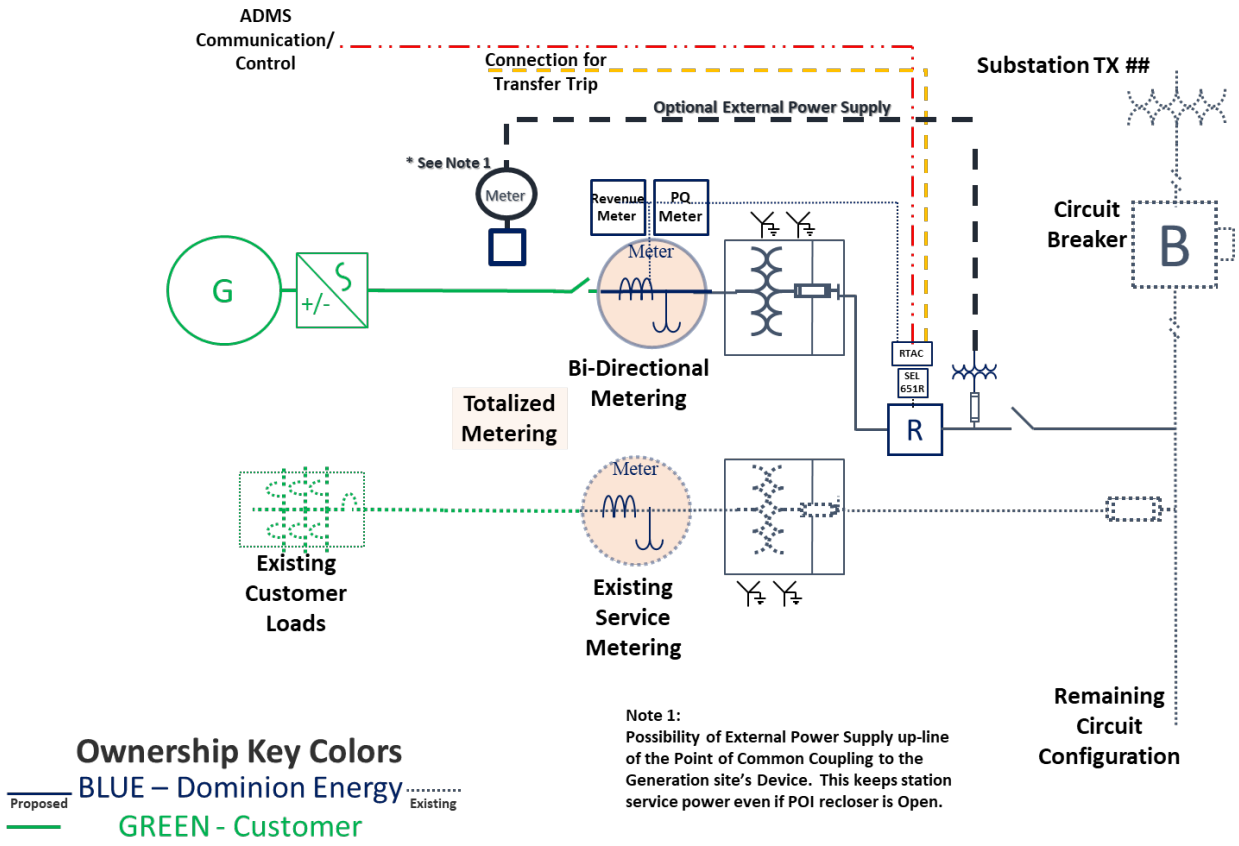


Figure 6: ***External Power Supply for Net Metering DER ≥1,000 kW and ≤3,000 kW (DER customer-owned Transformer)***

3.4.4 Net Metering DER ≥1,000 kW and ≤3,000 kW (DER customer-owned Transformer)

For interconnection of Net Metering DER 1,000 kW and above but not exceeding 3,000 kW, a Dominion Energy owned recloser with a SEL-651R controller and a PQ device will be required prior to interconnection. The Dominion Energy owned PQ device will provide Dominion Energy's ROC real time status of the generation through constant polling as well as control capability of the POI recloser. Further details on the parameters of the external power supply are provided in Figure 7 below.

