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# Appendix A – WDT1647

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## Queue Cluster 12 Phase I Report

January 15, 2020

This study has been completed in coordination with the California Independent System Operator Corporation (ISO) per Southern California Edison Company's Wholesale Distribution Access Tariff (WDAT), Attachment I Generator Interconnection Procedures (GIP)

### Interconnection Study Document History

No.	Date	Document Title	Description of Document
1	01/15/20	Queue Cluster 12 Phase I Appendix A Report	Final Phase I interconnection study report

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## A. INTRODUCTION

██████████, the Interconnection Customer (IC), has submitted a completed Interconnection Request (IR) to Southern California Edison (SCE), the Distribution Provider, for its proposed ██████████ (Generating Facility).

In accordance with FERC approved SCE's WDAT Attachment I Generator Interconnection Procedures (GIP), the Generating Facility was grouped with Queue Cluster 12 (QC12) Phase I projects to determine the impacts of the group as well as impacts of the Generating Facility on SCE's Distribution System and the ISO Grid.

An Area Report and, where applicable, a Subtransmission Assessment Report have been prepared separately identifying the combined impacts of all projects on the ISO Grid and to distribution facilities served out of the ██████████ Subtransmission System, respectively. This Appendix A report focuses only on the impacts or impact contributions of the Generating Facility. This report is not intended to supersede any contractual terms or conditions specified in a forthcoming Generator Interconnection Agreement (GIA).

## B. REPORT OBJECTIVE

SCE has now performed the QC12 Phase I Study for the Generating Facility, and this report addresses the results of the analysis.

The report provides the following:

1. Distribution and transmission system impacts allocated to the Generating Facility.
2. System reinforcements or mitigation necessary to address the adverse impacts allocated to the Generating Facility under various system conditions.
3. A list of required facilities and a good faith estimate of the Generating Facility's cost responsibility and time to construct<sup>1</sup>, with the assumption of SCE constructing the required facilities. Such information is provided in Attachment 1 and Attachment 2 as separate documents in the Appendix A report package of the Generating Facility.
4. Identification of potential short circuit duty impacts to Affected Systems served from the Subtransmission or Distribution System.

Lastly, since the Generating Facility encompasses energy storage devices, an analysis to determine the charging impacts on SCE's electric system was conducted as well. The analyses focused on the Charging Demand<sup>2</sup> aspects of the Generating Facility and considered varying levels of system demand with minimal generation dispatch within the local distribution system.

Accordingly, the report also discloses the adequacy of SCE's electric system to support the Generating Facility when operating in charging mode, identifies system limitations that may restrict the Generating Facility when operating in charging mode during certain demand conditions, and provides a high-level

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<sup>1</sup> It should be noted that construction is only part of the duration of months specified in the study, which includes final engineering, licensing, and other activities required to bring such facilities into service. These durations are from the execution of the GIA, receipt of: all required information, funding, and written authorization to proceed with final design and engineering, procurement, and construction from the IC as will be specified in the GIA to commence the work.

<sup>2</sup> Charging Demand: The flow of wholesale electric energy from the Distribution System solely to charge the storage component of the Eligible Customer's Resource from the Distribution System for later redelivery of such energy, net of Resource losses, to the Distribution System. Charging Demand does not include the delivery of energy for purposes that are subject to the SCE's retail tariff.

explanation of potential exposure to the Generating Facility of charging restrictions on the electric system.

### C. DESCRIPTION OF GENERATING FACILITY

The Generating Facility consists of all equipment and facilities comprising the IC’s battery storage [REDACTED] plant in [REDACTED], California, as disclosed by the IC in its IR, as may have been amended during the Interconnection Study process, as summarized below:

**Table A.1:** Generation Facility General Information per the IR

[REDACTED]	
<b>Generating Facility Output</b>	
[REDACTED]	[REDACTED]
[REDACTED]	[REDACTED]
<b>Generating Facility Charging</b>	
[REDACTED]	[REDACTED]
[REDACTED]	[REDACTED]

Note: Detailed loss analysis used in defining net capability at high side of main transformer bank and net capacity at the POI

#### Generation output limit for the Generating Facility

The forthcoming GIA will provide for, a total net capacity of [REDACTED] as measured at the high-side of the main step-transformer(s) and [REDACTED] at the POI. If the Generating Facility is capable of exceeding these values, the IC shall be required to install, own and maintain a control limiting device or, alternatively, by means of configuring the Generating Facility’s control system, as approved by SCE that will ensure the Generating Facility complies with these restrictions.

The IC has requested, and the forthcoming GIA will provide for, a total net capacity of [REDACTED] as measured at the high-side of the main step-up transformer(s) and [REDACTED] at the POI. The Parties acknowledge that the Generating Facility has a total net capability that exceeds these values. Accordingly, the IC agrees to install, own, operate and maintain a control limiting device or, alternatively, by means of configuring the Generating Facility’s control system to ensure the Generating Facility does not exceed the total net capacity provided under the forthcoming GIA at the high-side of the main step-up transformer(s) and POI.

#### As available-charging limit for the Generating Facility

The IC has requested, and the forthcoming GIA provide for a total Charging Capacity of [REDACTED] as measured at the high-side of the main step-up transformer(s) and [REDACTED] at the POI. The Parties

acknowledge that the Generating Facility has a total charging capability that exceeds these values. Accordingly, the IC agrees to install, own, operate and maintain a control limiting device or, alternatively, by means of configuring the Generating Facility's control system to ensure the Generating Facility does not exceed the total Charging Capacity provided under the GIA at the high-side of the main step-up transformer(s) and POI.

The proposed plan for interconnecting the Generating Facility is illustrated in Figure A.1. Whereas Figure A.2 illustrates the proposed location of the Generating Facility. Additional information is provided in Table A.2

