Appendix A – WDAT1029

[redacted]

QUEUE CLUSTER 6 PHASE I REPORT

January 17, 2014

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

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Attachments:

A. Introduction

[redacted] the Interconnection Customer (IC), has submitted a completed Interconnection Request (IR) to Southern California Edison Company (SCE) for their proposed [redacted] (Project) under the Generator Interconnection Procedures (GIP) of Attachment I of SCE's Wholesale Distribution Access Tariff (WDAT). The Project will utilize [redacted] with a proposed Point of Interconnection (POI) at Southern California Edison Company's (Distribution Provider) Sheephole 33 kV circuit out of Hi Desert Substation with a CAISO delivery point at the Devers 220 kV Substation. The IC has requested Full Capacity Deliverability Status, a proposed In-Service Date of August 1, 2015 and a proposed Commercial Operation Date (COD) of December 31, 2015[1].

In accordance with Section 4.5 of the GIP; the Project was grouped with Queue Cluster 6 (QC6) Phase I projects to determine the impacts of the group as well as impacts of the Project on the CAISO Controlled Grid.

The Transmission assessment information and corresponding results identifying the combined impacts of all projects in the group for the Area Bulk System (CAISO-controlled) are provided in the Area report. The Area report has been prepared separately and provided as part of the QC6 Phase I report package.

This report focuses only on the impacts or impact contributions of the Project on the SCE Distribution system[2], and it is not intended to supersede any contractual terms or conditions specified in an Interconnection Agreement.

The report provides the following:

1. Distribution 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 to construct[3] these facilities. Such information is provided in Attachment 1 and Attachment 2 as separate documents in the Appendix A Project report package.

All equipment and facilities comprising the Project located in Twenty Nine Palms, CA 92327, as disclosed by the IC in its IR, as may have been amended during the Interconnection Study process, which consists of (i) fourty (40) SMA 500 CP photovoltaic inverter units with an output of 0.50 MW each for a combined net output of 20 MW, (ii) the associated infrastructure, (iii) meters and metering equipment, (iv) appurtenant equipment, and (v) auxiliary loads. The Project shall consist of the Generating Facility and the IC's Interconnection Facilities as illustrated below in Figure A.1.

[1] Date as requested in the IR Appendix 1. Actual In-Service Date and COD depend on design and construction requirements..
[2] Distribution System: those non-CAISO-controlled transmission and distribution facilities owned by the Distribution Provider.
[3] It should be noted that 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. These durations are from the execution of the Interconnection Agreement, receipt of: all required information, funding, and written authorization to proceed from the IC as will be specified in the Interconnection Agreement to commence the work.

Figure A.1: Generating Facility One-Line Diagram

[redacted]

Table A.1 provides a summary of the Project information and Figure A.2 provides a map of the Project.

Table A.1: Project General Information

Project Location	[redacted] Twenty Nine Palms, CA 92327 San Bernardino County
Distribution Provider's Planning Area	Eastern Area
Number and Type of Generators	[redacted]
Interconnection Voltage	33 kV
Maximum Generator Output	[redacted]
Generator Auxiliary Load	TBD
Maximum Net Output to Grid	[redacted]
Power Factor Range	Lead 0.9/Lag 0.9
Step-up Transformer(s)	[redacted]
POI	Distribution Provider's Sheephole 33 kV circuit with a CAISO delivery point at the Devers 220 kV Substation
IC Requested COD	December 31, 2015

Figure A.2: Map of the Project

[redacted]

B. Study Assumptions

B.1 SCE Distribution System Assumptions

Below are the assumptions specific to the Project in respect to the SCE Distribution System.

1. **The following SCE Distribution System Planning Criteria and Conditions were included in the Phase I Study:**
   - The thermal rating of any conductor, connector, or apparatus shall not exceed 100% of its normal rated capacity with all facilities in service (base case).
   - The thermal rating of any conductor, connector, or apparatus shall not exceed 100% of its emergency rating under N-1 conditions.
   - Operational flexibility and reliability of the distribution system shall be maintained at all times.
   - Circuit voltage profiles should be maintained to comply within CPUC's Rule 2 requirements.
   - The power factor for the new generation facility was assumed to be within WDAT requirements of 0.95 lagging or leading.
   - Expected loading on the distribution system as projected by the SCE 2013 - 2022 distribution system plan was used.
   - Distributed Generation resources connected to the distribution system are analyzed offline and online during peak load conditions as well as during minimum daytime load conditions as to determine worst case scenario.
   - The Short circuit contribution from the inverter systems was determined using inverter manufacturer documents.
   - The Phase I Study assumes the upgrades triggered by previously queued projects, including Rule 21 projects under CPUC jurisdiction as in-service, are included in the base case for the Phase I projects. If any previously queued projects were to withdraw, then the Phase I projects may be subjected to the cost identified for those previously queued projects.
   - Current distribution standards are being updated to address generation interconnection systems. The proposed method of service in this report may change according on final design to comply with the updated distribution design standards.

