Interconnection Initiative

Fourth Replacement CAISO Tariff

May 25, 2010

A. Ulmer

* * *

8.2.3.3 Voltage Support.

The CAISO shall determine on an hourly basis for each day the quantity and location of Voltage Support required to maintain voltage levels and reactive margins within NERC and WECC reliability standards, including any requirements of the NRC using a power flow study based on the quantity and location of scheduled Demand. The CAISO shall issue daily voltage schedules (Dispatch Instructions) to Participating Generators, Participating TOs and UDCs, which are required to be maintained for CAISO Controlled Grid reliability. All other Generating Units shall comply with the power factor requirements set forth in contractual arrangements in effect on the CAISO Operations Date, or, if no such contractual arrangements exist and the Generating Unit exists within the system of a Participating TO, the power factor requirements applicable under the Participating TO's TO Tariff or other tariff on file with the FERC.

All Participating Generators that are Asynchronous Generating Facilities shall maintain the CAISO specified voltage schedule at the Point of Iinterconnection to the extent possible, except as permitted under Appendix H of the Large Generator Interconnection Agreement, while operating within the power factor range specified in their interconnection agreements. This shall not apply to any Asynchronous Generating Facility or phased portion of a Asynchronous Generating Facility installed on or before December 31, 2012 that meets the following two criteria: (1) the Facility supplies a purchased power agreement signed on or before May 18, 2010 and approved by the CPUC or other jurisdictional regulatory entity that does not allow for a pass through of the costs of complying with this Voltage Support Requirement and (2) the owner of the project can demonstrate that either (a) the cost of complying with the Voltage Support Requirement exceeds 0.25% of total costs of the facilities installed or $3 million, whichever is less, or (b) the developer was unable to choose equipment to meet the Voltage Support requirements with bids from at least three 3 suppliers offering equipment with normal commercial warrantees. Asynchronous Generating Facilities subject to this exemption must still provide reactive support if the Interconnection System Impact Study demonstrates a need for support for system safety or reliability.[p1]

All other Participating Generators shall maintain the CAISO specified voltage schedule at the Generating Unit terminal to the extent possible, while operating within the power factor range specified in their interconnection agreements or, for Regulatory Must-Take Generation, Regulatory Must-Run Generation and Reliability Must-Run Generation, consistent with existing obligations. For Generating Units that do not operate under one of these agreements, the minimum power factor range will be within a band of 0.90 lag (producing VARs) and 0.95 lead (absorbing VARs) power factors. Participating Generators with Generating Units existing at the CAISO Operations Date that are unable to meet this operating power factor requirement may apply to the CAISO for an exemption. Prior to granting such an exemption, the CAISO shall require the Participating TO or UDC to whose system the relevant Generating Units are interconnected to notify it of the existing contractual requirements for Voltage Support established prior to the CAISO Operations Date for such Generating Units. Such requirements may be contained in CPUC Electric Rule 21 or the Interconnection Agreement with the Participating TO or UDC. The CAISO shall not grant any exemption under this Section from such existing contractual requirements. The CAISO shall be entitled to instruct Participating Generators to operate their Generating Units at specified points within their power factor ranges. Participating Generators shall receive no compensation for operating within these specified ranges.

If the CAISO requires additional Voltage Support, it shall procure this either through Reliability Must-Run Contracts or, if no other more economic sources are available**,** by instructing a Generating Unit to move its MVar output outside its mandatory range. Only if the Generating Unit must reduce its MW output in order to comply with such an instruction will it be eligible to recover its opportunity cost in accordance with Section 11.10.1.4.

All Loads directly connected to the CAISO Controlled Grid shall maintain reactive flow at grid interface points within a specified power factor band of 0.97 lag to 0.99 lead. Loads shall not be compensated for the service of maintaining the power factor at required levels within the bandwidth. A UDC interconnecting with the CAISO Controlled Grid at any point other than a Scheduling Point shall be subject to the same power factor requirement.

The power factor for both the Generating Units and Loads shall be measured at the interconnection point with the CAISO Controlled Grid. The CAISO will develop and will be authorized to levy penalties against Participating Generators, UDCs or Loads whose Voltage Support does not comply with the CAISO's requirements. The CAISO will establish voltage control standards with UDCs and the operators of other Balancing Authority Areas and will enter into operational agreements providing for the coordination of actions in the event of a voltage problem occurring.

* * *

CAISO TARIFF APPENDIX A

Master Definitions Supplement

Asynchronous Generating Facility	An Interconnection Customer's Generating Unit(s), other than a synchronous Generating Unit, identified in the Interconnection Request that produces 60 Hz (nominal) alternating current.

