INTERCONNECTION GUIDEBOOK

FOR DEVELOPERS OF SMALL SCALE RENEWABLE ENERGY GENERATION SYSTEMS

Energy Trust of Oregon

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INTRODUCTION

Interconnection of a distributed power resource to the utility grid is one of the aspects of project development that can be new to small scale renewable project developers. It is often easy to underestimate the time, cost, and complexity of this process. Although new rules for small generator interconnection in Oregon were completed in 2009, which has helped to make interconnection more transparent and understandable for developers, there are many distinct steps in the process of interconnection, and it can be challenging to envision the entire process and understand the practical considerations involved.

Numerous documents listing the rules and procedures of interconnection exist but they lack explanation and practical tips. This guidebook is intended to help those new to the process navigate through the complexities. It explains the rules, regulations, and procedures associated with the interconnection of small renewable energy generation projects producing less than twenty megawatts (20MW) of power to the utility grid.

Although comprehensive, this guide is not a final authority. Rules and regulations are subject to change so please double-check your information according to the geographical location and jurisdiction in which you will employ your project.

What is Interconnection?

While renewable energy systems are capable of powering houses and businesses without any connection to the electricity grid, also known as running "off-grid", a grid-connection offers the system owner significant benefits.

1. Any excess electricity you produce beyond what you need is directly fed back into the grid. Likewise, if your system is not producing enough to meet your energy needs, the electricity from the grid is still there for you, thus eliminating the need for electricity storage devices like batteries.
2. If you plan to produce power beyond your needs it is possible to generate revenue from power sales.

In either case, connecting your system safely to the grid in a coordinated manner with the utility is critical. The process of interconnection is designed to ensure that systems are safely interconnected according to established rules and standards and is another piece to be carefully incorporated into the project development cycle.

From the time when you first apply to your utility for interconnection to when you have a fully interconnected system can take up to 18—24 months or longer (although shorter timelines are common with smaller projects, particularly net metered projects). Besides having the physical work of installing the necessary connection equipment completed, a significant amount of the time may be spent in studying how the characteristics of the proposed system will impact the grid at its point of interconnection (POI) and surrounding area and in defining the necessary equipment. The grid was designed to provide a one way delivery of electricity from central power plant to home or business. Interconnection of a distributed resource is asking the system to act in a different way. To help guide a project by project grid system upgrade, there are technical standards and industry rules nested within the interconnection process that must be followed to ensure the continuation of a safe, reliable grid system.

Here's a very general overview of the process and the types of questions that will arise along the way. Starting early is highly recommended. Up front planning and preparation can go a long way.

PROJECT DEFINITION

- Project size (MW) and variability around that amount?
- What do I want to connect? (generator type (induction, synchronous)/model/size)
- Where do I want to connect? (determine POI)

UTILITY APPLICATION

- Which utility do I interconnect with? (location dependent)
- What rules apply to my project? (AR 521 or FERC)
- Am I planning to use all the generation or export power to the grid?
- What type of interconnection do I have? (Which Tier, Level, or other category)

< 1 MONTH: SCOPING

- Can I communicate the technical details of my project to the utility?
- What are the options for interconnection? (other than POIs?)
- Does my design include basic connection equipment? (transformers and protection equipment)

~ 12 MONTHS: REVIEW/STUDY

- Do all three study levels apply to my project? (feasibility, system, facility)
- How does my design interact with the utility system?
- Can I offer alternatives to estimates?

< 1 MONTH: INTERCONNECTION AGREEMENT

- When will interconnection be complete?
- Do I need permits for the work to be done?

6–9 MONTHS: INTERCONNECTION TO GRID

- Can I plan to hire 3rd party contractors to do some of the work? (what pieces)
- Who pays for what and what do I own, what does the utility own and maintain?

The first step to a successful grid interconnection is research. Learn all you can about your project, intended POI interconnection and what your role and responsibilities will be. An early call to your utility can point you in the right directions towards finding this information.

If you're unfamiliar with how the electric grid works today the next section contains an overview along with history and description of roles. To skip to the information about interconnection please see the **Interconnection Process** section.

OVERVIEW OF THE ELECTRIC GRID

Electricity moves from generation facilities to customers, such as homes and businesses, over the electric grid. In order to clearly understand the interconnection process it is important to understand the components of the electric grid and how the grid functions.

Generation, Transmission, and Distribution

The electric power industry is arranged into three separate functional units: generation, transmission, and distribution. Understanding them is critical in planning to interconnect any electricity generation system to the grid.

GENERATION

Generation is the act of producing electric energy from a resource. When a turbine converts wind or moving water to electricity, or a photovoltaic panel converts solar rays to electricity, that turbine or panel is a generation facility. The large power plants, often operated by electric utilities, generate huge amounts of electricity, usually hundreds to thousands of megawatts (MW).

Non-utility entities, including landowners such as farmers, ranchers, and other independent companies, can generate electricity and sell it.

TRANSMISSION

Transmission is the process of moving bulk amounts of electricity over high-voltage lines. (115-765 kV)

Once generated, electricity needs to be transported to consumers, sometimes over great distances, by interconnecting the generator to the existing, complex system of power lines and associated equipment that move electricity: the grid.

DISTRIBUTION

High-voltage transmission lines transmit bulk power to substations, where the electricity is converted to a lower voltage. That low-voltage electricity is then distributed to homes and businesses on separate, lower-voltage distribution lines (generally ≤ 35 kV).

Historically, most electricity has been produced at large facilities, such as coal, hydroelectric, or nuclear power plants. These facilities produce vast amounts of power and require a large grid capacity to transport that power to customers.

By contrast, smaller generators can connect directly to low-voltage distribution lines; electricity is distributed locally, without having to be transferred to higher voltage transmission lines. This is referred to as distributed generation.

Putting several small generation facilities on the distribution side of a substation eliminates the need to convert electricity to higher voltage for transmission then back down to lower voltage for distribution; ideally this results in a more reliable and efficient electric system.

Once a new facility is connected to the electric system, its electricity is identical to other electricity; when the new electricity is fed into the grid, that specific pool of electricity cannot be directed to a specific end-user in a specific location. Newly generated electricity instantly joins all other electrons moving along the path of least resistance to the nearest customer who makes a demand for that electricity.

History of the United States Grid

The United States' electric grid began as a series of small, relatively isolated electric systems constructed by local utilities to transmit locally produced electricity to their own customers.

Over time, utilities realized that interconnecting these discrete but neighboring systems would improve reliability, because electricity could be transferred locally or regionally and utilities could share their energy to meet collective demands. Therefore, today's interconnected grid was not designed to transmit large quantities of electricity over vast distances.

The United States' grid is currently a combination of several utility-owned, interlocking electric systems. Improvements have evolved in a piecemeal approach. As specific needs emerged, utilities and independent power producers increased capacity and improved reliability.

NEED FOR FLEXIBILITY

Today, the need for increased and more flexible transmission capacity is regularly cited as the single biggest obstacle to developing new electric generation sources, both traditional and renewable. This is particularly true for renewable generation, which requires siting in specific locations to utilize the renewable resource, which may be located long distances from end-use customers.

Installing distributed renewable generation closer to load centers decreases the need for transmission system upgrades both costly to construct and requiring a long time to plan and permit.

MANAGEMENT AND COOPERATION

The grid has no capacity for electricity storage. To ensure constant, adequate and secure electric service, generation into and consumption out of the grid must be constantly monitored and balanced.

Traditional power plants control output by varying the amount of fossil fuels being burned. Many renewable energy projects generate electricity from intermittent and variable resources, making it difficult to manage output. Therefore, some projects may be shut down or curtailed if there are insufficient balancing reserves.

The grid operator incurs additional operating costs to maintain adequate balancing reserves as more variable generation is added to the system. These costs may be passed on to the generation facility owner/operator in the form of a renewable energy integration charge.

Electric industry oversight and regulation are necessary and can be very complex. Various utilities with discrete and sometimes competing interests must efficiently coordinate with local, state, regional, and federal regulators to ensure public access to affordable, reliable electricity. Multiple layers of government regulation are necessary to ensure it.

ROLE OF UTILITIES IN INTERCONNECTION

Utilities are the leading players in the electric industry and are collectively responsible for most generation, transmission, and distribution of electricity to the public.

Site location will determine which utility you work with to interconnect. Utilities are unique legal entities and are considered natural monopolies. The nature of their business makes it more efficient for only one utility to operate at a time in any given geographic area. The government permits the monopoly and instead protects the public interest in access to reasonably priced electricity by heavily regulating electric utilities and monitoring their functions.

Unless you plan to operate your generator to meet power needs off-grid (with the load never powered from the grid) always advise the utility of your plans.

Even if you plan to sell power to another utility, you will still interconnect to the local electric utility's transmission or distribution system.

Utility Types

There are three main types of electric utilities:

- Investor-owned
- Municipal
- Cooperatives

INVESTOR-OWNED UTILITIES

The most common investor-owned utilities in the U.S. are private, for-profit enterprises with stock-based ownership, such as Oregon's Pacific Power, Portland General Electric, and Idaho Power Company.

These utilities finance new projects through the sale of debt and equity; they are naturally motivated to maximize their profits, pay high returns to investors, and encourage further investment.

They are also the most heavily regulated utilities in the industry. In Oregon, the Oregon Public Utilities Commission regulates the prices that investor-owned utilities pay for the electricity they purchase from small renewable energy projects. This is a key item to note if you're planning to sell your generation output.

MUNICIPAL UTILITIES

Municipal utilities are created as functions of town, city, and county government. Oregon has twelve municipal utilities which provide distribution services.

Few states fully regulate municipal utilities. Most rely on elected officials as "owners" who are publicly accountable for the utility's operations. This ensures that customer rates remain reasonable and that environmental values are considered.

Although municipal utilities are not subject to comprehensive regulation, some general energy-specific laws do apply to municipal utilities. The state's renewable energy standards and the requirement for tariffs encouraging locally owned and on-site generation can apply to municipal utilities of sufficient size.

COOPERATIVES

Electric cooperatives are private, non-profit, consumer-owned utilities controlled by their member-owners through elected boards of directors.

Oregon has eighteen electrical cooperatives. Prevalent in rural areas, approximately 950 electric cooperatives serve fifty percent of rural people in the U.S., largely due to federal legislation.

The government subsidizes loans to promote electric development in places where investor-owned utilities found it too expensive to do business.

Because electric cooperatives are non-profit entities directly accountable to their member-owners, most states do not regulate the rates they can charge. In Oregon, for example, electric cooperatives are not generally subject to regulation by the public utility commission; however, the cooperative's members or stakeholders are guaranteed certain rights by law, including access to the cooperative's records and mandatory open meetings.

Members of an electric cooperative can vote to make the cooperative subject to Oregon's rate regulations. As with Oregon's municipal utilities, cooperatives are subject to some of Oregon's general energy laws. The state's renewable energy standard and tariff requirements encouraging locally-owned and on-site generation may apply.

DEVELOPMENT TYPES

There are three main classes of project development:

- installing and owning a small facility for **on-site** energy use
- developing a **commercial-scale** (locally- or community-owned) energy project with excess power sold for off-site use
- working with a **third-party** developer to develop commercial-scale systems with off-site delivery

On Site Use Facility

A land-owner or business can purchase and own a relatively small generator or facility designed to supply one's own energy needs. The generator in this instance might be off-grid and installed exclusively for on-site use, or might be grid connected.

Projects which supply energy for home or farm use provide land-owners with the economic benefit of producing their own electricity and not having to buy it from an electric utility.

NET METERING

Net metering is a specific billing arrangement with the utility which permits customers with small energy generators to first use the energy they produce for their own needs and then sell any excess power back to the electric grid using the power lines that normally bring electricity to the customer at the same rate of purchase.

Electricity flows to and from the customer through a single interconnection; conceptually, the customer's meter runs backward when excess power is fed to the grid. If a land-owner's generator produces more energy than he uses, the utility will pay the land-owner for the excess or credit it against the land-owner's future electric bills.

Net metering laws for Oregon investor-owned utilities allow for an energy generation system with a capacity up to 25 kW for residential customers, 2 MW for commercial. This size project is much smaller than most commercial developments; therefore, net metering is intended for small producers who want energy for their own facilities.

Commercial-Scale with Off Site Export

Commercial facilities are designed to produce more electricity than is needed on site with the excess electricity sold to utilities and/or customers for profit.

The sale of generated electricity requires a **power purchase agreement** between the project owner and the utility.

A land-owner developing a commercial-scale project must make careful decisions about how to structure the business side of the project, including which type of business entity will best fit the project's investment and ownership structure and how the project owners will comply with securities laws, filing and reporting requirements, and other legal obligations.

Third Party

Third-party development is a common form of commercial-scale ownership. This option usually requires comparatively little effort on the part of the land owner. A third-party developer will likely coordinate the interconnection application and process along with most other aspects of project development.

Land owners can sell or lease their land to someone who is willing to construct and operate an energy facility. The land-owner communicates the development rights to a developer, most likely using an option, lease, easement, or some combination of these.

The developer would then likely develop, build, and operate the generation project, with the land-owner providing the land on which the project sits and receiving rental income or a small percentage of revenue generated by the facility.

This option for development entails less risk to the land-owner than direct ownership and often requires no initial capital investment by the land-owner. Contracting with a developer does require the land-owner to carefully negotiate legal agreements to ensure fair compensation and a fair allocation of the rights, responsibilities, and risks associated with development. Negotiating this kind of agreement requires significantly less effort than independently developing an entire project.

PROJECT DEVELOPMENT

The interconnection process is just one the many tasks necessary when developing generation projects but it can't be considered separate or in parallel to other needs. Figure 1 (Page 7) illustrates a typical project development timeline with major task areas. Besides the main formal Interconnection Process, there are several points along the way that deserve to be highlighted.

Site Selection

Starting at the very beginning with site selection, interconnection potential should be considered. At this point ask, what is the access to transmission at this location and what is the capacity available?

There may be multiple distribution lines, transmission lines, or substations nearby. Distribution lines and transmission lines have a relatively fixed capacity and it can be difficult for a developer to determine how much accessible capacity exists. Since the developer is responsible for the costs of building new distribution or transmission lines (from the project site to the POI on the existing system) and any upgrades necessary to increase transmission capacity or improve system protection, having to design and build long distribution lines, transmission lines, new substations, or other upgrades may be financially prohibitive.

Permits

It will be the responsibility of the project developer to obtain all permits necessary to build any new lines, not the utility. When working through permitting for project construction, keep in mind that you may need permits for transmission work as well.

Power Purchase

The power purchase agreement often determines the primary revenue stream for the project and is negotiated between the project and utility to which generation is sold. A key element to the agreement, in addition to purchase rate, is the start date. If your system is not fully interconnected to the grid upon your agreed upon start date, you will likely be responsible for penalties associated with not delivering. This is a surprisingly common issue projects face. Be aware of the dates and obligations in all your contracts and how they relate before construction begins. Although you'll be talking with representatives at your interconnecting and purchasing utility, they will be different people in different departments and may even be at different companies (if you choose to wheel your power to sell to another utility beside your interconnecting utility). In summary, don't assume that other parties are communicating with each other about your project; you are the one responsible for pulling together all the pieces in the end.

