Facility Connection Requirements

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1. INTRODUCTION

1.1 BACKGROUND

Southern Maryland Electric Cooperative, Inc. (SMECO) is a customer-owned electric cooperative providing electricity to over 165,000 customers in southern Prince George's County, Charles County, Saint Mary's County, and all but the northeast portion of Calvert County.

SMECO is currently registered with the North American Electric Reliability Council (NERC) within the Reliability *First* (RF) Region as a Distribution Provider (DP) and Transmission Owner (TO). SMECO has also executed the Consolidated Transmission Owners Agreement (CTOA) and, as such, is a TO whose transmission facilities are under the operational control of PJM Interconnection, L.L.C. (PJM). SMECO's transmission facilities are interconnected with the Potomac Electric Power Company (PEPCO) transmission system, and SMECO serves as a Transmission Owner Control Center (TOCC) in PJM. SMECO complies with the "Amended and Restated Operating Agreement of PJM Interconnection, L.L.C." (PJM Operating Agreement), the PJM Open Access Transmission Tariff (Tariff), the "Interconnection and Mutual Operating Agreement" between PEPCO and SMECO, and the PJM Manual 14 series documents. The PJM Manual 14 series contains information specific to the generation and transmission interconnection process, planning studies, and facility connection requirements specific to the PJM system.

1.2 DISCLAIMER

This document, the associated Exhibits, and all the material contained herein are developed for guidance purposes only. It is produced as an informational and illustrational aid for customers considering purchasing generation equipment and interconnecting that generation equipment with the SMECO system (the interconnected arrangement of lines, transformers and generators that comprise SMECO's electric system). The information herein is intended to be of a general and typical nature and does not pertain to a specific facility or site. Furthermore, the requirements and practices described herein are subject to change based upon several factors, such as changing regulations. Accordingly, SMECO makes no warranty of any nature whatsoever concerning the information contained in this document.

1.3 PURPOSE

SMECO has prepared this document, and the associated Exhibits, to establish the requirements for interconnection to the SMECO electric system for generation, transmission, and end-user facilities.

These requirements are intended to promote safe operation, system integrity and reliability of the SMECO and interconnected systems. These requirements are minimums to be used as a guide toward SMECO's processing of interconnection requests. A thorough review and understanding of these requirements will assist a requesting party in obtaining timely and mutually satisfactory responses.

Each request for an interconnection will be evaluated on a case-by-case basis and will be subject to meeting the reasonable needs of the requesting party. The requesting party may be an Independent Power Producer (IPP), another electric utility, a municipality, or a retail customer. Interconnections must meet electric utility standards, including but not limited to, applicable NERC reliability and cyber security standards, PJM standards, and SMECO standards. SMECO standards are available on the www.smeco.coop website. The review and approval requirements detailed here shall apply to all interconnected facilities regardless of which party performs the design, construction, or installation work. The requesting party must obtain final design and equipment approval from SMECO.

This document, and the associated Exhibits, will be revised as needed to meet current conditions and NERC Reliability Standards. SMECO shall make this document available within five business days to the users of the electric system, the Regional Reliability Organization, and NERC on request.

1.4 SCOPE/APPLICABILITY

This document, and the associated Exhibits, applies to any and all third parties wishing to interconnect to the SMECO electric system at any location or voltage level. The PJM Tariff and / or PJM Interconnection Service Agreement (ISA) requirements will supersede SMECO Facility Connection requirements in cases of inadvertent conflict. Interconnections that are not subject to the PJM Tariff may instead be subject to Maryland State regulations as specified in Code of Maryland Regulations (COMAR), COMAR Section 20.50.09.

2. SMECO RESPONSIBILITIES

Managing Director Asset Management	Provides technical support with respect to interconnection operational requirements, monitoring, and project review.
System Planning and Reliability Director	Maintains and approves this procedure. Provides technical support with respect to system studies and project review.
Project Management and Services Director	Provides technical support with respect to project management, construction, engineering, material procurement.

Reliability, Compliance, and Security Managing Director	Acts as the Chief Compliance Officer for regulatory matters

3. PROCEDURE DETAIL

3.1 DOCUMENTATION OF FACILITY CONNECTION REQUIREMENTS

Interconnections to the SMECO electric system shall comply with NERC, Reliability First (RF), PJM, and, as applicable, Maryland State requirements. Proposed Interconnections must not degrade reliability, operating flexibility, or safety of the existing electric system. System Studies will be required to evaluate the potential impacts of any proposed interconnections. Any such studies will be entirely funded by the requesting entity. See Exhibit "A", **Electric System Planning Criteria**, for additional details.

3.1.1 GENERATION FACILITIES[1]

Generation facility connection requirements described in this document are general overviews of functional requirements for connecting new generation to the SMECO electric system. Detailed, project specific requirements will be developed as part of coordinated Joint Studies, Interconnection Agreements, other applicable PJM, NERC or Regional Reliability Standards, applicable Regional Reliability Organization, Sub-regional, Power Pool planning criteria and facility connection requirements, or the National Electrical Safety Code (NESC).

3.1.2 TRANSMISSION FACILITIES[2]

Transmission facility connection requirements described in this document are general overviews of functional requirements for connecting new transmission facilities to the SMECO electric system. Detailed, project specific requirements will be developed as part of coordinated Joint Studies, Interconnection Agreements, other applicable PJM, NERC or Regional Reliability Standards, applicable Regional Reliability Organization, Sub-regional, Power Pool planning criteria and facility connection requirements, or the NESC. See Exhibit "B", **Substation and Transmission Line Design Criteria, for additional details**.

3.1.3 END-USER FACILITIES[3]

In the event an end-user proposes to connect to the SMECO electric system, the facility connection requirements described in this document are general overviews of functional requirements for connecting as a Delivery Point. Detailed, project specific requirements will be developed as part of coordinated Joint Studies, Interconnection Agreements, other applicable PJM, NERC or Regional Reliability Standards, applicable Regional Reliability Organization, sub-regional, Power Pool planning criteria and facility connection requirements, or the NESC.

