TECHNICAL REQUIREMENTS FOR INTERCONNECTION TO THE BLACK HILLS POWER TRANSMISSION SYSTEM

Version 1.1
May 8, 2007

Transmission Planning Department

Revisions

Rev. No.	Date	Description	By	Approval
1.0	8/10/06	New Document	EME	MJF
1.1	5/8/07	Updated to expand on items included in FAC-001-0.	EME	VAC

TABLE OF CONTENTS

(This page left blank intentionally.)

1. INTRODUCTION

Black Hills Power (BHP) is a public utility that was formed in 1941 through the consolidation of several smaller electric suppliers in the Black Hills of South Dakota. BHP is part of the Black Hills Corporation family headquartered in Rapid City, SD. BHP currently owns and operates transmission and sub-transmission facilities in the states of South Dakota, Wyoming and Montana. These facilities provide service to over 50,000 residents in 10 counties and 20 communities.

BHP's transmission network involves facilities energized at 230 kV and operated as an interconnected electrical system. BHP also operates an extensive sub-transmission network energized at 69 kV. The BHP transmission system is operated as a part of the Western Interconnect electrical network and is located on the eastern edge of the Western Interconnection. The Western Interconnection spans the entire western half of the United States. BHP is a member of the Western Electricity Coordinating Council (WECC), one of ten NERC Reliability Councils. The WECC region encompasses all or parts of fourteen western states, two Canadian Provinces and the northern portion of Baja California.

BHP's 230 kV transmission facilities are incorporated into the CUS Tariff along with facilities owned by Basin Electric Power Cooperative (BEPC) and Powder River Energy Corporation (PRECorp). The CUS transmission facilities are operated as a single system.

BHP's sub-transmission facilities are operated at 69 kV and function as a radial power delivery system to provide for retail customer load. However, interconnection to BHP's 69 kV sub-transmission system can have an effect on system performance and reliability and therefore must meet the requirements set forth in this document.

2. PURPOSE

This document was developed to describe the general requirements for interconnection with the BHP transmission system. This document provides an overview of the technical and reliability requirements to address interconnection requests. The interconnections include facility additions and modifications to accommodate generation, transmission and end-user load facilities which are being connected to or planned to be connected to the BHP transmission system.

These requirements were established to promote safe operation, system integrity, reliability and compliance with national and regional Planning & Operating Standards. These requirements are considered a minimum to be used as a guide toward processing of interconnection requests by BHP. This document sets forth the minimum requirements for interconnection with BHP's transmission facilities.

There may be additional requirements by BHP depending upon the location and scope of the proposed interconnection. The steps outlined in the interconnection process may be further streamlined when BHP deems appropriate.

Interconnection is a separate process to the transmission service request process set forth in the CUS Open Access Transmission Tariff (CUS Tariff). Additionally, interconnection of large generators (> 20 MW) must follow the process set forth in Attachment L of the CUS Tariff. All requirements set forth in the CUS Tariff (agreements, schedules, studies, notification, etc.) with regards to interconnection of facilities supersede all similar requirements outlined in this document. For any conflicting requirements between the CUS Tariff and this document, the more restrictive technical requirement shall be used.

3. GENERAL INTERCONNECTION REQUIREMENTS

All requests for interconnection to the BHP transmission system must be consistent with regional reliability requirements and standard utility practices. A proposed interconnection must not degrade the reliability or operating flexibility of the existing transmission system. BHP assumes responsibility to operate and maintain its interconnected facilities in accordance with regional Planning and Operating standards. System Impact Studies may be required to evaluate the impact of the requested interconnection and alternative plans to meet established reliability criteria. A Facilities Study will be required to determine the detailed facility interconnection requirements. The Facilities Study will address direct assignment facilities, network upgrades, cost estimates and construction scheduling estimates.

All arrangements for system studies, engineering design, construction, ownership, operations, maintenance, replacement equipment, metering, facility controls and telecommunications must be set forth in written contracts between BHP and the Requestor. If additional equipment or replacement equipment is required to accommodate the facility interconnection, BHP will retain equivalent transmission capacity and operational control as previously existed. The cost associated with equipment modifications is the responsibility of the Requestor. BHP reserves the right to participate in the costs of proposed projects that may be accommodated through mutually advantageous alternatives which provide substantial benefits to regional reliability or transmission transfer capability.

The Requestor will generally be responsible for obtaining any necessary right-of-way or easements from landowners. All costs associated with environmental activities for the new facility will be the responsibility of the Requestor. Advance funds or deposits will be required by BHP prior to any work being performed.

A direct interconnection into BHP's transmission system does not guarantee transmission capacity on the BHP system. Transmission service requests must be made in accordance with the CUS Tariff. The CUS Tariff and the requirements to become a transmission customer are posted on the Open Access Same-Time Information System (OASIS) and BHP's website at www.blackhillspower.com.

4. INTERCONNECTION PROCESS

Each request for interconnection is evaluated on a case-by-case basis and is subject to meeting reasonable needs of the Requestor. BHP assumes responsibility to operate its interconnected facilities.

Direct interconnection to BHP's facilities does not involve nor guarantee transmission capacity on BHP's system. Transmission Service and Large Generator (> 20 MW) Interconnection requests must be made in accordance with the CUS Tariff. The CUS Tariff may be furnished to the entity requesting interconnection. It is also posted on the CUS Open Access Same-Time Information Systems (OASIS). Transmission Service and Large Generator Interconnection request review is a separate process from interconnection request review outlined below, though for efficiencies some steps are shared. An additional parallel process, land acquisition, is discussed in more detail later in this document.

For requests which are not required to proceed through the Tariff process, there are six general steps in the interconnection process. Within legal and technical parameters, the steps in this process may be modified by BHP on a case-by-case basis depending upon the specific circumstances of the requested interconnection.

4-A Interconnection Application

Requesting entities are encouraged to discuss proposed projects with a representative at the BHP office in which the interconnection will occur (see Appendix C, BHP Points of Contact). Discussion, and subsequent review of the request by BHP, will help BHP determine what studies are necessary.

After initial contact, BHP will provide interconnection related information, including BHP's *Technical Requirements for Interconnection* (this document) and other supporting safety and operations information as needed.

Formal requests for interconnection should be submitted 12 months in advance of when the equipment or construction specifications are to be issued for bid. Such lead time allows BHP to develop a proposed plan and designs and specifications for BHP owned, operated and maintained facilities, as well as to review line taps owned by others.

BHP may take up to 60 days to process the interconnection request unless a more restrictive time frame is specified by a parallel process.

When submitting an interconnection request to BHP, the Requestor should provide as much information as possible to help expedite the design and review process.

The application for interconnection does not pertain to transmission service,

which uses a separate application. Concurrent requests for transmission will share certain steps where appropriate, but are conducted under separate BHP authorities. For transmission application information, see the CUS Tariff.

If BHP denies the request for interconnection, a summary of reasons will be provided, and BHP will make every reasonable effort to support the Requestor in revising the request, as applicable.

4-B System Impact Study

If determined necessary, BHP will conduct a System Impact Study (SIS). The study will assess the capability of the transmission system to support the requested interconnection, including any special studies necessary to evaluate the need to offset potential BHP operating issues.

If necessary, within 60 days of receiving the Requestor's application for interconnection, BHP will provide a System Impact Study Agreement in which the Requestor agrees to advance funds for BHP to perform the study. The Requestor must sign and return the agreement to BHP within 15 days or the request is deemed withdrawn.

BHP will make every effort to complete the SIS within 60 days of agreement execution. The study will identify system constraints and any necessary additional direct assignment facilities and network upgrades.

Once the SIS is complete, a report will be developed and provided to the Requestor for review. If BHP determines that the requested interconnection may impact a neighboring system, BHP will notify the neighboring system of the requested interconnection and provide them a copy of the SIS report for their review and comment.