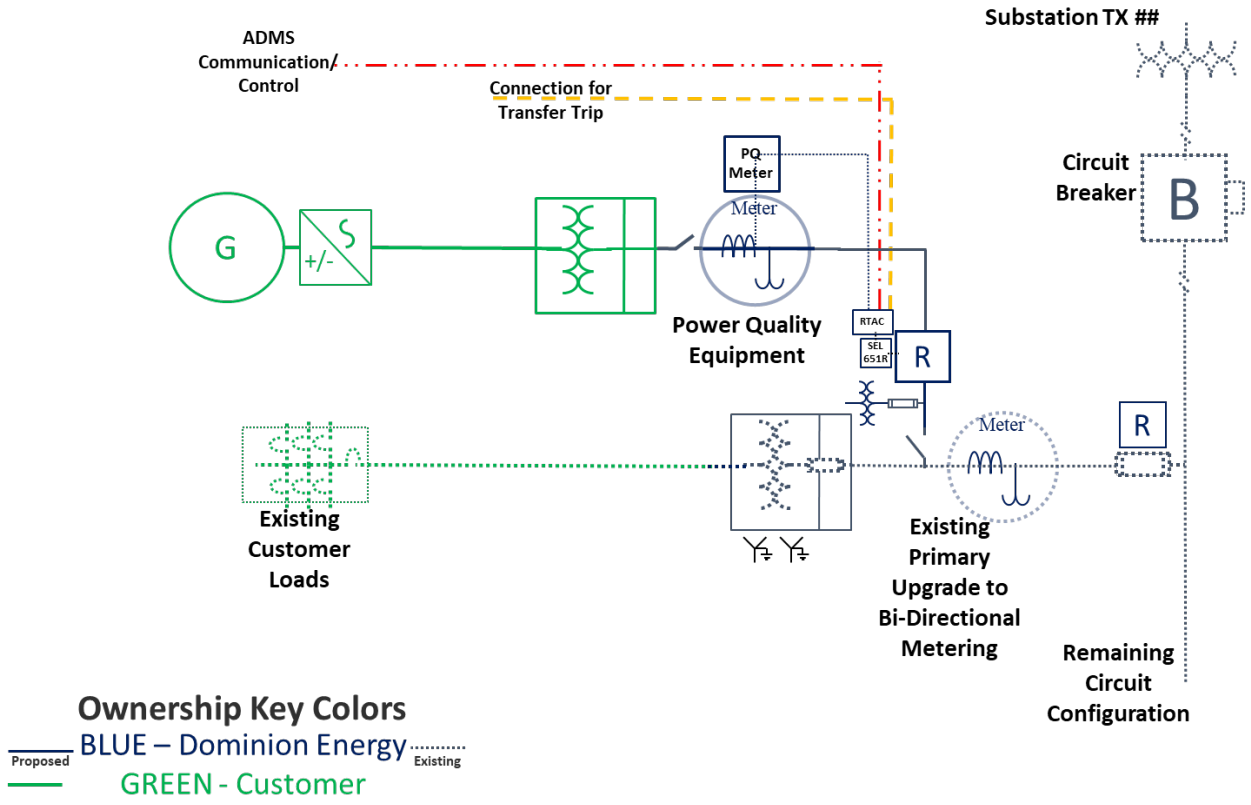


***Figure 7:** Typical Layout for Net Metering DER ≥1,000 kW and ≤3,000 kW (DER customer-owned Transformer)*

3.4.5 External power supply for Net Metering DER ≥1,000 kW and ≤3,000 kW (DER customer-owned transformer)

For interconnection of Net Metering DER 1,000 kW and above but not exceeding 3,000 kW, with customer owned GSU, the customer has the option of obtaining an external power supply up-line from the POI to the DER site for service power needs. This could be an alternate power supply to the site for emergency/auxiliary load. Further details on the parameters of the external power supply are provided in Figure 8 below. Please note that facilities charges for totalization/aggregation costs will typically apply.

