PUBLIC SERVICE COMPANY OF OKLAHOMA℠

An AEP Company

BOUNDLESS ENERGY®

THE COMPLETE GUIDE TO INTERCONNECTION

Requirements for the Interconnection of
Distributed Generation or Energy Storage Systems

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THIS GUIDE'S PURPOSE

In the interest of your safety, and the safety of the grid that serves our communities, this guide complies with all applicable laws and regulations that govern a source of energy that is not owned by us but is designed to be connected to our utility. In this guide, such equipment is called a distributed resource. A distributed resource can be energy generators such as solar panels and wind turbines or any energy storage technology that our company does not own.

In this guide, "you/yours" and "producer" refers to customers of our utility, and "we/us/our" refers to the Public Service Company of Oklahoma (PSO). "Your equipment" and "DER resource" means your energy generating equipment or your energy storage equipment. "Our system" means the wires and transmission systems PSO owns.

The guide details the rules, responsibilities and process for connecting your equipment to our system. Its purpose is to inform you and provide answers to technical and procedural questions. This guide should be read in conjunction with your **interconnectivity agreement with our utility.**

Our connection process has two main goals:

- Determine if your equipment is compatible with the electric power system at the proposed interconnection point
- Identify any necessary modifications to ensure compatibility

The information provided in this guide has limitations, and you should not make assumptions that are not explicitly supported.

First, this document gives you the minimum requirements. It may not cover all the details specific to your purchase or installation terms. We are not a party to your purchase or installation agreement, and executing its terms are between you and your seller. We undertake no responsibility for its execution. Consider sharing your plans with us before buying or installing equipment.

Second, you are responsible for protecting your equipment from any disturbances on our systems at all times. Our review of your equipment is not an endorsement or confirmation of its design, and we are not responsible for its safety, durability or reliability.

If you have an **isolated system,** you are not subject to these guidelines. This guide applies to generators that connect to PSO distribution facilities. Wholesale producers that sell to the bulk electrical transmission system are required to follow SPP interconnection guidelines but must comply with PSO technical standards.

For additional information about interconnection to our systems and the tariffs and rules that apply, contact dgcoordinator_PSO@aep.com.

OUR DEFINITIONS

"Distributed Resources" or "DER," means all sources of electric power that are not owned by us and that operate on our distribution system. This includes rotating electrical generators, wind turbines, microturbines, Photovoltaic (PV) systems, which are also known as "Distributed Generation or "DG," as well as batteries and fuel cells.

"Distribution System" and "Transmission System" refers to facilities owned, leased or controlled by us.

"Disconnect Switch" is the device that we operate to isolate your equipment and allow it to supply energy to your house.

"IEEE 1547 compliant" describes equipment that has been tested by a nationally recognized testing laboratory and verified to conform to the Institute of Electrical and Electronics Engineers (IEEE) Standard 1547.

"Induction Machine" is a rotating AC electrical generator similar in design to an induction motor. It is often referred to as an asynchronous machine. An induction machine acts as a motor when rotating slower than the electric system frequency but generates electricity when a prime mover such as an engine rotates the shaft faster than the system frequency.

"Interconnection" adds your equipment, operating in parallel, to our system.

"Interconnection Agreement" documents the terms under which we are authorizing you to connect your equipment to our system.

"Inverter" is a device or system that changes direct current (DC) power into alternating current (AC) power that is compatible with our supply line. An inverter is made up of electronic components, and it is not an AC electrical generator.

"Islanding" is a condition where your equipment is disconnected from our system, but your equipment continues to meet your electrical demands or the demands of other customers connected to the source feeder. Islanding your equipment is a safety hazard for our employees.

"Isolated system" is a generator or storage system that cannot be operated in parallel with our system or one that is temporarily connected for less than 100 milliseconds (1/10th of second). If you have a make-before-break system, it must be reviewed and approved by our team, and it also must meet Underwriters Laboratories Standard UL 1008.

"Line Section" is our feeder line or a part of a line connected to your equipment and bounded by automatic sectionalizing devices.

"Make-before-break" means load transfer equipment that makes a connection to our system before breaking the connection. During such transfers, our system and your equipment are temporarily connected.

"Parallel Operation" means the direct connection of the your power generation or energy storage equipment to our distribution system for periods longer than 100 millisecond (1/10th of a second).

"Pre-Certified" is a certification that the manufacturer gets from a nationally recognized testing lab verifying that the equipment was tested and proven to meet IEEE 1547.

"Point of Common Coupling" is the point at which the distributed resource is connected to the shared portion of the utility system or where an electrical system connects to the distribution system.

"Synchronous Machine" means a rotating AC electrical generator matches the AC power system frequency. Synchronous generators can be severely damaged if connected out of synchronism with a utility AC distribution system.

"System Impact" is a compromise to the safety, reliability or power quality of our systems, as a result of a breach of your equipment's limits.

"Technical Requirements" are requirements, specifications and standards for performance, operation, testing, safety and maintenance of equipment connected to our system. Your equipment may comply with all the technical requirements and still have significant impact.

"Transfer Trip" is a trip signal sent from one location to another via a communications system such as phone line, radio or fiber optics. Transfer trip is normally applied whenever large synchronous machines are connected to a utility feeder that utilizes high-speed breaker reclosing following line disturbances.

"Transmission system" refers to the facilities we own, lease or control that deliver electric power at primary voltages above 34.5 KV three phase.

"Two-Way Meter" measures how much power you draw from our system and how much power you put into it. If you generate more energy than your home uses, you'll get a net credit on your bill.

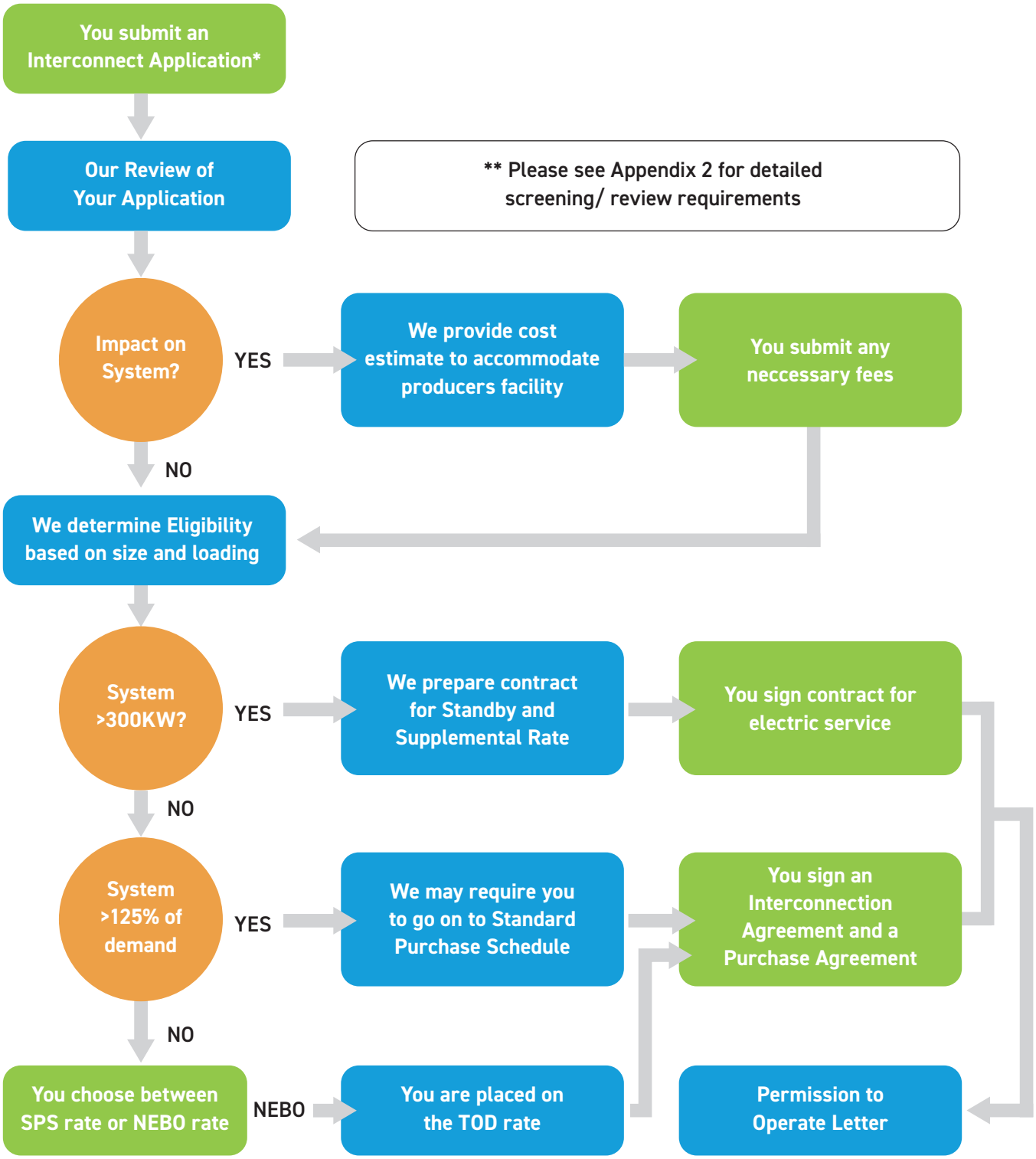
"UL certified non-islanding inverter" meets UL -1741 standards or has been tested by another nationally recognized testing laboratory and verified to conform to applicable sections of UL-1741 for utility interactive (grid connected) inverters.