3.1.4 MARYLAND STATE PRESCRIBED DISTRIBUTED GENERATION

Maryland State law may regulate the application, review, and approval process for connections at distribution voltages, including distributed generation such as, but not limited to, net-meter interconnections, aggregated net-meter interconnections, and Community Solar Energy Generation System interconnections. In such instances, the COMAR may supersede other SMECO requirements stated herein. Refer to COMAR for other potential applicable references.

3.2 DETAILED INFORMATION ON FACILITY CONNECTION REQUIREMENTS

This document has been prepared to identify the technical requirements for connecting new facilities to the SMECO electric system. It applies to new connections or substantial modifications of the system. Rather than give detailed technical specifications, this document provides a general overview of the functional objectives and requirements to be met in the design of facility connections. These requirements are written to establish a basis for maintaining reliability, power quality, and a safe environment for the general public, power consumers, maintenance personnel and the equipment. See Exhibit “C”, **Interconnection Requirements, for additional details**.

3.2.1 INTERCONNECTION STUDIES – PJM PROCEDURES

It is the intent of SMECO to achieve the required system performance and comply with the relevant NERC or Regional Reliability Standards as such relate to connections to the SMECO electric system throughout the applicable planning horizon. SMECO will work directly with PJM toward this intent as summarized in subsequent sections of this document.

3.2.2 COORDINATION THROUGH PJM PROCESSES

SMECO is registered as a TO with both NERC and PJM. PJM serves as the Transmission Service Provider, Planning Authority, Transmission Planner, Resource Planner, Reliability Coordinator, Balancing Authority, and Transmission Operator for SMECO. PJM operates its transmission system in compliance with NERC Reliability Standards, RFC standards, and PJM standards. Because PJM is the Transmission Service Provider for the SMECO transmission system, all entities requesting interconnection of a generating facility (including increases to the capacity of an existing generating unit or decommissioning of a generating unit) or requesting interconnection of a merchant transmission facility to the SMECO transmission system must do so within PJM's defined interconnection process. This process, in its entirety, ensures that all new or materially modified transmission facilities are within the metered boundaries of the PJM Balancing Authority Area[4]. See the PJM website http://www.pjm.com to obtain information about submitting requests for interconnecting to the transmission system. Part IV of the PJM Tariff discusses interconnections with the transmission system. The PJM Manual 14 series also addresses the interconnection process, planning study requirements, and facility connection requirements specific to the PJM transmission system:

PJM Manual 14A – New Services Request Process

PJM Manual 14A guides developers of generation and merchant transmission projects through the initial planning stage through the request for facility construction. This process ensures the successful, timely completion of PJM's planning, facility construction and operational and market infrastructure requirements. PJM Manual 14A explains how other parties are notified of new or modified facilities through the PJM RTEP process. [5]

PJM Manual 14B – PJM Region Transmission Planning Process

PJM Manual 14B focuses on the process for planning baseline expansion facilities under the PJM Region Transmission Planning Process. This planning process culminates in the Regional Transmission Expansion Plan (RTEP). The PJM RTEP process consists of baseline reliability reviews as well as analysis to identify the transmission needs associated with generation interconnection and merchant transmission interconnection.

PJM Manual 14C – Generation and Transmission Interconnection Facility Construction

PJM Manual 14C guides developers of generation and merchant transmission projects through the PJM RTEP queue project lifecycle from agreement execution to commercial operation and construction agreement closeout. In other words, this manual focuses on the requirements for interconnecting generating sources under PJM's RTEP and

describes the engineering and construction process to complete the interconnection of new facilities with the PJM grid. Also, this manual depicts the process for tracking projects driven by reliability criteria.

PJM Manual 14D – Generator Operational Requirements

PJM Manual 14D focuses on the operational requirements for generating entities to connect to the PJM system and their responsibilities as signatories to the PJM Operating Agreement.

PJM Manual 14E – Upgrade and Transmission Interconnection Projects

Among other things, this manual focuses on the specific requirements for interconnecting merchant transmission facilities, proposing capacity increases to specific TO facilities, and making upgrade requests to obtain incremental auction revenue rights under PJM's RTEP process. This manual describes the various rights available and agreements needed to complete the transmission interconnection or upgrade planning process."

Part IV of the PJM Tariff contains procedures for generation interconnection requests and transmission interconnection requests. Generally, to initiate the Interconnection Planning Process for a generation interconnection request, the developer must submit a completed Interconnection Request to PJM. This is accomplished via the execution of a Feasibility Study Agreement. Typically, the procedures used to process the requests for generation interconnection with the transmission system include three analytical steps[6]:

1. Feasibility Study

   The Feasibility Study assesses the practicality and cost of incorporating the generating unit or increased generation or transmission capacity into the PJM system. The analysis is limited to short-circuit studies and load-flow analysis of probable contingencies. This study does not include stability analysis. The study also focuses on determining preliminary estimates of the type, scope, and lead time for construction of the Transmission Owner's facilities required to interconnect the project.

2. System Impact Study

   The System Impact Study is a comprehensive regional analysis of the impact of adding the new generation and/or transmission facility to the system and an evaluation of their impact on deliverability to PJM load in the particular PJM region where the generator and/or new transmission facility is located. This Study identifies the system constraints relating to the project and the necessary Attachment Facilities, Local Upgrades, and Network Upgrades. The study refines and more comprehensively estimates cost responsibility and construction lead times for facilities and upgrades.

3. Interconnection Facilities Study

The Interconnection Facilities Study will document the engineering design work necessary to begin construction of any required transmission facilities. The Study also will provide a good-faith estimate of the cost to be charged to the applicant for Attachment Facilities, Local Upgrades and Network Upgrades necessary to accommodate the project and an estimate of the time required to complete detailed design and construction of the facilities and upgrades.

