Public Utility District No. 1
of Cowlitz County, Washington

Electric System
Interconnection Requirements

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1. Introduction

The Facility Connection Requirements (FCR) described herein provide a summary of technical requirements for entities seeking to interconnect generation resources, transmission lines, distribution lines and loads onto the Public Utility District No. 1 of Cowlitz County (District) electric system. The purpose of these requirements is to assure the safe operating integrity and reliability of the District owned electric system and to comply with mandatory reliability standards. Contractual matters, such as costs, ownership, scheduling, and billing are not the focus of these requirements.

Note: Generating facilities with peak generating capability less than 100 kW should follow the procedures contained in Cowlitz PUD’s “Interconnection Standards Policy – Interconnection of Electric Generators (Generating Capacity of Not More Than 100 Kilowatts)”. New end-use loads with Maximum Demand less than 2500 kW should follow the procedures contained in Cowlitz PUD’s Electric Service Requirements. Cowlitz PUD Engineering reserves the right to enforce the FCR’s in this document on loads under 2500 kW when circumstances require additional study. This will be determined at the sole discretion of the District.

All requests for transmission services, distribution services, and ancillary agreements must be made independent of interconnection requests. The term “Applicant” describes the utility, developer or other entity that requests a new or modified connection for a line, load or generation resource and includes both current District customers served under one of its retail electric rate schedules and entities that are not currently District electric customers but who intend to connect to the District’s electric system. Requests to interconnect generating resources or loads are typically submitted by the Applicant. The term “Customer” generally refers to an entity with facilities that are electrically connected to the District’s electric system.

Physical laws that govern the behavior of electric systems do not recognize boundaries of electric facility ownership. Therefore, the electric power system must be studied, without regard to ownership, to develop a properly designed interconnection that is compatible with the future electric system as well as present conditions. The complete review may include studies of short circuit fault duties, system protection requirements transient recovery voltages, reactive power requirements, stability requirements, harmonics, safety, operations, maintenance and prudent electric utility practices. It may also be required for the District to perform joint studies with other utilities to address any potential impact to the reliability of the bulk electrical system.

The general interconnection process consists of three (3) primary stages. Following the formal acceptance of an Interconnection Request from the Applicant the District may require execution of any or all of the following agreements and studies in determining the feasibility and impact to the District Transmission System:

**Stage 1:** Execution of Interconnection Feasibility Study Agreement, Feasibility Study completion, and approval of study results.

**Stage 2:** Execution of Interconnection System Impact Study Agreement, System Impact Study completion, and approval of study results.
Stage 3: Execution of Interconnection Facilities Study Agreement, Facility Study completion, and approval of study results.

Specific FCRs are provided back to the Applicant pending the successful completion and approval of all appropriate studies.

The FCRs identified in this document are not intended as a design specification or an instruction manual and the information presented is expected to change periodically based on industry events, evolving standards, and internal and external changes to the District’s electric system. Technical requirements stated herein are consistent with the District’s current internal electric facility planning guidelines and practices for system additions and modifications. These requirements are intended to be in full compliance with the North American Electric Reliability Corporation (NERC), and Western Electricity Coordinating Council (WECC) requirements and also to be consistent with the general principles and practices of the Institute of Electrical and Electronics Engineers (IEEE) and American National Standards Institute (ANSI) if applicable. To the extent that the codes, standards, criteria and regulations are applicable, the new or modified facilities shall be in compliance with those standards and practices. Specifically, these requirements are intended to comply with NERC Reliability Compliance Standards FAC-001-3 and FAC-002-2 (or currently effective versions).

Interconnecting generation, transmission lines, distribution lines, and load facilities and associated equipment shall include the following goals:

- Ensure the safety of the general public and District personnel.
- Minimize the possible damage to the property of the general public, the District and District Customers.
- Minimize adverse service impacts to present and future District customers.
- Minimize adverse impacts to the present and future District electric system.
- Adhere to District standards and requirements.
- Minimize adverse operating conditions on the present and future District's system.
- Provide required information to the District before District analysis is started.
- Obtain a review and approval by the District prior to interconnection.
- Avoid adverse rate and capital cost impacts.
- Permit the applicant to operate their generating equipment in parallel with the District's system in a safe and efficient manner.

In order to achieve these interconnection goals, certain protective devices (relays, control schemes, circuit breakers, etc.) must be installed to properly disconnect the Applicant's system from the District electric system whenever a fault or abnormality occurs. The determination of what type of protective devices is required depends primarily on three major factors:

- The type and size of the Applicant's load and/or generation equipment (i.e. synchronous, induction, inverter-based, etc.), or transmission lines.
- The location of the Applicant on the District system.
- The manner in which the installation will operate (one-way vs. two-way power flow).

In addition to protective devices, certain modification and/or additions may be required on the electric system due to the addition of the Applicant's Facility Interconnection. Each request for interconnection will be handled individually, and the District will make the final determination of the protective devices, maintenance and operation requirements, communication and
control requirements, modifications and/or additions required. The District will work with the Applicant to achieve an installation that meets the requirements of both the Applicant and the District.

The District cannot assume any responsibility for protection of the Applicant’s equipment, or of any other portion of the Applicant's electrical equipment. The Applicant is solely responsible for protecting its equipment in such a manner that faults, imbalances, or other disturbances on the District system do not cause damage to the Applicant’s equipment.

2. Facility Connection Process

The general facility connection process is outlined in Figure 1:

![Facility Connection Process Map](image)

**Figure 1: Facility Connection Process Map**

2.1. Request for Interconnection of New or Modified Facilities

For any service requests, the District should be contacted as early as possible in the planning process for any potential generation, load, or transmission or distribution line project within or adjacent to the District system where the project will interconnect with the District electric system.

Requests for transmission services are not addressed in this document. Contact Power Resources at the District for more information. Consistent with applicable law, transmission service requires compensation from the Applicant to mitigate stranded costs if a new transmission system interconnection will bypass or otherwise strand investment in an existing District facility.

*The Electric Service Requirements booklet* contains policies, standards and general requirements for providing overhead and underground service to District customers. For all interconnection requests, the Applicant shall have the responsibility of reading and understanding the Electric Service Requirements document, available from Customer Engineering.

2.1.1. Generation Interconnection

Applicants desiring to interconnect generation capable of being operated in parallel with the District system are required to complete the *Study Request for Interconnection of Generation Facilities* form. Requests for connection may also require additional related information as listed in Section 6 *Appendix A: Information Requirements.*
2.1.2. Transmission and Distribution Lines, and Load Facility Interconnection

The Study Request for Interconnection of Transmission Lines and Loads form must be completed and submitted to the District for any proposed transmission or distribution line interconnection to the District electric system.

2.2. Interconnection Feasibility Study

2.2.1. Interconnection Feasibility Study Agreement

Upon acceptance of the Request for Interconnection, an Interconnection Study Agreement, as seen in Section 7, will be provided to the Applicant. The Interconnection Study Agreement shall specify that the Applicant is responsible for the actual cost of the Interconnection Feasibility Study. The District shall provide a non-binding good faith estimate of the cost and timeframe for completing the Interconnection Feasibility Study.

2.2.2. Interconnection Feasibility Study Procedure and Scope

The completed Request for Interconnection for new generation, transmission and distribution lines, or load facility will be used by the District to perform a feasibility study to determine the required additions and modification to District substations, transmission lines, distribution lines, controls and communication circuits to accommodate the proposed interconnection. The Interconnection Feasibility Study shall preliminarily evaluate the feasibility of the proposed interconnection to the transmission system and will include a power flow and short circuit analysis. The Interconnection Feasibility Study will provide a list of facilities and a non-binding good faith estimate of cost responsibility and a non-binding good faith estimated time to construct.

