

FAC-001

Facility Connection Requirements (FCR)

Effective Date: 12/18/2015
Version 3.1



Powering forward. Together.

Contents

Preface	3
1. Introduction and Summary	4
2. General Facility Connection Requirements	5
3. Study Coordination and Notification Procedures	6
4. Voltage Level and MW and Capacity/Demand at Point of Connection	7
5. System Protection/Coordination/Breaker Duty	8
6. Metering and Telecommunications.....	8
7. Ground and Safety Issues	8
8. Insulation Coordination.....	9
9. Voltage, Reactive Power, and Power Factor Control	9
10. Power Quality Impacts	9
11. Equipment Ratings.....	10
12. Synchronizing of Facilities.....	10
13. Maintenance Coordination	10
14. Operational Issues	10
15. Inspection Requirements	11
16. Communications	11
Version Table.....	12

Preface

All connections to the Sacramento Municipal Utility District's (SMUD) electric system must be in compliance with all applicable SMUD Transmission Standards, Planning and Operating Policies of the North American Electric Reliability Corporation (NERC) or its successor as administered by the Western Electricity Coordinating Council (WECC) or its successor.

The introduction of the Facility Connection Requirements of the NERC/WECC Planning Standards under section I. System Adequacy and Security~ category C states:

“All facilities involved in the generation, transmission, and use of electricity must be properly connected to the bulk interconnected transmission systems (generally 100 kV and higher) to avoid degrading the reliability of the electric systems to which they are connected. To avoid adverse impacts on reliability when making connections to the interconnected bulk electric systems, generation and transmission owners and electricity end-users must meet facility connection and performance requirements as specified by those responsible for the reliability of the bulk interconnected transmission systems.”

1. Introduction and Summary

The Facility Connection Requirements (FCR) address the North American Electric Reliability Corporation (NERC), Western Electricity Coordinating Council (WECC) and SMUD's requirements for connection(s) of generation facilities, transmission facilities and end-user facilities. The Facility Connection Requirements specifically identify technical requirements and applicable regulatory requirements for connecting transmission lines/elements, large loads and generation resources to the SMUD transmission system. Additional details can be found in the following SMUD documents:

- SMUD Standard Large Generator Interconnection Procedures (LGIP)
- SMUD Standard Large Generator Interconnection Agreement (LGIA)
- SMUD Standard Small Generator Interconnection Procedures (SGIP)
- SMUD Standard Small Generator Interconnection Agreement (SGIA)

These documents are available upon request and are available on the SMUD OASIS.

Purpose

The primary purpose of these connection requirements is to ensure safe operation, integrity and reliability of the SMUD transmission system throughout the planning horizon. The FCR does not specifically address contractual matters such as cost allocation, ownership, billing and scheduling. Transmission service is not covered under the FCR; any transmission service should be addressed through the WestTTrans OASIS.

Interconnection Project Submission

Requests to interconnect generating resources, transmission elements or loads are typically submitted by a Requester (refers to a utility, developer, or other entity that requests a new or modified connection for a line, load, or generation resource) but may also originate by an interconnecting utility. SMUD will evaluate and study each Project (refers to a request to interconnect a generating resource, transmission line or a load that may impact the SMUD Transmission System) discretely as described in the request to determine the impacts the project has on the SMUD facilities. Generally, all costs for integrating the Requester's project to the SMUD system are borne by the Requestor.

Interconnection Studies

Interconnection studies may include a preliminary plan of service for physical and communications interconnections. Physical laws that govern the electrical behavior of the electric system do not recognize ownership boundaries of the facilities. The electrical power system will therefore be studied without regard to ownership to

determine proper interconnection design that assures safety, reliability and integrity of the SMUD transmission system. The final study may include but is not limited to analysis of fault duties, transient performance, voltage stability and reactive power requirements consistent with prudent electrical utility practices.

Other Applicable Standards

The Facility Connection Requirements are not intended to be design specifications or an instruction manual to the interconnecting facility. Information presented herein may change periodically due to industry requirements and events, regulatory requirements, evolving standards and practices or other industry determinations. These requirements are generally consistent with principles and practices of NERC, WECC, Institute of Electrical & Electronics Engineers and American National Standards Institute. The technical requirements stated herein are also consistent with SMUD's current internal principles and practices for system additions and modifications. The standards of the above-listed organizations are subject to change and, when applicable, the most recent version of such standards shall apply to each interconnection request.

Key Reliability and Availability Considerations

The new interconnection shall meet all applicable requirements of the WECC and NERC Operation and Planning Standards. Additionally, the following requirements apply to all projects:

- Tools and spare equipment must be readily available at the Requester's disposal to accomplish foreseeable operations and maintenance tasks;
- Standardization design, planning and operating practices and procedures should be used so that the new connection may be readily incorporated into the existing transmission network;
- To assure reliable operation certain telecommunications, control and protection equipment may need to be designed with redundancy;
- The equipment for the new connection shall have sufficient capabilities for both the initial operation and long term operation;
- Operation and maintenance personnel of the interconnecting facility must be properly trained from an industry recognized agency for both normal and emergency operating conditions;
- SMUD reserves the right to isolate the interconnecting facility to preserve overall safety of operating personnel or the general public or to preserve system integrity during emergency conditions.