PJM Manual 14F – Competitive Planning Process

PJM Manual 14F focuses on the process to conduct competitive proposal windows consistent with FERC Order No. 1000 regarding Transmission Planning and Cost Allocation.

PJM Manual 14G – Generation Interconnection Requests

PJM Manual 14G is a division out of Manual 14A Revision 23 that guides developers of generation projects through the planning and study phase of their proposed project up to the request for facility construction.

PJM will coordinate with all impacted utilities any request for connections that impact the lines of other interconnected utilities. This document is intended to highlight the minimum SMECO requirements and is not intended to fully replicate or to replace the PJM documentation. The scope of this document is limited to the technical requirements for connected facility design and operation. Parties requiring transmission service should refer to the PJM Open Access Transmission Tariff (OATT) to reserve and secure transmission service for their generation.

3.2.3 VOLTAGE LEVEL AND MW AND MVAR CAPACITY AT POINT OF CONNECTION

Voltage level and Megawatt (MW) and Megavar (MVAR) capacity or demand at point of inter-connection shall be analyzed, as necessary and appropriate, during the study process. Notwithstanding, the following are voltage issues that need to be considered:

All synchronous generators connected to the SMECO electric system are to be equipped with automatic voltage regulators (AVR). Generators with megavolt-ampere (MVA) ratings larger than 20.0 MVA connected to the SMECO electric system shall operate with the generator's AVR enabled and in the automatic voltage control mode to the extent practicable, unless otherwise approved by the applicable system operator consistent with NERC Reliability Standard VAR-002-1.1a as may be amended from time to time.

Entities connecting their electric system with SMECO's electric system shall endeavor to supply the reactive power required on their own system, except as otherwise mutually agreed with SMECO. SMECO shall not be obligated to supply or absorb reactive power for the other party when it interconnects with SMECO's electric system.

For end-users, the installation of power factor correction capacitor banks that compensate for the reactive power demands of customer loads may be required. The end-user should design and operate its load connections so that the load power factor measured at the customer service point is between 98.5% lagging and unity at all times. Delivery point(s) connections to the SMECO electric system shall operate to meet the power factor requirements agreed to by the parties.

3.2.4 Breaker Duty and Surge Protection

Breaker duty and surge protection requirements are applicable to all generation facilities, transmission facilities, and end-user facilities connected to the SMECO electric system.

All circuit breakers and other fault interrupting devices shall be capable of safely interrupting fault currents for any fault they may be required to interrupt. AC high voltage circuit breakers are specified by operating voltage, continuous current, interrupting current and operating time in accordance with ANSI/IEEE Standards C37 series, "Symmetrical Current Basis." These ratings are displayed on the individual Circuit Breaker nameplate. Breakers will be scheduled for replacement when they exceed 100% of ANSI C37 Guidelines for breaker duty ratings. There may be cases where adding generation will increase the available fault current above the present interrupting ratings of the existing breakers at a substation or stations. When this occurs, breaker upgrades are to be considered as part of the interconnection project. See Exhibit "B", for additional details.

Application of circuit breaker duty rating shall be in accordance with ANSI/IEEE C37 standards.

Basic Surge Level (BSL) or Basic Insulation Level (BIL), surge arrester, conductor spacing and gap application, substation and transmission line insulation strength, protection, and shielding shall be documented and submitted for evaluation as part of the interconnection plan.

3.2.5 System Protection and Coordination

Utility grade, transmission level protective relays and fault clearing systems are to be provided on the interconnected electric system. All protective relays should meet or exceed ANSI/IEEE Standard series C37.90. Current transformers used for protection must be designed and installed in accordance with IEEE Standards. Adjoining electric

systems may share a common zone of protection between two parties. Compatible relaying equipment must be used on each side of the point of ownership within a given zone of protection. The design must provide coordination for speed and sensitivity in order to maintain electric system security, system reliability, and system stability. All applicable NERC Reliability Standards for design, coordination, settings, and testing must be met.

System Protection Requirements for Generation Facilities:

Generator facilities connecting to any SMECO transmission line or facility are responsible for protecting those facilities from electrical faults and other hazardous conditions. Generator interconnections must be equipped with circuit breakers or other appropriate interrupting devices to protect those facilities. The generator owner must provide and own the primary circuit breaker or other interrupting device that protects the facility and disconnects it from the SMECO transmission line. The primary purpose of this interrupting device is to protect the generating plant facility. The protection system design must provide coordination for speed and sensitivity in order to maintain electric system security and reliability. See Exhibit "D", **Customer Generation Protective Relaying Requirements**, for additional details.

System Protection Requirements for Transmission Facilities and End-User Facilities:

All primary protective relaying must operate within a time that meets the performance criteria established under the NERC Transmission System Planning (TPL) series of Reliability Standards. Backup protective systems must provide additional coverage for breaker and relay failure. Backup systems should operate in a coordinated fashion for failures on either side of an interconnection point to the extent possible. Time and sensitivity coordination must be maintained to prevent mis-operations.

A power source for tripping and control must be provided at substations by a DC storage battery. The battery is to be sized with enough capacity to operate all tripping devices after eight hours without a charger and in accordance with IEEE Standards. An under-voltage alarm must be provided for remote monitoring by the facilities owners who shall take immediate action to restore power to the protective equipment. Dual independent communication schemes to the remote terminal(s) are required for many installations. It is used for communication assisted transmission line protection, backup protection and islanding schemes. Fiber optics is the preferred means of communication. Audio tone over phone line is the least preferred method because it may not meet requirements for speed and reliability. See Exhibit "B" for additional details.

End-users are responsible for providing a reliable protective relaying scheme for customer-owned power transformers connected to the electric system. All faults on the transformers, bushings and transformer high-side arresters must be isolated by tripping a transformer high side fault interrupting device. Faults on the transformer high-side windings, high-side bushings, and transformer high-side arresters must be cleared to coordinate with transmission protection systems. This is to assure that a permanent

failure in this zone would not result in a permanent outage of a transmission line segment. Faults in this zone must be coordinated with any applicable SMECO remote relaying.

