ORIGINAL

PACIFICORP
A MIDAMERICAN ENERGY HOLDINGS COMPANY

Pacific Power
Rocky Mountain Power
825 NE Multnomah Street
Portland, OR 97232

September 9, 2011

UTAH PUBLIC SERVICE COMMISSION
2011 SEP 13 A 5:39
RECEIVED

2928731

The Honorable Kimberly D. Bose
Secretary
Federal Energy Regulatory Commission
888 First Street, N.E.
Washington, DC 20426

RE: *PacifiCorp*
Docket No. ER11-_____-000

Dear Secretary Bose: Docket No. 11-999-01

Pursuant to Section 205 of the Federal Power Act, 16 U.S.C. § 824d (2006), Part 35 of the Federal Energy Regulatory Commission's ("Commission") regulations, 18 C.F.R. Part 35 (2010), and Order No. 714[1] regarding electronic filing of tariff submittals, PacifiCorp hereby tenders for filing the following jurisdictional agreement:

1. Transmission Interconnection Agreement for Points of Delivery ("Interconnection Agreement"), dated July 22, 2011, between Brigham City Corporation ("Brigham") and PacifiCorp, to be designated as PacifiCorp Rate Schedule FERC No. 679.

1. Background and Reason for Filing

PacifiCorp owns and operates certain transmission facilities in Utah. Brigham is a municipal electric utility in Utah whose electric system is interconnected with PacifiCorp's 138 kV Bridgerland-Ben Lomand transmission line. Brigham and PacifiCorp are parties to a Substation Operating Agreement, dated March 2, 1978, and designated as PacifiCorp Rate Schedule FERC No. 341 (the "O&M Agreement"), pursuant to which PacifiCorp provides Brigham certain operation and maintenance services at Brigham's East Substation.

As a result of Brigham's desire to make certain upgrades to its East Substation, which is interconnected with PacifiCorp's Bridgerland-Ben Lomand line, PacifiCorp and Brigham entered into a Project Construction Agreement, dated September 10, 2010 and designated as PacifiCorp Rate Schedule FERC No. 661. This Project Construction Agreement governs the design and construction of the facilities required for interconnection of Brigham's East Substation upgrades.

The Interconnection Agreement provides the terms and conditions of the interconnection of Brigham's electric system with PacifiCorp's transmission system. The parties further agree to replace the O&M Agreement with the Interconnection

[1] *Electronic Tariff Filings*, Order No. 714, 124 FERC ¶ 61,270 (2008).

Agreement.[2] PacifiCorp respectfully requests that the Commission accept the Agreement, attached as Enclosure 1 hereto, for filing in order to accommodate Brigham's request.

2. Effective Date

In accordance with 18 C.F.R. § 35.3(a)(1), PacifiCorp requests that the Commission establish an effective date 61 days from the date of this filing, or November 9, 2011, for the Agreement.

3. Designation

PacifiCorp respectfully requests that the Agreement be designated as PacifiCorp Rate Schedule FERC No. 679.

4. Enclosure

The following enclosure is attached hereto:

Enclosure 1 Transmission Interconnection Agreement for Points of Delivery between Brigham City Corporation and PacifiCorp, dated July 22, 2011, to be designated as PacifiCorp Rate Schedule FERC No. 679.

5. Communications

All communications and correspondence regarding this filing should be forwarded to the following persons:

Mark M. Rabuano
Legal Counsel
PacifiCorp
825 N.E. Multnomah, Suite 1800
Portland, OR 97232
(503) 813-5744
(503) 813-7252 (facsimile)
mark.rabuano@pacificorp.com

6. Service List

Pursuant to Rule 2010 of the Commission's Rules of Practice and Procedure, a copy of this filing is being served on each of the following:

[2] Concurrent with this filing, PacifiCorp is also filing a Notice of Cancellation of the O&M Agreement, with the same effective date for the cancellation.

Director
Brigham City Public Power
20 North Main Street
Brigham City, Utah 84302-1005

Utah Public Service Commission
Heber M. Wells Building
160 East 300 South
Salt Lake City, UT 84114

7. Waiver

To the extent that any filing requirement in Part 35 of the Commission's regulations is not satisfied by this filing and the materials enclosed herewith, PacifiCorp respectfully requests wavier of such requirements.

If you have any questions, or if I can be of further assistance, please do not hesitate to contact me.

Respectfully Submitted,

/s/ Mark M. Rabuano
Mark M. Rabuano

Attorney for PacifiCorp

CERTIFICATE OF SERVICE

I hereby certify that I have on this day caused a copy of the foregoing document to be served via first-class or electronic mail upon each of the parties listed in the enclosed Service List.

Dated at Portland, Oregon this 9th day of September, 2011.

/s/ Mark M. Rabuano

Mark M. Rabuano
PacifiCorp
825 N.E. Multnomah, Suite 1800
Portland, OR 97232
(503) 813-5744
(503) 813-7252 (facsimile)
mark.rabuano@pacificorp.com

PACIFICORP

and

BRIGHAM CITY CORPORATION
(Interconnection Customer)

for

EAST SUBSTATION

TRANSMISSION INTERCONNECTION AGREEMENT FOR POINTS OF DELIVERY

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Transmission Interconnection Agreement for Points of Delivery

This Transmission Interconnection Agreement for Points of Delivery ("Interconnection Agreement" or "Agreement"), executed as of the 22 day of July, 2011, is by and between **PACIFICORP**, an Oregon Corporation, and **BRIGHAM CITY CORPORATION**, owners of a Utah municipal electric utility, ("Interconnection Customer"). PacifiCorp and Interconnection Customer are sometimes referred to herein as "Party" and collectively as "Parties".

WITNESSETH

WHEREAS, PacifiCorp owns and operates facilities for the transmission of electric power and energy in interstate commerce (the "Transmission System"), and

WHEREAS, PacifiCorp and Interconnection Customer are parties to a Substation Operating Agreement, dated March 2, 1978, and designated as PacifiCorp Rate Schedule No. 341 (the "O&M Agreement"), pursuant to which PacifiCorp provides Interconnection Customer certain operation and maintenance services at the Interconnection Customer's East Substation; and

WHEREAS, The Interconnection Customer desires to make certain upgrades to Interconnection Customer's existing East Substation which is interconnected with PacifiCorp's 138 kV Bridgerland-Ben Lomond transmission line; and

WHEREAS, the Parties have entered into a Project Construction Agreement for the design and construction of the facilities required for interconnection of Interconnection Customer's East Substation due to the Interconnection Customer's East Substation upgrades; and

WHEREAS, the Parties agree that upon completion of the upgrades, and under separate purchase agreement, PacifiCorp shall take ownership of two motor operated switches nos. 120A & 122A and switch no. 124A and the interconnecting bus work and physical supports to provide a 138 kV electrical path that is owned and operated by PacifiCorp through the Customers East Substation; and

WHEREAS, the Parties further agree to replace the O&M Agreement with this Interconnection Agreement on or before the completion of the upgrades.

NOW, THEREFORE, in consideration of the mutual covenants and agreements contained herein, the Parties undertake and agree as follows:

SECTION 1: DEFINITIONS

(a) **Business Day** shall mean Monday through Friday, excluding Federal Holidays.

(b) **Point(s) of Interconnection** shall mean the point(s) at which the Interconnection Customer's electric system interconnects with PacifiCorp's Transmission System further described in Appendix A and shown in the one-line diagram in Appendix B to this Agreement.

(c) **Good Utility Practice**, shall mean 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.

SECTION 2: FILING, EFFECTIVE DATE, TERM AND TERMINATION

2.1 Filing agreement with FERC

(a) This Agreement shall be subject to its acceptance for filing by the Federal Energy Regulatory Commission ("FERC"). The Parties agree that no Party will be deemed the drafter of any term that may subsequently be found to be ambiguous or vague. PacifiCorp shall submit this Agreement for filing with FERC within thirty (30) calendar days after execution of the Agreement.

(b) This Agreement shall become effective upon the later of the date of this Agreement or the date established by FERC.

2.2 Term and Termination

(a) Subject to Section 2.2(b), this Agreement shall remain in effect for a term of thirty (30) years from the effective date, and shall be automatically renewed for each successive one-year period thereafter.

(b) This Agreement may be terminated effective on or after the expiration of the initial term specified in Section 2.2(a) by either Party after giving the non-terminating Party three (3) years' advance written notice. The Parties may also mutually agree to terminate this Agreement at any time through a written document signed by an authorized representative of each Party.

SECTION 3: INTERCONNECTION FACILITIES

3.1 Interconnection Customers may Interconnect

(a) The Interconnection Customer may interconnect its electric system to PacifiCorp's Transmission System via the interconnection facilities identified in Appendix A and described in one-line diagram format in Appendix B.

(b) Design, construction and continuing use, maintenance and operation of all interconnection facilities shall be pursuant to Good Utility Practices and meet to the extent relevant, PacifiCorp's Facility Connection Requirements for Transmission Systems ("FCRTS"), attached as Appendix C, as amended from time-to-time by PacifiCorp. If

there is a conflict between requirements in the FCRTS and the terms of this Agreement, the terms of this Agreement shall apply. PacifiCorp shall review and approve the Interconnection Customer's design prior to construction of the facilities prior to allowing interconnection.

3.2 System Impact Study

Performance of and responsibility for the cost of system studies, design, procurement and installation of the interconnection facilities required to connect the Interconnection Customer's electric system to PacifiCorp's Transmission System at the Point(s) of Interconnection, including all modifications to PacifiCorp's Transmission System necessary to complete the interconnection, have been provided for in separate agreements.

3.3 Costs of Upgrades

(a) Interconnection Customer shall be responsible for all costs associated with any future modifications necessary to upgrade the interconnection facilities to meet requirements proposed by the Interconnection Customer.

(b) Design and construction of any such future upgrade facilities shall be pursuant to Good Utility Practices and meet PacifiCorp's Transmission System design standards. PacifiCorp shall review and approve the upgrade design prior to construction of the facilities.

3.4 Change of Interconnecting System Voltage

In the event PacifiCorp changes the operating voltage of the Transmission System to which the Interconnection Customer is connected, Interconnection Customer shall be responsible for all costs associated with modifications necessary to upgrade Interconnection Customer's facilities to remain interconnected with PacifiCorp's Transmission System at the new operating voltage.

3.5 Ownership and Operation of Interconnection Facilities

(a) PacifiCorp shall have full ownership and operational control of the transmission path to which the Interconnected Customer's facilities are connected.

(b) PacifiCorp shall have the right to schedule power and energy through PacifiCorp owned 138 kV facilities located in Interconnection Customer's substation to the extent necessary to fully utilize PacifiCorp's Bridgerland-Ben Lomond transmission line capacity.

(c) All operation and maintenance activities by either Party shall be coordinated through the Parties' respective grid operations functions.

(d) PacifiCorp shall:

(i) retain full ownership and operational control of motor operated switches 120A and 122A and line switch 124A;

(ii) retain full ownership and operational control of interconnecting bus work and associated steel supports on the 138kV path that delivers electric energy over PacifiCorp's Transmission System and shown on the one-line diagram in Appendix B;

(iii) own and maintain the 138 kV line relays on Interconnection Customer's circuit breaker 1CB101 that coordinate with PacifiCorp's relays at Bridgerland and Ben Lomond substations; and

(iv) retain full operational control of Interconnection Customer's owned and maintained switches 101A and 125A.

(e) Interconnection Customer shall own all facilities at East Substation installed on the Interconnection Customer's side of the point of change of ownership shown on the one-line diagram in Appendix B, unless indicated otherwise herein.

(f) Interconnection Customer shall be obligated to maintain a power factor between 95% lagging and 95% leading. Interconnection Customer, at its expense and upon the written request of PacifiCorp, agrees to install or have installed switched capacitors or other equipment as may be reasonably required to eliminate that portion of reactive power flow which causes the reactive factor to fall outside the limits established herein. Such capacitors or other equipment shall be of a size consistent with voltage control requirements for PacifiCorp's Transmission System.

(g) Interconnection Customer shall design and operate its system so it shall not cause abrupt voltage changes on PacifiCorp's Transmission System in excess of PacifiCorp's standards as set forth in Appendix C as amended from time to time. Interconnection Customer, at its expense and upon the written request of PacifiCorp, agrees to install equipment as reasonably required to eliminate abrupt voltage changes outside PacifiCorp's standard.

(h) Should Interconnection Customer fail to take the corrective action requested by PacifiCorp within one (1) year after receipt of a notice detailing the corrective action to be taken, PacifiCorp may perform such services or supply and install such capacitors or other equipment as it deems necessary to provide the corrective action. Interconnection Customer shall compensate PacifiCorp for all amounts expended and all services contracted for or performed in taking the corrective action, including indirect costs and overheads. The total of these expenditures shall be paid by Interconnection Customer within thirty (30) days of receipt of an itemized statement of those expenditures reasonably incurred.

(i) PacifiCorp and Interconnection Customer shall operate and maintain their respective interconnection facilities in compliance with the FCRTS, Good Utility Practices and with all Western Electricity Coordinating Council (WECC) or such other reliability criteria set or promulgated by a regional or national standard setting body with authority to do so (including, but not limited to, the North American Electric Reliability Council's (NERC) Reliability Standards) as such criteria may be adopted or modified from time to time. PacifiCorp and Interconnection Customer shall be responsible for all costs associated with the operation and maintenance of the interconnection facilities each owns.

3.6 Interchange/Revenue Metering Equipment

(a) Meters shall be located on the high voltage side of transformation and voltage and current transformers used for revenue metering purposes shall be used for no other purpose unless approved by PacifiCorp

(b) PacifiCorp shall:

(i) own and maintain the 138kV revenue metering instrument transformers, meters, and metering cables;

(ii) operate, test and maintain, at its expense, metering equipment and conform to the FCRTS;

(iii) calibrate and test interchange metering equipment in accordance with applicable ANSI standards. PacifiCorp shall inspect and test all metering equipment upon installation and at least once every three (3) years thereafter;

(iv) give reasonable notice (but in any case, no less than two weeks) of the time when any inspection or test shall take place. If at any time metering equipment is found to be inaccurate or defective, it shall be adjusted, repaired or replaced at PacifiCorp's expense, in order to provide accurate metering; and

(v) A documented verification of instrument transformer ratios shall be performed by PacifiCorp as may be required. 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 metering test as provided in section 3.6(b)(iv) if there is no record of a verification being performed in the past and whenever the instrument transformers are replaced.

(c) Interconnection Customer shall:

(i) own and maintain at its expense revenue metering instrument transformer support structures and foundations; and

(ii) have rights for representation at an official metering testing or inspection.

3.7 Telemetering and Communications equipment

(a) PacifiCorp shall:

(i) own, operate and maintain, at its expense, a Remote Terminal Unit(RTU) at the interconnection facility to gather accumulated and instantaneous data to be communicated electronically to the location(s) designated by PacifiCorp and to interface with protection and control devices as required.

(ii) own, operate and maintain, at its expense, communication equipment at the interconnection facilities to deliver required interconnection data to PacifiCorp's control centers; and

(iii) correct errors or malfunctions as soon as reasonably feasible.

(b) Interconnection customer shall:

(i) promptly advise PacifiCorp if it detects or otherwise learns of any metering, telemetry or communications equipment errors or malfunctions that require the attention and/or correction by PacifiCorp; and

(ii) work diligently with PacifiCorp and any other entities that carry communication traffic back to PacifiCorp to resolve any such failure. Interconnection Customer and PacifiCorp shall correct such error or malfunction as soon as reasonably practicable.

(c) All RTU, telemetering and communications equipment shall conform to the FCRTS.

(d) Point of Interconnection for the communications facilities shall be at the fiber optic terminal panel in Interconnection Customer's substation.

3.8 Property Rights

Interconnection Customer shall provide a document acceptable to PacifiCorp that authorizes and grants PacifiCorp an easement and right-of-way for the construction, reconstruction, operation, maintenance, repair, replacement enlargement and removal of the PacifiCorp interconnection facilities located within Interconnection Customer's East Substation. PacifiCorp shall have the right to access Interconnection Customer's East Substation and control building to perform these activities. PacifiCorp shall notify Interconnection Customer prior to or as soon as reasonably possible upon entrance to the Interconnection Customer's East Substation.

SECTION 4: CONTINUITY OF INTERCONNECTION

4.1 Continuous Physical Interconnection

PacifiCorp shall make reasonable provisions consistent with Good Utility Practice to provide a continuous physical interconnection at the Point(s) of Interconnection.

4.2 Un-planned Interruptions

PacifiCorp may temporarily interrupt or isolate the interconnection in order to:

(a) maintain reliability on PacifiCorp's system; or

(b) to avoid death or injury to any person or harm to any property.

PacifiCorp shall attempt to provide the Interconnection Customer as much notice as reasonably possible before doing so.

4.3 Planned Interruptions

PacifiCorp may temporarily interrupt or isolate the interconnection for any planned interruption to the interconnection after giving as much notice as possible to the Interconnection Customer. A planned outage may be taken in order to:

(a) maintain, repair, replace or inspect any portion of PacifiCorp's system; or

(b) install equipment.

Notice shall be given to allow for the coordination of the date and time of the outage, in an effort to minimize the duration and number of the Interconnection Customer's customers affected by the outage.

4.4 Operating Procedures

An operating agreement shall be developed and on file to provide guidelines for the operation of the interconnection of PacifiCorp's Bridgerland-Ben Lomond 138kV line with Interconnection Customer's East Substation under normal and emergency conditions.

SECTION 5: FORCE MAJEURE

Neither Party shall be subject to any liability or damages for inability to maintain a continuous interconnection to the extent that such failure shall be due to causes beyond the control of either PacifiCorp or Interconnection Customer, including, but not limited to the following: act of God, labor disturbance, act of a public enemy, war, insurrection, riot, fire, storm or flood, explosion, breakage or accident to machinery or equipment, any order, regulation or restriction imposed by governmental, military or lawfully established civilian authorities, or any other cause beyond a Party's control.

A Force Majeure event does not include acts of negligence or intentional wrongdoing by the Party claiming Force Majeure.

SECTION 6: LIMITATION OF LIABILITY

Neither Party or its directors, board members, commissioners, officers, employees, or agents shall have any liability to the other Party for any injury or death to any person, or for any loss or damage to any property, or any lost profits, lost revenues, lost use of facilities, lost data, or any indirect, incidental, consequential, special, exemplary, or punitive damages caused by or arising out of any Electric Disturbance on the other Party's Transmission System, unless the Electric Disturbance is caused by the other Party's Willful Action. Willful Action means an action taken or not taken by a Party that is knowingly or intentionally taken or not taken with the intent that injury or damage would result or with a reckless disregard for the result. Willful Action does not include any act or failure to act that is involuntary, accidental or negligent. For the purposes of this clause, "Electrical Disturbance" means:

(a) electric disturbances that produce abnormal power flows;

(b) power system faults or equipment failures;

(c) over-voltages during ground faults;

(d) audible noise, radio, television, and telephone interference;

(e) power system harmonics; or

(f) other disturbances that might degrade the reliability of the interconnected PacifiCorp system.

SECTION 7: NOTICES

Any written notices to be given to PacifiCorp under this Agreement shall be directed to:

Director, Transmission Services
PacifiCorp
825 N.E. Multnomah St., Suite 1600
Portland, Oregon 97232

Any written notices to be given to Interconnection Customer under this Agreement shall be directed to:

Director
Brigham City Public Power
20 N. Main Street
Brigham City, Utah 84302-1005

SECTION 8: APPLICABLE LAW

The Parties in the performance of their obligations hereunder shall conform to all applicable laws, rules and regulations and, to the extent their obligations are subject to the jurisdiction of state or federal agencies, shall be subject to orders of such agencies. This Agreement shall be

construed in accordance with laws of the state of Utah unless preempted by the Federal Power Act or other federal law.

SECTION 9: WAIVER

Any waiver at any time by either Party hereto of its rights with respect to the other Party or with respect to any matter arising in connection with this Agreement shall not be considered a waiver with respect to any subsequent default of such matter.

SECTION 10: SUCCESSORS AND ASSIGNS

This Agreement shall inure to the benefit of, and be binding upon, the Parties and their respective successors and assigns, and may be assigned by either Party with prior written consent of the other Party, which written consent shall not be unreasonably withheld.

SECTION 11: NO DEDICATION OF FACILITIES

Any undertaking by one Party to the other Party under any provision of this Agreement is rendered strictly as an accommodation and does not constitute the provision of a public utility service, or the dedication of all or any portion of either Party's Transmission System or facilities to the other Party, the public, or any third party.

SECTION 12: NO THIRD PARTY BENEFICIARIES

This Agreement is not intended to and does not create rights, remedies, or benefits of any character whatsoever in favor of any persons, corporations, associations, or entities other than the parties, and the obligations herein assumed are solely for the use and benefit of the Parties, their successors in interest and , where permitted, their assigns.

SECTION 13: SEVERABILITY OF PROVISIONS.

The provisions of this Agreement are independent of and separable from each other. If any provision of this Agreement shall for any reason be held invalid or unenforceable, such invalidity or unenforceability shall not affect the validity or enforceability of any other provision hereof, but this Agreement shall be construed as if such invalid or unenforceable provision had never been contained herein.

SECTION 14: EFFECT OF SECTION HEADING

Section headings appearing in this Agreement are inserted for convenience of reference only and shall not be construed to be interpretations of the text of this Agreement.

SECTION 15: APPENDICES AND EXHIBITS

The Appendices and Exhibits hereto together with all attachments referenced therein, are incorporated herein by reference and made a part of this Agreement. Unless otherwise stated, in

the event of an inconsistency between a provision in the general terms of this Agreement and the terms contained Appendix C, the provisions of these general terms shall prevail to the extent of the inconsistency.

SECTION 16: DISPUTE RESOLUTION

Any controversy, claim or dispute of whatsoever nature or kind between or among the Parties arising out of or in connection with this Agreement (each a "Dispute") shall be resolved pursuant to the procedures of this Section.

If a Dispute arises between or among the Parties, then any Party to such Dispute may provide written notice thereof to the other Party, including a detailed description of the subject matter of the Dispute. Thereafter, representatives from the Parties shall meet within thirty (30) days of the initial notice and shall in good faith attempt to resolve such Dispute by informal negotiations within thirty (30) days, or such later date as mutually agreed upon by the Parties, from the date of receipt of such notice. If the Dispute is not resolved within such 30-day period, or such later date as the Parties may mutually agree, then the Parties may seek the assistance of the FERC's Dispute Resolution Service. Each Party shall be responsible for its own costs incurred during any dispute resolution process.

SECTION 17: COMPLETE AGREEMENT

This Agreement sets forth the entire agreement between the Parties on the subject matter of this Agreement, and supersedes all prior agreements of the Parties with respect to its subject matter.

SECTION 18: MODIFICATIONS

No amendment of any provision of this Agreement shall be effective unless set forth in a written document signed by authorized representatives of the Parties.

SECTION 19: RESERVATION OF RIGHTS

PacifiCorp may make a unilateral filing with FERC to modify this Agreement with respect to any terms and conditions, charges, classifications of service, rule or regulation under section 205 or any other applicable provision of the Federal Power Act and FERC's rules and regulations thereunder, provided that each Party shall have the right to protest any such filing by the other Party and to participate fully in any proceeding before FERC in which such modifications may be considered.

SECTION 20: EXECUTION

This Agreement may be executed in counterparts and upon execution by all Parties, each executed counterpart shall have the same force and effect as an original instrument.

IN WITNESS WHEREOF, the Parties hereto have caused this Agreement to be executed by their duly authorized officers as of the date first entered above.

PACIFICORP	**BRIGHAM CITY CORPORATION**
By: */s/ K.Houston*	By: Dennis J. Fife
Title: V.P., Transmission	Title: Mayor of Brigham City
Witness:	Attest:
(illegible)	DeputyJasonRoberts

Appendix A: Point of Interconnection

Point of Interconnection	The points in the Interconnection Customer's East Substation where the facilities owned by PacifiCorp on the Bridgerland-Ben Lomond 138 kV transmission line connect to facilities owned by the Customer as shown on the one-line diagram	
In PACE Control Area	Yes	
Metered or Scheduled	Metered	
Voltage (kV)	138 kV	
Nearest PacifiCorp substation	Ben Lomond	
One-line diagram	Appendix B	

Appendix B: One-Line Diagram

[See scanned pdf attachment]

Appendix C: Facility Connection Requirements for Transmission Systems

Facility Connection Requirements for Transmission Systems
(46 kV and Above)

Author:	Paul Della, Dennis Desmarais
Approval:	Greg Lyons
Authoring Department:	Standards Engineering
Approved File Location:	\\PdxShrn104\Shr04\Eng\Publications\WIR\POL
File Number-Name:	139-Facility Interconnection Requirements for Xmsn Systems.doc
Revision Number:	4
Revision Date:	3//30/2010

Facility Connection Requirements for Transmission Systems
(46 kV and Above)

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Facility Connection Requirements for Transmission Systems
(46 kV and Above)

1 INTRODUCTION

This policy addresses the requirements for generation facilities, transmission facilities, and end-user facilities that are interconnected to PacifiCorp's transmission system. This policy, along with PacifiCorp's OATT, ensures that adverse impacts on reliability of the transmission system is avoided. In addition to ensuring reliability, this policy is consistent with safety requirements for PacifiCorp employees and the general public. This document is maintained by Technology Development and Standards group and is published on PacifiCorp's internal and external websites. PacifiCorp will make a copy of this document available to qualified entities with five business days of the request.

Although this policy addresses certain aspects of interconnection cost responsibility, its scope is primarily technical and does not include the commercial requirements for connecting generators or transmission facilities. Tariffs and rules filed with FERC and jurisdictional state regulatory agencies address the rates, terms, and conditions under which PacifiCorp provides these services. If there are any inconsistencies between this policy and the tariffs and rules, the tariffs and rules shall apply.

1.1 Introductory Definitions

PacifiCorp Transmission System: For the purposes of this policy document, the PacifiCorp transmission system is defined as electric transmission facilities owned by PacifiCorp typically 46kV and above.

Customer Load: A person, company, or corporation interconnected to PacifiCorp's transmission system owning or operating only power-consuming facilities.

Facility Interconnection Customer: A person, company, partnership or corporation interconnecting to PacifiCorp's transmission system owning or operating generation facilities, transmission facilities, and end user facilities.

Any connected entity owning or operating both power-consuming and power-generating facilities shall be considered a Facility Interconnection Customer for the purposes of this policy. The technical requirements for interconnection of generation sources are generally more comprehensive. Any load-only entity which is interconnected to a third-party electric system having generation capabilities shall also be considered a Facility Interconnection Customer for the purposes of this policy. Technical requirements for multi-interconnected systems (systems interconnected to the PacifiCorp power system in addition to a third-party system) will be determined by PacifiCorp on a case-by-case basis.

1.2 Applicability

This standard applies to generation, transmission, and end user facilities that are physically connected to, or desire to physically connect to, PacifiCorp's transmission system. Applicability is further defined by the categories below:

1.2.1 Generation Facilities

All requirements described or referred to in this policy apply to new and decommissioned generation facilities. New generation facilities are facilities that have not been and are not yet connected with the PacifiCorp transmission system. Decommissioned generation facilities are facilities that were actively connected to PacifiCorp's electrical system in the past but presently are not connected nor actively producing power. Additional technical requirements may apply to special business arrangements or electrical configurations of PacifiCorp's transmission system or the interconnection point(s). Any such technical specifications would be documented within the interconnection agreement and the operation and maintenance agreement. All decommissioned generators must comply with all requirements contained in this policy document. It may be necessary for the decommissioned generator to upgrade existing equipment to adhere to this policy.

1.2.2 Transmission Facilities

Any proposed transmission facility interconnecting into PacifiCorp's transmission system shall be coordinated and reviewed through the Pacificorp's transmission planning process. The transmission facility addition shall maintain or improve the level of system reliability that existed prior to the interconnection. Power flows as a result of the transmission interconnection shall not overload or adversely affect the PacifiCorp transmission system or the WECC regional transmission system.

1.2.3 End-user Facilities

Any proposed load customer interconnecting into PacifiCorp's high voltage transmission system shall be coordinated and reviewed through the New Large Load Process.

1.2.4 Existing Facilities

To the extent this handbook contains more stringent requirements than were in place at the time that existing facilities were initially connected, the existing entity shall be responsible for adhering to current requirements only to the extent that the safety and reliability of the power system or the safety of utility employees would be jeopardized by not adhering to the current requirements and standards. The cost for any upgrading shall be borne by either the Facility Interconnection Customer or by PacifiCorp pursuant to applicable electric rules and/or the terms of any executed agreements between the Facility Customer and PacifiCorp.

1.3 Policy for Interconnection of Transmission Facilities

PacifiCorp has established this policy for operating, metering, and equipment protection requirements for the interconnection of new generation, transmission, and end user facilities. This policy covers the requirements for all facilities wishing to interconnect to the PacifiCorp transmission system. Additional project specific requirements may apply. These additional requirements may vary according to the specifications of the interconnection as well as local configuration of the PacifiCorp transmission system.

The technical studies will determine whether PacifiCorp will be required to modify its transmission system to interconnect the requested facilities. Parties requesting interconnection are responsible for the cost of these technical studies. Please contact the PacifiCorp Transmission Account Manager for details about the study process and additional data requirements which may apply.

1.4 Security Access to Facilities

PacifiCorp personnel will honor all reasonable requests from the facility owner when accessing PacifiCorp equipment located within a facility owner's premises. The facility owner will grant PacifiCorp 24-hour access to PacifiCorp-owned equipment on the facility owner's premises. If this access is not allowed for the reasonable day-to-day operation of PacifiCorp's power system affecting PacifiCorp's customers, including emergency incidents or other power delivery-related activities, PacifiCorp reserves the right to exercise the disconnection provision of the facility interconnection agreement.

1.5 Facility Connection Customer Equipment Requirements

Interconnected parties are responsible for designing, installing, operating, and maintaining interconnection equipment that they own (i.e., generators, transformers, switches, relays, breakers, etc). All protective devices necessary to protect the interconnected facilities are the responsibility of the Customer.

PacifiCorp's requirements specified in this policy are designed to protect PacifiCorp facilities and maintain grid reliability pursuant to applicable reliability criteria; **they are not designed to protect the facilities of interconnected customers.**

Interconnected Customers must satisfy the requirements in 1) this policy, 2) applicable rules and tariffs of jurisdictional state regulatory agencies and FERC, 3) applicable policies of the Western Electricity Coordinating Council (WECC), the North American Electric Reliability Council (NERC), or their successor organizations, and 4) PacifiCorp's project-specific requirements. PacifiCorp's review and written acceptance of the interconnected entity's equipment specifications and plans shall not be construed as confirming or endorsing the interconnected entity's design, as warranting the equipment's safety and durability, or in any way relieving the interconnecting entity from its responsibility to meet the above requirements. PacifiCorp shall not, by reason of such review or lack of review, be responsible for strength, details of design, adequacy, or capacity of equipment built to such specifications, nor shall PacifiCorp's acceptance be deemed an endorsement of such equipment.

Readers should be aware that the information in this policy document is subject to change. The latest version of this document is available at http://www.oasis.pacificorp.com/oasis/ppw/main.htmlx

PacifiCorp will not agree to interconnect new facilities unless all technical and contractual requirements are met. Copies of this policy will be supplied upon request. Contact the PacifiCorp Transmission Account Manager for referrals to the PacifiCorp employee who can respond to questions concerning PacifiCorp's policy for facility interconnection coordination procedures or additional copies of this document:

Director, Transmission Services
PacifiCorp
825 N.E. Multnomah Blvd. Suite 1600
Portland, Oregon 97232
(503) 813-6079

The document can also be obtained by emailing transmission.services@pacificorp.com.

2 OWNERSHIP POLICY AND OPERATION OF INTERCONNECTION EQUIPMENT

PacifiCorp shall own all interconnection facilities and system upgrades necessary to assure reliable service to PacifiCorp customers. This may include, but is not limited to: relaying, control systems, breakers, switches, bus work, and transmission lines. In all cases, revenue metering and communications circuits for the purpose of breaker status and transfer trip will be owned and maintained by PacifiCorp. PacifiCorp may, at its option, contract with the Facility Interconnection Customer, or a third party, for construction of any or all of these facilities.

2.1 Applicant Construction of PacifiCorp Facilities

When it is mutually agreed by PacifiCorp and the faciity interconnection customer, the customer shall design and build PacifiCorp facilities using a PacifiCorp approved engineering firm. The customer shall provide PacifiCorp with design drawings prior to the start of construction and shall continue to provide PacifiCorp with the latest revisions sent to the contractor for construction. Within 30 days of the completion of construction, the interconnect customer shall provide PacifiCorp with a complete set of design drawings revised to reflect as-built conditions. In addition, the interconnect customer shall be responsible for obtaining SAP numbers and equipment memorandum forms from PacifiCorp and for completing the equipment memorandums for all major equipment identified by PacifiCorp as requiring setup in SAP to provide the means for scheduling future maintenance. The interconnect customer shall provide PacifiCorp with the completed equipment memorandums upon the installation of the major equipment for which they are required.

3 INTERCONNECTION PROCESS, STUDIES, AND REQUIREMENTS

3.1 Facility Interconnection Process Summary

FERC provides procedures which govern generation facility interconnections where a generator chooses to sell power to the bulk power market or a transmission customer/end user chooses to take unbundled or wholesale electric service from a FERC jurisdictional transmission line. A FERC jurisdictional line is defined as a line or interconnection classified as FERC transmission by the host utility or by using the FERC Seven Factor Test. Generators, transmission line, and end users must follow all FERC procedures when using or interconnecting with FERC jurisdictional transmission.

1. The FERC processes and procedures have been incorporated into PacifiCorp's OATT which may be accessed at: http://www.oasis.pacificorp.com/

   If the generator, transmission line, or end user are not FERC jurisdictional, PacifiCorp applies applicable state processes, if they exist, and voluntarily applies the same processes and procedures for consistency and ease of processing when state rules do not exist.

2. Generators, transmission line, and end users must follow all FERC interconnection procedures and processes when they are FERC jurisdictional. The following FERC orders govern the interconnection processes and procedures:

   Generators with nameplate ratings greater than 20 MW are governed by the FERC Large Generator Interconnection Procedures and Agreements (LGIP/LGIA) process. These are incorporated into Section IV *Large Generator Interconnection Service* of PacifiCorp's OATT.

   Generators rated from 10 kW to 20,000 kW (20 MW) are governed by FERC Small Generator Interconnection Procedures and Agreements (SGIP/SGIA) process. These are incorporated into Section V *Small Generator Interconnection Service* of PacifiCorp's OATT.

   Line/End Users who choose to take unbundled or wholesale electric service are governed by PacifiCorp's (OATT).

3. Generators not governed by FERC procedures and agreements shall be governed by PacifiCorp procedures and agreements. Line/end users not governed by the PacifiCorp OATT shall be governed the corresponding PacifiCorp state tariffs (bundled electric service) and procedures.

4. All interconnecting customers will be required to meet all applicable standards, which include, but are not limited to NERC Reliability Standards, WECC Reliability Standards, FERC Generator Interconnection Procedures, FERC Generator Interconnection Agreements, Pacific Northwest Security Council

requirements, Northwest Power Pool Requirements, and PacifiCorp planning criteria and facility connection requirements

3.2 Coordinated Joint Studies

3.2.1 Procedures for Coordinated Joint Studies

Unless there are conflicts with FERC or state standards (such as Critical Energy Infrastructure Information (CEII) and/or standards or code of conduct issues) PacifiCorp will form ad hoc groups, distribute results, and facilitate any required meetings between Facility Interconnection Customer, PacifiCorp, potentially affected electric systems, and any governing authorities in accordance with the FERC Large Generation Interconnection Procedures/Agreements (LGIP/LGIA) or other applicable procedures. This includes requesting potentially affected parties to participate in joint studies and following accepted WECC regional planning practices. If a potential CEII conflict arises such as an unknown consultant requesting critical system data, PacifiCorp would require FERC approval and a confidentiality agreement. If, in the opinion of PacifiCorp, a potential standard or code of conduct issue arises which may involve parties that 1) are not FERC jurisdictional public utilities, or 2) decline to sign a confidentiality agreement, PacifiCorp will provide system criteria violations (thermal, voltage, or stability) specific to affected system only.

Results of coordinated joint studies shall be documented along with any conclusions and recommendations. Such documentation shall be retained by PacifiCorp shall be made available if requested by WECC or NERC, or any other entities responsible for the reliability of the interconnected transmission system as soon as feasible.

3.2.2 Procedures for Notification of New or Modified Facilities

PacifiCorp shall disseminate notification of new or modified facilities to the WECC, and NERC in accordance with notification procedures that such entities have established.

Facility Interconnection Customers that are seeking to integrate new facilities with PacifiCorp should contact:

Director, Transmission Services
PacifiCorp
825 N.E. Multnomah Blvd. Suite 1600
Portland, Oregon 97232
(503) 813-6079
transmission.services@pacificorp.com

3.2.3 Additional Requirements

1. All transmission facilities, whether owned by PacifiCorp or the Facility Interconnection Customer must be in complaince with all NERC reliability requirements. NERC reliability standards may be accessed on the internet at:

   http://www.nerc.com/~filez/standards/Reliability_Standards.html

   Some specific NERC standards which may apply are:

   - ☐ BAL Resource and Demand Balancing
   - ☐ CIP Critical Infrastructure Protection
   - ☐ COM Communications
   - ☐ EOP Emergency Preparedness and Operations
   - ☐ FAC Facilities Design, Connections and Maintenance
   - ☐ INT Interchange Scheduling and Coordination
   - ☐ IRO Interconnection Reliability Operations and Coordination
   - ☐ MOD Modeling, Data, and Analysis
   - ☐ ORG Organization Certification
   - ☐ PER Personnel Performance, Training, and Qualifications
   - ☐ PRC Protection and Control
   - ☐ TOP Transmission Operations
   - ☐ TPL Transmission Planning
   - ☐ VAR Voltage and Reactive

2. If the Facility Interconnection Customer interconnection is to a point on the transmission system that is 100 kV and greater, the Facility Interconnection Customer must then comply with the NERC reliability standards.

3. PacifiCorp may revise the technical requirements periodically to comply with new requirements from FERC, NERC, state, other governmental authorities. PacifiCorp may require that all generator, transmission line, and end user interconnections comply with new regulations by implementing similar procedures and/or upgrades as would be expected on PacifiCorp facilities in a non-discriminatory manner. If the Facility Interconnection Customer does not comply, PacifiCorp may upgrade the Facility Interconnection Customer's facilities as necessary to be compliant. Any such upgrades shall be executed at the customer's expense. Alternately, PacifiCorp may disconnect the Facility Interconnection Customer after proper notification according to OATT requirements and procedures.

4. The PacifiCorp "bulk power network" is defined in this document as all 100 kV and greater lines which serve more than local load. This may include

participation in the transport of long-distance power transfers according to the FERC Seven Factor Test.

5. The term "Facility Interconnection Customer" refers to the new generation, transmission, and end user facilities requesting authorization to interconnect with the PacifiCorp electric system where FERC has jurisdiction.
6. Generators interconnecting to the PacifiCorp electric system are governed by the most current version of the PacifiCorp OATT.
7. This document complies with NERC requirements to document, maintain, and publish facility connection requirements for NERC/FERC jurisdictional generation facilities (rated at 10 – 20,000 kW), and transmission/end user facilities to ensure compliance with:
   - NERC Reliability Standards
   - FERC Small Generator Interconnection Procedures and Agreements
   - Applicable Regional Reliability Organization Requirements
   - Sub-regional, Power Pool Requirements
   - PacifiCorp Requirements
8. These technical requirements specify the minimum technical requirements intended to ensure a safe, effective, and reliable interconnection. These requirements are intended to supplement, but not replace, information contained in regulatory codes, PacifiCorp's OATT, PacifiCorp electric service tariffs, and specific interconnection agreements. The requirements outlined in this document may not cover all details in specific cases.
9. Additional information regarding parallel operation of generation with the PacifiCorp system can be obtained by contacting the Transmission Account Manager.

3.3 General Requirements

1. The Facility Interconnection Customer shall identify the voltage level and capacity or demand at the point of interconnection in MW and MVAr.
2. The Facility Interconnection Customer shall interconnect to the PacifiCorp electric system at the nominal voltage at the agreed-to point of interconnection. PacifiCorp, at its sole discretion, may elect to upgrade or change the voltage level of the PacifiCorp electric system serving the Facility Interconnection Customer. Any costs to upgrade or change the Facility Interconnection Customer's equipment to maintain an interconnection with PacifiCorp shall be the responsibility of the Interconnection Customer. All direct assigned facilities required to interconnect to 46 kV systems will be designed and built to 138 kV

standards in anticipation of future conversion of all 46 kV systems to 138 kV.

3. The customer shall obtain PacifiCorp's acceptance of those portions of design documents that apply to protection and security of the PacifiCorp electric system according to OATT requirements and procedures. The customer is solely responsible for the design that affects the facility. Protection of the Facility Interconnection Customer's overall electrical system, including generation and connected load, is the sole responsibility of the Facility Interconnection Customer.
4. The customer will follow all FERC, NERC, and Regional Reliability Organization (RRO) requirements for review and approval of the facility interconnection and any required system changes or upgrades. This may include the development of such studies and data as a WECC subcommittee shall reasonably request.
5. PacifiCorp and/or its consultant shall conduct all electric system studies and issue reports required by FERC, NERC, RRO, PacifiCorp, and any other regulatory body for authorization and justification of the proposed interconnection to the PacifiCorp electric system. The customer shall reimburse PacifiCorp for all costs incurred for these studies and reports according to OATT requirements and procedures.
6. The customer shall comply with PacifiCorp, WECC, and industry design, construction, operating standards, and procedures.
7. The Facility Interconnection Customer's installation shall meet all applicable national, state, and local construction and safety codes.
8. The interconnection design shall be capable of accommodating PacifiCorp electric system reclosing practices.
9. The interconnection design shall incorporate equipment to detect system abnormalities or disturbances in either the Facility Interconnection Customer's system or the PacifiCorp system. This equipment shall have the capability to isolate the sources of the disturbance.
10. The interconnection design shall be such that failure of the generator, transformer, and other auxiliary equipment shall result in the automatic isolation of the affected equipment.
11. The customer shall design the facility to meet all current WECC reliability standards including the WECC System Performance Table as accessed on the WECC website or upon request from PacifiCorp.
12. The customer shall design the facility to meet technical requirements and facility rating standards as shown on the PacifiCorp website.

13. The customer shall not cause the PacifiCorp electric system to violate NERC voltage criteria or voltage ranges defined in ANSI Standard C84.1, Range A (plus or minus 5 percent of nominal).
14. The customer shall interconnect to the PacifiCorp electric system at the nominal voltage at the agreed to point of interconnection. PacifiCorp, at its sole discretion, may elect to upgrade or change the voltage level of the PacifiCorp electric system serving the Facility Interconnection Customer. Costs for upgrading the Customer's facility are the responsibility of the Customer.
15. The customer shall control the electrical real (MW) and reactive (MVAr) power output such that it will not exceed the capacity of the interconnection facilities.
16. The Facility Interconnection Customer 's three-phase generation shall be connected to the PacifiCorp power system with three-phase automatic disconnecting devices (circuit breakers), which are intended to significantly reduce the possibility of damaging the Facility Interconnection Customer 's generation equipment due to single-phase operation. These disconnecting devices shall be equipped with auxiliary contacts that indicate the actual status of the devices' main contacts.
17. A isolating device, typically a switch, must be installed to physically and visibly isolate the customer and PacifiCorp systems. The disconnect will serve as the point of change of ownership between the customer and PacifiCorp and will be labeled as such both on drawings and on-site signage. The disconnect shall be installed by the customer and shall be accessible to both PacifiCorp and the customer at all times with the ability to be padlocked open by either party. The disconnect shall be owned and operated by PacifiCorp to provide a visible air gap with clearances for adequate grounding, maintenance, and repairs of the PacifiCorp electric system. PacifiCorp may require the capability to apply safety grounds on the PacifiCorp side of the disconnect. The customer shall not remove any PacifiCorp padlocks or safety tags as per the Occupational Safety and Health Administration (OSHA) lockout/tagout requirements. In any case the device:
    - Must simultaneously open all phases (gang operated) to the interconnected facilities;
    - Must be accessible by PacifiCorp and must be under PacifiCorp Dispatcher jurisdiction;
    - Must be lockable in the open position by PacifiCorp;

- 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.

PacifiCorp 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 PacifiCorp equipment presents a hazardous condition;
- If the interconnected facilities jeopardize the operation of the PacifiCorp Electric System.

18. System flows as a result of the interconnection shall not overload nor adversely impact PacifiCorp's transmission system, nor neighboring transmission system. Where the Facility Interconnection Customer 's generation or transmission facilities supply fault currents to the PacifiCorp electric system in excess of breaker or other interrupting device maximum-rated interrupting capability, the customer shall be required to install and pay for fault-limiting equipment or pay for breaker or other interrupting-device replacements according to OATT requirements and procedures.
19. The harmonic content of the voltage and current wave forms of both the Facility Interconnection Customer 's and PacifiCorp's systems shall comply with the latest version of the IEEE Standard 519, Recommended Practices and Requirements for Harmonic Control in Electric Power Systems.
20. Industry standard basic insulation level ratings shall be used for electric system additions and electric system interface equipment. The electric equipment shall meet IEEE C62.41 or C37.90.1, V&I Withstand Requirements.
21. The customer shall be capable of withstanding electromagnetic interference environments in accordance with ANSI/IEEE Standard C37.90.2. The interconnection system and protection system shall not mis-operate due to electromagnetic interference, including hand-held communication devices.
22. PacifiCorp may install disturbance-recording equipment at the system interface according to NERC, OATT, or regional requirements and procedures.
23. The interconnection design shall incorporate adequate facilities to enable the on-site generation to be synchronized with the PacifiCorp electric system. The customer shall be solely responsible for synchronizing the generator to

the system. At PacifiCorp's discretion, all occurrences of synchronizing the generator to the system shall be preceded with advance notification of not less than one full clock hour to be provided to PacifiCorp's Portland or Salt Lake City dispatch centers.

24. All points at which the generator can be paralleled with the PacifiCorp electric distribution system must be clearly defined as synchronization points in the submittal documentation. A given installation may be designed such that there are several synchronization points.

25. For insulation and insulation coordination on transmission facilities 34.5 kV and above, PacifiCorp's Engineering Handbook, Section 1.B.7 shall govern facility design.

26. Determination of Equipment Rating: All series elements that together make up a line section or bulk power substation transformer circuit are reviewed to determine which facility has the most limiting rating. In the event that a line section or bulk power transformer terminates on a ring bus or a breaker-and-a-half, the facility rating will be determined assuming a closed ring bus or closed breaker-and-a-half. The most limiting facility rating of the entire ring bus or the most limiting facility rating of the breaker positions adjacent to the line section or bulk power transformer in a breaker-and-a-half scheme are considered in determining the rating of the line section or bulk power transformer. In order to account for the flow split when entering a closed-ring or a closed breaker-and-a-half, a multiplier is used to adjust the ratings of the ring bus or breaker-and-a-half facilities. The multiplier assumes a conservative split of 75/25 percent, meaning that 75 percent of the line section flow or bulk transformer flow is assumed to be transferred onto one leg of the ring bus or breaker-and-a-half. This means that an equivalent line section or bulk power transformer flow of 133 percent (100/75 percent) can be accommodated before exceeding the facility rating of the ring-bus limit or breaker-and-a-half limit. The most limiting series element facility rating, and where applicable, 133 percent of the most limiting ring-bus facility rating, or 133 percent of the most limiting facility rating of the adjacent breaker positions in a breaker-and-a-half is then used in the WECC model data submittal and in operations of PacifiCorp's system. In cases where a facility is jointly owned, the operator of the facility determines the facility rating and shares this rating information with the other joint owners. In cases where a facility is owned in segments (such as a transmission line terminal being owned by one party and the transmission line itself owned by another party), PacifiCorp coordinates with the owners of the other segments of the facility to insure that the most limiting rating is used by all parties.

27. For further information on general technical requirements for facility interconnections, see the appendices at the end of this document.

4 METERING POLICY FOR FACILITY INTERCONNECTION CUSTOMERS

4.1 General

The purpose of this section is to assist the customer in accommodating PacifiCorp metering for the measurement of electricity supplied to the PacifiCorp transmission system. This section is applicable only to those providing power to the PacifiCorp transmission system. The general requirements are similar to, if not identical to, the general requirements for metering the supply of electrical service by PacifiCorp.

Usually, when a generator is installed with the intent of providing power to the PacifiCorp transmission system, electric service to the auxiliary load associated with the generator plant is also needed. As such, power may flow into or out of the plant at different times. Deliveries to and from the plant (bi-directional metering) must be separately recorded and treated as separate transactions under PacifiCorp's tariffs.

All meters and instrument transformers will be provided, installed, owned, and maintained by PacifiCorp at the Facility Interconnection Customer's expense. Unless other arrangements have been made, the customer will provide, install, own, and maintain all mounting structures, conduits, meter sockets, meter socket enclosures, metering transformer cabinets, and switchboard service sections of the size and type approved by PacifiCorp.

PacifiCorp will require Generation Interconnection Customer's with multiple generators to install revenue net metering at each generator, to satisfy that hourly revenue data will be available at all times to validate the official metering at the point of interconnection. This is to eliminate estimating data during periods when the official meteing is questioned or lost. Any net generation metering used for any PacifiCorp revenue purpose or data validation will be tested and maintained identically to the official interconnect revenue metering.

For larger wind farms with multiple collector stations, metering will be required on the high side of each step up transformer, as well as at the point of interconnection. The general requirements for the collector metering are the same as the requirements for revenue metering at the point of interconnection.

Metering will be programmed such that the generators are only charged for consuming VArs when the project is drawing MWs; i.e., not generating.

4.2 Basic Metering Requirements for Generators

4.2.1 Metering Requirements

The standard PacifiCorp meter used for all generation and transmission interchange projects is the Landis & Gyr, Maxsys 2510 meter. The meter will be programmed with a standardized PacifiCorp internal program that will include bidirectional kWh and kVArh energy and kW and kVAr sliding 15-minute demand quantities, with instantaneous MW MVAr data. The meters will be programmed to record 15-minute interval profile demand that includes

bidirectional kWh and kVArh and per-phase volt-hour demand interval recording. Additional quantities can be added if necessary to the basic program.

Metering data collected will include working meter register reads, monthly register freeze reads, and 15-minute demand interval profile data. The meter will perform a self-freeze read at midnight each month. The meters shall be compatible with the PacifiCorp MV-90™ system and shall be interrogated daily or whenever necessary for maintenance purposes.

All meters will include both analog and digital output boards following current standard PacifiCorp specifications. The metering design will include a test switch with all data inputs and outputs terminated at a utility interposition block.

The final metering design requirements including hardware I/O and software specifications will be written into the specific project's scoping documentation. Requests from foreign utilities for digital or analog metering outputs must be made prior to final design. A second or backup meter will be added when needed or if there are additional metering outputs required beyond what is possible from the primary meter.

4.2.2 Meter Testing

PacifiCorp and the generation customer agree that a certification of the meter system accuracy be done at least biannually or as specifically agreed upon in the interchange agreement. PacifiCorp shall give all interested parties notification of at least two weeks for the impending test. A copy of the test results shall be available to all parties involved or on file for review.

4.3 Metering Installations ≥ 5 MW

PacifiCorp standard metering installation for 5 MW and above net generation facilities is required to be wye-connected on the high-voltage side of the step-up transformer. Primary and backup metering which will meter the net generation is required. Revenue metering must be installed at the physical point of interconnection with the PacifiCorp transmission system. If it is not possible to install metering at the physical point of interconnect, PacifiCorp will require that line losses be calculated. The calculated loss algorithm may be additive or subtractive depending upon current flow through the meter. The calculated loss algorithm will be programmed within the meter(s) firmware to adjust the registers, load profile, and any digital or analog outputs. PacifiCorp requires that any applicable line-loss compensation be performed in the meter, rather than calculated in the billing system.

4.3.1 Conduit for Revenue Metering Secondary Leads

For secondary metering leads between the connections at the meters and the instrument transformers located in the substation yard, the generation customer is to provide a minimum size of three-inch conduit. When the distance between the revenue instrument transformers and meter panel is greater than 250 feet, it may be necessary to increase the conduit size to accommodate paralleled CT

metering secondaries to reduce the burden to the current transformers. PacifiCorp shall procure all conductors and the generation customer shall install meter-wiring cable from the transformers to the revenue metering panel located in the substation. The conduit shall be PVC, rigid steel, or IMC and must be installed with long-radius sweeps. The customer contractor is responsible for proper installation practices.

4.3.2 Indoor Panel Applications

When indoor panels are required to mount meters and metering hardware, PacifiCorp will specify, order, and install all revenue panels and accessories. The meter panels will be 12" wide by 90" high and shall require a clear work space 36" wide by 90" high by 48" deep in front and to the rear of the panel.

4.3.3 Outdoor Meter Enclosure Applications

When it is necessary to mount meters and metering hardware in outdoor locations, PacifiCorp will specify and order the metering box enclosure. The enclosure will be mounted and installed by the customer's contractor. When outside meter enclosures are used they typically serve both as the junction box and meter socket enclosure. The meter enclosure box will be NEMA 3R-rated, and shall have sealing provisions.

4.3.4 Sealable Junction Box

The junction box provides a means of terminating the revenue metering service conductors within the substation yard for indoor panel applications. The use of this junction box shall be coordinated with PacifiCorp prior to installation. The junction box will be NEMA 3R-rated, and shall have sealing provisions.

4.3.5 Secondary Leads and Termination

The secondary circuits must be designed such that the maximum possible burden on any transformer will not exceed its rating. All metering secondary leads or cable will be provided by PacifiCorp. The secondary leads will conform to PacifiCorp standards and color-code requirements. Wire terminations may be done by manufacturer or contractor, but all will be inspected and approved by PacifiCorp.

4.3.6 Metering Bypass Switch

When applicable, the requirements for metering bypass switches will be provided by PacifiCorp to the customer. The generation customer shall purchase, install, and own switches which will isolate and bypass the metering transformers when necessary to allow for maintenance.

4.3.7 Primary Metering Structures

The high-side primary metering structure must be designed to accommodate the standard PacifiCorp wye-connected instrument transformers. The physical location will be determined during the design phase of the project. When

requested by the customer, PacifiCorp will supply outside parties with design details of the standard metering system.

