San Francisco Water Power Sewer

Services of the San Francisco Public Utilities Commission

HETCH HETCHY WATER AND POWER

FACILITY CONNECTION REQUIREMENTS

NERC STANDARD FAC-001

APPROVED BY: _____ DATE: 7/15/2011

DIVISION MANAGER HHWP

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1.0 PURPOSE

This document was developed to comply with the North American Electric Reliability Corporation (NERC) Reliability Standard FAC-001 Facility Connection Requirements. This document is to ensure compliance with NERC Reliability Standards and applicable Western Electricity Coordinating Council (WECC), subregional and Power Pool (for example, California Transmission Planning Group (CTPG), Sacramento Valley Study Group (SVSG), Transmission Expansion Planning Policy Committee (TEPPC), CAISO Balancing Authority Planning Area), and individual Transmission Owner (for example, City and County of San Francisco/Pacific Gas & Electric Company Interconnection Agreement, and Hetch Hetchy Water and Power (HHWP)) facility connection requirements. HHWP's interconnection requirements address Generation facilities, Transmission facilities, and transmission level End-user facilities. The requirements identified in this document are considered to be the minimum requirements to be used by HHWP as a guide in accommodating interconnection requests. There may be additional requirements depending on the location, type and characteristics of the proposed interconnection facility and those additional requirements, if any, will be addressed on a case-by-case basis.

Any entity seeking to interconnect Generation, Transmission, and/or transmission level End-user facilities to the HHWP electric system (hereinafter referred to as “Requesting Party”) shall provide a written summary of its plans to HHWP in order to achieve the required system performance, as described below, throughout the planning horizon.

This document addresses certain technical aspects of interconnection. It does not address the commercial requirements for interconnection or receiving transmission service, distribution service, or any other electric service from HHWP.

2.0 INTERCONNECTION REQUIREMENTS FOR GENERATION, TRANSMISSION, AND TRANSMISSION LEVEL END-USER FACILITIES

All requests for interconnection to the HHWP transmission system must be consistent with all of the applicable above facility connection requirements, as well as good utility practice. A proposed interconnection for Generation, Transmission, or transmission level End-user facilities must not degrade the reliability or operating flexibility of the existing HHWP transmission system, adjacent transmission systems, or the Bulk Electric System (BES).

All arrangements for system studies, engineering design, construction, ownership, operations, maintenance, replacement equipment, metering, facility controls, telecommunications, and so on, must be set forth in written contracts between HHWP and the Requesting Party. If additional equipment and/or replacement equipment is required to accommodate the facility interconnection,

such equipment shall not result in HHWP having diminished transmission capacity or operational control as previously existed on its transmission facilities. The costs associated with all studies and associated equipment additions and/or modifications shall be the responsibility of the Requesting Party, unless specifically agreed to in writing by the Parties. HHWP reserves the right to participate in any proposed facility expansion plans.

The Requesting Party will be responsible for obtaining any necessary rights-of-way or easements from landowners associated with the Requesting Party's facilities. All costs associated with environmental activities for the new facility will be the responsibility of the Requesting Party.

A direct interconnection into HHWP's transmission system does not guarantee transmission capacity on or through the HHWP transmission system. Transmission service requests must be made separately.

Attachments to this document provide a detailed listing of data requirements associated with a valid Generator Interconnection Request and should be submitted to HHWP. All completed forms should be submitted to the Division Manager, HHWP. The address is listed in Section 6.0 of this document.

The Requesting Party also must provide information and meet applicable City and County of San Francisco/Pacific Gas & Electric Company Interconnection Agreement third party interconnection requirements, and to comply with applicable Federal Energy Regulatory Commission-approved interconnection procedures for the CAISO Balancing Authority Area.

The following requirements and procedures must be satisfied by any Requesting Party seeking to connect Generation, Transmission, and/or transmission level End-user facilities to the HHWP electric system.

2.1 Procedures for Coordinated Joint Studies

2.1.1 HHWP shall determine which interconnection studies are required for a particular interconnection request. Typically there are three levels of interconnection studies performed.

2.1.1.1 The initial Screening Study, also referred to as the Feasibility Study, is to evaluate whether the project has the potential to proceed. This study will likely take a timeline of approximately 4-6 months. Entities wishing to connect will then have time to evaluate the results and make their decision to proceed to the next study effort.

2.1.1.2 The System Impact Study (SIS) will give entities a better idea of system improvements required to accommodate the project. SIS will evaluate the impact of the requested

facility interconnection on the HHWP transmission system, adjacent transmission systems and the BES. The SIS will likely take a timeline of approximately 10-12 months. The SIS may be done with other developers in a "cluster" study at the discretion of HHWP.

2.1.1.3 The Facility Study is the most detailed of the three studies and will determine the detailed facility interconnection requirements. The study also identifies requirements that the entity has to provide (on their facility) in order to meet WECC requirements such as metering, SCADA, communication requirements, etc. This study will likely take a timeline of approximately 12-18 months. The larger the project, the more complex the study could be and the longer the timeline to complete.

2.1.2 All costs to conduct or review interconnection studies are the responsibility of the Requesting Party, and shall be paid for upfront, non-refundable.

2.1.3 Studies evaluating the impacts of new or modified Generation, Transmission, or transmission level End-user facilities shall be conducted utilizing analytical tools and databases approved or deemed acceptable by HHWP, which would include any analytical tools or databases utilized by WECC or considered acceptable by WECC.

2.1.4 The scope of studies to be conducted shall include but not be limited to power flow analysis, post-transient analysis, dynamic stability analysis, and short-circuit analysis to ensure compliance with all applicable NERC, WECC, subregional, Power Pool, CAISO Balancing Authority Area, City and County of San Francisco/Pacific Gas & Electric Company Interconnection Agreement, and HHWP standards and requirements. Such study scope shall be as mutually agreed upon by HHWP and the entity seeking to connect Generation, Transmission, or transmission level End-user facilities.