3.2.6 METERING AND TELECOMMUNICATIONS

General – Unless otherwise agreed by the parties, SMECO shall install the metering equipment required for the operation of the interconnecting facilities and shall own, operate, test and maintain such equipment. Power flows to and from the interconnecting facility shall be measured in analog and/or digital form as required by SMECO. The interconnecting party shall bear all reasonable documented costs associated with the purchase, installation, operation, testing and maintenance of the metering equipment.

Current transformers – current transformers (CTs) used for revenue metering circuits must meet the accuracy standards, as specified under the American National Standards Institute (ANSI) C57.13, for an accuracy class of 0.3 percent at all burdens. Current transformers shall have a thermal rating factor of at least 2.0. Dedicated CTs are required for revenue metering.

Voltage transformers – voltage transformers (VTs) 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:

6.3.1. “W” through “Y” burden for 5 kV through 25 kV; and
6.3.2. “W” through “Z” burden for 25 kV and above.

Dedicated VTs are required for revenue metering.

Check Meters - The interconnecting party, at its option and expense, may install and operate, on its premise, one or more check meters to validate SMECO’s meters. Such check meters shall be for check purposes only and shall not be used for the measurement of power flows. The check meters shall be subject at all reasonable times to inspection and examination by SMECO or its designee. The installation, operation and maintenance thereof shall be performed entirely by the interconnecting party in accordance with Good Utility Practice.

Metering Standards - SMECO shall install, calibrate, and test revenue quality metering equipment in accordance with applicable ANSI standards. See Exhibit “F”, **Revenue Metering Requirements**, for additional details.

Testing of the Metering Equipment - SMECO shall inspect and test all metering equipment upon installation and at least once every two (2) years thereafter. If requested to do so by the interconnecting party, SMECO, at the interconnecting party’s expense, may inspect or test the metering equipment more frequently than every two (2) years. SMECO shall

give reasonable notice of the time when any inspection or test shall take place, and the interconnecting party may have representatives present at the test or inspection. If at any time the metering equipment is found to be inaccurate or defective, it shall be adjusted, repaired or replaced at the interconnecting party's expense, in order to provide accurate metering, unless the inaccuracy or defect is due to SMECO's failure to maintain, then SMECO shall pay. If the metering equipment fails to register, or if the measurement made by the metering equipment during a test varies by more than two percent from the measurement made by the standard meter used in the test, SMECO shall adjust the measurements by correcting all measurements for the period during which the metering equipment was in error by using the interconnecting party's check meters, if installed. If no such check meters are installed or if the period cannot be reasonably ascertained, the adjustment shall be for the period immediately preceding the test of the metering equipment equal to one-half the time from the date of the last previous test of the metering equipment.

Metering Data - At the interconnecting party's expense, the metered data shall be telemetered to one or more locations designated by SMECO and one or more locations designated by the interconnecting party.

Voice Communications – The interconnecting party shall maintain satisfactory operating communications with SMECO's electric system dispatcher or other designated representative. The interconnecting party shall provide standard voice line, dedicated voice line (generator interconnections only) and facsimile communications at its control room or central facility through use of either the public telephone system or a separate voice communications system.

Data communications - The interconnecting party shall also provide the dedicated data circuit(s) necessary to provide interconnecting facility data to SMECO as required for reliable electric system operation. Any required maintenance of such data circuit(s) shall be the responsibility of the interconnecting party. Operational communications shall be activated and maintained under, but not be limited to, the following events: system paralleling or separation, scheduled and unscheduled shutdowns, equipment clearances, and hourly and daily load data. See Exhibit "E", **SCADA and Communications Requirements**, for additional details.

Remote Terminal Unit (RTU) – Prior to the operation of the interconnecting facilities, an RTU shall be installed by the interconnecting party, or by SMECO at the interconnecting party's expense, to gather accumulated and instantaneous data to be telemetered to SMECO. The communication protocol for the data circuit(s) shall be specified by SMECO. Instantaneous bi-directional analog real power and reactive power flow information must be telemetered directly to the location(s) specified by SMECO. Each party will promptly advise the other party if it detects or otherwise learns of any metering, telemetry or communications equipment errors or malfunctions that require the attention and/or correction by the other party. The party owning such equipment shall correct such error or malfunction as soon as reasonably feasible. See Exhibit "E", for additional details.

3.2.7 GROUNDING AND SAFETY ISSUES

Safety is of utmost importance for all facilities associated with SMECO. Strict adherence to established switching, tagging and grounding procedures is required at all times for the safety of personnel. Any work carried out within a facility shall be performed in accordance with all applicable laws, rules, and regulations and in compliance with Occupational Safety and Health Administration, NESC, and good utility practice. Automatic and manual disconnect devices are to be provided as a means of removing all sources of current to any particular element of the electric system. Only trained operators are to perform switching functions within a facility under the direction of the responsible dispatcher or designated person as outlined in the NESC. See Exhibit "I", **Operational and Tagging Requirements**, for additional details.

Grounding Requirements for Generation Facilities (Source Systems):
When various switching devices are opened on an energized circuit, its ground reference may be lost if all sources are not effectively grounded. This situation may cause over voltages that affect personnel safety and damage equipment. This is especially true when one phase becomes short circuited to ground. Therefore, the interconnected transmission power system is to be effectively grounded from all sources. This is defined as $X_0/X_1 < 3$ and $R_0/X_1 < 1$. Interconnected generators should provide for effective system grounding of the high side transmission equipment by means of a grounded high voltage transformer.

