1. Table of Contents

2. Purpose

The purpose of this document is to present the Utility's planning and design requirements for generators connected to and operating in parallel with the Electric System to ensure the safety of people and property and the integrity of the Electric System.

This documentation is applicable to those individual generators or group of generators located at a single electrical location with an aggregate nameplate capacity greater than 10 MW.

The requirements herein for generators located at a single electrical location with an aggregate capacity of greater than 10 MW are general in nature and specific installations may be subject to additional requirements as determined in the reasonable judgment of the Utility.

3. Definitions

3.1 The Utility: NV Energy (NVE).

3.2 System User: Any customer connected to the Transmission or Distribution System.

3.3 Electric System: The combined Distribution and Transmission System of the Utility and all connected loads and generation sources.

3.4 Distribution System: Those electric facilities owned, controlled, and operated but the Utility that are not classified as part of the transmission system by the Federal Energy Regulatory Commission and subject to the Utility's open access transmission tariff (OATT) on file with the FERC.

3.5 Transmission System: Those facilities that are owned, controlled, and operated by the Utility that are classified as part of the transmission function in the Utility's open access transmission tariff (OATT) on file with the FERC.

3.6 A Parallel Generator: A generator that is interconnected to and operates in parallel with the Electric System.

3.7 Interconnection Study: The Interconnection Study examines steady state effects caused by parallel generators on the Utility Electric System.

3.8 Network Studies: The Network Study is performed using computer programs to determine the nature of any system impacts and to identify the corrective actions necessary to minimize these affects.

3.9 Parallel Operation: The operation of a system in which generation can be connected to a bus common with the Electric System such that power transfer between the Parallel Generator's facilities and the Distribution System mat result.

3.10 Capacity: The nameplate rating or aggregate total of the nameplate ratings of all of the units at one location.

3.11 WECC: Western Electric Coordinating Council.

4. Disclaimers

The standards outlined in Section 8.0 herein are for the protection of the Utility and System Users and are not for the protection of the Parallel Generator. The Utility's recommendations for Parallel Generator protection are included in Section 9.0. Such recommendations are not intended to be a comprehensive and exhaustive list of relays or equipment required to protect the Parallel Generator. The Parallel Generator is responsible for the protection of the generator and associated equipment.

5. Interconnection and Networking Study Requirements

An Interconnection Study, which develops requirements and alternatives with supporting cost estimates for the required interconnection facilities for all Parallel Generators with a Capacity greater than 10 MW, will be required. A Network Study may be required when the Utility believes that the size and location of the proposed generation may adversely impact the Electric System by decreasing reliability or degrading power quality below the values specified in approved tariffs and the Utility's standards. The Parallel Generator shall submit all data for the initial application (Attachment 1) and additional information as spelled out on Attachment 2 if a Network Study is required. In some cases, information in addition to that specified on the standard forms may be required to perform the necessary studies. The Utility will coordinate all necessary studies.

5.1 Interconnection Study

The Interconnection Study examines steady state effects caused by the Parallel Generators on the Electric System. The study is computer based and models the Parallel Generation within the Electric System.

The study will determine the optimum interconnection alternative for the project and recommend a system that meets the Utility's reliability and quality of service standards.

5.2 Network Study

Due to potential problems which may be caused by generation being added to the transmission system, Network Studies may be required. The Network Study is performed using computer programs to determine the nature of any system impacts and to identify the corrective actions necessary to minimize their affects, thereby assuring compliance with all WECC and Utility reliability standards. Depending on the size of the Parallel Generator, the Network Studies may require internal Utility review and possibly review by a WECC Study Group. All Network Studies are required to meet this WECC and Utility Assessment Practices Document. The need for a Network Study will be determined by preliminary analysis of the Interconnection Study. The following factors influence the need for a Network Study.

- Size of the Parallel Generator
- Location of the Parallel Generator with respect to other generators or System User's loads.
- Probability of islanding the Parallel generator
- Electrical Strength of the interconnected Electric System
- Location and use of series capacitors- SSR

6. Metering Arrangements

Metering installations shall comply with the Utility's Electric Service and Metering Requirements.

7. Interconnection Agreement, Application Forms and Data Forms

The application for interconnection is provided as Attachment 1.

The Parallel Generator must execute an interconnection agreement with the Utility prior to the interconnection and operation of the Parallel Generator.

8. Design Requirements: Parallel Generator

The following requirements are intended to protect other System Users and the Utility. The Parallel Generator may wish to install additional protective equipment for the protection of his facilities. Protection of the Parallel Generator and associated equipment is the sole responsibility of the Parallel Generator.

