

November 20, 2000

**POWER PURCHASE AGREEMENT**  
**executed by the**  
**UNITED STATES OF AMERICA**  
**DEPARTMENT OF ENERGY**  
**acting by and through the**  
**BONNEVILLE POWER ADMINISTRATION**  
**and**  
**CALPINE SISKIYOU GEOTHERMAL PARTNERS, L.P.**  
**(Fourmile Hill Geothermal Project)**

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This POWER PURCHASE AGREEMENT (Agreement), executed as of November 20, 2000, by the UNITED STATES OF AMERICA, Department of Energy , acting by and through the BONNEVILLE POWER ADMINISTRATION (Bonneville), and Calpine Siskiyou Geothermal Partners, L.P. (Seller), a Limited Partnership, organized and existing under the laws of the State of California. Both Seller and Bonneville are sometimes referred to herein individually as "Party" and collectively as "Parties."

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W I T N E S S E T H :

WHEREAS Bonneville is authorized and obligated to acquire sufficient capacity and energy (where "power" may herein refer to either or both terms) to meet the electric power requirements placed on Bonneville, consistent with the resource priorities of the Pacific Northwest Electric Power Planning and Conservation Act (Public Law 96-501, the "Northwest Power Act"); and

WHEREAS section 6(d) of the Northwest Power Act authorizes Bonneville to acquire experimental, developmental, demonstration, or pilot projects of a type with potential for providing cost-effective service to the region; and

WHEREAS during July 1991, Bonneville, as part of a geothermal pilot program, issued a Request for Proposals to supply electric power from geothermal demonstration projects; and

WHEREAS Seller plans to own and operate a nominal 49.9-megawatt (MW) electric generating facility located in the Fourmile Hill Project Area, Siskiyou County, California, such facility in all future correspondence to be identified as Fourmile Hill Geothermal Project (Project); and

WHEREAS Seller wishes to sell to Bonneville power from the Project, such sale to be pursuant to the terms and conditions set forth herein; and

WHEREAS Bonneville wishes to purchase power from the Project; and

WHEREAS on December 27, 1996, Seller and Bonneville executed a Settlement Agreement that restructured certain rights and obligations between the Parties; and

WHEREAS this Agreement establishes specific Bonneville rights, consistent with the Northwest Power Act, to review, as applicable, actions associated with construction and operation of the Project and associated Interconnection Facilities; and

WHEREAS Bonneville's obligation hereunder is not, nor shall it be construed to be, a general obligation of the United States, nor is it intended to be or is it secured by the full faith and credit of the United States; and

WHEREAS Bonneville is authorized pursuant to Federal law, including the Northwest Power Act and other applicable laws, to dispose of electric capacity and energy generated at various Federal hydroelectric projects in the Pacific Northwest or acquired from other resources, including geothermal facilities, to construct and operate transmission facilities, to provide transmission and other services, and to enter into agreements to carry out such authority;

NOW, THEREFORE, the Parties hereto mutually agree as follows:

**1. DEFINITIONS**

Whenever the following terms appear in this Agreement or the recitals hereto, whether singular or plural, present or past tense, they shall have the meaning stated below:

- (a) "Average Megawatt" or "aMW" is the unit of energy output over a year, equivalent to the energy produced by the continuous operation of one megawatt of capacity over a one-year period.
- (b) "Commercial Operation Date" is 0000 hours on the date following the successful completion of the Commercial Operation Test.
- (c) "Commercial Operation Test" means a test performed by or at the direction of the Seller during which, for a period of ninety-six (96) consecutive hours, the Metered Energy is greater than or equal to four thousand three hundred ten (4,310) megawatt-hours.
- (d) "Contract Year" means a year which begins at 0000 hours on October 1 and continues until 2400 hours on the following September 30, except for the first Contract Year, which shall commence on the Commercial Operation Date and end at 2400 hours on the following September 30, or such other 12-month period as mutually agreed upon by Bonneville and Seller. Notwithstanding anything to the contrary in this Agreement, Seller may in its sole discretion choose any date as the beginning of its fiscal year.
- (e) "Dedicated Area" means the portion of the leases that Seller may dedicate to the Project pursuant to section 10(j)(1) of this Agreement.
- (f) "Effective Date" means the later of the dates on which each Party executed this Agreement as such dates are indicated on the signature page of this Agreement.
- (g) "Emergency" means a condition or situation which, in the reasonable judgment of Bonneville, affects or may affect Bonneville's ability to meet its obligations to maintain safe and reliable electric service to Bonneville's customers or the customers of any of its client utilities.
- (h) "Federal System" has the meaning given in Exhibit A of this Agreement.
- (i) "Interconnection Facilities" means all facilities, wherever located, to enable Bonneville to receive Metered Energy, including but not limited to all metering and telemetering equipment, transmission and distribution lines and associated equipment, transformers and associated equipment, relay and switching equipment, control and protective devices, and safety equipment, as described in Exhibit D.
- (j) "Metered Energy" means the net amount of energy generated by the Project, after subtracting power consumed by the Project, during any specified period

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of time, as metered by the metering equipment at the Project.

- (k) "Operating Security" means the well drilling reserve and repair and replacement reserve funds or accounts described in section 17 of this Agreement.
- (l) "Point of Delivery" means the physical point, designated in Exhibit D, where the Metered Energy is delivered to Bonneville by Seller.
- (m) "Point of Interconnection" means the point where Seller's Interconnection Facilities connect to Bonneville's transmission system.
- (n) "Project" means the Fourmile Hill Geothermal Project, as further described in Exhibit D.
- (o) "Project Area" means the land encompassed by the leases that are identified in Exhibit D.
- (p) "Project Lender" means any entity or entities, other than the Seller, but including affiliates of the Seller, which provides equity or debt capital for financing the Project during or after its construction. Project Lender shall include, without limitation, the lessor in any sale and leaseback transaction used to finance the Project, and any trustee, paying agent, or other agent which acts on behalf of any Project Lender.
- (q) "Prudent Utility Practice" means the practices, methods, and equipment, as changed from time to time, that are commonly and lawfully used in prudent engineering and operation of equipment, taking into consideration: (1) safety; (2) dependability; (3) efficiency; (4) economy; (5) adherence to applicable qualifying facility or independent power industry codes, standards and regulations; and (6) the size, type and location of the Project. Prudent Utility Practice may include more than one practice, method, or item of equipment in any given application.
- (r) "Purchase Price" is the price per kilowatt-hour (kWh) of Metered Energy as defined in section 4 and Exhibit F of this Agreement.
- (s) "Scheduled Outage" means a planned interruption of the Project's generation that has been noticed in advance to Bonneville.
- (t) "Seller" is Calpine Siskiyou Geothermal Partners, L.P., a Limited Partnership organized and existing under the laws of the State of California, and its successors and assigns.
- (u) "Settlement Agreement" means the Settlement Agreement executed by the United States of America, Department of Energy, acting by and through the Bonneville Power Administration and Calpine Siskiyou Geothermal Partners, L.P., dated December 27, 1996.

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- (v) "Termination Date" is the date a termination of this Agreement by Bonneville or Seller becomes effective.
- (w) "Uncontrollable Force" means any cause or condition beyond a Party's control, as further defined in Exhibit A.
- (x) "Workday" means each day during the term of this Agreement which both Parties observe as a regular day of work.

## 2. TERM

This Agreement shall become effective upon the Effective Date and shall continue for a period of twenty (20) years from the Commercial Operation Date unless extended or terminated as provided for herein. Upon written notice, Bonneville shall have the option to extend this Agreement in five (5) year increments under the same terms and conditions for an additional twenty-five (25) years. Bonneville shall provide Seller with such written notice at least one year prior to the expiration of the initial twenty (20) year term and the expiration of each five (5) year extension of this Agreement.

## 3. EXHIBITS

Exhibit A (General Provisions), Exhibit B (Technical Requirements for the Interconnection of Generation Resources, April 1999), Exhibit C (Referenced Documents), Exhibit D (Description of Project and Interconnection Facilities), Exhibit E (Monthly Payment Calculation and Invoice Format), and Exhibit F (Purchase Price) are each hereby made a part of this Agreement.

## 4. SALE AND PURCHASE OF METERED ENERGY

### (a) Mutual Obligation

Subject to the terms and conditions of this Agreement, Seller agrees to deliver and sell and Bonneville agrees to accept and purchase the Metered Energy.

### (b) Consideration

Bonneville shall pay Seller for Metered Energy at the Purchase Price specified in section 4(c) below. The monthly payment for such Metered Energy shall be calculated in accordance with section 5 of this Agreement.

### (c) Purchase Price

- (1) Prior to the Commercial Operation Date and during the Commercial Operation Test, Bonneville shall pay Seller for Metered Energy at the rate of \$30.22 per megawatt-hour.

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- (2) Commencing at 0000 hours on the Commercial Operation Date, the Purchase Price shall be as defined in Exhibit F for the term of this Agreement.

## 5. MONTHLY PAYMENT COMPUTATION

The monthly payment shall be computed as follows:

Monthly Payment = (Metered Energy) x (1 - Line Losses) x (Purchase Price)

### (a) Line Losses

For the purpose of computing the monthly payment, Line Losses shall be the sum of the line and transformation losses on the transmission facilities between the Project and the Point of Interconnection. Such Line Losses shall be determined prior to the Commercial Operation Date by a consultant's report provided by Seller and reasonably acceptable to Bonneville. The authorized representatives of the Parties shall execute an acknowledgement to record the Line Losses.

### (b) Wheeling Charges

Seller shall pay all charges, if any, for wheeling the Metered Energy to the Point of Delivery.

## 6. BILLING AND PAYMENT

### (a) Invoicing by Seller

Commencing with the first delivery of Metered Energy, the Seller shall submit to Bonneville a monthly payment calculation and invoice for payment for Metered Energy in the form shown in Exhibit E. The monthly amount of Metered Energy shall not exceed the amount determined from the metering and telemetering equipment installed pursuant to section 8(d) below.

### (b) Payment by Bonneville

- (1) Payment of the amounts invoiced under this Agreement shall be due on the first Workday following thirty (30) calendar days after receipt of a proper invoice. Invoices shall be mailed or faxed to the designated billing office:

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Bonneville Power Administration  
Contract Generating Resources  
Geothermal Project Manager  
Routing PGC/6  
P.O. Box 3621  
Portland, OR 97208-3621  
905 NE 11th Street  
Portland, OR 97232  
FAX: (503) 230-4973

The designated billing office may be changed by Bonneville upon written notice to Seller. Invoices sent by fax shall be confirmed by mail.

- (2) Payment of amounts invoiced under this Agreement shall be made by electronic funds transfer to a financial institution designated by Seller.
- (3) Payments not received when due shall be subject to an interest charge consistent with the Prompt Payment Act (31 U.S.C. §§ 3901 *et seq.*) and Renegotiation Board's interest rate published in the Federal Register and effective in the month in which the bill is rendered.
- (4) In the event a monthly invoice is found to contain an error, including, without limitation, a meter error which results in a correction as provided in section 8(e) of this Agreement, Seller shall reflect the necessary adjustment (either positive or negative) on the next invoice.

**(c) Billing Disputes**

In the event a Party disputes an invoice, the Party disputing the invoice shall pay the invoice under protest. The Parties shall resolve such dispute in accordance with section 22 of this Agreement.

**7. TERMINATION**

**(a) Termination due to Governmental or Court Action**

Either Party may, by written notice to the other Party by the terminating Party's authorized representative, terminate this Agreement without incurring any liability to the other Party if:

- (1) the Project is denied, with no recourse, necessary governmental permits and approvals, or government agencies with jurisdiction over the Project are enjoined, by a court of competent jurisdiction under a final nonappealable order, from issuing or allowing the implementation of necessary permits and approvals; or

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- (2) a court of competent jurisdiction, under a final nonappealable order, enjoins Bonneville from carrying out its obligations under this Agreement.

Upon termination pursuant to this section 7(a), neither Party shall have any liability to the other Party arising out of or in connection with this Agreement.

**(b) Termination for Delay in Completion**

Bonneville may, upon written notice to Seller by Bonneville's authorized representative, terminate this Agreement without incurring any liability to Seller, if the Commercial Operation Date has not occurred for any reason on or before December 31, 2005 (Commercial Operation Deadline) provided, however, that if the Commercial Operation Date does not occur by the Commercial Operation Deadline due primarily to an Uncontrollable Force, then such Commercial Operation Deadline shall be extended for a period equal to the period during which such Uncontrollable Force prevented or delayed the occurrence of the Commercial Operation Date. For the purposes of this paragraph, Uncontrollable Force shall not include degradation or inadequacy of the geothermal resource. It is agreed and understood that termination of this Agreement pursuant to this section 7(b) shall be Bonneville's sole and exclusive remedy with respect to any failure to achieve the Commercial Operation Date by the Commercial Operation Deadline or any failure by Seller to provide energy to Bonneville as a result of such a failure to achieve the Commercial Operation Date by the Commercial Operation Deadline and, upon such termination, neither Party shall have any liability to the other Party arising out of or in connection with this Agreement.

**(c) Other Reasons to Terminate Agreement**

Bonneville may, upon sixty (60) calendar days written notice to Seller by Bonneville's authorized representative, as its sole and exclusive remedy terminate this Agreement for any one or more of the following reasons, except in the event of Uncontrollable Force:

- (1) By December 31, 2003, if Seller has not obtained and provided to Bonneville's authorized representative a reservoir report from a reservoir engineer retained by the Project Lender certifying that the reservoir capacity is equal to or greater than one hundred twenty-five (125) percent of that required to generate an annual amount of Metered Energy equal to or greater than three hundred ninety-three thousand three hundred (393,300) megawatt-hours for the first fifteen (15) years of this Agreement. If there is no Project Lender, Seller shall at its own expense retain a reservoir engineer reasonably acceptable

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to Bonneville to provide the reservoir report and certification described in this section. The date referred to in this subsection shall be extended for a period equal to any period during which an Uncontrollable Force prevented or delayed Seller from meeting the deadline. For the purposes of this paragraph, Uncontrollable Force shall not include degradation or inadequacy of the geothermal resource. If Bonneville terminates this Agreement pursuant to this paragraph, then neither Party shall have any liability to the other Party arising out of or in connection with this Agreement subsequent to such termination.

- (2) By December 31, 2004, if Seller has not cleared and graded the power plant site, installed foundations for the power plant, and taken other actions that demonstrate to Bonneville's reasonable satisfaction that construction of the Project is in progress and that Commercial Operation will occur on or before the Commercial Operation Deadline. The date referred to in this subsection shall be extended for a period equal to any period during which an Uncontrollable Force prevented or delayed Seller from meeting the deadline. For the purposes of this paragraph, Uncontrollable Force shall not include degradation or inadequacy of the geothermal resource. If Bonneville terminates this Agreement pursuant to this paragraph, then neither Party shall have any liability to the other Party arising out of or in connection with this Agreement subsequent to such termination.

- (3) **For Bonneville's Convenience before the Commercial Operation Date**

The Parties agree that if Bonneville terminates performance of its obligations hereunder for convenience before the Commercial Operation Date, Seller would suffer damages that cannot at this time be determined with reasonable certainty. The Parties therefore agree that as liquidated damages, and not as a penalty, Bonneville shall pay upon such termination an amount equal to all of the Facility Precommercial Total Capital Investment as provided in this section 7(c)(3). As used herein, "Facility Precommercial Total Capital Investment" or ("FPTCI") means the total amount invested or irrevocably obligated to be paid, at the time Seller receives written notice of termination by Bonneville, by Seller and/or its affiliates for the development and construction of the Project, including without duplication (a) the equity investment made by Seller and/or its affiliates in the Project and, if the Project has been financed, the amount of any loan made available to Seller or its affiliates by any Project Lender, and (b) all costs and expenses incurred by Seller and

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its affiliates in connection with the Project after the Effective Date (including, without limitation, the costs and expenses of consultants, legal advisors and other third parties engaged by Seller in connection with development and construction of the Project and internal administrative costs and expenses of Seller allocated to the Project, but excluding general overhead. Upon receipt of the written notice of termination from Bonneville, Seller shall take all reasonable actions to minimize the amount of FPTCI to be paid by Bonneville. FPTCI shall not be reduced by payments by Bonneville to Seller pursuant to the Settlement Agreement.

At such time as Seller becomes entitled to payment pursuant to this section, Seller shall prepare and submit to Bonneville an itemized statement detailing Seller's FPTCI incurred or irrevocably obligated prior to the effective date of termination that gave rise to the payment. Seller's request for payment shall be subject to review and audit by Bonneville for appropriateness. Bonneville shall not be required to reimburse Seller for FPTCI for which reasonably requested audit records are not made available by Seller. Bonneville shall reimburse Seller for FPTCI that meets the requirements of this section within sixty (60) calendar days after Seller submits the itemized statement.

**(4) For Bonneville's Convenience after the Commercial Operation Date**

The Parties agree that if Bonneville terminates performance of its obligations hereunder for convenience after the Commercial Operation Date, Seller would suffer damages that cannot at this time be determined with reasonable certainty. The Parties therefore agree that as liquidated damages, and not as a penalty, Bonneville shall pay upon such termination an amount equal to the Facility Total Capital Investment less depreciation and amortization at 3.33-percent per annum computed at the date of termination. As used herein, "Facility Total Capital Investment" means the total amount invested by Seller and/or its affiliates in the development and construction of the Project, including without duplication (a) the equity investment made by Seller and/or its affiliates in the Project and, if the Project has been financed, the amount of any loan made available to Seller or its affiliates by any Project Lender, and (b) all costs and expenses incurred by Seller and its affiliates in connection with the Project after the Effective Date (including, without limitation, the costs and

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expenses of consultants, legal advisors and other third parties engaged by Seller in connection with development and construction of the Project and internal administrative costs and expenses of Seller allocated to the Project, but excluding general overhead. Facility Total Capital Investment shall not be reduced by payments by Bonneville to Seller pursuant to the Settlement Agreement.

At such time as Seller becomes entitled to payment pursuant to this section, Seller shall prepare and submit to Bonneville an itemized statement detailing Seller's Facility Total Capital Investment incurred or irrevocably obligated prior to the effective date of termination that gave rise to the payment. Seller's request for payment shall be subject to review and audit by Bonneville for appropriateness. Bonneville shall only be required to reimburse Seller for Facility Total Capital Investment for which reasonably requested audit records are made available by Seller. Bonneville shall reimburse Seller for Facility Total Capital Investment that meets the requirements of this section within sixty (60) calendar days after Seller submits the itemized statement.

(5) For default by Seller in accordance with section 18(g).

Upon termination pursuant to section 7(c)(1), (2), (3) or (4), Seller shall have no liability to Bonneville arising out of or in connection with this Agreement.

**(d) Other Termination By Seller**

If at any time prior to the Commercial Operation Date Seller determines (which determination will be made by Seller in its sole discretion) that the Project is not feasible, Seller may, upon written notice to Bonneville by Seller's authorized representative, terminate this Agreement without incurring any liability to Bonneville.

**8. TRANSMISSION AND INTERCONNECTION**

**(a) Power Delivery Standards**

**(1) Character of Service**

Metered Energy shall be in the form of three phase current, alternating at a nominal frequency of sixty (60) hertz.

**(2) Voltage Schedules**

Seller shall operate the Project in accordance with the standards described in Exhibit B of this Agreement.

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(3) **General Power Delivery Standards**

The Metered Energy shall be made available to Bonneville in accordance with the standards described in Exhibit B of this Agreement.

(b) **Continuity of Service**

Each Party may temporarily interrupt or reduce deliveries of Metered Energy if such Party reasonably determines that such interruption or reduction is necessary to construct, install, maintain, repair, replace, remove, investigate, inspect, or test any part of the Project, Interconnection Facilities, or affected portion of the Federal System.

Such Party shall use reasonable efforts to schedule such activities during non-peak periods and to minimize the effect and duration of the interruption or reduction and shall use reasonable efforts to provide notice to the other Party fourteen (14) calendar days prior to the interruption or reduction. If such notice is provided by telephone, it shall be confirmed in writing.

(c) **Interruption for Safety or Emergency**

Each Party may effect an interruption or reduction of Metered Energy in accordance with the following.

(1) **Seller**

At Seller's discretion, if a condition exists which presents a physical threat to any person or property, or an Uncontrollable Force affects the Project or the Interconnection Facilities.

(2) **Bonneville**

At Bonneville's discretion, if a condition exists which presents a physical threat to any person or property, such condition including procedures used by Bonneville for energized transmission line maintenance, or an Uncontrollable Force or Emergency impacts portions of the Federal System or the Interconnection Facilities.

(3) **Notice**

The Party effecting such interruption or change shall give the other Party reasonable advance notice and shall use reasonable efforts to minimize the effect and duration of the interruption or reduction of Metered Energy. Notices under this section 8(c)(3) may be by telephone or telemetering channel as appropriate. However, either Party shall be given, upon request, follow-up written confirmation of oral or telemetering notifications.

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(d) **Metering and Telemetering Devices**

Before Bonneville will accept delivery of Metered Energy, Seller shall ensure that all equipment and facilities needed for safe and reliable interconnection to the transmission system have been installed and in operation as reasonably approved by Bonneville. All Metered Energy delivered under this Agreement shall be measured by meters at the Project ("Meters"), such meters to be paid for, owned, installed, operated, maintained, and calibrated by Seller. All metering and telemetering equipment shall meet the standards described in Exhibit B of this Agreement and shall be subject to the approval of Bonneville, which approval shall not be unreasonably withheld.

Meters shall be recalibrated every two years, and Bonneville or its representative shall be allowed to witness the calibration tests and have access to calibration records. The calibration standards used for calibration shall have their accuracy traceable to the National Institute of Standards and Technology. The calibration standard shall have been calibrated and certified within twelve (12) months prior to the actual meter calibration.

(e) **Adjustment for Inaccurate Meters.**

If a Meter fails to register or is found upon testing to be inaccurate by more than a quarter of one percent (0.25%), an adjustment shall be made correcting all measurements by the inaccurate or defective Meter, for both the amount of the inaccuracy and the period of the inaccuracy, in the following manner:

- (1) The Parties shall use their best efforts to determine the period during which inaccurate measurements were made. In the event that the Parties cannot agree on the actual period during which the inaccurate measurements were made, the period during which the measurements are to be adjusted shall be the shorter of (1) the last one-half of the period from the last previous test of the Meter to the test that found the Meter to be defective or inaccurate, or (2) the 180 calendar day period immediately preceding the test that found the Meter to be defective or inaccurate.
- (2) To the extent that the adjustment period overlaps with a period of deliveries for which payment has already been made by Bonneville, Bonneville shall use the corrected measurements as determined in accordance with this section to recompute the amount due for the period of the inaccuracy and shall subtract the previous payments by Bonneville for such period from such recomputed amount. If the difference is a positive number, the difference shall be paid by Bonneville to Seller; if the difference is a negative number, that difference shall be paid by Seller to Bonneville, or at the discretion of

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Bonneville may take the form of an offset to payments due Seller by Bonneville. Payment of such difference by the owing Party shall be made not later than thirty (30) calendar days after the owing Party receives notice of the amount due, unless the owing Party is Seller, in which case Bonneville may elect payment via an offset.

**Equipment Provided by Seller**

Seller shall provide the following equipment at its expense and in accordance with specifications approved by Bonneville, which approval shall not be unreasonably withheld:

- (1) telecommunication circuit to the operations center(s) nearest to the Project designated by Bonneville,
- (2) voice telephone extension for the purpose of accessing Bonneville's dial-up metering equipment and for communicating with the designated Bonneville operations centers,
- (3) extension of Bonneville's system operations center's voice communications system in the control room of the Project,
- (4) equipment to transmit and receive telecopies for purposes of generation scheduling and coordination of switching, and
- (5) current transformers and potential transformers as required for metering and telemetering purposes.

**(f) Rights-of-Way and Easements**

Seller shall grant to Bonneville all necessary rights-of-way and easements clear of any liens, except such liens that would not have an adverse effect on Bonneville's use of any right-of-way, including adequate and continuing access rights on property of Seller, to operate, maintain, replace, or remove Bonneville's Interconnection Facilities located on property of Seller.

Bonneville shall give Seller reasonable notice before entering property of Seller.

**(g) Special Control Modifications**

Subject to the approval of the other Party, each Party reserves the right to modify or expand, at its own expense, any control system of the Project that may be beneficial to the operation of the Project or the Federal System.

**9. REPRESENTATIONS, WARRANTIES, AND COVENANTS OF SELLER**

**(a) Organization, Qualification, and Authority**

Seller hereby represents and warrants that it is a limited partnership, duly organized, validly existing and in good standing under the laws of the State

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of California and in each other jurisdiction where the failure to so qualify would have a material adverse effect upon the business or financial condition of Seller; and that it has all requisite power and authority to conduct its business, own its properties, and execute, deliver, and perform its obligations under this Agreement. This is a valid and binding obligation of Seller.

(b) **Non-Contravention**

The execution and delivery of this Agreement by Seller does not, and the consummation by Seller of the transactions contemplated by this Agreement will not, violate any law, any agreement to which Seller is a Party, or any judgment or decree to which Seller is a Party or by which Seller is bound.

(c) **Seller Counsel Opinion**

Seller shall, upon the request of Bonneville and at no cost to Bonneville, cause its counsel to issue an opinion to Bonneville to the effect of the representations in section 9(a) above.

(d) **Preservation**

Seller shall preserve and keep in force and effect its corporate existence and all franchises, licenses, permits and leases necessary to perform its obligations under this Agreement, including without limitation the business of constructing, owning and operating the Project.

(e) **Taxes and Claims for Labor and Materials**

Seller shall pay all present and future Federal, state, municipal, and other lawful taxes applicable to it from the sale of Metered Energy. Seller also agrees that it shall promptly pay all lawful taxes, assessments, royalties, trade accounts, and governmental charges or levies imposed upon it or any part of its property or business related to the Project in accordance with usual and customary business terms.

Seller shall pay claims assessed for work, labor, or materials which might become a lien or charge upon any of its property related to the Project. However, Seller shall not be required to pay any such tax, assessment, charge, levy, account payable, or claim if:

- (1) Seller is contesting in good faith the proceeding, forfeiture, sale of any property by Seller, or any material interference, and
- (2) Seller establishes reserves or escrow accounts deemed reasonable by the Seller to satisfy the requirements of this section.

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**10. Performance Obligation of Seller**

**(a) Project Lender Assignment**

If there is more than one entity that is a Project Lender, Seller shall endeavor to accomplish the following:

In the case of multiple Project Lenders providing Project financing to Seller, designate or cause to be designated a single entity which shall represent all such Project Lenders for the purpose of communicating with Bonneville regarding the exercise of Project Lender assignment rights as provided in section 13 of this Agreement.

