Moon Lake Electric Assn., Inc.

Transmission System Interconnection Requirements

For Generators, New Transmission Facilities,

And End User Equipment

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1. GENERAL REQUIREMENTS

1-A. Safety and Isolating Devices

At every Point of Interconnection with the Moon Lake Electric System, an isolating device, which is typically a disconnect switch, shall be provided that physically and visibly isolates the Moon Lake Electric System from the interconnected facilities. All switching equipment that could energize equipment shall be visibly identified, in a manner that will make maintenance crews aware of the potential hazards. The isolating device may be placed in a location other than the Point of Interconnection by agreement of Moon Lake and Interconnection Customer. In any case the device

- Must simultaneously open all phases (gang operated) to the interconnected facilities;
- Must be accessible by Moon Lake and must be under ultimate Control Area Dispatcher jurisdiction;
- Must be lockable in the open position by Moon Lake;
- Shall not be operated without advance notice to affected parties, unless an emergency condition requires that the device be opened to isolate the interconnected facilities; and
- Must be suitable for safe operation under all foreseeable operating conditions.

All work involving Moon Lake owned, maintained, and/or operated equipment, shall be done in accordance with Moon Lake safety practices, and shall be done at the direction of Moon Lake Dispatchers. Moon Lake 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 interconnected facilities or Moon Lake equipment presents a hazardous condition; or
- If the interconnected facilities jeopardize the operation of the Moon Lake Electric System.

1-B. Point of Interconnection and End-Use Equipment Considerations

1. General Constraints

Interconnected facilities shall not restrain Moon Lake from taking a transmission line or line section or other equipment out of service for operation and maintenance purposes. The design and installation of the line and all components must be consistent with Moon Lake's right to maintain its property.

2. General Configurations

The Interconnection Customer will identify his desired connection voltage, location and the approximate load or demand for both real power and reactive power. In addition the Interconnection Customer will identify the nature and purpose of the end use equipment or the interconnection.

Moon Lake shall determine the appropriate interconnection configuration. The following are non-exclusive categorical examples of interconnection configurations that Moon Lake

may approve under appropriate circumstances. Interconnection with the Moon Lake Electric System typically falls into one of four categories:

- Connection into an existing 69 or 138 kV bulk power substation, with (depending on the bus configuration) the existing transmission lines and new interconnecting lines each terminated into separate bays containing one or more breakers;
- Connection on the low-voltage side of a new or existing power transformer in a Moon Lake-owned substation. This connection, which is discussed below, can create a multi-terminal line if the load side of the transformer includes a generation source or is non-radial on the low voltage side;
- Connection at 69 to 138 kV by directly tapping an existing transmission line; or
- Connection at 69 to 138 kV by looping an existing transmission line into a new customer or Moon Lake owned substation. This connection may result in a new, non-Moon Lake-owned substation within an existing transmission path. Moon Lake must maintain full operational control and ownership of the transmission path. This may include, but not be limited to, ownership, and Supervisory Control and Data Acquisition (SCADA) control and monitoring of circuit breakers, disconnects and other equipment in the new substation. Additionally, Moon Lake will retain capacity rights on the contract path. Any new equipment shall not degrade the operational capability of the line.

A multi-terminal line is created when the new connection, such as bullet 2 or bullet 3 above, becomes an additional source of real power and fault current beyond the existing sources at the line terminals. A line with three terminals affects Moon Lake's ability to protect, operate, dispatch, and maintain the transmission line. The increased complexity of the control and protection schemes affects system stability and reliability. The additional terminal may also decrease the overall performance and availability of the existing line. Moon Lake determines the feasibility of multi-terminal line connections on a case-by-case basis.

3. Other Considerations

(a) Existing Equipment

Existing electrical equipment, such as transformers, power circuit breakers, disconnect switches, arresters, and line conductors shall be operated consistent with design criteria and Prudent Utility Practice. System modifications proposed by the Interconnection Customer, such as the connection of a new line, equipment or load, may cause existing equipment to be inadequate, requiring replacement.

(b) System Stability and NERC/WECC Reliability Standards

The Moon Lake Electric System has been developed with careful consideration for system stability and reliability during disturbances. The future system will also be designed to meet the appropriate NERC and WECC Reliability Criteria throughout its life. From time to time and in the initial planning phase, joint coordinated studies will be required if the project affects the existing interconnected transmission system. Moon Lake, as soon as feasible, will initially act to coordinate the notification of those responsible for the reliability of affected systems about the new or materially modified existing interconnections being planned. Moon Lake, as soon as feasible, will initially act to coordinate the notification of those responsible for the reliability of affected systems requiring joint studies through existing or ad hoc transmission planning groups as may be required. Studies and modifications of existing interconnections and Facilities

will involve Deseret Power and PacifiCorp at a minimum. Moon Lake Electric's Transmission Planner will usually determine the studies required and perform such studies jointly with other utility engineers and organizations. The Interconnection Customer will modify any designs as required by the study results to meet the NERC and WECC Reliability Criteria. If the new facilities are significant to the interconnected system, an annual progress report will be submitted to WECC for notification to all member systems.

The type of connection, size of the load, breaker configurations, load characteristics, and the ability to set protective relays will affect where and how a new Point of Interconnection is permitted by Moon Lake. The Interconnection Customer may also be required to participate in special protection schemes, called Remedial Action Schemes (RAS) such as generator dropping, load shedding, or load tripping. The portion of the transmission path capacity that the Interconnection Customer uses will affect the share of the Interconnection Customer's RAS obligations. If RAS participation is required, the Interconnection Customer and Moon Lake shall jointly plan and coordinate the RAS implementation.

(c) Control and Protection

Moon Lake coordinates its protective relays and control schemes to provide for personnel safety and equipment protection and to minimize disruption of services during disturbances. New Points of Interconnection typically require the addition or modification of protective relays and/or control schemes. Sometimes the addition of voltage transformers, current transformers, or pilot schemes (transfer trips) is also necessary. Any necessary new protection must be compatible with Moon Lake's existing protective relays and/or control schemes. At the time of the connection request, Moon Lake will determine the protective relay systems suitable for the interconnection. In the event the Interconnection Customer suggests a relay system not on Moon Lake's approved list, Moon Lake reserves the right, at the Interconnection Customer's expense, to perform a full set of acceptance tests prior to granting permission to use the suggested protection scheme.

(d) Dispatching and Maintenance

Moon Lake operates and maintains its Electric System to provide reliable customer service while meeting seasonal and daily peak loads even during equipment outages and disturbances. New line and load connections must not restrict timely outage coordination, automatic switching or equipment maintenance scheduling. Preserving reliable service to all Moon Lake customers is essential and may require additional switchgear, equipment redundancy, or bypass capabilities at the Point of Interconnection for acceptable operation of the system. At the time of the connection request, Moon Lake will determine the additional equipment suitable for the interconnection.

The Interconnection Customer will coordinate its maintenance schedule with Moon Lake if its system affects the interconnected electric system. Under such circumstances, the Interconnection Customer will provide two week notice of its intent to conduct maintenance and must be willing to modify its maintenance schedule if in Moon Lake's judgment the maintenance will have an effect on the reliability of the interconnected electrical system.

(e) Atmospheric and Seismic

The effects of atmospheric and seismic events (including, but not limited to wind storms, floods, lightning, elevation, temperature extremes, icing, contamination and earthquakes)

on the reliability, safety, and stability of the Moon Lake Electric System must be considered in the design and operation of the interconnected facilities. The Interconnection Customer is responsible for ensuring that the appropriate standards, codes, criteria, recommended practices, guides and Prudent Utility Practices are satisfied for the equipment that it installs.

1-C. Transmission and Substation Facilities

Some new connections to the Moon Lake Electric System require that one or more Moon Lake lines (a transmission path) be looped through the Interconnection Customer's facilities, or sectionalized with the addition of switches. The design and ratings of these facilities and/or switches shall not restrict the capability of Moon Lake's line(s) and contractual transmission path rights. Moon Lake will design, own, and maintain any facilities that are part of Moon Lake's transmission path.

If the customer provides a circuit breaker at the point of interconnection, then Moon Lake will have no special requirements for the design and construction specifications of the customer's facilities. But, if at the point of interconnection, a breaker is not installed by the Interconnection Customer, the following requirements will need to be met by the Interconnection Customer due to the potential impact of the Interconnection Customer's facilities on Moon Lake's facilities:

- Transmission line designs shall meet the requirements of Moon Lake's design criteria. Specific criteria will be provided for each interconnection.
- Moon Lake will review and approve the Interconnection Customer's design prior to the start of construction.
- Moon Lake's construction specifications must also be followed. Moon Lake may require a full time-inspector during construction and will provide the final inspection before the line will be energized.

For Customer-owned Substations interconnected with Moon Lake's system, specific requirements must be met to protect Moon Lake's system from faults within the Interconnection Customer's facilities. When the interconnection is complete, Moon Lake must have the ability to operate its system without hindrance by the Interconnection Customer's facilities.

Moon Lake takes no responsibility for determining whether the Interconnection Customer's facilities comply with any regulations. Any inspections performed by Moon Lake of the Interconnection Customer's facilities do not constitute approval of the Interconnection Customer's design or construction. It is the Interconnection Customer's responsibility to be in compliance with all regulations.

1. Protection and Control

The protection and control requirements will be site specific for each interconnection but the follow are some general design criteria that need to be followed:

- Faults on the system that is operated at the same voltage as Moon Lake's service voltage or faults in the Interconnection Customer's transformers are to be detected and disconnected from Moon Lake's system in less than 0.14 seconds.
- Faults on the low side of the customer's transformers are to be detected and disconnected from Moon Lake's system in less than 1.0 second.

- Moon Lake's Engineering Department will approve the Interconnection Customer's protection plan. The Interconnection Customer will provide a one line of the proposed substation and their electrical service requirements. Moon Lake's Power System Superintendent will provide the form with all required information. See attachment A-"Moon Lake Request for Electrical Service Requirements".
- Dependent on the load carrying capability of the Interconnection Customer's substation, Moon Lake may require installation of under-frequency and/or under-voltage load-shedding equipment.

2. Ownership and Maintenance

Moon Lake must own and maintain all of the equipment associated with a continuous path of Moon Lake's system through the Interconnection Customer's substation. For example, if Moon Lake line loops into and then back out of the Interconnection Customer's substation, Moon Lake would own all equipment associated with this path (switches, circuit breakers, CVT's, etc.). Moon Lake will also own and maintain the revenue metering, battery and charger, RTU and all associated communication equipment.

3. Design and Construction

Moon Lake will perform the design of all equipment that is owned by Moon Lake within the Interconnection Customer's substation. Interconnection Customer can elect to construct these facilities but must utilize Moon Lake's design and construction standards. Moon Lake's designs and standards given to the Interconnection Customer are intended for the specific site only and shall not be used elsewhere by the Interconnection Customer.

4. Acceptable Transformer Configurations

The transformers connected to Moon Lake's system at 69 kV or higher voltage need to conform to one of the following conditions:

- If the Interconnection Customer's substation is to be a radial tap on a Moon Lake transmission line and no transmission line breakers at the Interconnection Customer's substation are required by Moon Lake, the transformer windings connected to the Transmission System must be connected in a delta.
- If the Interconnection Customer's substation is to be dual fed from two sources, transmission line breakers in Moon Lake's lines are required and may be located in the Interconnection Customer's substation. The transformer windings connected to the Transmission System can be connected in a grounded wye. The grounded wye connection with a delta low side or tertiary winding would be preferred but not required.

