# Appendix A – WDAT907

[redacted]

[redacted]

## Queue Cluster 5 Phase I Report

**January 30, 2013**

This study has been completed in coordination with the California Independent System Operator (CAISO) per CAISO Tariff Appendix DD Generator Interconnection and Deliverability Allocation Procedures (GIDAP)

# Table of Contents



Attachments:

1. Allocation of Network Upgrades for Cost Estimates
2. Escalated Cost and Time to Construct for Interconnection Facilities, Reliability Network Upgrades, Delivery Network Upgrades, and Distribution Upgrades
3. Interconnection Handbook
4. Short Circuit Calculation Study Results (see Appendix H of the group report)
5. Not Used.
6. Generator Dynamic Data

## A. Executive Summary

[redacted] an Interconnection Customer (IC), has submitted a completed Interconnection Request (IR) to the Southern California Edison Company (SCE) for their proposed [redacted] (Project), under the terms of SCE's Wholesale Distribution Access Tariff (WDAT). The Project is a Full Capacity Deliverability Status, Solar Photovoltaic (PV) Plant with a total rated output of 50 MW to the proposed Point of Interconnection (POI) at Southern California Edison Company's (SCE) Carodean – Leatherneck 115 kV transmission line in San Bernardino County, California. The customer has requested a proposed In-Service Date of January 1, 2015 and a proposed Commercial Operation Date of [redacted]

In accordance with Federal Energy Regulatory Commission (FERC) approved Generator Interconnection and Deliverability Allocation Procedures (GIDAP) (CAISO Tariff Appendix DD), the Project was grouped with Queue Cluster 5 Phase I (QC5) study projects to determine the impacts of the group as well as impacts of the Project on the CAISO Controlled Grid.

The group report has been prepared separately identifying the combined impacts of all projects in the group on the CAISO Controlled Grid. This report focuses only on the impacts of this Project.

The report provides the following:

1. Transmission system impacts caused by the Project;

2. System reinforcements necessary to mitigate the adverse impacts caused by the Project under various system conditions;

3. A list of required facilities and a good faith estimate of the Project's cost responsibility and time required to construct and bring these facilities into service.

The QC5 study has determined that the Project contributes to various reliability and/or deliverability problems for which mitigation plans have been proposed. These mitigation plans are detailed in Section C of this report. The cost responsibility and estimated time to construct[1] the facilities required for the Project are summarized below.

The good faith cost estimates of Interconnection Facilities[2] (IF) and Distribution Upgrades[3] to interconnect the Project are:

| | |
|---|---|
| Interconnection Facilities | $1,264,000 |
| ITCC for Interconnection Facilities | $442,000 |
| Distribution Upgrades | $32,425,000 |
| ITCC for Distribution Upgrades | $11,150,000 |

The non-binding cost estimate of Interconnection Facilities (IF) and Distribution Upgrades to interconnect the Project is approximately $1,706,000 and $43,575,000 respectively, including ITCC[4].

[1] Construction is only part of the duration of months specified in the study, includes final engineering, licensing, etc, and other activities required to bring such facilities into service.
[2] The transmission facilities identified between the generation facility and the point of interconnection necessary to physically and electrically interconnect the Project to the CAISO-Controlled Grid.
[3] These upgrades are not part of the CAISO Controlled Grid, and are not reimbursable.
[4] Income Tax Component of Contribution. The ITCC included in this cost estimate was computed using a 35% rate.

The good faith cost estimate for the allocated Reliability Network Upgrades[5] (RNUs) necessary to interconnect the project is $23,000.

The good faith cost estimate for Local Delivery Network Upgrades[6] (LDNUs) allocated to the project due to the requested Full Capacity Deliverability Status is $0.

The good faith estimated cost for Area Delivery Network Upgrades[7,8] (ADNUs) is $9,045,000.

The non-binding estimated time to interconnect the project and construct the facilities corresponding with the mitigation plans associated to the Project is as follows:

| Facility Type | Duration (Months) |
|---|---|
| Interconnection Facilities | 27 |
| Reliability Network Upgrades | 24 |
| Local Delivery Network Upgrades | NA |
| Area Delivery Network Upgrades | 105 |
| Distribution Upgrades | 43 |

These durations are from the execution of the Generator Interconnection Agreement, receipt of: all required information, funding, and written authorization to proceed from the IC as will be specified in the Generator Interconnection Agreement to commence the work.

## B. Project and Interconnection Information

The Project's general information, as stated in the IR provided by the IC, and Interconnection Facilities are illustrated below in Table B.1, Figure B.1 provides the map for the Project and the transmission facilities in the vicinity, and Figure B.2 shows the conceptual single line diagram of the Project as modeled in the study.