Upon the completion of the Interconnection Feasibility Study the District will provide the following to the Applicant:

- A determination of whether the Applicant’s generation is classified as parallel or non-parallel operation with the District’s electric system.
- Preliminary details of any modifications required to the District’s system and/or the Applicant’s proposed configuration

2.3. Interconnection System Impact Study

After reviewing an Applicant’s Request for Interconnection and completing an Interconnection Feasibility Study, the District shall determine on a nondiscriminatory basis whether an Interconnection System Impact Study, Interconnection Facilities Study, and/or Joint Study is needed. If the District determines that an Interconnection System Impact Study, Interconnection Facilities Study, and/or Joint Study is necessary to accommodate the requested service, it shall so inform the Applicant, as soon as practicable. Upon notice of Applicant’s intent to proceed, the District shall tender an Interconnection Study Agreement. If, at the District’s sole discretion, the electric system conditions have changed significantly before the Applicant elects to proceed with further study, additional study costs may be required to verify the validity of the previously completed study.
2.3.1. Interconnection System Impact Study Agreement

The Interconnection Study Agreement shall specify that the Applicant shall compensate the District the actual cost of the Interconnection System Impact Study. The District shall provide a non-binding good faith estimate of the cost and timeframe for completing the Interconnection System Impact Study.

2.3.2. Interconnection System Impact Study Procedure and Scope

The Interconnection System Impact Study shall evaluate the impact of the proposed interconnection on the reliability of the Transmission System. The study will use good utility practice, engineering and operating principals, and standards, guidelines, and criteria of the District, BPA, WECC, and NERC, or any similar organization that exists in the future of which the District is then a member.

The Interconnection System Impact Study will consist of a short circuit analysis, a stability analysis, and a power flow analysis. The study will identify District facilities that limit transfer capability and determine possible upgrades, expansions, other modifications, or re-dispatch to relieve the constraint. If a limit occurs in neighboring electric systems, the District will cooperate with other entities to develop solutions jointly acceptable to all parties. This may require that a “Joint Study” be performed with other regional utilities.

The Interconnection System Impact Study will state the assumptions upon which it is based; state the results of the analyses; and provide the requirements or potential impediments to providing the requested interconnection service, including a preliminary indication of the cost and length of time that would be necessary to correct any problems identified in those analyses and implement the interconnection. The Interconnection System Impact Study will provide a list of facilities that are required as a result of the Interconnection Request and a non-binding good faith estimate of cost responsibility and a non-binding good faith estimated time to construct.

The District shall coordinate the Interconnection System Impact Study with any system that is affected by the Interconnection Request, including metering, to ensure that it is within a Balancing Authority’s metered boundary. The District shall utilize existing studies to the extent practicable when it performs the study and shall use reasonable efforts to complete the Interconnection System Impact Study within a mutually agreeable timeframe. At the request of the Applicant, or at any time the District determines that it will not meet the required time frame for completing the Interconnection System Impact Study, the District shall notify the Applicant as to the schedule status. Upon request, The District shall provide the Applicant all supporting documentation, work papers and relevant pre-Interconnection Request and post-Interconnection Request power flow, short circuit and stability databases for the Interconnection System Impact Study, subject to confidentiality arrangements.

2.4. Interconnection Facilities Study

2.4.1. Interconnection Facilities Study Agreement

Upon notification to the District that the Applicant wishes to proceed with Facilities Study, the District shall provide an Interconnection Study Agreement. If, at the District’s sole discretion, the electric system conditions have changed significantly before the Applicant elects to proceed with further study, additional study costs may be required to verify the validity of the previously completed study. The Interconnection Study
Agreement shall specify that the Applicant shall compensate the District for the actual cost of the Interconnection Facilities Study. The District shall provide to the Applicant a nonbinding good faith estimate of the cost and timeframe for completing the Interconnection Facilities Study.

2.4.2. **Interconnection Facilities Study Procedure and Scope**

The Interconnection Facilities Study shall specify and estimate the cost of the equipment, engineering, procurement and construction work needed to implement the conclusions of the Interconnection System Impact Study in accordance with Good Utility Practice to physically and electrically connect the Interconnection Facility to the Transmission System.

The Interconnection Facilities Study shall also identify the electrical switching configuration of the connection equipment, including, without limitation: the transformer, switchgear, meters, and other station equipment; the nature and estimated cost of any Transmission Provider's Interconnection Facilities and Network Upgrades necessary to accomplish the interconnection; and an estimate of the time required to complete the construction and installation of such facilities.

The District shall coordinate the Interconnection Facilities Study with any affected system, including metering, to ensure that it is within a Balancing Authority’s metered boundary. The District shall utilize existing studies to the extent practicable in performing the Interconnection Facilities Study. The District shall use reasonable efforts to complete the study and issue a draft Interconnection Facilities Study report to the Applicant within a mutually agreeable timeframe. At the request of the Applicant, or at any time the District determines that it will not meet the mutually agreed upon time frame for completing the Interconnection Facilities Study, the District shall notify the Applicant as to the schedule status of the Interconnection Facilities Study. If the District is unable to complete the Interconnection Facilities Study and issue a draft Interconnection Facilities Study report within the agreed upon time, it shall notify the Applicant and provide an estimated completion date.

The Applicant may, within thirty (30) Calendar Days after receipt of the draft Facilities Study report, provide written comments to the District, which may be included in the final report. The District shall issue the final Interconnection Facilities Study report promptly upon receiving the Applicant’s statement that it will not provide comments. The District may extend the issuance date of the final Interconnection Facilities Study Report if Applicant's comments require the District to perform additional analyses or make other significant modifications prior to the issuance of the final Interconnection Facilities Report. Upon request, the District shall provide the Applicant supporting documentation, work papers, and databases or data developed in the preparation of the Interconnection Facilities Study, subject to confidentiality arrangements.

2.5. **Joint Studies**

The Cowlitz PUD System interconnects with the Bonneville Power Administration (BPA) System at various locations in Cowlitz County. BPA also serves as the Balancing Authority & Planning Coordinator for the Cowlitz PUD System. Accordingly, interconnections to the Cowlitz PUD System could have an impact on the BPA System, as well as BPA's Balancing Authority area. As a result, a Project may also be subject to all or portions of Bonneville’s Line and Load Interconnection Procedures, Generator Interconnection – Large (Business Practice), and Technical Requirements for Interconnection with the BPA Transmission Grid. The Project location, interconnection voltage, transmission access
requirements, and capacity will dictate the extent to which the Bonneville procedures and technical requirements apply to a given Project. In these cases Cowlitz PUD will submit study requests to BPA on the Applicant’s behalf.

2.6. Formal Interconnection Agreement

Upon completion of all required studies, Applicant specific facility connection requirements will be provided to the Applicant along with a formal Interconnection Agreement.

2.7. Notification Procedures

The District shall, as required and necessary, advise other regional entities of any proposed and/or implemented new or modified facilities interconnected to the District’s Electric System. The District will notify BPA or other agencies, at the earliest stage of the project as feasible.

The District complies with the NERC Facility Standard FAC-002 for notification of new or modified facilities to others. Furthermore, the District reviewed, revised, and submitted WECC base cases with projects under construction, budgeted, and planned for in the current capital construction plan. Below is the routine, annual data transmission and information exchange procedures with others to ensure correct data model exchange for use in system impact studies:

Transmission Data and Information Exchange:

- The District shall submit annual system data to BPA, the Planning Authority for a final submittal to WECC. The system data shall include but not be limited to the projected loads, system topology, and generation resources used in its planning studies.
- The District will submit as needed any generation dynamic characteristic modifications to BPA.
- Technical steady state and dynamic data used for District planning studies will be made available to other regional entities subject to appropriate non-disclosure, including the District planning base cases.
- The District transmission system planning base-case model is to be updated annually and includes the latest updates of generation, and customer and transmission connections.

3. General Interconnection Requirements

3.1. Voltage Level, MW, and MVAR Capacity or Demand

Assessments and studies shall comply with the latest applicable NERC Reliability Standards and WECC System Performance Criteria. Data requested from the Applicant includes, but shall not be limited to: average and peak load information, electric motor nameplate data, generator fuel type, generator maximum MW output, generator terminal voltage, transformer high-side and low-side voltages, generator MVA, generator nominal power factor and dynamic data.
3.2. Breaker Duty and Surge Protection: Switchgear

3.2.1. General Requirements
Circuit breakers, disconnect switches, and all other current-carrying equipment connected to the District transmission and distribution facilities shall be capable of carrying normal and emergency load currents, and must also withstand available fault currents without damage. This equipment shall not become a limiting factor in the ability to transfer power on the District electric system. During prolonged steady-state operation, all such equipment shall be capable of carrying the maximum continuous current that the interconnected facility can deliver. All circuit breakers and other fault-interrupting devices shall be capable of safely interrupting fault currents for any fault that they may be required to interrupt. Application shall be in accordance with ANSI/IEEE C37 Standards.