Figure A.1: Generating Facility One-Line Diagram

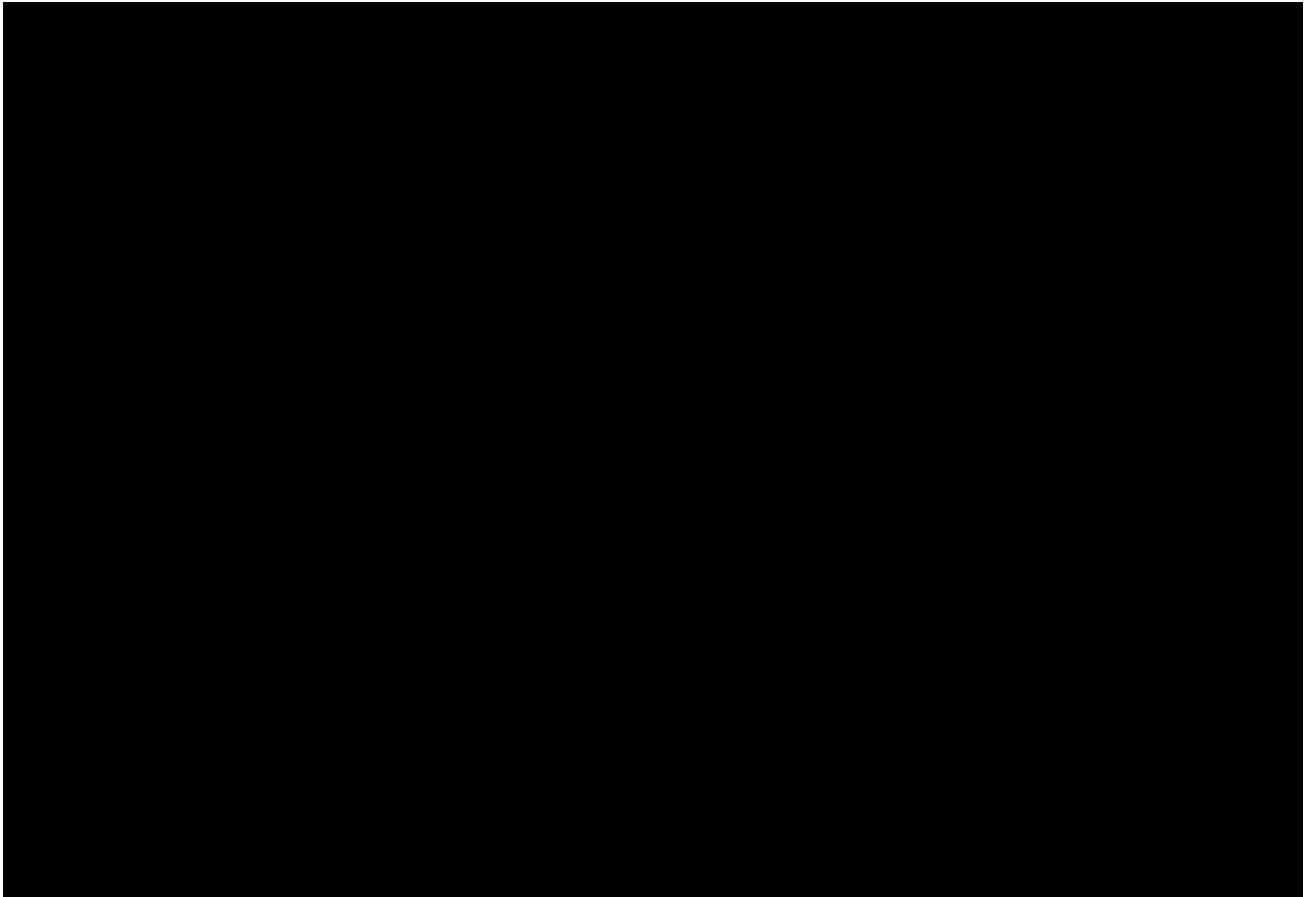


Figure A.2: Generating Facility Location Map

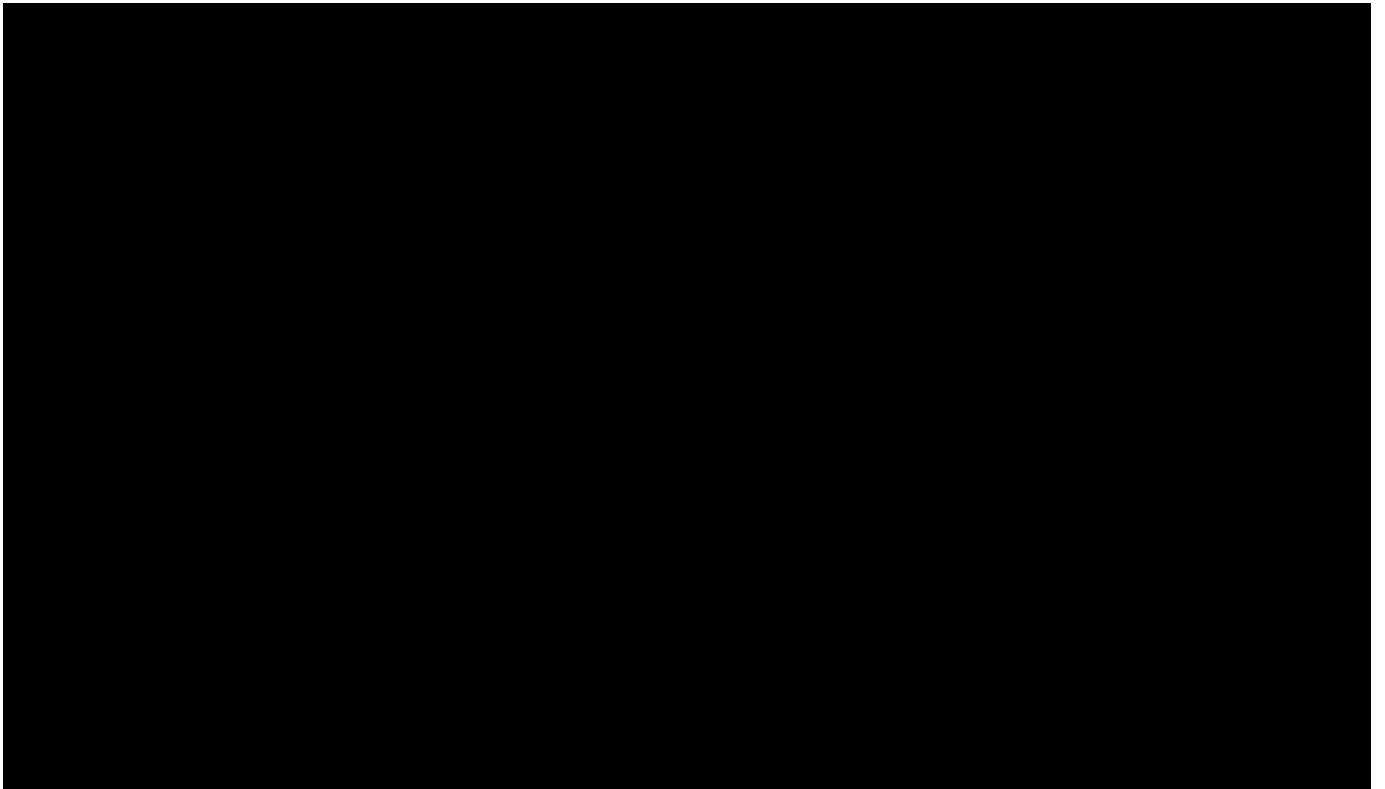


Table A.2: Additional Generating Facility General Information per IR

Generating Facility Location	[REDACTED]
SCE's Planning Area	[REDACTED]
Interconnection Voltage	[REDACTED]
POI	[REDACTED]
Number and Types of Generators	[REDACTED]
Generation Tie Line	[REDACTED]
Main Step-Up Transformer(s) Main Transformers T1 & T2	[REDACTED]
Collector Equivalent	[REDACTED]
Pad-Mount Transformer(s)	[REDACTED]
Generator Data	[REDACTED]



Generator Auxiliary Load and/or Station Light and Power	[REDACTED]
Voltage Regulation Devices	[REDACTED]
Dynamic Models Used	[REDACTED]
Deliverability Requested	[REDACTED]
Proposed Dates <sup>3</sup>	
In-Service Date (ISD)	[REDACTED]
Initial Synchronization Date/Trial Operation	[REDACTED]
Commercial Operation Date (COD)	[REDACTED]

## D. STUDY ASSUMPTIONS

For detailed assumptions regarding the group cluster analysis, please refer to the QC12 Phase I Area Report. Below are the assumptions specific to the Generating Facility:

1. The Generating Facility was modeled as described in Table A.1 and A.2 above.
2. Wildfire mitigation measures have been incorporated into all of SCE’s construction standards and operational practices. SCE has notified ICs with a proposed Generating Facility and associated Interconnection Facilities to be located in, or interconnecting to, an identified high fire risk area (HFRA) or high fire risk area circuit (HFRA circuit). As a result of implementing these mitigation measures, please be advised that the facilities and their associated costs identified in this Cluster Study (Attachment 1 and Attachment 2) are above and beyond the mitigation identified in previous cluster studies. SCE is implementing these measures to address the heightened wildfire risk in HFRA and HFRA circuits. In the future, SCE may develop and implement additional mitigation measures in these HFRA to continuously ensure the safety and reliability of SCEs Transmission System and the public it serves.
3. The facilities that will be installed by SCE and the IC are detailed in Attachment 1.
4. Environmental Activities, Permits, and Licensing.