[5] The SCE transmission facilities, other than Interconnection Facilities, at or beyond the point of interconnection necessary to physically and electrically interconnect the Project, needed to maintain system integrity and reliability.
[6] The SCE transmission facilities, other than Interconnection Facilities, at or beyond the point of Interconnection necessary to physically and electrically interconnect the Project, and are network upgrades built to address local deliverability constraints for projects that request Full or Partial Capacity Deliverability Status
7 The SCE transmission facilities, other than Interconnection Facilities, at or beyond the point of Interconnection necessary to physically and electrically interconnect the Project, and are network upgrades built to address area deliverability constraints for projects that request Full or Partial Capacity Deliverability Status
8 The CAISO developed the $/MW cost rate for Incremental Area Delivery Network Upgrades. The cost rate multiplied by the requested deliverable MW capacity provides the cost estimate for the Area Delivery Network Upgrades.

**Table B.1: Project General Information**

| | |
|---|---|
| Project Location | [redacted]<br>San Bernardino County |
| Participating TO's Planning Area | SCE Eastern System |
| Number and Type of Generators | [redacted] |
| Interconnection Voltage | 115 kV |
| Maximum Generator Output | 50.7 MW |
| Generator Auxiliary Load | 0.7 MW |
| Maximum Net Output to Grid | 50.0 MW |
| Power Factor Range | Lead 0.95 / Lag 0.95 |
| Step-up Transformer(s) | **Main Transformer:**<br>115/34.5 kV (YG-YG), 36/48/60 MVA<br>H-X Impedance Value: 9 % @ 36 MVA<br><br>**Padmount Transformer:**<br>34.5/0.270 (YG-D), 1.25 MVA<br>H-X Impedance Value: 5.75 % @ 1.25 MVA |
| Point of Interconnection | Carodean-Leatherneck 115 kV line |
| Interconnection Customer Requested Commercial Operation Date | [redacted] |