2. General Facility Connection Requirements

SMUD's facility connection requirements shall address but not be limited to the following:

- Coordination of joint studies for new facilities and their impacts on the interconnected transmission systems;
- Notification of new or modified facilities to others (those responsible for the reliability of the interconnected transmission system) as soon as feasible;
- Voltage level and MW and MVar capacity or demand at the point of connection;
- Breaker duty and surge protection;
- System protection and coordination;
- Metering and telecommunications;
- Grounding and safety issues;
- Insulation and insulation coordination;
- Voltage, Reactive Power and power factor control;
- Power quality impacts;
- Equipment ratings;
- Synchronizing of facilities;
- Maintenance coordination;
- Operational issues (abnormal frequency and voltages);
- Inspection requirements for existing or new facilities; and
- Communication and procedures during normal and emergency operating conditions.

Each of the items listed above will be addresses in SMUD's study(ies) as applicable to the specific interconnection request. More general requirements are detailed below.

3. Study Coordination and Notification Procedures

Parties may request interconnection of a transmission line, load or generation facility to the SMUD transmission system. For any such request the Requestor should contact SMUD as early as possible in the planning process. An interconnection study must be performed to determine the necessary additions and or modifications to SMUD's substations, transmission lines, control and communication circuits to accommodate the proposed interconnections. Also, SMUD follows the WECC procedure for coordinated joint studies of new facilities and the evaluation of their impact on the interconnected transmission systems.

Requests for transmission services are addressed by SMUD's current OATT and are not included in this document.

Interconnection Requests

- Generation Interconnection Request

Requests for new generation interconnections will be consistent with the process for interconnection outlined in the SMUD OATT. Where applicable

for generation interconnection requests, specific timeline, queuing and submission requirements in the OATT will be followed. Requirements for information about the generation interconnections process and necessary information to conduct the necessary studies can be found on the SMUD's OASIS website.

- **Transmission Interconnection Request**

Requests for new transmission interconnections are initiated by completion of the request form found on SMUD's OASIS.

- **End-User Interconnection Request**

SMUD is sole provider of electric service of all End-User (load) connections on the SMUD transmission system.

Interconnection Studies

The transmission planning process is an important first step in the determination of interconnection feasibility. The transmission planning studies will identify impact, deficiencies, available capacity, operational constraints or facility limitations and provide potential solutions that address the impacts, constraints or limitations. The system impact studies may include but are not limited to powerflow, dynamic stability and short circuit studies. Additional studies, if deemed necessary, may also include sub-synchronous resonance and electro-magnetic transient analysis. SMUD will, at the expense of the requesting entity, determine a time frame and cost of additions or upgrades necessary to interconnect the requestor's facility to SMUD's transmission system.

4. Voltage Level and MW and Capacity/Demand at Point of Connection

Interconnection to SMUD's transmission system may require one or more of SMUD's transmission lines to be looped through the requester's facilities or require the sectionalizing of transmission components through installation of switching equipment. The design and installation of the facility(ies) shall not restrict the capability of SMUD's existing or planned transmission system and SMUD's contractual transmission path rights.

Transmission Line Design

Transmission line designs for integration into SMUD's facilities shall meet the requirements of SMUD's transmission line design standards. The transmission line design will include OSHA requirements as well as other code requirements.

Substation Facilities

Substation facilities that interconnect with SMUD's transmission facilities must meet SMUD's substation design and construction standards. The interconnecting facility designed must be in adherence to applicable ANSI and IEEE standards requirements. Electrical equipment in the interconnecting facility must be sized to carry the full current rating of the intercepted transmission path. Further, all interrupting devices, i.e. circuit breakers, switches, fuses et al, shall have interrupting capability sufficient to satisfactorily interrupt the maximum short circuit currents that may occur at the location of the interconnecting facility including margin for circuit breaker duty and DC offset.

5. System Protection/Coordination/Breaker Duty

System protection and control schemes are coordinated to provide for safety, equipment protection and isolation of faulted components during abnormal system conditions. Interconnections generally require the addition or modification of such protection and control schemes. New or additional protection must be compatible with the existing protective relay schemes and shall not degrade the reliability or security of the existing protective relay schemes. Additionally, the protective scheme will ensure proper synchronization and separation of the system and interconnecting facility.

Interconnected generation facilities will be required to participate in the WECC under/over frequency program. Any interconnected End-User will be required to participate in the WECC under frequency program.

6. Metering and Telecommunications

All connections to the SMUD electrical transmission system will require metering. Metering equipment will be installed at the point of connection between the Requestor and SMUD. If the metering point is not located at the point of connection SMUD reserves the right to require transformer and/or line loss to be considered. Metering equipment shall include solid state metering for each revenue meter installed. All revenue metering packages installed on SMUD's system will be required to meet revenue accuracy requirements.

Voice communication and communication requirements for protection systems will be determined on a case-by-case basis. Communication systems will be compatible and reliable communication media for remote access, SCADA and voice communication functions.