8.1 Interconnection Facility:

If the Parallel Generator is connected to the Transmission System, and the interconnection switchyard is an integral part of the Utility's transmission system, used to carry power on the transmission grid for the Utility or other customer's, then the Utility will direct the design, procurement, and construction of the interconnection facility (point of delivery), separate from the generator facilities, that will isolate the generation from the Electric System when required.

If the Parallel Generator is connected to the Transmission System and the interconnection switchyard's sole function is to correct the parallel generator to the transmission system for the present or in the future, then the parallel generator will have sole responsibility for the design, procurement, and construction, and maintenance of the interconnection facility (point of delivery). The interconnection facility design shall be reviewed and accepted by the Utility and on any relaying installed, shall be compatible with the Utility's standard relaying practices as required. The interconnection facility and/or generation plant shall make provisions for any required Utility communications or metering equipment.

If the Parallel Generator is connected to the Distribution System, the design, procurement and construction of the interconnection facilities of the Parallel Generator shall be done in accordance with Rule 9 and Rule 15. All members of the WECC have agreed to minimum requirements for both their generating units and system operations. All Parallel Generator will comply with these same minimum requirements. These requirements are published by the WECC in "Interconnection Guidelines or IPP's," available from the Utility or the WECC.

8.1.1 Interconnection Facility Components:

The interconnection facility, as a minimum, will consist of a suitably controlled environment, the interrupting and isolating device(s), protective control devices, and data-acquisition equipment. All the above will be enclosed in a fenced yard with restricted access. The Utility's Substation Construction Standards present the minimum design specifications for substation interconnection facilities which supplement the following requirements:

8.1.2 The control building will be temperature controlled and weatherproof to enclose the AC and DC power sources, relaying equipment, telemetering, supervisory RTU, and communication equipment.

8.1.3 The interrupting device will be a power circuit breaker capable of interrupting maximum available fault circuit or industry-standard minimum levels which ever is greater. It shall be directly controlled by the Utility's supervisory control system via Remote Terminal Unit (RTU).

Air-break switches will be installed on each side of the circuit breaker to isolate the breaker for inspection and maintenance purposes. Single-breaker schemes will not include bypass provisions. Where transmission lines terminate on switches, ground blades will be required (Kirk-key interlocks are required on disconnect switches used with ground switches).

8.1.4 The following protective relays will be installed at the interconnection point (minimum requirement). Typical settings required by the Utility are defined below. The Utility will provide site-specific settings prior to interconnection testing.

- Phase and Neutral Overcurrent Relays (IEEE 50/51): The Phase and Neutral Overcurrent Relays (IEEE 50/51) shall be microprocessor based relays with fault current and voltage event reporting capability and communication ports.
- Over/Under-voltage Relays (IEEE 27/59) Over/under-voltage protection will be set to pick up at ± 10 percent deviation from nominal with a definite time to trip of 3.0 seconds. In addition, a high-speed (0.15 seconds) trip will be initiated if the voltage at the interconnection exceeds 120 percent of nominal.
- Over/under-Frequency Relays (IEEE81): Under-frequency protection will typically be set per WECC and manufacturer's Guidelines. The turbine generator supplied by the Parallel Generator should be designed to operate at 58.0Hz for 15 seconds without any loss of life. Over-frequency protection will also be set per WECC Guideline.
- Synch-Check Relay (IEEE 25): This synch-check relay has to be designed for synchronizing a generator onto the Electric System. It will prevent the circuit breaker from closing under excessive phase-angle differences. This relay will also be designed to prevent the generator from energizing a dead Utility circuit.

These functions may be provided by redundant multifunction relays.

8.1.5 Instrument Transformers. Current transformers serving interconnection relays shall be class C400 or better if contained in a single switchgear with the interconnection relays. C800 current transformers shall be used if the current transformer circuits run between separate sets of switchgear or outdoor circuit breakers and a switchgear cabinet or control house. Voltage transformers shall have an accuracy class of 1.2 and a VA rating adequate to carry the load on the circuit and stay within the accuracy class. Instrument transformers for the metering circuits will have separate requirements.

8.1.6 A Supervisory Remote Terminal Unit will be installed at the interconnection facility with the necessary interface to connect it to the Utility's communications system. This system will provide telemetering and control.

The minimum information which will be remotely monitored with the telemetering equipment is listed as follows:

- Watts in/out
- Vars in/out
- Amps
- KWhr and kVARhr
- Line voltage at interconnection
- Interconnection breaker status/control
- Phase angle across the interconnection power circuit breaker.

8.2 Electric System Modifications required to Support Parallel Generator

In addition to the above requirements, new and/or upgraded distribution or transmission lines, replacement and upgrades of existing protective device(s) at other locations on the Electric System may be necessary as a result of the addition of the generation. This may include but not be limited to, distribution and/or transmission lines, breakers, relays, controls, and other protective devices.