4.3.7.1 Metering Disconnects

High-side metering shall have a minimum of two gang-operated, lockable disconnect devices to facilitate establishing a visual open(s). Disconnect devices are necessary at the following locations:

1. At the point of interconnection with PacifiCorp (this switch is PacifiCorp-operated).
2. Between the generator side of PacifiCorp's metering and the Facility Interconnection Customer Facility Interconnection Customer's electrical facility (this switch is owned and operated by the Facility Interconnection Customer Facility Interconnection Customer).
3. If the generator is selling power to PacifiCorp on a surplus-sale basis, a separate disconnect device (generator or host-site owned and operated) is required on the metering side of the load. Refer to Figure 1 for typical interconnections. Distribution pole-top metering requires only one switch located on the load side of the metering.

4.4 Metering Installations < 5 MW

For 46 kV and above and the total net generation output is less than 5 MW, it is acceptable for the revenue metering to be located on the low side of the step-up transformer. All low side metering must be wye-connected and installed on the unregulated side of the voltage regulator. For this application the metering installation is normally inside the customer facility and PacifiCorp-approved metering enclosures are required. Instrument transformers shall be located inside an approved PacifiCorp metering enclosure. It is not acceptable for meters, metering transformers, and accessories to be located on outside structures.

4.4.1 Metering Enclosures > 600 volts for Underground and Overhead Applications

To meter medium-voltage interchange services, customers shall meet the requirements of the Electric Utility Service Equipment Requirements Code, EUSERC Section 400. The customer shall provide all necessary hardware per EUSERC Section 400. A clear work space 78" high by 36" wide by 48" deep in front of distribution metering equipment (per current NEC regulations) is required. A concrete mounting pad is required for the switchgear metering enclosure. The mounting pad shall be a minimum of 4" thick. The metering instrument transformers will be specified by PacifiCorp and shall be provided and installed by the manufacturer of the switchgear. The meter, test switch, and any specialized hardware will be specified, ordered, and installed by PacifiCorp.

4.4.2 Overhead Pole-Mounted Metering

Pole-mounted metering would be unusual inside a generation substation facility. To establish a mutually suitable location for pole-mounted metering, the customer shall consult with PacifiCorp before construction begins.

4.4.3 Metering < 600 volts

The service and metering installation requirements for all installations shall conform to the applicable standards of PacifiCorp's *Six State Electric Service Requirements*. Generation metering requirements for secondary below 600 volts, self-contained and instrument-rated metering are the same as commercial installations.

4.5 Metering for Station-Service Power

Depending upon the generation facility's electrical sources, the station service power for connecting substation facilities may also require revenue metering. The same metering requirements as generation meters apply to station-service metering.

4.6 Meter Communication Requirements

All generation metering will require a dedicated voice grade data phone line for use with the PacifiCorp MV-90 meter data collection system. It will be the responsibility of the generation customer to supply both the land line and any communication protection devices necessary for PacifiCorp to remotely interrogate the meter through a dial-up connection.

The following sections describe the detailed requirements for metering electricity supplied by generators connected to the PacifiCorp system:

Surplus-Sale Operation Co-Generation: Meters shall be required to measure both the net generator output and the surplus generation delivered to the PacifiCorp system.

Net-Sale Operation: Meters shall be required at the point of interconnection.

No-Sale Operation: Revenue metering will not be required for the measurement of power delivered into the PacifiCorp system, except that load profile and net generator profile metering may be required for standby service. The existing service metering shall be replaced with metering equipped with multiple register to separately measure all required quantities.

Wheeling Service: Wheeling service under certain existing agreements on the PacifiCorp system require two sets of revenue-metering equipment which may be totalized to accommodate various line and switch configurations. Import metering is required to the point of import (received) to (on) the PacifiCorp system. Export metering is required at the point of export (delivery) from (off) the PacifiCorp system.

Where non-utility generators (i.e., emergency generators, peak-shaving generators, etc.) or portable plug-ins (generators not permanently wired to the outlet) are connected via an electrical outlet or automatically connected via an automatic transfer switch, a visible disconnect shall be required. A visible disconnect can be a disconnect knife switch or a combination of a manual disconnect circuit breaker, built-in switch, and red

light indicators. The disconnect shall be visible at all times, and shall have one red light bulb per conductor indicating energized/de-energized conditions of the utility and generator source conductors on the line side of the main disconnect or circuit breaker.

All generators must meet applicable standards of the Western Electric Coordinating Council (WECC).

4.7 Instrument Transformers ≥ 5 MW

Voltage and current instrument transformers are required to be a wye-connected, wire-wound, extended-range type with 0.15 percent metering accuracy class. The instrument transformers will maintain their accuracy ranging from 1 amp to 4,000 amps Type-1 class and from 0.25 amps to 750 amps Type-3 primary current. The accuracy class addresses both ratio error and phase-angle error over the burden range of the installed metering circuit. Instrument transformers shall be stand alone, located on the line at the delivery point such that the metering is not interrupted during possible switching configurations at the delivery point unless the metering is being removed for service. Paralleling CTs and internal CTs located inside breakers and power transformers for the purpose of revenue metering will not be permitted.

4.8 Instrument Transformers < 5 MW

For low-side metering exceptions, it is not required for the metering transformer's accuracy to be extended-range. Voltage and current instrument transformers are required to be 0.3 percent standard metering accuracy class for both ratio error and phas- angle error over the burden range of the installed metering circuit. Instrument transformers shall be an approved PacifiCorp design and shall be located within the metering switchboard or switchgear enclosures.

4.9 Instrument Transformer Verification

At least once during the life of the transformer, 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 percent 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.

4.10 Telemetering Requirements for Generator Monitoring

4.10.1 For New Generation Facilities ≥ 3 MW

For generating facilities totaling 3 MW or greater, the following real-time data is to be telemetered to PacifiCorp's Control Center for each generating unit (both wind and non-wind units):

- kW

- kVAr
- kWh
- generator terminal voltage (kV)

A generator equipped with a voltage regulator and power system stabilizer (PSS) must also provide telemetry indicating the status of both the regulator and the PSS. In addition, transmission kW, kVAr, kV, and breaker status may be required, depending on the number of generators and transmission configurations. A telemetering circuit to the designated PacifiCorp Control Center is also required. A minimum number of alarms to be transmitted include the following:

- breaker trip
- transfer trip receive
- channel/equipment failure

Unless other arrangements are made, the customer must provide communication lines with the following minimum specifications: VG36, Class B, Type-3, 4-wire, full-duplex (1200 baud).

Telemetering equipment (usually a dual-ported RTU) shall be located in the metering enclosure. At the entity's expense, PacifiCorp will supply telemetering equipment at the Facility Interconnection Customer Facility Interconnection Customer 's site, at PacifiCorp's Control Center and at a designated PacifiCorp Alternate Control Center.

5 TELECOMMUNICATION REQUIREMENTS FOR FACILITY INTERCONNECTION

5.1 Application

Before a new facility is interconnected to the PacifiCorp power system, PacifiCorp will specify the metering, protection, supervisory control and data acquisition (SCADA), telemetering, and telecommunications channels required. Due to the highly specialized and critical nature of the protection, metering, SCADA, and telemetering equipment, PacifiCorp requires that all such equipment be owned, installed, and maintained by PacifiCorp at the generation facility's expense. Also, due to the critical protection requirements for the interconnection of the generation facility to PacifiCorp's system as well as the varied PacifiCorp internal telecommunications systems which may be available for the specific generation facility, the telecommunication channels described below must be defined on a case-by-case basis.

5.2 General Requirements

The interconnection facility customer will be responsible for acquiring the communication lines from the local telephone company or multiple telephone companies as required to meet the telecommunications required of the new generation

facility with the exception that if tele-protected (requires communications channel) relay channels are required, PacifiCorp will provide them at the cost of the generation facility. Due to the critical nature of the protection, metering, SCADA, and telemetering requirements, PacifiCorp will define the technical requirements and may provide, at its option, all or portions of the telecommunication channels on its existing internal telecommunication network at the cost of the generation facility.

5.3 Telecommunication Circuit Requirements

5.3.1 New Generation Facilities < 3 MW with No Teleprotection Requirement

5.3.1.1 Remote Metering Business Telephone Line

A business telephone line at the location of the interconnect point metering equipment is required for remote revenue-metering reading and maintenance work.

5.3.2 New Generation Facilities ≥ 3 MW or New Generation Facilities < 3 MW with Teleprotection Requirement

5.3.2.1 Remote Metering Business Telephone Line

A business telephone line is required at the location of the interconnect point metering equipment for remote revenue-metering reading. The generation entity must provide land-line telephone access, if possible. If local telco facilities are not available, other options for providing dial-up access to the meter will be considered.

5.3.2.2 Dispatch Business Telephone Line

A business telephone line is required so operating instructions from PacifiCorp can be given to the designated operator of the generation facility equipment. Unless other arrangements are made to use PacifiCorp's existing telecommunications network, the generation entity must provide a local telephone.

5.3.2.3 Protective Relay Remote Access Business Telephone Line

A business telephone line is required at the location of the protective relay equipment for remote maintenance of the protective relay equipment. Unless other arrangements are made to use PacifiCorp's existing telecommunications network, the generation entity must provide a local telephone.

5.3.2.4 Protective Relays

PacifiCorp will determine if non-pilot protective relays will be adequate for emergency tripping of the generation facility and/or protection of the distribution or transmission system or if tele-protected-type protection equipment is required. PacifiCorp will design and provide telecommunications channels suitable for the protective relay package

required at the cost of the generation facility. Local telephone company leased lines are not acceptable for protective relay channels. Telecommunication channels for protective relay equipment may consist of fiber optic system, power line carrier, microwave radio, or a combination of these systems.

5.3.2.5 SCADA Remote Terminal Unit (RTU)

Real-time data and/or control via a SCADA RTU is be communicated to PacifiCorp's Control Center. Unless other arrangements are made to use PacifiCorp's existing telecommunications network, the generation entity must provide a local telephone company VG36, Class B, Type-3, 4-wire, full-duplex communication line from the generation facility to PacifiCorp's Control Center. PacifiCorp will specify the location where the communication line will terminate. Telecommunication channels for SCADA RTU equipment, when using PacifiCorp's telecommunications network, may consist of fiber optic system, microwave radio, other radio system, or a combination of these systems.

5.3.2.6 Analog Telemetering

Analog telemetering of the total generation facility's kW output to one of PacifiCorp's alternate control sites (Medford, Oregon; Yakima, Washington; Goshen, Idaho; or Sigurd, Utah) is required as an interim solution per NERC Standard EOP-008-0, *Plans for Loss of Control Center Functionality*. Unless other arrangements are made to use PacifiCorp's existing telecommunications network, the generation entity must provide a local telephone company VG36, Class-B, Type-3, 2-wire, communication line from the generation facility to PacifiCorp's alternate control site. PacifiCorp will specify the location of the closest alternate control site where the communication line will terminate. Telecommunications channel for analog telemetering equipment, when using PacifiCorp's telecommunications network, may consist of fiber optic cable, power line carrier, microwave radio, or a combination of these systems. The analog telemetering channel may use the same telecommunications system as the SCADA RTU channel providing it is not routed through PacifiCorp's Control Centers.

5.4 Telephone Company Line Treatment Equipment

Proper cable and protection equipment may be required at substations and other high-voltage electric facilities for expected ground potential rise (GPR). The GPR testing required to determine the required telephone line protection may be performed by PacifiCorp at the cost of the generation facility or may be performed by generation facility itself. The calculated GPR value will determine what grade of telephone cable high-voltage protection equipment is required, as well as the distance from the facility at which the telco pedestal will be located. The local telephone company must be informed in advance (up to six months) so outside plant facilities can be engineered to

serve the generation facility location. Some independent telephone companies are not tariffed to provide protection equipment. In this case, the generation facility will be required to purchase and install the necessary telephone line protection equipment.

5.5 Communication Operating Conditions

5.5.1 Normal Operating Conditions

The customer shall provide to PacifiCorp the information necessary to communicate with the equipment and/or personnel at the generation facility during routine operating conditions. This information shall be updated as soon as a material change becomes available for use by notifying PacifiCorp's grid operations centers in either Salt Lake City, Utah or Portland, Oregon, depending on the facility's operating area.

5.5.2 Emergency Operating Conditions

The Facility Interconnection Customer shall provide to PacifiCorp the information necessary to communicate with the equipment and/or personnel at the generation facility during the loss of the primary communication medium. This would be considered the emergency operating condition. This information is also to be updated as soon as a material change becomes available for use by notifying PacifiCorp's grid operations centers in either Salt Lake City, Utah or Portland, Oregon, depending on the facility's operating area.

6 PROTECTION AND CONTROL POLICY

This section specifies the protective and control requirements for Facility Interconnection Customers to PacifiCorp's transmission system.

6.1 Applicability

The applicable protective standards of this section apply to all facilities interconnecting to any portion of PacifiCorp's transmission system. These policies, which govern the design, construction, inspection, and testing of protective devices, have been developed by PacifiCorp to be consistent with applicable reliability criteria.

6.2 Protective Requirements

An important objective in the interconnection of facilities to PacifiCorp's system is minimizing the potential hazard to life and property. A primary safety requirement is the ability to disconnect immediately when a fault is detected. Facility developers desiring interconnection with PacifiCorp's transmission system must comply with all applicable jurisdictional state regulatory agency rules in this regard.

The protection equipment for an interconnection facility must protect against faults within that facility and faults on the PacifiCorp system. As a general rule, an interconnection facility must also trip off-line (disconnect from the PacifiCorp system automatically) when PacifiCorp's transmission system is disconnected from the line into which the facility is connected.

In view of these objectives, PacifiCorp requires line-protective equipment to either 1) automatically clear a fault and restore power, or 2) isolate only the faulted section.

Due to the high-energy capacity of the PacifiCorp transmission system, high-speed fault clearing may be required to minimize equipment damage and potential impact to system stability. The requirement of high-speed fault clearing will be determined by PacifiCorp on a case-by-case basis. To achieve these results, relays and protective devices are needed. The requirements are outlined in the following pages. Some protection requirements can be standardized, however most line relaying depends on generator size and type, number of generators, line characteristics (i.e., voltage, impedance, and ampacity), and the existing protection equipment connected to the PacifiCorp system.

PacifiCorp's minimum protection requirements are designed and intended to protect PacifiCorp's system only. As a general rule, neither party should depend on the other for the protection of its own equipment. Interconnected Facilities are required to provide their own high side protection for their facilities. Additional protective relays are typically needed to protect the Interconnection Customer 's facility adequately. It is the Facility Interconnection Customer 's responsibility to protect their own system and equipment. PacifiCorp insists that the entity hire a qualified electrical engineer (with a PE license in electrical engineering) to review and stamp the electrical design of the proposed generation facility and ensure that it will be adequately protected.

The Facility Interconnection Customer must provide PacifiCorp test reports for all relays before PacifiCorp will allow the facility to parallel. Refer to Section 10.2 for information regarding pre-parallel inspections. Every four years thereafter, the Facility Interconnection Customer must test relays and provide written proof of the testing, that the relays are operable and within calibration. PacifiCorp will not test the entity's equipment, but may witness the testing performed by a qualified testing firm retained by the entity. The testing firm will be approved by PacifiCorp prior to the actual test. On-site power (typically 120 V) is required for the test equipment. Circuit breakers must be tested at least every eight years after the pre-parallel inspection. It is also in the Facility Interconnection Customer 's best interest to make sure all of its protective equipment is operating properly, since significant equipment damage and liability can result from failures of the entity's protective equipment. The Facility Interconnection Customer shall report relay problems to PacifiCorp and shall resolve problems in a reasonable time (within one year at a minimum). If this places PacifiCorp or the Facility Interconnection Customer in a compromised position of liability, the generation shall be disconnected until the relay issue(s) is/are resolved to PacifiCorp's satisfaction.

6.3 Reliability and Redundancy

The Facility Interconnection Customer shall design the protection system with sufficient redundancy or relay coordination such that the failure of any one component will still permit the Facility Interconnection Customer's facility to be isolated from the PacifiCorp system under a fault condition. Multi-function three-phase protective relays

must have redundant relay(s) for back up unless otherwise agreed to by PacifiCorp. The required breakers must be trip-tested by the Facility Interconnection Customer at least once a year.

6.4 Relay Elements

The following is a description of the relay elements shown in Figure 1.

21 – Distance relay is a relay that functions when the circuit admittance, impedance, or reactance increases or decreases beyond a predetermined value. This type of relay may be required when the Generation Entity is connecting two (2) or more generators to The PacifiCorp power system. This determination is made during the System Impact Study and is based on minimum peak loading of the feeder tow which the Generator Entity will connect.

27 – Undervoltage relay is a relay that operates when its input voltage is less than a predetermined value. PacifiCorp requires three (3) undervoltage elements with time delay. Settings will be determined during the System Impact Study.

50P – Phase instantaneous overcurrent relay is a relay that functions instantaneously on an excessive value of phase current. The requirement for this element is based on minimum peak loading of the feeder tow which the Generator Entity will connect.

59N – 3V0 overvoltage relay is a relay that functions instantaneously on an excessive value of 3V0 voltage. This element utilizes the second coil of the potential transformer wired in a broken delta. Settings will be determined during the System Impact Study.

59 – Overvoltage relay is a relay that operates when its input voltage is higher than a predetermined value. This element is utilizes a current transformer between the transformer and the high side breaker. Settings will be determined during the System Impact Study.

81O – Overfrequency relay is a relay that responds to the frequency of an electrical quantity, operating when the frequency or rate of change of frequency exceeds a predetermined value. PacifiCorp requires three (3) overfrequency elements with time delay. Settings will be determined during the System Impact Study and are based on radial or non-radial connections.

81U – Underfrequency relay is a relay that responds to the frequency of an electrical quantity, operating when the frequency or rate of change of frequency is less than a predetermined value. PacifiCorp requires three (3) underfrequency elements with time delay. Settings will be determined during the System Impact Study and are based on radial or non-radial connections.

TT – Transfer Trip is a scheme that operates based on a remote signal. Transfer trip could utilize, fiber, leased line, microwave, etc. as determined by PacifiCorp. Transfer trip may be required depending on PacifiCorp circuit configuration and loading, as determined by PacifiCorp. Typically, transfer trip shall be required if PacifiCorp determines that a generation facility cannot detect and trip on PacifiCorp end-of-line faults within an acceptable time frame or if the generation facility may be capable of

keeping a PacifiCorp line energized with the PacifiCorp source disconnected. It may be in the generation facility's best interest to purchase relays capable of communications in the event transfer trip is later required.

Figure 1–Typical Interconnection for Protection and Metering Installation 69 kV and Below

[See scanned pdf attachment]

6.5 Approved Vendors

PacifiCorp is familiar with all major utility-grade relay manufacturers. Below is a sample list of major vendors; it is not intended to be an exhaustive listing.

ABB

Areva

Beckwith

Basler

Cooper

GE

Schweitzer

Siemens

PacifiCorp will accept any utility-grade relay or combination of relays from this list provided that all required relay elements are fulfilled. All relays must be utility-grade, no other grade will be acceptable.

PacifiCorp approval does not indicate the quality or reliability of a product or service, and no endorsements or warranties shall be implied.

6.6 Line Protection

Many factors are considered when determining the protective relaying requirements needed by Facility Interconnection Customer to protect PacifiCorp facilities and customers' equipment. Some of these factors are: the zone of protection, location of connection to PacifiCorp system, location of customers relative to the location of connection, and type of protection system used on the PacifiCorp transmission system.

The zone of protection refers to the area in PacifiCorp's system where the Facility Interconnection Customer's facility must provide fault protection. When a fault occurs, the Facility Interconnection Customer's protective relays are to cause the isolation of the Facility Interconnection Customer's facilities from PacifiCorp's or the Facility

Interconnection Customer's system. If there are any PacifiCorp customers connected to the system in the zone of protection, the protection system is designed so that the service to those customers is not diminished by the addition of the Facility Interconnection Customer's facilities. This includes the amount of delay in automatic testing of the zone of protection by PacifiCorp's equipment following a fault.

There are many options for providing the protective relay system for the zone of protection. These options will affect the up-front cost and the reliability of the Facility Interconnection Customer's facilities. The use of pilot relaying or direct transfer trip communication may increase the cost to the Facility Interconnection Customer, but the use of these systems will limit the number of times the facility is forced offline to protect PacifiCorp's system. This is especially true when a PacifiCorp customer is connected to the system in the zone of protection. The protective relays at the Facility Interconnection Customer's facility will need to be set to detect any fault in the zone of protection and isolate the Facility Interconnection Customer's generator from PacifiCorp's system with no delay. Since the protective relays cannot be set to detect 100 percent of the faults without detecting and operating for faults outside the zone of protection, the Customer's interconnection facilities will be disconnected for fault conditions that normally would not require isolation of the facilities. With the use of a pilot relaying system or direct transfer trip, the number of these unnecessary operations can be greatly reduced. In addition, line-protection relays must coordinate with the protective relays at the PacifiCorp breakers for the line on which the generating facility is connected. The typical protective zone is a two-terminal line section with a breaker on each end. In the simplest case of a load on a radial line, current can flow in one direction only, so protective relays need to be coordinated in one direction and do not need directional elements. However, on the typical transmission system, where current may flow in either direction depending on system conditions, relays must be directional. Also, the complexity and the required number of protective devices increase dramatically with increases in the number of terminals in each protective zone. With two terminals in a protective zone, there are two paths of current flow. With three terminals there are six paths of current flow, and so on. Coordinating a multi-terminal scheme may sometimes require installation of a transmission line protective relay at the Facility Interconnection Customer 's sub-site. This is commonly the case whenever three-terminal permissive overreach transfer trip (POTT) schemes are employed to protect the line. Because this line relay participates in a scheme to protect the PacifiCorp transmission system, PacifiCorp must ensure the maintenance, testing, and reliability of this particular type of relay.

In addition, the breaker's relays must be set to have overlapping zones of protection in case a breaker within any given zone fails to clear. The line protection schemes must be able to distinguish between generation, inrush, and fault currents. Multiple terminal lines become even more complex to protect. Existing relay schemes may have to be reset, replaced, or augmented with additional relays at the Facility Interconnection Customer 's expense to coordinate with the Facility Interconnection Customer 's new facility.

The PacifiCorp-required relays must be located so that a fault in the zone of protection on any phase of the PacifiCorp line shall be detected. If transfer trip protection is required by PacifiCorp, the Facility Interconnection Customer shall provide at its expense a voice-grade communications circuit. This circuit may be a communication line from the telephone company or a dedicated cable. The line must have high-voltage protection equipment on the entrance cable so the transfer trip equipment will operate properly during fault conditions.

The PacifiCorp transmission system is designed for high reliability via multiple sources and paths to supply customers. Due to the multiple sources and paths, more complex protection schemes are required to properly detect and isolate faults. The addition of any new generation facility to the PacifiCorp system must not degrade the existing protection and control schemes or cause existing PacifiCorp customers to suffer lower levels of safety and/or reliability.

Table 1 lists the minimum protection that PacifiCorp typically uses on its own installations. Higher voltage interconnections require additional protection due to the greater potential for adverse impact to system stability, and the greater number of customers who would be affected. Special cases such as distribution-level network interconnections, if acceptable, may have additional requirements. The acceptability and additional requirements of these interconnection proposals shall be determined by PacifiCorp on a case-by-case basis.

6.7 PacifiCorp Protection and Control System Changes

PacifiCorp will perform a detailed interconnection study to identify the cost of any required modifications to PacifiCorp's protection and control systems are required to interconnect a new facility. These protection and control system modifications are in addition to any transmission and distribution system upgrades identified in the system impact or facilities studies for interconnection of the new facilities.

The following is a partial list of protection system modifications which may be required:

1. PacifiCorp's automatic restoration equipment shall be prevented from operating until the generator is below 25 percent of nominal voltage as measured at the restoration equipment. Generator damage and system disturbances may result from the restoration of power by automatically re-energizing PacifiCorp's facilities. This modification shall be required when the generator(s) has the capability of energizing a line when the PacifiCorp system is disconnected. PacifiCorp will not allow the Facility Interconnection Customer Facility Interconnection Customer 's generator(s) to automatically re-energize PacifiCorp facilities.
2. For generation facilities greater than 1,000 kW aggregate nameplate rating, all existing single-phase fault-interrupting devices (fuses) located in series between the generator and PacifiCorp's substation shall be replaced with three-phase interrupting device to prevent possible single-phasing of other customers.

3. The PacifiCorp substation transformer high-side fuses must be replaced with a three-phase interrupting device when the generator is on a distribution circuit fed from a fused PacifiCorp substation transformer bank and the bank's minimum load is equal to or less than 200 percent of the generator's nameplate rating.
4. A transfer trip scheme from the high-side circuit breaker/circuit switcher to the generator shall be installed if necessitated by PacifiCorp. An associated alarm circuit is required between the Facility Interconnection Customer Facility Interconnection Customer 's site and the PacifiCorp Control Center.

6.8 Warning Label for Protective Relays

A warning label shall be affixed within 6 inches of any relay in the Facility Interconnection Customer's control house (or similiar enclosure containing protective relays) **which affects the operation of PacifiCorp's electrical circuits**. The warning label shall state the following:

> ***Warning !!!*** *Do not alter or change any settings on this relay without first receiving approval from PacifiCorp's Protection and Control Engineering Dept. in Portland, Oregon. Failure to give notification to PacifiCorp of this action may result in damaged or destroyed electrical equipment, possible physical injury or fatality, facility disconnection, and/or legal action.*

Table 1–Line Protection Devices

Line Protection Device	Device[1] Number	34.5kV or less	46kV, 57kV or 69kV	115kV	230kV & above
Phase Overcurrent (Radial systems)	50/51	X	X		
Ground Overcurrent (Radial systems)	50/51N	X	X		
Phase Directional Overcurrent	67		X	X	
Ground Directional Overcurrent or Transformer Neutral	67N 50/51N		X	X	X
Distance Relay Zone I	21ZI		X[2]	X	X
Distance Relay Zone 2	21Z2		X[2]	X[2]	X
Distance Relay Carrier	21Z2C			X[2]	X
Ground Directional Overcurrent Carrier	67NC			X[2]	X
Pilot Wire	87L			X[2]	X
Permissive Overreaching Transfer Trip (POTI) or Hybrid	21/67T			X[2]	X
Direct Transfer Trip	TT	X[3]		X[3]	X[3]

Notes:

1. Refer to Section 6.4 for device number definitions and functions.
2. May be required on transmission or distribution interconnections depending on local circuit configurations, as determined by PacifiCorp.
3. Transfer trip may be required on transmission- level or distribution- level interconnections depending on PacifiCorp circuit configuration and loading, as determined by PacifiCorp. Typically, transfer trip shall be required if PacifiCorp determines that a generation facility cannot detect and trip on PacifiCorp end-of-line faults within an acceptable time frame or if the generation facility may be capable of keeping a PacifiCorp line energized with the PacifiCorp source disconnected (Appendix F).

6.9 Manual Disconnect Switch Requirements

A manual load-break disconnect switch is required for all interconnected facilities. For connections to the PacifiCorp transmission grid, a tap line switch may also be required if, in PacifiCorp's judgment, sufficient tap line exposure exists to warrant it. Refer to Appendix D for more details on tap line switches. For transmission line taps, two additional line switches, one on each side of the tap, are required to provide the facility better service and operating flexibility. Note that the installation of line switches may impact the protection requirements for the interconnection, specifically the need for direct transfer trip.

A PacifiCorp-operated disconnect device must be provided as a means of electrically isolating the PacifiCorp transmission system from the interconnected facilities. This device shall be used to establish visually-open working clearance for maintenance and repair work in accordance with PacifiCorp safety rules and practices. A disconnect device must be located at the point of interconnection with PacifiCorp. PacifiCorp shall own, operate, and maintain all disconnect switches for generation interconnection facilities. The disconnect switch shall be specified by the appropriate PacifiCorp engineers working on the interconnection project and shall come from PacifiCorp stock and be installed on PacifiCorp-owned facilities. PacifiCorp will notify the Facility Interconnection Customer in advance of the operation of the disconnect switch and follow all work practices associated with this procedure. In the event of an urgent incident or emergency, PacifiCorp may not be able to notify the developer in a timely fashion that it intends to operate a switch. Any deviation from this policy shall be signed off by a Vice-President of Engineering at PacifiCorp along with corporate legal counsel and shall be included in the interconnection agreement between PacifiCorp and the generator developer with an explanation of why this policy was not followed for the specific project.

For cases in which the state or federal regulatory policy conflicts with PacifiCorp's policy, the state and federal regulatory policy shall prevail.

The developer may at its option install other disconnect switch(es) on its property to operate as its sees fit. PacifiCorp asks that the developer notify a PacifiCorp dispatch center before operation of their disconnect switch(es).

PacifiCorp personnel shall inspect and approve the installation before parallel operation is permitted. If the disconnect device is in the Facility Interconnection Customer Facility Interconnection Customer 's substation, it should be located on the substation dead-end structure and must have a PacifiCorp-approved operating platform.

The disconnect device must not be used to make or break parallels between the PacifiCorp system and the generator(s). The device enclosure and operating handle (when present) shall be kept locked at all times with PacifiCorp padlocks.

The disconnect device shall be physically located for ease of access and visibility to PacifiCorp personnel. When installed on the Facility Interconnection Customer 's side of the interconnection, the device shall normally be installed close (within one foot) to the metering. The PacifiCorp-operated disconnect shall be identified with a PacifiCorp-designated switch number plate.

For transmission voltage interconnections, metering is normally on the high side of the Facility Interconnection Customer 's step-up transformers. Between the metering units and the circuit breaker, a second disconnect device is required; it shall not have a PacifiCorp lock and may be operated by the Facility Interconnection Customer.

Notes:

1. Disconnect switches must be rated for the voltage and current requirements of the particular installation.
2. Disconnect switches must be gang-operated unless otherwise agreed to by PacifiCorp.
3. Disconnect switches must be weatherproof or designed to withstand exposure to weather.
4. Disconnect switches must be lockable in both the open/closed positions with a standard PacifiCorp lock unless otherwise agreed to by PacfiCorp.

6.9.1 High-Voltage Disconnects

The Facility Interconnection Customer shall submit a proposed switch specification to PacifiCorp. It shall be reviewed and approved in writting by a PacifiCorp engineering manager prior to its purchase and installation.

6.9.2 Conditions for Manual Disconnection

Producers must discontinue parallel operation when requested by PacifiCorp under the following conditions:

1. To facilitate maintenance, test, or repair of PacifiCorp's facilities. PacifiCorp will coordinate this with each producer.
2. During system emergencies.
3. When a generator is interfering with other PacifiCorp customers or producers on the system.

4. When inspection of a generator reveals either a condition hazardous to PacifiCorp's system or personnel or a lack of scheduled maintenance or maintenance records for equipment necessary to protect PacifiCorp's system.

6.10 Fault-Interrupting Devices

The fault-interrupting device selected by the Facility Interconnection Customer must be reviewed and approved by PacifiCorp for each particular application.

There are three basic types of fault-interrupting devices:

- Circuit Breakers
- Circuit Switchers
- Fuses

PacifiCorp will determine the type of fault-interrupting device required for a generation facility based on the size and type of generation, the available fault duty, the local circuit configuration, and the existing PacifiCorp protection equipment.

6.10.1 Circuit Breakers

Three-phase circuit breaker(s) at the point of interconnection automatically separate the facility from the PacifiCorp system upon detection of a circuit fault. Additional breakers and protective relays may be installed in the generation facility for ease in operating and protecting the facility. The interconnection breakers must have sufficient capacity to interrupt maximum available fault current at its location and shall be equipped with accessories to:

1. Trip the breaker with an external trip signal supplied through a battery (shunt trip).
2. Telemeter the breaker status when it is required.
3. Lockout if operated by protective relays required for interconnection.

Generally, a three-phase circuit breaker is the required fault interruption device at the point of interconnection, due to its simultaneous three-phase operation and ability to coordinate with PacifiCorp line-side devices. However, fuses are allowed as high-side protection for the dedicated transformer at generation facilities of less than 1,000 kW connected on the distribution-level system, provided that coordination can be obtained with existing PacifiCorp phase and ground protection. If fuses are used, the Facility Interconnection Customer should consider installing a negative sequence relay and/or other devices to protect the facility against single phase conditions. If fuses are used for high-side transformer protection, a separate generator breaker will be required to isolate the generator from the PacifiCorp system under a fault or abnormal system conditions.

6.10.2 Circuit Switchers

A circuit switcher is a three-phase fault-interrupter with limited fault interrupting capability. These devices have typically been used at voltages of 115 kV and below and may substitute for circuit breakers when the fault duty is within the interrupting rating of the circuit switcher. With PacifiCorp approval, some circuit switchers with blades can double as the visual open disconnect switch between the metering transformers and the main transformer. Since circuit switchers do not have integral current transformers, they must be installed within 30 feet of the associated current transformers to minimize the length of the unprotected line/bus section.

6.10.2.1 Fuses

Fuses are single-phase, direct-acting sacrificial links that melt to interrupt fault current and protect the equipment. Blown fuses need to be replaced manually after each fault before the facility can return to service. Overhead primary fuses shall be replaced by trained personnel. Since fuses are single phase devices, they may not all melt during a fault, and may not automatically separate the generation facility from PacifiCorp. Fuses cannot be operated by the protective relays, hence they cannot be used as the primary protection for three-phase generation facilities. However, they may be used for high-side transformer protection for generation less than 1,000 kW, provided coordination can be obtained with the existing PacifiCorp phase and ground protection, and if a separate breaker provides the required primary protection. Fuses are not permitted for high side transformer protection for facilities of 1,000 kW or greater.

Large primary fuses which do not coordinate with the PacifiCorp substation breaker ground relays shall not be allowed. Such use could cause all the customers on the circuit to lose power due to a fault inside the generating facility.

7 GENERATOR PROTECTION AND CONTROL

Single-phase generators must be connected in multiple units so that an equal amount of generation capacity is applied to each phase of a three-phase circuit.

All synchronous, induction, and single-phase generators shall comply with the latest ANSI Standards C50.10 and C50.13, dealing with waveform and telephone interference.

Synchronous generators of any size require: a) synchronizing relays (Device No.25) to supervise generator breaker closing, and b) reclose blocking at the PacifiCorp side of the line to which the generator is connected (applies to substation breaker/recloser). Standard device numbers for commonly used protective elements are defined in Table 3. Direct transfer trip is preferred if coordinated protection is desired by the Facility Interconnection Customer. Coordinated protection will minimize the number of times the generator is forced offline without a dedicated feed.

The generator protection equipment listed in Section 6.4 is required to permit safe and reliable parallel operation of the Facility Interconnection Customer's equipment with the PacifiCorp system. Additional or alternate generator protection requirements for generators utilizing induction-type generator(s) or other specific situations shall be determined by PacifiCorp on a case by case basis.

7.1 Generator Requirements

7.1.1 Low Voltage Ride-Through (LVRT) Requirements for Generators

A generating plant shall be able to remain online during voltage disturbances up to the time periods and associated voltage levels set forth below. The LVRT standard is divided into three classifications by generation plant size.

7.1.1.1 Generating Plants with Capacity > 20 MW

7.1.1.1.1 Transition Requirements

For generators with interconnection agreements signed and filed with FERC between January 1, 2006 and December 31, 2006 with a scheduled in-service date no later than December 31, 2007 *or* for generating turbines subject to a turbine procurement contract executed prior to December 31, 2005 for delivery through 2007, the following requirement applies:

Generating plants are required to remain in-service during three-phase faults with normal clearing (which is a time period of approximately 4-9 cycles) and single line–to-ground faults with delayed clearing, as well as subsequent post-fault voltage recovery to pre-fault voltage unless clearing the fault effectively clears the generator from the system. The clearing time requirement for a three-phase fault will be specific to the generating plant substation location as determined by and documented by the transmission provider. The maximum clearing time the generating plant shall be required to withstand for a three-phase fault shall be nine cycles at a voltage as low as 0.15 pu, as measured at the high side of the generating plant step-up transformer (i.e., the transformer that steps the voltage up to the transmission interconnection voltage or GSU), after which, if the fault remains following the location-specific normal clearing time for three-phase faults, the generating plant may disconnect from the transmission system.

Notes:

1. This requirement does not apply to faults occurring between the generator terminals and the high side of the GSU or to faults that would result in a voltage lower than 0.15 pu on the high side of the GSU serving the facility.

2. Generating plants may be tripped after the fault period if this action is intended as part of a special protection system.
3. Generating plants may meet this LVRT standard by performance of the generators or by installing additional equipment (e.g., static VAR compensator, etc.) within the generating plant or by a combination of generator performance and additional equipment.
4. Any existing individual generator units that are, or have been, interconnected to the network at the same location before this requirement was written, are exempt from this requirement for the remaining life of the generation equipment. Existing individual generator units that are replaced must meet the requirements listed above.

7.1.1.1.2 Post-Transition Period

For all generators with capacity greater than 20 MW not subject to the transition period requirement above, the following requirement applies:

Generating plants are required to remain in-service during three-phase faults with normal clearing (which is a time period of approximately 4-9 cycles) and single line-to-ground faults with delayed clearing, as well as subsequent post-fault voltage recovery to pre-fault voltage unless clearing the fault effectively clears the generator from the system. The clearing time requirement for a three-phase fault will be specific to the generating plant substation location as determined by and documented by the transmission provider. The maximum clearing time the generating plant shall be required to withstand a three-phase fault shall be nine cycles, after which, if the fault remains following the location-specific normal clearing time for three-phase faults, the generating plant may disconnect from the transmission system. A generating plant shall remain interconnected during such a fault on the transmission system for a voltage level as low as zero volts, as measured at the high side of the GSU.

Notes:

1. This requirement does not apply to faults that would occur between the generator terminals and the high side of the GSU or to faults that would result in a voltage lower than 0.15 pu on the high side of the GSU serving the facility.
2. Generating plants may be tripped after the fault period if this action is intended as part of a special protection system.
3. Generating plants may meet this LVRT standard by performance of the generators or by installing additional equipment (e.g., static

VAR compensator, etc.) within the generating plant or by a combination of generator performance and additional equipment.

4. Any existing individual generator units that are, or have been, interconnected to the network at the same location before this requirement was written are exempt from this requirement for the remaining life of the generation equipment. Existing individual generator units that are replaced are required to meet the requirements listed above.

7.1.1.2 Generating Plants with Capacity ≥ 10 MVA and ≤ 20 MW

Generators are required to remain in-service during system faults (three-phase faults with normal clearing and single line-to-ground faults with delayed clearing) unless clearing the fault effectively disconnects the generator from the system. This requirement does not apply to faults that would occur between the generator terminals and the high side of the generator step-up transformer or to faults that would result in a voltage lower than 0.15 pu on the high side of the generator step-up transformer. In the post-fault transient period, generators are required to remain in-service for the low voltage excursions specified in the Table 4 as applied to a load bus.

Notes:

1. These performance criteria are applied to the generator interconnection point, not the generator terminals.
2. Generators may be tripped after the fault period if this action is intended as part of a special protection system.
3. This standard applies to any generation independent of the interconnected voltage level.
4. This standard can be met by the performance of the generators or by installing additional equipment (e.g., SVC, etc.).
5. Existing individual generator units that are interconnected to the network at the time of the adoption of this standard are exempt from meeting this standard for the remaining life of the existing generation equipment. Existing individual generator units that are replaced must meet the requirements listed above.

7.1.1.3 Generating Plants with Capacity < 10 MVA

Generators are required to remain in-service during system faults (three-phase faults with normal clearing and single line-to-ground faults with delayed clearing) unless clearing the fault effectively disconnects the generator from the system. This requirement does not apply to faults that would occur between the generator terminals and the high side of the

generator step-up transformer or to faults that would result in a voltage lower than 0.15 pu on the high side of the generator step-up transformer. In the post-fault transient period, generators are required to remain in-service for the low voltage excursions specified in Table 4 as applied to a load bus.

Notes:

1. These performance criteria are applied to the generator interconnection point, not the generator terminals.
2. Generators may be tripped after the fault period if this action is intended as part of a special protection system.
3. This standard applies to any generation independent of the interconnected voltage level.
4. This standard can be met by the performance of the generators or by installing additional equipment (e.g., SVC, etc.).
5. Existing individual generator units that are interconnected to the network at the time of the adoption of this standard are exempt from meeting this standard for the remaining life of the existing generation equipment. Existing individual generator units that are replaced must meet these requirements.

7.1.2 High Voltage Ride-Through (HVRT) Requirements for Generators

7.1.2.1 Generating Plants with Capacity > 20 MW

Generators are required to stay online indefinitely for dynamic voltages ≤ 1.1 pu at the point of interconnect. For dynamic voltages > 1.1 pu and ≤ 1.15 pu at the point of interconnect, generators are required to delay tripping one second to allow for fault clearing. For dynamic voltages > 1.15 pu and ≤ 1.2 pu, generators are required to delay tripping for 0.30 seconds to allow for fault clearing. For dynamic voltages > 1.2 pu at the point of interconnect, generators may trip without delay.

7.1.2.2 Generating Plants with Capacity ≥ 10 MVA and ≤ 20 MW

Generators are required to stay online indefinitely for dynamic voltages ≤ 1.1 pu at the point of interconnect. For dynamic voltages > 1.1 pu and ≤ 1.15 pu at the point of interconnect, generators are required to delay tripping one second to allow for fault clearing. For dynamic voltages > 1.15 pu and ≤ 1.2 pu, generators are required to delay tripping for 0.30 seconds to allow for fault clearing. For dynamic voltages > 1.2 pu at the point of interconnect, generators may trip without delay.

7.1.2.3 Generating Plants with Capacity < 10 MVA

Generators are required to stay online indefinitely for dynamic voltages ≤ 1.1 pu at the point of interconnect. For dynamic voltages > 1.1 pu and ≤ 1.15

pu at the point of interconnect, generators are required to delay tripping one second to allow for fault clearing. For dynamic voltages > 1.15 pu and ≤ 1.2 pu, generators are required to delay tripping for 0.30 seconds to allow for fault clearing. For dynamic voltages > 1.2 pu at the point of interconnect, generators may trip without delay.

7.1.3 Ride-through and Trip Voltage/Frequency Settings

The required devices and settings will be installed at the point of interconnection. The protection devices at the point of interconnection will send trip signals to the generator breakers (or to the wind turbine feeder breakers if in a wind plant). The Facility Interconnection Customer may also have frequency and voltage protection at its generating facility. The Facility Interconnection Customer's local protection settings must be compatible with the voltage ride-through requirements in Table 2.

In Table 3, separate transmission frequency settings are specified for a generation interconnection to an integrated network and for a generation interconnection to a radial transmission line. The voltage/frequency performance for each of the two transmission interconnection types is expected to be different.

Table 2–Ride-Through and Trip Voltage Relay Settings

Low Voltage Ride-Through Required	**High Voltage Ride-Through Required**		**Trip Required**	
	pu	delay(sec)	pu	delay(sec)
For Gen > 20 MW	> 1.20	0	> 1.50	0.1
See sec. 7.1.1.1	1.151-1.199	0.3	1.15-1.499	2.0
	1.101-1.15	1.0	1.101-1.149	4.0
For Gen 10 MVA - 20 MW	≤ 1.1	No trip	0.899-0.871	600.0[1]
See sec. 7.1.1.2			0.87-0.671	2.0
For Gen < 10 MVA			< 0.671	0.5
See sec. 7.1.1.3				

Table 3–Ride-Through and Trip Frequency Relay Settings

	Ride-Through Required		Trip Required	
	Hz	delay(sec)	Hz	delay(sec)
Integrated	> 61.8	0.0		
	61.6-61.7	30.0		
	60.6-61.5	180.0		
	59.5-60.5	infinite	None	
	59.4-58.5	180.0		
	58.4-57.9	30.0		
	57.8-57.4	7.5		
	57.3-56.9	0.75		
	≤ 57.0	0.0		
Radial			> 61.6	0.0
			61.0-61.6	0.5
			> 60.5-60.9	180.0
	60.5-59.5	infinite	< 59.5-59.1	180.0
			59.0-58.4	0.5
			< 58.3	0.0

Table 4–WECC Disturbance-Performance Table of Allowable Effects on Other Systems

NERC and WECC Categories	Outage Frequency Associated with Performance Category (outage/year)	Transient Voltage Dip Standard	Minimum Transient Frequency Standard
A	Not Applicable	Nothing in addition to NERC	
B	≥ 0.33	Not to exceed 25% at load buses or 30% at non-load buses Not to exceed 20% for more than 20 cycles at load buses	Not below 59.6 Hz for 6 cycles or more at a load bus
C	0.033 - 0.33	Not to exceed 30% at any bus Not to exceed 20% for more than 40 cycles at load buses	Not below 59.0 Hz for 6 cycles or more at a load bus
D	< 0.033	Nothing in addition to NERC	

Notes:

1. The WECC Disturbance-Performance Table applies equally to either a system with all elements in service, or a system with one element removed and the system adjusted.
2. As an example in applying the WECC Disturbance-Performance Table, a Category B disturbance in one system shall not cause a transient voltage dip in another system that is greater than 20% for more than 20 cycles at load buses, or exceed 25% at load buses or 30% at non-load buses at any time other than during the fault.
3. Additional voltage requirements associated with voltage stability are specified in WECC Standard I-D. If it can be demonstrated that post-transient voltage deviations that are less than the values in the table will result in voltage instability, the system in which the disturbance originated and the affected system(s) should cooperate in mutually resolving the problem.

7.2 Phase Overcurrent

Instantaneous overcurrent, or rate-of-rise relay is a device (50) which functions instantaneously on an excessive value of current or on an excessive rate of current rise, thus indicating a fault in the apparatus or circuit being protected.

AC time overcurrent relay is a device (51) with either a definite or inverse time characteristic which functions when the current in an AC circuit exceeds a pre-determined value.

7.3 Over/Undervoltage Relay

This protection is used to trip the circuit breaker when the voltage is above or below PacifiCorp's normal operating level (126 V – 114 V). It is used for generator protection and backup protection in the event that the generator is carrying load that has become isolated from the PacifiCorp system.

7.4 Over/Underfrequency Relay

This protection device is used to trip the circuit breaker when the frequency is above or below PacifiCorp's normal operating level. It is used for generator/turbine protection and backup protection.

Generator underfrequency relay settings are coordinated with other utilities in the Western Electricity Coordinating Council (WECC) to maintain generation online during system disturbances. Without prior written approval by PacifiCorp, settings should not be set for a higher frequency or shorter time delay than specified by PacifiCorp's Protection and Control Engineer.

7.5 Overcurrent Relay with Voltage Restraint/Voltage Control or Impedance Relay

These relays are used to detect phase–to-phase faults and initiate a circuit breaker trip. The relays must be located on the individual generator feeder. A group of generators aggregating over 400 kW must have an impedance relay or an overcurrent relay with voltage restraint located on each generator greater than 100 kW. Generators equal to or greater than 400 kW must have an impedance relay or an overcurrent relay with voltage restraint. As determined by PacifiCorp, an overcurrent relay with voltage control may also be acceptable if it can be set to adequately detect end-of-line faults.

7.6 Dedicated Step-Up Transformer

The dedicated transformer matches the generator voltage to the utility voltage and steps up the generator voltage to the interconnection level. It also serves to isolate the Facility Interconnection Customer from other customers to a small degree.

The impedance of a dedicated transformer limits fault currents on the generator bus from the PacifiCorp system and also limits fault currents on the PacifiCorp system from the generator. Hence, it reduces the potential damage to both parties due to faults. The transformer must have a delta winding to reduce the generator harmonics entering the PacifiCorp system unless otherwise agreed to by PacifiCorp. The delta winding will also reduce the PacifiCorp system harmonics entering the generation facility.

Generators of more than 10 kW require the use of a dedicated transformer. Generators of 10 kW or less and generating at a secondary voltage level may require a dedicated transformer. This need can be determined and identified in a detailed study.

A high-side fault-interrupting device such as a breaker or recloser is required for transformer protection. It is also required that the device be gang-operated so as to avoid the possibility of ferroresonance or loss of phase condition.

A three-phase circuit breaker is recommended, but fuses are acceptable for generation facilities of less than 1,000 kW provided that coordination can be obtained with the existing PacifiCorp protection equipment. If fuses are used, it is recommended that the generating entity install single-phase protection for its equipment.

Lightning arrestors, if the Facility Interconnection Customer chooses to install them, must be installed between the transformer and the fault-interrupting devices and shall be encompassed by the generator's relay protection zone.

7.7 Generators

The generating unit must meet all applicable American National Standards Institute (ANSI) and Institute of Electrical and Electronic Engineers (IEEE) standards. The prime mover and the generator should also be able to operate within the full range of voltage and frequency excursions that may exist on the PacifiCorp system without damage to them. To enhance system stability during a system disturbance, the generating unit must be able to operate through the specified frequency ranges for the time durations listed in Table 2.

7.7.1 Synchronous Generators

7.7.1.1 Synchronizing Relays

Synchronous generators and other generators with stand alone capability must use one of the following methods to synchronize with the PacifiCorp system:

1. Automatic Synchronization with Automatic Synchronizing (Device 25)

   The automatic synchronizing relay must have a slip frequency-matching window of 0.1 Hz or less, a voltage-matching window of ± 10 percent or less, a phase angle-acceptance window of ± 10 degrees or less, and breaker-closure time compensation.

   The automatic synchronizing relay sends a close signal to the breaker after the above conditions are met.

2. Automatic Synchronization with Automatic Synchronizer (Device 15/25)

   The automatic synchronizing relay must have a slip frequency-matching window of 0.1 Hz or less, a voltage-matching window of ± 10 percent or less, a phase angle-acceptance window of ± 10 degrees or less, and breaker-closure time compensation. For an automatic synchronizer which does not have breaker-closure time compensation, a tighter frequency window (± 5 degrees) with a one-second time-acceptance

window shall be used to achieve synchronization within ± 10 degrees phase angle.

In addition to the above characteristics, this automatic synchronizer has the ability to adjust generator voltage and frequency automatically to match system voltage and frequency.

3. Manual Synchronization with Synchroscope and Synch Check (Device 25) Relay Supervision

   The synch check relay must have a voltage-matching window of ± 10 percent or less and a phase angle-acceptance window of ± 10 degrees or less.

   Generators with greater than 1,000 kW aggregate nameplate rating must have automatic synchronizing relay or automatic synchronizer.

7.7.1.2 Frequency/Speed Control

Unless otherwise specified by PacifiCorp, a governor shall be required on the prime mover to enhance system stability. Governor characteristics shall be set to provide a five percent droop characteristic (a 0.15 Hz change in the generator speed shall cause a five percent change in the generator load). Governors on the prime mover must be operated unrestrained to help regulate PacifiCorp's system frequency.

7.7.1.3 Excitation System Requirements

An excitation system is required to regulate generator output voltage.

Static systems shall have a minimum ceiling voltage of 150 percent of rated full-load field voltage with 70 percent of generator terminal voltage and a maximum response time of two cycles (0.033 seconds).

Rotating systems shall have an ANSI voltage response ratio of 2.0 or faster.

Excitation systems shall respond to system disturbances equally in both the buck and boost directions.

Under certain conditions, PacifiCorp may grant an exemption for generation facilities which have excitation systems not meeting these requirements. Requests for exemption should be sent to PacifiCorp Transmission Account Manager.

7.7.1.4 Voltage Regulator

The regulator must be able to maintain the generator voltage under steady-state conditions without hunting and within ± 0.5 percent of any voltage level between 95 percent and 105 percent of the rated generator. The point of voltage sensing should be at the same point as the PacifiCorp revenue metering. As determined by the PacifiCorp Control Center, the generator shall be operated at either a voltage or a power factor schedule.

At various times, the generating facility may also be requested by the PacifiCorp Control Center to produce more or less reactive power from that indicated on the regular schedule in order to meet the system needs.

7.7.1.5 Power-Factor Controller

The controller must be able to maintain a power-factor setting within ± 1 percent of the setting at full load at any set point between 90 percent lagging and 95 percent leading. In addition, all power-factor controllers for synchronous generators greater than 1MW must have programmable capability to vary hourly settings.

7.7.1.6 Power-System Stabilizer (PSS)

Generators with properly tuned and calibrated PSS provide damping to electric power oscillations. Such damping improves stability in the electrical system and may also prevent an individual generator from unnecessary tripping. The current WECC policy requires that the PSS be an integral part of the voltage regulator and be incorporated into the excitation systems for all new generating units with suitable excitation systems. PacifiCorp can help determine, at the Facility Interconnection Customer Facility Interconnection Customer 's expense, the suitability of an excitation system for PSS.

The PSS must be calibrated and operated in accordance with the latest standard procedures for calibration, testing, and operation of such equipment. These procedures are available from PacifiCorp. In addition, the calibration and test reports must be submitted to PacifiCorp's Transmission Account Manager.

The facility shall not be considered operational until PSS has been calibrated to PacifiCorp's satisfaction. A copy of the PSS calibration and operation procedures, as well as the suitability requirements, may be obtained from the PacifiCorp Transmission Account Manager. Additional information on PSS can be found in Appendix A.

The following criteria shall be used to determine when a PSS shall be installed on a synchronous generator, regardless of ownership, connected to the transmission system (by generator step-up transformer to 60 kV or higher voltage):

1. A PSS shall be installed on every existing synchronous generator that is larger than 75 MVA and is equipped with a suitable excitation system as defined in the WECC report, *Criteria to Determine Excitation System Suitability for PSS* available from the WECC web site.
2. A PSS shall be installed on every existing synchronous generator larger than 30 MVA or part of a complex that has an aggregate capacity larger than 75 MVA, or if the excitation system is updated so that it becomes a

suitable excitation system as defined in the report mentioned in 1a above. This section applies to all machines whose excitation system is updated at any time after November 18, 1993.

3. A PSS shall be installed on every synchronous generator that is larger than 30 MVA or part of a complex that has an aggregate capacity larger than 75 MVA, and is equipped with suitable excitation systems as defined in paragraph 1a, and is commissioned after November 18, 1993.
4. A PSS is not required on a station service generator.

When a generator equipped with a functional PSS is online, the PSS shall be in operation except for the following reasons:

1. Maintenance and testing.
2. PSS exhibits instability due to nonstandard transmission line configuration.
3. PSS does not operate properly due to a failed component.
4. Unit is operating in the synchronous condenser mode (very near zero power level).
5. When a unit is generating less power than its design limit for effective PSS operation.
6. When a unit is passing through a range of output that is a known "rough zone."

The aggregate MVA of the synchronous machines tonline and equipped with a functioning PSS shall not fall below the level identified in the most recent power system stabilizer study commissioned by the WECC.

When a synchronous generator equipped with a PSS is operating in the pump mode (P/G unit), and is connected to a transmission system such that the PSS does not produce negative damping, the PSS should be in service.