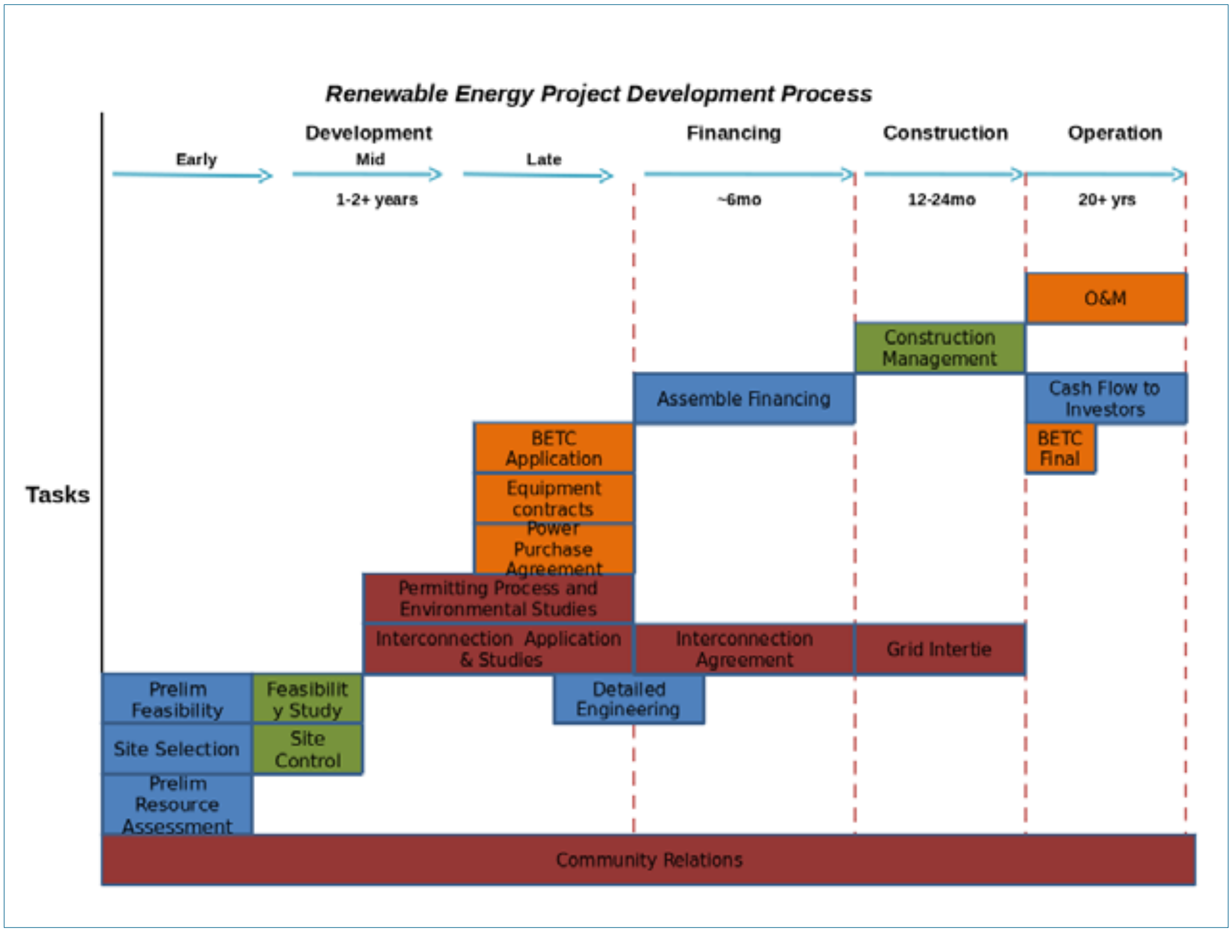


FIG. 1: A TYPICAL PROJECT DEVELOPMENT TIMELINE WITH MAJOR TASK AREAS.

INTERCONNECTION PROCESS

The interconnection process consists of the following:

- Project definition
- Interconnection
- Application submittal
- Application review
- Interconnection agreement

Project Definition

Several basic aspects of the project need to be defined prior to starting the interconnection process.

- Do you have site control? Site control is required by the utilities prior to interconnection application review.
- What size capacity (kW) are you planning to connect and how much variability exists around that amount?
- Where do you want to connect? Your expected point of interconnection (POI) or point of common coupling (PCC) will determine to which utility you will interconnect.
- Do you plan to export the power from the site for sale or use on-site only?
- What type of generator will you be using (induction, synchronous) and what model?
- Do you have a one-line diagram of the project? Applications will require a one-line diagram be included. See the Appendix for a sample.

Once you have these basics defined, the next step is applying for interconnection.

Application Procedures

The type of application you'll need depends on project size, jurisdiction, and intended use of the power (on-site or for export).

To obtain an interconnection request application, contact the utility company which owns the distribution line, transmission line, or substation at the proposed POI.

Most large utilities, such as Portland General Electric, PacifiCorp, and Idaho Power Company provide downloadable applications on their websites and usually have an interconnection office or contact person.

Portland General Electric (PGE): http://www.portlandgeneral.com/renewables_efficiency/generate_power/business/selling_power_pge.aspx

PacifiCorp (PAC): http://www.pacificorp.com/tran/ts/gip.html

Idaho Power Company (IPC): http://www.idahopower.com/aboutus/businesstobusiness/generationinterconnect/

If a small cooperative, public utility district, or municipal utility does not have a website or downloadable application form, call them to learn about their individual procedures.

Which Rules Apply?

There are three sets of interconnection rules (also known as procedures) utilities follow for all interconnections, one of which will apply to your project. (This assumes you are interconnecting to an investor-owned utility. See below for cases in which you are connecting to a consumer-owned utility.)

1. Oregon Net Metering Rules

   If you're planning to net meter your project which is less than 25kW for residential sites and less than 2MW for commercial sites, net metering rules will apply. This is typically the least complex connection process.

2. Oregon Interconnection procedures AR 521 (also referred to as Docket AR 521, or OAR Section 860 Division 82)

   Projects less than 10MW that are planning to connect to investor owned utilities (Portland General Electric, Pacific Power, or Idaho Power) in Oregon and sell the generation to that utility will follow these procedures referred to as AR 521 throughout the rest of this document.

3. FERC Small Generator Interconnection Procedures (FERC SGIP)

   Projects less than 20MW planning to connect to investor owned utilities in Oregon but planning to sell power elsewhere (wheel output) or directly connect to the Bonneville Power Administration (BPA) will follow FERC SGIP. All projects greater than 10MW will follow the FERC LGIP procedures.

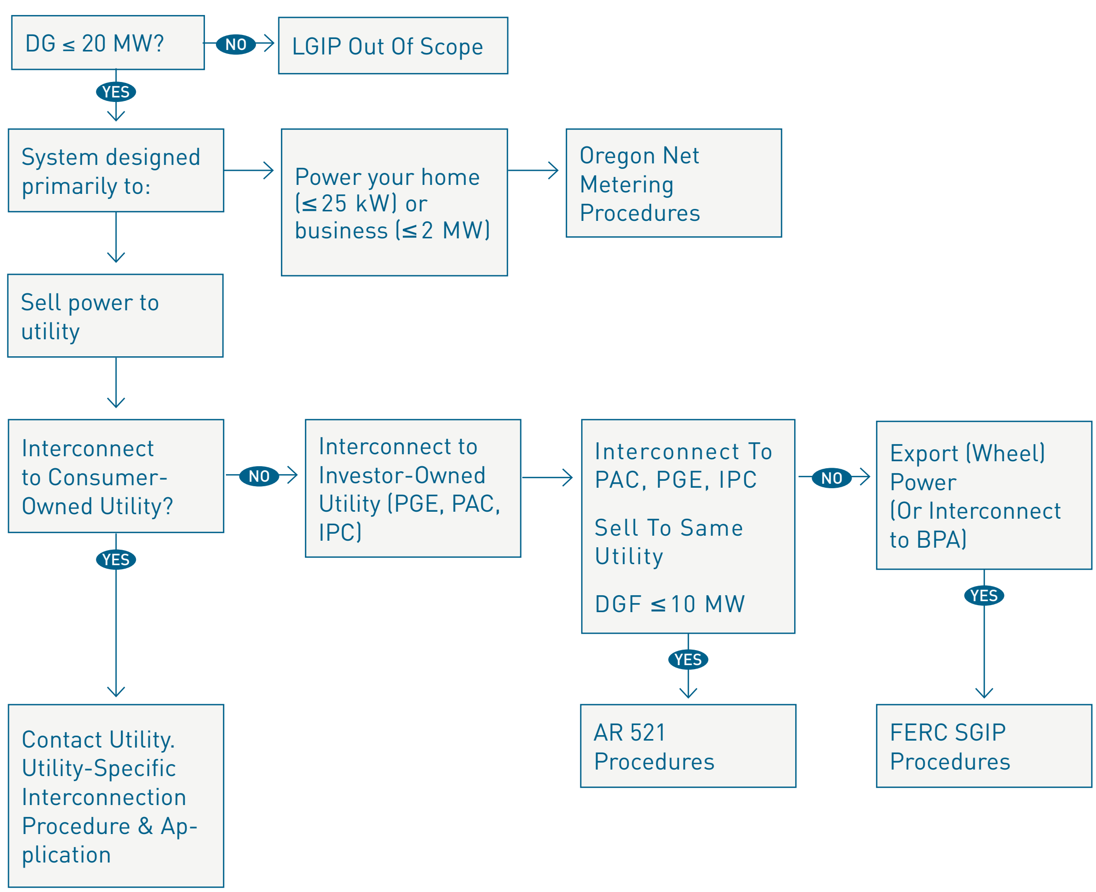
Each of the sets of rules (net metering, FERC SGIP and AR 521) have different levels or tiers, allowing different sizes and types of projects to use different applications and study and review processes.

This is beneficial for smaller projects because the process is streamlined and may require fewer studies. Larger project procedures typically require several studies that may extend the project timeline and have significant cost.

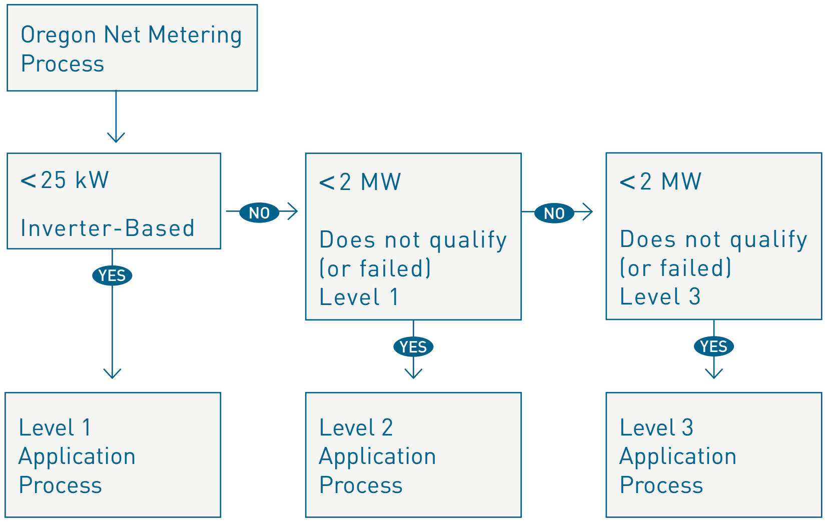
Use the following three flowcharts as a guide for determining which rules and subsequent tiers or levels of review will apply to your project.

If the interconnection is to a small utility not listed here, contact that utility to determine their procedure. It may be similar to the FERC SGIP or AR 521 procedures. Small utilities may use either procedure; however, they are also not required to use either. If connecting to one not listed here, ask about the procedures they follow early on to be well informed through the process.

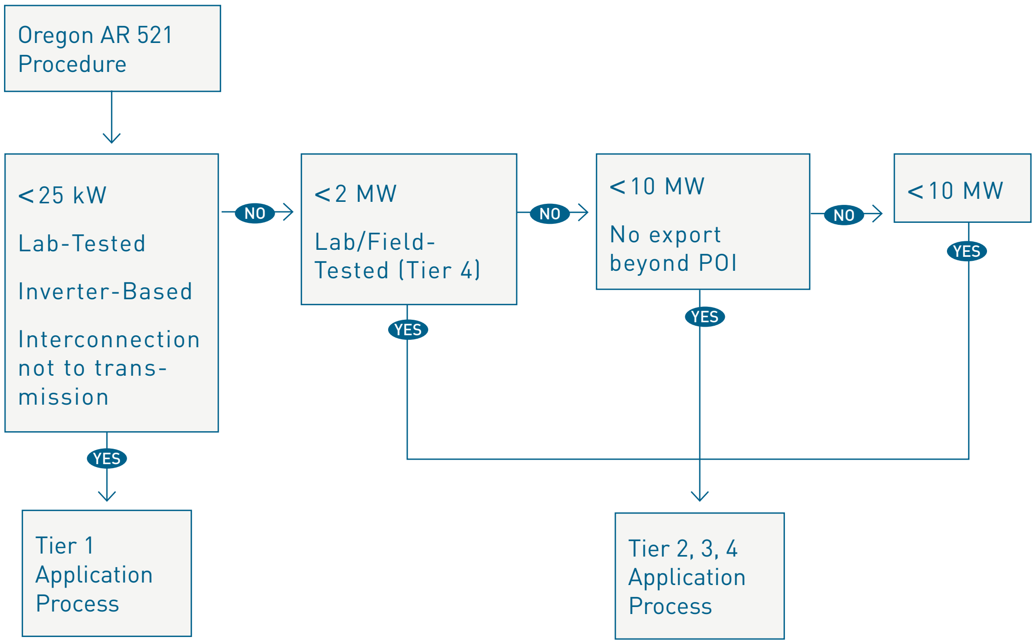
Flowchart 1: WHAT INTERCONNECTION PROCEDURES APPLY?



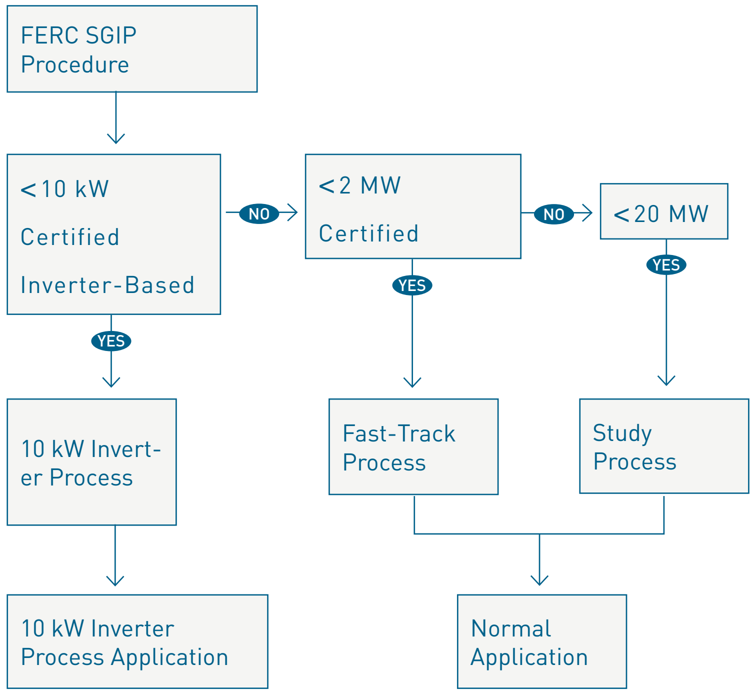
Flowchart 2: IF NET METERING RULES APPLY, WHICH TIER DO I APPLY FOR?