3.2.2. Circuit Breaker Operating Times
The rated interrupting times in cycles typically required of circuit breakers on the District electric system are as follows: 3 cycles or less for the distribution system, and the high voltage transmission system.

3.2.3. Other Fault-Interrupting Device
Depending on the application, the use of other fault-interrupting devices such as circuit switchers may be required. As determined by the District on a case by case basis, fuses may be adequate for protecting the high-voltage delta side of a delta-wye-grounded transformer. Use of transformer fuses may result in single phasing of low-side connected loads.

3.2.4. Surge Protection
Voltage stresses, such as lightning or switching surges, and temporary over voltages may affect equipment duty. Remedies depend on the equipment capability and the type and magnitude of the stress. In general, stations with equipment operated at 12.5 kV and above, as well as all power transformers shall be protected against lightning and switching surges by the use of the surge arrester devices and/or shielding. Typically, this includes station shielding against direct lightning strikes, surge arresters on all power transformers, and surge protection with rod gaps or arresters on the incoming lines.

Temporary over voltages can last from seconds to minutes, and are not characterized as surges. These over voltages may be present during islanding, faults, loss of load, or long-line situations. All new and existing equipment must be capable of withstanding these duties. The District follows NESC & WECC operating procedures such that normal voltage control practices do not cause temporary over voltage.

3.3. System Protection and Coordination
The District will work with the Applicant to achieve an installation that meets the Applicant’s and District requirements. The District cannot assume any responsibility for protection of the Applicant’s equipment. Applicants are solely responsible for protecting their equipment in such a manner that faults, imbalances, or other disturbances do not cause damage to their facilities or result in problems for other customers.
The District coordinates its protective relays and control schemes to provide for personnel safety and equipment protection and to minimize disruption of services during disturbances. Generating facility interconnection usually requires the addition or modification of protective relays and/or control schemes. New generating facilities shall be compatible with the existing protective relay schemes. Sometimes the addition of voltage transformers (VTs), current transformers (CTs), or communication assisted relaying scheme(s) are also necessary, depending on the interconnection point.

The protection system must be designed to reliably detect faults or abnormal system conditions and provide an appropriate means and location to isolate the equipment or system automatically. The protection system must be able to detect power system faults within the protection zone. The protection system should also detect abnormal operating conditions such as equipment failures or open-phase conditions. Special relaying practices may also be required for system disturbance, such as under voltage or under frequency detection for load shedding or reactive device switching. For most generation and some load, the Applicant will also be required to participate in special protection schemes or remedial action schemes (RAS) including automatic tripping or damping.

The protection schemes and equipment necessary to integrate the new connection must be consistent with these practices, standards, and guidelines. The District’s protection requirements address the following objectives:

- Ensure the safety of the general public, District and other utility personnel.
- Prevent property damage to the general public, District and customers.
- Minimize adverse operating conditions affecting the District and customers.
- Comply with NERC, WECC and NWPP protection criteria in existence.

In order to achieve these objectives, certain protection equipment (relays, circuit breakers, etc,) must be installed. These devices ensure that during faults or other abnormal conditions, the appropriate equipment is promptly disconnected from the District electric system. Protective equipment requirements depend on the specific equipment design and operation requirements of the Applicant’s proposed service connection. Significant issues that could affect these requirements include:

- The location and configuration of the proposed connection.
- The level of existing service and protection to adjacent facilities.
- The connection of a line or load that coincidentally connects a generation resource, which was not previously connected to the District electric system.

### 3.4. Metering Requirements

#### 3.4.1. Revenue and Interchange Metering System

All interconnections of facilities require District qualified metering for revenue or interchange. Energy data recording is required for District’s billing and scheduling functions. Revenue metering includes energy (kWh) and reactive energy (kVarh) recorded by revenue meters on a demand interval basis. Interchange metering includes bi-directional energy and reactive data as well as special telemetering requirements for scheduling purposes. The metering shall be located to measure the net power at the point of interface to or from the District power grid. The District typically owns and maintains the revenue metering at the load-metering and generation metering sites.
Revenue and interchange metering, telemetering, and data communication facilities require calibration and testing on a programmed periodic basis to ensure correct data readings. When the Project is not connected to the District’s system Cowlitz PUD will confirm which Balancing Authority the system is attached to.

3.4.2. **Generation Metering System**

Generation metering usually consists of bi-directional meters and related communications systems providing active power (in kW) and energy (in kWh) from the point of interface with the District. Active power is telemetered on a continuous basis for AGC and energy readings are sent to the District control center. Effective telemetering requires real-time knowledge of the quality of measurement. Associated with the telemetering signal, various indications of telecommunications quality or failure should be included.

Generation metering, telemetering, and data communication facilities require calibration and testing on a programmed periodic basis to ensure correct data readings.

3.5. **Grounding and Safety Issues**

The Applicant’s facilities must be designed in accordance with good utility practice, IEEE Std. 80, and the National Electric Safety Code. Studies must be performed to guarantee step and touch, as well as transferred, voltages are limited to safe levels. Furthermore, testing must be performed to verify the integrity of the installed system.

Each generation site and/or interconnecting switching station shall have a ground grid that solidly grounds all metallic structures and other non-energized metallic equipment. This grid shall limit the ground potential gradients to such voltage and current levels that will not endanger the safety of people or damage equipment which are in, or immediately adjacent to, the station under normal and fault conditions. The size, type, and ground grid requirements are in part based on local soil conditions and available electrical fault current magnitudes. In areas where ground grid voltage rises are not within acceptable and safe limits (due for example to high soil resistivity or limited substation space), grounding rods and wells can be used to reduce the ground grid resistance to acceptable levels.

If the generation site is close to another switching station or distribution substation, the two ground grids may be isolated or connected. If the ground grids are to be isolated, there may be no metallic ground connections between the two substation ground grids. Cable shields, cable sheaths, station service ground sheaths, and overhead high-voltage system shield wires can all inadvertently connect ground grids. Fiber-optic cables are excellent choices for telecommunications and control between two substations to maintain isolated ground grids. If the ground grids are to be interconnected, the interconnecting cables must have sufficient capacity to handle fault currents and control ground grid voltage rises. The District shall approve any connection to a District switching station (or distribution substation) ground grid.

The integration of generation may substantially increase fault current levels at nearby substations. Modifications to the ground grids of existing stations may be necessary to keep grid voltage rises within safe levels. The system study will determine if modifications are required and the estimated cost.
3.6. Insulation Coordination

Power system equipment is designed to withstand voltage stresses associated with expected operation. Adding or connecting new facilities can change equipment duty and may require that equipment be replaced or switchgear, telecommunications, shielding, grounding and/or surge protection be added to control voltage stress to acceptable levels. Preliminary Interconnection Studies and System Impact Studies include the evaluation of the impact on equipment insulation coordination. The District may identify additional requirements to maintain an acceptable level of District electric system availability, reliability, equipment insulation margins, and safety.

3.7. Voltage, Reactive Power, and Power Factor Control

Voltage schedules are necessary, in order to maintain optimal voltage profiles across the regional transmission system. Optimal profiles minimize transmission of reactive power, and preserve flexibility in use of reactive power control facilities. The District and/or BPA maintain voltages according to the ANSI Standard C84.1. This allows for variances for plus or minus 5% from nominal for all voltage levels.

Each entity shall provide for its own reactive power requirements, at both leading and lagging power factors unless otherwise specified by the District. The District generally requires customers to minimize exchange of reactive power with the District electric system within limits specified in the “Electric Service Requirements.” Reactive flows at interchange points between control areas should be kept at a minimum as per the “WECC Minimum Operating Reliability Criteria.”

Unless otherwise specifically agreed, the District shall not be obligated to deliver Electric energy to the Customer at any time at a power factor below 95% (refers to Average overall power factor for each individually metered service).