**(b) Compliance with Licenses, Permits, Regulations, and Environmental Provisions**

- (1) Seller shall obtain and comply with all terms and conditions of any permit, license, local regulation, or other approval which is required for the construction, operation, maintenance, repair, decommissioning, and site restoration of the Project, issued, or thereafter lawfully required, by any Indian Tribe, Federal, state, or local government agency, or any other body having jurisdiction. Seller shall furnish to Bonneville, on request, copies of all documents granting, evidencing, or otherwise relating to such permits, licenses, regulations, or approvals.
- (2) Failure to comply with a final order (after all applicable appeals) of a Federal, state, local government agency, Indian Tribe, or a court of competent jurisdiction which finds the Project or the Interconnection Facilities owned by Seller is in material noncompliance with any license, permit, regulation, or other required approval referred to in section 10(b)(1) above, shall constitute a material breach of this Agreement.
- (3) Seller shall comply with all mitigation plans and environmental agreements developed during the National Environmental Policy Act process for the Project and consultations by Bonneville or on Bonneville's behalf with the U.S. Fish and Wildlife Service and the California State Historic Preservation Office, regardless of whether those consultations are concluded before or after the execution of this Agreement. Such mitigation plans and environmental agreements shall include, without limitation, those required by the Record of Decision for Fourmile Hill Geothermal Project on Federal Leases CA21924 and CA21926, issued on May 31 2000, by the Department of Interior, Bureau of Land Management, Alturas Field Office, and the Department of Agriculture, U.S. Forest Service, Klamath National

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Forest and Modoc National Forest, or by successor mitigation plans and environmental agreements.

- (4) If Bonneville determines that the Project is in noncompliance with the provisions of section 10(b)(3) above, then the following provisions shall apply:
- (A) Following consultation with Seller, Bonneville shall provide Seller with written notice, stating the nature of the noncompliance with section 10(b)(3).
  - (B) Within sixty (60) calendar days following receipt of written notice from Bonneville pursuant to section 10(b)(4)(A) above, unless otherwise mutually agreed, Seller shall submit to Bonneville a plan to cure the noncompliance. Such plan shall include the course of conduct necessary and the period of time required to bring the Project into compliance.
  - (C) Bonneville shall review the plan submitted pursuant to section 10(b)(4)(B) above and shall notify Seller of the result of such review.
  - (D) If Bonneville accepts the plan submitted pursuant to section 10(b)(4)(B) above, Seller shall take actions to cure the noncompliance in the manner and within the time period set out in the plan.
  - (E) If Bonneville does not accept the plan submitted pursuant to section 10(b)(4)(B) above, then the Parties shall reach agreement on a plan pursuant to section 22 of this Agreement.
  - (F) If Seller fails to submit a plan pursuant to section 10(b)(4)(B) above, or if Seller fails to take the actions described in section 10(b)(4)(D) above, then Bonneville may terminate this Agreement upon thirty (30) calendar days written notice to Seller and neither Party shall have any liability to the other Party arising out of or in connection with this Agreement subsequent to such termination.

(c) **Cooperation on Emergency Plan**

At the request of Bonneville, Seller shall cooperate with Bonneville in the preparation and execution of emergency plans including without limitation, recovery from a local or widespread electrical blackout, voltage reduction in order to effect load curtailment, change in generation level for system reliability contingencies, and other plans that Bonneville reasonably determines are needed. In connection therewith, Seller shall make technical

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references available to Bonneville concerning start-up times, minimum load-carrying ability, and other pertinent Project operating characteristics.

(d) **Advance Notices**

Thirty (30) calendar days prior to the start of construction of the Project and the start of construction of the Interconnection Facilities, Seller shall submit a construction schedule to Bonneville for its information. Ninety (90) calendar days prior to the initial synchronization of the Project, Seller shall submit to Bonneville for its information a schedule of start-up and Commercial Operation Test activities and the expected Commercial Operation Date. Seller shall notify Bonneville of any changes to such schedules in a timely manner to allow for outage coordination and test power absorption by Bonneville.

(e) **Metered Energy Forecast and Limits**

(1) **Monthly and Annual Output Forecast**

Within one hundred eighty (180) calendar days prior to the Commercial Operation Date and not later than each January 1 thereafter during the term of this Agreement, Seller shall submit to Bonneville a written report stating Seller's expectation of the annual amounts of Metered Energy and the maximum hourly rate of delivery in megawatts from the Project at the Point of Interconnection for each of the succeeding five (5) Contract Years.

At least one week before the beginning of each month, Seller shall provide Bonneville with a forecast of deliveries for the month.

(2) **Annual Output Limit**

Bonneville shall not be obligated to purchase more than four hundred thirty-eight thousand (438,000) megawatt-hours of Metered Energy annually.

(f) **Installation, Operation and Maintenance**

Seller shall install at the Project equipment of a type normally used in construction of a facility of similar size and with similar operating characteristics. Further, Seller shall construct, operate, and maintain the Project in accordance with standards recommended by the Project's equipment suppliers, Prudent Utility Practices, and any procedures agreed to by Seller and Bonneville.

(g) **Annual Maintenance Schedules**

No later than each January 1 following the Commercial Operation Date and during the term of this Agreement, Seller shall submit to Bonneville for the succeeding five (5) Contract Years:

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- (1) the projected schedule of major maintenance of, modification of, replacement of, or addition to the Project which is expected to result in a Scheduled Outage longer than ninety-six (96) hours, and
- (2) all other operational and maintenance information which the Parties have mutually determined to be pertinent to integrating the Metered Energy into the Federal System.

Seller shall endeavor to arrange for Scheduled Outages of longer than ninety-six (96) hours to occur during the period April 15 through June 15 and likewise endeavor to avoid Scheduled Outages longer than ninety-six (96) hours during the period August 1 to April 15.

(h) **Operating Log**

Seller shall maintain, and make available to Bonneville on request, an accurate and up-to-date operating log at the Project with records of real and reactive hourly power production, scheduled and forced outages, and changes in operating status including any unusual conditions and actions taken to resolve each such condition. This operating log and associated records shall be maintained for a period of no less than five (5) years.

(i) **Availability of Personnel**

Seller shall employ qualified personnel for operating and maintaining the Project and for coordinating Project operations with Bonneville. Seller shall make reasonable efforts to ensure that a sufficient number of personnel are on duty or available to be called out upon two (2) hours notice at all times.

(j) **Leases Committed to the Project**

The leases committed to the Project are listed in Exhibit D, Table 1 of this Agreement. Seller shall not relinquish control over such committed leases held or controlled by Seller or its affiliates without the written consent of Bonneville. Such consent shall not be unreasonably withheld.

(1) **Dedicated Area**

Seller shall be entitled to define a portion of the leases committed to the Project as the productive geothermal reservoir (Dedicated Area) supporting the Project, provided that:

- (A) Seller provides, at Seller's expense, certification from a mutually acceptable consultant that the Dedicated Area is sufficient to produce an annual amount of Metered Energy equal to or greater than four hundred ninety-one thousand seven hundred (491,700) megawatt-hours for the term of this Agreement; and

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- (B) The Project has produced an annual amount of Metered Energy equal to or greater than three hundred fifty-four thousand (354,000) megawatt-hours for at least one (1) year prior to such certification.

When these two conditions have been satisfied, the Dedicated Area shall be deemed the location of the Project, and Exhibit D shall be revised accordingly. Notwithstanding the above, the leases held or controlled by Seller or its affiliates comprising the Project as of the Effective Date of this Agreement shall be subject to Bonneville's option rights pursuant to section 23 of this Agreement.

(k) **Agreements With Tribes**

Seller shall cause Calpine Corporation to comply with all terms and conditions applicable to Calpine Corporation set forth in the following agreements:

- (1) The Memorandum of Agreement entered into as of April 10, 2000, between Calpine Corporation and the Shasta and Upper Klamath River Canyon Tribes, together with any agreements entered into by Calpine Corporation and the Shasta and Upper Klamath River Canyon Tribes in connection therewith; and
- (2) The Memorandum of Agreement entered into as of November 11, 1999, between Calpine Corporation and the Klamath Tribes, together with any agreements entered into by Calpine Corporation and the Klamath Tribes in connection therewith.

It is Seller's intent to hire qualified employees from the local job market through its agreement with the California State Building and Construction Trades Council ("Union"). Seller shall request that the Union notify the local Native American tribes of open positions at the Project and refer to Seller qualified candidates from the tribes.

**11. REPRESENTATIONS, WARRANTIES, AND COVENANTS OF BONNEVILLE**

Bonneville hereby represents and warrants the following:

(a) **Organization, Qualification, and Authority**

Bonneville is authorized by Federal law, including the Northwest Power Act and other applicable laws, to dispose of electric power generated at various Federal hydroelectric projects in the Pacific Northwest or acquired from other resources, including geothermal energy facilities.

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(b) **Non-Contravention**

The execution and performance of Bonneville's obligations under this Agreement has been duly authorized by all necessary agency action, and does not and will not:

- (1) require any further agency consent or approval;
- (2) to the knowledge of Bonneville, violate any provision of Federal law, rule, regulation, order, writ, judgment, injunction, decree, determination, or award currently in effect having applicability to Bonneville, or conflict with or constitute a breach or default under any contract or agreement of any kind to which Bonneville is a party, the violation, conflict, breach, or default of which could have a material adverse effect on the ability of Bonneville to perform its obligations under this Agreement.

(c) **Binding Obligation**

This Agreement is a valid and binding obligation of Bonneville.

**12. INSURANCE**

Prior to the Commercial Operation Date, Seller shall procure and maintain at least the following levels of insurance coverage at its sole expense throughout the term of this Agreement. The amounts listed are based on 1991 industry practices, levels, and needs. As insurance practices change, Seller shall maintain coverages consistent with and equivalent to those coverages carried by similar types of entities with comparable equipment and operations similarly situated. Bonneville or its agents may review such insurance coverage for adequacy. If requested, but not more frequently than every three (3) years beginning with the Commercial Operation Date, Bonneville may request that Seller engage a third-party consultant acceptable to Bonneville to report on and certify such coverage. No increase shall be made in the insurance coverages if such insurance coverage, including the proposed increase, is not available on a commercially reasonable basis.

(a) **Liability Insurance**

<b>TYPE OF COVERAGE</b>	<b>LIMITS OF LIABILITY</b>
(1) Workers' Compensation Insurance	Statutory
(2) Employer's Liability Insurance	\$15,000,000 per occurrence

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- (3) Comprehensive General Liability Insurance \$15,000,000 per occurrence

Including:  
Coverage for bodily injury (including death), property damage, independent contractors, products and completed operations.

- (4) Comprehensive Automobile Liability Insurance \$2,000,000 per occurrence

Including:  
Coverage for all owned, hired, or non-owned automobiles.

The limits of the coverages provided may be satisfied by any combination of primary or excess insurance at Seller's sole discretion.

(b) **Property Insurance**

Seller shall maintain property insurance which covers the Project to the full replacement value of the Project. The property coverage will include "all risk" perils coverage including machinery breakdown. Seller shall not be obligated to carry more earthquake insurance than it typically carries on its other power plants in California and is commercially available. The proceeds of such insurance shall be used to repair or replace the Project to the condition it was in prior to the occurrence and subject to the feasibility of restoration.

Seller shall provide Bonneville with certificates of insurance which shall provide that the policies may not be canceled or changed without thirty (30) calendar days prior written notice to Bonneville, except for nonpayment of premiums, in which case ten (10) calendar days' prior written notice shall be provided. All such policies procured and maintained by Seller shall name Bonneville as an additional insured. Failure by Seller to maintain the policies required by this section shall constitute a material breach of this Agreement.

**13. ASSIGNMENT TO PROJECT LENDERS**

Notwithstanding any other provision of this Agreement to the contrary, including, without limitation, section 5 of Exhibit A of this Agreement, Seller shall have the right, without the consent of Bonneville, to grant a security interest in this Agreement and in the Project to any Project Lender, provided that such assignment

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is preceded by written notice to Bonneville setting forth the terms of such assignment and the name and address of the Project Lender to which the assignment is made. If Seller shall assign a security interest in this Agreement, then so long as any such assignment, or any consolidation, modification, or extension of any such assignment shall remain outstanding, the following provisions shall apply.

(a) **Notice**

Bonneville shall, upon serving upon Seller any notice of an event of default or termination pursuant to any provision of this Agreement, also serve a copy of such notice upon the Project Lender(s) at the address(es) provided for in the notice to Bonneville of the assignment. No notice of an event of default or a termination by Bonneville hereunder shall be deemed to have been duly given unless and until a copy thereof shall have been so served.

(b) **Cure by Project Lender**

From and after the date that written notice of an event of default or a termination pursuant to any provisions of this Agreement has been served upon the Project Lender(s), said Project Lender(s) shall, with Seller's consent, have the same period for remedying or commencing the remedy of any alleged event of default, or causing the same to be remedied, as is given to Seller pursuant to the terms of this Agreement to remedy, commence remedying, or cause to be remedied the event of default specified in any such notice. Bonneville shall, with Seller's consent, accept such performance by or on behalf of such Project Lender(s) as if the same had been done by Seller. Bonneville shall not interpose any objection if any Project Lender, with Seller's consent, takes such action or enters the Project for such purpose.

(c) **Seller's Continuing Obligation**

The making of an assignment pursuant to this section 13 shall not be deemed to constitute an assignment or transfer of this Agreement, nor shall any Project Lender, as such, be deemed to be an assignee or transferee of this Agreement so as to require such Project Lender, as such, to assume the performance of any of the terms or conditions on the part of Seller to be performed hereunder.

(d) **Notice of Termination**

In the event of the termination of this Agreement as a result of an event of default by Seller, Bonneville shall, in addition to providing the notice of such event of default as required in section 13(a) of this Agreement, provide each Project Lender with written notice that this Agreement has been terminated, together with a statement of all sums which would at that time be due under

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this Agreement but for such termination, and of all other events of default, if any, then known to Bonneville.

**14. CLEAN AIR OFFSETS OR ALLOWANCES**

Bonneville retains all rights, titles, and interests in any offsets or allowances resulting from Metered Energy under: (a) the Federal Clean Air Act (including but not limited to Title IV of the Clean Air Act Amendments of 1990); and (b) any state acts providing offsets or allowance related to emissions and Seller agrees to cooperate with Bonneville and provide such further assurances in connection therewith as may reasonably be requested by Bonneville or any transferee of such offsets or allowances.

**15. EXAMINATION OF RECORDS AND DATA**

Subject to section 21, either Party shall have the right from time to time, upon reasonable advance notice, to examine during normal working hours the records and data of the other Party relating to operations under this Agreement. The Party whose records are being examined may recover, from the Party exercising its right to examine, its reasonable cost attributable to the examinations in excess of four (4) calendar days cumulatively in any Contract Year, provided such examinations are not the result of negligence or repeated material violations of this Agreement by the Party whose records are being examined. For the purposes of this section and as it applies to Bonneville, "Party" shall exclude Bonneville's Transmission Business Line.

**16. OVERSIGHT BY BONNEVILLE**

**(a) Right to Review**

Subject to section 21, Bonneville or its agent shall have the right to review, monitor and physically inspect all aspects and phases of the Project and the Interconnection Facilities provided by Seller including financing, engineering/design, procurement, construction, startup and testing, and environmental compliance. Seller shall cooperate in such reviews, monitoring and physical inspections as may be reasonably required by Bonneville before, during, and after completion of construction. Bonneville shall give Seller reasonable advance notice of any review, monitoring or physical inspections which, unless circumstances dictate otherwise, shall be conducted during normal business hours. Such reviews, monitoring and physical inspection shall be in accordance with applicable safety standards. This is a right of review and inspection only, and shall not be construed as a right of approval by Bonneville. Bonneville's technical reviews, monitoring and physical inspections shall not be construed as endorsing the Project or

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any aspect thereof or as any warranty of the safety, durability, reliability, compliance, or suitability of the Project and the Interconnection Facilities provided by Seller.

(b) **Regular Progress Reports**

Beginning with the Effective Date and continuing until the Commercial Operation Date, Seller shall submit, on a quarterly basis, progress reports in a form reasonably satisfactory to Bonneville. Progress reports shall include such information as would be required by a Project Lender and shall indicate significant events that occurred during the previous quarter and activities planned for the next quarter.

(c) **Commercial Operation Date**

Seller shall notify Bonneville in writing of the Commercial Operation Date of the Project. The authorized representatives of the Parties shall execute an acknowledgement of the Commercial Operation Date.

**17. OPERATING SECURITY**

(a) **Reserves**

Seller shall maintain, without duplication of the applicable requirement of Project Lenders, a repair and replacement reserve and a well drilling reserve throughout the first fifteen (15) years of this Agreement. For the purposes of this section, the repair and replacement reserve account shall be in addition to any debt service account that is required by the Project Lender. The well drilling reserve, if any, and the repair and replacement reserve shall be established on or before the Commercial Operation Date. Beginning with the first calendar year following the Commercial Operation Date, the amount to be maintained in such reserves shall be the initial amount multiplied by the Gross Domestic Product Implicit Price Deflator or its successor index.

- (1) The reserves shall be replenished with cash flow from the Project that would otherwise be distributed to Seller.
- (2) Seller may withdraw funds from the repair and replacement reserve at any time and in any amount to pay for the reasonable cost of any repair, replacement, modification, or addition related to the Project.
- (3) Seller may withdraw funds from the well drilling reserve at any time and in any amount to pay for the reasonable cost of any geothermal well or gathering system replacement, workover, modification, or addition related to the Project.
- (4) Seller may withdraw funds from either reserve account for any other reason at any time and in any amount provided that Seller replace

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such funds with a letter of credit, parent company guarantee, or other credit support of equal value in a form and subject to terms and conditions reasonably acceptable to Bonneville.

- (5) The initial amount in the repair and replacement reserve shall be equal to or greater than the amount required by the Project Lender.
- (6) The initial amount in the well drilling reserve shall be equal to or greater than the larger of the following amounts:
  - (A) the average cost of drilling a production well placed in service on or before the Commercial Operation Date, multiplied by two; or
  - (B) the amount required by the Project Lender.
- (7) Seller shall be allowed to substitute proven well reserves for the well drilling reserve required in section 17(a)(6) as long as Seller meets the following conditions:
  - (A) Beginning no later than the Commercial Operation Date and continuing throughout the first fifteen (15) years of this Agreement, Seller shall maintain an excess of field steam production capacity equal to or greater than twenty-five (25) percent of that required to generate an annual amount of Metered Energy equal to or greater than three hundred ninety-three thousand three hundred (393,300) megawatt-hours. Field steam production capacity is defined as the sum of steam production rates, measured on a mass flow rate basis, of all reserve wells and of all production wells connected to the gathering system, at wellhead pressures equal to or greater than the minimum required to maintain normal operating conditions for three hundred ninety-three thousand three hundred (393,300) megawatt-hours of annual Metered Energy. For purposes of determining the minimum acceptable wellhead pressure at which a well's production capacity is established, pressure drops through the gathering system shall be determined at normal operating conditions for three hundred ninety-three thousand three hundred (393,300) megawatt-hours of annual Metered Energy.
  - (B) At the Seller's expense, field steam production capacity shall be satisfied if verified annually by a reservoir engineering consultant selected by Bonneville and reasonably acceptable to Seller, or the reservoir engineer of the Project Lender. Flow metering and pressure instrumentation shall be calibrated

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annually and documented in a manner acceptable to the consultant. Complete access to the site and production data records shall be granted to the consultant for the purpose of witnessing and certifying the field production capacity. Maximum production capacity of each well, at the limiting wellhead pressure defined above, may be demonstrated by a production test of at least twenty-four (24) hours duration or by reasonable extrapolation of a well-defined deliverability curve. The acceptability of the extrapolation as a substitute for the actual test at full flow rate shall be at the discretion of the consultant.

- (8) In the event that Seller does not maintain an excess of field steam production capacity equal to or greater than twenty-five (25) percent of that required to generate an annual amount of Metered Energy equal to or greater than three hundred ninety-three thousand three hundred (393,300) megawatt-hours, as determined by the reservoir engineering consultant selected by Bonneville pursuant to section 17(a)(7)(B), Seller shall, within seven calendar days of written notification of such deficiency by Bonneville, provide well drilling reserves as specified in section 17(a)(6), which well drilling reserve shall remain in force until such excess field steam production capacity is certified as provided above.
- (9) Seller may (A) withdraw funds from either reserve, for any reason, and in any amount, or (B) reduce either the contribution amount to or the maximum amount in either reserve, provided that Seller delivers a report to Bonneville prepared at Seller's expense by a consultant selected by Seller and reasonably acceptable to Bonneville that states, to the effect that, in the opinion of the consultant, such withdrawal or reduction will not have a material adverse effect on Seller's ability to achieve an annual amount of Metered Energy equal to or greater than three hundred fourteen thousand seven hundred (314,700) megawatt-hours during the remainder of the term of this Agreement.
- (10) Subsequent to withdrawal of funds pursuant to section 17(a)(9), Seller shall replace funds in the repair and replacement reserve and well drilling reserve from cash flow from the Project available for distribution to Seller or, at Seller's option, from other sources, to the total amounts specified in sections 17(a)(5) and 17(a)(6) of this Agreement, adjusted for inflation, using the method specified in those sections, provided that Bonneville delivers a report to the Seller prepared at Bonneville's expense by a consultant selected by Bonneville and reasonably acceptable to Seller that states, to the

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effect that, in the opinion of the consultant, such replacement of funds is necessary to maintain an annual amount of Metered Energy equal to or greater than three hundred fourteen thousand seven hundred (314,700) megawatt-hours during the remainder of the term of this Agreement.

(b) **Form of Operating Security**

The Operating Security may be provided in any one or a combination of:

- (1) an unconditional and irrevocable direct pay letter of credit issued by a bank reasonably acceptable to Bonneville in a form and with substance reasonably acceptable to Bonneville; or
- (2) cash in the form of a restricted bank account with investment provisions reasonably acceptable to Bonneville, an escrow account, a bond, a parent company guarantee or other credit support, or a surety designated by Seller and reasonably acceptable to Bonneville.

(c) **Maintenance of Operating Security**

- (1) If the Operating Security is in the form of an unconditional and irrevocable direct pay letter of credit, then such letter of credit shall contain a provision that Bonneville shall have the right to draw upon such letter of credit before it is terminated in the event such letter of credit has not been renewed or replaced prior to such termination and other security in any one or a combination of the forms described in section 17(b) has not been provided to Bonneville prior to such termination. Any draw by Bonneville under such provision would be held in an interest bearing escrow account and disbursed in accordance with this section 17.
- (2) If the Operating Security is in the form of cash, then the cash shall be held in a restricted bank account with investment provisions reasonably acceptable to Bonneville.

(d) **Bonneville Right to Audit Operating Security Accounts**

Bonneville shall have the right, at its own expense, to audit and examine any cost, payment, settlement, account, or supporting documentation associated with the Operating Security.

- (1) Seller shall receive fourteen (14) calendar days' written notice prior to any such audit.
- (2) Seller agrees to cooperate fully with any such audit, and agrees to retain all records and documentation related to the Operating Security for the term of this Agreement.

**18. DEFAULT AND CURE**

**(a) Notification of Material Breach or Default**

If a Party is in material breach of or default under this Agreement (Defaulting Party), the other Party (Terminating Party) may notify the Defaulting Party in writing that it is in material breach or default. Such notice shall be effective upon its receipt by the Defaulting Party.

**(b) Default by Seller**

Material breach or default by Seller of this Agreement includes, but is not limited to:

- (1) insolvency, i.e., Seller is unable to meet its financial obligations as they become due;
- (2) general assignment of substantially all of Seller's assets for the benefit of its creditors, filing of a petition for reorganization or seeking other relief under any applicable insolvency laws;
- (3) failure, except for reasons of Uncontrollable Force, to deliver any Metered Energy for a period of three hundred sixty-five (365) consecutive days or the rolling three (3) year average Metered Energy falls below one hundred ninety-six thousand seven hundred (196,700) megawatt-hours;
- (4) failure to maintain operating reserves in accordance with section 17 of this Agreement; or
- (5) failure to comply with licenses, permits, regulations, and environmental provisions pursuant to section 10(b) of this Agreement.

Notwithstanding the foregoing, this Agreement shall not be terminated as a result of an Uncontrollable Force.

**(c) Default by Bonneville**

The following shall constitute an event of default by Bonneville:

- (1) Bonneville materially breaches any material term or condition of this Agreement, including but not limited to any breach of any warranty, covenant, or representation which has a material adverse effect upon Seller; or
- (2) Bonneville fails to make payment to Seller when due under this Agreement.

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(d) **Right to Cure**

- (1) The Defaulting Party shall have the right to cure the material breach or default within sixty (60) calendar days of the receipt of notification of the material breach or default.
- (2) In the case of a material breach or default which may not reasonably be cured within sixty (60) calendar days, the Defaulting Party shall have the right to provide the Terminating Party with a plan for the appropriate actions to cure the breach or default. Within this sixty (60) calendar day period the Defaulting Party must commence diligently pursuing appropriate action under the plan to cure the default and no event of default shall be deemed to exist or be uncured, hereunder, so long as the Defaulting Party is diligently pursuing such plan of corrective action. Notwithstanding the foregoing, the circumstance described in section 18(b)(3) of this Agreement shall be considered an event of default.

(e) **Project Lender's Right to Cure**

In the case where Seller is the Defaulting Party and has a Project Lender, Bonneville shall:

- (1) Provide the Project Lender with a copy of the notification of material breach or default at the same time as Seller receives the notification.
- (2) Allow the Project Lender to cure non-monetary defaults within ninety (90) calendar days of the Project Lender's receipt of such notice or of the termination of Seller's right to cure under section 18(d), whichever comes later.
- (3) Allow the Project Lender to cure monetary defaults within sixty (60) calendar days of the Project Lender's receipt of such notice or of the termination of Seller's right to cure under section 18(d), whichever comes later.
- (4) Allow the Project Lender to cure by assuming, or causing a new lessee or purchaser of the Project to assume, Seller's rights and obligations under this Agreement, provided that Bonneville receives the Project Lender's or the new lessee's or purchaser's written assumption agreement within sixty (60) calendar days of the Project Lender's receipt of notification of material breach or default or of the termination of Seller's right to cure under section 18(d), whichever comes later. The party assuming this Agreement pursuant to this cure provision shall have sixty (60) calendar days from the effective date of such assumption to cure the material breach or default or if the default is a nonmonetary default, a longer period as is required so

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long as the party who assumes this Agreement has commenced and is diligently pursuing appropriate action to cure such default. The assumption of this Agreement does not release Seller from any obligations incurred by it under this Agreement. Notwithstanding the foregoing, the circumstance described in section 18(b)(3) of this Agreement shall be considered an event of default.