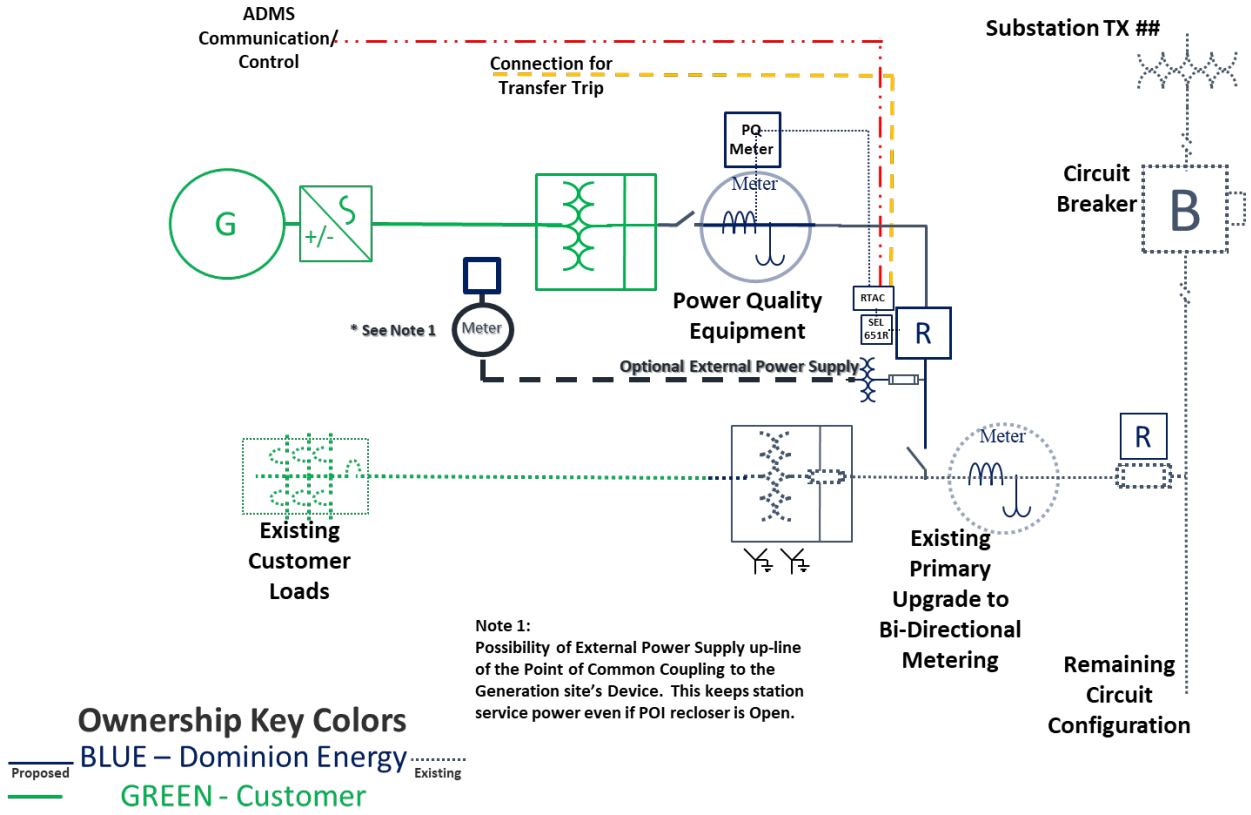


***Figure 8**: External Power Supply for Net Metering DER ≥1,000 kW and ≤3,000 kW (DER customer-owned Transformer)*

4 Applicable Guides, Codes & Standards, State Jurisdictional Rules & Procedures

The following list of applicable guides, codes and standards, state jurisdictional rules and procedures is not meant to be exhaustive. Procurement and understanding of standards referenced within this document are the responsibility of interconnection customer.

20 VAC 5-315: Code of Virginia, State Corporation Commission, Chapter 315, Regulation Governing Net Energy Metering.

Docket **No. E-100, Sub 101**: North Carolina Utilities Commission, Interconnection Procedures, Forms and Agreements, For State-Jurisdictional Generator Interconnections.

IEEE Std. 1547-2018: IEEE Standard for Interconnection and Interoperability of Distributed Energy Resources with Associated Electric Power Systems Interfaces.

IEEE Std. 1547a-2020: IEEE Standard for Interconnection and Interoperability of Distributed Energy Resources with Associated Electric Power Systems Interfaces.

Amendment 1: To Provide More Flexibility for Adoption of Abnormal Operating Performance Category III.

IEEE Std. 1547.1: IEEE Standard Conformance Test Procedures for Equipment Interconnecting Distributed Resources with Electric Power Systems.