Flowchart 3: IF AR 521 APPLIES, WHICH LEVEL DO I APPLY FOR?



Flowchart 4: IF FERC SGIP APPLIES, WHICH LEVEL DO I APPLY FOR?



Oregon Net Metering Rules

Oregon net metering rules have three levels. Size limits differ by customer type.

A residential customers' generation facility must have a nameplate capacity of 25 kW or less; a non-residential customers' generation facility must have a nameplate capacity of 2 MW or less. Each customer type may apply for any level of application.

- Level 1 applications are only for inverter-based facilities with a size of 25 kW or less. The application must pass a list of screens.
- Level 2 applications are for any facilities 2 MW or less and must pass a list of screens.
- Level 3 applications have a limit of 2 MW or less and require a study to determine impacts to the electric distribution system and necessary modifications, but do not require screens.

An initial request uses a Level 1 or Level 2 application. A level 2 application which fails to meet the required criteria proceeds to a level 3 application.

Oregon AR 521 Interconnection rules

The AR 521 small generator interconnection rules have 4 tiers.

- Tier 1 interconnections are for facilities that use lab-tested, inverter-based equipment (as opposed to rotating machine for the generator), have a nameplate capacity of 25 kilowatts or less, and are not interconnected to a transmission line.
- Tier 2 interconnections are for facilities that do not qualify for Tier 1, have a nameplate capacity of 2 megawatts or less, interconnected to either a radial distribution circuit or a spot network distribution circuit limited to serving one customer, not interconnected to a transmission line, and use lab-tested or Tier 4 field-tested equipment (equipment that has been previously used in a Tier 4 application).
- Tier 3 interconnections are for facilities that fail to qualify for Tier 1 or Tier 2, have a nameplate capacity of 10 megawatts or less, not connected to a transmission line, do not export power beyond the POI, and must use low forward power relays or other protection functions that prevent power flow onto the area network.
- Tier 4 interconnections are for facilities that fail to qualify for Tiers 1, 2, and 3, and must have a nameplate capacity of 10 megawatts or less.

There is a specific application form for Tier 1 projects and a separate application form for either Tier 2, 3, or 4. Indicate on the application form which tier you would like your request processed under.

The Tier 2 process is similar to the FERC SGIP fast track process; the Tier 4 process is similar to the FERC SGIP standard study process.

FERC SGIP

The FERC SGIP has 3 distinct processes:

≤ 10 kW inverter

≤ 2 MW fast-track

Standard study

The < 10 kW inverter and fast-track processes use a set of impact screens, in place of the standard study process, to evaluate an interconnection request. The < 10 kW inverter process has its own application, while the fast-track and study processes use the same application.

Application Fees

Each application requires payment of a fee to the utility, which may be applied as a deposit towards the feasibility study. Check this with the utility.

Application Level	Application Fee or Feasibility Study Deposit
AR 521 Tier 1	$100
AR 521 Tier 2	$500
AR 521 Tier 3	$1,000
AR 521 Tier 4	$1,000
FERC SGIP 10 kW Inverter Process	$100
FERC SGIP Fast-Track Process	$500
FERC SGIP Study Process	$1,000
Oregon Net Metering Level 1	$0
Oregon Net Metering Level 2	$2,050 Max
Oregon Net Metering Level 3	$4,100 Max

Standards

DISTRIBUTED GENERATION: UL 1741 AND IEEE 1547

Each of the procedures reference technical standards throughout. Standards are established industry requirements for system design and operation.

UL 1741 and IEEE 1547 are the two standards relevant for distributed generation equipment. The reasoning behind generator design and power plant layout may stem from these standards. If a well-proven generator is chosen and a competent engineer assists in the design, the developer may not need to learn the details of these standards.

The use of new or experimental generators may require extensive testing to verify adherence to these standards.

UL 1741, developed by Underwriters Laboratory, requires interconnection equipment to meet construction constraints, protect against risks of injury to persons, prescribe rating and marking, and set specific distributed resource tests for various technologies.

IEEE 1547 is the standard for interconnecting distributed resources to the electrical grid, required by the Oregon Public Utility Commission (for the interconnection of all distributed resources ≤ 10 MVA). IEEE 1547 describes the design technical and testing requirements, which guarantee that operation of the electric system is not degraded in normal operating conditions.

Newer or experimental generators may require extensive testing for potential power quality issues and anti-islanding. Islanding is when the distributed generation is running, but the POI is isolated in an abnormal way from all or part of the nearby grid.

APPLICATION REVIEW PROCEDURES

The application review process may be little more than a meeting and short evaluation, or it may consist of a scoping meeting and several studies for larger or more complicated projects. The utility will review the interconnection application. If rejected, the utility must inform the applicant of the reason and what additional information is required. If accepted, the utility places the project in their review queue and applicant and utility will schedule a scoping meeting to discuss the project. If the application is clear and complete with no obvious mistakes or irregularities, it will typically be accepted.

Smaller projects may not require further study; however, larger projects may require a feasibility study, system impact study, and/or facility study. These studies determine whether interconnection capacity exists, look at different interconnection options, determine possible impacts on the transmission system, and determine costs for upgrades and necessary system protection and telemetry devices.

The following sections detail the review process for each tier or level within the three rule types (AR 521, FERC SGIP, and OR Net Metering).

AR 521 Rules

AR 521: TIER 1

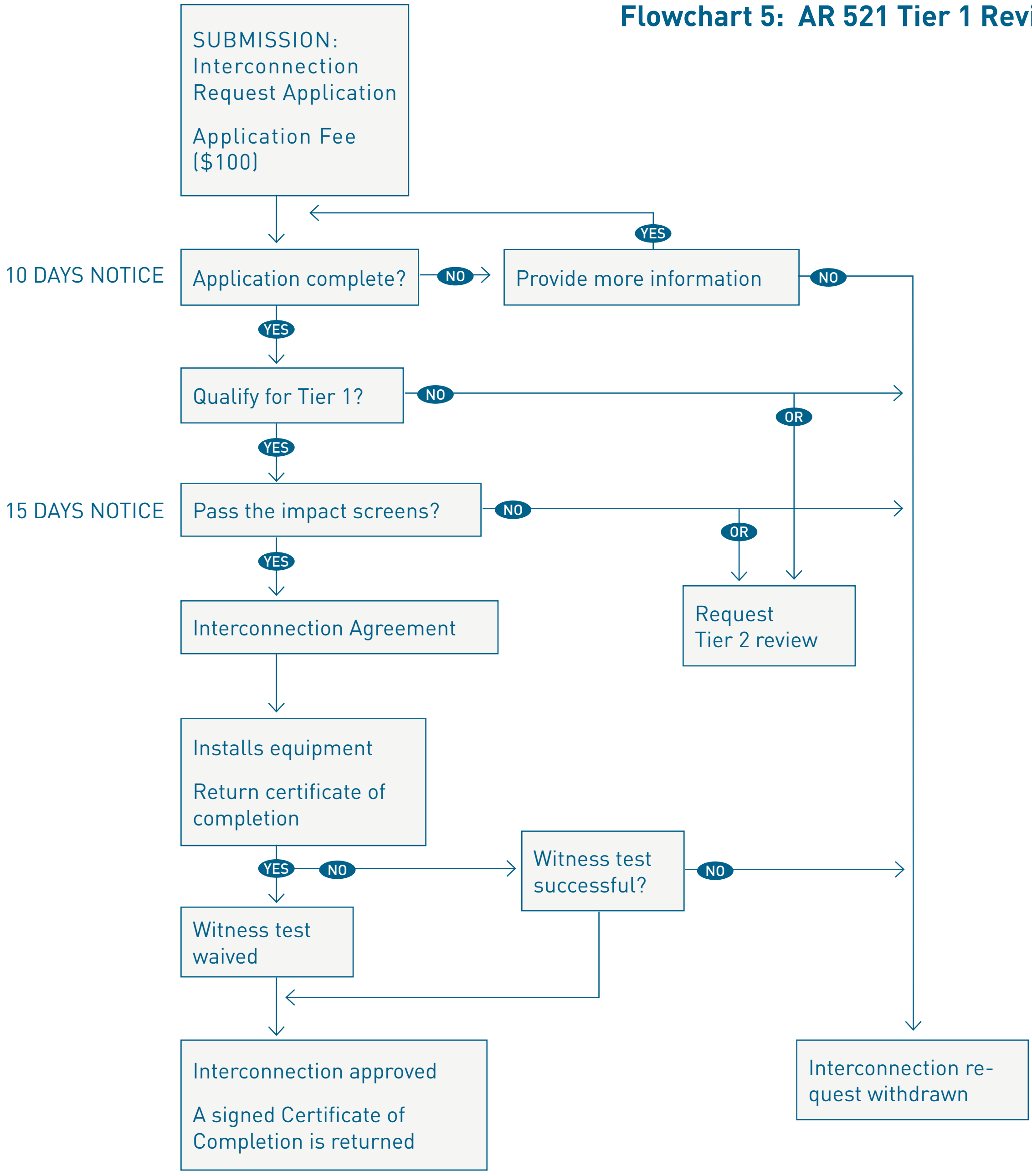
The AR 521 Tier 1 process is simple compared to other processes. The utility reviews the developer's application for completeness. The proposed interconnection must then qualify for Tier 1 review as follows:

- Must be inverter-based
- Must be less than or equal to 25 kVA
- Must be lab-certified

The utility must notify the developer of qualification status fifteen business days from when they deem the application "complete." Unlike all other AR 521 tiers, the Tier 1 process does not involve an interconnection agreement.

After the utility company determines whether the five criteria (below) are met, the developer is allowed to proceed with installation. The utility can opt to conduct a witness test and if waived or successful, the interconnection is approved and a certificate of completion must be signed.

Flowchart 5: AR 521 Tier 1 Review Process.



Tier 1 Interconnection Requirements (Impact Screens within flowchart)	
1	The facility interconnection must use existing public utility facilities.
2	The output must be less than 15% of the line section annual peak.
3	The output must be less than 5% of the spot network or maximum aggregate capacity on a network of 50 kVA.
4	Aggregate generation on single phase shared secondary is less than 20 kVA.
5	If the interconnection is single phase and interconnection is to a center tap neutral of a 240 volt service, then output must be less than 20% imbalance between the phases.

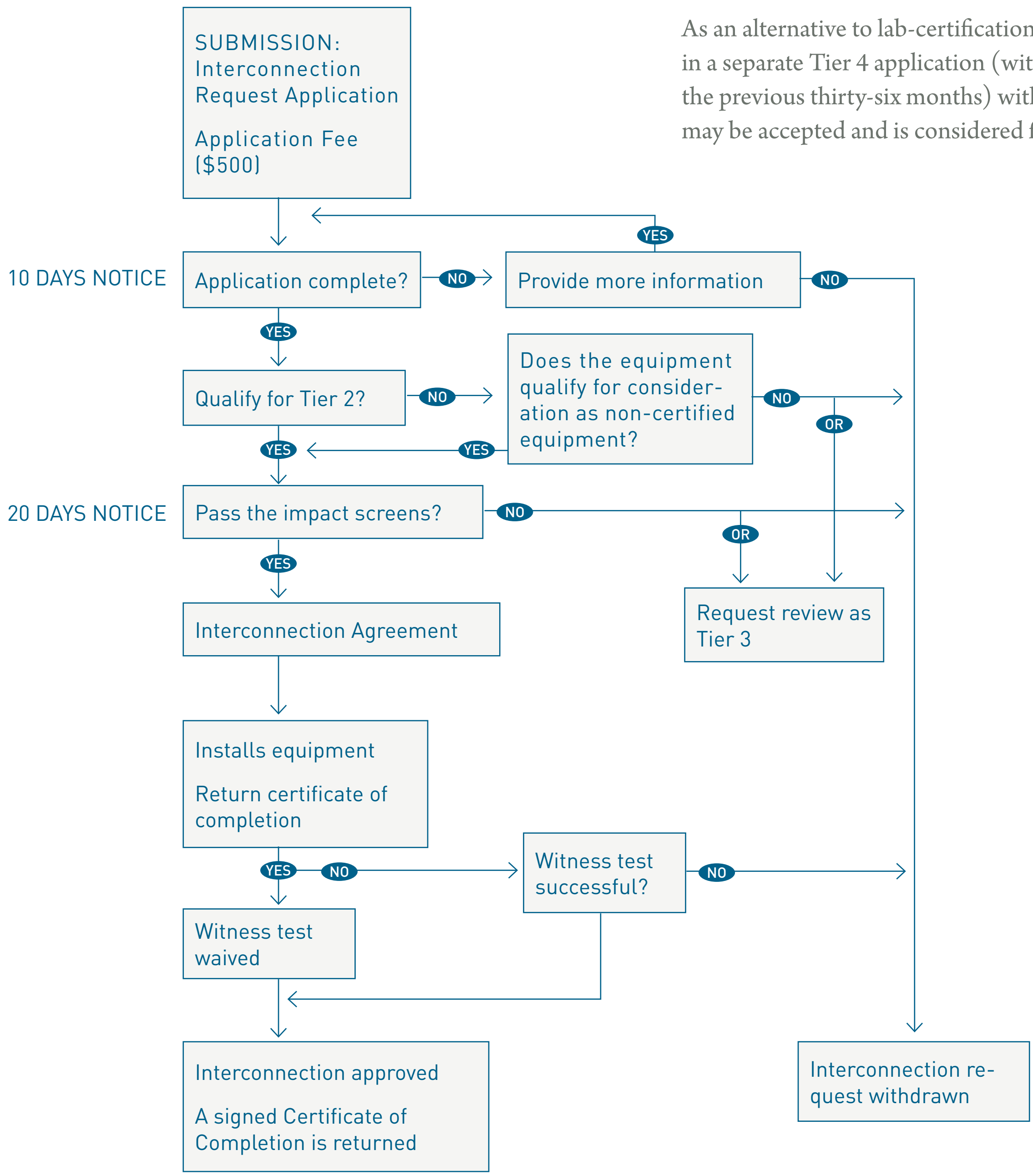
AR 521: TIER 2

AR 521 Tier 2 is a simplified process covering all types of generators. After the application is reviewed for completeness, the facility must qualify for Tier 2 review:

- Must be less than 2 MVA
- Must be interconnected to a radial distribution circuit or a spot network serving only one customer
- Must use lab-certified equipment

As an alternative to lab-certification, equipment approved in a separate Tier 4 application (with the same utility in the previous thirty-six months) with a successful witness test may be accepted and is considered field-certified.