**(f) Bonneville's Right to Cure**

- (1) If Bonneville notifies Seller of a material breach of or default under this Agreement, and Seller or the Project Lender fails to cure under section 18(d) or 18(e) above or indicates in writing its inability or unwillingness to cure (or cause to be cured) the material breach or default, Bonneville may cure or cause to be cured the material breach or default by the most expeditious means available to it and charge to or otherwise recover from Seller or a party assuming this Agreement all reasonable costs thereof. Bonneville's right to cure any breach or default by Seller shall not be construed or interpreted as obligating Bonneville to make any such cure.
- (2) If Seller, as a result of an uncured event of default, shall cease to operate the Project during the term of this Agreement, and if operation of the Project is not assumed by the Project Lender, its successors or assigns, Bonneville shall have the right to designate a trustee at its sole discretion to take custody of and to operate the Project for all or a portion of the remaining term of this Agreement. Such right to assume operation of the Project shall be limited by and subject to the following:
  - (A) Bonneville must give to Seller and the Project Lender, if any, written notice of Bonneville's intention to exercise its right to assume control and operation of the Project at least thirty (30) calendar days prior to such action.
  - (B) All revenues from the Project, beyond those necessary to operate and maintain the Project and to meet current obligations, including debt service, shall be held in escrow. Until all rights of Seller under this Agreement have been settled, such escrow shall serve as a fund for Project debt service, operation and maintenance expenditures.
  - (C) Assumption of control and/or operation of the Project shall not be construed as creating any duty or responsibility on Bonneville's part for the continued operation of the Project for the benefit of Seller or any other party.

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- (D) Bonneville through the trustee shall make good faith efforts to comply with Seller's existing contracts; however, neither Bonneville nor its trustee designated to operate the Project shall have any responsibility for any obligation Seller incurred prior to the date on which Bonneville's trustee takes possession of the Project.
- (E) The trustee shall act in good faith to protect the interest of all parties having an interest in the Project.

(g) **Right to Terminate**

If the Defaulting Party fails to cure under section 18(d), or, when applicable, Project Lender fails to cure under section 18(e), then the Terminating Party has the right to terminate this Agreement by giving the Defaulting Party written notice of termination. Such notice shall be effective upon its receipt by the Defaulting Party.

(h) **Rights and Remedies Cumulative**

Any right or remedy afforded to either Party under any provision of this Agreement on account of the breach or default by the other Party is in addition to, and not in lieu of, all other rights or remedies afforded to such Party under any other provision of this Agreement, by law or otherwise on account of the breach or default.

**19. AUTHORIZED REPRESENTATIVES**

(a) **Designation**

Each Party shall designate in writing one person as an authorized representative and one person as an alternate. Each Party shall notify the other Party in writing, within thirty (30) calendar days following the Effective Date, of the designated authorized representative and alternative and shall promptly notify the other Party in writing of any subsequent changes in such designations.

(b) **Implementation Procedures**

The authorized representatives may establish written procedures, as required, for implementing certain provisions of this Agreement. Such procedures shall be adopted by mutual agreement. Authorized representatives may delegate authority to act on a particular matter.

(c) **Authority**

Authorized representatives and alternates shall not have authority to modify any of the provisions of this Agreement.

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**20. NOTICES**

Except as provided for in section 8(c)(3) of this Agreement and unless this Agreement specifically requires otherwise, any notices or communication shall be in writing and given by: (a) registered, certified, or first class mail; (b) commercial courier; (c) telex; (d) telecopy; or (e) telegram. Such notice or communication shall be sent to the respective Parties at their address shown below.

Any notice shall be deemed to have been given when received. Communications by telex, telecopy, or telegram shall be confirmed by depositing a copy of the same in any commercial courier service or the postal service for transmission by registered, certified, or first class mail.

If to Bonneville:

Bonneville Power Administration  
Contract Generating Resources  
Routing PGC/6  
P.O. Box 3621  
Portland, OR 97208-3621  
or  
905 N.E. 11th  
Portland, OR 97232  
Attn: Geothermal Project Manager  
(503) 230-4386  
FAX: (503) 230-4973

If to Seller:

Calpine Siskiyou Partners L.P.  
c/o Calpine Corporation  
6700 Koll Center Parkway, Suite 200  
Pleasanton, CA 94566  
Attn: Vice President, Asset Optimization  
(925) 600-2000  
FAX: (925) 600-8925

Either Party may change or supplement such address or specified person by giving the other Party written notice of such change.

**21. CONFIDENTIALITY**

(a) The Parties have and will develop certain information, processes, know-how, techniques and procedures concerning the Project (collectively, "Information") which they consider confidential and proprietary. Notwithstanding the confidential and proprietary nature of such Information, Bonneville and the

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Seller (each, the "Disclosing Party") may make this Information available to the other (each, a "Receiving Party") subject to the provisions of this section 21.

- (b) At the time of furnishing or making available for inspection such confidential or proprietary Information, the Disclosing Party will expressly designate by label, stamp or oral communication (to be confirmed in writing) the Information which it considers to be confidential and/or proprietary.
- (c) The Receiving Party's obligations with respect to the use or disclosure of such Information thereafter will be as set forth in this section 21.
- (d) Upon receiving or learning of Information designated as confidential and/or proprietary by the Disclosing Party, the Receiving Party shall:
  - (1) treat such Information as confidential and use reasonable care not to divulge such Information to any third party except as required by law, subject to the restrictions set forth below;
  - (2) restrict access to such Information to employees (and others who agree to be bound by this Agreement) whose access is reasonably necessary in developing the Project and for the purposes of this Agreement;
  - (3) use such Information solely for the purpose of developing the Project and for the purposes of this Agreement; and
  - (4) upon the termination of this Agreement, destroy or return any such Information in written or other tangible form and any copies thereof to the Disclosing Party.
- (e) The restrictions in this section 21 do not apply to:
  - (1) release of this Agreement, which becomes a public document upon execution;
  - (2) Information which is, or becomes, publicly known or available otherwise than through the action of the Receiving Party in violation of this Agreement;
  - (3) Information which is in the possession of the Receiving Party prior to receipt from the Disclosing Party or is independently developed by the Receiving Party, provided that the person or persons developing same have not had access to such Information; or
  - (4) Information which is, in the reasonable written opinion of counsel to the Receiving Party, required to be disclosed pursuant to applicable law or regulation (including any Freedom of Information Act request); provided, however, that the Receiving Party, prior to such disclosure, shall provide reasonable advance notice to the Disclosing Party of the

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time and scope of the intended disclosure in order to permit the Disclosing Party opportunity to obtain a protective order or otherwise seek to prevent or limit the scope or otherwise impose conditions upon such disclosure.

- (f) The obligations of the Parties under this section 21 shall remain in full force and effect for four (4) years following the termination of this Agreement.

Bonneville further acknowledges that Seller's parent is a publicly traded company subject to Securities and Exchange Commission disclosure regulations and accordingly agrees that any written press releases by Bonneville relating to the Project which can be reasonably anticipated to adversely impact the public market for Seller's parent company's shares will be provided in advance to Seller pursuant to the notice provisions in section 20.

## **22. DISPUTE RESOLUTION**

If a dispute arises between the Seller and Bonneville over their respective rights and obligations with respect to matters contemplated under this Agreement, the Party that is alleging the dispute shall provide written notice to the other Party of the nature of the dispute pursuant to the notice provisions in section 20. Upon receipt of any such notice, for a period of sixty (60) calendar days the Seller and Bonneville shall exercise all reasonable efforts to arrive at an amicable settlement of the dispute. If, after diligently pursuing a settlement for sixty (60) calendar days, no such settlement is reached, then upon written notice by either Party, a member of senior management from the Seller and a Vice President, or designee, of Bonneville shall exercise reasonable efforts for an additional period of sixty (60) calendar days to arrive at an amicable settlement of such dispute.

If, however, no settlement is reached upon the expiration of the additional period of sixty (60) calendar days, then upon written notice by either Party, said dispute shall be finally settled by arbitration. The Parties agree to conduct the arbitration in accordance with the Commercial Arbitration Rules of the American Arbitration Association; provided, however, that in such arbitration proceedings the Parties shall have the same discovery rights and obligations as are provided by the Federal Rules of Civil Procedure. Each Party acknowledges that the Parties may agree to have the arbitration administered by an entity other than the American Arbitration Association. The arbitration shall be held before a neutral arbitrator chosen from a list provided by the American Arbitration Association and reasonably agreeable to the Parties. Any arbitration shall take place in Portland, Oregon, or such other location as the Parties may jointly agree. The decision of the arbitrator must be consistent with this Agreement, shall be rendered in writing, shall be final and conclusive and binding on the Parties, and judgment upon such decision may be entered in any court having jurisdiction thereof. Each Party shall pay its own

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expenses in connection with the arbitration. The arbitrator's fee and the common costs of the arbitration shall be borne by the substantially losing Party.

**23. OPTION**

**(a) Term of Option**

For a period of at least five (5) years beginning on the Effective Date of this Agreement, and continuing for as long as Seller maintains leases in the Glass Mountain KGRA, but not to exceed a total period of ten (10) years from the Effective Date of this Agreement, Seller grants to Bonneville a nonexclusive option to acquire a maximum of one hundred (100) megawatts in increments of at least 20 megawatts of electrical output based upon substantially the same terms and conditions offered to any third party purchaser.

It is agreed and understood that the option granted to Bonneville under this section 23 shall apply only to (1) build-out projects involving expansion of the Project beyond the initially installed electric generating facility; and (2) electric generating facility projects other than the Project that may in the future be developed by Seller or its affiliates in the Glass Mountain KGRA.

**(b) Notice**

To implement this provision, Seller shall provide written notice to Bonneville when Seller has executed an agreement evidencing the essential terms and conditions under which Seller and third party will negotiate a power purchase agreement for the sale by Seller and the purchase by a third party of geothermal power from the Glass Mountain KGRA. Seller shall inform Bonneville of all necessary terms and conditions.

**(c) Exercise of Option**

No later than thirty (30) calendar days after receipt of the written notice referred to in subsection 23(b) above, Bonneville shall notify Seller in writing whether Bonneville intends to exercise its option. If, in the sole judgement of Bonneville, an examination of the impacts of the proposed facility is required pursuant to NEPA, the California Environmental Quality Act, or other federal or state law, then Bonneville shall have no fewer than one hundred twenty (120) calendar days after the completion of such examination to exercise its option and execute a power purchase agreement with Seller for output from the facility. Bonneville shall make diligent efforts to cause such examination to be completed in a timely fashion. Seller shall cooperate in such examination. Seller's and Bonneville's obligations under this subsection are conditioned upon and subject to satisfaction of all Federal and state permitting and environmental requirements.

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**24. MISCELLANEOUS**

**(a) Counterparts**

This Agreement may be executed in any number of counterparts, and each executed counterpart shall have the same force and effect as an original instrument.

**(b) Interpretation**

Unless the context of the Agreement otherwise requires, (a) words of any gender include each other gender; (b) words using the singular or plural number also include the plural or singular number, respectively; (c) the terms "hereof," "herein," "hereby," and derivative or similar words refer to this entire Agreement including Exhibits; (d) the terms "Section," "Exhibit," or "Paragraph" refer to the specified Section, Exhibit, or Paragraph of this Agreement; and (e) any reference to the entirety or any part of this Agreement shall refer to any amendment, supplement, or replacement of the same. Whenever this Agreement refers to a number of days, such number shall refer to calendar days unless Workdays are specified.

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IN WITNESS WHEREOF, the Parties hereto have caused this Agreement to be executed  
the 20th day of November, 2000.

UNITED STATES OF AMERICA  
Department of Energy  
Bonneville Power Administration

By GK Delwiche  
Vice President  
Generation Supply

Name Gregory K DELWICHE  
(Print/Type)

Date 11/20/00

CALPINE SISKIYOU GEOTHERMAL PARTNERS, L.P.  
(Fourmile Hill Geothermal Project)

By Modoc Power, Inc.  
Its Managing Partner

By Jacob M. Rudisill  
Name JACOB M. RUDISILL  
(Print/Type) **SENIOR VICE PRESIDENT**

Title \_\_\_\_\_

Date 11/20/2000

**GENERAL PROVISIONS**

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1. DEFINITIONS

- (a) "Federal System" or "Federal System Facilities" means the facilities of the Federal Columbia River Power System, which for the purposes of this Agreement shall be deemed to include the generating facilities of the government in the Pacific Northwest for which Bonneville is designated as marketing agent; the facilities of the government under the jurisdiction of Bonneville; and any other facilities:
- (1) from which Bonneville receives all or a portion of the generating capability (other than station service) for use in meeting Bonneville's loads, such facilities being included only to the extent Bonneville has the right to receive such capability; **provided, however**, that "Bonneville's loads" shall not include that portion of the loads of any Bonneville customer which are served by a non-Federal generating resource purchased or owned directly by such customer which may be scheduled by Bonneville;
  - (2) which Bonneville may use under contract, or license; or
  - (3) to the extent of the rights acquired by Bonneville pursuant to the Treaty, between the government and Canada, relating to the cooperative development of water resources of the Columbia River Basin, signed in Washington, DC, on January 17, 1961.
- (b) "Uncontrollable Forces" means:
- (1) any curtailment for any reason of firm transmission used to deliver power to the Point of Delivery, including but not limited to planned or unplanned maintenance outages; or
  - (2) strikes or work stoppage affecting the performance of a Party; the term "strikes or work stoppage" shall be deemed to include threats of imminent strikes or work stoppage which reasonably require a Party to restrict or terminate its operations; or
  - (3) such of the following events as a Party by exercise of reasonable diligence and foresight, could not reasonably have been expected to avoid:

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- (A) Events, reasonably beyond the control of either Party, causing failure, damage, or destruction of any works, system or facilities necessary for performance; the word "failure" shall be deemed to include interruption of, or interference with, the actual operation of such works, system, or facilities;
- (B) Floods or other conditions caused by nature which limit or prevent the performance of either Party; and
- (C)
  - (i) action or inaction of a regulatory or administrative agency or governmental official in connection with issuing any permit, license or authorization required for the construction or operation of the Project provided that the application for such approval by Seller has been filed in a timely manner and thereafter pursued diligently; or
  - (ii) appeal to a court or administrative agency of a permit, license, or authorization necessary for the construction or operation of the Project and the Interconnection Facilities, regardless of whether such appeal stays the Seller's rights under such permit, license or approval; or
- (D) Orders and temporary or permanent injunctions which prevent said performance, and which are issued in any bona fide proceeding by:
  - (i) any duly constituted court of general jurisdiction; or
  - (ii) any administrative agency or officer, other than Bonneville or its officers, with proper jurisdiction
    - (I) if said Party has no right to a review of the validity of such order by a court of competent jurisdiction; or
    - (II) if such order is operative and effective and such order is not suspended, set aside, or annulled in a judicial proceeding prosecuted by said Party in good faith; **provided, however**, that if such order is suspended, set aside, or annulled in such

a judicial proceeding, it shall be deemed to be an Uncontrollable Force for the period during which it is in effect; **provided, further**, that said Party shall not be required to prosecute such a proceeding, in order to have the benefits of this section, if the Parties agree that there is no valid basis for contesting the order.

The term "operation" as used in this section shall be deemed to include construction, if construction is required to implement the Agreement and is specified therein.

- (4) degradation of or inadequacy of the geothermal resource which continues after all of the following actions have occurred:
  - (A) a mutually agreed upon consultant certifies that the degradation or inadequacy occurred for reasons beyond the reasonable control of Seller; and
  - (B) all funds reserved for well drilling pursuant to section 17(a) of this Agreement have been expended.

Seller shall not be obligated to expend funds in addition to those reserved for well drilling pursuant to section 17 of this Agreement in order to meet the requirements of (A) or (B).

It is agreed and understood that the existence of an Uncontrollable Force shall not excuse any Party from any obligation under this Agreement to pay money.

## **IN REFERENCE TO DELIVERY OF POWER**

### **2. UNCONTROLLABLE FORCES**

Each Party shall notify the other as soon as possible of any Uncontrollable Forces which may in any way affect performance in accordance with this Agreement. In the event the performance of either Party is interrupted or curtailed due to such Uncontrollable Forces, such Party shall be excused from such performance during such period of interruption or curtailment. However, such Party shall exercise due

diligence to reinstate such performance with reasonable dispatch.

### MISCELLANEOUS PROVISIONS

#### 3. INDEMNIFICATION

- (a) To the extent allowed by law, the Seller shall indemnify and hold Bonneville harmless from and against all claims, demands, losses, liabilities, and expenses (including reasonable attorneys' fees) for personal injury, bodily injury, or death to persons and damage to Bonneville's property or facilities or the property of any other person, entity, or corporation to the extent arising out of, resulting from or caused by the negligent or willful misconduct (whether acts or omissions) of the Seller or its agents.

Any fines or other penalties incurred by the Seller or its agents, employees or subcontractors for noncompliance by the Seller, its employees, or subcontractors with laws, rules, regulations, or ordinances shall not be reimbursed by Bonneville but shall be the sole responsibility of the Seller. If fines, penalties, or legal costs are assessed against Bonneville by any government agency or court due to noncompliance by the Seller with any of the laws, rules, regulations, or ordinances referred to in sections 21(a) and 21(b) of this Exhibit A, or any other laws, rules, contract, regulations, or ordinances with which compliance is required herein, or if the work of the Seller or any part thereof is delayed or stopped by order of any government agency or court due to the Seller's noncompliance with any such laws, rules, regulations, or ordinances except for Uncontrollable Forces, the Seller shall indemnify and hold harmless Bonneville against any and all losses, liabilities, damages, and claims suffered or incurred because of the failure of the Seller to comply therewith. The Seller shall also reimburse Bonneville for any and all reasonable legal or other expenses (including attorneys' fees) reasonably incurred by Bonneville in connection with such losses, liabilities, damages, or claims.

- (b) To the extent allowed by law, Bonneville shall indemnify and hold Seller harmless from and against all claims, demands, losses, liabilities, and reasonable expenses (including attorneys' fees) for personal injury, bodily injury, or death to persons and damage to Seller's property or facilities or the property of any other person, entity, or corporation arising out of, resulting from or caused by the negligence or willful misconduct (whether acts or omissions) of Bonneville or its agents. Any fines or other penalties incurred

by Bonneville or its agents, employees, or subcontractors for noncompliance by Bonneville, its employees, or subcontractors with laws, rules, regulations, or ordinances shall not be reimbursed by Seller but shall be the sole responsibility of Bonneville. If fines, penalties, or legal costs are assessed against Seller by any government agency or court due to noncompliance by Bonneville with any of the laws, rules, regulations, or ordinances referred to in sections 21(a) and 21(b) of this Exhibit A, or any laws, rules, contract, regulations, or ordinances with which compliance is required herein, or if the work of Bonneville or any part thereof is delayed or stopped by order of any government agency or court due to Bonneville's noncompliance with any such laws, rules, regulations, or ordinances, Bonneville shall indemnify and hold harmless Seller against any and all losses, liabilities, damages, and claims suffered or incurred because of the failure of Bonneville to comply therewith. Bonneville shall also reimburse Seller for any and all reasonable legal or other reasonable expenses (including attorneys' fees) incurred by Seller in connection with such losses, liabilities, damages, or claims.

#### 4. **DISCLAIMER OF LIABILITY**

- (a) Neither Party shall hold the other Party (including its corporate affiliates, parent, subsidiaries, directors, officers, employees and agents) liable for any claims, losses, costs, and expenses of any kind or character (including, without limitation, loss of earnings and attorneys' fees) for damage to property of Bonneville or the Seller in any way occurring incident to, arising out of, or in connection with a Party's performance under this Agreement, except as provided in section 3 of this Exhibit.
- (b) **Limitation on Damages.**  
Except as otherwise provided herein, neither Party shall be liable to the other Party for incidental, indirect, special, punitive, exemplary or consequential damages connected with or resulting from performance or nonperformance of this Agreement, including, without limitation, profits, irrespective of whether such claims are based upon warranty, negligence, strict liability, contract, operation of law, or otherwise.

#### 5. **ASSIGNMENT**

This Agreement will inure to the benefit of, and shall be binding upon, the respective successors and assigns of the parties. Neither this Agreement nor any interest therein shall be transferred or assigned by the Seller, except to an affiliate of Seller,

without the written consent of Bonneville, which consent shall not be unreasonably withheld. No assignment or transfer of the Agreement shall relieve the parties of any obligation hereunder.

**6. DISPUTE RESOLUTION**

Pending resolution of a disputed matter, the Parties shall continue performance of their respective obligations pursuant to this Agreement. Disputes regarding any matter relating to this Agreement shall be resolved in accordance with section 22 of this Agreement.

**7. AMENDMENT**

This Agreement, including the appendices and/or Exhibits thereto, can be amended only by agreement between the Parties in writing.

**8. WAIVERS**

The failure of either Party to insist in any one or more instances upon strict performance of any provisions of this Agreement, or to take advantage of any of its rights hereunder, shall not be construed as a waiver of any such provisions or the relinquishment of any such right or any other right hereunder, which shall remain in full force and effect.

**9. HEADINGS NOT BINDING**

The headings contained in this Agreement are used solely for convenience and do not constitute a part of the Agreement between the Parties hereto, nor should they be used to aid in any manner in the construction of this Agreement.

**10. NO THIRD-PARTY BENEFICIARIES**

This Agreement is intended solely for the benefit of the Parties hereto. Nothing in this Agreement shall be construed to create any duty to, or standard of care with reference to, or any liability to, any person not a Party to this Agreement.

**11. SEVERAL OBLIGATIONS**

This Agreement shall not be interpreted or construed to create an association, joint venture, or partnership between the Parties or to impose any partnership obligation

or liability upon either Party.

**12. CONTINUING OBLIGATIONS**

Cancellation, expiration, or earlier termination of this Agreement shall not relieve the Parties of obligations that by their nature should survive such cancellation, expiration or termination, including without limitation warranties, remedies, promises of indemnity, and confidentiality.

**13. CHOICE OF LAW**

This Agreement shall be interpreted and enforced in accordance with the laws of the State of California, excluding any choice-of-law rules that may direct the application of the laws of another jurisdiction, except to the extent such interpretation or enforcement is governed by Federal law.

**14. INTEGRATION**

This Agreement is intended by the Parties as the final expression of their Agreement and is intended also as a complete and exclusive statement of the terms of their Agreement with respect to the Project Output sold and purchased hereunder. All prior written or oral understandings, offers or other communications of every kind pertaining to the sale of Project Output hereunder to Bonneville by the Seller are hereby abrogated and withdrawn.

**PROVISIONS REQUIRED BY STATUTE OR EXECUTIVE ORDER**

**15. CONTRACT WORK HOURS AND SAFETY STANDARDS ACT**

**(a) Overtime Requirements**

Neither the Seller nor any subcontractor contracting for any part of the contract work which may require or involve the employment of laborers or mechanics shall require or permit any such laborers or mechanics in any workweek in which the individual is employed on such work to work in excess of 40 hours in such workweek unless such laborer or mechanic receives compensation at a rate not less than 1-1/2 times the basic rate or pay for all hours worked in excess of 40 hours in such workweek.

- (b) **Violation; Liability for Unpaid Wages; Liquidated Damages**  
In the event of any violation of the provisions set forth in section 15(a) of this Exhibit, the Seller and any subcontractor responsible therefor shall be liable for the unpaid wages. In addition, such Seller and subcontractor shall be liable to the United States for liquidated damages. Such liquidated damages shall be computed with respect to each individual laborer or mechanic employed in violation of the provisions set forth in section 15(a) of this Exhibit in the sum of \$10 for each calendar day on which such individual was required or permitted to work in excess of the standard workweek of 40 hours without payment of the overtime wages required by provisions set forth in section 15(a) of this Exhibit.
- (c) **Withholding for Unpaid Wages and Liquidated Damages**  
Bonneville may upon its own action or upon written request of an authorized representative of the Department of Labor withhold or cause to be withheld, from any moneys payable on account of work performed by the Seller or subcontractor under any such contract or any other Federal contract subject to the Contract Work Hours and Safety Standards Act which is held by the same prime contractor, such sums as may be determined to be necessary to satisfy any liabilities of such Seller or subcontractor for unpaid wages and liquidated damages as provided in section 15(b) of this Exhibit.
- (d) **Payrolls and Basic Records**
- (1) The Seller or subcontractor shall maintain payrolls and basic payroll records during the course of contract work and shall preserve them for a period of four (4) years from the completion of the contract for all laborers and mechanics working on the contract. Such records shall contain the name and address of each such employee, social security number, correct classifications, hourly rates of wages paid, daily and weekly number of hours of worked, deductions made, and actual wages paid.
  - (2) The records to be maintained under section 15(d)(1) of this Exhibit shall be made available by the Seller or subcontractor for inspection, copying, or transcription by authorized representatives of Bonneville or the Department of Labor. The Seller or subcontractor shall permit such representatives to interview employees during working hours on the job.

(e) **Subcontracts**

The Seller or subcontractor shall insert in any subcontracts the provisions set forth in sections 15(a) through this section 15(e) of this Exhibit and also a clause requiring the subcontractors to include these provisions in any lower tier subcontracts. The prime contractor shall be responsible for compliance by any subcontractor or lower tier subcontractor with the provisions set forth in sections 15(a) through this section 15(e) of this Exhibit.

**16. CONVICT LABOR**

In connection with the performance of work under this Agreement, the Seller or any subcontractor agrees not to employ any person undergoing sentence of imprisonment except as provided by 18 U.S.C. 4082(c)(2) (1982) and Executive Order No. 11755, Dec. 29, 1973.

**17. EQUAL OPPORTUNITY**

- (a) If, during any 12-month period (including the 12 months preceding the Effective Date of this Agreement), the Seller has been or is awarded nonexempt Federal contracts and/or subcontracts that have an aggregate value in excess of \$25,000, the Seller shall comply with sections 17(b)(1) through 17(b)(11) of this Exhibit. Upon request, the Seller shall provide information necessary to determine the applicability of this clause.
- (b) During the performance of this Agreement, the Seller agrees as follows:
- (1) The Seller shall not discriminate against any employee or applicant for employment because of race, color, religion, sex, or national origin.
  - (2) The Seller shall take affirmative action to ensure that applicants are employed, and that employees are treated during employment, without regard to their race, color, religion, sex, or national origin. Such action shall include, but not be limited to: (A) employment; (B) upgrading; (C) demotion; (D) transfer; (E) recruitment or recruitment advertising; (F) layoff or termination; (G) rates of pay or other forms of compensation; and (H) selection for training, including apprenticeship.
  - (3) The Seller shall post in conspicuous places, available to employees and applicants for employment the notices to be provided by Bonneville that explain this clause.

