The
CENTRAL NEBRASKA PUBLIC POWER
and IRRIGATION DISTRICT

FACILITY CONNECTION

REQUIREMENTS

DOCUMENT

TECHNICAL REQUIREMENTS FOR INTERCONNECTION TO THE CENTRAL NEBRASKA PUBLIC POWER AND IRRIGATION DISTRICT TRANSMISSION SYSTEM

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1.0 INTRODUCTION

The Central Nebraska Public Power and Irrigation District (Central) is a public corporation and political subdivision of the State of Nebraska. The utility is governed by a 12-member Board of Directors, who are popularly elected from Central's chartered territory.

Central currently owns and operates transmission and sub-transmission facilities in the south central region of the State of Nebraska. These facilities include the Kingsley, Jeffrey, Johnson No. 1 and Johnson No. 2 substations. Central's transmission network involves facilities energized at 115 kV or higher and operated as an interconnected electrical system with interconnections to the Nebraska Public Power District's (NPPD) transmission lines. The transmission system is operated as a part of the Eastern Interconnected Electrical Network and is located on the western end of the Eastern Interconnection. The Eastern Interconnection spans a large portion of the Midwest and the entire eastern portions of the United States and is the largest interconnected grid in North America. Central operates within the Southwest Power Pool (SPP) footprint and is a member of the Midwest Reliability Organization (MRO). SPP is the Balancing Authority and Transmission Operator for the Central facilities.

Central's sub-transmission facilities are operated at 34.5 kV and function as a radial power delivery system to the Dawson Public Power District.

2.0 PURPOSE

This document was developed to describe the general requirements for interconnection with the Central 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 facilities which are being connected to or planned to be connected to the Central transmission system. These requirements were established to promote safe operation, system integrity, reliability, and compliance with the Nuclear Energy Regulatory Commission (NERC) and regional Reliability Standards. These requirements are considered a minimum to be used as a guide toward processing of interconnection requests by Central. There may be additional requirements depending on the location and characteristics of the proposed interconnection facility and those requirements will be evaluated on a case by case basis.

3.0 GENERAL INTERCONNECTION REQUIREMENTS

All requests for interconnection to the Central transmission system must be consistent with regional reliability requirements and standard utility practices. A proposed interconnection (or materially modified existing interconnection) must not degrade the reliability or operating flexibility of the existing transmission system. Central assumes responsibility to operate and maintain its interconnected facilities in accordance with NERC and regional Reliability Standards. System Impact Studies are required to evaluate the impact of the requested interconnection and alternative plans to meet established reliability criteria. After acceptable completion of the System Impact Studies, a Facilities Study will be required to determine the detailed facility interconnection requirements. The Facilities Study will address direct assignment interconnection facilities, network upgrades, cost estimates, and construction scheduling estimates. Central will work with NPPD and SPP to conduct the Facilities Study and System Impact Studies.

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 Central and the requesting party. If additional equipment or replacement equipment is required to accommodate the facility interconnection, Central will retain equivalent transmission capacity and operational control as previously existed. The cost associated with equipment modifications is the responsibility of the requesting party. Central reserves the right to participate in the costs of proposed facility expansion plans that may be accommodated through mutually advantageous alternatives which provide substantial benefits to regional reliability or transmission transfer capability.

The requesting party 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 requesting party. Advance funds or deposits will be required by Central prior to any work being performed.

A direct interconnection into Central's transmission system does not guarantee transmission capacity on the system. Transmission service requests must be made in accordance with SPP's Federal Energy Regulatory Commission's (FERC) Electric Tariff. The SPP Tariff and the requirements to become a transmission customer are posted on the Open Access Same-Time Information System (OASIS) and SPP's website at www.spp.org .

4.0 RELIABILITY REQUIREMENTS

4.1 Transmission Planning

The Transmission Planning process is an important first step in the determination of interconnection feasibility for both new and materially modified existing. The transmission planning studies will identify impacts, deficiencies, operational issues, 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 NERC Planning & Operating Standards. The proposed interconnection must also comply with all MRO and SPP Standards and Criteria. The proposed interconnection must be reviewed by all impacted transmission owners and approved by the SPP Transmission Working Group (TWG).

