



Distribution System Interconnection Guide for Customer-Owned Power Production Facilities less than 10 MW

Revision History

Revision	Date	Revised by	Comments
14.0	11/12/2024	Chelon Bihon, Megan Brannen, Lacey Frerich, Christopher Johnson, Nicholas ONiell, Stuart Priour, Abdur Rahman, Bryan Viera	Major revision – Revised all sections to better align with City of Austin adoption of NEC 2023 code (see Section C. General System Requirements in particular), added a Contacts page, added Meter Variance process details, updated Metering diagrams, B8-B13 (removed diagram B7 for High-leg interconnections as this is covered within Section F. Definitions).
13.0	11/20/2023	David Cranston /Megan Brannen	Minor revision – Revised Section C to confirm change in ESS interconnection policy; updated hyperlinks throughout
12.0	11/21/2022	David Cranston	Major revision – Revised Sections A-D, revised Section B Process Flows, updated one-line diagrams in Appendix B, added Contractor Quick Reference Guide in Appendix C, Added Appendix H and accompanying one-line diagram for Resiliency as a Service, added process for utility-side solar interconnection, updated process for DG systems \geq 500 kW
11.0	6/23/2021	Valerie Paxton / Andrew Durham	Major revision – Revised Section C General Layouts and Requirements to include Inspection Checklist items, added language for Energy Storage Systems (ESS), removed 2 ESS layouts. Revised Appendix C to refer to Section C. Revised Appendix D Interconnection Agreement.
10.0	10/25/2019	Steve Allmond	Minor revision – Appendix F – Emergency Response Service (ERS) Application updated per program changes; revised Appendix E – Network Interconnection Specifications; made various formatting and other miscellaneous changes.
9.0	4/4/2018	Steve Allmond	Major revision – changed various descriptions and formatting; expanded definitions; added narratives for clarity in explanations; updated drawings, diagrams, & configurations and equipment requirements; updated flowchart for interconnection application process; changed requirements for transfer/trip to align with PUCT; added "ahead of the meter" shared solar systems to types of interconnections.
8.0	1/31/2017	Steve Allmond	Major revision – changed category limits, descriptions, formatting; reworked Definitions & Codes and Standards sections.
7.0	6/3/2016	Clayton Stice / Steve Allmond / Juan Ordonez	Minor revision – Appendix F – Emergency Response Service (ERS) Application updated per ERCOT program changes, added Appendix G - EV Connection Guide.

6.0	12/15/2015	Clayton Stice	Major revision – update for NEC2014, add references for energy storage, high leg systems, update metering and downtown network sections, change category limits, general updates.
5.0	12/19/2014	Brian Inocente	Minor revision – added Appendix F - Emergency Response Service (ERS) Application.
4.0	10/22/2013	Clayton Stice	Major revision – include all systems below 10 MW, reorganized sections to clarify process flow, added insurance requirements for systems over 500 kW, confidentiality notice and updated requirements based on proposed discussions regarding pIEEE 1547.8 and pIEEE 1547a.
3.0	5/15/2012	Clayton Stice/Sharon Bickford	Minor revision – update metering and code requirements and include updates to IEEE 1547.4, 1547.6.
2.0	9/15/2011	Clayton Stice Stanley Consultants TX - 174	Minor revision – revised Interconnection Package and Forms; included references to Downtown Network Installations; consolidated/rearranged divisions and expanded complex metering section due to new ERCOT reporting requirements, expanded codes and references sections.
1.0	10/7/2010	Clayton Stice Stanley Consultants TX - 174	Major revision – clarified scope of document for 50 kW to <10MW; added Appendix A-Interconnection Package and Forms; included references to AE Design Criteria Guide and ESPA; added complex metering to meet ERCOT requirements, expanded definitions, codes and references sections; added hyperlinks to other web references; general rewrite and updates to all sections.

AUSTIN ENERGY
 DISTRIBUTION SYSTEM INTERCONNECTION GUIDE FOR
 CUSTOMER-OWNED POWER PRODUCTION FACILITIES
 LESS THAN 10 MW

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CONTACTS

Division	Subject Matter	Email	Phone #
AE Solar Team	Rebates and Incentives, Billing, Value of Solar questions	solar@austinenergy.com	N/A
AE Solar Inspectors	Solar and ESS inspections, NEC, IBC, City Ordinances, IFC, RaaS	solarinspections@austinenergy.com	N/A
DER Integration	Systems >500kW, System Operations & Advanced Technology, Feasibility Studies, ESD Implementation studies, Transformer Upgrade analyses	aeesdderinteam@austinenergy.com	N/A
Distribution Metering Operations (DMO)	AE Revenue and PV Metering	AEDMODispatch@austinenergy.com	512-505-7620
St. Elmo Distribution	Scheduled and Unscheduled / emergency outages	StElmoDistribution@austinenergy.com	512-505-7620
Advanced Metering Engineering	Meter Variances, Service design questions	aeadvancedmeteringengineering@austinenergy.com	N/A
Development Services Department (DSD) Inspections Scheduling Manager, Hyatt Dunn	City of Austin Inspections and coordinated COA Shut-down scheduling	Hyatt.Dunn@austintexas.gov	N/A

Find additional contacts on the AE Website, using the Contractors / Construction and Renovation / Contact Information page, here: <https://austinenergy.com/contractors/construction-renovation/contact-information>.

INTRODUCTION

The primary purpose of this guide is to provide a general outline of the process for connecting a Distributed Generation (DG) or Distributed Energy Resource (DER) facility to the Austin Energy distribution system. This document also defines the minimum technical and financial liability requirements for safe integration of customer-owned power production facilities with the Austin Energy (AE) Distribution System (Note: The typical AE Distribution System voltage is 12.47 kV). This information is provided to maintain safe and reliable service to generating facilities and customers.

This guide covers the following types of Distributed Generation/Distributed Energy Resources (DG/DERs):

- i. Inverter Based Systems: Solar PV and Energy Storage Systems (ESS)
- ii. Synchronous or Induction Motor Systems: Wind generation, standard fossil-fuel based motor generators.
- iii. Other Types: Will be reviewed as encountered and may not be fully covered by this guide.

This guide is intended as a supplement to the requirements of the current version of IEEE Standard 1547, accepted industry practices/ standards, and applicable regulations. It is intended as a supplement to the PUC and the IEEE for installation/interconnection of DG/DER systems, specifically on Austin Energy’s electrical distribution system.

In general, the DG/DER System and associated facilities must be designed in accordance with, but not limited to, UL (Underwriters Laboratories) Standards, IEEE (Institute of Electrical and Electronics Engineers) Standards, NEC (National Electrical Code), NESC (National Electrical Safety Code), PUC (Public Utility Commission of Texas), ERCOT (Electric Reliability Council of Texas) Operating Guides and Protocols, Austin Energy Electric Service Standards and Design Criteria Manual, and any other applicable Local, State, or Federal codes or standards. Particular attention should be paid to UL 1741, UL9540, IEEE 519, and IEEE 1547.

The contents of this Guide are arranged as follows:

Sections A-B	Application Process
Sections C-D	Technical Requirements for Installations
Section E	Customer Responsibilities
Sections F-G	Applicable Codes and Standards and Definitions
Appendices A- E	References
Appendix F	Emergency Response Service (ERS) Applications and Form
Appendix G	Plug-in Electric Vehicles (PEV) paired with Time-of-Use (TOU) metering systems
Appendix H	Resiliency as a Service (RaaS) General Guidelines

Since this standard is updated regularly, it is the user’s responsibility to verify that the most recent version of this document is being used.

The latest released version of this guide can be found on the AE website at: https://austinenergy.com/-/media/project/websites/austinenergy/contractors/ae_dg_interconnection_guide.pdf?sc_lang=en&hash=48BD8C37259758E858F9C29544797654.

A. INTERCONNECTION CLASSIFICATIONS

AE specifies five classifications of interconnections on its Distribution System. The two primary classifications are the location on the distribution system (is it located on the downtown network) and size of the generation in kilowatts*. To determine if the system is on the downtown network use **Appendix A** of this guide or **Section 1.12** of the **AE Design Criteria Manual**.

* Note: The size of a system will be an aggregate of all systems combined, both existing and proposed, and all values used in this guide are noted in alternating current (AC), not direct current (DC).

Interconnection Classification	Size (kW)	On Downtown Network?	% of Systems Typically Installed	Section	Process Flow Diagram
1	<25	no	90%	B.1	1
2	25-499	no	10%	B.2	2
3	500-9,999	no	<1%	B.3	3
4	10,000+	no	NA	NA	NA
5	Any Size	yes	<1%	B.3 / Appendix E	3

1. Systems (not on the Downtown Network) which are less than 25 kW

The process for interconnecting systems less than 25 kW **and NOT** on the Downtown Network is covered in **Section B.1** of this Interconnection Guide.

2. Systems (not on the Downtown Network) which are 25 kW to less than 500 kW

The process for interconnecting systems from 25 kW to less than 500 kW **and NOT** on the Downtown Network is covered in **Section B.2** of this Interconnection Guide.

3. Medium Systems (not on the Downtown Network) 500 kW to less than 10 MW or Resiliency as a Service Systems

Detailed procedures for interconnecting systems 500 kW to less than 10 MW and NOT on the Downtown Network are covered in **Section B.3** of this Interconnection Guide.

4. Large Systems (not on the Downtown Network) 10 MW or greater

Standards for a facility this large (10 MW and up) are not established in this document and are typically interconnected at the transmission level. This process is handled by the Director of Transmission and Distribution Planning. These interconnections are completed using mutually agreed upon technical standards. Contact Transmission and Distribution Planning at **reza.ebrahimian@austinenergy.com**.

- a. Any entity proposing total generation 10 MW or greater needs to follow the Generation Interconnection or Change Request Procedure. Details are available on the ERCOT website at:
<http://www.ercot.com/gridinfo/generation>.
- b. The “Austin Energy Facility Connection Requirements” document may also be referenced and is available on AE’s website at:
<https://austinenergy.com/contractors/construction-renovation>
 - **Select the “Contractors” tab, then select the “Construction & Renovation” tab.**

5. Any Commercial or Residential System on the Downtown Network

Detailed procedures for interconnecting systems of any size that **are** on the AE Downtown Network are covered in **Section B.3** of this Interconnection Guide.

B. APPLICATION PROCESS FOR DISTRIBUTED GENERATION/ DISTRIBUTED ENERGY RESOURCES FACILITIES

The contractor is required to obtain an electrical permit for construction of any generation facility interfaced to the AE system per Austin Electrical Code Section §25-12-113. This applies to all entities served by Austin Energy, whether residential, commercial, or government agencies.

All procedures for obtaining a City of Austin (COA) electrical permit apply, regardless if the system is installed within Austin or a separate Extraterritorial Jurisdiction (ETJ).

AE offers rebates and incentives for customers to install Solar PV.

Refer to the AE website for more information: **[AustinEnergy.com/Solar](https://www.austintexas.gov/Solar)**

For commercial applications, please see the following link to Permit Application Instructions and Checklist:

- Commercial DG Permit Applications: <https://www.austintexas.gov/page/commercial-plan-review>
- Commercial DG Permit Application Checklist: https://www.austintexas.gov/sites/default/files/files/Development_Services/COM_QuickTurnaroundPermit.pdf

System Requirements General Overview

Combined Site Generation	<500kW	>=500kW	RaaS	>1MW	>2MW	>4MW	>5MW
Customer Completed DGPA	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Feasibility/ Hosting Capacity Study	High DER feeders may be required.	Yes	Yes	Yes	Yes	Yes	Yes
Application and Engineering Review		Yes	Yes	Yes	Yes	Yes	Yes
AE Isolation Device		Yes (If NOT Inverter Resource (IBR))	Yes	Yes (if not IBR)	Yes	Yes	Yes
Direct Transfer Trip		Yes (via wireless if not IBR)	Yes (via wireless)	Yes (via wireless if not IBR)	Yes (Via Fiber)	Yes (Via Fiber)	Yes (Via Fiber)
Application and Impact Study Required		Yes (If not IBR)	Yes	Yes	Yes	Yes	Yes
ERCOT registration with settlement only DG Meter (Ion Meter)			Yes (Additional Ion meters needed for Generation Meter and TDSP meter)	Yes	Yes	Yes	Yes
Dedicated feed or load split between feeders						Yes	Yes
Primary metering and transmission Interconnection study			May be needed depending on RaaS site/ project.				Yes

NOTE: Systems >10MW require transmission planning review and are **not covered in this table**.

1. Process for Systems Rated <25 kW and NOT on the Downtown Network

Systems less than 25 kW **and NOT** on the Downtown Network have a streamlined process that is covered in steps a thru i below and on the process flow diagram on p.19.

Systems in this category are typically handled through the Permit and Development Center with City of Austin (COA).

Please email Customer Energy Solutions (CES) at solarinspections@austinenergy.com if you have questions or need help getting started.

The contractor is required to fill out a **DGPA (Distributed Generation Planning Application)** which can be found on the AE website at:

<https://austinenergy.com/contractors/construction-renovation/documents-forms/customer-power-production>

- Select the “Contractors” tab, then select the “Construction & Renovation” tab; navigate to “Documents and Forms”, and then select the “Customer-Owned Power Production Facilities” sub-tab.
- Note that although the DGPA form is necessary for all Auxiliary Power projects, AE approval is NOT required for systems less than 25 kW.

b. For DG/DER resources interconnected directly to Austin Energy’s equipment (i.e., utility- side interconnections), the contractor is required to fill out an **Electric Service Planning Application (ESPA)**. Utility-side interconnection of DG/DER requires establishment of a new service, which is requested through the ESPA. This form can be found on the AE website at:

<https://austinenergy.com/contractors/construction-renovation>

- Select the “Contractors” tab, then select the “Construction & Renovation” tab.
- AE approval is ALWAYS required for the ESPA regardless of system size.

Required documentation for ESPA submission is listed in the AE Design Criteria Manual, Section 1.4.2.

c. The contractor is then required to obtain an **electrical permit** with Auxiliary Power work type from the City of Austin and shall submit the following documentation to the City of Austin permitting department to obtain the electrical permit:

- Physical layout drawing(s) clearly indicating the interconnection equipment shown in **Section C**.
- Electrical one-line diagram, up to, and including, the interface to the AE system.
- List of major equipment: manufacturer’s name, model number and information for inverter, overcurrent device, solar modules (if Solar PV).
- Copy of the inverter manufacturer’s string sizing calculations from their website to verify that the system is sized appropriately (if Solar PV).
- Completed DGPA.

- vi. **Energy Storage Systems may require approval by Austin Fire Department.** See Section C.13 to determine when to submit electrical drawings to afdazmat@austintexas.gov for review.
- a. Energy Storage Systems with a nameplate rating > 20 kWh shall be in accordance with the prevailing International Fire Code. Residential energy storage systems with a nameplate rating > 1 kWh shall be in accordance with the prevailing International Residential Code. Check with local Fire Department for additional requirements for projects outside of the City of Austin.

d. The contractor is required to obtain a second electrical permit with Upgrade work type from the City of Austin for utility-side interconnections. The approved ESPA should be submitted with this permit application.

- *For projects classified as Residential:* If no building permit is required, contractors shall apply for City of Austin electrical permit(s) through the Austin Build + Connect (AB+C) portal. Otherwise, they shall apply for permits through one application to the Development Services Department's (DSD) Residential Plan Review Division.
- *For projects classified as Commercial:* If located within the City of Austin full-or limited-purpose jurisdiction, a building permit is always required, and contractors shall apply for City of Austin permits through one application to the DSD Commercial Plan Review Division. If located outside CoA full-or limited-purpose jurisdiction, no building permit is required, and contractors shall apply for CoA permits through the AB+C portal.

e. The contractor is recommended to have a pre-construction meeting with an Austin Energy inspector to review their finished electrical drawings. Contact Austin Energy Solar Inspections to request this meeting after the Auxiliary Power electrical permit is issued and active. This meeting is optional for residential installations, and is **required** for the following circumstances:

- *For DG/DER installations at commercial properties.*
- *For utility-side interconnections above 25 kW AC of DG/DER systems.*

For both of the bullet points above, the contractor must consult with an Austin Energy inspector and provide a full set of drawings and project specifications.

Note: The Installer is required to verify NEC compliance of the modified system from the point of connection to the Point of Common Coupling. Specific attention should be focused to ensure the proper sizing of feeder cables and panel buses.

f. Contractor will build the system per plans submitted.

Note: Any significant change in the design must be approved by the City Inspector's office.

If any DG system components (e.g., conduit) will be hidden inside walls or underground

before the final inspection, the contractor shall request a rough inspection of these components before they are covered up. Contact AE Solar Inspections to complete this step.

- g. After the system is fully installed the contractor shall request the final electrical inspection from AE Solar Inspections.
- The contractor shall first request inspection with the CoA Electrical Inspection department through the AB+C portal for any scope of work performed under a separate Upgrade or Repair electrical permit, if performed simultaneously; such inspection must be completed and passed before the final DG/DER inspection by Austin Energy.
 - Except for on-site testing and/or inspection(s), the electrical generating equipment in parallel with the AE electrical system shall not be started or operated until the installation has passed all inspections. For solar PV systems that do not already have a PV meter, AE Distribution Metering will conduct a site visit to install this meter after the final inspection has passed. The customer may operate the system once the meter is installed.
- h. The customer's system and all equipment associated with the parallel operation of power production will be inspected to verify that all work has been correctly performed and the system installation complies with all applicable codes and standards.
- i. Refer to **Appendix C** for the current inspection checklist.
 - ii. The customer shall provide, at their expense, a contractor to demonstrate all protective functions for the inspector.
 - iii. At the final inspection, the contractor shall have a Master Electrician or Journeyman in attendance with proof of license (for residential inspections, a Residential Wireman is also acceptable.). Contractors may be required to provide photos of roof work and/or as-built system components and may do so by uploading photos and/or pdf files to the Auxiliary electrical permit.

2. Process for Systems Rated 25 kW to <500 kW and NOT on the Downtown Network

Systems 25 kW to less than 500 kW **and NOT** on the Downtown Network have a slightly more complex process to obtain a permit. (See steps a thru j below and the process flow diagram on p. 19. Also see **Section D** on p. 43 for any additional requirements.)

Systems in this category are typically handled through the Permit and Development Center with City of Austin (COA).

Please email Customer Energy Solutions (CES) at solarinspections@austinenergy.com if you have questions or need help getting started.

The contractor is required to submit a completed **DGPA (Distributed Generation Planning Application)** to Austin Energy for review for any interconnection to the AE system, which can be found on the AE website at:
<https://austinenergy.com/contractors/construction-renovation/documents-forms/customer-power-production>

- **Select the “Contractors” tab, then select the “Construction & Renovation” tab; navigate to “Documents and Forms”, and then select the “Customer-Owned Power Production Facilities” sub-tab.**

- b. The DGPA must be accompanied by a full set of drawings and specifications that have been sealed by a Professional Engineer licensed in the state of Texas. All drawings shall be in electronic files in either pdf or AutoCad .dwg formats. Files larger than 3 MB should be sent in a zipped or compressed format. The contractor shall submit to AE all technical data and additional information required to evaluate the proposed customer electrical generating facility.

These documents include but are not limited to the following:

- i. Physical layout drawings, including dimensions and interconnection distance.
- ii. Schematic drawings up to, and including, the interface to the AE system indicating the interconnection equipment shown in **Section C**.
- iii. Electrical one-line and three-line diagrams, and schematic diagrams identifying continuous and fault current ratings of all equipment to verify compliance to NEC Article 110.10.
- iv. System protection details.
- v. Integration of DG/DER grounding system with AE distribution system per IEEE 1547, NEC Article 250, and AE Design Criteria Manual.
- vi. Detailed list of equipment: manufacturer’s name, model number, and rating information.
 - a) Note: All equipment shall be listed and certified to either UL or NRTL (a Nationally Recognized Testing Laboratory).

- vii. Lightning protection and grounding details indicating conformance to NFPA 780 (if required).
- viii. Coordination data such as: **(for Primary fed customers only – this is not common)**
 - a) Functional and logic diagrams.
 - b) Control and meter diagrams.

If the total size (in kW AC) of all DG resources tied to a transformer will exceed 90% of the transformer rating, then the DGPA will be denied. In these cases, the customer can either downsize the proposed DG system to meet the limit, or request that AE upgrade the transformer. If requesting an upgrade, AE will review for feasibility and if approved, will build and install the new equipment at the customer’s expense.

For DG/DER resources interconnected directly to Austin Energy’s equipment (i.e., utility-side interconnections), the contractor is required to fill out an Electric Service Planning Application (ESPA). Utility-side interconnection of DG/DER requires establishment of a new service, which is requested through the ESPA. This form can be found on the AE website at: <https://austinenergy.com/contractors/construction-renovation>

- **Select the “Contractors” tab, then select the “Construction & Renovation” tab.**
- **AE approval is ALWAYS required for the ESPA regardless of system size.**

Required documentation for ESPA submission is listed in the AE Design Criteria Manual, Section 1.4.2.

- c. The contractor is then required to obtain an **electrical permit** with Auxiliary Power work type from the City of Austin and shall submit the following documentation to the City of Austin permitting department to obtain the electrical permit:
 - vii. Physical layout drawing(s) clearly indicating the interconnection equipment shown in **Section C**.
 - viii. Electrical one-line diagram, up to, and including, the interface to the AE system.
 - ix. List of major equipment: manufacturer’s name, model number and information for inverter, overcurrent device, solar modules (if Solar PV).
 - x. Copy of the inverter manufacturer’s string sizing calculations from their website to verify that the system is sized appropriately (if Solar PV).
 - xi. Completed DGPA with proof of AE approval.
 - xii. **Energy Storage Systems may require approval by Austin Fire Department. See Section C.13 to determine when to submit electrical drawings to afd hazmat@austintexas.gov for review.**
 - a. Energy Storage Systems with a nameplate rating > 20 kWh shall be in accordance with the prevailing International Fire Code. Residential energy storage systems with a nameplate rating > 1 kWh shall be in accordance with the prevailing International Residential Code. Check with local Fire Department for additional requirements for the projects outside of the City of Austin.

- d. The contractor is required to obtain a second electrical permit with Upgrade or Repair work type from the City of Austin for utility-side interconnections. The approved ESPA should be submitted with this permit application.
- *For projects classified as Residential:* If no building permit is required, contractors shall apply for City of Austin electrical permit(s) through the Austin Build + Connect (AB+C) portal. Otherwise they shall apply for permits through one application to the Development Services Department's (DSD) Residential Plan Review Division.
 - *For projects classified as Commercial:* If located within the City of Austin full-or limited-purpose jurisdiction, a building permit is always required, and contractors shall apply for City of Austin permits through one application to the DSD Commercial Plan Review Division. If located outside CoA full- or limited-purpose jurisdiction, no building permit is required, and contractors shall apply for CoA permits through the AB+C portal.
- e. The contractor shall have a pre-construction meeting with an Austin Energy inspector to review their finished electrical drawings. Contact Austin Energy Solar Inspections to request this meeting after the Auxiliary Power electrical permit is issued and active. This meeting is required for the following circumstances:
- For DG/DER installations at commercial properties.
 - For utility-side interconnection of DG/DER systems.

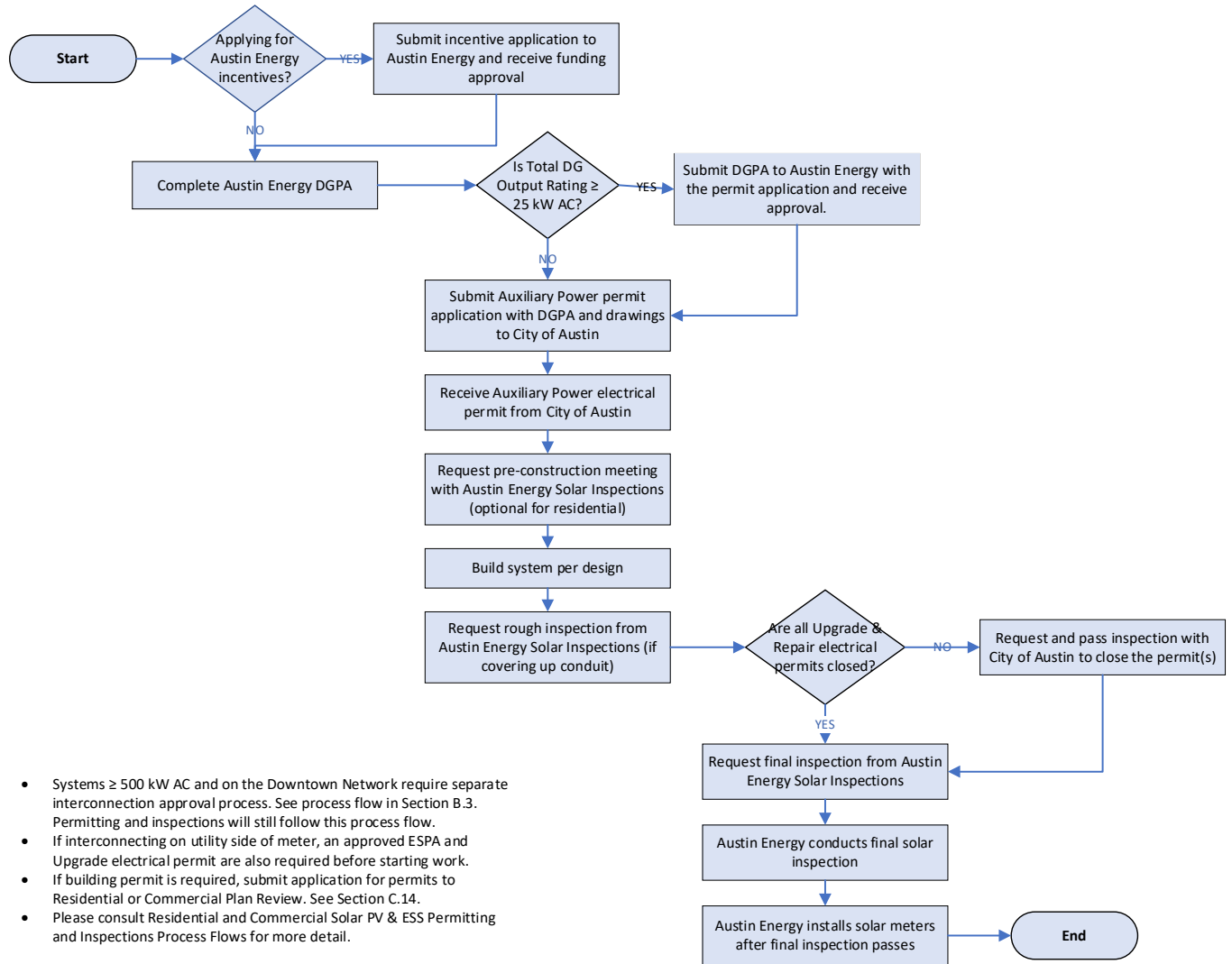
For both project types listed above, the contractor must consult with an Austin Energy inspector, provide, and upload engineer-stamped drawings to the AB+C portal before starting electrical work.

- f. Any significant change in the design must be approved by an Austin Energy Inspector.
- g. **If any DG system components (e.g., conduit) will be hidden inside walls or underground before the final inspection, the contractor shall request a rough inspection of these components before they are covered up. If covered up prior to inspection, any hidden system components will need to be re-exposed at the contractor's expense.** Contact AE Solar Inspections to complete this step.
- h. After the system is fully installed the contractor shall request the final electrical inspection from AE Solar Inspections.
- The contractor shall first request inspection(s) with the CoA Electrical Inspection department through the AB+C portal for any scope of work performed under a separate Upgrade or Repair electrical permit, if performed simultaneously; such inspection must be completed and passed before the final DG/DER inspection by Austin Energy.
 - Except for on-site testing and/or inspection(s), the electrical generating

equipment in parallel with the AE electrical system shall not be started or operated until the installation has passed all inspections. For solar PV systems that do not already have a PV meter, AE Distribution Metering will conduct a site visit to install this meter after the final inspection has passed. The customer may operate the system once the PV meter is installed.

- i. The customer's system and all equipment associated with the parallel operation of power production will be inspected to verify that all work has been correctly performed and the system installation complies with all applicable codes and standards.
 - i. Refer to **Appendix C** for the current inspection checklist.
 - ii. The customer shall provide, at their expense, a contractor to demonstrate all protective functions for the inspector.
 - iii. At the final inspection, the contractor shall have a Master Electrician or Journeyman in attendance with proof of license. (For residential inspections, a Residential Wireman is also acceptable.) The contractor shall bring final electrical drawings including one-line diagram.

Distributed Generation/DER Application Approval Process for Systems <500 kW and NOT on the Downtown Network



- Systems ≥ 500 kW AC and on the Downtown Network require separate interconnection approval process. See process flow in Section B.3. Permitting and inspections will still follow this process flow.
- If interconnecting on utility side of meter, an approved ESPA and Upgrade electrical permit are also required before starting work.
- If building permit is required, submit application for permits to Residential or Commercial Plan Review. See Section C.14.
- Please consult Residential and Commercial Solar PV & ESS Permitting and Inspections Process Flows for more detail.

3. Process for Systems Rated 500 kW to less than 10 MW OR on the Downtown Network OR Resiliency as a Service Systems

Due to the size and complexity of these systems, AE has implemented a multi-step approach to handling these requests. AE's DER Integration team will be the primary contact for processing DG and DER interconnection requests. (See steps a thru i below and the process flow diagram on p. 25. Also see **Section D** on p. 43 for any additional requirements.) This multi-step approach begins with submitting a Feasibility study and is followed by an application.

Feasibility Study: A feasibility study will be completed to verify that the proposed project will not cause any violations on the distribution system. This process will also provide an initial rough order of cost estimate (Note: This estimate will be provided prior to detailed engineering and design. This may result in under- or over-estimation of costs).

To submit a request for a feasibility study, the following documents will need to be provided to the AE DER Integration team using the following link:

AE DER Feasibility Study

For questions regarding the feasibility study, email aederfeasibility@austinenergy.com.

1. Tell us when the completed feasibility study is needed (Feasibility Study Need Date).
2. Attach the signed letter of authorization from the account holder.
3. Provide a PDF of the site layout with the proposed location of DG.
4. If you have an Austin Energy Key Account Manager, please provide the name of the representative.
5. Provide details for the new system DG Capacity (kWAC).
6. Provide details for the Existing DG size if applicable (kWAC).
7. Provide details for the interconnection method (line side or load side, other).
8. If known, provide details for the interconnection transformer size.