2.1.5 Evaluation of alternatives to the proposed facility connection, such as lower voltage construction, alternative interconnection points, reactive support facilities, or upgraded facilities, may be requested and shall be included in the System Impact Study or the Facility Study at the Requesting Party's expense.

2.1.6 Power flow analysis will require 10-year load and resource projections and the planned facilities needed to satisfy all pre-existing long term transmission service requirements on the HHWP

transmission system. If the studies indicate that additions or upgrades to the existing HHWP transmission system are necessary, HHWP will conduct or review Facilities Studies, at the expense of the Requesting Party, to determine the cost of additions or upgrades and the required timeframe for implementing system additions or upgrades.

2.1.7 The transmission planning process for a proposed new facility connection must also accommodate coordinated joint studies with other affected interconnected transmission system owners, as applicable, and as approved by HHWP. Planning studies must be coordinated with all affected or adjacent systems.

2.1.8 The Requesting Party shall provide the following detailed information for use in the transmission planning studies:

2.1.8.1 Required forms to be filled out by the Requesting Party:

2.1.8.1.1 Attachment 1, a detailed listing of the data requirements associated with a valid generator interconnection request.

2.1.8.1.2 Attachment 2, in addition, shall be used for any large generator interconnection requests.

2.1.8.1.3 Attachment 3, in addition, shall be used for any small (20 MW or less) generator interconnection requests.

2.1.8.2 Facility one-line diagram depicting detailed proposed facility connection points, voltage levels, equipment data, breaker/switch configurations, and protective relay schemes.

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

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

2.1.8.5 Generator rotor, governor, exciter, power system stabilizer and any other generator auxiliary data in accordance with WECC generator data specifications.

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

2.1.8.7 Transmission line configuration, impedance, and thermal ratings.

2.1.9 Results of the interconnection studies shall be documented along with any conclusions and recommendations. Such documentation shall be retained by HHWP and shall be made available if requested by NERC, WECC, or any other entities responsible for the reliability of the interconnected transmission system, as soon as feasible.

2.2 Procedures for Notification of New or Modified Facilities To Others

2.2.1 Notification of new or modified facilities shall be emailed by HHWP, or designee, to WECC, the Regional Reliability Coordinator (WECC RC), in accordance with the timelines established by the WECC RC, at rcrequesteddocuments@wecc.biz. Currently, the WECC RC requires that such notification be provided at least 30 days prior to the actual network change.

2.3 Voltage Level and MW and MVAR Capacity or Demand at Point of Connection

2.3.1 The Requesting Party for a proposed facility shall specify the requested voltage level and MW/MVAR capacity and/or demand at the point of connection. Also any special operational considerations or constraints shall be specified by the Requesting Party. This information will be utilized to develop computer models of the requested facility for input into the transmission planning studies. Costs associated with any specialized modeling development requirements are the responsibility of the Requesting Party.

2.4 Breaker Duty and Surge Protection

2.4.1 With respect to the connection of Generation, Transmission, or transmission level End-user facilities, HHWP shall review breaker duty and surge protection to identify any additions required to maintain an acceptable level of HHWP system availability, reliability, equipment insulation margins, and safety. Any costs associated with such review and additions shall be the responsibility of the Requesting Party.

2.5 System Protection and Coordination

2.5.1 HHWP's system protection requirements are designed and intended to protect the HHWP system from equipment damage, to protect the reliability and integrity of the Bulk Electric System

(BES), to ensure the safety of the general public, HHWP, and other utility personnel, to minimize adverse operating conditions affecting HHWP and its customers, and to comply with NERC, WECC, and HHWP protection criteria in existence, and to promote reliable system operation.

2.5.2 If additional protective relays and/or communication systems are required in the HHWP system to protect the HHWP generation and transmission facilities due to the addition of the Requesting Party's interconnection equipment, the cost to install and coordinate protective and associated communication systems shall be at the expense of the Requesting Party.

2.5.3 It is the Requesting Party's responsibility to install and coordinate the proper protective relaying and associated communication systems for the protection of the transmission level interconnect equipment of the Requesting Party's facilities to the HHWP system. HHWP does not assume responsibility for protection of the interconnected facilities. The Requesting Party is solely responsible for System Protection and Coordination of protection systems of its interconnection equipment so that faults, imbalances or other disturbances on the Requesting Party's system do not cause damage to the facilities on the HHWP system. The protective relaying and/or communication system for the protection of the interconnection between HHWP's facilities and Requesting Party's facilities shall be approved by HHWP. HHWP may require review and approval of the Requesting Party's protection system for the Requesting Party's interconnection substation to confirm that the Requesting Party's system does not cause damage to HHWP facilities or affect system reliability.

2.5.4 The protection system components of the proposed connected facilities shall meet the applicable requirements of the latest approved version of NERC Reliability Standard PRC-005. Protection components currently required to be included are protective relays, associated communication systems, voltage and current sensing devices, station batteries and DC control circuitry.

2.5.5 To meet the reliability requirements of NERC and WECC, under-frequency and/or under-voltage load shedding schemes may be required. Any load or reactive device connected to the HHWP system will be expected to participate in under-frequency or under-voltage load-shedding programs if HHWP determines such action is necessary to maintain system reliability. If HHWP requires load-shedding participation for a particular transmission level End-user

facility, the Requesting Party shall be responsible for all related costs.

2.6 Metering and Telecommunications

2.6.1 All required revenue metering and associated equipment used to measure a generator's energy and capacity output or a load's energy and demand consumed, shall be provided by the Requesting Party. Revenue metering shall be owned and maintained by HHWP at the Requesting Party's expense. Revenue metering may be required to be located in HHWP facilities to provide access to the meters by HHWP personnel.

In order to measure energy and capacity or demand within the CAISO Balancing Authority Area, the Requesting Party shall install all necessary meters, routers, telecommunications, and associated equipment to comply with the metering standards and requirements of the CAISO Tariff and Metering Protocol as required by the CAISO Tariff. Metering facilities shall be certified as required by the CAISO.