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Fourmile Hill Geothermal Project  
Effective at 2400 hours on  
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- (4) The Seller shall, in all solicitations or advertisement for employees placed by or on behalf of the Seller, state that all qualified applicants will receive consideration for employment without regard to race, color, religion, sex, or national origin.
- (5) The Seller shall send, to each labor union or representative of workers with which it has a collective bargaining agreement or other contract or understanding, the notice to be provided by Bonneville advising the labor union or workers' representative of the Seller's commitments under this clause, and post copies of the notice in conspicuous places available to employees and applicants for employment.
- (6) The Seller shall comply with Executive Order No. 11246, Sept. 24, 1965 (30 FR 12319), as amended, and the rules, regulations and order of the Secretary of Labor.
- (7) The Seller shall furnish to the contracting agency all information required by Executive Order No. 11246, as amended, and by the rules, regulations, and orders of the Secretary of Labor. Standard Form 100 (EEO-1), or any successor form, is the prescribed form to be filed within thirty (30) calendar days following the award, unless filed within twelve (12) months preceding the date of the award.
- (8) The Seller shall permit access to its books, records and accounts by the contracting agency or the Office of Federal Contract Compliance Programs (OFCCP) for purposes of investigation to ascertain the Seller's compliance with such rules, regulations, and orders.
- (9) If the OFCCP determines that the Seller is not in compliance with this clause or any rule, regulation, or order of the Secretary of Labor, this Agreement may be cancelled, terminated, or suspended in whole or in part and the Seller may be declared ineligible for further government contracts, under the procedures authorized in Executive Order No. 11246, as amended. In addition, sanctions may be imposed and remedies invoked against the Seller as provided in Executive Order No. 11246, as amended, the rules, regulations, and orders of the Secretary of Labor, or as otherwise provided by law.
- (10) The Seller shall include the terms and conditions of sections 17(b)(1) through 17(b)(11) of this Exhibit in every subcontract or purchase order that is not exempted by the rules, regulations, or orders of the

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Secretary of Labor issued under Executive Order No. 11246, as amended, so that these terms and conditions will be binding upon each subcontractor or vendor.

(11) The Seller shall take such action with respect to any subcontract or purchase order as the contracting agency may direct as a means of enforcing these terms and conditions, including sanctions for noncompliance; **provided**, that if the Seller becomes involved in, or is threatened with, litigation with a subcontractor or vendor as a result of any direction, the Seller may request the United States to enter into the litigation to protect the interest of the United States.

(c) Notwithstanding any other clause in this Agreement, disputes relative to this clause will be governed by the procedures in 41 CFR 60-1.1.

## 18. CERTIFICATION OF NONSEGREGATED FACILITIES

- (a) The Seller certifies that it does not and will not maintain or provide for its employees any segregated facilities at any of its establishments, and that it does not and will not permit its employees to perform their services at any location under its control where segregated facilities are maintained. The Seller agrees that a breach of this certification is a violation of the Equal Opportunity Clause of this Exhibit.
- (b) The Seller further agrees that it will: (1) obtain identical certifications from proposed subcontractors prior to the award of subcontracts exceeding \$10,000 which are not exempt from the provisions of the Equal Opportunity Clause; (2) retain such certifications in its files; and (3) forward the following notice to such proposed subcontractors, except where the proposed subcontractors have submitted identical certifications for specific time periods:

“Notice to Prospective Subcontractors of Requirement for Certifications of Nonsegregated Facilities.”

“A Certification of Nonsegregated Facilities must be submitted prior to the award of a subcontract under which the subcontractor will be subject to the Equal Opportunity clause. This certification may be submitted either for each subcontract or for all subcontracts during a period (i.e., quarterly, semiannually, or annually).”

**19. OFFICIALS NOT TO BENEFIT**

No member of or delegate to Congress, or resident commissioner, shall be admitted to any share or part of this Agreement or to any benefit arising from it. However, this clause does not apply to this Agreement to the extent that this Agreement is made with a corporation for the corporation's general benefit.

**20. BONNEVILLE'S OBLIGATIONS NOT GENERAL OBLIGATIONS OF THE UNITED STATES**

All offerings of obligations, and all promotional materials for such obligations, which may be offered by the Seller to fund its activities pursuant to this Agreement shall include the following language found in section 6(j)(1) of the Northwest Power Act:

"Such obligations are not, nor shall they be construed to be, general obligations of the United States, nor are such obligations intended to be or are they secured by the full faith and credit of the United States."

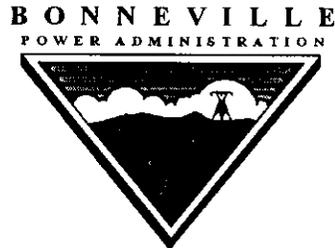
**21. OTHER STATUTES, EXECUTIVE ORDERS, AND REGULATIONS**

- (a) The Seller agrees to comply with all applicable provisions, and successor provisions thereto of:
- (1) False Claims Act, 31 U.S.C. 3729, et seq. Whoever makes or presents to any person or officer in the civil, military, or naval service of the United States, or to any department or agency thereof, any claim upon or against the United States, or any department or agency thereof, knowing such claim to be false, fictitious, or fraudulent, shall be fined not more than \$10,000 or imprisoned not more than 5 years, or both;
  - (2) Rehabilitation Act of 1973, as amended, (29 U.S.C. 793), Executive Order No. 11758, Jan. 15, 1974, and the regulations of the Secretary of Labor (41 CFR Part 60-741, et seq.), which concern affirmative action for handicapped workers;
  - (3) Vietnam Era Veterans Readjustment Assistance Act of 1974, Public Law 92-540, as amended, and the clauses contained in 41 CFR 60-250, et seq., concern affirmative action for disabled veterans and veterans of the Vietnam Era;

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- (4) Executive Order No. 11625 and implementing regulations which concern utilization of small disadvantaged business concerns;
  - (5) Small Business Act, as amended, 15 U.S.C. 631 et seq. (1982), including the requirements of 13 U.S.C. 637(d)(2) and (3) (1982);
  - (6) Anti-Kickback Act, 41 U.S.C. 51 et seq. (1982); and
  - (7) Privacy Act of 1974, Public Law 93-579, Dec. 31, 1974 (5 U.S.C. 552a).
- (b) The Seller agrees to comply with requirements deemed necessary by Bonneville in order to implement Bonneville's obligations under the National Historic Preservation Act, 16 U.S.C. 470 et seq. (1982). Such requirements, if any, shall be subject to analysis and comment by the Seller prior to becoming effective.

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Fourmile Hill Geothermal Project  
Effective at 2400 hours on  
the Effective Date



TECHNICAL REQUIREMENTS  
FOR THE  
INTERCONNECTION OF GENERATION RESOURCES

PREPARED BY THE GENERATION INTERCONNECTION DEVELOPMENT  
TEAM

U.S. DEPARTMENT OF ENERGY  
BONNEVILLE POWER ADMINISTRATION  
TRANSMISSION BUSINESS LINE  
VANCOUVER, WASHINGTON  
APRIL 1999

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## 1. Introduction

The Bonneville Power Administration Transmission Business Line (BPA TBL) has prepared this document to identify technical requirements for integrating generation resources into the BPA transmission system (BPA System). These technical requirements apply to new (including expanded, restarted and significantly modified) generating resources located within or adjacent to the BPA System. Some of the requirements will also apply to generators outside of the BPA System but inside the BPA Load Control Area. The aim of these requirements is to assure the safe operation, integrity and reliability of the BPA System.

In this document the terms BPA, BPA System, BPA TBL, BPA Load Control Area, etc. all refer only to the BPA Transmission Business Line (BPA TBL) and/or its transmission system, NOT to the BPA Power Business Line (BPA PBL). Generation integration proposals from the BPA PBL are handled in the same manner as those from any other Project Sponsor.

Proposals for generating resource projects (Projects) are generally submitted by the Project Sponsor or interconnecting utility. BPA TBL then evaluates these proposals on a case-by-case basis. Specific interconnection requirements are provided accordingly.

Contractual matters, such as costs, ownership, scheduling, and billing are not the focus of this document. However, in general, the Project Sponsor or interconnecting utility assumes the cost of all facilities needed to satisfy the technical requirements identified for integration of the Project.

Physical laws that govern the behavior of electric systems do not recognize boundaries of electric facility ownership. Thus, to design an interconnection properly, the electric systems must be studied and analyzed critically, without regard to ownership. If an interconnection would affect the BPA System, the agency studies the situation, using data from the appropriate sources. The Project Sponsor or interconnecting utility usually assumes the cost of detailed interconnection studies. Before approving these studies, BPA TBL reviews them with the affected parties, considering issues such as short-circuit duties, transient voltages, reactive power requirements, stability requirements, harmonics, safety, operations, maintenance and Prudent Electric Utility Practices.

This document is not intended as a design specification or an instruction manual. Technical requirements stated herein are generally consistent with Western Systems Coordinating Council (WSCC), North American Electric Reliability Council (NERC) and Northwest Power Pool (NWPP) principles and practices. This document is also intended to be consistent with the Federal Energy Regulatory Commission (FERC) regulations governing separation of transmission and generation functions. Important terms used in this document are capitalized (e.g. Project, Generation Site, Point of Interconnection) and defined in Section 9 - *Definitions*. The information presented is subject to change.

BPA TBL wishes to thank the many organizations which provided comments and to acknowledge Georgia Power Company and Pacific Gas & Electric for certain selected material used in this document.

**Copies of this document are available by calling:**

BPA's Document Request Line at (800) 622-4520 and  
Requesting DOE/BP - 3162

**If you have questions or need additional information, please call:**

BPA's Public Information Center at (503) 230-3478 or (800) 622-4519

## 2. Scope

The technical requirements contained herein generally apply to all new or expanded generating resources, regardless of type or size. The location of the resource, interconnection, and impacts on the BPA System or another utility's system determine the specific requirements. The Project and its interconnecting facilities must not degrade the safe operation, integrity and reliability of the BPA System. The requirements in this document are intended to protect BPA TBL facilities, but cannot be relied upon to protect the Project's facilities.

- **Applicable Codes, Standards, Criteria and Regulations**

To the extent that the Codes, Standards, Criteria and Regulations are applicable, the Project shall be in compliance with those listed in Section 10 of this document.

- **Environmental Considerations (National Environmental Policy Act (NEPA))**

Federal Law requires that BPA TBL comply with the National Environmental Policy Act (NEPA 42 U.S.C. & 4321 et seq.). Compliance includes a written assessment of the environmental impacts of a Federal action. Depending on the complexity of the project, NEPA requirements may include an Environmental Impact Statement (EIS), Environmental Assessment (EA), or Categorical Exclusion (CE). BPA TBL can make the final interconnection when those requirements are satisfied.

- **Safety, Protection, and Reliability**

BPA TBL, in cooperation with affected parties, makes the final determination as to whether the BPA System is properly protected from Project related problems before an interconnection is closed. The Project Sponsor and/or interconnecting utility is responsible for correcting such problems before interconnected operation begins. However, BPA TBL may determine equivalent measures to maintain the safe operation and reliability of the BPA System. In situations where there is direct interconnection with another utility's system, the requirements of that utility also apply.

- **Non-BPA TBL Responsibilities**

The Project Sponsor is responsible for the planning, design, construction, reliability, protection, and safe operation of non-BPA TBL-owned facilities (e.g. generator, interconnected equipment, etc.). The design is subject to applicable local, state and federal statutes.

- **Special Generator Disturbance Studies**

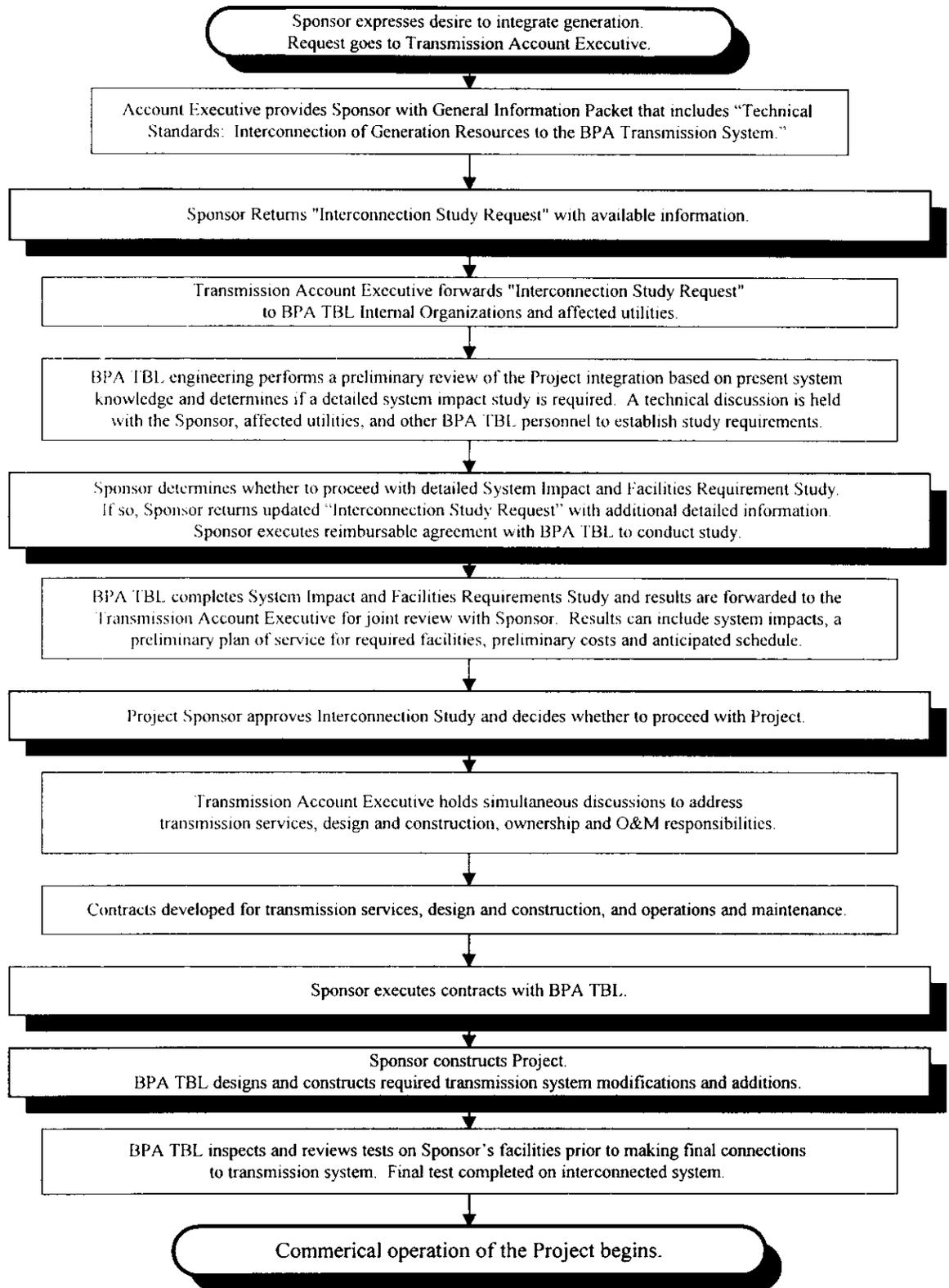
BPA TBL uses series capacitors, high-speed reclosing and single-pole switching at various locations. These devices and operating modes, as well as other disturbances and imbalances, may cause stress on the Project. This includes the possibility of electro-mechanical resonance (e.g., sub-synchronous resonance) between the generator and the power system. The Project Sponsor is responsible for any studies necessary to evaluate possible stresses to the Project and for all corrective actions.

- **Steps for Integrating Generation**

A flow chart (Figure 2-1) describes the steps for integrating a generation facility.

- **Estimates for Interconnection Studies**

BPA TBL develops cost estimates on a case-by-case basis when asked to perform interconnection studies. BPA TBL may provide estimates for the required interconnection facilities that are identified by the interconnection studies and shown on the approved Project Requirements Diagram.



Shadowed boxes indicate actions by the Sponsor.

**Figure 2-1 STEPS FOR INTEGRATING A GENERATION FACILITY**

### **3. Interconnection Studies and Sponsor-Supplied Information**

Project sponsors should contact BPA TBL as early in the planning process as possible for any potential generation project within or adjacent to the BPA System and/or where the output will enter the BPA Load Control Area. The Project Sponsor should not make its own assumptions about the final location, voltage, or interconnection requirements. Certain areas within the BPA System can accept only limited amounts of generation without costly reinforcements. BPA TBL may have to add or modify its transmission system substantially before connecting a Project. An interconnection study must be made to determine the required interconnection facilities and modifications to accommodate the Project. This study may also address the transmission system capability, transient stability, voltage stability, losses, voltage regulation, harmonics, voltage flicker, electromagnetic transients, machine dynamics, ferroresonance, metering requirements, protective relaying, substation grounding, and fault duties.

#### **3-A. Initial Request to BPA TBL for Interconnection**

The Project Sponsor should provide BPA TBL with sufficient information for adequate review of its Project proposal. The Sponsor should submit BPA Form No. F6420.24, *Interconnection Study Request*, as early as possible with all available information. (A copy of this form is at the end of this document). BPA TBL then performs a preliminary interconnection study, basing its analysis on the information provided and previous experience with similar facilities. (Detailed system studies are not required at this time.)

#### **3-B. Request for BPA to Conduct System Impact and Facility Requirement Study (Detailed Interconnection Study)**

On receipt of a formal request, BPA TBL performs technical studies necessary to integrate the Project. Only *this* detailed interconnection study can fulfill the requirements of this document. The study can require considerable time and effort, depending on the size of the Project and its potential system impacts. Before BPA TBL can begin a detailed interconnection study, the Project Sponsor must provide additional details about the proposed Project. BPA Form No. F6420.24, *Interconnection Study Request*, should be used to provide the following:

##### **1. A Technical Description of the Project, Including:**

- a) Electrical one-line diagrams, type of generation (natural gas, hydro, wind, geothermal, etc.), proposed nameplate ratings, site location maps, site plan, transmission routing, and a description of the proposed connection to the BPA System or the interconnecting utility.
- b) All available generator and transformer data. Note that the machine portion of this Form requests synchronous machine data. Other types of generators (such as induction generators or DC generators with inverters) are handled on a case-by-case basis.
- c) Validated models and data for power flow and dynamic (stability) simulation. This validated data can be specified as a requirement of commissioning tests. Generator electrical data shall be at the sub-transient level. The data requirements include:
  - 1) Generator reactive power limits (generator PQ capability curve) addressing effects of all control, protection, and operating/equipment limits that can restrict reactive power output,
  - 2) Exciter, voltage regulator including stabilizer and limiters, and high side voltage controls,
  - 3) Prime mover, governor, overfrequency protection, and underfrequency protection,
  - 4) Generator subtransient, transient, and steady-state reactance and time constant data, and
  - 5) Generator step-up transformer impedance data.

2. **A Description of Anticipated Operating Profile of the Project**, including the peak monthly megawatt (MW) output of the Project, expected period of operation, and maintenance periods.
3. **Tariff and Reference Number** of their official request for wheeling services from BPA TBL.

### **3-C. Study Results**

The detailed interconnection study results may include the following:

- The preferred and alternate locations where the Project facility(s) may be interconnected to the BPA System,
- Any modifications and/or additions needed to the BPA System to accommodate the Project,
- The major interconnection equipment that the Project Sponsor is required to furnish,
- The requirements for voltage regulation, harmonics, and power factor control,
- Revenue metering and telemetry/Automatic Generating Control (AGC) requirements,
- Protective relaying and control requirements,
- Telecommunication requirements,
- Operational control of facilities,
- Approximate schedule and lead times for BPA TBL to perform its design, material procurement, construction and energization,
- An estimate of costs for additions and modifications to the BPA System, and
- A preliminary Project Requirements Diagram that illustrates items a-h above.

## **4. General Requirements**

### **4-A. Safety**

At the Point of Interconnection to the BPA System, an isolating device, which is typically a disconnect switch, shall be provided that physically and visibly isolates the BPA System from the Project. Safety and operating procedures for the isolating device shall be in compliance with the Bonneville Power Administration Accident Prevention Manual (APM) and the Project Sponsor's and Interconnecting Utility safety manuals. The Project Operator shall visibly mark all switchgear that could leave equipment energized, so that all maintenance crews are aware of the potential hazards. The isolating device may be placed in a location other than the Point of Interconnection, by agreement of BPA TBL and affected parties. In any case the device:

- Must simultaneously open all phases (gang-operated) to the Project.
- Must be accessible by BPA TBL and under ultimate BPA TBL Dispatcher jurisdiction.
- Must be lockable in the open position by BPA TBL.
- Would not be operated without advanced notice to either party, unless an emergency condition requires that the device be opened to isolate the Project.
- Must be suitable for safe operation under the conditions of use.

BPA TBL 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 deenergized circuits.
- If the Project or BPA TBL equipment presents a hazardous condition.
- If the Project or BPA TBL equipment interferes with the operation of the BPA System.
- If the BPA System interferes with the operation of the Project.

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

### **4-B. Point of Interconnection Considerations**

#### **1. General Configurations and Constraints**

Integration of generation projects into power systems usually falls into one of three categories:

- a) Interconnection into a 69-kV to 500-kV bulk power substation, with (depending on the bus configuration) the transmission and generator feeder lines each terminated into bays containing one or more breakers.
- b) Interconnection on the low-voltage side (typically 12-kV to 69-kV) of an existing customer service transformer that was originally designed to serve loads and that taps an existing transmission line.
- c) Interconnection at 69-kV to 500-kV by directly tapping a transmission line.

The categories above include the situation where another utility owns the transmission line or equipment that directly connects to the BPA System.

Interconnections b) and c) above create the condition of a multi-terminal line, where the generator becomes an additional current source beyond the existing sources at the line terminals. A line with three or more terminals affects BPA TBL's ability to protect, operate, dispatch, and maintain the transmission line. The increased complexity of the control and protection schemes affect system stability and reliability. BPA TBL determines the feasibility of multi-terminal line interconnections on a case-by-case basis as discussed below.

## 2. Special Configurations and Constraints

The constraints and considerations described below may substantially affect the costs of a particular integration plan, sometimes making an alternate Point of Interconnection more desirable.

### a) Interconnection to Main Grid Transmission Lines

Main Grid transmission lines include all 500-, 345-, and some 230-kV lines, as defined by BPA's Reliability Criteria. These circuits form the backbone of the Pacific NW transmission system and provide the primary means of serving large geographical areas. As noted above, the use of three-terminal lines on the Main Grid often adversely affects system stability and reliability, as well as critical operation and maintenance of these lines. The use of three terminal lines will be evaluated individually based on the above considerations provided the following criteria is met:

- The line protection meets BPA TBL Protection Requirements (Section 6),
- Except by specific waiver, generation requirements shall not restrain BPA from taking a transmission line out of service for prudent purposes and generator outages shall not force the line out of service, and
- The line and all components are maintainable within current guidelines, including the contractual right to maintain.

Otherwise, a substation, with additional breakers at the Point of Interconnection, may have to be developed. The cost of this step may make interconnection to non-Main Grid lines more appropriate for smaller projects. A Main Grid line configuration with more than three terminals is not allowed.

### b) Interconnection to 287- and 345-kV Lines

BPA TBL can operate its 287-kV and 345-kV transmission lines at either the normal voltage or at 230-kV. Each of these lines is currently terminated in a transformer that can be bypassed for 230-kV operation. BPA TBL reserves the right to operate these lines at 230-kV. If a transformer fails at an end terminal, extended 230-kV operation may be required. The Project Sponsor will be required to switch off the generator during 230-kV operation or provide dual transformer termination to allow operation at 230-kV or the higher voltage.

## 3. Other Considerations

### a) Equipment

Existing electrical equipment, such as transformers, power circuit breakers, disconnect switches, arresters, and line conductors were purchased based on the duties expected in response to system additions identified in long-range plans. However, with the interconnection of a new generating resource, some equipment may become underrated and need to be replaced.

**b) System Stability and Reliability**

The BPA System has been developed with careful consideration for system stability and reliability during disturbances. The size of the Project, breaker configurations, generator characteristics, and the ability to set protective relays will affect where and how the Point of Interconnection is made. The Project may also be required to participate in special protection schemes (remedial action) such as generator dropping.

**c) Control and Protection**

BPA TBL coordinates its protective relays and control schemes to provide for personnel safety and equipment protection and to minimize disruption of services during disturbances. Project interconnection usually requires the addition or modification of protective relays and/or control schemes. New Projects must be compatible with existing protective relay schemes. Sometimes the addition of voltage transformers (VTs), current transformers (CTs), or pilot scheme (transfer trip) also are necessary, based on the Point of Interconnection. BPA TBL uses single-pole protective relaying on most 500-kV lines and pilot tripping on all 500-kV and most 230-kV lines. Conventional zone protection is usually used at 115-kV and below.

**d) Dispatching and Maintenance**

BPA TBL operates and maintains its system to provide reliable customer service while meeting the seasonal and daily peak loads even during equipment outages and disturbances. Project integration requires that the equipment at the Point of Interconnection not restrict timely outage coordination, automatic switching or equipment maintenance scheduling. Preserving reliable service to all BPA TBL customers is essential and may require additional switchgear, equipment redundancy, or bypass capabilities at the Point of Interconnection for acceptable operation of the system.

The generator will be expected to supply up to maximum available reactive capability and/or to adjust generation levels including reducing to zero if requested of the BPA dispatcher. This will always be for reliability purposes.

**e) Atmospheric and Seismic**

The effects resulting from wind storms, floods, lightning, elevation, temperature extremes, and earthquakes must be considered in the design and operation of the Project. The Project Sponsor is responsible for determining that the appropriate standards, codes, criteria, recommended practices, guides and prudent utility practices are met.

#### **4-C. Substation Grounding**

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

If the Generation Site is close to another substation, the two ground grids may be isolated or connected. If the ground grids are to be isolated, there may be no metallic ground connections between the two substation ground grids. Cable shields, cable sheaths, station service ground sheaths, and overhead transmission shield wires can all inadvertently connect ground grids. Fiber-optic cables are an excellent choice for telecommunications and control between two substations to maintain isolated ground grids. If the ground

grids are to be interconnected, the interconnecting cables must have sufficient capacity to handle fault currents and control ground grid voltage rises. BPA TBL must approve any connection to a BPA substation ground grid.

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

The project ground grid should be designed to ANSI/IEEE Std. 80-1986, *IEEE Guide for Safety in AC Substation Grounding*, and should be measured in accordance with IEEE - 81 Part 1: *Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Potentials* and Part 2: *Measurement of Impedance and Safety Characteristics of Large, Extended or Interconnected Grounding Systems*. Project grounding requirements shall also comply with the *National Electrical Safety Code*, ANSI/IEEE - 665 *Guide for Generating Station Grounding*, IEEE - 837 *Standard for Qualifying Permanent Connections Used in Substation Grounding*, IEEE - 487 *Protection of Wire-Line Communication Serving Electric Power Stations*, ANSI/IEEE 367-1987 *IEEE Recommended Practice for Determining the Electric Power Station Ground Potential Rise and Induced Voltage from a Power Fault*, and any applicable state and local codes.

#### **4-D. Insulation Coordination**

Power system equipment is designed to withstand voltage stresses associated with expected operation. Interconnecting new generation resources can change equipment duty, and may require that equipment be replaced or switchgear, communications, shielding, grounding and/or surge protection added to control voltage stress to acceptable levels. Interconnection studies include the evaluation of the impact of the Project on equipment insulation coordination. BPA TBL may identify additions required to maintain an acceptable level of BPA System availability, reliability, equipment insulation margins, and safety.