2. **The following Facilities were estimated and <u>are included</u> in the Phase I Study:**
   - Approximately 400 feet line extension of primary conductor [redacted]
   - 33 kV metering cabinet, meter, CTs, PTs, VTs
   - One (1) [redacted]
   - Two(2) primary riser poles
   - Remote Terminal Unit
   - Telecommunication System for RTU

3. **The following facilities are to be installed by the IC and <u>are not included</u> in this Phase I Study:**
   - Ducts as required
   - Structures as required

- POI breaker
- CAISO metering as required
- Protection Systems required to comply SCE Interconnection requirements
- Transformation as required
- Metering Equipment compliant with SCE Electrical Service Requirements (http://www.sce.com/AboutSCE/Regulatory/distributionmanuals/esr.htm)

C. Reliability Standards, Study Criteria and Methodology

Refer to Section B above for the Reliability Standards, Study Criteria and Methodology applied in this study.

D. Reliability Assessment Results

1. System Steady State Power Flow Analysis Results

(a) Distribution System Impacts of the Project

(i) Thermal Overloads

1. Substation

   a. Base Case – None

   b. N-1 – With the addition of the Project, an overload was identified on Devers 1A Bank by approximately 102% of its emergency rating under the loss of Devers 3A bank and after the utilization of the proposed Devers substation SPS

2. Distribution Lines

   a. Base Case – The addition of the Project will cause a section of 2/0 ACSR conductor on the Himo 33 kV circuit to be overloaded by approximately 126% of its normal rating. N-1 – None

(ii) Required Mitigations

1. Re-conductor approximately 10 feet of existing [redacted]

2. Devers 500/220/115 kV Capacity Increase

   ➢ Refer to Section D and F of corresponding Area Report for additional details.

(iii) System Limitations

With the inclusion of QC6 Phase I projects there are total of 89 MW of generation IRs at Hi Desert 115/33 kV Substation. The QC6 Phase I study results indicated that without the 115/33 kV transformer bank upgrades at Hi Desert Substation, triggered by a higher queued project, to provide the capacity needed to accommodate QC6 Phase I IRs, the maximum capacity at Hi Desert Substation is limited to less than 68 MW. Therefore, the Project must wait until the bank addition is complete and in-service in order to interconnect.

(b) Transmission System Impacts of the Project

The Project was allocated the following Network Upgrades.

1. Barre-Lewis T/Ls Capacity Increase

Refer to Section D, E and F of corresponding Area Report for additional details.

2. Short Circuit Analysis

Short circuit studies were performed to determine the fault duty impact of adding the QC6 Phase I projects to the transmission 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 QC6 Phase I is determined. Each project in the cluster will be responsible for its share of the upgrade cost.

(a) Short Circuit Study Input Data

The following input data was used in this study:

[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]

(b) Short Circuit Duty Study Results

All bus locations where the QC6 Phase I projects increase the short-circuit duty 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). These values have been used to determine if any equipment is overstressed as a result of the inclusion of QC6 Phase I interconnections and corresponding network upgrades, if any.

The responsibility to finance short circuit related Reliability Network Upgrades identified through a Group Study shall be assigned to all IRs in that Group Study pro rata on the basis of short circuit duty contribution of each Generating Facility.

As discussed in the area report, the QC6 Phase I breaker evaluation identified overstressed circuit breakers at the following buses. The pro-rata cost allocation for the Project, based on SCD contribution at each location, is also provided:

(i) Application Queue with RNUs and LDNUs Analysis Results

Fault duties were calculated with the inclusion of the QC6 projects and the identified RNUs and LDNUs to identify the incremental impacts associated with these Facilities. As discussed in Section D.5 of the area report, under this scenario the QC6 study breaker evaluation identified overstressed circuit breakers. The following is the pro-rata cost allocation for the Project, based on SCD contribution at each location.