2.7 Grounding and Safety Issues

2.7.1 Substation (new and/or existing) ground grids must be designed to keep ground grid voltage rises within safe levels. Modifications to existing HHWP switchyards and/or substations might be required. All costs associated with required modifications to existing HHWP facilities shall be at the expense of the Requesting Party. The ground grid should be designed to ANSI/IEEE Standard 80, IEEE Guide for Safety in AC Substation Grounding.

Interconnect substations must have a ground grid that solidly grounds all metallic structures and other non-energized metallic equipment. This grid shall limit the ground potential gradients to such voltage and current levels that will not endanger the safety of people or damage equipment located in, or immediately adjacent to, the station under normal and fault conditions.

HHWP personnel shall conduct an inspection of the new substation and associated interconnection facilities prior to the energization of these facilities. Only after a satisfactory inspection is completed will the new substation interconnection facilities be authorized for energization and synchronization.

The new interconnection facilities will be energized and tested for 48 hours prior to paralleling with the HHWP facilities, unless otherwise agreed in writing by the Parties.

2.8 Insulation and Insulation Coordination

2.8.1 System Impact and/or Facilities Studies shall include the evaluation of the impact of the new or modified facility on equipment insulation and insulation coordination.

A transmission line switching study may be required to evaluate transient over-voltages caused by switching operations involving the proposed new interconnection facility at HHWP's discretion in order to determine the Basic Insulation Level (BIL) requirements and/or breaker closing resistor requirements for the proposed new facilities.

2.9 Voltage, Reactive Power, and Power Factor Control

2.9.1 The power factor for both Generation and transmission level End-user facilities shall be measured at the interconnection point.

Synchronous generators shall produce or absorb reactive power between .95 leading and .95 lagging power factors for steady state conditions to support voltage schedules. Interconnected generators shall have the capability to produce or absorb reactive power up to the thermal capability of the generator during transmission system disturbances. The voltage regulator shall be capable of maintaining the voltage at the generator terminal bus without hunting and within 0.5 percent of any set point. The operating range of the regulator shall be at least plus or minus 5 percent of the rated voltage of the generator. The excitation system of generators shall be of a fast-response or High Initial Response type (voltage response time is 0.5 seconds or less).

Wind turbines or other induction type generators without VAR control capability will absorb VARs from the transmission system and therefore require reactive power support from the Requesting Party's or HHWP's system. For proposed wind induction type generator interconnections, HHWP will require power factor correction at a minimum. Power factor correction equipment must be installed either by the Requesting Party or by HHWP at the Requesting Party’s expense. Switched capacitor banks supplied by the generation owner shall be coordinated with HHWP voltage control requirements and may be switched at the request of HHWP if system conditions require additional reactive support. Owners of interconnected induction generators shall provide, at a minimum, sufficient reactive power capability to deliver the generator output at unity power factor at the point of interconnection. Dynamic reactive compensation through turbine based or substation based systems

are also acceptable methods to provide voltage control at the point of interconnection. Dynamic reactive power compensation may also be required in addition to static power factor compensation at some locations. The System Impact Study will determine the reactive compensation required for the wind turbine generator interconnection. Induction generators are usually not required to participate in voltage regulation; however, they must not adversely affect voltage schedules. Integration studies may be necessary to determine the reactive power capability necessary to ensure that schedules are maintained.

Power system disturbances initiated by faults and forced equipment outages expose connected generators to voltage and frequency oscillations. It is important that generators remain in service to help ensure that any dynamic or transient oscillations are stable and well damped. Therefore, each generator must be capable of continuous operation at 0.95 to 1.05 per unit voltage and frequency ranges as defined by WECC in the WECC Coordinated Off-Nominal Frequency Load Shedding and Restoration Plan. Over/under voltage and over/under frequency relays are normally installed to protect the generators from extended off-nominal voltage/frequency operations. To ensure that the interconnected generators do not trip prematurely, the time delays for these relays must be coordinated with HHWP's system protection schemes.

Interconnecting generators must meet the minimum low voltage ride thru (LVRT) requirements per FERC Order 661A.

A speed governor system is required on all synchronous generators. The governor regulates the output of the generator as a function of the system frequency. That function (called the governor's "droop" characteristic) must be coordinated as required by WECC. All new Requesting Party generators must comply with the WECC minimum operating reliability criteria for governor droop as applicable to that specific type of equipment.

All transmission level End-user facilities connected directly to the HHWP system shall maintain a power factor between 0.95 lead and 0.95 lag as measured at the point where the Requesting Party’s End-user load interconnects with HHWP owned facilities. If this power factor requirement is not met, HHWP may install power factor correction equipment at the Requesting Party’s expense.

HHWP maintains transmission voltages at levels required for the reliable delivery of power to its customers and to maintain the stability of its transmission system. Regulation to keep voltage

variations within limits acceptable to End-use customers is typically provided on the HHWP distribution system. Voltage regulation at transmission voltage levels is different from regulation at distribution voltage levels. HHWP typically maintains transmission voltage levels between 0.95 - 1.05 Per Unit during normal conditions and between 0.90 - 1.10 Per Unit during emergency conditions. Requesting Parties are required to install, for their transmission level End-user facilities, their own voltage regulation equipment and coordinate any voltage set points or time delays with HHWP within the normal transmission voltage bandwidths.

2.10 Power Quality Impacts

2.10.1 Unbalanced phase voltages and currents can affect protective relay coordination and cause high neutral currents and thermal overloading of transformers. To protect HHWP and its customers' equipment, the interconnected facility contribution at the point of interconnection shall not cause a voltage unbalance greater than 1 percent or a current unbalance greater than 5 percent. Phase unbalance is the percent deviation of one phase from the average of all three phases.