Central will conduct or review System Impact Studies required to evaluate the system impact of a proposed interconnection on the reliability and capability of the transmission system. All costs to conduct or review System Impact Studies are the responsibility of the requesting party. The System Impact Studies will include, but are not limited to, power flow, dynamic stability, and short circuit studies. Small Signal Stability Studies or Electro-magnetic Transients Program (EMTP) studies may also be required, if deemed necessary. Evaluation of alternatives to the proposed interconnection, such as lower voltage construction, alternative interconnection points, reactive support facilities, or upgraded facilities, may be requested. Power flow analysis will require 10-year load and resource growth projections and the planned facilities needed to satisfy all pre-existing long term transmission service requirements. If the studies indicate that additions or upgrades to the existing transmission system are necessary, Central will conduct or review Facilities Studies, at the expense of the requesting entity, to determine the cost of additions or upgrades and the required timeframe for implementing system additions or upgrades.

The transmission planning process for a proposed new interconnection facility must also accommodate coordinated joint studies with other affected interconnected transmission system owners. Once a new facility is considered feasible for interconnection, the requestor shall notify the Nebraska Subregional Planning Group (SPG) and/or the SPP TWG.

The Nebraska Subregional Planning Group and the SPP TWG provide an appropriate technical forum of regional transmission providers who can review proposed facility plans and readily identify concerns, issues, and impacts. The regional transmission providers and requestors can work together to develop the most efficient transmission plan that will accommodate the proposed project and meet NERC reliability criteria. Any transmission planning studies performed by either Central or others will need to be reviewed and coordinated with the appropriate impacted parties.

The requestor shall provide the following detailed information for use in the transmission

planning studies:

- Facility one-line diagram depicting detailed proposed interconnection points, voltage levels, equipment data, breaker/switch configurations and protective relay zones.

- Transformer impedance data, winding configurations, voltage levels, thermal ratings, and available tap ranges.

- Generator nameplate data and machine constants, generator voltage rating, step-up and auxiliary transformer data, impedance data and ratings.

- Generator rotor, governor, exciter, power system stabilizer and any other generator auxiliary data.

- Generator MW/MVAR levels, reactive capability curves, operational power factors and proposed load factors.

- Transmission line configuration, impedance and thermal ratings.

Attachment 1 of this Facility Connections Requirements Document provides a detailed listing of all of the data requirements associated with a valid Generator interconnection request.

The requestor for a proposed facility shall specify the requested voltage level and MW/MVAR capacity and/or demand at the point of connection. For Generator Interconnection studies, the full nameplate capacity will be studied for injection at the requested location. All power flow and stability studies will evaluate the impacts of the maximum capability of the requesting interconnection facility. Also the full approved capacity of other existing generators in the impacted region will be studied and maintained. Any special operational considerations or limitations associated with the interconnection facility 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 development requirements are the responsibility of the requestor.

The System Impact and Facilities Studies will typically be performed in multiple sequential stages. Phase 1 of the System Impact Study (Feasibility Study) will address a first level power flow screening analysis of the proposed interconnection facility. Phase 2 of the System Impact Study will address a much more detailed power flow analysis, dynamic stability analysis, short circuit analysis and any other required study work. Phase 3 (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 System Impact Studies into a final Planning/Design study which will be formatted for submittal to the regional approval authority. The Interconnection Agreement

will be under the SPP Large Generator Interconnection Agreement (LGIA) process. The SPP LGIA process and standard interconnection agreement can be found at www.spp.org.

4.2 Generation Facilities

When Central considers integrating a new generation facility interconnection into the transmission system, additional special studies may be required based on the requested location of the interconnection request.

Automatic synchronization shall be supervised by a synchronizing check relay Electrical and Electronics Engineers (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 system without damage to them.

System voltage regulation is necessary for efficient and reliable electrical power delivery and for adequate service to loads. Voltage schedules establish hourly operating requirements and may be set for seasons, holidays, and days of the week or time of day. All interconnected synchronous generators are required to participate in voltage regulation by meeting voltage scheduling requirements. Central may require additional reactive capability or voltage regulations on some parts of its system to integrate the new generation interconnections. It is the generator owner's responsibility to mitigate any unacceptable reactive or voltage regulation problems created due to the integration of the generator. If Central requires additional reactive or voltage regulation to solve other problems in an area, Central reserves the right to negotiate with the generator owner for any additional capability beyond the minimum requirements stated above.