UL 1741: Inverters, Converters, Controllers, and Interconnection System Equipment for Use with Distributed Energy Resources.

UL 6141: Wind Turbines Permitting Entry of Personnel.

UL 6142: Small Wind Turbine Systems.

UL 1973: Standard for Batteries for Use in Stationary, Vehicle Auxiliary Power and Light Electric Rail (LER) Applications.

UL 9540: Standard for Energy Storage Systems and Equipment.

IEEE 519-2014: IEEE Recommended Practices and Requirements for Harmonic Control in Electrical Power Systems.

IEEE P2030.2.1/D7.0: IEEE Draft Guide for Design, Operation, and Maintenance of Battery Energy Storage Systems, both Stationary and Mobile, and Applications Integrated with Electric Power Systems.

IEEE 2032.2-2015: IEEE Guide for the Interoperability of Energy Storage Systems Integrated with the Electric Power Infrastructure.

ANSI C84.1: Electric Power Systems and Equipment—Voltage Ratings (60 Hz).

IEEE 1453-2015: IEEE Recommended Practice for the Analysis of Fluctuating Installations on Power Systems.

IEEE C62.92.6-2017: IEEE Guide for Application of Neutral Grounding in Electrical Utility Systems, Part VI – System Supplied by Current-Regulated Sources.

IEEE C62.41.2: Recommended Practice on Characterization of Surges in Low-Voltage (1000 V and less) AC Power Circuits.

NFPA 70: National Electric Code (NEC).

NFPA 855: Standard for the Installation of Stationary Energy Storage Systems.

NESC: National Electrical Safety Code.