7. Ground and Safety Issues

Each interconnecting station must have a ground grid that is solidly connected to all metallic structures and other non-energized metallic equipment. The grid shall limit the ground potential gradients to such voltage and current levels that will not endanger the safety of person or damage equipment in or immediately adjacent to the substation facility during normal and short circuit conditions. Ground grid size and type are dependent upon local soil conditions and available fault current magnitudes, among other factors. In areas where ground grid voltages rise would not be within acceptable and safe limits, grounding rods and grounding wells may be required to reduce the ground grid resistance to acceptable levels.

8. Insulation Coordination

Power system equipment is designed to withstand voltage stresses associated with expected operational voltages. Adding or connecting new facilities may change equipment duty that may require equipment replacement. Switchgear, shielding, grounding or surge components may also be impacted and may also require replacement.

9. Voltage, Reactive Power, and Power Factor Control

Transformers, Shunt Capacitors, Shunt Reactors and other Voltage Control Devices

Transformer tap settings, voltage ratings and set points, shunt-connected reactor/capacitor size specifications shall be coordinated with SMUD to optimize and control reactive flows and voltage profiles. Automatic controls may be necessary to maintain these profiles on the interconnected system.

Power Factor Consideration

SMUD and the Requester shall jointly plan and operate their systems, including reactive devices, so as not to place an undue burden on either party to supply or absorb reactive power.

The generating facility power factor design limitation minimum requirement shall be a reactive power capability sufficient to maintain a composite power delivery at the Points of Interconnection at a power factor between 0.95 leading and 0.95 lagging.

10. Power Quality Impacts

Interconnection Requesters shall meet at minimum NESC, NEC, ANSI and IEEE Standards for voltage flicker and harmonic distortions.

11. Equipment Ratings

All connections to the SMUD electrical transmission system will require metering. Metering equipment will be installed at the point of connection between the Requestor and SMUD existing or planned transmission system and SMUD's contractual transmission path rights.

Transmission Line Rating

Transmission lines interconnecting to SMUD's transmission facilities shall meet the requirements of SMUD's transmission line designs standards. These design standards at minimum will include operating voltage, ampacity, insulation coordination structure design and short circuit duty will be accounted for in the design parameter.

Substation Facility Ratings

Substation facility ratings shall meet SMUD's substation and construction design standards. Electrical equipment shall be designed to carry full continuous transient current ratings of the proposed transmission facility that includes the full integration of SMUD and the Requester's components. All components shall be designed, constructed and energized per NESC, NEC, ANSI and IEEE Standards. All interrupting devices including but not limited to circuit breakers shall have sufficient interrupting capability to satisfactorily interrupt maximum expected short circuit duty and DC offset. Where the interconnecting facility bifurcate SMUD's system, at the Requestors expense, SMUD or a SMUD appointed contractor will design, construct and commission the interconnecting facility.

12. Synchronizing of Facilities

The interconnection customer shall assume all responsibility for properly synchronizing their generation for operation with the SMUD Transmission System.

13. Maintenance Coordination

Each Party maintenance practices should be performed at a level that ensures a safe and reliable to the interconnected transmission system and provide reasonable notification 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.

14. Operational Issues

The transmission system is designed to automatically activate a load shed program under under-frequency conditions. Frequency protection must include both an under-frequency and over-frequency functions. Interconnection Requester shall implement under-frequency and over-frequency for relay set points for generating facility to ensure safe and reliable to the interconnection transmission system during abnormal frequency conditions. Under-frequency and over-frequency studies shall be studied and coordinated with SMUD.

In addition, the Requester is responsible for protection of the generating facility and its equipment from such conditions as negative sequence currents, sudden load rejection, over-voltage or under-voltage, and generator loss-of-field.

15. Inspection Requirements

All transmission elements shall be inspected and maintained in conformance with regional standards. SMUD may request annual certification of the Requester documenting maintenance and inspection plans for the interconnecting facilities. Commission of the facilities including pre-energization equipment tests must be witnessed by SMUD or a SMUD designated contractor. The Requester's maintenance plan will include coordination with SMUD for routine maintenance, operational tests, inspections and meter testing.

16. Communications

Complete, precise and timely communication is required for maintaining system security and reliability of the electrical system. SMUD and the requester shall maintain communication that shall include at a minimum parallel system operation or separation, scheduled or unscheduled shutdown, equipment clearances, load reports, maintenance schedules, meter tests, relay tests and other routine communication. Emergency contact numbers should be exchanged between both SMUD and the Requester prior to the actual interconnection date.

Version Table

Version No.	Effective Date	Revision Description	Reviewed By	Approved by
1.0	2008	New	Sarah Majok	Craig Cameron
2.0	2010	Updated page numbers	Sarah Majok	Craig Cameron
3.0	12/17/2012	Added version table. Rearranged report format and updated SMUD logo.	Foung Mua	Craig Cameron
3.1	12/18/2015	Updated document to show compliance with FAC-001-2 (Effective on 1/1/2016).	Foung Mua	Craig Cameron