Under certain system configurations/situations, the system may not be grounded at the source. However, the electric system equipment insulation level in the area must be rated to withstand the amplitude and duration of all over voltages caused by neutral displacement. Also the source must be removed rapidly when any overvoltage condition occurs. This includes isolation of the ungrounded source for system faults simultaneously with other relaying systems within the protected zone. Since the source provides no ground fault current, relay protection devices typically operate for specific voltage conditions. Some switching operations may cause the loss of all remote ground sources by islanding a part of the system even under non-fault conditions. The protection scheme must also be able to quickly remove the generation under this situation before any adverse effects occur. Some form of communication with remote transmission stations is usually required in order to accomplish this.

Grounding Requirements for Transmission Facilities and End-User Facilities:
Each interconnection substation must have a ground grid that solidly grounds all metallic structures and other non-energized metallic equipment. This grid and grounding system shall be designed to meet the requirements of ANSI/IEEE 80, IEEE Guide for Safety in AC 10 Substation Grounding and ANSI/IEEE C2, National Electrical Safety Code. The transmission line overhead ground wire (OHGW) shall be connected to the substation ground grid. See Exhibit "B" for additional details.

If the interconnection substation is close to another substation, the two grids may be isolated or connected. Connected grids are preferred, since they are easier to connect than to isolate. If the ground grids are to be isolated, there may be no metallic ground connections between the two substation ground grids. There must also be sufficient physical separation to limit soil conduction. If the ground grids are to be interconnected, the interconnecting cables must have sufficient capacity to handle the fault currents, duration, and duty. SMECO must approve any connection to a SMECO ground.

All transmission line structures must be adequately bonded and grounded to control step and touch potential in compliance with the NESC, and to provide adequate lightning performance. All transmission lines should have a continuous ground wire, not relying on earth as the primary conductor, to transfer fault current between structures and to substations and plant switchyards. Any exceptions to a continuous ground wire shall be verified with a system study. All ground wires and bond wires must be adequately sized to handle anticipated maximum fault currents and duty without damage.

Transmission interconnections may substantially increase fault current levels at nearby substations and transmission lines. Modifications to the ground grids of existing substations and OHGWs of existing lines may be necessary. The interconnection studies will determine if modifications are required and the scope and cost of the modifications.

3.2.8 INSULATION AND INSULATION COORDINATION

Insulation and Insulation Coordination requirements are applicable to all generation facilities, transmission facilities and end-user facilities connected to the SMECO electric system. Insulation coordination is the selection of insulation strength. Insulation coordination must be done properly to ensure electrical system reliability and personnel safety. Basic Surge Level (BSL) or Basic Insulation Level (BIL), surge arrester, conductor spacing, and gap application, substation and transmission line insulation strength, protection, and shielding shall be documented and submitted for evaluation as part of the interconnection plan.

3.2.9 VOLTAGE, REACTIVE POWER, AND POWER FACTOR CONTROL

Voltage, reactive power and power factor control requirements will be considered on a case-by-case basis. In order to assess power factor, the end-user delivery point real (kW) and reactive demands (kVar) shall be recorded as agreed to with SMECO.

Voltage Schedule for Generation

The interconnecting generator shall maintain the following voltage schedule; however, the operating limits of the generator shall not be exceeded in an effort to follow the voltage

schedule. SMECO reserves the right to specify a different voltage schedule depending on specific interconnection tie point requirements.

230kV interconnecting bus voltage – 240kV

Voltage for Loads

It is the responsibility of the interconnecting facility owner to incorporate appropriate voltage regulation equipment in their facility if the interconnecting facility's supply voltage requirements are more restrictive than a range from 92% to 105% of the nominal voltages, listed below.

230kV
69kV
12.47kV

Reactive Power/Power Factor for Generator

The interconnected generator shall be designed and operated to maintain a composite power delivery at the continuous rated power output at a power factor between 0.95 lagging and 0.95 leading.

Reactive Power/Power Factor for Load

The interconnected facility shall be responsible for providing their own reactive power needs in order to maintain a power factor between 0.9850 lagging and 0.9925 leading. All reactive resources must be capable of operating within the voltage limits stated in the current NERC Standards and RFC Criteria for normal and emergency conditions. Switched reactive resources must be designed to minimize voltage transients on the system.

3.2.10 POWER QUALITY IMPACTS

Power quality requirements are applicable to all generation facilities, transmission facilities and end-user facilities connected to SMECO. Generation of harmonics should be limited to values prescribed by IEEE Standard 519 when measured at the interconnection point of ownership. Additionally, a SMECO facility should not be subjected to harmonic currents in excess of 5% of a transformer's rated current as stated in ANSI/IEEE Standard C57.12.00.

Power Quality

Adequate design precautions must be taken by the interconnected facility owner to prevent excessive and harmful harmonic voltages and/or currents from occurring on the SMECO system. The interconnected facility must be designed to operate with normal harmonic voltage and currents. Voltage and current harmonic levels need to be below the stated values in the current IEEE Standard 519 document. Excessive harmonics

originating from within the interconnected facility will be the responsibility of the interconnected facility owner to correct at their own expense.

Voltage Flicker

Voltage surges or flicker caused by the operation, synchronization, or isolation of the interconnected facility shall be within the standards set forth in the latest version of IEEE Std. 1453 voltage flicker curves. The interconnected facility shall provide suitable equipment to limit voltage flicker to below the "Border Line of Irritation" curve on the IEEE Std. 1453 voltage flicker chart at the point of interconnection, as well as the planning levels, per Tables 1 and 2.

Phase Imbalance

Imbalanced phase voltages and currents can affect coordination of protective relaying, create higher flows of current in neutral conductors, and cause thermal overloading of transformers and motors. The measurement of voltage imbalance, Negative Sequence Unbalance Factor (NSUF) is the ratio of the negative sequence voltage divided by the positive sequence voltage, expressed as a percentage. The NSUF limits listed herein applies to normal system operations. For connections at 30 kV and above, the voltage imbalance should not exceed 1%. For connections below 230 kV, the contribution at the interconnection point should not be allowed to cause a voltage imbalance greater than 1.3%. System problems such as a blown transformer fuse or open conductor on an electric system can result in extended periods of phase imbalance. It is the interconnecting facility owner's responsibility to protect all of its connected equipment from damage that could result from such an imbalanced condition.