3.8. Power Quality Impacts

In general, the customer has the responsibility not to degrade the voltage of the District system servicing other users by requiring nonlinear currents from District electric system. The customer also has certain responsibilities to account for transmission system events like switching transients and fault induced voltage sags. If it is determined that the new connection facility is causing a power quality problem, then the customer will be held responsible for installation of the necessary equipment or operational measures to mitigate the problem. All loads or system connections to the District shall comply with the requirements established by the most current version of IEEE Std. 519 and IEEE Std. 1547.

3.9. Equipment Ratings

The District’s electric system has been developed with careful consideration for equipment ratings. Some new connections to the District’s electric system require that one or more District’s lines be looped through the end-user’s facilities, or sectionalized with the addition of switches. The design and ratings of the Applicant’s facilities shall not restrict the capability of the line(s) or contractual transmission and distribution path rights. Generation facility ratings shall be based on limits provided by the generator manufacturer including the generator capability curve. Generators shall be rated at nameplate rating unless testing provides evidence to support an increase or decrease in capabilities.
3.10. Synchronizing of Facilities

The Applicant’s facility shall be automatically or manually synchronized with District’s system at all times and the Applicant shall be responsible for the automatic/manual synchronization. Automatic or manual synchronization shall be supervised by a synchronizing check relay. If a synchronizing check relay is used to supervise synchronization, then its output contacts shall be rated to interrupt the circuit breaker closing circuit current and the interrupting device shall be capable of trip-free operation. As mentioned above, synchronization shall be done at the utility tie breaker and also at the generator breaker(s). Interrupting devices with longer than 5-cycle closing time (such as reclosers) shall not be used for synchronization.

3.11. Maintenance Coordination

Transmission and distribution elements (e.g. lines, line rights of way, power transformers, circuit breakers, control and protection equipment, metering, and telecommunications) that are part of the proposed connection and could affect the reliability of the District electric system must be inspected and maintained in conformance with NERC and WECC standards, whichever is the most stringent. The customer has full responsibility for the inspection, testing, calibration, and maintenance of their equipment, up to the location of change of ownership or point of service. Transmission Maintenance and Inspection Plan (TMIP) requirements are a portion of the WECC Reliability Management System for Transmission Lines and may be required. The following is a summary for the Applicant to follow:

- Include the interval schedule for any time-based maintenance activities and a description of conditions that will initiate any performance-based activities.
- Describe the maintenance and inspection methods including specific details for each activity or component.
- Provide any checklists, forms, or reports used for maintenance activities.
- Where appropriate, provide criteria to be used to assess the condition of a transmission facility or component.
- Where appropriate, specify condition assessment criteria and the requisite response to each condition as may be appropriate for each specific type of component or feature of the transmission facilities.
- The TMIP shall describe the maintenance practices for all applicable transmission line activities including patrols and inspections, vegetation management, and contamination control.
- The TMIP shall describe the station maintenance practices for all applicable station facilities including circuit breakers, power transformers, regulators, protective relay systems, and remedial action schemes.
- Maintenance records of all maintenance and inspection activities shall be retained. The records of maintenance and inspection activities shall be made available to the WECC, the District, or other regulatory bodies, as requested.
- Revenue and interchange metering will be calibrated as needed by the District or if required by other agencies. All interested parties or their representatives may witness the calibration test. Calibration of standard meters and instruments must meet accuracy requirements of the National Institute of Standards and Technology.
3.12. Operational Issues (abnormal frequency and voltages)

3.12.1. Considerations to Minimize Disturbances

The new facilities shall be designed, constructed, operated, and maintained in conformance with other related District requirements, applicable laws and regulations, and standards to minimize the impact of the following:

- Abnormal power flows
- Power system faults or equipment failures
- Over voltages during ground faults
- Audible noise, radio, television, and telephone interference
- Power system harmonics
- Other disturbances that might degrade the reliability of the interconnected District electric system

3.12.2. System Frequency During Disturbances

Power system disturbances initiated by system events, such as faults and forced equipment outages, expose the system to oscillations in voltage and frequency. It is important that lines remain in service for dynamic oscillations that are stable and damped. Large-scale blackouts can result from the excessive loss of generation, outage of a major transmission facility, or load rejection during a disturbance. In order to prevent such events, under-frequency load shedding has been implemented throughout WECC, including the Pacific Northwest. Depending on the type and location of any new customer load, the customer may be required to participate in this scheme. It is important that lines and generators remain connected to the system during frequency excursions both to limit the amount of load shedding required and to help the system avoid a complete collapse.

3.12.3. Voltages During Disturbances

In order to prevent voltage collapse in certain areas of the Pacific Northwest, under-voltage load shedding has also been implemented. Most of the load interruptions will occur automatically near 0.9 per unit voltage after delays ranging from 3.5 to 8.0 seconds. Depending on the type and location of any new customer load, the customer may be required to participate in this scheme.

3.12.4. Local Islands

For those generators interconnected to the District electric system through a tapped transmission line, a local island is created when the breakers at the ends of the transmission line open. This leaves the generator and any other loads that also are tapped off this line isolated from the power system. Delayed fault clearing, overvoltage, over/under frequency, ferroresonance, and extended undervoltage can result from this local island condition and shall not be allowed to persist.

3.12.5. Ancillary Services

All loads and transmission and distribution facilities are part of the BPA’s Balancing Authority (BA) serving the District. The host BA provides critical ancillary services, including load regulation, frequency response, operating reserves, voltage control
from generating resources, scheduling, system controls and dispatching service, as defined by FERC, or their successors. All new connections to the District electric system also require a transmission contract with the BA.

All generators shall be operated in voltage control mode, regulating the voltage to a District and/or BPA provided schedule. The District reserves the right to review, accept or reject other control modes. Typically the generator should supply reactive power for its station service loads and reactive power losses up to the point of interconnection. Generator projects may be requested to supply reactive power as an ancillary service.

Normally, the generator will operate its governor to respond independently for frequency deviations. If the governor is controlled through the plant central controller, the governor shall be in ‘droop control’ mode. Droop setting shall be set at 5% and performance shall comply with NERC and WECC reliability standards.

3.13. Inspection Requirements for Existing or New Facilities

Transmission and distribution elements (e.g. lines, line rights of way, power transformers, circuit breakers, control and protection equipment, metering, and telecommunications) that are part of the proposed connection and could affect the reliability of the District electric system need to be inspected and maintained in conformance with NERC and WECC standards whichever is the most stringent. The Applicant has full responsibility for the inspection, testing, calibration, and maintenance of their equipment, up to the location of change of ownership or point of service. TMIP requirements are a portion of the WECC Reliability Management System for Transmission Lines for the Applicant to follow.

The Applicant is responsible for pre-energization and testing of their generation, line, and load facility equipment. For equipment that can impact the District electric system, the Applicant shall develop an “Inspection and Test Plan” for pre-energization and energization testing. The Applicant is responsible for the generator performance testing, monitoring and validation. The District may require additional tests as necessary to ensure compliance with WECC standards.


Applicant must provide a point of contact with reliable communication so that the District’s and Applicant’s personnel can monitor, coordinate, and cooperate to ensure the reliable operation of the electric system during normal and emergency conditions.

The Applicant shall not energize any de-energized District equipment unless the District Dispatcher specifically approves the energization. Where the Applicant is connected to a radial line, the circuit may be interrupted and re-energized by the District by means of an automatic reclosing device. In cases where the interconnection breaks an existing District line, an auto-isolation scheme may be required to maintain continuity to the District line. If the interconnected facilities are networked or looped back to the District electric system or where generation resources are present, a switching device must open to eliminate fault contributions or neutral shifts. Once open, the device must not reclose until approved by the District Dispatcher.

If the generation or load facility requires any type of telemetering, then voice communications to the District operator are also required. If the facility is not staffed with operators, alternative arrangements may be made subject to District approval. A dedicated, direct automatic ring down trunk (or equivalent) voice circuit between the District control center and the operator of the generators or loads may be required for generators or loads of 10 MVA or greater.
Emergency telecommunications conditions may develop that affect telecommunications equipment with or without directly affecting power transmission system facilities. Equipment redundancy and telecommunication route redundancy can protect against certain kinds of failure and telecommunications path interruption. A repair team dedicated to the telecommunications of the interconnecting facility should be retained along with an adequate supply of spare components.