## Figure B.1: Map of the Project

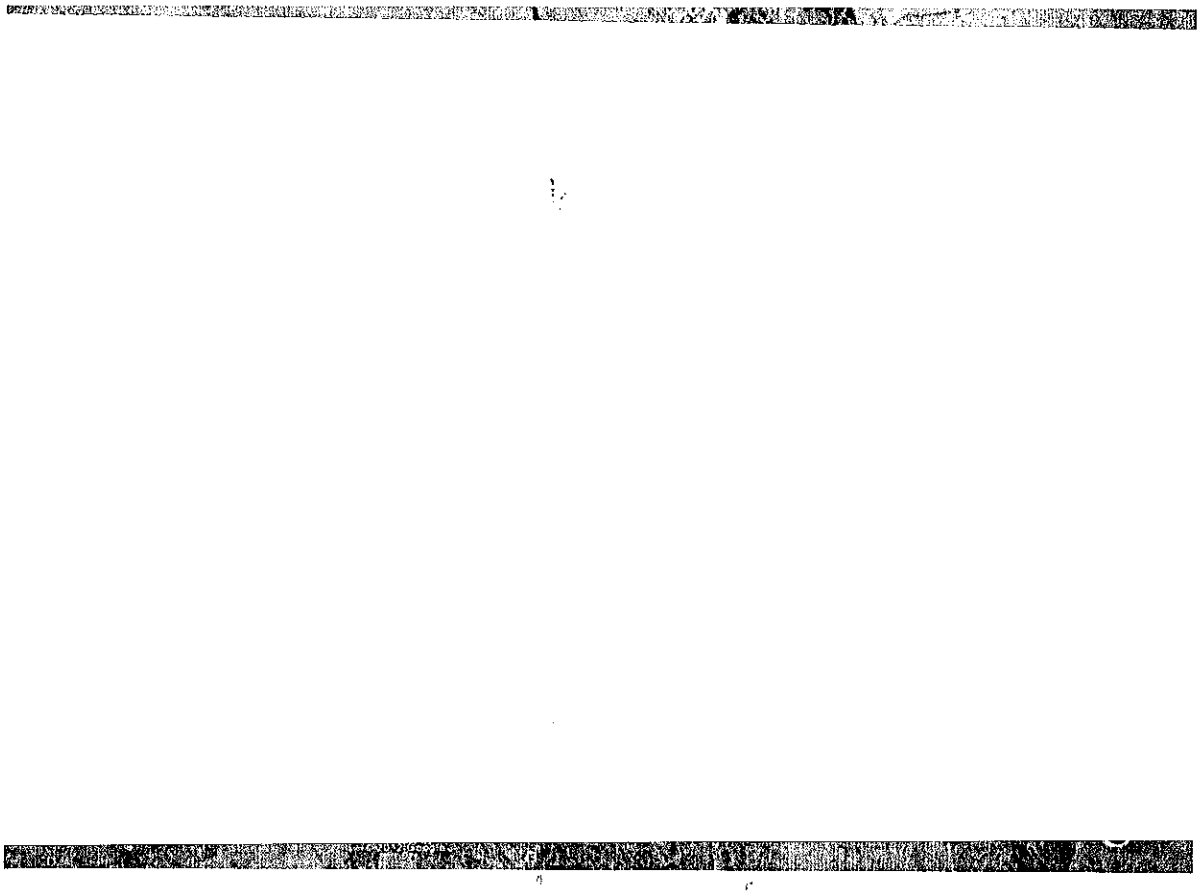
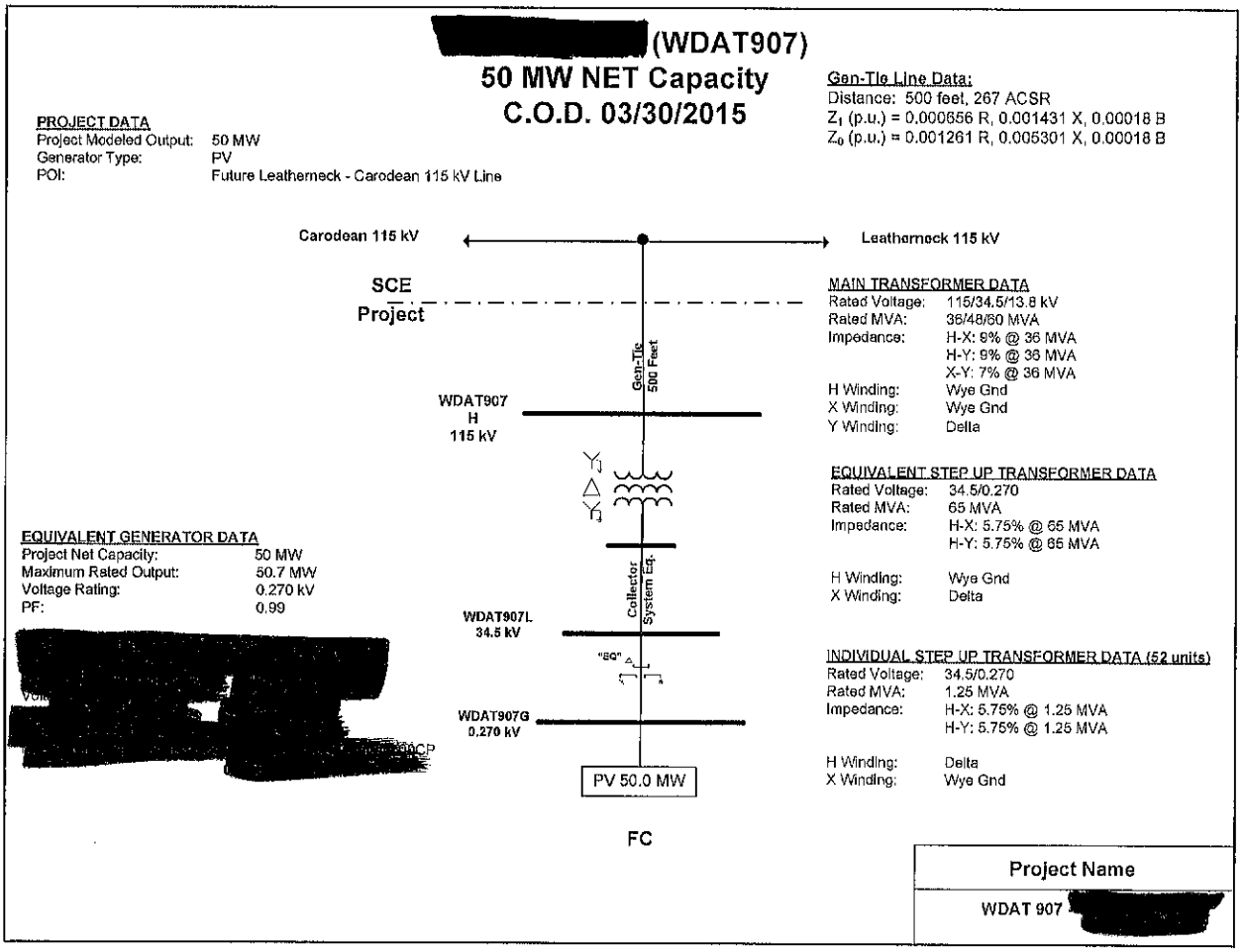


Figure B.2: Proposed Single Line Diagram




## C. Interconnection Facilities, Network Upgrades, and Distribution Upgrades

To determine the cost responsibility of each generation project in QC5, the CAISO developed cost allocation factors (Attachment 1) for Reliability Network Upgrades and Local Delivery Network Upgrades. The CAISO developed the $/MW cost rate for incremental Area Delivery Network Upgrades. The cost rate multiplied by the requested deliverable MW capacity provides the cost estimate for the Area Delivery Network Upgrades. The Interconnection Facilities are the sole cost responsibility of the Project. The Interconnection Facilities and Network Upgrades are listed below:

### *DISTRIBUTION PROVIDER'S INTERCONNECTION FACILITIES*

1. **Subtransmission**

   **WDAT907 115 kV Generation Tie Line**

   Install one (1) single circuit tubular steel pole, one 115 kV switch, and 200 circuit feet of overhead conductor.

2. **Substation**

   **Looped Substation**

   Install a ([redacted] three circuit breaker loop substation to terminate the new WDT907 115 kV generation tie line.

   The interconnection facilities will be installed as follows:

   - One (1) dead-end structure
   - Two (2) voltage transformers
   - Line protection relays

3. **Telecommunications**

   Install cross connects and associated equipment supporting diverse protection and SCADA.

   Also install all required lightwave, channel and related terminal equipment at each end of both FO paths to interface with the required Line Protection Relays and RTU.