SCD Mitigation - Table of Network Breaker Replacements (RNU and LDNUs)

Project	Vista 220 kV Substation		Barre 220 kV Substation		Rio Hondo 220 kV Substation	
	%	Allocated Cost (x1000) 2013 Dollars	%	Allocated Cost (x1000) 2013 Dollars	%	Allocated Cost (x1000) 2013 Dollars
WDAT1029	13.90	$142	1.40	$239	0.20	$13

(ii) Application Queue Distribution Analysis Results

Fault duties were calculated for the QC6 projects on the distribution system. Under this scenario the QC6 study breaker evaluation identified overstressed circuit breakers at the following distribution substations. The following is the pro-rata cost allocation for the Project, based on SCD contribution at each location.

SCD Mitigation -Table of Distribution Breaker Replacements

Project	Vista 220 kV Substation		Barre 220 kV Substation		Hesperia 12 kV Substation		Auld 12 kV Substation	
	%	Allocated Cost (x1000) 2013 Dollars	%	Allocated Cost (x1000) 2013 Dollars	%	Allocated Cost (x1000) 2013 Dollars	%	Allocated Cost (x1000) 2013 Dollars
WDAT1029	13.90	$109	1.40	$72	0.40	$14	0.00	$0

(c) Preliminary Protection Requirements

Protection requirements are designed and intended to protect the Distribution Provider's system only. The preliminary protection requirements were based upon the interconnection plan as described in the introduction and shown in the one-line diagram depicted in Figure A.1 of this report.

The IC is responsible for the protection of its own system and equipment and must meet the requirements in the Distribution Provider Interconnection Handbook provided in Attachment 4.

3. Voltage Performance

(a) Individual Project Power Factor Requirements

Based on the results of the Study, the Project will need to be designed to maintain a composite power delivery at continuous rated power at the POI at a power factor up to 0.95 leading and 0.95 lagging. Additionally, the generation system must be designed to accommodate a VAR schedule provided by SCE. SCE will determine if the VAR schedule is necessary based on future re-arrangements of SCE's distribution system.

(b) Distribution System Power Factor Requirements – 34.5 kV or below

The Sheephole 33 kV circuit is not expected to experience a voltage rise that exceeds allowable Rule 2 requirements with the Project in service. Information regarding VAR schedule is described above in Section D.3.(a).

E. Deliverability Assessment Results

See Section E in the area report

F. Interconnection Facilities, Network Upgrades, and Distribution Upgrades

Please see Attachment 1 for the Interconnection Facilities, Reliability Network Upgrades, Delivery Network Upgrades and Distribution Upgrades allocated to the Project.

G. Cost and Construction Duration Estimates

To determine the cost responsibility of each generation project in QC6, the CAISO developed cost allocation factors (Attachment 3) for Reliability Network Upgrades, Local Delivery Network

Upgrades and Area Delivery Network Upgrades. Attachment 2 provides the 'constant' 2013 dollars and their escalation to the estimated COD year for Interconnection Facilities, Reliability Network Upgrades, Delivery Network Upgrades, and Distribution Upgrades which the Project was allocated cost. For the QC6 Study, the estimated COD is derived by assuming the duration of the work element will begin in June 2015, which is the CAISO Tariff scheduled completion date of the QC6 Phase I study plus 120 days for the Interconnection Agreement signing period and submittal of required funds by the IC.

H. SCE Technical Requirements

The IC is responsible for the protection of its own system and equipment and must meet the requirements in the Distribution Provider Interconnection Handbook provided in Attachment 4.

I. Environmental Evaluation, Permitting, and Licensing

Please see Appendix K of the QC6 Phase I area report.

J. Affected System Coordination

The CAISO Generator Interconnection and Deliverability Allocation Procedures (GIDAP) tariff Appendix DD section 3.7 requires that as part of the generator interconnection process, the ISO must regularly coordinate with adjacent electric systems in order to facilitate studies of potential reliability concerns caused by the interconnection of generation in the ISO generation interconnection queue to the ISO controlled grid. Similarly, generators interconnecting to the facilities of transmission owners in adjacent electric systems may cause potential reliability concerns on the ISO controlled grid.

The ISO tariff defines an "Affected System" as an electric system other than the ISO controlled grid that may be affected by the proposed interconnection, and an "Affected System Operator" as the entity operating an Affected System. The ISO tariff provides a general framework for addressing the impact on Affected Systems of generation projects in the ISO interconnection queue. The tariff states that, in the initial project study stages, the ISO will:

- Notify potential Affected System Operators that could be impacted by a generator interconnection;
- Coordinate the conduct of studies to determine possible impacts; and
- Include potential Affected System Operators in all customer meetings.