* * *

CAISO TARIFF APPENDIX U

Standard Large Generator Interconnection Procedures (LGIP)

**Standard Large Generator
Interconnection Procedures (LGIP)**

**Attachment A
To LGIP Appendix 1
Interconnection Request**

LARGE GENERATING FACILITY DATA

Provide three copies of this completed form pursuant to Section 7 of LGIP Appendix 1.

1. Provide two original prints and one reproducible copy (no larger than 36" x 24") of the following:

A. Site drawing to scale, showing generator location and Point of Interconnection with the CAISO Controlled Grid.

B. Single-line diagram showing applicable equipment such as generating units, step-up transformers, auxiliary transformers, switches/disconnects of the proposed interconnection, including the required protection devices and circuit breakers. For wind generator farms, the one line diagram should include the distribution lines connecting the various groups of generating units, the generator capacitor banks, the step up transformers, the distribution lines, and the substation transformers and capacitor banks at the Point of Interconnection with the CAISO Controlled Grid.

2. Generating Facility Information

A) Total Generating Facility rated output (kW): _____

B) Generating Facility auxiliary Load (kW): _____

C) Project net capacity (kW): _____

D) Standby Load when Generating Facility is off-line (kW): _____

E) Number of Generating Units: _____
(Please repeat the following items for each generator)

F) Individual generator rated output (kW for each unit):
_____

G) Manufacturer: _____

H) Year Manufactured: _____

I) Nominal Terminal Voltage: _____

J) Rated Power Factor (%): _____

K) Type (Induction, Synchronous, D.C. with Inverter): _____

L) Phase (3 phase or single phase): _____

M) Connection (Delta, Grounded WYE, Ungrounded WYE, impedance grounded): _____

N) Generator Voltage Regulation Range: _____

O) Generator Power Factor Regulation Range: _____

P) For combined cycle plants, specify the plant output for an outage of the steam turbine or an outage of a single combustion turbine:

3. Synchronous Generator – General Information:

(Please repeat the following for each generator)

A. Rated Generator speed (rpm):_____
B. Rated MVA: _____
C. Rated Generator Power Factor: _____
D. Generator Efficiency at Rated Load (%): _____
E. Moment of Inertia (including prime mover): _____
F. Inertia Time Constant (on machine base) H: _____ sec or MJ/MVA
G. SCR (Short-Circuit Ratio - the ratio of the field current required for rated open-circuit
voltage to the field current required for rated short-circuit current): _____
H. Please attach generator reactive capability curves.
I. Rated Hydrogen Cooling Pressure in psig (Steam Units only): _____
J. Please attach a plot of generator terminal voltage versus field current that shows the air gap line, the open-circuit saturation curve, and the saturation curve at full load and rated power factor.

4. Excitation System Information

(Please repeat the following for each generator)

A. Indicate the Manufacturer _____ and Type _____of excitation system used for the generator. For exciter type, please choose from 1 to 8 below or describe the specific excitation system.

1) Rotating DC commutator exciter with continuously acting regulator. The regulator power source is independent of the generator terminal voltage and current.

2) Rotating DC commentator exciter with continuously acting regulator. The regulator power source is bus fed from the generator terminal voltage.

3) Rotating DC commutator exciter with non-continuously acting regulator (i.e., regulator adjustments are made in discrete increments).

4) Rotating AC Alternator Exciter with non-controlled (diode) rectifiers. The regulator power source is independent of the generator terminal voltage and current (not bus-fed).

5) Rotating AC Alternator Exciter with controlled (thyristor) rectifiers. The regulator power source is fed from the exciter output voltage.

6) Rotating AC Alternator Exciter with controlled (thyristor) rectifiers.

7) Static Exciter with controlled (thyristor) rectifiers. The regulator power source is bus-fed from the generator terminal voltage.

8) Static Exciter with controlled (thyristor) rectifiers. The regulator power source is bus-fed from a combination of generator terminal voltage and current (compound-source controlled rectifiers system.

B. Attach a copy of the block diagram of the excitation system from its instruction manual. The diagram should show the input, output, and all feedback loops of the excitation system.
C. Excitation system response ratio (ASA): _____
D. Full load rated exciter output voltage: _____

E. Maximum exciter output voltage (ceiling voltage): _____
F. Other comments regarding the excitation system?
_____
_____
_____

5. Power System Stabilizer Information.
(Please repeat the following for each generator. All new generators are required to install PSS unless an exemption has been obtained from WECC. Such an exemption can be obtained for units that do not have suitable excitation systems.)

A. Manufacturer: _____
B. Is the PSS digital or analog? _____
C. Note the input signal source for the PSS?
_____ Bus frequency _____ Shaft speed _____ Bus Voltage
_____ Other (specify source)
D. Please attach a copy of a block diagram of the PSS from the PSS Instruction Manual and the correspondence between dial settings and the time constants or PSS gain.
E: Other comments regarding the PSS?
_____
_____
_____

6. Turbine-Governor Information
(Please repeat the following for each generator)

Please complete Part A for steam, gas or combined-cycle turbines, Part B for hydro turbines, and Part C for both.