4-C Facilities Study and Design

A Facilities Study is necessary to determine upgrades or modifications needed at the point of interconnection to accommodate the requested interconnection. Within 30 days of completion of the SIS, BHP will provide a Facilities Study Agreement in which the Requestor agrees to advance funds for BHP to perform the study. The Requestor must sign and return the agreement to BHP within 15 days or the request is deemed withdrawn.

Upon receipt of a signed Facilities Study Agreement, BHP will notify neighboring systems, the Western Electric Coordinating Council (WECC) and the Rocky Mountain/Desert Southwest Reliability Coordinator (RDRC) of all new and/or modified facilities as a result of the interconnection request.

BHP will make every effort to complete the facilities study within 60 days of agreement execution. The study will include estimates of the cost of facilities design and construction as well as the time required to complete design and construction.

Once the facilities study is complete, a report will be developed and provided to the Requestor for review.

4-D Land Acquisition

Upon completion of the facilities study, negotiations for any necessary land rights begin. Negotiations should be complete and the land rights obtained prior to the start of construction. Requesting entities are required to advance funds for BHP to conduct the necessary land acquisition activities.

BHP will, unless otherwise agreed to by BHP and the Requestor, perform all land acquisition activities.

4-E Design and Construction

Once the Facilities Study is complete, BHP will tender a Construction Agreement to the Requestor. The Requestor has 30 days to sign and return the Agreement to BHP and provide advance payment. BHP cannot continue without funding in place.

BHP will, unless otherwise agreed to by BHP and the Requestor, design the interconnection. BHP will also, unless otherwise agreed to by BHP and the Requestor, perform all construction.

4-F Interconnection Agreement

Once construction has been completed—and before energizing the new interconnection—BHP will review and test the new facilities. BHP will use prudent utility practice in both review and testing.

Before energizing, BHP must also receive the appropriate as-built drawings, operating instructions and other relevant materials.

When the facilities are found to be in conformance with BHP's requirements, BHP will tender an Interconnection Agreement to the interconnecting entity. The Interconnection Agreement provides for the long-term operation and maintenance of the interconnected facilities. The Interconnection Agreement generally includes sections on licensing, maintenance, operations, special instructions, and funding, as applicable. When to the benefit of BHP and the interconnecting entity, the Interconnection Agreement may be tendered at the same time as the earlier Construction Agreement.

The interconnected facilities may be energized following execution of the Interconnection Agreement. If BHP does not maintain direct control of the facilities, then BHP will maintain backup control of all facilities deemed to be vital to system reliability.

5. FUNDING REQUIREMENTS

All BHP costs associated with the interconnection request are the responsibility of the Requestor. Advance funds are required before BHP performs any studies, design, land acquisition or construction. The contractual agreements will specify the amount of funds required to be advanced. Upon receipt by BHP, advance funds will be placed in a cost account for the project. Periodic cost statements will be furnished as studies and work progress.

5-A Application Processing Fee

Application processing fees apply only to transmission-related interconnection requests, as part of the transmission services request process. The application processing fees and requirements for all transmission service-related requests are as defined in the CUS Tariff. There is no application fee for non-transmission-related interconnections.

5-B System Impact Study Fee

A System Impact Study Agreement will be executed between BHP and the Requestor which will clearly specify BHP's estimate of the actual cost of the system impact study. The charge will not exceed the actual cost of the study. Requesting entities will not be assessed a charge for existing system studies when they are applicable, but the Requestor will be responsible for charges associated with any modifications to existing planning studies that are reasonably necessary to evaluate the entity's request. Funding is required after the System Impact Study Agreement is signed and before the System Impact Study is performed.

5-C Facilities Study Fee

A Facilities Study is necessary to evaluate the costs required to implement the requested interconnection, as well as mitigate any identified system impacts. Once a Facilities Study Agreement is executed between BHP and the Requestor, the Requestor will advance funds to BHP for performing the study. The Facilities Study fee is determined on a case-by-case basis.

5-D Land Acquisition Funding

Advance payment to BHP by the Requestor is required for BHP to perform any land acquisition activities. Costs are based on historical or set expenses for similar projects, are specifically determined on a case-by-case basis by BHP, and will not exceed the actual costs for acquiring land. Advance funding for land acquisition may be secured contractually through the System Impact or Facilities Study Agreements, and/or through the Construction Agreement.

5-E Facilities Design and Construction

The facilities study performed by BHP will include a good faith estimate of (1) the cost of direct assignment facilities to be charged to the Requestor and (2) the Requestor's appropriate share of the cost of any required network upgrades. The Requestor will pay its share of the costs of new facilities or upgrades, including design, before BHP can begin or allow construction. When the facilities study is complete and presented to the Requestor, the entity has 30 days to sign and return to BHP a Construction Agreement and provide the advance payment. If the construction of new facilities would require the expenditure of BHP funds, BHP reserves the right to halt construction until funds for construction are appropriated.

5-F Equipment Replacement

Should replacement of existing equipment be required, the equipment will be removed and replaced at the sole expense of the Requestor. However, BHP, at its sole discretion and option, may:

A. Participate in the costs of the proposed project; and/or
B. Allow ownership of replaced BHP equipment to be transferred to the Requestor in exchange for transfer of ownership of the new equipment to BHP.

The Requestor would then receive a contract right for the incremental capacity in the new equipment.

5-E Facilities Operation and Maintenance

The Interconnection Agreement or other agreement will set forth funding required by the interconnecting entity, if any, for long-term operations and maintenance associated with the interconnection.

5-E Excess Payments

Any advance payment made by the Requestor in excess of the actual costs incurred by BHP will be refunded, without interest.

6. RELIABILITY REQUIREMENTS

Interconnection to BHP's transmission facilities will be consistent with BHP's mission, CUS Tariff (when applicable) and prudent utility practices. A proposed interconnection must not degrade the reliability or operating flexibility of the existing power system, and must meet the North American Electric Reliability Council's (NERC) *Planning Standards* and *Operating Manual* procedures and all applicable Western Electrical Coordinating Council (WECC) policies and procedures. When involving BHP owned, operated and maintained facilities, the interconnection must also comply with BHP Engineering department standards. Additionally, the interconnection must adhere to any Independent System Operator reliability criteria in effect.

The interconnecting entity will be responsible for testing and reporting requirements in accordance with applicable NERC *Planning Standards,* WECC *Reliability Management Standards,* or any similar standards of a successor organization to either NERC or WECC.

7. LAND AQUISITION REQUIREMENTS

Land acquisition is a process that can begin as soon as the Application for Interconnection is received—initiating research of property ownership—and continue through other interconnection process steps with appraisals, preparation of legal descriptions, and title search. The process may extend through the completion of construction. Typically, negotiations between BHP, the interconnecting entity, and/or affected landowners begin prior to construction.

If the interconnecting facilities are to be owned by BHP, than any new land rights necessary for the interconnection must be owned by BHP. BHP typically conducts all land acquisition activities, including appraisals, legal descriptions, title evidence, negotiations, title clearance, recordation, and payment. Projects may also require damage resolution with landowners following construction. All land rights must be acquired pursuant to applicable laws governing acquisition of real property.

In certain circumstances, BHP may determine that the Requestor is capable of performing the necessary land rights activities. When this is the case, BHP will coordinate closely with the interconnecting entity to ensure proper procedures are followed, and that the proper land rights are obtained. Agreements concerning land acquisition issues such as fee or easement, right-of-way width, and title acceptability must be reached between BHP and the interconnecting entity before any land rights are acquired and transferred to BHP.

8. GENERAL REQUIREMENTS

8-A Transmission Planning

The Transmission Planning process is an important first step in the determination

of interconnection feasibility. The transmission planning studies will identify impacts, deficiencies, operational problems or interconnection facility concerns and evaluate potential solutions. A proposed interconnection must not degrade the reliability or operating flexibility of the existing power system. The proposed interconnection must comply with all North American Electric Reliability Council (NERC) Reliability Criteria and WECC Planning Standards.