Harmonics can cause telecommunication interference, thermal heating in transformers, disruptions to solid-state equipment and resonant overvoltages. To protect equipment from damage, harmonics must be managed and mitigated. The interconnected generator/load shall not cause voltage and current harmonics on the HHWP system that exceed the limits specified in Institute of Electrical and Electronics Engineers (IEEE) Standard 519. Harmonic distortion is defined as the ratio of the root mean square (RMS) value of the harmonic to the RMS value of the fundamental voltage or current. Single frequency and total harmonic distortion measurements may be conducted at the point of interconnection, generation/load site or other locations on HHWP's system to determine whether or not the interconnection project is the source of excessive harmonics.

The Requesting Party must obtain HHWP approval of the proposed method to restrict harmonics. The preferred method is to install a transformer with at least one delta connection between the generator/load and the HHWP system. This method significantly limits the amount of voltage and current harmonics entering the HHWP system.

Voltage fluctuations may be noticeable as visual lighting variations (flicker) and can damage or disrupt the operation of electronic

equipment. IEEE Standard 519 provides definitions and limits on acceptable levels of voltage fluctuation. All generators/loads connecting to the HHWP system shall comply with the limits set by this Standard.

The interconnected generator/load shall not cause Sub-Synchronous Resonance (SSR) or Sub-Synchronous Control Interactions (SSCI) with HHWP facilities. The interconnected generator/load shall be responsible for resolving any issues associated with SSR or SSCI including providing harmonic or stability studies and will be responsible for installing any equipment required to mitigate SSR or SSCI issues.

All transmission level End-user facilities connected to the HHWP system shall meet the power quality standards set forth above. The entity seeking to connect to the HHWP system is responsible for any mitigation efforts necessary to meet those standards. Electro-magnetic Transients Program (EMTP) studies may be required to analyze the power quality impacts of a proposed facility. Such studies, if required, will be at the Requesting Party's expense.

2.11 Equipment Ratings

2.11.1 With respect to the connection of Generation, Transmission, or transmission level End-user facilities, the Requesting Party is responsible for ensuring that the facilities shall not result in any violation of HHWP or adjacent Transmission Owner equipment ratings. In addition, the Requesting Party is responsible for ensuring that the interconnection facility is designed and operated to adhere to equipment ratings. Any costs associated with adhering to equipment ratings with respect to the new or modified facility shall be the responsibility of the Requesting Party.

2.12 Synchronizing of Facilities

2.12.1 Automatic synchronization shall be supervised by a synchronizing check relay IEEE Device 25. This assures that no generator is connected to the power system out of synchronization. Generators must meet all applicable NERC, WECC, and American National Standards Institute (ANSI) and IEEE standards. The prime mover and the generator shall also be able to operate within the full range of voltage and frequency excursions that may exist on the HHWP system without damage to them.

Following the execution of an Interconnection and Operating Agreement and the successful completion of all construction, inspection and facility checkout and testing procedures, the

interconnected facility will be released for energization. The initial parallel or synchronization will be supervised and coordinated with HHWP transmission operating personnel as appropriate. Future parallel or synchronization will be controlled by the appropriate entity personnel and will either be automatic or manual per the direction of HHWP.

2.13 Maintenance Coordination

2.13.1 The owner of installed equipment shall be responsible for its proper operation and maintenance. Equipment must be operated and maintained in accordance with NERC and WECC Reliability Standards, CAISO requirements, HHWP requirements, manufacturer's recommendations, good utility practice, and applicable environmental and safety standards. The facility owner shall coordinate maintenance with HHWP, adjacent Transmission Operators and the CAISO, as appropriate. HHWP may require additional equipment to ensure a reliable interconnection and to safeguard the proper operating conditions of its power system.

Maintenance will normally be performed by and at the expense of the entity that owns the equipment or facility when the proposed interconnection involves a tap or substation sectionalizing one of HHWP's transmission lines. HHWP shall be notified and have the right to witness settings and testing of relays, meters, and controls that could affect the integrity and security of HHWP's transmission system. HHWP shall also have the right to enter interconnected facilities for emergency operation and maintenance of equipment or structures HHWP deems necessary to maintain a reliable power system.

HHWP may require, in some cases, to provide required O&M services on the new interconnection facilities provided funds have been advanced to cover these costs. Costs may include training on maintenance procedures for unfamiliar equipment.

2.14 Operational Issues (abnormal frequency and voltages)

2.14.1 The facility connection studies shall identify impacts, deficiencies, operational issues (including abnormal frequency and voltages), or interconnection facility concerns and evaluate potential solutions. A proposed facility connection must not degrade the reliability or operating flexibility of the existing HHWP system, adjacent Transmission Owner systems and/or the BES. The proposed facility connection shall comply with all NERC and WECC Standards, HHWP Procedures, and good utility practice.

2.15 Inspection Requirements for Existing or New Facilities

2.15.1 Protective relays and control systems must be inspected and tested by functional trip checking prior to putting any interconnected facility in service. Approval of the facility commissioning procedures may be required by HHWP to confirm commission testing adequately tests protective devices and systems. The future maintenance and testing shall be in accordance with HHWP's Protective Relaying & Maintenance Procedures. HHWP personnel will need to be involved with procedures prior to and during any future maintenance and testing of protective relaying devices that are interconnected or integrated into HHWP relay protective systems. The Requesting Party is responsible for the costs associated with the ongoing testing and maintenance of the protective relaying and control equipment.

The protection system components of the proposed connected facilities shall meet the applicable requirements of the latest approved version of NERC reliability Standard PRC-005. Protection components required to be included are protective relays, associated communication systems, voltage and current sensing devices, station batteries and DC control circuitry.

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

2.16 Communications and Procedures During Normal and Emergency Operating Conditions

2.16.1 All communications and operating procedures during normal and emergency operating conditions (abnormal frequency and voltages for example) will be initiated and controlled by HHWP personnel. Any requests from the interconnected facility for any special operating considerations will be submitted to HHWP for review and approval prior to execution. Emergency operating conditions will be handled in accordance with NERC and WECC Standards, HHWP Procedures, and good utility practice. The interconnection facility must recognize the dynamic nature of an interconnected transmission system and the reliability and safety priorities of the grid operators.