5. Inspection

Moon Lake may require a full-time inspector for all construction of Moon Lake facilities within the Interconnection Customer's substation.

6. Switches

For all Moon Lake-owned switches within the Interconnection Customer's substation, Moon Lake will provide switch numbers. These numbers will be affixed to the switch structure per Moon Lake's standards. Moon Lake will provide its locks for these switches. Moon Lake locks only will be allowed on these switches.

7. Battery and Chargers

For Customer-owned substations that are looped through Moon Lake's system, Moon Lake must own and maintain the battery and charger. If the interconnection with Moon Lake is radial, the Interconnection Customer will own and maintain the battery and charger and will agree to maintain both per the contract agreement.

8. Final Inspection

For Customer-owned substations that are interconnected to Moon Lake's system from a radial tap, Moon Lake will only inspect the point of interconnection, metering, and communication's equipment owned by Moon Lake.

For a Customer-owned substation that is interconnected to Moon Lake's system by a continuous path (loop in/out, ring bus, etc.), Moon Lake will inspect all equipment owned by Moon Lake.

When the construction is complete, an inspection shall be arranged through Moon Lake's Manager-Operations. A minimum of five working days' advance notice is required to arrange this inspection.

9. Grounding

The Interconnection Customer will provide Moon Lake's Manager-Engineering with the ground grid design and calculations, geotechnical report and resistivity report. The Interconnection Customer will also provide the grid continuity tests with measurements indicated on the grounding plan drawing. The ground grid resistance to remote earth tests shall also be provided. This measurement shall not exceed 3 ohms.

10. Drawing Approval

For Customer-owned substations with a radial interconnection, the Interconnection Customer shall provide a complete One-Line drawing of their substation to Moon Lake's Manager-Engineering as early as possible in the design phase. Moon Lake will review to ensure the Interconnection Customer's protection plan is in compliance with Moon Lake's requirements for this substation interconnection.

For Customer-owned substations with a continuous path through Moon Lake's system, the Interconnection Customer shall provide a complete One Line drawing of their substation, the grounding design and calculations, and all drawings associated with equipment owned by Moon Lake that have been incorporated into the Interconnection Customer's substation drawings.

11. Revisions to the Customer-owned substation after initial approval

Any revisions to the Interconnection Customer's substation that impacts Moon Lake's system require notification to Moon Lake. At the time of notification, Moon Lake's Power System Line Superintendent or his designated representative will determine if further actions are needed and the process would start again.

12. Spill Prevention, Control and Counter Measures

An Interconnection Customer operating substation facilities should be aware of Federal requirements regarding the prevention, control, and containment of oil which may spill from oil-insulated equipment.

These regulations require the owner or operator of such facilities to prepare a "Spill Prevention and Containment Plan", to have such plans certified by a registered professional engineer, and to implement the plan.

Moon Lake takes no responsibility for determining whether the Interconnection Customer has complied with these regulations. This information is provided as part of this specification merely to alert the Interconnection Customer to the regulations. It is the Interconnection Customer's responsibility to assure that its substation is in compliance with the regulations.

1-D. 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 added to control voltage stress to acceptable levels. Moon Lake may require connection studies to evaluate the impact of a proposed interconnection on equipment insulation coordination. Moon Lake may identify requirements or additions that the Interconnection Customer must satisfy prior to interconnection to maintain an acceptable level of Moon Lake Electric System availability, reliability, equipment insulation margins, and safety.

Voltage stresses, such as lightning or switching surges, and temporary over-voltages may affect equipment duty. Remedies for these types of voltage stresses depend on the equipment capability and the type and magnitude of the stress. In general, stations with equipment operated 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 strokes, surge arresters on all wound devices, and shielding with rod gaps (or arresters) on the incoming lines. The following is a list of non-exclusive requirements or additions that Moon Lake may require the Interconnection Customer to meet in order to satisfy the intent of Moon Lake's reliability criteria.

1. Lightning Surges

If the Interconnection Customer proposes to tap a shielded transmission line, the tap line to the substation must also be shielded. For an unshielded transmission line, the tap line does not typically require shielding beyond that needed for substation entrance. However, special circumstances such as the length of the tap line may affect shielding requirements. Moon Lake shall determine the appropriate shielding requirements.

Lines at voltages of 69 kV and higher that terminate at Moon Lake substations must meet additional shielding and/or surge protection requirements identified in Section 1-C. Switching Surges

At voltages of 138 kV and below, Moon Lake will conduct a system impact and facility requirements study to identify the need for modifications to protect Moon Lake Electric System equipment from switching surges. Typically such modifications are not required; however, such a determination is within the discretion of Moon Lake based on the results of the study. At 138 kV, Moon Lake requires that arresters be added to new line terminations at Moon Lake substations.

2. Temporary Over-voltages

Temporary over-voltages can last from seconds to minutes, and are not characterized as surges. These over-voltages are present during islanding, faults, loss of load, or long-line situations. All new and existing equipment must be capable of withstanding these duties.

(a) Local Islanding

When the interconnection involves tapping a Moon Lake transmission line, a 'local island' may be created when the breakers at the ends of the transmission line open. This can leave generating resources and any other loads that also are tapped off this line isolated from the power system. Delayed fault clearing, over-voltages, ferro-resonance, extended under-voltages, and degraded service to other Moon Lake customers can result from this 'local island' condition. For these reasons, Moon Lake does not allow local islands involving Moon Lake transmission facilities to persist. Special relays to detect this condition and isolate the local generation from Moon Lake facilities are described in Section 3-B.2.

(b) Neutral Shifts

When generation or a source of 'back-feed' is connected to the low-voltage side of a delta-grounded wye customer service transformer, remote end breaker operations initiated by the detection of faults on the high-voltage side can cause over-voltages that can affect personnel safety and damage equipment. This type of over-voltage is commonly described as a 'neutral shift' and can increase the voltage on the un-faulted phases to as high as 1.73 per unit. At this voltage, the equipment insulation withstand-duration can be very short. The following is a list of non-exclusive remedies that Moon Lake may require the Interconnection Customer to meet in order to satisfy the intent of Moon Lake's reliability criteria.

- Provide an effectively grounded system on the high-voltage side of the transformer that is independent of other Transmission System connections.
- Size the high-voltage-side equipment to withstand the amplitude and duration of the neutral shift.
- Rapidly separate the back-feed source from the step-up transformer by tripping a breaker, using either remote relay detection with pilot scheme (transfer trip) or local relay detection of over-voltage condition (see Section 3-B.2).

As used in this section, "effectively grounded" is defined as an $X_0/X_1 \leq 3$ and $R_0/X_1 \leq 1$. Methods available to obtain an effective ground on the high-voltage side of the transformer include but are not limited to the following:

- A transformer with the transmission voltage (Moon Lake) side connected in a grounded-wye configuration and low voltage (Point of Interconnection) side in closed delta.
- A three-winding transformer with a closed-delta tertiary winding. Both the transmission and distribution side windings are connected in grounded wye.
- Installation of a grounding transformer on the transmission voltage (Moon Lake) side.

Moon Lake shall determine the appropriate method for obtaining an effective ground.

1-E. Substation Grounding

Each Customer-built substation must have a ground grid that is solidly connected to 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 ground grid size and type are in part

based on local soil conditions and available electrical fault current magnitudes. In areas where ground grid voltage rises would not be within acceptable and safe limits (due, for example, to high soil resistivity or limited substation space), grounding rods and grounding wells can be used to reduce the ground grid resistance to acceptable levels.

If a new ground grid is close to another substation, the two ground grids may be isolated or connected. If the ground grids are to be isolated, there must be no metallic ground connections between the two substation ground grids. Cable shields, cable sheaths, station service ground sheaths, and overhead transmission shield wires can all inadvertently connect ground grids. A fiber optic cable may be required 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. Moon Lake must approve any connection to a Moon Lake substation ground grid.

New interconnections of transmission lines and/or generation may substantially increase fault current levels at nearby substations. Modifications to the ground grids of existing substations may be necessary to keep grid voltage rises within safe levels. Moon Lake may require connection studies to determine if modifications are required and the estimated cost.

The Interconnection Customer must design the ground grid to applicable ANSI and IEEE Standards relating to safety in substation grounding.

1-F. Inspection, Test, Calibration and Maintenance for interconnections without a circuit breaker at the point of interconnection to Moon Lake

Transmission elements (e.g., lines, line rights-of-way, circuit breakers, control and protection equipment, metering, and telecommunications) that are a part of the proposed connection and could affect the reliability of the Moon Lake Electric System shall be inspected and maintained in conformance with regional reliability standards. The Interconnection Customer has full responsibility for the inspection, testing, calibration, and maintenance of its equipment, up to the location of change of ownership or Point of Interconnection. Protection System Maintenance Plan (PSMP) requirements are a portion of the Western Systems Coordinating Council (WECC) Reliability Management System for transmission. The Interconnection Customer or utility shall, as required by WECC or Moon Lake, annually certify that it has developed, documented, and implemented an adequate PSMP.

1. Pre-energization Inspection and Testing

Before initial energization, the Interconnection Customer shall develop an Inspection and Test Plan for pre-energization and energization testing. Section 3-D below describes specific installation testing requirements for protection systems. Moon Lake may request review of the test plan prior to the test(s). Moon Lake may require additional tests. The Interconnection Customer shall make available to Moon Lake, upon request, all drawings, specifications, and test records of the Point of Interconnection equipment. Upon reasonable request Moon Lake will make available to the Interconnection Customer similar documents describing the Moon Lake Point of Interconnection equipment.

2. Summary of the WECC Transmission Maintenance and Inspection Plan (PSMP)

Interconnection Customer shall prepare and provide to Moon Lake a written description of, and update as necessary, its annual PSMP.

Pursuant to WECC guidelines, the PSMP shall provide descriptions of the various maintenance activities, schedules and condition triggers for performing the maintenance, and samples of any checklists, forms, or reports used for maintenance activities. The PSMP may be performance-based, time-based, or both, as appropriate. Pursuant to WECC guidelines, the PSMP shall

- Include the schedule intervals (e.g., every two years) for any time-based maintenance activities and a description of specific conditions that will initiate any performance-based activities;
- 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;
- Describe and include specific details regarding transmission line and station maintenance and inspection practices as per Section 1-F.2.a and b below.

(a) Transmission Line Maintenance

The PSMP shall, at a minimum, describe the inspection and maintenance practices for all applicable transmission line activities including but not limited to

- Patrols and inspections, routine, detailed and emergency.
- Vegetation management and right-of-way maintenance.
- Contamination control (insulator washing)

(b) Station Maintenance

The PSMP shall, at a minimum, describe the inspection and maintenance practices for all applicable station facilities including, but not limited to

- Circuit breakers
- Power transformers
- Reactive devices (including, but not limited to, shunt capacitors, series capacitors, synchronous condensers, shunt reactors, and tertiary reactors)
- Regulators
- Protective relays

(c) Maintenance Record Keeping and Reporting

The Interconnection Customer shall maintain maintenance records of all maintenance and inspection activities for at least five years. The Interconnection Customer shall make available to Moon Lake, WECC or other regulatory body, as requested, the records of

maintenance and inspection activities to demonstrate compliance with the PSMP. The maintenance and inspection records shall, at a minimum,

- Identify the person(s) responsible for performing the work or inspection;
- Indicate the date(s) the work or inspection was performed;
- Identify the transmission facility; and
- Describe the inspection or maintenance that was performed.