"Utility Grade Protective Relaying" are relays that meet the requirements of IEEE standards. C37.90, C37.90.1, and C37.90.2.

OUR INTERCONNECTION PROCESS AT-A-GLANCE

Improper connection and operation of your equipment may cause injury and erode the reliability and quality of electric service for everyone. Your equipment may not be connected to our system without an **Interconnection Agreement**.

Notwithstanding exceptions for unusually large size of equipment or unique regulations or jurisdiction, the process to get an **Interconnection Agreement** is below.



DETAILS OF APPLICATION REVIEW PROCESS

Our process meets all applicable federal, state and local regulations while conforming to all industry standards and accepted industry practices. We comply with the Institute of Electrical and Electronics Engineers (IEEE) Standard 1547, Standard for Interconnecting Distributive Resources with Electric Power Systems and IEEE Standard 1547.2.

Upon receipt of a completed application form and required information, we'll review it using it the following criteria.

A. Automated Review of Units Equal to or Smaller than 25kW

If your UL-1741 Certified, non-**islanding inverter-based** generates no more than 25kW, it is authorized for interconnection after the following conditions are met.

1) You included the inverter manufacturer's proof of UL-1741 testing with your application.
2) We verified that you have a break isolation device within 10 feet of the main utility meter. The device sits 48" to 66" above ground level and is unlocked to our employees.
3) Passes a basic internal screen
4) We installed a **Generating Meter.**
5) You signed the **Interconnection Agreement.**

If your application is declined, we may present modifications you can take to pass the expedited review with minimal cost.

B. Expanded Review of Units Greater than 25kW

If your equipment exceeds 25kW, it is authorized for interconnection if the following conditions are met.

(1) All criteria that applies to inverter-based units no greater than 25kW listed in the preceding section -and-
(2) The total nameplate capacity of all proposed generation is no larger than 1MW. Applications larger than 1MW may require additional study.
(3) The combined total of all your equipment (new and any pre- existing) is less than 10% of the line section's maximum peak load.
(4) The short circuit current contribution of your equipment, at the **point of interconnection,** is less than 10% of the total available short circuit current.
(5) The addition of your equipment does not cause the available short circuit current to rise above 80% of the short circuit interrupt ratings of either our or your equipment. Your request will be declined if the existing circuit already exceeds this level.
(6) Single phase installations interconnected on the center tap of a 240V secondary service does not create an imbalance between windings of greater than 20% of the service transformer nameplate rating. If the secondary is to be shared with another customer, the aggregate of all generation on the shared secondary does not exceed 20kW.
(7) Proposed three phase interconnections to our primary distribution feeder must be connected four wire, grounded-wye with ground overcurrent protection. Your grounding transformer may be substituted for a grounded-wye connection.

Important notes

- ***Your application will be screened and evaluated based on the rated nameplate kW of the your proposed equipment, not the kW you plan to generate or sell.***
- ***You must prove ownership in or right to acquire sufficient space for the installation of your equipment. For a wind powered Distributed Resource, the minimum accepted site control (without a wind turbine layout) is 30 acres / MW of generation. For a solar powered generating facility, the minimum accepted site control (without a solar array layout) is 6 acres/MW of generation.***

(8) No construction of facilities or expense by us (other than metering) is required.

(9) Equipment is certified by a nationally recognized testing lab to meet all IEEE Std. 1547 requirements.

(10) You agree to undergo additional assessments that we identify at your cost, and we have verified that you made the additional modifications (also at your cost).

(11) Your equipment does not result in system impacts such as those listed in Appendix 2 of this document.

(12) Other considerations include, but are not limited to:

- Additional protective equipment may be required at our substation or sectionalizing device to **"transfer trip"** your generator breaker or **interconnect circuit breaker** for our feeder faults or when the source substation becomes isolated from the our transmission grid.
- If your equipment is rated more than 50% of our feeder circuit kVA rating, regulations require a dedicated feeder circuit for your exclusive use. We will perform a feasibility analysis and determine availability at the requested location. If the location is viable, we will provide a cost estimate to you for constructing the new feeder. Refer to Appendix B-4 of this document for typical requirements.

If you want to sell energy from your equipment that generates more than 5,000kW (5MW), a communications channel with telemetering of continuous generation is required. Supervisory Control and Data Acquisition (SCADA) indication and/or control may be required in some circumstances.

Facilities greater than 20MW must connect to a substation that is dedicated solely to you. While such installations are beyond the scope of this guide, Appendix B-5: Typical Technical and Protection Requirements for Dedicated Substations has been included for reference.

TECHNICAL REQUIREMENTS FOR INTERCONNECTION

Our requirements are based on IEEE Standard 1547-2003 "Standard for Interconnecting Distributed Resources with Electric Power Systems" (IEEE 1547)2 . These technical requirements apply to all **distributed resource** technologies including synchronous machines, induction machines, or static power inverters/converters.

The interconnection system hardware and software used by your equipment to meet these requirements do not have to be located at the **Point of Common Coupling.** However, the technical requirements shall be met at **the Point of Common Coupling.**

A table summarizing the Distributed Resource Technical Requirements is attached as Appendix 1. The pertinent IEEE 1547 clause number(s) are shown in this table.

Technical Requirements - The Technical Requirements in IEEE 1547 cover the following areas, Voltage Regulation, Voltage Disturbances, Harmonic Current Injection, Direct Current Injection, Grounding Scheme Compatibility, Inadvertent Energization, Monitoring Operation, Isolation Device, Withstand Performance, Paralleling Device, Response to Area EPS Faults, Reclosing Coordination, Unintentional Islanding, Voltage and Frequency Detection, Abnormal Voltage or Frequency, Reconnection Following a Disturbance, Secondary Grid and Spot Network Systems, and Testing and Maintenance.

Testing Requirements – A Distributed Resource proposing to interconnect with the Distribution System must be tested as per IEEE 1547 Clause 5 to demonstrate that the interconnection system meets the requirements of IEEE 1547 Clause 4. Documentation of the results of the Design Test and Production Tests shall be provided to the Company at the time of application unless such tests are to be conducted as part of the Commissioning Tests.

When your equipment comprises an assembly of discrete components, you must submit test results with your application to confirm compatible simultaneous operation of your discrete units. Otherwise, we require a test of your design as part of the required commissioning tests.

You must submit written procedures for all necessary Commission Tests to us for approval. To avoid delay, submit them well in advance of the scheduled date of the Commissioning Tests.