A. Steam, gas or combined-cycle turbines:

1.) List type of unit (Steam, Gas, or Combined-cycle):_____
2.) If steam or combined-cycle, does the turbine system have a reheat process (i.e., both high and low pressure turbines)? _____
3.) If steam with reheat process, or if combined-cycle, indicate in the space provided, the percent of full load power produced by each turbine:
Low pressure turbine or gas turbine:_____%
High pressure turbine or steam turbine:_____%

B. Hydro turbines:

1.) Turbine efficiency at rated load: _____%
2.) Length of penstock: _____ft
3.) Average cross-sectional area of the penstock: _____ft2
4.) Typical maximum head (vertical distance from the bottom of the penstock, at the gate, to the water level): _____ft
5.) Is the water supply run-of-the-river or reservoir: _____
6.) Water flow rate at the typical maximum head: _____ft3/sec
7.) Average energy rate: _____kW-hrs/acre-ft
8.) Estimated yearly energy production: _____kW-hrs

C. Complete this section for each machine, independent of the turbine type.

1.) Turbine manufacturer: _____

2.) Maximum turbine power output: _____MW
3.) Minimum turbine power output (while on line): _____MW
4.) Governor information:
a: Droop setting (speed regulation): _____
b: Is the governor mechanical-hydraulic or electro-hydraulic (Electro-hydraulic governors have an electronic speed sensor and transducer.)? _____
c: Other comments regarding the turbine governor system?
_____
_____
_____
_____

7. Generator and Associated Equipment – Dynamic Models:

A. Synchronous Generators

For each generator, governor, exciter and power system stabilizer, select the appropriate dynamic model from the General Electric PSLF Program Manual and provide the required input data. The manual is available on the GE website at www.gepower.com. Select the following links within the website: 1) Our Businesses, 2) GE Power Systems, 3) Energy Consulting, 4) GE PSLF Software, 5) GE PSLF User's Manual.

There are links within the GE PSLF User's Manual to detailed descriptions of specific models, a definition of each parameter, a list of the output channels, explanatory notes, and a control system block diagram. The block diagrams are also available on the CAISO Website.

If you require assistance in developing the models, we suggest you contact General Electric. Accurate models are important to obtain accurate study results. Costs associated with any changes in facility requirements that are due to differences between model data provided by the generation developer and the actual generator test data, may be the responsibility of the generation developer.

B. Asynchronous

For each generator, Interconnection Customer must provide the WECC approved standard study models (standard models), rather than user-defined models, to the extent standard models are available. If standard models for certain asynchronous generator technologies are not available, then the Interconnection Customers can supply user-written or equivalent models.

8. Induction Generator Data:

A. Rated Generator Power Factor at rated load: _____
B. Moment of Inertia (including prime mover): _____
C. Do you wish reclose blocking? Yes ___, No ___
Note: Sufficient capacitance may be on the line now, or in the future, and the generator may self-excite unexpectedly.

9. Generator Short Circuit Data

For each generator, provide the following reactances expressed in p.u. on the generator base:

- X”1 – positive sequence subtransient reactance: _____
- X”2 – negative sequence subtransient reactance: _____
- X”0 – zero sequence subtransient reactance: _____

Generator Grounding:

A. _____ Solidly grounded
B. _____ Grounded through an impedance

Impedance value in p.u on generator base. R:_____p.u.
X:_____p.u.
C. _____ Ungrounded

10. Step-Up Transformer Data

For each step-up transformer, fill out the data form provided in Table 1.

11. Line Data

There is no need to provide data for new lines that are to be planned by the Participating TO. However, for transmission lines that are to be planned by the generation developer, please provide the following information:

Nominal Voltage: _____
Line Length (miles): _____
Line termination Points: _____
Conductor Type: _____ Size: _____
If bundled. Number per phase: _____, Bundle spacing: _____in.
Phase Configuration. Vertical: _____, Horizontal: _____
Phase Spacing (ft): A-B: _____, B-C: _____, C-A: _____
Distance of lowest conductor to Ground: _____ft
Ground Wire Type: _____ Size: _____ Distance to Ground: _____ft
Attach Tower Configuration Diagram
Summer line ratings in amperes (normal and emergency) _____
Resistance (R): _____ p.u.**
Reactance: (X): _____ p.u**
Line Charging (B/2): _____ p.u**
** On 100-MVA and nominal line voltage (kV) Base

12. 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: _____

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: A completed General Electric Company Power Systems Load Flow (PSLF) data sheet 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.