4. **Metering Services Organization**

   Install SCE revenue meters required to meter the retail load at the generating facility. The SCE meter will be installed in tandem with the ISO meter circuit.

   The customer will provide the required metering equipment (voltage and current transformers and meter enclosure).

5. **Power System Controls**

   Install [redacted] at the generating facility to monitor typical generation elements such as MW, MVAR, terminal voltage and circuit breaker status at each generating unit and the plant auxiliary load and transmit this information to the SCE grid control center.

6. **Real Properties, Transmission Project Licensing, and Corporate Environmental Services**

   Obtain easements and / or acquire land, obtain licensing and permits and perform all required environmental activities for the installation of the following project elements if applicable:

   - Segment of 115 kV generation tie line within the new substation property

***PLAN OF SERVICE DISTRIBUTION UPGRADES***

1. **Subtransmission**

   **Carodean – Leatherneck 115 kV Line**

   Install [redacted] double circuit tubular steel poles and [redacted] spans of 115 kV circuit using 954 ACSR conductors to loop the line into the SCE WDAT907 Substation.

2. **Substation**

   **SCE WDAT907 Substation**

   Insta[redacted]5 kV three circuit breaker loop substation to terminate the new WDAT907 115 kV generation tie line.

   The Plan of Service Distribution Upgrade facilities are as follows:

   - [redacted]ox rack steel structure
   - [redacted]circuit breakers
   - [redacted]of disconnect switches
   - [redacted]oltage transformers
   - Relays

- MEER to house relays

3. **Power System Controls**

   Install [redacted]RTU at the new loop substation to monitor typical elements such as MW, MVAR, terminal voltage, and circuit breaker status at each generating unit and the plant auxiliary load and to transmit this information to the SCE Grid Control Center.

4. **Telecommunications**

   Construct diverse fiber optic (FO) taps onto the future FO on the Carodean-Leatherneck 115 kV line into the SCE WDAT907 Substation.

   Also, install lightwave, channel, and associated equipment at the new substation and affected/adjacent substations.

5. **Real Properties, Transmission Planning Licensing, and Corporate Environmental Services**

   Obtain easements and / or acquire land, obtain licensing and permits and perform all required environmental activities for the installation of the following project elements if applicable:
   - New substation property
   - Loop in Line
   - Telecommunication requirements

### *RELIABILITY NETWORK UPGRADES (RNU)*

1. **Short Circuit Duty (SCD) Mitigation - RNU**

   Upgrade transmission network circuit breakers (pro-rata share of upgrade based on project contribution to SCD at each location – refer to Section H of this report).

See group report for Section H and K for additional details.

### *LOCAL DELIVERY NETWORK UPGRADES (LDNU)*

No Local Delivery Network Upgrades were identified as part of this QC5 Phase I study for Project.

### *AREA DELIVERY NETWORK UPGRADES (ADNU)*

1. **Alberhill – Valley No.2 500 kV T/L**

See group report Section K for details.

### *DISTRIBUTION UPGRADES*

1. **Devers Substation capacity increase upgrade**

See group report Section K for details.

## *D. Cost and Construction Duration Estimates*

To determine the cost responsibility of each generation project in QC5, the CAISO developed cost allocation factors (Attachment 1) for Reliability Network Upgrades and Local Delivery Network Upgrades. The CAISO developed the $/MW cost rate for incremental Area Delivery Network

Upgrades. The cost rate multiplied by the requested deliverable MW capacity provides the cost estimate for the Area Delivery Network Upgrades. Attachment 2 provides the 'constant' 2012 dollars and their escalation to the estimated operating date year for Interconnection Facilities, Reliability Network Upgrades, Delivery Network Upgrades, and Distribution Upgrades which the Project was allocated cost. For the QC5 study, the estimated O.D. is derived by assuming the duration of the work element will begin in March 2014, which is the CAISO tariff scheduled completion date of the QC5 Phase II study plus 90 days for the interconnection agreement signing period.

## E. Study Assumptions

For detailed assumptions, please refer to the group report. The following assumptions are only specific to the Project:

1. **The following facilities will be installed by SCE and <u>are included</u> in this Phase I Study:**
   - The required Retail Meters to meter the generating facility retail load.
     **NOTE:** SCE installation <u>does not</u> include metering voltage and current transformers. The SCE meters will be connected to the generator – owned voltage and current transformers to be installed for their CAISO metering.
   - The required Remote Terminal Unit (RTU) to be installed at the generating facility which will be installed by SCE.

2. **The following facilities are to be installed by the Interconnection Customer and <u>are not included</u> in this Phase I Study:**
   - The 115 kV generation tie line with (FO) cable from the generating facility to the last structure outside the new looped substation.
   - The diverse telecommunications path from the new substation to the generator site.
   - The required CAISO metering equipment (voltage and current transformers and CAISO meters).
     **NOTE:** The metering voltage and current transformers installed for the CAISO metering will also be used for the SCE owned retail meters.
     - Line protection relays to be installed at the generating facility end of the WDT907 115 kV generation tie line.

## F. Deliverability Assessment

See Section F in the group report.