ADDITIONAL TECHNICAL REQUIREMENTS:

(1) Circuit Breaker - If a main circuit breaker (or circuit switcher) between the interconnection transformer and our system is required, the device must comply with the applicable current ANSI Standard from the C37 series of standards that specifies the requirements for circuit breakers, reclosers and interrupting switches.

(2) Main Disconnect Switch (Voltages exceeding 480 volts) – A gang operated disconnecting device must be located at the Point of Common Coupling for all three phase interconnections. In all cases the disconnecting device must be clearly labeled, accessible to our employees, suitable for use by our crews at all times and must be suitable for use by us as a protective tagging location. The disconnecting device shall have a visible open gap when in the open position and be capable of being locked in the open position. The disconnecting device must have a ground grid designed in accordance with our specifications. Operation of the device must be restricted to our employees and properly trained professionals you hire. The disconnecting device must comply with the applicable current ANSI Standard from the C37 series of standards that specifies the requirements for circuit breakers, reclosers and interrupting switches.

(3) Terminating Structure – When a new interconnection line is required, you provide a suitable structure to terminate the interconnection line. You are responsible for ensuring that terminating structure or substation structural material strengths are adequate for all requirements, incorporating appropriate safety factors. We will provide line tension information for maximum dead-end.

(4) The structure is designed for the maximum line tension along with an adequate margin of safety.

(5) Substation electrical clearances meets or exceeds the requirements of the National Electrical Safety Code. Installation of disconnect switches, bus support insulators and other equipment shall comply with accepted industry practices.

(6) Surge arresters are selected to coordinate with the Base Insulation Level (BIL) rating of major equipment components and comply with recommendations set forth in the applicable current ANSI Standard C62.2 that specifies the requirements for surge arresters and other surge protection devices.

(7) **Momentary Paralleling** – For situations where your equipment will only be operated in parallel with our system for a short duration (less than 100 milliseconds), as in a make-before-break automatic transfer scheme, the requirements of IEEE 1547 do not apply except as noted. All make-before-break automatic transfer switch systems proposed by the interconnection customer comply with UL 1741 and are listed by a nationally recognized testing laboratory.

(8) **Voltage Unbalance** – You are responsible for operating your equipment such that the voltage unbalance attributable to your equipment does not exceed 2.5% at the Point of Common Coupling.

(9) **Power Factor** – Your equipment is capable of operating at some point within a power factor range from 0.9 leading to 0.9 lagging. Operation outside this range is acceptable if the reactive power of your equipment is used to meet the reactive power needs of the electrical loads within your facility or if that reactive power is otherwise provided under tariff by us. You notify us if it is using your equipment for power factor correction.

(10) **System Stability** – We may require a stability study if the aggregate generation is greater than 10 MW and in an area where there are known or posted stability limitations to generation located in the general electrical vicinity (e.g., three or four transmission voltage level busses from the transmission voltage bus serving the distribution circuit where your equipment interconnects.

(11) **Maintenance and Testing** – You are responsible for the periodic scheduled maintenance on the interconnection system of your equipment (relays, interrupting devices, control schemes, and batteries that involve the protection of our system). Unless the equipment manufacturer provides study

results that demonstrate the need for less frequency, interconnection systems that depend upon a battery for proper function are checked and logged once per month for proper voltage. At least once every four years, the battery is replaced or a discharge test performed.

(12) A periodic maintenance program is established in accordance with the requirements of IEEE 1547. We may examine copies of the periodic test reports or inspection logs associated with the periodic maintenance program. Upon request, you inform us of the next scheduled maintenance so that we can witness the maintenance performed and any associated testing.

(13) Monitoring – We reserve the right, at our expense, to install special test equipment as may be required to perform a disturbance analysis and monitor the operation and control of your equipment to evaluate the quality of power it produces.

EVALUATION OF SYSTEM IMPACT

The connection of your equipment to our system may have significant impact on the safety and reliability of one or more of the following parts of the electric grid; our systems, the distribution and transmission systems of a third party (an "Affected System") and the electrical system where the your equipment is connected. We are not be responsible for the evaluation of the safety and reliability impacts on the electrical system where your equipment is to be connected. Our approval of your interconnection is not an endorsement, confirmation, warranty, guarantee, or representation concerning the safety, operating characteristics, durability, or reliability of your equipment or electrical system where it is connected.

Distribution System Impact – We evaluate the system impact of your interconnection based on the information you provide in the interconnection application.

A study is performed on the timeline established by the appropriate regulatory authority in your jurisdiction. The study time and study scope vary depending upon the type, size and proposed use of your equipment.

The Company supports limited study and the use of a screening process to expeditiously identify and approve interconnections without significant system impact. See Appendix 2 for the screening criteria in Appendix 2 to be used in impact studies.

Additional study time is generally required to evaluate equipment that is not pre-certified by the manufacturer using a nationally recognized lab. Equipment that has been previously evaluated and found to meet requirements may be excepted.

The possible outcomes of the system impact study include the following:

1) The proposed Distributed Resource interconnection meets the technical requirements and there are no System Impacts that would require modification or upgrade to either our facilities or yours;

2) The proposed Distributed Resource interconnection does not meet the technical requirements and modifications or changes are required to either our facilities or yours;

3) The proposed Distributed Resource interconnection results in negative system impact and modifications or changes are required to either our facilities or the Distributed Resource installation;

4) The proposed Distributed Resource interconnection requires new facilities.

The potential Distribution system impacts listed in Appendix 3 may need to be examined as part of the impact study.

Transmission System Impact – We review each request and determine if a Transmission System impact (including any system stability impact) or an impact to a third party's system.

Affected System Impact – We review each request for interconnection to the Distribution System to determine if the potential exists for impact to a third party's system. For example, the distribution systems of several Rural Electric Cooperatives (REC's) are interconnected to our distribution feeders. The interconnection of your equipment to our distribution feeder with an REC interconnection may result in significant impact to the REC system.

If the potential exists for impact, we will notify the third party of the proposed interconnection request and coordinate the processing of the interconnection request to ensure safety and compliance.

ENERGIZATION AND DISCONNECT

Once get and sign the **Interconnection Agreement,** your equipment will be inspected and certified by a municipal, state, or federal government authority having jurisdiction. If self-installed or no government party has jurisdiction, you need to commission an inspection by a licensed electrician or licensed professional engineer. We reserve the right to witness commissioning tests or operation of interconnect and related equipment, as well as inspect your equipment during normal business hours. Refer to appendix 4 at the back of this guide for a schematic of a typical installation, as approved. At the time of energization, we will collect a certificate of completion signed by you and the inspector.

We reserve the right to refuse connection or to disconnect you for failure to comply with these guidelines or the applicable law, rules, and regulations. We also reserve the right to your load or generation to stabilize the system during emergencies, or as part of system maintenance. You are liable if an inability to disconnect creates hazardous conditions resulting in damage or injury.

YOUR RESPONSIBILITIES

You are responsible for complying with all applicable laws, rules and regulations. You're also responsible for synchronization with the distribution system, and we are not responsible for damages resulting from out-of-phase reclosing. You should never energize a de-energized distribution circuit. You may not authorize anyone to change, remove, or tamper with our property, including tags or locks used for utility operations procedures.

