Ameren Illinois Distributed Energy Resources Interconnection Policy Public Facing Guide

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1. Definitions

Distributed Energy Resource (DER): a source of electric power that is not directly connected to a bulk power system. DER includes both generators and energy storage technologies capable of exporting active power to an EPS. An interconnection system or a supplemental DER device that is necessary for compliance with interconnection requirements is part of a DER.

Distributed Generation (DG): devices that are connected to the distribution or sub-transmission system that create electricity at or near the point at which the energy is used. Solar is commonly connected to the electric system as distributed generation.

Energy Storage System (ESS): a mechanical, electrical, or electrochemical means to store and release electrical energy, and its associated electrical inversion device and control functions. Batteries are commonly used as energy storage systems in DER systems.

Electric Power System (EPS): facilities that deliver electric power to a load.

Distribution System: in this document, distribution systems are electrical circuits with a nominal line-to-line voltage between 4kV and 15kV

Sub-transmission System: in this document, sub-transmission systems are electrical circuits with a nominal line-to-line voltage of 34.5kV or 69kV

Interconnection: the result of adding DER to the Ameren Illinois EPS.

Point of Interconnection (POI): the point at which a local EPS connects to the Ameren Illinois EPS. This is also referred to at the point of common coupling (PCC).

Ameren Service Manual (ASM): Ameren's reference guide that facilitates the planning and installation of electrical equipment on customer systems operated at or below 1000 volts in a safe and reliable manner. This guide is applicable in both Ameren Illinois and Ameren Missouri territories. Section 1500 of the ASM specifically covers DER interconnection requirements for Ameren Illinois customers.

Interconnection Agreement (IA): a contract agreed to by Ameren Illinois and the DER customer after the completion of interconnection studies. This agreement contains details about the interconnection including but not limited to DER operational requirements, required system modifications to facilitate interconnection, and associated costs for those modifications.

IEEE: the Institute of Electrical and Electronics Engineers. This organization publishes standards relevant to DER interconnection including but not limited to IEEE 1547 and IEEE P2800, standards that govern interconnection to the distribution system and sub-transmission system, respectively.

National Electrical Code (NEC): the code document that governs building and premise wiring.

National Electric Safety Code (NESC): the code document that governs electric and communication utilities.

Nameplate Capacity: the maximum rated output of a DER system under specific conditions designated by the manufacturer and usually indicated on a nameplate physically attached to the power production equipment.

Export Capacity: the maximum amount of power that a DER facility can export to the Ameren Illinois EPS. Export capacity is most often referred to with DER systems that limit their export of power to less than the nameplate capacity.

Behind the Meter (BTM) DER: distributed generation designed to operate in parallel with the Ameren Illinois EPS that is located at the premise of a load customer and shares a revenue meter with other loads.

Remotely Located Generation (RLG): distributed generation located remotely from the load/market they're intended to serve, such as independent power producers and community solar facilities.

Distribution Automation (DA): the use of modern technology on the EPS to facilitate the automated location of electrical faults and/or the automated restoration of customers experiencing an electric outage with automated switching.

Interconnection Study: the review that Ameren Illinois completes in response to a proposed customer interconnection. In this document, this term may refer to expedited reviews, supplemental reviews, feasibility studies, system impact studies, facilities studies, or any combination of these.

System Modifications: required addition or modification to the existing EPS to accommodate the interconnection of the DER facility.

Interconnection Facilities: facilities constructed specifically to safely and reliably interconnect DER to the Ameren Illinois EPS. This equipment is typically at or near the POI and includes a tap line to reach the desired POI, DER metering equipment, and Ameren Illinois-owned protective devices dedicated to the DER.

Witness Test: a set of commissioning tests for DER systems that are conducted by the Ameren Illinois to ensure the systems meet certain operational criteria prior to granting PTO. These tests ensure the safety and reliability of the Ameren Illinois EPS.

Permission to Operate (PTO): official permission granted by Ameren Illinois to operate DER in parallel of the Ameren Illinois EPS after successfully completing a witness test.

2. Introduction

2.1. Purpose and Scope

The Ameren Illinois Distributed Energy Resources Interconnection Policy Public Facing Guide is designed to familiarize Ameren Illinois customers, distributed energy resource (DER) developers, and installers with DER interconnection on the Ameren Illinois electric power system (EPS). Ameren Illinois' interconnection requirements are designed to facilitate customer-sited DER installations while simultaneously ensuring the delivery of safe and reliable power to all customers. Topics covered in this document include the interconnection application process, system requirements that must be upheld, construction and operational requirements of customer DER systems, the interconnection study process and an overview of typical EPS modifications required for interconnection projects, and the testing and commissioning of new DER sites. This document is meant to supplement, not replace, other pertinent requirements explained further in the DER Customer Responsibilities section below. More information around interconnection with Ameren Illinois can be found at the Ameren Illinois Renewable Resource Center.