The assumptions for the Environmental Activities, Permits, and Licensing are as follows:

- i. SCE’s Interconnection Facilities (IFs) and Distribution Upgrades (DUs) needed to interconnect the Generating Facility:

SCE’s scope of work will not require a California Public Utilities Commission (CPUC) license.

- a. SCE’s IFs and DUs needed to interconnect the Generating Facility:
  - SCE will act as the lead for regulatory agency communication for permits issued to SCE covering SCE facilities.
  - SCE environmental activities may include, but are not limited to, the following:

<sup>3</sup> Such dates are specified in the Generating Facility’s IR. Actual ISD, Initial Synchronization Date, and COD will depend on licensing, engineering, final engineering & design, and construction requirements to interconnect the Generating Facility after the GIA has been executed and/or filed at Federal Energy Regulatory Commission (FERC) for acceptance.

- Perform all environmental studies and construction monitoring of SCE internal substation construction activities and provide study results to the IC for inclusion in its environmental documents, if applicable.
- Collaborate with the IC during the environmental study phase on the IC's proposed study methodologies and findings, as studies are being planned and performed for SCE's scope of work.
- Review IC's California Environmental Quality Act (CEQA) and/or National Environmental Policy Act (NEPA) documents, technical studies, surveys, and other environmental documentation to ensure SCE's scope of work is adequately described in such documents (IC will include SCE's scope of work in its environmental documents. If the Generating Facility's CEQA and/or NEPA documents do not sufficiently incorporate SCE's scope of work, SCE's assumed environmental work and permitting level of effort may increase, resulting in the need to update cost and duration estimates, and potentially amend the IA).
- Review SCE's internal existing technical reports/documents when available.
- Prepare SCE's IF and DU project description, including scope changes during permitting/pre-construction or construction.
- Communicate scope changes to the IC's environmental team and discuss/approve subsequent actions including new surveys as necessary.
- Complete General Order 131-D Consistency Determination and Environmental Evaluation.
- Regulatory agency communication, consultation, reporting, and acquisition of SCE permits addressing SCE's facilities and scope of work.
- Prepare environmental requirements for construction clearance.
- Develop communication plan.
- Perform pre-construction coordination field visit.
- Provide Environmental Awareness/Worker Environmental Awareness Program (WEAP) training.
- Perform construction monitoring oversight for IFs and DUs.
- Complete construction and post-construction site assessments.
- IC performs all environmental studies and prepares draft environmental permit applications related to the installation of SCE's IFs and DUs, except for the SCE internal substation activities as described above. The IC's responsibilities include as applicable, but are not limited to: notifications to the Native American Heritage Commission (NAHC) and follow-up notifications to the tribes and individuals in the NAHC contact list; performing cultural and paleontological resources records searches, cultural resources inventories (survey and recording), testing and evaluation and/or data recovery of archaeological sites, and appropriate documents in the form of inventory reports, research design and/or data recovery reports; cultural and paleontological monitoring when/if required, and arranging curation agreements for artifacts and fossil specimens collected; performing a California Natural Diversity Database search, habitat assessment, and protocol or focused surveys for species with the potential of occurring in identified suitable habitat; conducting jurisdictional delineations for wetlands or other regulated waters; preparing draft environmental permit applications, pre-construction biological resource surveys for IFs and DUs, biological resource monitoring during construction for IFs and DUs, and cultural and paleontological monitoring during construction for IFs and DUs; mitigation costs including, but not limited to, offsite/compensatory

mitigation and onsite restoration, and developing mitigation plans or other environmental reports or submittals to support installation of SCE's IFs and DUs.

- Prior to commencing work and during execution of work, the IC should collaborate and obtain SCE concurrence on all work outlined above. Should the IC-performed environmental studies, surveys, or construction monitoring not meet the Federal or State industry standards in accordance with Applicable Laws and Regulations, and as determined by SCE, the IC shall be obligated to remedy deficiencies under SCE's direction.
  - The estimated costs provided in this study assume that the IC will perform part of the environmental scope of work that would normally be performed by SCE for SCE-owned IFs and DUs, if applicable, to interconnect the Generating Facility. The IC shall provide SCE a signed declaration summarizing the actual costs for work performed by the IC within thirty (30) calendar days from the Generating Facility's ISD. The IC acknowledges and accepts that these costs will be subject to an Interconnection Facilities Charge, a Distribution Facilities Charge, if applicable, and Income Tax Component of Contribution (ITCC).
- ii. SCE's Reliability Network Upgrades (RNUs) and Delivery Network Upgrades (DNU) assigned to the Generating Facility:
- SCE will perform all required environmental studies, prepare environmental permit applications, obtain required environmental permits, and perform monitoring of all SCE construction activities related to the installation of SCE's RNUs and DNU.
  - Under certain circumstances, the RNUs and/or DNU may need to be described and analyzed as part of the IC's California Environmental Quality Act (CEQA) and/or National Environmental Policy Act (NEPA) documents for the Generating Facility. Further coordination to discuss these circumstances may occur during IA negotiations and/or after IA execution. Any changes to the environmental and licensing assumptions may result in the need to update cost and duration estimates, and potentially amend the IA.
- iii. For further details on the environmental evaluation and permitting/licensing requirements for generation interconnection projects, refer to Appendix K of the Area report.
5. Energy Storage Considerations:
- With respect to charging, SCE currently offers "as available" service pursuant to the WDT. Charging restrictions will be required and implemented using the Distributed Energy Resource Management System (DERMS), as applicable.
  - SCE is in the course of developing a "firm charging" process. Once the process is established and accepted by FERC, SCE will notify ICs of the process along with its terms and conditions.
  - SCE's Distribution Standards and Practices are in the process of being updated to address energy storage facilities. The proposed Plan of Service in this report may require changes to comply with SCE's Distribution Standards and Practices.
  - This study assumes that the Generating Facility will include all equipment, software, appropriate controls, and other related equipment necessary to maintain Charging Demand restrictions per SCE's requirements.
  - In order to ensure limits are communicated in a timely and reliable manner, the IC is responsible for providing reliable communication between the Generating Facility and SCE to transmit the required telemetry data as outlined in SCE's Interconnection

Handbook. Should the communication channel fail, the Generating Facility's operating limits will automatically revert to zero (no charging allowed).

- If the Generating Facility does not follow the given charging limitations, the Generating Facility will be disconnected.
- Depending on the study results, the Generating Facility may need to participate in the DERMS upon COD. However, if the studies do not identify an immediate need, the Generating Facility may be required to be included in DERMS in the future. Currently, the cost to add the Generating Facility to DERMS could cost up to \$160k, in 2019 dollars. The actual cost to add the Generating Facility to DERMS is subject to change depending on when the Generating Facility will be added to the program. Such determination shall be made pursuant to a technical assessment to be performed by SCE at the time such potential need is identified.
- At this stage, since DERMS is conceptual and under development, it is assumed that DERMS will be available prior to the COD of the Generating Facility. Further details will be available during the final engineering and design phase of the Generating Facility. In concept, DERMS will monitor system loading conditions utilizing data from both SCE's and IC's facilities. DERMS will calculate the available charging capacity limits and will transmit the limits to the IC. It will be required that the IC's control system follows the provided limits. If the IC's control system does not comply with this requirement, SCE will mitigate this condition at its discretion including but not limited to disconnecting the Generating Facility from the grid using SCE controlled equipment.
- The preliminary charging analysis discussed in this report assumed that Charging Demand is curtailable before wholesale and retail load, and this assumption was used to determine the charging restrictions contained in this report for the Generating Facility. The energy storage component of the Generating Facility will need to be metered separately. The IC is required to install multiple sets of metering (i.e. separate sets of potential transformers & current transformers and supporting metering equipment) for the Generating Facility.