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

##### **1. Lightning Surges**

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

Those transmission lines at voltages of 69-kV and higher that terminate at BPA substations must meet additional shielding and/or surge protection requirements. Incoming lines must be shielded for ½ mile at 69-161-kV and 1 mile at 230-500-kV. Rod gaps must also be installed at the station entrance, except at 500-kV, when arresters are required. For certain customer service substations at 230-kV and below, BPA TBL may require only an arrester at the station entrance in lieu of line shielding, or a reduced shielded zone adjacent to the station. These variations depend on the tap line length, the presence of a power circuit breaker on the transmission side of the transformer, and the size of the transformer.

## 2. Switching Surges

At voltages below 500-kV, modifications to protect the BPA System against Project-generated switching surges are not anticipated. However, the interconnection study identifies the actual needs. At 500-kV, BPA TBL requires that arresters be added at the line terminations of the Project and BPA substations.

## 3. Temporary Overvoltages

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

### a) Islanding

A *local* island condition can expose equipment to higher-than-normal voltages. As described in Section 6-B3d, BPA TBL does not normally allow its facilities to become part of a *local* island for an extended duration. Special relays to detect this condition and isolate the generator from BPA facilities are described in Section 6-B.

### b) Neutral Shifts

When generation is connected to the low-voltage side of a delta-grounded wye (D-YG) customer service transformer, remote end breaker operations initiated by the detection of faults on the high-voltage side can cause overvoltages that can affect personnel safety and damage equipment. This type of overvoltage is commonly described as a *neutral shift* and can increase the voltage on the unfaulted phases to as high as 1.73 per unit. At this voltage, the equipment insulation withstand-duration can be very short. Several alternative remedies are possible:

- Provide an effective ground (as described below) on the high-voltage side of the transformer that is independent of other transmission system connections.
- Size the high-voltage-side equipment to withstand the amplitude and duration of the neutral shift.
- Rapidly separate the generator from the step-up transformer by tripping a breaker using either remote relay detection with pilot scheme (transfer trip) or local relay detection of overvoltage condition (see Section 6-B3).

*Effectively grounded* is defined as an  $X_0/X_1 \leq 3$  &  $R_0/X_1 \leq 1$ . Methods available to obtain an effective ground on the high-voltage side of the transformer include the following:

- A step-up transformer with the transmission voltage (BPA TBL's) side connected in a grounded-wye configuration and low voltage (Project) side in closed delta.
- A three-winding transformer with a closed-delta tertiary winding and the transmission voltage side connected in grounded wye.
- Installation of a properly sized grounding transformer on the transmission voltage (BPA TBL) side.

Any of these result in an effectively grounded system with little risk of damage to lightning arresters and other connected equipment.

## 4-E. Inspection, Test, Calibration and Maintenance

The Project Sponsor has full responsibility for the inspection, testing, calibration and maintenance of its equipment, up to the Point of Interconnection, consistent with the interconnection agreement.

## **1. Pre-energization Inspection and Testing**

Before initial energization, the Project Sponsor shall develop an Inspection and Test Plan for pre-energization and energization testing. BPA TBL reviews and approves the test plan prior to the test. BPA TBL may require additional tests; the costs of these tests are subject to negotiation. The Sponsor shall make available to BPA TBL all drawings, specifications, and test records of the Project equipment pertinent to interconnected operation.

## **2. Calibration and Maintenance**

### **a) Revenue Metering**

Revenue metering shall be calibrated at least every two years. More frequent calibration intervals may be negotiated. All interested parties or their representatives may witness the calibration tests. Calibration records shall be made available to all interested parties.

### **b) All other electrical equipment**

The Sponsor shall provide a plan for and carry out a preventive maintenance program for the electrical equipment. The program may be based on time or on other factors, including performance levels or reliability. Prudent electric utility preventive maintenance practices shall be followed. Maintenance records of the Project equipment pertinent to interconnected operation shall be made available to BPA TBL.

## **4-F. Station Service and Startup Power**

Power provided for local use at a generating plant or substation to operate lighting, heat and auxiliary equipment is termed *station service*. In addition, power generated by a generator and then consumed by equipment that contributes to the generation process is considered station service. (This is usually the difference between gross generator output and net generator output, possibly adjusted for interconnection losses.) Alternate station service is a backup source of power, used only in emergency situations or during maintenance when primary station service is not available.

Station service power is the responsibility of the Project Sponsor. The station service requirements of the Project, including voltage and reactive requirements, shall not impose operating restrictions on the BPA transmission system beyond those specified in applicable NERC, WSCC, and Northwest Power Pool reliability criteria.

Appropriate providers of station service and alternate station service are determined during the project planning process, including Project Requirements Diagram development and review. Generally, the local utility will be the preference provider of primary station service unless 1) it is unable to serve the load, or 2) costs to connect the local utility are prohibitive.

The Project Sponsor must provide metering for station service and alternate station service, as specified by the metering section of this document.

## **4-G. Isolating, Synchronizing and Blackstarting**

### **1. Isolation**

The Project shall not energize a *de-energized* BPA line unless the energization is specifically approved by the BPA TBL Dispatcher. If, for any reason, the BPA System is disconnected from the Project (fault conditions, line switching, etc.), the switching device connecting the Project to the system must open and not reclose until approved by the BPA TBL dispatcher or as specified in the interconnection agreement.

## **2. Synchronization**

The Project shall synchronize its equipment to the BPA System. Automatic synchronization shall be supervised by a synchronizing check relay, IEEE device 25. This assures the unit is not connected to the energized power system out of synchronization.

## **3. Blackstarts**

Blackstart is the condition when one unit of a generation project starts up under local power, in isolation from the power system. Blackstart capability is needed in some rare circumstances, depending on the size and location of the Project. It is generally not needed for small generators or for projects that are near other major generation. This capability is addressed in the planning and review process, and indicated on the Project Requirements Diagram.

Things to consider for blackstart capability include the following:

- Proximity to major generation facilities ( i.e., Can startup power be provided more efficiently from an existing plant?);
- Location on the transmission system (i.e., Is the Project near major load centers and far from generation?);
- Cost of on-site start-up, and
- Periodic testing to ensure personnel training and capability.

## **4-H. Generation Reserves**

Each control area is required to carry its own generation reserves according to requirements specified in the WSCC Minimum Operating Reliability Criteria. These include regulating reserves, contingency spinning reserves and contingency non-spinning reserves. Reserves are the obligation of the Project Operator or the obligation may be assumed by the purchasing entity. Reserves may be provided by the Project, some other generator via contract, or by purchasing the reserves from a separate entity. A portion of those reserves must be maintained as spinning reserves. In any case BPA TBL must approve reserve arrangements for a generation resource in the BPA Load Control Area.

## 5. Performance Requirements

The following performance requirements can be satisfied by various methods. It is the responsibility of the Project Sponsor to propose a preferred method for BPA TBL concurrence.

### 5-A. Electrical Disturbances

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

- Electric disturbances that produce abnormal power flows,
- Overvoltages during ground faults,
- Audible noise, radio, television and telephone interference, and
- Other disturbances that might degrade the reliability of the interconnected BPA System.

### 5-B. Switchgear

#### 1. All Voltage Levels

Circuit breakers, disconnect switches, and all other current carrying equipment connected to BPA's transmission facilities shall be capable of carrying normal and emergency load currents without damage. This equipment shall not become a limiting factor (bottleneck) in the ability to transfer power on the BPA System.

All circuit breakers and other fault-interrupting devices shall be capable of safely interrupting fault currents for any fault that they may be required to interrupt. The circuit breaker shall have this capability without the use of intentional time delay in clearing, fault reduction schemes, etc. Application shall be in accordance with ANSI/IEEE C37 Standards. These requirements apply to the Generation Site, the Interconnecting Substation, the Point of Interconnection as well as other locations on the BPA System. Minimum fault-interrupting requirements are supplied by BPA TBL, and are based on the greater of the fault duties at the time of the interconnection request or those projected in long-range plans.

The circuit breaker shall be capable of performing all other required switching duties such as but not limited to: capacitive current switching, load current switching, and out-of-step switching. The circuit breaker shall perform all required duties without creating transient overvoltages that could damage BPA TBL equipment. Switchgear on the high side of a D-YG transformer that can interrupt faults or load must be capable of the increased recovery voltage duty involving interruptions while ungrounded. When generation is connected to the low-voltage side of a D-YG transformer, the high-voltage side may become ungrounded when remote end breakers open, resulting in high phase-to-ground voltages. This phenomena is described in Section 4-D3b under 'neutral shifts.'

#### 2. Circuit Breaker Operating Times

Table 5-1 specifies the operating times typically required of circuit breakers on the BPA System. These times apply to equipment at the Generation Site and the Point of Interconnection. System stability considerations may require faster opening times than those listed. Breaker close times are typically four to eight cycles. The automatic recloser times listed above are the summation of the breaker close time plus intentionally added delay to allow for extinction of the fault arc (de-ionization), and the protective relay requirements.

**Table 5-1 Circuit Breaker Operating Times**

Voltage Class	Rated Interrupting Time (Cycles)	Automatic Reclose Time (Cycles)
500-kV	2	20 - 90
287-kV - 345-kV	2	35 - 60
230-kV	3	35 - 60
115-kV - 161-kV	3	35 - 120
69-kV - 100-kV	5	*
Below 69-kV	8	*

\* - Varies significantly by line.

### 3. Other Fault-Interrupting Device Operating Times

Depending on the application, the use of other fault-interrupting devices such as circuit switchers may be allowed. Trip times of these devices are generally slower, and current interrupting capabilities are often lower than those of circuit breakers.

#### 5-C. Generators, Step-Up and Auxiliary Transformers

For Sections 5-C, 5-D, and 5-E of this document, NERC Planning Standards Sections IIB and IIC apply. The NERC Planning Standards are available at [www.nerc.com](http://www.nerc.com).

Synchronous generators shall have an overexcited power factor rating of 0.9 or lower. Under-excited power factor rating shall be 0.95 or lower. Alternatively, a power factor capability rating at the point of interconnection (network side of step-up transformer) may be negotiated with BPA TBL. The active power output should be limited to rated power (MVA rating times rated overexcited power factor) so that rated continuous reactive power output is available for power system emergencies. Planned operation above rated power must be negotiated with BPA TBL and the Northwest Security Coordinator. NERC Planning Standards guide IIC G2 states:

**G2** - Generators and turbines should be designed and operated so that there is additional reactive power capability that can be automatically supplied to the system during a disturbance.

Transformer reactances and tap settings should be coordinated with BPA TBL to optimize the reactive power capability (lagging and leading) that can be provided to the network. Refer to IEEE Std. C57.116, *Guide for Transformers Directly Connected to Generators*. The generator continuous reactive power capability shall not be restricted by main or auxiliary equipment, control and protection, or operating procedures.

Induction generators with solid-state inverters shall have reactive power capability similar to synchronous generators. Conventional induction generators may require switchable (while energized) shunt capacitor bank compensation. Large installations may require controllable compensation such as static VAR compensators. Induction generators without solid-state inverters shall provide at a minimum, sufficient reactive power capability or the 'equivalent' to deliver the Project output at unity power factor at the Point of Interconnection. BPA TBL determines the acceptable locations for 'equivalent' reactive using integration studies. 'Equivalent' reactive power includes adding shunt capacitors at locations other than at the Point of Interconnection or the Generation Site or acquiring sufficient reactive power from BPA TBL or another utility.

### **5-D. Excitation Equipment including Power System Stabilizers, and Voltage Controls**

Synchronous generator excitation equipment shall follow industry best practice and applicable industry standards. Excitation equipment includes the exciter, automatic voltage regulator, power system stabilizer and over-excitation limiter. Supplementary controls are required to meet BPA TBL transmission voltage schedules.

The following NERC Planning Standards shall be followed. See Section IIIC of the standards.

**S1** - All synchronous generators connected to the interconnected transmission systems shall be operated with their excitation system in the automatic voltage control mode unless approved otherwise by the transmission system operator. (The intent is that continuous automatic voltage control *not* be overridden by supplementary power factor or reactive power controls.)

**S2** - Generators shall maintain a network voltage or reactive power output as required by the transmission system operator within the reactive capability of the units. Generator step-up and auxiliary transformers shall have their tap settings coordinated with the electric system voltage requirements.

**S4** - Voltage regulator controls and limit functions (such as over and under excitation and volts/hertz limiters) shall coordinate with the generator's short duration capabilities and protective relays.

Normally the exciter is of the brushless rotating type or the static thyristor type. The excitation system nominal response shall be 2.0 or higher (for definitions see IEEE 421.2). The excitation system nominal response defines combined response time and ceiling voltage. In some cases, the high initial response static type may be required to economically improve power system dynamic performance and transfer capability.

Automatic voltage regulators (AVRs) should be continuously acting solid state analog or digital. Tuning should be in accord with NERC Planning Standard guide IIC G8 reproduced below. Tuning results should be included in commissioning test reports provided to BPA TBL.

**G8** - Generator voltage regulators to extent practical should be tuned for fast response to step changes in terminal voltage or voltage reference. It is preferable to run the step change in voltage tests with the generator not connected to the system so as to eliminate the system effects on the generator voltage. Terminal voltage overshoot should generally not exceed 10% for an open circuit step change in voltage test.

The voltage regulator shall include a power system stabilizer. This is a long-standing WSCC requirement. The PSS should be tuned in accord with WSCC guidelines and other industry practice. The dual-input accelerating power type of stabilizer (Delta P-omega or variant) is preferred.

The voltage regulator shall include an overexcitation limiter. The overexcitation limiter shall be of the inverse-time type adjusted to coordinate with the generator field circuit time-overcurrent capability. Operation of the limiter shall cause a reduction of field current to the continuous capability. Automatic voltage regulation shall automatically be restored when system conditions allow field current below the continuous rating. BPA TBL may request connection of the voltage regulator line drop compensation circuit to regulate a virtual location 50-80% through the step-up transformer reactance.

A supplementary automatic control is required to adjust the AVR setpoint to meet the BPA network side voltage schedule. This supplementary control should operate in a 10–30 second time frame, and may also balance reactive power output of the power plant generators.

*Background on BPA TBL transmission voltage schedules.* BPA TBL operates the transmission network through a range of 95% to 105% of nominal voltage except for the 500-kV network where the range is 100% to 110% of 500-kV. Voltage schedules are normally in the upper half of this range. Limitations at generation facilities must not restrict this range of operation. Standard industry practice for many decades is that voltage control by generators provide the major contribution to successful voltage control. BPA TBL applies network shunt compensation to aid in voltage control, and to keep generators reasonably close to unity power factor so that reactive power is available from generators during emergencies.

Voltage schedules are necessary for efficient and reliable power transmission and for adequate service to loads. The voltage schedules establish hourly operating requirements and may be set for seasons, holidays, days of the week, and time of day. These schedules may be changed at any time to meet transmission requirements, e.g., a line out of service. Timing for schedule changes are coordinated by the NWPP with all utilities in the region.

### **5-E Governor Speed and Frequency Control**

NERC Planning Standards standard I1C S5 and guide I1C G6 apply:

**S5** - Prime mover control (governors) shall operate with appropriate speed/load characteristics to regulate frequency.

**G6** - Prime mover control (governors) should operate freely to regulate frequency. In the absence of Regional requirements for the speed/load control characteristics, governor droop should generally be set at 5% and total governor deadband (intentional plus unintentional) should generally not exceed  $\pm 0.06\%$ . These characteristics should in most cases ensure a coordinated and balanced response to grid frequency disturbances. Prime movers operated with valves or gates wide open should control for overspeed/overfrequency.

BPA TBL realizes that some generating facilities will operate at maximum turbine output unless providing frequency control and spinning reserve ancillary services.

### **5-F. Voltage and Frequency Operation During Disturbances**

Power system disturbances initiated by system events such as faults and forced equipment outages, expose connected generators to oscillations in voltage and frequency. It is important that generators remain in service for dynamic (transient) oscillations that are stable and damped. Therefore each generator must be capable of continuous operation at 0.95 to 1.05 pu voltage and 59.5 to 60.5 Hz and limited time operation for larger deviations. Nearly all generators have inherent capability for off-nominal operation. Over/under voltage and over/under frequency relays are normally installed to protect the generators from extended off-nominal operation. To insure that the Project generator is not tripped prematurely, the required time delays for setting these relays are presented in the 'Protection Requirements' Section 6-C.

To avoid large-scale blackouts that can result from the excessive generation loss during a disturbance, underfrequency load shedding has been implemented in the Pacific Northwest. When system frequency declines, loads are automatically interrupted in discrete steps, with most of the interruptions between 59.3 and 58.6 Hz. Load shedding attempts to stabilize the system by balancing the generation and load. It is imperative that generators remain connected to the system during frequency declines, both to limit the amount of load shedding required and to help the system avoid a complete collapse. This need, as well as the restricted ability of some generators to withstand off-nominal frequency operation, has been taken into account in the relay-setting delays provided in this Section 6-C.

To avoid voltage collapse in certain areas of the Pacific Northwest, undervoltage load shedding has also been implemented. Most of the load interruptions will occur automatically near 0.9 per unit voltage after delays ranging from 3.5 to 8.0 seconds. The undervoltage relay settings in Section 6-C coordinate with the undervoltage load shedding program.

For those generators interconnected to the BPA System through a tapped transmission line, a 'local island' is created when the breakers at the ends of the transmission line open. This leaves the generator and any other loads that also are tapped off this line isolated from the power system. Delayed fault clearing, overvoltages, ferroresonance, extended undervoltages, etc. can result from this 'local island' condition and are therefore not allowed to persist on BPA transmission facilities. For protection, special relaying and settings are used to disconnect the generator(s) in the 'local island.' (See also Protection Requirements, Section 6.)

#### **5-G. Voltage Fluctuations and Flicker**

Voltage fluctuations may be noticeable as visual lighting variations (flicker) and can damage or disrupt the operation of electronic equipment. *IEEE Recommended Practices and Requirements for Harmonic Control in Electric Power Systems* (IEEE Standard 519) provides definitions and limits on acceptable levels of voltage fluctuation. Projects connecting to the BPA System shall comply with the limits set by IEEE 519.

#### **5-H. Voltage and Current Harmonics**

Harmonics can cause telecommunication interference and thermal heating in transformers; they can disable solid state equipment and create resonant overvoltages. In order to protect equipment from damage, harmonics must be managed and mitigated. The Project shall not cause voltage and current harmonics on the BPA System that exceed the limits specified in IEEE Standard 519. Harmonic distortion is defined as the ratio of the root mean square (rms) value of the harmonic to the rms value of the fundamental voltage or current. Single frequency and total harmonic distortion measurements may be conducted at the Point of Interconnection, Generation Site, or other locations on BPA's System to determine whether the Project is the source of excessive harmonics.

#### **5-I. Phase Unbalance**

Unbalanced phase voltages and currents can affect protective relay coordination and cause high neutral currents and thermal overloading of transformers. To protect BPA TBL and customer equipment, the Project's contribution at the Point of Interconnection shall not cause a voltage unbalance greater than 1% nor a current unbalance greater than 5%. Phase unbalance is the percent deviation of one phase from the average of all three phases.

## **6. Protection Requirements**

### **6-A. Introduction**

The protection requirements identified in this document are intended to achieve the following objectives:

- Insure safety of the general public, BPA TBL personnel, and Project personnel.
- Minimize damage to the property of the general public, BPA TBL, and BPA's TBL customers.
- Minimize adverse operating conditions on the BPA TBL System and BPA's TBL customers.
- Permit the Sponsor to operate the Project in parallel with the BPA System in a safe and efficient manner.

To achieve these objectives, certain protective equipment (relays, circuit breakers, etc.) must be installed. These devices ensure that faults or other abnormalities initiate prompt and appropriate disconnection of the Project from the BPA System. Protective equipment requirements depend on the plan of service. Significant issues that could affect these requirements include:

- The configuration of the Project.
- The Point of Interconnection to the power system.
- The level of existing service and protection to adjacent facilities (including those of other BPA TBL customers and potentially those of other utilities).

In addition, certain modifications and/or additions to the BPA System may be required for Project interconnection. Each individual request for interconnection must result in a protection system consistent with these technical requirements. BPA TBL makes the final determination as to the protective devices and identifies modifications and/or additions required by the Project. BPA TBL works with Sponsors to achieve an installation that meets the Sponsor's and BPA TBL's requirements.

BPA TBL cannot assume any responsibility for protection of the Sponsor's Project. Sponsors are solely responsible for protecting their equipment in such a manner that faults, imbalances, or other disturbances on the BPA System do not cause damage to the Project facilities.

### **6-B. Protection Criteria**

The protection system must be designed such that the Project generating equipment is automatically isolated for the following situations:

- Internal faults within the Project.
- External faults within the power system (as necessary).
- Conditions that indicate abnormal operation, including islanding of the Project.

#### **1. General Protection Practices as Applied to the BPA System**

The information below is provided to identify general protection practices as applied to BPA System transmission lines and interconnections thereto. The protection schemes necessary to integrate the Project must be consistent with these practices and the equipment used to implement them.

##### **a) All voltages above 100 kV:**

1. Breaker failure relays are required.
2. Dual trip coils are required.

3. Redundant relay and communications are required if stability and cascading is an issue for time delay cleared faults.
4. Dual batteries are NOT required but each set of relays must have its own separately protected DC source.
5. Redundant relays should not be connected to a common current transformer winding.

**b) All voltages**

1. As described in Section 4-B, a generator may tap an existing transmission line only if the line protection can be coordinated without compromising reliability, system stability, or quality of service to BPA TBL's existing customers.
2. Relays, breakers, etc. are required at the Point of Interconnection or the Interconnecting Substation to isolate BPA TBL equipment from the Project (or the distribution system containing the Project) during faults.
3. A dedicated generator breaker is required at the Sponsor's Generation Site.
4. The Project is to be synchronized to the power system.
5. An automatic synchronizing function must supervise each breaker closure connecting the generator to the power system.
6. Any breaker dedicated for the sole purpose of isolating the generator from the interconnecting power system shall open all three phases and shall not automatically reclose.
7. The Project is not allowed to energize a de-energized line in the BPA System without approval of the BPA Dispatcher.
8. Breaker reclose supervision (automatic and manual including SCADA) may be required at the Interconnecting Substation and/or electrically 'adjacent' stations; e.g., hot bus/dead line check, synchronization check, etc.

**c) 500-kV**

1. Two independent sets of directional line protection with separate pilot communication for each relay set shall be installed at each line terminal to trip the line terminal breakers.
2. Total fault clearing time with a pilot scheme must not be more than four cycles, including relay and breaker time.
3. Relays shall provide backup protection for loss of communication channel.
4. Line protection may be required to be compatible with existing or future series compensation.
5. Protection must be able to interface with BPA's single-pole protection schemes.
6. Breaker failure relay (BFR) protection at the Sponsor's facilities is required. It must not have more than eight cycle pickup delay for backup tripping. Total time for BFR scheme fault-clearing must not exceed 14 cycles.
7. Automatic reclosing shall be no faster than 35 cycles and usually no slower than 60 cycles for standard three-pole or single-pole switching, and no slower than 100 cycles for 'hybrid' type single-pole switching.
8. Automatic reclosing is not allowed for multiphase faults.

**d) 230 to 345-kV**

1. Two independent sets of directional line protection shall be installed at each line terminal to trip the line terminal breakers.
2. A pilot communication scheme may be required. A scheme common to both relay sets is acceptable.
3. Total fault clearing time with a pilot scheme must not be more than four cycles, including relay and breaker time.
4. Pilot scheme must be compatible with existing BPA TBL equipment.
5. Relays shall provide backup protection for loss of communication channel.
6. BFR protection at the Sponsor's facilities is required. It must not have more than eight cycle pickup delay for backup tripping. Total time for BFR scheme fault clearing must not exceed 14 cycles.
7. Automatic reclosing for SL-G faults shall be no faster than 35 cycles and no slower than 60 cycles.
8. Automatic reclosing is not allowed for multiphase faults.

**e) 161-kV and below**

1. Two independent sets of directional line protection shall be installed at each line terminal to trip the line terminal breakers.
2. A pilot communication scheme may be required. A scheme common to both relay sets is acceptable.
3. Total fault-clearing times, with or without a pilot scheme, must be provided for BPA TBL review and concurrence. Breaker operating times, relay models, and relay settings must be identified specifically.
4. If a pilot scheme is necessary, it must be compatible with existing BPA TBL equipment.
5. If a pilot scheme is necessary, relays shall provide backup protection for loss of channel.
6. BFR protection at the Sponsor's facilities may be required above 115-kV. Backup protection measures for breaker failure must be identified and associated total fault clearing times for these measures must be provided for BPA TBL review and concurrence.
7. Automatic reclosing for SL-G faults shall be no faster than 35 cycles.
8. Automatic reclosing is allowed for multiphase faults.

**2. Implications for Project Interconnection to an Existing Customer Service Substation**

Many generation projects are proposed for integration into utility power systems through a step-down transformer that is designed only to serve loads; e.g., connection at the 12.5-kV side of a 115-kV/12.5-kV transformer.

Existing facilities may have fuse protection only on the high-voltage side of the transformer; other installations may use a circuit switcher or breaker with relay control. The device and associated relays (if any) at these sites are provided to isolate the BPA System from faults within the transformer and act as backup to the customers' (feeder) protective devices. The existing protection at these installations was applied under the assumption that there was not a source from the low-voltage side to infeed to faults in the power system.

Other protective relaying strategies are necessary when generation is connected into these sites. 'Neutral shift' can be attributed to interconnection into stations with a D-YG transformer. Ferroresonance is also cause of concern, regardless of transformer connection. Equipment damage, relay performance, and saturation of measuring devices are only a few of the issues.

Primary and/or backup relays used for detection of faults in the power system may be required at the Project as well as the Interconnecting Substation. Usually, changes to existing protection and reclosing schemes are not limited to those at the Interconnecting Substation.

### **3. Protection Measures**

Protection systems must be capable of performing their intended function during fault condition. This includes the generator contribution to the fault and neutral shift of the unfaulted phases. The duration of this contribution and neutral shift varies with generator size, type, and excitation. The magnitude of depends on the fault type, system configuration, and fault location. The discussion below identifies the conditions under which relay schemes must operate. Notably, the issues are:

- Infeed detection to phase and ground faults.
- Islanding
- Synchronizing and reclosing
- Unique problems related to system configuration.

#### **a) Phase fault detection**

Phase overcurrent (type 50/51) and neutral overcurrent (type 50/51-N) relays are provided to detect abnormally high currents. These non-directional relays are used to detect faults on the feeder line and serve to back up generator overcurrent relays. Line differential relays may be a necessary consideration for some projects when coordination with other relays is not possible.

Infeed detection to faults within the power system usually requires directional current-sensing relays to remove the Project's contribution to the fault. Zone-distance relays (type 21) usually serve this need. However, some generation projects (generally 'small-capacity') may not contribute sufficient infeed to power system phase faults to make distance-relay detection feasible. In these cases, relays at the Project need to provide the necessary detection.