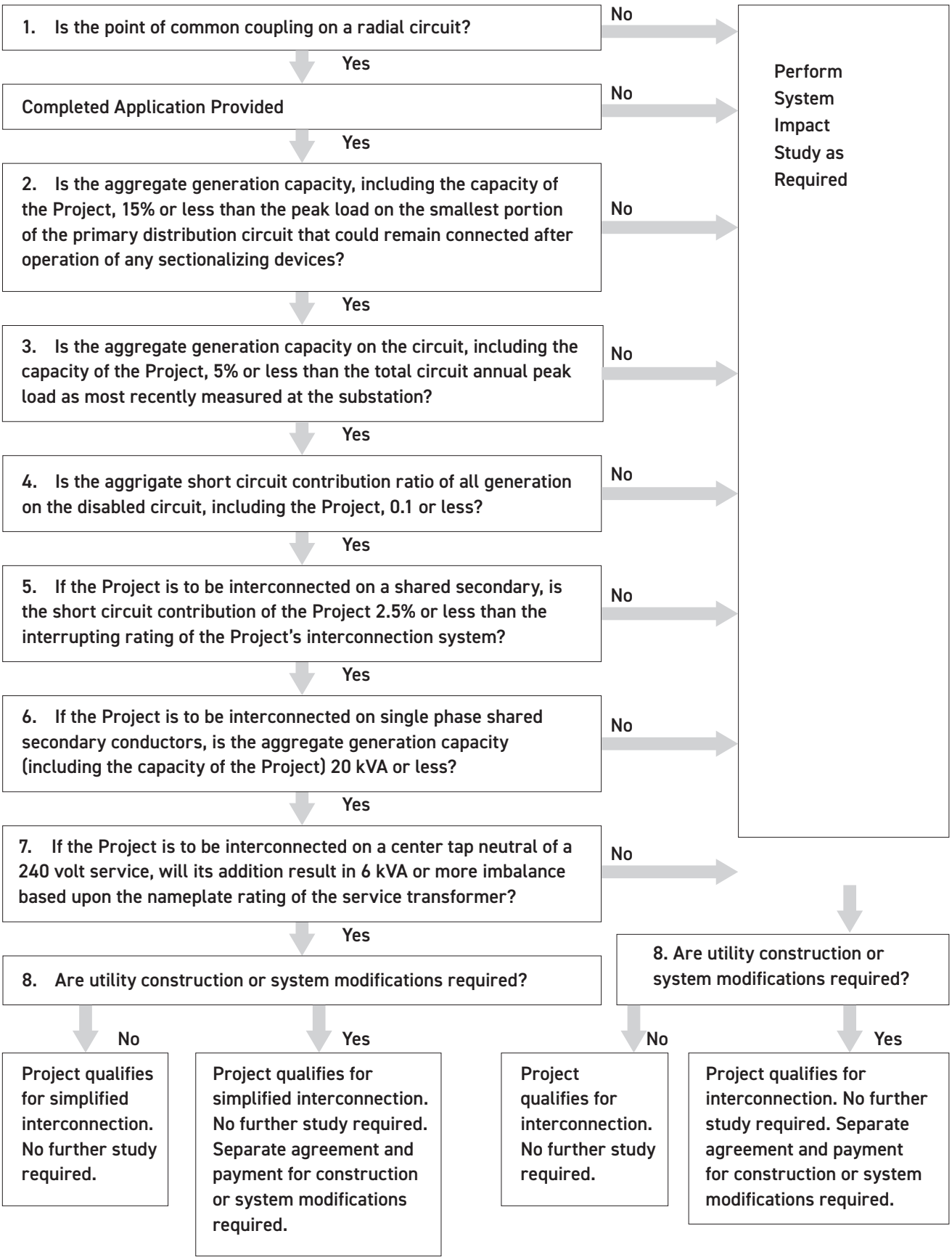
You are responsible for the easement, licensing, design, equipment, studies, protection, maintenance, and operation by qualified personnel required to accommodate power generation and/or storage. You'll be responsible for the cost of adverse system affects, investigation, and system hardening required, as well as future modifications due to utility changes in system protection, system load, or type of service provided. After an application has been approved, any changes in your project scope including but not limited to equipment type, size or rating requires you to re-submit an updated application for approval.

Commissioning tests and maintenance of interconnection and related equipment shall conform to the requirements of IEEE 1547. For large installations using utility grade interconnecting protective equipment, we require testing on a regular basis. All distribution generation certifications, maintenance, test results, production outage records, technical drawings, design specifications, equipment, and equipment settings must be kept up to date and be provided to us at our request.

APPENDIX 1: Distributed Resource Technical Requirements

Attribute	Requirement
Voltage Regulation	IEEE 1547 - Clause 4.1.1
Voltage Disturbances	IEEE 1547 - Clause 4.3.2
Harmonic Current Injection	IEEE 1547 - Clause 4.3.3
Direct Current Injection	IEEE 1547 - Clause 4.3.1
Grounding Scheme Compatibility	IEEE 1547 - Clause 4.1.2
Inadvertent Energization	IEEE 1547 - Clause 4.1.5
Monitoring Provisions	IEEE 1547 - Clause 4.1.6
Isolation Device	IEEE 1547 - Clause 4.1.7
Withstand Performance	IEEE 1547 - Clause 4.1.8.1 and Clause 4.1.8.2
Paralleling Device	IEEE 1547 - Clause 4.1.8.3
Response to Area EPS Faults	IEEE 1547 - Clause 4.2.1
Reclosing Coordination	IEEE 1547 - Clause 4.2.2
Unintentional Islanding	IEEE 1547 - Clause 4.4.1
Abnormal Voltage	IEEE 1547 - Clause 4.2.3
Abnormal Frequency	IEEE 1547 - Clause 4.2.4
Isolation Device	IEEE 1547 - Clause 4.2.6
Reconnection Following a Disturbance	IEEE 1547 - Clause 4.2.6
Secondary Grid and Spot Network Systems	IEEE 1547 - Clause 4.1.4
Testing	IEEE 1547 - Clause 5
Periodic Interconnection Tests	IEEE 1547 - Clause 5.5
Circuit Breaker	Meet appropriate ANSI C37 standard
Disconnection Switch	Three phase unit gang operated at Point of Common Coupling
Terminating Structure	Adequate structural material strength suitable to terminate line
Surge Arresters	Meet applicable ANSI C62.2 standard
Momentary Paralleling	Comply with Underwriter's Laboratories Standard 1741 and IEEE 1547 – Clause 1.3
Voltage Unbalance	Unbalance attributable to Distributed Resource 2.5% or less
System Stability	Study required for units greater than 10 MW when limitations exist

APPENDIX 2: Interconnection Application Screening Criteria



SIGNIFICANCE OF SCREENS:

1. Is the point of common coupling on a radial circuit?

If the point of common coupling is not on a radial distribution circuit, special considerations must be taken because of the design, protection and operational aspects of network distribution systems.

2. Is the aggregate generation capacity, including the capacity of the Project, 15% or less than the peak load on the smallest portion of the primary distribution circuit that could remain connected after operation of any sectionalizing devices?

The 15% of line section peak load screen is a catchall for a variety of potential problems (Unintentional islanding, voltage regulation, equipment rating, cold load pickup and protective device coordination) that can occur as the level of penetration of generation within a line section on the distribution system increases. Low penetration of generation will have a minimal impact on operation and load restoration. As the penetration increases the cumulative impact must be reviewed.

3. Is the aggregate generation capacity on the circuit, including the capacity of the Project, 5% or less than the total circuit annual peak load as most recently measured at the substation?

The 5% of total circuit annual peak load screen is a catchall for a variety of potential problems (Unintentional islanding, voltage regulation, equipment rating, cold load pickup and protective device coordination) that can occur as the level of penetration of generation on a circuit increases. Low penetration of generation will have a minimal impact on operation and load restoration. As the penetration increases the cumulative impact must be reviewed.

4. Is the aggregate short circuit contribution ratio of all generation on the distribution circuit (including the Project) 0.1 or less?

(The short circuit contribution ratio for a generator is the ratio of the generator's short circuit contribution to the utility's short circuit contribution for a three phase fault at the primary voltage level nearest the point of common coupling. The aggregate short circuit contribution ratio is the sum of the individual generator short circuit contribution ratios for all the generators connected to the circuit.)

If the short circuit current contribution from the proposed generation is small compared to the available fault current without the generation connected, there will be no significant impact on the distribution system's short circuit duty, fault detection sensitivity and protective device coordination schemes.

5. If the Project is to be interconnected on a shared secondary, is the short circuit contribution of the Project 2.5% or less than the interrupting rating of the Project's interconnection system?

If the short circuit current contribution from the proposed generation is small compared to the interrupting rating of the interconnection system, there will be no significant impact on the distribution system's short circuit duty, fault detection sensitivity and protective device coordination schemes.

6. If the Project is to be interconnected on single phase shared secondary conductors, is the aggregate generation capacity (including the capacity of the Project) 20 kVA or less?