6. Other Items to Consider:

- Final metering requirements will be identified as part of the execution the Generating Facility and could result in modifications to the Generating Facility.
- As a requirement for Interconnection Customers electing to share the responsibility to perform the Environmental Activities for SCE-owned Interconnection Facilities (IFs), Distribution Upgrades (DUs) as disclosed in Section D.4, and to ensure proper accounting of costs used in the calculation of the Income Tax Component of Contribution ("ITCC") and Operations & Maintenance ("O&M") charges, referred to as an Interconnection Facilities Charge and/or a Distribution Upgrades Charge, if applicable in the forthcoming GIA for the Generating Facility, the IC is required to complete and submit an Environmental Services Costs Declaration for SCE-owned IFs and/or DUs required to interconnect the Generating Facility. An authorized representative of the IC will sign the Form attesting to the actual costs spent on environmental services work that would otherwise have been performed by SCE for SCE-owned IF and/or DUs required to interconnect the Generating Facility.

The declaration shall be provided to SCE by a specified date in the Generating Facility's forthcoming GIA Appendix B - Milestone table. Should the IC fail to provide the declaration

by the specified deadline, SCE will hold the IC in default of the GIA pursuant to the terms therein. The costs declared by the IC in the declaration, once approved, will be used by SCE to adjust the ITCC and the applicable monthly O&M charges for the Generation Facility and will be reflected via an amendment to the GIA upon true-up.

The information declared in the declaration is subject to review and/or audit by SCE pursuant to the terms and conditions in the forthcoming GIA. Should an audit be deemed necessary by SCE, the IC will need to provide supporting documentation (copies of invoices/receipts) to substantiate the costs declared in the Form within ten (10) business days from receipt of notice.

The IC is advised that should the environmental studies and resulting reports not meet the industry standards utilized in the State of California and/or by SCE in accordance with Applicable Laws and Regulations, as determined by SCE, the IC shall be required to remedy all deficiencies under SCE's direction.

## **E. TECHNICAL REQUIREMENTS<sup>4</sup>**

### **1. Preliminary Protection Requirements**

Protection requirements are designed and intended to protect SCE's electric system only. The preliminary protection requirements were based upon the interconnection plan as shown in the one-line diagram depicted in line item #4 in Attachment 1.

The IC is responsible for the protection of its own system and equipment and must meet the requirements in the SCE's Interconnection Handbook.

### **2. Power Factor Requirements**

The Generating Facility will be required to maintain a composite power delivery at continuous rated power output at the high-side of the generator substation or other equivalent location. At that point, the generator must provide dynamic reactive power within the power factor range of 0.95 leading to 0.95 lagging. The Generating Facility may meet the dynamic reactive power requirement by utilizing a combination of the inherent dynamic reactive power capability of the inverter, dynamic reactive power devices, and static reactive power devices to make up for losses.

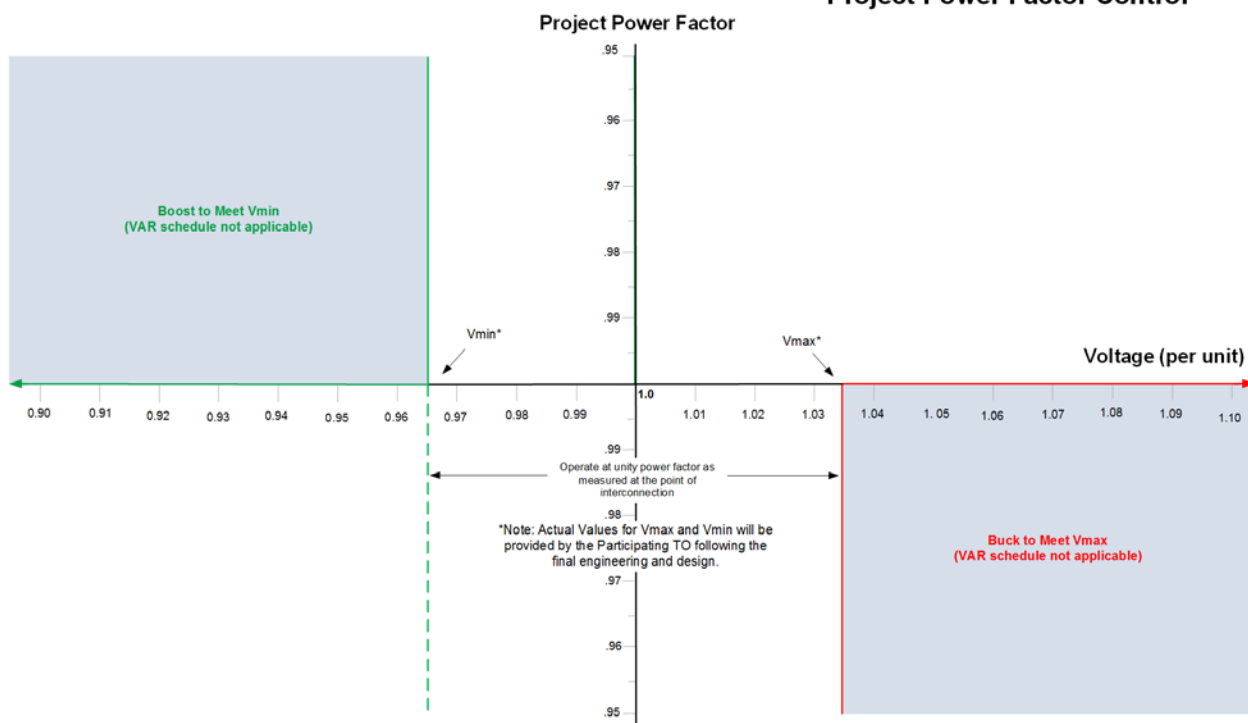
### **3. Operating Voltage Requirements**

Under real-time operations, the Generating Facility will be required to operate under the control of automatic voltage regulator with settings as shown in the figure below. The actual values of the Vmin and Vmax will be provided once the Generating Facility executes a Generation Interconnection Agreement and final engineering and design is complete. The Vmin and Vmax values are to be used as the basis for setting up the automatic voltage control mode (with its automatic voltage regulator in service and controlling voltage) of the Generating Facility in order to maintain scheduled voltage at a reference point.

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<sup>4</sup> The IC is advised that it shall comply with mandatory regulatory standards of but not limited to FERC/NERC/WECC/CPUC and there may be technical requirements in addition to those that outlined above in Section C of this report that are included in the SCE's Interconnection Handbook or that will be addressed in the Generating Facility's GIA.

## Project Power Factor Control



#### 4. Harmonic Requirements

The harmonic impact of the subject inverter-based generation was not part of this study. Impacts on voltage distortion levels may be significant due to the penetration level of the Generating Facility with respect to the local distribution grid strength. As with all equipment connected to SCE's Electric System, the Generating Facility will be subject to the provisions of CPUC Rule 2.E, allowing SCE to require the IC to mitigate interference with service to other SCE customers, including harmonic impacts, if the harmonic interference is caused by the IC.