Synchronous generators are required to produce or absorb reactive power between 0.95 leading and 0.95 lagging power factors for steady state conditions to meet voltage schedules. Interconnected generators are also required to produce or absorb reactive power up to the thermal capability of the generator during transmission system disturbances. The voltage regulator must be capable of maintaining the voltage at the generator terminal bus without hunting and 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.

The excitation system of synchronous generators is required to be of a fast-response or High Initial Response type (the voltage response time is 0.5 seconds or less). 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 75 MVA and larger. However, it may be necessary to use a PSS on a smaller generator, depending on where the generator is interconnected to Central's system and how this machine participates in critical damping modes within the region. A Small Signal Stability Analysis may be required to determine the applicability of a PSS to any proposed interconnected synchronous generator.

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 area to assure proper system response to frequency variations. The speed governor system shall have an adjustable droop characteristic setting typically set to 5 percent.

Central's system protection requirements are designed and intended to protect the transmission system. Additional protective relays will be required to protect a new interconnected generator. It is the generation owner's responsibility to install the proper protective relaying needed to protect the generator equipment in coordination with Central system protection and applicable NERC/Regional standards. The owner of the generator is solely responsible for protecting interconnected equipment in such a manner that faults, imbalances, or other disturbances on the system are isolated by the owner's protective equipment and do not cause damage to the interconnected generation facilities.

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 Central's system. For proposed wind induction type generator interconnections, Central will require power factor correction at a minimum. Power factor correction capacitors must be installed by the owner of the generation. Switched capacitor banks supplied by the generation owner shall be coordinated with Central voltage control requirements and switched at the request of transmission operator. Owners of interconnected induction generators shall provide, at a minimum, sufficient reactive power capability to deliver the generator output at unity power factor at the point of interconnection. Dynamic reactive compensation through turbine based or substation based systems are also acceptable methods to provide voltage control at the point of interconnection. Dynamic reactive power compensation may also be required in addition to static power factor compensation at some locations. The System Impact Study will determine the reactive compensation required for the wind turbine generator interconnection. Wind generator interconnections are also required to meet the current technical standards for Low Voltage Ride Through capability and Power Factor Design Criteria (Reactive Power) as specified in FERC Order 661 and SPP Appendix G to the LGIA.

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 58.0 to 61.8 Hertz (per NERC PRC-024 frequency and voltage curves, Attachments 1 and 2). Even larger voltage and frequency deviations may be experienced for short periods of time and interconnected generators must have capability for off-nominal operation. Over/under voltage and over/under frequency relays are normally installed to protect the generators from extended off-nominal voltage/frequency

operations. To ensure that the interconnected generators do not trip prematurely, the time delays for these relays must be coordinated with NPPD's system protection schemes and NERC requirements.

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 critical system disturbances and maintains 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 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 applicability depends on the overall location and size of the generator and load on the transmission system; the nature, consequences and expected frequency of disturbances (NERC TPL Standards Table 1 Category C and D only); and the nature of potential alternative transmission reinforcements. If NPPD requires RAS participation for a particular generation facility, the generator owner shall be responsible for all related costs.

Generation integration 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 replacement costs required due to fault currents associated with new generation is the responsibility of the requesting party. Modifications to the ground grids of existing substations may also be necessary to keep grid voltage rises within safe levels. The ground grid shall be designed to a minimum of ANSI/IEEE Standard 80-2000, IEEE *Guide for Safety in AC Substation Grounding.*

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 restrict voltage stress to acceptable levels. System impact and/or Facilities studies will need to include the evaluation of the impact of the interconnected generator on equipment insulation coordination. Surge protection requirements will be in accordance with ANSI C37.90.1-1989-1994. Central will review breaker duty and surge protection to identify any additions required to maintain an acceptable level of Central system availability, reliability, equipment insulation margins and safety.