If the aggregate generation capacity is in excess of 20 kVA, the voltage supplied to other customers who share the secondary conductors could exceed acceptable limits.

7. If the Project is to be interconnected on a center tap neutral of a 240 volt service, will its addition result in 6 kVA or more imbalance based upon the nameplate rating of the service transformer?

If an imbalance of more than 6 kVA is created on a 240 volt service, the voltage could exceed acceptable limits.

8. Are utility construction or system modifications required?

Any required utility construction or system modifications would require agreement on the scope, the cost and the schedule for the work.

APPENDIX 3: Potential Distribution System Impacts

Voltage Regulation - With the addition of the Distributed Resource, the voltage level on both the primary and secondary must be maintained within acceptable limits for both on peak and off peak conditions.

1) Reverse power flow through voltage regulators or load tap changers may cause the regulator or load tap changer to incorrectly regulate the voltage.

2) Improper settings of the Distributed Resource controls may result in the steady state voltage straying outside the + or - 5% limits at the point of common coupling on a 120 volt basis.

3) Low voltage may be experienced after a temporary fault or when restoring service after a permanent fault if the presence of the Distributed Resource is essential to the maintenance of adequate voltage.

4) The loss of Distributed Resource synchronous machine exciters may cause excessive reactive power losses and low voltages on a circuit.

5) The presence of Distributed Resources with varying output (e.g. wind turbines, photovoltaic cells, etc.) may cause excessive switching of capacitor banks and/or an excessive number of regulator or load tap changer operations.

6) When line drop compensators are used on a circuit, the presence of Distributed Resources may significantly alter the intended regulation scheme.

7) The presence of Distributed Resources on a secondary system may cause the off peak voltage level to exceed its upper limit.

8) The Distributed Resource owner could experience periods when his unit(s) trips off line from overvoltage due to system voltage excursions.

Voltage Flicker — Several Distributed Resource technologies have the potential for creating objectionable voltage flicker. In extreme cases the size of the Distributed Resource may need to be limited to prevent objectionable flicker or system improvements may be necessary to limit the voltage flicker. Possible flicker sources include:

1) Wind turbines may produce rapidly varying output due to changes in wind speed, wind turbulence, intensity, tower shadowing effects and blade pitching.

2) Photovoltaic (PV) installations may produce rapidly varying output due to intermittent cloud cover over the cells.

3) Reciprocating engine Distributed Resources may be produce rapid output fluctuations caused by engine misfiring due to low quality fuel.

4) Induction machine Distributed Resources may produce voltage flicker due to current inrush when they are connected.

5) Synchronous machine Distributed Resources may produce voltage flicker due to poor voltage matching and phase angle synchronization at contact closure.

6) Power inverter based Distributed Resources may not have soft start technology to limit the rate of change of power output at starting.

7) Interaction of Distributed Resources with other devices such as voltage regulators, load tap changers and switched capacitor banks may produce objectionable voltage flicker.

Overcurrent Protection and Protective Device Coordination - With the addition of a Distributed Resource on a circuit, another source of fault current is introduced. The available fault current at any location on the feeder will depend upon the type of fault (e.g. line-to-ground, three phase, double-line-to-ground, etc.), the fault impedance, and the status of the Distributed Resource on the feeder (i.e. on or off line). Each Distributed Resource technology has its own unique fault current characteristics.

The presence of Distributed Resources may create several problems with overcurrent protection and the coordination of protective devices. Some of the problems include:

1) The "reach" of overcurrent protective devices may be reduced due to a reduction in the fault current contribution from the station source with Distributed Resources on a feeder. For faults located downstream from a Distributed Resource, the fault current contribution from the station source will be reduced when the Distributed Resource unit is on line.

2) Recloser to fuse coordination may no longer exist with the introduction of a Distributed Resource on the feeder so fuses may blow for temporary faults.

3) Sectionalizers may mis-operate if the Distributed Resource maintains voltage when the sectionalizer should be "counting" an operation.

4) Nuisance tripping of a circuit recloser or station breaker may occur from a fault located on an adjacent feeder due to the fault current contribution from the Distributed Resource.

5) The presence of an interconnection transformer with a primary voltage wye grounded winding connection and a secondary voltage delta connection at the Distributed Resource can desensitize ground fault relays and the ground fault settings on recloser controls.

6) The introduction of Distributed Resource to a secondary spot or grid network system can cause nuisance trips of protectors and protector cycling and may lead to out of phase protector closing resulting in equipment damage.

7) The presence of a Distributed Resource may exacerbate cold load pickup problems following a feeder outage.

8) The addition of a Distributed Resource may increase the available fault current to the point where utility system or customer owned protective device fault interrupting ratings are exceeded.

9) If the Distributed Resource remains on the feeder after a protective device opens for any reason, then the protective device may reclose with the system voltage and the Distributed Resource voltage out of synchronism.

10) Distribution automation schemes may be adversely affected by the introduction of Distributed Resources.

11) System under frequency conditions may result in feeder or transformer overload conditions.

Harmonic Current Injection — Several Distributed Resource technologies have the potential for introducing harmonic distortion. Possible harmonic issues include:

1) Rotating machines produce 3rd harmonic distortion. Machines having a pitch of either 5/6 and 11/16 introduce the most distortion with 2/3 pitch being the preferred pitch to minimize distortion.

2) Inverter based Distributed Resources may inject harmonic voltages and currents into the utility grid or may serve as a system sink for harmonics.

3) Wye-wye transformer connected Distributed Resources and single phase Distributed Resources have the potential for being the worst harmonic sources.

Other Issues — Several other issues relating to the interconnection of Distributed Resources need to be considered. Potential problems to look for include:

1) Voltage on unfaulted phases may approach 1.73 times nominal during single line to ground faults when delta-wye or delta-delta connected transformer banks are used for the Distributed Resource transformation.

2) Resonant overvoltages can occur if a synchronous or induction generator Distributed Resource is isolated with capacitors during line to ground faults.

3) Single phase switching of a delta connected Distributed Resource transformer bank may create ferroresonant overvoltage conditions.

4) Distributed Resources may present utility worker and public safety concerns by inadvertently re-energizing the electric power system during abnormal system conditions.

5) The addition of Distributed Resource may overload conductors or equipment.

6) The presence of a Distributed Resource may defeat attempts to clear fault conditions by continuing to energize the feeder during fault events.

7) Induction and synchronous machine Distributed Resources may be over excited by the presence of a capacitor bank in an unintentional islanding situation and produce high voltages in the island.

8) Inverter based Distributed Resources may inject direct current onto the feeder causing transformer saturation.

9) When a grounded-wye high-side/delta low-side connected transformer bank is used to connect a Distributed Resource, circulating current in the delta winding may result in transformer overloading. This transformer connection allows zero sequence current to circulate in the delta winding.

10) When feeders are switched from their normal configuration to effect load transfers or to restore power to customers during outage situations, the presence of a Distributed Resource may create voltage regulation problems, objectionable voltage flicker, improper protective device operation and coordination or other problems.