TABLE 1

TRANSFORMER DATA

UNIT_____

NUMBER OF TRANSFORMERS_____ PHASE _____

RATED KVA	H Winding	X Winding	Y Winding
Connection (Delta, Wye, Gnd.)	_____	_____	_____
55 C Rise	_____	_____	_____
65 C Rise	_____	_____	_____
RATED VOLTAGE	_____	_____	_____
BIL	_____	_____	_____

AVAILABLE TAPS (planned or existing)	_____	_____	_____
LOAD TAP CHANGER?	_____	_____	_____
TAP SETTINGS	_____	_____	_____

COOLING TYPE : OA_____ OA/FA_____ OA/FA/FA_____ OA/FOA_____

IMPEDANCE	H-X	H-Y	X-Y
Percent	_____	_____	_____
MVA Base	_____	_____	_____
Tested Taps	_____	_____	_____

WINDING RESISTANCE	H	X	Y
Ohms	_____	_____	_____

CURRENT TRANSFORMER RATIOS

H_____ X_____ Y_____ N_____

PERCENT EXCITING CURRENT 100 % Voltage; _____ 110% Voltage_____

Supply copy of nameplate and manufacture's test report when available

*** * ***

CAISO TARIFF APPENDIX V

Standard Large Generator Interconnection Agreement

STANDARD LARGE GENERATOR INTERCONNECTION AGREEMENT (LGIA)

[INTERCONNECTION CUSTOMER]

[PARTICIPATING TO]

CALIFORNIA INDEPENDENT SYSTEM OPERATOR CORPORATION

*** * ***

[IN ADDITION TO THE PROPOSED MODIFICATIONS TO APPENDIX V BELOW, THE CAISO ALSO INTENDS TO MAKE CONFORMING CHANGES TO APPENDIX Z OF THE CAISO TARIFF, INCLUDING THE ADDITION OF THE DEFINED TERM "ASYNCHRONOUS GENERATION FACILITY."]

ARTICLE 5. INTERCONNECTION FACILITIES ENGINEERING, PROCUREMENT, AND CONSTRUCTION

5.4 **Power System Stabilizers**. The Interconnection Customer shall procure, install, maintain and operate Power System Stabilizers in accordance with the guidelines and procedures established by the Applicable Reliability Council and in accordance with the provisions of Section 4.6.5.1 of the CAISO Tariff. The CAISO reserves the right to establish reasonable minimum acceptable settings for any installed Power System Stabilizers, subject to the design and operating limitations of the Large Generating Facility. If the Large Generating Facility's Power System Stabilizers are removed from service or not capable of automatic operation, the Interconnection Customer shall immediately notify the CAISO and the Participating TO and restore the Power System Stabilizers to operation as soon as possible and in accordance with the Reliability Management System Agreement in Appendix G. The CAISO shall have the right to order the reduction in output or disconnection of the Large Generating Facility if the reliability of the CAISO Controlled Grid would be adversely affected as a result of improperly tuned Power System Stabilizers. The requirements of this Article 5.4 shall not apply to Asynchronous Generating Facilities.

* * *

ARTICLE 9. OPERATIONS

9.6 **Reactive Power.**

9.6.1 **Power Factor Design Criteria.** For all Generating Facilities other than Asynchronous Generating Facilities, the Interconnection Customer shall design the Large Generating Facility to maintain a composite power delivery at continuous rated power output at the terminals of the Electric Generating Unit at a power factor within the range of 0.95 leading to 0.90 lagging, unless the CAISO has established different requirements that apply to all generators in the Balancing Authority Area on a comparable basis.

For Asynchronous Generating Facilities, power factor design criteria are provided in Appendix H of this LGIA.

* * *

9.6.2.1 Governors and Regulators. For all synchronous Generating Facilities, whenever an Electric Generating Unit is operated in parallel with the CAISO Controlled Grid and the speed governors (if installed on the Electric Generating Unit pursuant to Good Utility Practice) and voltage regulators are capable of operation, the Interconnection Customer shall operate the Electric Generating Unit with its speed governors and voltage regulators in automatic operation. If the Electric Generating Unit's speed governors and voltage regulators are not capable of such automatic operation, the Interconnection Customer shall immediately notify the CAISO and the Participating TO and ensure that the Electric Generating Unit operates as specified in Article 9.6.2 through manual operation and that such Electric Generating Unit's reactive power production or absorption (measured in MVARs) are within the design capability of the Electric Generating Unit(s) and steady state stability limits. The Interconnection Customer shall restore the speed governors and voltage regulators to automatic operation as soon as possible and in accordance with the Reliability Management System Agreement in Appendix G. If the Large Generating Facility's speed governors and voltage regulators are improperly tuned or malfunctioning, the CAISO shall have the right to order the reduction in output or disconnection of the Large Generating Facility if the reliability of the CAISO Controlled Grid would be adversely affected. The
Interconnection Customer shall not cause its Large Generating Facility to disconnect automatically or instantaneously from the CAISO Controlled Grid or trip any Electric Generating Unit comprising the Large Generating Facility for an under or over frequency condition unless the abnormal frequency condition persists for a time period beyond the limits set forth in ANSI/IEEE Standard C37.106, or such other standard as applied to other generators in the Balancing Authority Area on a comparable basis.