3.15. Fault Duty Increase and Equipment Ratings

The high voltage circuit 3-phase fault duty may increase considerably due to the Customer-owned Facility and the single-line-to-ground fault duty may also increase. All existing high-voltage/distribution system apparatus (such as breakers, reclosers, fuses, current transformers, etc.) near the proposed generating facility shall be upgraded to handle these fault duty increases as required at the Customer’s expense.

3.16. Loading Increase and Equipment Ratings

The high voltage equipment loading may increase considerably due to the Customer-owned Facility. All existing high voltage system apparatus (such as breakers, disconnect switches, current transformers, conductors, switching station busses, autotransformers, etc.) shall be upgraded to handle these loading increases as required at the Customer’s expense.

3.17. Power System Stabilizer Requirements (PSS)

WECC Policy Statement on Power System Stabilizers, dated April 18, 2002, states, “PSS should be installed on all new generators, regardless of ownership or unit size, having suitable excitation systems as defined above.”

3.18. Governor Setting Requirements

WECC requires all generation over 10 MVA to have working governors set at 5% droop.

3.19. Switching Station Requirements

All Customer-owned Facility connections to the District’s high voltage system requires a new switching station in accordance with the District’s specifications. The acceptable bus configurations of the new switching station shall be a ring, main-and-transfer, and breaker-and-a-half. The District does not allow a three-terminal line configuration due to complexity of 3-terminal line protection and switching operation and also due to undesirable impact to system stability.

3.20. Generator Step-up Transformer Connection

The District requires a delta/wye grounded transformer with wye-grounded on the high side and delta on the low side. This type of connection will allow the District to continue using the conventional high voltage line protective devices and surge arresters without any major modifications to protective schemes and also to minimize hazardous Ferro-resonance/neutral-shift conditions.
3.21. Islanding

Islanding describes a condition where the power system splits into isolated load and generation groups, usually when breakers operate for fault clearing or system stability remedial action. Generally, the 'islanded groups’ do not have a stable load to generation resource balance. However, it is possible that, under unique situations, generator controls can establish a new equilibrium in an islanded group.

Some utilities isolate their distribution system and use local generation to feed loads during power system outages. The District does not allow islanding conditions to exist that include its facilities. When District customer loads are being served over another utility’s high-voltage/distribution system, where generation is also interconnected, the implications of islanding must be addressed to minimize adverse impacts on these loads.

When certain high voltage system relays are applied to detect faults and remove the generator infeed, they also prevent extended islanding. Two additional relays are applied to detect an island condition after it occurs; these are necessary to protect District customer loads from damage: over/under voltage (type 59/27), and over/under frequency (type 81). These relays are intended to trip the generator for the large voltage and frequency deviations that would tend to occur during a ‘local’ islanding condition. However, they are also set so the generator does not trip for the less severe deviations that could occur during most major disturbances on the interconnected power system.

3.22. Neutral Shifts

When the Customer-owned Facility is connected to the low voltage side of a delta-grounded wye transformer, the remote end breaker operations initiated by the detection of ground faults on the high-voltage side can cause overvoltages that can affect personnel safety and damage equipment. This type of overvoltage is commonly described as a neutral shift and can increase the voltage on the unfaulted phase to as high as 1.73 per unit. At this high voltage, the equipment insulation withstand duration can be very short. Therefore, one of the following remedies shall be implemented:

- Provide an effective ground (X₀/X₁ < 3 & R₀/X₁ < 1) on the high-side of the transformer that is independent of other high voltage system connections.
- Size the high-voltage side equipment to withstand the amplitude and duration of the neutral shift.
- Rapidly separate the generator from the step-up transformer by tripping a breaker using either the remote relay detection with pilot scheme (transfer trip) or local relay detection of overvoltage condition.

3.23. Direct Transfer Trip Relaying

This pilot relaying scheme is required to minimize problems such as poor power quality, slow protective device response due to low fault currents, accidental out-of-synchronization, damages to the Customer-owned Facilities, District-owned line apparatus, etc. At the District switching station the District will install two multi-function transmission relays. Since these relays are three phase, multi-function relays, one of the two will be the primary and the other is a backup (for redundancy). The Customer-owned Facility shall have the same arrangements at the utility tie breaker. A protection logic processor may need to be installed either at the District Substation and/or at the utility tie breaker, depending on possible configuration changes or contingencies.
In addition, the District may require Line Differential and Permissive Over-reaching Transfer Trip relaying schemes along with the Direct Transfer Trip relaying. No additional device is normally required to add one of these proposed schemes. The final design for protective relaying will be determined and specified by the District as a part of the facilities study.

### 3.24. Under/Over Frequency and Voltage Relays

To prevent any hazardous operating conditions, the Customer-owned Facility shall be isolated from the District high voltage system for over/under-voltage conditions in accordance with the setting recommendation. In addition, the Customer-owned Facility shall be isolated from the District high voltage system for any unacceptable over-frequency and under-frequency conditions within a reasonable period of time also shown later. The Customer’s frequency relay settings shall be reviewed and approved by the District prior to start-up of the Customer-owned Facility. In addition, the District shall verify the Customer’s relay settings by adequate functional testing.

The over/under voltage relay setting/delays listed below are intended to ensure that generators trip when the connections to the power system have been interrupted, preventing extended ‘local islanding.’ The 0.8-second minimum under-voltage delay is intended to coordinate with local fault-clearing times to avoid unnecessary generator tripping.

These requirements also ensure that generators do not disconnect for dynamic (transient) oscillations on the power system that are stable and damped. The oscillatory frequency of the system during a disturbance ranges between 0.25 and 1.5 Hertz. Also, each occurrence of over/under voltage on the system lasts for a short time period (less than one second) and is nearly damped within 20 seconds following the disturbance. During severe system voltage disturbances, it is critical that generators do not trip prior to the completion of all automatic under voltage load shedding.

The frequency ranges and minimum setting/delay requirements for over/under frequency relays (type 81) have been established by the WECC Coordinated Off Nominal Frequency Load Shedding and Restoration Program. The objective of these settings is to use the machine capability to support the power system and prevent unnecessary loss of system load during disturbances, and ultimately, to help prevent system collapse. Generating resources must not trip off before load is shed by underfrequency relays. Underfrequency tripping will be set by the Northwest Power Pool Enhanced Underfrequency Load Shedding Program and/or WECC.

Voltage and frequency relays must have a dropout time no greater than 2 cycles. Frequency relays shall be solid state or microprocessor technology.

### 3.25. Telecommunication Requirements

Telecommunications facilities shall be installed to fulfill the control, protection, operation, dispatching, scheduling, and revenue metering requirements. They may be owned by the District, another utility, a service customer, or a third party. At a minimum, telecommunications facilities must be compatible with, and have similar reliability and performance characteristics to, telecommunications facilities currently used for operation of the District power system to which the new generation or loads will be connected. Telecommunication facilities will be identified in the project requirements. Depending upon the performance and reliability requirements of the
control and metering systems to be supported, the facilities may consist of radio systems, fiber optic systems, or other data or voice communication.

### 3.26. Dedicated Communications Link for Pilot Relaying

The District prefers a fiber optic communications link, but other types of communications links may be acceptable pending approval by the District. Whichever communications link is used, the signal transmission delay caused by a communications link and all associated communications equipment shall not exceed 15 milliseconds.

### 3.27. Dedicated Communications Link for SCADA

To ensure safety of working personnel and prompt response to system abnormalities, the District shall be allowed to know the status of certain breakers (e.g., utility tie breaker, interconnection breaker, and generator breaker(s)) and the real & reactive power flow at the generator breakers and at the District primary meter. The District's Supervisory Control and Data Acquisition (SCADA) System will communicate with a Remote Terminal Unit (RTU) installed at the generating or load facility and it shall be able to open and close the interconnection breaker remotely.

A dedicated communications link for SCADA shall be required. In general, a District-owned local RTU shall be installed at the Customer-owned Facility to perform certain control and monitoring functions as specified elsewhere in this document.