Additional Electric System protection may be required if the Parallel Generator can be isolated with a portion of the Electric System so that the minimum load is less than or equal to the total output of all Parallel Generators on that portion of the Electric System. Additional relaying, a scheme utilizing transfer tripping, or some other method to minimize potential adverse effects caused by the Parallel Generator may be needed. Interconnection and Network Study results will determine any additional protection requirements.

8.2.1 Reclose Block: Reclose Block for Hot Line will be required on the circuit breaker(s) in the Utility substation(s) connecting the Parallel Generator to the Utility grid.

8.3 Interconnecting Line Extension

8.3.1 If the Parallel Generator is connected to the Distribution System the design, procurement and construction of the interconnection line extension of the Parallel Generator shall be done in accordance with Rule 9.

8.3.2 If the Parallel Generator is connected to the Transmission System, the Utility will direct the design, procurement, and construction of any interconnection line extension.

8.3.3 All interconnecting transmission or distribution lines must be constructed in compliance with the Utility's applicable design, construction, and material standards. In addition, all rights-of-way and permits will be reviewed and accepted by the Utility. It is the responsibility of the Parallel Generator to obtain all necessary rights-of-way and permits.

8.3.4 The extension line (Transmission or Distribution) design will be submitted to the Utility for review to ensure that the proposed installation meets the minimum requirements as specified by the Utility. The minimum standards include, but are not limited to, the Utility's Transmission Line Standards, the Utility's Distribution Line Standards, and WECC Rules.

8.4 Parallel Generator Facility Design Requirements

This section provides the minimum requirements that the Parallel Generator must meet for major equipment, design review, and design responsibility.

It is the Parallel Generator's responsibility to provide to the Utility, copies of operating manuals and procedures for Parallel Generator equipment.

Applicable codes- Installation of the Parallel Generator must meet all applicable national, state, and local building and safety codes such as but not limited to the National Electric Code, National Electric Safety Code (ANSI C2), ANSI and IEEE Standards, NEMA standards for electrical materials and equipment, and the Utility standards, as are in effect at the time of initial Parallel Operation and thereafter as may be required. The Parallel Generator is responsible for obtaining project approval, as necessary, from local authorities.

8.5 Major Equipment Requirements

8.5.1 Synchronous Generation- Units or groups of smaller units in one location with individual or total aggregate capacity of 10,000KVA or larger must use synchronous generators with speed-droop governors and high-speed excitation systems. The Utility may require direct or indirect voltage or power factor control of these units to maintain acceptable system operation. Multiple generator unit installations will require control voltage systems that provide for coordinated group operation. The Parallel Generator shall furnish reactive power as may be reasonably required by the Utility. The Utility will specify that generators with power factor control capability, including synchronous generators, be capable of operating continuously at any power factor between 95 percent leading (absorbing vars) and 90 percent lagging (producing vars) at any voltage level within ± 5.0 percent of rated voltage. For other types of generators with no inherent power factor control capability, the Utility reserves the right to specify the installation of capacitors by the Parallel Generator to correct generation output to near 95 percent leading power factor. The Utility may also require the installation of switched capacitors on its system to produce the amount of reactive support equivalent to that provided by operating a synchronous generator of the same size.

8.5.2 Exception: Units or groups of units connected directly to the Distribution System at a voltage of 25 kV or below must be reviewed for safety, security, and transient response associated with islanding conditions. Induction rather than synchronous generation may be required depending on the conclusions of this review. The Utility will specify induction or synchronous generation in those cases subsequent to the interconnection/transient studies.

8.5.3 Power Transformer- All step-up power transformers connected to the Electric System must have a grounded wye high-voltage winding. It is recommended that the low-voltage winding (generator side) of the step-up transformer be a delta connection (however, this connection may cause unacceptably high line to ground fault currents on the Utility distribution system and may need to be avoided for that reason). The nominal voltage ratings (high-side and BIL) must be compatible with the system voltages on the line to which it is attached. Nameplate drawing and certified test results detailing the losses and positive and zero sequence diagrams with impedance values of the transformer must be provided to the Utility.

8.5.4 Generator Controls. All generation facilities control equipment (continuous voltage regulators, limiters, controllers, etc.) will be functionally tested prior to final commissioning of the plant. Copies of all control equipment Laplace transform block diagrams will be forwarded to the Utility.

8.5.5 Speed-Droop Governors. Individual or groups of generators with a capacity greater than 10MW are required to have speed-droop governors with a permanent droop setting of 5% while synchronized to the Electric System. Separate generation controllers will have to be reviewed and accepted before the unit will be allowed to go into service.