APPENDIX A:
Typical Layout of Connection Facilities

***Figure 1**: Typical Primary Distribution Facility Layout (1,000 kW and above)*

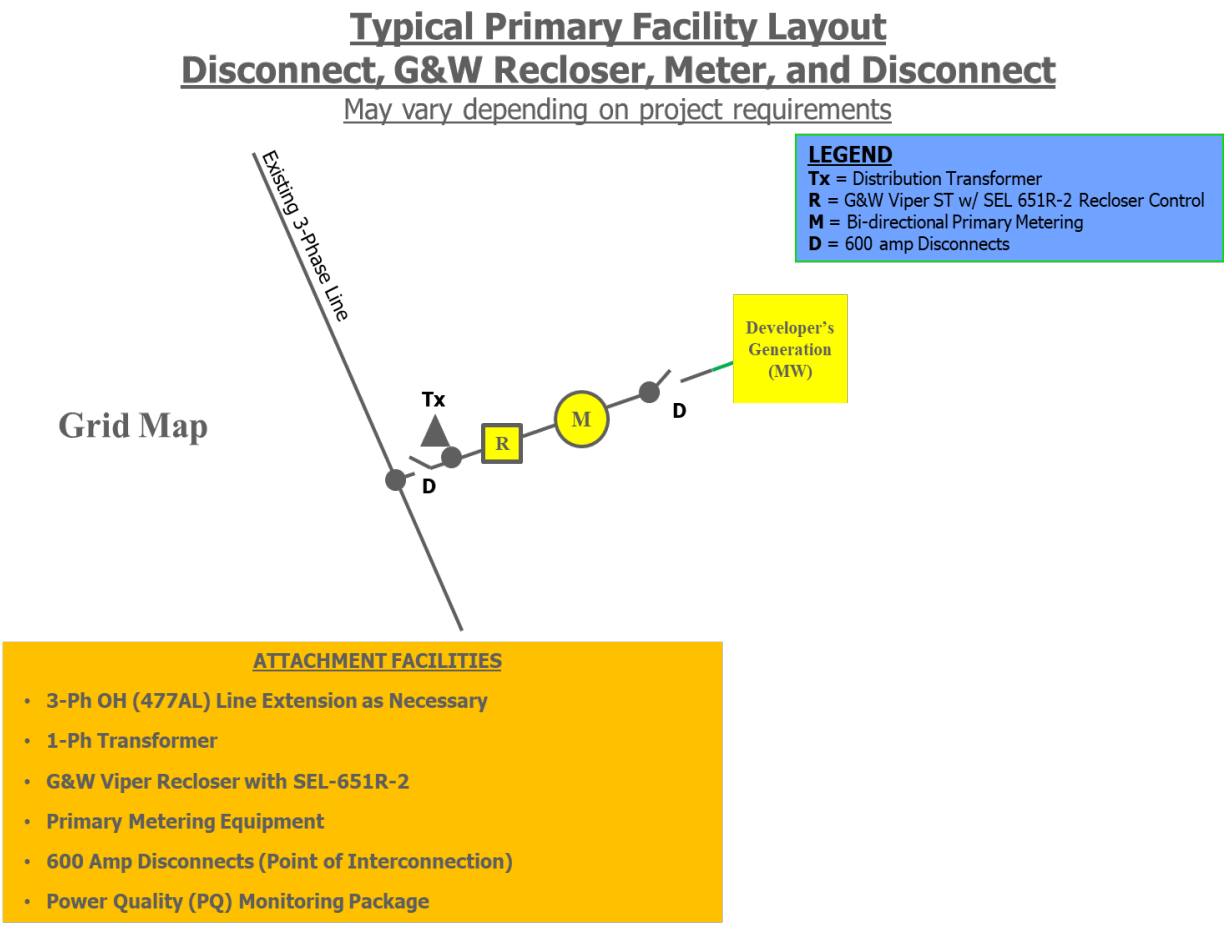


Figure 2: Typical Primary Distribution Facility Layout with additional details (DER customer owned transformer)