PSS equipment shall be tested and calibrated in conjunction with AVR testing and calibration. This will be done as often as is necessary to maintain reliable PSS performance in accordance with WECC *PSS Tuning Criteria*. PSS recalibration must be performed if AVR response parameters are modified. When a PSS is taken out of service because of a failed component, the party responsible will be expected to perform the needed repairs (or replacement) in a responsible and timely manner.

A PSS is not required for a synchronous condenser.

7.7.1.7 Power-Quality Analysis

At the discretion of the Area Planning Engineer, unattended generation facilities with capacity greater than 250 kW and with automatic or remotely-

initiated paralleling capability may require a power-quality investigation analysis performed by PacifiCorp or a power-quality consulting firm. The analysis shall provide PacifiCorp with sufficient information to determine the status of the generation facility during system disturbances. The analyzer may provide remote access from PacifiCorp's Control Center or engineering offices.

7.7.1.8 Generator Testing

Testing of the generator and excitation system must be performed to verify proper parameters of the generator and exciter. Testing shall meet the requirements of the WECC Generator Testing Program. Copies of the test reports with appropriate powerflow and stability data parameters identified shall be provided to the PacifiCorp Transmission Account Manager. If a stability model is not available, the interconnection entity will be responsible for developing a suitable model for use in PacifiCorp's transient stability program, which currently uses the Power Technologies, Inc. PSSE version 27.1 program.

7.7.1.9 Direct Digital Control (DDC)

Dispatchable generators larger than 10,000 kW are required to have real-time direct digital control of unit output from PacifiCorp's Control Center. This allows generation units to respond to power system load/frequency changes.

7.7.2 Induction Generators

Induction generators, and other generators with no inherent VAr (reactive power) control capability, shall be required to provide power to the unity point of interconnection. Such generators shall operate in as near a range of ± 0.95 power factor as is technically feasible without risk of self-excitation to provide an amount of reactive power equivalent to that required for a synchronous generator. They may also be required to follow a PacifiCorp-specified voltage or VAr schedule on an hourly, daily, or seasonal basis, depending on the location of the installation. Specific instructions shall be provided on a case-by-case basis by the PacifiCorp Control Center.

7.7.3 DC Generators

7.7.3.1 Inverters Capable of Stand-Alone Operation

Inverters capable of stand-alone operation are capable of islanding operation and shall have similar functional requirements as synchronous generators. For units less than 100 kW, usually it is acceptable to have the frequency and voltage functions built into the electronics of the inverter if the set points of these built-in protective functions are tamperproof and can be easily and reliably tested. The total harmonic distortion in the output current of the inverters must meet IEEE Standard 519, *Harmonics Requirements*.

Inverter-type generators connected to the PacifiCorp system must be pre-approved by PacifiCorp. For units over 10 kW, a dedicated transformer will be required to minimize the harmonics entering into the PacifiCorp system.

7.7.3.2 Inverters Incapable of Stand-Alone Operation

Inverters rated 10 kW or less which have been tested and certified by Underwriter Laboratories (UL) as 1741, are non-islanding, and meet IEEE Standard 519 harmonic requirements, may be interconnected to the PacifiCorp system as is. **No inverter(s) will be permitted to interconnect with PacifiCorp's electrical system that are not certified and will be disconnected until they are brought into compliance with this policy.** Certified inverters have a label affixed to the equipment which shall be inspected as part of the commissioning process before energization. These inverters are generally used in combination with wind turbines and solar-based generators. Inverters over 10 kW will require a dedicated transformer and may have other requirements depending on the installation location and local generation penetration.

7.8 Remedial Action Scheme (RAS) Participation Requirement for Generation Facilities

A RAS is a special protection system which automatically initiates one or more pre-planned corrective measures to restore acceptable power system performance following a disturbance. Application of RAS mitigates the impact of system disturbances and improves system reliability.

The output of electric generators may flow over the entire interconnected transmission system. A generation facility is therefore required to participate in remedial action schemes to protect local transmission lines and the entire system as PacifiCorp determines necessary.

A typical disturbance, as it is considered in the planning and design of the electric transmission system, is the sudden loss of one or more critical transmission lines or transformers. A widely applied corrective measure is to instantaneously drop a sufficient amount of generation on the sending end of the lost transmission facility. This is known as generation dropping, and a participating generation facility may be disconnected from the transmission by the automatic RAS controller in much the same way as by a transfer trip scheme. A generation facility should therefore have full load rejection capability as needed both for local line protection and RAS. The RAS design must be such that any single-point failure will not prevent the effective operation of the scheme.

Whether RAS shall be required will depend on the overall location and size of the generator and load on the transmission system, the nature, consequences, and expected frequency of disturbances as well as the nature of potential alternative transmission reinforcements.

If PacifiCorp requires RAS participation for a particular generation facility, the Facility Interconnection Customer shall be responsible for all related costs.

7.9 Emergency Generator Requirement

There are two major methods of transferring electric power supply between the PacifiCorp source and the emergency generator system:

1. Open transition (break-before-make)
2. Closed transition (make-before-break)

The open transition method can be accomplished via a double-throw transfer switch or an interlock scheme which prevents the two systems from operating in parallel. The Facility Interconnection Customer Facility Interconnection Customer 's main breaker shall not be allowed to close until the generator breaker opens. This open transition method does not require any additional protection equipment, however it does cause the Facility Interconnection Customer 's load to experience an outage while transferring back to PacifiCorp. The length of this transfer outage depends on the transfer equipment involved.

Emergency systems are routinely tested by the Facility Interconnection Customer under load, usually once a month. With a break–before-make system, the Facility Interconnection Customer 's load, or most often a portion of it, is removed from the PacifiCorp system and the emergency generator is tested under load conditions. After successful completion of the test, the generator is taken offline and the Facility Interconnection Customer is transferred back to PacifiCorp. This testing procedure results in the test load experiencing two outages (when bringing the emergency generator on and when taking it off) whenever the system is tested.

For generation facilities that cannot tolerate this momentary loss of power, the closed transition (make-before-break) method is intended to provide transfer without interruption. For the closed-transition method, the maximum parallel time with the PacifiCorp system shall be less than 0.5 seconds, both to and from the emergency generator source. The protection requirements for synchronous generators will also apply to emergency generators any time a parallel is to be made with the PacifiCorp system. These would include, but are not limited to, a dedicated transformer and automatic synchronizing.

As an alternative to the normally required voltage, frequency, and ground relays, PacifiCorp may, at its discretion, allow installation of three very sensitive, single-phase, reverse-power relays (such as the Basler BE1-32R) for emergency generator installations. The reverse power relays shall be set to pick up on transformer magnetizing current with a time delay not to exceed 0.5 second. The reverse power relay, in this case, will protect PacifiCorp personnel and the general public by preventing the generator from keeping the PacifiCorp system energized in the event the PacifiCorp source substation(s) have tripped for a fault while the generator is paralleled. The relay output shall trip the circuit breaker on the PacifiCorp side of the

transfer switch. This application can be used when the Facility Interconnection Customer 's emergency generator output is expected to be less than the entity's load.

7.9.1 Notification/Documentation

The Facility Interconnection Customer must notify its local PacifiCorp representative in writing of all new emergency generator installations or changes to the existing schemes regardless of method of interconnection or transfer.

Required documentation includes a description of generation and control system operation, single line diagrams, identification of all interlocks, sequence of events description for transfer operation, and specifications for any PacifiCorp-required protective devices. PacifiCorp may request additional documentation should it deem it necessary.

All documentation must be approved by PacifiCorp Engineering prior to installation.

7.9.2 Operation/Clearances

For the safety of PacifiCorp personnel and to ensure the proper operation of the PacifiCorp system, it is essential that the Facility Interconnection Customer notify the PacifiCorp Control Center of all emergency generator installations prior to paralleling. For operation and clearance purposes, emergency generator installations should be treated the same as any independent generation facility interconnected to the PacifiCorp system. A satisfactory visible open point shall be approved by PacifiCorp.

For all line work and clearances, the emergency generator shall be treated as a power source.

Facility interconnection customers using make-before-break transfer schemes are required to notify the PacifiCorp Control Center of their intent to transfer to their emergency generator and then again back to the PacifiCorp source, before any transfers are attempted. The notification of the make-before-break transfer scheme is necessary because such actions put another generation source in parallel with the PacifiCorp system. This notification is not essential on break-before-make schemes, but may be desirable in some instances.

7.10 Parallel-Only (No-Sale) Generator Requirement

Parallel-only generators shall have similar requirements as that of any other standard synchronous generator interconnection except that PacifiCorp may at its discretion allow the installation of three very sensitive, single-phase, reverse-power relays (such as the Basler BE 1 32R) along with the dedicated transformer as an alternative to the normally required ground relays. The reverse-power relays shall be set to pick up on transformer magnetizing current with a time delay not to exceed 0.5 second. This option may not be feasible on generating systems with a slow load rejection response since they may be tripped offline frequently for in-plant disturbances.

Owners of parallel-only generators must execute a parallel-only operating agreement with PacifiCorp prior to operation by the generation owner.

8 REACTIVE AND VOLTAGE RESTRICTIONS FOR FACILITY INTERCONNECTION CUSTOMERS

The purpose of this section is to help all customers satisfy applicable PacifiCorp policies and procedures with regard to voltage and reactive power flow.

The policies and procedures of this section apply to all facilities interconnecting with PacifiCorp's system. All facilities must meet applicable WECC standards.

Participating entities are required to schedule energy or ancillary services through a designated scheduling coordinator unless other arrangements have been made with PacifiCorp.

8.1 Reactive and Voltage Control Requirements

Reactive power (VAr) and voltage control are vital components of desired PacifiCorp system operation. It is essential that PacifiCorp receive both real and reactive power from interconnected generators. Where a generator is unable to furnish reactive power support due to interconnection limitations, type of generator, the generator loading, or other reasons, the Facility Interconnection Customer shall install equivalent reactive support at the Facility Interconnection Customer 's expense or make other arrangements with PacifiCorp.

How a generator meets PacifiCorp's reactive requirements depends on its type and size. Synchronous generators have an inherent reactive flexibility that allows them to operate within a range to either produce or absorb VArs. Induction generators operate at a power factor absorbing VArs and require reactive support from the interconnected system unless they have installed corrective equipment.

Generators 10 MVA and larger shall be equipped with automatic voltage-control equipment. All generating units with automatic voltage-control equipment shall normally be operated in voltage-control mode. These generating units shall not be operated in other control modes (e.g., constant power factor control) unless authorized in writing to do so by the host control area. The control mode of generating units shall be accurately represented in operating studies. The previous statements in this paragraph are consistent with the Western Electricity Coordinating Council (WECC)'s minimum operating reliability criteria.

Facility interconnection customers must provide reactive supply sufficient to operate at as near unity power factor as can be safely achieved without risk of self-excitation. Typically, the power factor should range from 97 percent leading power factor (absorbing VArs) and 1.0 (unity). PacifiCorp may further require the provision of reactive support equivalent to that provided by operating a synchronous generator anywhere within the range from 95 percent leading power factor (absorbing VArs) to 90 percent lagging power factor (producing VArs) within an operating range of ± 5 percent of rated generator terminal voltage and full load. This is typical of induction

generators. Generators shall be equipped and operated to control voltage. If the facility is not capable of providing positive reactive support (i.e., supplying reactive power to the system) immediately following the removal of a fault or other transient low voltage perturbations, the facility may be required to add dynamic voltage support equipment. The general control requirements are discussed below.

8.1.1 Generator Control

8.1.1.1 Voltage Control

Voltage regulators are required for all generators larger than 100 kW unless otherwise agreed. In some cases, particularly for small units connected to the distribution system, a power-factor controller will also be required to provide operational flexibility.

Voltage regulators must be capable of maintaining the interconnection reactive interchange between 0.95 leading/lagging power factor measured at the point of interconnection unless otherwise agreed. For synchronous machines, the regulators and exciters will be required to react during faults (i.e., within cycles). For wind farms that will have induction machines installed, PacifiCorp may accept slower adjustments to voltage regulation on a case-by-case basis.

The generator shall normally be operated with the generator automatic voltage regulator in a constant voltage regulation mode. The voltage regulator shall be adjusted periodically throughout each day to maintain reactive output within a range defined by PacifiCorp and consistent with the reactive requirements for the local transmission system. This may be a voltage that minimizes the reactive interchange between PacifiCorp's system and the generating facility or, at PacifCorp's discretion, the PacifiCorp dispatcher may ask the plant operator to hold a higher or lower voltage so as to cause the facility to supply or absorb reactive power in support of specific system-control objectives. It is the owner's responsibility to insure that the transformer tap position and all other equipment are compatible with this objective.

8.1.2 Power Factor Control

For units smaller than 100 kW and/or in special cases as mutually agreed, a power factor controller shall be utilized to maintain a constant power factor at the point of interconnection by controlling the voltage regulator or other relevant equipment. The controller must be capable of maintaining a power factor within ± 1 percent at full load at any set point between 95 percent lagging (producing VArs) and 95 percent leading (absorbing VArs) measured at the point of interconnection. In addition, all power-factor controllers for generators larger than 1,000 kW must have programmable capability to vary hourly settings. The PacifiCorp Control Center shall specify required settings for voltage or power factor. Generally, as noted above, a voltage will be specified

which minimizes the reactive interchange between PacifiCorp's system and the generating facility.

In the event that the generator by itself is not capable of providing sufficient reactive power at the point of interconnection so as meet the 0.95 leading/lagging power factor requirement, switched shunt compensation or dynamic VAr equipment may be required.

The programmable controller for units larger than 1,000 kW is normally obtained by combining a non-programmable controller and a general purpose programmable device.

Control over the VAr production associated with the delivery of power to PacifiCorp falls under the following general classifications, depending upon contractual arrangements:

Surplus-Sale Operation: When a Facility Interconnection Customer dedicates its generator to serving plant needs first, selling only the surplus to PacifiCorp, treatment differs depending on whether excess power is being sold *to* PacifiCorp or supplemental power (no-sale mode) is being purchased *from* PacifiCorp. In no-sale mode, the Facility Interconnection Customer has sole control over VAr production, however the customer shall meet the power factor requirements for its overall facility as described by applicable tariff(s). When surplus power is being sold, PacifiCorp has operational control of the power factor at which the power is delivered.

Net-Sale Operation: All electricity produced, excluding station load, is sold to PacifiCorp. PacifiCorp therefore has operational control of VAr production within the generator operating range.

No-Sale Operation: When a Facility Interconnection Customer uses generation exclusively to offset load, the customer has sole control of the generator power factor, however the customer shall meet the power factor requirements for its overall facility as described by applicable tariff(s).

For generation connected to the PacifiCorp transmission system at less than 1 MW with the total output being sold to PacifiCorp, all electricity produced, excluding station load, is sold to PacifiCorp. PacifiCorp therefore has operational control of VAr production within the generator operating range.

8.2 Synchronous Generator Frequency/Speed Control

To enhance system stability, a governor is required on the prime mover, set to provide a 5 percent droop characteristic (a 0.15 Hz change in the generator speed will cause a 5 percent change in the generator load). Exceptions must be approved by PacifiCorp. Governors shall be operated unrestrained to regulate system frequency.

8.2.1 Non-Synchronous Generator Control (without VAr Control)

Induction generators or other generators without VAr control absorb VArs and therefore require reactive power support from PacifiCorp's system. For facilities larger than 40 kW, PacifiCorp will require power factor correction. Power factor correction or capacitors must be installed either by the Facility Interconnection Customer or as part of the special facilities installed by PacifiCorp at customer expense. Care must be exercised by the Facility Interconnection Customer in connecting capacitors directly to the generator terminals to avoid self-excitation. Stand-alone switched capacitors supplied by the Facility Interconnection Customer that are not an integral part of the generator control system shall be switched on and off at the request of PacifiCorp.

8.2.2 Induction Generators

Switched capacitors may be required by PacifiCorp in areas where severe reactive limitations exist. The Facility Interconnection Customer must provide reactive supply sufficient to operate at as near-unity power factor as can be safely achieved without risk of self-excitation. Typically the power factor should range from 97 percent leading power factor (absorbing VArs) and 1.0 (unity). PacifiCorp may further require the provision of reactive support equivalent to that provided by operating a synchronous generator anywhere within the range from 95 percent leading power factor (absorbing VArs) to 95 percent lagging power factor (producing VArs) within an operating range of ± 5 percent of rated generator terminal voltage and full load. (This is typical if the induction project is greater than 1,000 kW.)

8.3 Generator Step-Up Transformer

The available voltage taps of a Facility Interconnection Customer 's step-up transformer must be reviewed by PacifiCorp for their suitability with PacifiCorp's system. The Facility Interconnection Customer is expected to have this reviewed before acquiring the transformer.
PacifiCorp shall determine which voltage taps would be suitable for a step-up transformer for the Facility Interconnection Customer 's proposed project. Suitable taps are required to give the transformer the essential capacity for the generator to:

- Deliver maximum reactive power to PacifiCorp's system at the point of interconnection (generator operating at 95 percent lagging power factor) and,
- Absorb maximum reactive power from the PacifiCorp system (generator operating at 95 percent leading power factor).

The Facility Interconnection Customer 's transformer, with correct voltage taps, helps maintain a specified voltage profile on PacifiCorp's system for varying operating conditions. Actual voltage tap settings can be different for transformers connected at the same voltage level, depending upon their geographic location.

8.4 Grid Operations

The following data will be gathered by PacifiCorp in order to fully comply with NERC Standard TOP-005-1, *Operational Reliability Information* and FAC-001-0, *Facility Connection Requirements*. Grid operations will need the following SCADA and tone-telemetered generator data for 3 MW and higher plants connected to PacifiCorp transmission system voltages (46KV and higher):

1. Status (of breakers).
2. MW and MVAr capability.
3. MW and MVAr net output.
4. Status of automatic voltage-control facilities (capacitors, reactors, dynamic VAr devices).

   The same standard requires that key voltages be metered (and PacifiCorp's voltage requirements adequately address this need).
5. Tone telemetry.

Note that in WECC units, 10 MVA and above must have automatic voltage requlation (AVR) installed on them.

8.5 Direct Digital Control

Dispatchable generator units larger than 10,000 kW are required to have real-time direct-digital control of unit output from the PacifiCorp Control Center. This will allow generation units to respond to system load/frequency changes.

8.6 Power System Stabilizer Operating Requirements for Generators

If a power system stabilizer (PSS) is a required part of the generator's voltage regulator, it must be operated and maintained in accordance with the standard procedures developed by WECC. Recalibration and testing of the PSS is required at least every five years, with data submitted for approval to PacifiCorp's Transmission Account Manager

PacifiCorp is responsible for the safe and reliable operation of the electric system. Because failure of the Facility Interconnection Customer to recalibrate and test its PSS could adversely impact system operation, PacifiCorp reserves the right either to disconnect from, or refuse to parallel with, any Facility Interconnection Customer which does not operate and maintain its generator control systems in accordance with applicable reliability criteria or standards. Any sanctions or penalties assessed due to failure to meet WECC Reliability Management System (RMS) operating requirements (available from the WECC website at *http://www.wecc.biz*) for units equipped with PSS shall be the sole responsibility of the Facility Interconnection Customer.

8.7 Power Quality Policy

8.7.1 Voltage Fluctuation Limits

A customer connected to the PacifiCorp system must not cause harmful voltage fluctuations or interference with service and communication facilities. Any generation facility that does so is subject to being disconnected from the PacifiCorp system until the condition has been corrected.

8.7.2 Harmonic Limits

All customers shall comply with the voltage and current harmonic limits specified in IEEE Standard 519 1992, *Recommended Practices and Requirements for Harmonic Control in Electrical Power Systems*.

The harmonic content of the voltage and current waveforms in the PacifiCorp system must be restricted to levels which do not cause interference or equipment operating problems for PacifiCorp or its customers.

Any harmonic problems shall be handled on a case-by-case basis. A customer facility causing harmonic interference is considered by PacifiCorp as a serious interference with service and is subject to disconnection from the PacifiCorp system until the condition has been corrected. If the cause of the problem is traceable to the Facility Interconnection Customer 's facilities, all costs associated with determining and correcting problems shall be at the customer's expense.

Many methods may be used to restrict harmonics. The preferred method is to install a transformer with at least one delta connection between the interconnected facility and the PacifiCorp system. This method significantly limits the amount of voltage and current harmonics entering the PacifiCorp system. Generation system configuration with a star-grounded generator and a two-winding (both star-grounded) transformer shall not be allowed.

8.7.3 Voltage Flicker Limits

PacifiCorp's Engineering Handbook Section 1C.5.1, *Voltage Fluctuation and Light Flicker* will be utilized to evaluate any voltage flicker issue that may arise during the interconnection study process for transmission voltages. This subject typically arises on wind-turbine installations. It is usually rare that voltage flicker is an issue on transmission voltages. It could become problematic on the very rare 34.5 kV transmission lines and 46 kV transmission lines PacifiCorp owns and/or in single-turbine installations.

All generation interconnection projects must comply with this standard. The cost of corrective measures necessary for a project that does not comply with this standard will be borne solely by the Facility Interconnection Customer. It is necessary to acquire written review and approval from PacifiCorp before any corrective equipment is purchased and installed.

9 OPERATING REQUIREMENTS

1. The Facility Interconnection Customer shall not commence parallel operation of interconnected facility(s) until final written acceptance has been given by PacifiCorp. PacifiCorp reserves the right to inspect the Facility Interconnection Customer's facility and witness testing of any equipment or devices associated with the interconnection. The Facility Interconnection Customer shall submit a written, detailed procedure with specific requirements for initial commissioning of the Facility Interconnection Customer's generation and interconnecting facilities for PacifiCorp approval. PacifiCorp and the Facility Interconnection Customer shall each identify one representative to serve as a coordination contact to be the initial point of contact and coordinate communications between the parties for both normal and emergency conditions. PacifiCorp and the Facility Interconnection Customer shall notify each other in writing of the personnel that it has appointed as its coordination contact. PacifiCorp and the Facility Interconnection Customer shall abide by their respective switching and tagging rules for obtaining clearances for work or for switching operations on equipment. Such switching and tagging rules shall be developed in accordance with OSHA standards. PacifiCorp and the Facility Interconnection Customer shall develop mutually acceptable switching and tagging rules for PacifiCorp's and the Facility Interconnection Customer 's facilities that involve common clearance requirements. The Facility Interconnection Customer shall follow PacifiCorp directives with regard to emergencies on the PacifiCorp system.
2. The following are required before the Customer will be given permission for each operational milestone:
    a. Back feed requires that protection and metering to be complete and operational.
    b. First synchronization requires that all protection, metering, *and communications* be complete and operational. Power delivered to the system after first synchronization but prior to commercial operations is test energy.
    c. Commercial operations requires that the customer all testing be complete and the customer is ready to deliver commercial power.
3. The Facility Interconnection Customer shall not be permitted to energize a de-energized PacifiCorp circuit and will follow lockout/tagout procedures.
4. The operation of the Facility Interconnection Customer's on-site equipment shall not result in unacceptable service to other PacifiCorp customers, such as voltage and frequency fluctuations or harmonic currents on the PacifiCorp system. The Facility Interconnection Customer shall comply with the latest revision of PacifiCorp's allowable voltage flicker standards
5. The operation of the Facility Interconnection Customer's on-site generation shall not cause the service voltage for other PacifiCorp customers to go outside the requirements of ANSI C84.1, Range A.
6. The operation of the Facility Interconnection Customer's on-site generation shall not adversely affect the voltage regulation of the PacifiCorp system.

7. The operation of the Facility Interconnection Customer's on-site generation shall be conducted in a manner that minimizes reactive flow from the on-site generation to the PacifiCorp system, except when requested to assist in voltage control on the PacifiCorp system.
8. The Facility Interconnection Customer shall design the large generating facility to maintain a composite power delivery at continuous rated power output measured at the generator terminals at a power factor within the range of 0.90 leading to 0.95 lagging, unless the transmission provider has established different requirements that apply to all generators in the control area on a comparable basis. This shall apply to all units unless specifically exempted by FERC, NERC, or PacifiCorp. The Facility Interconnection Customer's voltage regulation equipment will be designed and operated to limit VAr flow to a power factor between 0.90 leading and 0.95 lagging except for units connected to the PacifiCorp distribution system rated at 15 kV and less. These generators are to maintain unity power factor and shall not regulate the distribution system voltage unless requested or required to do so by PacifiCorp per IEEE 1547 Standards.
9. The operation of the Facility Interconnection Customer's on-site induction machines or other non-synchronous generation shall be required to provide the same VAr support as synchronous machines unless specifically exempted by FERC or other governmental authority.
10. Operation of the Facility Interconnection Customer 's equipment shall not adversely affect the voltage regulation of the PacifiCorp system. The Facility Interconnection Customer shall minimize the reactive flow, except when requested to assist in voltage control on the PacifiCorp system. The Facility Interconnection Customer shall provide adequate voltage control to minimize voltage regulation on the PacifiCorp system caused by generator loading conditions.
11. In cases where starting or load-changing on induction generators will have an adverse impact on PacifiCorp system voltage, step-switched capacitors or other techniques may be required to attenuate the voltage changes to acceptable levels.
12. For synchronous generators, sufficient generator reactive power capability shall be provided to withstand normal voltage changes on the PacifiCorp system. The generator voltage-VAr schedule, voltage regulator, and transformer ratio settings will be jointly determined by PacifiCorp and the Facility Interconnection Customer to ensure proper coordination of voltages and regulator action. The Facility Interconnection Customer is encouraged to genrate their own VAr requirements to minimize power factor adjustment charges and enhance generator stability.
13. Induction or other non-synchronous generating installations shall provide the same voltage and VAr support as synchronous installations referenced in Section 7.10, except where specifically exempted by FERC or other governmental authorities.
    a. Where the Facility Interconnection Customer's installation does not comply with this requirement, and the existing PacifiCorp system can reliably supply the VARs for voltage support without installations of reactive compensation, the Facility

Interconnection Customer may either purchase the reactive requirements for voltage support from PacifiCorp or supply such requirements with its own compensation. The reactive supply obtained from PacifiCorp shall be billed on a tariff to be determined during contract discussions.

b. Where the Facility Interconnection Customer's installation does not comply with this requirement and the existing PacifiCorp system cannot reliably supply the VArs for voltage support, PacifiCorp shall install apparatus on the PacifiCorp system to supply the required VArs. The cost of the apparatus, controls, installation, and operation shall be paid according to OATT requirements and procedures.

14. Reactive power supply requirements for inverter systems are similar to those for induction generators and the preceding comments apply except where specifically exempted by FERC or other governmental authorities.

15. To avoid self-excitation, care shall be exercised in applying power factor correction capacitors directly to or electrically near induction generator terminals.

16. The Facility Interconnection Customer shall discontinue parallel operation when requested by PacifiCorp for the following purposes:

    a. To facilitate maintenance, tests, or repairs of the PacifiCorp electric system.

    b. During emergencies on the PacifiCorp system.

    c. When the Facility Interconnection Customer generating equipment is interfering with customers on the PacifiCorp system.

    d. When an inspection of the Facility Interconnection Customer reveals a condition hazardous to the PacifiCorp system or a lack of scheduled maintenance records is found.

17. WECC requires all members to share in an operating reserve or Generation Reserve Sharing Pool. PacifiCorp shall require a specific agreement to supply operating reserve to cover the Facility Interconnection Customer 's generation to load at that site. The generator will provide or contract for adequate generation to meet WECC or power pool generation reserve, spinning reserve, and load-following requirements.

18. The Facility Interconnection Customer shall comply with all NERC, WECC, and PacifiCorp Underfrequency Load Shedding requirements. During any underfrequency situation, the Facility Interconnection Customer shall agree to immediately make available to PacifiCorp any spinning or operating reserves that exist on their generation.

19. The Facility Interconnection Customer shall adhere to WECC Operating Standards, any PacifiCorp Operating Guides, and any additional operating requirements either stated herein or mutually agreed to elsewhere. The latest revision of all applicable documents shall serve as the minimum requirements for system operation. These documents are available at the publishing organizations respective website. Contact the Transmission Account Manager for further details.

20. PacifiCorp and the Facility Interconnection Customer may, in accordance with good utility practice, remove from service facilities or network upgrades as necessary to perform maintenance, test, and install or replace equipment. PacifiCorp and the Facility Interconnection Customer will use reasonable efforts to coordinate outages for maintenance on dates and times mutually acceptable to both parties.
21. The Facility Interconnection Customer shall compensate PacifiCorp for any incremental energy or reactive losses and incremental demand charges resulting from changes in system power flow caused by the Facility Interconnection Customer 's system addition in accordance with OATT requirements and procedures.
22. The Facility Interconnection Customer shall operate the interconnection facilities in compliance with the latest revision of the National Electric Safety Code, applicable state codes, PacifiCorp safety rules, and IEEE Std 519. Failure to comply with said safety policies and power-quality standards will result in the interconnection being opened. The interconnection will not be re-established until compliance has been determined.
23. The Facility Interconnection Customer shall maintain its interconnection facilities and any generating equipment that could negatively impact the PacifiCorp system in good order. PacifiCorp reserves the right to inspect the Facility Interconnection Customer's facilities on a periodic basis or whenever it appears that the Facility Interconnection Customer is operating in a manner hazardous to PacifiCorp's system integrity.

9.1 Specific Generator Interconnection Requirements

The following requirements apply specifically to generation interconnections. The equipment associated with the Facility Interconnection Customer's generation equipment should be protected in accordance with the practices described in the latest revision of the following ANSI/IEEE standards or guides. There may be special requirements imposed by PacifiCorp due to the specific project or application.

ANSI C50.10-1990, *General Requirements for Synchronous Machines*

ANSI 50.12-1982, *Requirements for Salient Pole Synchronous Generators and Condensers*

ANSI C50.13-1989, *Requirements for Cylindrical-Rotor Synchronous Generators*

ANSI C50.14-1977, *Requirements for Combustion Gas Turbine Driven Cylindrical-Rotor Synchronous Generators*

ANSI/IEEE C37.101, *Guide for Generator Ground Protection*

ANSI/IEEE C37.102, *Guide for AC Generator Protection*

ANSI/IEEE C37.106, *Guide for Abnormal Frequency Protection for Power Generating Plants*

ANSI/IEEE Std 1001, *Guide for Interfacing Dispersed Storage and Generation Facilities with Electric Utility Systems*

IEEE 1547, *Standard for Interconnecting Distributed Resources with Electric Power Systems*

In addition to the above-listed requirements, the following standards apply:

1. Any generating unit or line/end user interconnection to the PacifiCorp electric system with its output purchased by PacifiCorp or another network customer shall be considered a "Network Resource" under the terms of Part III of the OATT.
2. Generator installations requesting WECC accreditation must meet all NERC, WECC, and PacifiCorp requirements, including WECC Generation Reserve Sharing Pool requirements, URGE testing, and any reactive testing requirements.
3. The generator step-up (GSU) transformer connection will be determined by the system impact study. In general, the GSU must be effectively grounded on the utility side providing an adequate ground reference and will isolate the generator's zero sequence current from the PacifiCorp system through the use of an ungrounded connection on the generator side. The transformer shall be equipped with a no-load tap changer covering the range of ± 5 percent in 2.5 percent steps from the nominal voltage of the interconnection.
4. PacifiCorp requires synch-check relays to be installed on all circuit breakers interconnecting a generating unit to the PacifiCorp electric system.
5. Induction generators may use a speed-matching relay (Device 15) as a means of synchronization and to limit the magnetizing inrush current/voltage drop. The speed matching must keep voltage flicker at the point of interconnection within PacifiCorp voltage flicker requirement and within IEEE 519 requirements.
6. Generation operated in parallel with the PacifiCorp electric system may supply additional fault current energy which shall be disconnected in case of a disturbance on PacifiCorp's system. The existence of parallel generation may alter the operation of protective devices normally used by PacifiCorp to protect the system.
7. Equipment shall be provided to detect system abnormalities in the Facility Interconnection Customer 's or PacifiCorp's system, and shall have the capability to isolate the sources of the disturbance. At a minimum, the Facility Interconnection Customer shall provide adequate protective devices to:
    a. Detect and clear the generator(s) from short circuits on PacifiCorp facilities serving the interconnecting facilities.
    b. Detect the voltage and frequency changes which can occur if PacifiCorp facilities serving the interconnecting facilities are disconnected from the main system, and clear any Facility Interconnection Customer generation/load from the isolated system if necessary.
    c. Prevent reclosing the Facility Interconnection Customer's generation to PacifiCorp after an incident of trouble, until authorized to recluse by PacifiCorp's Portland or Salt Lake City dispatch centers.

d. Isolate Facility Interconnection Customer's generation from the PacifiCorp electric system upon:

- ☐ Receipt of a direct trip signal from an upstream PacifiCorp substation.
- ☐ Failure of the communications channel used for direct tripping.
- ☐ Receipt of a trip command from the Portland or Salt Lake City dispatch center via SCADA.

8. PacifiCorp, at its discretion, may require out-of-step protection and/or loss of excitation protection and/or overexcitation protection to trip or block-trip the Facility Interconnection Customer 's interconnection. The requirement for this protection will be determined during system studies.
9. The Facility Interconnection Customer should be aware that certain conditions on PacifiCorp's system can cause negative sequence currents to flow in the generator. It is the sole responsibility of the Facility Interconnection Customer to protect the Facility Interconnection Customer's equipment from excessive negative sequence currents.
10. The Facility Interconnection Customer shall design its facilities (generation or otherwise) to avoid causing dynamic voltage excursions above 1.2 and below 0.7 pu according to WECC performance design standards (see the WECC Reliability Handbook for NERC/WECC Planning Standards, Guidelines, and System Performance Table). The WECC Reliability Handbook may be accessed via the WECC website or may be obtained upon request from the Transmission Account Manager.
11. The Facility Interconnection Customer shall design its generation to remain online for faults and for any resulting low voltages to maintain system reliability. Generation must remain online for the duration of a normally-cleared (single- or three-phase) fault on the electric system up to a maximum of nine cycles, as well as for the recovery from such a normally-cleared fault even where the voltage drops to zero during the clearing of the fault.
12. Generators must be designed to remain online for normal clearing system faults within close proximity to the plant switchyard. Voltage may approach zero at the switchyard bus for nine cycles for some types of faults. Control systems, contactors, motors, and auxiliary loads which are critical to the operation of the plant must not drop out under these conditions. Critical 480 V supply contactors must be provided with ride-through capability where required. Additionally, generator protection systems such as the Load Drop Anticipator, Early Valve Actuator, or Power Load Unbalance should not be designed to trip a generator for normal clearing external faults or stable swings.
13. The Facility Interconnection Customer shall design its generation to remain online for off-nominal frequency operation according to IEEE C.37.106 or the following

time frames in accordance with PacifiCorp and WECC region over/underfrequency requirements:

Table 5–Over/Underfrequency Requirements

Underfrequency Range (Hz)	Overfrequency Range (Hz)	Time
60.0 - 59.7	60.0 - 60.3	Continuous
59.7 - 59.5	60.4 - 61.5	Continuous Governor action
59.4 - 58.7	61.6 - 61.8	10 minutes
58.6 - 58.5	61.9 - 62.0	30 seconds
58.5 - 57.4	–	7.5 seconds
57.3 - 56.9	–	45 cycles
56.8 - 56.5	–	7.2 cycles
< 56.4	> 62.0	Instantaneous trip

14. Only solid state microprocessor underfrequency relays shall be used on generators to provide off-nominal frequency protection.

15. Synchronous generators with a nameplate rating greater than 20.0 MVA shall have generator protection set such that it does not result in tripping of the generator for the following conditions:

    a. Generator terminal voltages that are within five percent of the rated nominal design voltage.

    b. Generator terminal voltage deviations that exceed five percent but are within 10 percent of the rated nominal design voltage and persist for less than 10 seconds.

    c. Generator volts per hertz conditions that are less than 116 percent (of generator nominal voltage) that last for less than 1.5 seconds.

    d. Generator overexcited stator currents (or generator apparent impedance) less than 150 percent of nameplate rating persisting for less than five seconds.

16. Documentation of the generator protection and controls that could respond to these conditions by tripping the generator shall be provided to PacifiCorp. In the event the generating equipment owner cannot correct or mitigate these potential generator trip conditions, a request for a waiver may be made to PacifiCorp. A waiver may be justified in certain special circumstances such as low adverse reliability consequences from generator tripping.

17. All synchronous generators connected to the PacifiCorp transmission system are to be equipped with automatic voltage regulators (AVR). Generators must operate with their excitation system in the automatic voltage control mode unless otherwise

approved by the PacifiCorp system operator. Generating equipment owners shall maintain a log which records the date, time, duration and reason for not being in the automatic voltage control mode when operating in parallel with the PacifiCorp system. Generating equipment owners shall make this log available to PacifiCorp on request.

18. All synchronous generators connected to the PacifiCorp transmission system must maintain a network voltage or reactive power output as specified by the PacifiCorp system operator within the reactive power capability of the generating equipment. Generating equipment owners shall maintain a log which records the date, time, duration, and reason for not meeting the network voltage schedule or desired reactive power output when operating in parallel with the PacifiCorp system. Generating equipment owners shall make this log available to PacifiCorp on request.
19. The generator step-up and auxiliary transformer tap settings shall be coordinated with PacifiCorp transmission systems voltage requirements. Generating equipment owners shall provide PacifiCorp with generator step-up and auxiliary transformer tap settings and available ranges.
20. The AVR's control and limiting functions must coordinate with the generator's short time capabilities and protective relay settings. The generating equipment owner shall provide PacifiCorp with the AVR's control and limiter settings as well as the protection settings which coordinate with AVR control and limiting functions.
21. All new synchronous generators connected to the PacifiCorp transmission system with a nameplate rating greater than 20 MVA shall be equipped with a speed/load governing control that has a speed droop characteristic in the three to six percent range. The preferred droop characteristic setting is five percent. Notification of changes in the status of the speed/load governing controls must be provided to the PacifiCorp System Operator.
22. Prior to commercial operation, the generating equipment owner shall provide PacifiCorp with open circuit, step-in voltage test results. Recording of generator terminal voltage and field voltages shall be clearly labeled so that initial and final values can be identified in physical units.
23. Generating equipment owners shall annually test the gross and net dependable summer and winter capability of their units. These test results shall be provided to PacifiCorp.
24. Generating equipment owners shall test the gross and net reactive capability of their units at least every five years. These test results shall be provided to PacifiCorp.
25. Generating equipment owners shall test the AVR control and limit functions of their units at least every five years. An initial test result shall be provided to PacifiCorp prior to commercial operation and every five years thereafter. The initial test results shall include documentation of the settings AVR control and limit functions.

Typical AVR limit functions are maximum and minimum excitation limiters and volts per hertz limiters. Documentation of the generator protection that coordinates with these limit functions shall also be provided. Typical generator protection of this type includes overexcitition protection and loss of field protection.

26. The Facility Interconnection Customer generator shall meet all WECC requirements for providing an appropriate high-response excitation system and shall make provisions for a Power System Stabilizer (PSS) on all units rated at 70 MW and greater. The exciter shall meet the following requirements:
    a. The response ratio less is less than 2.0 as demonstrated through calculations consistent with IEEE Standard 421.2-1990.
    b. The response time is less than 0.1 second as demonstrated through the completion of a response ratio test.
    c. The open circuit step-response test is satisfactory; where satisfactory means that the response is not oscillatory in nature.
27. The Facility Interconnection Customer shall demonstrate that they have the appropriate exciter model by providing P/SSE or other plots of generator response ratio tests and opencircuit step tests that demonstrate the unit meets the criteria in item 29 below.
28. The Facility Interconnection Customer generator shall meet all WECC requirements for the installation and tuning of PSS where appropriate long-term dynamic stability and eigen value studies show a positive contribution to the damping torque in the frequency range from 0.25 Hz to 2.0 Hz.
29. Where stabilizing equipment is installed on generating equipment for the purpose of maintaining generator or transmission system stability, the generating equipment owner is responsible for maintaining the stabilizing equipment in good working order and promptly reporting to the PacifiCorp system operator any problems interfering with its proper operation.
30. PacifiCorp will maintain a contact list of all Facility Interconnection Customers tied to PacifiCorp's transmission circuits for routine and emergency grid operation use. This list will compile the normal and emergency phone numbers for the Facility Interconnection Customer's facilities and an e-mail address if available. It will be the responsibility of the Facility Interconnection Customer to notify PacifiCorp in a timely fashion when any of this information is altered or changed for whatever reason. To keep the list current, the new updated information will be supplied to:

    Transmission Interconnection Account Manager
    825 N.E. Multnomah Blvd. Suite 1600
    Portland, Oregon 97232
    (503) 813-6102

10 COMMISSIONING FOR FACILITY INTERCONNECTIONS

The following outlines PacifiCorp's procedure for performing commissioning activities. All time requirements must be met for PacifiCorp to provide the Facility Interconnection Customer with timely service. Any inspections required by local government agencies must be completed and permits signed off prior to the pre-parallel date.

Since the meter installed for the facility interconnection is PacifiCorp-owned, a PacifiCorp meter/relay technician will be the only person authorized to test the meter. Coordination between the developer and PacifiCorp's project manager is recommended at least two months before the start-up date to assure that timelines for project completion are met. The owner/developer will provide unrestricted access for PacifiCorp's employees or vendor employees (whichever are utilized) to the equipment to be commissioned.

PacifiCorp will either utilize its own qualified employees or a contractor from its approved contractor list. Commissioning of any relays which tie with the PacifiCorp system and affect PacifiCorp's customer must be certified by a Professional Engineer licensed in the state in which the interconnection project is located.

It is the Facility Interconnection Customer's responsibility to provide adequate notification through the PacifiCorp project manager for commissioning activities.

It shall be the owner/developer's responsibility to pay for all commissioning costs

Commissioning testing, where required on either PacifiCorp-owned equipment or equipment that affects the operational integrity of the electrical circuit, will be performed on site to verify protective settings and functionality. Upon initial parallel operation of a generating facility, or any time interface hardware or software is changed which may affect the functions listed below, a commissioning test must be performed. Individual qualified in testing protective equipment (a Professional Engineer, factory-certified technician, or licensed electrician with verifiable experience in testing the protective equipment) must perform commissioning testing in accordance with the manufacturer's recommended test procedure to prove that the settings and requirements of PacifiCorp's interconnection study report are met. PacifiCorp reserves the right to witness commissioning tests listed below and requires written certification stamped by a Professional Engineer from the state in which the project resides describing which tests were performed and their accompanying results.

10.1 Test Results

All tests outlined below must be complete and two copies of the test reports submitted to a PacifiCorp representative a minimum of 15 working days before the requested energize date unless otherwise agreed to by PacifiCorp. All test reports require header information reflecting the equipment identification matching the one- or three-line diagrams. One-line and three-line diagrams of the facility are required to be submitted with the test reports. All requirements must be met and test reports approved at least three working days before the requested pre-parallel date.

10.1.1 Proving Insulation

For any of the megger tests referred to below a 2,500 V DC megger or a hi-pot is preferred, but a 1,000 V DC megger is acceptable.

1. All transformers connected to the primary bus and the main transformer must be meggered winding-to-winding and each winding to ground. For purposes of this document, "primary bus or PacifiCorp side of the bus or conductor" is defined as the source-side bus or conductor from the primary interrupting device to the generating plant.
2. All circuit breakers and circuit switchers connected to the primary bus and at the interconnection point must be meggered in the following manner: breaker open each pole to ground, pole 1 2, pole 3 4, pole 5 6; breaker closed pole 1 ground, pole 3 ground, pole 5 ground and if the poles are in common tank or cell, pole 1 3, pole 3 5, pole 5 1.
3. All buses and cables shall be meggered phase–to-phase and phase-to-ground.
4. The main transformer(s) and main breaker(s) shall have a dielectric test performed on the insulating medium (gas or oil). The unit shall pass this test by keeping within the acceptable levels for all gasses or other elements in the oil as certified by the laboratory chemist before energization. This will not apply to factory-sealed circuit switcher interrupters.
5. The generator(s) must be meggered or hi-pot-tested phase-to-phase and phase-to-ground.

10.1.2 Proving Ratios

All ratios of transformers connected to the primary bus must be proven using either a turns ratio tester or a voltage ratios test. The main transformer must be tested on the final operating tap. This tap shall be recommended by PacifiCorp to best match current transmission system operating voltages.

10.1.3 Circuit Breakers and Circuit Switchers

1. A minimum to trip at 70 percent or less of the nominal DC control voltage must be performed on all circuit breakers and/or circuit switchers which are operated by PacifiCorp required relays. All units must pass this test.
2. A micro ohm test must be performed on all circuit breakers and circuit switchers. The units tested must pass the micro ohm test.
3. A timing test showing the time from trip initiation to main poles opening is required. All units must pass this test.
4. A timing test showing the time from close initiation to main poles closing is required. All units must pass this test.

10.1.4 Current Transformers and Current Circuits

1. A saturation check should be made on all current transformers (CTs) associated with the required PacifiCorp relays. If this is not possible, a manufacturer's curve is acceptable.

2. The ratio of all CTs must be proven by either a current (primary-to-secondary) or voltage (secondary-to-primary) test.
3. CT circuits must be checked for proper connections and continuity by applying primary current and reading the results in the relays. Each test must be performed in all combinations to prove proper connections to all phase and ground relays. Current must be applied or injected to achieve a secondary reading of five amps in each relay to ensure that no loose wiring or parallel current paths exists.
4. A single-phase burden check must be made on each phase of each current circuit feeding PacifiCorp required relays.
5. A megger check of the total circuit with the ground wire lifted must be done to prove that only one ground exists.

10.1.5 Relays

All relays must be field tested on site to their specified settings to verify the following:

1. Minimum operating point at which relay picks up (minimum pickup).
2. Time delay at three different current test points, in integral multiples of minimum pickup that closely characterize the relay time current curve.
3. Phase-angle characteristic of the directional relay.
4. Pickup points at maximum torque angle (MTA) and ± 30 degrees of MTA on impedance relays using the approved settings.
5. Slip-frequency, voltage-matching, phase angle-acceptance, and breaker compensation time on synchronizing relays.
6. PacifiCorp tolerances are listed below:

Table 6–PacifiCorp Relay Tolerances

Relay Type	Tolerance
Current / Voltage / Time	± 10.0 percent
Impedance / Phase Angle	± 0.05 percent
Frequency	± 0.05 percent

If a pilot relay system is required by PacifiCorp, signal level checks must be performed to PacifiCorp standards.

10.1.6 Primary Disconnect Switch

The primary disconnect switch at the point of interconnection shall be assigned a number by PacifiCorp. The switch, platform, and switch number plate bracket

must be constructed to PacifiCorp Engineering Standards, Section TS. A switch number plate bracket shall be furnished by PacifiCorp.

10.1.7 Checklists and Forms for Equipment Commissioning

The Transmission Account Manager will have available for both internal and external use checklists and forms for all relevant facility interconnection equipment to be commissioned for the Facility Interconnection Customer.

The commissioning process will be coordinated through the Project Manager with other PacifiCorp employees in the field.

10.2 Pre-Parallel Test for Generator Developers

Where generation has a rated output in excess of 100 kW, the entity shall reimburse PacifiCorp for the cost of performing the pre-parallel inspection.

The Facility Interconnection Customer is responsible for ensuring that all relays and other protective devices are adjusted and working properly prior to the pre-parallel inspection. If problems arise with equipment during testing, the PacifiCorp protection representative may elect to cancel the test and reschedule.

All pre-parallel tests should be scheduled to begin at 9 a.m., Monday through Friday only. Functional tests shall be performed by the Facility Interconnection Customer and all tests shall be observed by PacifiCorp as outlined below. The Facility Interconnection Customer shall provide all test equipment and qualified personnel to perform the required tests. PacifiCorp shall be there strictly as an observer. The appropriate commissioning form shall be completed by the PacifiCorp representative on site at the time of the pre-parallel inspection.

10.2.1 Functional Tests

The following functional tests shall be performed after the equipment has been energized, but before the generator is paralleled with PacifiCorp's system:

1. Check that each protective relay trips the appropriate generator breaker and/or main breaker. This may require injecting a signal. **Jumpering across contact on the back of the relay is not acceptable.**
2. When first energized, check that proper secondary potential is applied to all voltage and frequency relays.
3. Check the synchronizing meter, synchronizing equipment, and phasing panel (if used) with the paralleling breaker closed and the generator offline. This typically requires lifting the generator leads. The equipment should show an "in-phase" condition.
4. Check the generator phase rotation. (PacifiCorp's phase rotation is A B C counterclockwise).
5. All three phases must be checked using hot sticks with a phasing tool or a phasing panel provided by the Facility Interconnection Customer. The

synchronizing equipment typically checks one phase only. Phase rotation varies by area within the PacifiCorp system. Facility interconnection customers shall consult PacifiCorp for the correct rotation.

10.2.2 Impedance and Directional Relay Tests

Direction check all impedance and directional relays by doing the following:

1. Bring up load on the plant and/or generator.
2. Verify direction of power flow.
3. Measure the phase angle between the current and potential applied to the relay.
4. Observe the current action of the directional contacts according to the direction of power flow. Reverse either the potentials or current to prove contact operation for reverse power flow.

10.2.3 Generator Load Tests

For generators, the following load tests shall be performed after the generator picks up load:

1. Load check all PacifiCorp-required differential relays. The load current must balance to zero in all differential relays.
2. Load check voltage restraint overcurrent relays to prove correct connection of currents and potentials.
3. The generator(s) may have to be paralleled temporarily with PacifiCorp's system to run the load tests. Permission to do this shall be given by the PacifiCorp operations representative observing the test by PacifiCorp dispatch.
4. Verify operation of the generator at 90 percent lagging power factor and at 95 percent leading power factor at rated output.
5. Verify operation of the generator at 95 percent and 105 percent of per unit voltage while delivering rated output.
6. Typically, pre-parallel inspections can be performed within a normal working day. PacifiCorp shall dedicate one full work day to observe the tests. If a test cannot be completed by 6 p.m., the PacifiCorp representative may cancel the remainder of the test and reschedule it. In this case the Facility Interconnection Customer shall be charged another pre-parallel inspection fee.

10.3 Parallel Operation for Generator Developers

10.3.1 Clearance for Parallel Operation (For Testing Purposes Only)

The PacifiCorp representative shall contact the PacifiCorp Control Center at least 72 hours (3 days) before the pre-parallel test and obtain a clearance for parallel operation. The PacifiCorp representative shall provide the Control Center a drawing indicating which PacifiCorp circuit the generation facility will be connected to and which PacifiCorp operated disconnect will be identified with a PacifiCorp-designated number. When the pre-parallel test is passed, the generator may at PacifiCorp's discretion be allowed to operate in parallel with PacifiCorp for testing purposes only. This should not be mistaken as an official release for parallel operation. Once this testing only permission is granted, the generator may operate in accordance with a previously executed Generation Operating Agreement, or in the absence of such an agreement for a maximum of 14 days in accordance with good utility practice unless other arrangements are made with PacifiCorp.

10.3.2 Power System Stabilizer

During the 14-day testing period, the Power System Stabalizer (PSS) shall be calibrated and tested in accordance with the latest applicable WECC standard calibration and test procedures. The test report shall be submitted for approval to PacifiCorp's Transmission Account Manager. Adequate testing of the PSS can only occur on the generating unit(s) after pre-parallel inspection has been satisfactorily completed and the units are paralleled and supplying load. The generation facility shall not be considered officially operational until this PSS calibration and testing has been done to PacifiCorp's satisfaction.

10.3.3 Permission for Parallel Operation

At the end of this period, if the Facility Interconnection Customer has not received written permission from PacifiCorp to operate in parallel, the entity must isolate from PacifiCorp until written permission is received. Written permission to parallel shall be sent to the Facility Interconnection Customer via U.S. First Class mail. This shall be done after PacifiCorp has verified the following:

1. All proper contracts and documents have been executed and are in place.
2. The pre-parallel test has been passed.
3. PSS tests and calibration have been completed.
4. All other outstanding issues have been resolved, including rights-of-way, deeds of conveyance, insurance verification, and operating agreements.
5. PacifiCorp has received final copies of the one-line diagram and elementary diagrams that show as-built changes made during construction, as well as a completed finalized generator data sheet.
6. If applicable, firm capacity performance testing of new generators cannot begin until the Facility Interconnection Customer receives written permission from PacifiCorp to parallel.

10.4 General Notes

The PacifiCorp system has ABC counterclockwise rotation.

Any changes to PacifiCorp required protection equipment or major substation equipment (transformer, breaker, etc.) must be submitted to the PacifiCorp representative for review and approval by the appropriate PacifiCorp Engineer prior to the changes being made.

Routine maintenance on PacifiCorp-required protective relays and the breaker(s) must meet PacifiCorp's maintenance and test practices. After completion of these tests, test reports must be submitted to the PacifiCorp representative for review and approval by the appropriate PacifiCorp Engineer. A PacifiCorp technical representative shall then come to the customer's facilities and reseal the PacifiCorp required relays.

Questions should be directed to the PacifiCorp Transmission Account Manager.

10.5 Simplified Flow of Pre-Parallel/Parallel Test Procedure

Figure 2–Pre-Parallel/Parallel Test Procedure

[See scanned pdf attachment]

11 GLOSSARY

A

Alternating Current (AC): That form of electric current that alternates or changes in magnitude and polarity (direction) in what is normally a regular pattern for a given time period called frequency.

Ampere: The unit of current flow of electricity. This is analogous to quantity per unit of time when referring to the flow of water. One ampere is equal to a flow of one coulomb per second.

Applicable Reliability Criteria: The reliability policies established by NERC, WECC, and local reliability criteria as amended from time to time, including any requirements of the NRC which are applicable to the particular type of generator and prime mover.

Automatic: Self-acting, operated by its own mechanism when actuated by some impersonal influence as, for example, a change in current strength; not manual; without personal intervention.

Automatic Control: An arrangement of electrical controls which provide for opening and/or closing in an automatic sequence and under predetermined conditions; the switches which then maintain the required character of service and provide adequate protection against all usual operating emergencies.

Automatic Generation Control (AGC): Generation equipment that automatically responds to signals from the EMS control in real time to control the power output of electric generators within a prescribed area in response to a change in system frequency, tie-line loading, or the relation of these to each other, so as to maintain the target system frequency and/or the established interchange with other areas within the predetermined limits.
Automatic Reclosing: A feature of some circuit breakers which allows them to reclose automatically after being tripped under abnormal conditions.
Automatic Tripping or Automatic Opening: The opening of a circuit breaker under predetermined conditions without the intervention of an operator.