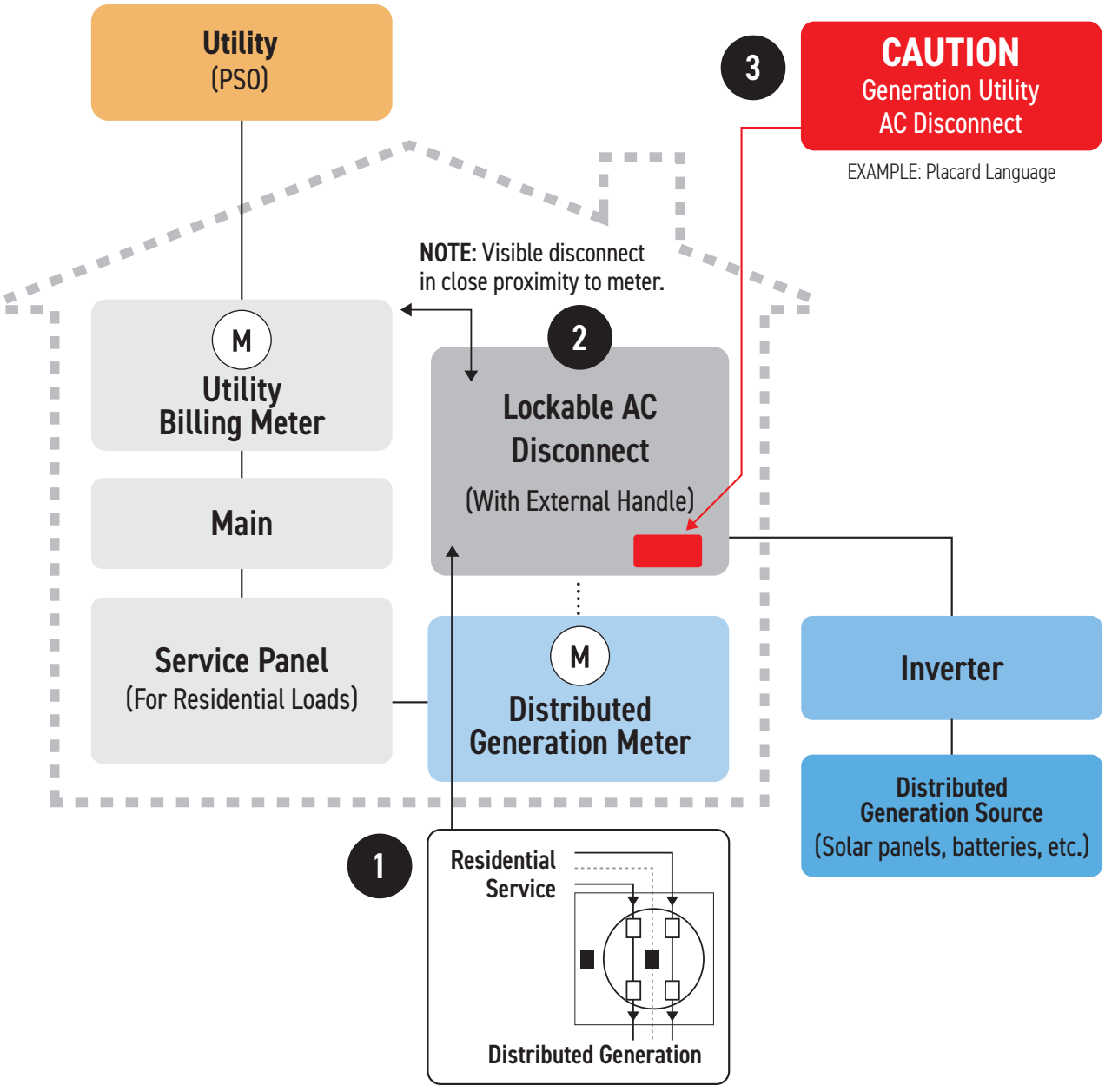
APPENDIX 4: Installer Requirements

Note: A system line drawing/diagram along with the Agreement for Interconnection must be submitted before installation.

1. PSO requires a meter socket to be installed on the output of Distributed Renewable Generation (DRG) system. The meter must be wired so that energy produciton flows through the meter. **The system will not be approved if the meter socket is not wired in this fashion.** A PSO meter will be provided and installed upon system approval at no cost. This is referred to as the DG Generation Meter.

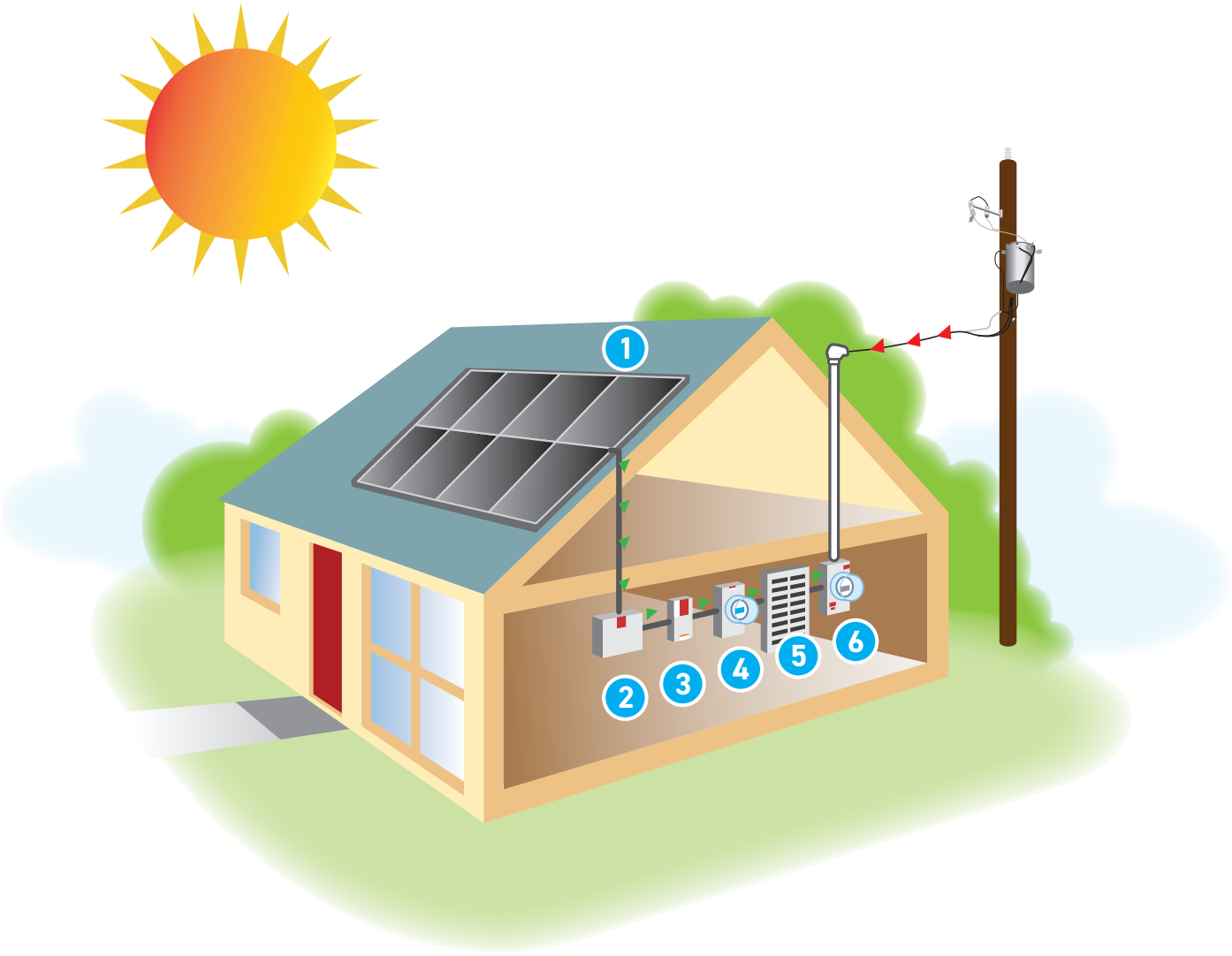
2. An accessible visible lockable labeled disconnect switch must be installed and located within 10 ft. of the Utility Billing Meter. If the disconnect cannot be within 10 feet, a placard signifying the disconnect's location will be allowed.

3. Appropriate signage/warning labels must be in place signifying that there is on-site generation.



Generation

APPENDIX 5: How Interconnection Works



How Interconnection Works

1. **Distributed Generation** — This is any source of power that is not owned by our utility. For homeowners, the most popular equipment is rooftop solar panels.

2. **Inverter** — Most distributed resources like rooftop solar panels generate direct current (DC) power, while homes appliances use alternating current (AC) power. An inverter converts DC power to usable AC power, and provides overcurrent or overvoltage protection.