The studies may include, but are not limited to, power flow, dynamic stability, short circuit studies, and Sub-Synchronous Torsional Interaction (SSTI) screening. Evaluation of alternatives to the proposed interconnection, such as lower voltage construction, alternative interconnection points, reactive support facilities, or upgraded facilities, may be requested.

- The Requestor shall provide the data requirements associated with a transmission or end-user facility interconnection request using the form found in Appendix A.
- Attachment A to Appendix 1 of the CUS Tariff provides a detailed listing of all of the data requirements associated with a large generator (> 20 MW) interconnection request.
- The Requestor shall provide the data requirements associated with a small generator (< 20 MW) interconnection request using the form found in Appendix B.

Any special operational considerations or constraints shall be specified by the requestor. This information will be utilized to develop computer models of the requested facility for input into the transmission planning studies. Any specialized modeling data is the responsibility of the requestor.

The interconnection studies will typically be performed in multiple sequential stages. Phase 1, the Feasibility Study, will address a first level power flow screening analysis of the proposed interconnection facility as well as a short circuit analysis. Phase 2, the System Impact Study, will address a much more detailed power flow analysis, dynamic stability analysis, and any other study work required by BHP. Phase 3, the Facilities Study, will detail the final interconnection facilities design, direct assignment facilities, costs and construction schedule estimates. The Facilities Study will merge the results of the Feasibility and System Impact Studies into a final study report which will be submitted to the WECC Transmission Studies Subcommittee or other regional review authority for approval. The Interconnection Agreement will not be executed until all of these steps have been successfully completed. The Requestor will have the option to rescind the interconnection request following the completion of any of the study phases.

8-A.1 Joint Planning

The transmission planning process for the proposed new facility must also

accommodate coordinated joint transmission planning with neighboring transmission system owners and operators. Once a new facility is considered feasible for interconnection, the requestor shall notify neighboring utilities, the Colorado Coordinated Planning Group and the WECC Transmission Studies Subcommittee as deemed necessary by BHP. The Colorado Coordinated Planning Group provides an appropriate technical forum of regional utilities, transmission providers and stakeholders who can review proposed facility plans and readily identify concerns, issues and impacts. Once discussions with neighboring or potentially effected systems are held, it may be determined that a joint transmission planning study would be beneficial to identify synergies among multiple proposed transmission projects. The neighboring systems and requestors can work together to develop the most efficient transmission plan that will accommodate the proposed project and meet regional reliability criteria with the least cost.

8-B Safety and Isolating Devices

For an interconnection to the BHP system, an isolating device, at a minimum a disconnect switch, shall be provided to physically and visibly isolate the BHP System from the connected facilities. The isolation device may be placed in a location other than the Point of Interconnection (POI), by agreement of BHP and affected parties. Safety and operating procedures for the isolating device shall be in compliance with the BHP Safety Manual, BHP System Control procedures and the Requester's and/or interconnecting utility's safety manuals. All switchgear that could energize equipment shall be visibly identified, so that all maintenance crews can be made aware of the potential hazards.

The following requirements apply for all isolating devices:

- Must simultaneously open all three phases (gang operated) to the connected facilities.
- Must be accessible by BHP.
- Must be lockable in the open position by BHP.
- Will not be operated without advance notice to affected parties, unless an emergency condition requires that the device be opened to isolate the connected facilities.
- Must be suitable for safe operation under all foreseeable operating conditions.

All work practices involving BHP owned, maintained, and/or operated equipment, must be done in accordance with the principles and procedures contained in the BHP *Safety Manual* and BHP *Operator Notes*, and done at the direction of BHP Dispatchers. BHP personnel may lock the isolating device in the open position and install safety grounds:

- For the protection of maintenance personnel when working on de-energized circuits.
- If the connected facilities or BHP equipment presents a hazardous condition.
- If the connected facilities jeopardize the operation of the BHP System.

8-C Transmission Facilities

Any proposed transmission facility interconnecting into BHP's high voltage transmission system shall be coordinated and reviewed through the Transmission Planning process described in this document. The transmission facility addition shall maintain or improve the level of system reliability which existed prior to the interconnection. Power flows as a result of the transmission interconnection shall not overload or adversely affect the BHP transmission system. Voltage levels shall be coordinated with BHP's existing transmission system and substation operational voltage levels. Currently, BHP's existing transmission system voltage level is 230 kV. The transmission line design and construction shall be in accordance with BHP's transmission line design and construction standards.

The requestor is responsible for all state required approvals, environmental requirements, protection coordination, interconnection metering, maintenance and control coordination.

8-C.1 Facility Ratings

All equipment ratings for the proposed transmission facilities shall be provided to BHP. The transmission facility ratings shall be based upon industry standards and BHP's transmission facility rating assumptions contained in BHP's *Facility Rating Methodology* document.

8-C.2 Line Taps

Proposed taps to BHP's transmission system are subject to approval on a case-by-case basis. Additional taps can be placed on existing lines provided single-contingency outage criteria is not violated and all loads can be fed radially from either terminal, system intact. Single-contingency outage criteria means the interconnected power system shall be operated at all times so that general system instability, uncontrolled separation, cascading outages and/or voltage collapse will not occur as a result of the loss of a single system element.

Taps to transmission lines of 230 kV will be evaluated on a case-by-case since lines at this voltage level makes up the bulk power delivery system and requires the highest level of reliability.

Entities requesting non-BHP designed transmission line taps shall submit

designs, calculations and drawings demonstrating that the structures and foundations have been designed in accordance with BHP Engineering Department standards. Taps to transmission lines with insulated Over Head Ground Wires (OHGWs) shall not degrade the capability of the existing OHGWs.

The tap should not adversely affect the protection scheme or outage frequency on the present tap(s). Additional taps can be placed on existing lines where delta-wye transformers are used. Auto-transformers or three-winding transformers present sources of zero sequence current and can make both directional ground over current and ground distance relaying complicated. It is best to sectionalize whenever auto or three-winding transformers are utilized. The proximity of the tap to either line terminal may affect the protective relaying scheme on the transmission line. The tap transformer impedance and relative location of the tap on the transmission line may necessitate pilot relaying be installed on the transmission line in order to prevent tripping of the transmission line for faults in the low voltage tap system.

8-D End – User Facilities

Typical end-user facilities considered for interconnection would encompass load (dynamic and static) and reactive devices (capacitors and reactors). The impacts on the transmission system must be studied to address any special operational limitations or facility requirements.

BHP's system protection requirements are designed and intended to protect the BHP system. Additional protective relays are required to protect an interconnected end-user facility. It is the requestor's responsibility to install the proper protective relaying needed to protect the end-user facilities. BHP does not assume responsibility for protection of the interconnected end-user facilities. The requestor is solely responsible for protecting interconnected equipment so that faults, imbalances or other disturbances on the BHP system do not cause damage to the end-user facilities.

To meet the reliability requirements of NERC and WECC, under frequency and/or under voltage load shedding schemes may be required. Any load or reactive device connected to the BHP system will be expected to participate in under frequency or under voltage load shedding if BHP determines such action is necessary to maintain system reliability. If BHP requires load-shedding participation for a particular end-user facility, the requestor shall be responsible for all related costs.

8-E Engineering

BHP will provide for engineering design, specification and construction of the

proposed interconnection to BHP owned, operated and maintained facilities. Non-BHP engineering design may be allowed, provided it receives initial approval and subsequent review by BHP. All engineering costs and engineering review costs are the responsibility of the requesting party. For transmission line taps owned by others, prints of applicable facility drawings will be furnished by BHP upon request. All work performed by BHP will include revisions to existing BHP drawings at the expense of the Requestor.

If the interconnected facilities are to be owned by BHP, then any new land rights necessary for the interconnection may be acquired by BHP from the affected landowners, at the expense of the Requestor. In certain circumstances, the Requestor may acquire these additional land rights, provided they coordinate with BHP as to what rights are necessary.

Modifications to BHP's transmission system to accommodate the proposed interconnection shall adhere to BHP Engineering Department standards. Any variation from BHP Engineering Department standards may be considered on a case-by-case basis. BHP Engineering Department standards will be communicated after the initial Letter of Agreement is signed.