#### **b) Ground fault detection**

Ground fault detection has varying requirements. The most significant consideration in ability to detect ground faults on the utility power system is the winding configuration of the transformer connecting the Project to the transmission system. The scenarios below assume that the Project is connected to the low-voltage side of this transformer.

##### **1. Transformer grounded wye connection on the transmission side**

If the transformer is connected in grounded-wye on the primary (high-voltage) side and delta on the secondary (low-voltage) side (YG-D), then a ground overcurrent relay (type 50/51-G) connected in the neutral of the wye is used to provide detection. This relay also protects the integrating transformer. This arrangement also applies to a transformer connected YG-Y(G) with delta tertiary. Either of these connections provide what is often referred to as a 'ground source' for the wye grounded terminal(s). The measured quantity in the transformer grounded-wye neutral is caused by zero-sequence circulating currents in the delta winding during ground faults.

A directional ground overcurrent relay (type 67-N) is generally provided for detection of ground faults in the transmission system when transformer connections are of the types identified above. Since this relay function complements zone-distance protection used for phase fault detection, it is included in many presently manufactured relays.

## 2. Transformer Delta Connection on the Transmission Side

Under the second common scenario (the most common configuration used at BPA TBL customer service substations), the interconnecting transformer is connected delta on the high-voltage winding and connected wye-grounded on the low-voltage winding (D-YG). For ground faults on the high voltage system, protective relaying cannot detect zero sequence current at this location unless a ground source (grounding bank) is connected to the high-voltage side of the transformer. Protective relay operation at the remote transmission line terminal(s) will isolate the line. However, the generator infeed (voltage effect) will continue to energize the transmission line and, with one phase grounded, can result in significant overvoltages (neutral shift). Thus protection must be applied to this situation to detect the fault and trip the generator as rapidly as possible.

A detection method for this situation uses three VTs or bushing potential devices on the primary side of the transformer connected phase-to-ground. The VTs or bushing potential devices must be capable of measuring voltages up to 1.9 PU without the output collapsing by the operation of a protective device, such as a protective gap. The VT's secondary windings are connected 'broken-delta' with an overvoltage relay (type 59-Z) connected across the 'open' corner of the delta. The relay measures the sum of the phase-to-neutral voltages. Under normal conditions, the measurement is near zero, while a ground fault either close to the transformer or with the remote line end(s) open yields a substantial voltage. The relay initiates a trip to eliminate the generator infeed on the faulted line. Fault detection using a single VT and an over/under voltage relay is not usually acceptable. Fault impedance, connected loads, and/or additional ground sources on the line can significantly compromise the ability of this scheme to detect the over-or-under voltage condition.

If 1) the minimum load (MW) in the 'local island' is four or more times the generator rating (MVA) and 2) the available system reactive power (capacitive VARs) is less than 25% of the generator rating, the system voltage should rapidly collapse after the remote end breakers trip. Under these circumstances, a single VT scheme is acceptable.

Pilot trip from the end(s) of the transmission line is an acceptable alternative. A grounding bank connected to the high side (delta side) of the interconnecting power transformer is another acceptable alternative.

### c) High-Side Overvoltage Protection

For scenario 2, described above, with the high side connected in Delta, the transmission line becomes ungrounded after the line-end breakers open. With a generator energizing the circuit and a fault on the transmission line, the voltages on the unfaulted phases can reach 1.7 PU and higher (full neutral shift). This can stress equipment insulation and cause rapid failure of surge arresters. Additional protective relays are required, to detect this overvoltage situation quickly and disconnect the generator from the circuit.

Three single-phase instantaneous overvoltage relays (type 59) are to be installed to detect phase-ground voltage using the three high-side VTs or bushing potential devices. These relays should be set to trip at 1.5 pu phase-ground voltage and have approximately a one-cycle detection time. Like the ground-fault detection scheme above, pilot trip from the transmission line end(s) is an acceptable alternative to this high-side overvoltage protection.

The 'open delta' protection scheme described above is intended to detect ground faults and assure a local trip of the generator. However, proper coordination of this scheme often requires relaying delays. Such delays may not provide adequate protection for equipment such as high-side arresters. The open delta scheme also cannot protect for the case of overvoltages created when a

small generator is isolated in a 'local island' with a relatively large amount of capacitance, such as a long line or a capacitor bank. The simple and inexpensive set of three overvoltage relays described above are intended to protect the arresters and other equipment on the high-voltage side with no intentional delays, regardless of the cause of the overvoltages.

**d) Islanding**

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

Some utilities isolate their distribution system and use local generation to feed loads during power system outages. BPA TBL does not allow islanding conditions to exist that include its facilities, except for a controlled (temporary, area-wide) grid separation. When BPA TBL customer loads are being served over another utility's transmission/distribution system, where generation is also interconnected, implications of islanding must be addressed to minimize adverse impacts on these loads.

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

**e) Relay Performance / Transfer Trip Requirements**

Relay systems shown in Figures 6-1 through 6-4 are designed to isolate the Project from the BPA transmission system at the Point of Interconnection. However, the performance (clearing time speed) of these local relay systems and the associated isolating devices (breakers, etc.) will vary. Integration of generating projects into the power system requires equal or better performance of protection systems. See 6-B.1 for general requirements associated for integration of the Project. In many cases, transfer trip (pilot) communications are necessary. Transfer trip is required when any of the conditions listed below implies the need for it.

1. Transient or steady state studies identify system instability under conditions that require immediate isolation of the Project from the power system. Or as determined by operational control needs.
2. The total clearing times listed in the table below identify the maximum permissible fault duration times allowed to provide prudent response to fault conditions. Extended fault duration represents an additional safety hazard to personnel and can cause significant damage to power system equipment (lines, transformers). Relay operate times are adjusted to coordinate for faults based on the local configuration (e.g. three terminal lines), fault currents available, etc. If protective relay schemes cannot be altered to accommodate the Project to meet the clearing times listed below, high speed tripping will become necessary.

Integration Voltage, kV	Total Clearing Time, Cycles	Maximum Relay Operate Time, Cycles	PCB Trip Time, Cycles	Time Delayed Tripping Acceptable?
500	4	1	2	No*
≥ 230 Main Grid	4	1	2	No*
230	28	≤ 25	3	Yes
100 to 230	47	≤ 42	5	Yes
≤ 69	68	≤ 60	8	Yes

\*transfer trip not an optional consideration

3. If time delayed fault clearing on lines in the vicinity of a customer can cause problems (voltage sag) to a customers' manufacturing process, high speed tripping may become necessary. This scenario is a distinct possibility should a BPA TBL circuit which connects other customer loads become part of a local island which includes the Project.

4. When remote breaker tripping is required to clear faults in a transformer not terminated by a high side breaker, high speed tripping will be necessary. Other unique configurations may impose the same requirement.

**f) Synchronizing and Reclosing**

The Project generator(s) shall be synchronized to the power system. The point of synchronism depends on the configuration of the Project's interconnection. All breaker closing operations must automatically synchronize the Project generator to the power system. The breaker used to synchronize the generator to the power system is usually the dedicated generator breaker.

If the Project connects to an existing line, automatic reclosing schemes at the remote line breakers will need to be modified to accommodate the generator. A hot bus/dead line check before attempting an automatic reclose is usually needed at one end. Hot bus/hot line with synchronism check supervision is necessary for automatic reclosing at the other end. When acceptable, automatic reclosing can be cutout at one or both remote ends. If the Project uses only induction generators, automatic reclosing of the breakers at the ends of the integrating line may be performed without supervision, but will usually be time delayed to assure isolation of the Project.

**g) Disturbance Monitoring**

Unique and unanticipated protection problems can result from the changed system configuration due to interconnection with the Project. BPA TBL may, at its discretion, install monitoring equipment to identify possible protection scheme problems and to provide power quality measurements of the new configuration. If monitoring or relay performance indicates inadequate protection of the BPA System, the owner of the Project will be notified of additional protection requirements. The monitor provides information similar to that of an oscillograph or fault recorder. The availability of current and voltage measurements determines the number of channels for the device. Monitoring equipment is also installed to aid in the understanding of the electrical phenomena, such as overvoltages and ferroresonance that can be associated with these projects. (BPA TBL plans to use the information acquired to update future editions of this document.) Remote access to monitored quantities is often accomplished using the Revenue Metering System (RMS) communication equipment.

### 6-C. Relay Coordination

Voltage and frequency relays used for protecting a generator and preventing a 'local island' condition from persisting must meet the following requirements to allow proper coordination with the adjacent power system(s). These relays are usually installed at the Generation Site or at the Interconnecting Substation.

The ranges, settings, and delays below for both voltage and frequency relays are understood by BPA TBL to be well within the capabilities of small and large modern steam turbines as well as other generators. BPA TBL will evaluate a Sponsor's proposed alternative voltage/frequency settings based upon the impact on system performance and reliability. The settings must comply with existing NWPP requirements.

#### 1. Voltage Relays

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

These requirements also insure that generators do not disconnect for dynamic (transient) oscillations on the power system that are stable and damped. The oscillatory frequency of the system during a disturbance ranges between 0.25 and 1.5 Hertz. Also, each occurrence of over/under voltage on the system lasts for a short time period (less than one second) and is nearly damped within 20 seconds following the disturbance. During severe system voltage disturbances it is critical that generators do not trip prior to the completion of all automatic undervoltage load shedding. The settings below coordinate with Pacific Northwest undervoltage load shedding, where loads are interrupted at voltages ranging from 0.85 to 0.92 per unit with time delays of 3.5, 5.0 or 8.0 seconds.

##### Overvoltage (type 59)

<u>Voltage</u>	<u>Action</u>
1.10 PU	5.0-second minimum delay before unit tripping
1.20 PU	2.0-second minimum delay before unit tripping
1.25 PU	0.8-second minimum delay before unit tripping
1.30 PU and above	no intentional delay before unit tripping

##### Undervoltage (type 27)

<u>Voltage</u>	<u>Action</u>
0.90 PU	10-second minimum delay before unit tripping
0.80 PU	2.0-second minimum delay before unit tripping
0.75 PU and below	0.8 -second minimum delay before unit tripping

#### 2. Frequency Relays

The following frequency ranges and minimum setting/delay requirements for over/under frequency relays (type 81) have been established by the WSCC Coordinated Off-Nominal Frequency Load Shedding and Restoration Program. The objective of these settings is to use the machine capability to support the power system and prevent unnecessary loss of system load during disturbances, and ultimately, to help prevent system collapse. Generating resources must not trip off before load is shed by underfrequency relays. The relay settings below insure that the underfrequency generator tripping coordinates with the Northwest Power Pool Enhanced Underfrequency Load Shedding Program, where most of load is shed as the system frequency declines from 59.3 down to 58.6 Hz.

Underfrequency Range	Overfrequency Range	Minimum Time Delay Setting
60.0-59.5 Hz	60.0-60.5 Hz	No Generator Tripping (Continuous)
59.4-58.5 Hz	60.6-61.5 Hz	3 minutes
58.4-57.9 Hz	61.6-61.7 Hz	30 seconds
57.8-57.4 Hz		7.5 seconds
57.3-56.9 Hz		45 cycles
56.8-56.5 Hz		7.2 cycles
Less than 56.4 Hz	Greater than 61.7 Hz	Instantaneous Trip

For generators that are not susceptible to damage for the frequency ranges listed above (e.g. typical hydro units), tripping at 61.7 and 56.4 Hz, with no intermediate steps is suggested. For steam generators and similar units, relay(s) with multiple frequency setpoints and discrete time delays could be used to realize the settings above.

Often, large generation resources are directly connected to a substation at the transmission level voltage and would not be part of the 'local island' condition described in Section 5-F. For these generators, the 61.7 Hz trip level may be raised and the 56.4 Hz trip level may be lowered. However, the minimum delays listed above for all frequency deviations from 60 Hz must be maintained. For those generators that can be part of a 'local island', a maximum delay of 0.1 sec at 56.4 and 61.7 Hz should be used. This will help insure that the generator trips for the 'local islanding' condition.

Voltage and frequency relays must have a dropout time no greater than 2 cycles. Frequency relays shall be solid state or microprocessor technology; electro-mechanical relays used for this function are considered unacceptable.

## **6-D. Protective Relays**

### **1. Relays to be Installed for Integration of the Project**

This set of relays has been developed in recognition of varied detection requirements. Relay performance under certain fault scenarios is also a consideration in the selection of these relays. The specific relays used must be functionally consistent with, and complementary to, BPA TBL's general protection practices identified in Section 6-B1.

The relays generally necessary to serve this purpose are:

- |   |                |
|---|----------------|
| a. Phase overcurrent (non-directional)              | (type 50/51)   |
| b. Neutral overcurrent (non-directional)            | (type 50/51-N) |
| c. Zone distance                                    | (type 21/21-N) |
| d. Directional ground overcurrent                   | (type 67-N)    |
| e. Ground overcurrent                               | (type 51-G)    |
| or ground fault detection scheme                    | (type 59-Z)    |
| f. Over/under voltage                               | (type 59/27)   |
| g. Over/under frequency                             | (type 81)      |
| h. Instantaneous overvoltage (ungrounded high-side) | (type 59)      |

- i. Remote automatic breaker reclose supervision (type 79-X)  
(HB/DL, HB/HL with synchronism check)

Except for Item i above, these relays are usually located in the Interconnecting Substation that contains the step-up transformer. Some or all may be located elsewhere if the interconnection to the Project suggests an equally acceptable or more logical location. All relays shall be of 'utility grade' quality, subject to review by BPA TBL.

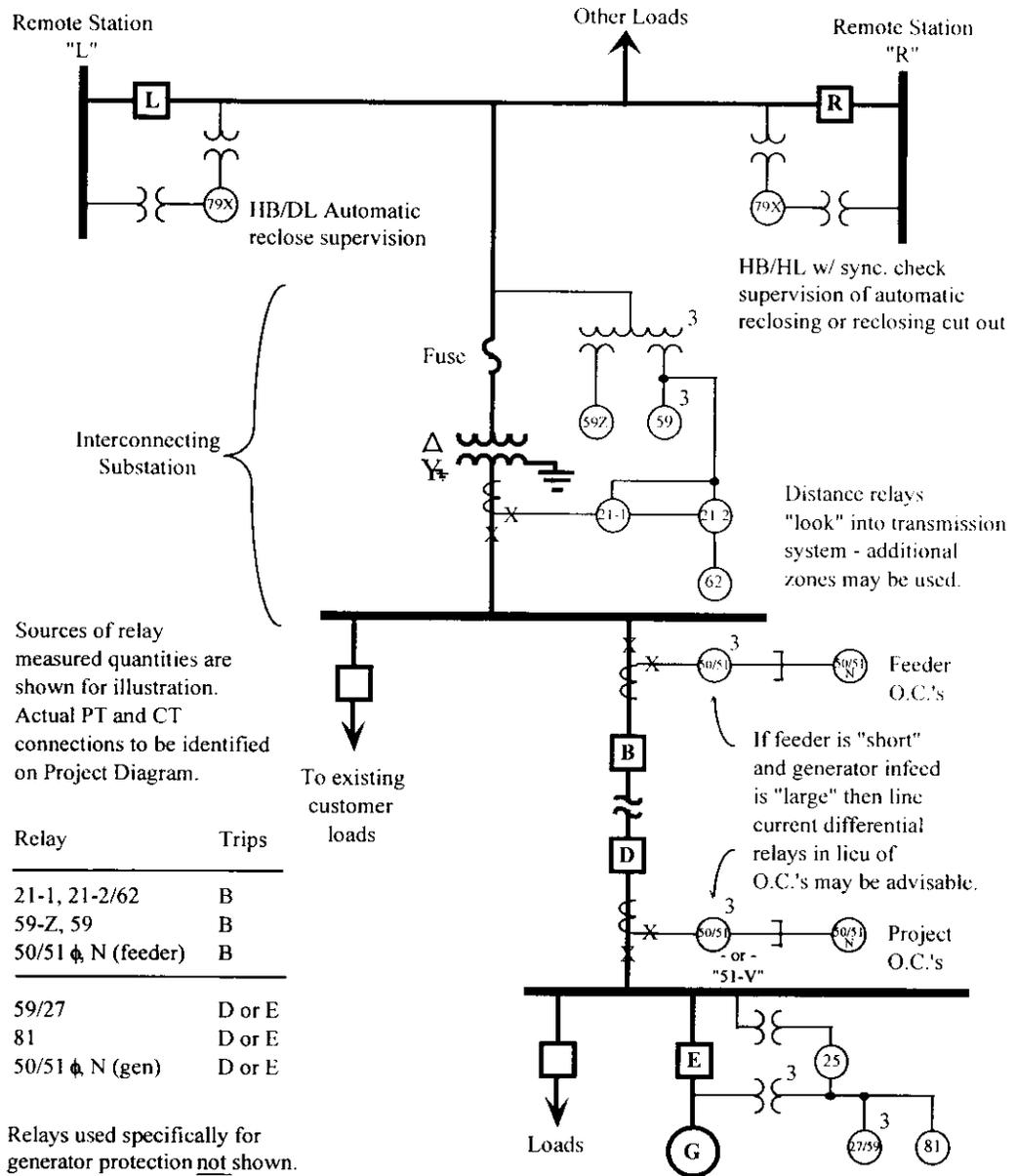
Slow clearing or other undesirable operations (e.g., extended overvoltages, ferroresonance, etc.), which can not be resolved by local conventional protection measures, will require the addition of pilot trip using remote relay detection at other substation sites.

Refer to Section 8-D for telecommunication issues as they pertain to control and protection requirements. See Figures 6-1 through 6-4 for examples of some typical integration plans.

## 2. Additional Relays

Although not required by BPA TBL, the Sponsor may note value in additional relays to isolate and protect the generator. Some of the most often used include:

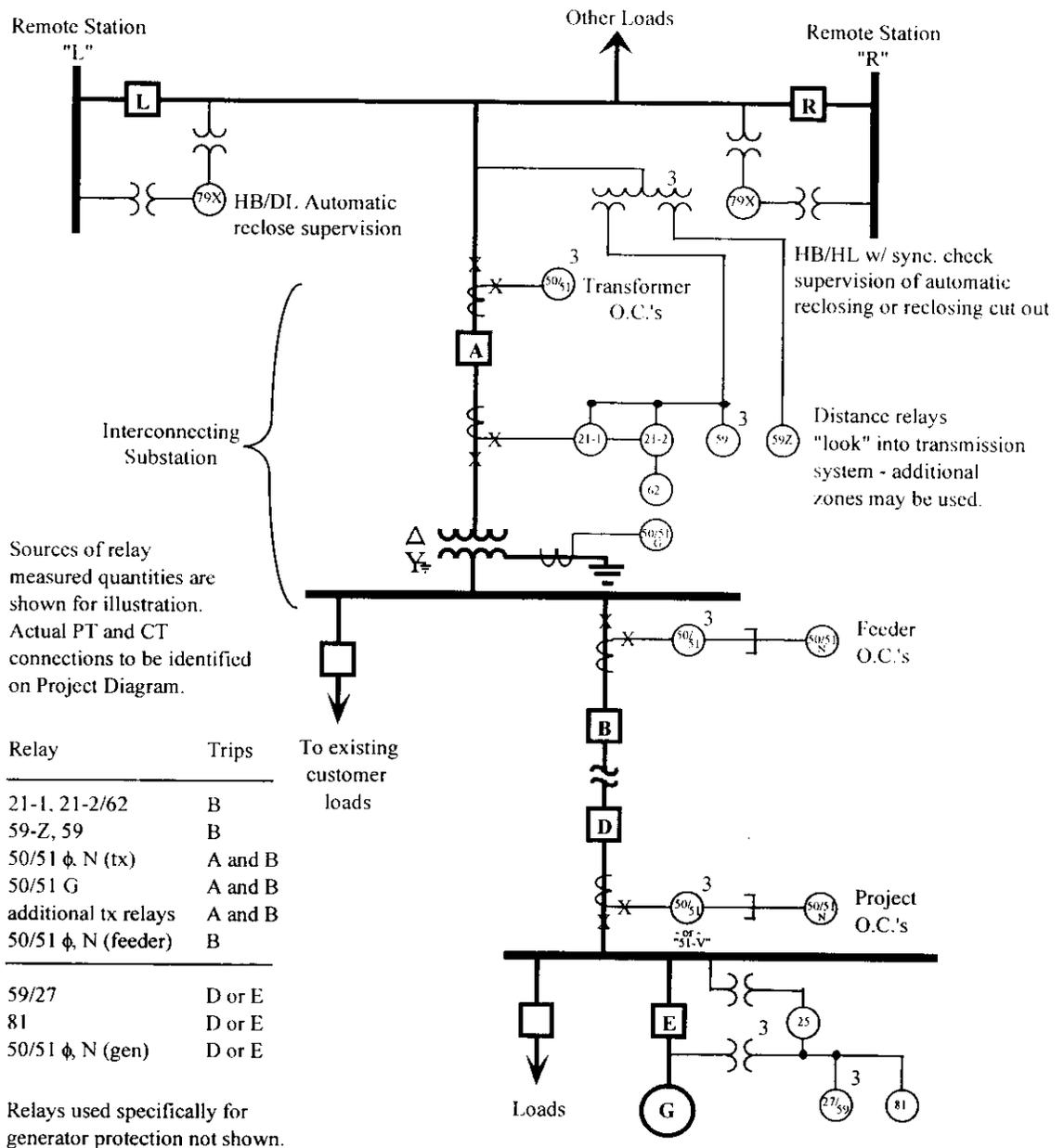
- a. Percentage differential (type 87)
- b. Phase balance current (type 46)
- c. Phase sequence voltage (type 47)
- d. Reverse power (type 32) (assumes one-way power flow)
- e. Thermal (type 49)
- f. Loss of field (type 40)
- g. Over-speed device (type 12)
- h. Transformer sudden pressure (type 63)
- i. Voltage controlled/restrained o.c. (type 51-V)
- j. Volts per Hertz (overexcitation) (type 24)
- k. Neutral overvoltage (type 59-N)



**Figure 6-1 Integration of Generation into an Existing Fused Customer Service Substation Connected into the Transmission System through a Delta - Wye grounded Transformer**

**Table 6-1 Relay Functions Descriptions for Figure 6-1**

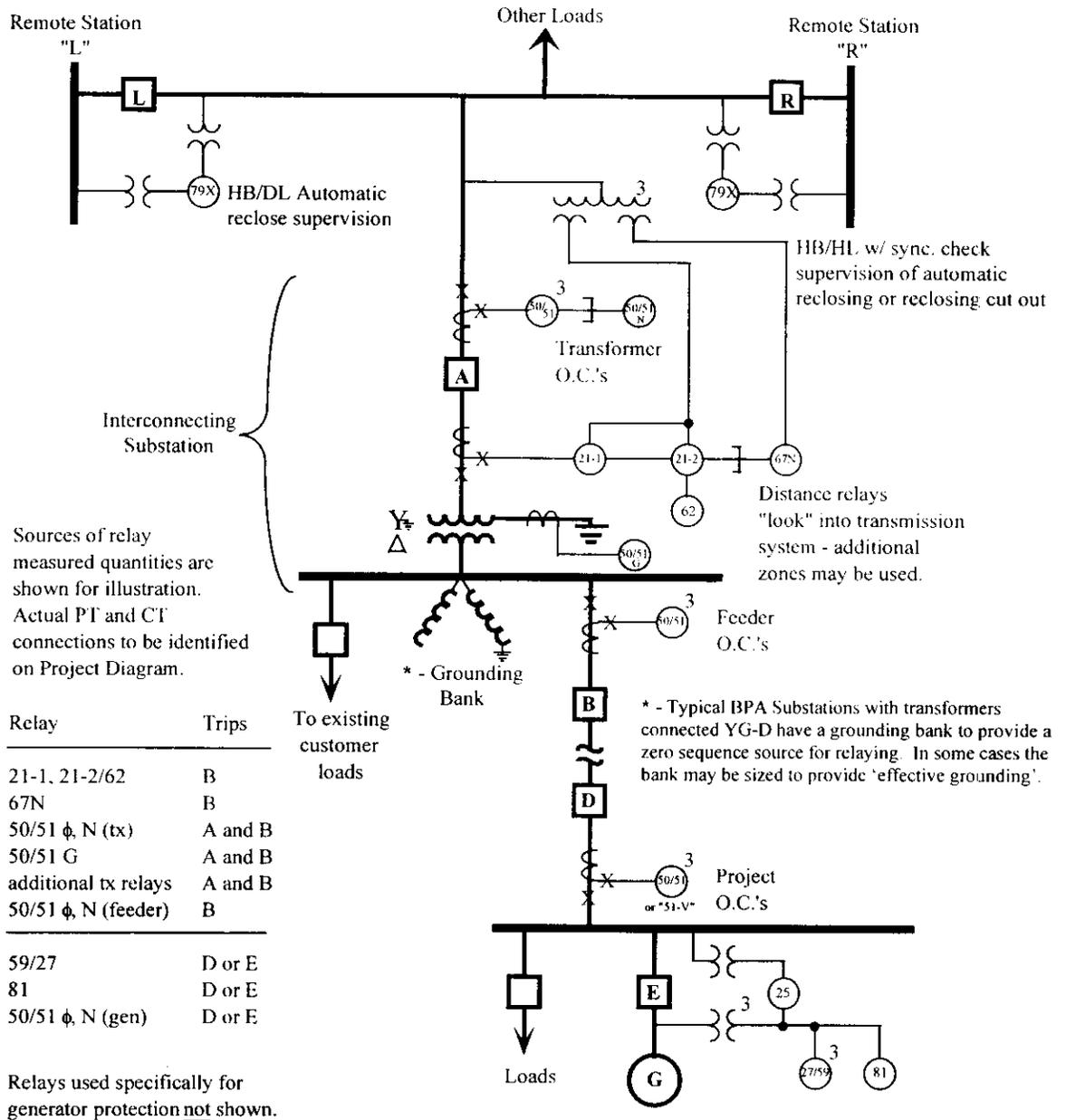
<u>Relay</u>	<u>Intent</u>
21-1, 21-2, 62	Zone distance relays trip feeder breaker 'B' to eliminate the contribution of the generator to multi-phase faults on the tapped transmission line.
59 Z	Ground fault detection scheme used to detect ground faults on the tapped transmission line. (Normally the open delta 3Vo scheme with inverse time characteristic.) Trips of this relay may need to be time coordinated with other relays so that faults beyond the tapped transmission line do not cause unnecessary trips of the generator feeder. Trips breaker 'B'.
59	High-speed overvoltage detection on transformer high side. Instantaneous trip upon overvoltage condition of 1.5 per unit on any phase that exists for one cycle or longer. Initiates trips of feeder breaker 'B' to avoid arrester failure.
50/51, 50/51N (Feeder)	Detects overcurrent condition caused by power system contribution to faults on the generator feeder or in the Project. Also, detects generator infeed to faults at or near the Interconnecting Substation. Trips breaker 'B'.
50/51, 50/51N (Project)	Detects overcurrent condition as caused by generator infeed to faults on the feeder line or Interconnecting Substation. Trips breaker 'D'. Voltage restrained time overcurrent phase relays, 51-V, may be desirable rather than the 51 for better selectivity of fault currents vs. load currents.
27/59	Detects abnormal voltage conditions often caused by islanded operation scenarios. Undervoltage relay can serve as a means of fault detection for instances of weak fault current infeed from generator to faults on the feeder or interconnected system. Protects generator against extended operation at abnormal voltages. Undervoltage relay settings are coordinated with Pacific Northwest undervoltage load shedding (Section 6-C1).
81	Detects abnormal frequency conditions, often caused by islanded operation scenarios. Protects generator against extended operation at abnormal frequencies. Underfrequency relay settings are coordinated with Pacific Northwest underfrequency load shedding (Section 6-C2).
25	Synchronism check supervising function for all closes of generator breaker 'E'.
79 X	Automatic reclose supervision function: Hot Bus/Dead Line (HB/DL), Hot Bus/Hot Line (HB/HL) as required. Synchronism check supervision may also be used at 'L' and/or 'R'. Relays at the remote ends 'L' and 'R' trip respective breakers for faults on the line.



