

Rule and Regulation No. 21

INTERCONNECTION, RELAYING AND METERING STANDARDS FOR GENERATORS, TRANSMISSION AND END USERS

I. Introduction

These guidelines state the minimum requirements for safe and effective operation of Customer-owned generation (Generating Facility) on the Farmington Electric Utility System (FEUS). Customers and FEUS personnel may be guided by this document when planning installations of a Generating Facility. These requirements are general and may not cover all details in specific cases. The Customer should discuss project plans with FEUS before purchasing or installing equipment. Depending on the size of the Generating Facility, a Customer may also have to abide by some additional requirements or agreements as follows:

- Qualifying Facilities less than 40 kW shall require Small Facility Interconnection Agreement.
- Non Emission Generating Facilities at or above 40 kW to less than 500 kW and all Emission Generating Facilities rated less than 100 kW shall require Medium Facility Interconnection Agreement.
- All other Generating Facilities, rated at or above 500 kW and less than 4,000 kW and proposing to connect to the FEUS distribution system, shall require Large Facility Interconnection Agreement.
- All Generating Facilities with point of interconnection at the transmission or sub-transmission voltage level shall follow the FEUS Facility Connection Requirements for Generation, Transmission and End-user Facilities. The transmission connected Generating Facilities shall also comply with applicable North American Electric Reliability Corporation (NERC) and Western Electricity Coordinating Council (WECC) reliability standards.

The term “Customer” for the purpose of this Rule and Regulation, will be used to refer to both cogenerators and small power producers, even though they may not actually be customers of FEUS electric services. The term “Generating Facility” refers collectively to power generating equipment and other associated electric devices located behind the Point of Common Coupling.

II. Interconnection Process

The requests for interconnections to the FEUS system under this Rule 21 will be processed according to the following basic flow chart. Further details are explained in the subsequent sections.