Flowchart 6: AR 521 Tier 2 Review Process.



Tier 2 Interconnection Requirements	
1	< 15% of line section annual peak load as most recently measured at the substation or calculated for the line section
2	For connection to Spot network, must be Certified, inverter-based and less than 5% of spot network or maximum aggregate capacity on network of 50 kW
3	Aggregate generation does not contribute more than 10% of circuit's maximum fault current the point on the primary voltage distribution line nearest the POI
4	Aggregate generation will not expose protective devices to more than 90% of their interrupting capability or located on a circuit that already exceeds 90% of the short circuit interrupting capability
5	Aggregate generation < 10MW, if there are transient stability limitations
6	Phase-to-phase connection, for three-phase, three-wire primary line; Line-to-neutral and effectively grounded connection, for three-phase, four-wire primary line
7	Aggregate generation on single phase shared secondary is < 20 kVA
8	If interconnection is single phase and interconnection is to a center tap neutral of a 240 volt service, then <20% imbalance between phases
9	No construction of new facilities is required or only minor modifications (≤ $10,000)
10	Aggregate generation cannot cause distribution circuit to exceed designed capacity
11	If the distribution circuit uses high speed reclosing with less than two seconds of interruption, then the small generator facility must not be a synchronous machine.

If a small generator facility fails to meet one or more criteria in subsections 2a through 2k, but the public utility determines that the small generator facility could be interconnected safely with minor modifications to the transmission or distribution system (such as changing meters, fuses, or relay settings) the public utility must offer the applicant a good-faith, non-binding estimate of proposed minor modification costs.

Modifications are not considered minor under subsection 2 if their cost exceeds $10,000. If the applicant authorizes the public utility to proceed with the minor modifications and agrees to pay their cost, the utility must approve the application under Tier 2.

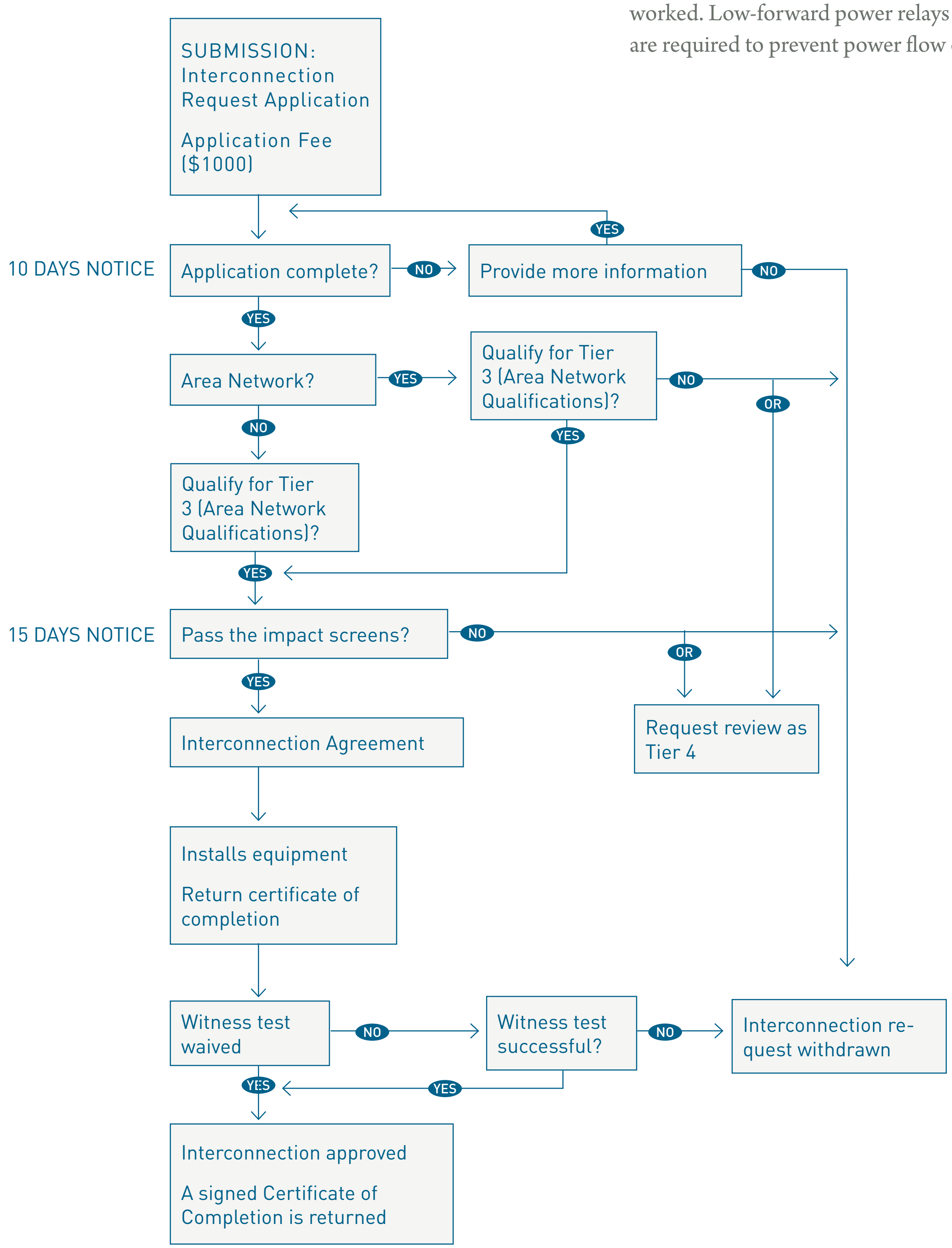
AR 521: TIER 3

The Tier 3 process is for larger generation that does not connect to transmission. The proposed facility:

- Must generate 10 MW or less
- Must interconnect to a radial distribution circuit or only one customer on a spot network
- Must not export power beyond the POI

The screening process is different for interconnection to an area network and a distribution circuit that is non-networked. Low-forward power relays (or other protection) are required to prevent power flow on the area network.

Flowchart 7: AR 521 Tier 3 Review Process.



Tier 3 Impact Screens for Interconnection to an Area Network	
1	Nameplate capacity of generator facility ≤ 50 kW
2	Lab-tested, inverter-based equipment
3	Aggregate generation must not exceed the lesser of 5% of the area network's maximum load or 50 kW
4	The facility interconnection must use existing public utility facilities.

Tier 3 Impact Screens for Interconnection to Un-Networked Distribution Circuit	
1	Nameplate capacity of generator facility ≤ 10MW
2	Aggregate generation ≤ 10MW
3	No export of power beyond POI
4	POI at a radial distribution circuit
5	No shared transformer
6	The facility interconnection must use existing public utility facilities.
7	If the distribution circuit uses high-speed reclosing (≤ 2 seconds interruption) then the generator cannot be a synchronous machine

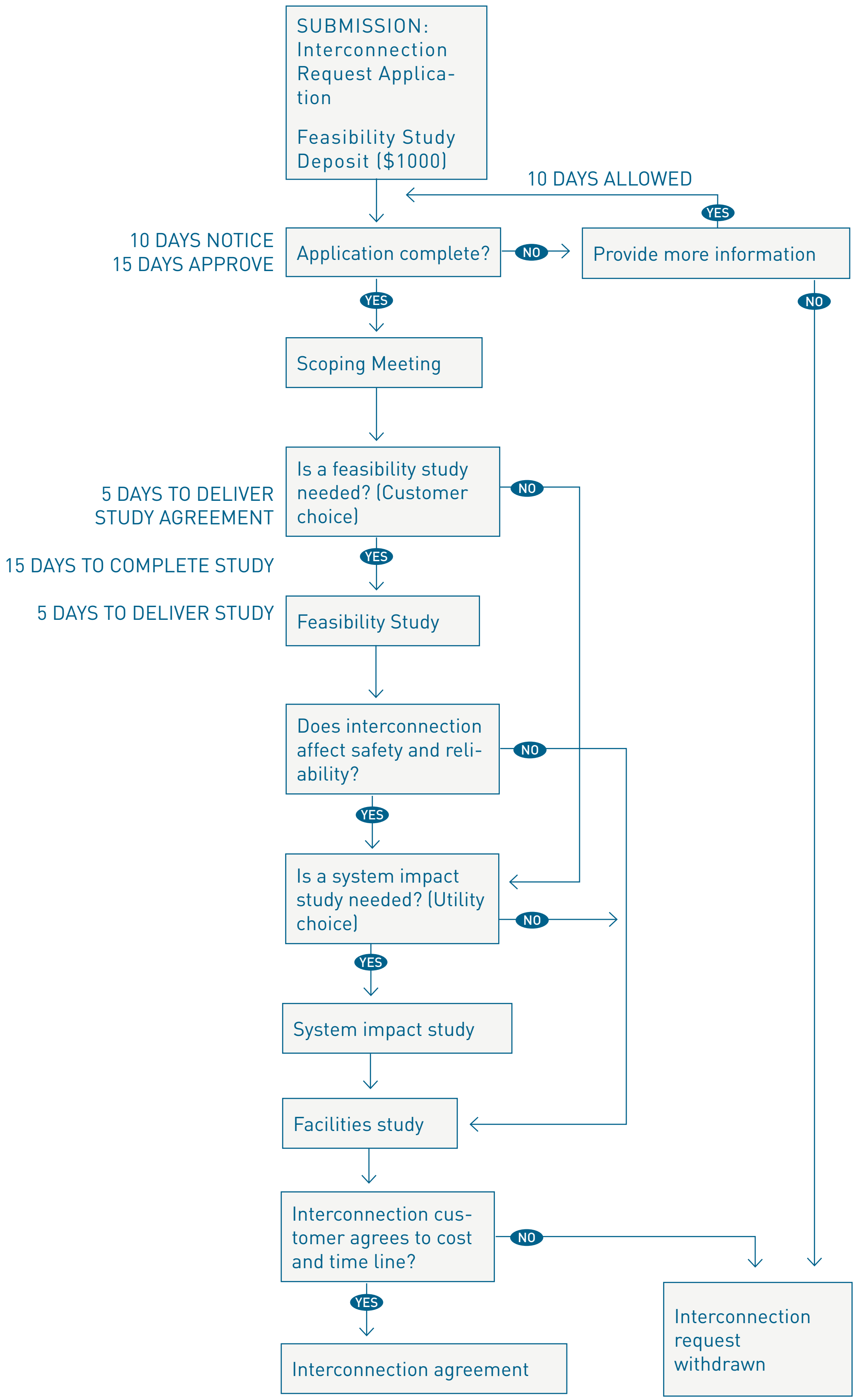
AR 521: TIER 4

The Tier 4 process is for facilities producing less than 10 MW, which may interconnect at the distribution or transmission level. Rather than screens, a rigorous series of studies is conducted to determine how the proposed project will impact the electrical system.

The interconnection customer may elect to skip the feasibility study, but the feasibility study is far less costly than the system impact study and will give a good estimate of system capacity and facility upgrade cost.

Although atypical, all studies can be waived upon mutual agreement between the developer and the utility.

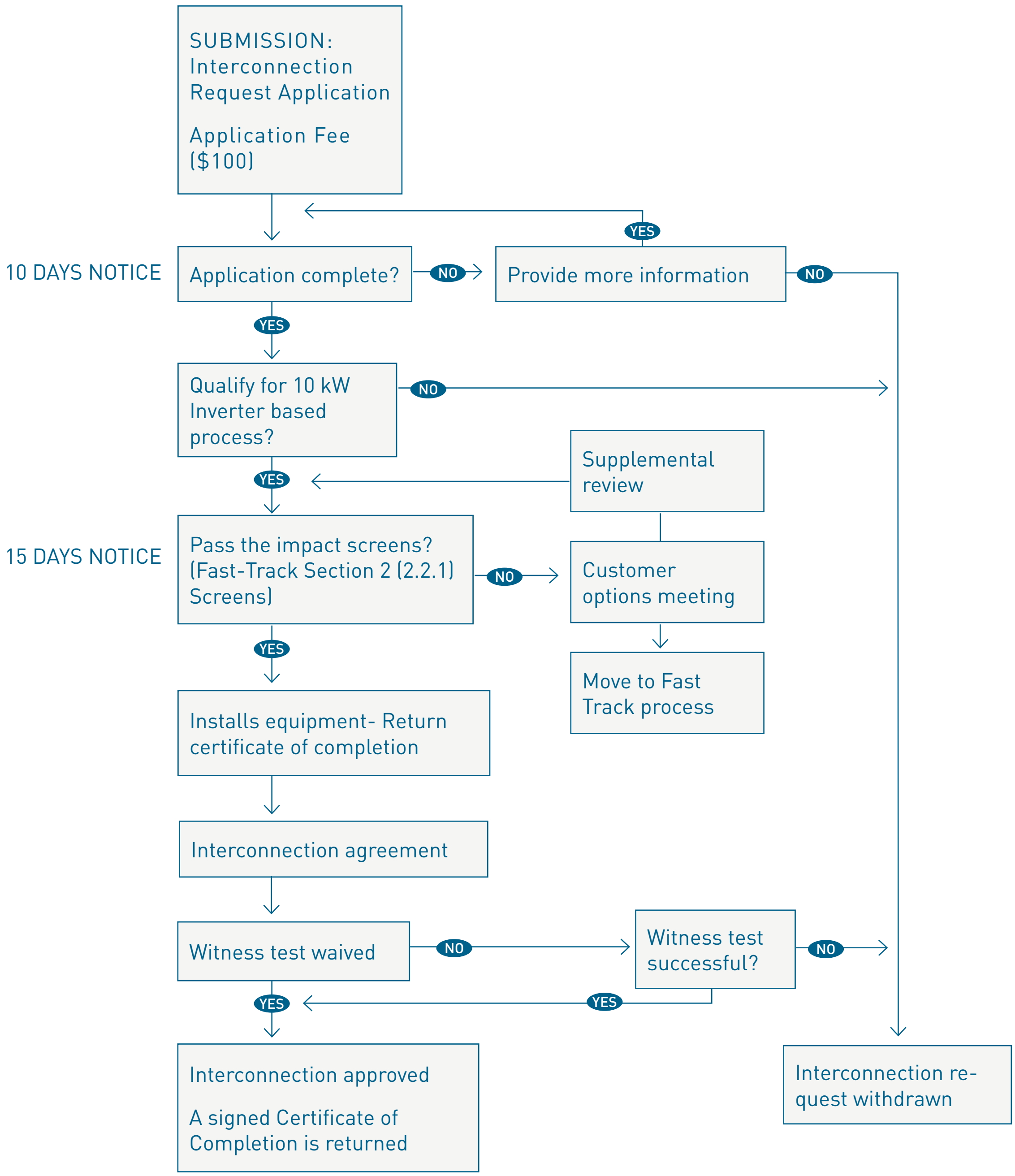
Flowchart 8: AR 521 Tier 4 Review Process.



FERC 10KW INVERTER PROCESS

The FERC 10 kW inverter is similar to AR 521 Tier 1 process, but size limit is smaller and impact screens differ. There is no field-certifying process, with prior use in the study process. A nationally recognized testing laboratory must certify equipment as being UL 1741 compliant. The proposed facility must pass the impact screens from Section 2 of the FERC SGIP (the same impact screens that a FERC Fast-Track facility must pass).