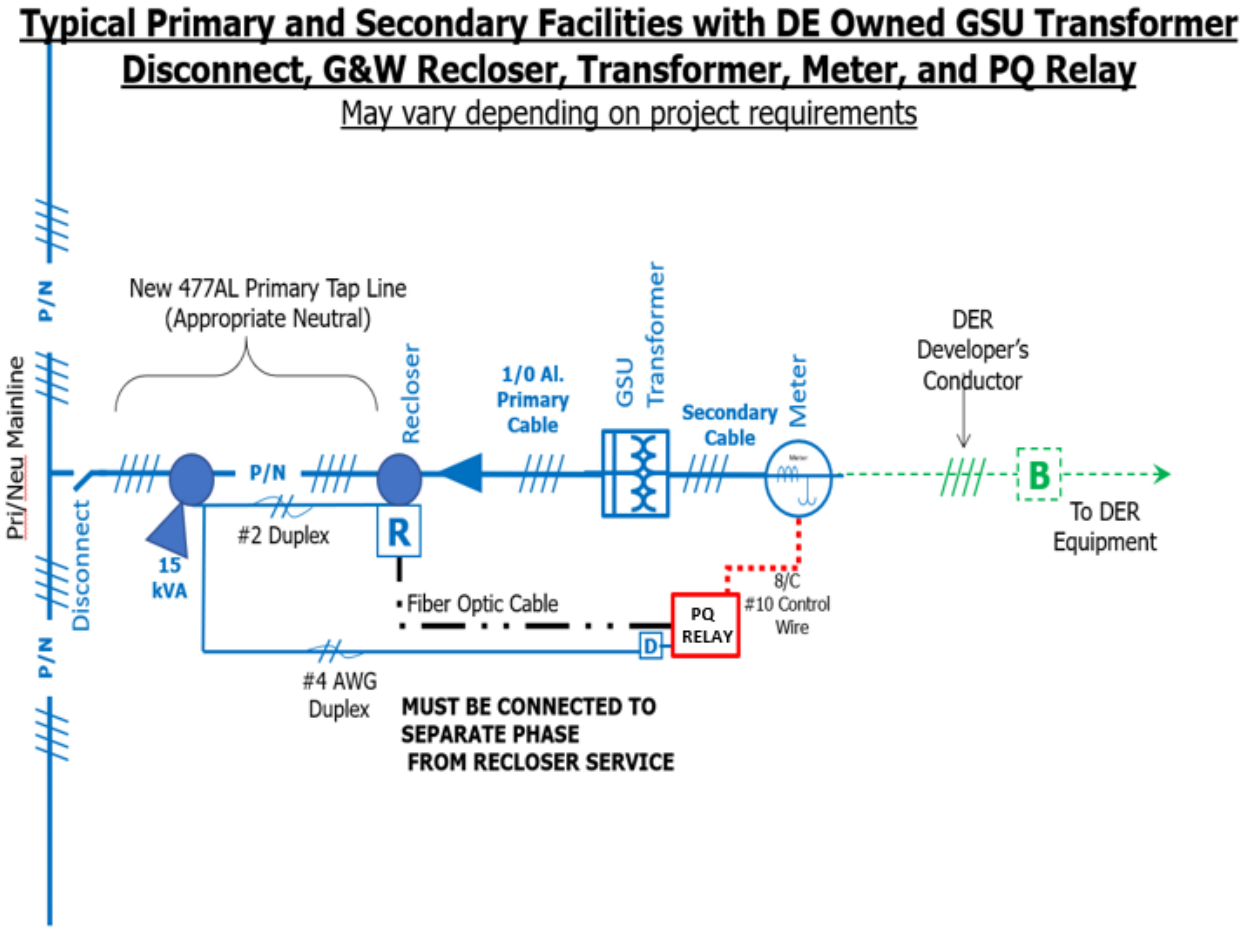
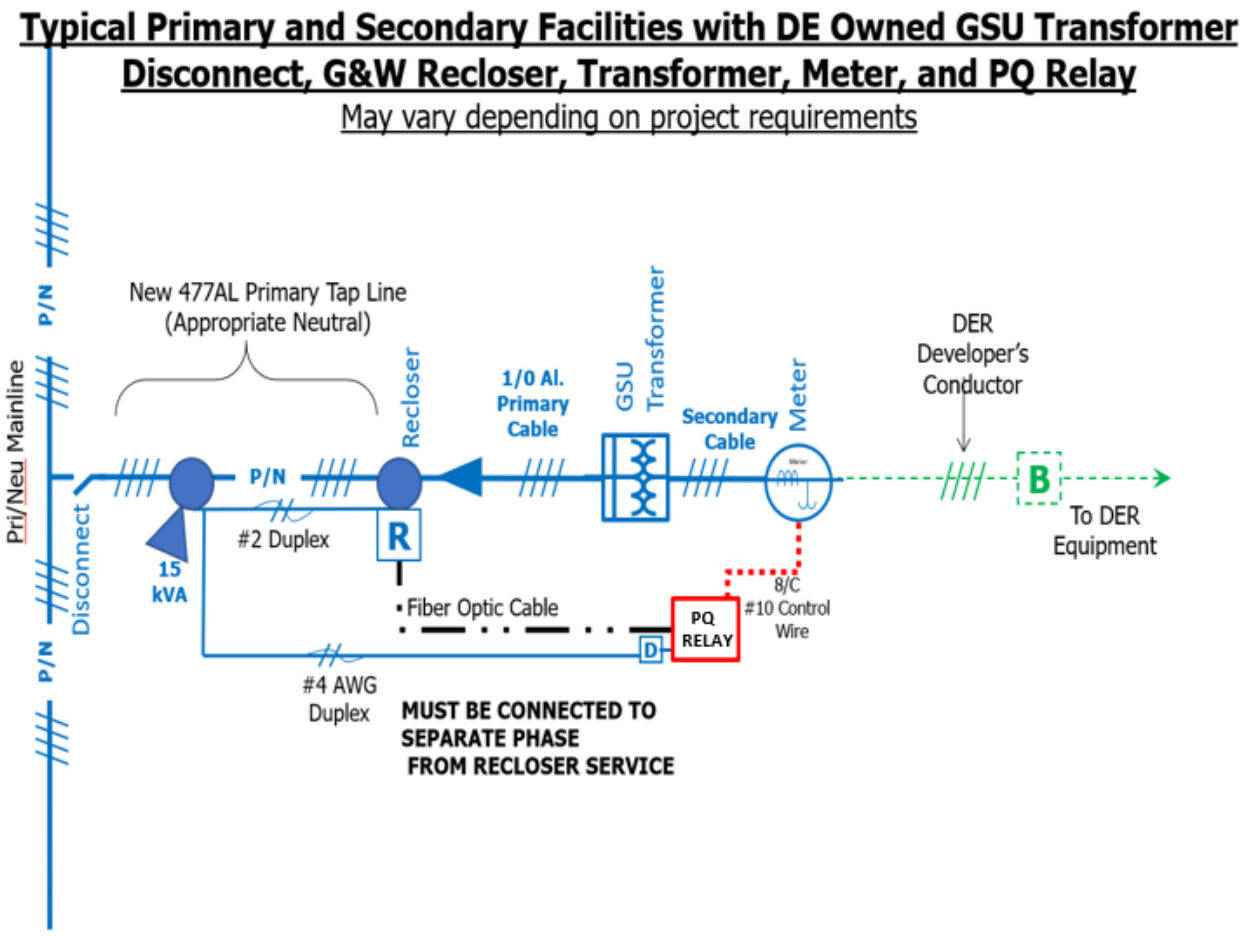