8.5.6 High Speed Excitation/Initial Response Systems. Individual or group of generators with a capacity greater than 10 MW shall have high speed excitation/high initial response systems with operational, continuously acting (IEEE 421.1-latest revision), automatic voltage regulators. The excitation system nominal response (IEEE421.1-latest revision) of said systems are required to be 0.5 or greater. The Parallel Generator must supply the Utility with test results documenting the response ratio performance. In addition, the maximum ceiling voltage and time to reach 95% of ceiling voltage upon sudden application of circuit conditions which would obtain exciter ceiling voltage shall also be supplied.

8.5.7 Power Factor Controller/Voltage Controller. Individual or groups of generators with a capacity greater than 10MW may be required to have a power factor controller(s) or alternatively to have voltage controller(s) to regulate system voltage via the generator voltage regulator. Voltage and Power factor controller(s) shall be designed to be fully compatible with high-speed excitation system requirements described in Section 8.5.6 Determination of this requirement will be dependent on the results of the Interconnection Study performed by the Utility. All controllers will be continuous in operation.

8.5.7.1 Plants having more than one generator shall be designed with parallel power factor or voltage controls such that all units making up individual plants will operate as one unit.

8.5.7.2 The Parallel Generator shall provide the following information to the Utility.

8.5.7.3 Type of parallel compensation to be used on their generators while paralleled to the Electric System.

8.5.7.4 All proposed settings.

8.5.7.5 Drawings of the voltage control equipment and settings.

8.5.8 Voltage/Frequency Limiting. Each individual generator shall have voltage/frequency limiting within its excitation system. The settings and the roll off rates are to be forwarded to the Utility.

8.5.9 Excitation Limiting: Each individual generator shall have a minimum/maximum excitation limiting within its excitation system. All instantaneous and time delayed thresholds and time settings for under-over-excitation are to be forwarded to the Utility.

8.5.10 Power System Stabilizers (PSS): Pursuant to the WECC policy statement on Power System Stabilizers, each individual generator in an installation with Capacity greater than 10 MW is required to have a PSS installed with its excitation system. The calibration, testing, and operation of PSS equipment must be conducted in accordance with WECC standard procedures. The test reports of the calibrated PSS must be submitted to the Utility for review and acceptance. The PSS shall be tested along with the overall facility. The facility will not be considered operational until calibration of the PSS has been performed to meet the Utility's standards. A copy of the WECC Power System Stabilizer Test Procedures may be obtained from the Utility.

8.5.11 Testing: Testing of the Parallel Generators and all control equipment will be performed prior to final commissioning of the plant. An individual qualified in testing protective equipment (professional engineer, factory-certified technician, or licensed electrician with experience in testing protective equipment) must perform all required testing in accordance with the applicable accepted test procedure to prove the settings and compliance with the requirements of this document. At the option of the Utility, a Utility representative may be present to witness the testing. The tests described are intended to provide assurance that the Parallel Generator will not adversely affect the Utility's Electric System and that it will cease providing power to the grid under abnormal conditions and to validate generating performance and modeling values. The test were developed assuming a low level of Generating Facility penetration. At high levels of Generating Facility penetration, other requirements and corresponding test procedures may need to be defined.

8.5.12 Upon initial Parallel Operation of a generating system, or any time interface hardware or software is changed that may affect the functions listed below, a Commissioning Test must be performed. The Utility has the right to witness Commissioning Tests as described below or to require written certification by the installer describing which tests were performed and their results. Functions to be tested during commissioning, may include any or all of the following:

- Over-and Under-voltage
- Over and Under-frequency
- Anti-Islanding function (if applicable)
- Non-Exporting function (if applicable)
- Inability to energize dead line
- Time delay restart after the Utility source is stable
- The Utility system fault detection (if used)
- Synchronizing controls (if applicable)
- Other interconnection protections that may be required as part of the Interconnection Agreement

8.5.12.1 Other checks and tests that may need to be performed include:

- Verifying final protective settings
- Trip test
- In-service test

8.5.12.2 The following tests are also to be performed prior to commissioning:

- Synchronous Unit Reactive Limits (WECC guidelines).
- Dynamic Testing/Model Validation (WECC guidelines).

8.6 Other Design Requirements

It is the responsibility of the Parallel Generator to incorporate the following into the design of their generation facility. The Parallel Generator's design should not be limited to only these items.

8.6.1 Full Load Rejection – The Parallel Generator must be designed with the capacity or protection to withstand loss of Electric System interconnection or load. The Utility is not responsible for damage to the Parallel Generator caused by a service interruption during abnormal Electric System conditions or the Utility Electric System reclosing.