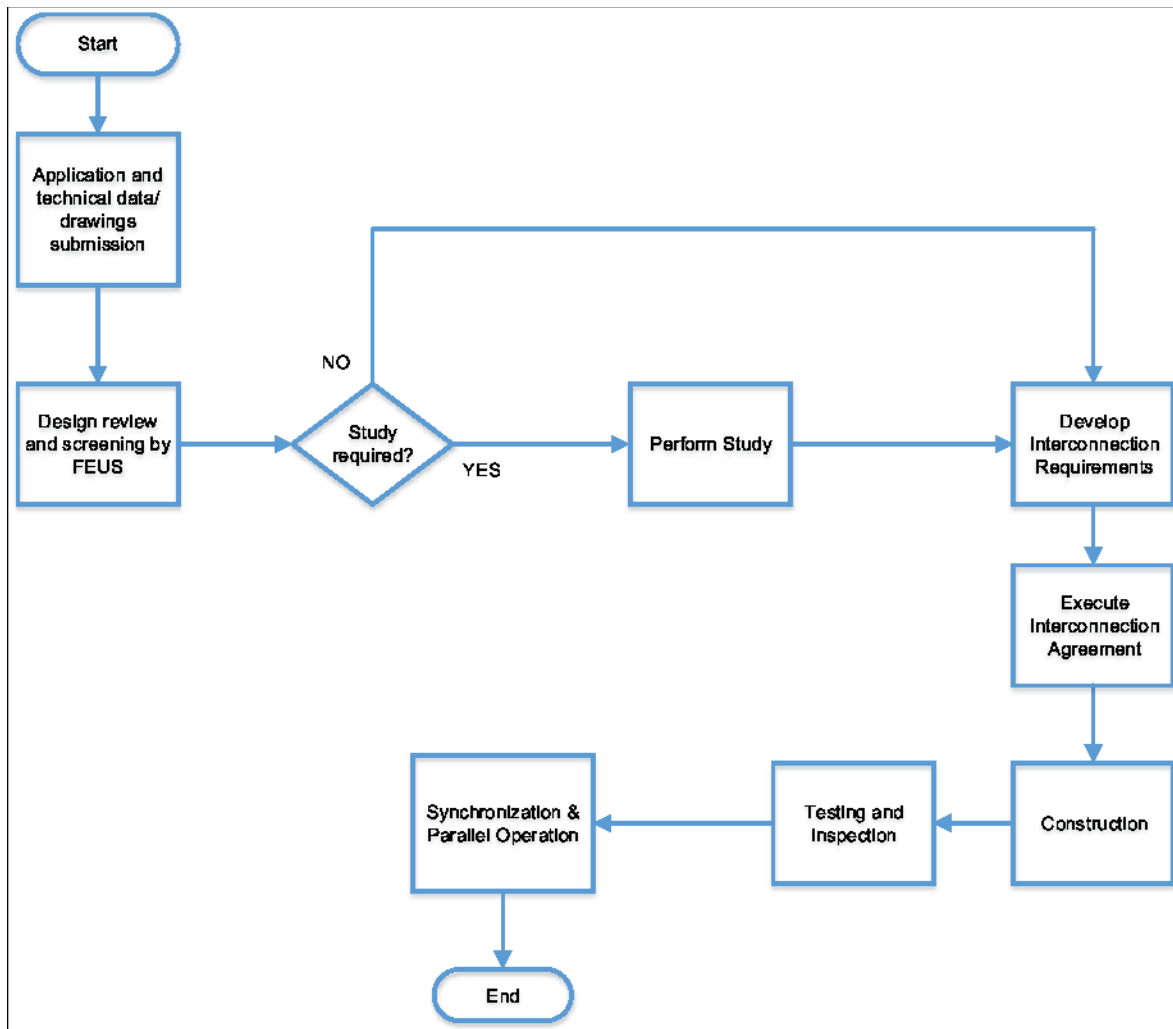


Figure 1. High-Level Process Flow Diagram for the FEUS Interconnections

The application package review and study will include, but not be limited to, evaluating MW and MVAR injection or withdrawal at the point of interconnection; thermal loadings of the impacted FEUS facilities; breaker duty; system protection and coordination; overall protection design, including surge arrestors, voltage, reactive power and power factor control, power quality impacts, voltage flicker, grounding and safety issues, metering and telecommunications, operational issues (abnormal frequency and voltages), generator ride through capabilities, stability and electromagnetic transients. The scope and schedule of the review and study will depend on several factors such as connection voltage, rating of the proposed Generating Facility, type and design of the Generating Facility, etc. FEUS and solely FEUS will set the budget for conducting review and study of the interconnection. The Customer shall be responsible for deposits and payments necessary to complete the review and study of the interconnection.

Generating Facilities that require a study, shall abide by the additional requirements identified in the study report for safe a reliable interconnection to the FEUS system.

Customers with Generating Facilities greater than 1 MW, intending to connect to the FEUS distribution system, shall follow the guidelines below.

- Customers must contact FEUS so that a study may be conducted to determine the feasibility of any proposal due to the restrictive nature of interconnecting with FEUS.
- Each installation will be unique and thereby must be discussed and reviewed on a case-by-case basis to establish the requirements.
- A separate contract may be developed between the Customer and FEUS to cover the agreement reached on the installation, wheeling and or purchase of the output of the generator.
- Carbon-based generators: All costs of connection and utility system upgrades shall be at the Customer's expense. The request shall follow the guidelines based on size in other sections of Rule 21.
- Where multiple generators are connected to FEUS' system through a single service point, the class will be determined by the sum of the ratings of the generators. The classes are based upon generator nameplate ratings.

If a Customer has a dispute, or asserts a claim, with FEUS that arises out of or in connection with a Generating Facility connected or proposing to connect under this Rule and Regulation No. 21, or their performance, such Customer shall provide FEUS with written notice of the dispute or claim ("Notice of Dispute"). Such dispute or claim shall be referred to a designated senior representative of each party for resolution on an informal basis as promptly as practicable after receipt of the Notice of Dispute by FEUS. In the event the designated representatives are unable to resolve the claim or dispute through unassisted or assisted negotiations within thirty (30) Calendar Days of receipt of the Notice of Dispute by FEUS, such claim or dispute may be appealed to the Public Utility Commission (PUC) in accordance with Rule and Regulation No. 25. The decision of the PUC shall be final.