Circuit breakers, disconnects, interrupters and motor-operated disconnect switches that are an integral part of HHWP's transmission system shall be operated and dispatched by the Transmission Operator. The Transmission Operator will direct switching and issue all clearances, hot-line orders, and general switching on the transmission portion of the interconnection or substation. This will involve use of approved Transmission Operator and HHWP switching and clearance procedures, including use of approved locks and tags.

The Requesting Party making the interconnection will write Standard Operating Procedures in coordination with HHWP and appropriate grid operators for the interconnected facility. Three sets of instructions and manufacturer's drawings shall be furnished to HHWP for each piece of equipment that HHWP operates.

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

2.17 NERC and WECC Registration

2.17.1 Prior to connection and/or synchronization of any Requesting Party facilities to the HHWP system, the Requesting Party must be registered with WECC as the appropriate entity type(s) (for example, Generator Owner). The Requesting Party must meet all applicable NERC and WECC Reliability Standards for that entity type(s). If the Requesting Party facilities do not meet the NERC and WECC criteria for registration, the Requesting Party shall document that fact in a letter to HHWP accompanying the connection request.

3.0 ENGINEERING

HHWP will provide for engineering design, specification, and construction of the proposed interconnection facilities to HHWP owned, operated, and maintained facilities at the expense of the Requesting Party. Non-HHWP engineering design may be used provided it receives initial approval and subsequent review by HHWP engineering staff. All engineering costs and engineering review costs are the responsibility of the Requesting Party. For transmission line taps to HHWP transmission that are owned by others, prints of applicable facility drawings shall be furnished by HHWP upon request, if available.

All work performed by HHWP will include revisions to existing HHWP drawings at the expense of the Requesting Party.

If the interconnection facilities are to be owned by HHWP, then any new land rights necessary for the interconnection may be acquired by HHWP from the affected landowners, at the expense of the Requesting Party. In certain circumstances, the Requesting Party may acquire these additional land rights, provided they coordinate with HHWP as to what rights are necessary, if parties agree to this in writing.

Modifications to HHWP's transmission system to accommodate the proposed interconnection shall adhere to HHWP's Standard Design Criteria. Any variation from the Standard Design Criteria may be considered on a case-by-case basis.

Drawings for facility additions must conform to HHWP's Drafting Standards and be approved by HHWP. The Requesting Party will supply drawings via an electronic file or other common storage device, compatible with HHWP's computer-aided design system, AutoCAD. The Requesting Party shall reimburse HHWP for drawing costs. Copies of HHWP's Drafting Standards will be furnished to the Requesting Party if the design is not produced by HHWP. "As-built" drawings must be provided prior to final approval by HHWP. Three complete sets of accurate substation drawings shall be provided to HHWP for non-HHWP-owned substations. These drawings shall include, but not be limited to, station plot plans, equipment layouts, single-line diagrams, control circuit schematics, wiring diagrams, and equipment list. Updated copies of these drawings shall be furnished to HHWP within 60 days of any modification to non-HHWP owned equipment or substations on HHWP's system.

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

HHWP may use an outside engineering consulting firm to conduct any or all of the required studies, design reviews, etc.

4.0 COSTS

All costs incurred by HHWP related to the interconnection request and any subsequent actual project shall be borne by the interconnecting Requesting Party. These funds could be advanced upfront, or reimbursed after the fact, as determined by a written agreement by both parties.

5.0 MAINTENANCE AND UPDATING OF HHWP's FACILITY CONNECTION REQUIREMENTS

HHWP shall maintain and update its Facility Connection Requirements as required. HHWP shall make its Facility Connection Requirements documentation available to the users of the transmission system, WECC, and NERC on request (five business days), and making documentation of the requirements available to requesting entities within ten business days.

6.0 CONTACT INFORMATION

The Facility Connection Requirements discussed in this document may not address all the technical requirements applicable to a specific facility interconnection, since each interconnection is unique. Once sufficient information is provided, HHWP will determine and communicate the additional project-specific technical requirements. Parties anticipating interconnection with HHWP facilities should discuss their project plans with HHWP before purchasing or installing equipment or making other major financial commitments.

For more information on interconnection to the HHWP System, please contact:

Contact:	Pamela Husing Manager, Wholesale and Retail Services SFPUC, Power Enterprise
Mailing Address:	1155 Market Street, 4th Floor San Francisco, CA 94103
Office Phone:	415-554-2469

7.0 DISCLAIMER

Nothing contained in this document is intended to modify the parties' rights and obligations under HHWP or applicable tariffs, or interconnection agreements. The provisions of those tariffs and agreements supersede any provisions contained in this document that may be inconsistent or contrary.

8.0 ATTACHMENTS

8.1 Attachment 1: HHWP Generator Interconnection Data Summary Request Form

8.2 Attachment 2: Large Generator Interconnection Request Form

8.3 Attachment 3: Small Generator Interconnection Request Form

9.0 VERSION HISTORY

9.1 Documentation Control:

Change History

The change history below reflects changes to the document or its structure.

Revision	Description of Change	Date
0	Initial Issue	7/15/2011

ATTACHMENT 1

HHWP Generator Interconnection Data Summary

Request Form

Generator Nameplate Ratings:

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

Generator Modeling Data: Reactance Data (Per-Unit Machine MVA Base)

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

Time Constant Data (Sec)

Open Circuit Subtransient T"do	_____	T"qo	_____
3-Ph short Circuit Armature Ta	_____		

Armature Winding Resistance

Positive R1 _____ Negative R2 _____ Zero R0 _____

Total Inertia (Generator + Turbine)

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

Generator Characteristic Curves:

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

Generator Vee Curves Attached? (Y/N) _____

Generator Saturation Curves Attached? (Y/N) _____

Excitation System Data:

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

Governor System Data:

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

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

Wind Generator Data

Number of Wind Turbines to be connected at the Point of Interconnection _____

Type of Induction Generating Unit _____

Manufacturer _____

Nameplate Rated MVA _____

Unit Maximum Output (MW) _____

Power Factor Control Characteristics _____

Voltage Control Characteristics _____

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

Generator Step-up (GSU) Transformer Data:

Generator Step-up Transformer MVA Base _____

Generator Step-up Transformer Rating(s) (MVA) _____

GSU Transformer Voltage Ratings H _____ L _____ T _____

GSU Winding Connection (Wye/Delta) H L T

Available Fixed Taps _____

Present Fixed Tap Setting _____

Generator Step-up Transformer Impedance:

(R + jX or % R & % X on transformer MVA Base)

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

Zero Sequence T-Model

Note: Following construction and testing, transformer test reports must be provided to HHWP.