8.6.2 Primary Voltage Changes – The generator exciter system and voltage regulation equipment on synchronous generators must be capable of operating subject to normal primary voltage changes on the Electric System ranging from 7.5% above or below nominal primary voltage to ±10% during emergency conditions. During a disturbance, the voltage may fluctuate beyond the ± 10% range. Therefore, it is the Parallel Generator's responsibility to protect all equipment from voltage excursions.

8.6.3 Harmonics – The Parallel Generator shall not cause unacceptable distortion of the sinusoidal voltage or current wave-form. The maximum allowable total harmonic voltage (all harmonics) and current distortion can not exceed the values published in the latest revision of IEEE Standard 519.

8.6.4 Voltage Sag – Motor starting and switching operations are limited so that the momentary voltage sag (flicker) during motor starting or switching does not exceed the Utility's standards for nominal system voltage for any other System User. Analysis of these requirements will be included in the Utility's Interconnection Study.

8.6.5 Protective Functions shall be equipped with automatic means to prevent reconnection of the Generating Facility with the Distribution System unless the Electric System service voltage and frequency is of specified settings and has been stable for a minimum of one minute.

8.6.6 Protective Relaying

8.6.6.1 The protective relays listed below are the responsibility of the Parallel Generator. The proposed relay settings are to be approved, stamped, and signed by a Professional Electrical Engineer with registration in the state where the Parallel Generator is located. The Parallel Generator one-line and three-line diagrams shall be submitted to the Utility for acceptance prior to interconnection.

8.6.6.2 In addition to the protective relaying required by the Utility at the interconnection point, the Parallel Generator must, as a minimum, install at the Parallel Generator site the protective relays described below. These relays: 1) provide short circuit protection for the Electric System and 2) provide backup for the voltage and frequency relaying located at the interconnection facility.

8.6.6.3 As part of the design review, the submitted one-line diagrams must indicate the following:

- Generator protective devices and their functions
- Current and potential transformer ratios and ratings
- Wiring demarcation points (when required)
- Other protective device types, styles, and setting

Acceptance of the proposed settings is intended for the protection of the Electric System and shall not constitute the acceptance of the adequacy of relay settings or liability for any inadequacy that may affect protection of the equipment used by the Parallel Generator.

The protective relays listed below shall meet all applicable sections of ANSI/IEEE Standard C37.90 for relay and relay systems, and ANSI/IEEE Standard C37.90.1 for surge withstand capability.

All relays specified below shall be applied to each generating unit at the facility unless noted otherwise.

8.6.6.3.1 Over/under Voltage Protection (IEEE 27/59): Shall be set no higher than +10% of nominal each with 3.0 seconds of delay.

8.6.6.3.2 Over-frequency Protection (IEEE81): Shall be set per the WECC Off Nominal Frequency Policy, generator manufacturer's recommendations, and the Utility guidelines. Only solid state or digital relays (including multifunction) are acceptable for over/under-frequency protection.

8.6.6.3.3 Under-frequency Protection (IEEE 81): Shall be set per the WECC Off Nominal Frequency Policy, generator manufacturer's recommendations, and the Utility guidelines. Only solid state or digital relays (including multifunction) are acceptable for over/under-frequency protection.

8.6.6.3.4 Voltage Controlled or Restrained Phase Overcurrent Protection (IEEE 50V/51V). These relays provide primary protection for multi-phase faults on the Electric System. Their settings will have to be determined on a site specified basis in a cooperative effort between the Utility and the Parallel Generator. These relays must have voltage control or voltage restraint, as they may be set below the full output level of the generating unit. The relays shall respond to all multi-phase faults on the inter-connection line up to the interconnection breaker (or beyond this point, depending upon the terminal configuration of the interconnection facility), and shall trip with typical delays of 0.5-2.0 seconds.

8.6.6.3.5 Transformer High Side Neutral Overcurrent Protection (IEEE 50/51). A single overcurrent relay with a Utility industry standard "very inverse" characteristic shall receive operating current from a multi-ratio transformer in the high voltage neutral of the step-up power transformer. The settings of this relay will also be determined through cooperation between the Utility and the Parallel Generator.

8.6.6.3.6 Breaker Failure Relaying (IEEE 50BF). Breaker Failure delaying shall be installed where feasible. It shall be designed to trip the individual generator breaker(s) or the Utility interconnection breaker after a breaker failure time interval if the Parallel Generator main breaker should fail to trip when required to do so. The breaker failure relay scheme shall be initiated by all protective relays that trip the main breaker and shall include current supervision. The breaker failure scheme shall trip the backup breakers through a manual reset lockout relay.

8.6.7 Synchronizing Equipment

8.6.7.1 Synchronizing equipment is required for synchronous generators at the interconnection, generator, and other breakers where synchronization may occur. The generator must be brought on-line parallel to the Electric System by one of the following methods:

8.6.7.2 Automatic synchronizing – A synchronizer, capable of issuing a close command in advance of synchronism such that breaker will close with zero voltage across the open breaker contacts, together with a synch-check relay, designed for synchronizing generators onto the Electric System, is required to automatically synchronize a generator onto the Electric System.