### 3.28. General Telemetering Requirements

The District System Operations Center requires telemetry data for the integration of new load or generation resources. This typically consists of the continuous telemetering of electric quantities and transmission from the Customer-owned facility to the District System Operations Center.

A dedicated communications link is required for General Telemetry, but this link may be shared with the Revenue Metering System and Voice Communications. Telemetry requirements are based on Customer-owned Facility size:

- For Customer-owned Facilities below 10.0 MVA, the District determines telemetry needs on a case-by-case basis. Note that should an existing plant expand to over 10.0 MVA, telemetry is required for the entire plant output.

- Telemetry is required for load interconnections of 10 MVA and greater.

### 3.29. Automatic Generation Control (AGC) Dedicated Communications Link

The district is not a Load Control Area provider and does not provide any AGC services. The Applicant is required to obtain AGC services from Load Control Area provider (BPA). The Applicant is required to install the equipment required for the Load Control Area provider to provide the service.

### 3.30. Dedicated Voice Communications Link

For coordination of system protection, control, and communications maintenance activities between the District and the Customer-owned Facility, a dedicated voice communications link shall be required in addition to communications links specified elsewhere in this document. A dedicated communications link is required for telemetry, but this link may be shared with the Revenue Metering System and General Telemetry.
3.31. **Primary Metering (Revenue Metering System)**

The District shall own, furnish, and install the standard bi-directional primary metering in a pad-mount (or overhead) enclosure to measure the energy delivered by the District to the Customer and the energy received by the District from the Customer. A dedicated communications link is required for this Revenue Metering System, but this link may be shared with the Voice Communications and General Telemetry.

3.32. **Visible Disconnect Switch Requirements**

At the interconnection point to the District system, an isolating device(s) shall be placed in an appropriate location, by agreement of the District and affected parties. The motor-operated, visible disconnect switch(es) at the interconnection point(s) shall be equipped with a lockable mechanism for clearance tagging to provide the visible air gap and also to isolate the Customer-owned Facility from the District high voltage system. This requirement may be waived on a case-by-case basis (with a mutually agreed-upon alternative developed). In any case the device:

- Must simultaneously open all phases (gang-operated) to the Customer-owned Facility.
- Must be accessible by the District and ultimately under the District System Operations Center jurisdiction.
- Must be lockable in the open position by the District.
- Would not be operated without advanced notice to either party, unless an emergency condition requires that the device be opened to isolate the Customer-owned Facility.
- Must be suitable for safe operation under the conditions of use.

The District personnel may lock the device in the open position and install safety grounds:

- If it is necessary for the protection of maintenance personnel when working on de-energized circuits.
- If the Customer-owned Facility or the District equipment presents a hazardous condition.
- If the Customer-owned Facility or the District equipment interferes with the operation of the District system.
- If the District system interferes with the operation of the Customer-owned Facility.

Since the device is primarily provided for safety and cannot normally interrupt load current, consideration shall be given as to the capacity, procedures to open, and the location of the device.

3.33. **Utility Tie Breaker(s) Owned by the Customer**

The Customer-owned utility tie breaker shall reliably detect all faults on the District high voltage system and trip without any intentional delay. The nominal breaker tripping time of 3 cycles shall be required to be used as a utility tie breaker. The automatic isolation shall be done prior to the District switching station breaker reclosing and within a reasonable period of time, typically less than 2 seconds in the absence of direct transfer trip relaying. In addition to all required relays as mentioned elsewhere in this document,
the utility tie breaker should have an automatic/manual synchronizing capability and also be able to handle a recovery voltage of 2 times rated voltage.

3.34. Mechanical (or Electrical) Interlocking System

To ensure safety of working personnel, the District requires a mechanical (or electrical) interlocking system between the utility tie breaker and the visible disconnect switch.

3.35. Disturbance Monitoring

Unique and unanticipated protection problems can result from the changed system configuration due to interconnection with the Customer-owned Facility. The District may, at its discretion, install or require monitoring equipment to identify possible protection scheme problems and to provide power quality measurements of the new configuration. If the monitoring or relay performance indicates inadequate protection of the District system, the owner of the Customer-owned Facility will be notified of additional protection requirements. Monitoring equipment is also installed to aid in the understanding of the electrical phenomena such as over-voltages and ferroresonance that can be associated with Customer-owned Facilities. Remote access to monitored quantities is often accomplished using the Revenue Metering System communication equipment.

3.36. Starting as Induction Motor (if applicable)

In general, induction generators start as motors and also synchronous generators may be designed to start as motors. The Customer-owned generator(s) starting as a motor(s) shall meet the motor starting requirements in the District Electric Service Requirements. The District may require the Customer to provide, at his/her expense, special or additional starting equipment.

3.37. Voltage Fluctuation

Turning the generator on and off may cause undesirable voltage fluctuation. A maximum of 3.5% voltage fluctuation is allowed, but the voltage dip caused by the Customer-owned Facility shall not exceed the Borderline of Visibility as shown in IEEE Standard 241 and also IEEE Standard 141.

3.38. Phase Unbalance

Unbalanced phase voltages and currents can affect protective relay coordination and cause high neutral currents and thermal overloading of transformers. To protect the District's and Customer-owned equipment, the Customer-owned Facility’s contribution at the interconnection point shall not cause a voltage imbalance greater than 1% nor a current imbalance greater than 5%. Phase unbalance is the percent deviation of one phase from the average of all three phases.

3.39. Power Quality and Reliability

The interconnection of the Customer-owned Facility with the District high voltage system shall not cause any reduction in the quality and reliability of service provided to other District customers. This includes, but not limited to, the following: There shall be no objectionable generation of abnormal voltages or voltage fluctuations and the harmonic content of the Customer-owned Facility output must be below that level which would cause undue interference with other customer loads, other utilities, or District equipment.
To minimize all interference, the District requires that the Customer-owned Facility shall meet the power quality requirements specified in the IEEE Recommended Practices and Requirements for Harmonic Control in Electrical Power Systems, IEEE Std 519-2014 (or latest version). In addition, the Customer-owned Facility shall meet all requirements elsewhere in this document and the District Electric Service Requirements.

3.40. Operating Limits

In general, the Customer-owned Facility shall not take reactive power from the District distribution system. Prior to start-up of the Customer-owned facility, the generator operating limits shall be reviewed and approved by the District. The Customer-owned Facility will be expected to supply up to maximum available reactive capability and/or to adjust generation levels including reducing to zero if requested by the District System Operations Center. This will always be for reliability purposes.

3.41. No Automatic Reclosing

The District transmission system power circuit breaker control schemes are normally designed to have at least one automatic reclosing in order to minimize unnecessarily prolonged outages. To minimize potentially hazardous operating conditions or equipment damages due to non-synchronized operation caused by automatic reclosing, no automatic reclosing shall be allowed to the utility tie breaker(s) and generator breaker(s).

3.42. Automatic Disconnection and Time-Delayed Automatic Reconnection

The Customer-owned Facility shall be designed to automatically disconnect and lockout when the District high voltage system service is interrupted for any reason. See Section 3.32 for visible disconnect switch requirements.

Automatic reconnection to the District high voltage system shall be done on Hot-Bus/Hot-Line/Sync-Check at least 5 minutes after the automatic disconnection.

3.43. Generating Facility Protection

The Customer shall be fully responsible for the protection of his/her generators and all of their associated equipment. Protection shall be provided for the Customer-owned equipment failures, faults, and other disturbances on the District system. If a three-phase, multi-functional, microprocessor-based generator protection relay is used; the Customer is required to install one additional relay (backup relay) of the same kind to ensure adequate protection. The Applicant shall provide equipment specifications, protection arrangement, and design drawings to the District for review and written approval prior to installation.

3.44. Blackstart Capability

Blackstart is the condition when one unit of a generation project starts up under local power, in isolation from the power system. Blackstart capability is needed in some rare circumstances, depending on the size and location of the Customer-owned Facility. It is generally not needed for small generators at the Customer-owned Facilities that are near other major generation. This capability is addressed in the planning and review process, and indicated on the specific Interconnection Requirements. Things to consider for blackstart capability include the following:
• Proximity to major generation facilities (i.e., Can startup power be provided more efficiently from an existing plant?);
• Location on the high voltage system (i.e., is the Customer-owned Facility near major load centers and far from generation?);
• Cost of on-site start-up, and
• Periodic testing to ensure personnel training and capability.