## G. Power Flow Analysis

1. **Transmission System – 220 kV and 500 kV**

   The QC5 study indicated that the Project contributes to the following transmission facility overloads or non-convergence problems. The details of the analysis and overload levels are provided in the group report.

   **(a) Overloaded Transmission Facilities**

   **Category "A"**

   - Devers 220/115 kV A banks

**Category "B"**

None

**Category "C"**

None

**(b) System Limitation**

As part of the Transition Cluster studies, generation projects located in the Eastern Area triggered the need to upgrade the West of Devers (WOD) 220 kV transmission lines by replacing all existing infrastructure with new structures that can support bundled 1590 KCMIL ACSR conductors. Generation resources queued after the Transition Cluster located in the East of Devers and Devers 115 kV system aggravates the overload on the WOD T/Ls. Due to limited system capacity, generation curtailments would be required until WOD upgrades complete. The completion date for this upgrade was initially estimated to be early 2018. However, the initial estimated In-Service Date predicated upon obtaining transmission rights-of-way across the Morongo Reservation in sufficient time to allow SCE to submit its Application for a Certificate of Public Convenience and Necessity to the CPUC by October 2012. Despite diligent efforts, SCE has yet to obtain the critical rights-of-way that would secure a project route location, which has impacted the ability to complete preliminary engineering and environmental surveys as well as license/permits for the route. In addition, SCE's recent experience with other large transmission projects indicates that the time to obtain regulatory approvals will likely take longer than originally anticipated, and that complying with environmental mitigation measures that may be imposed by the regulatory authorities could cause further delays to construction. As such, SCE has a reasonable expectation that the activities required for completion of West of Devers will be delayed by at least a year, and possibly longer.

**(c) Power Flow Non-Convergence**

There were non-convergence issues under certain contingencies identified by the addition of this project due to the limited system capacity.

**(d) Voltage Performance**

Under base case conditions, the Colorado River and Red Bluff 500 kV Substations were identified to have voltage performance below allowable limits.

**(e) Required Mitigations**

- Allocated SCD Mitigation– Refer to Section G below.

Based on the study findings, this project resulted in overloads under Peak conditions to Devers 220/115 kV Transformer Banks. Therefore, the following system upgrades were proposed to mitigate identified overloads:

- Devers Substation Capacity Increase: Install 4$^{th}$ 220/115 kV Transformer Bank.
- Sectionalizing Devers 115 kV Buses.

See the group report for additional details.

## *H. Short Circuit Analysis*

Short circuit studies were performed to determine the fault duty impact of adding the QC5 projects to the Participating TO 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 QC5 is determined. Each project in QC5 will be responsible for its share of the upgrade cost based on the rules set forth in CAISO Tariff Appendix DD.

## 1. Short Circuit Study Input Data

The customer provided technical data for the identified inverter (specified in Section B). If the technical data obtained from the inverter manufacturer by SCE illustrates differences in the Short Circuit Duty (SCD) parameters, then SCE utilized the manufacturer data of the inverter model specified by the IC in the application in the SCD study. Otherwise, SCE utilized the parameters provided by the IC. The IC should verify with the manufacturer the appropriate SCD contributions of the inverter prior to commencement of the Phase II study and should update the application to reflect the appropriate data. The data provided by the IC for this project did not match the technical data obtained from the inverter manufacturer.

The following additional input data was used in this study:

Generation Step-up Transformers [redacted]
Each transformer is a three-phase, 115/34.5/13.8 kV (YG- YG-D), 36/48/60 MVA with the following impedance information:

- H-X: 9% @ 36 MVA
- H-Y: 9% @ 36 MVA
- X-Y: 7% @ 36 MVA

Padmount Transformers [redacted]

Each transformer is a two-phase, 34.5/0.270 kV (D-YG), 1.25/1.25MVA with the following impedance information:

- H-X: 5.75% @ 1.25 MVA
- H-Y: 5.75% @ 1.25 MVA

Generation Tie Line

The generation tie line was assumed to be 0.10 miles of single-circuit 267 ACSR conductor.

## 2. Short Circuit Duty Study Results

All bus locations where the QC5 projects increase the short-circuit duty by 0.1 kA or more and where duty is in excess of 60% of the minimum breaker nameplate rating are listed in the group report Appendix H. These values have been used to determine if any equipment is overstressed as a result of the QC5 interconnections and corresponding network upgrades, if any.

The responsibility to finance short circuit related upgrades identified through a group study shall be assigned to all Interconnection Requests in that group study pro-rata on the basis of short circuit duty contribution of each Generating Facility. In addition, the SCD impact of the associated proposed Network Upgrades was allocated to each Generating Facility using the same percentage assigned for the triggered Network Upgrade.

### (a) Application Queue with RNUs and LDNUs Analysis Results

Fault duties were calculated with the inclusion of the QC5 projects and the identified RNUs and LDNUs to identify the incremental impacts associated with these Facilities. As discussed in Section H of the group report, under this scenario the QC5 study breaker evaluation

identified overstressed circuit breakers. The following is the pro-rata cost allocation for this project, based on SCD contribution at each location.