The Interconnection Customer shall maintain, and make available on request, records for substantial maintenance or inspection of the items listed in subsections **a.** and **b.** above.

3. Calibration and Maintenance of Revenue and Interchange Metering

Meters shall be located on the high-voltage side of transformation, and voltage and current transformers used for metering purposes shall be used for no other purpose.

The Interconnection Customer shall calibrate Revenue and Interchange Metering every two years. Other calibration intervals may be negotiated. Interconnection Customer shall provide metering quantities, in analog and/or digital form to Moon Lake. All affected parties or their representatives may witness the calibration tests. The Interconnection Customer shall make calibration records available to all affected parties.

The accuracy of the calibration standards used for calibration shall comply with the standards of the National Institute of Standards and Technology and applicable ANSI standards. The calibration standard(s) shall have been calibrated and certified within twelve months prior to the actual meter calibration.

1-G. Ancillary Services

All loads and transmission facilities must be part of a control area. The control area provides critical ancillary services, including load regulation, and frequency response, operating reserves, voltage control from generating resources, scheduling, system controls and dispatching service, as defined by the FERC, or its successors. The Interconnection Customer shall maintain the new facilities in its own control area and will be the source or provider of ancillary services, or the Interconnection Customer shall arrange for such services contractually, to the satisfaction of Moon Lake.

The Interconnection Customer shall select the source for regulating and contingency reserves, if required by Tariff or WECC or other applicable requirements. Moon Lake shall determine the telemetering, controls, and metering that will be required to integrate the load or facility into the applicable control area and to provide the necessary ancillary services. If the Interconnection Customer chooses self- or third-party provision of reserves, then special certification and deployment procedures must be incorporated into, or otherwise coordinated into, the Automatic Generation Control (AGC) system of the control area. The provision of the required ancillary services shall meet all relevant NERC, WECC, and NWPP (or their successors') reliability policies and criteria, or their successors.

2. PERFORMANCE REQUIREMENTS

The following performance requirements shall be satisfied. The Interconnection Customer shall propose its preferred method for satisfying the following performance requirements. Moon Lake shall determine whether the proposed method is appropriate and satisfies the relevant performance requirement.

2-A. Electrical Disturbances

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

- Electric disturbances that produce abnormal power flows,
- Power system faults or equipment failures,
- Overvoltages during ground faults,
- Audible noise, radio, television, and telephone interference,
- Power system harmonics, and
- Other disturbances that might degrade the reliability of the interconnected Moon Lake Electric System.

2-B. Switching Equipment

1. All Voltage Levels

Circuit breakers, disconnect switches, and all other current-carrying equipment connected to Moon Lake's transmission facilities shall be capable of carrying normal and emergency load currents without damage. The Interconnection Customer shall ensure that this equipment does not become a limiting factor, or bottleneck, in the ability to transfer power on the Moon Lake Electric System.

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 be interrupted without the use of intentional time delay in clearing, fault reduction schemes, etc. Application shall be in accordance with ANSI/IEEE C37 Standards. These requirements apply to the equipment at the Point of Interconnection as well as other locations on the Moon Lake Electric System. Moon Lake shall supply minimum fault-interrupting requirements, which are based on the greater of either the fault duties at the time of the interconnection request or the fault duties projected in long-range plans.

The circuit breaker shall be capable of performing other duties as required for the specific application. These duties may include but are not limited to: capacitive current switching, load current switching, and out-of-step switching. The circuit breaker shall perform all required duties without creating transient overvoltages that may damage Moon Lake equipment. Switchgear on the high side of a delta-grounded wye transformer that can interrupt faults or load must be capable of the increased recovery voltage duty involving interruptions while ungrounded. The connection of a transmission line or load can coincidentally include other generating resources. When this system configuration is connected to the low-voltage side of a delta-grounded wye transformer, the high-voltage side may become ungrounded when remote end breakers open, resulting in high phase-to-ground voltages. This phenomena is described in more detail in Section 1-D.3.b above under 'Neutral Shifts.'

2. Circuit Breaker Operating Times

Table 2-1 below specifies the operating times generally required of circuit breakers on the Moon Lake Electric System. These times will generally apply to equipment at or near the Point of Interconnection. System stability considerations may require faster opening times than those listed. Breaker close times are typically four to eight cycles. The automatic recloser times in Table 2-1 are the summation of the breaker close time plus

delay to allow for extinction of the fault arc (de-ionization), and the protective relay requirements. Circuit breaker interrupting time may vary from those in Table 2-1 but must coordinate with other circuit breakers and protective devices.

Table 2-1 Typical Circuit Breaker Operating Times

Voltage Class (kV L-L rms)	Rated Interrupting Time (Cycles)	Automatic Reclose Time (Cycles)
Below 100 kV	< 5	*
115 to 161 kV	< 3	20 to 120

* - Varies significantly by line.

3. Other Fault-Interrupting Device Operating Times

Depending on the application, Moon Lake may permit the use of other fault-interrupting devices such as circuit switchers. Fuses may be adequate for protecting the high voltage side of a high voltage delta - low voltage grounded wye transformer. Trip times of these devices are generally slower, and current-interrupting capabilities are often lower, than those of circuit breakers. If the Interconnection Customer proposes to use these devices, the Interconnection Customer must test the devices for the duty in which they are to be applied and provide assurances to Moon Lake's satisfaction that the devices coordinate with other protective devices' operating times.

2-C. Transformers, Shunt Reactive and Phase Shifters

The Interconnection Customer must coordinate the use of transformer tap settings (including those available for under load and no-load tap changers), reactive control set-points, and phase-shift angles with Moon Lake to optimize both reactive flows and voltage profiles. Automatic controls may be necessary to maintain voltage profiles on the interconnected system. The Interconnection Customer shall coordinate timed changes with the timed schedules established by the NWPP or its successor.

The Interconnection Customer's transformer-winding configuration will not provide a ground source to Moon Lake's system if breakers and protective relaying equipment are not installed at the interconnection site to detect and isolate faults on Moon Lake's system. The Interconnection Customer's transformer-winding configuration will provide a ground source to Moon Lake's system if the Interconnection Customer's system has a generation source, other than Moon Lake's, or if breakers and protective relaying equipment are installed at the interconnection site to detect and isolate faults on Moon Lake's system.

2-D. Power Quality Requirements

1. Voltage Fluctuations and Flicker

Voltage fluctuations may be noticeable as visual lighting variations (flicker) and can damage or disrupt the operation of electronic equipment and therefore must be managed and mitigated. IEEE Standard 1453-2004 provides definitions and limits on acceptable levels of voltage fluctuation. The new loads or system connections to the Moon Lake Electric System shall not exceed the limits specified in IEEE Standard 1453-2004. If Moon Lake determines that the new connection is the source of the fluctuations, the Interconnection Customer shall be responsible for all necessary equipment to control the fluctuations to the limits identified in IEEE 1453-2004.

2. Distortion

Harmonics and inter-harmonic distortion can cause telecommunication interference, increase thermal heating in transformers, disable solid state equipment and create resonant over-voltages. In order to protect equipment from damage, distortion must be managed and mitigated. IEEE Standard 519-1922 provides definitions and limits on acceptable levels of harmonic distortion at a point of common coupling (PCC) between a facility and its sourcing power system. The new facility connection shall not cause harmonic voltage or currents on the Moon Lake Electric System that exceed the limits specified in IEEE Standard 519-1922. Distortion measurements may be conducted at the PCC, or other locations on the Moon Lake Electric System to determine whether the new connection is the source of excessive distortion. If Moon Lake determines that the new connection is the source of the distortion, the Interconnection Customer shall be responsible for all necessary equipment to control the distortion to the limits identified in IEEE 519-1922.

3. Phase Unbalance

Unbalanced phase voltages and currents can affect protective relay coordination and cause high neutral currents and thermal overloading of transformers and therefore must be managed and mitigated. To protect Moon Lake and customer equipment, the contribution from the new facilities at the Point of Interconnection shall not cause an unbalanced phase voltage greater than 1% or a current unbalance greater than 5%. Phase unbalance is defined as the percent deviation of one phase from the average of all three phases, measured phase-neutral.

System problems such as a blown transformer fuse or open conductor on a Transmission System can result in extended periods of phase unbalance. It is the Interconnection Customer's responsibility to protect any of its interconnected equipment from damage that could result from such an unbalanced condition.

4. Voltage Schedules

Voltage schedules are necessary to maintain voltage profiles across the Transmission System to insure that reactive flows are kept low and that optimum use of reactive control facilities can be maintained. To this end, a voltage schedule shall be mutually developed between Moon Lake and the Interconnection Customer, when appropriate, which will be coordinated via time changes developed by the NWPP, or its successor, for such coordination purposes. Any such schedule shall take into account that Moon Lake maintains voltages to its customers, when regulated, according to the ANSI Standard C84.1. This allows for variances of ±5% off nominal for all voltage levels of the Moon Lake Electric System.

5. 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 (transient) oscillations that are stable and damped.

To avoid large-scale blackouts that can result from excessive generation loss, major transmission loss, or load loss during a disturbance, Interconnection Customer shall comply with regional under-frequency load shedding directives. Load shedding attempts to stabilize the system by balancing the generation and load. When system frequency declines, loads are automatically interrupted in discrete steps, with most of the

interruptions between 59.3 and 58.6 Hz. It is important that lines remain interconnected to the system during frequency declines, both to limit the amount of load shedding required and to help the system avoid a complete collapse.

6. Voltages During Disturbances

To avoid 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 load, the Interconnection Customer may be required to participate in this scheme. Moon Lake shall determine whether such participation is necessary.

2-E. Reliability and Availability

1. Maintaining service.

To minimize risk of overloads, instability, or voltage collapse, reliable operation of the interconnected power system requires the owners to insure the following: reactive sources, control of real and reactive generation, adequate real and reactive reserves, and maintenance of Transmission System voltages.

2. Transmission lines.

Key transmission lines and other facilities should be kept in service as much as possible. They may be removed from service for voltage control only after powerflow studies, in accordance with WECC requirements, indicate that system reliability will not be degraded below acceptable levels. The entity responsible for operating such transmission line(s) shall promptly notify other affected load control areas, per the WECC *Procedure for Coordination of Scheduled Outages and Notification of Forced Outages, or Other Applicable Outages*, when removing such facilities from, and returning them back to service.

3. Switchable devices.

The Interconnection Customer shall ensure that devices frequently switched to regulate transmission voltage and reactive flow shall be switchable without de-energizing other facilities. The Interconnection Customer shall ensure that switches designed for sectionalizing, loop switching, or line dropping shall be capable of performing their duty under heavy load and maximum operating voltage conditions.

4. Loop Flow Mitigation

The Interconnection Customer shall ensure through Prudent Utility Practice, prudent system operation and/or installation of proper equipment, the avoidance of Loop Flow through Moon Lake's system. It will be the Interconnection Customer's responsibility to control Loop Flow, failing which, Moon Lake reserves the right to open the interconnection.

5. Frequency and Duration of Outages.

Planned outages of significant system equipment shall be coordinated with all affected parties to minimize their impact on the remaining system. Automatic and forced outages should be responded to promptly, mitigating any impacts on the remaining system, and in a manner that treats all customer interruptions with the same priority.

6. Key Reliability and Availability Considerations

The Interconnection Customer shall ensure the following key reliability and availability considerations are satisfied:

- The new connection shall meet the NWPP and WECC (or their successors) Minimum Reliability Standards for Planning and Operation.