3.45. Start-Up
Prior to initial energization of the Customer-owned Facility, inspection and/or tests shall be jointly performed by both the Customer and designated District personnel to verify the proper operation of the generator(s) and associated equipment to the District's satisfaction.

3.46. District Inspection and Customer Maintenance Records
The Customer shall maintain his/her generating facility in good working order. The Customer-owned Facility (generator and associated equipment) may be subject to District inspection upon reasonable notice by the District. The Customer shall assume full responsibility for the routine maintenance of the generating facility and associated protective devices and the keeping of records for such maintenance. These records shall be available to the District for inspection at all times.

3.47. Surge Protection
The Customer shall be fully responsible for the protection of his/her generating facility from transient surges initiated by lightning, switching, or other system disturbances.

Power system equipment shall be designed to withstand voltage stresses associated with expected operation. Interconnecting new generation resources can change equipment duty, and may require that equipment be replaced or switchgear, communications, shielding, grounding and/or surge protection be added to control voltage stress to acceptable levels. The system study includes the evaluation of the impact of the Customer-owned Facility on equipment insulation coordination. The District may identify additions required to maintain an acceptable level of the District system availability, reliability, equipment insulation margins, and safety.

Voltage stresses, such as lightning or switching surges, and temporary overvoltages may affect equipment duty. Remedies depend on the equipment capability and the type and magnitude of the stress. Below are summarized possible additions that may be required to meet the intent of District’s reliability criteria and Standards. In general, stations with equipment rated at 15-kV and above, as well as all transformers and reactors, shall be protected against lightning and switching surges. Typically, this includes station shielding against direct lightning strikes, surge arresters on all wound devices, and shielding with rod gaps (or arresters) on the incoming lines.

3.48. Lightning Surges
Those high voltage lines at voltages of 115-kV and higher that terminate at District switching stations may require additional shielding and/or surge protection requirements. For certain switching stations at 115-kV and below, the District may require only an arrester at the station entrance in lieu of line shielding, or a reduced shielded zone adjacent to the station. These variations depend on the line length, the presence of a
power circuit breaker on the high voltage side of the transformer, and the size of the transformer.

3.49. Switching Surges
At voltages below 230-kV, modifications to protect the District system against Customer-owned Facility-generated switching surges are not anticipated. However, the system study identifies the actual needs.

3.50. Temporary Overvoltages
Temporary overvoltages can last from seconds to minutes, and are not characterized as surges. These overvoltages are present during islanding or faults.

3.51. Future Modification or Expansion
Any future modification or expansion of the Customer-owned Facility shall require an engineering review and approval by the District.

3.52. System Emergency
The District reserves the right to discontinue or interrupt the Customer-owned generation/load to correct any system emergency condition, outage, required system maintenance, or equipment failure.

3.53. Design Standards
In addition to all requirements as shown above, the Customer-owned Facility shall meet the requirements specified in the latest IEEE Guide for Interfacing Dispersed Storage and Generation Facilities with Electric Utility Systems, ANSI/IEEE Std 1001, and also the latest Standard for Interconnecting Distributed Resources with Electric Power Systems, IEEE P1547.

4. Documentation Requirements
The District shall maintain and update the Facility Connection Requirements reflected in this document as necessary to maintain compliance with current NERC, WECC and District standards and guidelines.

Copies of this document will be provided within 5 business days upon request by contacting the District.

5. Glossary of Terms
For industry standard definitions of electric industry terminology, please refer to: The New IEEE Standard Dictionary of Electrical and Electronic Terms, ANSI / IEEE Std 100-1992 or the latest version.

For the purposes of this document the following definitions apply:
**Bonneville (BPA):** The Bonneville Power Administration, a federal power marketing agency responsible for, among other things, operating High Voltage transmission facilities and a Balancing Authority area in the Pacific Northwest.

**Bonneville (BPA) System:** The integrated electrical transmission, control area, and generation facilities operated by Bonneville.

**Connection and Operating Agreement:** The document signed between Cowlitz PUD and the Project Sponsor and/or interconnecting utility for the electrical connection between both parties.

**Connection Point:** The physical location on the power system of the change of ownership between Cowlitz PUD and the Project Sponsor and/or Interconnecting Utility.

**Connection Study:** A study of the electrical effects of a proposed Generation – Transmission Connection and/or Interconnection Project connected to the Cowlitz PUD System, along with the determination of facility additions and associated costs necessary to maintain the reliability of the Cowlitz PUD System and surrounding electric systems, as well as verification that all technical requirements in the document are properly addressed.

**Cowlitz PUD:** Public Utility District No. 1 of Cowlitz County, a Washington State Public Utility District responsible for the planning and operation of certain High Voltage & distribution facilities located in and around Cowlitz County, Washington.

**Cowlitz PUD System:** The integrated electrical High Voltage and distribution facilities owned by Cowlitz PUD, including primarily 230, 115, 69, & 12.47 kV lines and stations. Please note that Cowlitz PUD has nearly completed a program to upgrade 69 kV transmission lines and substations to 115 kV. As a result, all new connections to the High Voltage portion of the Cowlitz PUD System will be at a Connection Point voltage of 115 KV or 230 kV.

**District:** Public Utility District No. 1 of Cowlitz County. See Cowlitz PUD above.

**Generation – Distribution Connection:** Technical Connection Requirements for Load Delivery Facilities and Small Generation Facilities apply to generation Projects connected to the low-voltage side of a new or existing customer service transformer that was originally designed to serve retail load, and having generating capability of greater than 100 kW, but less than i) 5 MW; and ii) 50% of the customer service transformer light load.

**Generation – Transmission Connection:** Technical Connection Requirements for Generation & Interconnection Facilities apply to generation Projects having generating capability in excess of 100 kW and that do not otherwise meet the criteria for “Generation – Distribution Connection”.

**High Voltage:** Nominal operating voltages above 34.5 kV (e.g. 69, 115, & 230 kV) are considered as “High Voltage”.

**Interconnection:** High Voltage or distribution system tie point between two Balancing Authority areas.

**Interconnecting Utility:** The utility that owns the High Voltage or distribution system that connects a Project to Cowlitz PUD’s System at the Connection Point.

**NERC:** North American Electric Reliability Corporation and its successors.

**NERC Reliability Standards:** Standards and criteria for the reliable operation of the North American electric power system that have been adopted by the NERC Board of Trustees and are applicable to Cowlitz PUD, Bonneville, and the Project.
**Project:** The Load Delivery, Interconnection, or generation facility and all equipment associated with integration of the Project up to the Connection Point with Cowlitz PUD High Voltage & distribution facilities. None of the facilities that make up the Project are owned or maintained by Cowlitz PUD.

**Project Operator:** The entity that operates a load delivery, Interconnection, or generation facility.

**Project Sponsor:** The company that owns and/or develops a new load delivery, Interconnection or generation facility.

**Protection Station:** Facility that satisfies the requirements necessary to provide complete protection for Cowlitz PUD’s system immediately beyond the Connection Point on Cowlitz PUD’s side instead of the Project Sponsor’s side.

**Prudent Electric Utility Practices or Prudent Utility Practice or Prudent Engineering Practices:** The generally accepted design, practices, methods, and operation of a power system, to achieve safety, dependability, efficiency, and economy, and to meet utility and industry codes, standards, and regulations.

**SCADA (Supervisory Control and Data Acquisition):** A system of remote control and data acquisition used to monitor and control the High Voltage and distribution system.

**System Impact Study:** A study of the electrical effects of a proposed Generation – Distribution Connection and/or Load connected to the Cowlitz PUD System, along with the determination of facility additions and associated costs necessary to maintain the reliability of the Cowlitz PUD System and surrounding electric systems, as well as verification that all technical requirements in the document are properly addressed.

**WECC:** Western Electricity Coordinating Council or its successor, which is responsible for overseeing the reliability of the Western Interconnection.