Drawings for facility additions must conform to BHP Drafting Department standards and be approved by BHP. The Requestor will supply drawings on a CD-ROM disk or through electronic mail, compatible with BHP's computer-aided design system, AutoCAD. The Requestor will reimburse BHP for drawing costs. Examples of BHP Drafting Department standards will be furnished to the entity requesting the interconnection if the design is not produced by BHP. "As-built" drawings must be provided prior to final approval by BHP. Three complete sets of accurate substation drawings shall be provided to BHP for non-BHP-owned substations. These drawings shall include, but not be limited to, station plot plans, equipment layouts, single-line diagrams, control circuit schematics and wiring diagrams. Updated copies of these drawings shall be furnished to BHP within 60 days of any modification to non-BHP owned equipment or substations on BHP's system.

Breakers and switches installed in BHP substations shall adhere to BHP numbering schemes. Breaker and switch operation numbers will be assigned by BHP. All switches to be operated by BHP will be locked with locks furnished by BHP. All switches to be operated by BHP shall be designed in accordance with BHP's Standard Design Criteria.

8-F Insulation Coordination

Power system equipment is designed to withstand voltage stresses associated with expected operation. Adding or connecting new facilities can change equipment duty, and may require that equipment be replaced or switchgear, telecommunications, shielding, grounding and/or surge protection be added to

control voltage stress to acceptable levels. Interconnection studies may include the evaluation of the impact on equipment insulation coordination when deemed necessary by BHP. BHP may identify additional requirements to maintain an acceptable level of BHP 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. 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 may include station shielding against direct lightning strokes, surge arresters on all transformers, reactors, and surge protection with rod gaps (or arresters) on the incoming lines.

8-G Substation Grounding

An interconnection 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 located in, or immediately adjacent to, the station under normal and fault conditions.

New interconnections of transmission and/or generation may substantially increase fault current levels at nearby substations. Modifications to the ground grids of existing substations may also be necessary to keep grid voltage rises within safe levels. Any costs associated with ground grid modifications required due to the new interconnection will be the responsibility of the Requestor.

The ground grid should be designed to ANSI/IEEE Standard 80-1986, IEEE *Guide for Safety in AC Substation Grounding.*

8-H Equipment Maintenance

The owner of the installed equipment will be responsible for its proper operation and maintenance. Equipment must be operated and maintained in accordance with manufacturer's recommendations, prudent utility practices and applicable environmental and safety standards. BHP may require additional equipment to assure a reliable interconnection and to safeguard the proper operating conditions of its power system. The equipment owner, if requested, may contract with BHP to provide required O&M services provided funds have been advanced to cover these costs. Costs may include training on maintenance procedures for unfamiliar equipment.

BHP shall also have the right to enter interconnected facilities for emergency maintenance of equipment or structures BHP deems necessary to maintain a

reliable power system.

8-I Inspection of Facilities

If construction activities are performed by other entities, BHP may require at least one BHP representative be present to coordinate and provide for switching, clearances, special work permits and inspections during construction work on BHP's right-of-way. The BHP representative will also conduct operability checkout on equipment, including metering, relay settings and tests and protective device operation (circuit breakers, motor-operated disconnects, etc.). Final electrical connections to BHP's system will be made by BHP or under BHP's supervision. Only after a satisfactory inspection is completed will the new facilities be authorized for energizing and synchronization.

9. PERFORMANCE REQUIREMENTS

9-A System Operations

9-A.1 Synchronization and Energization

Following the execution of an Interconnection and Operating agreement and the successful completion of all construction, inspection and facility checkout procedures, the interconnected facility will be released for energizing. The initial synchronization will be supervised and coordinated with BHP personnel. Future synchronization will be controlled by BHP System Control (SC) personnel and will either be automatic or manual per the direction of BHP SC.

9-A.2 Procedures and Communication

All communications and operating procedures during normal and emergency operating conditions will be initiated and controlled by BHP System Control (SC) personnel. Any requests from the interconnected facility for any special operating considerations will be submitted to BHP SC for review and approval prior to execution. Emergency operating conditions will be handled in accordance with NERC Operating Standards and good utility practice. The interconnection facility must recognize the dynamic nature of an interconnected transmission system and the reliability and safety priorities of the BHP SC. BHP SC personnel may not be available immediately during all emergency conditions and the BHP SC will communicate the system status and any special operating restrictions to the interconnected facility as soon as feasible.

The Requestor making the interconnection will write Standard Operating

Procedures in coordination with BHP for the interconnected facility. Three sets of instructions and manufacturer's drawings shall be furnished to BHP for each piece of equipment that BHP operates.

9-A.3 Dispatching and Control

Circuit breakers, disconnects, interrupters and motor-operated disconnect switches that are an integral part of BHP's transmission system shall be operated and dispatched by BHP. The BHP SC will direct switching and issue all clearances, hot-line orders and general switching on the transmission portion of the interconnection or substation. This will involve use of approved BHP switching and clearance procedures, including use of BHP locks and tags.

Supervisory control by BHP of circuit breakers, interrupters or motor-operated disconnects will be required on all interconnections that directly affect the security of BHP's transmission system. The Remote Terminal Units (RTU's) for supervisory control shall be compatible with the SCADA system used within the BHP system. The cost of providing and installing the RTU at a new location or proportionate cost of modifying an RTU at an existing facility will be at the expense of the Requestor. BHP will perform the necessary expansion, including hardware and software changes, to the SCADA master station equipment at the Requestor's expense for that portion attributed to the new interconnection.

Transducers, interface hardware and appropriate communication channels compatible with existing SCADA system requirements shall be furnished by the Requestor. Specifications for such equipment will be provided upon request. The Requestor shall provide necessary auxiliary and control relays, hot-line indication, supervisory local / remote switches, and all other equipment necessary to interface with BHP's supervisory control equipment.

9-A.4 Voltage Schedules

Voltage schedules are necessary, in order to maintain optimal voltage profiles across the transmission system. Optimal profiles minimize transmission of reactive power, and preserve flexibility in use of reactive power control facilities. BHP maintains transmission voltage levels between 0.95 – 1.05 per unit during normal conditions and between 0.90 – 1.10 per unit during emergency conditions.

Regulation to keep voltage variations within limits acceptable to end-use customers is typically provided at distribution voltage levels. Load owners are strongly urged to install their own voltage regulation equipment and coordinate any voltage set points or time delays with the

normal transmission voltage bandwidths. Limitations of equipment connected to the BHP System must not restrict this range of operation.

Deviations from the voltage schedule may be ordered by the BHP Dispatcher.

9-A.5 Reactive Power

Each entity shall provide for its own reactive power requirements, at both leading and lagging power factors unless otherwise specified by BHP. BHP requires customers to maintain a power factor between 0.95 lagging and 0.95 leading as measured at the point of interconnection with BHP-owned facilities. This can be accomplished by installing equipment to allow matching of internal supply and demand of reactive power. If this power factor requirement is not met, BHP may install power factor correction equipment at the load owner's expense. Minimizing flow of reactive power on a given line can increase its transfer capability and reduce its losses.

9-A.6 Emergency Operations – System Frequency

Power system disturbances initiated by system events such as faults and forced equipment outages, expose the system to oscillations in voltage and frequency. It is important that lines remain in service for dynamic oscillations that are stable and damped. Large-scale blackouts can result from the excessive loss of generation, outage of a major transmission facility, or rejection of load during a disturbance.

In order to prevent such events, under frequency load shedding (UFLS) has been implemented throughout WECC, including the Rocky Mountain Region. When system frequency declines, discrete blocks of load are automatically interrupted by frequency relays, with most of the interruptions initiated between 59.3 Hz and 58.6 Hz. Load shedding attempts to stabilize the system by balancing the generation and load. It is important that lines and generators remain connected to the system during frequency excursions, both to limit the amount of load shedding required and to help the system avoid a complete collapse.