All generation equipment ratings shall be submitted to Central, the Balancing Authority and to the Regional Transmission Officer (RTO) and Regional Entity (RE) in accordance

with their data submittal requirements. Attachment 1 (Central Generator Interconnection Data Request Form) provides a detailed listing of all of the data requirements associated with a Generator interconnection request.

4.3 Transmission Facilities

Any proposed transmission facility interconnecting into Central's high voltage transmission system shall be coordinated and reviewed through the Transmission Planning process described in Section 4.1. 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 Transmission System or the SPP Regional Transmission system. Voltage levels shall be coordinated with NPPD's existing transmission system and substation operational voltage levels. Currently, NPPD's existing transmission system voltage levels are 345 kV, 230 kV, 161 kV and 115 kV. The transmission line/substation design and construction shall be in accordance with NPPD's transmission line/substation design and construction standards.

A transmission system switching study may be required to evaluate transient overvoltages caused by switching operations involving the proposed new transmission line. This study will be required for proposed 345 kV transmission facilities to address insulation coordination requirements due to potential switching surges. Also, proposed lower voltage transmission lines which are electrically close to existing 345 kV facilities may require a switching surge study in order to determine the Basic Insulation Level (BIL) requirements and/or switching voltage surge protection requirements for the proposed new facilities. The requestor is responsible for all Nebraska State required approvals, environmental requirements, protection coordination, interconnection metering, maintenance and control coordination. The thermal ratings for the proposed transmission facilities shall also be provided to Central and subsequently submitted to the Balancing Authority, regional RTO and RE. The thermal ratings shall be coordinated with industry standards and Central's thermal rating assumptions contained in Central's Facility Ratings Methodology document.

4.4 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.

All end-use load connected directly to the Central system are to maintain a power factor between 0.95 lag and 0.95 lead as measured at the point where the load interconnects with Central-owned facilities.

Central and NPPD maintain transmission voltages at levels required for the reliable delivery of electricity. Regulation to keep voltage variations within limits acceptable to end-use customers is typically provided at the distribution system level. Voltage regulation at transmission voltage levels is different from distribution voltage levels. Central and NPPD typically maintain transmission voltage levels between 0.95-1.05 Per Unit during normal conditions and between 0.90-1.10 Per Unit during emergency conditions. 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.

All end-user facilities connected to the Central system must meet the power quality standards set forth in Technical Requirements for Power Quality (Section 5.1). The requestor is responsible for any mitigation efforts necessary to meet those standards.

Central's system protection requirements are designed and intended to protect the Central system along with the NPPD 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. Central 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 system do not cause damage to the end-user facilities.

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

5.0 TECHNICAL REQUIREMENTS

5.1 Power Quality

Unbalanced phase voltages and currents can affect protective relay coordination and cause high neutral currents and thermal overloading of transformers. To protect Central and customer equipment, the interconnected facility contribution at the point of interconnection shall not cause a voltage unbalance (Phase to Phase) greater than 2%, or a current unbalance greater than 5%. Algorithms that use only the root mean square (rms) values to calculate unbalance, fail to take into account the contributions of angular displacement to unbalance and cause unpredictable results when harmonic voltages are present. The negative sequence and zero sequence unbalance provide more precise and more directly useful values and should be measured with equipment conforming to IEC 61000-4-30.

Any switching operation or energization of the Customer's facilities will not cause a voltage change (delta V) of greater than 3% at the point of interconnection with Central. Application examples are: energizing the step-up transformer or any fixed shunt switching operation. The measurement will be in accordance with IEC 61000-4-30 and based on a 1/2 cycle average.

As evidence of a Customer's ability to consistently meet the 3% or less voltage change requirement, Central recommends the performance and documentation of not less than four consecutive successful switching operations or energizations as a sufficient test. A single successful switching operation or energization is not deemed to be an adequate test of a Customer's ability to consistently meet the requirement.

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 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/load site or other locations on Central'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 Central system. This method significantly limits the amount of voltage and current harmonics entering the 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. The system shall be

designed such that the maximum voltage fluctuation for starting motors, switching transformers, and switching reactive devices will be 3% or less. All generators/loads connecting to the system shall comply with the limits set by this Standard.