III. Policy on Customer Generation

It is the policy of the FEUS to permit any Customer to operate its Generating Facility in parallel with the FEUS electric system whenever this can be done without adverse effects to the general public or to FEUS personnel or equipment. Certain protective devices (relays, circuit breakers, etc.), specified by FEUS must be installed at any location where a Customer desires to operate generation in parallel with the FEUS system. The purpose of these devices is to promptly disconnect the Generating Facility from the FEUS system whenever faults or abnormal conditions occur. Other modifications to the electrical system configuration or protective relays may be required in order to accommodate parallel generation operation.

FEUS will not assume any responsibility for protection of the Generating Facility or any other portion of the Customer's electrical equipment. The Customer is fully responsible for protecting its equipment in such a manner that faults or other disturbances on the FEUS system do not cause damage to the Customer's equipment and the Customer's protective devices coordinate appropriately with the FEUS protection system. The Customer is responsible for any and all costs incurred by FEUS to allow for the operation of the Generating Facility.

IV. Generation Sources

The Customer may elect to use any of a variety of energy sources, including solar, wind, hydro or other types of sources in addition to conventional fossil fuels. FEUS will interconnect as required by all relevant Federal laws including PURPA and subsequent amendments, to a facility which is a “Qualifying Facility.” “Non-Qualifying Facilities” may be considered for interconnection by FEUS.

The end conversion for connection to the FEUS system must be 60 Hz sinusoidal alternating current at a FEUS standard voltage and FEUS phase rotation. The Customer may elect to operate its generator in parallel with FEUS or as a separate system with the capability of nonparallel load transfer between the two independent systems. The requirements for these two methods of operation are outlined below.

A. Separate System

A separate system is defined as one in which there is no possibility of connecting the Generating Facility in parallel with the FEUS system. For this design to be practical, the Customer must be capable of transferring load between the two systems in an open transition or non-parallel mode. This can be accomplished by either an electrically or mechanically interlocked switching arrangement that prevents operation of both switches in the closed position simultaneously. Many Uninterruptible Power Supply (UPS) systems do not specifically meet the separate system criteria.

If the Customer has a separate system, FEUS will require verification that the transfer scheme meets the non-parallel requirements. This will be accomplished by approval of drawings by FEUS in writing and, if FEUS so elects, by field inspection of the transfer scheme. FEUS will not be responsible for approving the Generating Facility and assumes no responsibility for its design, operation or effects on Customer loads.

B. Parallel Operation

A parallel system is defined as one in which the Customer’s generation can be connected to the utility’s system. A transfer of power between the two systems is a direct and often desired result.

Customer shall not commence Parallel Operation of its Generating Facility with FEUS unless it has received express written permission from FEUS to do so. FEUS shall authorize Customer’s Generating Facility for Parallel Operation or with FEUS, in writing, within five (5) Business Days of satisfactory compliance with the terms of all applicable agreements. Compliance may include, but not be limited to, provision of any required documentation and satisfactorily completing any required inspections or tests as described herein or in the agreements formed between the Customer and FEUS.

Utility lines are subject to a variety of natural and man-made hazards. The electric problems that can result from these hazards are principally short circuits, grounded conductors and broken conductors. These fault conditions require that the damaged equipment be de-energized as soon as possible because of the hazards they pose to the public and to the operation of the system. A parallel generator must have adequate protective devices installed to sense trouble on the utility system and promptly disconnect.

The protective devices and other requirements imposed by FEUS in the following sections are intended to disconnect the parallel generator when trouble occurs. The Customer is solely responsible for the protection of its equipment from automatic reclosing by FEUS. FEUS normally applies automatic reclosing to overhead distribution circuits. When the FEUS source breaker trips, the Customer must ensure that the Generating Facility is disconnected from the FEUS circuit prior to automatic reclosure by FEUS (the automatic reclosing on FEUS distribution feeders is normally delayed by at least 0.1 second or 6 cycles). Automatic reclosing not coordinated with the Generating Facility may cause severe damage to Customer equipment and could also pose a serious hazard. These requirements are few for small installations, but increase as the size of the generation increases. The general and specific requirements for parallel generation installations of various sizes are discussed in the following sections.