Flowchart 9: FERC 10 kW Inverter Review Process.

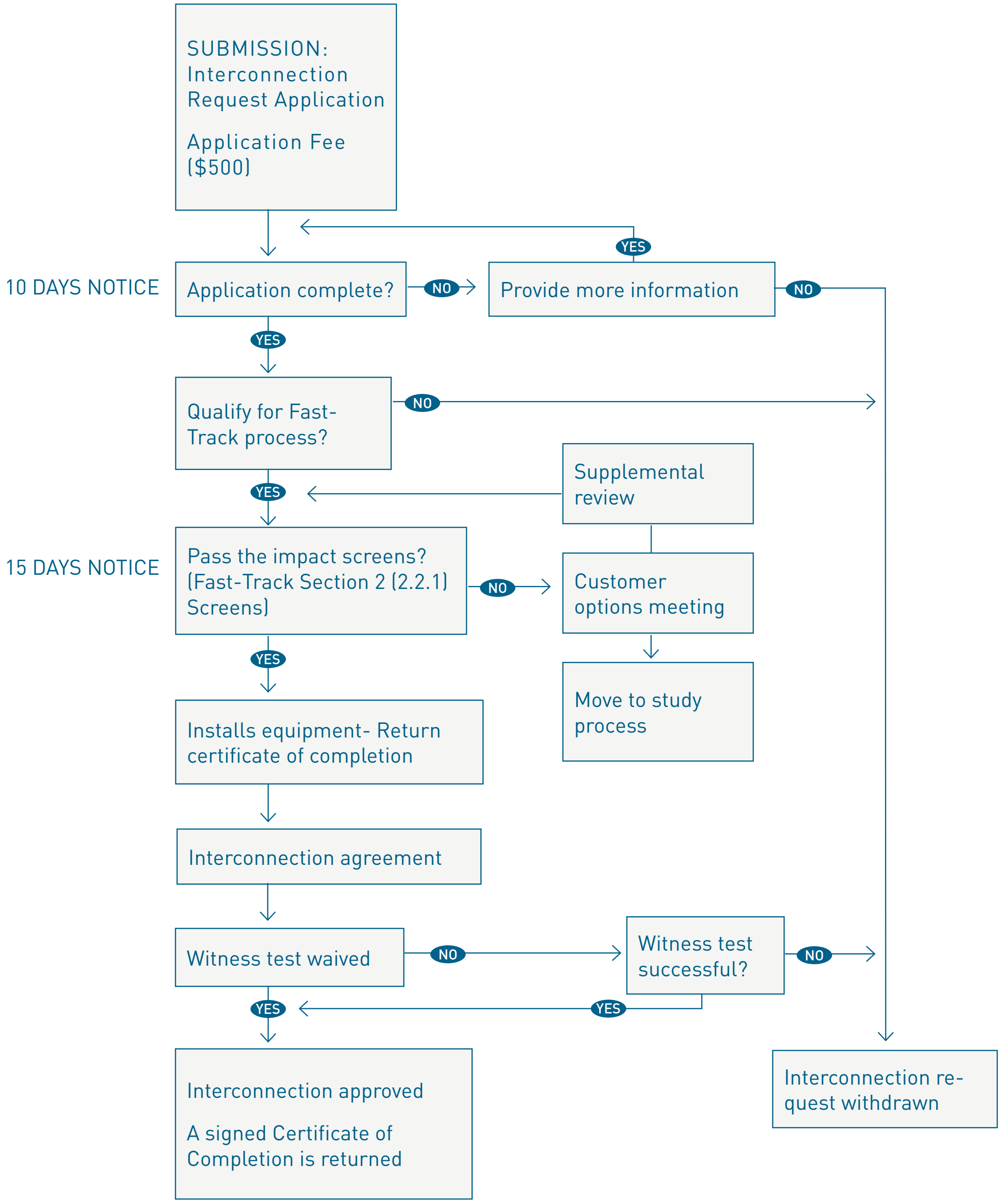


FERC Section 2 Screens (10 kW Inverter / Fast-Track Processes)	
1	The POI must be subject to the tariff (FERC jurisdiction)
2	Aggregate generation on a radial distribution circuit <15% of line section annual peak load
3	For spot network, inverter-based generator required, aggregate generation <5% of maximum load or 50 kW
4	Aggregate generation <10% maximum fault current on primary
5	Aggregate generation shall not cause equipment to exceed 87.5% of short-circuit interrupting capability, nor be proposed for a circuit that already exceeds 87.5%
6	For a three-phase, three-wire primary distribution line the interconnection must be three-phase or single-phase, phase-to-phase. For a three-phase, four-wire line the interconnection must be effectively-grounded three-phase or single-phase, line-to-neutral
7	If interconnected to single-phase shared secondary, aggregate generation <20kW
8	If the facility is single-phase, to be interconnected on a center tap neutral of a 240 volt service, it shall not create an imbalance between the two sides of more than 20% of the nameplate rating of the service transformer
9	Aggregate generation <10MW if there are known transient stability limitations
10	No construction of facilities by the transmission provider shall be required for accommodation

FERC FAST-TRACK

FERC Fast-Track is a simplified process that covers all types of generators, not just inverters. As with the 10 kW inverter process, the proposed facility must pass Section 2 impact screens. The same certification rule applies. A nationally recognized testing laboratory facility must certify the equipment as being UL 1741 compliant.

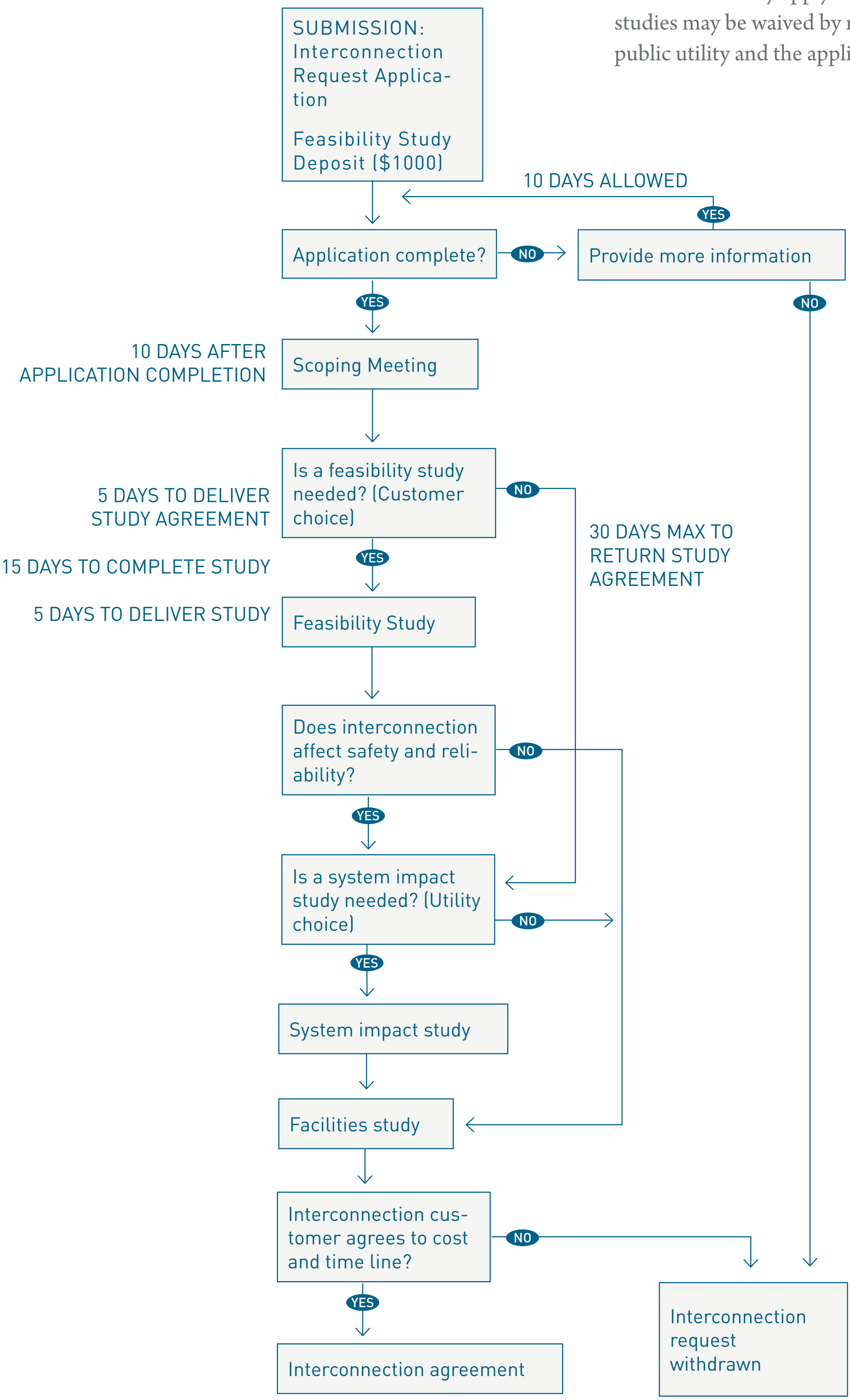
Flowchart 10: FERC Fast-Track Review Process.



FERC STUDY PROCESS

The FERC study procedure for FERC jurisdiction has little difference from the AR 521 study process. Projects up to 20 MW may be accepted. Small projects which do not pass other screens may apply using the study process. Rarely, studies may be waived by mutual agreement between the public utility and the applicant.

Flowchart 11: FERC Study Review Process.

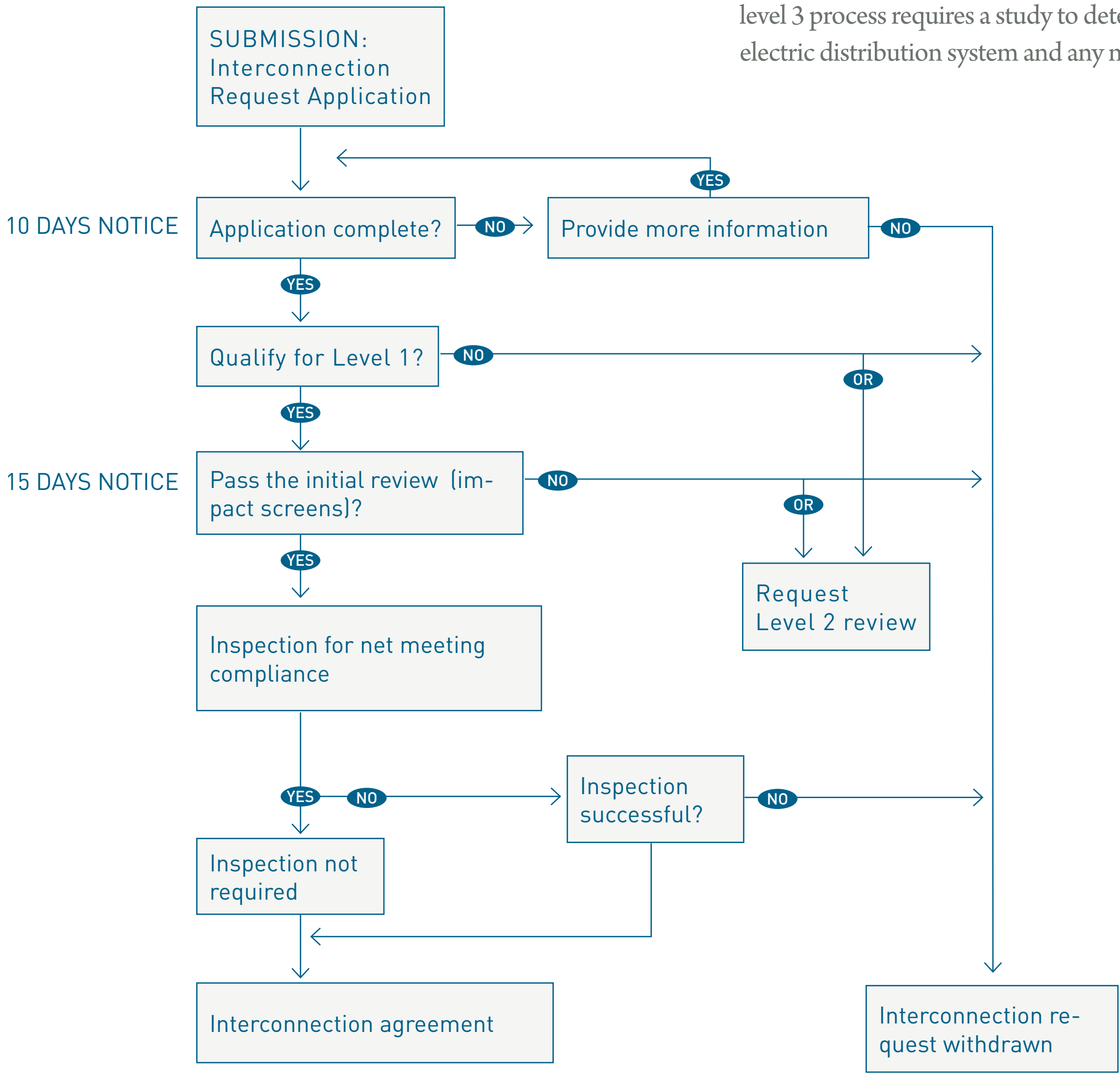


OREGON NET METERING INTERCONNECTION RULES

The net metering process is for projects which will be in a net metering arrangement with the interconnected utility. Residential customers are limited to 25 kW, while non-residential customers may net meter facilities up to 2 MW. Of the three application levels, 1 and 2 will require impact screens.