8.6.7.3 Manual synchronizing– A synch-check relay, designed for synchronizing generators onto the Electric System, together with a synch-scope is required to supervise manual closing of the generator circuit breaker.

8.6.8 Telephone Requirements

The Parallel Generator may be required to install a telephone for the Electric System Control Center (ESCC) at the Utility. The telephone communication between the Parallel Generator and ESCC shall be delay free.

8.6.9 Maintaining Efficiency and Safety

Following initial interconnection when existing equipment and measures are demonstrably insufficient to prevent damage to property or persons on the Electric System or unreasonably degrades the ability of the Utility to operate the Electric System efficiently or safely additional protective equipment, operational equipment, and safety measures may be required.

9. Protection Design Recommendations: Parallel Generator

The Parallel Generator is responsible for protection of its facilities from any and all sources of potential damage. This section identifies protection that the Parallel Generator should consider for its own protection. The protection identified is not all-inclusive and additional relays or other protective equipment may be appropriate for some installations. The minimum design requirements in Section 7.0 are not intended to protect the Parallel Generator from every possible source of damage. It is recommended that the Parallel Generator utilize a Professional Electrical Engineer with Registration in the state where the Parallel Generator is located to appropriately specify, apply and integrate the Parallel Generator into the Electric System.

- Over/under-speed protection (IEEE 12/14).
- Phase and/or ground distance (IEEE 21)
- Reverse power protection (IEEE 32)
- Loss of excitation protection (IEEE 40)
- Loss of phase/negative sequence protection (IEEE 46)
- Overcurrent protection (IEEE 50/51)
- Machine ground protection (IEEE 64)
- Generator differential protection (IEEE 87G)
- Transformer differential protection (IEEE 87T)

Multifunction microprocessor relays having functions appropriate for the application can often perform a number of these functions. In critical applications redundant relays are recommended. Further guidance for the protection of generators can be found in publications such as IEEE/ANSI C37 series guide recommendations and IEEE publication catalog number 95TP 102.

10. Attachments

Attachment 1: Application for the Interconnection of a Generator with a Capacitor Greater than 10 MW for Parallel Operation with the Utility System

Attachment 2: Data Required for a Generation Interconnection Network Study

Attachment 1

Application for the Interconnection of a Generator with a Capacitor Greater than 10 MW for Parallel Operation with the Utility System

Facility Information	**Where will the Generating Facility be Installed?**		
Contact Person	Phone	Fax	Email Address
Company Name	Meter Number		
Street Address	City	State	Zip Code
Mailing Address (if different from street address)	City	State	Zip Code

Applicant Information	**Who will be contractually obligated for this Generating Facility?**		
Contact Person	Phone	Fax	Email Address
Company Name	Meter Number		
Street Address	City	State	Zip Code
Mailing Address (if different from street address)	City	State	Zip Code

Contractor/Installer Information	**(if different from above)**		
Contact Person	Phone	Fax	Email Address
Company Name	Meter Number		
Street Address	City	State	Zip Code
Mailing Address (if different from street address)	City	State	Zip Code

Attachment 1: Standard Data Required for a Generation Interconnection Study.

Note: For values given in per unit, please include bases. If there are any questions concerning these forms, please contact The Utility.

1. **A range and township site map** of the planned facilities with the turbine/generator, step/up transformer, and substation identified (please attach).

2. **A one-line diagram** of the planned generation facilities (lease attach). The one-line diagram should include:

   A. Transmission/Distribution Line(s)
   B. Generators
   C. Transformers
   D. Motors
   E. Breakers
   F. Fuses
   G. Lightning arrestors
   H. Disconnect switchers
   I. Power factor correction equipment (i.e., capacitors/reactors)
   J. Station service loads
   K. Excitation system
   L. Other special devices

3. **A construction schedule** with construction power, start-up power, and full load testing dates identified. If a more detailed schedule is available, please attach.

   Start Construction: ____________________ *(date)*
   Construction Complete: ____________________ *(date)*
   Start-up, Begin Full-load Testing: ____________________ *(date)*
   Full-load Testing Complete ____________________ *(date)*

4. **An estimated one-line date** and the total future capacity for any additional generation added at the initial site.

   MW: ____________________ *(date)*
   MW: ____________________ *(date)*
   MW: ____________________ *(date)*
   Etc.

5. **Turbine/generation Data:**

Information should be provided for each generator. Generators must be synchronous if aggregate is 1MVA or greater.