Special studies, such as Electro-Magnetic Transients Program (EMTP) may be required to analyze the power quality impacts of a proposed facility. The customer will be responsible for the costs of any required special studies.

5.2 Engineering

Central will provide for engineering design and specifications of the proposed interconnection for Central-owned facilities. All engineering costs and engineering review costs for Central-owned facilities are the responsibility of the requesting party. For facilities owned by others, prints of applicable drawings will be furnished to Central upon request.

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

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

The requesting entity will supply drawings via an electronic file or other common storage device, compatible with Central's computer-aided design system, AutoCAD. If Central will operate and maintain the facilities, the Drawings for facility additions must conform to Central's Drafting Standards and be approved by Central. The requesting entity will reimburse Central for drawing costs. "As-built" drawings must be provided prior to final approval by Central. Three complete sets of accurate substation drawings shall be provided to Central for non-Central-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 Central within 60 days of any modification to non-Central owned equipment or substations on Central's system.

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

5.3 Substations

Generally, power circuit breakers must be installed at all interconnections with Central's system. Typical specifications covering circuit breaker requirements are available from Central upon request. A review of the surrounding area power system characteristics, including system stability studies, will be made for a final determination when the need for out-of-step switching capability is questionable.

Installation of equipment in substations must conform to Central's requirements and must be approved by Central. All oil-filled equipment, including bushings, shall not contain polychlorinated biphenyls (PCBs). In addition, oil-filled equipment shall be permanently labeled by the manufacturer as non-PCB (less than 2 parts/million). Certification shall be provided to Central 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 requesting entity.

The owner of 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, applicable NERC/Regional standards, and applicable environmental and safety standards. Central may require additional equipment to assure a reliable interconnection and to safeguard the proper operating conditions of its power system. Central prefers, in many cases, to provide required operation and maintenance (O&M) services provided funds have been advanced to cover these costs. Costs may include training on maintenance procedures for unfamiliar equipment.

The interconnection substation must have a ground grid that solidly grounds all metallic structures and other non-energized metallic equipment. This ground 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 substation under normal and fault conditions. The ground grid shall be designed to ANSI/IEEE Standard 80-2000, IEEE *Guide for Safety in AC Substation Grounding*.

Central personnel will conduct an inspection of the new substation interconnection facilities prior to the energization of these facilities. The inspection requirements will be consistent with the inspection requirements of existing substation facilities. Only after a satisfactory inspection is completed will the new substation interconnection facilities be authorized for energization and synchronization.

5.4 System Protection

Protective relaying requirements for each interconnection and relay scheme coordination will be determined by Central after review of the proposed interconnection and short circuit study work. Central requires receipt of a preliminary functional single-line drawing including relaying, current/potential transformer and basic control/tripping connections for the proposed interconnection and a single-line drawing and maps of the requesting entity's

system in the area. Any proposed pilot protection scheme (POTT, DCUB, DTT, etc.), including proposed communications channel and relay connections should be provided. The requestor will be required to provide all equipment ratings and positive, negative and zero sequence impedance data necessary to adequately model the proposed interconnection facility in a short circuit analysis. See requirements in Attachment 1. The requestor should also provide re-closer and fuse ratings, and relaying data necessary to address protective relaying coordination in accordance with NERC/Regional standards and requirements. High-speed piloted or communication assisted primary relaying, secondary relaying, breaker failure, and out-of-step relaying are normal Central requirements for 115 kV and higher voltage interconnections. Central will determine if the primary relaying scheme needs to be piloted, both the primary and secondary schemes needs to be piloted or if no piloted schemes are necessary for system stability. All short lines will have dedicated fiber for line differential relays for protection as determined by Central.

Specialized relaying may be required to provide automatic load, generation shedding or interconnected system separation. The NERC technical paper for Protection System Reliability will be applied on all BES equipment. The protection system will comply with all applicable NERC PRC standards. The protection system involves the protective relays, voltage and current sensing devices, associated communication equipment, DC circuitry and batteries as defined by the NERC PRC standards.

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 Central's Protective Relaying & Maintenance Procedures. Central personnel will need to be notified with procedures prior to and during any future maintenance and testing of protective relaying devices. The requesting entity is responsible for the costs associated with the ongoing testing and maintenance of the protective relaying and control equipment.