DER Application: The application process will include a detailed design review and cost estimate. This process is initiated by the submission of an application to the email below along with all the documents listed in (b) below. AE DER Integration will be responsible for coordinating with AE System Engineering, Complex Metering, Distribution Design, Distribution Planning, Network Design, Regulatory Analysis, System Operations, and Transmission Planning. To submit an application, please provide the documents listed in parts (a) and (b) below using the following link:

AE DER Application

For questions regarding the application process, email aederapplication@austinenergy.com. The contractor is required to submit a completed **DGPA (Distributed Generation Planning Application)** along with the **completed application** for any interconnection to the AE system, which can be found on the AE website at:

<https://austinenergy.com/contractors/construction-renovation/documents-forms/customer-power-production>

- **Select the “Contractors” tab, then select the “Construction & Renovation” tab; navigate to “Documents and Forms”, and then select the “Customer-Owned Power Production Facilities” sub-tab.**

The customer will submit the completed application (**Appendix D**) to AEDER Integration with all required Customer Data. All installations 500 kW and up or **of any size on the Downtown Network** must be accompanied with a full set of drawings and specifications that have been sealed by a Professional Engineer licensed in the state of Texas. All drawings shall be in electronic files in either pdf or AutoCad .dwg formats. Files larger than 3 MB should be sent in a zipped or compressed format. Systems to be installed that are 5 MW or above may be subject to additional requests for modeling information due to the size and complexity of these systems. The customer shall submit to AE all technical data and additional information required to evaluate the proposed customer electrical generating facility. These documents include but are not limited to the following:

- i. Physical layout drawings, including dimensions and interconnection distance.
- ii. Conductor sizes and length and technical parameters for circuit impedances.
- iii. Schematic drawings up to, and including, the interface to the AE system indicating the interconnection equipment shown in **Section C**.
- iv. Electrical main one-line and three-line diagrams and schematic diagrams identifying continuous and fault current ratings of all equipment to verify compliance to NEC Article 110.10.
- v. System protection details.
- vi. Integration of DG/DER grounding system with AE distribution system per IEEE 1547, NEC Article 250, and AE Design Criteria Manual.
- vii. Detailed list of equipment: manufacturer’s name, model number, and rating information.
- viii. Manufacturer's test data or certification indicating compliance with national codes concerned with radio noise, harmonic generation, and telephone interference factor.
- ix. Lightning protection and grounding details indicating conformance to NFPA 780 (if required).
- x. Coordination data such as:
 - a) Functional and logic diagrams.
 - b) Control and meter diagrams.
 - c) Any other data relevant to coordination of the customer system with the AE system.
 - d) Systems over **500 kW or on the Downtown Network** must also have

a written sequence of operation including documented switching procedure(s).

- e) Synchronizing methods (if any).
- xi. Load Data (**Downtown Network only**):
Electrical load analysis based on previous 12 months customer data (where possible) to verify maximum sizing of array for minimum import relay requirements. Refer to **Appendix E** for an example of how to calculate system size from load.

- a. AE DER Integration will review and provide feedback on the proposed facility. An interconnection study may also be required to determine any mitigation procedures that may be required. Once the final design has been determined AE System Engineering will issue a letter releasing the DGPA.
- b. For DG/DER resources interconnected directly to Austin Energy’s equipment (i.e., utility- side interconnections), the contractor is required to fill out an Electric Service Planning Application (ESPA). Utility-side interconnection of DG/DER requires establishment of a new service, which is requested through the ESPA. This form can be found on the AE website at:
<https://austinenergy.com/contractors/construction-renovation>
 - **Select the “Contractors” tab, then select the “Construction & Renovation” tab.**
 - **AE approval is ALWAYS required for the ESPA regardless of system size.**

Required documentation for ESPA submission is listed in the AE Design Criteria Manual, Section 1.4.2.

- c. The contractor is also required to go through DSD Commercial Plan Review to obtain an electrical permit with Auxiliary Power work type, and the DGPA must be accompanied with a full set of drawings. For utility-side interconnections, the customer is required to obtain a second electrical permit with Upgrade or Repair work type and must submit the approved ESPA. Upon successful completion of the plan review, the contractor will receive the electrical permit(s).

Exception: If located outside City of Austin full- or limited-purpose jurisdiction, contractors shall apply for CoA permits through the AB+C portal.

- d. The contractor is recommended to have a pre-construction meeting with an Austin Energy inspector to review their finished electrical drawings. Contact Austin Energy Solar Inspections to request this meeting after the Auxiliary Power electrical permit is issued. This meeting is required for the following circumstances:
 - For DG/DER installations at commercial properties.
 - For utility-side interconnection of DG/DER systems.

For both of the above, the contractor must consult with an Austin Energy inspector and provide engineer-stamped drawings before starting electrical work.

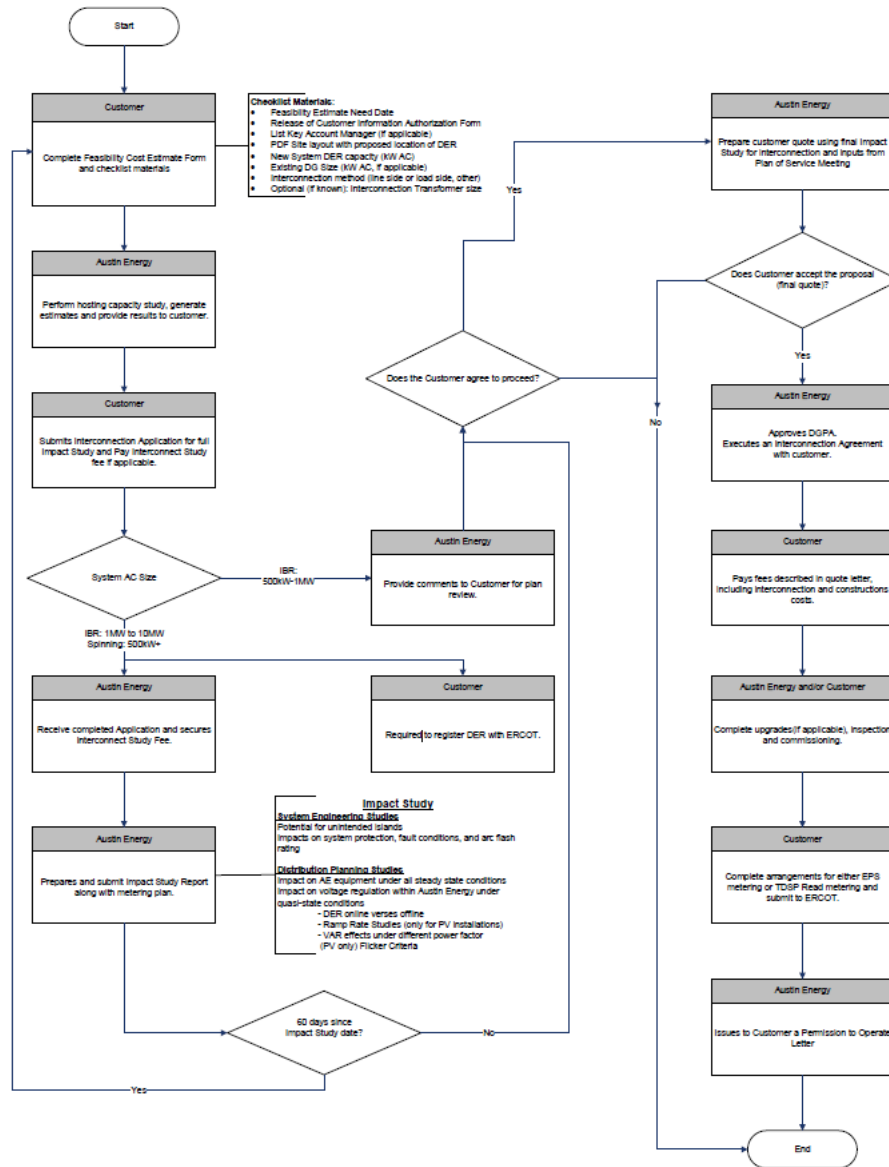
Note: The Installer is required to verify NEC compliance of the modified system from the point of connection to the Point of Common Coupling. Specific attention should be focused to ensure the proper sizing of feeder cables and panel buses.

- e. Contractor will build the system per plans submitted.

Note: Any significant change in the design must be approved by the City Permitting department.

- 9. If any DG system components (e.g., conduit) will be hidden inside walls or underground before the final inspection, the contractor shall request a rough inspection of these components before they are covered up. Contact AE Solar Inspections to complete this step.
 - a. After the system is fully installed the contractor shall request the final electrical inspection from AE Solar Inspections.
 - The contractor shall first request inspection with the CoA Electrical Inspection department through the AB+C portal for any scope of work performed under a separate Upgrade or Repair electrical permit, if performed simultaneously; such inspection must be completed and passed before the final DG/DER inspection by Austin Energy.
 - Except for on-site testing and/or inspection(s), the electrical generating equipment in parallel with the AE electrical system shall not be started or operated until the installation has passed all inspections. The customer may operate the system once the meter is installed.
 - b. The customer's system and all equipment associated with the parallel operation of power production will be inspected to verify that all work has been correctly performed and the system installation complies with all applicable codes and standards. Refer to Appendix C for the current inspection checklist.
 - i. The customer shall provide, at their expense, a contractor to demonstrate all protective functions for the inspector.
 - ii. At the final inspection, the contractor shall have a Master Electrician or Journeyman in attendance with proof of license. The contractor shall bring final electrical drawings including one-line diagram.
 - iii. Contractors may be required to provide photos of roof work and/or as-built system components and may do so by uploading photos and/or pdf files to the Auxiliary electrical permit.

DER Application Process for Systems >500 kW or on the Downtown Network



4. Process for Solar Pre-Wire Installations for All Austin Energy Customers

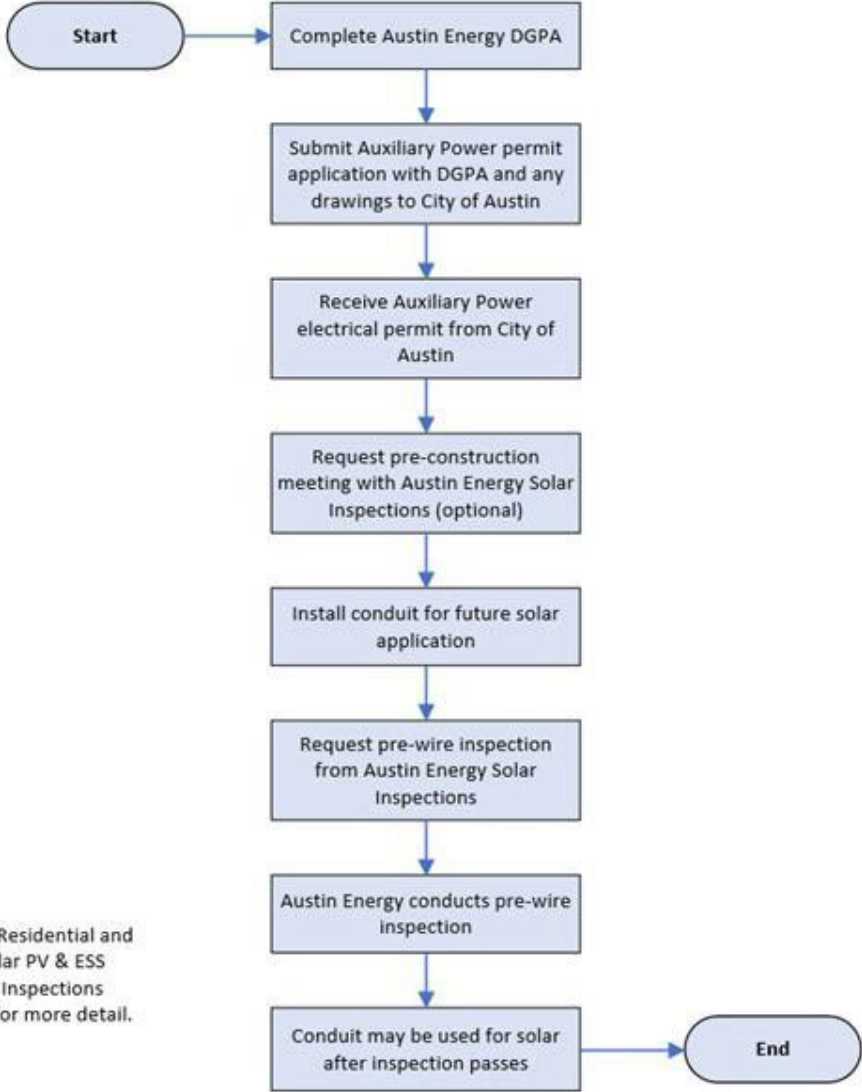
In certain cases, residential and commercial buildings are constructed to be solar ready – i.e. capable of accommodating the installation of a solar PV system at a later time, although no such installation is occurring at present. Contractors may install solar system components (conduit, and possibly wiring) during the construction process to make the site solar-ready. This scope of work requires contractors to follow a permitting and inspection process that is similar to, but less extensive than, those described above for full DG/ DER system installations. (See steps a through d below and the process flow diagram on p. 27.)

Installations in this category are typically handled through the Permit and Development Center with City of Austin (COA).

Please email Solar Inspections at solarinspections@austinenergy.com if you have any questions or need help getting started.

- a. The contractor is required to fill out a DGPA. On the DGPA, note the Distributed Generation Type as “Pre-Wire for Solar” and do not fill in Sections D or E, and AE approval is NOT required for “Pre-wire for Solar” projects.
- b. The contractor is then required to obtain an electrical permit with Auxiliary Power work type from the City of Austin and should provide the completed DGPA with the electrical permit application.
- c. Contractor installs the system components needed to make the building solar-ready.
- d. After these system components are installed, the contractor shall request an electrical inspection from AE Solar Inspections of the “pre-wire for solar” scope of work. AE must pass this inspection before the work is covered up, at which point the system components are approved for future use.

Application Approval Process for Solar Pre-Wire



- Please consult Residential and Commercial Solar PV & ESS Permitting and Inspections Process Flows for more detail.

C. GENERAL SYSTEM REQUIREMENTS AND LAYOUTS

This section reviews general system requirements and provides example system layouts for all DG/DER Systems that are **NOT** on the Downtown Network. See Austin Energy Design Criteria Manual, section 1.9.1.7 for additional information.

- The **General Requirements** section provides technical descriptions of the requirements that are applicable for **this category of DG/DER systems**.
- **Figures 1-5** represent simplified diagrams illustrating the key requirements for Solar PV and/or Energy Storage Systems **up to 10 kW**. For systems larger than 10 kW up to <10 MW, Figures 1-5 can be referenced, BUT some equipment might have to be resized or replaced.
- **Appendix C** offers a **DG/DER Inspection Checklist and Contractor Quick Reference Guide** that corresponds to this Section, to facilitate system design, installation, and quality checks in preparation for inspection.

Certain DG/DER systems may require review by AE and are **not specifically shown in these layouts**. These include systems from 50 kW to <10 MW, interconnected directly to the Austin Energy System, or on the Downtown Network.

More detailed requirements are shown in **Section D** for DG/DER systems 50 kW to <1MW, 1MW to <10MW, interconnected directly to the Austin Energy System, or on the Downtown Network. AE shall review all customer-selected interconnection equipment and the proposed configuration to verify it meets all requirements.

As a general rule, DG/DER systems shall be interconnected on the customer's side of the billing meter (i.e. behind the meter). In special cases, interconnection may be made on the utility's side of the billing meter (i.e. ahead of the meter). This includes Shared Solar systems. See Section D for acceptable methods of utility-side interconnection. These configurations contain similar overall interconnection requirements, and typical configurations are shown in **Appendix B**. AE shall review all customer-selected interconnection equipment and the proposed configuration to verify it meets all requirements. If interconnection through these methods is not feasible, then the site may not be suitable for a DG/ DER system.

The technical and operational impacts on the Austin Energy system will vary depending on the size of DG/DER system and in the manner of installation/interconnection. AE may require different equipment depending on the size of the DG/DER system, the amount of power being exported to the AE system, and the location of the DG/DER system. The DG/DER system owner must conduct their own analysis and conform to Austin Energy interconnection requirements as directed in this guide.

General Requirements for DG/DER Systems

An important differentiation for all solar PV projects is **the requirement of an Austin Energy PV meter**. For all residential and most commercial properties (exception: Shared Solar), the PV meter shall be installed on the customer's side of the existing billing meter. DG/DER installations that do not involve solar PV do not require a PV meter. **No electrical loads shall be connected on the solar side of the PV Meter, with the exception of residential energy storage system (ESS) equipment installed with solar, equipment needed to facilitate solar production. Where the system serves standby loads and the isolation point is in the inverter, then a 2nd PV Meter is required. All PV production must be metered prior to delivery to a load or the grid.** Refer to the requirements below for instances of how the PV meter will affect solar PV system installation requirements.

Details about system components are listed below and general layouts for system configurations are shown in **Figures 1-5** for different DG/DER scenarios. In addition to the design and component requirements, all systems shall comply with applicable laws and installation rules as detailed in **Section E** of this guide. Worth noting is that all solar PV systems require an Auxiliary Power electrical permit to be pulled by a licensed electrician. **Homeowner exemptions are NOT allowed for solar projects.**

All equipment is to be UL listed, suitable for the system voltage and current ratings, installed per the manufacturer's specifications, and properly labeled per the NEC and the Austin Energy Design Criteria.

Building and Trade Professionals who design or install electric facilities should use the information at the following website to ensure they are building according to Austin Energy Requirements: <https://austinenergy.com/contractors/construction-renovation>.

This website contains the Austin Energy Design Criteria and the Distribution Interconnection Guide (AE DC 1.12.0) along with information on solar installation inspections. The following equipment is to be grouped: Directory Plaque, Main Service Disconnect, Billing Meter, PV Meter, Main PV AC Disconnect, and ESS Main Disconnect (if applicable). When this is not practical, exceptions can be requested by contacting AE Solar Inspections. Ask for a meter variance form if the PV meter must be placed in an alternate location.

Solar Meter Variance Request Process

A solar meter variance (Meter Installation Alternate Location) is required **prior** to installation if the PV meter cannot be grouped with the Billing meter. Please submit requests to AEAdvancedMeteringEngineering@austinenergy.com

The Meter Installation Alternate Location form and instructions can be found on the Austin Energy

website: <https://austinenergy.com/green-power/solar-solutions/solar-inspections>

- **Meter Variance Request Form**

Metering Equipment

All metering equipment shall be grouped and located on the exterior finished surface of all buildings. Each meter enclosure or service disconnect shall be marked permanently with the address of each respective occupancy or unit.

When the metering equipment cannot be grouped, an alternate location must be approved by Austin Energy's Advanced Metering Systems & Engineering (AMSE). The alternate location of PV meter must be approved ahead of time. Failure to receive the required approval before installing the meter enclosure will result in a violation of Austin Energy Interconnection Guidelines. Other equipment or devices such as an electric service disconnect switch shall conform to the installation requirements of the Austin Energy Design Criteria and NEC.

Submittals: Submit the following documents in addition to the approval request:

1. Meter Installation Alternate Location Form
2. A site drawing showing all existing and proposed meters.
3. A proposed placard language describing the alternative location.
4. Any supporting documents that help to explain why an alternative location is needed.
5. Electric-one line

Approvals: Upon review of the documentation provided, the proposed site for installation of the electricity meter is Approved or Not Approved.

NOTE: These requirements are also applicable for all other customer-owned or Shared Solar DG/DER systems and for the standard complex meter configuration drawings shown in **Appendix B**. The DG/DER Inspection Checklist & Contractor Quick Reference Guide are available in **Appendix C**.

1. Directory Plaque:

A directory/plaque of all DG/DER disconnects and sources on site, including contact information, shall be provided as per NEC Articles 690.31(D)(2) and/or 705. Reference also AE Design Criteria Manual 1.9.1.7.

- a. A rapid shutdown label shall be installed in accordance with NEC Article 690.
- b. The plaque must also include information on any standby systems or energy storage system in accordance with NEC Article 705.10.
- c. Where an ESS is installed, a directory plaque shall be installed by the ESS equipment if the equipment is not grouped, not to exceed 20 feet without an Austin Energy approved meter variance (Reference Austin Energy Design

Criteria Manual 1.9.3.1.j.).

- d. For utility-side interconnections, a directory plaque shall be installed at the point of interconnection, at each disconnecting means, and on the roof (by the PV array).
- e. Where a PV aggregate panel is installed, a label shall be affixed to the panel that reads: PV AGGREGATE PANEL: DO NOT ADD, REMOVE OR RELOCATE LOADS.

2. Billing Meter:

Metering requirements can be found in the Austin Energy Design Criteria Manual 1.9.0. Requirements for metering equipment clearances are listed in 1.9.2 Clearances and Mounting Heights for Metering Equipment and Enclosures:

- a. A minimum 2-inch installation clearance shall be maintained on all sides of meter sockets, trans-sockets, and metering enclosures.
- b. The minimum working clearances for metering equipment and enclosures shall be as follows:
 - i. 30-inch-wide front working space
 - ii. 36 inches in front (direction of access measured from the face of the meter socket)
 - iii. 6-foot 6-inch headroom.
- c. Approved Socket-Mounted Transfer Switch Devices permitted per AE Design Criteria 1.9.1.4.

3. Service Disconnect:

All customers must have a code-compliant service disconnecting means. Refer to the AE Design Criteria Manual 1.8.4 for specifics.

4. Overcurrent Protection:

An overcurrent protective device is required for all DG/DER systems. The type and size of the device shall be reviewed by AE depending upon the installation. Adequate test data or technical proof that the device meets the criteria specified in IEEE 1547 and the NEC 690.8 and 690.9 must be supplied by the customer to AE.

- a. For supply-side taps, overcurrent protection must meet the requirements of NEC Article 705.11(C). **See Appendix B – Standard Complete Meter Configurations** of this Guide for more information on supply-side taps.

5. PV Meter:

An Austin Energy PV Meter is required for all new solar PV installations. For general metering requirements, refer to the Austin Energy Design Criteria Manual Section 1.9.0

regarding metering and NEC Article 110.26 for working clearances.

- a. The PV Meter shall be grouped with billing meter and disconnects.
- b. PV AC disconnect line side conductors shall terminate on the line side (top) terminals of PV meter socket.
- c. Electrical loads are NOT allowed on the solar side of the PV meter, with the exception of residential ESS equipment or unless such load is needed to facilitate solar production. All energy produced by the PV system must be metered before serving any other loads.
 - i. **Residential solar systems are allowed to serve standby loads on the PV side of the meter where the isolation point is in the (multimode) inverter, but a 2nd PV meter is required to be placed between the inverter and the standby loads panel.**
- d. Electric meters shall not be installed in any of the following locations:
 - i. On or under porches, stairways, or similar structures,
 - ii. Under overhangs (overhead services only), carports, or similar structures that exceed 72 inches,
 - iii. Where moving objects might damage the metering equipment, or
 - iv. Within a circle radius of 3 feet of gas meters, regulators, relief valves, and electrical apparatuses.
- e. Meter enclosures are to be installed with neutral broken (and isolated) in PV meter can and main PV AC Disconnect.
- f. PV communication wires must be run separately (see Austin Energy Design Criteria Manual, section 1.12.1.8.a for more information).
- g. Meter enclosures shall be installed over flat or near level ground. Enclosures shall not be installed over points of egress for garden story window wells or recessed drainage areas.
- h. **Installations <1 MW:**
 - a. Contact **AE Distribution Metering Operations:**
aedistributionmetering@austinenergy.com
 - b. AE will install a watt-hour meter for solar PV systems.
 - c. Refer to **Section C**, Figure 1 for an example of a simplified Solar PV installation and **Appendix B** for standard configurations. Contact AE Distribution Metering Operations for any clarification.
 - d. Refer to the AE website for detailed meter socket, meter hub, and CT specifications.
<https://austinenergy.com/contractors/construction-renovation>
 - **Select the “Contractors” tab, then select the “Construction & Renovation” tab.**

- a) Single phase services less than 350 amps and three phase services less than 225 amps typically require a self-contained meter.
- b) Single phase services greater than 350 amps and three phase services greater than 225 amps will require an instrument rated meter.
- c) Final determination of meter type and configuration shall be made by the AE Distribution Metering group.
- e. If an instrument rated (CT) meter is required, the instrument rated (CT) meter inspection must be completed **after** an approved 304 Temporary inspection and **before** the final 305 electrical inspection is requested. The contractor shall contact AE Distribution Metering at AEDistributionMetering@austinenergy.com to review or assess any service requirements and metering equipment needed for the project.
 - All CT Services require a passed 304 Temporary before energizing and before scheduling a CT meter inspection.
 - To schedule an instrument-rated (CT) service inspection and meter installation, contact AE Distribution Metering Operations Dispatch at AEDMODispatch@austinenergy.com. Refer to the Metering Guidelines for Instrument Rated Metering to ensure readiness for inspection. Austin Energy will set the meter within 5 business days after the 304 Temporary inspection (and CT Meter inspection) passes.
 - If the project requires a utility outage to perform electrical work, the contractor is recommended to schedule the AE Distribution Metering inspection alongside the utility outage.
- f. All solar PV interconnections require smart meters. **Solar customers may not participate in smart meter opt-out.**

i. Installations >1 MW to <10 MW:

- i. Contact **AE Distribution Metering Operations: aedistributionmetering@austinenergy.com**
- ii. The distributed generation facility owner will need to register the resource with ERCOT. Refer to ERCOT website for more information: **<http://www.ercot.com/services/rq/re/dgresource>**.
- iii. AE shall provide, at AE's expense, the necessary EPS metering equipment for interconnection to the AE system.
- iv. All solar PV interconnections require smart meters. **Solar customers may not participate in smart meter opt-out.**

6. Grounding and Bonding:

- a. Grounding shall be done in accordance with UL 1741 and NEC Articles 250 and 690 unless otherwise specified by the Austin Energy Design Criteria.

- b. System Bonding or Equipment Grounding Conductors shall be a minimum of #6 AWG copper from the Point of Interconnection to the PV and ESS disconnects (see Austin Energy Design Criteria Manual, 1.5.2.1.P. for details).
- c. Neutral conductors shall be sized to have the full-current-carrying capacity of the largest energized conductor from the Customer's PV AC Disconnect to the Point of Interconnection. The neutral conductor must be properly marked and grounded, as per Austin Energy Design Criteria Manual, 1.17.0.

7. Main PV AC Disconnect:

A manual load break disconnect switch with visible blades shall be provided at the customer's distributed generation service point to provide a separation point between the customer's electrical generation system and the AE electrical utility system. Note that the Solar PV system disconnect may also be integrated with the Rapid Shutdown system. AE will coordinate and approve the location and type of the disconnect switch(es) as shown in **Appendix B**. For "old" service improvements, reference AE Design Criteria Manual 1.9.1.8. For the main disconnect, reference AE Design Criteria Manual 1.8.4.

- a. The disconnect switch(es) shall be grouped with the metering equipment and other switches and labeled per NEC Article 690.15 and connected per NEC Article 404.6. No toggle switches are allowed.
- b. Inverter output conductors should terminate on the load side of the PV AC disconnect. Line side conductors should run to the line side of PV meter socket.
- c. For solar PV systems, the main PV AC disconnect shall be installed on the solar side of the PV meter so that the meter will remain energized while the PV system is disconnected (except for 480V).
 - i. For 480 V systems an additional disconnecting means is required between the PV meter and the interconnection. See diagrams B-5 and B-6 in **Appendix B**.
- d. The disconnecting means shall maintain a radius of 3 feet of distance from gas meters, regulators, and relief valves in accordance with Austin Energy Design Criteria Manual, 1.9.3.1.
- e. The neutral must be broken (and isolated) in the main PV AC disconnect and the PV Meter to allow for testing. Service rated equipment is required.
- f. For supply side tap interconnections, the handle rating of the fusible disconnect shall be a minimum of 60 amps. See **Appendix B** for schematics.

- g. The switch shall be readily accessible to AE personnel at all times and be capable of being locked in the open position with an AE padlock and should not be locked by the owner.
- h. AE reserves the right to open the disconnect switch isolating the customer's electrical generating system (which may or may not include the customer's load) from the AE system for the following reasons:
 - i. To facilitate maintenance or repair of the AE electrical system or of the distributed generation system.
 - ii. During AE electrical system emergency conditions.
 - iii. When the customer's electrical generating system is determined to be operating in a hazardous or unsafe manner or adversely affecting AE's system.
 - iv. Failure of the customer to comply with applicable codes, regulations, and standards in effect at that time.
 - v. Failure to abide by any contractual arrangement or operating agreement with AE.

8. Surge Protection Device (Solar PV only):

A surge protective device (SPD), as defined by NEC Article 242, is required for all PV interconnections at the service. The device must meet the requirements of Article 242 regardless of the manufacturer's description (i.e., lightning vs. surge). SPDs must be Type 1 or Type 2 and listed for the purpose.

9. Inverters (for inverter-based systems):

- a. Solar PV inverters shall be certified to UL 1699B, UL 1741, and IEEE 1547 and must be on the approved list published by the California Energy Commission (CEC) on its website <http://www.gosolarcalifornia.org>.
- b. **Non-solar inverters may not be installed on the solar side of the PV Meter, with the exception of ESS inverters.** These inverters must meet the requirements of IEEE 1547 and be certified to UL 1741, and UL 2200, if applicable, and may not be self-commutating while paralleled with the AE system.
 - i. Inverters shall be set per the default settings as defined in IEEE 1547-2018 (or 300 seconds).
 - ii. Inverters in areas with high levels of DG/DER penetration may require alternate settings.
- c. Inverters used with energy storage systems shall be certified by the Energy Storage System battery manufacturer for use with their system. Inverters shall be listed to UL 1741 or UL 9540 and shall be listed for utility interaction.
- d. Inverters used to provide backup power (such as for ESS) shall include a transfer

switch to disconnect from the AE system while operating in island mode using self-commutation as per NEC Article 705 Part II.

- e. *For three-phase systems*: Either a three-phase inverter or single-phase inverters arranged in a wye configuration shall be used. Single phase inverters arranged in a delta configuration are not allowed due to grounding concerns.

9.1 Protective Devices and Functions:

All DG/DER installations shall have protective devices that provide an automatic method of disconnecting its generation equipment from the AE system along with electronic programmable relays to meet the requirements of IEEE 1547, Section 4 - "General Interconnection Technical Specifications and Performance Requirements". The automatic disconnecting device may be of the manual or automatic reclose type and shall not be capable of reclosing until the AE System voltage and frequency return to normal range and the system is stabilized for the duration specified in (f) below. Note that inverters certified to UL 1741 provide many of these functions.