ATTACHMENT 2
LARGE GENERATOR INTERCONNECTION REQUEST FORM

1. The undersigned Interconnection Customer submits this request to interconnect its Large Generating Facility with Transmission Provider's Transmission System pursuant to a Tariff.

2. This Interconnection Request is for (check one):
   _____ A proposed new Large Generating Facility.
   _____ An increase in the generating capacity or a Material Modification of an existing Generating Facility.

3. The type of interconnection service requested (check one):
   _____ Energy Resource Interconnection Service
   _____ Network Resource Interconnection Service

4. _____ Check here only if Interconnection Customer requesting Network Resource Interconnection Service also seeks to have its Generating Facility studied for Energy Resource Interconnection Service

5. Interconnection Customer provides the following information:

   a. Address or location or the proposed new Large Generating Facility site (to the extent known) or, in the case of an existing Generating Facility, the name and specific location of the existing Generating Facility;

   b. Maximum summer at ____ degrees C and winter at _____ degrees C megawatt electrical output of the proposed new Large Generating Facility or the amount of megawatt increase in the generating capacity of an existing Generating Facility;

   c. General description of the equipment configuration;

   d. Commercial Operation Date (Day, Month, and Year);

   e. Name, address, telephone number, and e-mail address of Interconnection Customer's contact person;

f. Approximate location of the proposed Point of Interconnection (optional); and

g. Interconnection Customer Data (set forth in Attachment A)

6. Applicable deposit amount as specified in the LGIP.

7. Evidence of Site Control as specified in the LGIP (check one)
____ Is attached to this Interconnection Request
____ Will be provided at a later date in accordance with this LGIP

8. This Interconnection Request shall be submitted to the representative indicated below:

[To be completed by Transmission Provider]

9. Representative of Interconnection Customer to contact:

[To be completed by Interconnection Customer]

10. This Interconnection Request is submitted by:

Name of Interconnection Customer: _____

By (signature): _____

Name (type or print): _____

Title: _____

Date: _____

LARGE GENERATING FACILITY DATA

UNIT RATINGS

kVA _____ °F _____ Voltage _____
Power Factor _____
Speed (RPM) _____ Connection (e.g. Wye) _____
Short Circuit Ratio _____ Frequency, Hertz _____
Stator Amperes at Rated kVA _____ Field Volts _____
Max Turbine MW _____°F _____

COMBINED TURBINE-GENERATOR-EXCITER INERTIA DATA

Inertia Constant, H = _____ kW sec/kVA
Moment-of-Inertia, WR^2 = _____ lb. $ft.^2$

REACTANCE DATA (PER UNIT-RATED KVA)

	DIRECT AXIS		QUADRATURE AXIS	
Synchronous – saturated	X_{dv}	_____	X_{qv}	_____
Synchronous – unsaturated	X_{di}	_____	X_{qi}	_____
Transient – saturated	X'_{dv}	_____	X'_{qv}	_____
Transient – unsaturated	X'_{di}	_____	X'_{qi}	_____
Subtransient – saturated	X''_{dv}	_____	X''_{qv}	_____
Subtransient – unsaturated	X''_{di}	_____	X''_{qi}	_____
Negative Sequence – saturated	$X2_v$	_____		
Negative Sequence – unsaturated	$X2_i$	_____		
Zero Sequence – saturated	$X0_v$	_____		
Zero Sequence – unsaturated	$X0_i$	_____		
Leakage Reactance	Xl_m	_____		

FIELD TIME CONSTANT DATA (SEC)

Open Circuit	T'_{do}	_____	T'_{qo}	_____
Three-Phase Short Circuit Transient	T'_{d3}	_____	T'_{q}	_____
Line to Line Short Circuit Transient	T'_{d2}	_____		
Line to Neutral Short Circuit Transient	T'_{d1}	_____		
Short Circuit Subtransient	T''_{d}	_____	T''_{q}	_____
Open Circuit Subtransient	T''_{do}	_____	T''_{qo}	_____

ARMATURE TIME CONSTANT DATA (SEC)

Three Phase Short Circuit	T_{a3}	_____
Line to Line Short Circuit	T_{a2}	_____
Line to Neutral Short Circuit	T_{a1}	_____

NOTE: If requested information is not applicable, indicate by marking "N/A."

MW CAPABILITY AND PLANT CONFIGURATION
LARGE GENERATING FACILITY DATA

ARMATURE WINDING RESISTANCE DATA (PER UNIT)

Positive	R_1	_____
Negative	R_2	_____
Zero	R_0	_____

Rotor Short Time Thermal Capacity I_2^2t = _____
Field Current at Rated kVA, Armature Voltage and PF = _____ amps
Field Current at Rated kVA and Armature Voltage, 0 PF = _____ amps
Three Phase Armature Winding Capacitance = _____ microfarad
Field Winding Resistance = _____ ohms _____ °C
Armature Winding Resistance (Per Phase) = _____ ohms _____ °C

CURVES

Provide Saturation, Vee, Reactive Capability, Capacity Temperature Correction curves. Designate normal and emergency Hydrogen Pressure operating range for multiple curves.