V. General Design Requirements

- A. The Customer's installation must meet New Mexico Public Regulation Commission rules for cogeneration and small power production, technical requirements of IEEE 1547 standard for connecting distributed resources, as well as all applicable national, state and local construction and safety codes.
- B. Protective devices (relays, circuit breakers, etc.) for the protection of FEUS system, metering equipment and synchronizing equipment must be installed as required by FEUS. The protective devices differ with the size of the installation. The Customer will be responsible for having the Generating Facility protective schemes tested by a qualified testing/calibration company.
- C. A manual disconnecting device, capable of interrupting the load, accessible to FEUS personnel, and which can be operated and secured for line clearances, must be provided. The form of this device will vary with the service voltage and capacity, but the device must allow visible verification indicating whether it is in the open or closed position.
- D. The Customer is required to submit detailed design specification and engineering information one hundred twenty (120) calendar days prior to interconnection. The design specifications must include the following:
 - 1. The service voltage and location of the point of interconnection.
 - 2. An electrical one-line diagram of the Generating Facility beginning at the interconnection point and the AC and DC schematics. Prior to being submitted to FEUS, all drawings/documents shall be approved by a Professional Electrical Engineer registered in the State of New Mexico. All drawings are to be prepared to professional drafting standards (no hand sketched drawings will be accepted).

The drawings should have sufficient detail to show the major elements of the facility electrical connections, interconnection and protective equipment, and point of interconnection. At a minimum the drawing should include:

- a. Generating unit.
 - b. Circuitry of the facility with conductor types, sizes, and bus electrical ratings.
 - c. Metering points and instrument transformers.
 - d. Interconnection transformer with impedance data and voltage ratios.
 - e. Relays or Intelligent Electronic Devices with relay device numbers and circuit breaker / interrupting devices.
 - f. Switchgear (as applicable).
 - g. Utility circuitry at point of interconnection.
3. A detailed description of how and where the Customer's load will be connected and disconnected.
 4. The capacity and ownership of all equipment and circuits.
 5. Capacity and interrupting ratings for equipment and safety devices, including detailed information of all protective relaying with settings.
- E. FEUS will review such plans and either accept or outline specific additional functions that must be provided along with supportive data within a reasonable period of time according to existing PURPA and NMPPRC requirements. A rejected plan must be modified and resubmitted for review.
- F. FEUS will approve only those portions of the design specifications that apply to protection of FEUS' electric system. FEUS may choose to comment on other areas that may appear to be incorrect or deficient, but will not assume any responsibility for the completeness, adequacy or accuracy of such comments or the adequacy of the design of these other areas.
- G. The Customer must agree to grant at no expense to FEUS all easements and rights-of-way necessary for FEUS to install, operate, maintain, replace and remove FEUS' metering and interconnection facilities, including but not limited to, adequate and continuous access rights to property owned by the Customers.

VI. General Operating Requirements

- A. The interconnection of the Generating Facility with FEUS shall not cause any reduction in the quality of service being provided to other Customers. The Generating Facility shall abide by the technical and performance requirements of IEEE 1547 standard unless FEUS has a more restrictive requirement documented to address specific reliability, safety or service quality concerns. If violation of a performance standard or technical requirement is identified as a result of operation of the Customer's generation, such generating equipment shall be disconnected until the problem is resolved to the satisfaction of FEUS at the expense of the Customer.
- B. The Customer shall not commence parallel generator operation until final written certification of compliance has been received from FEUS. FEUS reserves the right to inspect the Customer's facility and witness testing of any equipment or devices associated with interconnection.
- C. The Customer shall not be permitted to energize a de-energized FEUS circuit under any circumstances without prior FEUS permission. Failure to observe this

requirement will be cause for immediate and permanent disconnection of the generation facility. In addition, the Customer will be held responsible for all damages and injuries resulting from such actions.

Operation of the Generating Facility shall not adversely affect the voltage profile of the FEUS system to which it is connected. Unless specifically requested by FEUS, the Generating Facility shall not attempt to control or regulate the FEUS system voltage while operating in parallel with the FEUS distribution system. The generating facility shall not degrade the normal voltage provided by FEUS outside the voltage limits of ANSI C84.1. Automatic power factor or VAR controllers must be provided for installations utilizing synchronous generators. All generator installations over 100 kW must have the capability to operate within the full range of a 0.95 lead to lag power factor.