2-F. Power Factor Requirements

Each Party's system shall provide for its own reactive power requirements, both leading and lagging. Reactive power control including reserves is required to maintain adequate voltage levels to prevent voltage instabilities and insure transient stability.

Interconnection Customer shall at all times effectively control and limit the flow of reactive power at the Point(s) of Interconnection to maintain a power factor of ninety-five percent (95%) or higher lagging or leading. Interconnection Customer shall design and operate its system so it shall not cause abrupt voltage changes greater than +/-3% on Moon Lake's Transmission System.

The Interconnection Customer shall maintain its own power factor without relying on the Moon Lake Transmission System, especially under peak load conditions. Controlling reactive flow can enhance the transfer capability of the affected line and may also reduce system losses. Reactive flows at Interchange points between Control Areas shall be kept at the minimum specification pursuant to the WECC, *Minimum Operating Reliability Criteria*.

2-G. Isolating, Synchronizing and Blackstarts

1. Isolation

At the Point of Interconnection, the Interconnection Customer shall not energize a de-energized Moon Lake line unless the Moon Lake dispatcher specifically approves the energization. Where the connection is to a radial load, the circuit may be interrupted and reclosed by Moon Lake. In cases where the connection breaks an existing path, an auto-isolation scheme may be required to sectionalize the connection to the Moon Lake Electric System. If the interconnected facilities are networked or looped back to the Moon Lake Electric System or where generation resources are present, a switching device must open to eliminate fault contributions or neutral shifts (described in Section 1-D.3.b above). Once open, the device must not reclose until approved by the Moon Lake dispatcher or as specified in the interconnection agreement.

2. Synchronization

The Interconnection Customer must synchronize its system, or portion of its system with energized generating equipment, to the Moon Lake Electric System. Automatic synchronization shall be supervised by a synchronizing check relay, IEEE device 25.

3. Blackstarts

Loads that are scheduled and available for blackstarts are selected to avoid the trip-out of generation units by exceeding frequency and voltage setpoints. This is accomplished by selecting voltage variable loads, avoiding motor start-up loads and imposing block size limits (50 MW). During blackstart restoration, the tapped connection must be able to be opened to avoid interference with Moon Lake restoration procedures on the Moon Lake transmission path.

2-H. Responsibilities During Emergency Conditions

Each Control Area operator has the ultimate responsibility to maintain the frequency within its control area boundaries. All emergency operation involving the Moon Lake Transmission System must be coordinated with the Moon Lake dispatcher and control area operator. Each Party, as appropriate, must participate in any local or regional remedial action schemes. All loads tripped by under-frequency or under-voltage action must not be restored without the Control Area operator's permission. All schedule cuts need to be coordinated with the appropriate Control Area operator, and must be made promptly. Each Party has the responsibility for clear communications regarding actual or suspected problems and must report promptly any actual or suspected problems affecting others.

3. PROTECTION REQUIREMENTS

3-A. Introduction

The protection requirements identified herein are intended to achieve the following objectives:

- Insure safety of the general public, Moon Lake and other utility personnel.
- Minimize property damage to the general public, Moon Lake, and Moon Lake's customers.
- Minimize adverse operating conditions affecting Moon Lake's Electric System and customers.
- Permit the Interconnection Customer to operate its system in a safe and efficient manner with minimum impact to the Moon Lake Electric System and Moon Lake's customers.
- Comply with NERC, WECC and NWPP (or their successors) protection criteria in existence at the time of the connection request.

To achieve these objectives, certain protective equipment (relays, circuit breakers, etc.) must be installed. These devices ensure that faults or other abnormalities initiate prompt and appropriate disconnection from the Moon Lake Electric System. Protective equipment requirements depend on the plan of service. Significant issues that could affect these requirements include but are not limited to

- The location and configuration of the proposed connection
- The level of existing service and protection to adjacent facilities (including those of other Moon Lake customers and potentially those of other utilities).

At the time of the interconnection request, Moon Lake will supply the Interconnection Customer with an approved list of protective relay systems considered to be suitable for use at the Point of Interconnection. The Interconnection Customer shall design and propose a protection system based on that list that satisfies the criteria described in this section. Moon Lake reserves the right to make the final determination as to the devices used for protecting the Moon Lake Electric System and shall identify modifications and/or additions to the Moon Lake Electric System that are required by the connection. Moon Lake will cooperate with the Interconnection Customer to achieve an installation that meets the Interconnection Customer's and Moon Lake's requirements.

Moon Lake does not assume any responsibility for protection of the Interconnection Customer's system. Interconnection Customers are solely responsible for protecting their systems and equipment in such a manner that faults, imbalances, or other disturbances on the Moon Lake Electric System do not cause damage to their facilities or result in problems with their customers.

3-B. Protection Criteria

In designing the protection system, the Interconnection Customer shall endeavor to design a system that reliably

- Detects power system faults or various abnormal system conditions;
- Provides an appropriate means and location to isolate the faulted equipment or system automatically; and
- Detects abnormal operating conditions such as equipment failures or open phase conditions.

Special relaying practices may also be required for system disturbances, such as under-voltage or under-frequency detection for load shedding. Moon Lake reserves the right to review and recommend changes to the protection system and settings for equipment at the Point of Interconnection proposed by the Interconnection Customer.

1. General Protection Practices

The following section provides a non-exhaustive list of the general protection practices as required by NERC and the WECC and the specific practices and applications as applied to Moon Lake Electric System transmission lines and interconnections. The protection schemes necessary to integrate the new connection and the equipment used to implement these schemes must be consistent with these practices. Table 3-1 gives relay and breaker operating time versus voltage levels.

(a) All Voltages

- It is preferred that relays, breakers, etc are installed at the Point of Interconnection to isolate Moon Lake's equipment from faults on the Interconnection Customer's system. Some minimal exposure will be accepted.
- At the Point of Interconnection, the Interconnection Customer shall not energize a de-energized line in the Moon Lake Electric System without prior approval of the Moon Lake Dispatcher.
- Breaker reclose supervision (automatic and manual including SCADA) may be required at the connecting substation and/or electrically 'adjacent' stations (e.g., hot bus and dead line check, synchronization check, etc.).
- Dual batteries are not required but each set of relays must have its own separately protected DC source.
- Relay settings shall not infringe upon Moon Lake's ability to operate at maximum transfer levels, even with system voltages as low as 0.85 per unit.
- Redundant relays shall not be connected to a common current transformer secondary winding.

- Redundant relay systems, which are electrically separated, are required in order to ensure that no single protection system component failure or other event or condition would disable the entire relay system.
- Protection schemes shall be designed with a sufficient number of test switches and isolating devices to provide ease of testing and maintenance without the necessity for lifting wires. Isolating switches shall be alarmed, or operating and maintenance tagging procedures developed and followed, to assure switches are not inadvertently left in an open position.
- Directional relay systems are required on all non-radial connections.
- The protection system security and dependability and their relative effects on the power system must be carefully weighed when selecting the protection system.
- If required, automatic under-frequency load tripping total trip time, including relay operate time and breaker operate time shall not exceed 14 cycles.

(b) Voltages Below 100 kV

- Redundant or overlapping relays systems are required in order to ensure that no single protection system component failure would disable the entire relay system and result in the failure to trip for a fault condition.
- Total fault-clearing times, with or without a pilot scheme, must be provided for Moon Lake review and approval. Breaker operating times, relay makes, types and models, and relay settings must be identified specifically.
- Multi-shot automatic reclosing is permitted; however the total number of automatic reclosures should not exceed three.

(c) Additional Requirements for Voltages Between 100 and 200 kV

- A pilot telecommunication scheme may be required if high-speed clearing is required for any fault location for stability purposes or if remote tripping for equipment protection is required. If a pilot telecommunications scheme is required for stability purposes, it must be redundant or designed to allow high-speed tripping by the protective relays upon failure of the pilot scheme.
- Total fault-clearing times, with or without a pilot scheme, must be provided for Moon Lake review and approval. Breaker operating times, relay makes, types and models, and relay settings must be identified specifically.
- Automatic reclosing for single line-to-ground faults shall be no faster than 20 cycles.
- Automatic reclosing is permitted for multi-phase faults.
- Multi-shot automatic reclosing may be required for automatic line sectionalizing schemes; however, the total number of automatic reclosures should not exceed two.

2. Protection Measures

Protection systems must be capable of performing their intended function during fault conditions. The magnitude of the fault that the protection system must be designed for depends on the fault type, system configuration, and fault location. Moon Lake may in its discretion require the performance of extensive model line tests of the protective relay system to provide assurance the selected relay system is capable of detecting faults for various system configurations. Power system swings, major system disturbances and

islanding may require the application of special protective devices or schemes. Moon Lake reserves the right to make the final determination as to the devices necessary for the protection of the Moon Lake Electric System. The following sections identify the conditions under which relay schemes must be capable of operating.

(a) Phase Fault Detection

Phase over-current (type 50/51) and neutral over-current (type 50/51-N) relays are provided to detect abnormally high currents. These non-directional relays are used to detect faults on the distribution class lines or serve as supervisory fault detectors for transmission relays. They may also serve to backup other protective relays. Line differential relays may be necessary for some connections when coordination with other relays is not possible.

In-feed detection to faults within the power system usually requires directional current-sensing relays to remove the contribution to the fault from the Point of Interconnection. Zone-distance relays (type 21) generally serve this need because they are generally immune to changes in the source impedance.

(b) Ground Fault Detection

Ground fault detection has varying requirements. The availability of sufficient zero sequence current sources and the ground fault resistance both significantly affect the relay's ability to properly detect ground faults. The same types of relays used for phase fault detection discussed above are suitable for ground fault detection. If ground fault distance relays are used, backup ground time-overcurrent relays should also be applied to provide protection for high-resistance ground faults.

(c) 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.

Moon Lake does not permit islanding conditions to exist that include its facilities, except for a controlled temporary separation. .

While operating in an islanded condition or during a system disturbance, power swings may result which can affect the operation of protective relays, especially distance relays. Out-of-step blocking is commonly available for distance relays to prevent them from operating during a power swing. However, the application of such schemes must be coordinated with Moon Lake to assure that the blocking of the distance elements will not result in inappropriate or undesirable formation of islands.

(d) Load Shedding

The proposed connection may require special load-shedding schemes based upon Moon Lake's Control Area requirements. These may include under-frequency load shedding, under-voltage load shedding, or direct load tripping. The intent of load shedding is to balance the load to the available generation, reduce the possibility of voltage collapse, and to minimize the impact of a system disturbance. Under-frequency load shedding generally includes a coordinated restoration plan, which is intended to minimize frequency overshoot following a load shedding condition. Tripping levels, restoration, and other details of load-shedding schemes shall be determined by Moon Lake, in accordance with NERC, WECC and NWPP (or their successors') criteria.

(e) Other Special Protection and Control Schemes

Moon Lake shall determine whether other special protection and control schemes are necessary. The location of the Point of Interconnection, amount of load transfer expected and various other system conditions may require other special protection schemes. The need for and type of schemes required will be determined by Moon Lake as part of the system studies done following the request for a new connection. The following are non-exclusive examples of other schemes that Moon Lake may require under appropriate circumstances:

- RAS may be required for stability purposes;
- Out-of-step tripping may be needed for controlled system grid separations;
- Special breaker tripping or closing schemes (e.g., staggered closing, point-on-wave closing) may be necessary to reduce switching transients; and
- Over-voltage tripping may be required to protect equipment following a system disturbance that may result in lightly loaded transmission lines.

These special protection and control schemes may require stand alone relay systems or additional capabilities of particular substation equipment (e.g., independent-pole operation of circuit breakers).