5.5 System Operations

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 energization. The initial synchronization will be supervised and coordinated with Central and NPPD personnel. Future synchronization will be controlled by NPPD Transmission System Control (TSC) personnel and will either be automatic or manual per the direction of NPPD TSC.

All communications and operating procedures during normal and emergency operating conditions will be initiated and controlled by NPPD TSC personnel. Any requests from the interconnected facility for any special operating considerations will be submitted to NPPD TSC for review and approval prior to execution. Emergency operating conditions will be handled in accordance with NERC 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 NPPD TSC. NPPD TSC personnel may not be

available immediately during all emergency conditions and the NPPD TSC will communicate the system status and any special operating restrictions to the interconnected facility as soon as feasible.

Circuit breakers, disconnects, interrupters and motor-operated disconnect switches that are an integral part of the transmission system shall be operated and dispatched by NPPD TSC. The NPPD Transmission System Control Center 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 NPPD switching and clearance procedures, including use of NPPD locks and tags.

The requesting entity making the interconnection will write Standard Operating Procedures in coordination with NPPD for the interconnected facility. Three sets of instructions and manufacturer's drawings shall be furnished to NPPD for each piece of equipment that NPPD operates.

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

Maintenance will normally be performed by and at the expense of the entity that owns the equipment or facility. Central shall be notified and have the right to witness settings and testing of relays, meters and controls that could affect the integrity and security of the transmission system. Central shall also have the right to enter interconnected facilities for emergency operation and maintenance of equipment or structures Central deems necessary to maintain a reliable power system.

5.6 System Control

Supervisory control by Central of circuit breakers, interrupters or motor-operated disconnects will be required on all interconnections that directly affect the security of Central's transmission system. The Remote Terminal Units (RTU's) for supervisory control shall be compatible with the Supervisory Control and Data Acquisition (SCADA) system used within the Central 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 requesting entity. Central will perform the necessary expansion, including hardware and software changes, to the SCADA master station equipment at the requesting entity'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 requesting entity. Specifications for such equipment will be provided upon request. The requesting entity

shall provide necessary auxiliary and control relays, hot-line indication, supervisory local/remote switches, and all other equipment necessary to interface with Central's supervisory control equipment.

Any new wind power generation interconnection facility will be required to provide a SCADA system with the ability to interface in real time with Central's Gothenburg Control Central and/or NPPD's Transmission System Control Center (Reference Appendix G of FERC Order 661A).

Interconnections that establish additional or new balancing area boundaries require the requesting entity to furnish all necessary balancing 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 Central's Gothenburg Control Center.

(3) Totalizing equipment at the point of interconnection or some intermediate point on the communications link. A multiport RTU may be substituted in some cases. If a multiport RTU is used, a points list identifying alarms, events and telemetered quantities will be jointly developed between the requesting entity and Central. The service agreement implementing the multiport 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 the Gothenburg Control Center and/or NPPD's Transmission System Control Center and other organization's power system control centers (if required).

Central'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.

Central reserves the right to maintain backup control on all facilities that interconnect with Central's transmission system and that may be vital to system stability and telemetry values.

5.7 Telecommunications

The requesting entity shall provide telecommunications facilities sufficient to meet Central's telephone, radio, system protection, remote meter reading and SCADA requirements. The communication channel and channel hardware will be provided by the requesting entity. Central 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 requesting entity will be reviewed and approved by Central. The requesting entity will reimburse Central for the costs of any additional facilities provided by Central.

Fiber optic additions to new or existing transmission facilities 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. Central reserves the right to charge a fee for right-of-way, pole attachments and/or acquire individual optical fibers on the circuit, per agreement between the interconnecting entity and Central.

5.8 Metering

Central will procure, supply and maintain all required metering equipment at the requestor's expense. 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.

Coupling capacitor voltage transformers (CCVTs) will not be used for metering.

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 Central.