B
Balanced Load: An equal distribution of load on all phases of an alternating current circuit.
Boost: To increase voltage.
Bundled Service or Bundled Utility Service: Traditional PacifiCorp service: transmission and distribution capacity for delivery, energy, and ancillary services.
Breaker: A switch which can open a circuit, usually designed for automatic operation.

C
Capacitance: Capacitance is developed when two charged or energized conductors are separated by a dielectric. An excess or deficiency of electrons is maintained on opposite plates of a charged capacitor. It may be said to be the property of an electrical circuit which opposes any change of voltage.
Capacity: The number of amperes of electric current a wire will carry without becoming unduly heated; the capacity of a machine, apparatus, or devices is the maximum of which it is capable under existing service conditions; the load for which a generator, turbine, transformer, transmission circuit, apparatus, station, or system is rated. Capacity is also used synonymously with capability.
Capacity Factor: The ratio of average load on a generating resource to its capacity rating during a specified period of time, expressed in percentages.
Circuit: A conducting part through which an electric current is intended to flow.
Circuit Breaker: A device for interrupting a circuit between separable contacts under normal or fault conditions.
Circuit Switcher: A device for interrupting a circuit between separable contacts under normal or fault conditions.
Class A Telephone Circuit: Service performance objective classification for a circuit which is non-interruptible before, during, and after a power fault condition.
Class B Telephone Circuit: Service performance objective classification for a circuit which is non-interruptible before and after a power fault condition exists.
Clearance: Permission to contact or to come in close proximity to wires, conductors, switches, or other equipment which normally might be energized at electrical, hydraulic, or pneumatic potential dangerous to human life. Conditions which must prevail before such permission can be granted are, in general, that the equipment or lines be completely isolated from all possible power sources and be tagged with properly filled out "man on line" tags.

Cogeneration: The sequential production of electricity and heat, steam, or useful work from the same fuel source.
Conductor: Material that can be used as a carrier of an electric current.
Control, Supervisory: A system for selecting control and automatic indication of remotely located units by electrical means, over a relatively small number of common transmission channels.
Control Switch: A switch controlling the circuit through circuit breakers or other switches which are magnetically operated.
Current: The part of a fluid (air, water, etc.) flowing in a certain direction. A flow of electric charge measured in amperes.
Current Transformer (CT): A transformer intended for metering, protective, or control purposes which is designed to have its primary winding connected in series with a circuit carrying the current to be measured or controlled. A current transformer normally steps down current values to safer levels. A CT secondary circuit must never be open-circuited while energized.

D
Dead-End Structure: The structure on which the last span of PacifiCorp-owned conductors terminates. Also called a landing structure. From the interconnection requester's point of view, it is sometimes called the take-off structure.
Delta-Connected Circuit: A three-phase circuit with three source windings connected in a closed delta (triangle). A closed delta is a connection in which each winding terminal is connected to the end (terminal) of another winding.
Demand: The rate at which electric energy is delivered to or by a system; normally expressed in kilowatts, megawatts, or kilovolt amperes.
Direct Access: Service election that allows customers to purchase electric power and additional related services from non-utility entities known as Energy Service Providers (ESPs).
Direct Current (DC): A unidirectional current in which the changes in value are either zero or so small that they may be neglected. (As ordinarily used, the term designates a practically non-pulsating current, such as the output of an electric battery.)
Disconnect: (noun) A device used to isolate a piece of equipment. A disconnect may be gang-operated (three operated together) or individually operated.
Dispatchability: Ability and availability of a generating facility to operate so that a utility can call upon it to increase or decrease deliveries of capacity to any level up to contract capacity.
Distribution Control Center: This center directs, coordinates, and implements routine and emergency switching activities on the PacifiCorp distribution system within its geographical jurisdiction.
Disturbance: Trouble (e.g., fault, sudden loss of load or generation, breaker operations, etc.) on the PacifiCorp power system resulting in abnormal performance of the system. See also System Emergency.
Droop: The slope of the prime mover's speed power characteristic curve. The speed droop, typically 5 percent, enables interconnected generators to operate in parallel with stable load division.

E

Electric Circuit: A path or group of interconnected paths capable of carrying electric current.
Electric Generator: See Generator.
Electric Substation: An assemblage of equipment for purposes other than generation or utilization, through which bulk electric energy is passed for the purpose of switching or modifying its characteristics. Service equipment, distribution transformer installations, and transmission equipment are not classified as substations.
End-Use Customer or End User: A purchaser of electric power who purchases such power to satisfy a load directly connected to the Electrical Power Grid and who does not resell the power.
Energize: To apply voltage to a circuit or piece of equipment; to connect a de-energized circuit or piece of equipment to a source of electric energy.

F

Fault Indicator: A device attached to lines which target when the current through the line exceeds the device setting.
Feeder: A circuit having as its primary purpose the distribution of electric energy.
FERC: Federal Energy Regulatory Commission.
Firm Capacity: Power committed to be available at all times during the period covered, except for forced outages and scheduled maintenance.
Forced Outage: Any unplanned outage resulting from a design defect, inadequate construction, operator error, or a breakdown of the mechanical or electrical equipment that fully or partially curtails the delivery of electricity between a load or Facility Interconnection Customer Facility Interconnection Customer 's facility and the PacifiCorp power system.
Frequency: The number of cycles occurring in a given interval of time (usually one second) in an electric current. Frequency is commonly expressed in Hertz (Hz).
Fuse: A short piece of conducting material of low melting point which is inserted in a circuit and will melt and open the circuit when the current reaches a certain value.

G

Generation Facility: A plant in which electric energy is produced from some other form of energy by means of suitable converting apparatus. The term includes the generation apparatus and all associated equipment owned, maintained, and operated by the Facility Interconnection Customer.
Generator: The physical electrical equipment that produces electric power. Sometimes used as a brief reference to a Facility Interconnection Customer.
Grid-Critical Protective Systems: Protective relay systems and Remedial Action Schemes that the may have a direct impact on the ability to maintain system security.
Ground: A term used to refer to the earth as a conductor or as the zero of potential. For safety purposes, circuits are grounded while any work is being done on or near a circuit or piece of equipment in the circuit; this is usually called protective grounding.
Ground Bank: A secondary transformer bank installed on delta-connected winding to provide a path to ground for relaying purposes.
Ground Fault: An unintentional electric current flow between one or more energized conductors and the ground.

Ground Potential Rise: A calculated value of the highest expected voltage due to a line-to-ground fault at or near the station (power switchyard). The value is calculated as follows:

GPR = 1.2 (DC Transient Factor) x 1.4. x Ground Fault Return Current (rms) x Ground Resistance

H

Hertz (Hz): The term denoting cycles per second or frequency; named after Heinrich Hertz, the pioneering German scientist who performed research on electrical power.

I

IEC: International Engineering Consortium.
IEEE: Institute of Electrical and Electronic Engineers.
Inductance: The property of an electric circuit which produces a voltage by electromagnetic induction when the current in the circuit changes or varies. It opposes any change of circuit current.
Induction Generator: Typically an induction motor that is being driven by a prime mover at a speed which is faster than the synchronous mechanical speed to generate electric power. It typically depends on the host system for its excitation and speed regulation.
Interconnection Agreement (IA): An agreement between the utility and the Facility Interconnection Customer specifying and outlining the terms and conditions of the interconnection of the generators to PacifiCorp's electrical system.
Facility interconnection customer: An entity interconnected to the PacifiCorp power system which has generation facilities (including back-up generation in parallel) on its side of the point of interconnection with the PacifiCorp power system.
Interconnection Facilities: All means required and apparatus installed to interconnect and deliver power from a load or Facility Interconnection Customer facility to the PacifiCorp power system including, but not limited to, connection, transformation, switching, metering, communications, and safety equipment, such as equipment required to protect: 1) the PacifiCorp power system and the load or Facility Interconnection Customer from faults occurring at the load or generation, and 2) the load or generation facility from faults occurring on the PacifiCorp power system or on the systems of others to which the PacifiCorp power system is directly or indirectly connected. Interconnected facilities also include any necessary additions and reinforcements by PacifiCorp to its system required as a result of the interconnection of a facility to the PacifiCorp power system.
Interconnection Study Agreement (ISA): An agreement between the Facility Interconnection Customer and PacifiCorp specifying what is to be done in the engineering interconnection study to interconnect the generator to PacifiCorp's system. This agreement specifies not only the items to be studied but the timeframe in which the study will be completed and the report results submitted to the applicant.
Interconnection Study: Those studies performed in conjunction with an interconnection request to determine the facilities needed to interconnect the load or Facility Interconnection Customer in accordance with applicable reliability requirements.
Interrupting Capacity: The amount of current a switch or circuit breaker can safely interrupt.

Interruption: A temporary discontinuance of the supply of electrical power.

K

Kilovolt (kV): 1,000 volts.
Kilovolt Ampere (kVa): The product of kilovolts times amperes. Used to refer to high voltage alternating current systems.
Kilovolt Ampere Reactive (kVAr): A measure of reactive power which is required to regulate system voltage.
Kilowatt (kW): An electrical unit of power which equals 1,000 watts.
Kilowatt-hour (kWh): 1,000 watts of energy supplied for I hour. A basic unit of electric energy equal to the use of I kilowatt for a period of I hour.

L

Lagging Power Factor: Occurs when reactive power flows in the same direction as real power. Stated with respect to the generator, lagging power factor occurs when the generator is producing VArs.
Leading Power Factor: Occurs when reactive power flows in the opposite direction to real power. Stated with respect to the generator, leading power factor occurs when the generator is absorbing VArs.
Line Losses: Electrical energy converted to heat in the resistance of all transmission and/or distribution lines and other electrical equipment (i.e., transformers) on the system.
Load-Only Entity or Customer Load: An entity interconnected to the PacifiCorp power system at a transmission or distribution voltage level which does not have generation of its own in parallel with the PacifiCorp power system and is not interconnected with any source of generation other than PacifiCorp's.
Log: A computer file, book, or loose leaf sheets for recording all station operations, clearances, readings, ratio reports, and other pertinent active daily data.

M

Maximum Torque Angle (MTA): The phase angle between the relay measured quantities at which the relay is the most sensitive.
Metering Services: Consists of removal, ensuring of meter design specifications, installation, calibration, and ongoing testing and maintenance of meters.
Meter Service Agreement (MSA): The agreement issued by PacifiCorp concerning meter services.
Megawatt (MW): 1 million watts.
Megger: An ohm meter device used to measure the ability of insulation to withstand voltage, as well as measuring the insulation resistance. A poor megger test would mean that the insulation is breaking down.

N

Nameplate Rating, Facility: Output rating information appearing on a generator nameplate or other electrical device, in accordance with applicable industry policies.
NEMA: National Electrical Manufacturers Association.

NERC: North American Electric Reliability Council or its successor.
Net Energy Output: The generation facility's gross output in kilowatt hours, less station use, to the point of delivery into the PacifiCorp power system.
Net Sale: The generation facility's gross output, in kW and kWh, less station use, to the point of delivery into the PacifiCorp power system.
Neutral: The common point of a star-connected transformer bank, a point which normally is at zero potential with reference to the earth.
No-Sale: The Facility Interconnection Customer desires to operate in parallel and not sell power to PacifiCorp.

O
Ohm: The unit of resistance of an electric circuit.
One-Line Diagram: A diagram in which several conductors are represented by a single line and various devices or pieces of equipment are denoted by simplified symbols. The purpose of such a diagram is to present an electrical circuit in a simple way so that its function and configuration can be readily grasped.
Operating Procedures: Policies and procedures governing the operation of the transmission grid as PacifiCorp, the WECC, or the NERC may from time to time develop as applicable to the particular type of generator and prime mover.
Operational Control: The rights of PacifiCorp to operate their transmission lines, facilities, and other electric plant equipment affecting the reliability of those lines and facilities for the purpose of affording comparable non-discriminatory transmission access and meeting applicable reliability criteria and policies.
Outage: A condition existing when a line or a substation is de-energized.
Output: The energy delivered by a generation facility during its operation.
Overload: A load in amperes greater than an electric device or circuit is designed to carry.
Overvoltage: Voltage higher than that desired or higher than that for which the equipment in question is designed.

P
PacifiCorp Control Center: The PacifiCorp location, manned 24 hours a day, which has been assigned operational jurisdiction over a load or Facility Interconnection Customer 's substation.
Parallel: (verb) To connect electrically a generator or energized source, operating at an acceptable frequency and voltage, with an adjacent generator or energized system, after matching frequency, voltage, and phase angle.
Parallel Operation: As used in this manual, the operation of a non-utility owned generator while connected to the utility's grid. Parallel operation may be required solely for the Facility Interconnection Customer's operating convenience or for the purpose of delivering power to the utility's grid.
Peaking: Operation of generating facilities to meet maximum instantaneous electrical demands.
Permissive Overreach Transfer Trip Scheme (POTTS): A very secure line protection scheme for insuring that a fault is within the protected line section. It requires the presence of both a trip signal from a remote terminal and a trip signal from the local relay before tripping the local breaker.

PacifiCorp Power System: The electric transmission and distribution wires, and their related facilities owned by PacifiCorp.
Point of Interconnection (POI): The point where the load or Facility Interconnection Customer 's conductors or those of their respective agents meet the PacifiCorp power system (point-of-ownership change).
Potential Transformer (PT): A transformer intended to reproduce in its secondary circuit, in a known proportion, the voltage of the primary circuit; also known as a voltage transformer.
Power: The time rate of transferring or transforming energy.
Power Factor (PF): The ratio of real (MW) power to apparent power (MVA). Power factor is the cosine of the phase angle difference between the current and voltage of a given phase.
Power Purchase Agreement (PPA): An agreement/contract between the utility and Facility Interconnection Customer whereby the amount for the purchase of power has been determined and is contractually binding on both parties.
Primary: Normally considered as the high-voltage winding of a substation or distribution transformer; any voltage used for transmission of electric power in reasonably good-sized blocks and for some distance, as contrasted with low voltage for the immediate supply of power and light locally, such as the distribution within a building. The lowest voltage considered as a primary voltage is 2.4 kV although this is also used for some heavy-power requirements over short distances.
Primary System: A system of alternating current distribution for supplying the primaries of transformers from the generating station or distribution substation.
Protection: All of the relays and other equipment used to open the necessary circuit breakers to clear lines or equipment when trouble develops.
Protective Relay: A device whose function is to detect defective lines or apparatus, or other power system conditions of an abnormal or dangerous nature, and to initiate appropriate control circuit action.

R
Reactance: In an alternating current circuit, the opposition to the flow of current attributable to the inductance and capacitance of the circuit.
Reactive Component of Current: That part of a current that does no useful work because its phase is 90 degrees leading or lagging the voltage.
Reactive Load: In alternating current work, a load whose current is not in phase with the voltage across the load.
Reactor: A coil with no secondary winding provided. The primary use is to introduce inductance into the circuit for purposes such as starting motors, paralleling transformers, and controlling current. A current limiting reactor is a reactor for limiting the current that can flow in a circuit under short circuit conditions.
Reclose: To again close a circuit breaker after it has opened by relay action.
Recloser: A protective device designed to: 1) sense overcurrent, 2) time and interrupt the overcurrent according to a preset characteristic, and 3) reclose to test and possibly reenergize the line after a specified time interval.
Remedial Action Scheme (RAS): Protective systems that typically utilize a combination of conventional protective relays, computer based processors, and telecommunications to

accomplish rapid, automated response to unplanned power system events; also refers to details of RAS logic and any special requirements for arming of RAS schemes or changes in RAS programming that may be required.
Remote Station Alarms: Alarms received at an attended location from unattended stations or plants.
Remote Terminal Unit (RTU): Remotely located equipment used for collecting data and/or for supervisory control via communication channel.
Residual Current: The current which flows in the neutral or wye-connected current transformers when the current in the three phases of a line are unbalanced.
Resistance: Anything placed or already located in an electric circuit which opposes the flow of electric current.
Resistor: A device whose primary purpose is to introduce resistance into an electric circuit. An adjustable resistor is one so constructed that its amount of resistance can be readily changed.
Retail Service: Electric sales to PacifiCorp's end-use or retail customers. Such service is regulated by the jurisdictional state regulatory agencies.

S
Schematic: A diagram showing the essential features of a piece of equipment or a control system.
Secondary: The winding of a transformer which is normally operated at a lower voltage than the primary winding.
Secondary Distribution System: A low-voltage alternating current system which connects the secondaries of distribution transformers to the consumer's services.
Self-Excited: A term to describe an electric machine in which the field current is secured from its own armature current. In the case of induction generators, it refers to the condition in which the induction generator is separated from its normal excitation source and is unintentionally excited by the power factor correction capacitors in the vicinity.
Separately-Excited: Use of an exciter for sending current through the field windings of an electric machine in place of taking the field current from its own armature current.
Service Reliability: The time an entity or group of entities is served compared to the amount of time the entity or entities are without service over a given time period.
Service Restoration: The switching procedure a system operator directs or executes to restore services to entities following an outage.
Setting: The values of current, voltage, or time at which a relay is adjusted.
Single-Phase Circuit: A circuit in which all current can be represented by only one regular sine-wave pattern. Differs from a three-phase circuit, where when all circuit current is plotted, it produces three regular sine-wave patterns 120 electrical degrees apart.
Special Facilities: Those additions and reinforcements to the PacifiCorp power system which are needed to accommodate the receipt and/or delivery of energy and capacity from and/or to the entity's facility(ies), and those parts of the interconnection facilities which are owned and maintained by PacifiCorp at the entity's request, including metering and data processing equipment.
Standby Capacity: The lesser of: 1) net generation capacity, 2) connected loads to generator, or 3) 80 percent of main switch rating.

Star-Connected Circuit (Wye-Connected Circuit): A term applied to the manner in which a motor's windings or a transformer's windings are connected, (i.e., star-connected armature having one end of each of the coils connected to a common junction). A star-connected transformer is one in which the primaries and secondaries are connected in a star grouping.
Station Use: Energy used to operate the generating facility's auxiliary equipment. Auxiliary equipment includes, but is not limited to: forced and induced draft fans, cooling towers, boiler feed pumps, lubricating oil systems, power plant lighting, fuel handling systems, control systems, and sump pumps.
Step-Down Transformer: A transformer in which the secondary winding has fewer turns than the primary, so that the secondary delivers a lower voltage than is supplied to the primary.
Step-Up Transformer: A transformer in which the secondary winding has more turns than the primary, so that the secondary delivers a higher voltage than is applied to the primary.
Supervisory Control: A system by which equipment is operated by remote control at a distance using some type of code transmitted by wire or electronic means.
Surplus Sale: The generator's gross output, in kW and kWh, less any plant load and transformation and transmission losses, delivered to the PacifiCorp system.
Switch: A device for making, breaking, or changing the connections in an electric circuit.
Switch, Air: A switch in which the arc interruption of the circuit occurs in the air.
Switch, Alarm: A form of auxiliary switch which closes the circuit to a bell or other audible signaling device upon automatic opening of the circuit breaker or other apparatus with which it is associated.
Switch, Auxiliary: A switch actuated by some main device such as a circuit breaker for signaling, interlocking, or other purpose.
Synchronism: The condition across an open circuit wherein the voltage sine wave on one side matches the voltage sine wave on the other side in frequency and without phase angle difference.
System: The entire generating, transmitting, and distributing facilities of an electric utility.
System Emergency: Conditions beyond the normal control that affect the ability of the control area to function normally, including any abnormal system condition which requires immediate manual or automatic action to prevent loss of load, equipment damage, or tripping of system elements which might result in cascading outages or to restore system operation to meet the minimum operating reliability criteria.
System Protection Facilities: The equipment required by the utility to protect: 1) the PacifiCorp power system from faults occurring at a load or Facility Interconnection Customer ' facility, and 2) the load or Facility Interconnection Customer 's generating facility from faults occurring on the PacifiCorp power system or on the system of others to which it is directly or indirectly connected.

T
Telephone Working Limit: A voltage potential of 300 V or less, so personnel can work on the telephone cable without rubber gloves.
Telemetering: Measurement with the aid of a communication channel that permits power metering measurements to be interpreted at a distance from the primary detector.
Transfer Trip (TT): A form of remote trip in which a communication channel is used to transmit the trip signal from the relay location to a remote location.

Transformer: An electric device without continuously moving parts in which electromagnetic induction transforms electric energy from one or more other circuits at the same frequency, usually with changes in value of voltage and current.
Transformer Efficiency: Ratio of the electric power of the current going into a transformer to the power of the secondary circuit from the transformer.
Transformer Loss: The difference between the input power to a transformer and the output power of the transformer.
Transformer Ratio: The ratio of the voltage secured from a transformer to the voltage supplied to that transformer.
Transmission Line: A line used for electric power transmission. Distinguished from a distribution line by voltage. Lines rated 46 kV and higher are transmission lines.
Transmission Control Center: This center implements switching operations on the PacifiCorp transmission system within a specific geographical area.

U
UL: Underwriters Laboratories.
Undervoltage Protection: Upon failure or reduction of voltage, the protection device interrupts power to the main circuit and maintains the interruption.
Undervoltage Release: Upon failure or reduction of voltage, the protective device interrupts power to the main circuit but does not prevent again completing the main circuit upon return to voltage.
Unity Power Factor: A power factor of 1.000 which exists in a circuit wherein the voltage and current are in phase. There are no VArs in this condition, only watts.

V
VAr: A unit of measurement of reactive power. It is an expression of the difference between current and voltage sine waves in a given circuit; short for volt amps reactive.

$$VA2 = (Watts)2 + (VArs)2$$

Volt: The unit of electrical pressure similar to the pounds per square inch pressure on a steam gauge.
Volt Ampere: A unit of apparent power in an alternating current circuit. Equal to the product of volts and amperes without reference to the phase difference, if any. At unity power factor, a volt ampere equals a watt. Whenever there is any phase difference between voltage and current, the true power in watts is less than the apparent power in volt amperes.
Voltage Drop: The difference in voltage level between one point and another in a circuit (see line voltage drop).
Voltage Loss: The drop of potential in an electric circuit due to the resistance and reactance of the conductor. This loss exists in every circuit.
Voltage Ratio of Transformer: The ratio of the effective primary voltage to the effective secondary voltage of a transformer.
Voltage Transformer: See potential transformer.

W

Watt: A unit of electric power.

Watts AC = volts x amperes x power factor (single phase circuits).

Watt Hour: A measure of electric power. The power of one watt used for one hour.

Watt Hour Meter: An electrical measuring instrument which indicates power in watt hours.

WECC: Western Systems Coordinating Council or its successor.

Wholesale Customer: A person wishing to purchase energy and ancillary services at a bulk supply point or a scheduling point for resale.

Wholesale Sales: The sale of energy and ancillary services at a bulk supply point or a scheduling point for resale.

Wholesale Service: Electric sales to wholesale customers for resale. Such service is regulated by FERC.

"Wye"-Connected Circuit: A three-phase circuit which is star-connected, meaning the windings of all three phases have one common connection which may be connected to ground.

12 Revision History

Revision	Date	Action	Name of Editor
0	08/31/07	1. Drafted and published original document	Paul Della
1	9/27/07	1. Changed title to Facility Connection Requirement to be consistent with NERC standards. 2. Modified introduction to include details about responsible parties and publishing. 3. Modified section 3.1.1 to clarify procedures. 4. Added details for procedures for inspecting end-use and transmission facilities. 5. Modified Section 4 to clarify telecommunications requirements.	Dennis Desmarais
2	4/13/09	1. General revision to clarify and add latest interconnection requirements.	Dennis Desmarais

3	10/09/09	1. General revision to clean up document and remove redundant material. 2. Revised Sections 6 & 7 to group generator specific requirements in Section 7.	Dennis Desmarais
4	5/25/10	1. General edits to clarify that standard applies to all facilities interconnected to PacifiCorp transmission system.	Dennis Desmarais

Appendix A Power System Stabilizer Operation and Performance Requirements

The Power System Stabilizer (PSS) aids overall electric system stability by providing additional machine damping. It will supplement the proportional voltage control used on the excitation system.

There are several types of PSS. Each type uses a different input signal, such as frequency, shaft slip, or accelerating power. The most common type of PSS uses frequency as its input signal; it consists of a source-signal transducer providing frequency deviation of the generator bus from 60 Hz and derivative and lead-lag networks to provide proper phase advance. Generator excitation is controlled by a composite of voltage and frequency.

Figure H1 provides a mathematical control block diagram of a conventional excitation system which includes a PSS that uses frequency as its input signal. The transducer provides translation of bus frequency deviation into an appropriately noise-free electrical signal to serve as input to the derivative network.

The associated filtering and wave-shaping shall be designed to emit the following signal requirements:

- Linearity between 59.5 and 60.5 Hz.
- Filtering and noise suppression to provide ripple shall not exceed one percent and a time constant less than 0.02 second.
- Large variations of power-supply voltage and frequency resulting from external or internal causes shall not affect performance of the PSS.

To provide the required phase lead, the PSS parameters shall be adjustable by calibrated dial settings. The parameter ranges shall be as follows:

KQs	0. 1 to 50 per unit
TQ	0. 1 to 60 seconds
T4QJ	0. 1 to 1. 5 seconds
TQi	0. 02 to 0. 1 second
T'Q2	0. 1 to 1. 5 seconds
TQ2	0.02 to 0. 1 second

FIGURE A-1

Block Diagram of Regulator-Exciter System with Power System Stabilizer

[See scanned pdf attachment]

Appendix B Site Documentation

PacifiCorp requires system drawings and relay instruction books from the dispersed generation facility. Sets of preliminary drawings are needed first. Sets of final drawings and equipment instruction books are required according to the timetable outlined below.

I. Provide one set of preliminary drawings one year prior to energizing the plant. The required drawings include:
   A. Station location plot plan.
   B. Station one-line.

II. Provide a set of final drawings and instruction books four months prior to energizing the plant.
   A. Provide three sets of the following:
      1. Station one-line.
      2. Tie breaker schematics, including:
         a. control schematics,
         b. current schematics, and
         c. potential schematics.
      3. Diagram of the relay panel arrangements.

One copy each of these drawings shall be routed to the Area Engineer, Relay and Protection Department, and the Transmission/Distribution Account Manager.
It is preferred that the copies be provided in paper format. Electronic files are acceptable if they are convertible to paper format in the size acceptable to the engineer assigned to the project. Please send all of these documents to the following address:

Pacificorp Transmission Account Manager
825 NE Multnomah Blvd., Suite 1600
Portland, Oregon 97272

Appendix C Technical Data Sheet

TECHNICAL DATA SHEET

FOR

SYNCHRONOUS MACHINES

ON THE

PACIFICORP SYSTEM

FOR POWER FLOW, TRANSIENT STABILITY, AND FAULT ANALYSIS

Questions regarding this Technical Data Sheet should be directed to:

PacifiCorp Transmission Account Manager
830 NE Holladay, Suite 210
Portland, OR 97232
(503) 813-5738

NOTE 1: Please complete a separate data sheet for each generator that normally operates interconnected with PacifiCorp's Transmission System.

NOTE 2: This data sheet is for synchronous machines only, not induction machines

Technical Data Sheet for Synchronous Machines on the PacifiCorp System

Project Name _____ Unit Number _____ Log Number _____

Name of Person Completing Data Sheet _____

Telephone _____ FAX _____ Email _____

GENERATOR DATA

1. Generator Manufacturer _____
2. Year Generator was Manufactured _____
3. Rated Generator MVA _____ MVA
4. Rated Generator Terminal Voltage _____ kV
5. Rated Generator Speed _____ RPM
6. Number of Poles _____
7. Rated Generator Power Factor _____
8. Generator Efficiency at Rated Load _____ %
9. Moment of Inertia (Turbine plus Generator) ωR^2: _____ $lb\text{-}ft^2$
10. Inertia Time Constant (on machine base) (MJ/MVA) H: _____ sec.
11. SCR (Short-Circuit Ratio - the ratio of the field current required for rated open-circuit voltage to the field current required for rated short-circuit current) _____
12. Typical Generator Auxiliary Load _____ MW
13. Maximum Power Output _____ MW
14. Please attach generator reactive capability curves. If these curves are not available give the maximum and minimum reactive limits. Q_{MAX} _____ MVAR, lagging
    Q_{MIN}: _____ MVAR, leading
15. Rated Hydrogen Coating Pressure (Steam Units) _____ psig

16. Please attach a simple one-line diagram that includes the generator step-up transformer bark plant load, meter, and transmission-level bus.

Technical Data Sheet for Synchronous Machines on the PacifiCorp System

GENERATOR DATA (continued)

All impedance data should be based on MVA given in (3) and on kV given in (4) an previous page.

17.	X_d	direct-axis unsaturated synchronous reactance	_____pu
18.	X_q	quadrature-axis unsaturated synchronous reactance	_____pu
19.	X'_d	direct-axis unsaturated transient reactance	_____pu
20.	X'_{ds}	direct-aids saturated transient reactance	_____pu
21.	X'_q	quadrature-Axis unsaturated transient reactance	_____pu
22.	X'_{qs}	quadrature-axis saturated transient reactance	_____pu
23.	X''_d	direct-axis unsaturated subtransient reactance	_____pu
24.	X''_{ds}	direct-axis saturated subtransient reactance	_____pu
25.	X''_q	quadrature-axis unsaturated subtransient reactance	_____pu
26.	X''_{qs}	quadrature-axis saturated subtransient reactance	_____pu
27.	X_L	stator leakage reactance or Potier reactance	_____pu
28.	R_a	armature resistance	_____pu
29.	T_{q0}	direct-axis transient open-circuit tin,* constant	_____sec
30.	T_{q0}	quadrature-axis open-circuit time constant	_____sec
31.	T'_{q0}	direct-axis subtransient open-circuit time Constant	_____sec
32.	T'_{q0}	quadrature-axis subtransient open-circuit time constant	_____sec
33.	TA_{GEN}	armature short-circuit time constant	_____sec
34.	T_D	direct-axis transient short-circuit time constant	_____sec
35.	T_Q	quadrature-axis transient short-circuit time constant	_____sec
36.	T'_D	direct-axis subtransient short-circuit fine constant	_____sec
37.	T'_Q	quadrature-exis subtransient short-circuit time constant	_____sec

38. X_2 negative sequence reactance (sat./unsat.) _____/_____pu

39. X_0 zero sequence reactance (sat/unsat) _____/_____pu

40. Please attach a plot of generator terminal voltage versus field current that shows the air gap line, the open-circuit saturation curve, and the saturation curve at full load and rated power factor.

Technical Data Sheet for Synchronous Machines on the PacifiCorp System

EXCITATION SYSTEM INFORMATION

Listed below are the most common excitation systems used for voltage regulation of large synchronous generators. Each type of excitation system has been specified according to its manufacturer and name. In addition, the different excitation systems have been grouped together according to common characteristics.

Please indicate, in the space provided on the left, the excitation system used for your generator. if your type of excitation system is not listed, please write the manufacturer and exciter type under the category that most accurately describes your excitation system.

A. Rotating DC commutator exciter with continuously acting regulator. The regulator power source is independent of the generator terminal voltage and current.

_____1. Allis Chalmers, Regulex regulator
_____2. General Electric, Amplidyne regulator - NA101
_____3. General Electric, Amplidyne regulator - NA108
_____4 General Electric, Amplidyne regulator - NA143
_____5. General Electric, GDA regulator
_____6. Westinghouse, Mag-A-Stat regulator
_____7. Westinghouse, Rototrol regulator
_____8. Westinghouse, Silverstat regulator
_____9. Westinghouse, TRA regulator
_____10. Brown Boveri, Type AB or Type ABC regulator
_____11. Brown Boveri, Type DC regulator
_____12. Other. Manufacturer/Type: _____/_____

B. Rotating DC commutator exciter with continuously acting regulator. The regulator power source is bus fed from the generator terminal voltage

_____1. Westinghouse, PRX-400 regulator
_____ 2. Other. Manufacturer/Type _____/_____

C Rotating DC commutator exciter with non-continuously acting regulator (i.e., regulator adjustments are made in discrete increments

_____1. General Electric, GFA4 regulator
_____2. Westinghouse, BJ30 regulator
_____3. Other. Manufacturer/Type _____/_____

Technical Data Sheet for Synchronous Machines on the PacifiCorp System

EXCITATION SYSTEM INFORMATION (Continued)

D. Rotating AC Altemator Exciter with non-controlled (diode) rectifiers. The regulator power source is independent of the generator terminal voltage and current (not bus-fed).
_____1. Westinghouse Brushless
_____2. Westinghouse High Initial Response Brushless
_____3. Other: Manufacturer/Type_____/_____

E. Rotating AC Alternator Exciter with controlled (thrysistor) rectifiers. The regulator power source is fed from the exciter output voltage.
_____1. General Electric Alterrex
_____2. Other: Manufacturer/Type_____/_____

F. Rotating AC Alternator Exciter with controlled (thyristor) rectifiers.
_____1. General Electric Alterrex
_____2. Other: Manufacturer/Type_____/_____

G. Static Exciter with controlled (thyristor) rectifiers. The regulator power source is bus-fed from the generator terminal voltage.
_____1. Canadian General Electric Silcomatic
_____2. Westinghouse Canada Solid State Thyristor System
_____3. Westinghouse Type PS Static System, Type WTA, WHS, WTA-300 regulators
_____4. ASEA Static System
_____5. Brown Boveri Static System
_____6. Rayrolle-Parsons Static System
_____7. GEC-Eliott Static System
_____8. Toshiba Static System
_____9. Mitsubishi Static System
_____10. General Electric Potential Source Static System
_____11. Hitachi Static System
_____12. Other: Manufacturer/Type_____/_____

H. Static Exciter with controlled (thyristor) rectifiers. The regulator power source is bus-fed from a combination of generator terminal voltage and current (compound-source controlled rectifiers system).
_____1. General Electric SCT-PPT or SCPT System
_____2. Other: Manufacturer/Type_____/_____

Technical Data Sheet for Synchronous Machines on the PacifiCorp System

Other Excitation System Information

I. Please attach a *copy of* the instruction manual for your excitation system. Make sure that a block diagram or schematic of the excitation system is included in the manual. The diagram should show the input, output, and all feedback loops of the excitation system.

J. If the manufacturer's data *for* the excitation system (i.e., time constants, gains, and saturation curves) are available, please attach these also.

K. What is the excitation system response ratio (ASA) ?
(See *Power System Control and Stability* by Anderson and Fouad, 1st ed., 1977, pg 456, Fig E.1, for a precise definition of ASA.)

L. What is the rated exciter output voltage at *full* load? _____Volts

M. What is the maximum exciter output voltage (ceiling voltage)?_____Volts

N. Other comments regarding the excitation system?

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

Technical Data Sheet for Synchronous Machines on the PacifiCorp System

POWER SYSTEM STANTLTZER INFORMATION (supplementary excitation system)

(Note: Complete this section only if your machine has PSS control.)

A. Manufacturer.
_____1. General Electric
_____2. Westinghouse
_____3. Toshiba
_____4. TTI
_____5. Alsthom
_____6. Other: Manufacturer _____

B. Is your PSS digital or analog? _____

C. What is the actuating signal (the input signal) for your PSS?

___ Bus frequency ___ Shaft slip ___Accelerating power ___Other

If "Other", indicate signal: _____

D. Please attach the instruction manual for your PSS. The manual should include a block diagram or schematic of the PSS and the correspondence between dial settings and the time constants or PSS gain.

E. Please attach a copy of the test report for your PSS. This report should contain the dial settings or time constants and TISS gain. If this report is not available, write the dial settings below:

1. T_1 washout or reset time constant dial setting _____
2. T_2 first lead time constant dial setting _____
3. T_3 first lag time constant dial setting _____
4. T_4 second lead time constant dial setting _____
5. T5 second lag time constant dial setting _____
6. K MS gain dial setting _____
7. V_{max} maximum PSS output dial setting _____
8. V_{cut} dial setting for which PSS is set to zero when generator terminal voltage deviation is too large _____
9. Other _____ / _____

10. Other _____ / _____

F. Who installed your PSS?

Name: _____

Company: _____

City, State: _____

Phone/Fax: _____/_____

Technical Data Sheet for Synchronous Machines on the PacifiCorp System

POWER SYSTEM STABILIZER INFORMATION (continued)

C. Other comments regarding the PSS?

Technical Data Sheet for Synchronous Machines on the PacifiCorp System

TURBINE-GOVERNOR INFORMATION

Please complete part A for steam, gas or combined-cycle turbines, part B for hydro turbines, and part C for both.

A. Steam, gas or combined-cycle turbines

1. Steam turbine, Gas turbine, or Combined-cycle: _____

2. If steam or combined-cycle, does the turbine system have a reheat process (i.e., both high and low pressure turbines) ? _____

3. If steam with reheat process, or if combined-cycle, indicate, in the space provided, the percent of full load power produced by each turbine:

   by low pressure turbine or gas turbine _____%

   by high pressure turbine or steam turbine _____%

B. Hydro turbines

1 What is the turbine efficiency at rated load _____%

2. What is the length of the penstock? _____ft

3. What is the average cross-sectional area of the penstock _____ft^2

4. What is the typical maximum head (vertical distance from the bottom of penstock, at the gate, to the water level)? _____ft

5. Is the water supply run-of-the-river or reservoir? _____

6. What is the water flow rate at the typical maximum head? _____ft^3/sec

7. What is the average energy rate? _____kW-hrs/acre-ft

8. What is the estimated yearly energy production? _____kW-hrs

Technical Data Sheet for Synchronous Machines on the PacifiCorp System

C. Complete this section for each machine, independent of the turbine type.

1. Turbine manufacturer _____

2. Maximum turbine power output _____MW

3. Minimum turbine power-output (while on line) _____MW

4. Governor information:

   a. Droop setting (speed regulation) _____

   b. Is the governor mechanical-hydraulic or Electro-hydraulic? (Electrco-hydraulic governors have an electronic speed sensor and transducer.) _____

   c. Please provide below any time constants you have from the manufacturer describing the speed of response of the governor. Be sure to identify each time constant.

   _____ _____sec

   _____ _____sec

   _____ _____sec

   _____ _____sec

   d. Other comments regarding the turbine governor system?

   _____

   _____

   _____

   _____

   _____

   _____

   _____

Technical Data Sheet for Synchronous Machines on the PacifiCorp System

STEP-UP TRANSFORMER DATA

1. Transformer Bank No._____

2. Rated MVA _____MVA

3.

Available H.V. Taps		Available L.V. Taps	
_____	kV	_____	kV
_____	kV	_____	kV
_____	kV	_____	kV
_____	kV	_____	kV
_____	kV	_____	kV
_____	kV	_____	kV

4. Please indicate present tap settings: H.V. Tap: _____kV
   L.V. Tap: _____kV

5. Does transformer have tap changing under load? _____

6. Is transformer a regulating-type transformer? _____

   If yes, please indicate regulating voltage range and the number of steps.
   _____kV to _____kV Number of steps: _____

7. Please indicate how the transformer windings are connected.

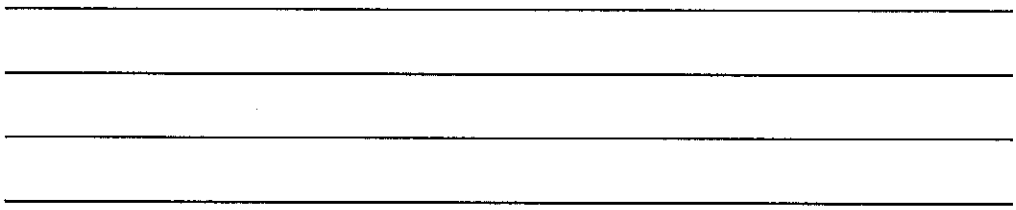
H.V. Side:			LV. Side:	
_____	Wye		_____	Wye
	Gumnded			Grounded
_____	Wye		_____	Wye
_____	Delta		_____	Delta

8. Please attach a copy of the transformer test report, if available.

9. If the transformer test report is not available, please provide the "lowing impedances using the IAVA base given in (2) above:

R_T	per unit resistance	_____PU
X_T	per unit reactance	_____PU
B_T	per unit magnetizing susceptance	_____PU
C_T	per unit core loss conductance	_____PU

10. Other comments regarding the transformer?



OF OPERATING PRACTICE QUESTIONNAIRE
SYNCHRONOUS GENERATORS

NOTE: The information on this survey is used to improve transmission models used in engineering studies.

A. Generation and Plant Load (served by own generation) Pattern:

1. Generator Size _____MVA

2. Please indicate typical peak generation level (in MW). If generator serves plant load on the same side of the PacifiCorp meter, also indicate typical load level. (Metered power equals peak generation level minus corresponding plant load).

   a. Peak Generation Level _____MW

   b. Corresponding Plant Load _____MW

3. Please indicate typical planned seasonal and time period variations as percentage of levels specified in (2) above. Approximate a percentages in Increments; of 25% (0%, 25%,50%,75%, 100%)

	Summer April thru October		Winter November thru March	
Time of Day (24-Hr format)	Generation	Load	Generation	Load
06:00 - 12:00				
12:00 -18:00				
18:00 - 22:00				
22:00 - 06:00.				

B. Type of Regulation (Complete either Section 1 or 2)

1. Maintain Voltage _____
   Typical Voltage Range __kV to _____kV
   Generator Rated Terminal Voltage _____kV

   Standard PacifiCorp operation bandwidth is 0.90 lagging (producing vars) to 0.95 leading (absorbing vars). If actual operation (not capability) is typically narrower than these limits, please indicate range.

   _____Lagging (producing vars) to _____Leading (absorbing vars)

   Do you ever operate with manual voltage control (excitation system bypassed)? _____

   If yes, what percent of the time? _____

   Under what conditions?

   _____

   _____

   _____

   _____

2. Maintain Power Factor _____

   Typical Machine Power Factor Range _____
   To _____

   Is this automatically controlled? _____

   If so, approximately how fast can the controller respond to a change in power factor?

   _____0 - 20 seconds
   _____20 seconds - 3 minutes
   _____greater than 3 minutes

   Standard Pacificorp bandwidth is 95 to 105% of rated voltage. If actual operation (not capability) is typically narrower than these limits please indicate range.

   _____ to _____ % of rated voltage

C. Governor Control

Do you operate with an automatic turbine speed controller (governor)? _____

If yes, do you operate with it blocked? _____

If yes, what percent of the time? _____%

Under what conditions?

_____

_____

_____

D. Other comments regarding operation of your generator?

_____

_____

_____

_____

_____

_____

_____

_____

Appendix D Requirements for Transmission Line Selector Switches and Associated Cost Responsibilities

Purpose

The purpose of this guideline is to: 1) ensure service availability can be maintained to single-tapped customers, 2) ensure system-wide consistency in the installation of selector switches on transmission lines, and 3) provide a clear understanding of the associated cost responsibilities wherever transmission lines are single-tapped.

Definition of Selector Switches

Line selector switches are installed on one or both sides of a single-tap in order to provide operational flexibility in service to customers on the tap line. Selector switches are operated to avoid customer outages for planned maintenance in the main line and to restore service in the case of an unplanned interruption of the main line (see Figure 1). Selector switches do not reduce the number of outages to the customer, but they do provide a relatively inexpensive way of reducing the duration of a sustained outage[1] by allowing the transmission line to be sectionalized. Selector switches cannot reduce the frequency of maintenance or unplanned outages on the single-tap line to the customer.

Applicability

Effective immediately, selector switches are a standard service requirement for all new single-tap interconnections to PacifiCorp's transmission system. This is applicable where a single-tap configuration is to be used to interconnect a new load or generation customer to a PacifiCorp-owned transmission line (46 kV and above) or when a change in service is requested by an existing load or generation customer. This guideline will also be incorporated into PacifiCorp's transmission interconnection requirements.

At PacifiCorp's discretion, a selector switch may not be required should the distance from the new single-tap interconnection to either end of the transmission line or to an existing selector switch on the line be approximately one mile or less, with minimal exposure to causes of outages (trees, traffic, etc.). Refer to Attachment 1 for a list of criteria in determining the need for selector switches.

[1] A sustained outage is an outage to a customer extending more than two minutes.

Single-Tap Configuration

For standard transmission tap interconnection to a customer-owned substation, a single-tap is provided from the most feasible transmission line to the customer's facility. With standard service, the customer will experience interruptions to their facility during a transmission line outage unless the customer has adequate on-site back-up generation.

The installation of selector switches reduces the duration of a sustained outage, but it does not eliminate momentary outages to a customer. For a sustained outage on the transmission line, service to the customer will be interrupted for the duration of time[2] it takes PacifiCorp to open the appropriate selector switch to isolate the faulted line section and close the breaker on the non-faulted line section. As an example, for a sustained outage between Station "B" and the tap point, selector switch "B" would be opened to isolate the problem and service to the customer would be restored by closing the circuit breaker at Station "A".

Figure 1–Typical Single-Tap Configuration with Selector Switches

[See scanned pdf attachment]

Ownership and Accessibility

- Pacificorp shall own, operate, and maintain all selector switches in the system to serve customer-owned substations or customer load.
- PacifiCorp's personnel must be able to access all selector switches installation 24 hours a day.

Cost Responsibilities for New Single-Tap Interconnections[3]

Effective immediately, with the exception allowed in Attachment 1, line selector switches are a PacifiCorp requirement for all new single-tap interconnections to the transmission system as a means of providing adequate level of service availability. In accordance with PacifiCorp's electric tariff, if line selector switches are considered special facilities, the installation cost of the switches will be determined by the application of relevant jurisdictional state commision rules as appropriate[4].

[2] Duration of time refers to the time it takes a Pacificorp operator to manually operate the selector switches from the time Pacificorp was notified of an outage. This time could vary from about a half hour to several hours depending on the nature of the outage. Should the outage be such that the customer could be energized from one end of the transmission line, the appropriate selector switch would be opened.
[3] New Single-Tap Interconnections: A customer requesting PacifiCorp's service who is not currently interconnected to PacifiCorp's transmission system.

[4] Unbundling of electric and transmission services may reqire the cost responsibilities be revised.

For existing single-tap interconnections, refer to Attachment 2 for the need and installation cost responsibilities for line selector switches.

Selector Switches Capability

- PacifiCorp will determine on a case-by-case basis whether selector switches should be capable of line dropping and/or loop splitting and would specify the capabilities of the selector switches and any associated interrupting devices.

- PacifiCorp will identify locations with access difficulties, such as mountainous terrain, and may recommend that the selector switches be motor-operated and remotely controlled.

Selector Switches Installation

Selector switches must be located in close proximity (within one pole or tower structure) on either side of the single-tap on the transmission line. All structures used for mounting the selector switches will be determined and designed by PacifiCorp.

Appendix D, Attachment 1

Criteria for Determining When One or No Selector Switch Is Required

- Radial Transmission Line

  At PacifiCorp's discretion, only one selector switch may be required on the non-source side of the tapped transmission line.

- When One Selector Switch Is Sufficient

  At PacifiCorp's discretion, PacifiCorp may elect to install only one selector switch on one side of the single-tap provided that the line section without the selector switch is: 1) approximately one mile or less from the tap point to the end of the transmission line, with minimal exposure to causes of outages (trees, traffic, etc.), or 2) approximately one mile or less from the interconnection tap point of another customer with line selector switches, with minimal exposure to causes of outages.

- When No Selector Switches Are Required

  At PacifiCorp's discretion, selector switches may not be required on the transmission line if the distances on either side of the tap to the ends of the transmission line or other selector switches on the line are approximately one mile or less, with minimal exposure to causes of outages.

Criteria for Determining When Selector Switches Are Required

- Length of Transmission Line

  Long transmission lines have more exposure and have a greater frequency of being forced out of service for maintenance. Long lines are also at greater risk of experiencing sustained faults due to increased exposure to adverse elements.

- Location and Route of Transmission Line

  Geographic and environmental conditions affect the total exposure of the line to adverse elements. For example, transmission lines that traverse mountainous areas are subject to a greater number of outages due to exposure to trees and inclement weather.

- Multiple Customers on Transmission Line

  At PacifiCorp's discretion, PacifiCorp may require selector switches on a

transmission line where multiple customers are tapped as a means of maintaining service availability.

Appendix D, Attachment 2
Need and Installation Cost Responsibilities for Existing Single-Tap Interconnections

This guideline is not intended for retroactive application to existing single-tap interconnections, however the installation of line selector switches on existing single-tap interconnections will be considered on a case-by-case basis based on the following:

Existing Single-Tap Customer's Request for Selector Switches

When an existing single-tap customer requests selector switches as a means of minimizing down time to his/her facility, the selector switches will be treated as Special Facilities and shall be paid for by the customer in accordance with applicable jurisdictional state utility commission rules.

PacifiCorp Determines When Selector Switches Are Necessary

When line selector switches are determined by PacifiCorp to be needed for system benefits, the installed cost of the selector switches will be borne by PacifiCorp. System benefits include but are not limited to: 1) minimizing sustained outages to multiple customers on a single-tap line, and 2) avoiding difficult clearance coordination with multiple customers.

On existing single-tap interconnections, should the need for selector switches be identified, then the criteria outlined in Attachment I also applies.

Appendix E Typical One-Line Generator Interconnection ≥ 230 kV

[See scanned pdf attachment]

Appendix F Typical One-Line Generator Interconnection < 230 kV

[See scanned pdf attachment]

PACIFICORP

and

BRIGHAM CITY CORPORATION
(Interconnection Customer)

for

EAST SUBSTATION

TRANSMISSION INTERCONNECTION AGREEMENT FOR POINTS OF DELIVERY

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Transmission Interconnection Agreement for Points of Delivery

This Transmission Interconnection Agreement for Points of Delivery ("Interconnection Agreement" or "Agreement"), executed as of the 22 day of July, 2011, is by and between **PACIFICORP**, an Oregon Corporation, and **BRIGHAM CITY CORPORATION**, owners of a Utah municipal electric utility, ("Interconnection Customer"). PacifiCorp and Interconnection Customer are sometimes referred to herein as "Party" and collectively as "Parties".

WITNESSETH

WHEREAS, PacifiCorp owns and operates facilities for the transmission of electric power and energy in interstate commerce (the "Transmission System"), and

WHEREAS, PacifiCorp and Interconnection Customer are parties to a Substation Operating Agreement, dated March 2, 1978, and designated as PacifiCorp Rate Schedule No. 341 (the "O&M Agreement"), pursuant to which PacifiCorp provides Interconnection Customer certain operation and maintenance services at the Interconnection Customer's East Substation; and

WHEREAS, The Interconnection Customer desires to make certain upgrades to Interconnection Customer's existing East Substation which is interconnected with PacifiCorp's 138 kV Bridgerland-Ben Lomond transmission line; and

WHEREAS, the Parties have entered into a Project Construction Agreement for the design and construction of the facilities required for interconnection of Interconnection Customer's East Substation due to the Interconnection Customer's East Substation upgrades; and

WHEREAS, the Parties agree that upon completion of the upgrades, and under separate purchase agreement, PacifiCorp shall take ownership of two motor operated switches nos. 120A & 122A and switch no. 124A and the interconnecting bus work and physical supports to provide a 138 kV electrical path that is owned and operated by PacifiCorp through the Customers East Substation; and

WHEREAS, the Parties further agree to replace the O&M Agreement with this Interconnection Agreement on or before the completion of the upgrades.

NOW, THEREFORE, in consideration of the mutual covenants and agreements contained herein, the Parties undertake and agree as follows:

SECTION 1: DEFINITIONS

(a) **Business Day** shall mean Monday through Friday, excluding Federal Holidays.

(b) **Point(s) of Interconnection** shall mean the point(s) at which the Interconnection Customer's electric system interconnects with PacifiCorp's Transmission System

further described in Appendix A and shown in the one-line diagram in Appendix B to this Agreement.

(c) **Good Utility Practice**, shall mean 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.

SECTION 2: FILING, EFFECTIVE DATE, TERM AND TERMINATION

2.1 Filing agreement with FERC

(a) This Agreement shall be subject to its acceptance for filing by the Federal Energy Regulatory Commission ("FERC"). The Parties agree that no Party will be deemed the drafter of any term that may subsequently be found to be ambiguous or vague. PacifiCorp shall submit this Agreement for filing with FERC within thirty (30) calendar days after execution of the Agreement.

(b) This Agreement shall become effective upon the later of the date of this Agreement or the date established by FERC.

2.2 Term and Termination

(a) Subject to Section 2.2(b), this Agreement shall remain in effect for a term of thirty (30) years from the effective date, and shall be automatically renewed for each successive one-year period thereafter.

(b) This Agreement may be terminated effective on or after the expiration of the initial term specified in Section 2.2(a) by either Party after giving the non-terminating Party three (3) years' advance written notice. The Parties may also mutually agree to terminate this Agreement at any time through a written document signed by an authorized representative of each Party.

SECTION 3: INTERCONNECTION FACILITIES

3.1 Interconnection Customers may Interconnect

(a) The Interconnection Customer may interconnect its electric system to PacifiCorp's Transmission System via the interconnection facilities identified in Appendix A and described in one-line diagram format in Appendix B.

(b) Design, construction and continuing use, maintenance and operation of all interconnection facilities shall be pursuant to Good Utility Practices and meet to

the extent relevant, PacifiCorp's Facility Connection Requirements for Transmission Systems ("FCRTS"), attached as Appendix C, as amended from time-to-time by PacifiCorp. If there is a conflict between requirements in the FCRTS and the terms of this Agreement, the terms of this Agreement shall apply. PacifiCorp shall review and approve the Interconnection Customer's design prior to construction of the facilities prior to allowing interconnection.

3.2 System Impact Study

Performance of and responsibility for the cost of system studies, design, procurement and installation of the interconnection facilities required to connect the Interconnection Customer's electric system to PacifiCorp's Transmission System at the Point(s) of Interconnection, including all modifications to PacifiCorp's Transmission System necessary to complete the interconnection, have been provided for in separate agreements.

3.3 Costs of Upgrades

(a) Interconnection Customer shall be responsible for all costs associated with any future modifications necessary to upgrade the interconnection facilities to meet requirements proposed by the Interconnection Customer.

(b) Design and construction of any such future upgrade facilities shall be pursuant to Good Utility Practices and meet PacifiCorp's Transmission System design standards. PacifiCorp shall review and approve the upgrade design prior to construction of the facilities.

3.4 Change of Interconnecting System Voltage

In the event PacifiCorp changes the operating voltage of the Transmission System to which the Interconnection Customer is connected, Interconnection Customer shall be responsible for all costs associated with modifications necessary to upgrade Interconnection Customer's facilities to remain interconnected with PacifiCorp's Transmission System at the new operating voltage.

3.5 Ownership and Operation of Interconnection Facilities

(a) PacifiCorp shall have full ownership and operational control of the transmission path to which the Interconnected Customer's facilities are connected.