2.2. DER Customer Responsibilities

In Illinois, the interconnection of DER to the distribution system is governed by Illinois Administrative Code Title 83, Part 466 "Electric Interconnection of Distributed Energy Resources Facilities" and Part 467 "Electric Interconnection of Large Distributed Energy Resources Facilities" (abbreviated to as Part 466/467 in this document). Both the electric distribution companies (EDCs) and interconnection customers in Illinois are bound to these rules. Additionally, DER customers must adhere to the terms and conditions defined in the Interconnection Agreement (IA). DER facilities found to be out of compliance with Part 466/467 and/or the IA may be subject to disconnection. DER facilities that operate at a voltage of less than 1000 V are also subject to the requirements defined in the Ameren Service Manual (ASM). Specifically, section 1500 of the ASM covers DER related topics, but all sections of the ASM may contain requirements due to the similar nature of DER interconnection to other types of electric service work.

Customer DER equipment and facilities must be designed, constructed, and maintained by the customer according to Part 466/467, IEEE Standard 1547, IEEE Standard P2800, the National Electrical Code (NEC), the National Electric Safety Code (NESC), the ASM, the requirements defined in this document, and any other applicable laws or regulations that may apply based on the site-specific properties of a DER interconnection. Ameren Illinois' interconnection requirements are primarily designed to protect Ameren Illinois employees and facilities and mitigate negative reliability and power quality impacts of DER interconnection to other Ameren Illinois customers; protection of a customer owned DER system is the sole responsibility of the DER customer.

3. DER Interconnection Process

3.1. Illinois Interconnection Incentives

There are multiple existing and potential revenue streams for customers that drive growth of DERs across Ameren Illinois service territory. The primary revenue stream for customers installing distributed generation are the renewable energy credits ("RECs") provided through the Illinois Power Agency's ("IPA") Long-Term Renewable Resource Procurement Plan ("LTRRPP"). Additionally, the federal investment tax credit significantly offsets the upfront costs associated with the development of on-site renewable generation facilities, followed closely by the smart inverter rebates. Monetization of generation output following construction is primarily provided through retail tariffs.

Residential and non-residential customers who own or operate a renewably fueled generator of 5,000 kW capacity or less and located at their point of electric service may qualify for net metering. Net metering customers can apply revenues from renewable generation towards supply costs from Ameren Illinois. Additionally, smaller Ameren Illinois customers (customers with a peak yearly demand of less than 150 kW) may carry excess generation credits into future billing periods in accordance with the tariff governing net metering.

DER customers can also apply to become a Qualifying Facility (QF) and receive compensation for all of a qualifying generator's output based on Midwest wholesale electric market prices. QFs are small-scale generators of commercial energy that meet Federal Energy Regulatory Commission's (FERC) requirements for ownership, size, and efficiency to qualify as non-utility generation units, and are limited to 20 MW. Because they do not directly serve utility customers, QFs are exempt from many federal and state regulatory requirements, including federal and state rate regulation and oversight by the Securities and Exchange Commission. QFs are not exempt from environmental regulations.

3.2. Applying for Interconnection:

All Interconnection application forms can be located here at the Ameren Illinois Renewables web page. Additionally, all applications can be submitted electronically via PowerClerk, Ameren Illinois' application portal. Interconnection in Illinois is broken down into several different levels depending on the size of the proposed DER system and the type of EPS used for interconnection. There is also a pre-application process that can be used to gather information about the existing facilities at a given proposed POI. While the pre-application process is valid for all levels of interconnection, it is not required, and is often bypassed for smaller behind the meter (BTM) facilities that do not have the flexibility of choosing their POI. The application levels and fees as defined in Part 466/467 are summarized in Table 1 below for reference.