	Unit 1	Unit 2	Unit 3
A. Type of generating unit			
(i.e., induction or synchronous)	______	______	______
Manufacturer	______	______	______
Excitation system type	______	______	______
B. Rated MVA	______	______	______
C. Maximum Gross Output (MW)	______	______	______
D. Rated leading power factor	______	______	______
Rated lagging power factor	______	______	______
E. Nominal voltage and acceptable voltage range (volts +/-%)	______	______	______
F. Estimated load factor, number of hours/year of operation, or MWH/year.	______	______	______
G. Stability Data:			
1. Inertia of turbine/generator (MW-Sec)	______	______	______
2. Transient direct axis reactance (PU)	______	______	______
3. Excitation system data (Note 1, Attach)	______	______	______
4. Governor data (Note 1, Attach)	______	______	______
5. Laplace transform block diagrams of the control equipment (Note 1, Attach)	______	______	______
H. Voltage/Frequency Limits			
1. Pickup settings	______	______	______
2. Roll off rates	______	______	______
I. Minimum/maximum Excitation Limits			
1. Underexcitation			
a. Instantaneous	______	______	______
b. Time delayed	______	______	______
2. Overexcitation			
a. Instantaneous	______	______	______
b. Time delayed	______	______	______

Note 1: This information may not be required for an Interconnection Study, but required before the actual operation of the unit.

6. **Step Up Transformer Data:**

Note: Information should be provided for each transformer. Step-up transformer(s) shall normally be grounded WYE on the high voltage winding.

	XFMR 1	XFMR 2	XFMR 3
A. Self-cooled and top MVA ratings (OA/FOA MVA)	________	________	______
B. Nominal voltage rating (kV) available taps for each winding (+/-%)	________	________	______
C. Electrical configuration of each winding (Delta or Wye)			
1. High side winding	________	________	______
2. Low side winding	________	________	______
D. Impedance of the OA Base (%)			
1. Positive sequence	________	________	______
2. Zero sequence	________	________	______

7. **Auxiliary Load Data:**

A. Maximum load and power factor (i.e., during plant shutdown and minimum facilities operating) __________________ *(kW & PF)*

B. Maximum load during start-up __________________ *(kVA)*

C. Maximum load and power factor during normal operation (KW & PF). Provide for one unit operating, two units operating, etc.

One Unit Operating __________________ *(kW & PF)*

Two Units Operating __________________ *(kW & PF)*

Etc.

D. Largest motor to be started __________________ *(HP)*
Starting method __________________ *(Starting Method))*
Inrush KVA at rated motor voltage __________________ *(kVA)*
Starts per hour __________________ *(Starts)*

8. **Conductor, spacing, and length of any distribution or transmission lines** planned to be constructed by the power producer:

A. Conductor size & type __________________ *(Conductor Size/Type)*

B. Spacing __________________ *(Feet)*

C. Length __________________ *(Miles)*

D. Voltage __________________ *(kV)*

9. **Power system stabilizer:**

Calibration and test reports.

Attachment 2: Data Required for a Generation Interconnection Network Study

Note:All items are considered mandatory. Ignore any items for which the data has previously been supplied. For values given in per unit, please include bases. If more than 3, please attach additional data sheets.

1. **Transmission/distribution line data:**
   - A. Voltage, Line-to-Line ________________ *(kV)*
   - B. Line Length(s) ________________ *(Miles)*
   - C. Conductor Size/Type ________________ *(Conductor Size/Type)*
   - D. Neutral Size/Type (if applicable) ________________
   - E. Neutral Grounding Configuration ________________
   - F. Line Structure Type(s) (configuration of conductors and neutral with height above ground and spacing's denoted) ________________

2. **Transformer Data:**

	XFMR 1	XFMR 2	XFMR 3
A. Primary/Secondary/Tertiary MVA Ratings	_______	_______	_______
B. Primary/Secondary/Tertiary kV Ratings	_______	_______	_______
C. Primary/Secondary/Tertiary Tap(s) (Note intended operational taps)	_______	_______	_______
D. Winding Connection Diagrams (Please attach)			
E. BIL Ratings (kV)	_______	_______	_______
F. Impedance on the OA Base			
Positive	_______	_______	_______
Zero Sequence	_______	_______	_______

3. **Capacitor/Reactor Data:**
   - A. Type ________________
   - B. Rated KVA ________________ *(kVA)*
   - C. Rated kV ________________ *(kV)*
   - D. Impedance (ohms) ________________ *(ohms)*

4. **Station Service Load Data:**

   A. Types of Loads and KVA ____

   B. Total Operational Load KVA and Power Factor

      1. Normal ________________ *(kVA & PF)*
      2. Maximum ________________ *(kVA & PF)*
      3. Minimum ________________ *(kVA & PF)*