SCD Mitigation - Table of Network Breaker Replacements (RNU)

| Project | Vista 220 kV | |
|---|---|---|
| | % | Allocated Cost |
| WDAT907 | 1.00% | $23,437 |

### (b) Application Queue with RNUs, LDNUs, & ADNUs Analysis Results

Fault duties were re-calculated to include the QC5 projects and the identified RNUs, LDNUs, and ADNUs from the power flow and stability analysis to identify the incremental impacts associated with these Facilities. As discussed in Section H of the group report, under this scenario the QC5 study breaker evaluation identified overstressed circuit breakers at Mira Loma and Valley. As part of this Phase I cost estimates for mitigation of short circuit duty impacts under this scenario are not included. As part of Phase II if this mitigation is identified to still be required, cost estimates and corresponding pro-rata cost allocation will be determined.

### (c) Application Queue Distribution Analysis Results

Fault duties were calculated for the QC5 projects on the distribution system. Under this scenario the QC5 study breaker evaluation identified overstressed circuit breakers at the following distribution substations. The following is the pro-rata cost allocation for this project, based on SCD contribution at each location.

SCD Mitigation -Table of Distribution Breaker Replacements

NA

## 3. Preliminary Protection Requirements

Protection requirements are designed and intended to protect SCE's system only. The preliminary protection requirements were based upon the interconnection plan as shown in Figure B.2.

The applicant is responsible for the protection of its own system and equipment and must meet the requirements in the SCE Interconnection Handbook which is provided in Attachment 3.

# *I. Reactive Power Deficiency Analysis*

## 1. Transmission System Reactive Power Deficiency Analysis - 220 kV and 500 kV

Limited reactive power deficiency analysis was performed. In the base case study, serious voltage and VAR issues were identified based on system VAR requirements for power flow convergence. Specifically, with addition of QC5 projects, the following VAR support is proposed:

With all proposed system upgrades listed above, the power flow studies for Category "B" and Category "C" contingencies indicated that this QC5 project did not cause voltage drops of 5% or more from the pre-project levels, or cause the SCE system to fail to meet applicable voltage criteria. This project, therefore, did not cause any adverse voltage impacts on the CAISO Controlled Grid with the proposed upgrades in place.

A more detailed reactive power deficiency analysis will need to be performed as part of the Phase II Study.

2. **Subtransmission System Reactive Power Deficiency Analysis - 66 kV and 115 kV**

   A more detailed reactive power deficiency analysis will need to be performed as part of the Phase II Study.

3. **Individual Project Power Factor Requirements**

   Based on the findings obtained from QC5 study analysis, it is expected that the Project will need to be designed to maintain a composite power delivery at continuous rated power at the Point of Interconnection at a power factor within the range of 0.95 leading to 0.95 lagging. This will be fully evaluated as part of the Phase II Study.

## J. Transient Stability Evaluation

Limited transient stability studies were conducted using full loop base cases to ensure that the Participating TO system remains in operating equilibrium, as well as operating in a coordinated fashion; through abnormal operating conditions after the QC5 projects begin operation. The generator dynamic data used in the study for the Project is shown in (Attachment 6).

1. **Transmission System – 220 kV and 500 kV**

   **(a) Transient Stability Study Scenarios**

   Disturbance simulations were performed for a study period of 10 seconds to determine whether the QC5 projects will create any system instability during a variety of line and generator outages. The most critical single contingency and double contingency outage conditions in the Eastern Bulk System were evaluated.

   For the list of specific line and generator outages evaluated, see the group report.

   **(b) Transient Stability Study Results**

   Limited stability analysis was performed for the Eastern Bulk system to identify "relative" as opposed to "absolute" conclusions regarding the stability impacts of the QC5 queued generation projects. In the limited stability analysis performed in the 500 kV, 220 kV and 115 kV systems with the upgrades in place to mitigate base case and outage related overload problems, the transient voltage showed unacceptable performance, and a voltage collapse under the following N-2 contingency

   - Colorado River – Red Bluff No. 1 & 2 500 kV T/Ls
   - Devers – Red Bluff No. 1 & 2 500 kV T/Ls
   - Devers – Valley No.1 & 2 500 kV T/Ls

   **(c) Mitigation**

   These results illustrate that there will be significant limitations in the Eastern Bulk System with the addition of QC5 for both N-1 and N-2 outage conditions unless additional area export transmission facilities are constructed. With additional area export upgrades, Eastern Bulk System stability performance with QC5 projects will significantly improve under both N-1 and N-2 outage conditions.

   Stability plots are shown in Appendix F of the group report.

## K. Environmental Evaluation/Permitting

Please see Section L of the QC5 group report.

## L. Items not covered in this study

1. **Conceptual Plan of Service**

   The results provided in this study are based on conceptual engineering and a preliminary plan of service and are not sufficient for permitting of facilities. The Plan of Service is subject to change as part of the Phase II Interconnection Study.

2. **Customer's Technical Data**

   Additional technical data related to the Interconnection Customer's project may be required as part of the Phase II study. The study accuracy and results for the QC5 Phase I Study are contingent upon the accuracy of the technical data provided by the Interconnection Customer. Any changes from the data provided could void the Study results.