**Western Interconnection:** The interconnected electric systems of the western portions of the United States, Canada, and Mexico, which operate synchronously with each other.
6. Appendix A: Information Requirements

6.1. Introduction
When a request is submitted for a connection to the District electric system certain information must be included so the District can properly consider the interconnection request. The actual information required by the District will vary depending upon the type of request. Applicants should contact the District Account Executive and request applications forms and procedures. This appendix describes typical information and data that the District will require for Generators, Transmission Lines, Distribution Lines, and Load Facilities.

6.2. Connection Location
The District needs location information for the proposed interconnection in order to adequately study the impacts. Location information required will vary depending upon the proposal. Locations of new substations, generators or new taps on existing lines must include the township, range, elevation, latitude and longitude. The District also requires driving directions to the location for a site evaluation.

6.3. Electrical Data
The electrical data required will depend upon the type of connection requested.

6.3.1. Electrical One-Line Diagram
The electrical one-line diagram should include equipment ratings, equipment connections, transformer configuration, generator configuration and grounding, bus, circuit breaker and disconnect switch arrangements.

6.3.2. Generator Data
If one or more generators are included as part of the connection request, the following data is needed. If different types of generators are included, data for each different type of generator and generator step up transformer is needed.

6.3.2.1. Generator General Specifications
- Energy source
- Number of rotating generators
- Number of turbines (combustion, steam, hydro, wind, etc.)
- Total project output, MW at 0.95 power factor for synchronous generators
- Station service load for plant auxiliaries, kW, kVAr
- Station service connection plan

6.3.2.2. Generator Data, Synchronous Machines
Data for each different rotating-machine generator assembly (generator, turbine, and shaft) is required. Also, provide the graphs and parameters for each type and size of specified generator as supporting technical documentation:
- Machine capability, PQ curves
- Vee curves
- Open circuit saturation curve
- Identifier (e.g. GTG#12)
- Number of similar generators
- Complex power, kVA or MVA
- Active power, kW or MW
- Terminal voltage, kV
- Machine parameters
  - Sb – Complex power base, (MVA)
  - H – Inertia constant, normalized rotational kinetic energy of the generator, kW·sec/kVA
  - WR2 – Moment of inertia, Lb·ft²
  - Ra – Armature resistance, pu
  - Xd – Direct axis unsaturated synchronous reactance, pu
  - X’d – Direct axis saturated and unsaturated transient reactances, pu
  - X'q – Quadrature axis saturated and unsaturated transient reactances, pu
  - X”d – Direct axis saturated and unsaturated subtransient reactances, pu
  - X”q – Quadrature axis saturated and unsaturated Subtransient reactances, pu
  - XI – Stator leakage reactance, pu
  - X2 – Negative–sequence reactance, pu
  - Zg – Grounding impedance, ohm
  - T’dO – Direct axis transient open circuit time constant, seconds
  - T’qO – Quadrature axis transient open circuit time constant, seconds
  - T”dO – Direct axis sub transient open circuit time constant, seconds
  - T”qO – Quadrature axis sub transient open circuit time constant, seconds
  - S(1.0) – Saturation factor at rated terminal voltage, A/A
  - S(1.2) – Saturation factor at 1.2 per unit of rated terminal voltage, A/A
- Excitation system modeling information
  - Type (static, brushless, rotating, etc.)
  - Maximum/Minimum/Rated field current
  - Maximum/Minimum/Rated field voltage
  - Nameplate information
  - WECC approved Excitation system model for GE PSLF, PowerWorld
  - WECC approved Power System Stabilizer (PSS) type, characteristics, and model for GE PSLF, PowerWorld
  - Speed governor information with detailed modeling information for each type of turbine
  - Turbine type Total capability, MW Number of stages
  - Manufacturer and model
  - Frequency vs. time operational limits, seconds at Hz
  - Maximum turbine ramping rates, MW/minute
  - WECC approved Governor model for GE PSLF, PowerWorld
6.3.2.3. Generator Data, Asynchronous Machines

- Shunt reactive devices for power factor correction with induction generators or converters.
- PF without compensation
- PF with full compensation
- Reactive power of total internal shunt compensations voltage, kVAR
- AC/DC Converter devices employed with certain types of induction motor installations or with dc sources
- Number of converters
- Nominal ac voltage, kV
- Capability to supply or absorb reactive power, kVAR
- Converter manufacturer, model name, number, version
- Rated/Limitation on Fault current contribution, kA

Machine parameters

- Sb - Complex power base, (MVA)
- H – Inertia constant, normalized rotational kinetic energy of the generator, kW-sec/kVA
- WR2 – Moment of inertia, Lb-Ft²
- Ra – Armature resistance, pu
- Xd – Direct axis unsaturated synchronous reactance, pu
- X’d – Direct axis saturated and unsaturated transient reactances, pu
- X’q – Quadrature axis saturated and unsaturated transient reactances, pu
- X’d – Direct axis saturated and unsaturated subtransient reactances, pu
- X”q – Quadrature axis saturated and unsaturated Subtransient reactances, pu
- Xl – Stator leakage reactance, pu
- X2 – Negative–sequence reactance, pu
- Zg – Grounding impedance, ohm
- T’do – Direct axis transient open circuit time constant, seconds
- T”do – Direct axis sub transient open circuit time constant, seconds
- S(1.0) – Saturation factor at rated terminal voltage, A/A
- S(1.2) – Saturation factor at 1.2 per unit of rated terminal voltage, A/A
- Vt – Voltage threshold for tripping, pu
- Vr – Voltage at which reconnection is permitted, pu
- Tv – Pickup time for voltage-based tripping, seconds
- Tvr – Time delay for reconnection, seconds
- Ft – Frequency threshold for tripping, Hz
- Tf – Pickup time for frequency-based tripping, seconds
- Reactive power required at no load, kVAR
- Reactive power required at full load, kVAR
- External Shunt compensation
  - Bus Voltage
6.3.2.4. DC Sources

If the generator project includes dc sources such as fuel cells or photovoltaic devices, the number of dc sources and maximum dc power production per source, kW, is required.

6.3.3. Load Facility Information Requirements

If a new load facility or point of delivery is requested, the following information will generally be required.

- Type of load, such as industrial, commercial, residential or combination
- Load data
  - Delivery voltage, kV
  - Projected peak load, kW or MW
  - Summer peak load, kW or MW
  - Winter peak load, kW or MW
  - Anticipated power factor patterns (summer, winter, peak, etc.)

6.3.4. Transformer Data

If one or more power transformers are included as part of the proposed connection, the following data is required for each unique transformer. The District may require specific primary and secondary winding connections.

- Transformer number or identifier
- Number of similar transformers
- Transformer type and number of windings
- Transformer winding data. For a two winding transformer, only winding H and X data is required.
- Transformer MVA ratings
  - Winding H to X, MVA
  - Winding H to Y, MVA
  - Winding X to Y, MVA
- Transformer impedances, positive and zero sequence
  - Winding H to X %X and R at MVA
  - Winding H to Y %X and R at MVA
  - Winding X to Y %X and R at MVA
- Transformer tap changer information
  - No load and/or load
  - Tap changer winding location, H, X, or Y Available taps
- Transformer cooling requirements if required from the District Load, amps
  - Voltage, single or three phase, Volts
6.3.5. Transmission or Distribution Line Data

If a new transmission or distribution line is to be included as part of the proposed connection, the following transmission and distribution line data is required.

- Nominal operating voltage, kV
- Line length, miles
- Line capacity, amps at 27°C
- Overhead/underground construction
- Positive and zero sequence line characteristics in primary values
- Shunt susceptance, B μS (or μΩ⁻¹)
7. Interconnection Study Agreement

PUBLIC UTILITY DISTRICT NO. 1 OF COWLITZ COUNTY

AGREEMENT

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11. TITLE/BRIEF DESCRIPTION OF WORK TO BE PERFORMED UNDER THIS AMENDMENT

LINE AND LOAD INTERCONNECTION STUDY AND ASSOCIATED TASKS FOR INTERCONNECTION REQUEST NO._______

Description:

Project Schedule:

Costs:

The following document is attached to and becomes part of this Amendment:
- Financial Terms and Conditions Statement

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Public Utility District No. 1 of Cowlitz County

ATTN:
961 12th Avenue
Longview, WA 98632

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