5. **Lightning Arrestor Data** (Provide information for all Arrestors; i.e., Line and Transformers):

   A. Manufacturer ________________

   B. Type ________________

   C. Voltage Ratings ______________________________________ *(V)*

6. **Induction Generator Data:**

	UNIT 1	UNIT 2	UNIT 3
A. Full Load Current	______	______	______
B. Power Factor	______	______	______
C. Slip or Speed at Full Load	______	______	______
D. Locked rotor current at 100% voltage	______	______	______
E. Locked Rotor Power Factor	______	______	______
F. Electrical Torque and Current Versus Speed Curve from 1% to 100% Speed	______	______	______
G. Moment of Inertia (WR2) of the Generator and Turbine (gearcase also if used)	______	______	______
H. Governor System Model with Parameters	______	______	______
I. Primer Mover System Model with Parameters	______	______	______

7. **The Utility/WSCC Full Representation Synchronous Generator Data:**

A. Generator Data:

	UNIT 1	UNIT 2	UNIT 3
1. Full Load Current	________	________	______
2. Maximum kW	________	________	______
3. Minimum kW	________	________	______
4. Terminal Voltage (kV)	________	________	______
5. Rated Power Factor	________	________	______
6. Direct-Axis Subtransient Reactance, X"D (PU)	________	________	______
7. Quadrature-Axis Subtransient Reactance, X"Q (PU)	________	________	______
8. Direct-Axis Subtransient Open Circuit Time Constant, T"DO (SEC)	________	________	______
9. Quadrature-Axis Subtransient Open Circuit Time Constant, T'QO (SEC)	________	________	______
10. Kinetic Energy, EMWS	________	________	______
11. Armature Resistance, RA (PU)	________	________	______
12. Direct-Axis Transient Reactance, X'D (PU)	________	________	______
13. Quadrature-Axis Transient Reactance, X'Q (PU)	________	________	______
14. Direct-Axis Non-Saturated Synchronous Reactance, XD (PU)	________	________	______
15. Quadrature-Axis Non-Saturated Synchronous Reactance, X'Q (PU)	________	________	______
16. Direct-Axis Transient Open Circuit Time Constant, T'DO (Sec)	________	________	______
17. Quadrature-Axis Transient Open Circuit Time Constant T'QO (Sec)	________	________	______

18.	Stator Leakage Reactance, XL (PU)	______	______	______
19.	Saturation at 1.0 P.U. Terminal Voltage, SG1.0	______	______	______
20.	Saturation at 1.2 P.U. Terminal Voltage, SG1.2	______	______	______

B. Exciter Data:

		UNIT 1	UNIT 2	UNIT 3
1.	Voltage Regulator Gain, kA	______	______	______
2.	Voltage Regulator Lag Time Constant, TA (sec)	______	______	______
3.	Maximum Voltage Regulator Output, VRMAX (PU)	______	______	______
4.	Minimum Voltage Regulator Output, VRMIN (PU)	______	______	______
5.	Exciter Constant Related to Self-Exciter Field, KE (PU)	______	______	______
6.	Exciter Time Constant, TE (sec)	______	______	______
7.	Exciter Saturation at Maximum Field Voltage, SE1 (PU)	______	______	______
8.	Exciter Saturation at 75% Maximum Field Voltage, SE2 (PU)	______	______	______
9.	Minimum Exciter Output Voltage, EFDMIN (PU)	______	______	______
10.	Maximum Field Voltage, EFDMAX (PU)	______	______	______
11.	Analytical Functions and Associated Constants:			
	a. Exciter Gain Constants	______	______	______
	b. Exciter Time Constants (sec)	______	______	______

C. Governor/Turbine Data:

1. Power Output of Turbine (MW) ________ ________ _______

2. Steady-State Droop ________ ________ _______

3. Maximum Valve Opening Velocity (/sec) ________ ________ _______

4. Maximum Valve Closing Velocity (/sec) ________ ________ _______

5. Analytical Block Diagram with Transfer Function and Associated Constants:

   a. Governor Time Constants (sec) ________ ________ _______

   b. Turbine Time Constants (sec) ________ ________ _______

   c. Turbine Gain Constants ________ ________ _______

   d. Voltage/HZ Limited Data:

      1. Pick-Up ________ ________ _______

      2. Roll Off Rate ________ ________ _______

   e. Minimum/Maximum Excitation Limiter Data:

      1. Minimum Capability Curve ________ ________ _______

      2. Instantaneous Field Current Threshold ________ ________ _______

      3. Delayed Field Current Threshold ________ ________ _______

      4. Delayed Field Current Time Delay ________ ________ _______

         A. Inverse Timer Setting ________ ________ _______

         B. Fixed Timer Setting ________ ________ _______