(f) Relay Performance and Transfer Trip Requirements

Relay systems are designed to isolate the Interconnection Customer's faulted transmission line and/or load facilities from the Moon Lake Electric System. The Interconnection Customer shall ensure that the protection equipment of the new connection must at a minimum maintain the performance level of the existing protection equipment at that location. This may require transfer trip (pilot telecommunications) to insure high-speed and secure fault clearing. Other types of pilot tripping such as directional comparison, phase comparison or current differential may be acceptable if the scheme chosen can achieve the total clearing times required. Transfer trip shall be required when any of the following conditions apply to the new connection:

- Transient or steady-state studies identify conditions where maintaining system stability requires immediate isolation of the Point of Interconnection facilities from the power system.
- Special operational control considerations require immediate isolation of the Point of Interconnection.
- Extended fault duration represents an additional safety hazard to personnel and can cause significant damage to power system equipment (e.g., lines, transformers).
- Slow clearing or other undesirable operations (e.g., extended over-voltages, ferro-resonance, etc.), which cannot be resolved by local conventional protection measures, will require the addition of pilot tripping using remote relay detection at other substation sites. This scenario is likely if a Moon Lake circuit that connects other customer loads become part of a 'local island' that includes a generator.
- When Relay operating times are adjusted to coordinate for faults based on the local configuration (e.g., three terminal lines), fault currents available, etc. Total clearing times must be less than those listed in Table 3-1. Otherwise, immediate isolation of the Point of Interconnection is required.

Table 3-1 – Relay and Breaker Operating Times by System Voltage

Connection Voltage (kV L-L rms)	Total Clearing Time (Cycles)	Maximum Relay Operate Time (Cycles)	PCB Trip Time (Cycles)	Time Delayed Tripping Acceptable?
≤ 46	65	≤ 60	≤ 5	Yes
46 to 200	5-30*	≤ 25	≤ 5	Yes

(g) Synchronizing and Re-closing

If the interconnection is made to an existing line, automatic re-closing schemes at the remote line breakers may need to be modified. On transmission lines below 161 kV, automatic-sectionalizing schemes may be installed to isolate a portion of the system that has a permanent fault. This may include multi-shot automatic re-closing at remote terminals. A new Point of Interconnection should be compatible with such existing schemes. If the new connection results in the possibility of connecting a generation source to the Moon Lake Electric System, special considerations may be required. Moon Lake shall determine whether such schemes are necessary.

(h) Protection System Performance Monitoring

Depending upon the type and location of the interconnection, monitoring equipment may be required. The monitoring equipment is intended to identify possible protection scheme problems and to provide power quality measurements. The monitoring equipment may provide information similar to that of an oscillograph or fault recorder. The availability of current and voltage measurements determines the number of channels for the device. Sequential event recorders and/or annunciators may also be required to record and time-tag operations of protection equipment. In some cases, it may be acceptable to utilize the recording and monitoring capabilities of a protective relay system to provide for system monitoring and event recording.

These recorders shall be connected to a GPS satellite receiver or other time source with equivalent accuracy. Remote access to monitoring equipment may be required. Moon Lake will supply a list of quantities to be monitored and the appropriate terminology when connections are made at a Moon Lake-owned substation. If monitoring or relay performance indicates inadequate protection of the Moon Lake Electric System, Moon Lake will notify the owner of the interconnected facilities of additional protection requirements or changes.

Moon Lake may request limited remote telecommunications access to relay systems at the Point of Interconnection to query their operational history and fault data. Upon request, and if available, Moon Lake will reciprocate by supplying the Interconnection Customer with limited access to the appropriate Moon Lake relays.

3-C. Protection System Selection and Coordination

1. Relays to be Installed for the Connection

At the time of the connection request, Moon Lake will supply the Interconnection Customer with an approved list of protective relay systems considered to be suitable for use at the Point of Interconnection. The performance of protective relays applied at the connection that can directly affect the performance of the Moon Lake Electric System shall follow the recommendations from the supplied list. Should the Interconnection

Customer select a relay system not on Moon Lake's approved list, Moon Lake reserves the right, at the Interconnection Customer's expense, to perform a full set of acceptance tests prior to granting permission to use the selected protection scheme. Alternatively, the relay vendor or a third party may be asked to perform thorough model line tests of the proposed relay system.

2. Protection System Coordination and Programming

Depending upon the complexity and criticality of the system at the Point of Interconnection, complete model line testing of the protection system, including the settings and programming, may be required prior to installation to verify the protection system performance. The following are non-exclusive, basic considerations that must be used in determining the settings of the protection systems:

- Fault study models used for determining protection settings should take into account significant mutual and zero sequence impedances. Up-to-date fault study system models shall be used.
- Protection system applications and settings should not normally limit transmission use.
- The application of zone 3 relays will meet with the NERC requirements for zone 3 relays.
- Protection systems should avoid tripping for stable swings on the interconnected Transmission Systems.
- Protection system applications and settings shall be reviewed whenever significant changes in generating sources, transmission facilities, or operating conditions are anticipated.
- All protection system trip mis-operations shall be analyzed for cause and corrective action taken.

3-D. Installation and Commissioning Test Requirements for Protection Systems

Thorough commissioning or installation testing of the protection system(s) shall be required for the installation of a new terminal or when changes to the prior protection system are made. The protection system includes the protective relays, the circuit breakers, instrument transformer inputs, and all other inputs and outputs associated with the protection scheme. The actual protection equipment used also will affect the type and extent of commissioning tests required. The following tests are the minimum tests that must be performed. These tests shall be performed on all protection schemes at the Point of Interconnection that could affect the performance of the Moon Lake Transmission System.

- Verifying all protective system inputs.
    - Current and voltage transformers: check the ratio, polarity, accuracy class, and single-point grounding.
    - Verify all other inputs to the protection system including battery supplies, circuit breaker auxiliary switches, pilot channel inputs, etc.
- Verify protection system settings.
    - Check protection system settings and programming.

- Perform acceptance testing of protection system if not done previously.
- Perform calibration tests of the protection system using actual settings.

- Protection system drawings and wiring
  - Verify switchboard panel and equipment wiring is intact and matches drawings.
  - Verify drawings are correct.
- Verify proper relay system operation and directionality.
- Verify all protective system outputs.
  - Trip outputs: trip intended trip coil(s) and open breaker.
  - Close outputs: energize close coils and close the breaker(s).
  - Assure relay outputs to pilot channel are functional.
  - Assure all other outputs such as breaker failure initiate, special protection scheme signals, alarms, event recorder points, etc. are functional.
- Perform trip or other operational tests.
  - Assure correct operation of the overall protection systems.
  - Test automatic re-closing.
- Pilot schemes.
  - Measure channel delays.
  - Check for noise immunity.
  - Check for proper settings, programming, etc.
  - Check transmit and receive levels.
  - If automatic channel switching or routing is utilized, check for proper relay operation for alternate routing.

Moon Lake uses coordinated end-to-end tests to verify the overall operation of the protection system and the pilot channel as part of their commissioning tests. This test may be required as part of the operational testing. Modifications to a protection system also require similar testing to ensure correct system operation. The extent of testing and types of tests required depend upon the modifications made. Moon Lake shall determine the extent and types of testing required.

4. SYSTEM OPERATION AND SCHEDULING DATA REQUIREMENTS

4-A. Introduction

All transmission arrangements for power schedules within, across, into or out of the Moon Lake Transmission System require metering and telemetering. Transmission arrangements with loads or new transmission facilities may include wheeling, voltage control, and AGC. The technical plan of service for interconnecting a load or new transmission facility will include the metering and telemetering equipment consistent with the transmission contract provisions. Such metering and telemetering equipment may be owned, operated, and maintained by Moon Lake or by other parties approved by Moon Lake.

Revenue metering, system dispatching, operation, control, transmission scheduling and power scheduling each impose different requirements concerning metering, telemetering, data acquisition, and control. Specific requirements also vary depending upon whether the new connection is directly interconnected to the Moon Lake Transmission System or electronically interconnected via telemetering that places the connection within or outside the Moon Lake Transmission System.

4-B. System Operation Requirements

1. Telemetering Requirements

Moon Lake Electric System Dispatching requires telemetering data for the integration of new interconnections at adjacent Load Control Area boundaries. This typically consists of the continuous telemetering of kW quantities and hourly transmission of the previous hour's kWh from the Point of Interconnection to the Moon Lake transmission dispatching and control center.

Section 5-D discusses telecommunications requirements for telemetering and AGC. Table 4-1 summarizes telemetering requirements and Table 4-2 identifies requirements based on connection location. Typical requirements based on connection type include, but are not limited to the following:

- Telemetering is required for all normally closed interconnections at a Moon Lake Transmission System boundary. Telemetering of real power and energy (kW, kWh) is required. In addition, Moon Lake may require reactive power (kvar, kvarh) information for power factor billing purposes. High capacity interconnections may require redundant metering and telemetering.
- For normally open or emergency tie connections, Moon Lake shall determine telemetering needs on a case-by-case basis. FERC requires telemetering for these connections.
- For loads connected internally to the Moon Lake Transmission System, AGC telemetering is not normally required. For interruptible loads, Moon Lake shall determine telemetering needs on a case-by-case basis. Connecting eccentric (non-conforming) loads may require an interface to the Moon Lake AGC system. A warning signal of pre-loading may be required in order to assure that adequate generation reserves are spinning before any sudden load change occurs.
- Telemetering for interconnection of shared or jointly-owned loads or generation commonly use dynamic signals. These signals are usually a calculated portion of an actual metered value. The calculation may include adjustments for losses, changing ratios of customer obligations or shares, or thresholds and limits. Two-way dynamic signals are used when a customer request for MW change can only be met by an actual change in generation. In this case, a return signal is the official response to the request and its integrated value is designated the official meter reading. Integration intervals are generally one hour. Some types of dynamic signals may require shorter integration intervals. The integration interval shall be determined by the type of service provided consistent with Moon Lake tariffs to properly account for transmission usage.

2. Data Requirements for Control Area Services

Non-traditional sources are sometimes used for supplying ancillary services. If a load provides regulating or contingency reserve services, data requirements for deployment of the reserves will be similar to those applied to generating resources.

To the extent that a third party may externally supply regulating or contingency reserve services at the Control Area interconnecting boundary, data requirements for their deployment may be similar to those applied to generating resources.

- Technical discussions between the Interconnection Customer and Moon Lake are necessary before the specific data requirements will be determined by Moon Lake, in conjunction with the control area operator.

The Interconnection Customer shall demonstrate that whatever options it selects are technically sound and meet all relevant reliability policies and criteria of NERC, WECC and NWPP or their successors. Moon Lake reserves the right to modify or reject a selected option if it does not meet these requirements.

3. Supervisory Control and Data Acquisition (SCADA) Requirements

Interconnection with Moon Lake's Electric System may require Control Area SCADA control and status indication of the power circuit breakers and associated isolating switches used to connect with Moon Lake. SCADA indication of real and reactive power flows and voltage levels are also required. If the interconnection is made directly to another utility's Transmission System, SCADA control and status indication requirements shall be jointly determined by the Interconnection Customer and Moon Lake. SCADA control of breakers and isolating switches that are not located at the Point of Interconnection is generally not required, however, status indication may be necessary. Section 5-D below discusses telecommunications requirements for SCADA systems.