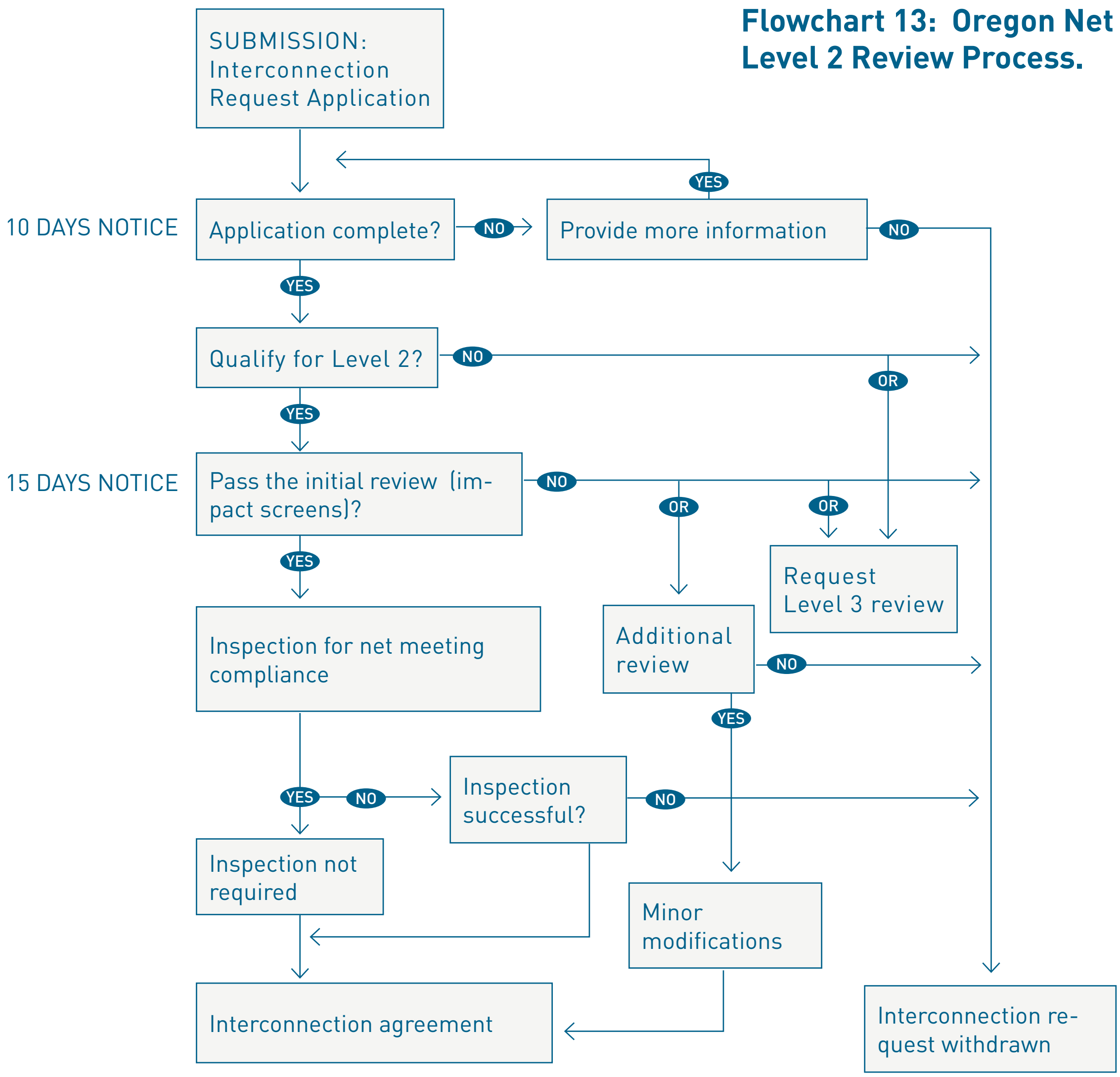
These impact screens are similar to AR 521 screens, but some requirements are specific to the net metering process. The level 3 process requires a study to determine impact to the electric distribution system and any necessary modifications.

Flowchart 12: Oregon Net Metering Level 1 Review Process.



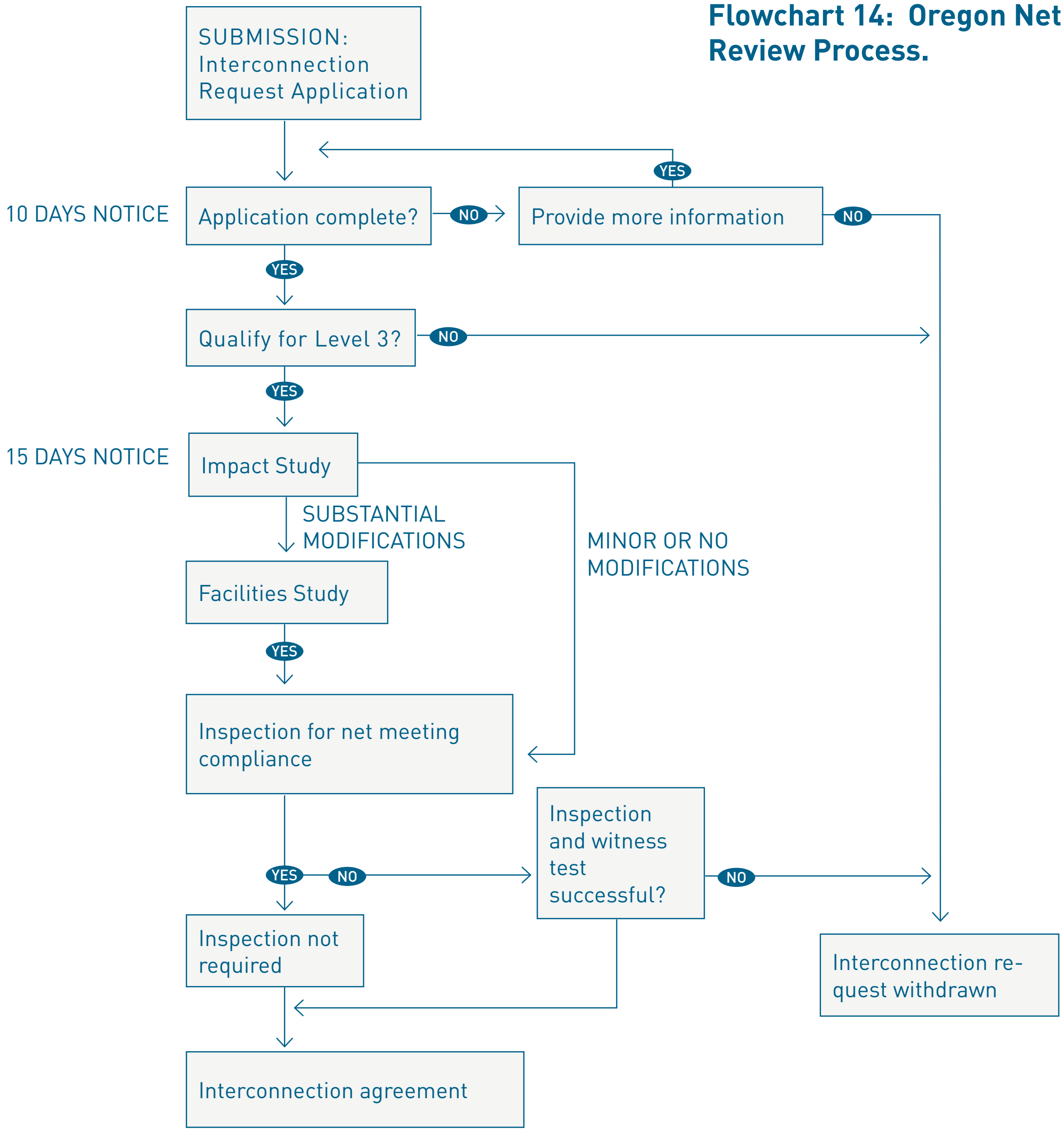
Level 1 Net Metering Requirements	
1	Aggregate generation ≤ 10% of maximum fault current
2	POI is not on a transmission line, spot network, or area network
3	Aggregate generation ≤ 10% (15% for solar electric) of total annual peak load, if POI is on a radial distribution circuit
4	Aggregate capacity ≤ 20-kVA, if connected to a single-phase shared secondary
5	If the facility is single-phase, to be interconnected on a center tap neutral of a 240 volt service, it shall not create an imbalance between the two sides of more than 20% of the nameplate rating of the service transformer

Flowchart 13: Oregon Net Metering Level 2 Review Process.



Level 2 Net Metering Requirements	
1	Aggregate generation will not cause equipment to exceed 90% of short-circuit interrupting capability
2	Aggregate generation ≤ 10MW if there are transient stability limits
3	Aggregate generation ≤ 10% of maximum fault current
4	Aggregate generation ≤ 10% (15% for solar electric) of total annual peak load, if POI is on a radial distribution circuit
5	For a three-phase, three-wire primary distribution line the interconnection must be three-phase or single-phase, phase-to-phase. For a three-phase, four-wire line the interconnection must be effectively-grounded three-phase or single-phase, line-to-neutral
6	If interconnected to single-phase shared secondary, aggregate generation <20kW
7	If the facility is single-phase, to be interconnected on a center tap neutral of a 240 volt service, it shall not create an imbalance between the two sides of more than 20% of the nameplate rating of the service transformer
8	The POI cannot be on a transmission line
9	For spot network aggregate generation ≤ 5% of maximum load, for inverter-based generator aggregate generation ≤ 10% of lesser of minimum annual load or 500 kW. If these conditions are not met for a spot or area network, low-forward power relays must ensure no power export

Flowchart 14: Oregon Net Metering Level 3 Review Process.



INTERCONNECTION REVIEW

Once the application is submitted and accepted by the utility, the review process begins.

AR 521 Tier 4 and FERC SGIP Study Process

SCOPING MEETING

The scoping meeting is a first in-depth look at interconnection options. Survey all possible interconnection routes before holding a scoping meeting. There may be many transmission or distribution lines near the project. Different lines may have different amounts of available capacity, or be owned by different entities.

Explore different scenarios of interconnecting at transmission lines owned by different utilities via separate, utility-specific applications and meetings. Public utility representatives, applicant, and consultants representing the applicant should attend.

The outcome identifies interconnection point and determines initial project study. Often the specific point of common-coupling or interconnection, and potential upgrades and equipment required will be discussed.

FEASIBILITY STUDY

The feasibility study is a first technical look at the impact of the project on the electric system at the POI. It identifies potential adverse system impacts and considers all generating facilities on the system, with approved applications, or in a higher queue position, which may impact the proposed generation facility. For the feasibility study, two separate POI can be considered by the utility.

The outcome estimates system upgrades, cost, and implementation timeline.

SYSTEM IMPACT STUDY

The system impact study identifies and details impacts on the transmission and distribution system, if no upgrades were made. Potential impediments to providing the requested interconnection service are identified. Alternative findings from independent studies can be evaluated and addressed.

Unlike the feasibility study, the system impact study analyzes technical aspects of the potential interconnection. Short-circuit issues, grid stability, power flow, voltage drop, voltage flicker, protection and set-points, and grounding are analyzed.

Impact study outcome identifies system upgrades (if needed) to correct any adverse impacts. It is a refined estimate of cost and implementation timeline.

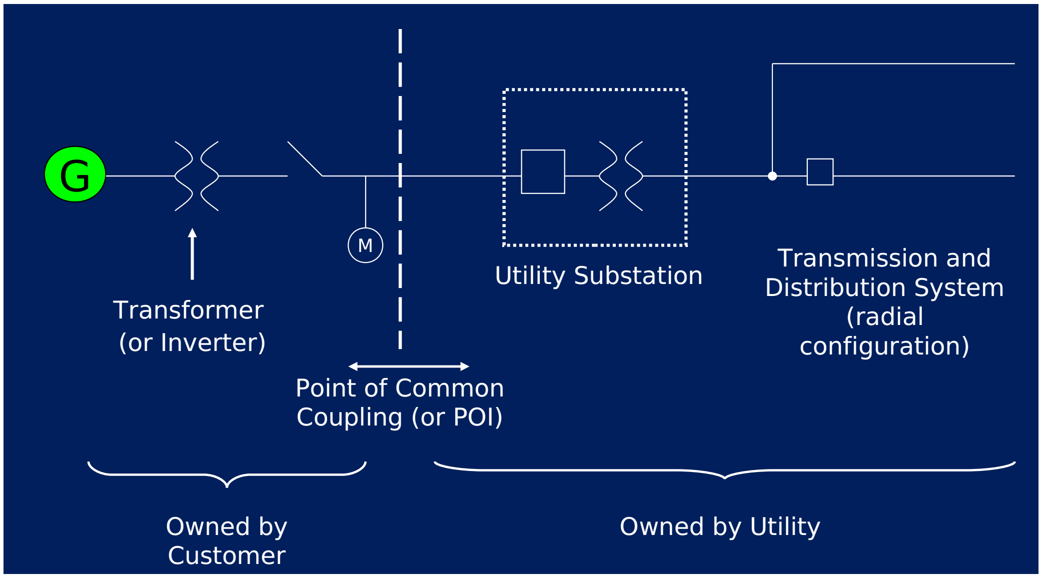


FIG. 2: THE POINT OF INTERCONNECTION (POI)

FACILITIES STUDY

The facilities study is used to identify the interconnection facilities and system upgrades required to safely interconnect. The cost for facilities and upgrades are determined, including equipment, engineering, procurement, and construction. The study includes the design and switching configuration of the equipment, including the transformer, switchgear, meters, communications, protection, and other station equipment.

Detailed estimates of the time to procure, construct, and install upgrades is included.

RESPONDING TO INFORMATION REQUESTS

The interconnection application and review process is intended to be thorough and expeditious. Its intent is to provide the utility with all information it may need to evaluate screens or complete any necessary studies and thoroughly review the interconnection.

If the application is filled out completely, any issue with new types of generators, generating facilities, and unique siting or design should not require extensive supplementary materials and communication with the utility.

Early, regular communication and prompt responsiveness will ensure that the process goes smoothly and quickly, without stalls. Do not risk losing your position in the queue by not responding promptly.

An open line of communication to the utility contact person is critical to the review process. Information submitted in the application may not be exactly what was intended, or there may be specific project siting issues which affect the project and must be discussed.

Clarification by phone, fax, and/or email is a normal part of the review process. Ready access to utility personnel keeps the process on track. If you are having difficulty getting the required details, a utility contact or engineering consultant may be able to help.

Utilities have obligations to their customers to maintain safe operation of their facilities for their employees and the public. They operate under a complex set of rules, regulations, reliability obligations, and government oversight.

Maintaining a collaborative approach with the utility and responding to the concerns identified in the studies with an open mind, will go far to ensuring a smooth and timely interconnection process.

AGREEMENTS

Agreements by Type and Utility

WHAT IS THE INTERCONNECTION AGREEMENT?

Before interconnection construction can occur, the utility and developer enter into an interconnection agreement. It outlines rights, financial responsibilities regarding transmission line and/or equipment modifications, and procedure for interconnection.

This agreement is not a contract for electricity purchase, or transmission to other specific utilities. A power purchase agreement and possibly a transmission agreement are negotiated and contracted for separately.

There is little difference between standard interconnection agreements adopted by most utilities. Rights and responsibilities of generation owners throughout different territories are similar. The interconnection agreement is based on the Interstate Renewable Energy Council (IREC) model for interconnection rules. The standardized and simplified interconnection agreement is designed to encourage customers to move forward with a viable project, so that a customer is not required to navigate and comprehend difficult legal and technical language.

Large investor-owned utilities subject to state or federal regulation have standardized interconnection agreements mandated by FERC (Federal Energy Regulatory Commission) or the Oregon Public Utility Commission. Smaller utilities like cooperatives and municipalities may not have standard interconnection agreements and may follow the standard agreement outline provided by FERC, or may have unique requirements.

INTERCONNECTION AGREEMENT CONTENT

Interconnection agreements must include:

- Detailed technical descriptions of the generation facilities
- Exact design and specifications for agreed upon interconnection with the grid
- Detailed description of the chosen metering equipment

The generation facility description must clearly specify:

- Maximum installed capacity permitted to interconnect with the grid
- Exact point at which the facility will be connected to the electric grid (called the POI) even if there is no power transmitted from the generation facility to the utility grid
- Who is responsible for building the generation project
- Who is responsible for building, installing, and operating the interconnection facilities
- Ownership of every piece of the interconnection equipment

Note: In many cases, some of the interconnection facilities are owned by the generation project, and some are owned by the utility. Grid upgrades are typically owned by the utility that controls those particular lines.