The Requestor may be required to participate in BHP's UFLS program. All loads or generators tripped by under frequency action must not be restored without BHP Dispatcher permission.

9-A.7 Emergency Operations – System Voltage

Due to various events the BHP System may experience a decline in system voltage. In order to restore depressed system voltage, or to arrest

declining system voltage, it may be necessary for BHP Dispatchers to manually shed load. The Requestor may be required to shed load in these circumstances as determined by BHP. All loads shed due to BHP Dispatcher action must not be restored without BHP Dispatcher permission.

9-B Power Quality

Unbalanced phase voltages and currents can affect protective relay coordination and cause high neutral currents and thermal overloading of transformers. To protect BHP and customer equipment, the interconnected facility contribution at the point of interconnection shall neither cause a voltage unbalance greater than 1 percent nor a current unbalance greater than 5 percent. Phase unbalance is the percent deviation of one phase from the average of all three phases.

Harmonics can cause telecommunication interference, thermal heating in transformers, disruptions to solid state equipment and resonant over voltages. To protect equipment from damage, harmonics must be managed and mitigated. The interconnected generator/load shall not cause voltage and current harmonics on the BHP system that exceed the limits specified in Institute of Electrical and Electronics Engineers (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/load site or other locations on BHP's system to determine whether the project is the source of excessive harmonics.

Many methods may be used to restrict harmonics. The preferred method is to install a transformer with at least one delta connection between the generator/load and the BHP system. This method significantly limits the amount of voltage and current harmonics entering the BHP system.

Voltage fluctuations may be noticeable as visual lighting variations (flicker) and can damage or disrupt the operation of electronic equipment. IEEE Standard 519 provides definitions and limits on acceptable levels of voltage fluctuation. All generators/loads connecting to the BHP system shall comply with the limits set by this Standard.

9-C Switchgear

Circuit breakers, disconnect switches, and all other current-carrying equipment connected to BHP's transmission facilities shall be capable of carrying normal and emergency load currents, and must also withstand available fault currents without damage. This equipment shall not become a limiting factor, or bottleneck, in the ability to transfer power on the BHP System. During prolonged steady-state

operation, all such equipment shall be capable of carrying the maximum continuous current that the interconnected facility can reasonably deliver.

All circuit breakers and other fault-interrupting devices shall be capable of safely interrupting fault currents for any fault that they may be required to interrupt. Application shall be in accordance with ANSI/IEEE C37 Standards. These requirements apply to the equipment at the POI as well as other locations on the BHP System. BHP will supply the fault-interrupting requirements.

Circuit breakers shall be capable of performing other duties as required for specific applications. These duties may include capacitive current, and out-of-step switching. Circuit breakers shall perform all required duties without creating transient over voltages that could damage BHP equipment.

Installation of equipment in substations must conform to BHP's requirements and must be approved by BHP. All Oil-filled equipment, including bushings, shall not contain polychlorinated biphenyls (PCB's). In addition, oil-filled equipment shall be permanently labeled by the manufacturer as non-PCB. Certification shall be provided to BHP at or before the time of installation. Oil-filled equipment may require an oil spill containment system to comply with U.S. Environmental Protection Agency or state regulations. Any increased equipment costs due to these requirements will be borne by the entity requesting the equipment.

New interconnections of transmission and/or generation may substantially increase fault current levels at nearby substations. Increased fault currents may exceed existing equipment ratings, interrupting ratings and/or through fault ratings. Any existing equipment replacements required due to new fault current requirements associated with new generation is the responsibility of the requesting party.

9-C.1 Circuit Breaker Operating Times

Table 1 specifies the interrupting times typically required of circuit breakers on the BHP System. These times will generally apply to equipment at or near the POI. System stability considerations may require faster opening times than those listed. Breaker close times are typically four to eight cycles. Circuit breaker interrupting time may vary from those in Table 1 but must coordinate with other circuit breakers and protective devices.

Table 1: Typical Circuit Breaker Interrupting Times

Voltage Class (kV L-L rms)	Rated Interrupting Time (Cycles)
Below 69 kV	≤ 8
69 kV to 230 kV	≤ 3
345 kV and Above	≤ 2

9-D Generators (General Requirements)

When BHP considers integrating a generation facility interconnection into the BHP System, additional special studies are required. There have historically been stability limitations in the Wyodak area that require transient stability analysis. There are also other voltage constraint issues that exist in the Black Hills. Operational studies may also be required to evaluate impacts on present generation operations in the Black Hills area. Operational problems on the BHP System, either during normal or emergency conditions, may affect BHP System performance. Special region-specific operational studies will evaluate the transmission system and reliability considerations. Should replacement of existing equipment be required as a result of the interconnection, BHP will retain equivalent transmission capacity and operational control as previously existed.

9-D.1 Generator Protection

BHP's system protection requirements are designed and intended to protect the BHP transmission system. Additional protective relays will be required to protect an interconnected generator. It is the generation owner's responsibility to install the proper protective relaying needed to protect the generation in coordination with BHP system protection. The owner of the generator is solely responsible for protecting interconnected equipment in such a manner that faults, imbalances, or other disturbances on the BHP system do not cause damage to the interconnected generation facilities. Any interconnected generator must comply with the under/over-frequency protection requirements as stated in the current *WECC Coordinated Off-Nominal Frequency Load Shedding and*

Restoration Plan. To ensure that the interconnected generators do not trip prematurely, the time delays for these relays must be coordinated with BHP's system protection schemes.

9-D.2 Ride-Through Capability

Power system disturbances initiated by faults and forced equipment outages expose connected generators to voltage and frequency oscillations. It is important that generators remain in service to help ensure that any dynamic or transient oscillations are stable and well damped. Therefore, each generator must be capable of continuous operation at 0.95 to 1.05 per unit voltage and 59.5 to 60.5 Hertz. Even larger voltage and frequency deviations may be experienced for short periods of time and interconnected generators must have capability for off-nominal operation. Additionally, any interconnected generator must be able to meet the current proposed *WECC Voltage Ride Through Standard*.

9-D.3 Remedial Action Scheme/Special Protection Scheme

A Remedial Action Scheme (RAS) is a special protection system that automatically initiates one or more pre-planned corrective measures to restore acceptable power system performance following a disturbance. RAS application mitigates the impact of system disturbances and improves system reliability. A typical disturbance, as considered in the planning and design of the electrical transmission system, is the sudden loss of one or more critical transmission lines or transformers. A widely applied corrective measure is to instantaneously reduce a sufficient amount of generation on the sending end of the lost transmission facility. This is known as generator "fast-valving" or "tripping," and a participating generation facility may be disconnected from the transmission system by the automatic RAS controller, in much the same way as by a transfer-trip scheme. A generation facility should therefore have full load-rejection capability as needed both for local line protection and RAS.

The determination of RAS requirements depends on the overall location and size of the generator and load on the transmission system and the nature of potential alternative transmission reinforcements. If BHP requires a RAS to be installed for a particular generation facility, the generator owner shall be responsible for all related costs.

BHP has installed a Remedial Action Scheme (RAS) at the Rapid City DC Tie. The status of critical lines, breakers, Rapid City generation and Rapid City load are continuously monitored. For combinations that would cause reliability performance criteria violations, a system of logic sends signals to run back the Rapid City DC Tie. Any proposed generation

interconnection must not adversely affect the operation of the RCDC RAS or degrade the reliability of the Black Hills area system. All dynamic stability analysis of the impacts of proposed generation will be performed or reviewed by BHP and any facility additions or modifications are the responsibility of the requesting party.

9-D Synchronous Generators

9-D.1 Synchronization

Automatic synchronization shall be supervised by a synchronizing check relay IEEE Device 25. This assures that no synchronous generator is connected to the power system out of synchronization. Generators must meet all applicable American National Standards Institute (ANSI) and IEEE standards. The prime mover and the generator should also be able to operate within the full range of voltage and frequency excursions that may exist on the BHP system without damage to themselves.