Table 1. Application Level Criteria and Fees

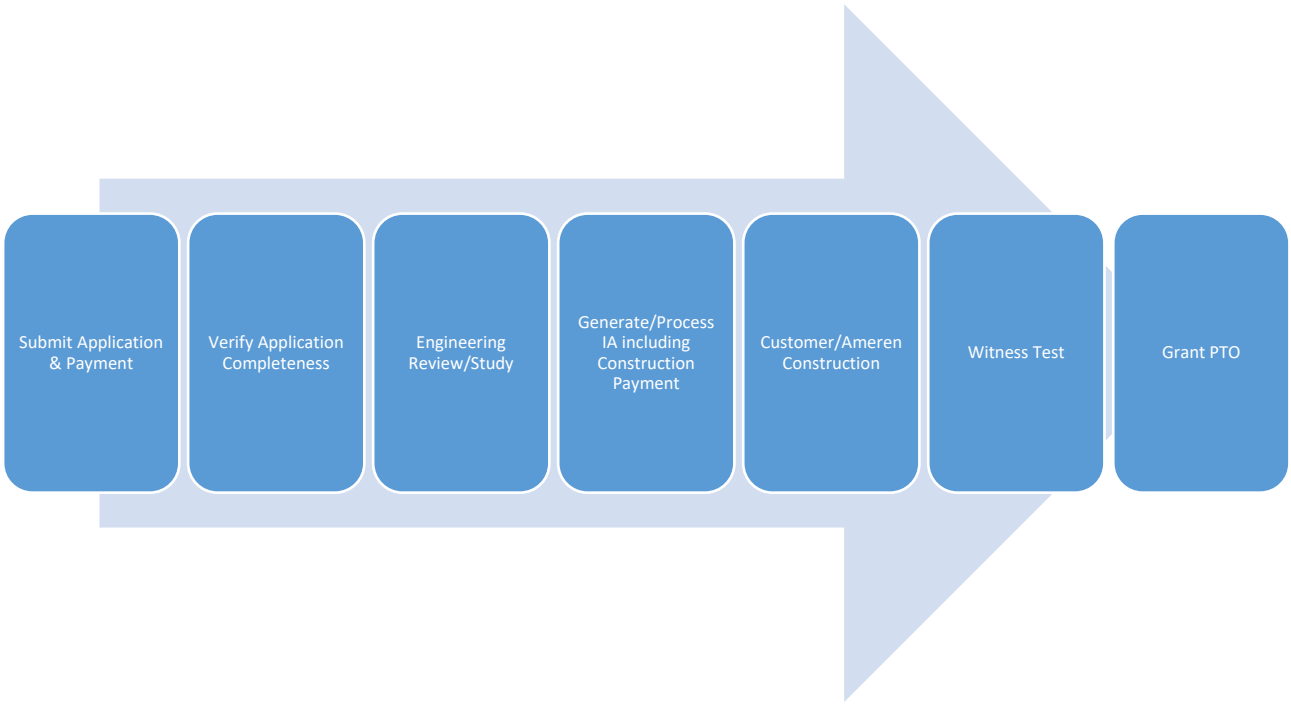
Application Level	System Requirements	Fee to Apply
Pre-Application	No system requirements, but is typically designed for projects larger than Level 1. An alternative to the pre-application process would be to utilize Ameren Illinois' Hosting Capacity Maps, which are available to the public at no cost. They can be found here.	$300
Level 1	DER export capacity of 25 kW or less, nameplate capacity of 50 kW or less (likely connected behind the meter at a residence or small business)	$50
Level 2	DER is connected to a distribution or sub-transmission line (69 kV or less) and has a nameplate capacity up to 5 MW depending on interconnection voltage	$100 plus $1 per kVA nameplate capacity*
Level 3	DER connected to a networked system and does not export power, nameplate capacity of 50 kW or less OR connected to radial distribution with nameplate under 10 MVA	$500 plus $2 per kVA nameplate capacity
Level 4	DER is 10 MVA or less and does not qualify for one of the lower levels of application	$1,000 plus $2.00 per kVA nameplate capacity (part of this is refundable)
Part 467 Interconnection	DER is larger than 10 MVA	$5,000 plus $10,000 study fee subject to true-up

*Level 2 applications that fail the expedited review are typically given the opportunity to continue with a supplemental Level 2 review that requires a $1,500 review fee

3.3. Interconnection Process Overview

The interconnection process begins when a customer or developer submits an interconnection application. The application must include information about the DER facility including the fuel source, nameplate capacity, export capacity, and equipment being used. Level 2 and above interconnections must also include a site plan and electrical diagram (one-line) in the application. When an applicant is not currently an Ameren Illinois customer at the proposed site, the applicant shall provide, at the time of the interconnection request, proof of the applicant's legal right to control the site, evidenced by the applicant's name on a property tax bill, deed, lease agreement, option agreement, another legally binding contract, or a signed letter from the owner of the property. Applications are reviewed based on the processes and procedures defined in Part 466/467 to ensure the delivery of safe and reliable power to all customers and Ameren's co-workers. If the interconnection study identifies system modifications to the Ameren Illinois EPS that are required for interconnection to proceed, the applicant will be provided with an estimated cost for modifications. Ameren Illinois will then generate an Interconnection Agreement (IA) that includes any necessary system modifications and DER customer charges. When any charges are paid and both parties sign the IA the project is considered to be moving forward and the interconnection queue progresses accordingly. The DER customer constructs their facilities, Ameren Illinois constructs any required facilities, and when both parties are ready a witness

test is scheduled. After the DER facility successfully passes the witness testing, permission to operate (PTO) is granted to the DER customer. The flow chart on the next page gives an illustration of the interconnection process.



3.4. Energy Storage Systems

Applications for energy storage system (ESS) interconnections follow the same process as other DER interconnections. An "ESS Supplemental Form" must be completed for such applications and can be accessed via PowerClerk by indicating in an application that ESS interconnection is desired. For ESS-only applications, the application level and associated fees is based on the AC nameplate size of the inverter following the same guidelines from Table 1 above. Each ESS application will fall under one of the six categories of ESS charging and export listed in Table 2 below.