3. **Study Impacts on Neighboring Utilities**

   Results or consequences of this QC5 Phase I Study and/or to-be-performed Phase II 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 CAISO Controlled Grid, and sub-synchronous resonance (SSR).

4. **Use of Participating TO Facilities**

   The Interconnection Customer is responsible for acquiring all property rights necessary for the Interconnection Customer's Interconnection Facilities, including those required to cross Participating TO facilities and property. This Interconnection Study does not include the method or estimated cost to the Interconnection Customer of Participating TO mitigation measures that may be required to accommodate any proposed crossing of Participating TO facilities. The crossing of Participating TO property rights shall only be permitted upon written agreement between Participating TO and the Interconnection Customer at Participating TO's sole determination. Any proposed crossing of Participating TO property rights will require a separate study and/or evaluation, at the Interconnection Customer's expense, to determine whether such use may be accommodated.

5. **Participating TO Interconnection Handbook**

   The Interconnection Customer shall be required to adhere to all applicable requirements in the Participating TO Interconnection Handbook. These include, but are not limited to, all applicable protection, voltage regulation, VAR correction, harmonics, switching and tagging, and metering requirements.

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

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

7. **System Protection Coordination**

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

8. **Standby Power and Temporary Construction Power**

   The QC5 Phase I Study does not address any requirements for standby power or temporary construction power that the Project may require prior to the In-Service Date of the Interconnection Facilities. Should the Project require standby power or temporary construction power from Participating TO prior to the In-Service Date of the Interconnection Facilities, the IC

is responsible to make appropriate arrangements with Participating TO to receive and pay for such retail.

**9. Licensing Cost and Duration Estimate (Estimated Construction Schedule)**

The estimated licensing cost and durations applied to this project are based on the project scope details presented in this study. These estimates are subject to change as project environmental and real estate elements are further defined. Upon execution of the Interconnection Agreement, 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.

**10. Network/Non-Network Classification of Telecommunication 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 diverse telecommunication paths associated with the IC's gen tie, excluding terminal equipment at both ends. In addition, the telecommunication requirements for SPS were assumed based on tripping of the generator breaker as opposed to tripping the circuit breakers at the Participating TO substation. Due to uncertainties related to telecommunication upgrades for the numerous projects in queue ahead of QC5 Phase I, telecommunication upgrades for higher queued projects were not considered in this study. Depending on the outcome of interconnection studies for higher queued projects, the telecommunication upgrades identified for QC5 Phase I may be reduced. Any changes in these assumptions may affect the cost and schedule for the identified telecommunication facilities.

**11. Applicability**

This document has been prepared to identify the impact(s) contributions of the Project on the SCE electrical system; as well as establish the technical requirements to interconnect the Project to the Point of Interconnection that was evaluated in the QC5 Phase I Study for the Project. Nothing in this report is intended to supersede or establish terms/conditions specified in interconnection agreements agreed to by SCE, CAISO and the Interconnection Customer.

# Attachment 1

## Allocation of Network Upgrades for Cost Estimates

### Allocation of RNU and LDNU for Cost Estimates

| Type of Upgrade | Upgrade | Description | Estimated Cost x 1,000 (Note 1) | Estimated Cost x 1,000 Constant Dollar (OD Year) (Note 1) | | Cost share | Allocated Cost (OD year) ($1000) |
|---|---|---|---|---|---|---|---|
| Reliability Network Upgrades | Expansion of the proposed Colorado River Corridor SPS | Expand the proposed Colorado River corridor SPS to trip QC5 Generation projects. | $668 | $724 | 2016 | 0 | 0 |
| | Expansion of the proposed Colorado River Substation SPS | Expand the proposed Colorado River SPS to trip QC5Generation projects under (N-1) Single Contingency caused by the outage of any of Colorado River 500/220 kV Transformer banks | $1,105 | $1,198 | 2016 | 0 | 0 |
| | New Vista Substation SPS | Implement an SPS to trip QC5 generation project under N-1 caused by the outages described in Section G2.1 in group report | $2,083 | $2,320 | 2016 | 0 | 0 |
| | Short Circuit Duty (SCD) Mitigation | See Section H and K for description. | $2,344 | $2,541 | 2016 | 1% | $2,541 |
| Local Delivery Network Upgrades | Colorado River AA-Bank No.4 500/220 kV and split Colorado River 220 kV bus | Install No.4 500/220 kV AA-Bank at Colorado River Substation and sectionalize the 220 kV buses | $55,812 | $63,758 | 2017 | 0 | 0 |
| Distribution Upgrades (Note 2) | Devers Substation Capacity Increase | See Section K for description in the group report | $25,702 | $29,361 | 2017 | 100% | $29,361 |

Note1 : SCE's Phase I cost estimating is done in 'constant' dollars 2012 and then escalated to the estimated O.D.year. For the Phase I Study, the estimated O.D. is derived by assuming the duration of the work element will begin in March 2014, which is the CAISO tariff scheduled completion date of the QC5 Phase II study plus 90 days for the Interconnection Agreement signing period. For instance, if a work element is estimated to take a total of 24 months (permitting, design, procurement, and construction), then the estimated O.D. would be March 2016. If an IC's requested O.D.(in- service) is beyond the estimated O.D. of a work element, the IC's requested O.D. is used. However, should the Generator Interconnection Agreement not be executed, or the necessary information, funding, and written authorization to proceed is not provided by the IC, in time for the Participating TO to perform the work within these time frames, the information provided in Table D.1 may be subject to change.
Note 2: These upgrades are not identified in the ISO tariff, and are not reimbursable. Allocated costs may change if all projects responsible for these upgrades do not execute Interconnection Agreements.