9-D.2 Voltage Control

System voltage regulation is necessary for efficient and reliable electrical power transmission and for adequate service to loads. Voltage schedules establish hourly operating requirements and may be set for seasons, holidays, day of the week and time of day. All interconnected synchronous generators are required to participate in voltage regulation by meeting voltage scheduling requirements provided by BHP Dispatchers. BHP may require additional reactive capability or voltage regulation on some parts of its system to integrate the generation. It is the generator owner's responsibility to mitigate any unacceptable reactive or voltage regulation problems created due to the integration of the generator.

The voltage regulator must be capable of maintaining the voltage at the generator terminal, without hunting, within 0.5 percent of any set-point. The operating range of the regulator shall be at least plus or minus 5 percent of the rated voltage of the generator.

9-D.3 Reactive Power

Generators shall be designed to maintain a composite power delivery at continuous rated power output at the Point of Interconnection at a power factor within the range of 0.95 leading to 0.95 lagging. The design shall consider the effects of step-up transformer reactance and voltage taps/turns ratios, and bus-fed auxiliary load.

Generators are also required to produce or absorb reactive power up to the generation unit's reactive capability curve (a.k.a. "D" curve) during

transmission system disturbances.

If BHP requires additional reactive or voltage regulation to mitigate known system weaknesses, BHP will negotiate with the generator owner for any additional capability beyond the minimum requirements stated above.

9-D.4 Excitation System

The excitation system of synchronous generators may be required to be of a fast-response or High Initial Response type (the voltage response time is 0.5 seconds or less). All interconnected generators must be able to meet the current *WECC Excitation/AVR Design and Performance Criteria*. A Power System Stabilizer (PSS) uses auxiliary stabilizing signals to control the excitation system to improve power system dynamic performance. A PSS is required with the excitation system for all interconnected synchronous generators per the current *WECC PSS Policy Statement* and must be able to meet the current *WECC Power System Stabilizer Design and Performance Criteria.* Additionally, all interconnected generators with an AVR and/or PSS must operate in accordance with BHP's *AVR and PSS Operating Policy*.

9-D.5 Governor

A speed governor system is required on all synchronous generators. The governor regulates the output of the generator as a function of the system frequency. That function (called the governor's "droop" characteristic) must be coordinated with the governors of other generating units located within the BHP control area to assure proper system response to frequency variations. The speed governor system shall have an adjustable droop characteristic setting set to 5 percent.

9-E Asynchronous Generators

The Requestor must provide wind turbine detailed technical data for each wind turbine type to be installed at the wind power Generating Facility. If BHP or the Requestor do not have an approved Power Technologies, Inc. PSS/E software model(s) for each of the proposed wind turbines, the Requestor shall be responsible for funding the development of a new wind turbine model(s).

9-E.1 Asynchronous Generators With Solid-State Inverters or Double-fed Wound Rotor Induction Generators

These machines shall be operated to provide reactive power similar to that of synchronous generators within the capabilities of the machines. This

may include operation on voltage schedules provided by the BHP Dispatchers.

9-E.2 Voltage and Reactive Power Control

Wind turbines or other induction type generators without VAR control capability will absorb VARs from the transmission system and therefore require reactive power support from the BHP System. Induction type generators shall be required to provide power to the POI within the range of ± 95% power factor and be controllable on voltage. Devices used for power factor correction must be installed either by the generator owner or by BHP at the owner's expense.

Dynamic reactive compensation through turbine based or substation based systems are acceptable methods to provide voltage control at the POI. Dynamic reactive power compensation may be required in addition to static power factor compensation at some locations. The System Impact Study will determine the reactive compensation required for the induction type generator interconnection. Integration studies may be necessary to determine the reactive power capability necessary to ensure that required voltage schedules are maintained. Switched capacitor banks owned by the generation owner shall be switched on and off at the request of BHP.

Voltages at the POI shall not vary more than 0.5% per capacitor switching operation; and shall not deviate more than 3% due to changes in generation output caused by rapid fluctuations in the prime mover speed. Any automatic voltage control systems shall be fast enough to react to the maximum change in generation anticipated without invoking the operation of system voltage control devices such as shunt capacitors and tap changers. Further, any automatic control system shall be coordinated to minimize operation of customer load regulation equipment including voltage regulators and tap changers. This may require the control system to adjust reactive compensation in less than 30 seconds. The alternative may be to require controllable compensation such as Static Var Compensators (SVC).

Under lagging reactive power facility conditions, the Requestor is responsible for ensuring that self-excitation of the induction type generator does not occur, including under the various outage combinations that might occur on the BHP System. The Requestor is responsible for ensuring that high-voltages from self-excitation are not applied to the BHP System.

10. PROTECTION REQUIREMENTS

10-A Introduction

Protective relaying requirements for each interconnection and relay scheme coordination will be determined by BHP after review of existing interconnection protection schemes and short circuit study work. BHP requires receipt of a preliminary one-line drawing of the proposed interconnection and a one-line drawing and maps of the Requestor's system in the area.

10-B Data Requirements

The requestor will be required to provide all positive, negative and zero sequence impedance data necessary to adequately model the proposed interconnection facility in a short circuit analysis. The requestor should also provide re-closer and fuse ratings, and relaying data necessary to address protective relaying coordination. High-speed pilot, backup, breaker failure and out-of-step relaying are normal BHP requirements for 230 kV voltage interconnections. Specialized relaying may be required to provide automatic load, generation shedding or interconnected system separation.

10-C Maintenance and Testing

Protective relays and control systems must be inspected and tested by functional trip checking prior to putting any interconnected facility in service. The future maintenance and testing shall be in accordance with BHP protective relaying maintenance and testing procedures. BHP personnel are required to be involved with procedures prior to and during any future maintenance and testing of protective relaying devices. The Requestor is responsible for the costs associated with the ongoing testing and maintenance of the protective relaying and control equipment.

11. TELECOMMUNICATIONS REQUIREMENTS

The Requestor shall provide telecommunications facilities sufficient to meet BHP's telephone, radio, system protection, remote meter reading and SCADA requirements. The communication channel and channel hardware will be provided by the Requestor. BHP will specify the type, speed and characteristics of the communication channel equipment so that compatibility with existing communications, supervisory control, relaying and telemetering equipment is maintained. The specific type of communication equipment to be furnished by the Requestor will be reviewed and approved by BHP. The Requestor will reimburse BHP for the costs of any additional facilities provided by BHP.

Fiber optic additions to new or existing BHP transmission lines will be considered

on a case-by-case basis. Technical analysis of clearances, structural loads and electrical field effects may limit applications. Outage restrictions and maintenance responsibilities may also impact potential paths. BHP reserves the right to charge a fee for ROW, pole attachments and/or acquire individual optical fibers on the circuit, per agreement between the interconnecting entity and BHP.

12. METERING REQUIREMENTS

12-A Revenue Metering

Current transformers used for revenue metering circuits must meet the accuracy standards, as specified under ANSI C57.13, for an accuracy class of 0.3 percent at all burdens. The thermal current rating of current transformers shall exceed the maximum current capacity of the circuit involved by a factor of 1.5 to 2.0.

Voltage transformers used for revenue metering circuits must meet the accuracy standards, as specified under ANSI C57.13, of 0.3 percent accuracy with the following burdens:

(1) "W" through "Y" burden for 25-kV and below

(2) "W" through "ZZ" burden for above 25-kV.

Revenue metering with mass memory storage shall be used if the estimated maximum demand is 500 KVA or greater, or if maximum simultaneous demand billing is contractually required. Such revenue metering shall be compatible with the metering policy established by BHP.

12-B Control Area Boundaries

Interconnections that establish additional or new control area boundaries require the Requestor to furnish all necessary control area metering equipment. These requirements may include, but are not limited to:

(1) Analog and/or digital telemetering at the point of interconnection.

(2) Analog to digital conversion equipment and tone gear, as required, at both the point of interconnection and BHP's System Control.