#### 5. Low/High Voltage Ride-Through (LHVRT) and Low/High Frequency Ride-Through (LHFRT) Capability

Consistent with PRC-024, the Generating Facility may not trip or cease to inject current within the "no-trip" zone of the frequency and voltage ride through curves of PRC-024. Momentary cessation—ceasing to inject current during a fault—is prohibited unless transient high voltage conditions rise to 1.20 per unit or more. For transient low voltage conditions, the Generating Facility will inject reactive current directionally proportional to the decrease in voltage. The inverter must produce full rating reactive current when the AC voltage at the inverter terminals drops to a level of 0.50 per unit and must continue to operate and attempt to maintain voltage for transient voltage conditions between 1.10 and 1.20 per unit. In addition, the Generating Facility may not trip or cease to inject current for momentary loss of synchrony within the no-trip zone of PRC-024.

#### 6. Primary Frequency Response Requirement

Per FERC Order 842, the IC is required to install a governor or equivalent controls with the capability of operating: (1) with a maximum 5 percent droop and  $\pm 0.036$  Hz deadband; or (2) in accordance with the relevant droop, deadband, and timely and sustained response settings from the Approved Applicable Reliability Standards providing for equivalent or more stringent parameters. The IC shall ensure that the Electric Generating Unit's real power response to sustained frequency deviations outside of the deadband setting is automatically provided and shall begin immediately after frequency deviates outside of the deadband, and to the extent the Electric Generating Unit has operating capability in the direction needed to correct the frequency deviation.

Per FERC Order 841, nuclear generating facilities and certain Combined Heat and Power (CHP) facilities are exempt from these primary frequency response requirements.

An operating range shall be identified in the GIA that specifies a minimum state of charge and a maximum state of charge between which the electric storage resource will be required to provide primary frequency response. The GIA shall also specify whether the operating range is static or dynamic; in addition, the operating range is subject to reevaluation and modification by SCE in consultation with the IC and ISO.

## **F. RELIABILITY STANDARDS, STUDY CRITERIA AND METHODOLOGY**

### **1. SCE Analysis**

The generator interconnection studies were conducted to ensure the ISO Grid follows the North American Electric Reliability Corporation (NERC) reliability standards, WECC regional criteria, and the ISO planning standards. Refer to Section C of the Area Report for details of the applicable reliability standards, study criteria, and methodology. In addition, the Subtransmission Assessment was performed in compliance with SCE's Subtransmission Planning Criteria.

### **2. Coordination with Affected Systems**

Per GIP section 3.7, SCE will notify the Affected System Operators that are potentially affected by an IC's IR or group of interconnection requests subject to a Group Study. SCE will coordinate the conduct of any studies required to determine the impact of the IR on Affected Systems with Affected System Operators and, if possible, include those results (if available) in its applicable Interconnection Study within the time frame specified in the GIP. SCE will include such Affected System Operators in all meetings held with IC as required by the GIP. IC will cooperate with SCE in all matters related to the conduct of studies and the determination of modifications to Affected Systems. A transmission provider which may be an Affected System shall cooperate with SCE with whom interconnection has been requested in all matters related to the conduct of studies and the determination of modifications to Affected Systems.

Refer to Section F for additional information.

## **G. POWER FLOW RELIABILITY ASSESSMENT RESULTS**

### **I. Discharging Analysis of the Generating Facility**

#### **a) Steady State Power Flow Analysis Results – ISO controlled facilities**

[REDACTED]

[REDACTED]

[REDACTED]

Lastly, Section J – Deliverability Assessment Results of this report provides information on any Delivery Network Upgrades (Local or Area) assigned to the Generation Facility, if any.

b) Steady State Power Flow Analysis Results - 66 kV or 115 kV (non-ISO controlled)

**1. Thermal Overloads**

[REDACTED]

Provided below is a summary of the overloaded facilities under normal, single contingency, and/or multiple contingency conditions with associated mitigation, if applicable.

- 1. [REDACTED]
- 2. [REDACTED]
- 3. [REDACTED]

**2. Power Flow Non-Convergence**

[REDACTED] refer to Area Report and/or Subtransmission Assessment Report for additional details.

**3. Voltage Performance**

[REDACTED] refer to Area Report and/or Subtransmission Assessment Report for additional details.



**4. Required Mitigations**



**5. Line Loss Analysis for Generating Facility**

Based on the technical data provided for the individual generator unit(s), the collector system equivalent, pad-mount and main transformer banks, the internal Generating Facility losses are shown in Table 1. In addition, losses incurred on the generation tie line are shown in Table 2 below. The Generating Facility losses identified represent those assuming the Generating Facility is limiting its output at the high side of the main transformer bank to achieve the desired MW delivery at the POI.

Table 1

Resource	Gross output to Achieve Desired output at POI (MW)*	Internal Generating Facility Losses (MW)			Aux Load (MW)	Net Output (MW)
		Pad-Mount	Collector	Main Transformer		
[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]

\*This represents the MW value needed at the inverter terminal to achieve the desired Net Output MW in order to meet the requested POI MW.

Table 2

Resource	Net Output* (MW)	Losses on Interconnection Facilities (MW)		POI (MW)
		Generating Facility Gen-Tie		
[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]

\*MW (net) represents the MW value as measured on the high side of the main transformer bank to achieve the desired MW delivery at the POI.

**6. Power Factor Evaluation**

FERC Order 827 provides the reactive power requirements for newly interconnecting non-synchronous generators which requires these resources to design the facility to be capable of providing reactive power to meet power factor 0.95 as measured on the high-side of the IC’s substation or other equivalent location. This capability should be dynamic.

Base case power flow was evaluated to determine reactive power losses internal to the Generating Facility in order to ascertain if the reactive capability of the Generating Facility is adequate to supply these losses and meet the power factor requirements. A summary of the power factor evaluation is provided in the table below.

Evaluation Assumptions		
	Avg. High Temp	Record High Temp
Generating Facility MW Output at Terminal(MW)	[REDACTED]	[REDACTED]
Ambient Temperature for Generator Capability (°C)	[REDACTED]	[REDACTED]
Effective Power Factor at Generator Terminal	[REDACTED]	[REDACTED]
Generating Facility MW at High Side of the Transformer (MW)	[REDACTED]	[REDACTED]
<b>Reactive Power Requirements</b>		

Pad-mount transformer losses (Mvar)	[REDACTED]	[REDACTED]
Collector equivalent losses (Mvar)	[REDACTED]	[REDACTED]
Main transformer losses (Mvar)	[REDACTED]	[REDACTED]
PF Requirements at High Side of Transformer (Mvar)	[REDACTED]	[REDACTED]
<b>Total VAR Requirements (Mvar)</b>	[REDACTED]	[REDACTED]
<b>Reactive Power Supply</b>		
[REDACTED] Inverters at Pgen (Mvar)	[REDACTED]	[REDACTED]
Shunt Capacitors (Mvar)	[REDACTED]	[REDACTED]
Collector Line Charging (Mvar)	[REDACTED]	[REDACTED]
Other Dynamic VAR Devices (Mvar)	[REDACTED]	[REDACTED]
<b>Total VAR Supply (Mvar)</b>	[REDACTED]	[REDACTED]
<b>Total Dynamic VAR Supply (Mvar)</b>	[REDACTED]	[REDACTED]
Total Reactive Power (Shortage) / Surplus	[REDACTED]	[REDACTED]
Total Requirements less Total Supply	[REDACTED]	[REDACTED]
Dynamic Reactive Power (Shortage) / Surplus	[REDACTED]	[REDACTED]
PF Requirements at High Side of Transformer less Total Dynamic VAR Supply	[REDACTED]	[REDACTED]

[REDACTED]

## II. As-Available Charging Analysis of the Generating Facility

### a) Steady State Power Flow Analysis Results – ISO controlled facilities

[REDACTED]

### b) Steady State Power Flow Analysis Results - 66 kV or 115 kV (non-ISO controlled)

#### 1. Thermal Overloads

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

#### 2. Power Flow Non-Convergence

[REDACTED] refer to Area Report and/or Subtransmission Assessment Report for additional details.