## Allocation of Delivery Network Upgrades for Cost Estimates

| Upgrade | Estimated Cost x 1,000 Constant Dollars (2012) (Note 4) | Estimated Cost x 1,000 Constant Dollar (OD Year) (Note 4) | Phase I Incremental MW | ADNU Cost Rate (O.D. Year) ($1000/MW) | Estimated Time to Construct in Months (Note 1) (Note 3) | Allocated cost (O.D. year) ($1000) |
|---|---|---|---|---|---|---|
| Colorado River – Red Bluff No.3 500 kV T/L | $206,728 | $267,167 | 3479 | 76.79 | 105 | 0 |
| Red Bluff – Valley No.1 500 kV T/L | $1,027,279 | $1,327,612 | | 381.61 | 105 | 0 |
| New 500 kV (2 x 150 MVAr) Shunt Capacitor Banks at Eldorado | $54,236 | $58,805 | 3310 | 22.70 | 24 | 0 |
| New 500 kV (2 x 150 MVAr) Shunt Capacitor Banks at Pisgah or Mohave | $54,236 | $58,805 | | 22.70 | 24 | 0 |
| Alberhill – Valley No.2 500 kV T/L | $173,658 | $224,428 | 960 | 233.78 | 105 | $11.689 |
| New/Upgrade M-Lugo – Lugo 500 kV T/L Series Capacitor | $48,378 | $55,265 | 2590 | 42.65 | 40 | 0 |
| Upgrade M-Lugo – Lugo 500 kV T/L Substation Terminal Equipment at Lugo to 4,000 Amps | $12,031 | $13,744 | | 5.31 | 40 | 0 |

Note1: The estimated licensing cost and durations applied to this project are based on the project scope details presented in this study. These estimates are subject to change as project environmental and real estate elements are further defined. Upon execution of the Interconnection Agreement, 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.
Note 2: These upgrades are not identified in the ISO tariff, and are not reimbursable. Allocated costs may change if all projects responsible for these upgrades do not execute Interconnection Agreements.
Note 3: Each Upgrade category may contain multiple scope durations. The longest duration is shown under the Estimated Time to Construct.
Note 4: SCE's Phase I cost estimating is done in 'constant' dollars 2012 and then escalated to the estimated O.D.year. For the Phase I Study, the estimated O.D. is derived by assuming the duration of the work element will begin in March 2014, which is the CAISO tariff scheduled completion date of the QC5 Phase II study plus 90 days for the Interconnection Agreement signing period. For instance, if a work element is estimated to take a total of 24 months (permitting, design, procurement, and construction), then the estimated O.D. would be March 2016. If an IC's requested O.D.(in- service) is beyond the estimated O.D. of a work element, the IC's requested O.D. is used. However, should the Generator Interconnection Agreement not be executed, or the necessary information, funding, and written authorization to proceed is not provided by the IC, in time for the Participating TO to perform the work within these time frames, the information provided in Table D.1 may be subject to change.

# 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

## Participating TO Interconnection Handbook

Preliminary Protection Requirements for Interconnection Facilities are outlined in the Participating TO Interconnection Handbook.

# Attachment 4

## Short Circuit Calculation Study Results

Please refer to the Appendix H of the group report.

# Attachment 5

## Not Used

# Attachment 6

## Customer Provided Project Dynamic Data

The following data was submitted by the Interconnection Customer for Dynamic simulation:

epcgen 96374 "WDT907_G " 0.270 "1 " : #7 mva=50.0000 "smascpv.p" 3.0000 "rsrc" 0.0000 "xsrc" 0.0000 "Vratio" 1.2000 "Iratio" 1.1000 "Tdc" 0.0020 "Kpdc" 2.0000 "Kidc" 20.0000 "Kpq" 0.1000 "Kiq" 10.0000 "Ilim" 1.1100 "PFC" 1.0000 "PPS" -0.2500 "RPS" -5.1700 "PFS" -0.4000 "FSP" 999.9000 "FRP" 60.0500 "Qreg" 0.0000 "MOD" 0.0000 "OV1L" 1.2000 "OV1T" 0.1600 "OV2L" 1.1000 "OV2T" 1.0000 "UV1L" 0.4500 "UV1T" 0.1600 "UV2L" 0.8500 "UV2T" 2.0000 "OFL" 62.0000 "OFT" 0.1600 "UFL" 57.0000 "UFT" 0.1600 "LVL" 0.0000 "VSP" 0.2000 "VRP" 0.2500