(3) Totalizing equipment at the point of interconnection or some intermediate point on the communications link. A multi-port RTU may be substituted in some cases. If a multi-port RTU is used, a points list identifying alarms, events and telemetered quantities will be jointly developed between the Requestor and BHP. The service agreement implementing the multi-port RTU will include operating/dispatch jurisdiction, primary and backup service control

protocol, SCADA tagging and control design, switching procedures and definitions of terms used by the system operators.

(4) Automatic Generation Control (AGC) hardware and software modifications to BHP's System Control and other organization's power system control centers (if required).

BHP's telemetering, scheduling and interconnection metering are performed on a megawatt or whole megawatt-hour basis, therefore, interconnection metering and totalizing equipment shall meet this criterion. Dynamic schedules to the appropriate automatic generation controller may be a consideration for radial tap lines to the BHP system whenever the load is supplied from a source outside the BHP system. Similarly, internal generating resources supplying loads outside BHP's load control area may require special equipment at BHP's and other power system control centers.

APPENDIX A

TRANSMISSION LINES AND LOADS CONNECTION INFORMATION

Any entity expressing an interest in connecting transmission lines or loads to BHP's Transmission System must submit the below application. This application should be completed as soon as possible and returned to BHP in order to begin processing the request.

This application will be used by Black Hills Power to determine if System Impact Studies are required. These studies are used to determine the location (Point of Interconnection), equipment requirements (Requestor & BHP), system modifications, etc. to connect transmission lines and/or loads. Sections 1 and 2 should be completed as soon as possible and returned to BHP. Section 3 must be completed if it is determined that a System Impact Study is required. Following completion of the required studies the Requestor will receive a preliminary estimate of the utility connection requirements that may be used in calculating the overall project connection requirements.

SECTION 1 – INTERCONNECTION REQUESTOR AND CONTRACTORS

REQUESTOR/OWNER INFORMATION

Company			
Mailing Address			
City		State	Zip Code
Phone Number	Email	Contact	

CONNECTION DESIGN/ENGINEERING CONSULTANT (*As applicable*)

Company			
Mailing Address			
City		State	Zip Code
Phone Number	Email	Contact	

ELECTRICAL CONTRACTOR (*As applicable*)

Company			
Mailing Address			
City		State	Zip Code
Phone Number	Email	Contact	

DATE	**SIGNATURE**
NAME (*Please Print or Type*)	**TITLE**

APPENDIX A - TRANSMISSION LINES AND LOADS CONNECTION INFORMATION

SECTION 2 – GENERAL SPECIFICATIONS, LOCATION, AND DIAGRAMS FOR CONNECTION

PRELIMINARY INFORMATION

1. Type of Connection

[ ] Radial Load [ ] Non-radial Network Connection Operating Voltage: _____ kV

Comments:

2. Connection Point Location

State	County	Nearest Community
Township	Range	Section

Street Address

Identify the BHP Line or Substation Connection Point:

3. Type of Load

Identify the characteristics which best describe the type of load to be served. (HVAC, lighting, pumps, motors, etc.)

More specific information may be required for loads such as those associated with arc furnaces, large motors, etc.

4. Load Data (at the time of energization and every year for 10 years)

Projected Peak Load (kW)

Summer Peak Load (kW)

Winter Peak Load (kW)

Anticipated Power Factor

5. Quality of Service (Special Requirements such as power quality, frequency and duration of outages, etc.)

6. Future Plans (Where known)

Modification, changes, or additions affecting the connection or connected equipment

7. Documentation

Attach an electrical one-line diagram of the project that includes proposed protective relaying, breaker and switching arrangements, ground sources (zero sequence), and assumed electrical equipment parameters for the connection.

FOR INTERNAL USE ONLY:	
Received by:	Phone Number
Copy of Interconnection Study Request and Attachments to: Manager, Transmission Planning & Operations Manager, System Control	 Manager, Engineering Supervisor, Energy Services

APPENDIX A - TRANSMISSION LINES AND LOADS CONNECTION INFORMATION

SECTION 3 – STUDY DATA REQUIREMENTS

1. Network Power Flow Model (as required)

Enclose a model using Siemens PTI PSS/E format

2. Interconnecting Transmission Line(s) or Cable (provide all parameters in physical units if applicable:)

Nominal voltage _____ kV Length _____ miles

Transmission Line Impedances

Quantity	Positive Sequence	Zero Sequence
Series Resistance, R Ω		
Series Reactance, X Ω		
Shunt Susceptance, B μS		

Will this line be built on common structures with other circuits? [ ] Yes [ ] No

Will this line be transformer-terminated at either end? [ ] Yes [ ] No

If "yes", state which end(s) and the transformer identifier:

3. Transformers (provide parameters if applicable)

Identifier: _____ Number of Windings *(2 or 3)* [ ] Autotransformer? [ ] Yes [ ] No

Winding ("H"): Nominal Voltage: [kV] Configuration (Δ or YG) [ ] Nameplate MVA, H to X [/ /]

Winding ("X"): Nominal Voltage: [kV] Configuration (Δ or YG) [ ] Nameplate MVA, H to Y [/ /]

Winding ("Y"): Nominal Voltage: [kV] Configuration (Δ or YG) [ ] Nameplate MVA, X to Y [/ /]

Tap Information Winding (H, X, or Y): [ ] Operational kV _____ Available Taps (kV) [/ / / /]

Transformer Impedance: Winding H to X: [% @ MVA] H to Y: [% @ MVA] X to Y: [% @ MVA]

4. System Data (only applicable where generation resources are present or if the connection includes another network source.)

Provide a system equivalent (R1,X1,R0,X0 in per unit on a 100 MVA base) at the proposed Connection Point looking into the connecting system These values should be determined such that the system model *does not* include the physical connection to the BHP System. Assuming there are no other connections to the BHP System at any other point, these quantities are available by computing a single line-to-ground "bus fault" at the proposed Connection Point.

5. Reactive Equipment (Location, size, and rated voltage)

More specific information is required for reactive equipment with dynamic capability (SVC, TCSC, Sync Condensers, etc.)

APPENDIX B

SMALL GENERATOR INTERCONNECTION INFORMATION

Any entity expressing an interest in connecting small generator (less than 20 MW) to BHP's System must submit the below application. This application should be completed as soon as possible and returned to BHP in order to begin processing the request.

This application will be used by Black Hills Power to determine if any Interconnection Studies are required. These studies are used to determine the equipment requirements (Requestor & BHP), system modifications, etc. base on location and size needed to connect the proposed generation. Following completion of any required studies the Requestor will receive a preliminary estimate for the utility interface requirements that may be used in calculating the overall project connection requirements.

SECTION 1 – INTERCONNECTION REQUESTOR AND CONTRACTORS

REQUESTOR/OWNER INFORMATION (*or, if an individual, individual's name*)

Company			
Mailing Address			
City		State	Zip Code
Phone Number	Email	Contact	

CONNECTION DESIGN/ENGINEERING CONSULTANT (*As applicable*)

Company			
Mailing Address			
City		State	Zip Code
Phone Number	Email	Contact	

ELECTRICAL CONTRACTOR (*As applicable*)

Company			
Mailing Address			
City		State	Zip Code
Phone Number	Email	Contact	

APPENDIX B – SMALL GENERATOR INTERCONNECTION INFORMATION

SECTION 2 – GENERAL DATA REQUIREMENTS

PRELIMINARY INFORMATION

1. Type of Application

[ ] New Small Generating Facility [ ] Capacity addition to Existing Small Generating Facility

If capacity addition to existing facility, please describe:

2. Connection Point Location (*if different from above*)

State	County	Nearest Community
Township	**Range**	**Section**

Street Address

3. Type of Use

To Supply Power to the Interconnection Customer? [ ] Yes [ ] No To Supply Power to Others? [ ] Yes [ ] No

For installations at locations with existing electric service to which the proposed Small Generating Facility will interconnect, provide:

(Local Electric Service Provider*) (Existing Account Number*)

*To be provided by the Interconnection Customer if the local electric service provider is different from the Transmission Provider

4. Small Generator Facility Information (*Data apply only to the Small Generating Facility, not the Interconnection Facilities*)

Energy Source:

□ Solar □ Wind □ Hydro □ Diesel □ Natural Gas □ Fuel Oil □ Other (state type) _____

If Hydro, type (*e.g. Run-of-River*): _____

Prime Mover:

□ Fuel Cell □ Recip Engine □ Gas Turbine □ Steam Turbine □ Microturbine □ Photo-voltaic (PV) □ Other _____

Type of Generator:

□ Synchronous □ Induction □ Inverter Generator Nameplate Rating: _____ kW (Typical) _____ kVAR

Interconnection Customer or Customer-Site Load: _____ kW (if none, so state)

Typical Reactive Load: _____ kVAR (if known)

Maximum Physical Export Capability Requested: _____ kW

5. Certified Equipment

List components of the Small Generating Facility equipment package that are currently certified:

Equipment Type	Certifying Entity
1.	
2.	
3.	
4.	
5.	