***Figure 3**: Typical Primary and Secondary Distribution Facilities Layout (Dominion owned transformer)*



APPENDIX B: ESS Interconnection Configurations

This Appendix shows the typical ESS configurations. This is only an illustrative example of potential configurations and is not an exhaustive list. Dominion Energy may add or modify configurations in the future.

C1 DC coupled ESS

A DC coupled ESS consists of a uni-directional DC-AC inverter which is shared by both the ESS and the renewable resource (i.e., typically Solar PV). Although, the ESS's DC to DC converter is designed to be bi-directional, the design is such that the ESS can only be charged by the DC source. This configuration is subject to Dominion Energy's Net Metering DER interconnection study parameters.

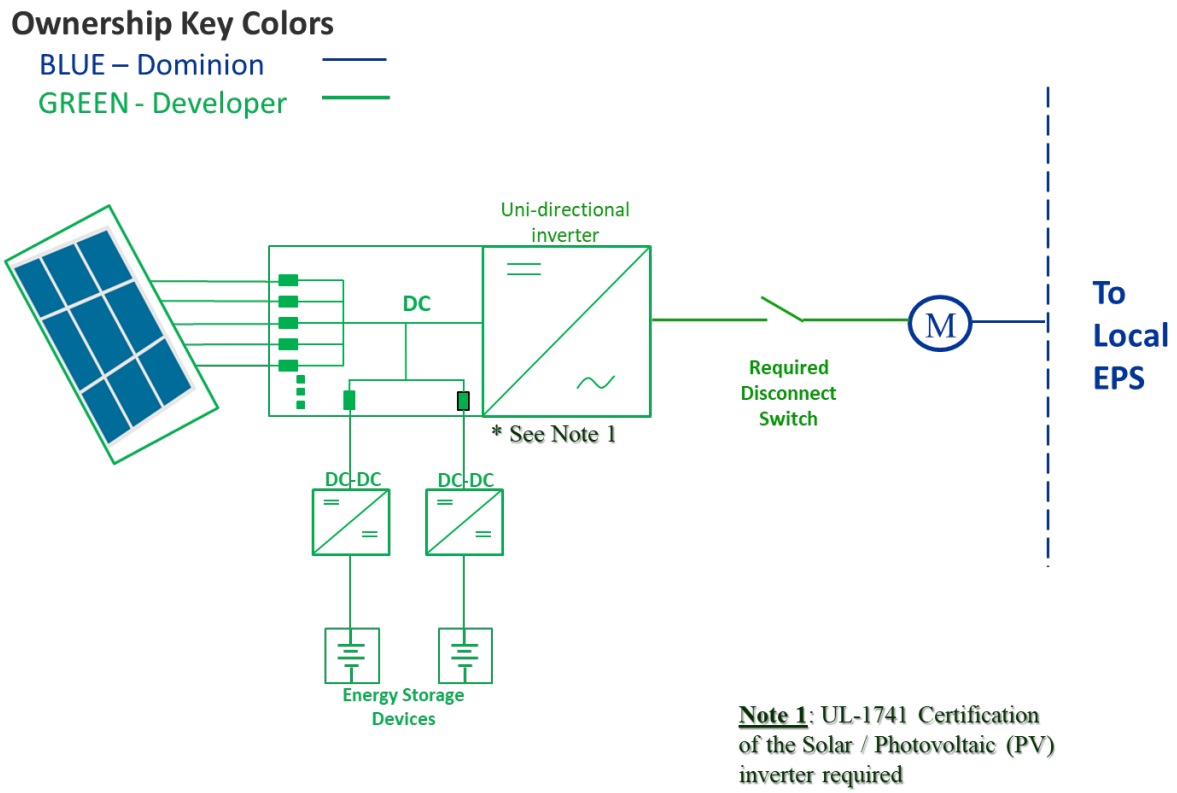


Figure 4: DC coupled ESS (Configuration 3)