Attachment 1

Central Generator Interconnection
Data Request Form

Requestor: *Organization:* _____
Contact: _____
Address: _____
_____
Phone: _____
E-Mail: _____

Interconnection Site Information:

_____ *Proposed New Generation Facility*
_____ *Increased Capacity At An Existing Generation Site*
Physical Location Site Description (County, City, Address, etc.):
_____
_____
_____
Electrical Location Site Description (Point of Interconnection):
_____
_____
Attached One-Line Diagram? (Y/N) _____

Generator General Information:

Fuel Type (Coal, Diesel, Wind, etc.): _____
Maximum Total Generation Capacity (MW): _____
Number of Generating Units: _____
Generator Type (Synchronous / Induction): _____
Expected Commercial In-Service Date: _____
Expected Initial Synchronization Date: _____

Generator Nameplate Ratings:

Machine MVA:	_____	*Power Factor:*	_____
Terminal Voltage (kV):	_____	*Machine Speed (RPM):*	_____
Frequency (Hz):	_____	*Short Circuit Ratio:*	_____

Generator Modeling Data:

Reactance Data (Per-Unit Machine MVA Base)

	Direct Axis		***Quadrature Axis***	
Synchronous - saturated	*Xdv*	_____	*Xqv*	_____
Synchronous - unsaturated	*Xdi*	_____	*Xqi*	_____
Transient - saturated	*X'dv*	_____	*X'qv*	_____
Transient - unsaturated	*X'di*	_____	*X'qi*	_____
Subtransient - saturated	*X''dv*	_____	*X''qv*	_____
Subtransient - unsaturated	*X''di*	_____	*X''qi*	_____
Negative Sequence - saturated	*X2v*	_____		
Negative Sequence - unsaturated	*X2i*	_____		
Zero Sequence - saturated	*X0v*	_____		
Zero Sequence - unsaturated	*X0i*	_____		
Leakage Reactance	*Xlm*	_____		

Time Constant Data (Sec)

Open Circuit Subtransient	*T''do*	_____	*T''qo*	_____
3-Ph Short Circuit Armature	*Ta*	_____		

Armature Winding Resistance

Positive R1_____ Negative R2_____ Zero R0_____

Total Inertia (Generator + Turbine)

Inertia Constant H_____ MW-sec/MVA (On Machine MVA Base)

Generator Characteristic Curves

Generator Reactive Capability Curves	*Attached? (Y/N)*	_____
Generator Vee Curves	*Attached? (Y/N)*	_____
Generator Saturation Curves	*Attached? (Y/N)*	_____

Excitation System Data

Identify appropriate IEEE model block diagram or PTI Power System Simulator Model of the excitation control system and power system stabilizer. The corresponding constant data is required for computer representation in power system stability simulations.

Governor System Data

Identify appropriate IEEE model block diagram or PTI Power System Simulator Model of the governor system. The corresponding governor system constant data is required for computer representation in power system stability simulations.

- *Note: If actual generator data is not available, Central will work with the customer to develop representative modeling data for use in the System Impact Study. Once the facility is constructed and tested, the models must be updated with actual data and the complete data and test results must be provided to Central.*

Wind Generator Data

Number of Wind Turbines to be connected at the Point of Interconnection _____
Type of Induction Generating Unit _____
Manufacturer _____
Nameplate Rated MVA _____
Unit Maximum Output (MW) _____
Power Factor Control Characteristics _____
Voltage Control Characteristics _____

- *Note: Detailed dynamic modeling data for the specified wind turbines is required for computer representation in power system stability simulations. This includes data required to develop a detailed generator/converter model, electrical control model, turbine, and turbine control model. The data is required in compatible IEEE or PTI PSS/E format.*

Generator Step-up (GSU) Transformer Data

Generator Step-up Transformer MVA Base _____
Generator Step-up Transformer Rating(s)(MVA) _____
GSU Transformer Voltage Ratings *H*_____ *L*_____ *T*_____
GSU Winding Connection (Wye/Delta) *H*_____ *L*_____ *T*_____
Available Fixed Taps _____
Present Fixed Tap Setting _____

Generator Step-up Transformer Impedance
(R+jX or % R & % X on transformer MVA Base)

Positive Sequence	*R*	*X*	*MVA Base*
H-L	_____	_____	_____
H-T	_____	_____	_____
L-T	_____	_____	_____

Zero Sequence T-Model

- *Note: Following construction and testing, transformer test reports must be provided to Central.*