**Figure 6-2 Integration of Generation into an Existing Customer Service Substation Protected by a High-Side Breaker (switcher) and Connected into the Transmission System through a Delta - Wye grounded Transformer**

**Table 6-2 Relay Functions Descriptions for Figure 6-2**

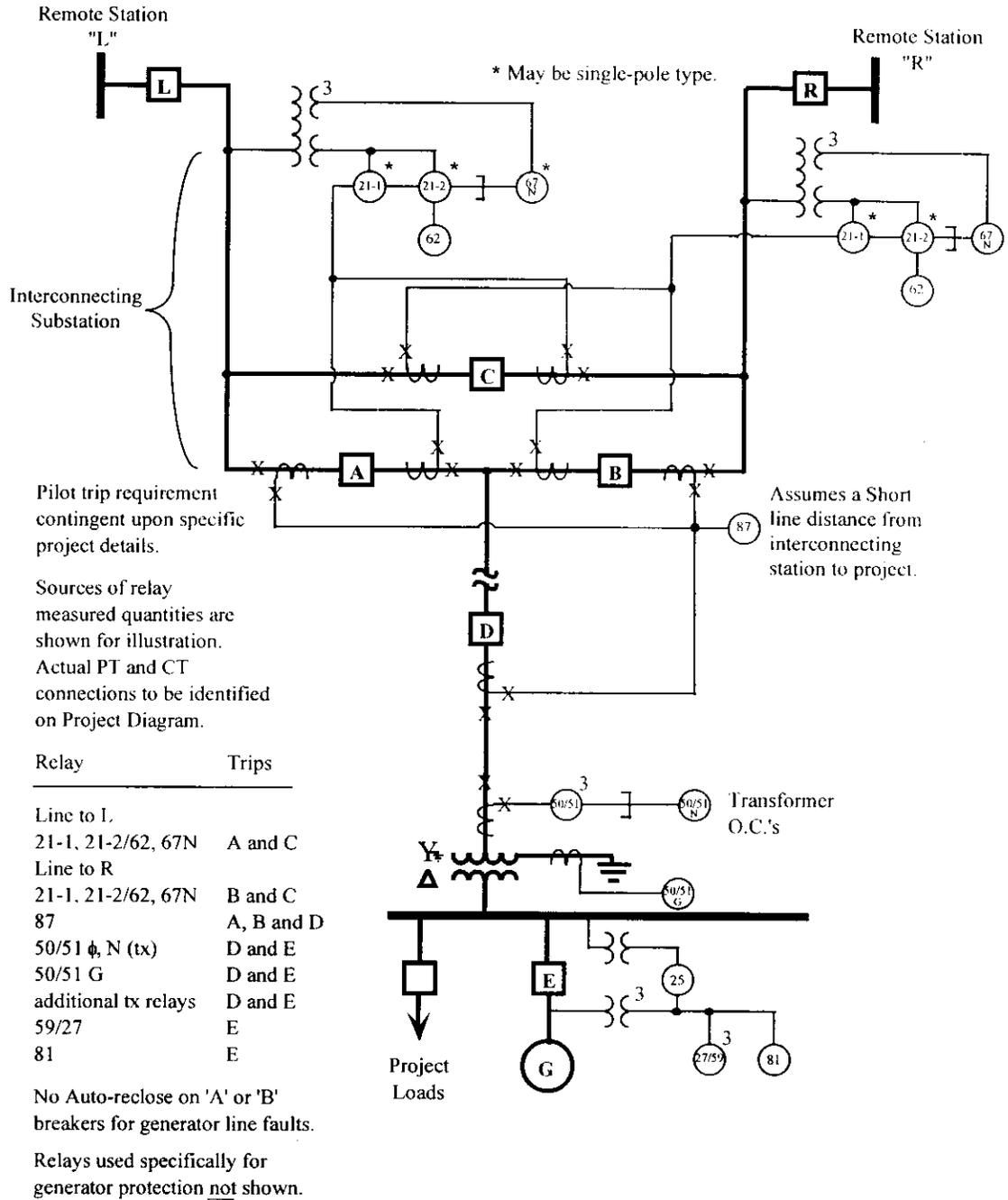
<u>Relay</u>	<u>Intent</u>
21-1, 21-2, 62	Zone distance relays trip feeder breaker 'B' to eliminate the contribution of the generator to multi-phase faults on the tapped transmission line.
59 Z	Ground fault detection scheme used to detect ground faults on the tapped transmission line. (Normally the open delta 3Vo scheme, inverse time characteristic.) Trips of this relay may need to be time coordinated with other relays so that faults beyond the tapped transmission line do not cause unnecessary trips of the generator feeder. Trips breaker 'B'.
59	Detects overvoltages, and ground faults as indicated above. Instantaneous trip upon overvoltage condition of 1.5 per unit on any phase. Initiates trips of feeder breaker 'B' to avoid arrester failure.
50/51, 50/51N (Transformer)	Protects transformer from overcurrent conditions caused by lowside faults, extreme overloads, or unbalances. Phase overcurrent relays are usually set to pickup at approximately twice the transformer thermal rating. These relays are time-coordinated with lowside feeder relaying (backup). The relays trip breakers 'A' and 'B'. Differential relays (87) may be substituted for the 50/51 and 50/51N.
50/51G (Transformer)	Protects transformer from overcurrent conditions caused by lowside ground faults or extreme unbalances. These relays are time-coordinated with lowside feeder relaying (backup). The relays trip breakers 'A' and 'B'.
50/51, 50/51N (Feeder)	Detects overcurrent condition caused by power system contribution to faults on the generator feeder or in the Project. Also, detects generator infeed to faults at or near the Interconnecting Substation. These relays trip breaker 'B'.
50/51, 50/51N (Project)	Detects overcurrent condition as caused by generator infeed to faults on the feeder line or Interconnecting Substation. Trips breaker 'D'. Voltage restrained time overcurrent phase relays, 51-V, may be desirable rather than the 51 for better selectivity of fault currents vs. load currents.
27/59	Detects abnormal voltage conditions often caused by islanded operation scenarios. Undervoltage relay can serve as a means of fault detection for instances of weak fault current infeed from generator to faults on the feeder or interconnected system. Protects generator against extended operation at abnormal voltages. Undervoltage relay settings are coordinated with Pacific Northwest undervoltage load shedding (Section 6-C1).
81	Detects abnormal frequency conditions, often caused by islanded operation scenarios. Protects generator against extended operation at abnormal frequencies. Underfrequency relay settings are coordinated with Pacific Northwest underfrequency load shedding (Section 6-C2).
25	Synchronism check supervising function for all closes of generator breaker 'E'.
79 X	Automatic reclose supervision function: Hot Bus/Dead Line (HB/DL), Hot Bus/Hot Line (HB/HL) as required. Synchronism check supervision may also be used at 'L' and/or 'R'. Relays at the remote ends 'L' and 'R' trip respective breakers for faults on the line.



**Figure 6-3 Integration of Generation into an Existing Customer Service Substation Protected by a High-Side Breaker and Connected into the Transmission System through a YG - D (as shown) or YG - Y(G) - D Transformer**

**Table 6-3 Relay Functions Descriptions for Figure 6-3**

<b>Relay</b>	<b>Intent</b>
<b>21-1, 21-2, 62</b>	Zone distance relays trip feeder breaker 'B' to eliminate the contribution of the generator to multi-phase faults on the tapped transmission line.
<b>67 N</b>	Directional ground overcurrent relay trips feeder breaker 'B' to eliminate the contribution of the generator to ground faults on the tapped transmission line. Potential polarization shown in figure; may also be current polarized from transformer neutral or negative sequence polarized.
<b>59</b>	Detects overvoltages, and ground faults as indicated above. Instantaneous trip upon overvoltage condition of 1.5 per unit on any phase. Initiates trips of feeder breaker 'B' to avoid arrester failure.
<b>50/51, 50/51N (Transformer)</b>	Protects transformer from overcurrent conditions caused by lowside faults extreme overloads or unbalances. Phase overcurrent relays are usually set to pickup at approximately twice the transformer thermal rating. These relays are time-coordinated with lowside feeder relaying (backup). The relays trip breakers 'A' and 'B'. Differential relay (87) may be substituted for the 50/51 and 50/51N.
<b>50/51G (Transformer)</b>	Protects transformer from overcurrent conditions caused by lowside ground faults or extreme unbalances. These relays are time-coordinated with lowside feeder relaying (backup). The relays trip breakers 'A' and 'B'.
<b>50/51, 50/51N (Feeder)</b>	Detects overcurrent condition caused by power system contribution to faults on the generator feeder or in the Project. Also, detects generator infeed to faults at or near the Interconnecting Substation. These relays trip breaker 'B'.
<b>50/51, 50/51N (Project)</b>	Detects overcurrent condition as caused by generator infeed to faults on the feeder line or Interconnecting Substation. Trips breaker 'D'. Voltage restrained time overcurrent phase relays, 51-V, may be desirable rather than the 51 for better selectivity of fault currents vs. load currents.
<b>27/59</b>	Detects abnormal voltage conditions often caused by islanded operation scenarios. Undervoltage relay can serve as a means of fault detection for instances of weak fault current infeed from generator to faults on the feeder or interconnected system. Protects generator against extended operation at abnormal voltages. Undervoltage relay settings are coordinated with Pacific Northwest undervoltage load shedding (Section 6-C1).
<b>81</b>	Detects abnormal frequency conditions, often caused by islanded operation scenarios. Protects generator against extended operation at abnormal frequencies. Underfrequency relay settings are coordinated with Pacific Northwest underfrequency load shedding (Section 6-C2).
<b>25</b>	Synchronism check supervising function for all closes of generator breaker 'E'.
<b>79 X</b>	Automatic reclose supervision function: Hot Bus/Dead Line (HB/DL), Hot Bus/Hot Line (HB/HL) as required. Synchronism check supervision may also be used at 'L' and/or 'R'. Relays at the remote ends 'L' and 'R' trip respective breakers for faults on the line.



**Figure 6-4 Integration of Generation into a Transmission Level Substation**

**Table 6-4 Relay Functions Descriptions for Figure 6-4**

<u>Relay</u>	<u>Intent</u>
21-1, 21-2 / 62	Zone distance relays trip line breakers for multi-phase faults on the transmission lines to the Interconnecting Substation. These relays may have single pole tripping capability. They also may be connected to a transfer trip or other pilot channel.
67 N	Directional ground overcurrent relay trips line breakers for ground faults on the transmission lines to the Interconnecting Substation. These relays may have single pole tripping capability. They also may be connected to a transfer trip or other pilot channel. Potential polarization shown in figure; current polarizing or negative sequence polarizing may also be used.
87	Figure shows a short line (typically 0-2 miles) between the Project and the Interconnecting Substation. Differential relays are often necessary to avoid coordination problems with other relays to limit nuisance trips of the generator.
50/51, 50/51N (Transformer)	Protects transformer from overcurrent conditions caused by lowside faults extreme overloads or unbalances. Phase overcurrent relays are usually set to pickup at approximately twice the transformer thermal rating. These relays are time-coordinated with lowside feeder relaying (backup). The relays trip breakers 'A' and 'B'. Differential relay (87) may be substituted for the 50/51 and 50/51N. Voltage restrained time overcurrent phase relays, 51-V, may be desirable rather than the 51 for better selectivity of fault currents vs. load currents.
27/59	Detects abnormal voltage conditions often caused by islanded operation scenarios. Undervoltage relay can serve as a means of fault detection for instances of weak fault current infeed from generator to faults on the feeder or interconnected system. Protects generator against extended operation at abnormal voltages. Undervoltage relay settings are coordinated with Pacific Northwest undervoltage load shedding (Section 6-C1).
81	Detects abnormal frequency conditions, often caused by islanded operation scenarios. Protects generator against extended operation at abnormal frequencies. Underfrequency relay settings are coordinated with Pacific Northwest underfrequency load shedding (Section 6-C2).
25	Synchronism check supervising function for all closes of generator breaker 'E'.
79 X	Automatic reclose supervision function: Hot Bus/Dead Line (HB/DL), Hot Bus/Hot Line (HB/HL) as required. Synchronism check supervision may also be used at 'L' and/or 'R'. Relays at the remote ends 'L' and 'R' trip respective breakers for faults on the line.

## **7. System Operation and Generation Scheduling Data Requirements**

### **7-A. Introduction**

All transmission arrangements for power schedules within, across, into or out of the BPA Load Control Area require metering and telemetering. Transmission arrangements with generating resources may include wheeling, reserves and Automatic Generation Control (AGC). The technical plan of service for interconnecting a generating resource, as shown on the Project Requirements Diagram, will include the metering and telemetering equipment consistent with the transmission contract provisions. Such metering and telemetering equipment may be owned, operated, and maintained by BPA TBL or by other parties approved by BPA TBL.

Revenue metering, system dispatching, operation, control, transmission scheduling and power scheduling each have slightly different needs and requirements concerning metering, telemetering, data acquisition, and control. Specific requirements also vary depending upon whether the Project is directly connected to the BPA system and within or outside the BPA Load Control Area. Under some arrangements, only a portion of the Project output may be incorporated into the BPA Load Control Area.

Beyond the basic production and delivery of electrical energy, successful operation of generators, loads, and the transmission system requires Ancillary Services. Some of these services include scheduling, control and dispatch, reactive support from generators, load regulation, and operating reserves. Ancillary Services are purchased by or for load customers and generation resource operators. BPA TBL purchases Ancillary Services from certain generation resources and may provide these services to others. BPA TBL metering and telemetering requirements may depend upon whether or not the Project is a dispatchable resource for Ancillary Services.

### **7-B. System Operation Requirements**

#### **1. Telemetry Requirements**

BPA System Dispatching requires telemetry data for the integration of new generation resources. This typically consists of the continuous telemetering of kW quantities and hourly transmission of the previous hour's kWh from the Project to the appropriate BPA transmission dispatching and control center. The net Project output, which is the Project generation less the station service load and step-up losses, is normally telemetered.

Section 8-C2 discusses telecommunications requirements for telemetry and AGC. Table 7-1 summarizes telemetry requirements and Table 7-2 identifies requirements based on Project location. The following includes specific requirements based on Project size:

- a) Telemetry is required when the output of the Project entering the BPA Load Control Area is three MVA or greater: For this case, telemetry of real power and energy (kW, kWh), and reactive power (kVAr, kVArh) is normally required.
- b) For Projects below three MVA, BPA TBL determines telemetry needs on a case-by-case basis. Note that should an existing plant expand to over three MVA, telemetry is required for the entire plant output.
- c) Station service load may require separate telemetry if it comes from a different Load Control Area.

## 2. Data Requirements for Load Control Area Services

Data requirements for Load Control Area services, such as AGC, apply only to generation resources inside the BPA TBL Load Control Area, (that is: BPA is the Project's Host Load Control Area). For resources that are not part of BPA's Load Control Area, the operator of the Host Load Control Area determines the data requirements for Load Control Area services.

For generation resources inside BPA TBL Load Control Area, Ancillary Services, (e.g. reserves) must be acquired. Provision for all Ancillary Services are specified in the transmission contract. BPA TBL must specifically approve all arrangements for Projects intending to provide Ancillary Services to BPA TBL. If the Project is capable of providing Ancillary Services in excess of its obligation, then BPA TBL may choose to contract with the Project operator to provide additional Ancillary Services. Certification procedures conform to NERC Standards and should be portable to all control areas. This removes the need to re-certify Project capability.

The technical information below is included for general conceptual purposes only. Technical discussions are necessary before the specific implementation requirements can be determined. The AGC data to be passed over the data link may include some or all of the data quantities listed in Table 7-3. The list in Table 7-3 provides an example of the quantities necessary for a generation resource that is operating on full AGC regulation.

- a) If BPA TBL is purchasing AGC services from the Project, AGC control of the generator capability is required on a long-term basis. Prior to purchasing AGC services, a capabilities, cost, and benefit investigation as to the AGC control capabilities of the Project is required to determine the specific AGC requirements
- b) Ancillary Services requirements are also driven by how the Project operator or the purchaser chooses to meet the reserve obligations of the Project, as described below. Either the Project operator or the entity making the transmission arrangements is liable for the reserve obligations associated with the operation of the Project. The responsible party may fulfill these obligations in any of the following ways:
  - Make these reserves available to BPA TBL from the Project.
  - Make these reserves available to BPA from another one of their generation-resources.
  - Contract with another Project operator to make these reserves available to BPA on their behalf.
  - Contract with BPA to cover this reserve obligation.

## 3. Supervisory Control and Data Acquisition (SCADA) Requirements

Interconnection may require BPA TBL SCADA control and status indication of the power circuit breakers and associated isolating switches used to connect BPA TBL to the Project. SCADA indication of real and reactive power flows and voltage levels are also required. If the Project is interconnected directly to another utility's transmission system, SCADA control and status indication requirements shall be jointly determined among that utility, the Project Sponsor, and BPA. SCADA control of breakers and isolating switches that are located at the Generation Site is not normally required; however, status indication may be necessary. Section 8-C1 discusses telecommunications requirements for SCADA systems.

## **7-C. Generation Scheduling Requirements**

Scheduling and accounting of generation normally requires telemetered data, from the Project to the transmission control center of the Load Control Area operator. This data is termed Generation Metering/Telemetry by BPA and includes kW and kWh quantities. BPA TBL requires that all generation be pre-scheduled for each hour using the normal scheduling procedures. The end-of-hour actual generation must be conveyed each hour to the BPA TBL Hourly Accounting Desk (Numbers) in System Operations. This can be accomplished through the use of telemetry or data link.

### **1. Generation Metering Requirements**

Generation Metering generally consists of bi-directional meters and related communications systems providing kW and kWh at or near the Point of Interconnection. The kW measurement is telemetered on a continuous basis for AGC and hourly kWh is sent each hour to the Numbers accounting function. Telemetry is required when the generation is 3 MVA or greater and in the BPA Load Control Area. Telemetry is also required when BPA TBL is responsible for wheeling the output of a Project that is outside of the BPA Load Control Area.

All generation Projects in the BPA Load Control Area of 1 MVA or greater requires hourly pre-scheduling. BPA TBL may require indication of the number of units both available and on line. BPA TBL requires indication of the MW of spinning reserve available and the MW of reserve under control. (See Section 7-F for more information on reserves.)

Table 7-1 summarizes telemetry requirements and Table 7-2 identifies different scenarios that require telemetry. Generation metering accuracy and calibration requirements are identical with those stated in Sections 7-D2 and 7-D3 below.

### **2. Data Acquisition System**

Projects such as wind, tidal, geothermal, etc. require additional data to make generation scheduling more predictable. Such additional data may include, but not be limited to, ambient temperature, wind speed, solar index, pressure gradients etc. SCADA control may also be required. Specific requirements and needs are determined for each Project. Section 8-C3 discusses telecommunications requirements for telemetering and data acquisition.

## **7-D. Revenue or Interchange Metering**

All Projects one kW or greater require TBL-qualified Revenue and Interchange Metering and data recording for the TBL billing processes. Interchange Metering includes instantaneous power measurement (kW) and energy data (kWh) produced by revenue meters. The metering shall be located to measure the net power output from the Project to the BPA System, which is the Project generation, less the station service load and step-up or other losses.

Hourly kWh data is downloaded from the metering recorder on a daily basis over voice-grade telephone lines. All recorders must be fully compatible with the BPA TBL Billing Data Acquisition System. Demand data will be available to the Customer or their Agent. The hourly data will appear on the BPA TBL "Billing Information System" web site, typically by 0800 hours the following day.

### **1. Revenue and Interchange Metering Requirements for Billing Data**

Metering shall be bi-directional to record reactive flow to or from the Project as well as Generation out of the Project and Station Service (if any) from the transmission system into the Project.

The following assumes that BPA TBL supplies the metering.

**a) Generation less than 3 MVA**

If Generation kW/kWh telemetering is not needed, the following meters are used: a single Scientific Columbus JEM 10 meter (recording function is part of meter) or a single Scientific Columbus JEM 1 meter with external recorder (Process Systems Sentry 100, Aptech SSR 403 Solid State Recorder or equivalent).

NOTE: For generation Projects with an output under three MVA: If generation is added in the future and the total exceeds three MVA, the entire generation must then have Generation kW/kWh metering and telemetering.

**b) Generation More Than 3 MVA but less than 25 MVA**

Generation kW/kWh telemetering is required using a single Scientific Columbus JEM 1 with EXJ register and external recorder for billing. The EXJ register is required for the BPA kWh telemetering data system and the JEM 1 analog output provides the kW measurement.

**c) Generation over 25 MVA**

Redundant (primary and backup) Scientific Columbus JEM 1 meters with EXJ registers (for kW/kWh telemetering) and an external recorder (for Billing) are required.

Other meters will be considered, subject to BPA TBL approval, if the metering and telemetering functions are performed by an authorized non-BPA TBL party. Three-element, three-phase, four-wire meters shall be used on grounded power systems. Two-element, three-phase, three-wire meters can be used on ungrounded power systems.

Section 8-C4 discusses telecommunications requirements for the RMS system. Table 7-1 summarizes Revenue Metering requirements and Table 7-2 identifies requirements based on resource location.

## **2. Meter Accuracy**

Watt-hour meters shall be calibrated to  $\pm 0.1\%$  accuracy at unity power factor for both full load and light load. Watt-hour meters shall also be calibrated to  $\pm 0.3\%$  accuracy for 0.5 power factor at full load. VAR-hour meters shall have  $\pm 0.2\%$  accuracy at unity power factor and  $\pm 0.6\%$  accuracy at 0.5 power factor. Full load is defined as nominal voltage, 100% meter current rating. Light load is nominal voltage, 10% meter current rating.

## **3. Instrument Transformers**

Voltage and current instrument transformers shall be 0.3% accuracy class for both magnitude and phase angle over the burden range of the installed metering circuit. The instrument transformers shall be of a shielded design. This is a safety requirement to prevent unintentional energization of the transformer secondary during a transformer failure.

## **4. Loss Compensation**

Transmission system losses (such as transformer losses in the revenue metering process) often must be accounted for. BPA TBL prefers that this accounting be done as a calculated part of the TBL billing and settlement process. If the Project strongly desires that the loss compensation be performed in the meter rather than calculated, BPA will consider modifying the revenue metering to accommodate the request. However, compensation in JEM-1 meters will not be performed. (Compensation affects only the pulse integrator circuits, which disturbs the relationship between the direct analog outputs and the integrated pulse outputs).

## **5. Station Service Power**

Depending upon its electrical source and electrical location within the Project, station service power may also require Revenue Metering. It may not be necessary to meter station service VAR hours although most modern electronic meters include this feature as part of the meter. The other requirements of this section do apply to station service metering.

### ***7-E. Calibration of Revenue and Interchange Metering Facilities***

Revenue and Interchange Metering shall be calibrated every two years. More frequent calibration intervals may be negotiated. All interested parties or their representatives may witness the calibration tests. Calibration records shall be made available to all interested parties. The calibration standards used for calibration shall have their accuracy traceable to the National Institute of Standards and Technology, (NIST). The calibration standard shall have been calibrated and certified within twelve months prior to the actual meter calibration.

**Table 7-1 General Metering and Telemetry Requirements**

<b>BPA Data Requirements<sup>1</sup></b>			
<b>System or Quantity</b>	<b>System Dispatching and Operations</b>	<b>Transmission Scheduling</b>	<b>Revenue Billing</b>
kW	Yes	No	No <sup>2</sup>
kWh	Yes	Yes	Yes
kVAr	Maybe	No	No
kVArh	Maybe	No	Yes
kV	Yes	No	No
Number of Units	Number on Line Number Available	Number on Line Number Available	No
Resource Size	≥ 3 MVA <sup>1</sup>	≥ 1 MVA	≥ 1 kW
AGC	≥ 50 MVA	No	No
Data Sample Rate	1 Second or other approved rate compatible with NERC Policy	Last Hour kWh sent each hour	Hourly kWh Data Retrieved daily
Generation Reserves	Contingency non-spinning MW Contingency Spinning MW Regulating MW	Contingency non-spinning MW Contingency Spinning MW Regulating MW	No

## Notes

1. Requirements for projects below 3 MVA are determined on an individual basis.
2. A kW reading for revenue billing may be required where special transmission arrangements are necessary.