(b) PacifiCorp shall have the right to schedule power and energy through PacifiCorp owned 138 kV facilities located in Interconnection Customer's substation to the extent necessary to fully utilize PacifiCorp's Bridgerland-Ben Lomond transmission line capacity.

(c) All operation and maintenance activities by either Party shall be coordinated through the Parties' respective grid operations functions.

(d) PacifiCorp shall:

(i) retain full ownership and operational control of motor operated switches 120A and 122A and line switch 124A;

(ii) retain full ownership and operational control of interconnecting bus work and associated steel supports on the 138kV path that delivers electric energy over PacifiCorp's Transmission System and shown on the one-line diagram in Appendix B;

(iii) own and maintain the 138 kV line relays on Interconnection Customer's circuit breaker 1CB101 that coordinate with PacifiCorp's relays at Bridgerland and Ben Lomond substations; and

(iv) retain full operational control of Interconnection Customer's owned and maintained switches 101A and 125A.

(e) Interconnection Customer shall own all facilities at East Substation installed on the Interconnection Customer's side of the point of change of ownership shown on the one-line diagram in Appendix B, unless indicated otherwise herein.

(f) Interconnection Customer shall be obligated to maintain a power factor between 95% lagging and 95% leading. Interconnection Customer, at its expense and upon the written request of PacifiCorp, agrees to install or have installed switched capacitors or other equipment as may be reasonably required to eliminate that portion of reactive power flow which causes the reactive factor to fall outside the limits established herein. Such capacitors or other equipment shall be of a size consistent with voltage control requirements for PacifiCorp's Transmission System.

(g) Interconnection Customer shall design and operate its system so it shall not cause abrupt voltage changes on PacifiCorp's Transmission System in excess of PacifiCorp's standards as set forth in Appendix C as amended from time to time. Interconnection Customer, at its expense and upon the written request of PacifiCorp, agrees to install equipment as reasonably required to eliminate abrupt voltage changes outside PacifiCorp's standard.

(h) Should Interconnection Customer fail to take the corrective action requested by PacifiCorp within one (1) year after receipt of a notice detailing the corrective action to be taken, PacifiCorp may perform such services or supply and install such capacitors or other equipment as it deems necessary to provide the corrective action. Interconnection Customer shall compensate PacifiCorp for all amounts expended and all services contracted for or performed in taking the corrective action, including indirect costs and overheads. The total of these expenditures shall be paid by Interconnection Customer within thirty (30) days of receipt of an itemized statement of those expenditures reasonably incurred.

(i) PacifiCorp and Interconnection Customer shall operate and maintain their respective interconnection facilities in compliance with the FCRTS, Good Utility

Practices and with all Western Electricity Coordinating Council (WECC) or such other reliability criteria set or promulgated by a regional or national standard setting body with authority to do so (including, but not limited to, the North American Electric Reliability Council's (NERC) Reliability Standards) as such criteria may be adopted or modified from time to time. PacifiCorp and Interconnection Customer shall be responsible for all costs associated with the operation and maintenance of the interconnection facilities each owns.

3.6 Interchange/Revenue Metering Equipment

(a) Meters shall be located on the high voltage side of transformation and voltage and current transformers used for revenue metering purposes shall be used for no other purpose unless approved by PacifiCorp

(b) PacifiCorp shall:

(i) own and maintain the 138kV revenue metering instrument transformers, meters, and metering cables;

(ii) operate, test and maintain, at its expense, metering equipment and conform to the FCRTS;

(iii) calibrate and test interchange metering equipment in accordance with applicable ANSI standards. PacifiCorp shall inspect and test all metering equipment upon installation and at least once every three (3) years thereafter;

(iv) give reasonable notice (but in any case, no less than two weeks) of the time when any inspection or test shall take place. If at any time metering equipment is found to be inaccurate or defective, it shall be adjusted, repaired or replaced at PacifiCorp's expense, in order to provide accurate metering; and

(v) A documented verification of instrument transformer ratios shall be performed by PacifiCorp as may be required. 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 metering test as provided in section 3.6(b)(iv) if there is no record of a verification being performed in the past and whenever the instrument transformers are replaced.

(c) Interconnection Customer shall:

(i) own and maintain at its expense revenue metering instrument transformer support structures and foundations; and

(ii) have rights for representation at an official metering testing or inspection.

3.7 Telemetering and Communications equipment

(a) PacifiCorp shall:

(i) own, operate and maintain, at its expense, a Remote Terminal Unit(RTU) at the interconnection facility to gather accumulated and instantaneous data to be communicated electronically to the location(s) designated by PacifiCorp and to interface with protection and control devices as required.

(ii) own, operate and maintain, at its expense, communication equipment at the interconnection facilities to deliver required interconnection data to PacifiCorp's control centers; and

(iii) correct errors or malfunctions as soon as reasonably feasible.

(b) Interconnection customer shall:

(i) promptly advise PacifiCorp if it detects or otherwise learns of any metering, telemetry or communications equipment errors or malfunctions that require the attention and/or correction by PacifiCorp; and

(ii) work diligently with PacifiCorp and any other entities that carry communication traffic back to PacifiCorp to resolve any such failure. Interconnection Customer and PacifiCorp shall correct such error or malfunction as soon as reasonably practicable.

(c) All RTU, telemetering and communications equipment shall conform to the FCRTS.

(d) Point of Interconnection for the communications facilities shall be at the fiber optic terminal panel in Interconnection Customer's substation.

3.8 Property Rights

Interconnection Customer shall provide a document acceptable to PacifiCorp that authorizes and grants PacifiCorp an easement and right-of-way for the construction, reconstruction, operation, maintenance, repair, replacement enlargement and removal of the PacifiCorp interconnection facilities located within Interconnection Customer's East Substation. PacifiCorp shall have the right to access Interconnection Customer's East Substation and control building to perform these activities. PacifiCorp shall notify Interconnection Customer prior to or as soon as reasonably possible upon entrance to the Interconnection Customer's East Substation.

SECTION 4: CONTINUITY OF INTERCONNECTION

4.1 Continuous Physical Interconnection

PacifiCorp shall make reasonable provisions consistent with Good Utility Practice to provide a continuous physical interconnection at the Point(s) of Interconnection.

4.2 Un-planned Interruptions

PacifiCorp may temporarily interrupt or isolate the interconnection in order to:

(a) maintain reliability on PacifiCorp's system; or

(b) to avoid death or injury to any person or harm to any property.

PacifiCorp shall attempt to provide the Interconnection Customer as much notice as reasonably possible before doing so.

4.3 Planned Interruptions

PacifiCorp may temporarily interrupt or isolate the interconnection for any planned interruption to the interconnection after giving as much notice as possible to the Interconnection Customer. A planned outage may be taken in order to:

(a) maintain, repair, replace or inspect any portion of PacifiCorp's system; or

(b) install equipment.

Notice shall be given to allow for the coordination of the date and time of the outage, in an effort to minimize the duration and number of the Interconnection Customer's customers affected by the outage.

4.4 Operating Procedures

An operating agreement shall be developed and on file to provide guidelines for the operation of the interconnection of PacifiCorp's Bridgerland-Ben Lomond 138kV line with Interconnection Customer's East Substation under normal and emergency conditions.

SECTION 5: FORCE MAJEURE

Neither Party shall be subject to any liability or damages for inability to maintain a continuous interconnection to the extent that such failure shall be due to causes beyond the control of either PacifiCorp or Interconnection Customer, including, but not limited to the following: act of God, labor disturbance, act of a public enemy, war, insurrection, riot, fire, storm or flood, explosion, breakage or accident to machinery or equipment, any order, regulation or restriction imposed by governmental, military or lawfully established civilian authorities, or any other cause beyond a Party's control.

A Force Majeure event does not include acts of negligence or intentional wrongdoing by the Party claiming Force Majeure.

SECTION 6: LIMITATION OF LIABILITY

Neither Party or its directors, board members, commissioners, officers, employees, or agents shall have any liability to the other Party for any injury or death to any person, or for any loss or damage to any property, or any lost profits, lost revenues, lost use of facilities, lost data, or any indirect, incidental, consequential, special, exemplary, or punitive damages caused by or arising out of any Electric Disturbance on the other Party's Transmission System, unless the Electric Disturbance is caused by the other Party's Willful Action. Willful Action means an action taken or not taken by a Party that is knowingly or intentionally taken or not taken with the intent that injury or damage would result or with a reckless disregard for the result. Willful Action does not include any act or failure to act that is involuntary, accidental or negligent. For the purposes of this clause, "Electrical Disturbance" means:

(a) electric disturbances that produce abnormal power flows;

(b) power system faults or equipment failures;

(c) over-voltages during ground faults;

(d) audible noise, radio, television, and telephone interference;

(e) power system harmonics; or

(f) other disturbances that might degrade the reliability of the interconnected PacifiCorp system.

SECTION 7: NOTICES

Any written notices to be given to PacifiCorp under this Agreement shall be directed to:

Director, Transmission Services
PacifiCorp
825 N.E. Multnomah St., Suite 1600
Portland, Oregon 97232

Any written notices to be given to Interconnection Customer under this Agreement shall be directed to:

Director
Brigham City Public Power
20 N. Main Street
Brigham City, Utah 84302-1005

SECTION 8: APPLICABLE LAW

The Parties in the performance of their obligations hereunder shall conform to all applicable laws, rules and regulations and, to the extent their obligations are subject to the jurisdiction of state or federal agencies, shall be subject to orders of such agencies. This Agreement shall be construed in accordance with laws of the state of Utah unless preempted by the Federal Power Act or other federal law.

SECTION 9: WAIVER

Any waiver at any time by either Party hereto of its rights with respect to the other Party or with respect to any matter arising in connection with this Agreement shall not be considered a waiver with respect to any subsequent default of such matter.

SECTION 10: SUCCESSORS AND ASSIGNS

This Agreement shall inure to the benefit of, and be binding upon, the Parties and their respective successors and assigns, and may be assigned by either Party with prior written consent of the other Party, which written consent shall not be unreasonably withheld.

SECTION 11: NO DEDICATION OF FACILITIES

Any undertaking by one Party to the other Party under any provision of this Agreement is rendered strictly as an accommodation and does not constitute the provision of a public utility service, or the dedication of all or any portion of either Party's Transmission System or facilities to the other Party, the public, or any third party.

SECTION 12: NO THIRD PARTY BENEFICIARIES

This Agreement is not intended to and does not create rights, remedies, or benefits of any character whatsoever in favor of any persons, corporations, associations, or entities other than the parties, and the obligations herein assumed are solely for the use and benefit of the Parties, their successors in interest and , where permitted, their assigns.

SECTION 13: SEVERABILITY OF PROVISIONS.

The provisions of this Agreement are independent of and separable from each other. If any provision of this Agreement shall for any reason be held invalid or unenforceable, such invalidity or unenforceability shall not affect the validity or enforceability of any other provision hereof, but this Agreement shall be construed as if such invalid or unenforceable provision had never been contained herein.

SECTION 14: EFFECT OF SECTION HEADING

Section headings appearing in this Agreement are inserted for convenience of reference only and shall not be construed to be interpretations of the text of this Agreement.

SECTION 15: APPENDICES AND EXHIBITS

The Appendices and Exhibits hereto together with all attachments referenced therein, are incorporated herein by reference and made a part of this Agreement. Unless otherwise stated, in the event of an inconsistency between a provision in the general terms of this Agreement and the terms contained Appendix C, the provisions of these general terms shall prevail to the extent of the inconsistency.

SECTION 16: DISPUTE RESOLUTION

Any controversy, claim or dispute of whatsoever nature or kind between or among the Parties arising out of or in connection with this Agreement (each a "Dispute") shall be resolved pursuant to the procedures of this Section.

If a Dispute arises between or among the Parties, then any Party to such Dispute may provide written notice thereof to the other Party, including a detailed description of the subject matter of the Dispute. Thereafter, representatives from the Parties shall meet within thirty (30) days of the initial notice and shall in good faith attempt to resolve such Dispute by informal negotiations within thirty (30) days, or such later date as mutually agreed upon by the Parties, from the date of receipt of such notice. If the Dispute is not resolved within such 30-day period, or such later date as the Parties may mutually agree, then the Parties may seek the assistance of the FERC's Dispute Resolution Service. Each Party shall be responsible for its own costs incurred during any dispute resolution process.

SECTION 17: COMPLETE AGREEMENT

This Agreement sets forth the entire agreement between the Parties on the subject matter of this Agreement, and supersedes all prior agreements of the Parties with respect to its subject matter.

SECTION 18: MODIFICATIONS

No amendment of any provision of this Agreement shall be effective unless set forth in a written document signed by authorized representatives of the Parties.

SECTION 19: RESERVATION OF RIGHTS

PacifiCorp may make a unilateral filing with FERC to modify this Agreement with respect to any terms and conditions, charges, classifications of service, rule or regulation under section 205 or any other applicable provision of the Federal Power Act and FERC's rules and regulations thereunder, provided that each Party shall have the right to protest any such filing by the other Party and to participate fully in any proceeding before FERC in which such modifications may be considered.

SECTION 20: EXECUTION

This Agreement may be executed in counterparts and upon execution by all Parties, each executed counterpart shall have the same force and effect as an original instrument.

IN WITNESS WHEREOF, the Parties hereto have caused this Agreement to be executed by their duly authorized officers as of the date first entered above.

PACIFICORP

By: _____

Title: UP Transmission

Witness:

_____

Deputy

BRIGHAM CITY CORPORATION

By: _____

Title: Mayor of Brigham City

Attest:

_____

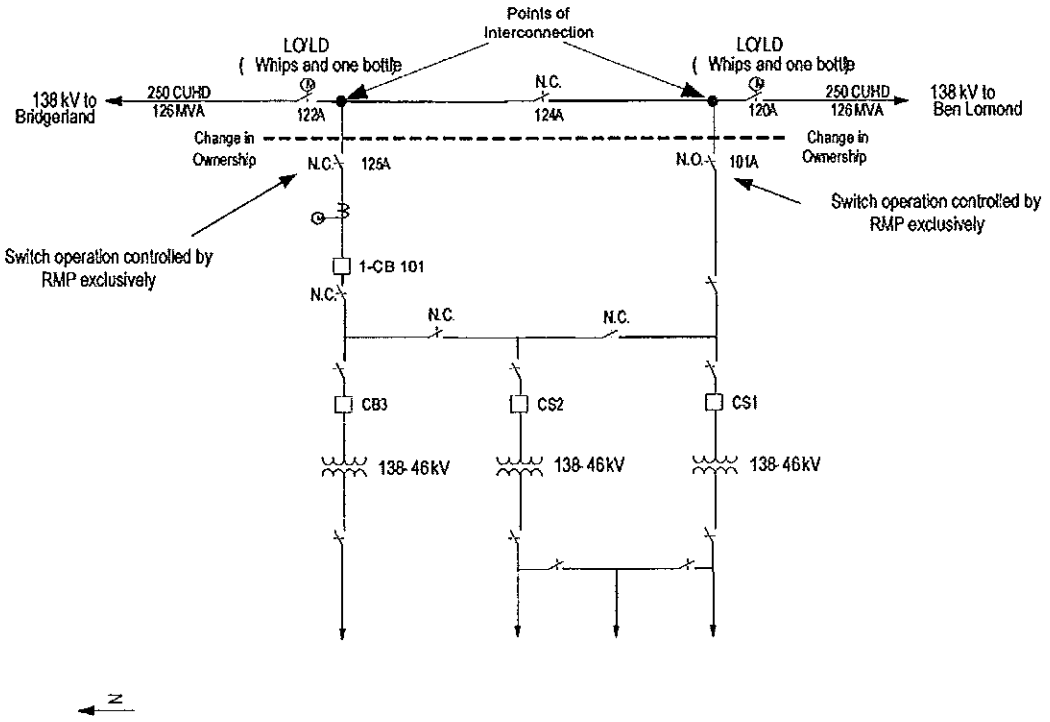
City Recorder

Appendix A: Point of Interconnection

Point of Interconnection	The points in the Interconnection Customer's East Substation where the facilities owned by PacifiCorp on the Bridgerland-Ben Lomond 138 kV transmission line connect to facilities owned by the Customer as shown on the one-line diagram	
In PACE Control Area	Yes	
Metered or Scheduled	Metered	
Voltage (kV)	138 kV	
Nearest PacifiCorp substation	Ben Lomond	
One-line diagram	Appendix B	

Appendix B: One-Line Diagram

Brigham City138-46 kV Substation
Configuration



Appendix C: Facility Connection Requirements for Transmission Systems

PACIFICORP
A MIDAMERICAN ENERGY HOLDINGS COMPANY

139

Facility Connection Requirements for Transmission Systems
(46 kV and Above)
Power Delivery Policy 139

Author:	Paul Della, Dennis Desmarais
Approval:	Greg Lyons
Authoring Department:	Standards Engineering
Approved File Location:	\\PdxShrn104\Shr04\Eng\Publications\WIR\POL
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PACIFICORP
A MIDAMERICAN ENERGY HOLDINGS COMPANY

POL 139

Facility Connection Requirements for Transmission Systems
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PACIFICORP
A MIDAMERICAN ENERGY HOLDINGS COMPANY

Facility Connection Requirements for Transmission Systems
(46 kV and Above) Power Delivery Policy 139

1 INTRODUCTION

This policy addresses the requirements for generation facilities, transmission facilities, and end-user facilities that are interconnected to PacifiCorp's transmission system. This policy, along with PacifiCorp's OATT, ensures that adverse impacts on reliability of the transmission system is avoided. In addition to ensuring reliability, this policy is consistent with safety requirements for PacifiCorp employees and the general public. This document is maintained by Technology Development and Standards group and is published on PacifiCorp's internal and external websites. PacifiCorp will make a copy of this document available to qualified entities with five business days of the request.

Although this policy addresses certain aspects of interconnection cost responsibility, its scope is primarily technical and does not include the commercial requirements for connecting generators or transmission facilities. Tariffs and rules filed with FERC and jurisdictional state regulatory agencies address the rates, terms, and conditions under which PacifiCorp provides these services. If there are any inconsistencies between this policy and the tariffs and rules, the tariffs and rules shall apply.

1.1 Introductory Definitions

PacifiCorp Transmission System: For the purposes of this policy document, the PacifiCorp transmission system is defined as electric transmission facilities owned by PacifiCorp typically 46kV and above.

Customer Load: A person, company, or corporation interconnected to PacifiCorp's transmission system owning or operating only power-consuming facilities.

Facility Interconnection Customer: A person, company, partnership or corporation interconnecting to PacifiCorp's transmission system owning or operating generation facilities, transmission facilities, and end user facilities.

Any connected entity owning or operating both power-consuming and power-generating facilities shall be considered a Facility Interconnection Customer for the purposes of this policy. The technical requirements for interconnection of generation sources are generally more comprehensive. Any load-only entity which is interconnected to a third-party electric system having generation capabilities shall also be considered a Facility Interconnection Customer for the purposes of this policy. Technical requirements for multi-interconnected systems (systems interconnected to the PacifiCorp power system in addition to a third-party system) will be determined by PacifiCorp on a case-by-case basis.

1.2 Applicability

This standard applies to generation, transmission, and end user facilities that are physically connected to, or desire to physically connect to, PacifiCorp's transmission system. Applicability is further defined by the categories below:

1.2.1 Generation Facilities

All requirements described or referred to in this policy apply to new and decommissioned generation facilities. New generation facilities are facilities that have not been and are not yet connected with the PacifiCorp transmission system. Decommissioned generation facilities are facilities that were actively connected to PacifiCorp's electrical system in the past but presently are not

connected nor actively producing power. Additional technical requirements may apply to special business arrangements or electrical configurations of PacifiCorp's transmission system or the interconnection point(s). Any such technical specifications would be documented within the interconnection agreement and the operation and maintenance agreement. All decommissioned generators must comply with all requirements contained in this policy document. It may be necessary for the decommissioned generator to upgrade existing equipment to adhere to this policy.

1.2.2 Transmission Facilities

Any proposed transmission facility interconnecting into PacifiCorp's transmission system shall be coordinated and reviewed through the Pacificorp's transmission planning process. The transmission facility addition shall maintain or improve the level of system reliability that existed prior to the interconnection. Power flows as a result of the transmission interconnection shall not overload or adversely affect the PacifiCorp transmission system or the WECC regional transmission system.

1.2.3 End-user Facilities

Any proposed load customer interconnecting into PacifiCorp's high voltage transmission system shall be coordinated and reviewed through the New Large Load Process.

1.2.4 Existing Facilities

To the extent this handbook contains more stringent requirements than were in place at the time that existing facilities were initially connected, the existing entity shall be responsible for adhering to current requirements only to the extent that the safety and reliability of the power system or the safety of utility employees would be jeopardized by not adhering to the current requirements and standards. The cost for any upgrading shall be borne by either the Facility Interconnection Customer or by PacifiCorp pursuant to applicable electric rules and/or the terms of any executed agreements between the Facility Customer and PacifiCorp.

1.3 Policy for Interconnection of Transmission Facilities

PacifiCorp has established this policy for operating, metering, and equipment protection requirements for the interconnection of new generation, transmission, and end user facilities. This policy covers the requirements for all facilities wishing to interconnect to the PacifiCorp transmission system. Additional project specific requirements may apply. These additional requirements may vary according to the specifications of the interconnection as well as local configuration of the PacifiCorp transmission system.

The technical studies will determine whether PacifiCorp will be required to modify its transmission system to interconnect the requested facilities. Parties requesting interconnection are responsible for the cost of these technical studies. Please contact the PacifiCorp Transmission Account Manager for details about the study process and additional data requirements which may apply.

1.4 Security Access to Facilities

PacifiCorp personnel will honor all reasonable requests from the facility owner when accessing PacifiCorp equipment located within a facility owner's premises. The facility owner will grant PacifiCorp 24-hour access to PacifiCorp-owned equipment on the facility owner's premises. If this access is not allowed for the reasonable day-to-day operation of PacifiCorp's power system affecting PacifiCorp's customers, including

emergency incidents or other power delivery-related activities, PacifiCorp reserves the right to exercise the disconnection provision of the facility interconnection agreement.

1.5 Facility Connection Customer Equipment Requirements

Interconnected parties are responsible for designing, installing, operating, and maintaining interconnection equipment that they own (i.e., generators, transformers, switches, relays, breakers, etc). All protective devices necessary to protect the interconnected facilities are the responsibility of the Customer.

PacifiCorp's requirements specified in this policy are designed to protect PacifiCorp facilities and maintain grid reliability pursuant to applicable reliability criteria; **they are not designed to protect the facilities of interconnected customers.**

Interconnected Customers must satisfy the requirements in 1) this policy, 2) applicable rules and tariffs of jurisdictional state regulatory agencies and FERC, 3) applicable policies of the Western Electricity Coordinating Council (WECC), the North American Electric Reliability Council (NERC), or their successor organizations, and 4) PacifiCorp's project-specific requirements. PacifiCorp's review and written acceptance of the interconnected entity's equipment specifications and plans shall not be construed as confirming or endorsing the interconnected entity's design, as warranting the equipment's safety and durability, or in any way relieving the interconnecting entity from its responsibility to meet the above requirements. PacifiCorp shall not, by reason of such review or lack of review, be responsible for strength, details of design, adequacy, or capacity of equipment built to such specifications, nor shall PacifiCorp's acceptance be deemed an endorsement of such equipment.

Readers should be aware that the information in this policy document is subject to change. The latest version of this document is available at http://www.oasis.pacificorp.com/oasis/ppw/main.htmlx

PacifiCorp will not agree to interconnect new facilities unless all technical and contractual requirements are met. Copies of this policy will be supplied upon request. Contact the PacifiCorp Transmission Account Manager for referrals to the PacifiCorp employee who can respond to questions concerning PacifiCorp's policy for facility interconnection coordination procedures or additional copies of this document:

Director, Transmission Services
PacifiCorp
825 N.E. Multnomah Blvd. Suite 1600
Portland, Oregon 97232
(503) 813-6079

The document can also be obtained by emailing transmission.services@pacificorp.com.

2 OWNERSHIP POLICY AND OPERATION OF INTERCONNECTION EQUIPMENT

PacifiCorp shall own all interconnection facilities and system upgrades necessary to assure reliable service to PacifiCorp customers. This may include, but is not limited to: relaying, control systems, breakers, switches, bus work, and transmission lines. In all cases, revenue metering and communications circuits for the purpose of breaker status and transfer trip will be owned and maintained by PacifiCorp. PacifiCorp may, at its option, contract with the Facility Interconnection Customer, or a third party, for construction of any or all of these facilities.

2.1 Applicant Construction of PacifiCorp Facilities

When it is mutually agreed by PacifiCorp and the faciity interconnection customer, the customer shall design and build PacifiCorp facilities using a PacifiCorp approved engineering firm. The customer shall provide PacifiCorp with design drawings prior to the start of construction and shall continue to provide PacifiCorp with the latest revisions sent to the contractor for construction. Within 30 days of the completion of construction, the interconnect customer shall provide PacifiCorp with a complete set of design drawings revised to reflect as-built conditions. In addition, the interconnect customer shall be responsible for obtaining SAP numbers and equipment memorandum forms from PacifiCorp and for completing the equipment memorandums for all major equipment identified by PacifiCorp as requiring setup in SAP to provide the means for scheduling future maintenance. The interconnect customer shall provide PacifiCorp with the completed equipment memorandums upon the installation of the major equipment for which they are required.

3 INTERCONNECTION PROCESS, STUDIES, AND REQUIREMENTS

3.1 Facility Interconnection Process Summary

FERC provides procedures which govern generation facility interconnections where a generator chooses to sell power to the bulk power market or a transmission customer/end user chooses to take unbundled or wholesale electric service from a FERC jurisdictional transmission line. A FERC jurisdictional line is defined as a line or interconnection classified as FERC transmission by the host utility or by using the FERC Seven Factor Test. Generators, transmission line, and end users must follow all FERC procedures when using or interconnecting with FERC jurisdictional transmission.

1. The FERC processes and procedures have been incorporated into PacifiCorp's OATT which may be accessed at: http://www.oasis.pacificorp.com/

   If the generator, transmission line, or end user are not FERC jurisdictional, PacifiCorp applies applicable state processes, if they exist, and voluntarily applies the same processes and procedures for consistency and ease of processing when state rules do not exist.

2. Generators, transmission line, and end users must follow all FERC interconnection procedures and processes when they are FERC jurisdictional. The following FERC orders govern the interconnection processes and procedures:

   Generators with nameplate ratings greater than 20 MW are governed by the FERC Large Generator Interconnection Procedures and Agreements (LGIP/LGIA) process. These are incorporated into Section IV *Large Generator Interconnection Service* of PacifiCorp's OATT.

Generators rated from 10 kW to 20,000 kW (20 MW) are governed by FERC Small Generator Interconnection Procedures and Agreements (SGIP/SGIA) process. These are incorporated into Section V *Small Generator Interconnection Service* of PacifiCorp's OATT.

Line/End Users who choose to take unbundled or wholesale electric service are governed by PacifiCorp's (OATT).

3. Generators not governed by FERC procedures and agreements shall be governed by PacifiCorp procedures and agreements. Line/end users not governed by the PacifiCorp OATT shall be governed the corresponding PacifiCorp state tariffs (bundled electric service) and procedures.
4. All interconnecting customers will be required to meet all applicable standards, which include, but are not limited to NERC Reliability Standards, WECC Reliability Standards, FERC Generator Interconnection Procedures, FERC Generator Interconnection Agreements, Pacific Northwest Security Council requirements, Northwest Power Pool Requirements, and PacifiCorp planning criteria and facility connection requirements

3.2 Coordinated Joint Studies

3.2.1 Procedures for Coordinated Joint Studies

Unless there are conflicts with FERC or state standards (such as Critical Energy Infrastructure Information (CEII) and/or standards or code of conduct issues) PacifiCorp will form ad hoc groups, distribute results, and facilitate any required meetings between Facility Interconnection Customer, PacifiCorp, potentially affected electric systems, and any governing authorities in accordance with the FERC Large Generation Interconnection Procedures/Agreements (LGIP/LGIA) or other applicable procedures. This includes requesting potentially affected parties to participate in joint studies and following accepted WECC regional planning practices. If a potential CEII conflict arises such as an unknown consultant requesting critical system data, PacifiCorp would require FERC approval and a confidentiality agreement. If, in the opinion of PacifiCorp, a potential standard or code of conduct issue arises which may involve parties that 1) are not FERC jurisdictional public utilities, or 2) decline to sign a confidentiality agreement, PacifiCorp will provide system criteria violations (thermal, voltage, or stability) specific to affected system only.

Results of coordinated joint studies shall be documented along with any conclusions and recommendations. Such documentation shall be retained by PacifiCorp shall be made available if requested by WECC or NERC, or any other entities responsible for the reliability of the interconnected transmission system as soon as feasible.

3.2.2 Procedures for Notification of New or Modified Facilities

PacifiCorp shall disseminate notification of new or modified facilities to the WECC, and NERC in accordance with notification procedures that such entities have established.

Facility Interconnection Customers that are seeking to integrate new facilities with PacifiCorp should contact:

Director, Transmission Services
PacifiCorp
825 N.E. Multnomah Blvd. Suite 1600
Portland, Oregon 97232
(503) 813-6079
transmission.services@pacificorp.com

3.2.3 Additional Requirements

1. All transmission facilities, whether owned by PacifiCorp or the Facility Interconnection Customer must be in complaince with all NERC reliability requirements. NERC reliability standards may be accessed on the internet at:

   http://www.nerc.com/~filez/standards/Reliability_Standards.html

   Some specific NERC standards which may apply are:

   - BAL Resource and Demand Balancing
   - CIP Critical Infrastructure Protection
   - COM Communications
   - EOP Emergency Preparedness and Operations
   - FAC Facilities Design, Connections and Maintenance
   - INT Interchange Scheduling and Coordination
   - IRO Interconnection Reliability Operations and Coordination
   - MOD Modeling, Data, and Analysis
   - ORG Organization Certification
   - PER Personnel Performance, Training, and Qualifications
   - PRC Protection and Control
   - TOP Transmission Operations
   - TPL Transmission Planning
   - VAR Voltage and Reactive

2. If the Facility Interconnection Customer interconnection is to a point on the transmission system that is 100 kV and greater, the Facility Interconnection Customer must then comply with the NERC reliability standards.

3. PacifiCorp may revise the technical requirements periodically to comply with new requirements from FERC, NERC, state, other governmental authorities. PacifiCorp may require that all generator, transmission line, and end user interconnections comply with new regulations by implementing similar procedures and/or upgrades as would be expected on PacifiCorp facilities in a non-discriminatory manner. If the Facility Interconnection Customer does not comply, PacifiCorp may upgrade the Facility Interconnection Customer's facilities as necessary to be compliant. Any such upgrades shall be executed at the customer's expense. Alternately, PacifiCorp may disconnect the Facility Interconnection Customer after proper notification according to OATT requirements and procedures.

4. The PacifiCorp "bulk power network" is defined in this document as all 100 kV and greater lines which serve more than local load. This may include participation in the transport of long-distance power transfers according to the FERC Seven Factor Test.
5. The term "Facility Interconnection Customer" refers to the new generation, transmission, and end user facilities requesting authorization to interconnect with the PacifiCorp electric system where FERC has jurisdiction.
6. Generators interconnecting to the PacifiCorp electric system are governed by the most current version of the PacifiCorp OATT.
7. This document complies with NERC requirements to document, maintain, and publish facility connection requirements for NERC/FERC jurisdictional generation facilities (rated at 10 – 20,000 kW), and transmission/end user facilities to ensure compliance with:
   - NERC Reliability Standards
   - FERC Small Generator Interconnection Procedures and Agreements
   - Applicable Regional Reliability Organization Requirements
   - Sub-regional, Power Pool Requirements
   - PacifiCorp Requirements
8. These technical requirements specify the minimum technical requirements intended to ensure a safe, effective, and reliable interconnection. These requirements are intended to supplement, but not replace, information contained in regulatory codes, PacifiCorp's OATT, PacifiCorp electric service tariffs, and specific interconnection agreements. The requirements outlined in this document may not cover all details in specific cases.
9. Additional information regarding parallel operation of generation with the PacifiCorp system can be obtained by contacting the Transmission Account Manager.

3.3 General Requirements

1. The Facility Interconnection Customer shall identify the voltage level and capacity or demand at the point of interconnection in MW and MVAr.
2. The Facility Interconnection Customer shall interconnect to the PacifiCorp electric system at the nominal voltage at the agreed-to point of interconnection. PacifiCorp, at its sole discretion, may elect to upgrade or change the voltage level of the PacifiCorp electric system serving the Facility Interconnection Customer. Any costs to upgrade or change the Facility Interconnection Customer's equipment to maintain an interconnection with PacifiCorp shall be the responsibility of the Interconnection Customer. All direct assigned facilities required to interconnect to 46 kV systems will be designed and built to 138 kV standards in anticipation of future conversion of all 46 kV systems to 138 kV.
3. The customer shall obtain PacifiCorp's acceptance of those portions of design documents that apply to protection and security of the PacifiCorp electric system according to OATT requirements and procedures. The customer is solely responsible for the design that affects the facility. Protection of the Facility Interconnection Customer's overall electrical system,

including generation and connected load, is the sole responsibility of the Facility Interconnection Customer.

4. The customer will follow all FERC, NERC, and Regional Reliability Organization (RRO) requirements for review and approval of the facility interconnection and any required system changes or upgrades. This may include the development of such studies and data as a WECC subcommittee shall reasonably request.
5. PacifiCorp and/or its consultant shall conduct all electric system studies and issue reports required by FERC, NERC, RRO, PacifiCorp, and any other regulatory body for authorization and justification of the proposed interconnection to the PacifiCorp electric system. The customer shall reimburse PacifiCorp for all costs incurred for these studies and reports according to OATT requirements and procedures.
6. The customer shall comply with PacifiCorp, WECC, and industry design, construction, operating standards, and procedures.
7. The Facility Interconnection Customer's installation shall meet all applicable national, state, and local construction and safety codes.
8. The interconnection design shall be capable of accommodating PacifiCorp electric system reclosing practices.
9. The interconnection design shall incorporate equipment to detect system abnormalities or disturbances in either the Facility Interconnection Customer's system or the PacifiCorp system. This equipment shall have the capability to isolate the sources of the disturbance.
10. The interconnection design shall be such that failure of the generator, transformer, and other auxiliary equipment shall result in the automatic isolation of the affected equipment.
11. The customer shall design the facility to meet all current WECC reliability standards including the WECC System Performance Table as accessed on the WECC website or upon request from PacifiCorp.
12. The customer shall design the facility to meet technical requirements and facility rating standards as shown on the PacifiCorp website.
13. The customer shall not cause the PacifiCorp electric system to violate NERC voltage criteria or voltage ranges defined in ANSI Standard C84.1, Range A (plus or minus 5 percent of nominal).
14. The customer shall interconnect to the PacifiCorp electric system at the nominal voltage at the agreed to point of interconnection. PacifiCorp, at its sole discretion, may elect to upgrade or change the voltage level of the PacifiCorp electric system serving the Facility Interconnection Customer. Costs for upgrading the Customer's facility are the responsibility of the Customer.
15. The customer shall control the electrical real (MW) and reactive (MVAr) power output such that it will not exceed the capacity of the interconnection facilities.
16. The Facility Interconnection Customer 's three-phase generation shall be connected to the PacifiCorp power system with three-phase automatic disconnecting devices (circuit breakers), which are intended to significantly

reduce the possibility of damaging the Facility Interconnection Customer 's generation equipment due to single-phase operation. These disconnecting devices shall be equipped with auxiliary contacts that indicate the actual status of the devices' main contacts.

17. A isolating device, typically a switch, must be installed to physically and visibly isolate the customer and PacifiCorp systems. The disconnect will serve as the point of change of ownership between the customer and PacifiCorp and will be labeled as such both on drawings and on-site signage. The disconnect shall be installed by the customer and shall be accessible to both PacifiCorp and the customer at all times with the ability to be padlocked open by either party. The disconnect shall be owned and operated by PacifiCorp to provide a visible air gap with clearances for adequate grounding, maintenance, and repairs of the PacifiCorp electric system. PacifiCorp may require the capability to apply safety grounds on the PacifiCorp side of the disconnect. The customer shall not remove any PacifiCorp padlocks or safety tags as per the Occupational Safety and Health Administration (OSHA) lockout/tagout requirements. In any case the device:

    - Must simultaneously open all phases (gang operated) to the interconnected facilities;
    - Must be accessible by PacifiCorp and must be under PacifiCorp Dispatcher jurisdiction;
    - Must be lockable in the open position by PacifiCorp;
    - 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.

    PacifiCorp 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 PacifiCorp equipment presents a hazardous condition;
    - If the interconnected facilities jeopardize the operation of the PacifiCorp Electric System.

18. System flows as a result of the interconnection shall not overload nor adversely impact PacifiCorp's transmission system, nor neighboring transmission system. Where the Facility Interconnection Customer 's generation or transmission facilities supply fault currents to the PacifiCorp electric system in excess of breaker or other interrupting device maximum-rated interrupting capability, the customer shall be required to install and pay for fault-limiting equipment or pay for breaker or other interrupting-device replacements according to OATT requirements and procedures.

19. The harmonic content of the voltage and current wave forms of both the Facility Interconnection Customer 's and PacifiCorp's systems shall comply

with the latest version of the IEEE Standard 519, Recommended Practices and Requirements for Harmonic Control in Electric Power Systems.

20. Industry standard basic insulation level ratings shall be used for electric system additions and electric system interface equipment. The electric equipment shall meet IEEE C62.41 or C37.90.1, V&I Withstand Requirements.

21. The customer shall be capable of withstanding electromagnetic interference environments in accordance with ANSI/IEEE Standard C37.90.2. The interconnection system and protection system shall not mis-operate due to electromagnetic interference, including hand-held communication devices.

22. PacifiCorp may install disturbance-recording equipment at the system interface according to NERC, OATT, or regional requirements and procedures.

23. The interconnection design shall incorporate adequate facilities to enable the on-site generation to be synchronized with the PacifiCorp electric system. The customer shall be solely responsible for synchronizing the generator to the system. At PacifiCorp's discretion, all occurrences of synchronizing the generator to the system shall be preceded with advance notification of not less than one full clock hour to be provided to PacifiCorp's Portland or Salt Lake City dispatch centers.

24. All points at which the generator can be paralleled with the PacifiCorp electric distribution system must be clearly defined as synchronization points in the submittal documentation. A given installation may be designed such that there are several synchronization points.

25. For insulation and insulation coordination on transmission facilities 34.5 kV and above, PacifiCorp's Engineering Handbook, Section 1.B.7 shall govern facility design.

26. Determination of Equipment Rating: All series elements that together make up a line section or bulk power substation transformer circuit are reviewed to determine which facility has the most limiting rating. In the event that a line section or bulk power transformer terminates on a ring bus or a breaker-and-a-half, the facility rating will be determined assuming a closed ring bus or closed breaker-and-a-half. The most limiting facility rating of the entire ring bus or the most limiting facility rating of the breaker positions adjacent to the line section or bulk power transformer in a breaker-and-a-half scheme are considered in determining the rating of the line section or bulk power transformer. In order to account for the flow split when entering a closed-ring or a closed breaker-and-a-half, a multiplier is used to adjust the ratings of the ring bus or breaker-and-a-half facilities. The multiplier assumes a conservative split of 75/25 percent, meaning that 75 percent of the line section flow or bulk transformer flow is assumed to be transferred onto one leg of the ring bus or breaker-and-a-half. This means that an equivalent line section or bulk power transformer flow of 133 percent (100/75 percent) can be accommodated before exceeding the facility rating of the ring-bus limit or breaker-and-a-half limit. The most limiting series element facility rating, and where applicable, 133 percent of the most limiting ring-bus facility rating, or 133 percent of the most limiting facility rating of the adjacent breaker positions in a breaker-and-a-half is then used in the WECC model data submittal and in operations of PacifiCorp's system. In cases where a facility is

jointly owned, the operator of the facility determines the facility rating and shares this rating information with the other joint owners. In cases where a facility is owned in segments (such as a transmission line terminal being owned by one party and the transmission line itself owned by another party), PacifiCorp coordinates with the owners of the other segments of the facility to insure that the most limiting rating is used by all parties.

27. For further information on general technical requirements for facility interconnections, see the appendices at the end of this document.

4 METERING POLICY FOR FACILITY INTERCONNECTION CUSTOMERS

4.1 General

The purpose of this section is to assist the customer in accommodating PacifiCorp metering for the measurement of electricity supplied to the PacifiCorp transmission system. This section is applicable only to those providing power to the PacifiCorp transmission system. The general requirements are similar to, if not identical to, the general requirements for metering the supply of electrical service by PacifiCorp.

Usually, when a generator is installed with the intent of providing power to the PacifiCorp transmission system, electric service to the auxiliary load associated with the generator plant is also needed. As such, power may flow into or out of the plant at different times. Deliveries to and from the plant (bi-directional metering) must be separately recorded and treated as separate transactions under PacifiCorp's tariffs.

All meters and instrument transformers will be provided, installed, owned, and maintained by PacifiCorp at the Facility Interconnection Customer's expense. Unless other arrangements have been made, the customer will provide, install, own, and maintain all mounting structures, conduits, meter sockets, meter socket enclosures, metering transformer cabinets, and switchboard service sections of the size and type approved by PacifiCorp.

PacifiCorp will require Generation Interconnection Customer's with multiple generators to install revenue net metering at each generator, to satisfy that hourly revenue data will be available at all times to validate the official metering at the point of interconnection. This is to eliminate estimating data during periods when the official meteing is questioned or lost. Any net generation metering used for any PacifiCorp revenue purpose or data validation will be tested and maintained identically to the official interconnect revenue metering.

For larger wind farms with multiple collector stations, metering will be required on the high side of each step up transformer, as well as at the point of interconnection. The general requirements for the collector metering are the same as the requirements for revenue metering at the point of interconnection.

Metering will be programmed such that the generators are only charged for consuming VArs when the project is drawing MWs; i.e., not generating.

4.2 Basic Metering Requirements for Generators

4.2.1 Metering Requirements

The standard PacifiCorp meter used for all generation and transmission interchange projects is the Landis & Gyr, Maxsys 2510 meter. The meter will be programmed with a standardized PacifiCorp internal program that will include

bidirectional kWh and kVArh energy and kW and kVAr sliding 15-minute demand quantities, with instantaneous MW MVAr data. The meters will be programmed to record 15-minute interval profile demand that includes bidirectional kWh and kVArh and per-phase volt-hour demand interval recording. Additional quantities can be added if necessary to the basic program.

Metering data collected will include working meter register reads, monthly register freeze reads, and 15-minute demand interval profile data. The meter will perform a self-freeze read at midnight each month. The meters shall be compatible with the PacifiCorp MV-90™ system and shall be interrogated daily or whenever necessary for maintenance purposes.

All meters will include both analog and digital output boards following current standard PacifiCorp specifications. The metering design will include a test switch with all data inputs and outputs terminated at a utility interposition block.

The final metering design requirements including hardware I/O and software specifications will be written into the specific project's scoping documentation. Requests from foreign utilities for digital or analog metering outputs must be made prior to final design. A second or backup meter will be added when needed or if there are additional metering outputs required beyond what is possible from the primary meter.

4.2.2 Meter Testing

PacifiCorp and the generation customer agree that a certification of the meter system accuracy be done at least biannually or as specifically agreed upon in the interchange agreement. PacifiCorp shall give all interested parties notification of at least two weeks for the impending test. A copy of the test results shall be available to all parties involved or on file for review.

4.3 Metering Installations ≥ 5 MW

PacifiCorp standard metering installation for 5 MW and above net generation facilities is required to be wye-connected on the high-voltage side of the step-up transformer. Primary and backup metering which will meter the net generation is required. Revenue metering must be installed at the physical point of interconnection with the PacifiCorp transmission system. If it is not possible to install metering at the physical point of interconnect, PacifiCorp will require that line losses be calculated. The calculated loss algorithm may be additive or subtractive depending upon current flow through the meter. The calculated loss algorithm will be programmed within the meter(s) firmware to adjust the registers, load profile, and any digital or analog outputs. PacifiCorp requires that any applicable line-loss compensation be performed in the meter, rather than calculated in the billing system.

4.3.1 Conduit for Revenue Metering Secondary Leads

For secondary metering leads between the connections at the meters and the instrument transformers located in the substation yard, the generation customer is to provide a minimum size of three-inch conduit. When the distance between the revenue instrument transformers and meter panel is greater than 250 feet, it may be necessary to increase the conduit size to accommodate paralleled CT metering secondaries to reduce the burden to the current transformers. PacifiCorp shall procure all conductors and the generation customer shall install meter-wiring cable from the transformers to the revenue metering panel located in the substation. The conduit shall be PVC, rigid steel, or IMC and must be

installed with long-radius sweeps. The customer contractor is responsible for proper installation practices.

4.3.2 Indoor Panel Applications

When indoor panels are required to mount meters and metering hardware, PacifiCorp will specify, order, and install all revenue panels and accessories. The meter panels will be 12" wide by 90" high and shall require a clear work space 36" wide by 90" high by 48" deep in front and to the rear of the panel.

4.3.3 Outdoor Meter Enclosure Applications

When it is necessary to mount meters and metering hardware in outdoor locations, PacifiCorp will specify and order the metering box enclosure. The enclosure will be mounted and installed by the customer's contractor. When outside meter enclosures are used they typically serve both as the junction box and meter socket enclosure. The meter enclosure box will be NEMA 3R-rated, and shall have sealing provisions.

4.3.4 Sealable Junction Box

The junction box provides a means of terminating the revenue metering service conductors within the substation yard for indoor panel applications. The use of this junction box shall be coordinated with PacifiCorp prior to installation. The junction box will be NEMA 3R-rated, and shall have sealing provisions.

4.3.5 Secondary Leads and Termination

The secondary circuits must be designed such that the maximum possible burden on any transformer will not exceed its rating. All metering secondary leads or cable will be provided by PacifiCorp. The secondary leads will conform to PacifiCorp standards and color-code requirements. Wire terminations may be done by manufacturer or contractor, but all will be inspected and approved by PacifiCorp.

4.3.6 Metering Bypass Switch

When applicable, the requirements for metering bypass switches will be provided by PacifiCorp to the customer. The generation customer shall purchase, install, and own switches which will isolate and bypass the metering transformers when necessary to allow for maintenance.

4.3.7 Primary Metering Structures

The high-side primary metering structure must be designed to accommodate the standard PacifiCorp wye-connected instrument transformers. The physical location will be determined during the design phase of the project. When requested by the customer, PacifiCorp will supply outside parties with design details of the standard metering system.

4.3.7.1 Metering Disconnects

High-side metering shall have a minimum of two gang-operated, lockable disconnect devices to facilitate establishing a visual open(s). Disconnect devices are necessary at the following locations:

1. At the point of interconnection with PacifiCorp (this switch is PacifiCorp-operated).

2. Between the generator side of PacifiCorp's metering and the Facility Interconnection Customer Facility Interconnection Customer's electrical facility (this switch is owned and operated by the Facility Interconnection Customer Facility Interconnection Customer).
3. If the generator is selling power to PacifiCorp on a surplus-sale basis, a separate disconnect device (generator or host-site owned and operated) is required on the metering side of the load. Refer to Figure 1 for typical interconnections. Distribution pole-top metering requires only one switch located on the load side of the metering.

4.4 Metering Installations < 5 MW

For 46 kV and above and the total net generation output is less than 5 MW, it is acceptable for the revenue metering to be located on the low side of the step-up transformer. All low side metering must be wye-connected and installed on the unregulated side of the voltage regulator. For this application the metering installation is normally inside the customer facility and PacifiCorp-approved metering enclosures are required. Instrument transformers shall be located inside an approved PacifiCorp metering enclosure. It is not acceptable for meters, metering transformers, and accessories to be located on outside structures.

4.4.1 Metering Enclosures > 600 volts for Underground and Overhead Applications

To meter medium-voltage interchange services, customers shall meet the requirements of the Electric Utility Service Equipment Requirements Code, EUSERC Section 400. The customer shall provide all necessary hardware per EUSERC Section 400. A clear work space 78" high by 36" wide by 48" deep in front of distribution metering equipment (per current NEC regulations) is required. A concrete mounting pad is required for the switchgear metering enclosure. The mounting pad shall be a minimum of 4" thick. The metering instrument transformers will be specified by PacifiCorp and shall be provided and installed by the manufacturer of the switchgear. The meter, test switch, and any specialized hardware will be specified, ordered, and installed by PacifiCorp.

4.4.2 Overhead Pole-Mounted Metering

Pole-mounted metering would be unusual inside a generation substation facility. To establish a mutually suitable location for pole-mounted metering, the customer shall consult with PacifiCorp before construction begins.

4.4.3 Metering < 600 volts

The service and metering installation requirements for all installations shall conform to the applicable standards of PacifiCorp's *Six State Electric Service Requirements*. Generation metering requirements for secondary below 600 volts, self-contained and instrument-rated metering are the same as commercial installations.

4.5 Metering for Station-Service Power

Depending upon the generation facility's electrical sources, the station service power for connecting substation facilities may also require revenue metering. The same metering requirements as generation meters apply to station-service metering.

4.6 Meter Communication Requirements

All generation metering will require a dedicated voice grade data phone line for use with the PacifiCorp MV-90 meter data collection system. It will be the responsibility of the

generation customer to supply both the land line and any communication protection devices necessary for PacifiCorp to remotely interrogate the meter through a dial-up connection.

The following sections describe the detailed requirements for metering electricity supplied by generators connected to the PacifiCorp system:

Surplus-Sale Operation Co-Generation: Meters shall be required to measure both the net generator output and the surplus generation delivered to the PacifiCorp system.

Net-Sale Operation: Meters shall be required at the point of interconnection.

No-Sale Operation: Revenue metering will not be required for the measurement of power delivered into the PacifiCorp system, except that load profile and net generator profile metering may be required for standby service. The existing service metering shall be replaced with metering equipped with multiple register to separately measure all required quantities.

Wheeling Service: Wheeling service under certain existing agreements on the PacifiCorp system require two sets of revenue-metering equipment which may be totalized to accommodate various line and switch configurations. Import metering is required to the point of import (received) to (on) the PacifiCorp system. Export metering is required at the point of export (delivery) from (off) the PacifiCorp system.

Where non-utility generators (i.e., emergency generators, peak-shaving generators, etc.) or portable plug-ins (generators not permanently wired to the outlet) are connected via an electrical outlet or automatically connected via an automatic transfer switch, a visible disconnect shall be required. A visible disconnect can be a disconnect knife switch or a combination of a manual disconnect circuit breaker, built-in switch, and red light indicators. The disconnect shall be visible at all times, and shall have one red light bulb per conductor indicating energized/de-energized conditions of the utility and generator source conductors on the line side of the main disconnect or circuit breaker.

All generators must meet applicable standards of the Western Electric Coordinating Council (WECC).

4.7 Instrument Transformers ≥ 5 MW

Voltage and current instrument transformers are required to be a wye-connected, wire-wound, extended-range type with 0.15 percent metering accuracy class. The instrument transformers will maintain their accuracy ranging from 1 amp to 4,000 amps Type-1 class and from 0.25 amps to 750 amps Type-3 primary current. The accuracy class addresses both ratio error and phase-angle error over the burden range of the installed metering circuit. Instrument transformers shall be stand alone, located on the line at the delivery point such that the metering is not interrupted during possible switching configurations at the delivery point unless the metering is being removed for service. Paralleling CTs and internal CTs located inside breakers and power transformers for the purpose of revenue metering will not be permitted.

4.8 Instrument Transformers < 5 MW

For low-side metering exceptions, it is not required for the metering transformer's accuracy to be extended-range. Voltage and current instrument transformers are required to be 0.3 percent standard metering accuracy class for both ratio error and phas- angle error over the burden range of the installed metering circuit. Instrument transformers shall be an approved PacifiCorp design and shall be located within the metering switchboard or switchgear enclosures.

4.9 Instrument Transformer Verification

At least once during the life of the transformer, 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 percent 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.

4.10 Telemetering Requirements for Generator Monitoring

4.10.1 For New Generation Facilities ≥ 3 MW

For generating facilities totaling 3 MW or greater, the following real-time data is to be telemetered to PacifiCorp's Control Center for each generating unit (both wind and non-wind units):

- kW
- kVAr
- kWh
- generator terminal voltage (kV)

A generator equipped with a voltage regulator and power system stabilizer (PSS) must also provide telemetry indicating the status of both the regulator and the PSS. In addition, transmission kW, kVAr, kV, and breaker status may be required, depending on the number of generators and transmission configurations. A telemetering circuit to the designated PacifiCorp Control Center is also required. A minimum number of alarms to be transmitted include the following:

- breaker trip
- transfer trip receive
- channel/equipment failure

Unless other arrangements are made, the customer must provide communication lines with the following minimum specifications: VG36, Class B, Type-3, 4-wire, full-duplex (1200 baud).

Telemetering equipment (usually a dual-ported RTU) shall be located in the metering enclosure. At the entity's expense, PacifiCorp will supply telemetering equipment at the Facility Interconnection Customer Facility Interconnection Customer 's site, at PacifiCorp's Control Center and at a designated PacifiCorp Alternate Control Center.

5 TELECOMMUNICATION REQUIREMENTS FOR FACILITY INTERCONNECTION

5.1 Application

Before a new facility is interconnected to the PacifiCorp power system, PacifiCorp will specify the metering, protection, supervisory control and data acquisition (SCADA), telemetering, and telecommunications channels required. Due to the highly specialized and critical nature of the protection, metering, SCADA, and telemetering equipment, PacifiCorp requires that all such equipment be owned, installed, and maintained by PacifiCorp at the generation facility's expense. Also, due to the critical protection requirements for the interconnection of the generation facility to PacifiCorp's system as well as the varied PacifiCorp internal telecommunications systems which may be available for the specific generation facility, the telecommunication channels described below must be defined on a case-by-case basis.

5.2 General Requirements

The interconnection facility customer will be responsible for acquiring the communication lines from the local telephone company or multiple telephone companies as required to meet the telecommunications required of the new generation facility with the exception that if tele-protected (requires communications channel) relay channels are required, PacifiCorp will provide them at the cost of the generation facility. Due to the critical nature of the protection, metering, SCADA, and telemetering requirements, PacifiCorp will define the technical requirements and may provide, at its option, all or portions of the telecommunication channels on its existing internal telecommunication network at the cost of the generation facility.