4-C. Interchange Scheduling Requirements

Loads integrated into the Moon Lake Electric System shall adhere to the scheduling requirements of the prevailing tariff under which the load is taking transmission service from Moon Lake. Customers may be required to provide Moon Lake Transmission Scheduling with an estimate of the hourly load, hourly generation schedules, and/or net hourly interchange transactions, depending on the size of the load, metering, telemetry, and ancillary service arrangements. These estimates, if required, will be used both for pre-scheduling and planning purposes. Moon Lake will require customers to provide these estimates, as may be necessary, in order for Moon Lake to manage the load/resource balance within the Moon Lake Transmission System and to determine usage of the Moon Lake Electric System.

In the case of transmission facilities, scheduling and accounting procedures shall be required if the facility is part of an interface between the Moon Lake Transmission System and another transmission provider. This scheduling and accounting of interchange between two control areas generally requires telemetered data from the Point of Interconnection to the control centers of the Control Area operators. This data is termed "interchange metering and telemetering" by Moon Lake and includes kW and kWh quantities. All inter-Control Area transactions must be prescheduled for each hour using the host control area's normal scheduling procedures. The end-of-hour actual interchange must be conveyed each hour to host control area through the use of telemetering or data link.

When the interconnection represents a shared or jointly-owned interface to Moon Lake, then a calculated allocation is generally required to divide up the total metered interchange. This non-physical interface is accomplished by dynamic signal. A two-way dynamic signal is required when a combined request and response interface are used (e.g., supplemental AGC services). A one-way dynamic signal is required when a response (or following) interface is used (e.g., moving a control area boundary).

1. Interchange Telemetering Requirements

Interchange telemetering generally consists of bi-directional meters and related telecommunications systems providing kW and kWh at or near the Point of Interconnection. The kW measurement is telemetered on a continuous basis for AGC. Hourly kWh information is sent each hour. Table 4-1 summarizes telemetering requirements. Table 4-2 identifies different scenarios that require telemetering. Interchange telemetering accuracy and calibration requirements are identical with those stated in Sections 4-D and 4-F.

Telemetering requires continuous knowledge of the quality of the meter reading. Associated with the telemetering signal are various indications of this quality. Analog telemetering is commonly accompanied with squelch and telemetering carrier fail alarms. A loss of meter potential or meter potential phase unbalance should trigger a telemetering carrier failure alarm. Digital telemetering has equivalent signal failure alarms. The metering equipment must also be monitored and alarmed in the telemetering signal. Typical alarms include but are not limited to:

- Loss of meter potential
- Loss of telemetering signal
- Meter potential phase unbalance

2. Data Acquisition System

Loads such as steel rolling mills, wind tunnels, etc. require additional data to make generation control performance more predictable. Such additional data includes, but is not limited to, precursor signals of expected load changes and SCADA control. Moon Lake shall determine specific requirements and needs for each load. Section 5-D below discusses telecommunications requirements for telemetering and data acquisition.

4-D. Revenue and Interchange Metering System

All connections of one kW or greater require Moon Lake standard revenue or interchange metering system for the Moon Lake billing and/or scheduling processes. Interchange metering will supply both dial-up readings and EMS SCADA output data to the Revenue Metering System (RMS). The KWH accumulator data collected through a remote terminal unit (RTU) will be compared monthly against the dial-up data for meter system accuracy. Metering data collected over a voice grade communication system will include working meter register reads, monthly register freeze reads and demand interval profile data. The meters shall be compatible with the MV-90™ system, or as approved by Moon Lake, and interrogated daily or whenever necessary for maintenance purposes. The KWH digital or analog accumulator data will be read hourly and compiled for the monthly kWH interchange report.

Interchange metering includes bi-directional energy data (kWh) and reactive data (kVARh), as well as telemetry requirements for alternate control purposes. The alternate control path is necessary in the event of a failure in the primary metering system. The metering shall be located to measure the net power at the Point of Interconnection delivered to or received from the Moon Lake Transmission System.

Moon Lake typically owns and maintains the revenue metering at metering sites. Moon Lake will supply the Interconnection Customer the design details of the standard metering system should the Interconnection Customer desire to furnish, own and/or maintain the metering system. If the selected system is not a Moon Lake's standard

metering system, Moon Lake reserves the right to perform a full set of acceptance tests at the Interconnection Customer's expense, prior to granting permission to use the non-standard system. Other meter types will be considered, subject to Moon Lake approval, where a Moon Lake authorized party performs the metering and telemetry functions.

1. Revenue and Interchange Metering Requirements

Moon Lake's standard meter package provides only three element meters for both grounded and ungrounded systems; for ungrounded metering, one element is unused.

The interchange metering package will include two revenue quality meters with all inputs and outputs terminated at a utility panel interposition block. One meter will be designated a primary meter and be used for EMS data that includes bidirectional kWh quantities, and instantaneous MW MVAr data. The second or backup meter will be used for telemetry MW data sent to the Moon Lake alternate control center. All meters will be programmed identically as bi-directional meters in order to record real and reactive flow delivered or received from the Point of Interconnection. The standard revenue metering interval profile demand package includes bidirectional kWh and kVArh and per phase volt-hour demand interval recording. Additional quantities can be added if necessary in the Moon Lake RMS.

The final metering design requirements including hardware I/O and software specifications will be written into the specific projects scoping documentation. Requests from foreign utilities for digital or analog metering outputs must be made prior to final design.

If the new Point of Interconnection results in the addition of generation to the Moon Lake Electric System not previously accounted for, there will be additional metering requirements.

Section 5-D discusses telecommunications requirements for the RMS system. Table 4-1 summarizes Revenue Metering requirements and Table 4-2 identifies requirements based on resource location.

2. Meter Accuracy

The performance of the meter used for interchange metering shall comply with ANSI C12.20 (current edition) Electricity Meters 0.5 and 0.2 Accuracy Classes. The interchange meter type shall be 0.2 accuracy class. Full load is defined as nominal voltage, 100% meter test amperes (TA). Light load is nominal voltage, 10% of meter test amperes (TA).

3. Instrument Transformers

Voltage and current instrument transformers are required to be a wire wound extended range type with .15% metering accuracy class. The instrument transformers will maintain their accuracy ranging from 1 amp to 4000 amp current to .25 A to 750 amp current for both ratio error and phase angle error over the burden range of the installed metering circuit. Instrument transformers shall be standalone, located on the line at the delivery point such that the metering is not interrupted during possible switching configurations at the delivery point.

Paralleling CT's and internal CT's located inside breakers and power transformers for the purpose of revenue metering are not permitted. Moon Lake may permit the use of optical transformers, if used additional equipment may be required for optical metering.

4. Loss Compensation

Moon Lake may require that Transmission System losses, such as those in lines and transformers, be accounted for in the revenue metering process. Moon Lake requires that any applicable loss compensation be performed in the meter, rather than calculated in the billing system. Moon Lake will modify the revenue metering to accommodate the transformer and/or line loss factors applicable to each site.

5. Station Service Power

Depending upon its electrical source and electrical location, the station service power for the connecting substation facilities may also require Revenue Metering. It may or may not be necessary to meter station service VAr-hours. The other requirements of this section apply to station service metering.

6. Initial and Periodic System Verification

At least once, a documented verification of instrument transformer ratios shall be performed. This requires measurement of primary current simultaneously with secondary current to determine actual ratio to within 10% of marked nameplate ratio. Transformer turns ratio (TTR) on voltage transformers or CT tester check shall substitute if in-service primary measuring equipment is unavailable. The objective is to ensure that the instrument transformer ratios are documented and are connected to known taps under known burden conditions. This test shall be performed during a scheduled bi-annual test if there is no record of a verification being performed and when instrument transformers are replaced.

Moon Lake and the Interconnection Customer agree that a certification of the meter system accuracy be done at least biannually or as specifically agreed upon in the interchange agreement. The owner of the facility shall give the other Party notification of at least two weeks for the impending test. A copy of the test results shall be available to all affected parties involved or on file for review.

Table 4-1 General Metering and Telemetering Data Requirements

System or Quantity	System Dispatching and Operations	Transmission Scheduling	Revenue Billing
kW	Yes	No	No[1]
kWh	Yes	Yes	Yes
kvar	Maybe	No	No
kvarh	Maybe	No	Yes
kV	Yes	No	No
Load Size	≥ 1 MVA	≥ 1 MVA	≥ 1 kW
Data Sample Rate	kW: 1 second or other approved rate compatible with NERC Policy	Last Hour kWh sent each hour	Hourly kWh Data Retrieved daily (RMS type system)[2]
Tie Capacity	all normally closed ties	all normally closed ties	all ties

System or Quantity	System Dispatching and Operations	Transmission Scheduling	Revenue Billing
AGC	all Load Control Area boundaries & customer connections providing ancillary services	No	No

Notes:

1. A kW reading for revenue billing may be required where special transmission arrangements are necessary.
2. Dial-up phone line required for the RMS.

Table 4-2 Metering, Telemetering and SCADA Data Requirements vs. Connection Location

	Connection Located INSIDE PAC Load Control Area	Connection Located OUTSIDE PAC Load Control Area
Direct Electrical Connection to Moon Lake's System	kW, kWh, RMS, kvar, kvarh, kV breaker status & control	kW, kWh, RMS, kvar, kvarh, kV breaker status & control
NO Direct Electrical Connection to Moon Lake's System	kW, kWh, RMS	None

Note - Dedicated circuit is required for kW, kWh, kVAr, kVArh, and kV

5. TELECOMMUNICATION REQUIREMENTS

5-A. Introduction

Telecommunications facilities shall be tailored to fulfill the control, protection, operation, dispatching, scheduling, and revenue metering requirements. At a minimum, telecommunications facilities must be compatible with, and have similar reliability and performance characteristics to, that currently used for the operation of Moon Lake's Electric System at the Point of Interconnection.

Interconnection Customer shall own, operate and maintain a Remote Terminal Unit at its interconnection facility to gather accumulated and instantaneous data to be telemetered to the location(s) designated by Moon Lake. Moon Lake will promptly advise the Interconnection Customer if it detects or otherwise learns of any metering, telemetry or communications equipment errors or malfunctions that require the attention and/or correction by Interconnection Customer. Interconnection Customer shall correct such error or malfunction as soon as reasonably feasible.

Interconnection Customer shall own, operate and maintain communication equipment at its interconnection facilities as required by Moon Lake to deliver required interconnection data to Moon Lake's control centers. Moon Lake will promptly advise the Interconnection Customer if it detects malfunctions in the communication equipment. Interconnection Customer shall have call out repair crews available 24 hours a day 7 days a week. Interconnection Customer shall work diligently with Moon Lake and any other entities that carry communication traffic back to Moon Lake to resolve any such failure. Interconnection Customer and Moon Lake shall correct such error or malfunction as soon as reasonably practicable.

All RTU, telemetering and communications equipment shall conform to Moon Lake's Transmission System Interconnection Requirements attached as Appendix C

Telecommunications facilities shall be identified on the Project Requirements Diagram. The telecommunications facilities may consist of any or all of the following depending on the performance and reliability requirements of the control and metering systems to be supported:

1. Microwave Systems

A microwave system requires transmitters, receivers, telecommunication fault alarm equipment, antennas, batteries, and multiplex equipment. It may also include buildings, towers, emergency power systems, mountaintop repeater stations and their associated land access rights, as needed to provide an unobstructed and reliable telecommunications path. Where needed to meet power system reliability requirements by protecting against telecommunications outages caused by equipment failure or atmospheric conditions, microwave path diversity, equipment redundancy, and/or route redundancy shall be required.