**Table 7-2 BPA TBL Metering and Telemetry Requirements vs. Project Location**

	<b>Project Located INSIDE BPA Load Control Area</b>	<b>Project Located OUTSIDE BPA Load Control Area</b>
<b>Direct Electrical Connection to BPA TBL System</b>	kW, kWh, RMS, kVAr, kVArh, kV breaker status & control	kW, kWh, RMS, kVAr, kVArh, kV breaker status & control
<b>NO Direct Electrical Connection to BPA TBL System</b>	kW, kWh, RMS	None

## Notes

1. Dedicated circuit required for: kW, kWh, kVAr, kVArh, kV
2. Dial-up phone line required for: RMS.

**TABLE 7-3 AGC QUANTITIES****a. BPA TBL to Plant**

1. Generation Request @ Rated Frequency Setpoint - AGC-requested power output level in MW for the following look-ahead time horizons: 0, 5, 10, 15, 20, 30 minutes.
2. Generation Requested Rate of Response.
3. Amount of Regulating Reserve to carry.
4. Generation Basepoint - The generation level in MW at which BPA TBL expects to be operating the plant at the end of the ramp.
5. Plant Control Mode - Regulating, Baseload, Standby, or Off Control
6. BPA TBL Operating Mode Indication to the Plant – Normal, Assist, Emergency
7. Bus voltage schedule in kV and actual measurement @ 115 kV or lower
8. Bus voltage schedule in kV and actual measurement @ 230 kV
9. Bus voltage schedule in kV and actual measurement @ 500 kV
10. BPA TBL AGC Control Center Identifier - Dittmer or Munro Control Center

**b. Plant to BPA TBL**

1. Plant in BPA Mode - BPA TBL AGC system enabled at the plant. Plant is controlling power output to meet the Generation Request and Generation Rate originating from BPA TBL, or
2. Plant in Local Mode - BPA TBL AGC system is disabled at the powerhouse. The powerhouse is not controlling its power output to meet Generation Request and Generation Rate originating from BPA TBL.
3. Net Instantaneous Power Output (MW)
4. Plant Output attributed to natural governor response (MW)
5. Plant Ramp Rate Capability – maximum raise and lower
6. Plant Jerk Rate Capability (rate of change of ramp rate) -- maximum raise and lower
7. Regulating Reserve Capability - during next 10-minutes
8. Spinning Reserve Capability - during next 10-minutes
9. Operating Reserve Capability - during next 10-minutes
10. Maximum Capability - Normal Conditions
11. Maximum Capability - Power System Emergency Conditions
12. Minimum Generation Capability
13. Unit PSS and AVR Status
14. Unit Status - Defined below for each generator unit in numerical order.
  - Out of Service - Unit NOT AVAILABLE for use on 10 minute's notice.
  - Standby Mode - Unit AVAILABLE for use on 10 minute's notice.
  - Standby Mode – Unit AVAILABLE for use within 60 minutes
  - ON-LINE / NOT On AGC Control
  - ON-LINE / On AGC Control
  - ON-LINE / CONDENSING
16. Total MVAR Output
17. Total Instantaneous Maximum MVAR Capacity Boost
18. Total Maximum MVAR Capacity Boost
19. Total Instantaneous Maximum MVAR Capacity Buck
20. Total Maximum MVAR Capacity Buck

## 8. Telecommunication Requirements

### 8-A. Introduction

Telecommunications facilities shall be tailored to fulfill the control, protection, operation, dispatching, scheduling, and revenue metering requirements. At a minimum, telecommunications facilities must be compatible with, and have similar reliability and performance characteristics to that currently used for operation of the power system to which the generation is being interconnected. Telecommunications facilities will be identified on the Project Requirements Diagram and, depending on the performance and reliability requirements of the control and metering systems to be supported they may consist of any or all of the following:

#### 1. Microwave systems

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

#### 2. Fiber-optic systems

A fiber-optic system requires light wave transmitters/receivers, communication fault alarm equipment, multiplex equipment, batteries, emergency power systems, fiber-optic cable (underground or overhead) and rights-of-way. Cable route redundancy may be required to protect against cable breaks and resulting communications outage.

#### 3. Wireline facilities

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

Dedicated telecommunication facilities are required for the operation of main grid power system control and protection functions. Main grid facilities are defined by the BPA Reliability Criteria for System Planning to be 500-kV, 345-kV and certain critical 230-kV facilities. Common carrier telecommunications are not considered acceptable for supporting main grid control and protection functions. However, for secondary transmission systems (other 230-kV and below), common carrier telecommunications alternatives may be considered, subject to reliability and availability requirements and capabilities.

### 8-B. Voice Communications

If the resource is within the BPA Load Control Area:

1. **Voice communications** to the Project Operator are required whenever any type of telemetry is required.
2. A **dedicated, direct, automatic ringdown trunk** (or equivalent) voice circuit between the appropriate BPA TBL dispatchers and the Project Operator is required for: Projects with 50 MW or greater output, or Projects that provide automatic generation dropping for BPA power system remedial action.
3. **Independent voice communications** for coordination of system protection, control, and communications maintenance activities between BPA TBL and the Project should be provided, in addition to the voice communications specified above.

### **8-C. Data Communications**

Communications for SCADA and Telemetry must function at the full performance level before, during and after any power system fault condition. Communications for RMS must function at the full performance level before and after any power system fault condition.

- 1. SCADA requirements** typically include one or more dedicated circuits between the Project and the appropriate BPA transmission dispatching center(s).
- 2. AGC Interchange and Control telemetering** for operations and scheduling applications typically require one or more dedicated circuits between the Project and the appropriate BPA transmission dispatching center(s). Digital telecommunications capabilities from 1200 to 2400 baud are required.
- 3. General Telemetry** for kWh and DAS typically require one or more circuits between the Project and the appropriate kWh or DAS master computer.
- 4. Revenue Metering System (MV-90)** remote equipment require commercial 'dial-up' telephone exchange line facilities to communicate with the MV-90 master computer at the Dittmer Control Center. The circuit used for this purpose may also be shared with voice communications and other dial-up data communications.

### **8-D. Telecommunications for Control & Protection**

Communications for Control and Protection must function at the full performance level before, during, and after any power system fault condition.

- 1. Main Grid Transmission Systems.** Projects interconnecting to the BPA Main Grid, and projects for which generation dropping is required for remedial actions on the BPA System, shall have redundant (i.e. hot-standby or frequency-diversity) telecommunications systems. Alternately routed communications circuits shall be used where feasible.
- 2. Secondary Transmission Systems.** Projects interconnecting to BPA secondary grid transmission may require redundant telecommunications systems.
- 3. Speed of Operation.** Throughput operating times of the telecommunications system must not add unnecessary delay to the clearing or operating times of protection or remedial action schemes. Maximum permissible throughput operating times of control schemes are determined by system studies.
- 4. Equipment Compatibility.** In order to provide maintainability and operability between the Project and the BPA System, teleprotection terminal equipment such as transfer trip units shall be functionally compatible. 'Tone' equipment must be of the same manufacturer and type. The need or implementation of peripheral capabilities such as signal counters, test switches, etc. are not required to be identical to those used at BPA facilities. BPA TBL prefers the use of terminal equipment that is the current BPA TBL standard for the control application. BPA TBL will acknowledge the use of alternative equipment and/or technologies as proposed by the Project Sponsor as long as the equipment is suitable for the purposes of the control application required.

## 9. Definitions

For industry standard definitions of electric industry terminology, please refer to:  
The New IEEE Standard Dictionary of Electrical and Electronic Terms,  
IEEE Std 100-1992.

For Bonneville Power definitions of electric utility terminology, please refer to:  
BPA Definitions, December 1993, available through BPA's Document Request Line by  
calling (800) 622-4520.

For the purposes of this document the following definitions apply:.

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

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

**Automatic Generation Control (AGC) System** - A system that measures instantaneous loads at interchange points (boundaries with adjacent Load Control Area) and adjusts generation to follow load. It consists of continuous, real time load signal (kW) from the site, telemetered to AGC computers at a transmission control center. At BPA TBL this would require connection to the microwave system.

*NERC Definition: Equipment which automatically adjusts a Load Control Area's generation from a central location to maintain its interchange schedule plus frequency bias.*

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

**Bonneville Power Administration Transmission System (BPA System)** - The transmission facilities owned or controlled by BPA's Transmission Business Line (BPA TBL).

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

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

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

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

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

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

**Generation Site** - The geographical location of the Project generator(s) and local generator equipment. This may be near or far from either the Point of Interconnection or the Interconnecting Substation.

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

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

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

**Interconnecting Substation** - Normally the substation closest to the Point of Interconnection which contains the step-up transformer and feeder breakers. This substation may be owned by BPA TBL, the Project, or an Interconnecting Utility.

**Interconnecting Utility** - The utility that owns the transmission or distribution system that connects the Project to the BPA System at the Point of Interconnection.

**Intertie Point** - Connects electrical regions together such as Northwest to California or Canada, or east-side generation to west-side load. These connections can be entirely inside the BPA System and not metered at all, or can be interchanges with other Load Control Areas (with interchange metering). Not all interchanges are interties.

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

**kWh System (Kilowatt Hour System)** - Provides interchange point hourly data *each hour* (as compared to RMS system that reports hourly load data each day). Requires connection into BPA microwave system. Old system provides bi-directional kWh; new system (presently being installed to replace old one) will also provide bi-directional reactive. kWh data is used to verify hourly schedules.

**Load Control Area** - 1. The electrical (not necessarily geographical) area within which a controlling utility has the responsibility to adjust its generation to match internal load and power flow across interchange boundaries to other Load Control Areas. 2. A resource or portion of a resource that is scheduled by a specific utility. If the utility schedules the resource, the resource becomes part of its Load Control Area. Physical location of the Project does not determine its Load Control Area.

**WSCC Definition:** *A system which regulates its generation in order to maintain its interchange schedule with other Load Control Areas and contributes its frequency bias obligation to the interconnection.*

**Main Grid** - As presently defined by the BPA Reliability Criteria and Standards, BPA's Main Grid transmission facilities include all 500-kV lines, 345-kV lines, 500-kV substations, 500/230-kV transformers, 345/230-kV transformers, four 230-kV lines and one 230-kV substation bus.

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

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

**Non-Synchronous Generators** - Power-generating equipment that uses induction machines or dc-to-ac conversions.

**Operating Reserve** - That reserve above firm system load capable of providing for regulation within the hour to cover load variations and power supply reductions. It consists of spinning reserve and non-spinning reserve. (WSCC)

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

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

**Point of Interconnection (POI)** - The physical location on the power system of the change of ownership between BPA TBL and the Project or BPA TBL and an Interconnecting Utility. This may be at a different location than the Generation Site.

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

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

**Power System Stabilizer (PSS)**- A device that provides an additional input to the exciter of a machine to provide damping of power system oscillations and improve system stability.

**Project** - The generator and all equipment associated with the integration of a generation resource, up to the Point of Interconnection with BPA TBL.

**Project Requirements Diagram (PRD)** - A BPA TBL simplified drawing showing the electrical interconnection and integration of a new project to the BPA System.

**Project Operator** - The company that operates a generating resource.

**Project Sponsor** - A company that owns and/or develops a new generating resource.

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

**Reactive Power** - The component of total volt-amperes in an alternating current circuit where the voltage and current are out of phase by ninety electrical degrees. It is measured in units of volt-amperes reactive (VAr), kVAr or MVAR. It represents the power involved in the alternating exchange of stored energy in inductive and capacitive electromagnetic fields. Although this type of power supplies no useful energy, it is an inherent requirement for all alternating current power systems. By convention, positive reactive power is 'absorbed' by an inductance and 'generated' by a capacitance. Reactive power transferred over time is measured in VAr-hours (VArh). See power factor.

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

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

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

**Remedial Action Scheme (RAS)** - - A protection system that automatically initiates one or more remedial actions. Also called 'Special Protection System.' (WSCC)

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

**Revenue Metering System (RMS)** - Provides hourly data *daily* (as compared to kWh system that reports hourly load each hour). Meter/Recorder is installed at points where billing quality data is required. Consists of kW and kVAr metering (bi-directional for POIs). Meter/Recorder stores kWh and kVArh data on a hourly basis. Data is retrieved over dial-up (voice grade) telephone lines by the MV-90 system located at Dittmer Control Center. The MV-90 system automatically polls the meter/recorder every morning beginning at 0001 am. The MV-90 system can also be forced to poll a remote at any time through dial-in-terminal ports available to BPA TBL personnel.

**Single Pole Switching (SPS)** - The practice of tripping and reclosing one pole (phase) of a multipole circuit breaker without changing the state of the remaining poles. Tripping is initiated by single-pole relays that respond selectively to the faulted phase. Notes: 1) Circuit breakers used for single pole switching must inherently be capable of independent pole opening. 2) In most single pole switching schemes it is the practice to trip all poles for any fault involving more than one phase. (IEEE)

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

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

**Supervisory Control and Data Acquisition (SCADA)** A system of remote control and telemetry used to monitor and control the transmission system. (NERC)

**Telemetry** - Continuous, real time data reporting, as for AGC and Generation kW (but not for kWh or RMS Systems, which are not continuously reported).

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

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

## 10. References

- **Applicable State and Local Codes**
- **Bonneville Power Administration - *BPA Definitions***, December 1993 - DOE/BP 2279
- **Bonneville Power Administration - *Accident Prevention Manual (APM)*** - DOE/BPA I-9326
- **Bonneville Power Administration - *Reliability Criteria and Standards*** - DOE/BP I-9113
- **Bonneville Power Administration – *AGC Requirements Document***
- **ANSI/IEEE Std 80 - *Guide for Safety in AC Substation Grounding***
- **ANSI/IEEE Std 665 - *Guide for Generating Station Grounding***
- **IEEE Std 100 - *IEEE Standard Dictionary of Electrical and Electronic Terms***,.
- **IEEE Std 421.4 - *IEEE Guide for the Preparation of Excitation System Specifications***
- **IEEE Std 519 - *IEEE Recommended Practices and Requirements for Harmonic Control in Electrical Power Systems***
- **IEEE Std 81 Part 1 - *Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Ground System* & **Part 2: *Guide for Measurement of Impedance and Safety Characteristics of Large, Extended or Interconnected Grounding Systems.*****
- **IEEE - 487 - *Recommend Practice for the Protection of Wire-Line Communication Facilities Serving Electric Power Stations***
- **IEEE - 837 - *Standard for Qualifying Permanent Connections Used in Substation Grounding***
- **NESC C2 - *National Electrical Safety Code***
- **National Environmental Policy Act - 42 U.S.C. & 4321 et seq.**
- **NERC Operating Standards**
- **NERC Planning Standards**
- **NWPP Operating Manual**
- **Uniform Building Code**
- **WSCC Reliability Criteria including:**
  - Reliability Criteria for System Design*
  - Power Supply Design Criteria*
  - Minimum Operating Reliability Criteria.*

BPA F 6420.24

Electronic Form

**U.S. DEPARTMENT OF ENERGY  
 BONNEVILLE POWER ADMINISTRATION  
 TRANSMISSION BUSINESS LINE  
 INTERCONNECTION STUDY REQUEST**

**WHO SHOULD FILE THIS APPLICATION:**

*Any customer expressing an interest in interconnecting generation. This application should be completed as soon as possible and returned to the BPA Account Executive in order to begin processing the request.*

**INFORMATION:**

*This application will be used by the Bonneville Power Administration to perform Preliminary and Detailed Interconnection Studies to determine the Interface requirements at the customer's Point of Interconnection. The applicant should attempt to fill in as much of the form as possible. The applicant will receive a preliminary estimate for the utility interface requirements that may be used in calculating the overall Project requirements.*

**OWNER/PROJECT SPONSOR INFORMATION**

Owner of Project		Project Sponsor	
Company		Company	
Contact		Contact	
Mailing Address:		Mailing Address:	
City/State/ 9 Digit Zip Code		City/State/ 9 Digit Zip Code	
Phone Number		Phone Number	

**PROJECT DESIGN/ENGINEERING ARCHITECT (As applicable)**

Company			
Mailing Address			
City	County	State	9 Digit Zip Code
Phone Number	Contact		

**ELECTRICAL CONTRACTOR (As applicable)**

Company			
Mailing Address			
City	County	State	9 Digit Zip Code
Phone Number	Contact		

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(Page 2)

<b>GENERATOR DATA</b>				
Manufacturer (If available)			Model:	
<b>TYPE</b>				
Synchronous	Induction	Phases: Single	Three	Frequency (Hz)
Rated Output:		Kilowatts	Kilovolt-Ampere	
Rated Power Factor		% Rated Voltage	Volts Rated Amperes:	Amps
Energy Source (Gas, Hydro, Wind, Co-Gen., Geothermal, etc.):				
Plant Load (Auxiliaries)			kW	KVAR
Net Maximum Power to BPA			kW	KVAR
Operating Dates and Capacity:			kW	Date
Ultimate Output (Max.)			kW	Date
Estimated Peak and Energy Production (Ultimate Output)				
January			peak kw	kwh
February			peak kw	kwh
March			peak kw	kwh
April			peak kw	kwh
May			peak kw	kwh
June			peak kw	kwh
July			peak kw	kwh
August			peak kw	kwh
September			peak kw	kwh
October			peak kw	kwh
November			peak kw	kwh
December			peak kw	kwh
<b>PROJECT LOCATION</b>				
STATE		COUNTY	NEAREST COMMUNITY	
TOWNSHIP		RANGE	SECTION	
STREET ADDRESS				
DATE			SIGNATURE	
NAME (Please Print or Type)			TITLE	
<b>**ATTACH MAP SHOWING PROJECT BOUNDARIES AND SUBSTATION LOCATION **</b>				

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(Page 3)

**ELECTRICAL AND SYNCHRONOUS MACHINE INFORMATION**

1. **Electrical One-Line Diagram** of the generation Project that includes proposed protective relaying, breaker and switching arrangements, ground sources (zero sequence), ground resistance (Project to remote earth), and assumed line parameters for and Project tie lines.

2. **Shunt capacitors** associated with the Project for power factor correction.

3. <b>Step-up transformer</b> nominal voltage [	kV	impedance [	% @	kVars
MVA rating(s) [	MVA],	the electrical configuration (e.g., delta-wye) [		MVA],
and taps and tap range [				].

4. **Station service load** (both kW and KVAR) and the type of load (e.g., 70% motors and 30% heating).

	kW	kVa	Load
--	----	-----	------

5. The following machine data:

MVA	Machine base rating on which the data is on (for each unit)
KV	Rated KV
P.F.	Power factor of machine
H	Inertia constant of the machine, MW-sec./MVA
Ra	Armature resistance, pu
Xd	Direct axis unsaturated synchronous reactance, pu
Xq	Quadrature axis unsaturated synchronous reactance, pu
X'd	Direct axis unsaturated transient reactance
X'q	Quadrature axis unsaturated transient reactance
X''d	Direct axis unsaturated subtransient reactance
Xl	Stator leakage reactance
T'do	Direct axis transient open circuit time constant, sec
T'qo	Quadrature axis transient open circuit time constant, sec
T''do	Direct axis subtransient open circuit time constant, sec
T''qo	Quadrature axis subtransient open circuit time constant, sec
P max	Maximum power output of the turbine in MW
S(1.0)	Machine data at 1.0 per unit of rated voltage
S(1.2)	Machine data at 1.2 per unit of rated voltage

6. The type of exciter, block diagram, and parameters in IEEE, PTI or WSCC format.

7. The type of power system stabilizer, block diagram and parameters in IEEE, PTI, or WSCC format.

8. The type of governor and turbine, block diagram and parameters in IEEE, PTI or WSCC format.

9. The turbine frequency versus time operation limits.

To be filled out by the BPA Transmission Account Executive:

Transmission Account Executive	Region
Internal Routing	Phone Number

Copy of Interconnection Study Request and Attachments to:

- Transmission Planning Manager - TOP
- System Protection Manager - TNC
- Customer Service Engineering - TOC

Exhibit C, Page 1 of 1  
Contract No. DE-MS79-93BP93956  
Procurement No. 56701  
Fourmile Hill Geothermal Project  
Effective at 2400 hours on  
the Effective Date

### REFERENCED DOCUMENTS

1. Pacific Northwest Electric Power Planning and Conservation Act, 16 U.S.C. § 839
2. National Environmental Policy Act of 1969, 42 U.S.C. § 4321 et seq.
3. Record of Decision for Fourmile Hill Geothermal Project on Federal Leases CA21924 and CA21926; Department of Interior, Bureau of Land Management, Alturas Field Office; Department of Agriculture, U.S. Forest Service, Klamath National Forest, Modoc National Forest; Siskiyou and Modoc Counties, California; issued May 31, 2000.
4. Memorandum of Agreement entered into as of April 10, 2000, between Calpine Corporation and Shasta and Upper Klamath River Canyon Tribes, together with any agreements entered into by Calpine Corporation and the Shasta and Upper Klamath River Tribes in connection therewith.
5. Memorandum of Agreement entered into as of November 11, 1999, between Calpine Corporation and the Klamath Tribes, together with any agreements entered into by Calpine Corporation and the Klamath Tribes in connection therewith.
6. Prompt Payment Act, 31 U.S.C. §§ 3901 et seq.

Exhibit D, Page 1 of 3  
Contract No. DE-MS79-93BP93956  
Procurement No. 56701  
Fourmile Hill Geothermal Project  
Effective at 2400 hours on  
the Effective Date

## **DESCRIPTION OF PROJECT AND INTERCONNECTION FACILITIES**

The Fourmile Hill Geothermal Project (Project) consists of a powerplant and related facilities, including, but not limited to, related land leases, easements and rights-of-way; engineering and design documents; all energy producing equipment and auxiliary equipment, including well field and pipelines; and all generation plant related equipment either installed or to be installed on Seller's side of the Point of Interconnection.

### **Location.**

The Project is located in the Fourmile Hill Project Area, in Siskiyou County, California. The Project Area consists of the Federal geothermal leases shown in Table 1 of this Exhibit.

The powerplant is expected to be located in Section T.44N.R.3E Section 28, on Federal Lease No. CA-21926.

### **Point of Delivery**

The Point of Delivery is at the Point of Interconnection.

### **Point of Interconnection**

The Point of Interconnection is on Bonneville's Malin-Warner 230-kV transmission line near Perez, California.

### **Interconnection Facilities**

Interconnection facilities consist of approximately 24 miles of 230 kV transmission line and related equipment connecting the Project to Bonneville's Malin-Warner 230 kV transmission line near Perez, California, as shown in Figure 3 of this Exhibit.

Exhibit D, Page 2 of 3  
 Contract No. DE-MS79-93BP93956  
 Procurement No. 56701  
 Fourmile Hill Geothermal Project  
 Effective at 2400 hours on  
 the Effective Date

**TABLE 1  
 FOURMILE HILL PROJECT AREA**

	<b>Lease Number</b>	<b>Property Description</b>	<b>Calpine Net Acres</b>
1.	CACA 21924	T44N-R3E Section 15: All Section 16: All Section 21: All Section 22: All	2560
2.	CACA 21925	T44N-R3E Section 13: All Section 14: All Section 23: All	1,920
3.	CACA 21926	T44N-R3E Section 28: All Section 29: All Section 30: All	1,920
4.	CACA 39724	T44N-R3E Section 32: All	640
5.	CACA 6111	T44N-R3E Section 33: All	640
6.	CACA 21929	T44N-R3E Section 5: All	640
7.	CACA 39728	T44N-R3E Section 4: N/2, SW/4	480
8.	CACA 39724	T44N-R3E Section 27: W/4	160
<b>TOTAL</b>			<b>8,960</b>

Exhibit D, Page 3 of 3  
Contract No. DE-MS79-93BP93956  
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**Placeholder Page  
for  
Figure 3  
Interconnection Facilities**

Exhibit E, Page 1 of 2  
Contract No. DE-MS79-93BP93956  
Procurement No. 56701  
Fourmile Hill Geothermal Project  
Effective at 2400 hours on  
the Effective Date

**Contract No. DE-MS79-93BP93956**  
**Calpine Siskiyou Geothermal Partners, L.P.**  
**Fourmile Hill Geothermal Project**

Directions: Photocopy and complete the following information.

**1. IDENTIFICATION OF SELLER**

Full name and address (include complete mailing address)

**TAX IDENTIFICATION NUMBER:**

**2. SELLER BANK IDENTIFICATION**

Full name and address of Seller's bank

Bank account number	American Bankers Association 9-digit routing number
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**3. PAYMENT**

Total payment requested from Page 2 of this Exhibit E \$ \_\_\_\_\_

**4. CERTIFICATION BY SELLER**

Acting as a duly authorized representative of Seller, I hereby certify that the information contained in this Exhibit E and the amount requested on this invoice is true, correct and complete.

\_\_\_\_\_  
Signature  
\_\_\_\_\_  
Title  
\_\_\_\_\_  
Date

Exhibit E, Page 2 of 2  
Contract No. DE-MS79-93BP93956  
Procurement No. 56701  
Fourmile Hill Geothermal Project  
Effective at 2400 hours on  
the Effective Date

**MONTHLY PAYMENT CALCULATION AND INVOICE FORMAT**

**Contract No. DE-MS79-93BP93956**  
**Calpine Siskiyou Geothermal Partners, L.P.**  
**Fourmile Hill Geothermal Project**

**Month for Which Payment is Requested**

Beginning Date \_\_\_\_\_

Ending Date \_\_\_\_\_

**Metered Energy Payment**

1.	Metered Energy	_____	kWh
2.	Line Losses	_____	%
3.	Line Loss Deduction (1 - Line 2)	_____	%
4.	Purchase Price	\$ _____	\$/kWh
5.	<b>Output Payment</b> (Line 1 x Line 3 x Line 4)	\$ _____	
6.	Adjustments (see explanation below)	\$ _____	
7.	<b>Total Payment Requested</b> (Line 5 +/- Line 6)	_____	

## **PURCHASE PRICE**

The Purchase Price shall be the sum of the Fixed Component and Indexed Component as each is defined below:

1. **FIXED COMPONENT**

Commencing at 0000 hours on the Commercial Operation Date and continuing for the term of this Agreement, the Fixed Component of the Purchase Price shall be \$0.031 per kilowatt-hour.

2. **INDEXED COMPONENT**

Commencing at 0000 hours on the Commercial Operation Date and continuing to 0000 hours on January 1 of the following year, the Indexed Component of the Purchase Price shall be equal to \$0.0211 per kilowatt-hour. On January 1 of the year following the Commercial Operation Date, and on each January 1 thereafter during the term of this Agreement, the value of the Indexed Component shall be adjusted by multiplying it by the percentage change from the previous year in the Gross Domestic Product Implicit Price Deflator (GDPIP). The GDPIP shall be as published by the Bureau of Economic Analysis of the U.S. Department of Commerce in the table of Implicit Price Deflators for Gross Domestic Product or its successor. [The GDPIP is published on a quarterly basis in arrears. The adjustment for the first quarter of a calendar year may need to occur after the fact.]

The value for the Fixed Component, and the initial value for the Indexed Component, are based on the assumption that the Commercial Operation Date will occur in calendar year 2001. If the Commercial Operation Date occurs after December 31, 2001, then the value for the Fixed Component, and the initial value of the Indexed Component, shall be adjusted by the percentage change in the GDPIP as described in the previous paragraph.

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 Contract No. DE-MS79-93BP93956  
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The following is for illustrative purposes only. The actual values of the Indexed Component and Total Cost will change after the first year.

Calendar Year	Fixed Component (mills/kwh)	Indexed Component (mills/kwh)	TOTAL COST (mills/kwh)
2001	31.0	21.1	52.1
2002	31.0	21.7	52.7
2003	31.0	22.4	53.4
2004	31.0	23.1	54.1
2005	31.0	23.7	54.7
2006	31.0	24.5	55.5
2007	31.0	25.2	56.2
2008	31.0	26.0	57.0
2009	31.0	26.7	57.7
2010	31.0	27.5	58.5
2011	31.0	28.4	59.4
2012	31.0	29.2	60.2
2013	31.0	30.1	61.1
2014	31.0	31.0	62.0
2015	31.0	31.9	62.9
2016	31.0	32.9	63.9
2017	31.0	33.9	64.9
2018	31.0	34.9	65.9
2019	31.0	35.9	66.9
2020	31.0	37.0	68.0