5.3 Telecommunication Circuit Requirements

5.3.1 New Generation Facilities < 3 MW with No Teleprotection Requirement

5.3.1.1 Remote Metering Business Telephone Line

A business telephone line at the location of the interconnect point metering equipment is required for remote revenue-metering reading and maintenance work.

5.3.2 New Generation Facilities ≥ 3 MW or New Generation Facilities < 3 MW with Teleprotection Requirement

5.3.2.1 Remote Metering Business Telephone Line

A business telephone line is required at the location of the interconnect point metering equipment for remote revenue-metering reading. The generation entity must provide land-line telephone access, if possible. If local telco facilities are not available, other options for providing dial-up access to the meter will be considered.

5.3.2.2 Dispatch Business Telephone Line

A business telephone line is required so operating instructions from PacifiCorp can be given to the designated operator of the generation facility equipment. Unless other arrangements are made to use PacifiCorp's existing telecommunications network, the generation entity must provide a local telephone.

5.3.2.3 Protective Relay Remote Access Business Telephone Line

A business telephone line is required at the location of the protective relay equipment for remote maintenance of the protective relay equipment. Unless other arrangements are made to use PacifiCorp's existing telecommunications network, the generation entity must provide a local telephone.

5.3.2.4 Protective Relays

PacifiCorp will determine if non-pilot protective relays will be adequate for emergency tripping of the generation facility and/or protection of the distribution or transmission system or if tele-protected-type protection equipment is required. PacifiCorp will design and provide telecommunications channels suitable for the protective relay package required at the cost of the generation facility. Local telephone company leased lines are not acceptable for protective relay channels. Telecommunication channels for protective relay equipment may consist of fiber optic system, power line carrier, microwave radio, or a combination of these systems.

5.3.2.5 SCADA Remote Terminal Unit (RTU)

Real-time data and/or control via a SCADA RTU is be communicated to PacifiCorp's Control Center. Unless other arrangements are made to use PacifiCorp's existing telecommunications network, the generation entity must provide a local telephone company VG36, Class B, Type-3, 4-wire, full-duplex communication line from the generation facility to PacifiCorp's Control Center. PacifiCorp will specify the location where the communication line will terminate. Telecommunication channels for SCADA RTU equipment, when using PacifiCorp's telecommunications network, may consist of fiber optic system, microwave radio, other radio system, or a combination of these systems.

5.3.2.6 Analog Telemetering

Analog telemetering of the total generation facility's kW output to one of PacifiCorp's alternate control sites (Medford, Oregon; Yakima, Washington; Goshen, Idaho; or Sigurd, Utah) is required as an interim solution per NERC Standard EOP-008-0, *Plans for Loss of Control Center Functionality*. Unless other arrangements are made to use PacifiCorp's existing telecommunications network, the generation entity must provide a local telephone company VG36, Class-B, Type-3, 2-wire, communication line from the generation facility to PacifiCorp's alternate control site. PacifiCorp will specify the location of the closest alternate control site where the communication line will terminate. Telecommunications channel for analog telemetering equipment, when using PacifiCorp's telecommunications network, may consist of fiber optic cable, power line carrier, microwave radio, or a combination of these systems. The analog telemetering channel may use the same telecommunications system as the SCADA RTU channel providing it is not routed through PacifiCorp's Control Centers.

5.4 Telephone Company Line Treatment Equipment

Proper cable and protection equipment may be required at substations and other high-voltage electric facilities for expected ground potential rise (GPR). The GPR testing required to determine the required telephone line protection may be performed by PacifiCorp at the cost of the generation facility or may be performed by generation

facility itself. The calculated GPR value will determine what grade of telephone cable high-voltage protection equipment is required, as well as the distance from the facility at which the telco pedestal will be located. The local telephone company must be informed in advance (up to six months) so outside plant facilities can be engineered to serve the generation facility location. Some independent telephone companies are not tariffed to provide protection equipment. In this case, the generation facility will be required to purchase and install the necessary telephone line protection equipment.

5.5 Communication Operating Conditions

5.5.1 Normal Operating Conditions

The customer shall provide to PacifiCorp the information necessary to communicate with the equipment and/or personnel at the generation facility during routine operating conditions. This information shall be updated as soon as a material change becomes available for use by notifying PacifiCorp's grid operations centers in either Salt Lake City, Utah or Portland, Oregon, depending on the facility's operating area.

5.5.2 Emergency Operating Conditions

The Facility Interconnection Customer shall provide to PacifiCorp the information necessary to communicate with the equipment and/or personnel at the generation facility during the loss of the primary communication medium. This would be considered the emergency operating condition. This information is also to be updated as soon as a material change becomes available for use by notifying PacifiCorp's grid operations centers in either Salt Lake City, Utah or Portland, Oregon, depending on the facility's operating area.

6 PROTECTION AND CONTROL POLICY

This section specifies the protective and control requirements for Facility Interconnection Customers to PacifiCorp's transmission system.

6.1 Applicability

The applicable protective standards of this section apply to all facilities interconnecting to any portion of PacifiCorp's transmission system. These policies, which govern the design, construction, inspection, and testing of protective devices, have been developed by PacifiCorp to be consistent with applicable reliability criteria.

6.2 Protective Requirements

An important objective in the interconnection of facilities to PacifiCorp's system is minimizing the potential hazard to life and property. A primary safety requirement is the ability to disconnect immediately when a fault is detected. Facility developers desiring interconnection with PacifiCorp's transmission system must comply with all applicable jurisdictional state regulatory agency rules in this regard.

The protection equipment for an interconnection facility must protect against faults within that facility and faults on the PacifiCorp system. As a general rule, an interconnection facility must also trip off-line (disconnect from the PacifiCorp system automatically) when PacifiCorp's transmission system is disconnected from the line into which the facility is connected.

In view of these objectives, PacifiCorp requires line-protective equipment to either 1) automatically clear a fault and restore power, or 2) isolate only the faulted section.

Due to the high-energy capacity of the PacifiCorp transmission system, high-speed fault clearing may be required to minimize equipment damage and potential impact to system stability. The requirement of high-speed fault clearing will be determined by PacifiCorp on a case-by-case basis. To achieve these results, relays and protective devices are needed. The requirements are outlined in the following pages. Some protection requirements can be standardized, however most line relaying depends on generator size and type, number of generators, line characteristics (i.e., voltage, impedance, and ampacity), and the existing protection equipment connected to the PacifiCorp system.

PacifiCorp's minimum protection requirements are designed and intended to protect PacifiCorp's system only. As a general rule, neither party should depend on the other for the protection of its own equipment. Interconnected Facilities are required to provide their own high side protection for their facilities. Additional protective relays are typically needed to protect the Interconnection Customer 's facility adequately. It is the Facility Interconnection Customer 's responsibility to protect their own system and equipment. PacifiCorp insists that the entity hire a qualified electrical engineer (with a PE license in electrical engineering) to review and stamp the electrical design of the proposed generation facility and ensure that it will be adequately protected.

The Facility Interconnection Customer must provide PacifiCorp test reports for all relays before PacifiCorp will allow the facility to parallel. Refer to Section 10.2 for information regarding pre-parallel inspections. Every four years thereafter, the Facility Interconnection Customer must test relays and provide written proof of the testing, that the relays are operable and within calibration. PacifiCorp will not test the entity's equipment, but may witness the testing performed by a qualified testing firm retained by the entity. The testing firm will be approved by PacifiCorp prior to the actual test. On-site power (typically 120 V) is required for the test equipment. Circuit breakers must be

tested at least every eight years after the pre-parallel inspection. It is also in the Facility Interconnection Customer 's best interest to make sure all of its protective equipment is operating properly, since significant equipment damage and liability can result from failures of the entity's protective equipment. The Facility Interconnection Customer shall report relay problems to PacifiCorp and shall resolve problems in a reasonable time (within one year at a minimum). If this places PacifiCorp or the Facility Interconnection Customer in a compromised position of liability, the generation shall be disconnected until the relay issue(s) is/are resolved to PacifiCorp's satisfaction.

6.3 Reliability and Redundancy

The Facility Interconnection Customer shall design the protection system with sufficient redundancy or relay coordination such that the failure of any one component will still permit the Facility Interconnection Customer's facility to be isolated from the PacifiCorp system under a fault condition. Multi-function three-phase protective relays must have redundant relay(s) for back up unless otherwise agreed to by PacifiCorp. The required breakers must be trip-tested by the Facility Interconnection Customer at least once a year.

6.4 Relay Elements

The following is a description of the relay elements shown in Figure 1.

21 – Distance relay is a relay that functions when the circuit admittance, impedance, or reactance increases or decreases beyond a predetermined value. This type of relay may be required when the Generation Entity is connecting two (2) or more generators to The PacifiCorp power system. This determination is made during the System Impact Study and is based on minimum peak loading of the feeder tow which the Generator Entity will connect.

27 – Undervoltage relay is a relay that operates when its input voltage is less than a predetermined value. PacifiCorp requires three (3) undervoltage elements with time delay. Settings will be determined during the System Impact Study.

50P – Phase instantaneous overcurrent relay is a relay that functions instantaneously on an excessive value of phase current. The requirement for this element is based on minimum peak loading of the feeder tow which the Generator Entity will connect.

59N – 3V0 overvoltage relay is a relay that functions instantaneously on an excessive value of 3V0 voltage. This element utilizes the second coil of the potential transformer wired in a broken delta. Settings will be determined during the System Impact Study.

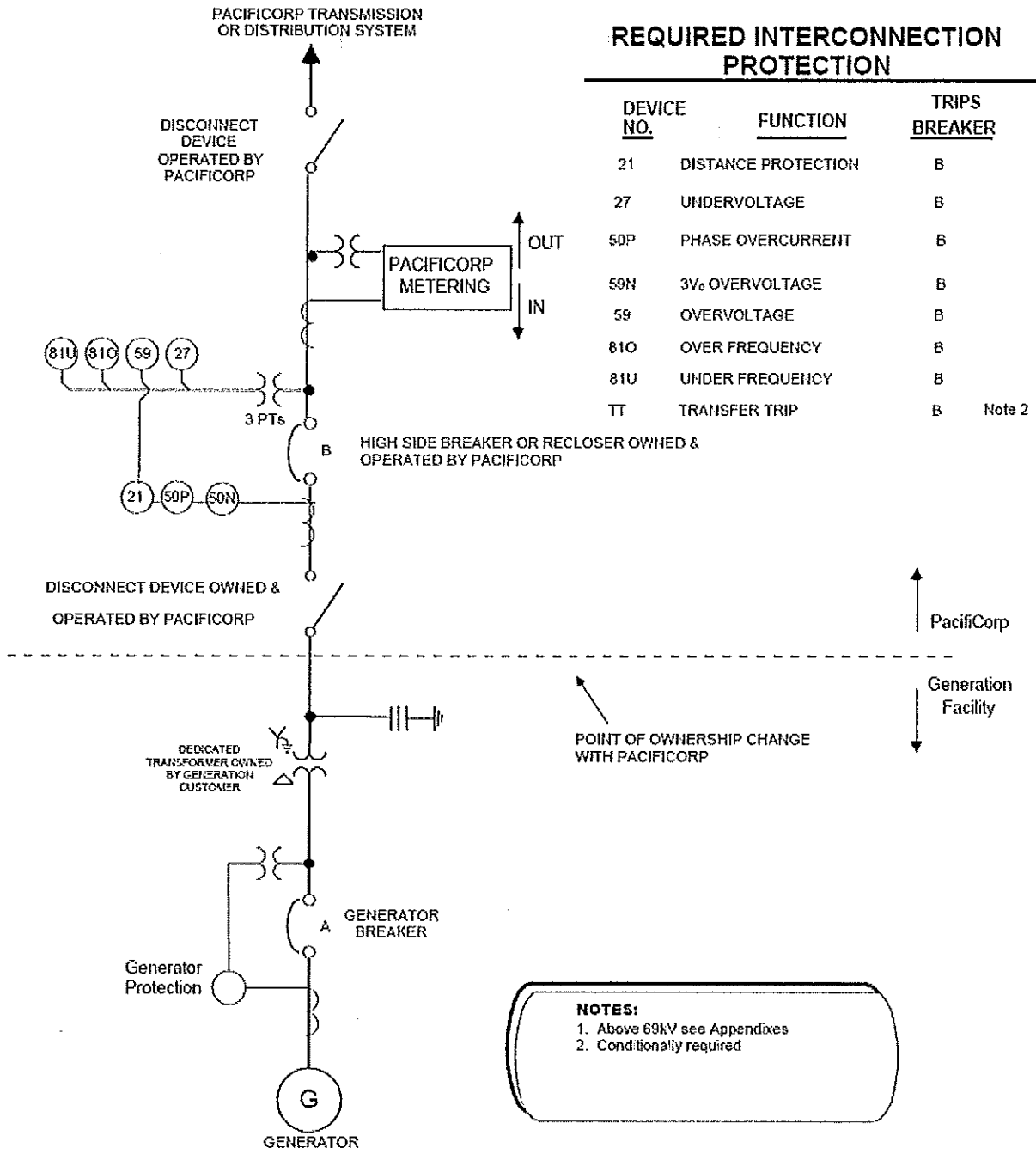
59 – Overvoltage relay is a relay that operates when its input voltage is higher than a predetermined value. This element is utilizes a current transformer between the transformer and the high side breaker. Settings will be determined during the System Impact Study.

81O – Overfrequency relay is a relay that responds to the frequency of an electrical quantity, operating when the frequency or rate of change of frequency exceeds a predetermined value. PacifiCorp requires three (3) overfrequency elements with time delay. Settings will be determined during the System Impact Study and are based on radial or non-radial connections.

81U – Underfrequency relay is a relay that responds to the frequency of an electrical quantity, operating when the frequency or rate of change of frequency is less than a predetermined value. PacifiCorp requires three (3) underfrequency elements with time delay. Settings will be determined during the System Impact Study and are based on radial or non-radial connections.

TT – Transfer Trip is a scheme that operates based on a remote signal. Transfer trip could utilize, fiber, leased line, microwave, etc. as determined by PacifiCorp. Transfer trip may be required depending on PacifiCorp circuit configuration and loading, as determined by PacifiCorp. Typically, transfer trip shall be required if PacifiCorp determines that a generation facility cannot detect and trip on PacifiCorp end-of-line faults within an acceptable time frame or if the generation facility may be capable of keeping a PacifiCorp line energized with the PacifiCorp source disconnected. It may be in the generation facility's best interest to purchase relays capable of communications in the event transfer trip is later required.

Figure 1–Typical Interconnection for Protection and Metering Installation 69 kV and Below



REQUIRED INTERCONNECTION PROTECTION

DEVICE NO.	FUNCTION	TRIPS BREAKER	
21	DISTANCE PROTECTION	B	
27	UNDERVOLTAGE	B	
50P	PHASE OVERCURRENT	B	
59N	$3V_o$ OVERVOLTAGE	B	
59	OVERVOLTAGE	B	
81O	OVER FREQUENCY	B	
81U	UNDER FREQUENCY	B	
TT	TRANSFER TRIP	B	Note 2

NOTES:
1. Above 69kV see Appendixes
2. Conditionally required

6.5 Approved Vendors

PacifiCorp is familiar with all major utility-grade relay manufacturers. Below is a sample list of major vendors; it is not intended to be an exhaustive listing.

- ABB
- Areva
- Beckwith
- Basler
- Cooper
- GE
- Schweitzer
- Siemens

PacifiCorp will accept any utility-grade relay or combination of relays from this list provided that all required relay elements are fulfilled. All relays must be utility-grade, no other grade will be acceptable.

PacifiCorp approval does not indicate the quality or reliability of a product or service, and no endorsements or warranties shall be implied.

6.6 Line Protection

Many factors are considered when determining the protective relaying requirements needed by Facility Interconnection Customer to protect PacifiCorp facilities and customers' equipment. Some of these factors are: the zone of protection, location of connection to PacifiCorp system, location of customers relative to the location of connection, and type of protection system used on the PacifiCorp transmission system.

The zone of protection refers to the area in PacifiCorp's system where the Facility Interconnection Customer's facility must provide fault protection. When a fault occurs, the Facility Interconnection Customer's protective relays are to cause the isolation of the Facility Interconnection Customer's facilities from PacifiCorp's or the Facility Interconnection Customer's system. If there are any PacifiCorp customers connected to the system in the zone of protection, the protection system is designed so that the service to those customers is not diminished by the addition of the Facility Interconnection Customer's facilities. This includes the amount of delay in automatic testing of the zone of protection by PacifiCorp's equipment following a fault.

There are many options for providing the protective relay system for the zone of protection. These options will affect the up-front cost and the reliability of the Facility Interconnection Customer's facilities. The use of pilot relaying or direct transfer trip communication may increase the cost to the Facility Interconnection Customer, but the use of these systems will limit the number of times the facility is forced offline to protect PacifiCorp's system. This is especially true when a PacifiCorp customer is connected to the system in the zone of protection. The protective relays at the Facility Interconnection Customer's facility will need to be set to detect any fault in the zone of protection and isolate the Facility Interconnection Customer's generator from PacifiCorp's system with no delay. Since the protective relays cannot be set to detect 100 percent of the faults without detecting and operating for faults outside the zone of protection, the Customer's interconnection facilities will be disconnected for fault conditions that normally would not require isolation of the facilities. With the use of a pilot relaying system or direct transfer

trip, the number of these unnecessary operations can be greatly reduced. In addition, line-protection relays must coordinate with the protective relays at the PacifiCorp breakers for the line on which the generating facility is connected. The typical protective zone is a two-terminal line section with a breaker on each end. In the simplest case of a load on a radial line, current can flow in one direction only, so protective relays need to be coordinated in one direction and do not need directional elements. However, on the typical transmission system, where current may flow in either direction depending on system conditions, relays must be directional. Also, the complexity and the required number of protective devices increase dramatically with increases in the number of terminals in each protective zone. With two terminals in a protective zone, there are two paths of current flow. With three terminals there are six paths of current flow, and so on. Coordinating a multi-terminal scheme may sometimes require installation of a transmission line protective relay at the Facility Interconnection Customer 's sub-site. This is commonly the case whenever three-terminal permissive overreach transfer trip (POTT) schemes are employed to protect the line. Because this line relay participates in a scheme to protect the PacifiCorp transmission system, PacifiCorp must ensure the maintenance, testing, and reliability of this particular type of relay.

In addition, the breaker's relays must be set to have overlapping zones of protection in case a breaker within any given zone fails to clear. The line protection schemes must be able to distinguish between generation, inrush, and fault currents. Multiple terminal lines become even more complex to protect. Existing relay schemes may have to be reset, replaced, or augmented with additional relays at the Facility Interconnection Customer 's expense to coordinate with the Facility Interconnection Customer 's new facility.

The PacifiCorp-required relays must be located so that a fault in the zone of protection on any phase of the PacifiCorp line shall be detected. If transfer trip protection is required by PacifiCorp, the Facility Interconnection Customer shall provide at its expense a voice-grade communications circuit. This circuit may be a communication line from the telephone company or a dedicated cable. The line must have high-voltage protection equipment on the entrance cable so the transfer trip equipment will operate properly during fault conditions.

The PacifiCorp transmission system is designed for high reliability via multiple sources and paths to supply customers. Due to the multiple sources and paths, more complex protection schemes are required to properly detect and isolate faults. The addition of any new generation facility to the PacifiCorp system must not degrade the existing protection and control schemes or cause existing PacifiCorp customers to suffer lower levels of safety and/or reliability.

Table 1 lists the minimum protection that PacifiCorp typically uses on its own installations. Higher voltage interconnections require additional protection due to the greater potential for adverse impact to system stability, and the greater number of customers who would be affected. Special cases such as distribution-level network interconnections, if acceptable, may have additional requirements. The acceptability and additional requirements of these interconnection proposals shall be determined by PacifiCorp on a case-by-case basis.

6.7 PacifiCorp Protection and Control System Changes

PacifiCorp will perform a detailed interconnection study to identify the cost of any required modifications to PacifiCorp's protection and control systems are required to interconnect a new facility. These protection and control system modifications are in addition to any transmission and distribution system upgrades identified in the system impact or facilities studies for interconnection of the new facilities.

The following is a partial list of protection system modifications which may be required:

1. PacifiCorp's automatic restoration equipment shall be prevented from operating until the generator is below 25 percent of nominal voltage as measured at the restoration equipment. Generator damage and system disturbances may result from the restoration of power by automatically re-energizing PacifiCorp's facilities. This modification shall be required when the generator(s) has the capability of energizing a line when the PacifiCorp system is disconnected. PacifiCorp will not allow the Facility Interconnection Customer Facility Interconnection Customer 's generator(s) to automatically re-energize PacifiCorp facilities.
2. For generation facilities greater than 1,000 kW aggregate nameplate rating, all existing single-phase fault-interrupting devices (fuses) located in series between the generator and PacifiCorp's substation shall be replaced with three-phase interrupting device to prevent possible single-phasing of other customers.
3. The PacifiCorp substation transformer high-side fuses must be replaced with a three-phase interrupting device when the generator is on a distribution circuit fed from a fused PacifiCorp substation transformer bank and the bank's minimum load is equal to or less than 200 percent of the generator's nameplate rating.
4. A transfer trip scheme from the high-side circuit breaker/circuit switcher to the generator shall be installed if necessitated by PacifiCorp. An associated alarm circuit is required between the Facility Interconnection Customer Facility Interconnection Customer 's site and the PacifiCorp Control Center.

6.8 Warning Label for Protective Relays

A warning label shall be affixed within 6 inches of any relay in the Facility Interconnection Customer's control house (or similiar enclosure containing protective relays) **which affects the operation of PacifiCorp's electrical circuits**. The warning label shall state the following:

> ***Warning !!!*** *Do not alter or change any settings on this relay without first receiving approval from PacifiCorp's Protection and Control Engineering Dept. in Portland, Oregon. Failure to give notification to PacifiCorp of this action may result in damaged or destroyed electrical equipment, possible physical injury or fatality, facility disconnection, and/or legal action.*

Table 1–Line Protection Devices

Line Protection Device	Device[1] Number	34.5kV or less	46kV, 57kV or 69kV	115kV	230kV & above
Phase Overcurrent (Radial systems)	50/51	X	X		
Ground Overcurrent (Radial systems)	50/51N	X	X		
Phase Directional Overcurrent	67		X	X	
Ground Directional Overcurrent or Transformer Neutral	67N 50/51N		X	X	X
Distance Relay Zone I	21ZI		X[2]	X	X
Distance Relay Zone 2	21Z2		X[2]	X[2]	X
Distance Relay Carrier	21Z2C			X[2]	X
Ground Directional Overcurrent Carrier	67NC			X[2]	X
Pilot Wire	87L			X[2]	X
Permissive Overreaching Transfer Trip (POTI) or Hybrid	21/67T			X[2]	X
Direct Transfer Trip	TT	X[3]		X[3]	X[3]

Notes:
1. Refer to Section 6.4 for device number definitions and functions.
2. May be required on transmission or distribution interconnections depending on local circuit configurations, as determined by PacifiCorp.
3. Transfer trip may be required on transmission- level or distribution- level interconnections depending on PacifiCorp circuit configuration and loading, as determined by PacifiCorp. Typically, transfer trip shall be required if PacifiCorp determines that a generation facility cannot detect and trip on PacifiCorp end-of-line faults within an acceptable time frame or if the generation facility may be capable of keeping a PacifiCorp line energized with the PacifiCorp source disconnected (Appendix F).

6.9 Manual Disconnect Switch Requirements

A manual load-break disconnect switch is required for all interconnected facilities. For connections to the PacifiCorp transmission grid, a tap line switch may also be required if, in PacifiCorp's judgment, sufficient tap line exposure exists to warrant it. Refer to Appendix D for more details on tap line switches. For transmission line taps, two additional line switches, one on each side of the tap, are required to provide the facility better service and operating flexibility. Note that the installation of line switches may impact the protection requirements for the interconnection, specifically the need for direct transfer trip.

A PacifiCorp-operated disconnect device must be provided as a means of electrically isolating the PacifiCorp transmission system from the interconnected facilities. This device shall be used to establish visually-open working clearance for maintenance and repair work in accordance with PacifiCorp safety rules and practices. A disconnect device must be located at the point of interconnection with PacifiCorp. PacifiCorp shall own, operate, and maintain all disconnect switches for generation interconnection facilities. The disconnect switch shall be specified by the appropriate PacifiCorp

engineers working on the interconnection project and shall come from PacifiCorp stock and be installed on PacifiCorp-owned facilities. PacifiCorp will notify the Facility Interconnection Customer in advance of the operation of the disconnect switch and follow all work practices associated with this procedure. In the event of an urgent incident or emergency, PacifiCorp may not be able to notify the developer in a timely fashion that it intends to operate a switch. Any deviation from this policy shall be signed off by a Vice-President of Engineering at PacifiCorp along with corporate legal counsel and shall be included in the interconnection agreement between PacifiCorp and the generator developer with an explanation of why this policy was not followed for the specific project.

For cases in which the state or federal regulatory policy conflicts with PacifiCorp's policy, the state and federal regulatory policy shall prevail.

The developer may at its option install other disconnect switch(es) on its property to operate as its sees fit. PacifiCorp asks that the developer notify a PacifiCorp dispatch center before operation of their disconnect switch(es).

PacifiCorp personnel shall inspect and approve the installation before parallel operation is permitted. If the disconnect device is in the Facility Interconnection Customer Facility Interconnection Customer 's substation, it should be located on the substation dead-end structure and must have a PacifiCorp-approved operating platform.

The disconnect device must not be used to make or break parallels between the PacifiCorp system and the generator(s). The device enclosure and operating handle (when present) shall be kept locked at all times with PacifiCorp padlocks.

The disconnect device shall be physically located for ease of access and visibility to PacifiCorp personnel. When installed on the Facility Interconnection Customer 's side of the interconnection, the device shall normally be installed close (within one foot) to the metering. The PacifiCorp-operated disconnect shall be identified with a PacifiCorp-designated switch number plate.

For transmission voltage interconnections, metering is normally on the high side of the Facility Interconnection Customer 's step-up transformers. Between the metering units and the circuit breaker, a second disconnect device is required; it shall not have a PacifiCorp lock and may be operated by the Facility Interconnection Customer.

Notes:

1. Disconnect switches must be rated for the voltage and current requirements of the particular installation.
2. Disconnect switches must be gang-operated unless otherwise agreed to by PacifiCorp.
3. Disconnect switches must be weatherproof or designed to withstand exposure to weather.
4. Disconnect switches must be lockable in both the open/closed positions with a standard PacifiCorp lock unless otherwise agreed to by PacfiCorp.

6.9.1 High-Voltage Disconnects

The Facility Interconnection Customer shall submit a proposed switch specification to PacifiCorp. It shall be reviewed and approved in writting by a PacifiCorp engineering manager prior to its purchase and installation.

6.9.2 Conditions for Manual Disconnection

Producers must discontinue parallel operation when requested by PacifiCorp under the following conditions:

1. To facilitate maintenance, test, or repair of PacifiCorp's facilities. PacifiCorp will coordinate this with each producer.
2. During system emergencies.
3. When a generator is interfering with other PacifiCorp customers or producers on the system.
4. When inspection of a generator reveals either a condition hazardous to PacifiCorp's system or personnel or a lack of scheduled maintenance or maintenance records for equipment necessary to protect PacifiCorp's system.

6.10 Fault-Interrupting Devices

The fault-interrupting device selected by the Facility Interconnection Customer must be reviewed and approved by PacifiCorp for each particular application.

There are three basic types of fault-interrupting devices:

- Circuit Breakers
- Circuit Switchers
- Fuses

PacifiCorp will determine the type of fault-interrupting device required for a generation facility based on the size and type of generation, the available fault duty, the local circuit configuration, and the existing PacifiCorp protection equipment.

6.10.1 Circuit Breakers

Three-phase circuit breaker(s) at the point of interconnection automatically separate the facility from the PacifiCorp system upon detection of a circuit fault. Additional breakers and protective relays may be installed in the generation facility for ease in operating and protecting the facility. The interconnection breakers must have sufficient capacity to interrupt maximum available fault current at its location and shall be equipped with accessories to:

1. Trip the breaker with an external trip signal supplied through a battery (shunt trip).
2. Telemeter the breaker status when it is required.
3. Lockout if operated by protective relays required for interconnection.

Generally, a three-phase circuit breaker is the required fault interruption device at the point of interconnection, due to its simultaneous three-phase operation and ability to coordinate with PacifiCorp line-side devices. However, fuses are allowed as high-side protection for the dedicated transformer at generation facilities of less than 1,000 kW connected on the distribution-level system, provided that coordination can be obtained with existing PacifiCorp phase and ground protection. If fuses are used, the Facility Interconnection Customer should consider installing a negative sequence relay and/or other devices to protect the facility against single phase conditions. If fuses are used for high-side transformer protection, a separate generator breaker will be required to isolate the generator from the PacifiCorp system under a fault or abnormal system conditions.

6.10.2 Circuit Switchers

A circuit switcher is a three-phase fault-interrupter with limited fault interrupting capability. These devices have typically been used at voltages of 115 kV and below and may substitute for circuit breakers when the fault duty is within the interrupting rating of the circuit switcher. With PacifiCorp approval, some circuit switchers with blades can double as the visual open disconnect switch between the metering transformers and the main transformer. Since circuit switchers do not have integral current transformers, they must be installed within 30 feet of the associated current transformers to minimize the length of the unprotected line/bus section.

6.10.2.1 Fuses

Fuses are single-phase, direct-acting sacrificial links that melt to interrupt fault current and protect the equipment. Blown fuses need to be replaced manually after each fault before the facility can return to service. Overhead primary fuses shall be replaced by trained personnel. Since fuses are single phase devices, they may not all melt during a fault, and may not automatically separate the generation facility from PacifiCorp. Fuses cannot be operated by the protective relays, hence they cannot be used as the primary protection for three-phase generation facilities. However, they may be used for high-side transformer protection for generation less than 1,000 kW, provided coordination can be obtained with the existing PacifiCorp phase and ground protection, and if a separate breaker provides the required primary protection. Fuses are not permitted for high side transformer protection for facilities of 1,000 kW or greater.

Large primary fuses which do not coordinate with the PacifiCorp substation breaker ground relays shall not be allowed. Such use could cause all the customers on the circuit to lose power due to a fault inside the generating facility.

7 GENERATOR PROTECTION AND CONTROL

Single-phase generators must be connected in multiple units so that an equal amount of generation capacity is applied to each phase of a three-phase circuit.

All synchronous, induction, and single-phase generators shall comply with the latest ANSI Standards C50.10 and C50.13, dealing with waveform and telephone interference.

Synchronous generators of any size require: a) synchronizing relays (Device No.25) to supervise generator breaker closing, and b) reclose blocking at the PacifiCorp side of the line to which the generator is connected (applies to substation breaker/recloser). Standard device numbers for commonly used protective elements are defined in Table 3. Direct transfer trip is preferred if coordinated protection is desired by the Facility Interconnection Customer. Coordinated protection will minimize the number of times the generator is forced offline without a dedicated feed.

The generator protection equipment listed in Section 6.4 is required to permit safe and reliable parallel operation of the Facility Interconnection Customer's equipment with the PacifiCorp system. Additional or alternate generator protection requirements for generators utilizing induction-type generator(s) or other specific situations shall be determined by PacifiCorp on a case by case basis.

7.1 Generator Requirements

7.1.1 Low Voltage Ride-Through (LVRT) Requirements for Generators

A generating plant shall be able to remain online during voltage disturbances up to the time periods and associated voltage levels set forth below. The LVRT standard is divided into three classifications by generation plant size.

7.1.1.1 Generating Plants with Capacity > 20 MW

7.1.1.1.1 Transition Requirements

For generators with interconnection agreements signed and filed with FERC between January 1, 2006 and December 31, 2006 with a scheduled in-service date no later than December 31, 2007 *or* for generating turbines subject to a turbine procurement contract executed prior to December 31, 2005 for delivery through 2007, the following requirement applies:

Generating plants are required to remain in-service during three-phase faults with normal clearing (which is a time period of approximately 4-9 cycles) and single line–to-ground faults with delayed clearing, as well as subsequent post-fault voltage recovery to pre-fault voltage unless clearing the fault effectively clears the generator from the system. The clearing time requirement for a three-phase fault will be specific to the generating plant substation location as determined by and documented by the transmission provider. The maximum clearing time the generating plant shall be required to withstand for a three-phase fault shall be nine cycles at a voltage as low as 0.15 pu, as measured at the high side of the generating plant step-up transformer (i.e., the transformer that steps the voltage up to the transmission interconnection voltage or GSU), after which, if the fault remains following the location-specific normal clearing time for three-phase faults, the generating plant may disconnect from the transmission system.

Notes:

1. This requirement does not apply to faults occurring between the generator terminals and the high side of the GSU or to faults that would result in a voltage lower than 0.15 pu on the high side of the GSU serving the facility.
2. Generating plants may be tripped after the fault period if this action is intended as part of a special protection system.
3. Generating plants may meet this LVRT standard by performance of the generators or by installing additional equipment (e.g., static VAR compensator, etc.) within the generating plant or by a combination of generator performance and additional equipment.
4. Any existing individual generator units that are, or have been, interconnected to the network at the same location before this requirement was written, are exempt from this requirement for the remaining life of the generation equipment. Existing individual generator units that are replaced must meet the requirements listed above.

7.1.1.1.2 Post-Transition Period

For all generators with capacity greater than 20 MW not subject to the transition period requirement above, the following requirement applies:

Generating plants are required to remain in-service during three-phase faults with normal clearing (which is a time period of approximately 4-9 cycles) and single line-to-ground faults with delayed clearing, as well as subsequent post-fault voltage recovery to pre-fault voltage unless clearing the fault effectively clears the generator from the system. The clearing time requirement for a three-phase fault will be specific to the generating plant substation location as determined by and documented by the transmission provider. The maximum clearing time the generating plant shall be required to withstand a three-phase fault shall be nine cycles, after which, if the fault remains following the location-specific normal clearing time for three-phase faults, the generating plant may disconnect from the transmission system. A generating plant shall remain interconnected during such a fault on the transmission system for a voltage level as low as zero volts, as measured at the high side of the GSU.

Notes:

1. This requirement does not apply to faults that would occur between the generator terminals and the high side of the GSU or to faults that would result in a voltage lower than 0.15 pu on the high side of the GSU serving the facility.
2. Generating plants may be tripped after the fault period if this action is intended as part of a special protection system.
3. Generating plants may meet this LVRT standard by performance of the generators or by installing additional equipment (e.g., static VAR compensator, etc.) within the generating plant or by a combination of generator performance and additional equipment.

4. Any existing individual generator units that are, or have been, interconnected to the network at the same location before this requirement was written are exempt from this requirement for the remaining life of the generation equipment. Existing individual generator units that are replaced are required to meet the requirements listed above.

7.1.1.2 Generating Plants with Capacity ≥ 10 MVA and ≤ 20 MW

Generators are required to remain in-service during system faults (three-phase faults with normal clearing and single line-to-ground faults with delayed clearing) unless clearing the fault effectively disconnects the generator from the system. This requirement does not apply to faults that would occur between the generator terminals and the high side of the generator step-up transformer or to faults that would result in a voltage lower than 0.15 pu on the high side of the generator step-up transformer. In the post-fault transient period, generators are required to remain in-service for the low voltage excursions specified in the Table 4 as applied to a load bus.

Notes:

1. These performance criteria are applied to the generator interconnection point, not the generator terminals.
2. Generators may be tripped after the fault period if this action is intended as part of a special protection system.
3. This standard applies to any generation independent of the interconnected voltage level.
4. This standard can be met by the performance of the generators or by installing additional equipment (e.g., SVC, etc.).
5. Existing individual generator units that are interconnected to the network at the time of the adoption of this standard are exempt from meeting this standard for the remaining life of the existing generation equipment. Existing individual generator units that are replaced must meet the requirements listed above.

7.1.1.3 Generating Plants with Capacity < 10 MVA

Generators are required to remain in-service during system faults (three-phase faults with normal clearing and single line-to-ground faults with delayed clearing) unless clearing the fault effectively disconnects the generator from the system. This requirement does not apply to faults that would occur between the generator terminals and the high side of the generator step-up transformer or to faults that would result in a voltage lower than 0.15 pu on the high side of the generator step-up transformer. In the post-fault transient period, generators are required to remain in-service for the low voltage excursions specified in Table 4 as applied to a load bus.

Notes:

1. These performance criteria are applied to the generator interconnection point, not the generator terminals.
2. Generators may be tripped after the fault period if this action is intended as part of a special protection system.

3. This standard applies to any generation independent of the interconnected voltage level.
4. This standard can be met by the performance of the generators or by installing additional equipment (e.g., SVC, etc.).
5. Existing individual generator units that are interconnected to the network at the time of the adoption of this standard are exempt from meeting this standard for the remaining life of the existing generation equipment. Existing individual generator units that are replaced must meet these requirements.

7.1.2 High Voltage Ride-Through (HVRT) Requirements for Generators

7.1.2.1 Generating Plants with Capacity > 20 MW

Generators are required to stay online indefinitely for dynamic voltages ≤ 1.1 pu at the point of interconnect. For dynamic voltages > 1.1 pu and ≤ 1.15 pu at the point of interconnect, generators are required to delay tripping one second to allow for fault clearing. For dynamic voltages > 1.15 pu and ≤ 1.2 pu, generators are required to delay tripping for 0.30 seconds to allow for fault clearing. For dynamic voltages > 1.2 pu at the point of interconnect, generators may trip without delay.

7.1.2.2 Generating Plants with Capacity ≥ 10 MVA and ≤ 20 MW

Generators are required to stay online indefinitely for dynamic voltages ≤ 1.1 pu at the point of interconnect. For dynamic voltages > 1.1 pu and ≤ 1.15 pu at the point of interconnect, generators are required to delay tripping one second to allow for fault clearing. For dynamic voltages > 1.15 pu and ≤ 1.2 pu, generators are required to delay tripping for 0.30 seconds to allow for fault clearing. For dynamic voltages > 1.2 pu at the point of interconnect, generators may trip without delay.

7.1.2.3 Generating Plants with Capacity < 10 MVA

Generators are required to stay online indefinitely for dynamic voltages ≤ 1.1 pu at the point of interconnect. For dynamic voltages > 1.1 pu and ≤ 1.15 pu at the point of interconnect, generators are required to delay tripping one second to allow for fault clearing. For dynamic voltages > 1.15 pu and ≤ 1.2 pu, generators are required to delay tripping for 0.30 seconds to allow for fault clearing. For dynamic voltages > 1.2 pu at the point of interconnect, generators may trip without delay.

7.1.3 Ride-through and Trip Voltage/Frequency Settings

The required devices and settings will be installed at the point of interconnection. The protection devices at the point of interconnection will send trip signals to the generator breakers (or to the wind turbine feeder breakers if in a wind plant). The Facility Interconnection Customer may also have frequency and voltage protection at its generating facility. The Facility Interconnection Customer's local protection settings must be compatible with the voltage ride-through requirements in Table 2.

In Table 3, separate transmission frequency settings are specified for a generation interconnection to an integrated network and for a generation interconnection to a radial transmission line. The voltage/frequency performance for each of the two transmission interconnection types is expected to be different.

Table 2–Ride-Through and Trip Voltage Relay Settings

Low Voltage Ride-Through Required	High Voltage Ride-Through Required		Trip Required	
	pu	delay(sec)	pu	delay(sec)
For Gen > 20 MW	> 1.20	0	> 1.50	0.1
See sec. 7.1.1.1	1.151-1.199	0.3	1.15-1.499	2.0
	1.101-1.15	1.0	1.101-1.149	4.0
For Gen 10 MVA - 20 MW	≤ 1.1	No trip	0.899-0.871	600.0[1]
See sec. 7.1.1.2			0.87-0.671	2.0
For Gen < 10 MVA			< 0.671	0.5
See sec. 7.1.1.3				

Table 3–Ride-Through and Trip Frequency Relay Settings

	Ride-Through Required		Trip Required	
	Hz	delay(sec)	Hz	delay(sec)
Integrated	> 61.8	0.0		
	61.6-61.7	30.0		
	60.6-61.5	180.0		
	59.5-60.5	infinite	None	
	59.4-58.5	180.0		
	58.4-57.9	30.0		
	57.8-57.4	7.5		
	57.3-56.9	0.75		
	≤ 57.0	0.0		
Radial			> 61.6	0.0
			61.0-61.6	0.5
			> 60.5-60.9	180.0
	60.5-59.5	infinite	< 59.5-59.1	180.0
			59.0-58.4	0.5
			< 58.3	0.0

Table 4–WECC Disturbance-Performance Table of Allowable Effects on Other Systems

NERC and WECC Categories	Outage Frequency Associated with Performance Category (outage/year)	Transient Voltage Dip Standard	Minimum Transient Frequency Standard
A	Not Applicable	Nothing in addition to NERC	
B	≥ 0.33	Not to exceed 25% at load buses or 30% at non-load buses Not to exceed 20% for more than 20 cycles at load buses	Not below 59.6 Hz for 6 cycles or more at a load bus
C	0.033 - 0.33	Not to exceed 30% at any bus Not to exceed 20% for more than 40 cycles at load buses	Not below 59.0 Hz for 6 cycles or more at a load bus
D	< 0.033	Nothing in addition to NERC	

Notes:
1. The WECC Disturbance-Performance Table applies equally to either a system with all elements in service, or a system with one element removed and the system adjusted.
2. As an example in applying the WECC Disturbance-Performance Table, a Category B disturbance in one system shall not cause a transient voltage dip in another system that is greater than 20% for more than 20 cycles at load buses, or exceed 25% at load buses or 30% at non-load buses at any time other than during the fault.
3. Additional voltage requirements associated with voltage stability are specified in WECC Standard I-D. If it can be demonstrated that post-transient voltage deviations that are less than the values in the table will result in voltage instability, the system in which the disturbance originated and the affected system(s) should cooperate in mutually resolving the problem.

7.2 Phase Overcurrent

Instantaneous overcurrent, or rate-of-rise relay is a device (50) which functions instantaneously on an excessive value of current or on an excessive rate of current rise, thus indicating a fault in the apparatus or circuit being protected.

AC time overcurrent relay is a device (51) with either a definite or inverse time characteristic which functions when the current in an AC circuit exceeds a pre-determined value.

7.3 Over/Undervoltage Relay

This protection is used to trip the circuit breaker when the voltage is above or below PacifiCorp's normal operating level (126 V – 114 V). It is used for generator protection and backup protection in the event that the generator is carrying load that has become isolated from the PacifiCorp system.

7.4 Over/Underfrequency Relay

This protection device is used to trip the circuit breaker when the frequency is above or below PacifiCorp's normal operating level. It is used for generator/turbine protection and backup protection.

Generator underfrequency relay settings are coordinated with other utilities in the Western Electricity Coordinating Council (WECC) to maintain generation online during system disturbances. Without prior written approval by PacifiCorp, settings should not be set for a higher frequency or shorter time delay than specified by PacifiCorp's Protection and Control Engineer.

7.5 Overcurrent Relay with Voltage Restraint/Voltage Control or Impedance Relay

These relays are used to detect phase–to-phase faults and initiate a circuit breaker trip. The relays must be located on the individual generator feeder. A group of generators aggregating over 400 kW must have an impedance relay or an overcurrent relay with voltage restraint located on each generator greater than 100 kW. Generators equal to or greater than 400 kW must have an impedance relay or an overcurrent relay with voltage restraint. As determined by PacifiCorp, an overcurrent relay with voltage control may also be acceptable if it can be set to adequately detect end-of-line faults.

7.6 Dedicated Step-Up Transformer

The dedicated transformer matches the generator voltage to the utility voltage and steps up the generator voltage to the interconnection level. It also serves to isolate the Facility Interconnection Customer from other customers to a small degree.

The impedance of a dedicated transformer limits fault currents on the generator bus from the PacifiCorp system and also limits fault currents on the PacifiCorp system from the generator. Hence, it reduces the potential damage to both parties due to faults. The transformer must have a delta winding to reduce the generator harmonics entering the PacifiCorp system unless otherwise agreed to by PacifiCorp. The delta winding will also reduce the PacifiCorp system harmonics entering the generation facility.

Generators of more than 10 kW require the use of a dedicated transformer. Generators of 10 kW or less and generating at a secondary voltage level may require a dedicated transformer. This need can be determined and identified in a detailed study.

A high-side fault-interrupting device such as a breaker or recloser is required for transformer protection. It is also required that the device be gang-operated so as to avoid the possibility of ferroresonance or loss of phase condition.

A three-phase circuit breaker is recommended, but fuses are acceptable for generation facilities of less than 1,000 kW provided that coordination can be obtained with the existing PacifiCorp protection equipment. If fuses are used, it is recommended that the generating entity install single-phase protection for its equipment.

Lightning arrestors, if the Facility Interconnection Customer chooses to install them, must be installed between the transformer and the fault-interrupting devices and shall be encompassed by the generator's relay protection zone.

7.7 Generators

The generating unit must meet all applicable American National Standards Institute (ANSI) and Institute of Electrical and Electronic Engineers (IEEE) standards. The prime mover and the generator should also be able to operate within the full range of voltage and frequency excursions that may exist on the PacifiCorp system without damage to them. To enhance system stability during a system disturbance, the generating unit must

be able to operate through the specified frequency ranges for the time durations listed in Table 2.

7.7.1 Synchronous Generators

7.7.1.1 Synchronizing Relays

Synchronous generators and other generators with stand alone capability must use one of the following methods to synchronize with the PacifiCorp system:

1. Automatic Synchronization with Automatic Synchronizing (Device 25)

   The automatic synchronizing relay must have a slip frequency-matching window of 0.1 Hz or less, a voltage-matching window of ± 10 percent or less, a phase angle-acceptance window of ± 10 degrees or less, and breaker-closure time compensation.

   The automatic synchronizing relay sends a close signal to the breaker after the above conditions are met.

2. Automatic Synchronization with Automatic Synchronizer (Device 15/25)

   The automatic synchronizing relay must have a slip frequency-matching window of 0.1 Hz or less, a voltage-matching window of ± 10 percent or less, a phase angle-acceptance window of ± 10 degrees or less, and breaker-closure time compensation. For an automatic synchronizer which does not have breaker-closure time compensation, a tighter frequency window (± 5 degrees) with a one-second time-acceptance window shall be used to achieve synchronization within ± 10 degrees phase angle.

   In addition to the above characteristics, this automatic synchronizer has the ability to adjust generator voltage and frequency automatically to match system voltage and frequency.

3. Manual Synchronization with Synchroscope and Synch Check (Device 25) Relay Supervision

   The synch check relay must have a voltage-matching window of ± 10 percent or less and a phase angle-acceptance window of ± 10 degrees or less.

   Generators with greater than 1,000 kW aggregate nameplate rating must have automatic synchronizing relay or automatic synchronizer.

7.7.1.2 Frequency/Speed Control

Unless otherwise specified by PacifiCorp, a governor shall be required on the prime mover to enhance system stability. Governor characteristics shall be set to provide a five percent droop characteristic (a 0.15 Hz change in the generator speed shall cause a five percent change in the generator load). Governors on the prime mover must be operated unrestrained to help regulate PacifiCorp's system frequency.

7.7.1.3 Excitation System Requirements

An excitation system is required to regulate generator output voltage.

Static systems shall have a minimum ceiling voltage of 150 percent of rated full-load field voltage with 70 percent of generator terminal voltage and a maximum response time of two cycles (0.033 seconds).

Rotating systems shall have an ANSI voltage response ratio of 2.0 or faster.

Excitation systems shall respond to system disturbances equally in both the buck and boost directions.

Under certain conditions, PacifiCorp may grant an exemption for generation facilities which have excitation systems not meeting these requirements. Requests for exemption should be sent to PacifiCorp Transmission Account Manager.

7.7.1.4 Voltage Regulator

The regulator must be able to maintain the generator voltage under steady-state conditions without hunting and within ± 0.5 percent of any voltage level between 95 percent and 105 percent of the rated generator. The point of voltage sensing should be at the same point as the PacifiCorp revenue metering. As determined by the PacifiCorp Control Center, the generator shall be operated at either a voltage or a power factor schedule.

At various times, the generating facility may also be requested by the PacifiCorp Control Center to produce more or less reactive power from that indicated on the regular schedule in order to meet the system needs.

7.7.1.5 Power-Factor Controller

The controller must be able to maintain a power-factor setting within ± 1 percent of the setting at full load at any set point between 90 percent lagging and 95 percent leading. In addition, all power-factor controllers for synchronous generators greater than 1MW must have programmable capability to vary hourly settings.

7.7.1.6 Power-System Stabilizer (PSS)

Generators with properly tuned and calibrated PSS provide damping to electric power oscillations. Such damping improves stability in the electrical system and may also prevent an individual generator from unnecessary tripping. The current WECC policy requires that the PSS be an integral part of the voltage regulator and be incorporated into the excitation systems for all new generating units with suitable excitation systems. PacifiCorp can help determine, at the Facility Interconnection Customer Facility Interconnection Customer 's expense, the suitability of an excitation system for PSS.

The PSS must be calibrated and operated in accordance with the latest standard procedures for calibration, testing, and operation of such equipment. These procedures are available from PacifiCorp. In addition, the calibration and test reports must be submitted to PacifiCorp's Transmission Account Manager.

The facility shall not be considered operational until PSS has been calibrated to PacifiCorp's satisfaction. A copy of the PSS calibration and operation procedures, as well as the suitability requirements, may be obtained from the PacifiCorp Transmission Account Manager. Additional information on PSS can be found in Appendix A.

The following criteria shall be used to determine when a PSS shall be installed on a synchronous generator, regardless of ownership, connected to the transmission system (by generator step-up transformer to 60 kV or higher voltage):

1. A PSS shall be installed on every existing synchronous generator that is larger than 75 MVA and is equipped with a suitable excitation system as defined in the WECC report, *Criteria to Determine Excitation System Suitability for PSS* available from the WECC web site.
2. A PSS shall be installed on every existing synchronous generator larger than 30 MVA or part of a complex that has an aggregate capacity larger than 75 MVA, or if the excitation system is updated so that it becomes a suitable excitation system as defined in the report mentioned in 1a above. This section applies to all machines whose excitation system is updated at any time after November 18, 1993.
3. A PSS shall be installed on every synchronous generator that is larger than 30 MVA or part of a complex that has an aggregate capacity larger than 75 MVA, and is equipped with suitable excitation systems as defined in paragraph 1a, and is commissioned after November 18, 1993.
4. A PSS is not required on a station service generator.

When a generator equipped with a functional PSS is online, the PSS shall be in operation except for the following reasons:

1. Maintenance and testing.
2. PSS exhibits instability due to nonstandard transmission line configuration.
3. PSS does not operate properly due to a failed component.
4. Unit is operating in the synchronous condenser mode (very near zero power level).
5. When a unit is generating less power than its design limit for effective PSS operation.
6. When a unit is passing through a range of output that is a known "rough zone."

The aggregate MVA of the synchronous machines tonline and equipped with a functioning PSS shall not fall below the level identified in the most recent power system stabilizer study commissioned by the WECC.

When a synchronous generator equipped with a PSS is operating in the pump mode (P/G unit), and is connected to a transmission system such that the PSS does not produce negative damping, the PSS should be in service.

PSS equipment shall be tested and calibrated in conjunction with AVR testing and calibration. This will be done as often as is necessary to maintain reliable PSS performance in accordance with WECC *PSS Tuning Criteria*. PSS recalibration must be performed if AVR response parameters are modified. When a PSS is taken out of service because of a failed component, the party responsible will be expected to perform the needed repairs (or replacement) in a responsible and timely manner.

A PSS is not required for a synchronous condenser.

7.7.1.7 Power-Quality Analysis

At the discretion of the Area Planning Engineer, unattended generation facilities with capacity greater than 250 kW and with automatic or remotely-

initiated paralleling capability may require a power-quality investigation analysis performed by PacifiCorp or a power-quality consulting firm. The analysis shall provide PacifiCorp with sufficient information to determine the status of the generation facility during system disturbances. The analyzer may provide remote access from PacifiCorp's Control Center or engineering offices.

7.7.1.8 Generator Testing

Testing of the generator and excitation system must be performed to verify proper parameters of the generator and exciter. Testing shall meet the requirements of the WECC Generator Testing Program. Copies of the test reports with appropriate powerflow and stability data parameters identified shall be provided to the PacifiCorp Transmission Account Manager. If a stability model is not available, the interconnection entity will be responsible for developing a suitable model for use in PacifiCorp's transient stability program, which currently uses the Power Technologies, Inc. PSSE version 27.1 program.

7.7.1.9 Direct Digital Control (DDC)

Dispatchable generators larger than 10,000 kW are required to have real-time direct digital control of unit output from PacifiCorp's Control Center. This allows generation units to respond to power system load/frequency changes.

7.7.2 Induction Generators

Induction generators, and other generators with no inherent VAr (reactive power) control capability, shall be required to provide power to the unity point of interconnection. Such generators shall operate in as near a range of ± 0.95 power factor as is technically feasible without risk of self-excitation to provide an amount of reactive power equivalent to that required for a synchronous generator. They may also be required to follow a PacifiCorp-specified voltage or VAr schedule on an hourly, daily, or seasonal basis, depending on the location of the installation. Specific instructions shall be provided on a case-by-case basis by the PacifiCorp Control Center.

7.7.3 DC Generators

7.7.3.1 Inverters Capable of Stand-Alone Operation

Inverters capable of stand-alone operation are capable of islanding operation and shall have similar functional requirements as synchronous generators. For units less than 100 kW, usually it is acceptable to have the frequency and voltage functions built into the electronics of the inverter if the set points of these built-in protective functions are tamperproof and can be easily and reliably tested. The total harmonic distortion in the output current of the inverters must meet IEEE Standard 519, *Harmonics Requirements*. Inverter-type generators connected to the PacifiCorp system must be pre-approved by PacifiCorp. For units over 10 kW, a dedicated transformer will be required to minimize the harmonics entering into the PacifiCorp system.

7.7.3.2 Inverters Incapable of Stand-Alone Operation

Inverters rated 10 kW or less which have been tested and certified by Underwriter Laboratories (UL) as 1741, are non-islanding, and meet IEEE Standard 519 harmonic requirements, may be interconnected to the PacifiCorp system as is. **No inverter(s) will be permitted to interconnect**

with PacifiCorp's electrical system that are not certified and will be disconnected until they are brought into compliance with this policy. Certified inverters have a label affixed to the equipment which shall be inspected as part of the commissioning process before energization. These inverters are generally used in combination with wind turbines and solar-based generators. Inverters over 10 kW will require a dedicated transformer and may have other requirements depending on the installation location and local generation penetration.