- a. **Voltage and Flicker**: The customer equipment shall provide under/overvoltage trip capability. AE shall endeavor to maintain the voltages on the AE system but shall not be responsible for factors or circumstances beyond its control. If the customer's electrical generation equipment has automatic voltage control capability, it shall be operated in the manual mode with power factor control consistent with the power factor requirement set out below and in IEEE 1547.
 - i. The customer owned equipment will not cause AE system voltage to go outside of the limits set by ANSI C84.1.
 - ii. In accordance with IEEE 519, the flicker shall not exceed 3.0% voltage change, measured at the point of common coupling. If high or low voltage complaints or flicker complaints result from the operation of the customer's electrical generation, the customer's generating system shall be disconnected until the problem is resolved.
- b. **Frequency**: The customer equipment shall provide under/over-frequency trip capability. AE will endeavor to maintain a 60-hertz nominal frequency on the AE system. If the customer's electrical generation equipment has speed or frequency control, it shall be operated in the manual droop mode.
- c. **Harmonics**: The customer's electrical generation system shall not cause voltage harmonic content or total harmonic distortion (THD) in excess of the limits of IEEE 519 and IEEE 1547 when measured at the point of common coupling with the AE system.
- d. **Fault and Loss of Source**: In accordance with IEEE 1547, in the event of a fault on the customer's system or a fault or loss of source on the AE system, the

- customer shall provide an automatic method of disconnecting its generation equipment from the AE system within 10 cycles should the voltage on one or more phases fall below 50% of nominal voltage on the AE system serving the customer premises at the point of common coupling.
- i. In the event of an outage, the DG/DER system shall contain anti-islanding protection to de-energize the system and prevent inadvertent backfeed during an outage into AE's electrical system.
 - ii. Installations over 2 MW shall provide for transfer trip of the DG/DER facility.
- e. Power Factor: The customer's electrical generation system shall be designed, operated, and controlled at all times to provide reactive power requirements at the point of interconnection per IEEE 1547, but in no case operating outside the range of 0.95 lagging to 0.95 leading power factor unless approved in writing by AE. Refer to **Section D** for systems over 50 kW.
- f. Reconnection to AE Service: After any disturbance resulting in a service interruption or feeder breaker actuation, no Distributed Generation/DER source may reconnect until the AE System voltage and frequency return to normal range and the system is stabilized for a period of 300 seconds, or as approved in writing by AE. This disconnect timing ensures that the generator is disconnected from the AE System prior to automatic re-close of feeder breakers.
- g. Relay Settings (if applicable): The settings for all distribution interconnections shall be approved by System Engineering in conjunction with IEEE 1547 and AE Transmission and Substation Engineering and Construction as necessary.

To enhance system reliability and safety and with AE's approval, the customer may employ a modified relay scheme with delayed frequency or voltage tripping using communications equipment between the customer and AE.

- h. Energy Management Systems, as defined by NEC Article 750, may be required to set export limits at final inspection. If/when export limits are required for a project, the contractor shall attach proof of the export limit settings on the auxiliary power permit, and settings shall not be altered after final inspection of the system.

10. Energy Storage System (ESS):

- a. All Energy Storage System equipment shall be certified to UL 1973, and installation shall comply with manufacturer's instructions. All ESS that contains electrochemical cells shall be listed in accordance with UL 9540. Lithium-Ion systems shall be certified to UL 1642. Lead-Acid systems shall be

certified to UL 1989.

- b. Energy Storage System plans shall be sealed by a Professional Engineer licensed in the state of Texas.
- c. When an enclosure contains backed-up circuits and non-backed-up circuits, a label shall be affixed that reads: THIS ENCLOSURE CONTAINS FEED THROUGH CONDUCTORS THAT MAY BE ENERGIZED WHEN THE DISCONNECT IS DE-ENERGIZED. When ESS is installed, Austin Energy will provide a label to be affixed to the ESS system that contains a QR Code directing customers to a website, explaining how to recycle batteries and corresponding materials within the City of Austin.
- d. During inspection, batteries must exhibit ability to hold charge without damage. PV system may be operational at the time of inspection and be able to demonstrate full functionality.
- e. A disconnecting means shall be provided for all ungrounded conductors derived from an ESS. This disconnecting means shall be installed per NEC 706.15. A disconnecting means also shall be grouped with the main service.
- f. Within the City of Austin, Fire Department approval shall be required for individual ESS units exceeding 20 kWh, and for ESS installations exceeding a total of 80 kWh. In these instances, submit electrical drawings to afd hazmat@austintexas.gov for review.
- g. Residential ESS installations exceeding 1 kWh shall comply with the prevailing International Residential Code (2021). See especially IRC 2021 Section R328. Installation in garages: When ESS are installed in the vehicle drive path approved vehicle impact protection must be installed.
 - If installed in residential dwellings, ESS must be listed and labeled for the purpose.

11. Solar PV Array:

- a. When the customer is located inside City of Austin full- or limited-purpose jurisdiction, **a building permit shall be required if any of the following apply:** PV modules are not mounted parallel to the roof surface (e.g., tilt-up), extend past the existing roof, are built on a new and separate structure (e.g., ground-mount), are installed on a commercial building, or where solar roof tiles are being installed. In each of these scenarios, plans must be sealed by a Professional Engineer licensed in the state of Texas. When a building permit is required, submit the application to DSD Residential Plan Review or Commercial

Plan Review to obtain the building and electrical permits.

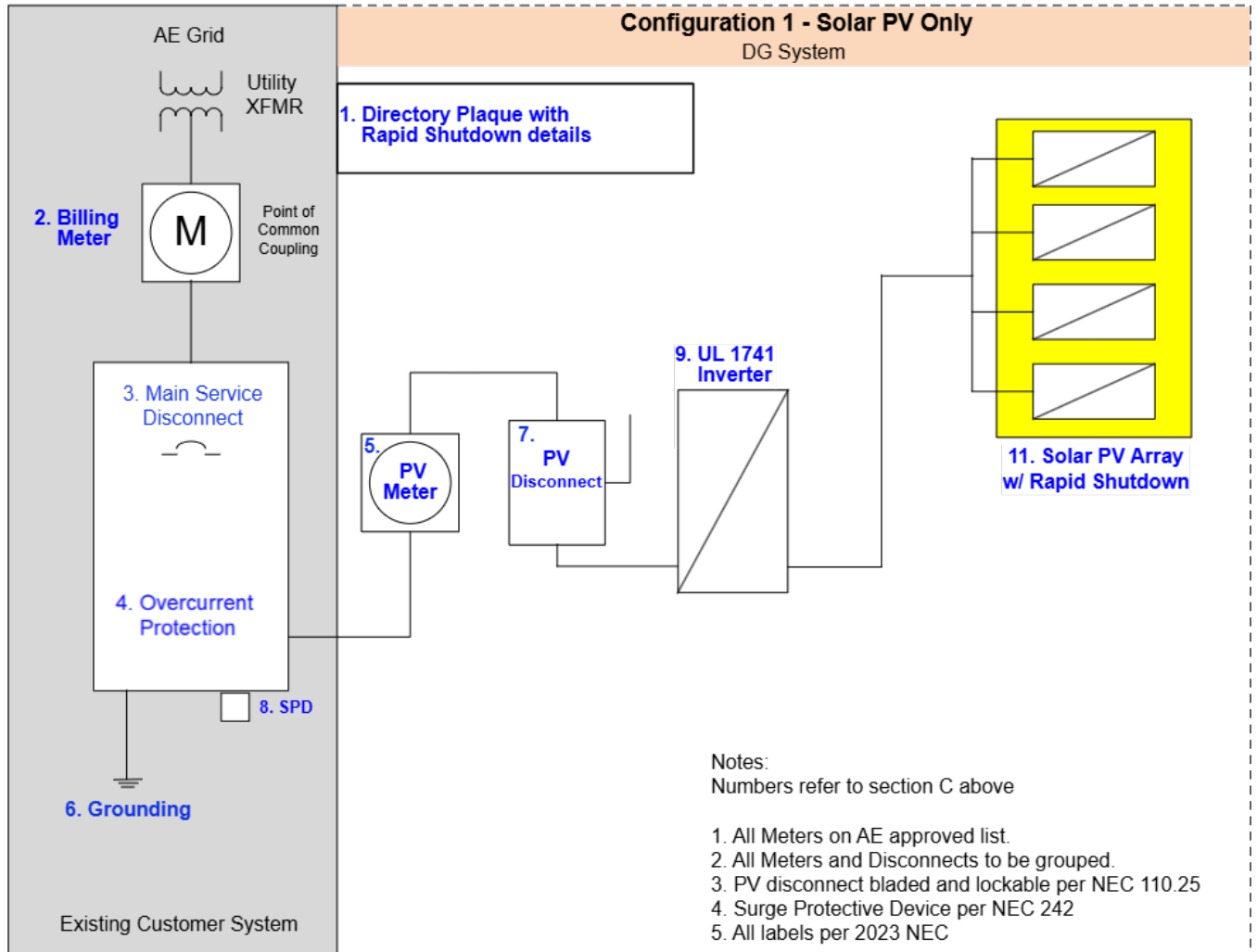
- i. For Residential applications, follow the Express Permit process for modules not mounted parallel to the roof surface and for solar roof tiles.
 - ii. For Residential applications, follow the New Construction and Addition process for modules built on a new and separate structure, and for modules that extend past the existing roof.
 - iii. Applications submitted to Plan Review may receive a structural review **but will not receive electrical review** (except for Commercial projects involving energy storage).
- b. Check with your local Fire Department to ensure solar panel installation meets fire code requirements. The IFC and many other codes can be found at: www.codes.iccsafe.org/codes/texas
- c. All roof penetrations must be flashed.

12. Rapid Shutdown Feature (Solar PV only):

All installations submitted for approval shall incorporate a rapid shutdown feature per NEC Article 690.12: Voltage below 30 volts within 30 seconds of rapid shut down initiation.

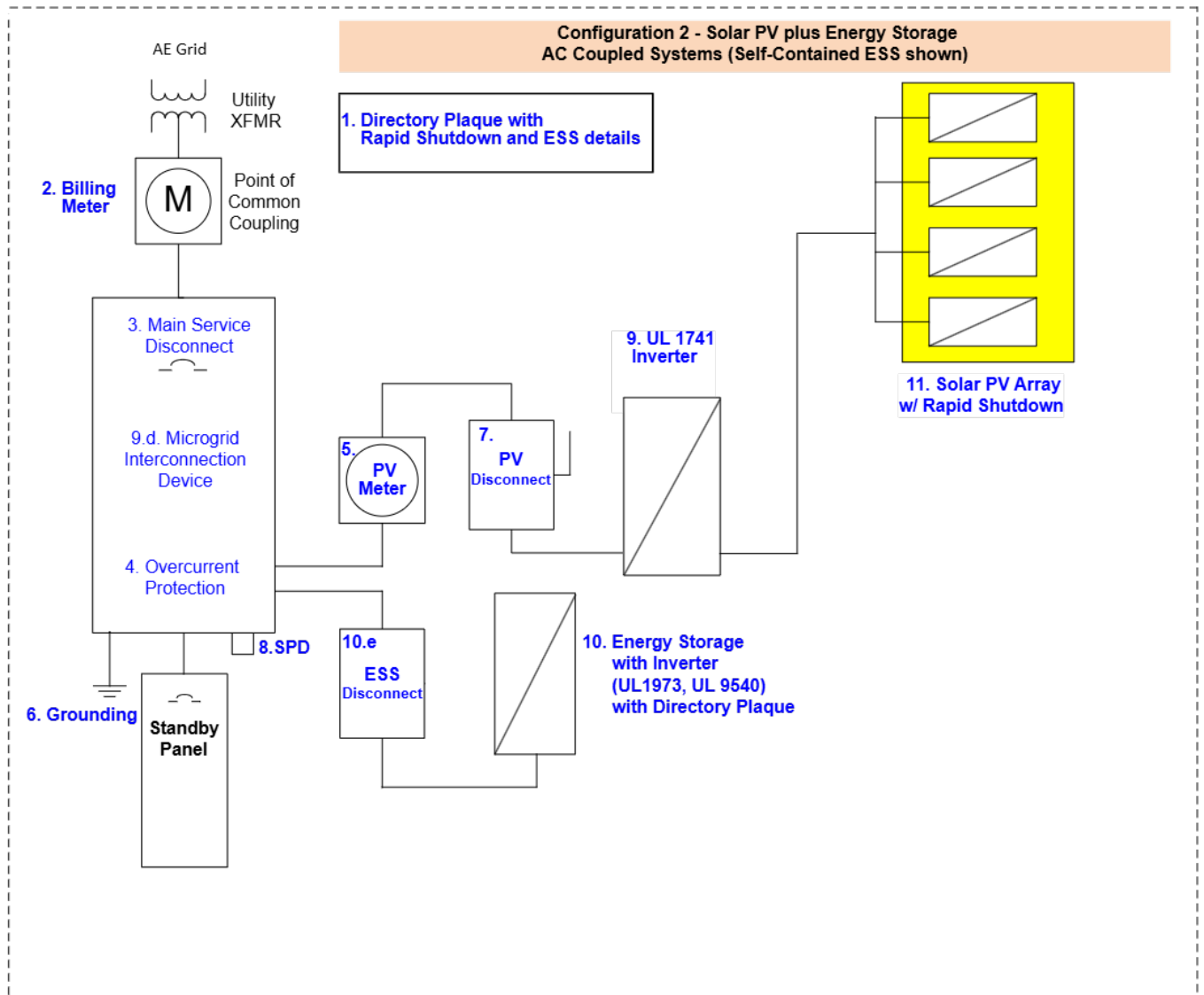
TYPICAL INTERCONNECTION CONFIGURATIONS

Figure 1: Simplified Diagram for Solar PV Only – Systems <10 kW and NOT on the Network (Typically Residential)



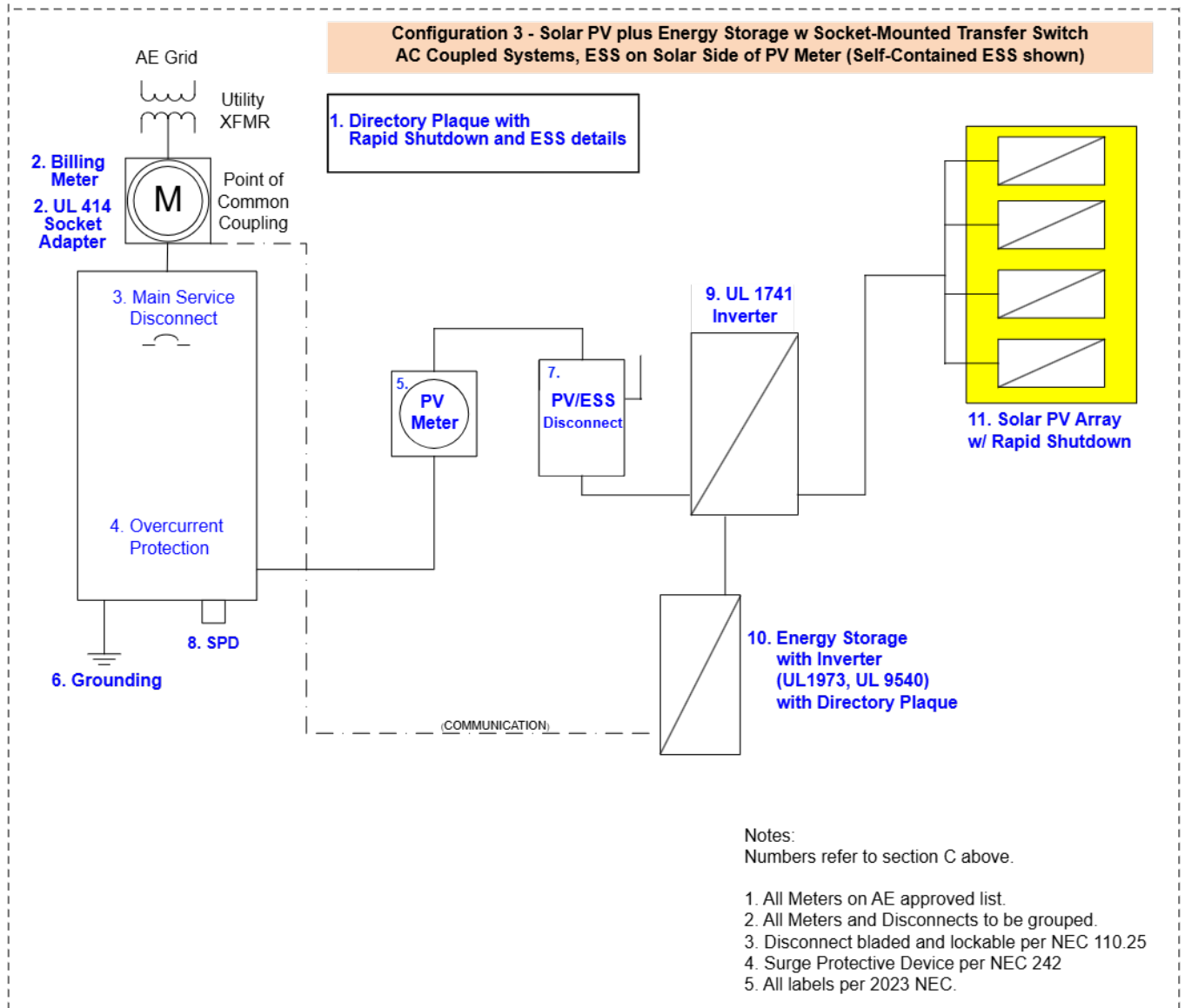
NOTE: Back feed Breaker Interconnection shown here. See Appendix B for Line Side Taps.

Figure 2: Simplified Diagram for AC Coupled Solar PV plus Energy Storage, with ESS on



Line Side of PV Meter – Systems <10 kW and NOT on the Network (Typically Residential)

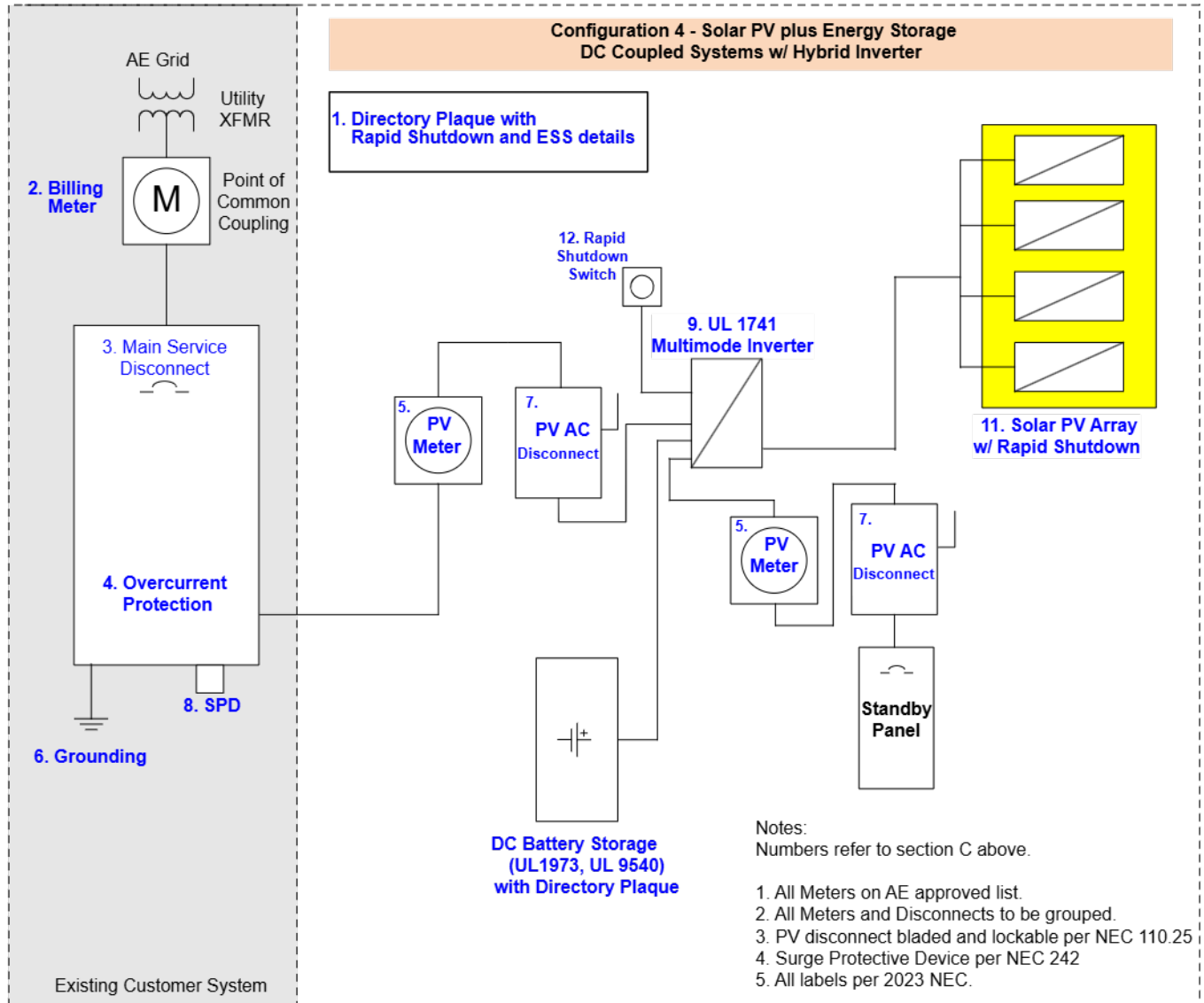
Figure 3: Simplified Diagram for AC Coupled Solar PV plus Energy Storage, with ESS on Solar Side of PV Meter – Systems <10 kW and NOT on the Network (Typically Residential)



*NOTE: Additional disconnects might be required based on your system design.

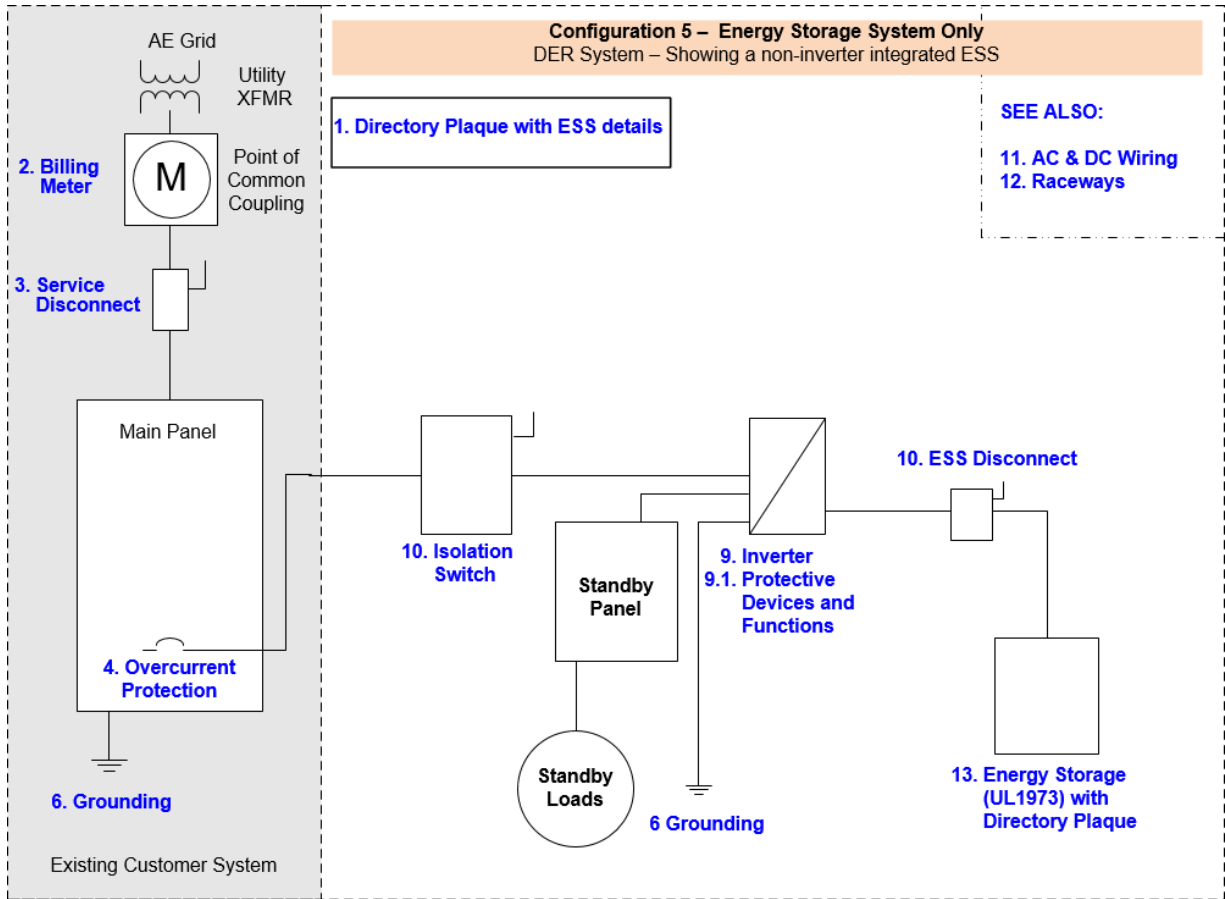
Solar PV plus Energy Storage for AC Coupled systems (see Section C.5.c within this document for more details).

Figure 4: Simplified Diagram for Solar PV plus Energy Storage, with ESS on Solar Side of PV Meter and Standby Loads – Systems <10 kW and NOT on the Network (Typically Residential)



*NOTE: Additional disconnects might be required based on your system design.

Figure 5: Simplified Diagram for Energy Storage Only – Systems <10 kW and NOT on the Network (Typically Residential)



D. DETAILED REQUIREMENTS FOR PARALLEL SYSTEMS

Additional Technical Requirements by System Classification

- a. **Systems (not on the Downtown Network) less than 50 kW (typically residential):**
 - i. No additional requirements.
- b. **Systems (not on the Downtown Network) rated at least 50 kW to less than 1 MW must also have:**
 - i. An automatic sync-check relay (if generator is synchronous or self-commutated) or open transition transfer switch.
 - ii. If the facility is exporting power, the power direction protective function may be used to block or delay the under-frequency trip with the agreement of AE (not common).
 - iii. The system must have the ability to provide power factor support from 0.9 lagging to 0.9 leading. Exact settings will be determined with AE.
 - iv. Refer to simplified diagrams in **Section C, Figures 1 thru 3**, for "typical" layouts. Figures 1 thru 3 represent simplified diagrams illustrating the key requirements for Solar PV and/or Energy Storage Systems not on the Downtown Network. For systems larger than 10 kW up to <10 MW, Figures 1-3 can be referenced, BUT some equipment might have to be resized or replaced.
 - v. Certain DG/DER systems may require review by AE and are not specifically shown in these layouts. These include systems 50 kW to < 10 MW, interconnected directly to the Austin Energy System, or on the Downtown Network.
- c. **Systems (not on the Downtown Network) rated >1 MW to less than 10 MW must have:**
 - i. If the facility is capable of exporting to the AE system, there shall be a redundant circuit breaker interfaced to the AE relay system (**required for 2 MW and up for DG/DER inverter based systems, and for 1 MW and up for synchronous or induction motor systems**).
 - ii. EPS metering is required for systems 1 MW and up. Refer to Metering, **Section C.5**, for additional requirements.
 - iii. Utility grade relays approved by AE and compatible with AE relay communication. The relay shall be compatible with Mirrored Bits protocol. The relay shall provide the following functions at a minimum:
 - a) An undervoltage/overvoltage trip with sensing/readout by phase.
 - b) An under/over frequency trip with sensing/readout by phase.
 - c) An automatic synchronism check relay (for facilities with stand-alone capability).
 - d) Telemetry/transfer trip to be done in accordance with IEEE 1547 and PUC Substantive Rule §25.212 (**transfer trip for DG/DER inverter-based systems rated more than 2 MW but less than 10 MW**). For

synchronous or induction motor systems 1 MW and up, install transfer trip function per AE requirements.

- e) Either a ground overvoltage or a ground overcurrent trip depending on the grounding system.
 - f) If the facility is exporting power, the power direction protective function may be used to block or delay the under-frequency trip with the agreement of AE.
 - g) On-board data acquisition and event log to record actual readings for all events.
 - h) All required fault-detection relays shall coordinate with AE's devices, as necessary.
 - i) All interconnection relays shall be set to provide overlapping or coordinated protection to prevent extensive damage should an interrupting device fail to clear when required. The line-protection schemes shall be able to distinguish between generation, inrush, and fault current.
 - j) Where the existing relay schemes have to be reset, replaced, or augmented with additional relays to coordinate with the customer's new facility, all work shall be done at the customer's expense.
- iv. Systems greater than 2 MW must have two-way fiber optic communications channel between AE and the customer's facility for monitoring and relay communication and shall comply with the requirements of IEEE 1547.3. The customer will pay for all installation charges and communications equipment.
- v. DG/DER facilities of 4 MW or larger defined as intermittent sources will either require a dedicated feeder, or have the facility load split between multiple feeders to minimize/reduce voltage fluctuations that would affect other customers.
- vi. DG/DER facilities of 5 MW or larger shall be provided electrical service at primary voltage (12.47 kV) and will be responsible for providing their own step-up transformers which shall be a grounded-wye configuration on the utility side.
- vii. The system must have the ability to ramp output up or down either by use of dynamically controlled inverters or staged ramping sequences. Ramping sequences shall be for minimizing adverse voltage effects and shall be approved by AE.
- viii. The system must have the ability to provide power factor support from 0.9 lagging to 0.9 leading. Exact settings will be determined with AE.

d. Utility-side interconnected systems (not on the Downtown Network) of ALL sizes must:

- i. The point of interconnection for the solar conductors shall be one of the following:
 - a) At the transformer serving the site. For sites that are master metered at the transformer, a new transformer may be built ahead of the existing one in order to establish the utility-side interconnection but will require a written exception from Austin Energy.

- b) At a service distribution enclosure located between the billing meter and transformer. A new service distribution enclosure may be built for this purpose; or
- c) In the modular metering bank (for facilities that have one), on the line side of the main disconnect.
- ii. If the point of interconnection is the transformer:
 - a) For pad-mounted: The solar conductors shall be terminated at the point of service.
 - b) For pole-mounted: Where the point of service is a weatherhead, the contractor shall be responsible to construct a new riser for the solar conductors. The contractor will be responsible to install a separate weatherhead for these conductors, and AE will connect it to the existing weatherhead to make the final interconnection. Where the point of service is a pull box fed from a secondary riser, the solar conductors shall be brought into the pull box to make the final interconnection.
- iii. If the point of interconnection is a service distribution enclosure:
 - a) Enclosures must be solid and lockable with a full-size barrel lock, to be provided by Austin Energy. AE will lock the enclosure with an AE-supplied lock after the final inspection passes.
 - b) Enclosures shall conform to the specifications listed in the AE Design Criteria Manual, Section 1.9.1.9 for Current Transformers (CTs) and Enclosures. Also refer to Design Criteria Manual, Section 1.8.5 for enclosure sizing requirements.
 - c) The customer will own this equipment and will be responsible for installing and maintaining it.
 - d) If the customer requires access to the enclosure after it is locked, they must contact AE Revenue Protection. AE will require an active electrical permit before unlocking the enclosure.
- iv. To complete the interconnection, the customer must request a temporary disconnect through AE Dispatch.
- v. All underground (i.e., trench) work required to establish a utility-side solar interconnection must be inspected by AE Civil Inspections/ Work Management or AE Service Spot & Conduit, in addition to AE Solar Inspections, prior to backfilling. See AE Design Criteria Manual 1.4.2.3 and 1.4.2.4 to determine whether Civil Inspections/ Work Management or Service Spot & Conduit is responsible to inspect and see Design Criteria 1.2 for their contact info.
- vi. Refer to simplified diagrams B-8 through B-13 in **Appendix B** for accepted layouts.

e. **Facilities on the Downtown Network:**

Refer to Appendix E for interconnecting DG/DER in the Downtown Network.