9.6.2.2 Loss of Voltage Control and Governor Control for Asynchronous Generating Facilities.
For Asynchronous Generating Facilities, Appendix H to this LGIA sets forth the requirements for the Large Generating Facility to respond to the loss of voltage control capability, governor response to over-frequency conditions, and ability not to disconnect automatically or instantaneously from the CAISO Controlled Grid or trip any Electric Generating Unit comprising the Large Generating Facility for an under or order frequency condition. Asynchronous Generating Facilities are not required to provide governor response to under-frequency conditions.

* * *

9.7.3 Under-Frequency and Over Frequency Conditions. The CAISO Controlled Grid is designed to automatically activate a load-shed program as required by the Applicable Reliability Council in the event of an under-frequency system disturbance. The Interconnection Customer shall implement under-frequency and over-frequency protection set points for the Large Generating Facility as required by the Applicable Reliability Council to ensure "ride through" capability. Large Generating Facility response to frequency deviations of pre-determined magnitudes, both under-frequency and over-frequency deviations, shall be

studied and coordinated with the Participating TO and CAISO in accordance with Good Utility Practice. The term "ride through" as used herein shall mean the ability of a Generating Facility to stay connected to and synchronized with the CAISO Controlled Grid during system disturbances within a range of under-frequency and over-frequency conditions, in accordance with Good Utility Practice. Asynchronous Generating Facilities shall be subject to the over-frequency ride through capability requirements set forth in Appendix H to this LGIA.

* * *

Appendix H
To LGIA
INTERCONNECTION REQUIREMENTS FOR AN ASYNCHRONOUS GENERATING FACILITY

Appendix H sets forth the requirements and provisions specific to all Asynchronous Generating Facilities that have not executed an LGIA or been tendered an LGIA by the CAISO as of June 10, 2010. All other requirements of this LGIA continue to apply to Asynchronous Generating Facility interconnections.

A. Technical Standards Applicable to Asynchronous Generating Facilities

I. Low Voltage Ride-Through (LVRT) Capability

An Asynchronous Generating Facility shall be able to remain online during voltage disturbances up to the time periods and associated voltage levels set forth in the requirements below. The requirement set forth in this section A(I) to Appendix H shall not apply to any solar photovoltaic Asynchronous Generating Facility in the Interconnection Queue on June 10, 2010 that can demonstrate a binding commitment, as of May 18, 2010, to purchase inverters for thirty(30) percent or more of the Large Generating Facility's maximum Generating Facility Capacity that are incapable of complying with the low-voltage ride-through requirement. The Interconnection Customer must include a statement from the inverter manufacturer confirming the inability to comply with this requirement in addition to any information requested by the CAISO to determine the applicability of this exemption.

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{First version: incorporates minimal changes to the FERC 661a language.}

1. Asynchrnous Generating Facilities 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, and subsequent post-fault voltage recovery to prefault voltage unless clearing the fault effectively disconnects the generator from the system. The clearing time requirement for a three-phase fault will be specific to the Asynchronous Generating Facility substation location, as determined by and documented by the Participating TO. The maximum clearing time the wind generating plant shall be required to withstand for a three-phase fault shall be nine (9) cycles after which, if the fault remains following the location-specific normal clearing time for three-phase faults, the Asynchronous Generating Facility may disconnect from the CAISO Controlled Grid. An Asynchronous Generating Facility shall remain interconnected during such a fault on the CAISO Controlled Grid for a voltage level as low as zero volts, as measured at the high voltage side of the Asynchronous Generating Facility GSU.

2. This requirement does not apply to faults that would occur between the Asynchronous Generator Unit terminals and the high side of the GSU.

3. Asynchronous Generating Facilities may be tripped after the fault period if this action is intended as part of a special protection system.

4. Asynchronous Generating Facilities may meet the LVRT requirements of this standard by the performance of the generators or by installing additional equipment (e.g., Static VAr Compensator) within the Asynchronous Generating Facility or by a combination of generator performance and additional equipment.

5. Existing individual Generator Units that are, or have been, interconnected to the CAISO Controlled Grid at the same location at the effective date of the Appendix H LVRT Standard are exempt from meeting the Appendix H LVRT Standard for the remaining life of the existing generation equipment. Existing individual Generator Units that are replaced are required to meet the Appendix H LVRT Standard.