7.8 Remedial Action Scheme (RAS) Participation Requirement for Generation Facilities

A RAS is a special protection system which automatically initiates one or more pre-planned corrective measures to restore acceptable power system performance following a disturbance. Application of RAS mitigates the impact of system disturbances and improves system reliability.

The output of electric generators may flow over the entire interconnected transmission system. A generation facility is therefore required to participate in remedial action schemes to protect local transmission lines and the entire system as PacifiCorp determines necessary.

A typical disturbance, as it is considered in the planning and design of the electric transmission system, is the sudden loss of one or more critical transmission lines or transformers. A widely applied corrective measure is to instantaneously drop a sufficient amount of generation on the sending end of the lost transmission facility. This is known as generation dropping, and a participating generation facility may be disconnected from the transmission by the automatic RAS controller in much the same way as by a transfer trip scheme. A generation facility should therefore have full load rejection capability as needed both for local line protection and RAS. The RAS design must be such that any single-point failure will not prevent the effective operation of the scheme.

Whether RAS shall be required will depend on the overall location and size of the generator and load on the transmission system, the nature, consequences, and expected frequency of disturbances as well as the nature of potential alternative transmission reinforcements.

If PacifiCorp requires RAS participation for a particular generation facility, the Facility Interconnection Customer shall be responsible for all related costs.

7.9 Emergency Generator Requirement

There are two major methods of transferring electric power supply between the PacifiCorp source and the emergency generator system:

1. Open transition (break-before-make)
2. Closed transition (make-before-break)

The open transition method can be accomplished via a double-throw transfer switch or an interlock scheme which prevents the two systems from operating in parallel. The Facility Interconnection Customer Facility Interconnection Customer 's main breaker shall not be allowed to close until the generator breaker opens. This open transition method does not require any additional protection equipment, however it does cause the Facility Interconnection Customer 's load to experience an outage while transferring back to PacifiCorp. The length of this transfer outage depends on the transfer equipment involved.

Emergency systems are routinely tested by the Facility Interconnection Customer under load, usually once a month. With a break–before-make system, the Facility Interconnection Customer 's load, or most often a portion of it, is removed from the PacifiCorp system and the emergency generator is tested under load conditions. After successful completion of the test, the generator is taken offline and the Facility Interconnection Customer is transferred back to PacifiCorp. This testing procedure results in the test load experiencing two outages (when bringing the emergency generator on and when taking it off) whenever the system is tested.

For generation facilities that cannot tolerate this momentary loss of power, the closed transition (make-before-break) method is intended to provide transfer without interruption. For the closed-transition method, the maximum parallel time with the PacifiCorp system shall be less than 0.5 seconds, both to and from the emergency generator source. The protection requirements for synchronous generators will also apply to emergency generators any time a parallel is to be made with the PacifiCorp system. These would include, but are not limited to, a dedicated transformer and automatic synchronizing.

As an alternative to the normally required voltage, frequency, and ground relays, PacifiCorp may, at its discretion, allow installation of three very sensitive, single-phase, reverse-power relays (such as the Basler BE1-32R) for emergency generator installations. The reverse power relays shall be set to pick up on transformer magnetizing current with a time delay not to exceed 0.5 second. The reverse power relay, in this case, will protect PacifiCorp personnel and the general public by preventing the generator from keeping the PacifiCorp system energized in the event the PacifiCorp source substation(s) have tripped for a fault while the generator is paralleled. The relay output shall trip the circuit breaker on the PacifiCorp side of the transfer switch. This application can be used when the Facility Interconnection Customer 's emergency generator output is expected to be less than the entity's load.

7.9.1 Notification/Documentation

The Facility Interconnection Customer must notify its local PacifiCorp representative in writing of all new emergency generator installations or changes to the existing schemes regardless of method of interconnection or transfer.

Required documentation includes a description of generation and control system operation, single line diagrams, identification of all interlocks, sequence of events description for transfer operation, and specifications for any PacifiCorp-required protective devices. PacifiCorp may request additional documentation should it deem it necessary.

All documentation must be approved by PacifiCorp Engineering prior to installation.

7.9.2 Operation/Clearances

For the safety of PacifiCorp personnel and to ensure the proper operation of the PacifiCorp system, it is essential that the Facility Interconnection Customer notify the PacifiCorp Control Center of all emergency generator installations prior to paralleling. For operation and clearance purposes, emergency generator installations should be treated the same as any independent generation facility interconnected to the PacifiCorp system. A satisfactory visible open point shall be approved by PacifiCorp.

For all line work and clearances, the emergency generator shall be treated as a power source.

Facility interconnection customers using make-before-break transfer schemes are required to notify the PacifiCorp Control Center of their intent to transfer to their emergency generator and then again back to the PacifiCorp source, before any transfers are attempted. The notification of the make-before-break transfer scheme is necessary because such actions put another generation source in parallel with the PacifiCorp system. This notification is not essential on break-before-make schemes, but may be desirable in some instances.

7.10 Parallel-Only (No-Sale) Generator Requirement

Parallel-only generators shall have similar requirements as that of any other standard synchronous generator interconnection except that PacifiCorp may at its discretion allow the installation of three very sensitive, single-phase, reverse-power relays (such as the Basler BE 1 32R) along with the dedicated transformer as an alternative to the normally required ground relays. The reverse-power relays shall be set to pick up on transformer magnetizing current with a time delay not to exceed 0.5 second. This option may not be feasible on generating systems with a slow load rejection response since they may be tripped offline frequently for in-plant disturbances.

Owners of parallel-only generators must execute a parallel-only operating agreement with PacifiCorp prior to operation by the generation owner.

8 REACTIVE AND VOLTAGE RESTRICTIONS FOR FACILITY INTERCONNECTION CUSTOMERS

The purpose of this section is to help all customers satisfy applicable PacifiCorp policies and procedures with regard to voltage and reactive power flow.

The policies and procedures of this section apply to all facilities interconnecting with PacifiCorp's system. All facilities must meet applicable WECC standards.

Participating entities are required to schedule energy or ancillary services through a designated scheduling coordinator unless other arrangements have been made with PacifiCorp.

8.1 Reactive and Voltage Control Requirements

Reactive power (VAr) and voltage control are vital components of desired PacifiCorp system operation. It is essential that PacifiCorp receive both real and reactive power from interconnected generators. Where a generator is unable to furnish reactive power support due to interconnection limitations, type of generator, the generator loading, or other reasons, the Facility Interconnection Customer shall install equivalent reactive support at the Facility Interconnection Customer 's expense or make other arrangements with PacifiCorp.

How a generator meets PacifiCorp's reactive requirements depends on its type and size. Synchronous generators have an inherent reactive flexibility that allows them to operate within a range to either produce or absorb VArs. Induction generators operate at a power factor absorbing VArs and require reactive support from the interconnected system unless they have installed corrective equipment.

Generators 10 MVA and larger shall be equipped with automatic voltage-control equipment. All generating units with automatic voltage-control equipment shall normally be operated in voltage-control mode. These generating units shall not be operated in other control modes (e.g., constant power factor control) unless authorized in writing to do so by the host control area. The control mode of generating units shall be accurately represented in operating studies. The previous statements in this paragraph are consistent with the Western Electricity Coordinating Council (WECC)'s minimum operating reliability criteria.

Facility interconnection customers must provide reactive supply sufficient to operate at as near unity power factor as can be safely achieved without risk of self-excitation. Typically, the power factor should range from 97 percent leading power factor (absorbing VArs) and 1.0 (unity). PacifiCorp may further require the provision of reactive support equivalent to that provided by operating a synchronous generator anywhere within the range from 95 percent leading power factor (absorbing VArs) to 90 percent lagging power factor (producing VArs) within an operating range of ± 5 percent of rated generator terminal voltage and full load. This is typical of induction generators. Generators shall be equipped and operated to control voltage. If the facility is not capable of providing positive reactive support (i.e., supplying reactive power to the system) immediately following the removal of a fault or other transient low voltage perturbations, the facility may be required to add dynamic voltage support equipment. The general control requirements are discussed below.

8.1.1 Generator Control

8.1.1.1 Voltage Control

Voltage regulators are required for all generators larger than 100 kW unless otherwise agreed. In some cases, particularly for small units connected to the distribution system, a power-factor controller will also be required to provide operational flexibility.

Voltage regulators must be capable of maintaining the interconnection reactive interchange between 0.95 leading/lagging power factor measured at the point of interconnection unless otherwise agreed. For synchronous machines, the regulators and exciters will be required to react during faults (i.e., within cycles). For wind farms that will have induction machines installed, PacifiCorp may accept slower adjustments to voltage regulation on a case-by-case basis.

The generator shall normally be operated with the generator automatic voltage regulator in a constant voltage regulation mode. The voltage regulator shall be adjusted periodically throughout each day to maintain reactive output within a range defined by PacifiCorp and consistent with the reactive requirements for the local transmission system. This may be a voltage that minimizes the reactive interchange between PacifiCorp's system and the generating facility or, at PacifCorp's discretion, the PacifiCorp dispatcher may ask the plant operator to hold a higher or lower voltage so as to cause the facility to supply or absorb reactive power in support of specific system-control objectives. It is the owner's responsibility to insure that the transformer tap position and all other equipment are compatible with this objective.

8.1.2 Power Factor Control

For units smaller than 100 kW and/or in special cases as mutually agreed, a power factor controller shall be utilized to maintain a constant power factor at the point of interconnection by controlling the voltage regulator or other relevant equipment. The controller must be capable of maintaining a power factor within ± 1 percent at full load at any set point between 95 percent lagging (producing VArs) and 95 percent leading (absorbing VArs) measured at the point of interconnection. In addition, all power-factor controllers for generators larger than 1,000 kW must have programmable capability to vary hourly settings. The PacifiCorp Control Center shall specify required settings for voltage or power factor. Generally, as noted above, a voltage will be specified which minimizes the reactive interchange between PacifiCorp's system and the generating facility.

In the event that the generator by itself is not capable of providing sufficient reactive power at the point of interconnection so as meet the 0.95 leading/lagging power factor requirement, switched shunt compensation or dynamic VAr equipment may be required.

The programmable controller for units larger than 1,000 kW is normally obtained by combining a non-programmable controller and a general purpose programmable device.

Control over the VAr production associated with the delivery of power to PacifiCorp falls under the following general classifications, depending upon contractual arrangements:

Surplus-Sale Operation: When a Facility Interconnection Customer dedicates its generator to serving plant needs first, selling only the surplus to PacifiCorp, treatment differs depending on whether excess power is being sold *to* PacifiCorp or supplemental power (no-sale mode) is being purchased *from* PacifiCorp. In no-sale mode, the Facility Interconnection Customer has sole control over VAr production, however the customer shall meet the power factor requirements for its overall facility as described by applicable tariff(s). When surplus power is being sold, PacifiCorp has operational control of the power factor at which the power is delivered.

Net-Sale Operation: All electricity produced, excluding station load, is sold to PacifiCorp. PacifiCorp therefore has operational control of VAr production within the generator operating range.

No-Sale Operation: When a Facility Interconnection Customer uses generation exclusively to offset load, the customer has sole control of the generator power factor, however the customer shall meet the power factor requirements for its overall facility as described by applicable tariff(s).

For generation connected to the PacifiCorp transmission system at less than 1 MW with the total output being sold to PacifiCorp, all electricity produced, excluding station load, is sold to PacifiCorp. PacifiCorp therefore has operational control of VAr production within the generator operating range.

8.2 Synchronous Generator Frequency/Speed Control

To enhance system stability, a governor is required on the prime mover, set to provide a 5 percent droop characteristic (a 0.15 Hz change in the generator speed will cause a 5 percent change in the generator load). Exceptions must be approved by PacifiCorp. Governors shall be operated unrestrained to regulate system frequency.

8.2.1 Non-Synchronous Generator Control (without VAr Control)

Induction generators or other generators without VAr control absorb VArs and therefore require reactive power support from PacifiCorp's system. For facilities larger than 40 kW, PacifiCorp will require power factor correction. Power factor correction or capacitors must be installed either by the Facility Interconnection Customer or as part of the special facilities installed by PacifiCorp at customer expense. Care must be exercised by the Facility Interconnection Customer in connecting capacitors directly to the generator terminals to avoid self-excitation. Stand-alone switched capacitors supplied by the Facility Interconnection Customer that are not an integral part of the generator control system shall be switched on and off at the request of PacifiCorp.

8.2.2 Induction Generators

Switched capacitors may be required by PacifiCorp in areas where severe reactive limitations exist. The Facility Interconnection Customer must provide reactive supply sufficient to operate at as near-unity power factor as can be safely achieved without risk of self-excitation. Typically the power factor should range from 97 percent leading power factor (absorbing VArs) and 1.0 (unity). PacifiCorp may further require the provision of reactive support equivalent to that provided by operating a synchronous generator anywhere within the range from 95 percent leading power factor (absorbing VArs) to 95 percent lagging power factor (producing VArs) within an operating range of ± 5 percent of rated generator terminal voltage and full load. (This is typical if the induction project is greater than 1,000 kW.)

8.3 Generator Step-Up Transformer

The available voltage taps of a Facility Interconnection Customer 's step-up transformer must be reviewed by PacifiCorp for their suitability with PacifiCorp's system. The Facility Interconnection Customer is expected to have this reviewed before acquiring the transformer.
PacifiCorp shall determine which voltage taps would be suitable for a step-up transformer for the Facility Interconnection Customer 's proposed project. Suitable taps are required to give the transformer the essential capacity for the generator to:

- Deliver maximum reactive power to PacifiCorp's system at the point of interconnection (generator operating at 95 percent lagging power factor) and,
- Absorb maximum reactive power from the PacifiCorp system (generator operating at 95 percent leading power factor).

The Facility Interconnection Customer 's transformer, with correct voltage taps, helps maintain a specified voltage profile on PacifiCorp's system for varying operating conditions. Actual voltage tap settings can be different for transformers connected at the same voltage level, depending upon their geographic location.

8.4 Grid Operations

The following data will be gathered by PacifiCorp in order to fully comply with NERC Standard TOP-005-1, *Operational Reliability Information* and FAC-001-0, *Facility Connection Requirements*. Grid operations will need the following SCADA and tone-telemetered generator data for 3 MW and higher plants connected to PacifiCorp transmission system voltages (46KV and higher):

1. Status (of breakers).
2. MW and MVAr capability.
3. MW and MVAr net output.
4. Status of automatic voltage-control facilities (capacitors, reactors, dynamic VAr devices).

   The same standard requires that key voltages be metered (and PacifiCorp's voltage requirements adequately address this need).
5. Tone telemetry.

Note that in WECC units, 10 MVA and above must have automatic voltage requlation (AVR) installed on them.

8.5 Direct Digital Control

Dispatchable generator units larger than 10,000 kW are required to have real-time direct-digital control of unit output from the PacifiCorp Control Center. This will allow generation units to respond to system load/frequency changes.

8.6 Power System Stabilizer Operating Requirements for Generators

If a power system stabilizer (PSS) is a required part of the generator's voltage regulator, it must be operated and maintained in accordance with the standard procedures developed by WECC. Recalibration and testing of the PSS is required at least every five years, with data submitted for approval to PacifiCorp's Transmission Account Manager

PacifiCorp is responsible for the safe and reliable operation of the electric system. Because failure of the Facility Interconnection Customer to recalibrate and test its PSS

could adversely impact system operation, PacifiCorp reserves the right either to disconnect from, or refuse to parallel with, any Facility Interconnection Customer which does not operate and maintain its generator control systems in accordance with applicable reliability criteria or standards. Any sanctions or penalties assessed due to failure to meet WECC Reliability Management System (RMS) operating requirements (available from the WECC website at *http://www.wecc.biz*) for units equipped with PSS shall be the sole responsibility of the Facility Interconnection Customer.

8.7 Power Quality Policy

8.7.1 Voltage Fluctuation Limits

A customer connected to the PacifiCorp system must not cause harmful voltage fluctuations or interference with service and communication facilities. Any generation facility that does so is subject to being disconnected from the PacifiCorp system until the condition has been corrected.

8.7.2 Harmonic Limits

All customers shall comply with the voltage and current harmonic limits specified in IEEE Standard 519 1992, *Recommended Practices and Requirements for Harmonic Control in Electrical Power Systems.*

The harmonic content of the voltage and current waveforms in the PacifiCorp system must be restricted to levels which do not cause interference or equipment operating problems for PacifiCorp or its customers.

Any harmonic problems shall be handled on a case-by-case basis. A customer facility causing harmonic interference is considered by PacifiCorp as a serious interference with service and is subject to disconnection from the PacifiCorp system until the condition has been corrected. If the cause of the problem is traceable to the Facility Interconnection Customer 's facilities, all costs associated with determining and correcting problems shall be at the customer's expense.

Many methods may be used to restrict harmonics. The preferred method is to install a transformer with at least one delta connection between the interconnected facility and the PacifiCorp system. This method significantly limits the amount of voltage and current harmonics entering the PacifiCorp system. Generation system configuration with a star-grounded generator and a two-winding (both star-grounded) transformer shall not be allowed.

8.7.3 Voltage Flicker Limits

PacifiCorp's Engineering Handbook Section 1C.5.1, *Voltage Fluctuation and Light Flicker* will be utilized to evaluate any voltage flicker issue that may arise during the interconnection study process for transmission voltages. This subject typically arises on wind-turbine installations. It is usually rare that voltage flicker is an issue on transmission voltages. It could become problematic on the very rare 34.5 kV transmission lines and 46 kV transmission lines PacifiCorp owns and/or in single-turbine installations.

All generation interconnection projects must comply with this standard. The cost of corrective measures necessary for a project that does not comply with this standard will be borne solely by the Facility Interconnection Customer. It is necessary to acquire written review and approval from PacifiCorp before any corrective equipment is purchased and installed.

9 OPERATING REQUIREMENTS

1. The Facility Interconnection Customer shall not commence parallel operation of interconnected facility(s) until final written acceptance has been given by PacifiCorp. PacifiCorp reserves the right to inspect the Facility Interconnection Customer's facility and witness testing of any equipment or devices associated with the interconnection. The Facility Interconnection Customer shall submit a written, detailed procedure with specific requirements for initial commissioning of the Facility Interconnection Customer's generation and interconnecting facilities for PacifiCorp approval. PacifiCorp and the Facility Interconnection Customer shall each identify one representative to serve as a coordination contact to be the initial point of contact and coordinate communications between the parties for both normal and emergency conditions. PacifiCorp and the Facility Interconnection Customer shall notify each other in writing of the personnel that it has appointed as its coordination contact. PacifiCorp and the Facility Interconnection Customer shall abide by their respective switching and tagging rules for obtaining clearances for work or for switching operations on equipment. Such switching and tagging rules shall be developed in accordance with OSHA standards. PacifiCorp and the Facility Interconnection Customer shall develop mutually acceptable switching and tagging rules for PacifiCorp's and the Facility Interconnection Customer 's facilities that involve common clearance requirements. The Facility Interconnection Customer shall follow PacifiCorp directives with regard to emergencies on the PacifiCorp system.
2. The following are required before the Customer will be given permission for each operational milestone:
   a. Back feed requires that protection and metering to be complete and operational.
   b. First synchronization requires that all protection, metering, *and communications* be complete and operational. Power delivered to the system after first synchronization but prior to commercial operations is test energy.
   c. Commercial operations requires that the customer all testing be complete and the customer is ready to deliver commercial power.
3. The Facility Interconnection Customer shall not be permitted to energize a de-energized PacifiCorp circuit and will follow lockout/tagout procedures.
4. The operation of the Facility Interconnection Customer's on-site equipment shall not result in unacceptable service to other PacifiCorp customers, such as voltage and frequency fluctuations or harmonic currents on the PacifiCorp system. The Facility Interconnection Customer shall comply with the latest revision of PacifiCorp's allowable voltage flicker standards
5. The operation of the Facility Interconnection Customer's on-site generation shall not cause the service voltage for other PacifiCorp customers to go outside the requirements of ANSI C84.1, Range A.
6. The operation of the Facility Interconnection Customer's on-site generation shall not adversely affect the voltage regulation of the PacifiCorp system.
7. The operation of the Facility Interconnection Customer's on-site generation shall be conducted in a manner that minimizes reactive flow from the on-site generation to the PacifiCorp system, except when requested to assist in voltage control on the PacifiCorp system.
8. The Facility Interconnection Customer shall design the large generating facility to maintain a composite power delivery at continuous rated power output measured at the generator

terminals at a power factor within the range of 0.90 leading to 0.95 lagging, unless the transmission provider has established different requirements that apply to all generators in the control area on a comparable basis. This shall apply to all units unless specifically exempted by FERC, NERC, or PacifiCorp. The Facility Interconnection Customer's voltage regulation equipment will be designed and operated to limit VAr flow to a power factor between 0.90 leading and 0.95 lagging except for units connected to the PacifiCorp distribution system rated at 15 kV and less. These generators are to maintain unity power factor and shall not regulate the distribution system voltage unless requested or required to do so by PacifiCorp per IEEE 1547 Standards.

9. The operation of the Facility Interconnection Customer's on-site induction machines or other non-synchronous generation shall be required to provide the same VAr support as synchronous machines unless specifically exempted by FERC or other governmental authority.
10. Operation of the Facility Interconnection Customer 's equipment shall not adversely affect the voltage regulation of the PacifiCorp system. The Facility Interconnection Customer shall minimize the reactive flow, except when requested to assist in voltage control on the PacifiCorp system. The Facility Interconnection Customer shall provide adequate voltage control to minimize voltage regulation on the PacifiCorp system caused by generator loading conditions.
11. In cases where starting or load-changing on induction generators will have an adverse impact on PacifiCorp system voltage, step-switched capacitors or other techniques may be required to attenuate the voltage changes to acceptable levels.
12. For synchronous generators, sufficient generator reactive power capability shall be provided to withstand normal voltage changes on the PacifiCorp system. The generator voltage-VAr schedule, voltage regulator, and transformer ratio settings will be jointly determined by PacifiCorp and the Facility Interconnection Customer to ensure proper coordination of voltages and regulator action. The Facility Interconnection Customer is encouraged to genrate their own VAr requirements to minimize power factor adjustment charges and enhance generator stability.
13. Induction or other non-synchronous generating installations shall provide the same voltage and VAr support as synchronous installations referenced in Section 7.10, except where specifically exempted by FERC or other governmental authorities.
    a. Where the Facility Interconnection Customer's installation does not comply with this requirement, and the existing PacifiCorp system can reliably supply the VARs for voltage support without installations of reactive compensation, the Facility Interconnection Customer may either purchase the reactive requirements for voltage support from PacifiCorp or supply such requirements with its own compensation. The reactive supply obtained from PacifiCorp shall be billed on a tariff to be determined during contract discussions.
    b. Where the Facility Interconnection Customer's installation does not comply with this requirement and the existing PacifiCorp system cannot reliably supply the VArs for voltage support, PacifiCorp shall install apparatus on the PacifiCorp system to supply the required VArs. The cost of the apparatus, controls, installation, and operation shall be paid according to OATT requirements and procedures.
14. Reactive power supply requirements for inverter systems are similar to those for induction generators and the preceding comments apply except where specifically exempted by FERC or other governmental authorities.

15. To avoid self-excitation, care shall be exercised in applying power factor correction capacitors directly to or electrically near induction generator terminals.
16. The Facility Interconnection Customer shall discontinue parallel operation when requested by PacifiCorp for the following purposes:
    a. To facilitate maintenance, tests, or repairs of the PacifiCorp electric system.
    b. During emergencies on the PacifiCorp system.
    c. When the Facility Interconnection Customer generating equipment is interfering with customers on the PacifiCorp system.
    d. When an inspection of the Facility Interconnection Customer reveals a condition hazardous to the PacifiCorp system or a lack of scheduled maintenance records is found.
17. WECC requires all members to share in an operating reserve or Generation Reserve Sharing Pool. PacifiCorp shall require a specific agreement to supply operating reserve to cover the Facility Interconnection Customer 's generation to load at that site. The generator will provide or contract for adequate generation to meet WECC or power pool generation reserve, spinning reserve, and load-following requirements.
18. The Facility Interconnection Customer shall comply with all NERC, WECC, and PacifiCorp Underfrequency Load Shedding requirements. During any underfrequency situation, the Facility Interconnection Customer shall agree to immediately make available to PacifiCorp any spinning or operating reserves that exist on their generation.
19. The Facility Interconnection Customer shall adhere to WECC Operating Standards, any PacifiCorp Operating Guides, and any additional operating requirements either stated herein or mutually agreed to elsewhere. The latest revision of all applicable documents shall serve as the minimum requirements for system operation. These documents are available at the publishing organizations respective website. Contact the Transmission Account Manager for further details.
20. PacifiCorp and the Facility Interconnection Customer may, in accordance with good utility practice, remove from service facilities or network upgrades as necessary to perform maintenance, test, and install or replace equipment. PacifiCorp and the Facility Interconnection Customer will use reasonable efforts to coordinate outages for maintenance on dates and times mutually acceptable to both parties.
21. The Facility Interconnection Customer shall compensate PacifiCorp for any incremental energy or reactive losses and incremental demand charges resulting from changes in system power flow caused by the Facility Interconnection Customer 's system addition in accordance with OATT requirements and procedures.
22. The Facility Interconnection Customer shall operate the interconnection facilities in compliance with the latest revision of the National Electric Safety Code, applicable state codes, PacifiCorp safety rules, and IEEE Std 519. Failure to comply with said safety policies and power-quality standards will result in the interconnection being opened. The interconnection will not be re-established until compliance has been determined.
23. The Facility Interconnection Customer shall maintain its interconnection facilities and any generating equipment that could negatively impact the PacifiCorp system in good order. PacifiCorp reserves the right to inspect the Facility Interconnection Customer's facilities on a periodic basis or whenever it appears that the Facility Interconnection Customer is operating in a manner hazardous to PacifiCorp's system integrity.

9.1 Specific Generator Interconnection Requirements

The following requirements apply specifically to generation interconnections. The equipment associated with the Facility Interconnection Customer's generation equipment should be protected in accordance with the practices described in the latest revision of the following ANSI/IEEE standards or guides. There may be special requirements imposed by PacifiCorp due to the specific project or application.

ANSI C50.10-1990, *General Requirements for Synchronous Machines*

ANSI 50.12-1982, *Requirements for Salient Pole Synchronous Generators and Condensers*

ANSI C50.13-1989, *Requirements for Cylindrical-Rotor Synchronous Generators*

ANSI C50.14-1977, *Requirements for Combustion Gas Turbine Driven Cylindrical-Rotor Synchronous Generators*

ANSI/IEEE C37.101, *Guide for Generator Ground Protection*

ANSI/IEEE C37.102, *Guide for AC Generator Protection*

ANSI/IEEE C37.106, *Guide for Abnormal Frequency Protection for Power Generating Plants*

ANSI/IEEE Std 1001, *Guide for Interfacing Dispersed Storage and Generation Facilities with Electric Utility Systems*

IEEE 1547, *Standard for Interconnecting Distributed Resources with Electric Power Systems*

In addition to the above-listed requirements, the following standards apply:

1. Any generating unit or line/end user interconnection to the PacifiCorp electric system with its output purchased by PacifiCorp or another network customer shall be considered a "Network Resource" under the terms of Part III of the OATT.
2. Generator installations requesting WECC accreditation must meet all NERC, WECC, and PacifiCorp requirements, including WECC Generation Reserve Sharing Pool requirements, URGE testing, and any reactive testing requirements.
3. The generator step-up (GSU) transformer connection will be determined by the system impact study. In general, the GSU must be effectively grounded on the utility side providing an adequate ground reference and will isolate the generator's zero sequence current from the PacifiCorp system through the use of an ungrounded connection on the generator side. The transformer shall be equipped with a no-load tap changer covering the range of ± 5 percent in 2.5 percent steps from the nominal voltage of the interconnection.
4. PacifiCorp requires synch-check relays to be installed on all circuit breakers interconnecting a generating unit to the PacifiCorp electric system.
5. Induction generators may use a speed-matching relay (Device 15) as a means of synchronization and to limit the magnetizing inrush current/voltage drop. The speed matching must keep voltage flicker at the point of interconnection within PacifiCorp voltage flicker requirement and within IEEE 519 requirements.
6. Generation operated in parallel with the PacifiCorp electric system may supply additional fault current energy which shall be disconnected in case of a disturbance on PacifiCorp's system. The existence of parallel generation may alter the operation of protective devices normally used by PacifiCorp to protect the system.

7. Equipment shall be provided to detect system abnormalities in the Facility Interconnection Customer 's or PacifiCorp's system, and shall have the capability to isolate the sources of the disturbance. At a minimum, the Facility Interconnection Customer shall provide adequate protective devices to:

   a. Detect and clear the generator(s) from short circuits on PacifiCorp facilities serving the interconnecting facilities.

   b. Detect the voltage and frequency changes which can occur if PacifiCorp facilities serving the interconnecting facilities are disconnected from the main system, and clear any Facility Interconnection Customer generation/load from the isolated system if necessary.

   c. Prevent reclosing the Facility Interconnection Customer's generation to PacifiCorp after an incident of trouble, until authorized to recluse by PacifiCorp's Portland or Salt Lake City dispatch centers.

   d. Isolate Facility Interconnection Customer's generation from the PacifiCorp electric system upon:

      - Receipt of a direct trip signal from an upstream PacifiCorp substation.
      - Failure of the communications channel used for direct tripping.
      - Receipt of a trip command from the Portland or Salt Lake City dispatch center via SCADA.

8. PacifiCorp, at its discretion, may require out-of-step protection and/or loss of excitation protection and/or overexcitation protection to trip or block-trip the Facility Interconnection Customer 's interconnection. The requirement for this protection will be determined during system studies.

9. The Facility Interconnection Customer should be aware that certain conditions on PacifiCorp's system can cause negative sequence currents to flow in the generator. It is the sole responsibility of the Facility Interconnection Customer to protect the Facility Interconnection Customer's equipment from excessive negative sequence currents.

10. The Facility Interconnection Customer shall design its facilities (generation or otherwise) to avoid causing dynamic voltage excursions above 1.2 and below 0.7 pu according to WECC performance design standards (see the WECC Reliability Handbook for NERC/WECC Planning Standards, Guidelines, and System Performance Table). The WECC Reliability Handbook may be accessed via the WECC website or may be obtained upon request from the Transmission Account Manager.

11. The Facility Interconnection Customer shall design its generation to remain online for faults and for any resulting low voltages to maintain system reliability. Generation must remain online for the duration of a normally-cleared (single- or three-phase) fault on the electric system up to a maximum of nine cycles, as well as for the recovery from such a normally-cleared fault even where the voltage drops to zero during the clearing of the fault.

12. Generators must be designed to remain online for normal clearing system faults within close proximity to the plant switchyard. Voltage may approach zero at the switchyard bus for nine cycles for some types of faults. Control systems, contactors, motors, and auxiliary loads which are critical to the operation of the plant must not drop out under these conditions. Critical 480 V supply contactors must be provided

with ride-through capability where required. Additionally, generator protection systems such as the Load Drop Anticipator, Early Valve Actuator, or Power Load Unbalance should not be designed to trip a generator for normal clearing external faults or stable swings.

13. The Facility Interconnection Customer shall design its generation to remain online for off-nominal frequency operation according to IEEE C.37.106 or the following time frames in accordance with PacifiCorp and WECC region over/underfrequency requirements:

Table 5–Over/Underfrequency Requirements

Underfrequency Range (Hz)	Overfrequency Range (Hz)	Time
60.0 - 59.7	60.0 - 60.3	Continuous
59.7 - 59.5	60.4 - 61.5	Continuous Governor action
59.4 - 58.7	61.6 - 61.8	10 minutes
58.6 - 58.5	61.9 - 62.0	30 seconds
58.5 - 57.4	--	7.5 seconds
57.3 - 56.9	–	45 cycles
56.8 - 56.5	–	7.2 cycles
< 56.4	> 62.0	Instantaneous trip

14. Only solid state microprocessor underfrequency relays shall be used on generators to provide off-nominal frequency protection.

15. Synchronous generators with a nameplate rating greater than 20.0 MVA shall have generator protection set such that it does not result in tripping of the generator for the following conditions:

    a. Generator terminal voltages that are within five percent of the rated nominal design voltage.

    b. Generator terminal voltage deviations that exceed five percent but are within 10 percent of the rated nominal design voltage and persist for less than 10 seconds.

    c. Generator volts per hertz conditions that are less than 116 percent (of generator nominal voltage) that last for less than 1.5 seconds.

    d. Generator overexcited stator currents (or generator apparent impedance) less than 150 percent of nameplate rating persisting for less than five seconds.

16. Documentation of the generator protection and controls that could respond to these conditions by tripping the generator shall be provided to PacifiCorp. In the event the generating equipment owner cannot correct or mitigate these potential generator trip conditions, a request for a waiver may be made to PacifiCorp. A waiver may be justified in certain special circumstances such as low adverse reliability consequences from generator tripping.

17. All synchronous generators connected to the PacifiCorp transmission system are to be equipped with automatic voltage regulators (AVR). Generators must operate with their excitation system in the automatic voltage control mode unless otherwise approved by the PacifiCorp system operator. Generating equipment owners shall

maintain a log which records the date, time, duration and reason for not being in the automatic voltage control mode when operating in parallel with the PacifiCorp system. Generating equipment owners shall make this log available to PacifiCorp on request.

18. All synchronous generators connected to the PacifiCorp transmission system must maintain a network voltage or reactive power output as specified by the PacifiCorp system operator within the reactive power capability of the generating equipment. Generating equipment owners shall maintain a log which records the date, time, duration, and reason for not meeting the network voltage schedule or desired reactive power output when operating in parallel with the PacifiCorp system. Generating equipment owners shall make this log available to PacifiCorp on request.
19. The generator step-up and auxiliary transformer tap settings shall be coordinated with PacifiCorp transmission systems voltage requirements. Generating equipment owners shall provide PacifiCorp with generator step-up and auxiliary transformer tap settings and available ranges.
20. The AVR's control and limiting functions must coordinate with the generator's short time capabilities and protective relay settings. The generating equipment owner shall provide PacifiCorp with the AVR's control and limiter settings as well as the protection settings which coordinate with AVR control and limiting functions.
21. All new synchronous generators connected to the PacifiCorp transmission system with a nameplate rating greater than 20 MVA shall be equipped with a speed/load governing control that has a speed droop characteristic in the three to six percent range. The preferred droop characteristic setting is five percent. Notification of changes in the status of the speed/load governing controls must be provided to the PacifiCorp System Operator.
22. Prior to commercial operation, the generating equipment owner shall provide PacifiCorp with open circuit, step-in voltage test results. Recording of generator terminal voltage and field voltages shall be clearly labeled so that initial and final values can be identified in physical units.
23. Generating equipment owners shall annually test the gross and net dependable summer and winter capability of their units. These test results shall be provided to PacifiCorp.
24. Generating equipment owners shall test the gross and net reactive capability of their units at least every five years. These test results shall be provided to PacifiCorp.
25. Generating equipment owners shall test the AVR control and limit functions of their units at least every five years. An initial test result shall be provided to PacifiCorp prior to commercial operation and every five years thereafter. The initial test results shall include documentation of the settings AVR control and limit functions. Typical AVR limit functions are maximum and minimum excitation limiters and volts per hertz limiters. Documentation of the generator protection that coordinates with these limit functions shall also be provided. Typical generator protection of this type includes overexcitition protection and loss of field protection.
26. The Facility Interconnection Customer generator shall meet all WECC requirements for providing an appropriate high-response excitation system and shall make provisions for a Power System Stabilizer (PSS) on all units rated at 70 MW and greater. The exciter shall meet the following requirements:

a. The response ratio less is less than 2.0 as demonstrated through calculations consistent with IEEE Standard 421.2-1990.

b. The response time is less than 0.1 second as demonstrated through the completion of a response ratio test.

c. The open circuit step-response test is satisfactory; where satisfactory means that the response is not oscillatory in nature.

27. The Facility Interconnection Customer shall demonstrate that they have the appropriate exciter model by providing P/SSE or other plots of generator response ratio tests and opencircuit step tests that demonstrate the unit meets the criteria in item 29 below.

28. The Facility Interconnection Customer generator shall meet all WECC requirements for the installation and tuning of PSS where appropriate long-term dynamic stability and eigen value studies show a positive contribution to the damping torque in the frequency range from 0.25 Hz to 2.0 Hz.

29. Where stabilizing equipment is installed on generating equipment for the purpose of maintaining generator or transmission system stability, the generating equipment owner is responsible for maintaining the stabilizing equipment in good working order and promptly reporting to the PacifiCorp system operator any problems interfering with its proper operation.

30. PacifiCorp will maintain a contact list of all Facility Interconnection Customers tied to PacifiCorp's transmission circuits for routine and emergency grid operation use. This list will compile the normal and emergency phone numbers for the Facility Interconnection Customer's facilities and an e-mail address if available. It will be the responsibility of the Facility Interconnection Customer to notify PacifiCorp in a timely fashion when any of this information is altered or changed for whatever reason. To keep the list current, the new updated information will be supplied to:

Transmission Interconnection Account Manager
825 N.E. Multnomah Blvd. Suite 1600
Portland, Oregon 97232
(503) 813-6102

10 COMMISSIONING FOR FACILITY INTERCONNECTIONS

The following outlines PacifiCorp's procedure for performing commissioning activities. All time requirements must be met for PacifiCorp to provide the Facility Interconnection Customer with timely service. Any inspections required by local government agencies must be completed and permits signed off prior to the pre-parallel date.

Since the meter installed for the facility interconnection is PacifiCorp-owned, a PacifiCorp meter/relay technician will be the only person authorized to test the meter. Coordination between the developer and PacifiCorp's project manager is recommended at least two months before the start-up date to assure that timelines for project completion are met. The owner/developer will provide unrestricted access for PacifiCorp's employees or vendor employees (whichever are utilized) to the equipment to be commissioned.

PacifiCorp will either utilize its own qualified employees or a contractor from its approved contractor list. Commissioning of any relays which tie with the PacifiCorp system and affect PacifiCorp's customer must be certified by a Professional Engineer licensed in the state in which the interconnection project is located.

It is the Facility Interconnection Customer's responsibility to provide adequate notification through the PacifiCorp project manager for commissioning activities.

It shall be the owner/developer's responsibility to pay for all commissioning costs

Commissioning testing, where required on either PacifiCorp-owned equipment or equipment that affects the operational integrity of the electrical circuit, will be performed on site to verify protective settings and functionality. Upon initial parallel operation of a generating facility, or any time interface hardware or software is changed which may affect the functions listed below, a commissioning test must be performed. Individual qualified in testing protective equipment (a Professional Engineer, factory-certified technician, or licensed electrician with verifiable experience in testing the protective equipment) must perform commissioning testing in accordance with the manufacturer's recommended test procedure to prove that the settings and requirements of PacifiCorp's interconnection study report are met. PacifiCorp reserves the right to witness commissioning tests listed below and requires written certification stamped by a Professional Engineer from the state in which the project resides describing which tests were performed and their accompanying results.

10.1 Test Results

All tests outlined below must be complete and two copies of the test reports submitted to a PacifiCorp representative a minimum of 15 working days before the requested energize date unless otherwise agreed to by PacifiCorp. All test reports require header information reflecting the equipment identification matching the one- or three-line diagrams. One-line and three-line diagrams of the facility are required to be submitted with the test reports. All requirements must be met and test reports approved at least three working days before the requested pre-parallel date.

10.1.1 Proving Insulation

For any of the megger tests referred to below a 2,500 V DC megger or a hi-pot is preferred, but a 1,000 V DC megger is acceptable.

1. All transformers connected to the primary bus and the main transformer must be meggered winding-to-winding and each winding to ground. For purposes of this document, "primary bus or PacifiCorp side of the bus or conductor" is defined as the source-side bus or conductor from the primary interrupting device to the generating plant.

2. All circuit breakers and circuit switchers connected to the primary bus and at the interconnection point must be meggered in the following manner: breaker open each pole to ground, pole 1 2, pole 3 4, pole 5 6; breaker closed pole 1 ground, pole 3 ground, pole 5 ground and if the poles are in common tank or cell, pole 1 3, pole 3 5, pole 5 1.
3. All buses and cables shall be meggered phase–to-phase and phase-to-ground.
4. The main transformer(s) and main breaker(s) shall have a dielectric test performed on the insulating medium (gas or oil). The unit shall pass this test by keeping within the acceptable levels for all gasses or other elements in the oil as certified by the laboratory chemist before energization. This will not apply to factory-sealed circuit switcher interrupters.
5. The generator(s) must be meggered or hi-pot-tested phase-to-phase and phase-to-ground.

10.1.2 Proving Ratios

All ratios of transformers connected to the primary bus must be proven using either a turns ratio tester or a voltage ratios test. The main transformer must be tested on the final operating tap. This tap shall be recommended by PacifiCorp to best match current transmission system operating voltages.

10.1.3 Circuit Breakers and Circuit Switchers

1. A minimum to trip at 70 percent or less of the nominal DC control voltage must be performed on all circuit breakers and/or circuit switchers which are operated by PacifiCorp required relays. All units must pass this test.
2. A micro ohm test must be performed on all circuit breakers and circuit switchers. The units tested must pass the micro ohm test.
3. A timing test showing the time from trip initiation to main poles opening is required. All units must pass this test.
4. A timing test showing the time from close initiation to main poles closing is required. All units must pass this test.

10.1.4 Current Transformers and Current Circuits

1. A saturation check should be made on all current transformers (CTs) associated with the required PacifiCorp relays. If this is not possible, a manufacturer's curve is acceptable.
2. The ratio of all CTs must be proven by either a current (primary-to-secondary) or voltage (secondary-to-primary) test.
3. CT circuits must be checked for proper connections and continuity by applying primary current and reading the results in the relays. Each test must be performed in all combinations to prove proper connections to all phase and ground relays. Current must be applied or injected to achieve a secondary reading of five amps in each relay to ensure that no loose wiring or parallel current paths exists.
4. A single-phase burden check must be made on each phase of each current circuit feeding PacifiCorp required relays.

5. A megger check of the total circuit with the ground wire lifted must be done to prove that only one ground exists.

10.1.5 Relays

All relays must be field tested on site to their specified settings to verify the following:

1. Minimum operating point at which relay picks up (minimum pickup).
2. Time delay at three different current test points, in integral multiples of minimum pickup that closely characterize the relay time current curve.
3. Phase-angle characteristic of the directional relay.
4. Pickup points at maximum torque angle (MTA) and ± 30 degrees of MTA on impedance relays using the approved settings.
5. Slip-frequency, voltage-matching, phase angle-acceptance, and breaker compensation time on synchronizing relays.
6. PacifiCorp tolerances are listed below:

Table 6–PacifiCorp Relay Tolerances

Relay Type	Tolerance
Current / Voltage / Time	± 10.0 percent
Impedance / Phase Angle	± 0.05 percent
Frequency	± 0.05 percent

If a pilot relay system is required by PacifiCorp, signal level checks must be performed to PacifiCorp standards.

10.1.6 Primary Disconnect Switch

The primary disconnect switch at the point of interconnection shall be assigned a number by PacifiCorp. The switch, platform, and switch number plate bracket must be constructed to PacifiCorp Engineering Standards, Section TS. A switch number plate bracket shall be furnished by PacifiCorp.

10.1.7 Checklists and Forms for Equipment Commissioning

The Transmission Account Manager will have available for both internal and external use checklists and forms for all relevant facility interconnection equipment to be commissioned for the Facility Interconnection Customer.

The commissioning process will be coordinated through the Project Manager with other PacifiCorp employees in the field.

10.2 Pre-Parallel Test for Generator Developers

Where generation has a rated output in excess of 100 kW, the entity shall reimburse PacifiCorp for the cost of performing the pre-parallel inspection.

The Facility Interconnection Customer is responsible for ensuring that all relays and other protective devices are adjusted and working properly prior to the pre-parallel inspection. If problems arise with equipment during testing, the PacifiCorp protection representative may elect to cancel the test and reschedule.

All pre-parallel tests should be scheduled to begin at 9 a.m., Monday through Friday only. Functional tests shall be performed by the Facility Interconnection Customer and

all tests shall be observed by PacifiCorp as outlined below. The Facility Interconnection Customer shall provide all test equipment and qualified personnel to perform the required tests. PacifiCorp shall be there strictly as an observer. The appropriate commissioning form shall be completed by the PacifiCorp representative on site at the time of the pre-parallel inspection.

10.2.1 Functional Tests

The following functional tests shall be performed after the equipment has been energized, but before the generator is paralleled with PacifiCorp's system:

1. Check that each protective relay trips the appropriate generator breaker and/or main breaker. This may require injecting a signal. **Jumpering across contact on the back of the relay is not acceptable.**
2. When first energized, check that proper secondary potential is applied to all voltage and frequency relays.
3. Check the synchronizing meter, synchronizing equipment, and phasing panel (if used) with the paralleling breaker closed and the generator offline. This typically requires lifting the generator leads. The equipment should show an "in-phase" condition.
4. Check the generator phase rotation. (PacifiCorp's phase rotation is A B C counterclockwise).
5. All three phases must be checked using hot sticks with a phasing tool or a phasing panel provided by the Facility Interconnection Customer. The synchronizing equipment typically checks one phase only. Phase rotation varies by area within the PacifiCorp system. Facility interconnection customers shall consult PacifiCorp for the correct rotation.

10.2.2 Impedance and Directional Relay Tests

Direction check all impedance and directional relays by doing the following:

1. Bring up load on the plant and/or generator.
2. Verify direction of power flow.
3. Measure the phase angle between the current and potential applied to the relay.
4. Observe the current action of the directional contacts according to the direction of power flow. Reverse either the potentials or current to prove contact operation for reverse power flow.

10.2.3 Generator Load Tests

For generators, the following load tests shall be performed after the generator picks up load:

1. Load check all PacifiCorp-required differential relays. The load current must balance to zero in all differential relays.
2. Load check voltage restraint overcurrent relays to prove correct connection of currents and potentials.
3. The generator(s) may have to be paralleled temporarily with PacifiCorp's system to run the load tests. Permission to do this shall be given by the

PacifiCorp operations representative observing the test by PacifiCorp dispatch.

4. Verify operation of the generator at 90 percent lagging power factor and at 95 percent leading power factor at rated output.
5. Verify operation of the generator at 95 percent and 105 percent of per unit voltage while delivering rated output.
6. Typically, pre-parallel inspections can be performed within a normal working day. PacifiCorp shall dedicate one full work day to observe the tests. If a test cannot be completed by 6 p.m., the PacifiCorp representative may cancel the remainder of the test and reschedule it. In this case the Facility Interconnection Customer shall be charged another pre-parallel inspection fee.

10.3 Parallel Operation for Generator Developers

10.3.1 Clearance for Parallel Operation (For Testing Purposes Only)

The PacifiCorp representative shall contact the PacifiCorp Control Center at least 72 hours (3 days) before the pre-parallel test and obtain a clearance for parallel operation. The PacifiCorp representative shall provide the Control Center a drawing indicating which PacifiCorp circuit the generation facility will be connected to and which PacifiCorp operated disconnect will be identified with a PacifiCorp-designated number. When the pre-parallel test is passed, the generator may at PacifiCorp's discretion be allowed to operate in parallel with PacifiCorp for testing purposes only. This should not be mistaken as an official release for parallel operation. Once this testing only permission is granted, the generator may operate in accordance with a previously executed Generation Operating Agreement, or in the absence of such an agreement for a maximum of 14 days in accordance with good utility practice unless other arrangements are made with PacifiCorp.

10.3.2 Power System Stabilizer

During the 14-day testing period, the Power System Stabalizer (PSS) shall be calibrated and tested in accordance with the latest applicable WECC standard calibration and test procedures. The test report shall be submitted for approval to PacifiCorp's Transmission Account Manager. Adequate testing of the PSS can only occur on the generating unit(s) after pre-parallel inspection has been satisfactorily completed and the units are paralleled and supplying load. The generation facility shall not be considered officially operational until this PSS calibration and testing has been done to PacifiCorp's satisfaction.

10.3.3 Permission for Parallel Operation

At the end of this period, if the Facility Interconnection Customer has not received written permission from PacifiCorp to operate in parallel, the entity must isolate from PacifiCorp until written permission is received. Written permission to parallel shall be sent to the Facility Interconnection Customer via U.S. First Class mail. This shall be done after PacifiCorp has verified the following:

1. All proper contracts and documents have been executed and are in place.
2. The pre-parallel test has been passed.
3. PSS tests and calibration have been completed.

4. All other outstanding issues have been resolved, including rights-of-way, deeds of conveyance, insurance verification, and operating agreements.
5. PacifiCorp has received final copies of the one-line diagram and elementary diagrams that show as-built changes made during construction, as well as a completed finalized generator data sheet.
6. If applicable, firm capacity performance testing of new generators cannot begin until the Facility Interconnection Customer receives written permission from PacifiCorp to parallel.

10.4 General Notes

The PacifiCorp system has ABC counterclockwise rotation.

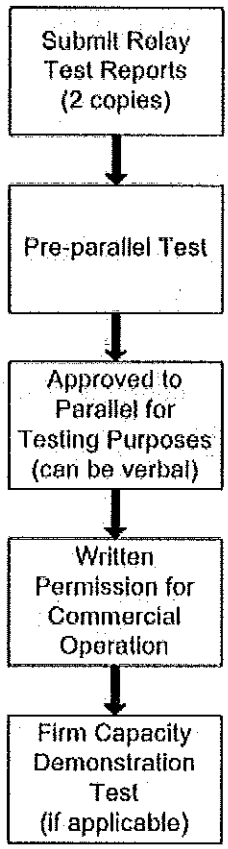
Any changes to PacifiCorp required protection equipment or major substation equipment (transformer, breaker, etc.) must be submitted to the PacifiCorp representative for review and approval by the appropriate PacifiCorp Engineer prior to the changes being made.

Routine maintenance on PacifiCorp-required protective relays and the breaker(s) must meet PacifiCorp's maintenance and test practices. After completion of these tests, test reports must be submitted to the PacifiCorp representative for review and approval by the appropriate PacifiCorp Engineer. A PacifiCorp technical representative shall then come to the customer's facilities and reseal the PacifiCorp required relays.

Questions should be directed to the PacifiCorp Transmission Account Manager.

10.5 Simplified Flow of Pre-Parallel/Parallel Test Procedure

Figure 2–Pre-Parallel/Parallel Test Procedure



11 GLOSSARY

A

Alternating Current (AC): That form of electric current that alternates or changes in magnitude and polarity (direction) in what is normally a regular pattern for a given time period called frequency.

Ampere: The unit of current flow of electricity. This is analogous to quantity per unit of time when referring to the flow of water. One ampere is equal to a flow of one coulomb per second.

Applicable Reliability Criteria: The reliability policies established by NERC, WECC, and local reliability criteria as amended from time to time, including any requirements of the NRC which are applicable to the particular type of generator and prime mover.

Automatic: Self-acting, operated by its own mechanism when actuated by some impersonal influence as, for example, a change in current strength; not manual; without personal intervention.

Automatic Control: An arrangement of electrical controls which provide for opening and/or closing in an automatic sequence and under predetermined conditions; the switches which then maintain the required character of service and provide adequate protection against all usual operating emergencies.

Automatic Generation Control (AGC): Generation equipment that automatically responds to signals from the EMS control in real time to control the power output of electric generators within a prescribed area in response to a change in system frequency, tie-line loading, or the relation of these to each other, so as to maintain the target system frequency and/or the established interchange with other areas within the predetermined limits.

Automatic Reclosing: A feature of some circuit breakers which allows them to reclose automatically after being tripped under abnormal conditions.

Automatic Tripping or Automatic Opening: The opening of a circuit breaker under predetermined conditions without the intervention of an operator.

B

Balanced Load: An equal distribution of load on all phases of an alternating current circuit.

Boost: To increase voltage.

Bundled Service or Bundled Utility Service: Traditional PacifiCorp service: transmission and distribution capacity for delivery, energy, and ancillary services.

Breaker: A switch which can open a circuit, usually designed for automatic operation.

C

Capacitance: Capacitance is developed when two charged or energized conductors are separated by a dielectric. An excess or deficiency of electrons is maintained on opposite plates of a charged capacitor. It may be said to be the property of an electrical circuit which opposes any change of voltage.

Capacity: The number of amperes of electric current a wire will carry without becoming unduly heated; the capacity of a machine, apparatus, or devices is the maximum of which it is capable under existing service conditions; the load for which a generator, turbine, transformer, transmission circuit, apparatus, station, or system is rated. Capacity is also used synonymously with capability.

Capacity Factor: The ratio of average load on a generating resource to its capacity rating during a specified period of time, expressed in percentages.

Circuit: A conducting part through which an electric current is intended to flow.

Circuit Breaker: A device for interrupting a circuit between separable contacts under normal or fault conditions.

Circuit Switcher: A device for interrupting a circuit between separable contacts under normal or fault conditions.

Class A Telephone Circuit: Service performance objective classification for a circuit which is non-interruptible before, during, and after a power fault condition.

Class B Telephone Circuit: Service performance objective classification for a circuit which is non-interruptible before and after a power fault condition exists.

Clearance: Permission to contact or to come in close proximity to wires, conductors, switches, or other equipment which normally might be energized at electrical, hydraulic, or pneumatic potential dangerous to human life. Conditions which must prevail before such permission can be granted are, in general, that the equipment or lines be completely isolated from all possible power sources and be tagged with properly filled out "man on line" tags.

Cogeneration: The sequential production of electricity and heat, steam, or useful work from the same fuel source.

Conductor: Material that can be used as a carrier of an electric current.

Control, Supervisory: A system for selecting control and automatic indication of remotely located units by electrical means, over a relatively small number of common transmission channels.

Control Switch: A switch controlling the circuit through circuit breakers or other switches which are magnetically operated.

Current: The part of a fluid (air, water, etc.) flowing in a certain direction. A flow of electric charge measured in amperes.

Current Transformer (CT): A transformer intended for metering, protective, or control purposes which is designed to have its primary winding connected in series with a circuit carrying the current to be measured or controlled. A current transformer normally steps down current values to safer levels. A CT secondary circuit must never be open-circuited while energized.

D

Dead-End Structure: The structure on which the last span of PacifiCorp-owned conductors terminates. Also called a landing structure. From the interconnection requester's point of view, it is sometimes called the take-off structure.

Delta-Connected Circuit: A three-phase circuit with three source windings connected in a closed delta (triangle). A closed delta is a connection in which each winding terminal is connected to the end (terminal) of another winding.

Demand: The rate at which electric energy is delivered to or by a system; normally expressed in kilowatts, megawatts, or kilovolt amperes.