Dedicated Service

AE will determine the need and feasibility for dedicated service on a case-by-case assessment of each customer-owned power production facility. The customer is

responsible for all connection charges above standard service.

Dedicated Feeder - Proposed Distributed Generation/DER facilities may not represent greater than 25% of the existing feeder load or 15% of the maximum available fault available on the circuit without written approval from AE.

Additional Requirements for Non-Inverter Based Generation

- a. All generating units must comply with all of the applicable standards of ANSI and IEEE as well as be certified to UL 2200 “Stationary Engine Generator Assemblies”.
- b. The customer should contact Austin Energy to determine the phase rotation at their proposed site.
- c. Fault current of the system must be recalculated to include the proposed generation, and all equipment must be rated to handle the increased fault current.
- d. Machine rating will be determined from faceplate rating of the generator at 100% power factor.
- e. Synchronous machines:
 - i. The distributed generation facility’s circuit breakers shall be three-phase devices with electronic control.
 - ii. The customer is solely responsible for proper synchronization of its generator with the AE system.
 - iii. The generator’s excitation system shall conform to the field voltage versus time criteria specified in the most recent version of IEEE Standard C50.13.
 - iv. For generating systems greater than 2 (two) megawatts (MW) the customer shall maintain the automatic voltage regulator (AVR) of each generating unit in service and operable at all times. AE shall be notified if the AVR is removed from service for maintenance or repair.
- f. Induction machines:
 - i. The induction machines used for generation may be connected and brought up to synchronous speed (as an induction motor) if it can be demonstrated that the initial voltage drop at the point of interconnection is within the flicker limits specified in this document.
 - ii. Induction generators shall have static capacitors that provide at least 95% of the magnetizing current requirements of the induction generator field. AE may, in the interest of safety, authorize the omission of capacitors. However, where capacitors are used for power factor correction, additional protective devices may be required to guard against self-excitation of the customer's generator field.

Additional Requirements for Electric Energy Storage Systems

- a. All Energy Storage Systems (ESS) shall be installed per manufacturer's instructions.
- b. A second AC disconnect means shall be installed in proximity to the Energy Storage System if the AE required disconnect is not within sight.
- c. A disconnecting means shall be provided for all ungrounded conductors derived from an ESS. The disconnecting means shall be readily accessible and located within sight of the ESS.
- d. Energy Storage Systems installed in parallel with other DG, such as Solar PV (as shown in Figure 2), may not both simultaneously discharge to the AE distribution system, unless the capacity of the transformer serving the customer has been reviewed by AE to ensure safe operation.

Other Protective Devices

The foregoing provides a statement of the minimum requirements for parallel operation on the AE system. In addition, AE will have the right to specify certain protective devices including relays and circuit breakers that must be installed at the customer's expense to operate in parallel with AE's system, to protect the safety of its employees and equipment, maintain the reliability of the system, or improve the accuracy of its metering equipment.

Technical Exceptions

- a. AE will review and consider exceptions that customers may have to the "Requirements for Parallel Systems" provided, however, that legal requirements such as compliance with fire safety, electrical, or construction codes may not be waived unless such law, code, or ordinance provides for waiver or approval of alternate requirements and then only under the conditions set out therein for the grant of such waiver or written approval of alternate requirements.
- b. Customers desiring to present exceptions for consideration should submit in writing a completed description of the nature of each such exception to AE.
- c. Customers submitting exceptions should also include recommendations for an alternative approach to this particular requirement.

E. COMPLIANCE WITH APPLICABLE LAWS AND INSTALLATION RULES

1. Compliance with Laws: All customer-owned power production facilities located in the AE service area shall comply with the latest version of the Austin Electrical Utility Service regulations, City of Austin Electrical Code (§25-12-111), ERCOT Distributed Generation Requirements, NFPA 70 (National Electrical Code), and NESC (National Electrical Safety Code), as well as the most current version of all other applicable federal, state, or local laws or ordinances as of date of installation. Refer to **Section G** for a listing of additional codes and standards. AE customers in areas outside of the City of Austin may be required to have an additional permit depending on any local authority having jurisdiction (AHJ).
2. Compliance with Installation Rules: All customer-owned power production facilities shall also comply with the Installation Rules and Standards for Electric Service established for the AE service area. All equipment rated for use at 1000V or below shall be UL listed and shall comply with NEC Article 490.

a. Note that per City and State Law, Solar PV systems may only be installed by a licensed contractor. Homeowner exemptions do not apply for working on electrical services.

3. Applicability for Emergency or Standby Systems: Emergency and/or standby systems as defined in Articles 700 through 702 of the NEC not in parallel with the AE electrical distribution system, other than brief transition switching periods, are not required to follow this interconnection procedure. However, if the design of the system involves parallel operation with the AE distribution system for periods typically longer than 1 second, then the customer is required to follow the procedure outlined in this guide. Note: Any closed transition switching requires synchronizing controls.
4. Interconnection Studies: Detailed interconnection studies may be required if the generation is connected to AE's distribution system and AE determines it to be necessary for safety and reliability purposes:
 - a. Facilities rated <500 kW (not on the network)
 - i. Interconnection study typically not required for equipment pre-certified to UL 1741.
 - b. Facilities rated 500 kW to <1 MW
 - i. Interconnection study typically not required for equipment pre-certified to UL 1741.
 - ii. If an interconnection study is desired, AE to bear all costs for studies performed.
 - c. Facilities rated >1 MW but less than 10 MW, or on the Downtown Network
 - i. Interconnection study typically required at customer's expense.

- ii. Austin Energy shall determine the cost and timeline for performing a detailed interconnection study.
- 5. Installation Safety: Due to the arc flash hazards present in larger commercial systems, all work on the customer electrical system shall be performed under the direct supervision of a Master Electrician.
 - a. All energized meter sockets shall be covered with a UL listed plastic meter cover blank-off plate until the meter has been installed to prevent inadvertent electrical contact.
- 6. Inspection: All customer-owned power production facilities shall be inspected for compliance with minimum safety code requirements and installation rules by a licensed electrical inspector. Isolated systems will also be inspected to ensure that the customer's load and power production equipment are not connected to an electrical circuit in common with the AE system. Inspection approval shall mean only that as of the date of the inspection, the customer's system met minimum code requirements at the time of such inspection and shall not be construed as endorsement, approval, or recommendation of a particular system design for the customer's needs nor a representation that the facility continues to comply with such codes following the inspection.
- 7. Enforcement: AE reserves the right to discontinue electric service to customers who have interconnected without AE authorization, fail or refuse to comply with minimum requirements or applicable law, or who, as determined by AE, are operating their power production equipment in a hazardous or unsafe manner. AE may also pursue such other and further rights or remedies as are available to enforce these requirements.
- 8. Operating Safety: Adequate protection and documented operational procedures must be jointly developed and followed by the customer and AE for each customer power production facility operating in parallel with the AE system. These operating procedures must be approved by both the customer and AE. The customer shall be required to furnish, install, operate, and maintain in good order and repair and be solely responsible for, without cost to AE, all facilities required for the safe operation of a customer generation system in parallel with the AE system.
- 9. Maintenance of Protective Equipment: All interconnection equipment on the customer's facility shall be installed and maintained by the customer at their sole expense and in accordance with minimum guidelines established by AE.
 - a. The customer shall provide a maintenance schedule and perform maintenance of protective equipment at their sole expense at least every two (2) years, or as mandated by current standards, equipment manufacturer recommendations, or as required by AE to provide a safe, reliable system while operating in parallel with the AE system. Circuit breakers must be trip-tested

- by the customer at least once each year.
- b. A periodic test report log shall be maintained. Testing shall include, but is not limited to, for example, the tripping of the circuit breakers by the protective relays. The customer shall provide appropriate access to all facilities for the purpose of such inspections. AE reserves the right to periodically re-inspect the system with prior notification to the customer.
 - c. Maintenance records for parallel systems must be provided to AE upon request.
10. Self-Protection: The minimum protection requirements are designed and intended to protect the Austin Energy electrical distribution system only. The customer shall provide, at their sole expense, all devices necessary to protect the customer's electrical generating system by conditions that may occur on the AE system resulting in interruptions and restorations of electrical service. The equipment so installed must protect the customer's electric generating system from overvoltage, undervoltage, overload, short circuits, including ground fault conditions, open circuits, phase imbalance and reversal, over and under frequency conditions, and other injurious electrical conditions that may arise during the operation of the AE system.
11. Capital Cost Responsibility: The customer is required to bear all initial and subsequent costs associated with the change-out, upgrading, or addition of protective devices, transformers, poles, line, services, meters, switches, and associated equipment and devices beyond that which would be required to provide normal service to the customer if no generation was involved. The customer shall be invoiced for all material and labor that are required in excess of those covered by other applicable installation charges or fees (see appropriate schedules). Upon written request, AE shall supply the customer a cost estimate prior to any work being done.
12. Liability: The customer assumes all responsibility for damage or loss that may occur from improper coordination and synchronization of its generator with the AE system.
- a. The customer shall provide proof of insurance of at least \$500,000 for systems over 500 kW and at least \$1M for systems over 1 MW.
 - b. The customer shall be responsible for coordination and synchronization of the customer's electrical generating system with all aspects of AE's electrical system.
13. Confidentiality: Due to the nature of the rapidly evolving regulations for DG/DER, non-specific information might be shared among working groups to better understand and optimize the process for interconnection. Detailed or specific

information provided, such as customer identification, one-line or site diagrams, or specific component information, shall not be shared without customer approval.

14. Third Party Leases: Austin Energy is the exclusive provider of electric service within its service territory. State law prohibits other owners of electric equipment from furnishing electricity for compensation. Therefore, leases related to solar generation must be equipment leases for flat payments and may not be based on volumetric charges or multipliers for the kWh output of the photovoltaic equipment, nor may leases be based on the customer's consumption from the equipment. As such, a customer may generate electricity to meet its own needs but cannot buy electricity from anyone else. A customer may lease the equipment on a cost basis but may not have lease payments based on the energy produced, which would be construed as the sale of electricity. It is up to each customer lessee and solar equipment lessor to ensure that a lease does not violate state law.

F. DEFINITIONS

1. **AE System:** The Electric Utility System of Austin Energy (AE). A detailed map of the service area is available on the Austin Energy Storm Center Website: <https://austinenergy.com/outages>
2. **Anti-islanding:** Detection circuitry required for DG systems that sense when a power outage has occurred on the utility lines and shuts itself off so there is no possibility of backfeeding into the utility system.
3. **Backfeed:** A situation whereby the normal power flow is reversed and current flows from the customer system into the AE distribution system.
4. **Customer:** Refers to both co-generators and small power producers within the AE service area who use conventional fossil fuels or alternative sources such as solar, wind, or biomass to produce power. The customer must have legal ownership rights of the proposed distributed generation facility and property.
5. **Dedicated Service:** A feeder or transformer, or both, in the AE Distribution system that only serves a single customer.

DGPA: Distributed Generation Planning Application form(s) which are required to be filled out for any Distributed Generation or DER interconnection to Austin Energy:

<https://austinenergy.com/contractors/construction-renovation/documents-forms/customer-power-production>

- **Select the “Contractors” tab, then select the “Construction & Renovation” tab; navigate to “Documents and Forms”, and then select the “Customer-Owned Power Production Facilities” sub-tab.**
6. **Distributed Energy Resources (DER):** Systems that are small-scale power generation or storage technologies (typically in the range of 1 kW to 10,000 kW) used to provide an alternative to or an enhancement of the traditional electric power system.
 7. **Distributed Generation (DG):** An electrical generating facility located within the Austin Energy service territory of less than 10 MW and connected at a voltage of 35kV and below, which may be connected in parallel operation to the Austin Energy system. The facility may include energy storage technologies as well as conventional generation technologies.
 8. **Downtown Network:** The network refers to an area of the AE distribution system in downtown Austin where multiple feeders are "networked" together. Areas of downtown Austin are on the Downtown Network, and due to safety and power quality concerns, additional protection is required so that **no** distributed generation facility will be allowed to export power to the AE grid. These requirements are

documented in IEEE Standard 1547.6 and an analysis of the issues was documented by the National Renewable Energy Labs at:
<https://www.nrel.gov/docs/fy09osti/45061.pdf>.

9. Electric Energy Storage (or Energy Storage Systems): Electric Energy Storage Systems connected in parallel to the AE distribution system are considered to be distributed generation assets.
10. EPS: Utility Electric Power Systems.
11. EPS Metering: ERCOT Polled Settlement Metering. May be required for DG/DER greater than 1 MW. Refer to: <http://www.ercot.com/mktinfo/metering/eps>
12. ERCOT (Electric Reliability Council of Texas): The area in Texas served by electric utilities, municipally owned utilities, and electric cooperatives that are not synchronously connected with electric utilities outside the state. ERCOT manages the flow of electric power to the customers, schedules power on the grid that connects transmission lines and generation units and manages financial settlement for the competitive wholesale bulk- power market.
13. ERS: ERCOT Emergency Response Service. Refer to:
<http://www.ercot.com/services/programs/load/eils/>
14. ESPA: **Electric Service Planning Application form(s)** which are required to be filled out for any change in the service connection to Austin Energy:
<https://austinenergy.com/contractors/construction-renovation>
 - **Select the “Contractors” tab, then select the “Construction & Renovation” tab.**
15. Generating Facility Capacity: The net capacity of the generating facility connecting at a single point of common coupling and the aggregate net capacity of the facility where multiple generators connect at the same point of common coupling.
16. High-Leg Service: Refers to a 4-wire 3-phase open delta system where the midpoint of one phase winding is grounded. See NEC Article 110.15, and the DIG section 9.e. A licensed electrician should verify each phase relative to ground using suitable equipment to determine the exact circuits powered by the high leg.
17. Inverter Based Resources (IBR): distributed generation systems that require use of an inverter to convert DC to AC power are considered IBR systems.
18. IEEE: Institute of Electrical and Electronics Engineers.
19. Interconnection: The physical means by which electric energy is received from a

generating source. The principal elements of an electric interconnection include transmission and distribution circuits, transformers, and switching devices such as circuit breakers, fuses, and isolating disconnect switches. Supplemental elements may include sensing devices and protective relay equipment.

20. Interconnection Study: A study or studies that may be undertaken by AE in response to the receipt of a completed Interconnection Application and parallel operation with the AE system. Interconnection studies may include, but are not limited to, Interconnection Feasibility Studies (the standard Interconnection Application process, a "screening" process or "Preliminary Studies" per IEEE 1547.7), System Impact Studies (more detailed studies "required" by the potential for adverse impacts to the distribution system and that carefully review the potential effect of a DR unit on the area EPS, or "Conventional Studies" per IEEE 1547.7), and Facilities Studies (studies to determine whether any modifications, upgrades, or additional facilities will be required to the AE system, or "Special Studies" per IEEE 1547.7).
21. Islanding: A condition in which a portion of a utility electric power system is energized solely by one or more local electric power systems throughout the associated Point of Interconnection while that portion of the utility electric power system is electrically separated from the rest of the utility electric power system.
22. Isolated System: A system in which there is no interconnection of the customer's power source or load served by the customer's power source to an electrical circuit common with the AE electric utility system. Customers dedicating their power production equipment to a particular load without standby electric service from AE would be considered as having a totally isolated system.
23. Maintenance Electric Service: Electrical power which is required to serve the customer's load during specific prearranged periods of scheduled outage of the customer's power source for maintenance or repair.
24. Microgrid: A local energy network offering integration of DG/DER with local electric loads, which can operate in parallel with the AE System or in an intentional island mode.
25. Network Protector: An assembly comprising a circuit breaker and its complete control equipment for automatically disconnecting a transformer from a secondary network in response to predetermined electrical conditions on the primary feeder or transformer and for connecting a transformer to a secondary network, either through manual control or automatic control responsive to predetermined electrical conditions on the feeder and the secondary network.
26. Parallel System: A system in which the customer's electrical generation system can be connected to an electrical circuit common with the AE electric utility

system. Customers who receive supplementary electric service from AE will be considered as having a parallel system. This system allows for the flow of power from AE to the customer and from the customer to AE. Typical distributed generation falls into this category.

27. Point of Interconnection: The point at which energy first enters or leaves the line or apparatus owned by the customer and leaves or enters the line or apparatus owned by AE. See DCM 1.12.1.5.A for details.
28. PUC[T] (The Public Utility Commission of Texas): The PUCT regulates the state's electric, telecommunication, and water and sewer utilities, implements respective legislation, and offers customer assistance in resolving consumer complaints.
29. Separate System: A system in which there is no intended interconnection of the customer's electrical generation system in parallel with the AE electric utility system but whose load receives standby service from AE. Customers dedicating their power production equipment to a particular load and who receive standby electric service for the load from AE must be capable of transferring the load between the two electrical systems in an open transition in order to be considered as having a separate system; that is, the customer's power production equipment is not connected to the AE electric utility system directly or indirectly through the load. Typical emergency backup generation systems with an automatic transfer switch fall into this category. However, power production equipment intended to operate with a closed transition must be reviewed by AE as well.
30. Service Distribution Enclosure: An above-grade, AE-approved enclosure located on the line side of the revenue meter, where the customer's conductors and AE's conductors are electrically connected. Serves as an acceptable point of utility-side interconnection for DG systems. See Design Criteria Manual 1.17 for further definition.
31. Shared Solar: A solar-electric system that provides power and/or financial benefit to multiple community members.
32. Supplementary Electric Service: Electric power required on a regular basis to serve a portion of the customer's load in addition to that served by the customer's power source.
33. UPS: An Uninterruptible Power Supply (UPS) system that is not normally capable of backfeed into the AE system, other than brief transition periods, will be classified as a separate system. If the UPS system is capable of backfeed into the AE system for periods exceeding 1 second, it will be classified as a parallel system.

34. Utility-side Interconnection: Where the DG/DER is electrically connected directly to the Austin Energy System, i.e. on the line side (ahead) of the revenue meter.

G. CERTIFICATION CODES and STANDARDS

Refer to the most recent version of the following documents.

Many codes are available from the City of Austin Planning and Zoning website:

<https://www.austintexas.gov/department/planning-department>

City of Austin Electrical Codes:

<http://www.austintexas.gov/department/building-technical-codes>

Austin Energy Design Criteria Manual

<https://austinenergy.com/contractors/construction-renovation/documents-forms/design-reference-and-process-documentation>

- See the “Contractors” tab, then select the “Construction & Renovation” tab, and navigate to the “Documents & Forms” tab. Then select the “Design Reference & Process Documentation” sub-tab.

ANSI C84.1 - Electric Power Systems and Equipment – Voltage Ratings (60 Hz)

California Energy Commission (CEC) Solar Energy Resource

<http://www.gosolarcalifornia.org/>

IEEE Std 519 - IEEE Recommended Practices and Requirements for Harmonic Control in Electric Power Systems

IEEE Std 1547 - IEEE Standard for Interconnection and Interoperability of Distributed Energy Resources with Associated Electric Power Systems Interfaces (including IEEE 1547.1, 1547.2, 1547.3, 1547.4, 1547.6, and 1547.7)

IEEE Std C37.90.1 - IEEE Standard Surge Withstand Capability (SWC) Tests for Relays and Relay Systems

IEEE Std C37.90.2 - IEEE Standard Withstand Capability of Relay Systems to Radiated Electromagnetic Interference from Transceivers

IEEE Std C37.108 - IEEE Guide for the Protection of Network Transformers

IEEE Std C50.13 - IEEE Standard for Cylindrical-Rotor Synchronous

Generators

IEEE Std C57.12.44 - IEEE Standard Requirements for Secondary Network Protectors

IEEE Std C62.41.2 - IEEE Recommended Practice on Characterization of Surges in Low

Voltage (1000V and Less) AC Power Circuits

IEEE Std C62.45 - IEEE Recommended Practice on Surge Testing for Equipment Connected to Low-Voltage (1000V and Less) AC Power Circuits

IEEE Std P2030.1 - IEEE Draft Guide for Electric-Sourced Transportation Infrastructure

International Fire Code (IFC)

NEMA MG 1 - Motors and Generators

NESC - National Electrical Safety Code

NFPA 70 - National Electrical Code, version as approved by City of Austin Electrical Code

NFPA 780 - Standard for the Installation of Lightning Protection Systems

SAE J1772 - SAE Electric Vehicle and Plug in Hybrid Electric Vehicle Conductive Charge Coupler

UL 1449 - Standard for Surge Protective Devices

UL 1642 - Standard for Lithium Batteries

UL 1699B - Photovoltaic (PV) DC Arc-Fault Circuit Protection

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

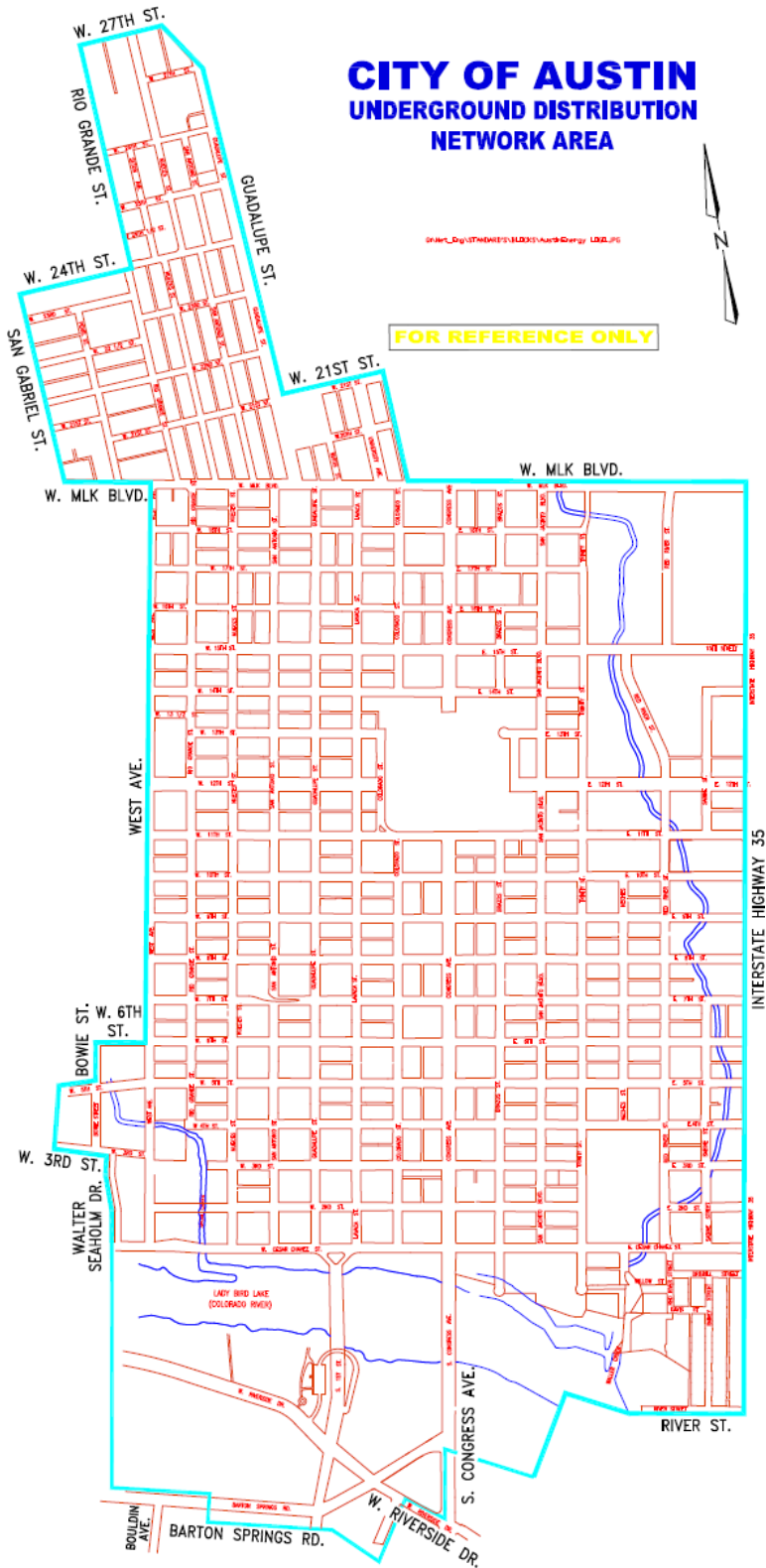
UL 1973 - Batteries for Use in Stationary, Vehicle Auxiliary Power and Light Electric Rail (LER) Applications