{Second version: incorporates additional modifications to the FERC 661a language.}

An Asynchronous Generating Facility shall be able to remain online during voltage disturbances of durations and associated voltage levels set forth in the standard below.

1. An Asynchronous Generating Facility shall remain online for the voltage disturbance caused by any fault on the transmission grid, or within the asynchronous generating plant between the point of interconnection and the high voltage terminals of the plant step up transformer, having a duration equal to the lesser of the normal three-phase fault clearing time or 150 milliseconds, plus any subsequent post-fault voltage recovery to the final steady-state post-fault voltage. Clearing time shall be based on the maximum normal clearing time associated with any three-phase fault location that reduces the voltage at the asynchronous generating plant point of interconnection to 0.2 per-unit of nominal or less, independent of any fault current contribution from the asynchronous generating plant, as demonstrated by the transmission operator.~~.~~

2. An Asynchronous Generating Facility shall remain online for any voltage disturbance caused by a single-phase fault on the transmission grid, or within the asynchronous generating plant between the point of interconnection and the high voltage terminals of the plant step up transformer, having a duration equal to the lesser of the normal delayed clearing time or 150 milliseconds[p2]~~with delayed clearing~~, plus any subsequent post-fault voltage recovery to the final steady-state post-fault voltage. Clearing time shall be based on the maximum backup clearing time associated with a single point of failure (protection or breaker failure) for any single-phase fault location that reduces any phase-to-ground or phase-to-phase voltage at the asynchronous generating plant point of interconnection to 0.2 per-unit of nominal or less, independent of any fault current contribution from the asynchronous generating plant, as demonstrated by the transmission operator.~~.~~

3. Remaining on-line shall be defined as continuous connection between the point of interconnection and the asynchronous generators, without any mechanical isolation. Asynchronous generators may cease to inject current into the transmission grid during a fault[p3]. ~~, and up to fifty (50) ms after fault clearing. Within fifty (50) ms of fault clearing, the asynchronous generators must resume operation with output commensurate with the voltage level present.~~

4. For single phase faults exceeding the duration described in (2), or multi-phase faults exceeding the duration described in (1), the asynchronous generating plant may disconnect from the CAISO Controlled Grid.

5. These requirements do not apply to faults that would occur between the asynchronous generator terminals and the high side of the GSU.

6. Asynchronous Generating Facilities may be tripped after the fault period if this action is intended as part of a special protection system.

7. Asynchronous Generating Facilities may meet the LVRT requirements of this standard by the performance of the generators or by installing additional equipment (e.g., Static VAr Compensator) within the asynchronous generating plant, or by a combination of generator performance and additional equipment.

8. Existing individual generator units that are, or have been, interconnected to the CAISO Controlled Grid at the same location at the effective date of the Appendix H LVRT Standard are exempt from meeting the Appendix H LVRT Standard for the remaining life of the existing generation equipment. Existing individual generator units that are replaced are required to meet the Appendix H LVRT Standard.

II. Frequency Disturbance Ride-Through Capability

An Asynchronous Generating Facility shall comply with the off nominal frequency requirements set forth in WECC Under Frequency Load Shedding Relay Application Guide or successor requirements as these may be amended from time to time.

III. Power Factor Design Criteria (Reactive Power)

The reactive power capability design of an Asynchronous Generating Facility shall meet the following criteria:

1. An Asynchronous Generating Facility shall be designated to have sufficient reactive power sourcing capability to achieve a net power factor of 0.95 lagging or less, at the Generating Facility's maximum Generating Facility Capacity.

An Asynchronous Generating Plant shall be designed to have sufficient reactive power absorption to achieve a net power factor of 0.95 leading or less, at the Generating Facility's maximum Generating Facility Capacity.

2. Net power factor shall be measured at the Point of Interconnection as defined in this LGIA.

3. Asynchronous Generating Facilities shall meet the full reactive power range as measured at a positive sequence voltage at the Point of Interconnection of 1.0 per unit of nominal voltage. When the positive sequence voltage at the Point of Interconnection is between 0.95 and 1.05 per unit, the Asynchronous Generating Facility will only be required to provide reactive power within the ratings of any equipment in the Asynchronous Generating Facility. ~~Asynchronous Generating Facilities shall meet the full reactive power range with the positive sequence voltage at the Point of Interconnection at any value between 0.95 and 1.05 per unit of nominal voltage without exceeding the ratings of any equipment in the Asynchronous Generating Facility.~~[p4]

4. Asynchronous Generating Facilities may meet the power factor range requirement by using power electronics designed to supply the required level of reactive capability (taking into account any limitations due to voltage level and real power output) or

fixed and switched capacitors, or a combination of the two, if agreed to by the Participating TO and CAISO.