GENERATOR STEP-UP TRANSFORMER DATA RATINGS

Capacity Self-cooled/
Maximum Nameplate
_____/_____kVA

Voltage Ratio(Generator Side/System side/Tertiary)
_____/_____/_____kV

Winding Connections (Low V/High V/Tertiary V (Delta or Wye))
_____/_____/_____

Fixed Taps Available
_____

Present Tap Setting
_____

IMPEDANCE

Positive Z_1 (on self-cooled kVA rating)_____ % _____ X/R

Zero Z_0 (on self-cooled kVA rating)_____ % _____ X/R

EXCITATION SYSTEM DATA

Identify appropriate IEEE model block diagram of excitation system and power system stabilizer (PSS) for computer representation in power system stability simulations and the corresponding excitation system and PSS constants for use in the model.

GOVERNOR SYSTEM DATA

Identify appropriate IEEE model block diagram of governor system for computer representation in power system stability simulations and the corresponding governor system constants for use in the model.

WIND GENERATORS

Number of generators to be interconnected pursuant to this Interconnection Request:
_____

Elevation: _____ _____ Single Phase _____ Three Phase

Inverter manufacturer, model name, number, and version:
_____

List of adjustable setpoints for the protective equipment or software:
_____

Note: A completed General Electric Company Power Systems Load Flow (PSLF) data sheet or other compatible formats, such as IEEE and PTI power flow models, must be supplied with the Interconnection Request. If other data sheets are more appropriate to the proposed device, then they shall be provided and discussed at Scoping Meeting.

INDUCTION GENERATORS

(*) Field Volts: _____
(*) Field Amperes: _____
(*) Motoring Power (kW): _____
(*) Neutral Grounding Resistor (If Applicable): _____
(*) I_2^2t or K (Heating Time Constant): _____
(*) Rotor Resistance: _____
(*) Stator Resistance: _____
(*) Stator Reactance: _____
(*) Rotor Reactance: _____
(*) Magnetizing Reactance: _____
(*) Short Circuit Reactance: _____
(*) Exciting Current: _____
(*) Temperature Rise: _____
(*) Frame Size: _____
(*) Design Letter: _____
(*) Reactive Power Required In Vars (No Load): _____
(*) Reactive Power Required In Vars (Full Load): _____
(*) Total Rotating Inertia, H: _____Per Unit on KVA Base

Note: Please consult Transmission Provider prior to submitting the Interconnection Request to determine if the information designated by (*) is required.

ATTACHMENT 3
SMALL GENERATOR INTERCONNECTION REQUEST FORM

Transmission Provider: _____

Designated Contact Person: _____

Address: _____

Telephone Number: _____

Fax: _____

E-Mail Address: _____

An Interconnection Request is considered complete when it provides all applicable and correct information required below. Per SGIP section 1.5, documentation of site control must be submitted with the Interconnection Request.

Preamble and Instructions

An Interconnection Customer who requests a Federal Energy Regulatory Commission jurisdictional interconnection must submit this Interconnection Request by hand delivery, mail, e-mail, or fax to the Transmission Provider.

Processing Fee or Deposit:

If the Interconnection Request is submitted under the Fast Track Process, the non-refundable processing fee is $500.

If the Interconnection Request is submitted under the Study Process, whether a new submission or an Interconnection Request that did not pass the Fast Track Process, the Interconnection Customer shall submit to the Transmission Provider a deposit not to exceed $1,000 towards the cost of the feasibility study.

Interconnection Customer Information

Legal Name of the Interconnection Customer (or, if an individual, individual's name)

Name: _____

Contact Person: _____

Mailing Address: _____

City: _____ State: _____ Zip: _____

Facility Location (if different from above): _____

Telephone (Day): _____ Telephone (Evening): _____

Fax: _____ E-Mail Address: _____

Alternative Contact Information (if different from the Interconnection Customer)

Contact Name: _____

Title: _____

Address: _____

Telephone (Day): _____ Telephone (Evening): _____

Fax: _____ E-Mail Address: _____

Application is for: _____New Small Generating Facility
_____Capacity addition to Existing Small Generating Facility

If capacity addition to existing facility, please describe: _____
_____

Will the Small Generating Facility be used for any of the following?

Net Metering? Yes ___ No ___
To Supply Power to the Interconnection Customer? Yes ___No ___
To Supply Power to Others? Yes ____ No ____

For installations at locations with existing electric service to which the proposed Small Generating Facility will interconnect, provide:

_____ _____
(Local Electric Service Provider*) (Existing Account Number*)

[*To be provided by the Interconnection Customer if the local electric service provider is different from the Transmission Provider]

Contact Name: _____

Title: _____

Address: _____

_____

Telephone (Day): _____ Telephone (Evening): _____

Fax: _____ E-Mail Address: _____

Requested Point of Interconnection: _____

Interconnection Customer's Requested In-Service Date: _____

Small Generating Facility Information
Data apply only to the Small Generating Facility, not the Interconnection Facilities.

Energy Source: ___ Solar ___ Wind ___ Hydro ___ Hydro Type (e.g. Run-of-River): _____
Diesel ___ Natural Gas ___ Fuel Oil ___ Other (state type) _____

Prime Mover: ___Fuel Cell ___Recip Engine ___Gas Turb ___Steam Turb
___Microturbine ___PV ___Other

Type of Generator: ____Synchronous ____Induction ____ Inverter

Generator Nameplate Rating: _____kW (Typical) Generator Nameplate kVAR: _____

Interconnection Customer or Customer-Site Load: _____kW (if none, so state)

Typical Reactive Load (if known): _____

Maximum Physical Export Capability Requested: _____ kW

List components of the Small Generating Facility equipment package that are currently certified:

Equipment Type	Certifying Entity
1. _____	_____
2. _____	_____
3. _____	_____
4. _____	_____
5. _____	_____

Is the prime mover compatible with the certified protective relay package? ____Yes ____No

Generator (or solar collector)
Manufacturer, Model Name & Number: _____
Version Number: _____

Nameplate Output Power Rating in kW: (Summer) _____ (Winter) _____
Nameplate Output Power Rating in kVA: (Summer) _____ (Winter) _____

Individual Generator Power Factor
Rated Power Factor: Leading: _____Lagging: _____

Total Number of Generators in wind farm to be interconnected pursuant to this
Interconnection Request: _____ Elevation: _____ ___Single phase ___Three phase

Inverter Manufacturer, Model Name & Number (if used):
_____

List of adjustable set points for the protective equipment or software:
_____

Note: A completed Power Systems Load Flow data sheet must be supplied with the Interconnection Request.