3.2.11 EQUIPMENT RATINGS

Equipment ratings shall be suitable for the ambient temperature range of -40° C to 50°C. Equipment ratings shall be sized for load and system expansion for the 15-20 year time frame. Equipment ratings shall comply with the latest ANSI, IEEE, NEMA, and NERC requirements and must be in accordance with the SMECO methodology for determining facility ratings.

3.2.12 SYNCHRONIZING OF FACILITIES

Generation Facilities:

Prior to commercial operation, the owner of a synchronous generator with a rating larger than 20 MVA shall provide the identified SMECO contact with documentation that describes the functional operation and settings for the AVR's control functions. This documentation shall demonstrate the AVR's controls are coordinated with the generator protection and with the generator's short-term capabilities. In cases where the AVR has been set to regulate a voltage other than the generator's terminal voltage or it has been

set to regulate a compensated terminal voltage, sufficient data shall be provided to allow the AVR to be modeled accurately.

Provision of Generator Test Data

One of the standard generator commissioning tests is to introduce a step change in the AVR's reference voltage with the generator running at synchronous speed but not connected to the electric system. This is referred to the open circuit, step in voltage test and is used to confirm the AVR is functioning properly. Prior to commercial operation, the owner of a synchronous generator with a rating larger than 20 MVA should provide SMECO with open circuit, step in voltage test results. Recordings of the generator terminal voltage and generator field voltage magnitudes should be provided together with any calibration data necessary to equate the recordings with actual voltages. In situations where it is impractical to measure the generator field voltage (*e.g.,* brushless excitation systems) alternate quantities with equivalent response characteristics can be provided. An estimate of the generator's field winding temperature during this test should also be provided.

Each generating facility shall provide a point of contact to SMECO. A point of contact shall be reachable and available through telephone or other agreed upon means of communication at all times when the generating facility is energized or in operation. Any synchronizing to, or disconnecting the facility from SMECO must be pre-approved by the SMECO contact.

Disconnection without prior approval is permitted only when necessary to prevent injury to personnel or damage to equipment. Permission to synchronize to the interconnected system must be requested of SMECO following any overhaul, unit trip or islanding. It is the responsibility of the generation facility owner to provide all devices necessary to protect the customer's equipment from damage by abnormal conditions and operations that might occur on the interconnected electric system. The facility owner shall protect its generator and associated equipment from overvoltage, undervoltage, overload, short circuits (including ground fault conditions), open circuits, phase unbalance, phase reversal, surges from switching and lightning, over and under frequency conditions, and other injurious electrical conditions that may arise on the interconnected system.

Transmission and End-User Facilities:

It is the responsibility of the facility owner to provide for the orderly re-energization and synchronizing of their high voltage equipment to other parts of the electric system. Appropriate operating procedures and equipment designs are needed to guard against out-of-synch closure or uncontrolled energization. Each owner is responsible for knowing and following all applicable regulations, industry guidelines, safety requirements, and accepted practice for the design, operation and maintenance of the facility.

3.2.13 MAINTENANCE COORDINATION

The maintenance of facilities is the responsibility of the owner of those facilities. Adjoining facilities on the interconnected power system are to be maintained in accordance with accepted industry practices and procedures. Each party is to have a documented maintenance program ensuring the proper operation of equipment. SMECO will have the right to review maintenance reports and calibration records of equipment that could impact SMECO; SMECO is to be notified as soon as practicable about any out of service equipment that might affect the protection, monitoring, or operation of interconnected facilities.

Obligations – SMECO and the interconnecting party shall maintain their facilities in a safe and reliable manner in accordance with Good Utility Practice.

Coordination - SMECO and the interconnecting party shall confer regularly to coordinate the planning, scheduling and performance of preventive and corrective maintenance on the interconnecting facilities.

Secondary Systems – SMECO and the interconnecting party shall cooperate with the other in the inspection, maintenance, and testing of control or power circuits that operate below 600 volts, AC or DC, including, but not limited to, any hardware, control or protective devices, cables, conductors, electric raceways, secondary equipment panels, transducers, batteries, chargers, and voltage and current transformers that directly affect the operation of the interconnecting facilities and equipment which may reasonably be expected to impact the other party. SMECO and the interconnecting party shall provide advance notice to the other party before undertaking any work on such circuits, especially on electrical circuits involving circuit breaker trip and close contacts, current transformers, or potential transformers.

3.2.14 OPERATIONAL ISSUES

Generators connected to SMECO must be able to withstand certain temporary excursions in voltage, frequency, reactive and real power output without tripping. A waiver may be justified in certain special circumstances such as low adverse reliability consequences from generator tripping, if mutually agreed to by SMECO. See Exhibit "I", **Operational and Tagging Requirements**, for additional details.

Generating facilities must be designed to remain online for normally cleared three-phase and delayed clearing single-line-to-ground faults within the close proximity to the plant switchyard (on the high-side of the generator step-up transformer). The ability of the generating unit to stay connected and synchronized with the electric system during system disturbances is known as low voltage ride-through. Voltage may approach zero at the

switchyard bus for four to nine cycles for some types of faults. Generating plants are required to remain in-service during three-phase faults with normal clearing (which is a time period of approximately 4 – 9 cycles) and single line to ground faults with delayed clearing (10 – 30 cycles), and subsequent post-fault voltage recovery to pre-fault voltage unless clearing the fault effectively disconnects the generator from the system except as allowed under the current NERC Standards.