5. Asynchronous Generating Facilities shall also provide dynamic voltage support if the Interconnection System Impact Study requires dynamic voltage support for system safety or reliability.

6. Asynchronous Generating Facilities shall vary the reactive power output between the full sourcing and full absorption capabilities such that any step change in the reactive power output does not cause a step change in voltage at the Point of Interconnection greater than 0.02 per unit of the nominal voltage.[p5]

7. The maximum voltage change requirement shall apply when the transmission network is fully intact (no line or transformer outages), or during outage conditions which do not decrease the three-phase short circuit capacity at the Point of Interconnection to less than ninety (90) percent of the three-phase short-circuit capacity that would be present without the transmission network outage.

In operation, the reactive power capability of an Asynchronous Generating Facility shall meet the following criteria:

1. For plant output power greater than twenty (20) percent of the Asynchronous Generating Facility's maximum Generating Facility Capacity. the Asynchronous Generating Facility shall have a net reactive power range achieving 0.95 lagging to 0.95 leading at the Point of Interconnection, based on the actual real power output level delivered to the POI. ~~Reactive power output capability must be proportional to real power output.~~[p6]

2. Power output may be curtailed at the direction of CAISO to a value where the net power factor range is met if~~If~~ the reactive power capability of an Asynchronous Generating Facility is partially or totally unavailable~~,~~ and ~~power output may be curtailed at the direction of CAISO to a value where the net power factor range is met,~~ if non-curtailed operation ~~beyond that level~~ causes deviation of the voltage at the Point of Interconnection outside +/- 0.02 per unit of scheduled voltage level. [p7]

3. If the output power of the Asynchronous Generating Facility is less than twenty (20) percent of the Generating Facility's maximum Generating Facility Capacity, the net reactive power shall be within the range between –6.6% and +6.6% of the Asynchronous Generating Facility's real power rating. The Asynchronous Generating Facility reactive power output must remain within this range.

4. If the Point of Interconnection voltage exceeds 1.05 per unit, the Asynchronous Generating Facility shall provide reactive power absorption to the extent possible without violating the ratings of any the Asynchronous Generating Facility's equipment.

5. If the Point of Interconnection voltage is less than 0.95 per unit, the Asynchronous Generating Facility shall provide reactive power injection to the extent possible without violating the ratings of any equipment.

6. All reactive power devices used to vary the Asynchronous Generating Facility's reactive power output shall be under the control of an Automatic Voltage Control system.

7. A solar photovoltaic Asynchronous Generating Facility with an executed LGIA or tendered LGIA as of June 10, 2010, can elect to comply with this Section A(III), rather than Sections 9.6.1 and 9.6.2 of the executed LGIA or tendered LGIA. Any solar photovoltaic Asynchronous Generating Facility that elects to comply with this Section A(III) shall also be deemed to have elected to comply with Section A(IV) below.

IV. Voltage Regulation and Reactive Power Control Requirements

The Asynchronous Generation Facility's reactive power capability shall be controlled by an automatic system having both a voltage regulation and a net power factor regulation operating mode. The default mode of operation will be voltage regulation.

The voltage regulation function shall automatically control the net reactive power of the Asynchronous Generating Facility to regulate the Point of Interconnection positive sequence component of voltage to within a tolerance of +/- 0.02 per unit of the voltage schedule assigned by the Participating TO or CAISO, within the constraints of the reactive power capacity of the Asynchronous Generation Facility. Deviations outside of this voltage band, except as caused by insufficient reactive capacity to maintain the voltage schedule tolerances, shall not exceed five minutes duration per incident.

The power factor mode will regulate the net power factor measured at the Point of Interconnection. If the Asynchronous Generating Facility uses discrete reactive banks to provide reactive capability, the tolerances of the power factor regulation shall be consistent with the reactive banks' sizes meeting the voltage regulation tolerances specified in the preceding paragraph.

The net reactive power flow into or out of the Asynchronous Generating Facility, in any mode of operation, shall not cause the positive sequence component of voltage at the Point of Interconnection to exceed 1.05 per unit, or fall below 0.95 per unit.

The CAISO, in coordination with the PTO, may permit the Interconnection Customer to regulate the voltage at a point on the Asynchronous Generating Facility's side of the Point of Interconnection. Regulating voltage to a point other than the Point of Interconnection shall not change the Asynchronous Generating Facility's net power factor requirements set forth in Article III of this Appendix H.

The Interconnection Customer shall not disable voltage regulation controls, without the specific permission of CAISO, while the Asynchronous Generating Facility is in operation at a power level greater than twenty (20) percent of the Asynchronous Generating Facility's maximum Generating Facility Capacity.