Small Generating Facility Characteristic Data (for inverter-based machines)

Max design fault contribution current: _____ Instantaneous ___ or RMS? _____

Harmonics Characteristics: _____

Start-up requirements: _____

Small Generating Facility Characteristic Data (for rotating machines)

RPM Frequency: _____
(*) Neutral Grounding Resistor (If Applicable): _____

Synchronous Generators:

Direct Axis Synchronous Reactance, Xd: _____ P.U.
Direct Axis Transient Reactance, X'_d: _____P.U.
Direct Axis Subtransient Reactance, X''_d: _____P.U.
Negative Sequence Reactance, X_2: _____ P.U.
Zero Sequence Reactance, X_0: _____ P.U.
KVA Base: _____
Field Volts: _____
Field Amperes: _____

Induction Generators:

Motoring Power (kW): _____
I_2^2t or K (Heating Time Constant): _____
Rotor Resistance, Rr: _____
Stator Resistance, Rs: _____
Stator Reactance, Xs: _____
Rotor Reactance, Xr: _____
Magnetizing Reactance, Xm: _____
Short Circuit Reactance, Xd": _____
Exciting Current: _____
Temperature Rise: _____
Frame Size: _____
Design Letter: _____
Reactive Power Required In Vars (No Load): _____
Reactive Power Required In Vars (Full Load): _____
Total Rotating Inertia, H: _____ Per Unit on kVA Base

Note: Please contact the Transmission Provider prior to submitting the Interconnection Request to determine if the specified information above is required.

Excitation and Governor System Data for Synchronous Generators Only

Provide appropriate IEEE model block diagram of excitation system, governor system and power system stabilizer (PSS) in accordance with the regional reliability council criteria. A PSS may be determined to be required by applicable studies. A copy of the manufacturer's block diagram may not be substituted.

Interconnection Facilities Information

Will a transformer be used between the generator and the point of common coupling? ___Yes ___No

Will the transformer be provided by the Interconnection Customer? ____Yes ____No

Transformer Data (If Applicable, for Interconnection Customer-Owned Transformer):

Is the transformer: ____single phase _____three phase? Size: _____kVA
Transformer Impedance: _____% on _____kVA Base

If Three Phase:
Transformer Primary: _____ Volts _____ Delta _____Wye _____ Wye Grounded
Transformer Secondary: _____ Volts _____ Delta _____Wye _____ Wye Grounded
Transformer Tertiary: _____ Volts _____ Delta _____Wye _____ Wye Grounded

Transformer Fuse Data (If Applicable, for Interconnection Customer-Owned Fuse):

(Attach copy of fuse manufacturer's Minimum Melt and Total Clearing Time-Current Curves)

Manufacturer: _____ Type: _____ Size: _____Speed: _____

Interconnecting Circuit Breaker (if applicable):

Manufacturer: _____ Type: _____
Load Rating (Amps): _____ Interrupting Rating (Amps): _____ Trip Speed (Cycles): _____

Interconnection Protective Relays (If Applicable):

If Microprocessor-Controlled:

List of Functions and Adjustable Setpoints for the protective equipment or software:

Setpoint Function	Minimum	Maximum
1. _____	_____	_____

2. _____ _____ _____

3. _____ _____ _____

4. _____ _____ _____

5. _____ _____ _____

6. _____ _____ _____

If Discrete Components:

(Enclose Copy of any Proposed Time-Overcurrent Coordination Curves)

Manufacturer: _____ Type: _____ Style/Catalog No.: _____ Proposed Setting: _____
Manufacturer: _____ Type: _____ Style/Catalog No.: _____ Proposed Setting: _____
Manufacturer: _____ Type: _____ Style/Catalog No.: _____ Proposed Setting: _____
Manufacturer: _____ Type: _____ Style/Catalog No.: _____ Proposed Setting: _____
Manufacturer: _____ Type: _____ Style/Catalog No.: _____ Proposed Setting: _____

Current Transformer Data (If Applicable):

(Enclose Copy of Manufacturer's Excitation and Ratio Correction Curves)

Manufacturer: _____
Type: _____ Accuracy Class: ___ Proposed Ratio Connection: ____

Manufacturer: _____
Type: _____ Accuracy Class: ___ Proposed Ratio Connection: ____

Potential Transformer Data (If Applicable):

Manufacturer: _____
Type: _____ Accuracy Class: ___ Proposed Ratio Connection: ____

Manufacturer: _____
Type: _____ Accuracy Class: ___ Proposed Ratio Connection: ____

General Information

Enclose copy of site electrical one-line diagram showing the configuration of all Small Generating Facility equipment, current and potential circuits, and protection and control schemes. This one-line diagram must be signed and stamped by a licensed Professional Engineer if the Small Generating Facility is larger than 50 kW. Is One-Line Diagram Enclosed? ___Yes ___No

Enclose copy of any site documentation that indicates the precise physical location of the proposed Small Generating Facility (e.g., USGS topographic map or other diagram or documentation).

Proposed location of protective interface equipment on property (include address if different from the Interconnection Customer's address)
_____

Enclose copy of any site documentation that describes and details the operation of the protection and control schemes. Is Available Documentation Enclosed? ___Yes ____No

Enclose copies of schematic drawings for all protection and control circuits, relay current circuits, relay potential circuits, and alarm/monitoring circuits (if applicable).
Are Schematic Drawings Enclosed? ___Yes ____No

Applicant Signature

I hereby certify that, to the best of my knowledge, all the information provided in this Interconnection Request is true and correct.

For Interconnection Customer: _____ Date: _____