Typically, the generation project owner is solely responsible for construction, operation, and maintenance of the generation facility, while each party is responsible for its own interconnection facilities as identified in the agreement.

The utility or regional transmission provider that administers the distribution and transmission lines carrying the generated energy is usually responsible for the design, construction, and installation of any distribution or network upgrades.

COSTS AND PAYMENT SCHEDULING

Who pays the costs of interconnection and how much those costs amount to are major issues for generation project feasibility. Typically, the generation project owner is responsible for the costs of all interconnection facilities, including metering equipment, and all distribution and transmission upgrades that are necessary as a result of the project.

In addition to outright equipment expenses, these costs can include overhead, construction, operation, maintenance, repairs, and replacement of any newly installed facilities.

Interconnection agreements require a payment schedule for the facilities and upgrades which are the generation project owner's responsibility. The interconnection agreement provides a process for termination of the agreement.

Upgrades may be required for your project due to a transmission or distribution line, with other generation on the line, that is at full capacity. However, the other generation will not be required to pay for these upgrades; only the new interconnecting generation pays.

20-DAY TERMINATION NOTICE

In the FERC and OPUC interconnection agreements, the generation project owner may terminate the interconnection agreement at any time by giving the utility twenty business days written notice.

The utility does not have the same right to terminate the agreement at any time after giving notice, but either the utility or the generation project owner may terminate the interconnection agreement in case of default by the other party.

TESTING AND INSPECTION

Interconnection agreements allow for testing and inspection of the generation facility before interconnection. The generation project owner is responsible for testing and inspection, but the utility has the right to observe and inspect the site at its own expense.

The interconnection agreement gives the utility an ongoing right of access to the generation facility under certain conditions. The utility has the right of access to the generation project premises for a reasonable purpose and at a reasonable time, if the generation project owner receives reasonable notice from the utility.

The utility also has a right to access the premises at any time in the event of an emergency or hazardous condition.

TEMPORARY DISCONNECTION

A utility might need to disconnect a generator from its system for a variety of reasons. Such situations should be provided for in the interconnection agreement. The utility has the right to temporarily disconnect the generation project if it is reasonably necessary due to emergency conditions, routine maintenance, construction and repair, forced outages for immediate repairs, or adverse operating effects on the grid created by the operation of the generation facility.

CHANGES AND INSURANCE COVERAGE

Written authorization for generation facility changes must be obtained from the utility. The interconnection agreement includes a requirement that the project owner obtain sufficient liability insurance to cover the generation project and interconnection, except for the smallest generation projects.

Standardized agreements may or may not include specific requirements for the type and amount of coverage.

CONFIDENTIALITY

A provision in the interconnection agreement describes each party's obligation to protect the confidential information of the other party. Information about the design, operating specifications, and metering data of the generation facility might be considered confidential information.

TIMELINES

The interconnection agreement will state its length of time and how to go about renewal. The initial term of might be long (10 years) with shorter renewal periods.

An important aspect of both the interconnection and power purchase agreements are construction milestones and delivery date for power produced. The generation project owner is responsible for observing these dates, because physical interconnection of the generation facility and the power purchase processes are managed separately.

LIABILITY—IMPORTANT!

Very important: the generation project owner must manage the agreed upon dates to ensure that the power delivery date is not earlier than the construction completion date. If this date is earlier than when the utility is able to complete the required construction for the interconnection, the generation project owner can be liable for fines, be considered in default of the power purchase agreement, or both.

DOs AND DON'Ts

Dos

Do learn about the interconnection rules and power purchase agreement options for the type and size of generator you are proposing to develop with the specific utility to which you intend to interconnect.

Do learn as much as you can about the utility electrical system(s) near your project, before submitting an application for interconnection.

Do investigate if other generation projects are proposed in the vicinity of your possible POI and discuss the process with others who have successfully gone through it. Much can be learned by reviewing previous studies available online and through utilities. This may also provide an insight into how far down you are in the interconnection queue.

Remember: "Last on the feeder pays," meaning that if there is already a lot of generation on the distribution line where you'll interconnect, extra costs may be added to your project, which other developers before you didn't incur.

Do have a clearly defined project before submitting an interconnection application. What type and model of generator will you use? What is the maximum or minimum size of your project (nameplate capacity)? What is your expected in-service date?

Do attend the scoping meeting (if needed) with all project information in hand. Be prepared to describe your project.

Do bring any technical consultants with you to the meeting. Uncertainties can be discussed here. The utility will appreciate knowing this information and they'll inform you how it might impact the processing of your application.

Do listen to the issues raised by the utility during the scoping meeting and keep a calm and open mind. Not every challenge identified at this point will actually prove to be a problem, nor ultimately require any action or expenditures on your part.

Do ask the utility if there alternative approaches to an issue and even propose some of your own. This will help keep a collaborative approach. Focus on solving any problems identified. There are often several ways to meet the requirements of the applicable rules and standards.

Don'ts

Don't confuse the interconnection process with the power purchase process. Getting an interconnection agreement is completely separate from getting a power purchase agreement (PPA), even if it's the same utility company. Often, different departments handle the PPA and Interconnection Agreements.

Don't let the PPA process get far ahead of the interconnection process. PPAs have binding responsibilities for power production, and penalties if these are not met. There may also be overlapping equipment requirements, such as metering that is specified in both agreements.

Don't assume that you can wait too long to begin talks with the utility about a PPA. Be aware that rates can and do change without a great deal of notice and a rate change could affect the viability of a project.

Don't let cost and timeline estimates from the feasibility or system impact studies scare you away. With uncertainty, a large contingency may be included. Don't assume these estimates are high, new information could drive costs higher than projected.

Don't expect the utility interconnection process to necessarily accommodate your development timeline. Utilities have limited staff available to process an ever-increasing number of generation interconnection requests. Flexibility can serve you well in the long run, especially with unexpected delays or changes to your system design.

Don't neglect to secure transmission service if you are planning to wheel power across one utility's system and sell to another utility. Transmission service and interconnection are separate processes and agreements, typically handled by different departments within a utility company.

APPENDIX

This section provides charts, diagrams, and specifications to accompany previous information described in this guidebook.

STATE OF OREGON WEBSITE

The State of Oregon's website discusses renewable resource projects and provides links to useful documentation. For more information, please visit: **http://www.oregon.gov/ENERGY/RENEW/index.shtml**

Interconnection issues are discussed in the State of Oregon's Wind Energy Home Page. For more information, please visit: **http://www.oregon.gov/ENERGY/RENEW/Wind/windhome.shtml** and check the Small Wind Systems and Interconnection Issues section.

IDENTIFYING TRANSMISSION LINE STRUCTURES

In order to determine possible interconnection options near a proposed distributed generation project, identify the local distribution or transmission lines. Identifying a line's voltage level can help determine other characteristics, like ownership of the line.

3-phase lines up to 345-kV will have 3 individual wires; 3 sets of 2 or more wires indicates a voltage of 345-kV or higher (345-kV lines fit in both categories). The most useful discriminator of voltage level is the number of insulators attaching each wire to the pole structure. (See page 33 for examples.)

EXAMPLE ONE-LINE DIAGRAM

A one-line diagram is required with the interconnection application. This one-line diagram serves as an example of the level of detail required. (See page 34.)

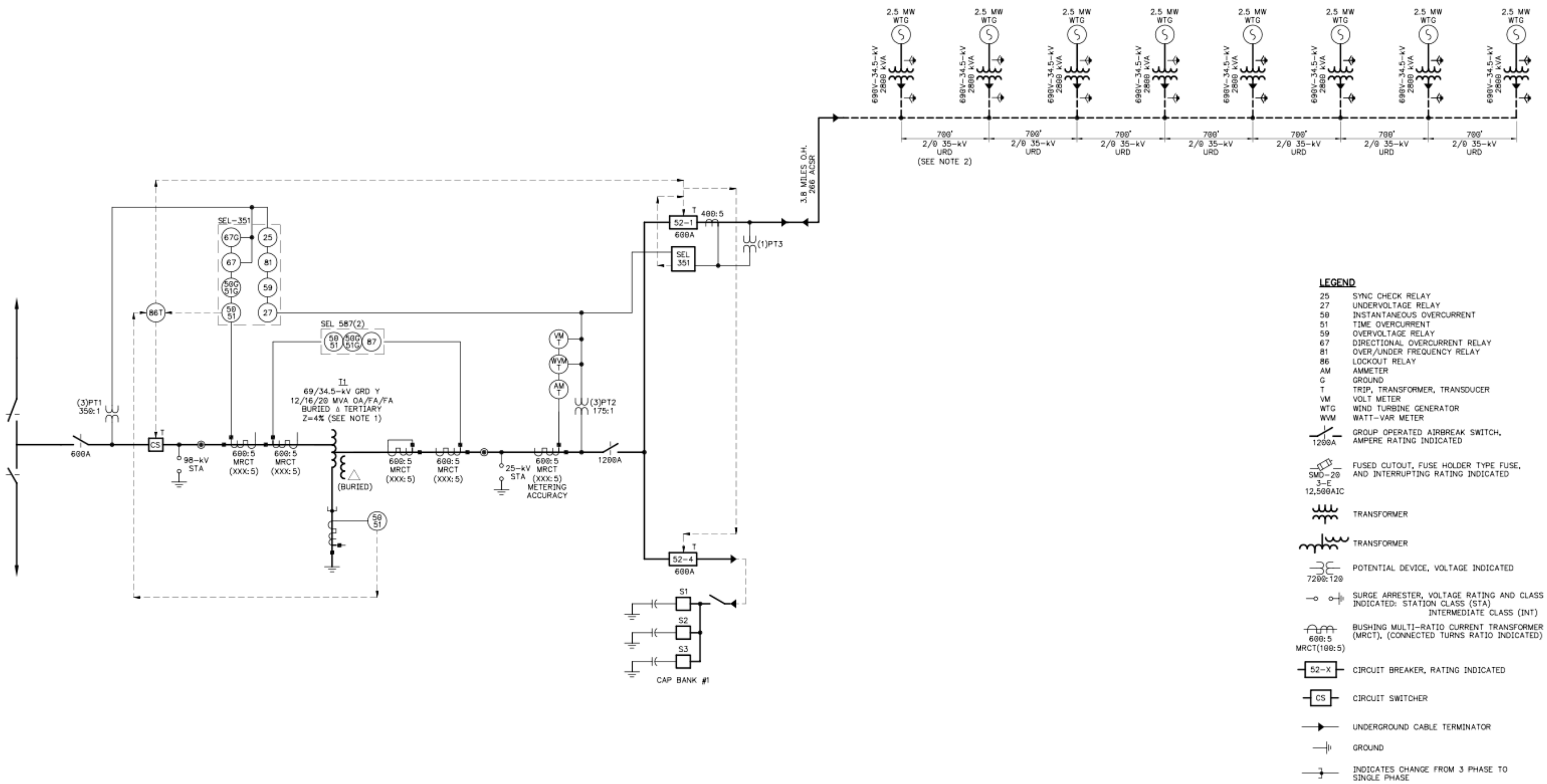
Voltage Level	Number of Insulators
12-kV	2
34.5-kV	3
46-kV	4
69-kV	5 (4 to 6)
92-kV	7
115-kV	8
138-kV	9 (8 to 11)
161-kV	11
196-kV	13
230-kV	15 (12 to 21)
287-kV	19
345-kV	22 (18 to 21)

FIGURE 3: 3-phase 12.5-kV line

FIGURE 4: 69-kV to 34.5-kV (3-phase)

FIGURE 5: 115-kV line (3-phase)

FIGURE 6: 115-kV to 230-kV line (3phase)



600A
(3)PT1
350:1
CS
T
98-kV
STA
SEL-351
67G
67
50G
51G
50
51
25
81
59
27
86T
600:5
MRCT
(XXX:5)
SEL 587(2)
87
T1
69/34.5-kV GRD Y
12/16/20 MVA OA/FA/FA
BURIED Δ TERTIARY
Z=4% (SEE NOTE 1)
(BURIED)
25-kV
STA
METERING
ACCURACY
VM
WVM
AM
(3)PT2
175:1
1200A
52-1
400:5
SEL
351
(1)PT3
52-4
S1
S2
S3
CAP BANK #1
3.8 MILES O.H.
266 ACSR
2.5 MW
WTG
690V-34.5-kV
2800 kVA
700'
2/0 35-kV
URD
(SEE NOTE 2)
LEGEND
25 SYNC CHECK RELAY
27 UNDERVOLTAGE RELAY
50 INSTANTANEOUS OVERCURRENT
51 TIME OVERCURRENT
59 OVERVOLTAGE RELAY
67 DIRECTIONAL OVERCURRENT RELAY
81 OVER/UNDER FREQUENCY RELAY
86 LOCKOUT RELAY
AM AMMETER
G GROUND
T TRIP, TRANSFORMER, TRANSDUCER
VM VOLT METER
WTG WIND TURBINE GENERATOR
WVM WATT-VAR METER
GROUP OPERATED AIRBREAK SWITCH, AMPERE RATING INDICATED
FUSED CUTOUT, FUSE HOLDER TYPE FUSE, AND INTERRUPTING RATING INDICATED
SMD-20
3-E
12,500AIC
TRANSFORMER
TRANSFORMER
POTENTIAL DEVICE, VOLTAGE INDICATED
7200:120
SURGE ARRESTER, VOLTAGE RATING AND CLASS INDICATED: STATION CLASS (STA) INTERMEDIATE CLASS (INT)
BUSHING MULTI-RATIO CURRENT TRANSFORMER (MRCT), (CONNECTED TURNS RATIO INDICATED)
MRCT(100:5)
52-X
CIRCUIT BREAKER, RATING INDICATED
CIRCUIT SWITCHER
UNDERGROUND CABLE TERMINATOR
GROUND
INDICATES CHANGE FROM 3 PHASE TO SINGLE PHASE

APPLICATION CHECKLISTS

General information required for all applications:

Customer contact information

Documentation of Site control or Ownership of the property

Application level or tier

Facility Location

Interconnecting Utility

One-line diagram

Generator Manufacturer

Generator Model

Generator Nameplate Rating (kW and kVA)

Generator Voltage

Type of Service (Wye or Delta)

Phase

Design Capacity

Prime Mover (Inverter or Turbine – Induction, Synchronous)

Energy Source

Installation Date, In-Service, and Commissioning Dates

INFORMATION GENERALLY REQUIRED FOR SGIP FAST-TRACK, STUDY PROCESS, AND FOR AR 521, TIERS 2, 3, AND 4 PROCESSES.

Documentation of Field-Tested Equipment, optional for Tier 2

Documentation of Lab-Certified Equipment

Transformer (Phase, Voltages, Configuration, Impedance)

Operation Mode (Qualifying Facility or Not)

Energy Production Equipment Type

Total Electric Nameplate Rating (kW and kVA), Rated Voltage, Rated Current

Synchronous generator specifications

Induction generator specifications

Inverter-based facilities

Inverter specifications

Reverse Power Relay Information, for Tier 3 (Manufacturer, Model, Electric Nameplate Capacity Rating)

A note on generator specifications: Communicate with your generator manufacturer early on about purchasing a generator and obtaining all necessary information. Interconnection applications require specific generator information.