V. Plant Power Management

The power change ramp rate requirements set forth in this Section A(V) to Appendix H ("Active Power Management Requirement") shall not apply to any Asynchronous Generating Facility or phased portion of a Asynchronous Generating Facility installed on or before December 31, 2012 that meets the following two criteria: (1) the Facility supplies a purchased power agreement signed on or before May 18, 2010 and approved by the CPUC or other jurisdictional regulatory entity that does not allow for a pass through of the costs of complying with this Active Power Management Requirement and (2) the owner of the project can demonstrate that either (a) the cost of complying with the Active Power Management exceeds 0.25% of total costs of the facilities installed or $3 million, whichever is less, or (b) the developer was unable to choose equipment to meet the Active Power Management with bids from at least three 3 suppliers offering equipment with normal commercial warrantees. Asynchronous Generating Facility subject to this exemption must still be able to limit active power output.[p8]

All of the Plant Power Management requirements listed in this Section V shall not be required until January 1, 2012. After this date, and notwithstanding the exemption provided in the first paragraph of this Section V, all Asynchronous Generating Facilities must have the capability to meet the following Plant Power Management requirements.

Asynchronous Generating Facilities must have the capability to limit active power output in response to a Dispatch Instruction or operating order from CAISO.~~Asynchronous Generating Facilities must have the capability, as of January 1, 2012, to limit active power output in response to a Dispatch Instruction or operating order from CAISO.~~ [p9]This capability shall extend from the Minimum Operating Limit to the Maximum Operating Limit of the Asynchronous Generating Facility in increments of five (5) MW or less. Changes to the power management set point shall not cause a change in voltage at the Point of Interconnection exceeding 0.02 per unit of the nominal voltage.

For Asynchronous Generating Facilities that are also Eligible Intermittent Resources, the power management establishes only a maximum output limit. There is no requirement for the Eligible Intermittent Resource to maintain a level of power output beyond the capabilities of the available energy source.

When issued a Dispatch or operating order from CAISO to adjust active power output, Asynchronous Generating Facilities must have the installed capability to limit power change ramp rates automatically when moving between issued setpoints, except when downward ramps result from a decrease of the available energy resource for Eligible Intermittent Resources. The power ramp control shall be capable of limiting rates of power change to a value ranging from five (5) percent to twenty (20) percent of the Asynchronous Generating Facility's maximum Generating Facility Capacity per minute, with a default value of ten (10) percent per minute, when moving between setpoints, averaged over the time period between setpoints. The Asynchronous Generating Facility may implement this ramping limit by using stepped increments if the individual step size is five (5) MW or less.~~Asynchronous Generating Facilities must have the installed capability to limit power change ramp rates automatically, except for downward ramps resulting from decrease of the available energy resource for Eligible Intermittent Resources. The power ramp control shall be capable of limiting rates of power change to a value ranging from five (5) percent to twenty (20) percent of the Asynchronous Generating Facility's maximum Generating Facility Capacity per minute, with a default value of ten (10) percent per minute. The Asynchronous Generating Facility may implement this ramping limit by using stepped increments if the individual step size is five (5) MW or less.~~[p10]

Variable generation resources must have the installed capability to automatically reduce plant power output in response to an over-frequency condition. This frequency response control shall, when enabled at the direction of CAISO, continuously monitor the system frequency and automatically reduce the real power output of the Asynchronous Generating Facility with a droop equal to a one-hundred (100) percent decrease in plant output for a five (5) percent rise in frequency (five (5) percent droop) above an intentional dead band of 0.036 Hz.

VI. Supervisory Control and Data Acquisition (SCADA) Capability

An Asynchronous Generating Facility shall provide SCADA capability to transmit data and receive instructions from the Participating TO and CAISO to protect system reliability.

An Asynchronous Generating Facility must be able to receive and respond to Automated Dispatch System (ADS) instructions and any other form of communication authorized by the CAISO Tariff. The Asynchronous Generating Facility's response time should be capable of conforming to the periods prescribed by the CAISO Tariff. In the event that the Asynchronous Generating Facility's generation management is insufficient, the CAISO may, at its discretion, instruct the Participating TO to disconnect the Asynchronous Generating Facility. If an Asynchronous Generating Facility is ordered off-line, the Operator of the Asynchronous Generating Facility shall not reconnect the Asynchronous Generating Facility to the CAISO Controlled Grid without prior approval from the CAISO, and may be required to ramp its output in a controlled manner.

The Participating TO and CAISO and the Asynchronous Generating Facility Interconnection Customer shall determine what SCADA information is essential for the proposed wind plant, taking into account the size of the plant and its characteristics, location, and importance in maintaining generation resource adequacy and transmission system reliability in its area.

VII. Power System Stabilizers (PSS)

Power system stabilizers are not required for Asynchronous Generating Facilities.

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