Is the prime mover compatible with the certified protective relay package? [ ] Yes [ ] No

APPENDIX B – SMALL GENERATOR INTERCONNECTION INFORMATION

SECTION 2 – GENERAL DATA REQUIREMENTS (CONTINUED)

6. Generator (or Solar Collector) Data

Manufacturer: _____ Model Name & Number: _____

Nameplate Output Power Rating in kW: (Summer) _____ (Winter) _____

Nameplate Output Power Rating in kVAR: (Summer) _____ (Winter) _____

Rated Power Factor: Leading _____ Lagging _____

Number of generators: _____ Elevation: _____ ft. Single phase [ ] or Three phase [ ]

Inverter Manufacturer, Model Name & Number (if used): _____

Provide a list of adjustable set points for the generator protective equipment or software.

* Generator data sheets may be supplied in lieu of above section if all data above is contained in the data sheets

7. Inverter-based Machine Characteristics

Max design fault contribution current: _____ Instantaneous [ ] or RMS [ ]

Harmonics Characteristics: _____

Start-up Requirements: _____

8. Rotating Machine Characteristics (*if required by Transmission Provider*)

Rated Speed: _____ RPM Neutral Grounding Resistor (If Applicable): _____ Ω

Synchronous Generators:

Direct Axis Synchronous Reactance, Xd: _____ P.U. Negative Sequence Reactance, X_2: _____ P.U.

Direct Axis Transient Reactance, X'_d: _____ P.U. Zero Sequence Reactance, X_0: _____ P.U.

Direct Axis Subtransient Reactance, X''_d: _____ P.U. KVA Base: _____

Field Volts: _____ V Field Amps: _____ A

Induction Generators:

Motoring Power (kW): _____ I_2^2t or K (Heating Time Constant): _____

Rotor Resistance, Rr: _____ P.U. Rotor Reactance, Xr: _____ P.U.

Stator Resistance, Rs: _____ P.U. Stator Reactance, Xs: _____ P.U.

Magnetizing Reactance, Xm: _____ P.U. Short Circuit Reactance, Xd": _____ P.U.

Exciting Current: _____ A Temperature Rise: _____

Frame Size: _____ Design Letter: _____

Reactive Power Required (No Load) : _____ Vars Total Rotating Inertia, H (P.U. on kVA base): _____

Reactive Power Required (Full Load) : _____ Vars

9. Excitation and Governor System Data (*Synchronous Generators Only*)

Provide appropriate IEEE model block diagram of excitation system, governor system and power system stabilizer (PSS) in accordance with the regional reliability council criteria. A PSS may be determined to be required by applicable studies. A copy of the manufacturer's block diagram may not be substituted.

10. Interconnection Facilities

Will a transformer be used between the generator and the point of common coupling? [ ] Yes [ ] No

Will the transformer be provided by the Interconnection Customer? [ ] Yes [ ] No

11. Transformer Data (*If applicable, for Interconnection Customer-Owned Transformer*)

Single phase [ ] Three phase [ ] Size: _____ kVA Transformer impedance: _____ % on _____ kVA base

If Three phase transformer:

Winding ("H"): Nominal Voltage: _____ kV Configuration (Δ, Y or YG) [ ]

Winding ("X"): Nominal Voltage: _____ kV Configuration (Δ, Y or YG) [ ]

Winding ("Y"): Nominal Voltage: _____ kV Configuration (Δ, Y or YG) [ ]

12. Transformer Fuse Data (*If applicable, for Interconnection Customer-Owned Fuse*)

Manufacturer: _____ Type: _____ Size: _____ Speed: _____

Attach copy of fuse manufacturer's Minimum Melt and Total Clearing Time-Current Curves

APPENDIX B – SMALL GENERATOR INTERCONNECTION INFORMATION

SECTION 2 – GENERAL DATA REQUIREMENTS (CONTINUED)

13. Circuit Breaker Data (*If applicable*)

Manufacturer: _____ Type: _____

Load Rating _____ A Interrupting Rating: _____ A Trip Speed: _____ Cycles

14. Protective Relay Data (*If applicable*)

If microprocessor-controlled:

List of Functions and Adjustable Set-points for the protective equipment or software:

Set-point Function	Minimum Value	Maximum Value
1.		
2.		
3.		
4.		
5.		
6.		

If discrete components:

Manufacturer: _____ Type: _____ Style/Catalog No.: _____ Proposed Setting: _____

Manufacturer: _____ Type: _____ Style/Catalog No.: _____ Proposed Setting: _____

Manufacturer: _____ Type: _____ Style/Catalog No.: _____ Proposed Setting: _____

Manufacturer: _____ Type: _____ Style/Catalog No.: _____ Proposed Setting: _____

Manufacturer: _____ Type: _____ Style/Catalog No.: _____ Proposed Setting: _____

Manufacturer: _____ Type: _____ Style/Catalog No.: _____ Proposed Setting: _____

Enclose a copy of any proposed time-overcurrent coordination curves

15. Current Transformer Data (*If applicable*)

Manufacturer: _____ Type: _____ Accuracy Class: _____ Proposed Ratio/Connection: _____

Manufacturer: _____ Type: _____ Accuracy Class: _____ Proposed Ratio/Connection: _____

Enclose a copy of the manufacturer's excitation and ratio correction curves

16. Potential Transformer Data (*If applicable*)

Manufacturer: _____ Type: _____ Accuracy Class: _____ Proposed Ratio/Connection: _____

Manufacturer: _____ Type: _____ Accuracy Class: _____ Proposed Ratio/Connection: _____

17. Required Documentation

Enclose copies of the following documents:

1. Site electrical one-line diagram showing the configuration of all Small Generating Facility equipment, current and potential circuits, and protection and control schemes. This one-line diagram must be signed and stamped by a licensed Professional Engineer if the Small Generating Facility is larger than 50 kW.
2. Site documentation that indicates the physical location of the proposed Small Generating Facility (e.g., USGS topographic map or other diagram or documentation) and location of protective interface equipment on property. (include address if different from the Interconnection Customer's address)
3. Site documentation that describes and details the operation of the protection and control schemes.
4. Schematic drawings for all protection and control circuits, relay current circuits, relay potential circuits, and alarm/monitoring circuits (*if applicable*).

DATE	**SIGNATURE**

NAME (*Please Print or Type*)	**TITLE**

FOR INTERNAL USE ONLY:

Received by:	Phone Number

Copy of Interconnection Study Request and Attachments to:
Manager, Transmission Planning & Operations

APPENDIX C

BHP POINTS OF CONTACT

Transmission and Generator Interconnection:

Vance Crocker
Manager, Transmission Planning & Operations
409 Deadwood Ave.
Rapid City, SD 57702
vcrocker@blackhillspower.com

Load Interconnection:

Jim Keck
Supervisor, Energy Services
409 Deadwood Ave.
Rapid City, SD 57702
jvkeck@blackhillspower.com