UL 1989 - Standard for Standby Batteries

UL 2200 - Standard for Stationary Engine Generator Assemblies

UL 9540 - Standard for Energy Storage Systems and Equipment

Appendix A: Map of the Downtown Network



Appendix B: Standard Complex Meter Configurations

Figure B-1: 1P 3W 120/240V PV Meter Tap on Load Side

Figure B-2: 1P 3W 120/240V PV Meter Tap on Line Side

Figure B-3: 3P 4W 208/120V PV Meter Tap on Load Side

Figure B-4: 3P 4W 208/120V PV Meter Tap on Line Side

Figure B-5: 3P 4W 480/277V PV Meter Tap on Load Side

Figure B-6: 3P 4W 480/277V PV Meter Tap on Line Side

Figure B-7: Utility-Side Interconnection – Modular Metering

Figure B-8: Utility-Side Interconnection – Service Distribution Enclosure

Figure B-9: 208/120V Utility-Side Interconnection – Transformer
Secondary

Figure B-10: 480/277V Utility-Side Interconnection – Transformer
Secondary

Figure B-11: Utility-Side Interconnection – Pullbox

Figure B-12: Utility-Side Interconnection –

Weatherhead

Figure B-1: 1P 3W 120/240V PV Meter Tap on Load Side

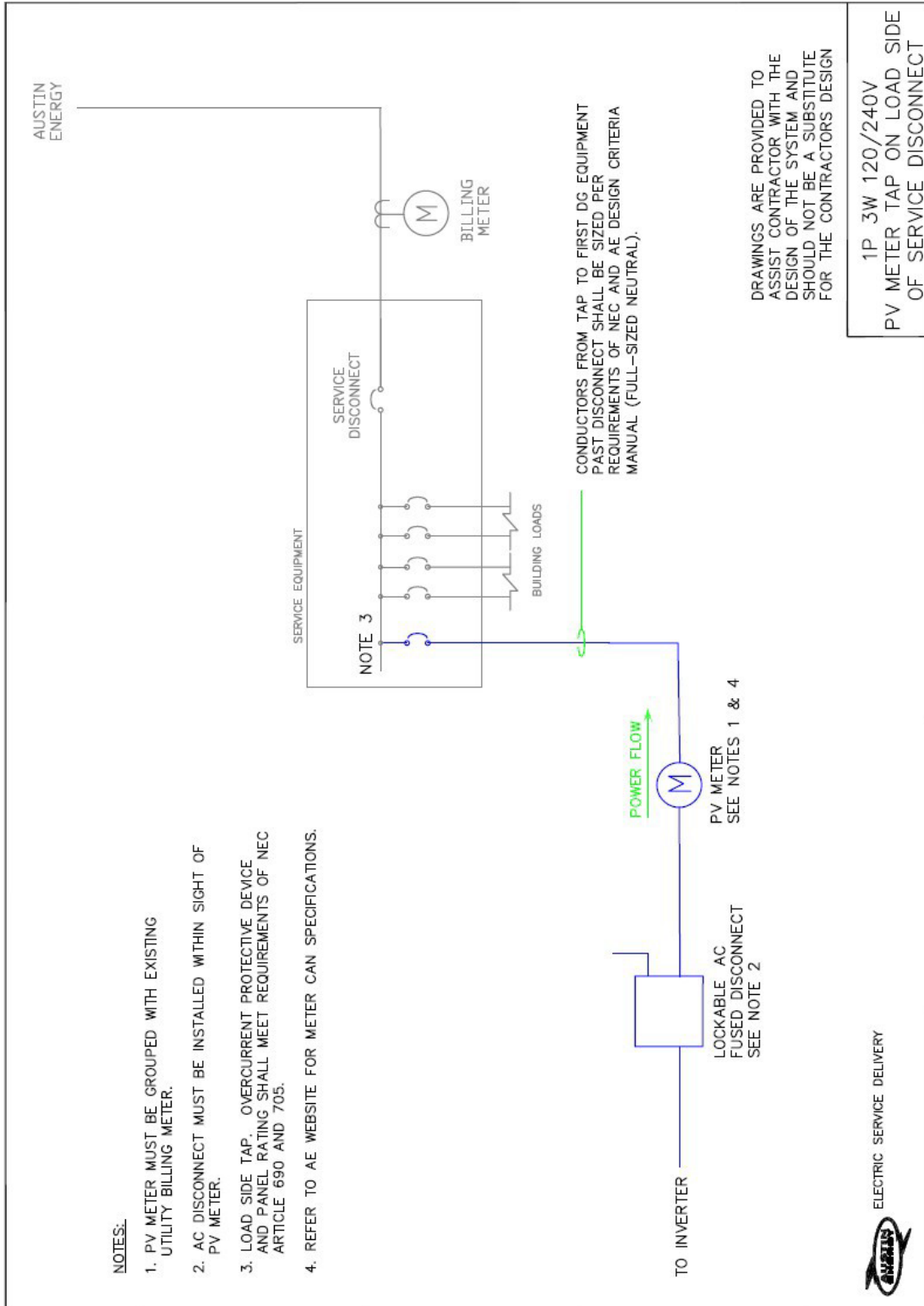


Figure B-2: 1P 3W 120/240V PV Meter Tap on Line Side

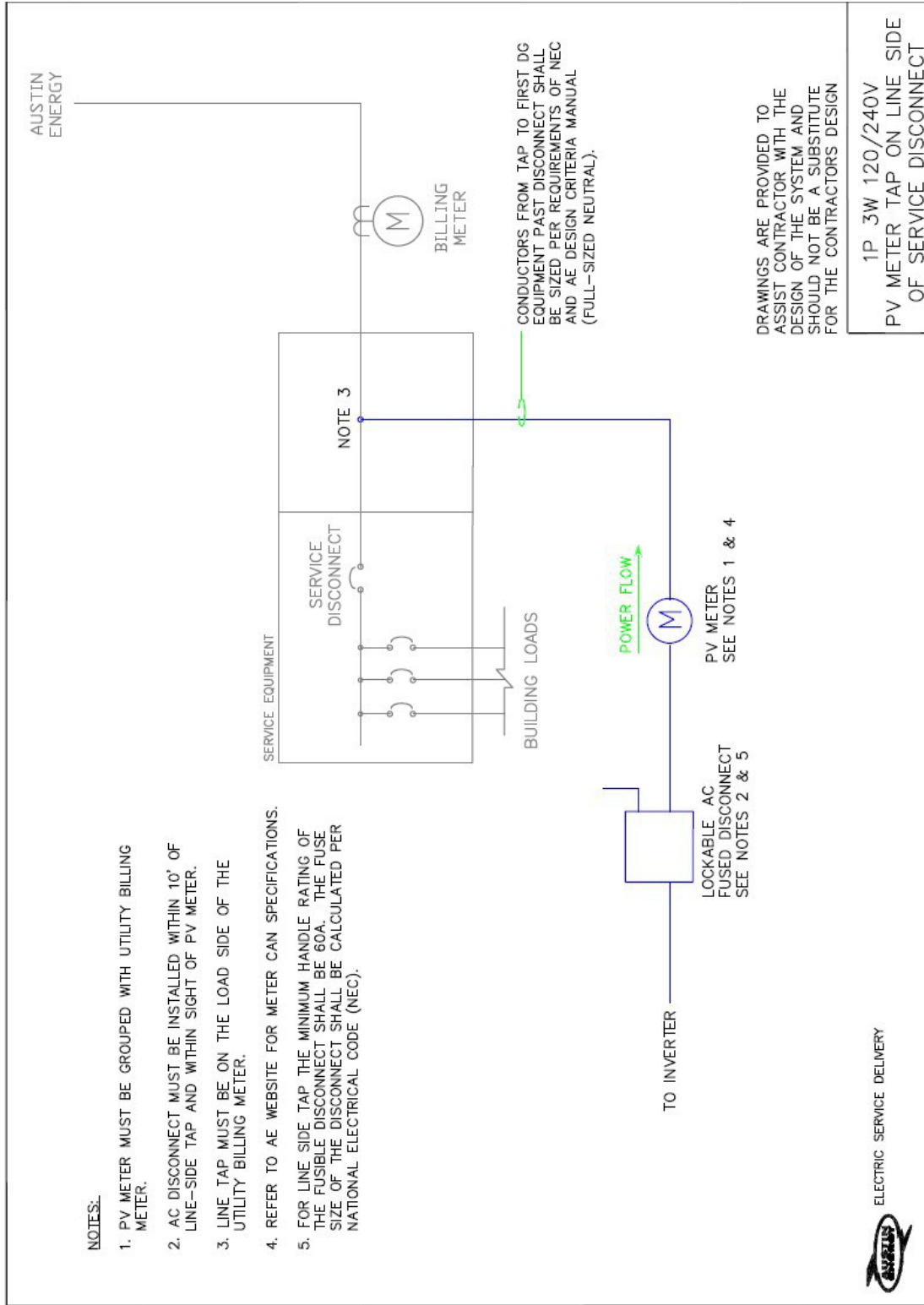


Figure B-3: 3P 4W 208/120V PV Meter Tap on Load Side

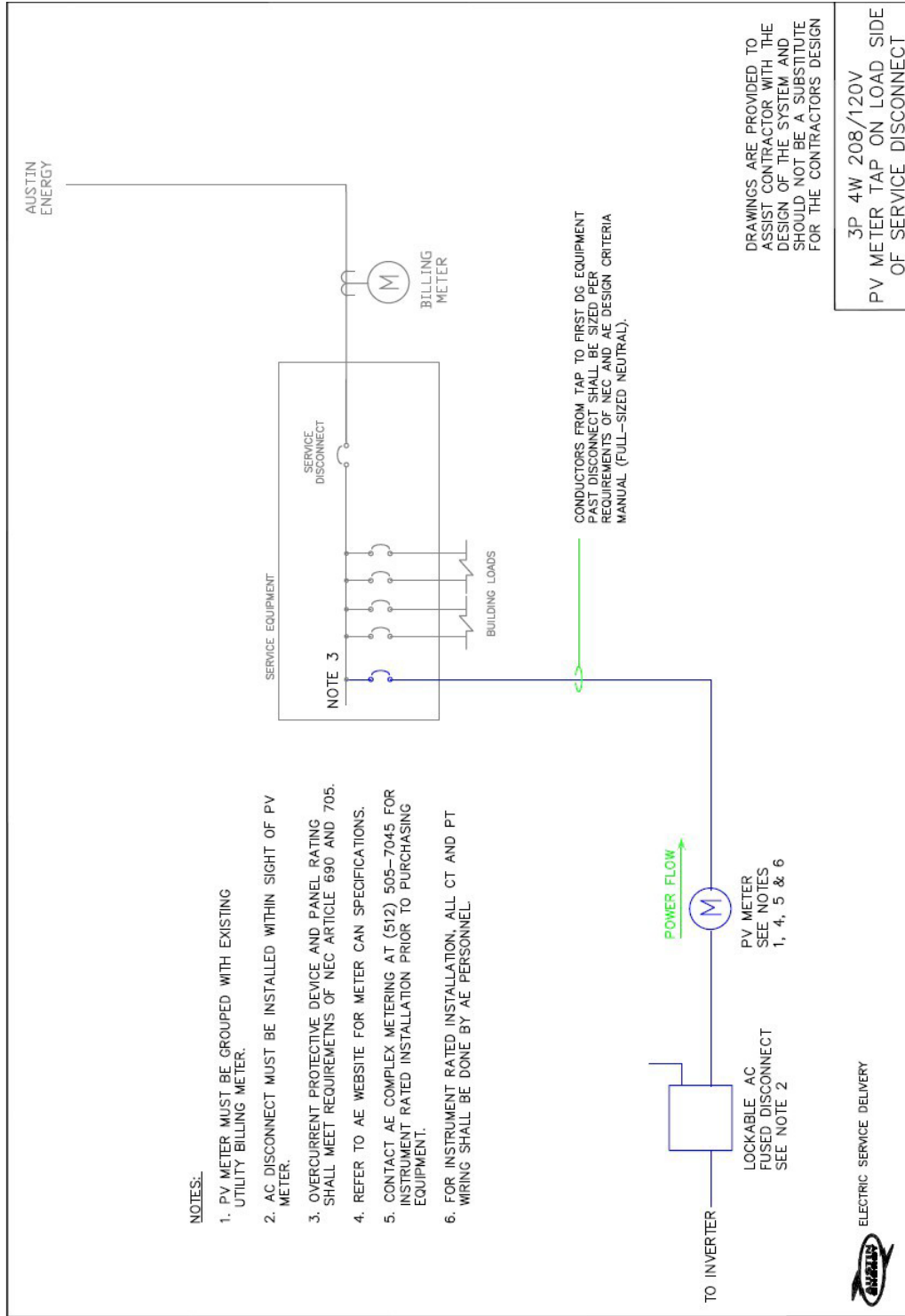


Figure B-4: 3P 4W 208/120V PV Meter Tap on Line Side

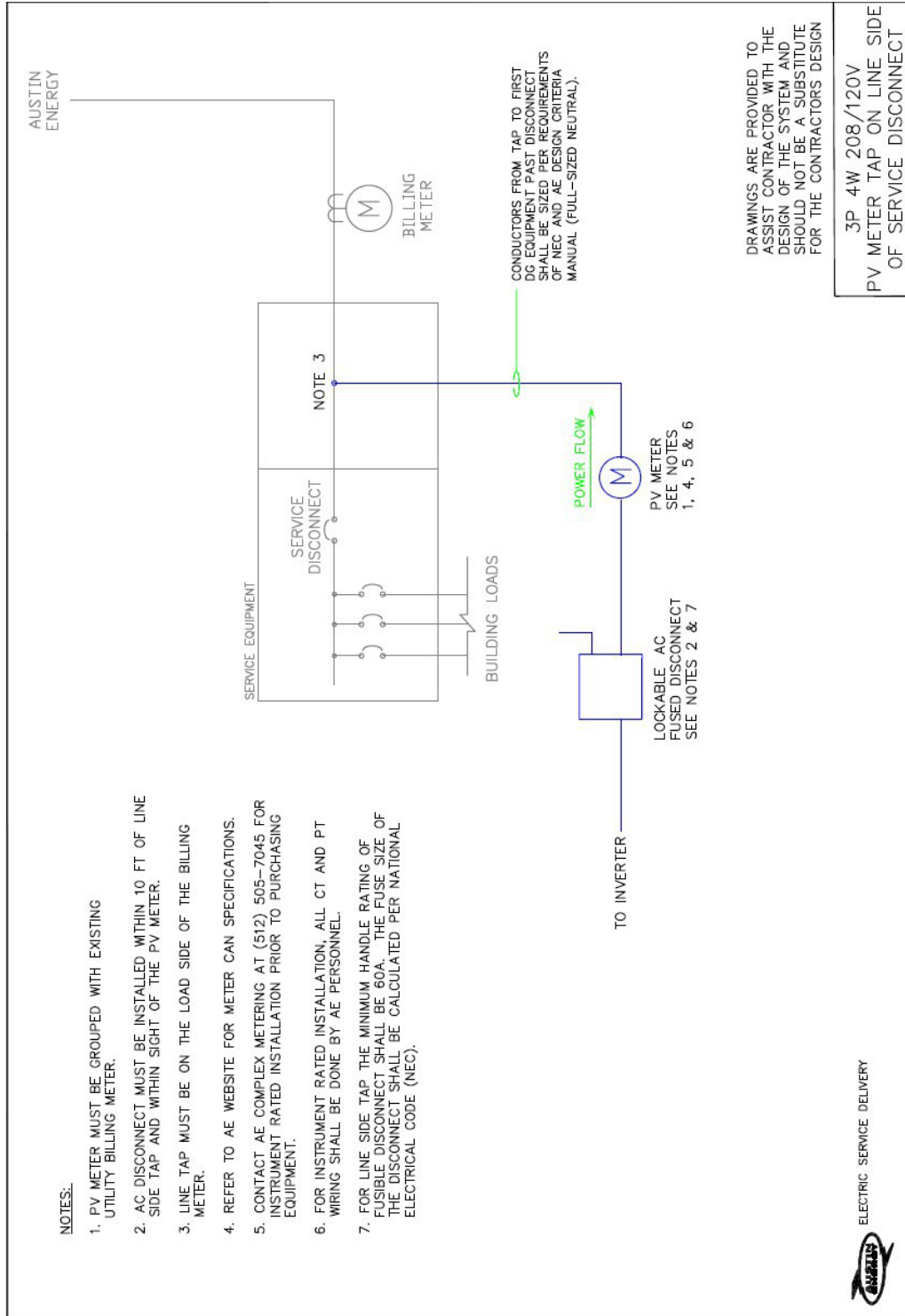


Figure B-5: 3P 4W 480/277V PV Meter Tap on Load Side

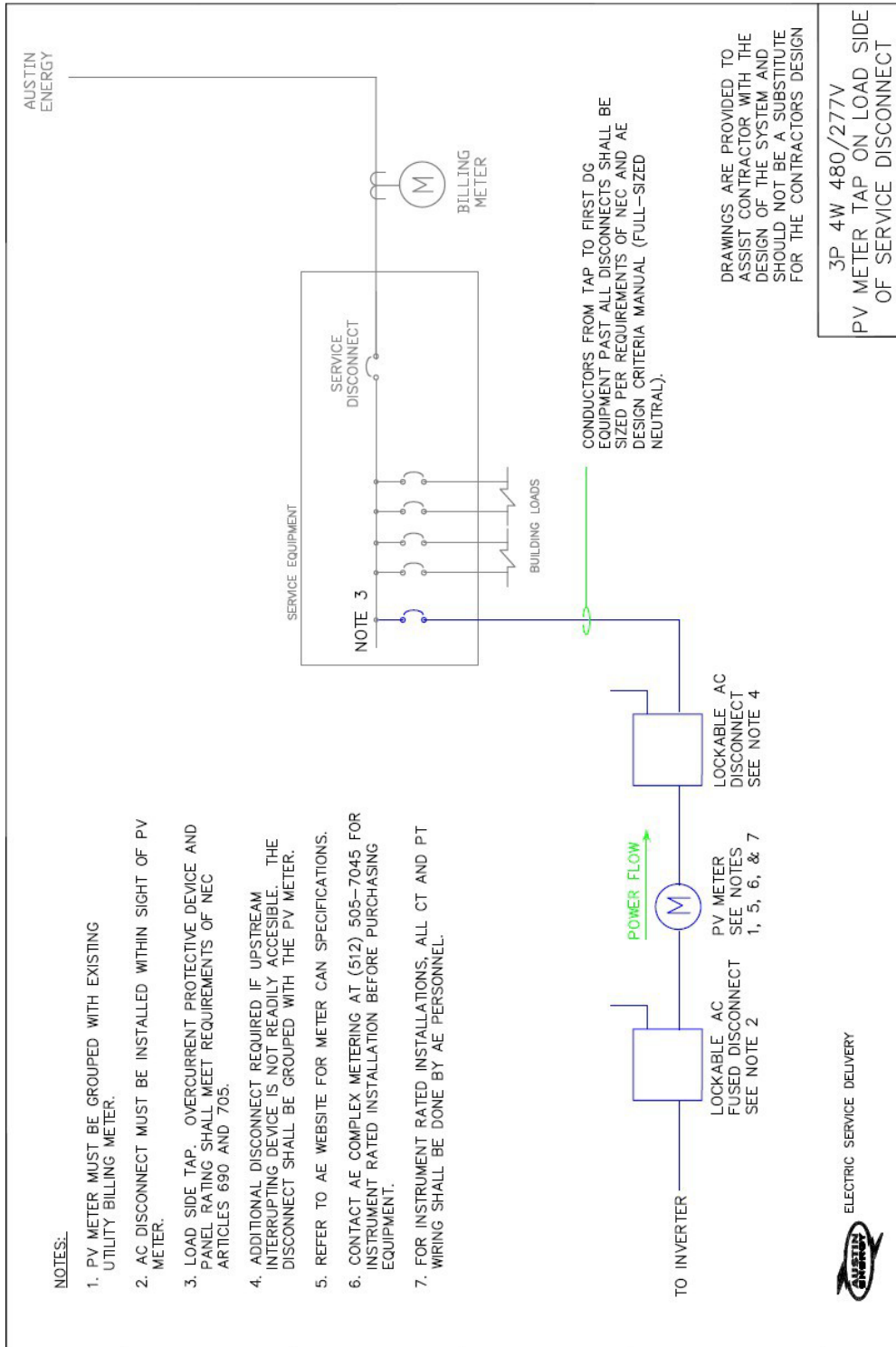


Figure B-6: 3P 4W 480/277V PV Meter Tap on Line Side

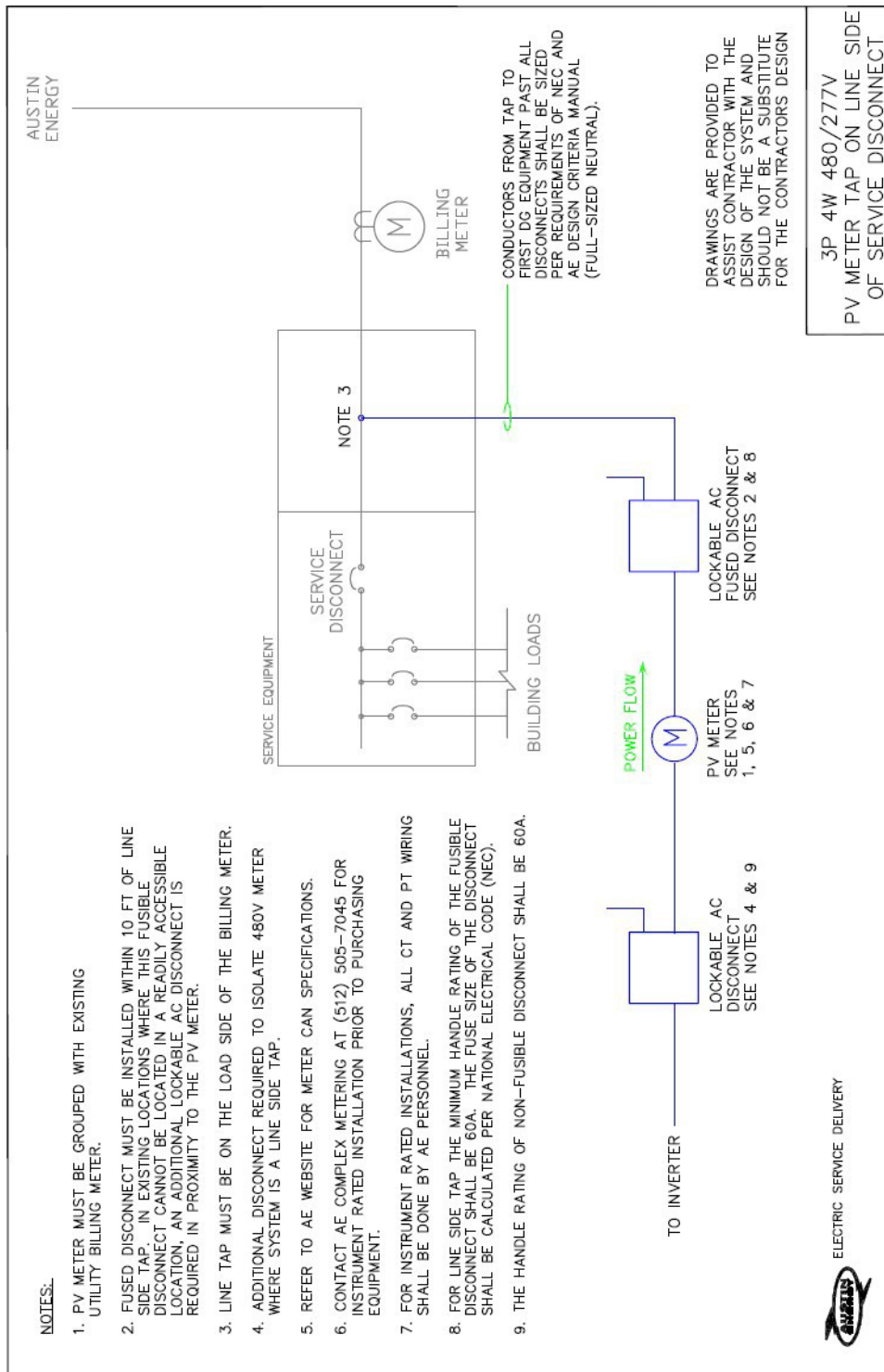
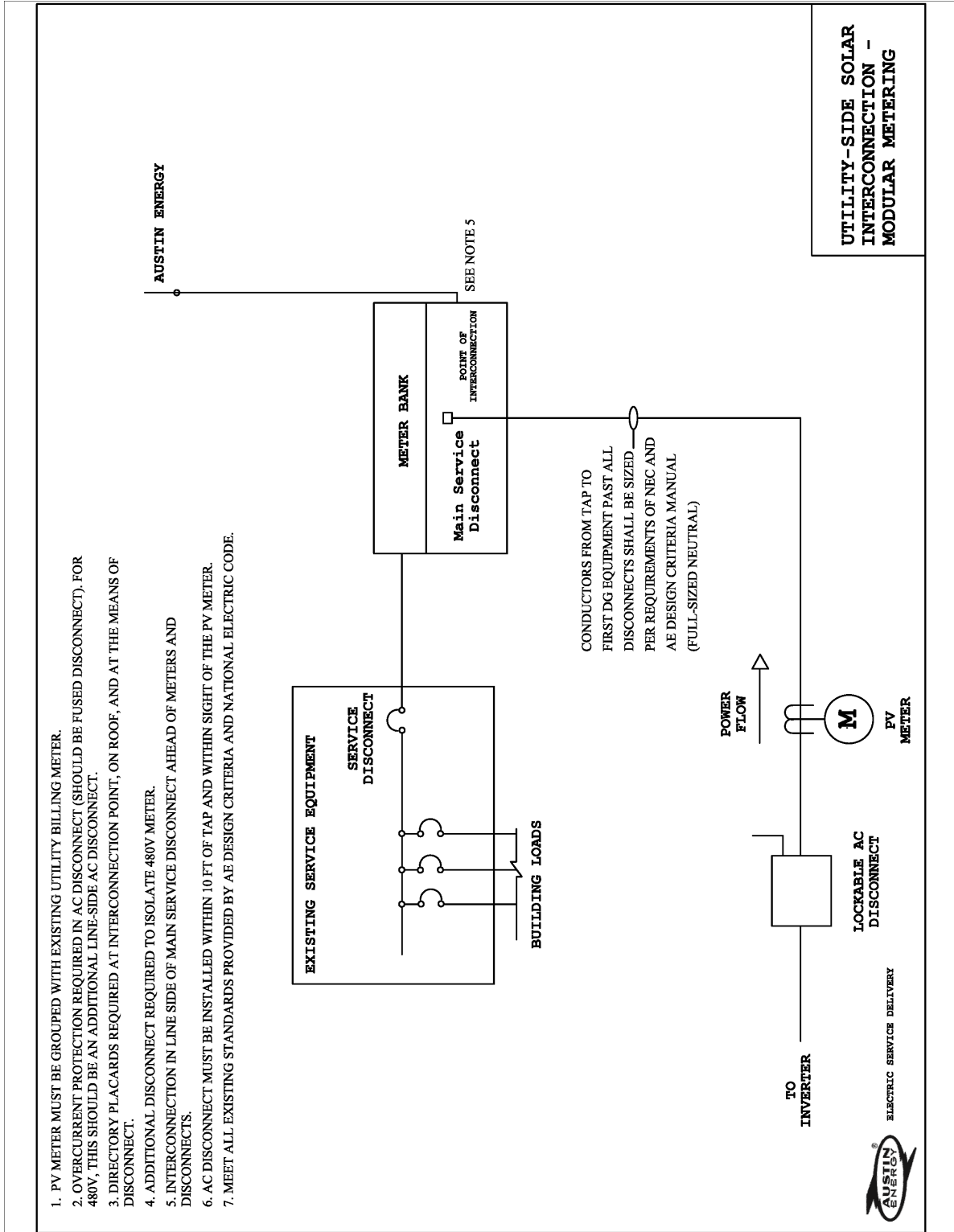


Figure B-7: Utility-Side Interconnection – Modular Metering



1. PV METER MUST BE GROUPED WITH EXISTING UTILITY BILLING METER.
2. OVERCURRENT PROTECTION REQUIRED IN AC DISCONNECT (SHOULD BE FUSED DISCONNECT). FOR 480V, THIS SHOULD BE AN ADDITIONAL LINE-SIDE AC DISCONNECT.
3. DIRECTORY PLACARDS REQUIRED AT INTERCONNECTION POINT, ON ROOF, AND AT THE MEANS OF DISCONNECT.
4. ADDITIONAL DISCONNECT REQUIRED TO ISOLATE 480V METER.
5. INTERCONNECTION IN LINE SIDE OF MAIN SERVICE DISCONNECT AHEAD OF METERS AND DISCONNECTS.
6. AC DISCONNECT MUST BE INSTALLED WITHIN 10 FT OF TAP AND WITHIN SIGHT OF THE PV METER.
7. MEET ALL EXISTING STANDARDS PROVIDED BY AE DESIGN CRITERIA AND NATIONAL ELECTRIC CODE.

Figure B-8: Utility-Side Interconnection – Service Distribution Enclosure

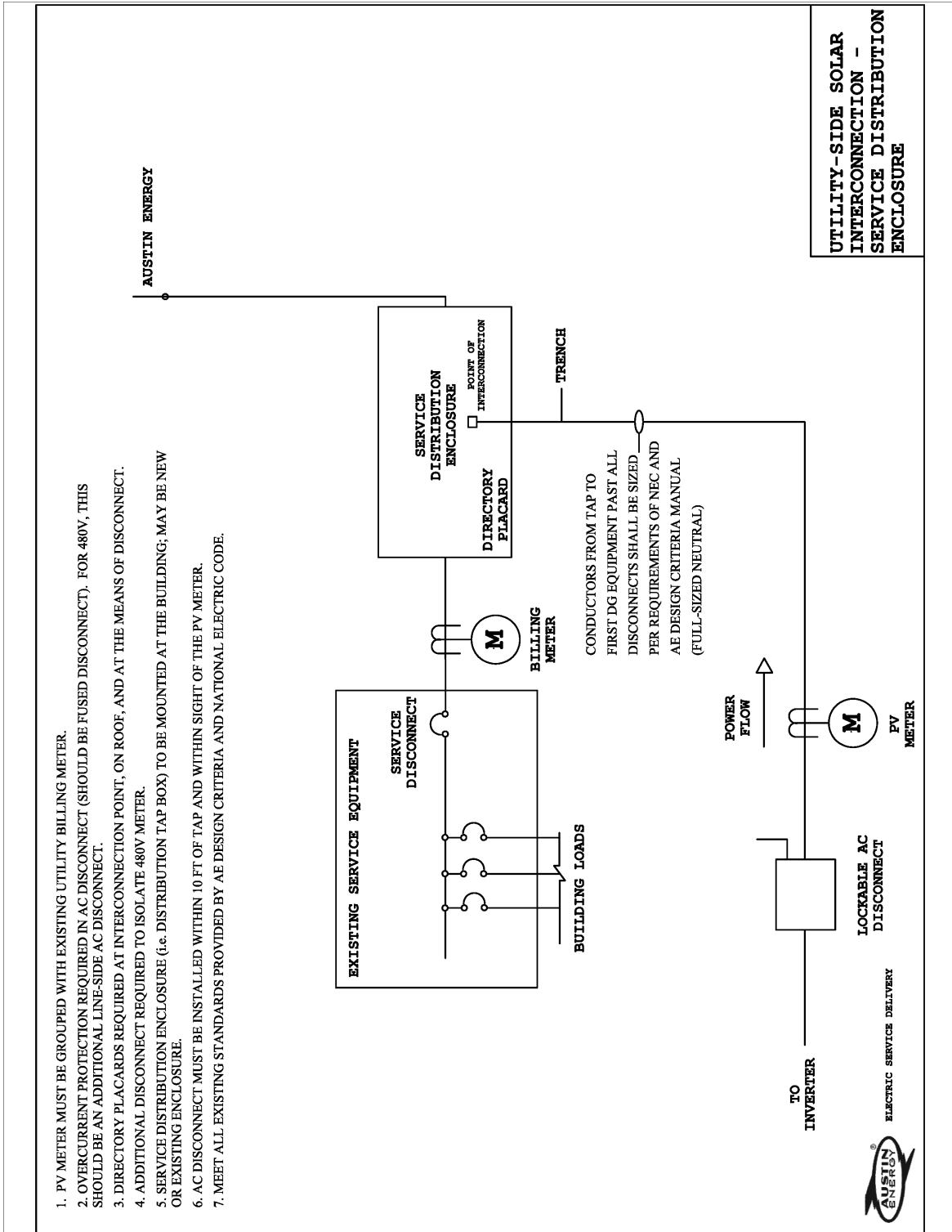


Figure B-9: 208/120V Utility-Side Interconnection – Transformer Secondary

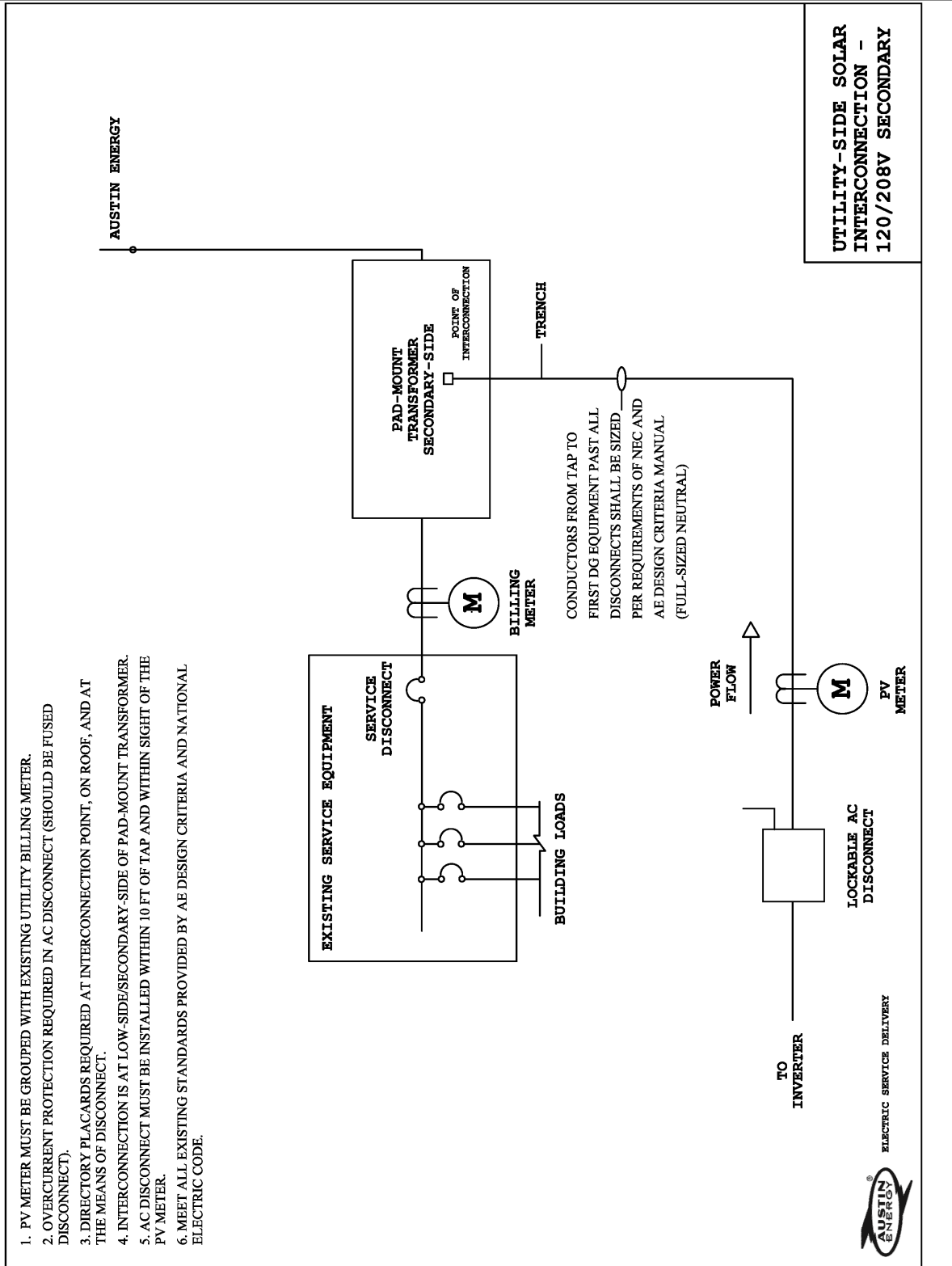
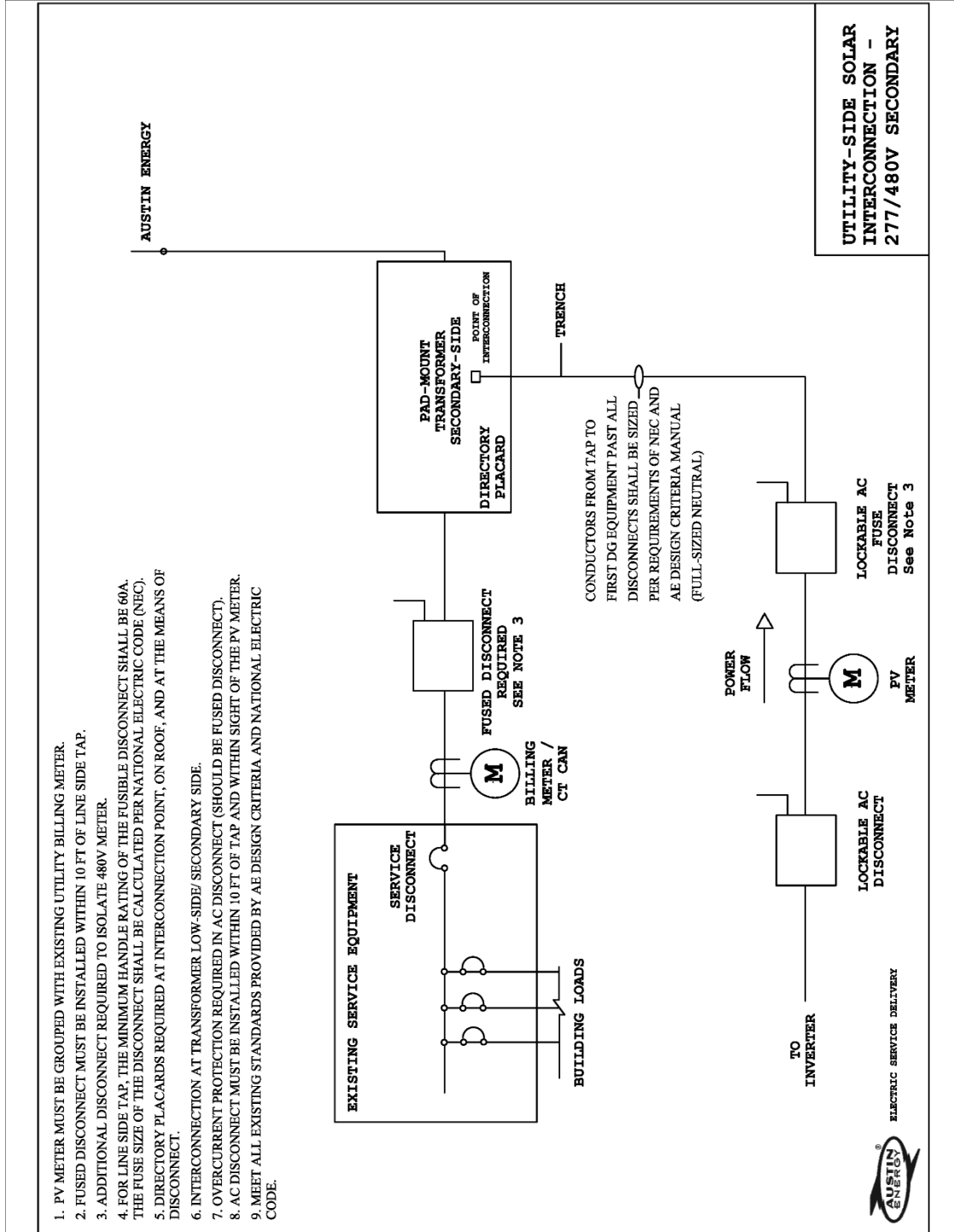