- D. For synchronous generators, sufficient generator reactive power capability shall be provided to withstand normal voltage changes on the FEUS system.
 - 1. The generator voltage-VAR schedule, voltage regulator and transformer ratio settings will be jointly determined by FEUS and the Customer to ensure proper coordination of voltages and regulator action.
 - 2. In cases where starting or load changing on induction generators will have an adverse impact on FEUS system voltage, step-switched capacitors or other techniques may be required to bring the voltage changes to acceptable levels. Units over 100 kW must be brought to within 5% of synchronous speed before connection to FEUS.
- E. The Customer shall maintain his equipment in good order. FEUS reserves the right to inspect the Generating Facility from time to time as it deems necessary upon reasonable notice to the Customer. Functional testing of all breakers, relays and transformers must be performed yearly. Installations over 100 kW must have a full relay calibration check performed every three (3) years or less by qualified personnel and certified test reports are to be sent to the designated FEUS representative.
- F. The Customer shall discontinue parallel operation when requested by FEUS for various reasons such as:
 - 1. To facilitate maintenance, test or repair of utility facilities.
 - 2. During FEUS system emergencies.
 - 3. When the Customer's generating equipment is interfering with other customers on the system.
 - 4. When an inspection of the Customer's generating equipment reveals a condition hazardous to the FEUS system or a lack of scheduled maintenance or maintenance records for equipment necessary to protect the FEUS system.
- G. The Customer may be required to notify FEUS of the power and energy production of each generator. Large power producers may be required to report energy and peak demand information daily.

VII. Design Information - FEUS System

- A. FEUS primary distribution voltage is 13.8 kV. Other voltages are also used in specific areas. Sub-transmission voltage is 69 kV. The 13.8 kV circuits are effectively grounded and are used for four-wire distribution (phase to neutral connected loads).

- B. Because most short circuits on overhead lines are of a temporary nature, it is FEUS' practice to reclose the circuit breakers on distribution lines within 0.1 seconds (6 cycles) and sub-transmission lines within three seconds after they have automatically tripped. The protective relays specified by FEUS for parallel generating interfaces are intended to disconnect the generation from faulty or isolated lines before reclosing occurs. It is the responsibility of the Customer to insure a proper disconnection before reclosing occurs.

VIII. Induction Generators

For generation aggregating less than or equal to 100 kW capacity, FEUS will supply the VAR requirements from general system sources at the current monthly charge specified in the applicable electric rate schedule. Installations over 100 kW capacity will require reactive compensation, such as capacitors, to be installed to maintain a power factor of at least 0.95. Such equipment will be installed at the expense of the Customer.

The self-excited induction generator can produce abnormally high voltages, which can cause damage to the equipment of other customers. Over voltage relays can limit the duration of such over voltages, but cannot control their magnitude. Because of these problems, the reactive power supply for large induction generators must be studied on an individual basis. In general, self-excitation problems are most likely in rural areas where the FEUS system capacity and load density are low. Where self-excitation problems appear likely, special service arrangements will be required, such as sub-transmission service in order to avoid the induction generator becoming isolated with small amounts of load. In many cases, the additional expense for such special service methods will outweigh the cost savings associated with induction generators.

IX. Inverter-based Generating Facilities

Inverter-based Generating Facilities shall comply with UL-1741 standard design guidelines. The inverter-based generation shall have adjustable voltage and frequency protection settings that shall comply with IEEE-1547 voltage and frequency ride through requirements. FEUS may develop more restrictive ride through requirements in the future, and the Customer shall adjust the protection set points or make reasonable efforts to make appropriate design changes (e.g., firmware upgrades) to comply with such requirements.

Reactive power supply requirements for inverter systems are similar to those for induction generators and the general guidelines discussed previously apply. Because of the possibility of self-excited operation, inverter-based Generating Facilities are treated the same as induction machines in these guidelines.

Total harmonic distortion (THD) in the Customers current waveform must be limited to values less than 20%. If a Customer using such a device for parallel generation is found to be interfering with other customers or FEUS, the generating Customer will be required to install filtering or other corrective measures to bring the harmonic output of his inverter to an acceptable level. A THD under 5% seldom causes interference problems. Inverters over 1 MW must have 5% or less THD.