2. Fiber Optic Systems

A fiber optic system requires light wave transmitters, receivers, telecommunication fault alarm equipment, multiplex equipment, batteries, emergency power systems, fiber optic cable (underground or overhead) and rights-of-way. Where needed to protect against cable breaks and resulting telecommunications outages, cable route redundancy shall be required.

3. Wireline Facilities

A wireline facility requires telecommunications cable (underground or overhead), high-voltage isolation equipment and rights-of-way. It may also include multiplex equipment, emergency power systems, and batteries, depending on the wireline technology employed. Cable route redundancy may be required to protect against cable breaks and resulting telecommunications outage.

4. Power Line Carrier Current Systems

A power line carrier current system uses the actual power line conductor(s) as the transmission media. Coupling capacitors, line tuning units, and wave traps are connected to the circuit to connect the carrier transmitter and receiver to the power line. Because power line carrier availability and performance is greatly affected by line outages, its use for control, data, and voice communications is limited and must be pre-approved by Moon Lake. In some instances, power line carrier current systems can be used with line protective devices.

5-B. Telecommunications Availability

1. Common Carrier

Dedicated telecommunication facilities shall be required for the operation of Main Grid power system control and protection functions. Common carrier telecommunications shall not be acceptable for supporting Main Grid control and protection functions. However, for secondary Transmission Systems, other than Main Grid, Moon Lake may, in its discretion, approve the use of common carrier telecommunications alternatives, subject to reliability and availability requirements and capabilities.

2. Main Grid

Telecommunications systems serving Main Grid Transmission Systems shall be fully redundant with a service availability time equal to or exceeding the power system availability goal. The design availability for telecommunications systems serving Main Grid transmission shall be at least 99.986%. This required percentage is based on total outage time of 24 hours in 20 years due to path or components. The design availability for telecommunications systems serving secondary transmission shall be at least 99.88%. This required percentage is based on total outage time of 10-1/2 hours per year due to path or components.

3. Alternate Routing

If alternately routed telecommunications are required for Main Grid protective relaying schemes, the overall availability of the alternately-routed telecommunications shall be at least 99.9998%. Availability is determined for the total path of the protective relaying circuit, from one end of the transmission line to the other. Moon Lake will consider options for achieving these availability requirements by utilizing two or more separate telecommunication methods, routes or systems. When alternately routed telecommunications for protective relaying schemes are required, a combination of two of these telecommunications methods may be used to meet availability requirements.

5-C. Voice Communications

If the Point of Interconnection is within the Moon Lake Transmission System:

1. Voice Communications

Voice Communications between the Moon Lake dispatchers and the Point of Interconnection operator or dispatcher shall be required whenever any type of telemetering is required.

2. A Dedicated, Direct, Automatic Ringdown Trunk

A Dedicated, Direct, Automatic Ringdown Trunk (or equivalent) voice circuit between the Moon Lake dispatchers and the Point of Interconnection operator or dispatcher may be required for:

- Loads of 50 MW or greater,
- Eccentric (non-conforming) Loads
- Connected networks that include automatic generation dropping for Moon Lake Transmission system remedial action.
- A non-radial interconnection to another electric utility with a transfer capability in either direction of 50 MW or greater.

- Moon Lake shall determine whether a dedicated, direct, automatic ringdown trunk (or equivalent) voice circuit is required.
- Independent Voice Communications for coordination of system protection, control, and telecommunication maintenance activities between the Moon Lake dispatchers and the Point of Interconnection operator or dispatcher shall be provided, in addition to the voice telecommunications specified.

5-D. Data Communications

Telecommunications for SCADA, RMS and Telemetering shall be designed to function at the full performance level before and after any power system fault condition. Service continuity shall be restored immediately after the fault without requiring any repair personnel activity.

1. SCADA Requirements

SCADA Requirements generally include one or more dedicated circuits between the new Point of Interconnection and the appropriate Moon Lake transmission dispatching center(s).

2. AGC Interchange and Control Telemetering

AGC Interchange and Control Telemetering for operations and scheduling applications generally require one or more dedicated circuits between the new Point of Interconnection and the appropriate Moon Lake transmission dispatching center(s). Digital telecommunications capabilities from 1200 to 2400 baud rate shall be required. The Inter-Control Center Communications Protocol network can be used for AGC purposes upon the agreement of Moon Lake and the Interconnection Customer only for very small and/or radial interchanges and generation quantities. These situations may require a NERC waiver. (For these rare circumstances, refresh times as slow as one minute may be acceptable.)

3. General Telemetering

General Telemetering for kWh and data acquisition systems generally require one or more dedicated circuits between the new Point of Interconnection and the appropriate kWh or data acquisition system master computer.

4. Revenue Metering System

Revenue Metering System (MV-90™) remote equipment require commercial 'dial-up' telephone exchange line facilities to communicate with a MV-90™ master computer, or Moon Lake-approved alternative. The circuit used for this purpose may also be shared with voice communications and other dial-up data communications.

5-E. Telecommunications for Control and Protection

Telecommunications for Control and Protection shall be designed to function at the full performance level before, during, and after any power system fault condition. The delivery of a false trip or control signal, or the failure to deliver a valid trip signal is not acceptable. Active telecommunication circuits for control and/or protection shall not be tested, switched, shorted, grounded or changed in any manner by any person, unless prior arrangements have been made and approval granted through the Moon Lake Dispatcher.

1. Main Grid Transmission

New connections to the Moon Lake Main Grid, and connections which require remedial actions on the Moon Lake Electric System, shall have redundant (i.e., hot-standby or frequency-diversity) telecommunications systems. Alternately routed telecommunication circuits are required on 138 kV and higher protection circuits.

2. Secondary Transmission.

New connections to the Moon Lake secondary grid transmission generally do not require redundant telecommunications systems. However, under some circumstances, redundant telecommunications are required to satisfy stability criteria. Moon Lake shall determine if such circumstances exist.

3. Speed of Operation

Throughput operating times of the telecommunications system shall not add unnecessary delay to the clearing or operating times of protection or remedial action schemes. Maximum permissible throughput operating times of control schemes are determined by Moon Lake by conducting system studies.

4. Equipment Compatibility

In order to provide maintainability and operability between the new connection and the Moon Lake Electric System, the protection systems and their supporting telecommunications system equipment (teleprotection) shall be functionally compatible. At the time of the new connection request, Moon Lake shall supply the Interconnection Customer with a list of acceptable, pre-qualified equipment. Should the Interconnection Customer choose to use something other than what has been pre-qualified by Moon Lake, Moon Lake reserves the right to test, at the Interconnection Customer's expense, and approve or disapprove the equipment prior to installation.

Moon Lake may permit the use of alternative equipment and/or technologies as proposed by the Interconnection Customer where the equipment is suitable for the purposes of the control application required. The teleprotection systems, including transfer trip, proposed by the Interconnection Customer must be engineered and tested to demonstrate that they perform their intended functions. When applying sophisticated digital telecommunications systems to certain protection schemes, the Interconnection Customer shall avoid combining approaches with inherent technical conflicts or incompatible methodologies.

5-F. Telecommunications during Emergency Conditions

1. Emergency Conditions

The requirements discussed in the previous sections address the availability and redundancy for telecommunications systems and equipment to assure reliable operation of the Moon Lake Electric System under normal telecommunications conditions. Normal conditions for telecommunications include both normal and emergency conditions for the Transmission System. However, emergency conditions may develop that affect power system telecommunications with or without directly affecting power Transmission System facilities.

Examples of telecommunications emergencies include but are not limited to the following:

- Interruption of power service to telecommunications repeater and relay stations.

- Telecommunications equipment failure, whether minor or catastrophic.
- Interruption or failure of commercial, public telephone network facilities or services.
- Damage to telecommunications facilities resulting from accident, acts of vandalism, or natural causes.

Equipment redundancy and telecommunications route redundancy can protect against certain kinds of failure and telecommunications path interruption. The Interconnection Customer shall maintain a dedicated repair team along with an adequate supply of spare components.

2. Backup Equipment

Where commercial public telephone network facilities or services support significant power system telecommunications, the Interconnection Customer shall develop a backup strategy to protect against interruption of such services. Backup methodologies could include, but are not limited to, redundant services, self-healing services, multiple independent routes and/or carriers, and combinations of independent facilities such as wireline and cellular, fiber and radio, etc. The Interconnection Customer must incorporate backup telecommunications system equipment such as emergency standby power generators with ample on-site fuel storage, and reserve storage battery capacity in critical telecommunications facilities. The Interconnection Customer should consider backup equipment for certain non-critical telecommunications to assure continued operation of power system telecommunications during interruption of power services.

3. Disaster Recovery

The Interconnection Customer shall have in place a disaster recovery plan for telecommunications restoration, and should exercise this plan periodically. The disaster recovery plan shall include the ability to deploy transportable restoration equipment capable of temporarily bypassing or replacing entire telecommunication stations or major apparatus until permanent repairs can be made.

4. Telecommunications Security

The Interconnection Customer shall continuously monitor the operation of power system telecommunications facilities at a central alarm point so that trouble can be immediately reported, diagnosed, repaired and service restored. The Interconnection Customer shall secure power system telecommunication sites and facilities against unauthorized access by means of locked gates, security fences, warning signs, security doors, and entry alarms.

5. Definitions

For industry standard definitions of electric industry terminology, the *IEEE Standard Dictionary of Electrical and Electronic Terms*, IEEE Std 100-1992, as amended or replaced, shall apply.

For the purposes of this document the following definitions apply:

ACE – Area Control Error is the instantaneous difference between net actual and scheduled interchange, taking into account the effects of frequency bias including a correction for meter error.

Active Power - The component of total volt-amperes in an electric circuit where the voltage and current are in phase. It is also called real power and is measured in watts (W), kW or MW. This is the electrical power associated with useful energy, including

mechanical work and heat. Active power used or transmitted over time is measured in kilowatt-hours (kWh) or MWh.

Ancillary Services - The term used by FERC to describe the special services that must be exchanged among generation resources, load customers and transmission providers to operate the system in a reliable fashion and allow separation of generation, transmission and distribution functions. These include: 1) scheduling, system control and dispatch, 2) reactive supply and voltage control from generators, 3) regulation and frequency response, 4) energy imbalance, 5) spinning reserves, and 6) supplemental reserves. FERC requires transmission providers to include these services in an open access transmission tariff. Most of these services are included in a similar set by NERC and termed Interconnected Operations Services, which also include load following and black start capability.

Automatic Generation Control (AGC) System - A system that measures instantaneous loads at interchange points (boundaries with adjacent Load Control Areas) and adjusts generation to follow load. It consists of continuous, real time load signals (kW), telemetered to AGC computers at a transmission control center. At Moon Lake this would require connection to the microwave system. An AGC System automatically adjusts a Load Control Area's generation from a central location to maintain its interchange Schedule Plus frequency bias.

Baud Rate – A unit of signaling speed equal to the number of discrete conditions or signal events per second, or the reciprocal of the time of the shortest signal element in a character.

Bi-directional Metering - Measures kWh and kvarh flowing in both directions ('in' and 'out' kWh and leading and lagging reactive).

Blackstart Capability - The ability of a generating plant to start its unit(s) with no external source of electric power. (WECC)

Bottleneck – A location in the Transmission System where line or equipment ratings limit transfer capabilities. These situations may require special operating practices to avoid overloads under certain system conditions.

Point of Interconnection - The location on the Moon Lake Electric System where a new connection is established to serve a load or connect a line to another electrical system.

Demand - The rate at which energy is being used by a customer. (NERC)

Directional Relay - A relay that responds to the relative phase position of a current with respect to another current or voltage reference.