Figure B-10: 480/277V Utility-Side Interconnection – Transformer Secondary



1. PV METER MUST BE GROUPED WITH EXISTING UTILITY BILLING METER.
2. FUSED DISCONNECT MUST BE INSTALLED WITHIN 10 FT OF LINE SIDE TAP.
3. ADDITIONAL DISCONNECT REQUIRED TO ISOLATE 480V METER.
4. FOR LINE SIDE TAP, THE MINIMUM HANDLE RATING OF THE FUSIBLE DISCONNECT SHALL BE 60A. THE FUSE SIZE OF THE DISCONNECT SHALL BE CALCULATED PER NATIONAL ELECTRIC CODE (NEC).
5. DIRECTORY PLACARDS REQUIRED AT INTERCONNECTION POINT, ON ROOF, AND AT THE MEANS OF DISCONNECT.
6. INTERCONNECTION AT TRANSFORMER LOW-SIDE/ SECONDARY SIDE.
7. OVERCURRENT PROTECTION REQUIRED IN AC DISCONNECT (SHOULD BE FUSED DISCONNECT).
8. AC DISCONNECT MUST BE INSTALLED WITHIN 10 FT OF TAP AND WITHIN SIGHT OF THE PV METER.
9. MEET ALL EXISTING STANDARDS PROVIDED BY AE DESIGN CRITERIA AND NATIONAL ELECTRIC CODE.

Figure B-11: Utility-Side Interconnection – Pullbox

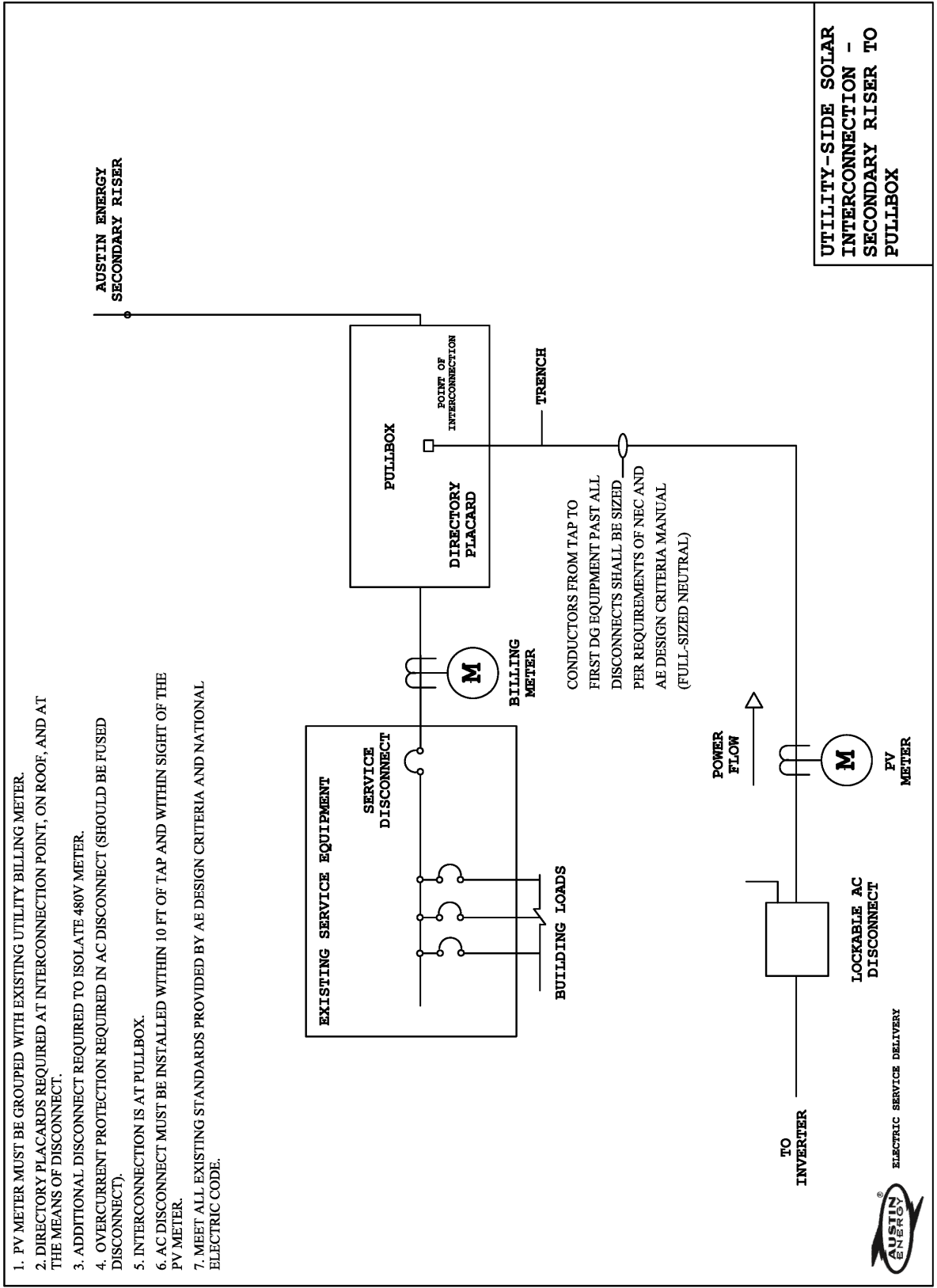
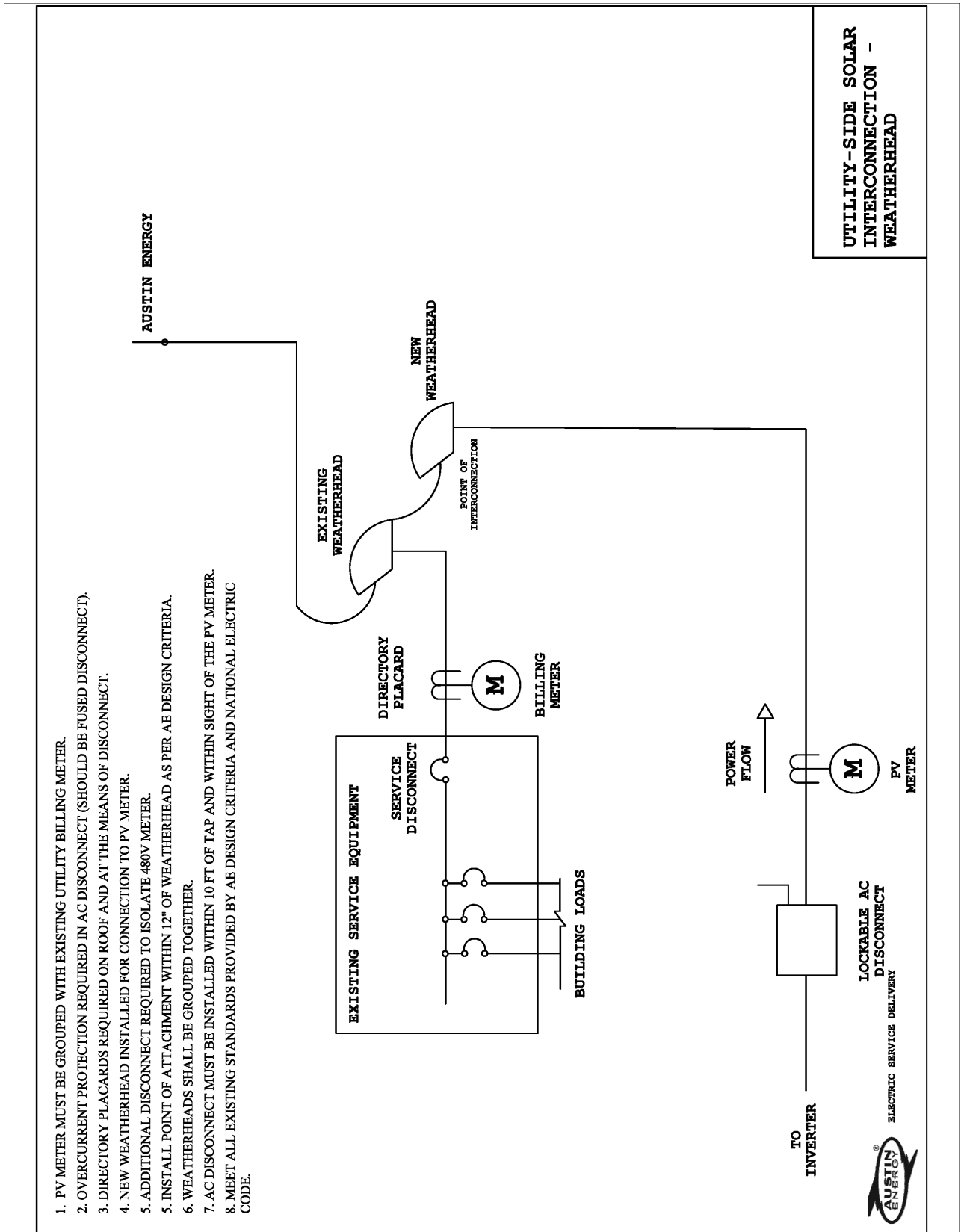


Figure B-12 Utility-Side Interconnection – Weatherhead



Appendix C: Interconnection Guide for DG Systems <500kW, AE DG/DER Inspection Checklist, and Contractor Quick Reference Guide.

Austin Energy Distribution System Interconnection Guide Appendix C: DG/DER Inspection Checklist

Address:			
Customer:		Meter Number:	
Contractor:		Permit Number:	
Inspector:		Enrollment Number:	
Date:	Time:	Solar System Size:	ESS Size:

Notes:

See SECTION C: GENERAL DESIGN REQUIREMENTS AND LAYOUT for References to Checklist Items

PASS	Checklist Items	DEFICIENCIES
	1. Directory Plaque	<input type="checkbox"/> Location <input type="checkbox"/> Material <input type="checkbox"/> Size <input type="checkbox"/> RPS <input type="checkbox"/> Variance? <input type="checkbox"/> System Drawings
	2. Billing Meter	<input type="checkbox"/> Address Labels <input type="checkbox"/> Clearances <input type="checkbox"/> Gas Clearance
	3. Service Disco	<input type="checkbox"/> Label <input type="checkbox"/> Mounting <input type="checkbox"/> Clearances <input type="checkbox"/> Terminations <input type="checkbox"/> Rating <input type="checkbox"/> LST
	4. Overcurrent Protection	<input type="checkbox"/> Rating <input type="checkbox"/> Manufacture <input type="checkbox"/> Fuses for LST
	5. PV Meter	<input type="checkbox"/> Label/Stamp <input type="checkbox"/> Mounting <input type="checkbox"/> Clearances <input type="checkbox"/> Terminations <input type="checkbox"/> Neutral Broke
	6. Grounding/Bonding	<input type="checkbox"/> Size <input type="checkbox"/> Continuous <input type="checkbox"/> Terminations <input type="checkbox"/> Rating
	7. Main PV AC Disco	<input type="checkbox"/> Label <input type="checkbox"/> Mounting <input type="checkbox"/> Clearances <input type="checkbox"/> Location <input type="checkbox"/> Size <input type="checkbox"/> Neutral Broke
	8. Surge Protector	<input type="checkbox"/> Type <input type="checkbox"/> Rating <input type="checkbox"/> Mounting <input type="checkbox"/> Lightning Arrestor?
	9. Inverter(s)	<input type="checkbox"/> Label <input type="checkbox"/> Mounting <input type="checkbox"/> Clearances <input type="checkbox"/> Terminations <input type="checkbox"/> Rating
	10. Additional Disco(s)	<input type="checkbox"/> Label <input type="checkbox"/> Mounting <input type="checkbox"/> Clearances <input type="checkbox"/> Terminations <input type="checkbox"/> Rating <input type="checkbox"/> Location(s)
	11. Wiring	<input type="checkbox"/> Size <input type="checkbox"/> Type/Rating <input type="checkbox"/> Terminations <input type="checkbox"/> Workman-like <input type="checkbox"/> Identification <input type="checkbox"/> Damage
	12. Raceways	<input type="checkbox"/> Label <input type="checkbox"/> Mounting <input type="checkbox"/> Type/Rating <input type="checkbox"/> Terminations <input type="checkbox"/> Bonded <input type="checkbox"/> Dedicated
	13. ESS (if applicable)	<input type="checkbox"/> Label <input type="checkbox"/> Mounting <input type="checkbox"/> Clearances <input type="checkbox"/> Terminations <input type="checkbox"/> Rating <input type="checkbox"/> Drawings
	14. Solar Array	<input type="checkbox"/> Panel Count: _____ <input type="checkbox"/> Mounting <input type="checkbox"/> Cabling <input type="checkbox"/> Eng. Docs? <input type="checkbox"/> Shading
	14. Aggregation Panel	<input type="checkbox"/> Label <input type="checkbox"/> Mounting <input type="checkbox"/> Clearances <input type="checkbox"/> Terminations <input type="checkbox"/> Rating <input type="checkbox"/> Bonding

TEST: System Performance	Inverter(s) Reporting Power	Performance within range for all strings
TEST: 15. RPS		
TEST: ESS (if applicable)	10.d.: Island Mode	13.c.: Hold Full Charge

Quick Reference Guide for Contractors

Contractors installing DG/DER systems should follow this guide when performing quality checks of the installed system prior to final inspection. This guide intends to help contractors adhere to the provisions of the Distribution System Interconnection Guide, applicable provisions of the Austin Energy Design Criteria Manual, and local ordinance.

General

- Auxiliary Power electrical permit from City of Austin is in Active status (and the address on the permit matches address of the installation).
- All Upgrade or Repair electrical permits for the same property are closed.
- For commercial installations, modules mounted on new structures, modules extending past the roof, modules not mounted parallel to the roof, and solar roof tiles: Electrical plans are sealed by Professional Engineer and Building Permit (if needed) from City of Austin is in Active status.
- Installation is consistent with electrical design drawings.
- All installed equipment is UL listed.
- Installed equipment is mounted securely and does not display signs of physical damage.
- All electrical components are listed for voltage and current ratings required for the application.
- All electrical components are installed per manufacturer's specifications.
- All equipment has permanent labels.
- All meters, disconnects, and directory placard are grouped.
 - Any equipment that cannot be grouped has a variance approval.
- All building penetrations are sealed and fire resistance is maintained.
- All taps are made in appropriate locations of the enclosure.
- Dissimilar metals that have galvanic action are isolated.

Meters

- PV Output circuit is landed on line(top) side of PV meter socket.
- See DCM section 1.9.1.8.b. for questions regarding existing metering equipment conditions.
- Solar PV meter socket is installed between the point of interconnection and PV AC disconnect.
 - For system serving standby loads and isolation point is in inverter, 2nd PV meter socket is installed between inverter and standby loads panel.
- Meter socket is approved by Austin Energy for use (i.e., socket is listed on AE website or has written approval from AE Distribution Metering).
- Meter socket is mounted per clearance requirements in AE Design Criteria Manual 1.9.2.
- Meter socket location does not violate AE Design Criteria Manual 1.9.3.1, and location is over flat or near-level ground.
- *If installation has CT meter:* CT inspection is complete and PV meter is installed.
- *If installation requires registration with ERCOT:* EPS meter is installed.

Service Disconnect

- Main building disconnect is present and adjacent to the billing meter per AE Design Criteria Manual 1.8.4.

Overcurrent Protection

- OCPD is sized correctly for main panel busbar per NEC 705.11 (for supply-side connections) or per NEC 705.12 (for backfeed breaker interconnection).

- OCPD sized correctly in AC and DC disconnects.

Grounding and Bonding

- All metallic raceways, enclosures and equipment shall be bonded according to latest edition of the NEC
- Bonding conductor is a minimum #6 AWG copper through the PV meter.
- Neutral is sized to match largest energized conductor through PV meter.
- Neutral is broken and isolated in PV meter socket and PV AC disconnect.

AC Disconnect

- Manual bladed disconnect is installed to separate DG/DER system from rest of electrical system.
- Disconnect is in readily accessible location and can be locked in open position.
- Maintains 3-foot clearance from gas relief valves or regulators.
- *For supply-side connections:* Handle rating of fusible disconnect is minimum 60A.
 - Fuse size is calculated per NEC.
- *For 480V:* AC disconnects are installed on both load and line side of PV meter.

Surge Protection

- SPD is Type 1 or 2 and listed for the purpose.
- SPD is sized correctly for service entrance per NEC 230.67.

Inverters

- Solar PV inverter is certified to UL1741, UL1699B, and UL1547, and listed by California Energy Commission.
- ESS inverter is certified to UL1741 or UL9540 and listed for utility interaction.
- All inverters shall be used as listed.
- For systems with multiple PV inverters:: An Aggregation panel is installed on the solar side of PV meter.
- For three-phase systems: Either a three-phase inverter or single-phase inverters arranged in a wye configuration shall be used . Single phase inverters arranged in a delta configuration are not allowed due to grounding concerns.

Wiring

- All conductors are color coded per AE Design Criteria Manual 1.3.7.
- Wire management is performed in neat and workmanlike manner:
 - All conduit is properly connected (wrench tight). No loose fittings and no cross threading.
 - All conductors are properly secured above the roof surface. No wires touching roof.

Raceways

- Conduit with DC PV output conductors is labeled every 10 feet, per NEC 690.31.D.2.
- PV communication wires are in separate raceway from PV output conductors.
- No more than 360° total of bends in any conduit run.
- DC conductors within buildings are in metal raceways or cable

- Expansion fittings installed over expansion joints.

Solar PV Module Array

- Module string configuration is designed per inverter manufacturer's string sizing calculations.
- Modules are not modified such that it voids the listing or warranty.
- Stainless steel fasteners are used on modules and racking.
- Mounting system meets structural requirements:
 - Roof can sustain extra weight.
 - Array is capable of sustaining wind requirements.
- All roof penetrations are flashed.
- Roof perimeter access meets fire code.
- If applicable: Fuses in combiner box are properly sized.

Energy Storage Systems

- ESS is certified to UL1973. ESS with electrochemical cells is certified to UL9540.
 - Lithium ion ESS is certified to UL1642.
 - Lead-acid ESS is certified to UL1989.
- ESS plans are sealed by Professional Engineer.
- Directory placard installed by ESS (if equipment is not grouped).
- ESS disconnect is readily accessible and within sight of ESS and installed within 5 feet of main panel.
- ESS installed complies with International Residential Code R328 and NEC requirements.

System Performance Validation

- Inverter generating correct power.
- All modules are producing power.
- Inverter de-energizes when disconnected from AC source.
- Inverter does not reconnect for 300 seconds after AC source is turned back on.
- Rapid shutdown installed, and voltage is below 30V within 30 seconds of shutdown initiation.
- ESS capable of operating in island mode.

Appendix D: Interconnection Application and Forms for Systems 500kW to less than 10MW or on the Downtown Network

Application Checklist

- 1) Copy enclosed of completed DGPA Application indicating whether or not proposed facility is in the Downtown Network.
- 2) Copy enclosed of other completed documentation, including the Application form, Customer information, DG application--either PV or rotating machine sheets, Interconnecting facilities information, and the Interconnection Agreement (**refer to Appendix C**).
- 3) Copy enclosed of site electrical one-line diagram and schematic drawings showing the configuration of all Distributed Generation equipment, current and potential circuits, and protection and control schemes, signed and stamped by a professional engineer licensed in the state of Texas.
- 4) Copy enclosed of any site documentation that indicates the precise physical location of the proposed distributed generation facility (e.g., USGS topographic map or other diagram or documentation).
- 5) Copy enclosed of proposed location of Disconnect Switch(es) in relation to meter, generator, and main service meter.
- 6) Copy enclosed of any site documentation that describes and details the operation of the protection and control schemes, as well as proposed directory/plaque location.
- 7) Copy enclosed of schematic drawings for all protection and control circuits, relay current circuits, relay potential circuits, and alarm/monitoring circuits (if applicable).
- 8) Enclosed certificate of insurance and initial payment per fee schedule (if applicable). (**Refer to Section E of this guide, notes 11 and 12**).
- 9) Enclosed Signed Interconnection Agreement.
- 10) Upon completion of construction, schedule COA inspection at least 7 business days prior to energizing DG system.

Applicant Signature

I hereby certify that, to the best of my knowledge, all of the information provided in this Interconnection Request is true and correct.

Interconnection Customer: _____ Date: _____



Austin Energy Distributed Generation Application For facilities from 500 kW to <10 MW or on the Downtown Network

Designated Contact Person:

Address:

Telephone Number:

Fax:

E-Mail Address:

Requested In-Service Date:

An Interconnection Request is considered complete when it provides all applicable and correct information as required on the following pages.

Preamble and Instructions

An Interconnection Customer who requests an Austin Energy jurisdictional interconnection must submit this Interconnection Request by hand delivery, mail, e-mail, or fax.

Processing Fee or Deposit

The Interconnection Customer shall submit to Austin Energy a deposit towards the cost of the feasibility study as detailed on the Austin Energy Fee Schedule. To determine the cost of the feasibility study, review the following AE webpage: <http://www.austinenergy.com>, and navigate to the "Rates" tab, then "Approved Rates Schedule" tab, and then review "Fee Schedules".

Interconnection Customer Information

Legal Name of the Interconnection Customer (or, if an individual, individual's name)
Name: _____
Contact Person: _____
Mailing Address: _____
City: _____ State: _____ Zip: _____
Facility Location (if different from above): _____
Telephone (Day): _____ Telephone (Evening): _____
Fax: _____ E-Mail Address: _____

Application is for:
New Small Generating Facility Capacity addition to Existing Facility

A) If capacity addition to existing facility, please describe:

B) Provide existing Account Number:

Will the Small Generating Facility use Net Metering? Yes No

Is customer site in the AE Downtown Network? Yes _____ No _____

Interconnection Customer or Customer-Site Load: kW (if none, so state)

Maximum Physical Export Capability Requested: kW

Distributed Generation Facility Information

(Data apply only to the Generating Facility, not the Interconnection Facilities)
Technology Type: ___Renewable ___Non-renewable
Fuel Type: ___Solar ___Wind ___Diesel ___Natural Gas ___Fuel Oil
 ___Other (state type) _____
Type of Generator: ___Synchronous ___Induction ___Inverter

Distributed Generation Application for Solar PV

Generator (or solar collector)

Manufacturer, Model Name & Number: Version Number:

Nameplate Output Power Rating in kW: (Summer) (Winter)

Nameplate Output Power Rating in kVA: (Summer) (Winter)

Inverter Manufacturer, Model Name & Number (if used):

Is the inverter on the CEC list of approved equipment? Yes No

List components of the Small Generating Facility equipment package that are currently

certified:	Equipment Type	Certifying Entity
------------	----------------	-------------------

- 1.
- 2.
- 3.
- 4.
- 5.

Is the generation equipment compatible with the certified protective relay package? Yes No

List of adjustable set points for the protective equipment or software:

Distribution Facility Characteristic Data for inverter-based machines

Max design fault contribution current: Instantaneous or RMS?

Harmonics Characteristics:

Start-up requirements:

Note: An approved ESPA must be supplied with the Interconnection Request.

For installations less than 1 MW, City permits should be obtained using the Quick-turn process.

Interconnection Facilities Information

Part A - Transformer

Will a transformer be used between the generator and the point of common coupling?

Yes No Will the
transformer be provided by the Interconnection Customer or AE?

If transformer is provided by AE, the rest of part A (below) is left blank

Transformer Data (for Customer-Owned Transformer only):

Size:	kVA	Transformer Impedance:	% on	kVA Base
Transformer Primary:	Volts	Delta	Wye	Wye Grounded
Transformer Secondary:	Volts	Delta	Wye	Wye Grounded
Transformer Tertiary:	Volts	Delta	Wye	Wye Grounded

Transformer Fuse Data (if applicable):

Manufacturer: Type: Size: Speed:

Interconnecting Circuit Breaker (if applicable):

Manufacturer: Type:
Load Rating (Amps): Interrupting Rating (Amps): Trip Speed (Cycles):

Interconnection Protective Relays (If Applicable):

List of Functions and Adjustable Setpoints for the protective equipment or software:

Setpoint Function	Minimum	Maximum
1.		
2.		
3.		

Part B - Reconnection Time

Programmed Time Delay for Reconnection after Interruption:

300 Seconds (default) Other (specify)

**Distributed Generation Application for Rotating Machines
(not required for Solar PV systems)**

RPM Frequency:

(*) Neutral Grounding Resistor (If Applicable):

Synchronous Generators:

Direct Axis Synchronous Reactance, X_d : P.U.
 Direct Axis Transient Reactance, X'_d : P.U.
 Direct Axis Subtransient Reactance, X''_d : P.U.
 Negative Sequence Reactance, X_2 : P.U.
 Zero Sequence Reactance, X_0 : P.U.
 KVA Base:
 Field Volts:
 Field Amperes:

Induction Generators:

Motoring Power (kW):

Locked Rotor Current (I_{2t} or K , Heating the Constant): _____

Rotor Resistance, R_r : P.U.

Stator Resistance, R_s : P.U.

Stator Reactance, X_s : P.U.

Rotor Reactance, X_r : P.U.

Magnetizing Reactance, X_m : P.U.

Short Circuit Reactance, X_d'' : P.U.

Exciting Current:

Temperature Rise:

Frame Size:

Design Letter:

Reactive Power Required In KVars (No Load):

Reactive Power Required In KVars (Full Load):

Total Rotating Inertia, H : Per Unit on kVA Base

Excitation and Governor System Data for Synchronous Generators Only:

Individual Generator Power Factor

Rated Power Factor: Leading: _____ Lagging: _____

If Discrete Components:

(Enclose Copy of any Proposed Time-Overcurrent Coordination Curves)

Manufacturer:	Type:	Style/Catalog No.:	Proposed Setting:

Manufacturer:	Type:	Style/Catalog No.:	Proposed Setting:

Manufacturer:	Type:	Style/Catalog No.:	Proposed Setting:

Manufacturer:	Type:	Style/Catalog No.:	Proposed Setting:

Current Transformer Data (If Applicable):

(Enclose Copy of Manufacturer's Excitation and Ratio Correction

Curves) Manufacturer:

Type: Accuracy Class: Proposed Ratio Connection:

Manufacturer:

Type: Accuracy Class: Proposed Ratio Connection:

Potential Transformer Data (If Applicable):

Manufacturer:

Type: Accuracy Class: Proposed Ratio Connection:

Manufacturer:

Type: Accuracy Class: Proposed Ratio Connection:

**AGREEMENT FOR INTERCONNECTION AND PARALLEL OPERATION OF
DISTRIBUTED GENERATION**

This Interconnection Agreement (“Agreement”) is made and entered into this ___ day of _____, 20___, by Austin Energy and _____ (“Customer”), a [specify whether corporation, and if a corporation name state, municipal corporation, cooperative corporation, or other], each hereinafter sometimes referred to individually as “Party” or both referred to collectively as the “Parties”.