To avoid a frustrating experience for all parties concerned: when requesting generator specifications, be specific about each item for the application. If purchasing a generator second-hand, ensure that the technical information is available for make and model.

SYNCHRONOUS GENERATOR SPECIFICATIONS:

Manufacturer

Model Number

Version Number

Field Amperes

Reactances

Other information

INDUCTION GENERATOR SPECIFICATIONS:

Manufacturer

Model Number

Version Number

Locked Rotor Current

Resistances

Reactances

Phase

Frame Size

Design Letter

Temperature Rise

INVERTER-BASED FACILITIES DC COMPONENT INFORMATION:

Manufacturer

Model

Rated Voltage

Open Circuit Voltage

Rated Current

Short Circuit Current

INVERTER-BASED GENERATOR SPECIFICATIONS:

Manufacturer

Model

Electric Nameplate Capacity

Rated Output Current

Voltage

Power

Power efficiency

Power factor

INVERTER-BASED GENERATOR SPECIFICATIONS:

Manufacturer

Model

Electric Nameplate Capacity Rated Output Current, Voltage, and Power

Efficiency

Power Factor

Interconnection Process Timelines

A summary of some of the key timeframes for response are identified below. This is not a complete list: always confirm the timeframe identified with the actual rule or regulations. Timeframes may change as rules or regulations are updated.

AR 521 Timelines	# of business days
Allowed for the public utility to give notice of any deficiencies, after the witness test	5
Allowed to resolve any deficiencies, after notice of deficiencies	20
Allowed to give notice of operation to the public utility, before operation	10
Allowed to give notice of emergency site entry, after the public utility enters the site for the purpose of an emergency	5
Allowed to refund any surplus deposit to the applicant for facilities, after the facilities costs are determined	20
Allowed for the public utility to deliver a copy of the interconnection application, interconnection agreement, or certificate of completion to the customer, after request	15

AR 521 Timelines – Tier 1	# of business days
Allowed for the public utility to give notice of Tier 1 approval, after the application is determined complete	15
Allowed for the public utility to give an explanation for the denial of a request, after the application is determined to be denied	5

AR 521 Timelines – Tier 2	# of business days
Allowed to schedule the scoping meeting, after the application is determined complete	10
Allowed to evaluate the application, review any independent analysis, and provide notice of approval or denial, after the scoping meeting (if applicable) or after the notice of application completeness, whichever is later	20
Allowed for the public utility to give an explanation for the denial of a request, after the application is determined to be denied	5

AR 521 Timelines – Tier 3	# of business days
Allowed to schedule the scoping meeting, after the application is determined complete	10
Allowed to evaluate the application, review any independent analysis, and provide notice of approval or denial, after the scoping meeting (if applicable) or after the notice of application completeness, whichever is later	20
Allowed for the public utility to give an explanation for the denial of a request, after the application is determined to be denied	5

AR 521 Timelines – Tier 4	# of business days
Allowed to schedule the scoping meeting, after the application is determined complete	10
Allowed to give notice of approval, after the scoping meeting, if no studies are necessary, no system upgrades or facilities modifications required, and no safety or reliability issues	15
Allowed to give notice of approval, after the scoping meeting and the applicant agrees to pay for the cost of any modifications, if no studies are necessary and minor modifications are required	15

Allowed to provide the feasibility study agreement to the applicant, after the scoping meeting	5
Allowed for the applicant the execute the feasibility study agreement	15
Allowed for the public utility to provide the feasibility study results to the applicant, after completion	5
Allowed for application approval, after the feasibility study, if the feasibility study does not identify any adverse conditions, no system impact study is required, and no facilities study is required	15
Allowed for application approval, after the feasibility study and the applicant agrees to pay for the cost of any modifications, if the feasibility study does not identify any adverse conditions, no system impact study is required, no facilities study is required, and minor modifications are required	15
Allowed for the public utility to deliver the system impact study agreement to the applicant, after the scoping meeting, if no feasibility study is required	5
Allowed for the applicant to execute the system impact study agreement, after receipt	15
Allowed for the public utility to supply the system impact study results, after completion	5
Allowed for application approval, after the system impact study, if all criteria are met and no interconnection facilities or system upgrades are required	15
Allowed for application approval, after the system impact study and the applicant agrees to pay for the cost of any modifications, if all criteria are met and minor modifications are required	15
Allowed for the public utility to supply the applicant with the facilities study agreement, after the system impact study (if applicable) or scoping meeting	15
Allowed for the applicant to execute the facilities study agreement	15
Allowed for application approval, after the applicant agrees to pay for any interconnection facilities and system upgrades identified in the facilities study	15

FERC SGIP Timelines	# of business days
Allowed for the public utility to give the applicant notice of receipt of the application	3
Allowed for the public utility to give the applicant notice of whether the application is complete or incomplete, after receipt	10
Allowed for the public utility to supply the applicant with a list of required information, after an application is determined to be incomplete	10

FERC SGIP Fast-Track Process Timelines	# of business days
Allowed to determine if the application passes the initial screens, after the application is determined to be complete	15
Allowed for the public utility to deliver an interconnection agreement, after the application passes the initial screens and is approved	5
Allowed for the public utility to deliver an interconnection agreement, after the application is approved, despite failing the initial screens, if the public utility determines that the proposed facility may be interconnected consistent with safety, reliability, and power quality standards	5
Allowed for the public utility to give notice to the applicant, after determination that a facility cannot be approved without minor modifications	5
Allowed for the public utility to offer a customer options meeting, after notice has been given to the applicant that a facility cannot be approved without minor modifications	10
Allowed for the applicant to agree in writing to a supplemental review and submit a deposit, after a supplemental review is offered	15
Allowed for the applicant to pay a supplemental review invoice that exceeds the deposit, after receipt of the invoice	20
Allowed for the public utility to return any excess deposit for a supplemental review, after the invoice	20
Allowed for the public utility to determine if a facility can be interconnected safely and reliably, after receipt of the deposit for a supplemental review	10

Allowed for the public utility to deliver an executable interconnection agreement to the applicant, after it is determined that the facility can be interconnected safely and reliably or it is determined that the facility can be interconnected safely and reliably with minor modifications and the applicant agrees to pay for any modifications	5

FERC SGIP Study Process Timelines	# of business days
Allowed before the scoping meeting is held, after the application is determined to be complete	10
Allowed to deliver the feasibility study agreement to the applicant, after the scoping meeting	5
Allowed to return the executed feasibility study agreement, after receipt	15
Allowed to deliver the system impact study agreement to the applicant, after the scoping meeting, if no feasibility study is required	5
Allowed to deliver an executable interconnection agreement to the applicant, after the feasibility study shows that there are no potential for adverse system impacts (an no system impact study is required) and no additional facilities are required (no facilities study is required)	5
Allowed for the public utility to deliver a distribution system impact study agreement, after the feasibility study (if applicable) or the scoping meeting, if potential adverse system impacts are identified, but no system impact study is required	15
Allowed for the public utility to deliver a system impact study agreement, after the feasibility study or distribution system impact study, if a system impact study is required	5
Allowed for the applicant to return an executed system impact study agreement	30
Allowed for the public utility to deliver the system impact study report and facilities study agreement, after the system impact study is complete	5
Allowed for the applicant to return an executed facilities study agreement	30
Allowed for the public utility to deliver an interconnection agreement, after the facilities study is complete and the applicant agrees to pay for any required interconnection facilities and system upgrades	5
Allowed for the applicant to give written notice to the public utility prior to any commissioning tests	5
Allowed for the applicant to return an executed interconnection agreement	30

Oregon Net Metering Level 1 Timelines	# of business days
Allowed for notice of a complete or incomplete application, after receipt	3
Allowed for the queue to be retained for resubmittal of application at a higher level, after denial	30
Allowed for evaluation of application against required criteria, after notice of a complete application	10
Allowed for approval of the application, if there is no notice of application completeness	20
Allowed for the public utility to notify the applicant if an inspection is required and whether an interconnection agreement is required (and to deliver the interconnection agreement, if applicable), after the notice of approval	3
Allowed for the applicant to notify the public utility of operation, prior to operation	5

Oregon Net Metering Level 2 Timelines	# of business days
Allowed for notice of a complete or incomplete application, after receipt	3
Allowed for the queue to be retained for resubmittal of application at a higher level, after denial	30
Allowed for evaluation of application against required criteria, after notice of a complete application	15
Allowed for the public utility to deliver the executable interconnection agreement, after notice of approval	3
Allowed for the public utility to deliver the executable interconnection agreement, after notice of approval, if the application failed the criteria, but was accepted anyway	5
Allowed for the applicant to return the executed interconnection agreement and indicate the operation date, after receipt	10

Oregon Net Metering Level 3 Timelines	# of business days
Allowed for the public utility to provide all pertinent information to the applicant, after receipt of the application	3
Allowed for the public utility to provide an impact study agreement, after receipt of the application	7
Allowed for the public utility to deliver notice of any necessary minor modifications with an interconnection agreement, or notice of sub-stantial modifications, after execution of the impact study agreement	30
Allowed for the applicant to execute the interconnection agreement, pay any deposit, complete facility installation, and agree to the cost, prior to operation	10
Allowed or the public utility to arrange witness commissioning tests, after notice of installa-tion	15
Allowed for notice of approval, after passing any required commissioning tests	3

GLOSSARY

Adverse system impact
A negative effect caused by the interconnection of a small generator

Aggregate Generation
The total combined generation on an area electric power system.

Area Network
A type of distribution system served by multiple transformers interconnected in an electrical network circuit in order to provide high reliability of service. This term has the same meaning as the term “secondary grid network” as defined in IEEE 1547, section 4.1.4.

Certificate of Completion
A certificate signed by an applicant and an interconnecting public utility attesting that a small generator facility is complete, meets the applicable requirements of the small generator interconnection rules, and has been inspected, tested, and certified as physically ready for operation. A certificate of completion includes the “as built” specifications and initial settings for the small generator facility and its associated interconnection equipment.

Consumer-Owner Utility
A municipal electric utility, a public utility district, an irrigation district, a cooperative, or a mutual corporation or association, that is engaged in the business of distributing electricity to more than one retail electric customer in the state.

Distribution System
The portion of an electric system that delivers electricity from transformation points on the transmission system to points of connection on a customer’s premises.

Facilities Study
A study that determines exactly what must be done to interconnect the facility to the utility electric system, including equipment and costs. This usually follows a system impact study.

Feasibility Study
A preliminary study that can determine if additional facilities are necessary for the proposed project to interconnect to the utility. This study does not go into as much detail as a system impact study and facilities study. This usually precedes a system impact study.

Field-Tested Equipment
Interconnection equipment that is identical to equipment that was approved by the interconnecting public utility for a different small generator facility interconnection under Tier 4 review and successfully completed a witness test within three years before the date of the submission of the current application.

Impact Screens
A set of conditions that the interconnecting facility and the electric network must meet in order to qualify for specific interconnection tiers.

Induction (Asynchronous) Machine
A generator that produces electrical power when the shaft is rotated faster than the synchronous frequency of the equivalent induction motor. Wind turbines and small hydro often use induction generators due to their ability to produce power at varying rotor speeds.

Interconnection
The result of adding a distributed resource, such as a generator, wind farm, or other resource, to an electric power system.

Interconnection Equipment
Devices, such as transformers, meters, and telemetry equipment, used in an interconnection system.

Inverter-Based
Refers to a generator that uses an inverter to convert DC power to AC power. Generally this refers to photovoltaic generation, but other types of generation may be inverter-based.

Investor-Owned Utility
A public utility managed as private enterprise rather than a function of government or a utility cooperative.

Lab-Certified Equipment

Interconnection equipment that has been designed to comply with IEEE 1547, tested in accordance with IEEE 1547.1, and certified and labeled as compliant with these IEEE standards at the point of manufacture by a nationally recognized testing lab.

Minor Equipment Modification

A change to a small generator facility or its associated interconnection equipment that does not affect the application of the approval requirements, does not, have a material impact on the safety or reliability of the public utility's transmission or distribution system or an affected system, and does not affect the nameplate capacity of a small generator facility.

Point of Common-Coupling

The point where a local electric power system is connected to an area electric power system. Synonymous with Point of Interconnection.

Point of Interconnection

The point where a small generator facility is electrically connected to a public utility's transmission or distribution system. Synonymous with Point of Common-Coupling.

Public Utility

Public utility generally refers to any utility providing electric service to customers. This includes both investor-owned utilities and consumer-owned utilities. The utility is referred to as a public utility because it provides a service to the public.

Qualifying Facility (QF)

A small power production facility generating 80 MW or less, whose primary energy source is renewable (hydro, wind, solar) or biomass, waste, or geothermal. Some exceptions apply to the 80 MW size limit, which apply to certain facilities certified prior to 1995 and designated under section 3(17)(E) of the Federal Power Act (FPA) (16 U.S.C. § 796(17)(E)), which have no size limitation. To be "qualifying," a small wind facility must meet all requirements of 18 C.F.R. §§ 292.203(a), 292.203(c), and 292.204 for size and fuel use and be certified as a QF pursuant to 18 C.F.R. § 292.207.

Radial distribution network

A radial network passes from the substation through the network area with no connection to any other transmission or distribution lines. This is common for rural lines with isolated loads. Radial lines are susceptible to outages during faults, whereas non-radial lines can supply power from other connecting lines.

Scoping Meeting

An initial meeting between representatives of an applicant and an interconnecting public utility that is conducted to discuss alternative interconnection options; to exchange information, including any relevant transmission or distribution system data and earlier studies that would reasonably be expected to affect the interconnection options; to analyze such information; and to determine the potentially feasible points of interconnection.

Spot network

A type of transmission or distribution system that uses two or more intertied transformers protected by network protectors to supply an electrical network circuit. A spot network may be used to supply power to a single customer or a small group of customers.

Synchronous Machine

A generator that operates at synchronous speed. The speed of the rotor always matches supply frequency. These are often used in steam turbines, gas turbines, reciprocating engines, hydro turbines, and wind turbines.

System Impact Study

A study that focuses on the electric system impacts that would results if the proposed facility were interconnected without modifications. This generally follows a feasibility study and precedes a facilities study.

System Upgrade

An addition or modification to a public utility's transmission or distribution system or to an affected system that is required to accommodate the interconnection of a small generator facility.

Transmission System

A public utility's high voltage facilities and equipment used to transport bulk power or to provide transmission service under the public utility's open access transmission tariff.

Wheeling Power (Export of Power)

The act of providing the service of transporting electric power over transmission lines.

Witness Test

The on-site visual verification of the interconnection installation and commissioning as required in IEEE 1547, sections 5.3 and 5.4. For interconnection equipment that does not meet the definition of lab-tested equipment, the witness test may, at the discretion of the public utility, also include a system design and production evaluation according to IEEE 1547, sections 5.1 and 5.2, as applicable to the specific interconnection equipment used.

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