Distribution – The lower voltage lines and equipment directly serving electrical consumers. This is generally a radial circuit, operating at voltages at or below 69 kV. The term 'distribution' may also be used to refer to equipment operating at or below 69 kV.

Disturbance - An unplanned event that produces an abnormal system condition. (WECC)

Dynamic Schedule - A telemetered reading or value which is updated in real time and which is used as schedule in the automatic generation control and area control error equation (AGC/ACE) and the integrated value of which is treated as a schedule for interchange accounting purposes. Commonly used for 'scheduling' jointly owned generation to or from another control area.

Dynamic Scheduling Service - Provides the metering, telemetering, computer software, hardware, telecommunications, engineering, and administration required to electronically move a transmission customer's generation or demand out of the Control Area to which it is physically interconnected and into a different Control Area.

Dynamic Signal - A telemetered reading or value that is updated in real time, and which is used either as a tie line flow or as a schedule in the AGC/ACE equation (depending on the particular circumstances). Common applications of dynamic signals include 'scheduling' jointly owned generation to or from another control area and to move control area boundaries. Another application provides for an entity to request (schedule) a change in power flow. The resulting response is telemetered to the entity signifying the actual movement of a resource. This form of dynamic signal is applied to supplemental control area services. The integrated value of this signal is used for interchange accounting purposes, as appropriate.

Eccentric (Non-Conforming) Loads - Any cyclic load with the ability to change periodically by more than 50MW at a rate of greater than 50MW per minute, regardless of the duration of this change.

Effectively Grounded - A system that provides an $X_0/X_1<3$ & $R_0/X_1<1$ where X_0 and R_0 are zero sequence reactance and resistance respectively, and X_1 is positive sequence reactance.

Fault - A short circuit on an electrical transmission or distribution system between phases or between phases(s) and ground, characterized by high currents and low voltages.

FERC - Federal Energy Regulatory Commission

Ferroresonance - A phenomenon usually characterized by over-voltages and very irregular voltage and current wave shapes and associated with the excitation of one or more saturable inductors through capacitance in series with the inductor (IEEE). A condition of sustained waveform distortion and over-voltages created when a relatively weak source of voltage energizes the combination of capacitance and saturable transformers. A sufficient amount of damping, or resistance, in the circuit usually controls or eliminates the phenomenon.

Hybrid Switching - A variation of single-pole switching that is used on long lines to extinguish the secondary arc of single line-to-ground faults. The faulted phase is detected and opened first via single-pole relaying. After approximately fifty cycles the two un-faulted phases are opened to extinguish the secondary arc. Three-phase automatic reclosing follows.

IEEE - Institute of Electrical and Electronic Engineers.

Interchange Metering - Metering at interchange points between two controlling utilities. Consists of AGC (continuous kW) telemetering and hourly kWh (on-the-hour hourly load kWh). These quantities must go to both controlling utilities so they can manage their respective Load Control Areas.

Interchange Point - Locations where power flows from one Load Control Area to another (i.e., connection between two controlling utilities).

Island - A portion of the interconnected WECC system that has become isolated due to the tripping of Transmission System elements. 'Local' Island - A portion of the Transmission System, often a single line, that is isolated from the main system and energized by a local generator.

kWh System (Kilowatt Hour System) - Provides interchange point hourly data each hour (as compared to RMS system that reports hourly load data each day). Requires connection into the Moon Lake microwave system. kWh data is used to verify hourly schedules.

Load Control Area - The electrical (not necessarily geographical) area within which a controlling utility has the responsibility to adjust its generation to match internal load and power flow across interchange boundaries to other Load Control Areas. A Load Control Area may include a resource or portion of a resource that is scheduled by a specific utility. If the utility schedules the resource, the resource becomes part of its Load Control Area. Physical location of the Point of Interconnection does not determine its Load Control Area. A Load Control Area contributes its frequency bias obligation to the interconnection.

Loop Flow – The unscheduled use of another utility's transmission resulting from movement of electricity along multiple paths in a grid, whereby power, in taking a path of least resistance, might be physically delivered through any of a number of possible paths that are not easily controlled.

Main Grid - As presently defined Moon Lake's Main Grid transmission facilities include all 138 kV lines that perform the main grid function. Those portions of substations, including transformers, supporting the main grid, are also included.

MV-90· - The Multi-Vendor Translation System interprets a variety of metering communication protocols used for data collection and analysis. Data is retrieved over dial-up (voice grade) telephone lines by the MV90· master. Master automatically polls the remotes daily. Master can also be forced to poll a remote at any time through dial-in terminal ports available on the master. In addition to polling raw impulses from the recorders, MV-90· can perform data validation, editing, reporting and historical database functions.

NERC - North American Electric Reliability Council is a not-for-profit company formed by the electric utility industry in 1968 to promote the reliability of the electricity supply in North America. NERC consists of nine Regional Reliability Councils, one of which is the Western Electricity Coordinating Council.

Non-spinning Reserve - That portion of the operating reserve capable of being connected to the bus and loaded within ten minutes. Also included is any load which is designated for use as reserve and can be reduced by dispatcher action within ten minutes. (WECC)

NWPP - Northwest Power Pool

OASIS – Open Access Same-Time Information System is an electronic posting system for transmission access data that allows all Transmission Customers to view the data simultaneously.

Operating Reserve - That reserve above firm system load capable of providing for regulation within the hour to cover load variations and power supply reductions. It consists of spinning reserve and non-spinning reserve. (WECC) Operating reserve capacity may be supplied by generators that are on line, loaded to less than their maximum output, and available to serve customer demand immediately should a contingency occur.

Phase Unbalance - The percent deviation of voltage or current in one phase as compared to the average of all three phases.

Pilot Protection - A form of line protection that uses a communication channel as a means to compare electrical conditions at the terminals of a line. (IEEE) The communication channel may be power line carrier, microwave or other radio, fiber optics, leased telephone line or a dedicated hardwire circuit.

Power Factor - The ratio of real power in watts to the product of volts times amperes in an alternating current circuit. The power factor is unity when the voltage and current are in phase. A 'lagging' power factor is associated with a partially or wholly inductive load that 'absorbs' positive reactive power. A 'lagging' power factor is also associated with a generator that 'delivers' positive reactive power. A 'leading' power factor is associated with a capacitive load that 'delivers' or a generator that 'absorbs' positive reactive power.

Power System - The integrated electrical generation and transmission facilities owned or controlled by one electric utility organization. (WECC)

Prudent Electric Utility Practices or 'Prudent Utility Practice' - Any of the practices, methods and acts engaged in or approved by a significant portion of the electric utility industry during the relevant time period, or any of the practices, methods and acts which, in the exercise of reasonable judgment in light of the facts known at the time the decision was made, could have been expected to accomplish the desired result at a reasonable cost consistent with good business practices, reliability, safety and expedition. Good Utility Practice is not intended to be limited to the optimum practice, method, or act to the exclusion of all others, but rather to be acceptable practices, methods, or acts generally accepted in the region.

Pseudo-Tie - A telemetered reading or value that is updated in real time and used as a tie line flow in the AGC/ACE equation but for which no physical tie or energy metering actually exists. It usually represents a portion of an actual metered flow. The integrated value is used as a metered megawatthour (MWh) value for interchange accounting purposes. A pseudo-tie is one form of dynamic signal.

Radial Line - A transmission line that is connected to the transmission network only at one end, or a distribution line where only one end connects back to the network and loads are served at the other end and along the line.

Reactive Power - The component of total volt-amperes in an alternating current circuit where the voltage and current are out of phase by ninety electrical degrees. It is measured in units of volt-amperes reactive (VAr), kVAr or MVAr. It represents the power involved in the alternating exchange of stored energy in inductive and capacitive electromagnetic fields. By convention, positive reactive power is 'absorbed' by an inductance and 'generated' by a capacitance. Reactive power transferred over time is measured in VAr-hours (VArh).

Real Power - The component of total volt-amperes in an electric circuit where the voltage and current are in phase. It is also called active power and is measured in watts (W), kW or MW. This is the electrical power associated with useful energy, including mechanical work and heat. Real power used or transmitted over time is measured in kilowatt-hours (kWh) or MWh.

Real Time - Data reported as it happens, with reporting (update) intervals no longer than a few seconds. Applies to AGC type data, but not to kWh or RMS data, which are accumulated and reported only when queried by a master station.

Remedial Action - Special pre-planned corrective measures which are initiated following a disturbance to provide for acceptable system performance. (WECC)

Remedial Action Scheme (RAS) - A protection system that automatically initiates one or more control actions following electrical disturbances. Also called 'Special Protection System.' (WECC) Typical examples are generating dropping, load tripping, shunt capacitor switching and shunt reactor switching.

Revenue Metering - General term for metering which is calibrated to ANSI Standards for Billing Accuracy.

Revenue Metering System (RMS) - Provides hourly data daily (as compared to kWh system that reports hourly load each hour). A meter and recording device is installed at points where billing quality data is required. The device meters kW and kVAr (bi-directional for Points of Interconnection) and records kWh and kVArh data on a hourly basis.

SAIDI - System automatic interruption duration index is a measure of electric utility performance using the length of automatic interruptions as the measure.

SAIFI - System automatic interruption frequency index is a measure of electric utility performance using the number of automatic interruptions as the measure.

Single Pole Switching (SPS) - The practice of tripping and reclosing one pole (phase) of a three pole circuit breaker without changing the state of the remaining poles. Tripping is initiated by single-pole relays that respond selectively to the faulted phase. Circuit breakers used for single pole switching must inherently be capable of independent pole opening. In most single pole switching schemes it is the practice to trip all poles for any fault involving more than one phase. (IEEE)

Spinning Reserve - That portion of the operating reserve which is synchronized to the system, responds automatically to fluctuations in system frequency, and is capable of assuming load up to the cited spinning reserve magnitude within ten minutes. (WECC)

Station Service - The electric supply for the ancillary equipment used to operate a generating station or substation. (NERC)

Supervisory Control and Data Acquisition (SCADA) - A system of remote control and telemetering used to monitor and control the Transmission System. (NERC)

Tap Line – A line that connects to an existing transmission or distribution line without breakers at the tap point, resulting in an additional terminal on the existing line.

TCSC – Thyristor Controlled Series Capacitor

Telemetering - The process by which measurable electrical quantities from substations and generating stations are instantaneously transmitted using telecommunication techniques, including, but not limited to continuous real time data reporting for AGC and Generation kW (but not for kWh or RMS Systems, which are not continuously reported).

Three-Pole Switching - A relay system and corresponding switchgear that trips or opens all three poles (phases) regardless of fault type.

Wheeling - Transmitting power from one point to another within a Load Control Area or between Load Control Areas.

WECC - Western Electricity Coordinating Council.

Version	Date	Reviewers	Revision Description
0	May 24, 2007		
1	October 16, 2007	KW	Improved organization
2	November 5, 2007	KW	Review with Internal Compliance Committee
3	August 1, 2012	KW	Highlighting
4	December 30, 2013	KW	Annual Review, update for FAC-001-1 compliance
5	December 5, 2015	KW	Update for FAC-001-2 compliance and Annual Review

Note: These Transmission System Interconnection Requirements are meant to comply with NERC FAC-001-2 Facility Connection Requirements, and applicable Regional Entity, subregional, Power Pool, and Transmission Owner planning criteria, reliability and interconnection requirements. They are similar to that which other utilities in the area prescribe. They have been written specifically for the Moon Lake Electric transmission grid.