Place a check mark in the applicable space or spaces below to indicate the type of entity entering into this Agreement:

- Option 1: For purposes of this Agreement, the end-use customer will act as a Party to this Agreement.
- Option 2: For purposes of this Agreement, the entity other than the end-use customer that owns the distributed generation facility (“Generator”) will act as a Party to this Agreement.
- Option 3: For purposes of this Agreement, the entity other than the end-use customer that owns the premises where the distributed generation facility will be located (also referred to as “Premises Owner”) will act as a Party to this Agreement.
- Option 4: For purposes of this Agreement, an entity who by contract is assigned ownership rights to energy produced from distributed renewable generation located at the premises of the end-use customer on the end-use customer’s side of the meter, will act as a Party to this Agreement.

Notwithstanding any other provision herein, the entity referred to as “Customer” herein shall refer to the entity defined in the option selected above by the end-use customer.

If any option other than Option 1 as outlined above is selected, the end-use customer must sign, print his or her name, and date the affirmation in the End-Use Customer Affirmation Schedule attached to this Agreement.

In consideration of the mutual covenants set forth herein, the Parties agree as follows:

1. Scope of Agreement -- This Agreement is applicable to conditions under which Austin Energy and Customer agree that one or more generating facility or facilities of ten megawatts or less and related interconnecting facilities to be interconnected at less than 60 kilovolts (“Facilities”) may be interconnected to Austin Energy’s facilities, as described in Exhibit A. If Customer is not the end-use customer, Customer affirms that the end-use customer has approved of the design and location of the Facilities.

2. Establishment of Point(s) of Interconnection -- Austin Energy and Customer agree to interconnect Facilities at the locations specified in this Agreement, in accordance with the Austin Energy “Distribution Interconnection Guide for Customer Owned Power Production Facilities less than 10 MW” (the “Guide”) or any successor guide addressing distributed generation and as described in the attached Exhibit A (the “Point(s) of Interconnection”).

3. Responsibilities of Austin Energy and Customer -- Customer shall, at its own cost and expense, operate, maintain, repair, and inspect, and shall be fully responsible for, Facilities specified in Exhibit A. Customer shall conduct operations of Facilities in compliance with all aspects of the Guide, and Austin Energy shall conduct operations on its facilities in compliance with all aspects of the Guide, and as further described and mutually agreed to in the applicable Facility Schedule. Maintenance of Facilities shall be performed in accordance with the applicable manufacturer’s recommended maintenance schedule. Customer agrees to cause Facilities to be constructed in accordance with specifications equal to or greater than those provided by the National Electrical Safety Code, approved by the American National Standards Institute, in effect at the time of construction as well as applicable City of Austin Code and the Austin Energy Design Criteria Manual adopted as part of the Utilities Criteria Manual.

Each Party covenants and agrees to design, install, maintain, and operate, or cause the design, installation, maintenance, and operation of, facilities on its side of the point of common coupling so as to reasonably minimize the likelihood of a disturbance, originating in the facilities of one Party, affecting or impairing the facilities of the other Party, or other facilities with which Austin Energy is interconnected.

Austin Energy shall notify Customer if there is evidence that operation of Facilities causes disruption or deterioration of service to other utility customers or if the operation of Facilities causes damage to Austin Energy’s facilities or other facilities with which Austin Energy is interconnected. Austin Energy and Customer shall work cooperatively and promptly to resolve the problem.

Customer shall notify Austin Energy of any emergency or hazardous condition or occurrence with Facilities that could affect safe operation of Austin Energy’s facilities or other facilities with which Austin Energy is interconnected.

Customer shall provide Austin Energy at least 14 days’ written notice of a change in ownership; any circumstances necessitating a change in the person who is the Customer to this Agreement; or cessation of operations of one or more Facilities. Upon notice by Customer of circumstances necessitating a change in the person who is the Customer to this Agreement, Austin Energy shall undertake in a reasonably expeditious manner entry of a new Agreement with the change in person who is the Customer.

4. Limitation of Liability and Indemnification

a. Customer shall indemnify, defend and hold harmless Austin Energy, its officers, employees, agents, city council members and other elected officials (each, an “Indemnified Party”) from and against all claims, demands, losses, liabilities, penalties, expenses (including reasonable attorneys’ fees and expenses), suits and proceedings of any nature whatsoever, for personal injury or death to natural persons and/or physical damage to tangible property of any Person, to the extent arising out of, resulting from, or caused by (i) violation of any applicable Legal Requirements by Customer, its directors, officers, employees, or agents; or (ii) the negligent or tortious acts, errors or omissions of Customer, its directors, officers, employees, or agents. This indemnification obligation shall apply notwithstanding any negligent or intentional acts, errors or omissions of the Indemnified Party, but Customer’s liability to pay damages to the Indemnified Party shall be reduced in proportion to the percentage by which the Indemnified Party’s negligent or intentional acts, errors or omissions caused the damages. Indemnified Party shall not be indemnified for its damages resulting from its sole negligence, intentional acts or willful misconduct. This indemnity provision shall not be construed to relieve any insurer of its obligation to pay claims consistent with the provisions of a valid insurance policy.

b. Austin Energy and Customer shall each be responsible for the safe installation, maintenance, repair, and condition of their respective facilities on their respective sides of the Points of Interconnection. Austin Energy does not assume any duty of inspecting Customer’s Facilities.

c. For the mutual protection of Customer and Austin Energy, only with Austin Energy prior authorization are the connections between Austin Energy’s service wires and Customer’s service entrance conductors to be energized.

5. Right of Access, Equipment Installation, Removal & Inspection -- Upon reasonable notice, Austin Energy may send a qualified person to the premises where the Facilities are located at or immediately before the time Facilities first produce energy to inspect the interconnection, and observe Facilities’ commissioning (including any testing), startup, and operation for a period of up to three days after initial startup of Facilities.

Following the initial inspection process described above, at reasonable hours, and upon reasonable notice, or at any time without notice in the event of an emergency or hazardous condition, Austin Energy shall have access to the premises where the Facilities are located for any reasonable purpose in connection with the performance of the obligations imposed on it by this Agreement or if necessary to meet its legal obligation to provide service to its customers.

Customer warrants it has, or has obtained from other entities, all necessary rights to provide Austin Energy with access to the premises and Facilities, as necessary or appropriate for Austin Energy to exercise its rights under this Agreement and the Guide.

6. Disconnection of Facilities -- Customer retains the option to disconnect from Austin Energy's facilities. Customer shall notify Austin Energy of its intent to disconnect by giving Austin Energy at least thirty days' written notice. Such disconnection shall not be a termination of this Agreement unless Customer exercises rights under Section 7.

Customer shall disconnect Facilities from Austin Energy's facilities upon the effective date of any termination under Section 7.

For routine maintenance and repairs of Austin Energy's facilities, Austin Energy shall provide Customer with seven business days' notice of service interruption.

Austin Energy shall have the right to suspend service in cases where continuance of service to Customer will endanger persons or property. During the forced outage of Austin Energy's facilities serving Customer, Austin Energy shall have the right to suspend service to effect immediate repairs of Austin Energy's facilities, but Austin Energy shall use its best efforts to provide Customer with reasonable prior notice.

7. Effective Term and Termination Rights -- This Agreement becomes effective when executed by both Parties and shall continue in effect until terminated. The Agreement may be terminated for the following reasons: (a) Customer may terminate this Agreement at any time, by giving Austin Energy sixty days' written notice; (b) Austin Energy may terminate upon failure by Customer to generate energy from Facilities in parallel with Austin Energy's facilities within twelve months after the interconnection final inspection permit date; (c) either Party may terminate by giving the other Party at least sixty days written notice that the other Party is in default of any of the material terms and conditions of the Agreement, so long as the notice specifies the basis for termination and there is reasonable opportunity to cure the default; or (d) Austin Energy may terminate by giving Customer at least sixty days' notice in the event that there is a material change in an applicable Guide, ordinance, rule or statute that necessitates termination of this Agreement.

8. Governing Law and Regulatory Authority -- This Agreement was executed in the State of Texas and must in all respects be governed by, interpreted, construed, and enforced in accordance with the laws thereof. This Agreement is subject to, and the parties' obligations hereunder include, operating in full compliance with all valid, applicable federal, state, and local laws or ordinances, and all applicable rules, regulations, orders of, and tariffs approved by, duly constituted regulatory authorities having jurisdiction.

9. **Amendment** --This Agreement may be amended only upon mutual agreement of the Parties, which amendment will not be effective until reduced to writing and executed by the Parties.

10. **Entirety of Agreement and Prior Agreements Superseded** -- This Agreement, including the attached Exhibit A and Facility Schedules, which are expressly made a part hereof for all purposes, constitutes the entire agreement and understanding between the Parties with regard to the interconnection of the facilities of the Parties at the Points of Interconnection expressly provided for in this Agreement. The Parties are not bound by or liable for any statement, representation, promise, inducement, understanding, or undertaking of any kind or nature (whether written or oral) with regard to the subject matter hereof not set forth or provided for herein. This Agreement replaces all prior agreements and undertakings, oral or written, between the Parties with regard to the subject matter hereof, including without limitation [specify any prior agreements being superseded], and all such agreements and undertakings are agreed by the Parties to no longer be of any force or effect. It is expressly acknowledged that the Parties may have other agreements covering other services not expressly provided for herein, which agreements are unaffected by this Agreement.

11. **Written Notices** -- Written notices given under this Agreement are deemed to have been duly delivered if submitted via first class mail or email, to:

(a) If to Austin Energy:

Austin Energy System Engineering 2500
Montopolis Dr
Austin, TX 78741
Email: SystemEngineeringAdm@austinenergy.com

(b) If to Customer:

The above-listed names, titles, and addresses of either Party may be changed by written notification to the other, notwithstanding Section 10.

12. **Invoicing and Payment** -- Invoicing and payment terms for services associated with this agreement shall be consistent with applicable tariffs and fee schedules established by Austin Energy or the City of Austin.

13. **Disclosure of Information to End-Use Customer** -- If Customer is not the end-use customer, Austin Energy is hereby authorized to provide any information requested by the end-use customer concerning the Facility.

14. **No Third-Party Beneficiaries** -- This Agreement is not intended to and does not create rights, remedies, or benefits of any character whatsoever in favor of any persons, corporations, associations, or entities other than the Parties, and the obligations herein assumed are solely for the use and benefit of the Parties, their successors in interest and, where permitted, their assigns.

15. **No Waiver** -- The failure of a Party to this Agreement to insist, on any occasion, upon strict performance of any provision of this Agreement will not be considered to waive the obligations, rights, or duties imposed upon the Parties.

16. **Headings** -- The descriptive headings of the various parts of this Agreement have been inserted for convenience of reference only and are to be afforded no significance in the interpretation or construction of this Agreement.

17. **Multiple Counterparts** -- This Agreement may be executed in two or more counterparts, each of which is deemed an original, but all constitute one and the same instrument.

IN WITNESS WHEREOF, the Parties have caused this Agreement to be signed by their respective duly authorized representatives.

AUSTIN ENERGY

[CUSTOMER NAME]

BY:

BY:

PRINTED NAME

PRINTED NAME

TITLE:

TITLE:

DATE:

DATE:

FACILITY SCHEDULE NO.

[The following information is to be specified for each Point of Interconnection, if applicable.]

1. Customer Name:

2. Premises Owner Name:

3. Facility location:

4. Delivery voltage:

5. Metering (voltage, location, and other):

6. Normal Operation of Interconnection:

7. One line diagram attached (check one): Yes / No

If Yes, then the one-line drawing should show the most current drawing(s) available as of the signing of this Schedule. Austin Energy and Customer agree drawing(s) may be updated to meet as built or design changes that occur during construction. Customer understands and agrees that any changes that substantially affect the protective or functional requirements required by Austin Energy will need to be reviewed and accepted by Austin Energy.

8. Equipment to be furnished by Austin Energy:

(This section is intended to generally describe equipment to be furnished by Austin Energy to effectuate the interconnection and may not be a complete list of necessary equipment.)

9. Equipment to be furnished by Customer: (This section is intended to describe equipment to be furnished by Customer to effectuate the interconnection and may not be a complete list of necessary equipment.)

10. Cost Responsibility and Ownership and Control of Austin Energy Facilities: Unless otherwise agreed or prescribed by applicable regulatory requirements or other law, any payments received by Austin Energy from Customer will remain the property of Austin Energy. Austin Energy shall at all times have title and complete ownership and control over facilities installed by Austin Energy.

11. Modifications to Customer Facilities. Customer understands and agrees that, before making any modifications to its Facilities that substantially affect the protective or interconnection parameters or requirements used in the interconnection process (including in an Pre-interconnection Study performed by Austin Energy), Customer will both notify Austin Energy of, and receive approval by Austin Energy for, such modifications. Customer further understands and agrees that, if required pursuant to the requirements found in this Agreement, it will submit a new Application for Interconnection and Parallel Operation request for the desired modifications.

12. Supplemental terms and conditions attached (check one): Yes / No

END-USE CUSTOMER AFFIRMATION SCHEDULE

The end-use customer selecting the entity who owns the DG facility (the DG owner or Option 2 entity), the owner of the premises at which the DG facility is located (premises owner or Option 3 entity), or the person who by contract is assigned ownership rights to energy produced by the DG facility (Option 4 entity) to act as Customer and Party to the Interconnection Agreement must sign and date the consent below.

“I affirm that I am the end-use customer for the distributed generation facility addressed in Facility Schedule No. [insert applicable number] in the Interconnection Agreement between Austin Energy and [insert name of Customer], and that I have selected [insert name of Customer] or successor in interest to act as Customer and a Party to this Interconnection Agreement rather than me.

[END-USE CUSTOMER NAME] SIGNATURE:

DATE:

Appendix E: Network Interconnection Specifications

Purpose: This appendix to the Austin Energy “**Distribution System Interconnection Guide**” will detail the requirements, safeguards, modeling, and performance criteria that are required for successfully integrating distributed generation (DG), typically Solar PV, operating at less than 1000VAC on the Downtown Network, that meet all of the initial requirements in **Section B.3**. Please refer to **Appendix A** of the guide for a map of the Secondary (Downtown) Network.

The requirements shall be met at the point of common coupling although the devices used to meet the requirements can be located elsewhere.

This specification does not address self-protection of the DG or provide any safeguard to the operating facility as that is the responsibility of the DG owner. Implementation of DG on the network fundamentally affects the design of the network and may result in outages to the customer. The customer is required to acknowledge and accept that outages may occur, and Austin Energy will not be liable for any damages to the DG system, or outages that are a result of the customer's DG system backfeeding the AE system, since although the methods outlined in this section are fairly detailed, they do not guarantee the system will never backfeed.

This specification does not address financial impacts as a result of curtailing generation during periods of low customer loads. It is the responsibility of the customer to understand the impact to the generation capability, and Austin Energy will not be liable for any loss of generation as a result of curtailment systems required to interconnect the system.

References (covered in Section G as well)

- IEEE 1547 - IEEE Standard for Interconnection and Interoperability of Distributed Energy Resources with Associated Electric Power Systems Interfaces.
- IEEE 1547.6 - IEEE Recommended Practice for Interconnecting Distributed Resources with Electric Power Systems Distribution Secondary Networks.
- IEEE C37.108 - Guide for the Protection of Network Transformers.
- IEEE C57.12.44 - Standard Requirements for Secondary Network Protectors.
- ANSI C84.1 - Electric Power Systems and Equipment.

Introduction and Background

Secondary Networks were not designed to accommodate generation of any kind. They were designed to provide highly reliable service to dense urban areas by putting multiple

feeders in parallel. For safety reasons, they are designed to intercept and react to faults that could cause backfeed on the network system, and as a result, network protectors (NP) are designed to instantaneously open upon detecting a reverse current flow. Distributed generation can be installed, as long as steps are taken to ensure that backfeed will not occur.

All DG on the secondary network must be inverter-based and less than 2 MW. Typical synchronous or induction generators can easily contribute fault currents that exceed a network protector's rating.

Note: Emergency or standby generators may not utilize closed-transition transfer switches where facilities are connected to the Downtown Network.

Fundamental Design Requirements

The primary concern about tripping network protectors is that they operate by interrupting current flow using spring-loaded finger contacts, so as a result, their lifetimes are typically a limited number of operations, compared to an average circuit breaker which has almost unlimited operations. In addition, network protectors (NP) are not designed or tested for interrupting increased fault currents, so these restrictions have led to some fundamental requirements as outlined in IEEE Standard 1547.6, Section 6:

- DG may not cause any NP to exceed its fault interrupting capability.
- DG may not cause any NP to separate two dynamic sources.
- DG may not cause any NP to connect two dynamic systems together.
- DG may not cause any NP to operate more frequently than prior to DG operation.
- DG may not prevent or delay the NP from opening for faults on the network feeders.
- DG may not delay or prevent NP closure.
- DG may not energize a de-energized network.
- DG may not require the NP settings to be adjusted except by consent of the area EPS operator.
- DG may not cause an islanding condition within part of a grid network.
- DG may not remain connected to the network if 50% or more of the NP's serving the network are open.

Distributed generation on a secondary spot network must be designed with all above requirements taken into consideration.

Network Interconnection Requirements

Part 1: Network Interconnection Utilizing Load Calculation and System Sizing Analysis

The customer should contact the AE Accounts department to obtain the usage data and calculate the minimum loads for the months of November, December, January, and February. Contact System Engineering for all-new facilities.

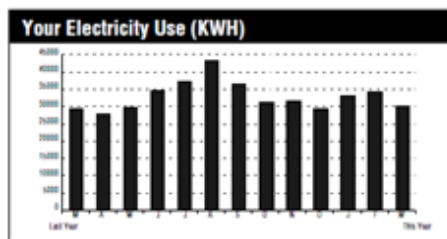
A. Determine average minimum load for the facility (see example below)

1. Contact AE customer support for actual daily metered load data. If not available, divide total usage for the month by the number of days in the billing cycle to get the average usage per day (if not already shown on bill).
2. Take the results from step 1 and divide by 24 to get average use/hr.
3. Take results from step 2 and divide by 2 to get estimated minimum load for the month.
4. Take the average of the four months (if available) to determine the average minimum load.

B. Determine estimated PV system size

The Solar PV system should be sized no greater than 25% of the minimum load from step 3 to qualify for a de-minimis installation per PUCT guidelines. Refer to **Part 2** of this appendix for "de minimis" requirements for interconnection.

Service Details



	Current Month
Days of service	29
kWh used	30000
Avg. kWh per day	1034.5
Avg. cost per day	\$110.46
13 month avg. consumption: 32923.08	

Example from Customer Bill

Step 1: $30000 \text{ kWh} / 29 \text{ days} = 1034.5 \text{ kWh}$

Step 2: $1034.5 / 24 = 43.1 \text{ kW}$

Step 3: $43.1 \text{ kW} / 2 = 21.6 \text{ kW min load}$

Step 4: Maximum PV system size = **5.4 kW**

Part 2: Network Interconnection Utilizing “de minimis” Method

Conceptually, the goal of “de minimis” interconnection is not that complex - the distributed generation must not generate more than the facility load at any given time to prevent backfeeding and tripping a network protector, as described in Section 7 of IEEE 1547.6. This is achieved by sizing the distributed generation small enough so that it is unlikely that the load drops below the generation during operational hours, resulting in backfeed.

Part 3: Network Interconnection Utilizing "Dynamic Controls" or Alternate Methods

To prevent backfeeding which will trip a Network Protector, a solar PV system must not generate more than the facility load at any given time. This can be achieved through dynamically controlled inverters which are interfaced to a digital control system that instantaneously monitors dynamic generation and utility supply and modulates generation to maintain a defined minimum forward current flow through the network protectors.

Control System Design Requirements

Only contractors with a minimum of 2 years of experience installing commercial Solar PV systems should attempt the design and execution of a system interfaced to the downtown network for safety reasons, due to the complexity of the installation, as well as the high fault currents involved. The solar contractor is also responsible for contracting for engineering services to perform the design of the control system. The engineer must be licensed in the state of Texas.

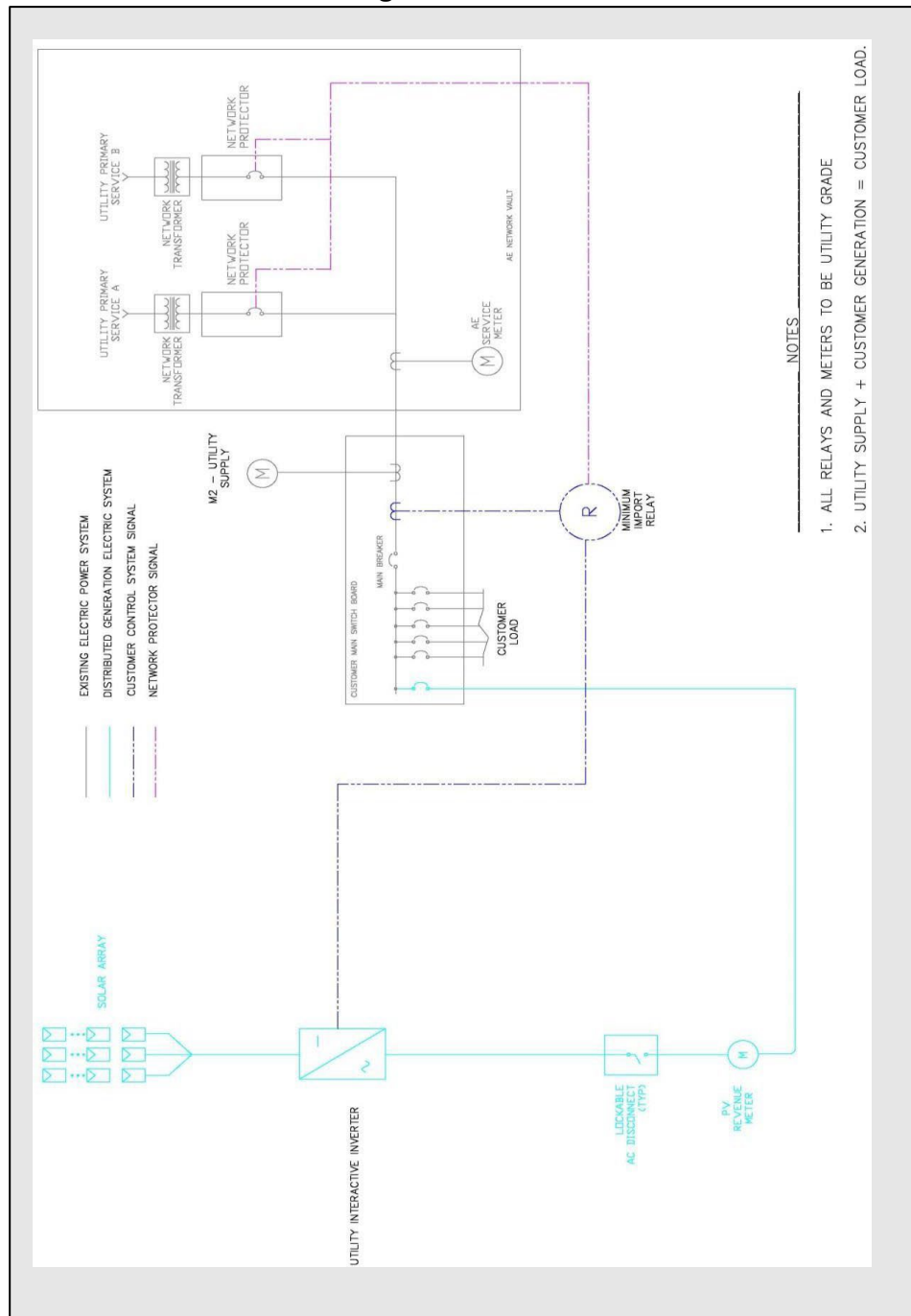
- The control system shall have a minimum import relay installed, which should continuously monitor both the generation and utility supply, set to maintain a 3:1 ratio of utility supplied power to on-site generation. If the customer load drops so that the utility supply is below this 3:1 ratio, the relay should send a signal to the inverter to either reduce or disable generation.
- The control system must have a backup minimum import relay installed along with a shunt trip electronically reclosable breaker set to a minimum forward current in case the primary control system fails.
- All CT’s shall be metering accuracy class.
- The network protectors shall be monitored by AE, and loss of any network protector

shall result in loss of a control signal that will shut down the inverter(s). The solar contractor shall provide a wet (24VDC) signal to AE to route to the network protectors and then return to a dry contact on the inverter. Loss of this signal shall cause the inverters to shut down.

- It is recommended that the control system be remotely connected via Ethernet to enable remote diagnostics by the contractor.

Refer to Figure E-1 on Page 106 for a conceptual diagram of the system and controls.

Figure E-1



Design, Installation, and Commissioning Requirements

Once the system size and control setpoints have been defined, basic design drawings and documents shall be submitted for approval per the Interconnection process.

The overall system one-line diagram, three-line diagram, System Instrument and Control schematic, including complete controls narrative, and a control wiring diagram shall be submitted for joint review. All drawings should be sealed by an electrical engineer licensed in the state of Texas.

A commissioning test for the proposed installation will be jointly developed based on the final system design and intended operation. After installation, the system will not be energized for testing prior to the commissioning test.

Maintenance and Operation Requirements

There should be a short review of the system after the first 6 months of operation. The requirement is for there to be zero actuation of the network protectors caused by the DG. Note that in normal operation, AE will occasionally open network protectors for maintenance activities and these actuations will not be considered being caused by the DG.

Failure of the control system, resulting in backfeed that trips the network protectors, will result in the system being locked out by AE until the contractor can review and modify the control system with new setpoints, and the commissioning tests repeated to validate the new settings.

It is the customer's responsibility to ensure the control system does not trip the network protectors. Therefore, a long-term maintenance contract for the control system is strongly recommended so the customer can reap the projected economic benefit of the system.

Appendix F: Emergency Response Service (ERS) Application

ERCOT Emergency Response Service (ERS) Process

This process applies to ALL customers served by the AE Electrical System

AE Customer Participation Requirements:

- Load Shed ERS customers will not require any technical approval.
- Load Shed with Generation will require a simple review to verify that the generation is not paralleled with the AE Distribution system.
- ERS Generation utilizing Parallel generation on the AE Distribution system must be approved by Austin Energy DER Integration. Refer to the main sections of this guide for details on that process.
- ERS Generation utilizing Parallel generation on the AE Transmission system must be approved by Austin Energy Substation & Transmission Engineering & Construction Department.
- Closed-transition transfer-switching is not permitted for customers on the Downtown Network. (Refer to **Appendix A.**) All non-network customers shall refer to "Distribution System Interconnection Guide for Customer Owned Power Production Facilities less than 10 MW" for interconnection requirements.
- Austin Energy prohibits accessing or modifying utility meters and CT enclosures. Customer based sub-metering CT's may not be used in Austin Energy equipment.

If you already have a third party QSE representing you in the ERS program:

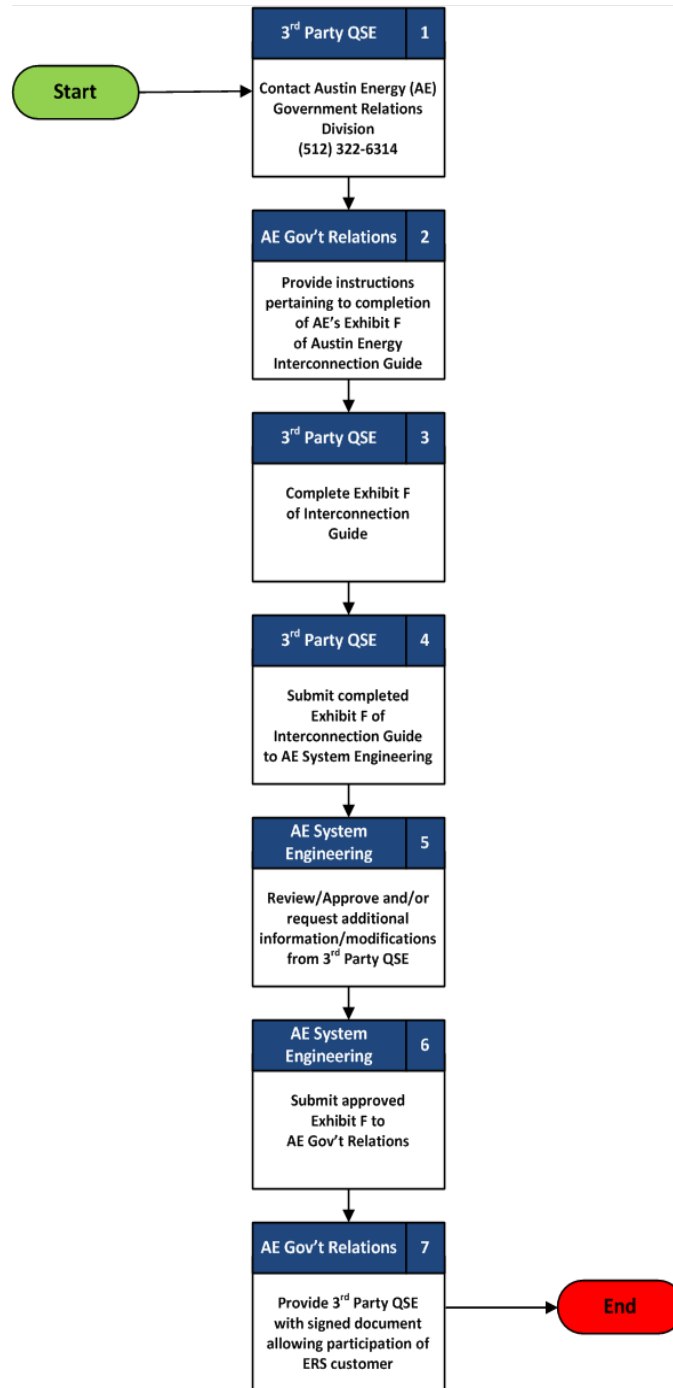
- Please follow the process outlined on the next page.
- AE's System Engineering group will perform a technical review of your application and facility and approve or request additional information and/or clarification.

Application Checklist for ERS Load Customers with Generator

- 1) Completed ERS Application and Interconnection Application (if required).
- 2) Copy enclosed of site electrical one-line diagram and schematic drawings showing the configuration of all generation equipment, current and potential circuits, and protection and control schemes.
- 3) Copy enclosed of any site documentation that indicates the precise physical location of the proposed generation facility (e.g., USGS topographic map or other diagram or documentation).

2. Emergency Response Service (ERS) 3rd Party QSE Representation Process Flowchart

This flowchart represents the steps 3rd Party QSE's should follow to represent ERS customers within AE's Service Area.