Table 2. ESS Charging and Export Configurations

Description	Export Compensation	Applicable Tariff	Hardware And Controls Required
Type 1-NEx: ESS can only charge from appropriate source , no ESS export allowed	All export netted through NM or gross output compensated thru QF	Rider NM or QF	Power Control System (PCS)* (No Exchange Mode)
Type 1-Ex: ESS can only charge from appropriate source, ESS export allowed	All export netted through NM or gross output compensated thru QF	Rider NM or QF	PCS (Export Only Mode) or DC Coupled with 2 Quadrant Inverter (Generation Only)
Type 2-NEx: ESS can charge from appropriate source and Grid, no ESS export allowed	All export netted through NM or gross output compensated thru QF	Rider NM or QF	PCS (Import Only Mode)
Type 2-Ex: ESS can charge from appropriate source and Grid, ESS export allowed	Only energy-sourced kWHr receive export netting or gross output compensated thru QF	Rider NM or QF	Separate energy-source and ESS meters
Type 3-NEx: ESS can only charge from Grid, no ESS export allowed	NA	Standard rates	PCS (Import Only Mode) or Relaying
Type 3-Ex: ESS can only charge from Grid, ESS exports allowed	MISO or NA	Standard rates	No Requirement

*** Power Control System (PCS)**: Depending on the 'description,' PCS equipment can be certified by UL 1741 for the following modes:

- *Export Only Mode* – ESS may export to grid during discharging, but shall not import from grid for charging purposes
- *Import Only Mode* – ESS may import from grid during charging, but shall not export to the grid for discharging purposes
- *Unrestricted Mode* – ESS may import from grid during charging and may export to grid for discharging purposes
- *NO Exchange Mode* – ESS shall not exchange power with grid for charging or discharging purposes

3.5. Interconnection Queue Process

DER interconnection applications are studied following a queue process to ensure fairness and consistency when considering system impacts, balancing a holistic view of the electric distribution system with expedience. Level 1 and smaller Level 2 applications are queued based on the time the application is submitted and the circuit that will serve the proposed interconnection. Larger distribution voltage projects that have a higher potential to impact the sub-transmission system are reviewed by an engineer to screen for potential issues due to aggregate impacts of the proposed DER with other proposed DER on that sub-transmission circuit. If no such issues are observed during the initial screening, the project proceeds into the distribution circuit level queue akin to the smaller applications. If the project has the potential to cause aggregate impacts, the application would then be placed in the appropriate queue position taking into consideration prior pending applications on the distribution and sub-transmission systems.

4. System Requirements and Limits

Ameren Illinois' interconnection study process is designed to facilitate the interconnection of customer owned DER while maintaining the safety, reliability, and affordability of the EPS. The following criteria and considerations determine if a proposed interconnection can occur without system modifications, or the scope of any required system modifications and associated customer charges.

4.1. Thermal Loading Limits: DER interconnections must not cause Ameren Illinois' conductors or devices to exceed 90 percent of their thermal ratings.

4.2. Ameren Illinois' Steady State Voltage Requirements: Ameren Illinois is required by the ICC to maintain a delivery service voltage for residential customers of 120 volts ± 7 volts (120V base). For non-residential customers, Ameren Illinois must maintain a delivery service voltage within 10% of the nominal service voltage. DER interconnections onto the Ameren Illinois distribution system must not cause steady state voltage to deviate from these requirements. For more information on Ameren Illinois's service voltage regulations, please see ICC Administrative Code Title 83: Chapter 1 Section 410.300 Voltage Regulation.

4.3. Rapid Voltage Change (RVC) Limits: In accordance with the IEEE 1547 Rapid Voltage Change Criteria, Ameren Illinois requires that the maximum voltage change at any point on the distribution system due to the DER tripping off-line must be less than 3% of the nominal voltage. Additionally, the maximum voltage change due to the DER instantly ceasing to generate at any voltage regulation device must be less than 2% of the nominal voltage to prevent excessive operations of the device.

4.4. Voltage Variation Limits: These limits apply to sub-transmission interconnection studies.

4.4.1. Frequent Voltage Variation: Voltage variation on the EPS caused by the intermittent output of solar- and wind-based DER shall not exceed 1.5% after the DER output has dropped from 100% of the AC megawatt export limit to 50%. This is to limit the excessive operation of voltage regulating equipment, resulting in loss of life and premature failure.

4.4.2. Infrequent Voltage Variation: Voltage variation on the EPS caused by switching, unplanned tripping, or maintenance of a DER shall be limited to 10%.

4.5. Stability Analysis Requirements: These requirements apply to sub-transmission interconnection studies. A short-circuit ratio (SCR) metric is applied to determine the need for a dynamic analysis. The SCR at the inverter terminals of the DER must be greater than 3 during both normal and contingency system conditions. When the SCR is below the limit, the developer shall provide Ameren Illinois proof (1) from the inverter manufacturer that the inverters can operate at the lowest observed SCR value and (2) that the DER remains stable under all system conditions. When the SCR is below the limit and other electrically close inverter-based resources are present, then Ameren Illinois requires an electromagnetic transient (EMT) analysis to determine impacts on the EPS. All requested forms of proof and additional studies must be submitted and completed before continuing the interconnection study process.