Most synchronous generator AVRs are equipped with limiting controls that help protect the generator while also allowing the generator to support the grid during temporary excursions in transmission voltage. The AVR's control and limiting functions must coordinate with the generator's short time capabilities and protective relay settings. These limiting controls must be properly coordinated with generator protection and with the generator's short-term voltage/reactive capabilities. Two common examples of these controls are the maximum excitation limiter (coordinates with over excitation protection) and the minimum excitation limiter (coordinates with the loss of field protection). The generating equipment owner shall provide SMECO the AVR's control and limiter settings as well as the protection settings which coordinate with AVR control and limiting functions. All new synchronous generators connected to the SMECO electric system with a nameplate rating greater than 20 MVA shall be equipped with a speed/load governing control that has a speed droop characteristic in the 3 to 6% range. Notification of changes in the status of the speed/load governing controls must be provided to SMECO.

All new synchronous generators connected to the SMECO electric system with a nameplate rating greater than 100 MVA shall be equipped with a power system stabilizer. Technical evaluations of oscillatory stability will be conducted for the interconnection of new generating plants. New generators that cause a decrease in the damping of an existing mode of oscillation or cause a poorly damped mode of oscillation will be required to operate with the power system stabilizer in service. The determination of the power system stabilizer's control settings will be coordinated with SMECO. Typically, this coordination would be to provide SMECO with preliminary power system stabilizer settings prior to the stabilizer's field commissioning tests, with the final settings provided after the field commissioning tests are completed.

All operational issues shall be considered during the study phase. Prior approval from SMECO is required for any switching that energizes or de-energizes portions of the SMECO connection or that may adversely affect SMECO. Industry and OSHA switching and safety procedures shall be strictly adhered to when maintenance is being performed. Also, each party shall maintain its system and facilities so as to avoid or minimize the likelihood of disturbances that might impair or interrupt service to the customers of the other party.

Abnormal Frequency Conditions -- It shall be the responsibility of the interconnecting facility owner to provide adequate protection or safeguards to prevent damage to SMECO caused by over/under frequency originating in the interconnected facility. The interconnecting facility owner shall provide adequate protection and safeguards to protect

the interconnected facility from inadvertent over/under voltage conditions originating from the SMECO electrical system. Steady-state voltages must be maintained within the normal and emergency limits as defined in the current NERC Standards and any applicable RFC criteria or standard.

Abnormal Frequency Conditions Specific for Generators – the electric system is designed to automatically activate a load shed program in the event of an under frequency system disturbance. The interconnected generator shall implement under and over frequency relay set points to endure ride-through capability of the electric system. The generator's response to frequency deviations of pre-determined magnitudes shall be studied and coordinated with SMECO. Per PJM Manual 14 requirements, generators may not be tripped for under frequency operation until 57.5 Hz with a 5 second delay.

Generator Frequency Control - 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 must be coordinated with the governors of other resources, all located within the same control area, to assure proper system response to frequency variations.

Abnormal Voltages - It shall be the responsibility of the interconnecting facility owner to provide adequate protection or safeguards to prevent damage to SMECO caused by over/under voltages originating in the interconnected facility. The interconnecting facility owner shall provide adequate protection and safeguards to protect the interconnected facility from inadvertent over/under voltage conditions originating from the SMECO electrical system. Steady-state voltages must be maintained within the normal and emergency limits as defined in the current NERC Standards and RFC criteria or standard.

3.2.15 INSPECTION REQUIREMENTS FOR EXISTING OR NEW FACILITIES

SMECO shall have access, at all times, to the disconnect switch of the Unit which isolates the Unit from the SMECO system. At reasonable hours and upon reasonable notice consistent with this Agreement, or at any time without notice in the event of an emergency (as defined in paragraph 4.1), SMECO shall have access to the Unit.

If necessary, for the purposes of this Agreement, the Customer shall allow SMECO access to SMECO's equipment and facilities located on Customer's property. To the extent that the Customer does not own all or any part of the property on which SMECO is required to locate its equipment or facilities to serve the Customer under this Agreement, the Customer shall secure and provide in favor of SMECO the necessary rights to obtain access to such equipment or facilities, including easements if the circumstances so require.

Pre In-service Operation Testing and Inspection - Prior to the new interconnection facilities being placed in service, SMECO shall inspect, test, or witness the testing of the interconnecting facilities to ensure their safe and reliable operation. Similar testing may be required after initial operation. SMECO and the interconnecting party shall make any modifications to its facilities that are found to be necessary as a result of such testing. The interconnecting party shall bear the cost of all such testing, inspection, and modifications.

Post In-service Operation Testing and Modifications – Both SMECO and the interconnecting party shall perform routine inspection and testing of its interconnecting facilities and equipment in accordance with Good Utility Practice as may be necessary to ensure the continued interconnection of the new facility in a safe and reliable manner. Both SMECO and the interconnecting party shall have the right, upon advance written notice, to request additional testing of the other's interconnecting facilities.

Advance Notice - Both SMECO and the interconnecting party shall notify the other party in advance of its performance of tests of the interconnecting facilities. The other party has the right, at its own expense, to observe such testing.

Right to Inspect – SMECO and the interconnecting party shall have the right, but shall have no obligation to:

- Observe the other party's tests and/or inspection of any of its system protection facilities and other protective equipment;
- Review the settings of the other party's system protection facilities and other protective equipment; and
- Review the other party's maintenance records relative to the interconnection facilities, the system protection facilities and other protective equipment.

Exercise rights - SMECO and the interconnecting party may exercise these rights from time to time as it deems necessary upon reasonable notice to the other party. The exercise or non-exercise by a party of any such rights shall not be construed as an endorsement or confirmation of any element or condition of the interconnection facilities or the system protection facilities or other protective equipment or the operation thereof, or as a warranty as to the fitness, safety, desirability, or reliability of same.

3.2.16 COMMUNICATIONS AND PROCEDURES FOR ALL OPERATING CONDITIONS

General -- Operational communications between the interconnected facility and the SMECO Operations Center shall be active and maintained under both normal and emergency conditions.

Normal Conditions -- include, but not limited to, the following events: system paralleling or separation, scheduled and unscheduled shutdowns, equipment clearances, and hourly and daily load data.

Emergency Conditions -- are events or scenarios in which immediate action must be taken to ensure safety, prevent equipment damage, or jeopardize the reliability of the SMECO or interconnected party's system.