3. Exhibit F - ERS APPLICATION FORM

<u>ERS Customer Information</u>	
Designated Contact _____	_____
Person: _____	_____
Address: _____	_____
Telephone Number: _____	_____
E-Mail Address: _____	_____
Customer Name: _____	_____
Location Address: _____	_____
Facility Phone # (Day/night): _____	_____
Facility E-Mail Address: _____	_____

ERS RESOURCE

Nameplate Rating of generator (if applicable): _____ (MW)

Contract Time Period: _____

<input type="checkbox"/> TP1 (5:00AM TO 9:00AM) Maximum Offer: _____(kW) Load Description: _____	<input type="checkbox"/> ERS-10 Weather-Sensitive <input type="checkbox"/> ERS-10 Non-Weather-Sensitive	<input type="checkbox"/> ERS-30 Weather-Sensitive <input type="checkbox"/> ERS-30 Non-Weather-Sensitive
<input type="checkbox"/> TP2 (9:00AM TO 1:00PM) Maximum Offer: _____(kW) Load Description: _____	<input type="checkbox"/> ERS-10 Weather-Sensitive <input type="checkbox"/> ERS-10 Non-Weather-Sensitive	<input type="checkbox"/> ERS-30 Weather-Sensitive <input type="checkbox"/> ERS-30 Non-Weather-Sensitive
<input type="checkbox"/> TP3 (1:00PM TO 4:00PM) Maximum Offer: _____(kW) Load Description: _____	<input type="checkbox"/> ERS-10 Weather-Sensitive <input type="checkbox"/> ERS-10 Non-Weather-Sensitive	<input type="checkbox"/> ERS-30 Weather-Sensitive <input type="checkbox"/> ERS-30 Non-Weather-Sensitive
<input type="checkbox"/> TP4 (4:00PM TO 7:00PM) Maximum Offer: _____(kW) Load Description: _____	<input type="checkbox"/> ERS-10 Weather-Sensitive <input type="checkbox"/> ERS-10 Non-Weather-Sensitive	<input type="checkbox"/> ERS-30 Weather-Sensitive <input type="checkbox"/> ERS-30 Non-Weather-Sensitive
<input type="checkbox"/> TP5 (7:00PM TO 10:00PM) Maximum Offer: _____(kW) Load Description: _____	<input type="checkbox"/> ERS-10 Weather-Sensitive <input type="checkbox"/> ERS-10 Non-Weather-Sensitive	<input type="checkbox"/> ERS-30 Weather-Sensitive <input type="checkbox"/> ERS-30 Non-Weather-Sensitive
<input type="checkbox"/> TP6 (5:00AM TO 9:00AM) Maximum Offer: _____(kW) Load Description: _____	<input type="checkbox"/> ERS-10 Weather-Sensitive <input type="checkbox"/> ERS-10 Non-Weather-Sensitive	<input type="checkbox"/> ERS-30 Weather-Sensitive <input type="checkbox"/> ERS-30 Non-Weather-Sensitive
<input type="checkbox"/> TP7 (3:00PM TO 9:00PM) Maximum Offer: _____(kW) Load Description: _____	<input type="checkbox"/> ERS-10 Weather-Sensitive <input type="checkbox"/> ERS-10 Non-Weather-Sensitive	<input type="checkbox"/> ERS-30 Weather-Sensitive <input type="checkbox"/> ERS-30 Non-Weather-Sensitive
<input type="checkbox"/> TP8 (All Other Hours) Maximum Offer: _____(kW) Load Description: _____	<input type="checkbox"/> ERS-10 Weather-Sensitive <input type="checkbox"/> ERS-10 Non-Weather-Sensitive	<input type="checkbox"/> ERS-30 Weather-Sensitive <input type="checkbox"/> ERS-30 Non-Weather-Sensitive

Applicant Signature

I hereby certify and acknowledge that, to the best of my knowledge, all of the information provided in this ERS Application is true and correct.

QSE Company
(print): _____
QSE
Representative: _____
ERS Customer: _____

Date: _____
Date: _____

Austin Energy System Engineering Review

Reviewed

Resubmit

Meter ID _____

Service Point ID: _____

Feeder: _____

Appendix G: Electric Vehicle Connection Guide for Residential Customers

Purpose: The Austin Energy “Electric Vehicle Connection Guide for Residential Customers” is to provide guidelines and configurations for connecting plug-in electric vehicles (PEVs) to a residential Time-of-Use (TOU) metering system. The guide contains information on application processes, technical requirements, applicable codes, metering configurations, and rate structures.

Customers will have the option of getting their Electric Vehicle (EV) usage on a separate meter with a Time-of-Use rate. Otherwise, customers can keep their EV load as part of their whole house consumption for the standard rate. For Time of Use metering, apply for a residential sub- meter (EV Meter) thru the AE program. The Rate Structure for Time of Use metering can be found at the following: <https://austinenergy.com/green-power/plug-in-austin/home-charging>. Select the “Green Power” tab, then “Electric Vehicles.”

1. Electric Vehicle (EV) Charging Basics

Power is delivered to the Electric Vehicle (EV) onboard battery through the EV inlet to the charger. The charger converts Alternating Current (AC) from the home to the Direct Current (DC) required to charge the battery in the vehicle. The charger and EV inlet are considered part of the EV. A connector is a device that, by insertion into an EV inlet, establishes an electrical connection to the EV for the purpose of charging and information exchange. The EV inlet and connector together are referred to as the coupler. The Electric Vehicle Supply Equipment (EVSE) consists of the connector, cord, and interface to utility power. The interface between the EVSE and utility power will generally be a plug and receptacle. At the present time, the Society of Automotive Engineers (SAE) has agreed that all vehicles produced by automakers in the United States will conform to a single design, known as the J1772 Standard.

2. Connection Classifications

For Austin Energy designations, there are two classifications of connection to Electric Vehicles. They are as follows: (1) Level 1 and Level 2 <10 kW and (2) Level 2 >10 kW.

For Level 1, 120 volt AC, the system uses a standard 120 volt AC branch circuit, which is the lowest common voltage level found in residential areas. Typical amp ratings for these receptacles are 15 or 20 amps. All EVs come equipped with Level 1 chargers from auto manufacturers. It is the slowest, but simplest, charging.

For Level 2 <10 kW, 240 volt AC, the system is typically described as the “primary” and “standard” system for the EVSE for both private and publicly available facilities. This system specifies a single-phase branch circuit. A typical circuit rating would be 40 amps.

For Level 2 >10 kW, 240 volt AC, the system allows a much faster battery charge, but Level 2 has a higher level of safety requirements than Level 1 under the National Electrical Code (NEC), including the requirement that the connector and cord be hardwired to the control device and premises wiring in certain cases. The J1772-approved connector allows current as high as 80 amps (100 amp rated circuit). Level 2 charging (240 volts, maximum 80 amps) usually requires a dedicated circuit and will most likely require an **electrical panel upgrade**.

3. Application Processes for Electric Vehicle Connections

The customer/contractor is required to obtain an electrical permit for construction of any facility interfaced to the AE system per Austin Electrical Code Section §25-12-113. This applies to all entities served by Austin Energy: residential, commercial, and government agencies. All procedures for obtaining a City of Austin (COA) electrical permit apply regardless of whether the system is installed within Austin or a separate extraterritorial jurisdiction (ETJ). The system must be installed in compliance with the National Electrical Code (NEC), NFPA 70.

3.1. Process for Residential Systems – Level 1 and Level 2 <10 kW

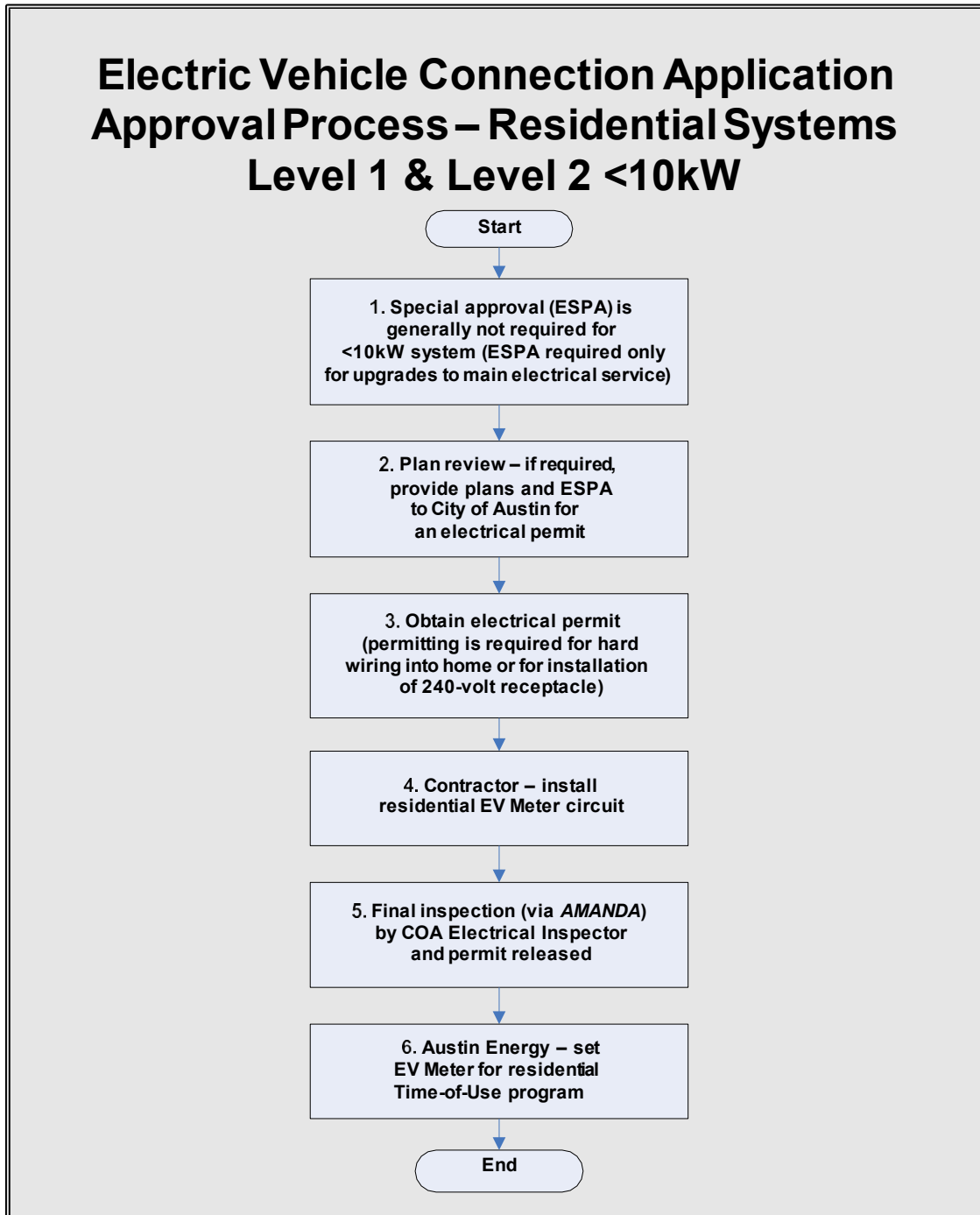
Residential Systems less than 10 kW are generally required to have Electric Service Planning Applications (ESPA) **only** for upgrades to the **main electrical service**. Residential systems may require electrical permitting. A COA electrical permit must be pulled for the installation of a 240-volt charging station that is hard wired into the home, or the installation of a 240-volt receptacle for which to plug a Level 2 charging station into. Residential systems less than 10 kW should use the following process for obtaining a permit. Systems in this category are typically handled through 311.

- a. The customer is required to submit an **ESPA** for review for connection to the AE system only for upgrades to the main electrical service. Generally, it should still be submitted for tracking purposes. It can be found on the AE website at (or call AE Customer Service at 512-494-9400):
<https://austinenergy.com/contractors/construction-renovation>
 - **Select the “Contractors” tab, then select the “Construction & Renovation” tab.**
 - **AE approval is ALWAYS required for the ESPA regardless of system size.**
- b. If the customer is **required to go through plan review for obtaining an electrical permit**, the ESPA must be accompanied with a full set of drawings. Call COA Plan Review at 512- 978-4000.
- c. Upon successful completion of the process, the contractor will receive an electrical

permit. Contact the COA Permit Center at 512-974-2747.

- d. Contractor builds system and installs residential EV Meter circuit. Note: Any significant change in the design must go back through the plan review process.
- e. After the system is installed, the contractor shall request the final electrical inspection from the COA Electrical Inspection department via the AB+C portal or call 512-480-0623. Permit is then released.
- f. Austin Energy sets the EV Meter and the process is complete. Call AE Distribution Metering at 512-505-7045.

Electric Vehicle Connection Application Approval Process – Residential Systems Level 1 & Level 2 <10kW



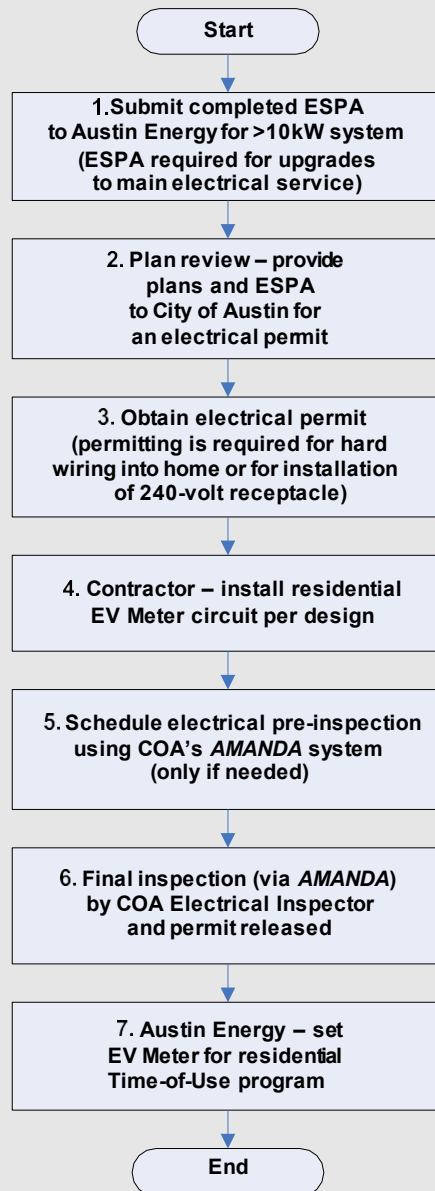
Approval Process Flow for Residential Systems <10 kW

3.2. Process for Residential Systems – Level 2 >10 kW

Residential Systems greater than 10 kW are required to have Electric Service Planning Applications (ESPA) for upgrades to the **main electrical service**. Residential systems may require electrical permitting. A COA electrical permit (but not an ESPA) must be pulled for the installation of a 240-volt charging station that is hard wired into the home, or the installation of a 240-volt receptacle for which to plug a Level 2 charging station into. Residential systems greater than 10 kW should use the following process for obtaining a permit. Systems in this category are typically handled through the **AE Distribution Design groups** which can be reached using the 311 hotline.

- a. The customer is required to submit an **ESPA** for review for connection to the AE system for upgrades to the main electrical service. It can be found on the AE website at (or call AE Customer Service at 512-494-9400):
<https://austinenergy.com/contractors/construction-renovation>
 - **Select the “Contractors” tab, then select the “Construction & Renovation” tab.**
 - **AE approval is ALWAYS required for the ESPA regardless of system size.**
- b. If the customer is **required to go through plan review for obtaining an electrical permit**, the ESPA must be accompanied with a full set of drawings. Call COA Plan Review at 512- 978-4000.
- c. Upon successful completion of the process, the contractor will receive an electrical permit. Contact the COA Permit Center at 512-974-2747.
- d. Contractor builds system and installs residential EV Meter circuit. Note: Any significant change in the design must go back through the plan review process.
- e. After the system is installed, the customer/contractor shall request the electrical pre- inspection from the COA Electrical Inspection department via the AB+C portal or call 512- 480-0623. Pre-inspection covers only the transformer and concrete encased electrode and trench (**only if needed**).
- f. The contractor shall request the final electrical inspection from the COA Electrical Inspection department via the AB+C portal or call 512-480-0623. Permit is then released.
- g. Austin Energy sets the EV Meter and the process is complete. Call AE Distribution Metering at 512-505-7045.

Electric Vehicle Connection Application Approval Process – Residential Systems Level 2 >10kW



Approval Process Flow for Residential Systems >10 kW

4. General System Layouts and Technical Requirements

This section reviews general system layouts and components for simple Residential EV Systems. Figure G-1 represents a simplified diagram illustrating the key requirements for typical EV systems less than 10 kW.

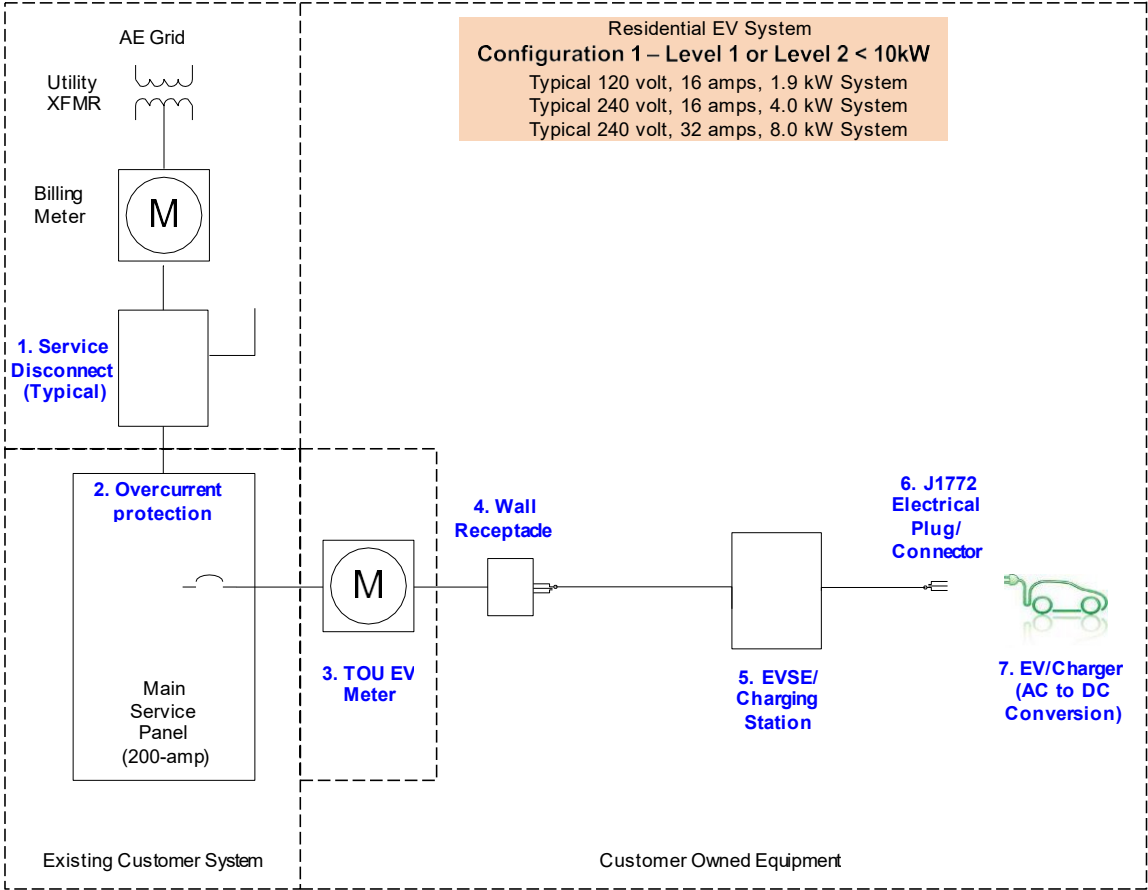


Figure G-1: Simplified Diagram for Level 1 and Level 2 (<10 kW) for “typical” EV System (with Time of Use Meter)

The charging station in Configuration 1 refers to a standardized cord that is provided with the EV. The Level 2 EVSE could also be directly hardwired, bypassing the receptacle.

Figure G-2 represents a simplified diagram illustrating the key requirements for other “typical” EV systems, greater than 10 kW, that require review by AE.

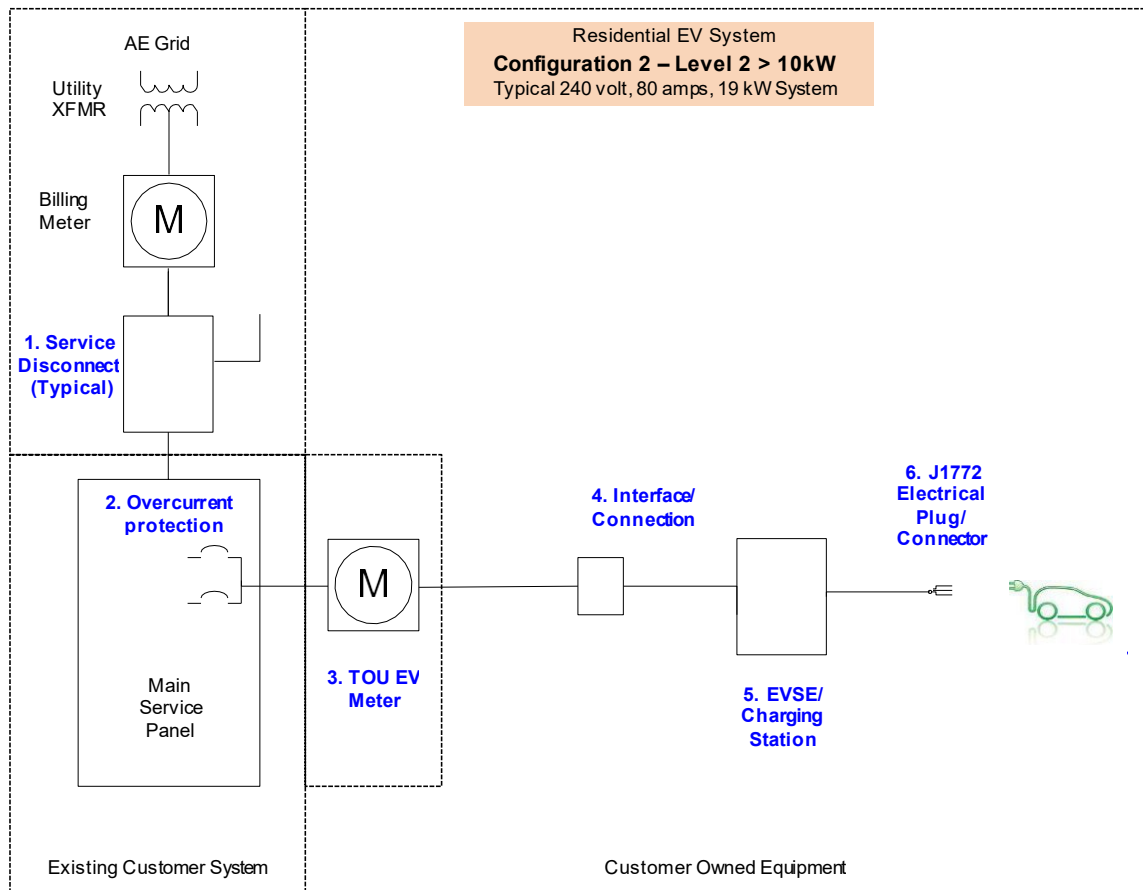


Figure G-2: Simplified Diagram for Level 2 (>10 kW) for “typical” EV system (with Time of Use Meter)

The charging station in Configuration 2 refers to a directly hardwired system. This configuration would most likely require an electrical panel upgrade.

Notes from Figures G-1 and G-2 (see this page and previous page):

1. Service Disconnect
All customers must have a code-compliant service disconnecting means. Refer to the AE Design Criteria Manual for specifics.
2. Overcurrent Protection
Overcurrent protection to be sized per NEC Article 625.40.

3. EV Meter (to be on Time of Use rate)

a. Installations

- a. For questions, contact **AE Distribution Metering: (512) 505-7045 or EV/ET staff (512) 482-5376.**
- b. Refer to Figures G-1 and G-2 for examples of simplified EV installations and contact AE Distribution Metering for clarifications.
 - a) The EV Meter shall be grouped with billing meter and disconnects.
 - b) Facilities with <200 amps current would typically use a self-contained meter.
 - c) Facilities with >200 amps current would typically use an instrument rated meter.
 - d) Final determination of meter type and configuration shall be made by the AE Distribution Metering group.
- c. Refer to the AE website for detailed meter socket, meter hub, and other related equipment.
- d. Design Criteria Manual can be found here:
<https://austinenergy.com/contractors/construction-renovation/documents-forms/design-reference-and-process-documentation>
 - **See the “Contractors” tab, then select the “Construction & Renovation” tab, and navigate to the “Documents & Forms” tab. Then select the “Design Reference & Process Documentation” sub-tab.**

4. Receptacle/Interface/Connection

The interface between the EVSE and utility power will generally be a plug and receptacle. A receptacle (120-volt or 240-volt rated in the case of Figure G-1) or a hardwired 240-volt connection (in the case of Figure G-2) shall be provided for the customer’s service connection to the EV system. EVSE connection to comply to NEC Article 625.44.

Disconnecting means rated 60 amps or more to comply with NEC Article 625.42.

5. EVSE/Charging Station

Charging station to comply with IEEE 1547 and P2030.1 safety standards. The EVSE is a safety device that allows electricity to flow. Safety is enhanced by enabling two-way communications between the charging station and the EV and by safely delivering and managing electrical energy between an electrical source and an electric vehicle. The EVSE consists of the J1772 connector, cord, and interface to utility power.

6. Electrical Plug

All vehicles produced by automakers in the United States will conform to a single design, known as the J1772 Standard.

7. EV/Charger

Power is delivered to the EV’s onboard battery through the EV inlet port to the charger.

The charger converts Alternating Current (AC) from the home to the Direct Current

(DC) required to charge the battery in the vehicle. The charger and EV inlet port are considered part of the EV.

Appendix H: Resiliency as a Service (RaaS) General Guideline

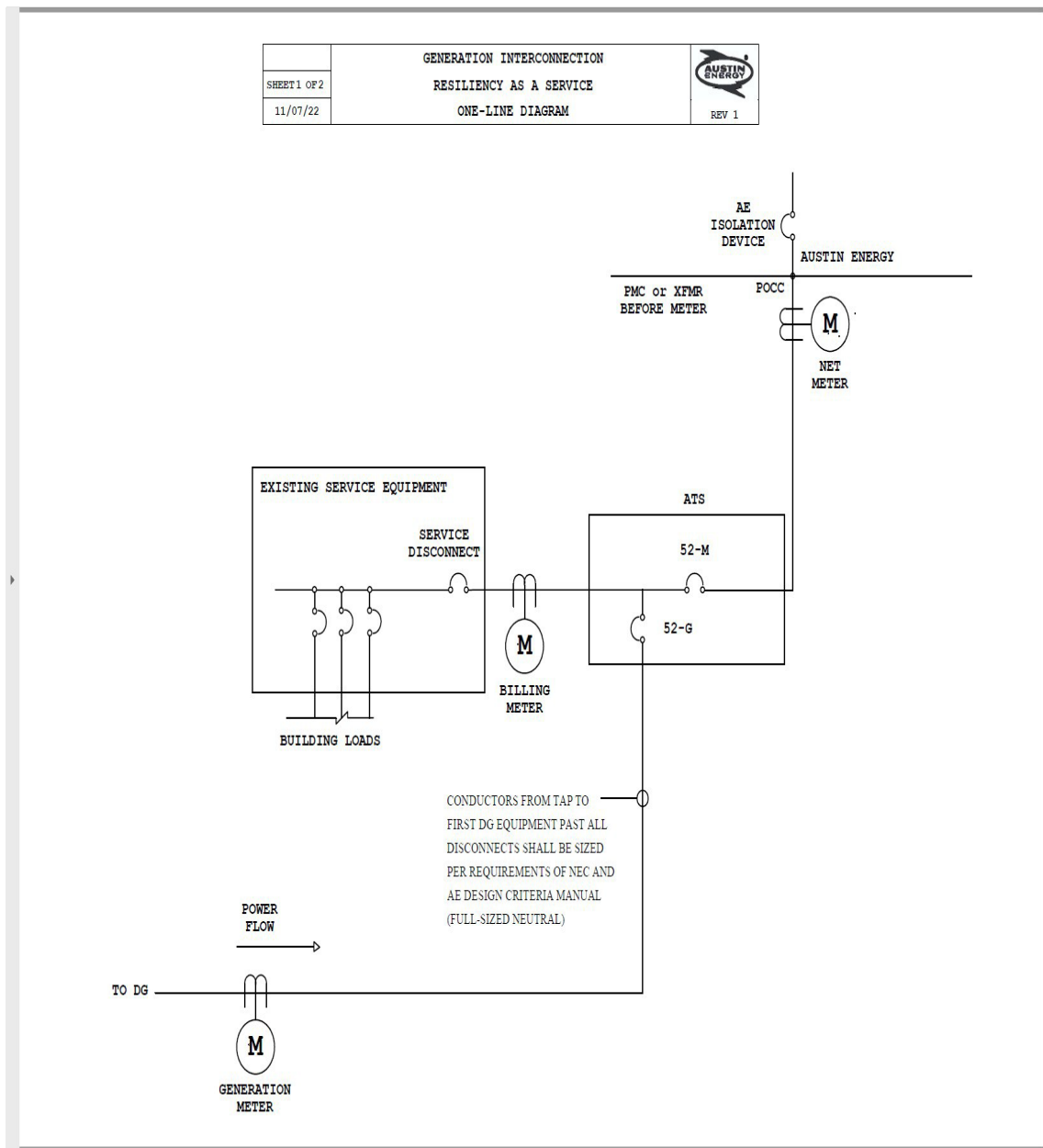
Resiliency as a Service (RaaS): This program is available to customers who are looking to have additional Resiliency equipment at their site for emergency backup. RaaS has approved vendors that meet Austin Energy requirements. The customer can select whichever approved vendor that meets their goals. For more information on the currently approved vendors or to request information on how to become an approved vendor please contact ResiliencyServices@AustinEnergy.com.

General Requirements for behind the meter systems: The following are additional requirements specific to the RaaS program:

1. Main disconnect: A main disconnect (labeled 52-M) will be available to isolate the generation and customer from the utility. This disconnect must have a built-in locking mechanism to provide for lockout.
2. Generator disconnect: A generator disconnect will be provided that will be able to isolate all available generation from both the customer and the utility. This disconnect must have a built-in locking mechanism to provide for lockout.
3. Meter requirements: The site will be monitored by a total of three meters, shown in the diagram below. A TDSP meter at the point of common coupling (The Net Meter), a meter for customer loads (The Billing Meter), and a Generation Meter) that will measure the generator output.
4. An AE controlled disconnect/ recloser will be installed to ensure safety of the grid and employees in abnormal situations.
5. The generator must at minimum be rated to the standards for a Class G2 generator per ISO 8528 and use natural gas.
6. These systems are required to meet all other requirements of this manual along with all other applicable codes and standards.

NOTE: The RaaS program is currently designed to accommodate spinning generation only. Any generation sources that can be charged from the grid should be behind the customer meter.

The following is the general layout requirement for this program:



End of Interconnection Guide