Direct Access: Service election that allows customers to purchase electric power and additional related services from non-utility entities known as Energy Service Providers (ESPs).

Direct Current (DC): A unidirectional current in which the changes in value are either zero or so small that they may be neglected. (As ordinarily used, the term designates a practically non-pulsating current, such as the output of an electric battery.)

Disconnect: (noun) A device used to isolate a piece of equipment. A disconnect may be gang-operated (three operated together) or individually operated.

Dispatchability: Ability and availability of a generating facility to operate so that a utility can call upon it to increase or decrease deliveries of capacity to any level up to contract capacity.

Distribution Control Center: This center directs, coordinates, and implements routine and emergency switching activities on the PacifiCorp distribution system within its geographical jurisdiction.

Disturbance: Trouble (e.g., fault, sudden loss of load or generation, breaker operations, etc.) on the PacifiCorp power system resulting in abnormal performance of the system. See also System Emergency.

Droop: The slope of the prime mover's speed power characteristic curve. The speed droop, typically 5 percent, enables interconnected generators to operate in parallel with stable load division.

E

Electric Circuit: A path or group of interconnected paths capable of carrying electric current.

Electric Generator: See Generator.

Electric Substation: An assemblage of equipment for purposes other than generation or utilization, through which bulk electric energy is passed for the purpose of switching or modifying its characteristics. Service equipment, distribution transformer installations, and transmission equipment are not classified as substations.

End-Use Customer or End User: A purchaser of electric power who purchases such power to satisfy a load directly connected to the Electrical Power Grid and who does not resell the power.

Energize: To apply voltage to a circuit or piece of equipment; to connect a de-energized circuit or piece of equipment to a source of electric energy.

F

Fault Indicator: A device attached to lines which target when the current through the line exceeds the device setting.

Feeder: A circuit having as its primary purpose the distribution of electric energy.

FERC: Federal Energy Regulatory Commission.

Firm Capacity: Power committed to be available at all times during the period covered, except for forced outages and scheduled maintenance.

Forced Outage: Any unplanned outage resulting from a design defect, inadequate construction, operator error, or a breakdown of the mechanical or electrical equipment that fully or partially

curtails the delivery of electricity between a load or Facility Interconnection Customer Facility Interconnection Customer 's facility and the PacifiCorp power system.

Frequency: The number of cycles occurring in a given interval of time (usually one second) in an electric current. Frequency is commonly expressed in Hertz (Hz).

Fuse: A short piece of conducting material of low melting point which is inserted in a circuit and will melt and open the circuit when the current reaches a certain value.

G

Generation Facility: A plant in which electric energy is produced from some other form of energy by means of suitable converting apparatus. The term includes the generation apparatus and all associated equipment owned, maintained, and operated by the Facility Interconnection Customer.

Generator: The physical electrical equipment that produces electric power. Sometimes used as a brief reference to a Facility Interconnection Customer.

Grid-Critical Protective Systems: Protective relay systems and Remedial Action Schemes that the may have a direct impact on the ability to maintain system security.

Ground: A term used to refer to the earth as a conductor or as the zero of potential. For safety purposes, circuits are grounded while any work is being done on or near a circuit or piece of equipment in the circuit; this is usually called protective grounding.

Ground Bank: A secondary transformer bank installed on delta-connected winding to provide a path to ground for relaying purposes.

Ground Fault: An unintentional electric current flow between one or more energized conductors and the ground.

Ground Potential Rise: A calculated value of the highest expected voltage due to a line-to-ground fault at or near the station (power switchyard). The value is calculated as follows:

GPR = 1.2 (DC Transient Factor) x 1.4. x Ground Fault Return Current (rms) x Ground Resistance

H

Hertz (Hz): The term denoting cycles per second or frequency; named after Heinrich Hertz, the pioneering German scientist who performed research on electrical power.

I

IEC: International Engineering Consortium.

IEEE: Institute of Electrical and Electronic Engineers.

Inductance: The property of an electric circuit which produces a voltage by electromagnetic induction when the current in the circuit changes or varies. It opposes any change of circuit current.

Induction Generator: Typically an induction motor that is being driven by a prime mover at a speed which is faster than the synchronous mechanical speed to generate electric power. It typically depends on the host system for its excitation and speed regulation.

Interconnection Agreement (IA): An agreement between the utility and the Facility Interconnection Customer specifying and outlining the terms and conditions of the interconnection of the generators to PacifiCorp's electrical system.

Facility interconnection customer: An entity interconnected to the PacifiCorp power system which has generation facilities (including back-up generation in parallel) on its side of the point of interconnection with the PacifiCorp power system.

Interconnection Facilities: All means required and apparatus installed to interconnect and deliver power from a load or Facility Interconnection Customer facility to the PacifiCorp power system including, but not limited to, connection, transformation, switching, metering, communications, and safety equipment, such as equipment required to protect: 1) the PacifiCorp power system and the load or Facility Interconnection Customer from faults occurring at the load or generation, and 2) the load or generation facility from faults occurring on the PacifiCorp power system or on the systems of others to which the PacifiCorp power system is directly or indirectly connected. Interconnected facilities also include any necessary additions and reinforcements by PacifiCorp to its system required as a result of the interconnection of a facility to the PacifiCorp power system.

Interconnection Study Agreement (ISA): An agreement between the Facility Interconnection Customer and PacifiCorp specifying what is to be done in the engineering interconnection study to interconnect the generator to PacifiCorp's system. This agreement specifies not only the items to be studied but the timeframe in which the study will be completed and the report results submitted to the applicant.

Interconnection Study: Those studies performed in conjunction with an interconnection request to determine the facilities needed to interconnect the load or Facility Interconnection Customer in accordance with applicable reliability requirements.

Interrupting Capacity: The amount of current a switch or circuit breaker can safely interrupt.

Interruption: A temporary discontinuance of the supply of electrical power.

K

Kilovolt (kV): 1,000 volts.

Kilovolt Ampere (kVa): The product of kilovolts times amperes. Used to refer to high voltage alternating current systems.

Kilovolt Ampere Reactive (kVAr): A measure of reactive power which is required to regulate system voltage.

Kilowatt (kW): An electrical unit of power which equals 1,000 watts.

Kilowatt-hour (kWh): 1,000 watts of energy supplied for I hour. A basic unit of electric energy equal to the use of I kilowatt for a period of I hour.

L

Lagging Power Factor: Occurs when reactive power flows in the same direction as real power. Stated with respect to the generator, lagging power factor occurs when the generator is producing VArs.

Leading Power Factor: Occurs when reactive power flows in the opposite direction to real power. Stated with respect to the generator, leading power factor occurs when the generator is absorbing VArs.

Line Losses: Electrical energy converted to heat in the resistance of all transmission and/or distribution lines and other electrical equipment (i.e., transformers) on the system.

Load-Only Entity or Customer Load: An entity interconnected to the PacifiCorp power system at a transmission or distribution voltage level which does not have generation of its own in parallel with the PacifiCorp power system and is not interconnected with any source of generation other than PacifiCorp's.

Log: A computer file, book, or loose leaf sheets for recording all station operations, clearances, readings, ratio reports, and other pertinent active daily data.

M

Maximum Torque Angle (MTA): The phase angle between the relay measured quantities at which the relay is the most sensitive.

Metering Services: Consists of removal, ensuring of meter design specifications, installation, calibration, and ongoing testing and maintenance of meters.

Meter Service Agreement (MSA): The agreement issued by PacifiCorp concerning meter services.

Megawatt (MW): 1 million watts.

Megger: An ohm meter device used to measure the ability of insulation to withstand voltage, as well as measuring the insulation resistance. A poor megger test would mean that the insulation is breaking down.

N

Nameplate Rating, Facility: Output rating information appearing on a generator nameplate or other electrical device, in accordance with applicable industry policies.

NEMA: National Electrical Manufacturers Association.

NERC: North American Electric Reliability Council or its successor.

Net Energy Output: The generation facility's gross output in kilowatt hours, less station use, to the point of delivery into the PacifiCorp power system.

Net Sale: The generation facility's gross output, in kW and kWh, less station use, to the point of delivery into the PacifiCorp power system.

Neutral: The common point of a star-connected transformer bank, a point which normally is at zero potential with reference to the earth.

No-Sale: The Facility Interconnection Customer desires to operate in parallel and not sell power to PacifiCorp.

O

Ohm: The unit of resistance of an electric circuit.

One-Line Diagram: A diagram in which several conductors are represented by a single line and various devices or pieces of equipment are denoted by simplified symbols. The purpose of such a diagram is to present an electrical circuit in a simple way so that its function and configuration can be readily grasped.

Operating Procedures: Policies and procedures governing the operation of the transmission grid as PacifiCorp, the WECC, or the NERC may from time to time develop as applicable to the particular type of generator and prime mover.

Operational Control: The rights of PacifiCorp to operate their transmission lines, facilities, and other electric plant equipment affecting the reliability of those lines and facilities for the purpose of affording comparable non-discriminatory transmission access and meeting applicable reliability criteria and policies.

Outage: A condition existing when a line or a substation is de-energized.

Output: The energy delivered by a generation facility during its operation.

Overload: A load in amperes greater than an electric device or circuit is designed to carry.

Overvoltage: Voltage higher than that desired or higher than that for which the equipment in question is designed.

P

PacifiCorp Control Center: The PacifiCorp location, manned 24 hours a day, which has been assigned operational jurisdiction over a load or Facility Interconnection Customer 's substation.

Parallel: (verb) To connect electrically a generator or energized source, operating at an acceptable frequency and voltage, with an adjacent generator or energized system, after matching frequency, voltage, and phase angle.

Parallel Operation: As used in this manual, the operation of a non-utility owned generator while connected to the utility's grid. Parallel operation may be required solely for the Facility Interconnection Customer's operating convenience or for the purpose of delivering power to the utility's grid.

Peaking: Operation of generating facilities to meet maximum instantaneous electrical demands.

Permissive Overreach Transfer Trip Scheme (POTTS): A very secure line protection scheme for insuring that a fault is within the protected line section. It requires the presence of both a trip signal from a remote terminal and a trip signal from the local relay before tripping the local breaker.

PacifiCorp Power System: The electric transmission and distribution wires, and their related facilities owned by PacifiCorp.

Point of Interconnection (POI): The point where the load or Facility Interconnection Customer 's conductors or those of their respective agents meet the PacifiCorp power system (point-of-ownership change).

Potential Transformer (PT): A transformer intended to reproduce in its secondary circuit, in a known proportion, the voltage of the primary circuit; also known as a voltage transformer.

Power: The time rate of transferring or transforming energy.

Power Factor (PF): The ratio of real (MW) power to apparent power (MVA). Power factor is the cosine of the phase angle difference between the current and voltage of a given phase.

Power Purchase Agreement (PPA): An agreement/contract between the utility and Facility Interconnection Customer whereby the amount for the purchase of power has been determined and is contractually binding on both parties.

Primary: Normally considered as the high-voltage winding of a substation or distribution transformer; any voltage used for transmission of electric power in reasonably good-sized blocks

and for some distance, as contrasted with low voltage for the immediate supply of power and light locally, such as the distribution within a building. The lowest voltage considered as a primary voltage is 2.4 kV although this is also used for some heavy-power requirements over short distances.

Primary System: A system of alternating current distribution for supplying the primaries of transformers from the generating station or distribution substation.

Protection: All of the relays and other equipment used to open the necessary circuit breakers to clear lines or equipment when trouble develops.

Protective Relay: A device whose function is to detect defective lines or apparatus, or other power system conditions of an abnormal or dangerous nature, and to initiate appropriate control circuit action.

R

Reactance: In an alternating current circuit, the opposition to the flow of current attributable to the inductance and capacitance of the circuit.

Reactive Component of Current: That part of a current that does no useful work because its phase is 90 degrees leading or lagging the voltage.

Reactive Load: In alternating current work, a load whose current is not in phase with the voltage across the load.

Reactor: A coil with no secondary winding provided. The primary use is to introduce inductance into the circuit for purposes such as starting motors, paralleling transformers, and controlling current. A current limiting reactor is a reactor for limiting the current that can flow in a circuit under short circuit conditions.

Reclose: To again close a circuit breaker after it has opened by relay action.

Recloser: A protective device designed to: 1) sense overcurrent, 2) time and interrupt the overcurrent according to a preset characteristic, and 3) reclose to test and possibly reenergize the line after a specified time interval.

Remedial Action Scheme (RAS): Protective systems that typically utilize a combination of conventional protective relays, computer based processors, and telecommunications to accomplish rapid, automated response to unplanned power system events; also refers to details of RAS logic and any special requirements for arming of RAS schemes or changes in RAS programming that may be required.

Remote Station Alarms: Alarms received at an attended location from unattended stations or plants.

Remote Terminal Unit (RTU): Remotely located equipment used for collecting data and/or for supervisory control via communication channel.

Residual Current: The current which flows in the neutral or wye-connected current transformers when the current in the three phases of a line are unbalanced.

Resistance: Anything placed or already located in an electric circuit which opposes the flow of electric current.

Resistor: A device whose primary purpose is to introduce resistance into an electric circuit. An adjustable resistor is one so constructed that its amount of resistance can be readily changed.

Retail Service: Electric sales to PacifiCorp's end-use or retail customers. Such service is regulated by the jurisdictional state regulatory agencies.

S

Schematic: A diagram showing the essential features of a piece of equipment or a control system.

Secondary: The winding of a transformer which is normally operated at a lower voltage than the primary winding.

Secondary Distribution System: A low-voltage alternating current system which connects the secondaries of distribution transformers to the consumer's services.

Self-Excited: A term to describe an electric machine in which the field current is secured from its own armature current. In the case of induction generators, it refers to the condition in which the induction generator is separated from its normal excitation source and is unintentionally excited by the power factor correction capacitors in the vicinity.

Separately-Excited: Use of an exciter for sending current through the field windings of an electric machine in place of taking the field current from its own armature current.

Service Reliability: The time an entity or group of entities is served compared to the amount of time the entity or entities are without service over a given time period.

Service Restoration: The switching procedure a system operator directs or executes to restore services to entities following an outage.

Setting: The values of current, voltage, or time at which a relay is adjusted.

Single-Phase Circuit: A circuit in which all current can be represented by only one regular sine-wave pattern. Differs from a three-phase circuit, where when all circuit current is plotted, it produces three regular sine-wave patterns 120 electrical degrees apart.

Special Facilities: Those additions and reinforcements to the PacifiCorp power system which are needed to accommodate the receipt and/or delivery of energy and capacity from and/or to the entity's facility(ies), and those parts of the interconnection facilities which are owned and maintained by PacifiCorp at the entity's request, including metering and data processing equipment.

Standby Capacity: The lesser of: 1) net generation capacity, 2) connected loads to generator, or 3) 80 percent of main switch rating.

Star-Connected Circuit (Wye-Connected Circuit): A term applied to the manner in which a motor's windings or a transformer's windings are connected, (i.e., star-connected armature having one end of each of the coils connected to a common junction). A star-connected transformer is one in which the primaries and secondaries are connected in a star grouping.

Station Use: Energy used to operate the generating facility's auxiliary equipment. Auxiliary equipment includes, but is not limited to: forced and induced draft fans, cooling towers, boiler feed pumps, lubricating oil systems, power plant lighting, fuel handling systems, control systems, and sump pumps.

Step-Down Transformer: A transformer in which the secondary winding has fewer turns than the primary, so that the secondary delivers a lower voltage than is supplied to the primary.

Step-Up Transformer: A transformer in which the secondary winding has more turns than the primary, so that the secondary delivers a higher voltage than is applied to the primary.

Supervisory Control: A system by which equipment is operated by remote control at a distance using some type of code transmitted by wire or electronic means.

Surplus Sale: The generator's gross output, in kW and kWh, less any plant load and transformation and transmission losses, delivered to the PacifiCorp system.

Switch: A device for making, breaking, or changing the connections in an electric circuit.

Switch, Air: A switch in which the arc interruption of the circuit occurs in the air.

Switch, Alarm: A form of auxiliary switch which closes the circuit to a bell or other audible signaling device upon automatic opening of the circuit breaker or other apparatus with which it is associated.

Switch, Auxiliary: A switch actuated by some main device such as a circuit breaker for signaling, interlocking, or other purpose.

Synchronism: The condition across an open circuit wherein the voltage sine wave on one side matches the voltage sine wave on the other side in frequency and without phase angle difference.

System: The entire generating, transmitting, and distributing facilities of an electric utility.

System Emergency: Conditions beyond the normal control that affect the ability of the control area to function normally, including any abnormal system condition which requires immediate manual or automatic action to prevent loss of load, equipment damage, or tripping of system elements which might result in cascading outages or to restore system operation to meet the minimum operating reliability criteria.

System Protection Facilities: The equipment required by the utility to protect: 1) the PacifiCorp power system from faults occurring at a load or Facility Interconnection Customer ' facility, and 2) the load or Facility Interconnection Customer 's generating facility from faults occurring on the PacifiCorp power system or on the system of others to which it is directly or indirectly connected.

T

Telephone Working Limit: A voltage potential of 300 V or less, so personnel can work on the telephone cable without rubber gloves.

Telemetering: Measurement with the aid of a communication channel that permits power metering measurements to be interpreted at a distance from the primary detector.

Transfer Trip (TT): A form of remote trip in which a communication channel is used to transmit the trip signal from the relay location to a remote location.

Transformer: An electric device without continuously moving parts in which electromagnetic induction transforms electric energy from one or more other circuits at the same frequency, usually with changes in value of voltage and current.

Transformer Efficiency: Ratio of the electric power of the current going into a transformer to the power of the secondary circuit from the transformer.

Transformer Loss: The difference between the input power to a transformer and the output power of the transformer.

Transformer Ratio: The ratio of the voltage secured from a transformer to the voltage supplied to that transformer.

Transmission Line: A line used for electric power transmission. Distinguished from a distribution line by voltage. Lines rated 46 kV and higher are transmission lines.

Transmission Control Center: This center implements switching operations on the PacifiCorp transmission system within a specific geographical area.

U

UL: Underwriters Laboratories.

Undervoltage Protection: Upon failure or reduction of voltage, the protection device interrupts power to the main circuit and maintains the interruption.

Undervoltage Release: Upon failure or reduction of voltage, the protective device interrupts power to the main circuit but does not prevent again completing the main circuit upon return to voltage.

Unity Power Factor: A power factor of 1.000 which exists in a circuit wherein the voltage and current are in phase. There are no VArs in this condition, only watts.

V

VAr: A unit of measurement of reactive power. It is an expression of the difference between current and voltage sine waves in a given circuit; short for volt amps reactive.

$$VA2 = (Watts)2 + (VArs)2$$

Volt: The unit of electrical pressure similar to the pounds per square inch pressure on a steam gauge.

Volt Ampere: A unit of apparent power in an alternating current circuit. Equal to the product of volts and amperes without reference to the phase difference, if any. At unity power factor, a volt ampere equals a watt. Whenever there is any phase difference between voltage and current, the true power in watts is less than the apparent power in volt amperes.

Voltage Drop: The difference in voltage level between one point and another in a circuit (see line voltage drop).

Voltage Loss: The drop of potential in an electric circuit due to the resistance and reactance of the conductor. This loss exists in every circuit.

Voltage Ratio of Transformer: The ratio of the effective primary voltage to the effective secondary voltage of a transformer.

Voltage Transformer: See potential transformer.

W

Watt: A unit of electric power.

Watts AC = volts x amperes x power factor (single phase circuits).

Watt Hour: A measure of electric power. The power of one watt used for one hour.

Watt Hour Meter: An electrical measuring instrument which indicates power in watt hours.

WECC: Western Systems Coordinating Council or its successor.

Wholesale Customer: A person wishing to purchase energy and ancillary services at a bulk supply point or a scheduling point for resale.

Wholesale Sales: The sale of energy and ancillary services at a bulk supply point or a scheduling point for resale.

Wholesale Service: Electric sales to wholesale customers for resale. Such service is regulated by FERC.

"Wye"-Connected Circuit: A three-phase circuit which is star-connected, meaning the windings of all three phases have one common connection which may be connected to ground.

12 Revision History

Revision	Date	Action	Name of Editor
0	08/31/07	1. Drafted and published original document	Paul Della
1	9/27/07	1. Changed title to Facility Connection Requirement to be consistent with NERC standards. 2. Modified introduction to include details about responsible parties and publishing. 3. Modified section 3.1.1 to clarify procedures. 4. Added details for procedures for inspecting end-use and transmission facilities. 5. Modified Section 4 to clarify telecommunications requirements.	Dennis Desmarais
2	4/13/09	1. General revision to clarify and add latest interconnection requirements.	Dennis Desmarais
3	10/09/09	1. General revision to clean up document and remove redundant material. 2. Revised Sections 6 & 7 to group generator specific requirements in Section 7.	Dennis Desmarais
4	5/25/10	1. General edits to clarify that standard applies to all facilities interconnected to PacifiCorp transmission system.	Dennis Desmarais

POWER SYSTEM STABILIZER
OPERATION AND PERFORMANCE REQUIREMENTS

The Power System Stabilizer (PSS) aids overall electric system stability by providing additional machine damping. It will supplement the proportional voltage control used on the excitation system.

There are several types of PSS. Each type uses a different input signal, such as frequency, shaft slip, or accelerating power. The most common type of PSS uses frequency as its input signal; it consists of a source-signal transducer providing frequency deviation of the generator bus from 60 Hz and derivative and lead-lag networks to provide proper phase advance. Generator excitation is controlled by a composite of voltage and frequency.

Figure H1 provides a mathematical control block diagram of a conventional excitation system which includes a PSS that uses frequency as its input signal. The transducer provides translation of bus frequency deviation into an appropriately noise-free electrical signal to serve as input to the derivative network.

The associated filtering and wave-shaping shall be designed to emit the following signal requirements:

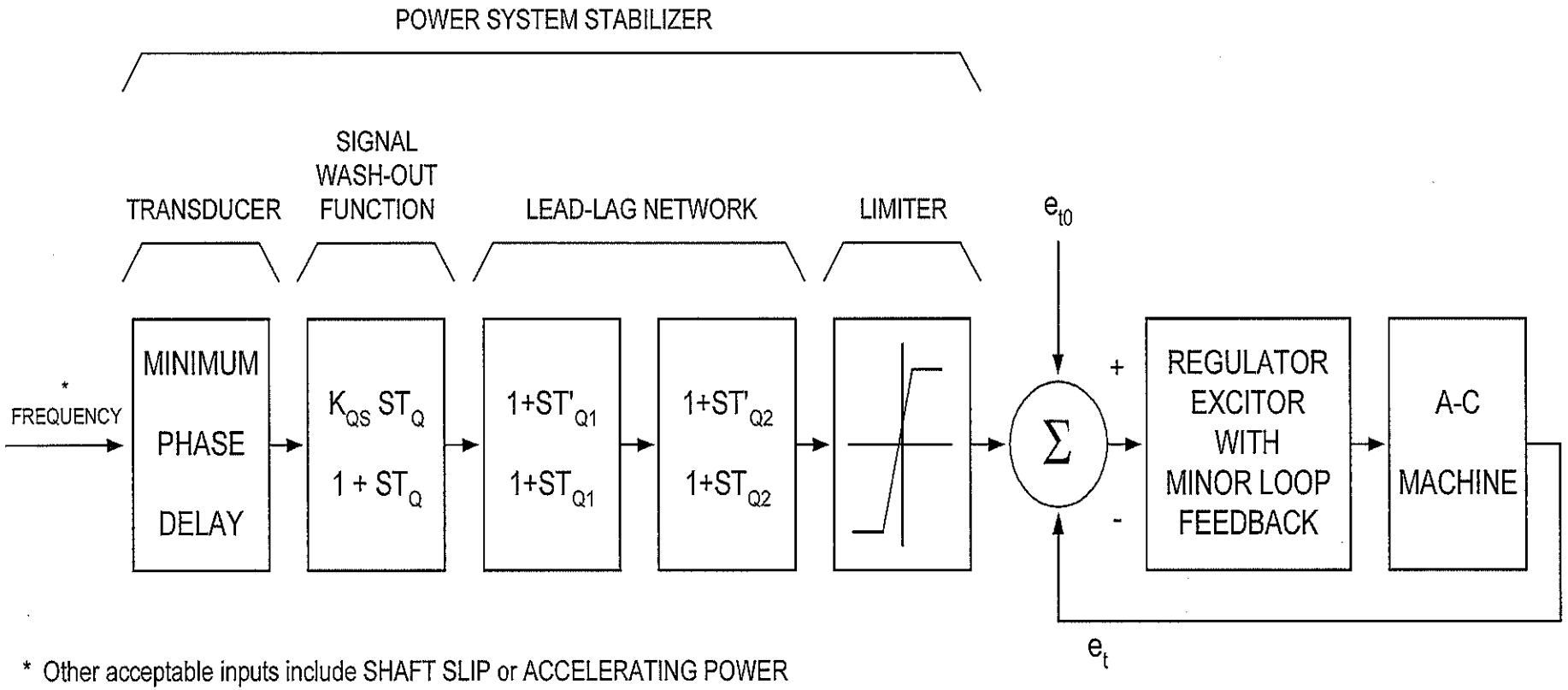
- Linearity between 59.5 and 60.5 Hz.
- Filtering and noise suppression to provide ripple shall not exceed one percent and a time constant less than 0.02 second.
- Large variations of power-supply voltage and frequency resulting from external or internal causes shall not affect performance of the PSS.

To provide the required phase lead, the PSS parameters shall be adjustable by calibrated dial settings. The parameter ranges shall be as follows:

KQs	0. 1 to 50 per unit
TQ	0. 1 to 60 seconds
T4QJ	0. 1 to 1. 5 seconds
TQi	0. 02 to 0. 1 second
T'Q2	0. 1 to 1. 5 seconds
TQ2	0.02 to 0. 1 second

FIGURE A-1

Block Diagram of Regulator-Exciter System with Power System Stabilizer



* Other acceptable inputs include SHAFT SLIP or ACCELERATING POWER

SITE DOCUMENTATION

PacifiCorp requires system drawings and relay instruction books from the dispersed generation facility. Sets of preliminary drawings are needed first. Sets of final drawings and equipment instruction books are required according to the timetable outlined below.

I. Provide one set of preliminary drawings one year prior to energizing the plant. The required drawings include:

   A. Station location plot plan.

   B. Station one-line.

II. Provide a set of final drawings and instruction books four months prior to energizing the plant.

   A. Provide three sets of the following:

      1. Station one-line.

      2. Tie breaker schematics, including:

         a. control schematics,

         b. current schematics, and

         c. potential schematics.

      3. Diagram of the relay panel arrangements.

One copy each of these drawings shall be routed to the Area Engineer, Relay and Protection Department, and the Transmission/Distribution Account Manager.

It is preferred that the copies be provided in paper format. Electronic files are acceptable if they are convertible to paper format in the size acceptable to the engineer assigned to the project. Please send all of these documents to the following address:

Pacificorp Transmission Account Manager
825 NE Multnomah Blvd., Suite 1600
Portland, Oregon 97272

TECHNICAL DATA SHEET

FOR

SYNCHRONOUS MACHINES

ON THE

PACIFICORP SYSTEM

FOR POWER FLOW, TRANSIENT STABILITY, AND FAULT ANALYSIS

Questions regarding this Technical Data Sheet should be directed to:

PacifiCorp Transmission Account Manager
830 NE Holladay, Suite 210
Portland, OR 97232
(503) 813-5738

NOTE 1: Please complete a separate data sheet for each generator that normally operates interconnected with PacifiCorp's Transmission System.

NOTE 2: This data sheet is for synchronous machines only, not induction machines

Technical Data Sheet for Synchronous Machines on the PacifiCorp System

Project Name _____ Unit Number _____ Log Number _____

Name of Person Completing Data Sheet _____

Telephone _____ FAX _____ Email _____

GENERATOR DATA

1. Generator Manufacturer _____
2. Year Generator was Manufactured _____
3. Rated Generator MVA _____ MVA
4. Rated Generator Terminal Voltage _____ kV
5. Rated Generator Speed _____ RPM
6. Number of Poles _____
7. Rated Generator Power Factor _____
8. Generator Efficiency at Rated Load _____ %
9. Moment of Inertia (Turbine plus Generator) ωR^2: _____ lb-ft^2
10. Inertia Time Constant (on machine base) H: _____ sec. (MJ/MVA)
11. SCR (Short-Circuit Ratio - the ratio of the field current required for rated open-circuit voltage to the field current required for rated short-circuit current) _____
12. Typical Generator Auxiliary Load _____ MW
13. Maximum Power Output _____ MW
14. Please attach generator reactive capability curves. If these curves are not available give the maximum and minimum reactive limits. Q_{MAX} _____ MVAR, lagging; Q_{MIN}: _____ MVAR, leading
15. Rated Hydrogen Coating Pressure (Steam Units) _____ psig
16. Please attach a simple one-line diagram that includes the generator step-up transformer bark plant load, meter, and transmission-level bus.

Technical Data Sheet for Synchronous Machines on the PacifiCorp System

GENERATOR DATA (continued)

All impedance data should be based on MVA given in (3) and on kV given in (4) an previous page.

17.	X_d	direct-axis unsaturated synchronous reactance	_____pu
18.	X_q	quadrature-axis unsaturated synchronous reactance	_____pu
19.	X'_d	direct-axis unsaturated transient reactance	_____pu
20.	X'_{ds}	direct-aids saturated transient reactance	_____pu
21.	X'_q	quadrature-Axis unsaturated transient reactance	_____pu
22.	X'_{qs}	quadrature-axis saturated transient reactance	_____pu
23.	X''_d	direct-axis unsaturated subtransient reactance	_____pu
24.	X''_{ds}	direct-axis saturated subtransient reactance	_____pu
25.	X''_q	quadrature-axis unsaturated subtransient reactance	_____pu
26.	X''_{qs}	quadrature-axis saturated subtransient reactance	_____pu
27.	X_L	stator leakage reactance or Potier reactance	_____pu
28.	R_a	armature resistance	_____pu
29.	T_{q0}	direct-axis transient open-circuit tin,* constant	_____sec
30.	T_{q0}	quadrature-axis open-circuit time constant	_____sec
31.	T'_{q0}	direct-axis subtransient open-circuit time Constant	_____sec
32.	T'_{q0}	quadrature-axis subtransient open-circuit time constant	_____sec
33.	TA_{GEN}	armature short-circuit time constant	_____sec
34.	T_D	direct-axis transient short-circuit time constant	_____sec
35.	T_Q	quadrature-axis transient short-circuit time constant	_____sec
36.	T'_D	direct-axis subtransient short-circuit fine constant	_____sec
37.	T'_Q	quadrature-exis subtransient short-circuit time constant	_____sec
38.	X_2	negative sequence reactance (sat./unsat.)	_____/_____pu
39.	X_0	zero sequence reactance (sat/unsat)	_____/_____pu

40. Please attach a plot of generator terminal voltage versus field current that shows the air gap line, the open-circuit saturation curve, and the saturation curve at full load and rated power factor.

Technical Data Sheet for Synchronous Machines on the PacifiCorp System

EXCITATION SYSTEM INFORMATION

Listed below are the most common excitation systems used for voltage regulation of large synchronous generators. Each type of excitation system has been specified according to its manufacturer and name. In addition, the different excitation systems have been grouped together according to common characteristics.

Please indicate, in the space provided on the left, the excitation system used for your generator. if your type of excitation system is not listed, please write the manufacturer and exciter type under the category that most accurately describes your excitation system.

A. Rotating DC commutator exciter with continuously acting regulator. The regulator power source is independent of the generator terminal voltage and current.

_____1. Allis Chalmers, Regulex regulator
_____2. General Electric, Amplidyne regulator - NA101
_____3. General Electric, Amplidyne regulator - NA108
_____4 General Electric, Amplidyne regulator - NA143
_____5. General Electric, GDA regulator
_____6. Westinghouse, Mag-A-Stat regulator
_____7. Westinghouse, Rototrol regulator
_____8. Westinghouse, Silverstat regulator
_____9. Westinghouse, TRA regulator
_____10. Brown Boveri, Type AB or Type ABC regulator
_____11. Brown Boveri, Type DC regulator
_____12. Other. Manufacturer/Type: _____/_____

B. Rotating DC commutator exciter with continuously acting regulator. The regulator power source is bus fed from the generator terminal voltage

_____1. Westinghouse, PRX-400 regulator
_____ 2. Other. Manufacturer/Type _____/_____

C Rotating DC commutator exciter with non-continuously acting regulator (i.e., regulator adjustments are made in discrete increments

_____1. General Electric, GFA4 regulator
_____2. Westinghouse, BJ30 regulator
_____3. Other. Manufacturer/Type _____/_____

Technical Data Sheet for Synchronous Machines on the PacifiCorp System

EXCITATION SYSTEM INFORMATION (Continued)

D. Rotating AC Altemator Exciter with non-controlled (diode) rectifiers. The regulator power source is independent of the generator terminal voltage and current (not bus-fed).
_____1. Westinghouse Brushless
_____2. Westinghouse High Initial Response Brushless
_____3. Other: Manufacturer/Type_____/_____

E. Rotating AC Alternator Exciter with controlled (thrysistor) rectifiers. The regulator power source is fed from the exciter output voltage.
_____1. General Electric Alterrex
_____2. Other: Manufacturer/Type_____/_____

F. Rotating AC Alternator Exciter with controlled (thyristor) rectifiers.
_____1. General Electric Alterrex
_____2. Other: Manufacturer/Type_____/_____

G. Static Exciter with controlled (thyristor) rectifiers. The regulator power source is bus-fed from the generator terminal voltage.
_____1. Canadian General Electric Silcomatic
_____2. Westinghouse Canada Solid State Thyristor System
_____3. Westinghouse Type PS Static System, Type WTA, WHS, WTA-300 regulators
_____4. ASEA Static System
_____5. Brown Boveri Static System
_____6. Rayrolle-Parsons Static System
_____7. GEC-Eliott Static System
_____8. Toshiba Static System
_____9. Mitsubishi Static System
_____10. General Electric Potential Source Static System
_____11. Hitachi Static System
_____12. Other: Manufacturer/Type_____/_____

H. Static Exciter with controlled (thyristor) rectifiers. The regulator power source is bus-fed from a combination of generator terminal voltage and current (compound-source controlled rectifiers system).
_____1. General Electric SCT-PPT or SCPT System
_____2. Other: Manufacturer/Type_____/_____

Technical Data Sheet for Synchronous Machines on the PacifiCorp System

Other Excitation System Information

I. Please attach a *copy of* the instruction manual for your excitation system. Make sure that a block diagram or schematic of the excitation system is included in the manual. The diagram should show the input, output, and all feedback loops of the excitation system.

J. If the manufacturer's data *for* the excitation system (i.e., time constants, gains, and saturation curves) are available, please attach these also.

K. What is the excitation system response ratio (ASA) ?
(See *Power System Control and Stability* by Anderson and Fouad, 1st ed., 1977, pg 456, Fig E.1, for a precise definition of ASA.)

L. What is the rated exciter output voltage at *full* load? _____Volts

M. What is the maximum exciter output voltage (ceiling voltage)? _____Volts

N. Other comments regarding the excitation system?

Technical Data Sheet for Synchronous Machines on the PacifiCorp System

POWER SYSTEM STANTLTZER INFORMATION (supplementary excitation system)

(Note: Complete this section only if your machine has PSS control.)

A. Manufacturer.
_____1. General Electric
_____2. Westinghouse
_____3. Toshiba
_____4. TTI
_____5. Alsthom
_____6. Other: Manufacturer _____

B. Is your PSS digital or analog? _____

C. What is the actuating signal (the input signal) for your PSS?

___ Bus frequency ___ Shaft slip ___Accelerating power ___Other

If "Other", indicate signal: _____

D. Please attach the instruction manual for your PSS. The manual should include a block diagram or schematic of the PSS and the correspondence between dial settings and the time constants or PSS gain.

E. Please attach a copy of the test report for your PSS. This report should contain the dial settings or time constants and TISS gain. If this report is not available, write the dial settings below:

1. T_1 washout or reset time constant dial setting _____
2. T_2 first lead time constant dial setting _____
3. T_3 first lag time constant dial setting _____
4. T_4 second lead time constant dial setting _____
5. T5 second lag time constant dial setting _____
6. K MS gain dial setting _____
7. V_{max} maximum PSS output dial setting _____
8. V_{cut} dial setting for which PSS is set to zero when generator terminal voltage deviation is too large _____
9. Other _____ / _____
10. Other _____ / _____

F. Who installed your PSS?

Name: _____
Company: _____
City, State: _____
Phone/Fax: _____/_____

Technical Data Sheet for Synchronous Machines on the PacifiCorp System

POWER SYSTEM STABILIZER INFORMATION (continued)

C. Other comments regarding the PSS?

Technical Data Sheet for Synchronous Machines on the PacifiCorp System

TURBINE-GOVERNOR INFORMATION

Please complete part A for steam, gas or combined-cycle turbines, part B for hydro turbines, and part C for both.

A. Steam, gas or combined-cycle turbines

1. Steam turbine, Gas turbine, or Combined-cycle: _____

2. If steam or combined-cycle, does the turbine system have a reheat process (i.e., both high and low pressure turbines) ? _____

3. If steam with reheat process, or if combined-cycle, indicate, in the space provided, the percent of full load power produced by each turbine:

   by low pressure turbine or gas turbine _____%

   by high pressure turbine or steam turbine _____%

B. Hydro turbines

1 What is the turbine efficiency at rated load _____%

2. What is the length of the penstock? _____ft

3. What is the average cross-sectional area of the penstock _____ft^2

4. What is the typical maximum head (vertical distance from the bottom of penstock, at the gate, to the water level)? _____ft

5. Is the water supply run-of-the-river or reservoir? _____

6. What is the water flow rate at the typical maximum head? _____ft^3/sec

7. What is the average energy rate? _____kW-hrs/acre-ft

8. What is the estimated yearly energy production? _____kW-hrs

Technical Data Sheet for Synchronous Machines on the PacifiCorp System

C. Complete this section for each machine, independent of the turbine type.

1. Turbine manufacturer

_____

2. Maximum turbine power output _____MW

3. Minimum turbine power-output (while on line) _____MW

4. Governor information:

   a. Droop setting (speed regulation) _____

   b. Is the governor mechanical-hydraulic or Electro-hydraulic? (Electrco-hydraulic governors have an electronic speed sensor and transducer.) _____

   c. Please provide below any time constants you have from the manufacturer describing the speed of response of the governor. Be sure to identify each time constant.

   _____ _____sec

   _____ _____sec

   _____ _____sec

   _____ _____sec

   d. Other comments regarding the turbine governor system?

   _____

   _____

   _____

   _____

   _____

   _____

   _____

   _____

   _____

Technical Data Sheet for Synchronous Machines on the PacifiCorp System

STEP-UP TRANSFORMER DATA

1. Transformer Bank No._____

2. Rated MVA _____MVA

3.

Available H.V. Taps		Available L.V. Taps	
_____	kV	_____	kV
_____	kV	_____	kV
_____	kV	_____	kV
_____	kV	_____	kV
_____	kV	_____	kV
_____	kV	_____	kV

4. Please indicate present tap settings: H.V. Tap: _____kV
   L.V. Tap: _____kV

5. Does transformer have tap changing under load? _____

6. Is transformer a regulating-type transformer? _____

   If yes, please indicate regulating voltage range and the number of steps.
   _____kV to _____kV Number of steps: _____

7. Please indicate how the transformer windings are connected.

H.V. Side:		LV. Side:	
_____	Wye	_____	Wye
_____	Gumnded Wye	_____	Grounded Wye
_____	Delta	_____	Delta

8. Please attach a copy of the transformer test report, if available.

9. If the transformer test report is not available, please provide the "lowing impedances using the IAVA base given in (2) above:

R_T	per unit resistance	_____PU
X_T	per unit reactance	_____PU
B_T	per unit magnetizing susceptance	_____PU
C_T	per unit core loss conductance	_____PU

10. Other comments regarding the transformer?

_____

_____

_____

_____

OF OPERATING PRACTICE QUESTIONNAIRE
SYNCHRONOUS GENERATORS

NOTE: The information on this survey is used to improve transmission models used in engineering studies.

A. Generation and Plant Load (served by own generation) Pattern:

1. Generator Size _____MVA

2. Please indicate typical peak generation level (in MW). If generator serves plant load on the same side of the PacifiCorp meter, also indicate typical load level. (Metered power equals peak generation level minus corresponding plant load).

   a. Peak Generation Level _____MW

   b. Corresponding Plant Load _____MW

3. Please indicate typical planned seasonal and time period variations as percentage of levels specified in (2) above. Approximate a percentages in Increments; of 25% (0%, 25%,50%,75%, 100%)

	Summer April thru October		Winter November thru March	
Time of Day (24-Hr format)	Generation	Load	Generation	Load
06:00 - 12:00				
12:00 -18:00				
18:00 - 22:00				
22:00 - 06:00.				

B. Type of Regulation (Complete either Section 1 or 2)

1. Maintain Voltage _____
   Typical Voltage Range ____kV to _____kV
   Generator Rated Terminal Voltage _____kV

   Standard PacifiCorp operation bandwidth is 0.90 lagging (producing vars) to 0.95 leading (absorbing vars). If actual operation (not capability) is typically narrower than these limits, please indicate range.

   _____Lagging (producing vars) to _____Leading (absorbing vars)

   Do you ever operate with manual voltage control (excitation system bypassed)? _____

   If yes, what percent of the time? _____

   Under what conditions?

   _____

   _____

   _____

   _____

2. Maintain Power Factor _____

   Typical Machine Power Factor Range _____
   To _____

   Is this automatically controlled? _____

   If so, approximately how fast can the controller respond to a change in power factor?

   _____0 - 20 seconds
   _____20 seconds - 3 minutes
   _____greater than 3 minutes

   Standard Pacificorp bandwidth is 95 to 105% of rated voltage. If actual operation (not capability) is typically narrower than these limits please indicate range.

   _____ to _____ % of rated voltage

C. Governor Control

Do you operate with an automatic turbine speed controller (governor)? _____

If yes, do you operate with it blocked? _____

If yes, what percent of the time? _____%

Under what conditions?

_____

_____

_____

D. Other comments regarding operation of your generator?

_____

_____

_____

_____

_____

_____

_____

_____

REQUIREMENTS FOR TRANSMISSION LINE SELECTOR SWITCHES AND ASSOCIATED COST RESPONSIBILITIES

Purpose

The purpose of this guideline is to: 1) ensure service availability can be maintained to single-tapped customers, 2) ensure system-wide consistency in the installation of selector switches on transmission lines, and 3) provide a clear understanding of the associated cost responsibilities wherever transmission lines are single-tapped.

Definition of Selector Switches

Line selector switches are installed on one or both sides of a single-tap in order to provide operational flexibility in service to customers on the tap line. Selector switches are operated to avoid customer outages for planned maintenance in the main line and to restore service in the case of an unplanned interruption of the main line (see Figure 1). Selector switches do not reduce the number of outages to the customer, but they do provide a relatively inexpensive way of reducing the duration of a sustained outage[1] by allowing the transmission line to be sectionalized. Selector switches cannot reduce the frequency of maintenance or unplanned outages on the single-tap line to the customer.

Applicability

Effective immediately, selector switches are a standard service requirement for all new single-tap interconnections to PacifiCorp's transmission system. This is applicable where a single-tap configuration is to be used to interconnect a new load or generation customer to a PacifiCorp-owned transmission line (46 kV and above) or when a change in service is requested by an existing load or generation customer. This guideline will also be incorporated into PacifiCorp's transmission interconnection requirements.

At PacifiCorp's discretion, a selector switch may not be required should the distance from the new single-tap interconnection to either end of the transmission line or to an existing selector switch on the line be approximately one mile or less, with minimal exposure to causes of outages (trees, traffic, etc.). Refer to Attachment 1 for a list of criteria in determining the need for selector switches.

---

[1] A sustained outage is an outage to a customer extending more than two minutes.

Single-Tap Configuration

For standard transmission tap interconnection to a customer-owned substation, a single-tap is provided from the most feasible transmission line to the customer's facility. With standard service, the customer will experience interruptions to their facility during a transmission line outage unless the customer has adequate on-site back-up generation.

The installation of selector switches reduces the duration of a sustained outage, but it does not eliminate momentary outages to a customer. For a sustained outage on the transmission line, service to the customer will be interrupted for the duration of time[2] it takes PacifiCorp to open the appropriate selector switch to isolate the faulted line section and close the breaker on the non-faulted line section. As an example, for a sustained outage between Station "B" and the tap point, selector switch "B" would be opened to isolate the problem and service to the customer would be restored by closing the circuit breaker at Station "A".

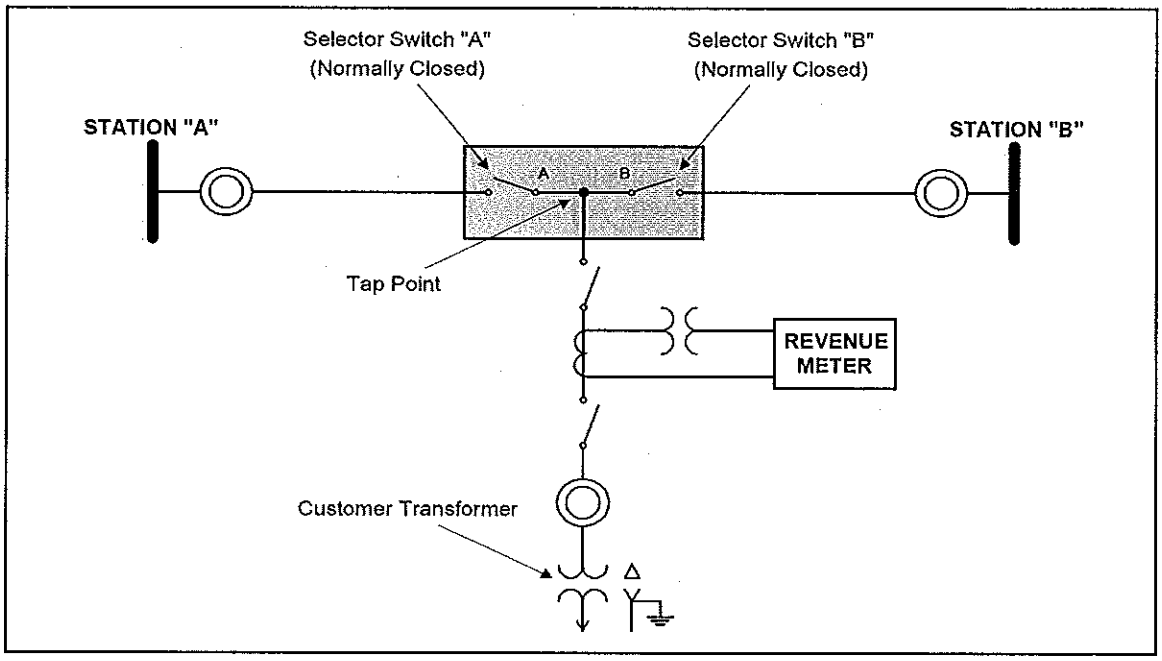


Figure 1–Typical Single-Tap Configuration with Selector Switches

Ownership and Accessibility

- Pacificorp shall own, operate, and maintain all selector switches in the system to serve customer-owned substations or customer load.

[2] Duration of time refers to the time it takes a Pacificorp operator to manually operate the selector switches from the time Pacificorp was notified of an outage. This time could vary from about a half hour to several hours depending on the nature of the outage. Should the outage be such that the customer could be energized from one end of the transmission line, the appropriate selector switch would be opened.

- PacifiCorp's personnel must be able to access all selector switches installation 24 hours a day.

Cost Responsibilities for New Single-Tap Interconnections[3]

Effective immediately, with the exception allowed in Attachment 1, line selector switches are a PacifiCorp requirement for all new single-tap interconnections to the transmission system as a means of providing adequate level of service availability. In accordance with PacifiCorp's electric tariff, if line selector switches are considered special facilities, the installation cost of the switches will be determined by the application of relevant jurisdictional state commision rules as appropriate[4].

For existing single-tap interconnections, refer to Attachment 2 for the need and installation cost responsibilities for line selector switches.

Selector Switches Capability

- PacifiCorp will determine on a case-by-case basis whether selector switches should be capable of line dropping and/or loop splitting and would specify the capabilities of the selector switches and any associated interrupting devices.

- PacifiCorp will identify locations with access difficulties, such as mountainous terrain, and may recommend that the selector switches be motor-operated and remotely controlled.

Selector Switches Installation

Selector switches must be located in close proximity (within one pole or tower structure) on either side of the single-tap on the transmission line. All structures used for mounting the selector switches will be determined and designed by PacifiCorp.

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[3] New Single-Tap Interconnections: A customer requesting PacifiCorp's service who is not currently interconnected to PacifiCorp's transmission system.

[4] Unbundling of electric and transmission services may reqire the cost responsibilities be revised.

ATTACHMENT 1

Criteria for Determining When One or No Selector Switch Is Required

- Radial Transmission Line

  At PacifiCorp's discretion, only one selector switch may be required on the non-source side of the tapped transmission line.

- When One Selector Switch Is Sufficient

  At PacifiCorp's discretion, PacifiCorp may elect to install only one selector switch on one side of the single-tap provided that the line section without the selector switch is: 1) approximately one mile or less from the tap point to the end of the transmission line, with minimal exposure to causes of outages (trees, traffic, etc.), or 2) approximately one mile or less from the interconnection tap point of another customer with line selector switches, with minimal exposure to causes of outages.

- When No Selector Switches Are Required

  At PacifiCorp's discretion, selector switches may not be required on the transmission line if the distances on either side of the tap to the ends of the transmission line or other selector switches on the line are approximately one mile or less, with minimal exposure to causes of outages.

Criteria for Determining When Selector Switches Are Required

- Length of Transmission Line

  Long transmission lines have more exposure and have a greater frequency of being forced out of service for maintenance. Long lines are also at greater risk of experiencing sustained faults due to increased exposure to adverse elements.

- Location and Route of Transmission Line

  Geographic and environmental conditions affect the total exposure of the line to adverse elements. For example, transmission lines that traverse mountainous areas are subject to a greater number of outages due to exposure to trees and inclement weather.

- Multiple Customers on Transmission Line

  At PacifiCorp's discretion, PacifiCorp may require selector switches on a transmission line where multiple customers are tapped as a means of maintaining service availability.

ATTACHMENT 2
Need and Installation Cost Responsibilities for Existing Single-Tap Interconnections

This guideline is not intended for retroactive application to existing single-tap interconnections, however the installation of line selector switches on existing single-tap interconnections will be considered on a case-by-case basis based on the following:

Existing Single-Tap Customer's Request for Selector Switches

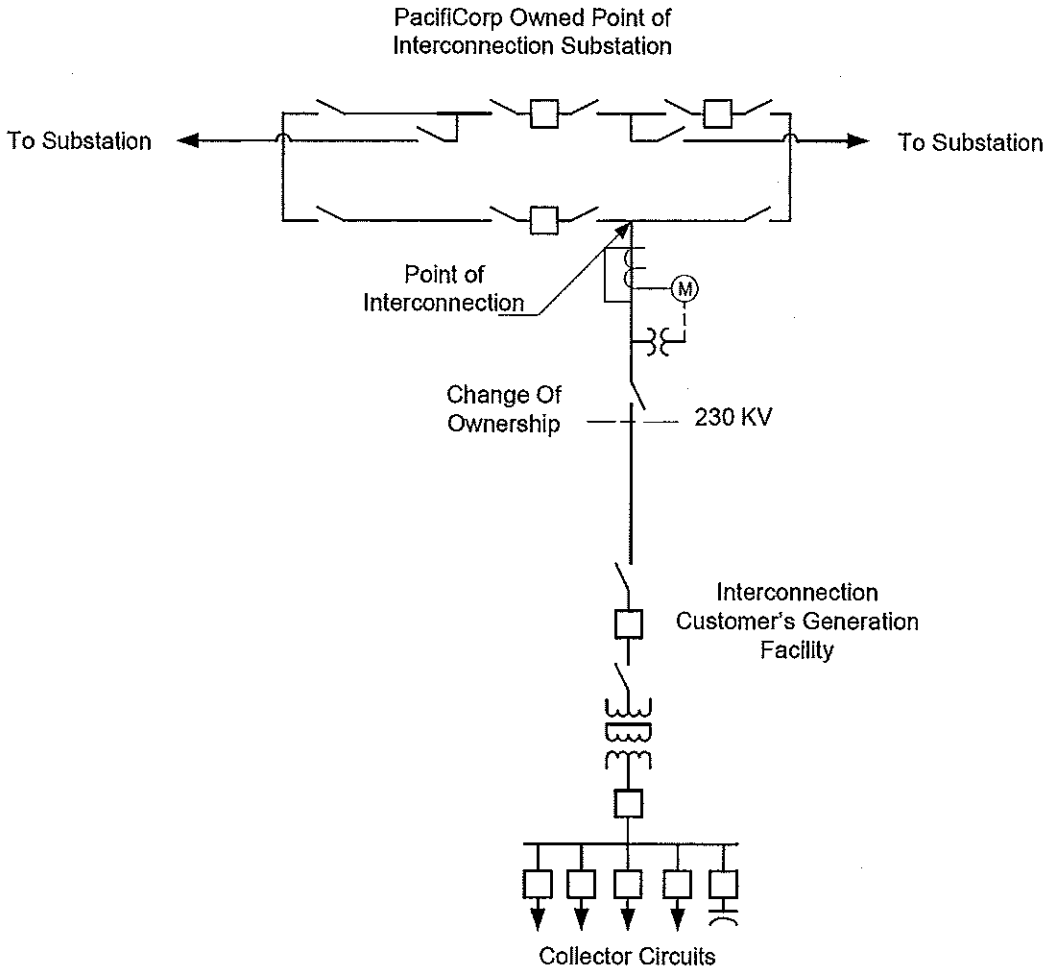
When an existing single-tap customer requests selector switches as a means of minimizing down time to his/her facility, the selector switches will be treated as Special Facilities and shall be paid for by the customer in accordance with applicable jurisdictional state utility commission rules.

PacifiCorp Determines When Selector Switches Are Necessary

When line selector switches are determined by PacifiCorp to be needed for system benefits, the installed cost of the selector switches will be borne by PacifiCorp. System benefits include but are not limited to: 1) minimizing sustained outages to multiple customers on a single-tap line, and 2) avoiding difficult clearance coordination with multiple customers.

On existing single-tap interconnections, should the need for selector switches be identified, then the criteria outlined in Attachment I also applies.

Typical One Line
Generator Interconnection ≥ 230 kV



Typical One Line
Generator Interconnection < 230 kV