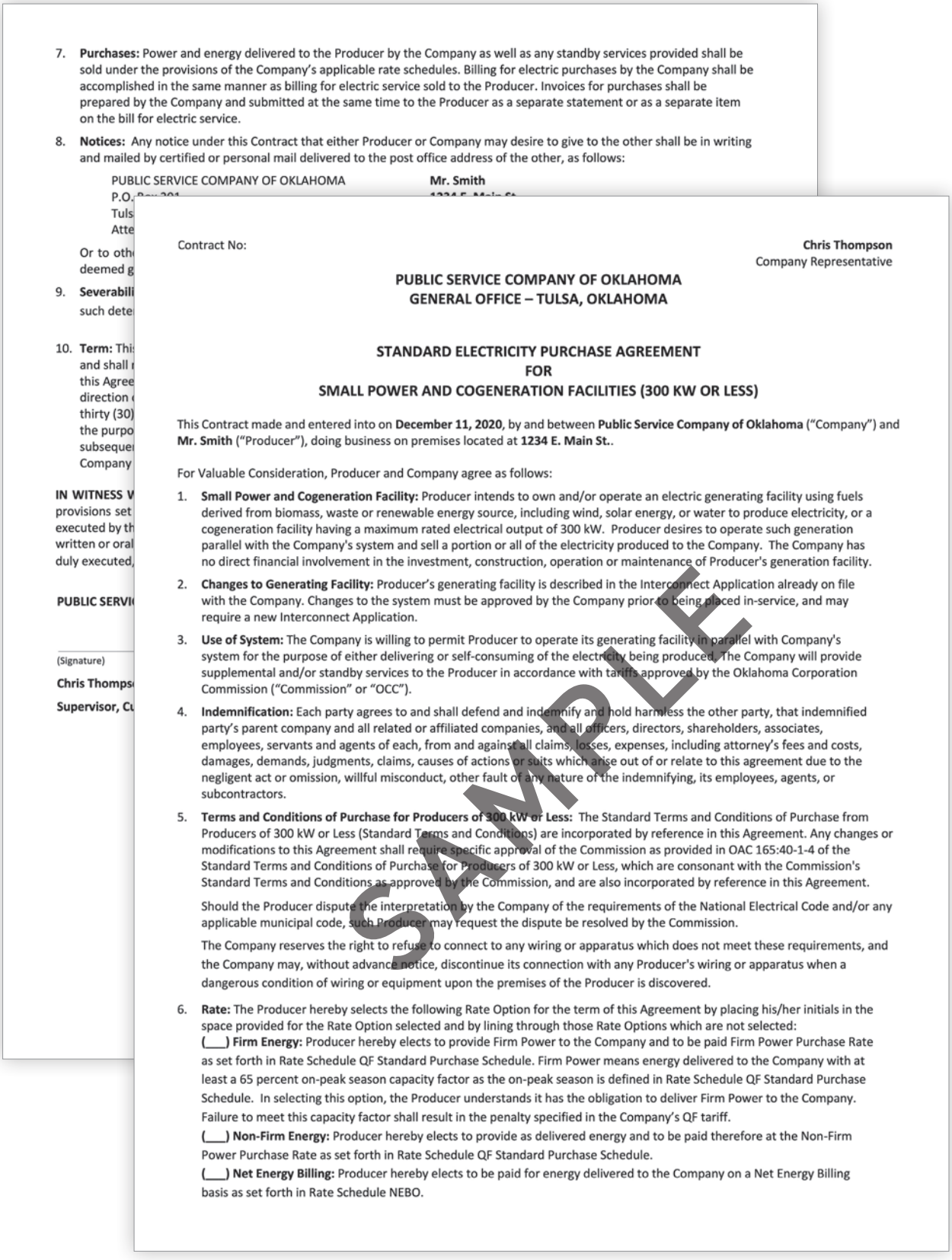
3. **Lockable AC Disconnect** — (Non-Fused with External Handle). We use this device to safety isolate your equipment from our power supply. This must be accessible and unlocked to our crews at all times.

4. **Distributed Generation Meter** — This meter measures how much energy your equipment generates. This meter is sometimes called a "production meter" and it operates separately from your existing electric meter. This must be accessible to our crews at all times.

5. **Breaker Box** — This is the control box that allows you to shut off power to different sections of your home (or all of your home if desired).

6. **Utility Meter** — This meter is the typical meter installed in every home when it is powered by our utility. This meter measures how much energy your home is consuming from our utility.

APPENDIX 6: Sample Contract/Agreement



7. **Purchases:** Power and energy delivered to the Producer by the Company as well as any standby services provided shall be sold under the provisions of the Company's applicable rate schedules. Billing for electric purchases by the Company shall be accomplished in the same manner as billing for electric service sold to the Producer. Invoices for purchases shall be prepared by the Company and submitted at the same time to the Producer as a separate statement or as a separate item on the bill for electric service.
8. **Notices:** Any notice under this Contract that either Producer or Company may desire to give to the other shall be in writing and mailed by certified or personal mail delivered to the post office address of the other, as follows:

PUBLIC SERVICE COMPANY OF OKLAHOMA
P.O.
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Mr. Smith
1234 E. Main St

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Company

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provisions set
executed by th
written or oral
duly executed,

PUBLIC SERVI

(Signature)

Chris Thomps

Supervisor, Cu

Contract No:

Chris Thompson
Company Representative

PUBLIC SERVICE COMPANY OF OKLAHOMA
GENERAL OFFICE – TULSA, OKLAHOMA

STANDARD ELECTRICITY PURCHASE AGREEMENT
FOR
SMALL POWER AND COGENERATION FACILITIES (300 KW OR LESS)

This Contract made and entered into on **December 11, 2020**, by and between **Public Service Company of Oklahoma** ("Company") and **Mr. Smith** ("Producer"), doing business on premises located at **1234 E. Main St.**.

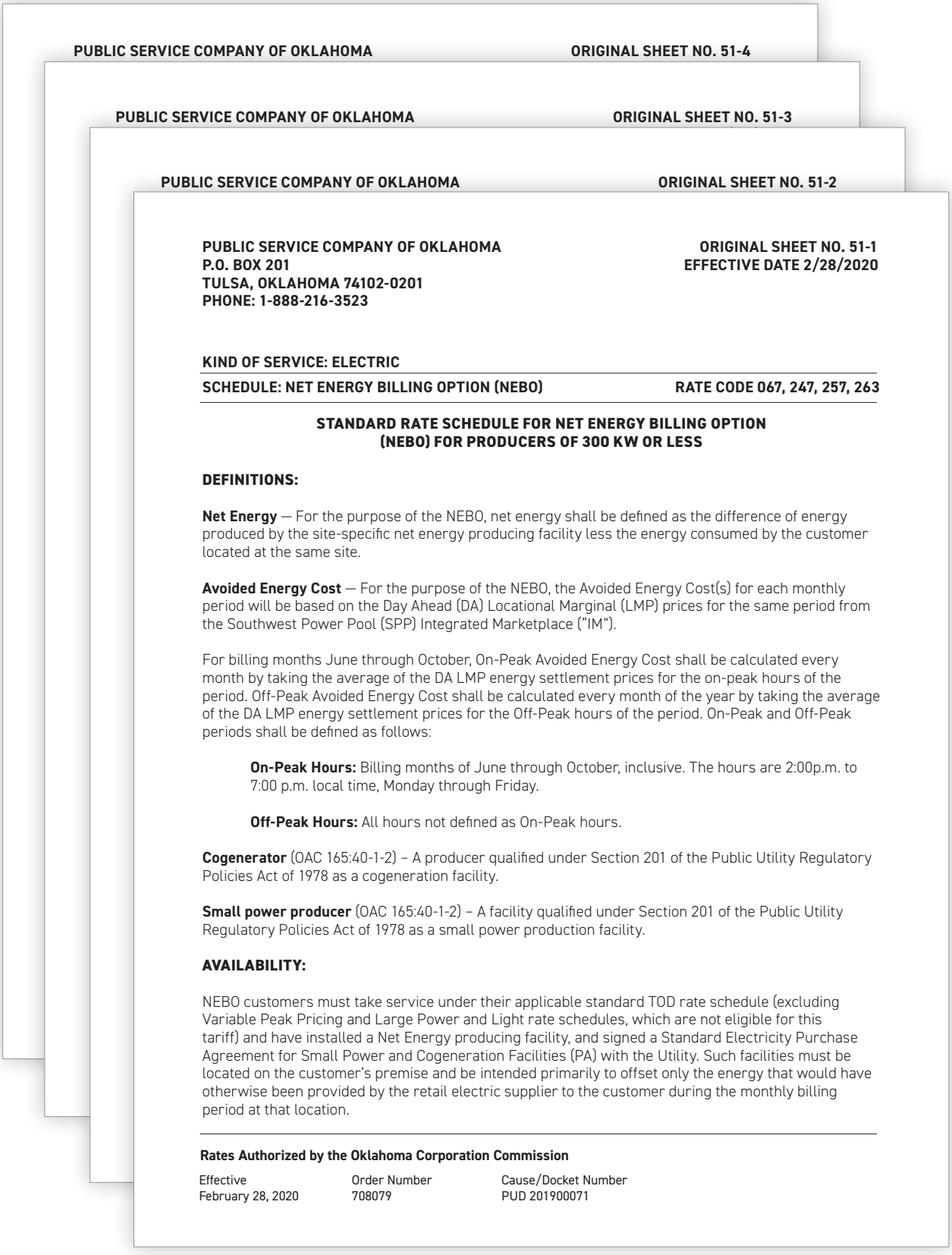
For Valuable Consideration, Producer and Company agree as follows:

1. **Small Power and Cogeneration Facility:** Producer intends to own and/or operate an electric generating facility using fuels derived from biomass, waste or renewable energy source, including wind, solar energy, or water to produce electricity, or a cogeneration facility having a maximum rated electrical output of 300 kW. Producer desires to operate such generation parallel with the Company's system and sell a portion or all of the electricity produced to the Company. The Company has no direct financial involvement in the investment, construction, operation or maintenance of Producer's generation facility.
2. **Changes to Generating Facility:** Producer's generating facility is described in the Interconnect Application already on file with the Company. Changes to the system must be approved by the Company prior to being placed in-service, and may require a new Interconnect Application.
3. **Use of System:** The Company is willing to permit Producer to operate its generating facility in parallel with Company's system for the purpose of either delivering or self-consuming of the electricity being produced. The Company will provide supplemental and/or standby services to the Producer in accordance with tariffs approved by the Oklahoma Corporation Commission ("Commission" or "OCC").
4. **Indemnification:** Each party agrees to and shall defend and indemnify and hold harmless the other party, that indemnified party's parent company and all related or affiliated companies, and all officers, directors, shareholders, associates, employees, servants and agents of each, from and against all claims, losses, expenses, including attorney's fees and costs, damages, demands, judgments, claims, causes of actions or suits which arise out of or relate to this agreement due to the negligent act or omission, willful misconduct, other fault of any nature of the indemnifying, its employees, agents, or subcontractors.
5. **Terms and Conditions of Purchase for Producers of 300 kW or Less:** The Standard Terms and Conditions of Purchase from Producers of 300 kW or Less (Standard Terms and Conditions) are incorporated by reference in this Agreement. Any changes or modifications to this Agreement shall require specific approval of the Commission as provided in OAC 165:40-1-4 of the Standard Terms and Conditions of Purchase for Producers of 300 kW or Less, which are consonant with the Commission's Standard Terms and Conditions as approved by the Commission, and are also incorporated by reference in this Agreement.

   Should the Producer dispute the interpretation by the Company of the requirements of the National Electrical Code and/or any applicable municipal code, such Producer may request the dispute be resolved by the Commission.

   The Company reserves the right to refuse to connect to any wiring or apparatus which does not meet these requirements, and the Company may, without advance notice, discontinue its connection with any Producer's wiring or apparatus when a dangerous condition of wiring or equipment upon the premises of the Producer is discovered.
6. **Rate:** The Producer hereby selects the following Rate Option for the term of this Agreement by placing his/her initials in the space provided for the Rate Option selected and by lining through those Rate Options which are not selected:
   (___) Firm Energy: Producer hereby elects to provide Firm Power to the Company and to be paid Firm Power Purchase Rate as set forth in Rate Schedule QF Standard Purchase Schedule. Firm Power means energy delivered to the Company with at least a 65 percent on-peak season capacity factor as the on-peak season is defined in Rate Schedule QF Standard Purchase Schedule. In selecting this option, the Producer understands it has the obligation to deliver Firm Power to the Company. Failure to meet this capacity factor shall result in the penalty specified in the Company's QF tariff.
   (___) Non-Firm Energy: Producer hereby elects to provide as delivered energy and to be paid therefore at the Non-Firm Power Purchase Rate as set forth in Rate Schedule QF Standard Purchase Schedule.
   (___) Net Energy Billing: Producer hereby elects to be paid for energy delivered to the Company on a Net Energy Billing basis as set forth in Rate Schedule NEBO.

APPENDIX 7: NEBO Billing Form



PUBLIC SERVICE COMPANY OF OKLAHOMA ORIGINAL SHEET NO. 51-4

PUBLIC SERVICE COMPANY OF OKLAHOMA ORIGINAL SHEET NO. 51-3

PUBLIC SERVICE COMPANY OF OKLAHOMA ORIGINAL SHEET NO. 51-2

PUBLIC SERVICE COMPANY OF OKLAHOMA
P.O. BOX 201
TULSA, OKLAHOMA 74102-0201
PHONE: 1-888-216-3523

ORIGINAL SHEET NO. 51-1
EFFECTIVE DATE 2/28/2020

KIND OF SERVICE: ELECTRIC

SCHEDULE: NET ENERGY BILLING OPTION (NEBO) **RATE CODE 067, 247, 257, 263**

STANDARD RATE SCHEDULE FOR NET ENERGY BILLING OPTION (NEBO) FOR PRODUCERS OF 300 KW OR LESS

DEFINITIONS:

Net Energy — For the purpose of the NEBO, net energy shall be defined as the difference of energy produced by the site-specific net energy producing facility less the energy consumed by the customer located at the same site.

Avoided Energy Cost — For the purpose of the NEBO, the Avoided Energy Cost(s) for each monthly period will be based on the Day Ahead (DA) Locational Marginal (LMP) prices for the same period from the Southwest Power Pool (SPP) Integrated Marketplace ("IM").

For billing months June through October, On-Peak Avoided Energy Cost shall be calculated every month by taking the average of the DA LMP energy settlement prices for the on-peak hours of the period. Off-Peak Avoided Energy Cost shall be calculated every month of the year by taking the average of the DA LMP energy settlement prices for the Off-Peak hours of the period. On-Peak and Off-Peak periods shall be defined as follows:

On-Peak Hours: Billing months of June through October, inclusive. The hours are 2:00p.m. to 7:00 p.m. local time, Monday through Friday.

Off-Peak Hours: All hours not defined as On-Peak hours.

Cogenerator (OAC 165:40-1-2) – A producer qualified under Section 201 of the Public Utility Regulatory Policies Act of 1978 as a cogeneration facility.

Small power producer (OAC 165:40-1-2) – A facility qualified under Section 201 of the Public Utility Regulatory Policies Act of 1978 as a small power production facility.

AVAILABILITY:

NEBO customers must take service under their applicable standard TOD rate schedule (excluding Variable Peak Pricing and Large Power and Light rate schedules, which are not eligible for this tariff) and have installed a Net Energy producing facility, and signed a Standard Electricity Purchase Agreement for Small Power and Cogeneration Facilities (PA) with the Utility. Such facilities must be located on the customer's premise and be intended primarily to offset only the energy that would have otherwise been provided by the retail electric supplier to the customer during the monthly billing period at that location.

Rates Authorized by the Oklahoma Corporation Commission

Effective	Order Number	Cause/Docket Number
February 28, 2020	708079	PUD 201900071


PUBLIC SERVICE
COMPANY OF
OKLAHOMA
SM
An AEP Company
BOUNDLESS ENERGY®