4.6. Single-Phase DER Interconnection Limits:

Ameren Illinois developed several limits regarding single phase DER systems based on the Admin Code Part 466 screen limiting imbalance on a single phase 120/240 V service (specifically, this limit is presented in Parts 466.90(a)(4) and 466.100(a)(8)). These limits are designed to maintain system phase balancing while allowing smaller applications, which often do not have three-phase equipment available, to proceed with interconnection. Installations behind a three-phase meter should be balanced, three-phase generators whenever possible to preserve phase balancing. In all cases, single phase DER interconnections are limited to 100kVA to prevent phase imbalance. Additional limits around single phase DER interconnections may apply depending on the existing service voltage for BTM DER installations.

4.7. Supervisory Control and Data Acquisition (SCADA) Requirements

4.7.1. For Behind the Meter installations larger than 200 kW AC, a SCADA-capable meter shall be installed to allow Ameren to monitor the output of the generation. This meter will connect to Ameren approved, customer-installed PT's and CT's. The assembled meter cabinet will be provided to the customer to be mounted and connected to their instruments. The meter will be installed and programmed during the witness test by Ameren personnel.

4.7.2. In some cases, BTM DER installations with an export capacity of 1MW or greater (including contribution from both generation and energy storage) will require a SCADA-capable electronic recloser upstream of the point of delivery when engineering judgement deems the device necessary. This protective device is intended to prevent EPS issues when a customer installs large generation or energy storage such that the BTM DER could impact the system in a similar manner to remotely located generation (RLG) DER.

4.7.3. For installations interconnecting at distribution voltage or greater, a SCADA-capable recloser shall be installed at the POI. This device will be owned and installed by Ameren to monitor the output of the generation and disconnect the generation in the event of an emergency.

4.7.4. For any voltage regulation device upstream of a generator that can experience reverse power flow due to the generator, a SCADA communications package will be required to monitor system voltage, current, active and reactive power and ensure proper regulator operation. This will be installed by Ameren and paid for by the generation owner that creates the reverse power flow condition.

4.8. Direct Transfer Trip (DTT)

Direct Transfer Trip is a high-speed communication/relay function usually initiated by a protective relay device upstream of generation. It is intended to rapidly remove generation for EPS faults so that it does not aggravate the situation or cause any unexpected impacts (overvoltage, islanding, etc.) to Ameren Illinois customers. DTT is also required to properly isolate the generation if the circuit or line has an automated Distribution Automation scheme, in order to ensure proper operation of the automatic transferring of load to alternative sources.

4.8.1. For 34.5kV and 69kV connections, Direct Transfer Trip (DTT) to either customer equipment, Ameren Illinois owned equipment, or a combination of both, may be required for the following conditions:

- Generation has ability to cause reverse power flow onto the transmission system
- An unintentional islanding condition could be formed with a mix of synchronous, asynchronous, and/or inverter-based generation
- Aggregate generation capacity exceeds two-thirds of the minimum line loading
- Generation facility capacity is greater than 10 MVA

Ameren Illinois typically requires fiber optic cabling as the communications path for direct transfer trip schemes. Other methods may be considered, but it will depend upon multiple factors specific to the site including geographic location, existing facilities and equipment, and the local system configuration of the circuit.

4.8.2. For 15kV and below three-phase primary interconnections, DTT shall be required for DER that is able to reverse power flow at the substation protective device. This will be facilitated by enabling communication between the protective device at the POI and the other protective devices on the circuit upstream of the POI.

5. Customer Construction Requirements

5.1. The customer shall install and maintain ownership of all required interconnection facilities on the customer side of the POI. For RLG facilities, Ameren Illinois will install and maintain ownership of all required interconnection facilities on the utility side of the POI and the POI will mark the point of change of ownership of facilities. BTM facilities will often have customer owned equipment and conductors on the utility side of the POI.

5.2. All inverter-based generation shall utilize inverters that are IEEE 1547 and UL 1741 SA compliant. All inverter-based DER must be capable of and set to disconnect for a loss of utility phase within two seconds. Inverter-based DER must also wait 300 seconds after the restoration of full grid voltage to begin to reconnect, and reconnect at a rate of no greater than 2% of nameplate capacity per second or less. For inverters incapable of a smooth, linear ramp function, a step function may be used such that the average increase in generation is less than or equal to 2% per second, provided that each step is no more than 20% of the DER's nameplate capacity spread across equal intervals over the same period of time (no less than 50 seconds). Additionally, generation utilizing a smart inverter must meet the Ameren Illinois Smart Inverter Specifications to be eligible to receive a Distributed Generation Rebate. The rebate application can be found here. Ameren reserves the right to verify these settings to ensure compliance.

5.3. A generator disconnect switch must be installed by the customer that can safely isolate all parallel generation or energy storage (DG or ESS) from the distribution. This switch must be the first device on the generation side of the POI and must comply with the guidance provided in the Generation Customer Checklist provided during the application process. A separate disconnect switch for an ESS may be required for systems that incorporate both DG and ESS. This switch must be lockable, readily accessible to utility, gang operated (if three-phase), and have a visible indicator of the switch's position. If the voltage at the POI is greater than 1000V, the switch must also have a visible air gap when in the open position. This switch is required per the 2020 NEC (sections 480.7(B), 690.12(C), 694.22(C)(1), and 706.15(A)) to allow utility personnel, the customer, or emergency first responders to isolate DER facilities for maintenance, reliability, or safety concerns. In cases where the generator disconnect switch is locked closed or locked behind a gate, a lock box will be provided by Ameren Illinois and installed by the customer at an accessible location to Ameren Illinois personnel. The lock box will contain a key to access and operate the generator disconnect switch and will be locked closed with an Ameren Illinois lock.