Failure of Communications -- Emergency telecommunications conditions may develop that affect telecommunications equipment with or without directly affecting power electric system facilities. Therefore, the interconnecting facility owner shall provide equipment redundancy and telecommunications route redundancy to protect against certain kinds of failure and telecommunications path interruption. A repair team dedicated to the telecommunications of the interconnecting facility should be retained along with an adequate supply of spare components.

Backup Communications Strategy -- Where commercial, public telephone network facilities or services support important power system telecommunications, a backup strategy should always be developed by the Customer to protect against interruption of such services. Backup methods could include redundant services, self-healing services, multiple independent routes, carriers and combinations of independent facilities such as land-line and cellular, fiber and radio, etc. Backup telecommunications system equipment such as emergency standby power generators with ample on-site fuel storage and reserve storage battery capacity must be incorporated in critical telecommunications facilities. Backup equipment should also be considered for certain non-critical telecommunications to provide continued operation of telecommunications during interruption of transmission services.

3.2.17 Engineering and Construction Deliverables

General – Guidelines for Engineering and Construction Deliverables for Contractors' construction projects being proposed and/or approved for connection to the SMECO Electric System shall be as outlined in Exhibit "G", **Engineering and Construction Deliverables**.

3.2.18 Construction Management Requirements for Interconnection Customers

General – Construction Management Requirements and Procedures will follow industry accepted best practices for all activities, including safety. See Exhibit "H", **Construction**

Management Requirements for Interconnection Customers, for additional details.

3.2.19 Approved Consultants, Material Suppliers and Contractors

General – Only Approved Consultants, Material Suppliers and Contractors will be used for services and equipment for SMECO. Other companies may be permitted to bid on substation and transmission work, but they will need to go through the SMECO formal contractor qualification process. See Exhibit "J", **Approved Engineers, Contractors, and Equipment Manufacturers**, for additional details.

4. Supporting Information

4.1 List of Exhibits

These Exhibits provide additional details:
Exhibit "A" Electric System Planning Criteria
Exhibit "B" Substation and Transmission Line Design Criteria
Exhibit "C" Interconnection Requirements
Exhibit "D" Customer Generation Protective Relaying Requirements
Exhibit "E" SCADA and Communication Requirements
Exhibit "F" Revenue Metering Requirements
Exhibit "G" Engineering and Construction Deliverables
Exhibit "H" Construction Management Requirements for Interconnection Customers
Exhibit "I" Operational and Tagging Requirements
Exhibit "J" Approved Engineers, Contractors, and Equipment Manufacturers

4.2 Operationally Affected Parties

None Identified

4.3 Training

No required training has been identified.

4.4 REFERENCES

References are as listed in the individual sections of this document.

4.5 DEFINITIONS

Transmission Owner Control Center	An entity that participates in the Operating Agreement of PJM Interconnection, L.L.C. (Agreement) and assists PJM in operating and controlling Designated Transmission Facilities establishes a Transmission Owner (TO) Control Center to facilitate its responsibilities regarding the security of the PJM RTO.

4.6 MAINTENANCE AND UPDATES OF FACILITY CONNECTION REQUIREMENTS

SMECO will maintain its facility connection requirements as necessary or required. SMECO will make these documents available to users of the electric system, the Regional Entity and NERC upon request within five business days.

4.7 VERSION HISTORY

Version #	Change	By	Date
1	Initial Issue	H. Reigel	4/22/2013
2	Minor document revisions throughout.	H. Reigel	8/1/2016
3	Section 3.2.1.1 was updated with PJM Manuals, Previous section 3.2.1.1 (Procedures for Coordinated Joint Studies and Notifications) was removed and replaced. Other minor document revisions.	H. Reigel	1/17/2017
3.1	Minor document revisions to the Purpose section. Updates made throughout the document to reflect SMECO's change in status relative to PJM, NERC, and RFC.	H. Reigel	10/1/2017
3.2	PJM requirements supersede SMECO requirements statement added to section 1.4 SCOPE/APPLICABILITY	H. Reigel	10/18/2017
3.3	Annual Review	H. Reigel	12/31/2018

4.0	Minor revisions throughout the document. The addition of sections 3.2.17 - Engineering and Construction Deliverables and 3.2.18 – Construction Management Requirements for Interconnection Customers and the inclusion of Exhibit "A" through "J": • Exhibit "A" Electric System Planning Criteria • Exhibit "B" Substation and Transmission Line Design Criteria • Exhibit "C" Interconnection Requirements • Exhibit "D" Customer Generation Protective Relaying Requirements • Exhibit "E" SCADA and Communication Requirements • Exhibit "F" Revenue Metering Requirements • Exhibit "G" Engineering and Construction Deliverables • Exhibit "H" Construction Management Requirements for Interconnection Customers • Exhibit "I" Operational and Tagging Requirements • Exhibit "J" Approved Engineers, Contractors, and Equipment Manufacturers	J. Bredenkamp	2/28/2019
4.1	Review and updated references from Local Control Center (LCC) to Transmission Owner Control Center (TOCC) per PJM Manual. Added Transmission Owner Control Center (TOCC) definition to section 4.5.	H. Reigel	1/7/2020
4.2	Annual Review; Section 3.2.2 was updated to include new PJM Manuals 14F and 14G.	H. Peregoy	12/18/2020

TECHNICAL REVIEW

Reviewed By	Signature	Date
Herb Reigel, System Planning and Reliability Director		

APPROVAL

Approved By	Signature	Date
Roger Schneider, System Engineering & Construction Managing Director		

[1] FAC-001-2, R1 PART 1.1
[2] FAC-001-2, R1 PART 1.2
[3] FAC-001-2, R1 PART 1.3
[4] FAC-001-3, R3 PART 3 and R4 PART 3
[5] FAC-001-2, R3 PART 3.2
[6] FAC-001-2, R3 PART 3.1