APPENDIX C: Estimated facilities costs for typical DER upgrades

ESTIMATED FACILITIES COSTS REVISION HISTORY:

Facilities Costs type	Date	Revisions
Distribution Improvement	March 2021	Initial Release
Substation Improvement	February 2021	Initial Release
Distribution Improvement	January 2024	Update 2.0
Substation Improvement	January 2024	Update 2.0

Disclaimer:

The following cost estimates are not binding for actual facilities costs and are provided for informational purposes only to assist customers in their planning for DERs. These cost estimates have not been determined in connection with any particular interconnection and are subject to change at any time by Dominion Energy. In addition, other substation upgrades and protection facilities that are not identified below may be required for transformers. The distribution and substation improvement estimates are for materials only; engineering, labor, and construction costs are adders. Notwithstanding these cost estimates, a customer shall be responsible for the actual costs for any required distribution and substation improvements required for the interconnection of its DER.

Distribution Improvement:

1-Mile of Small 1-phase Wire Upgraded to 3-phase 477 AAC	$ 700K - $ 900K
1-Mile 3-phase Re-Conductor from Small Wire to 477 AAC	$ 700K - $ 1.1M
1-Mile Conversion to 34.5 kV - Same wire	$ 700K - $ 900K
1-Mile Over-build Existing Line with 477 AAC	$ 900K - $ 1.1M
1-Mile Conversion and Re-Conductor to 477 AAC	$ 900K - $ 1.1M
Adder[2] – Distribution Wire Upgrade, Overbuild, or Conversion (Engineering \ Mobilization \ Construction Management)	$ 200K - $ 400K
Install New or Replace Existing Recloser with G&W Unit	$ 125K
Install New 1- 1-phase Regulator	$60k
Install New 3- 1-phase Regulators as a Bank	$ 125K
Adder[3] - Off-Road Work - 1- Mile - Varies	$ 400K - $ 800K

[2] This adder is applicable to the following distribution improvement work, and is not on a per mile basis:
- 1-Mile of Small 1-phase Wire Upgraded to 3-phase 477 AAC.
- 1-Mile 3-phase Re-Conductor from Small Wire to 477 AAC.
- 1-Mile Conversion to 34.5 kV - Same wire.
- 1-Mile Over-build Existing Line with 477 AAC.
- 1-Mile Conversion and Re-Conductor to 477 AAC.

[3] [4] [5] These adders could apply to any distribution improvement work

Adder[4] - Permit/Hours Restrictions - 1-Mile of Work - Varies	$ 80k - $120k
Adder[5] - 2000 Feet of Environmental Matting	$ 200K - $350k
Install Power Quality Equipment	$ 20-25k
Install new over-head service transformer	$ 4k –14k
Install new pad-mount service transformer	$ 30k - $ 100k
1-Mile Fiber Install for Transfer Trip	$150k - $250k
Install Low Voltage Breaker & associated devices/equipment	$60k - $90k

Substation Improvement:

Adding New Circuit Breaker (34.5 kV) in Existing Bay	$ 200K - $500k
Adding New Circuit Breaker (34.5 kV) and Adding New Bay	$ 250K - $1.0M
Adding 115/34.5 kV, 20/27/33.6 MVA Transformer	$ 2.6M - $ 2.9M
Adding 230/34.5 kV, 20/27/33.6 MVA Transformer	$ 2.9M - $ 3.2M
Adding 230/34.5 kV, 33.6/44.8/56 MVA Transformer	$ 3.4M- $ 3.6M
Adding 230/34.5 kV, 50.4/67/84 MVA Transformer	$ 3.6M - $ 4.2M
DG Relay Panel Only	$ 250K
Additional Typical Protection - Varies	$ 150 - $ 250 K
10-Foot Control Enclosure Expansion	$ 250K
New Control Enclosure	$ 800K
Adder[6] - TX Engineering \ Mobilization \ Construction Management	$ 200K - $ 1,200K

[6] This adder is applicable to all substation improvement work.