**3. Voltage Performance**

[REDACTED] refer to Area Report and/or Subtransmission Assessment Report for additional details.

**4. Required Mitigations**

The Generating Facility is required to provide 0.95 leading/0.95 lagging power factor regulation capability at the high-side of the IC’s substation or other equivalent location. With respect to Charging Demand, SCE currently offers “as-available” service pursuant to the WDAT. [REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

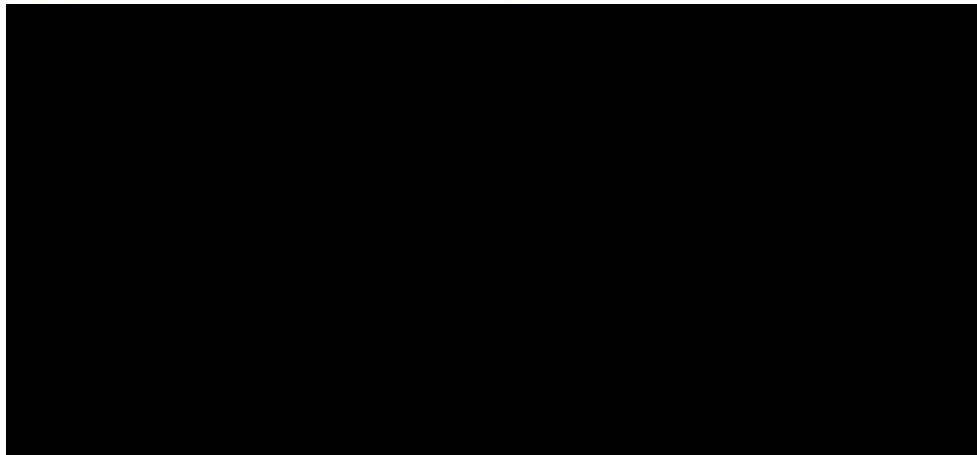
[REDACTED]

**H. TRANSIENT STABILITY EVALUATION**

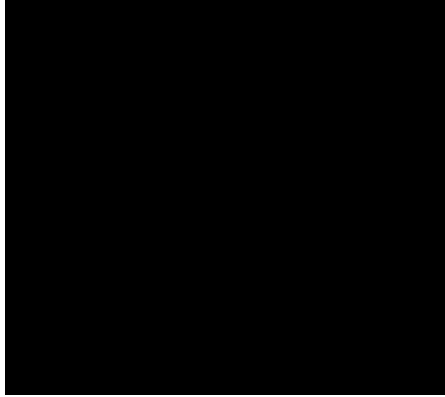
**1. Generating Facility Performance**

Dynamic simulation study results illustrating the frequency and voltage performance of the Generating Facility based on the technical parameters supplied for the Generating Facility are provided below.


Voltage and Frequency Plots for Generating Facility at the high-side of the IC’s substation with fault at POI



Power Output Flow Plots for Generating Facility at inverter terminal with fault at POI



## 2. System Performance

 Refer to the Area Report for additional details pertaining to the Phase I transient stability evaluation criteria and assessment results, respectively.

# I. SHORT-CIRCUIT DUTY RESULTS

Short-circuit duty (SCD) studies were performed to determine the fault duty impact of adding the Phase I projects to SCE’s electric system and to ensure system coordination. The fault duties were calculated with and without the projects to identify any equipment overstress conditions. Once overstressed circuit breakers are identified, the fault current contribution from each individual project in Phase I is determined. Each project in the cluster will be responsible for its share of the upgrade cost based on the rules set forth in Section 4 of the GIP.

## 1. SCE-owned Facilities

All bus locations where the Phase I projects increased the SCD by 0.1 kA or more and where duty was found to be in excess of 60% of the minimum breaker nameplate rating are listed in the Area Report (Appendix H) and applicable Subtransmission Assessment Report (Attachment 7). These values have been used to determine if any equipment is overstressed as a result of the inclusion of Phase I interconnections and corresponding Network Upgrades, if any.

If any equipment is found to be overstressed with the inclusion of the cluster, corresponding Area Deliverability Network Upgrade and/or corresponding Local Deliverability Network Upgrade, further analysis is performed to identify the specific projects that drive the need for the upgrade and/or mitigation. Individual project contribution at the impacted location are then used to determine which project or group of projects drives the need for the upgrade and/or mitigation.

The QC12 Phase I SCD evaluation results are summarized below.

### a. ISO controlled facilities:

[REDACTED]

Please refer to the Area Report for additional details.

**b. Subtransmission Level Results (66 kV or 115 kV non-ISO controlled):**

[REDACTED]

Please refer to the Subtransmission Assessment Report for additional details.

**2. Affected Systems**

[REDACTED]

[REDACTED]

[REDACTED]

Substation	Voltage	Entity	Generating Facility Impact	
			3-Phase (kA)	Single Line-to-Ground (kA)
[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]
[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]
[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]
[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]
[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]
[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]
[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]
[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]
[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]

**3. SCE's Ground Grid Duty Concerns**

[REDACTED]

Refer to the Area Report and/or Subtransmission Assessment Report (if applicable) for further information.

**4. Short Circuit Duty Considerations**

[REDACTED]

Please refer to the Subtransmission Assessment Report for further details.

**J. DELIVERABILITY ASSESSMENT RESULTS**

**1. On Peak Deliverability Assessment**

[REDACTED]

Contingency	Overloaded Facility	Loading
[REDACTED]	[REDACTED]	[REDACTED]
[REDACTED]	[REDACTED]	[REDACTED]
[REDACTED]	[REDACTED]	[REDACTED]

**2. Off- Peak Deliverability Assessment**

[REDACTED]

**3. Required Mitigations**

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

**K. INTERCONNECTION FACILITIES, NETWORK UPGRADES, AND DISTRIBUTION UPGRADES**

Please see Attachment 1 for SCE’s IF’s, RNU’s, Delivery Network Upgrades<sup>5</sup> (DNU’s), and DU’s allocated to the Generating Facility. Please note that SCE considered current system configuration, approved SCE sponsored projects, and all queued generation in determining scope for IFs and/or Plan of Service but will not “reserve” the identified scope of upgrades for the proposed POI unless a GIA is executed per the specified timelines shown in Table M.1.

**L. COST AND CONSTRUCTION DURATION ESTIMATE**

**1. Cost Estimate**

The Generating Facility’s estimated interconnection costs, adjusted for inflation and provided in 'constant' 2019 dollars escalated to the Generating Facility’s feasible operating date (as identified below), are provided in Attachment 2 and the Generating Facility’s allocated cost for shared network upgrades are provided in Attachment 3. The costs will be utilized in developing the GIA. However, should there be a delay in executing the GIA beyond 2021, a new cost estimate adjusted for inflation will be required and reflected into the GIA.

**2. Construction Duration Estimate**

The construction duration for the identified facilities is as follows:

a. SCE’s Interconnection Facilities – [REDACTED]

[REDACTED]

<sup>5</sup> At the IC’s discretion, the IC or parties other than SCE pursuant to Section 10.2 under GIP may construct an Option (B) Generating Facility Area Delivery Network Upgrades (ADNUs) not allocated TP Deliverability. If SCE does not construct the ADNUs, the IC is not required to make the third Interconnection Financial Security posting to SCE pursuant to Section 4.8.4.2.1 under GIP.

b. Reliability Network Upgrades

[REDACTED]

c. Distribution Upgrades

[REDACTED]

Please refer to Attachment 1 for details related to this item.