X. Specified Protective Relaying Requirements

FEUS has established three different classes for Customer-owned parallel generation, each with its own protective relaying. These classes are:

- A. Installation of systems over 10 kW but less than 100 kW.
 - 1. All installations in this class will require a site review. The larger installations in this class must use high quality industrial grade relays or utility grade relays.
(See Appendix A). Requirements for small generators are as follows:
 - a. A dedicated transformer and fused cutout will be required to interconnect the small power producer with the FEUS system.
 - b. Over / under frequency relays.
 - c. Over / under voltage relays.
 - d. Circuit breaker or over current relay for fault protection.
 - e. Three-phase synchronous generators or forced commutated inverters will also require automatic synchronizing relays, electrically operated air-magnetic breaker for connecting the generator to the FEUS system.
 - f. Voltage unbalance relays.
- B. Installation from 100 kW to 1 MW.

All installations in this class require full, utility grade, protective relaying and a site review. Each installation will be unique and some variation from the Appendix B layout will be accepted provided the intent of the requirements is met.
- C. Installation over 1 MW.

The Generating Facility shall, at a minimum, provide adequate protective devices that include over/under voltage trip, over/under frequency trip, reverse power relay (for non-export generating facilities if required by FEUS), and a means for automatically disconnecting the generating facility from the FEUS distribution system whenever a protective device initiates a trip. Based on the review of the proposed project design, FEUS may require additional protective devices. The Generating Facility shall be equipped with protective equipment designed to automatically disconnect the generating facility from the FEUS distribution system for faults on the FEUS distribution circuit to which it is connected, and remain disconnected until the voltage and frequency have stabilized.
- D. Following are the general requirements for each project:
 - 1. Protection designs must be failsafe and ensure that the Generating Facility and FEUS' distribution system, customers, and general public safety are maintained.
 - 2. The design of the protections at the Generating Facility shall be done by a qualified professional engineer to ensure that the overall protection scheme will ensure a safe and reliable interconnection to FEUS' Distribution System and the Generating Facility.
 - 3. The protection schemes employed shall coordinate with FEUS' transmission and distribution system protections and shall be designed for present fault current levels; however, there should be sufficient margin to account for fault current increase due to system changes in near-term planning horizon (1-5 years).
 - 4. All protection operations shall ensure that the Generating Facility and all sources of disturbance are tripped within the required time from the start of the

disturbance. This time is measured from the start of the abnormal condition to the time the generation will cease energizing FEUS' electrical grid.

5. Communication facilities between the substation and/or recloser and the Generating Facility may be required as a result of Generating Facility interconnections to coordinate tripping and reclosing for all of the protective devices (e.g., Direct Transfer Trip).
6. The protection schemes shall be designed to detect and respond to abnormal system conditions, including but not limited to:
 - a. Balanced and unbalanced faults (line to ground, line to line, three phase).
 - b. Abnormal voltages.
 - c. Open Phase Detection.
 - d. Abnormal frequencies.
 - e. Islanding conditions.

XI. Metering Requirements

FEUS may install special meter(s) in order to obtain load research information. The Customer shall supply, at his own expense, a suitable location for all meters, visible disconnect switch and associated equipment. Such location must conform to the FEUS meter location policy and provide safe (no tripping hazards, domesticated animals or other obstructions, etc.) and easy, unrestricted and unimpeded access to FEUS personnel. All meter standards and testing shall be in compliance with FEUS' rules and regulations. The metering configuration will be one of FEUS' standard metering configurations as set out in the FEUS Meter and Service Guide.

XII. Telemetry

Should FEUS require telemetry equipment, the Customer must provide a suitable enclosure with a convenience outlet to house such equipment. The Customer must provide the appropriate secondary current and voltage quantities through either separate voltage and current transformers or access to their protective relaying circuit. Reasonable access must be provided by the Customer to FEUS or their designated representative for installation, testing and repair of the telemetry.

Original date: circa 1978

Revision 1: 1998

Revision 2: 2003

Revision 3: February 5, 2008

Revision 4: September 8, 2015

Revision 5: Approved February 23, 2016

Revision 6: May 17, 2018