However, the ISO does not comprehensively study the impacts of generator interconnections on Affected Systems, for several reasons. First, the ISO does not have detailed information about Affected Systems on a transmission-element level, nor does the ISO know the details of the various reliability and operating criteria applicable to the Affected Systems. Second, because the operation of transmission systems changes over time along with NERC reliability standards, the ISO cannot presume to know all of the impacts of these changes on Affected Systems. Consequently, the interconnection customer is responsible for:

- Cooperating with the ISO in all matters related to the Affected System studies;
- Signing a separate study agreement with the Affected System Operator so that potential impacts on the Affected System can be evaluated; and
- Paying for necessary studies and any upgrades necessary to mitigate the impacts of their interconnection on the Affected System.

Further, the Affected System Operator is required to cooperate with the ISO on all matters related to the conduct of studies and modifications to the Affected System.

The interconnection customer is obligated by the terms of the ISO's relevant generator interconnection agreement (large or small) to enter into an agreement with the Affected System Operator, which must specify the terms governing payments for studies and mitigation, if required, to be made by the customer to the Affected System owner, and repayment by the Affected System Operator.

California Department of Water Resources (CDWR) and Los Angeles Department of Water and Power (LADWP)'s transmission networks adjoin the Northern Area. As such, the Project could potentially impact CDWR and /or LADWP systems. The ISO has notified CDWR and LADWP of the Project and provided study data and information for their review.

Prior to its generating unit in-service date, the Interconnection Customer must provide documentation to the ISO confirming that the Affected System Operators have been contacted, that any system reliability impacts have been addressed (or that there are no system impacts), or that the interconnection customer has taken all reasonable steps to address potential reliability system impacts with the Affected System Operator but has been unsuccessful.

K. 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 final engineering and design.

2. IC's Technical Data

The study accuracy and results for the QC6 Phase I Study are contingent upon the accuracy of the technical data provided by the IC. Any changes from the data provided could void the study results.

3. Study Impacts on Neighboring Utilities

Results or consequences of this QC6 Phase I 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 Distribution Provider Facilities

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

5. **Distribution Provider Interconnection Handbook**

   The IC shall be required to adhere to all applicable requirements in the Distribution Provider 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 IC 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 Distribution Provider-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.

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

   The QC6 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 Distribution Provider prior to the In-Service Date of the Interconnection Facilities, the IC is responsible to make appropriate arrangements with Distribution Provider to receive and pay for such retail.

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

   The estimated licensing cost and durations applied to the 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 generation tie line, 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 Distribution Provider substation. Due to uncertainties related to telecommunication upgrades for the numerous projects in queue ahead of QC6 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 QC6 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 POI that was evaluated in the QC6 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 IC.

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

Allocation of RNU and LDNU for Cost Estimates

	NU Cost (2013 $1000)	Cost Share (%)	Allocated Cost (2013 $1000)	Allocated Cost (Escalated $1000)
⊖RNU				
Vista 220kV substation CB upgrade	$943	13.90%	$131	$141
Barre 220kV substation CB upgrade	$16,309	1.40%	$228	$246
Rio Hondo 220kV substation CB upgrade	$915	0.20%	$2	$2
Vista Substation grid ground study	$11	100.00%	$11	$12
Barre Substation grid ground study	$11	100.00%	$11	$12
Rio Hondo Substation grid ground study	$11	100.00%	$11	$12
Grand Total	**$18,198**		**$393**	**$424**

Allocation of Delivery Network Upgrades for Cost Estimates

	ADNU Cost (2013 $1000)	ADNU Cost (Escalated $1000)	ADNU Incremental MW	Cost Rate (2013 $1000/MW)	Cost Rate (Escalated $1000/MW)	Project ADNU Cost (2013 $1000)	Project ADNU Cost (Escalated $1000)
Equipment Upgrade to Increase Barre – Lewis, Barre – Villa Park, Villa Park – Lewis 220kV transmission line ratings	$10,173	$10,982	$1,545	$7	$7	$132	$142
Grand Total	**$10,173**	**$10,982**				**$132**	**$142**

Attachment 4

Distribution Provider Interconnection Handbook

Preliminary Protection Requirements for Interconnection Facilities are outlined in the Distribution Provider Interconnection Handbook.

Attachment 5

Short Circuit Calculation Study Results

Please refer to the Appendix H of the area report.

Attachment 6

Not Used

Attachment 7

Not Used