**Note 1—Construction Duration Estimates and Identified Upgrades.** Any construction durations identified in this section may vary. During the cluster study process, SCE includes all queued and active generation projects without regard to corresponding desired in-service dates or actual project status to identify SCD and Distribution Upgrades and a duration for SCE to build them. Such duration, of course, affects the In-Service Date for this specific project. As status for queued projects change (withdrawals, downsizing, suspensions, or deferred in-service dates), SCE may be able to accelerate in-service dates for projects affected by status changes. Furthermore, SCE will only begin design/construction of an identified SCD and Distribution Upgrade when enough projects 1) execute and fund a Generation Interconnection Agreement and/or a Letter of Agreement with SCE and 2) those projects trigger the need for an upgrade.

**Note 2 -- Construction Duration Estimates and Coordination of Environmental Work.** Where this study assumes that the IC will perform environmental work related to the installation of SCE’s IFs, DUs, and RNUs as specified in this report, the IC is advised that any durations provided above assume so and that the IC will perform this environmental work

related to the installation of SCE’s IFs and/or DUs specified in this report and will perform them in parallel with SCE’s preliminary design and engineering. The IC is expected to engage SCE to obtain concurrence prior to commencement of any environmental work and during execution of that work. Since SCE will be using the IC’s environmental documents and/or work products, IC delays producing them may delay SCE’s ability to obtain required permits and/or license(s). Such delays would likely cause additional delays in the commencement of SCE’s final engineering, procurement, and construction. These delays could increase any durations identified in this report and push out the feasible ISD provided in Table M.1 ISD and COD Assessment.

**3. Other Potential Costs to the Generating Facility**



**M. IN-SERVICE DATE AND COMMERCIAL OPERATION DATE ASSESSMENT**

An ISD and COD assessment was performed for this Generating Facility to establish SCE’s estimate of the earliest achievable ISD based on the QC12 Phase I Interconnection Study process timelines and the time required for SCE to complete the facilities needed to enable physical interconnection as an Interim Deliverability or Energy Only Deliverability interconnection (as applicable) for the Generating Facility. This date may be different from the IC’s requested ISD and will be the basis for establishing the associated milestones in the draft GIA.

Details pertaining to Full Capacity Deliverability Status and Partial Capacity Deliverability Status are provided below.

**1. ISD Estimation Details**

For the QC12 Phase I Interconnection Study, the estimated earliest achievable ISD is derived by the time requirements to complete the QC12 Interconnection Study Process, tender a draft GIA, negotiate and execute the GIA, and construct the necessary facilities as described below in Table M.1.

Table M.1 ISD and COD Assessment

Reference starting point	Days/Months	Issuance of Phase II Interconnection Study Report	
<b>Add:</b>	<b>30 CD</b>	Phase II Results Meetings	
<b>Add:</b>	<b>15 BD (20 CD)</b>	<b>Starting Point:</b> TPD Results issued and IC response provided	
<b>Add:</b>	<b>30 CD</b>	<b>Earliest Reasonable Tender of draft GIA</b>	
<b>Add:</b>	<b>90 CD</b>	GIA negotiation time, execution, filing, and related activities.	





## N. ADDITIONAL STUDY ANNOTATIONS

### 1. Conceptual Plan of Service

The results provided in this study are based on conceptual engineering and are preliminary. The information is not sufficient for permitting purposes and is subject to change as part of final engineering and design.

### 2. The study does not include analysis related to the power output rate of change that may occur due to the following or other conditions:

- System morning start up for solar generating facilities: That is when each morning the Generating Facility commences to generate and export electrical energy to the electric system.
- Cloud Cover: Solar generating facilities have significant generation output variation (Variability) which can have an impact on electric system voltage profiles.

### 3. IC's Technical Data

The study accuracy and results for the QC12 Phase I Interconnection Study was contingent upon the accuracy of the IR technical data provided by each IC during the Interconnection Study Cycle. Any changes from the data provided as allowed under GIP should be submitted in Attachment B within ten (10) Business Days following the Phase I Interconnection Study Results Meeting. Any changes in the Attachment B submission that extend beyond the modifications allowed in accordance with Section 4.5.7.2.2 of GIP would need to be evaluated under a Material Modification Assessment (MMA). To determine if such change(s) results in a material impact to queued-behind generation.

### 4. Study Impacts on Affected Systems

Results or consequences of this Phase I Interconnection Study may require additional studies, facility additions, and/or operating procedures to address impacts to neighboring utilities and/or regional forums. For example, impacts may include but are not limited to WECC Path Ratings, short-circuit duties outside of the ISO Controlled Grid, and sub-synchronous resonance (SSR). Refer to Affected Systems Coordination Section H of the Area Report and above in Section F for additional information.

### 5. Use of SCE's Facilities

The IC is responsible for acquiring all property rights necessary for the IC's Interconnection Facilities, including those required to cross the SCE's facilities and property. This Phase I Interconnection Study does not include the method or estimated cost to the IC of SCE mitigation measures that may be required to accommodate any proposed crossing of SCE's facilities. The crossing of SCE's property rights shall only be permitted upon written agreement between SCE and the IC at SCE's sole determination. Any proposed crossing of SCE property rights will require a separate study and/or evaluation, at the IC's expense, to determine whether such use may be accommodated. If the IC's Facilities result in the need to modify SCE's existing facilities, SCE recommends that the IC identify and include a description of such modifications in the IC's environmental study reports submitted to the lead agency permitting the Generating Facility.

### 6. SCE's Interconnection Handbook

The IC shall be required to adhere to all applicable requirements in SCE's Interconnection Handbook. These include, but are not limited to, all applicable protection, voltage regulation, VAR correction, harmonics, switching and tagging, and metering requirements.

**7. Western Electricity Coordinating Council (WECC) Policies**

The IC shall be required to adhere to all applicable WECC policies including, but not limited to, the WECC Generating Unit Model Validation Policy.

**8. System Protection Coordination**

Adequate Protection coordination will be required between SCE-owned protection and IC-owned protection. If adequate protection coordination cannot be achieved, then modifications to the IC-owned facilities (i.e., Generation-tie or Substation modifications) may be required to allow for ample protection coordination.

**9. Standby Power and Temporary Construction Power**

The Phase I Interconnection Study does not address any requirements for standby power or temporary construction power that the Generating Facility may require prior to the ISD of the Interconnection Facilities (IF's). Should the Generating Facility require standby power or temporary construction power from SCE prior to the ISD of the IF's, the IC is responsible to make appropriate arrangements with SCE to receive and pay for such retail service. SCE recommends that the IC identify and include a description of such facilities in the IC's environmental study reports submitted to the lead agency permitting the Generating Facility.

**10. Licensing Cost and Estimated Time to Construct Estimate (Duration)**

The estimated licensing cost and durations applied to this Generating Facility are based on the Generating Facility scope details presented in this Phase I Interconnection Study. These estimates are subject to change as the Generating Facility's environmental and real estate elements are further defined. Upon execution of the GIA, additional evaluation including but not limited to preliminary engineering, environmental surveys, and property right checks may enable licensing cost and/or duration updates to be provided.