5.4. Ameren Illinois requires a fault isolating device at the generation connection to ensure the reliability and integrity of the EPS. For RLG, the customer is required to install a protective device at the tap or within 500 feet of the tap. The customer's main protective device shall be owned by the customer, and the customer is responsible for maintenance and replacement of the protective device. For RLG interconnections at distribution voltage (4.16kV, 12.47kV, 13.2kV) Ameren Illinois highly recommends that the protective device be an electronically controlled recloser or breaker. For 34kV and above interconnections, the protective device is **required** to be an electronically controlled recloser or breaker. When installed, this device should be programmed to sense voltage imbalance and loss of phase to disconnect the DER

accordingly. The protective device must be capable of detecting faults on the customer's system and on the Ameren Illinois system and must separate the customer generation from the Ameren Illinois system either directly or through an auxiliary device such as a circuit breaker. The protective device should coordinate with the Ameren Illinois protection equipment and be capable of interrupting the available fault current at the device location. The customer is responsible for protecting the customer generation equipment in such a manner that faults or other disturbances on the Ameren Illinois system do not cause damage to the customer generation.

5.5. The customer shall provide lightning protection through either a static wire or lightning arresters for any line section which would cause an outage for Ameren Illinois facilities.

5.6. For 69 kV and 34.5 kV generation interconnections, the customer interconnection transformer must have a delta connected winding on the Ameren Illinois side. 59N protective schemes are also required to sense and clear ground faults on sub-transmission feeders that may be fed from the generation customer.

5.7. For 5 kV and 15 kV class distribution systems, Ameren Illinois circuits most often employ 4-wire configurations with multiple neutral grounding connections. To mitigate potential ground fault overvoltage (GFOV) conditions, new RLG customer interconnection transformers may be required to act as a ground source, as determined by Ameren Illinois during the interconnection study process.

RLG systems required to act as ground sources should be designed for a coefficient of grounding of 0.8 or less without the consideration of connected loads for ground faults on the Ameren Illinois feeder when temporarily islanded with the RLG. The interconnection transformer configuration may be grounded-wye on the high voltage side and grounded-wye on the low voltage side with a supplemental grounding transformer, or grounded-wye with a neutral impedance on the high voltage side and delta on the low voltage side.

Three-phase, three-legged, core form transformers should not be used because internal magnetic coupling can disguise the loss of an incoming phase and prevent the proper shut-down of inverter-connected generation. This type of core form is more prone to ferro-resonance during open phase conditions and grounded-wye / grounded-wye winding configurations typically produce excessive tank wall heating during ground faults due to zero-sequence currents circulating in the tank.

5.8. For interconnections at service voltage (<1000V) that require the use of a customer-installed transformer, the DER customer must carefully evaluate the operational characteristics of the system such that additional transformation beyond the POI does not prevent the DER system from being able to detect a loss of phase condition (applicable for three-phase interconnections). More information on transformer selection can be found in the Ameren Service Manual, Section 900.10.

5.9. Consistent with Section 2.F of the Ameren Illinois Standards and Qualifications for Electric Service filed with the Illinois Commerce Commission, the customer is responsible for obtaining all right of way and property needed to build and maintain the facilities required to make the

connection to the Ameren system, including all necessary environmental, zoning, and/or special use permits. This includes building and maintaining a road suitable for accessing the Ameren-owned meter pole for operations, maintenance, testing, and inspection. Easements obtained by the customer from the POI to the point of ownership change shall be transferred to Ameren Illinois. The customer shall grant Ameren Illinois all necessary easements for Ameren Illinois facilities on customer property.

6. Standards for Evaluating Interconnection Requests and Methodology for Determining the Scope of System Modifications and Cost Estimates

To ensure that the system requirements outlined above are maintained, Ameren Illinois screens all potential DER interconnections using the interconnection study procedures mandated by ICC Administrative Code Part 466 and 467 (specifically, subparts 466.90, 466.100, 466.110, 466.120, and 467.70 define the various review processes). Computer-based system models are used to assist with this process. These studies are performed in the order in which the applications are received, and any subsequent applications that submitted for the same circuit are placed in a queue until it has been determined if the first application will proceed with interconnection, based on the results of the study. This allows Ameren Illinois to update each subsequent study with the impacts of the DER interconnecting ahead in queue. This process is standardized to ensure that all applications are reviewed and studied consistently throughout the entire Ameren Illinois territory.

Co-located three-phase RLG interconnections are sites that are owned by the same customer, are sited on adjacent parcels of land, and are back-to-back in queue. These sites will be studied simultaneously (in most cases). If it is possible to protect two or more co-located sites with the same protective device while maintaining coordination with other protective devices on the circuit, then the interconnection customer shall be presented with two options. The first would utilize a single protective device for all co-located sites, which would minimize the interconnection cost assessed to the customer. The second option would be to install an additional device at each metering point, which would come at the customer's expense but reduce the likelihood that all the generation is disconnected during a system disturbance. The standard option would be the use of the shared protective device; additional protective devices should only be installed at customer request or in cases where there is a substantial risk to utilizing the single protective device.

The results of interconnection studies are used to determine which, if any, system modifications will be required to interconnect the proposed DER without causing negative system impacts. For sub-transmission voltage interconnections, this may include system modifications required to serve the proposed DER during N-1 system contingencies, consistent with other Ameren Illinois sub-transmission planning processes. Akin to system upgrades required for the connection of new load customers, the applicant must bear the cost of these modifications, including installation of any required Ameren Illinois facilities at the POI, if they would like to proceed with interconnection upon receiving the results of the interconnection study. System modifications required for interconnection must be completed prior to interconnection of a customer's DER system. Ameren Illinois strives to meet customer requested deadlines and in-service dates, but project completion is ultimately subject to material lead times which can be affected by shortages and other factors. A list of most typical examples of these modifications (commonly referred to as interconnection costs) and a high-level estimated cost of each modification is listed below. Please note that location and equipment specific conditions may cause actual cost estimates to deviate from the estimated costs below, and that these values are provided for informational purposes only.

6.1. Any voltage regulators that will experience reverse power flow due to the proposed DER must have controllers able to detect and correctly operate with co-generation. SCADA

communications must be added to these regulators as well to ensure voltage limits are maintained. This typically costs between $15,000 and $25,000 per regulator bank.

6.2. Any substation load tap changer (LTC) that experiences reverse power flow due to the proposed DER must have controllers able to detect and correctly operate with co-generation. SCADA must be added to these LTCs as well to ensure voltage limits are maintained. This typically costs between $40,000 and $50,000 per LTC.

6.3. Any hydraulically controlled recloser that will experience reverse power flow due to the proposed DER must be replaced with an electronically controlled recloser. This is to ensure a recloser does not open and reclose before an inverter is able to detect a loss of source and cease generation, which could cause the parallel sources to be out of phase. Typical costs for this work are between $60,000 and $100,000 for a pole-mounted line recloser. If the hydraulic recloser is in a substation, typical replacement cost would be between $150,000 and $300,000.

6.4. The ratings of surge arresters on the high side of delta connected distribution substation transformers may need to be evaluated for reverse power flow through a high-side delta connection if the transformer could experience reverse flow under light loading conditions and is protected by a circuit switcher or breaker (three phase tripping device) or if the aggregate DER connected to the sub-transmission line would be large enough to support the minimum loading of the line if the sub-transmission line becomes isolated from its source. If one of these conditions exists for a proposed DER, the surge arresters must be replaced with arresters that have a higher voltage rating. Typical costs for this work range between $40,000 and $50,000 if a mobile substation is not needed to prevent an outage to customers during construction. If use of a mobile substation is required, an **additional** estimated $60,000 to $75,000 to set the mobile substation would be added to the estimated costs above.

6.5. When a proposed DER exceeds RVC criteria, some or all of the line conductor between the proposed DER and the substation will need to be replaced with larger conductor to reduce line impedance, which in turn reduces RVC. Line reconductor costs can vary widely due to geographic diversity, population density, existing system condition, and a litany of other circuit-specific factors. Distribution system (<15kV) line reconductoring generally costs anywhere between $150,000 per mile and $400,000 per mile but could exceed that range in some cases. Sub-transmission system (34kV and 69kV) line reconductoring generally costs anywhere between $250,000 and $1,000,000 per mile depending on several conditions including line condition, geographic constraints, line voltage, and the potential of multiple circuits sharing the same pole line adding complexity.

6.6. Similar in cost to a line reconductor, a line extension may be required to serve a proposed DER that is not located at an existing service point. Most DER-related line extensions will be three-phase line extensions, with an estimated extension cost range of $150,000 to $300,000 per mile for 15kV and below circuits and $750,000 to $1,000,000 per mile for 34.5kV and 69kV circuits.

6.7. Service transformer replacement is required in cases where the output of a proposed DER exceeds the nameplate rating of the existing service transformer. The cost for replacement varies greatly and depends on the required size of the new transformer and whether the transformer is pole mounted or pad mounted.

6.8. For DER installations on 15kV and below distribution lines where DTT functionality is required, a communications device may be required to be added to the substation recloser, with an approximate cost between $20,000 and $40,000. In cases where the existing substation protective device is incompatible with the communications device, the substation protective device must be replaced as well to facilitate this requirement. For DER installation at voltages above 15 kV, a communications device may be required at the substation breaker with an approximate cost of $25,000 or greater.

6.9. As determined by Ameren Illinois System Protection Engineering, in some cases hot-bus-dead-line reclosing and synchronous check reclosing may be required to be added at substations upstream of customer owned DER. This may require a voltage transformer to be added at the line-side substation terminal at a cost of $110,000 or greater for sub-transmission circuits. The cost to enable hot-bus-dead-line reclosing and synchronous check reclosing on distribution circuits will depend on the existing protective device but will likely not exceed $110,000.