**11. Network/Non-Network Classification of Telecommunication Facilities**

- a. Non-Network (Interconnection Facilities) Telecommunications Facilities: The cost for telecommunication facilities that were identified as part of the IC's Interconnection Facilities was based on an assumption that these facilities would be sited, licensed, and constructed by the IC. The IC will own, operate, maintain, and construct main and diverse telecommunication paths associated with the IC's generation tie line, excluding terminal equipment at both ends. In addition, the telecommunication requirements for the RAS were assumed based on tripping of the generator's breaker in lieu of tripping the circuit breakers and opening the IC's gen-tie at SCE's substation.
- b. Network (Network Upgrades) Telecommunications Upgrades: Due to uncertainties related to telecommunication upgrades for the numerous projects in queues ahead of this Generating Facility, telecommunication upgrades for earlier queued projects without a signed GIA which upgrades have not been constructed were not considered in this study. Depending on the scope of these earlier queued projects, the cost of telecommunication upgrades identified for Phase I may be reduced. Any changes in these assumptions may affect the cost and schedule for the identified telecommunication upgrades.

**12. Ground Grid Analysis**

A detailed ground grid analysis will be required as part of the final engineering for the Generating Facility at the SCE substations whose ground grids were flagged with duty concerns.

**13. SCE Technical Requirements**

The IC is advised that there may be technical requirements in addition to those that outlined above in Section C of this report that will be addressed in the Generating Facility GIA.

**14. Applicability**

This document has been prepared to identify the impact(s) of the Generating Facility on the SCE's electric system; as well as establish the technical requirements to interconnect the Generating Facility to the POI that was evaluated in the final Phase I Interconnection Study for the Generating Facility. Nothing in this report is intended to supersede or establish terms/conditions specified in GIAs agreed to by the SCE, ISO, and the IC.

**15. Process for Initial Synchronization Date/Trial Operation Date and COD of the Generating Facility**

The IC is reminded that the ISO has implemented a New Resource Implementation (NRI) process that ensures that a generation resource meets all requirements before Initial Synchronization Date/Trial Operation Date and COD. The NRI uses a bucket system for deliverables from the IC that are required to be approved by the ISO. The first step of this process is to submit an "ISO Initial Contact Information Request form" at least seven (7) months in advance of the planned Initial Synchronization Date. Subsequently an NRI project number will be assigned to the Generating Facility for all future communications with the ISO. SCE has no involvement in this NRI process except to inform the IC of this process requirement. Further information on the NRI process can be obtained from the ISO Website using the following links:

New Resource Implementation webpage:

<http://www.caiso.com/participate/Pages/NewResourceImplementation/Default.aspx>

NRI Checklist:

<http://www.caiso.com/Documents/NewResourceImplementationChecklist.xls>

NRI Guide:

<http://www.caiso.com/Documents/NewResourceImplementationGuide.doc>

**16. ISO Market Dispatch**

This study did not evaluate any potential limitations that may be driven by the ISO market under real-time operating conditions.

**17. Interconnection Request to Third-Party Owned Facilities**

Generating Facility's requesting to interconnect to a Third party owned facility will need to obtain written approval from the owner(s) of the facility prior to execution of the GIA.

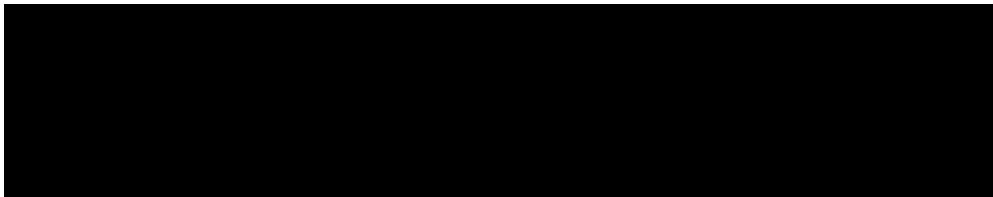
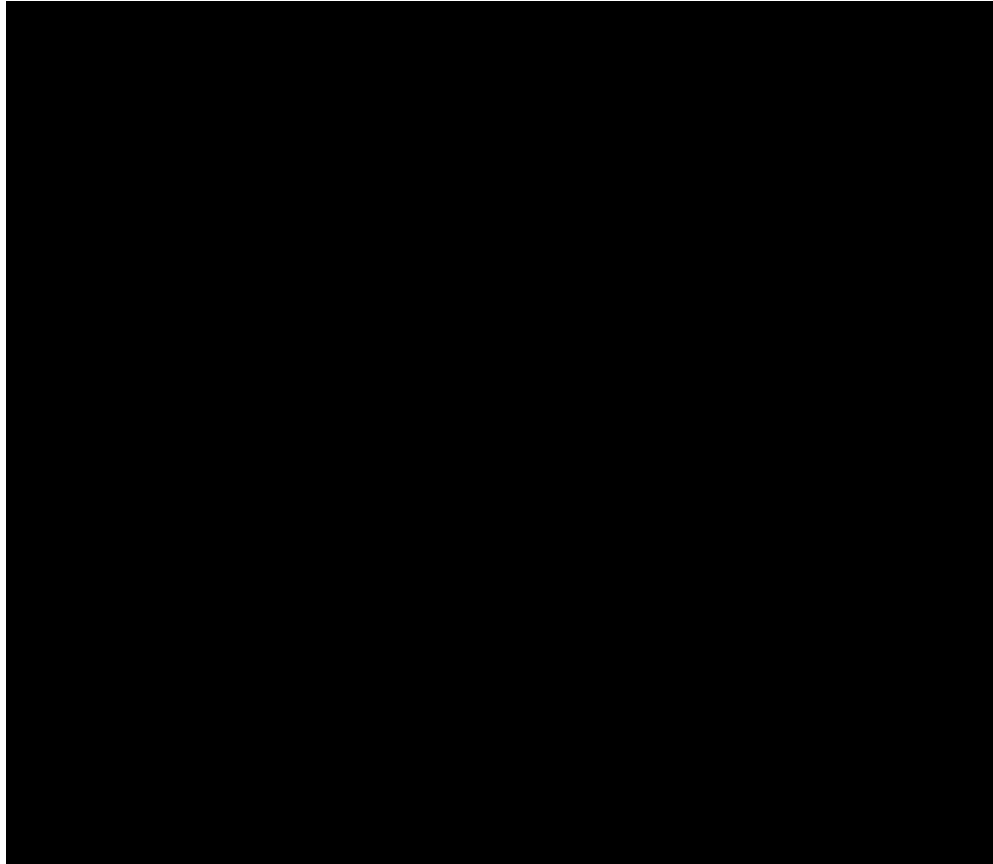
**18. Future Charging Restrictions**

Charging restrictions not identified in this study may occur in the future if the underlying operating assumptions prove to be different from the conditions evaluated in this study.

**Attachment 1:**  
**Interconnection Facilities, Network Upgrades, and Distribution Upgrades**  
Please refer to separate document

**Attachment 2:**  
**Escalated Cost and Time to Construct for Interconnection Facilities, Reliability Network Upgrades,  
Delivery Network Upgrades, and Distribution Upgrades**  
Please refer to separate document

**Attachment 3:  
Allocation of Network Upgrades for Cost Estimates and Maximum Network  
Upgrade Cost Responsibility**



**Attachment 4:**

**SCE's Interconnection Handbook**

Preliminary Protection Requirements for Interconnection Facilities are outlined in SCE's Interconnection Handbook at the following link:

[https://www.sce.com/sites/default/files/inline-files/SCE\\_InterconnectionHandbook.pdf](https://www.sce.com/sites/default/files/inline-files/SCE_InterconnectionHandbook.pdf)



**Attachment 5:**  
**Short-Circuit Duty Calculation Study Results**  
Please refer to the Appendix H of the Area Report

**Attachment 6:  
IC Provided Generating Facility Dynamic Data**

[Redacted]

[Redacted]

[Redacted]

[Redacted]

[Redacted]

**Attachment 7:**  
**Subtransmission Assessment Report**  
Please refer to separate document