6.10. Additional system work and associated costs not covered in this document may be necessary to safely and reliably connect a new DER system.

6.11. <u>Interconnection Facilities:</u>

6.11.1. For RLG DER interconnected on a distribution voltage circuit, the following equipment will be required at the POI: three-phase tap, electronically controlled SCADA-capable recloser, primary metering, and the associated poles and conductor to facilitate installation. Estimated interconnection costs for this work range between $95,000 and $120,000.

6.11.2. For RLG DER greater than 10 MW (singular or co-located) and interconnected to a networked sub-transmission system, the following Ameren-owned equipment will be required at the POI: (1) either a new switching station or line extension from a new terminal position at an existing Ameren substation; (2) primary metering; (3) the associated poles and conductor to facilitate installation. Estimated interconnection costs for a breaker station range between $4,000,000 and $6,000,000 and required land space is 2-3 acres. The Customer is responsible for purchasing the required land and transferring ownership to Ameren Illinois. New terminal positions range between $500,000 and $750,000.

6.11.3. For RLG DER interconnected to a radial-looped sub-transmission system or less than 10 MW (singular or co-located) and interconnected to a networked sub-transmission system, the following Ameren-owned equipment will be required at the POI: (1) three-phase line tap; (2) main line load break switch on both sides of the tap; (3) electronically controlled SCADA-capable recloser; (4) primary metering; (5) associated poles and conductor to facilitate installation. Estimated interconnection costs for this work range from $300,000 to $500,000.

6.11.4. For BTM DER with an AC nameplate rating of 200kW, SCADA-capable generation metering is required. The SCADA metering package is provided by Ameren Illinois to the customer at the customer's expense. The SCADA-capable meter will connect to the

customer's instruments and be set up by Ameren Illinois personnel during the witness test. The SCADA metering package and installation generally costs between $7,000 and $20,000.

6.11.5. For renewable generation systems combined with energy storage, separate metering may be required for the energy storage in cases where it is either AC coupled with the generation, or DC coupled with the generation using a bi-directional inverter.

7. Testing and Commissioning

7.1. Purpose

All DER interconnections to the Ameren Illinois EPS, including Level 1 facilities, are witness tested to ensure safe and reliable system operation. A witness test consists of simulating utility system outages to ensure that parallel generation responds accordingly and does not create an unintentional island. During the witness test, Ameren Illinois personnel also verifies that the DER system installed by the customer aligns with the system proposed during the application process. The witness test is scheduled at the time that the DER customer submits documentation informing Ameren Illinois that their construction is complete. While larger systems (Level 2 and above) typically require scheduling a test with multiple representatives from Ameren Illinois and the DER customer present, Level 1 witness tests are completed within 15 business days as a technician becomes available to complete the test.

Witness testing is a critical step in ensuring that DER is connected to the system safely. In our experience, at all levels of interconnection – regardless of whether the installer is a local firm or a national developer – the tests have prevented unsafe conditions from being created by DER interconnection projects. Not only is an unintentional island dangerous for customers and equipment served temporarily by the island, but during a grid outage it may create a risk of contact with energized equipment at ground level for utility personnel as well as the general public. There are also site-specific situations that must be reviewed on-site after construction is complete that cannot be addressed simply by performing an interconnection study or through the use of a screening question. For example, use of step-up or step-down transformers between POI and the inverter terminals can cause a certified inverter to fail to detect a grid outage and cease power output, which can only be identified during an on-site witness test. Once all test conditions are satisfied and any issues are resolved, the DER system is issued permission to operate ("PTO").

In addition to the DER system performance testing detailed above, Ameren Illinois may, but is not required to, identify wiring and electric equipment practices that may raise safety and/or reliability concerns for Ameren and/or the DER customer on the customer side of the point of delivery. Ameren Illinois reserved the right to identify and require the correction of such concerns prior to connection of service. Please see the Ameren Illinois Witness Test Criteria and Ameren Service Manual for more information.

7.2. Permission to Operate

If all test conditions are successfully met during the on-site witness test and a power quality meter was not used during the test, then the customer will receive a written conditional permission to operate. An official and permanent PTO will be issued by Ameren Illinois' DER Application Team, typically within two business days of the witness test. If a power quality meter is used during the test, the recorded data must be reviewed by Ameren Illinois engineering before a full permission to operate can be awarded. At Ameren Illinois' sole discretion, the generation may remain connected and generating while the data is reviewed in the form of a conditional PTO. Otherwise, the generator disconnect switch must be locked open until a permanent PTO is issued by the DER Application team. Witness test results will be provided to the customer within 48 hours of the witness test.

If on-site test conditions are not met during the witness test, or if the power quality meter data raises an issue with the operation of the generator, another witness test will be scheduled within 30 business

days to allow the customer time to resolve any problems. The 30 business days may be extended upon the mutual agreement of Ameren Illinois and the customer, so long as no other queued DER installations are affected by the extension