Appendix A – WDAT1039

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:

1. **Interconnection Facilities, Network Upgrades, and Distribution Upgrades**
2. **Escalated Cost and Time to Construct for Interconnection Facilities, Reliability Network Upgrades, Delivery Network Upgrades, and Distribution Upgrades**
3. **Allocation of Network Upgrades for Cost Estimates**
4. **Distribution Provider Interconnection Handbook 00**
5. **Short Circuit Calculation Study Results (see Appendix H of the area report)**
6. **Customer Provided Project Dynamic Data**
7. **SCE Northern Hemisphere Import Nomogram**

A. Introduction

[redacted] the Interconnection Customer (IC), has submitted a completed Interconnection Request (IR) to Southern California Edison Company (SCE) for their proposed [redacted] 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) Apple Valley-Cottonwood-Pluess-Savage 115 kV line with a CAISO delivery point at the Victor 115 kV Substation. The IC has requested Full Capacity Deliverability Status, a proposed In-Service Date of September 1, 2018 and a proposed Commercial Operation Date (COD) of December 1, 2018[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 Subtransmission System (Non-CAISO controlled), and it is not intended to supersede any contractual terms or conditions specified in an Interconnection Agreement

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 to construct[2] 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 [redacted] as disclosed by the IC in its IR, as may have been amended during the Interconnection Study process, which consists of [redacted], (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] 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

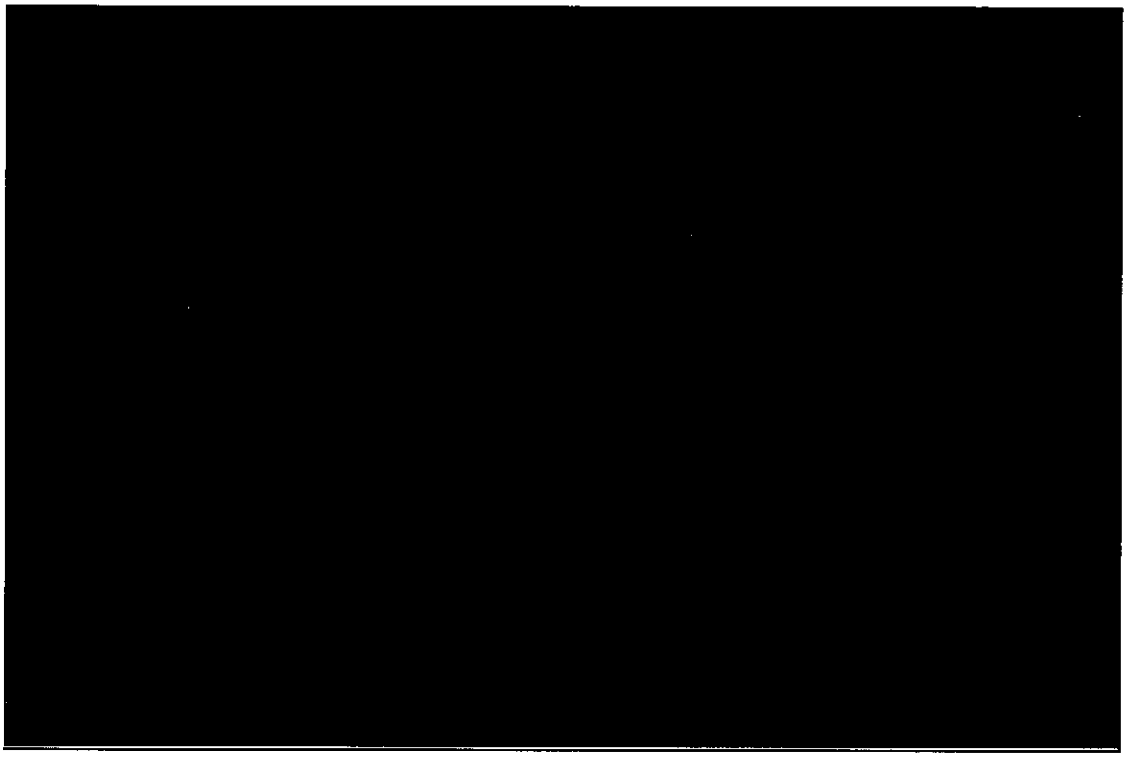
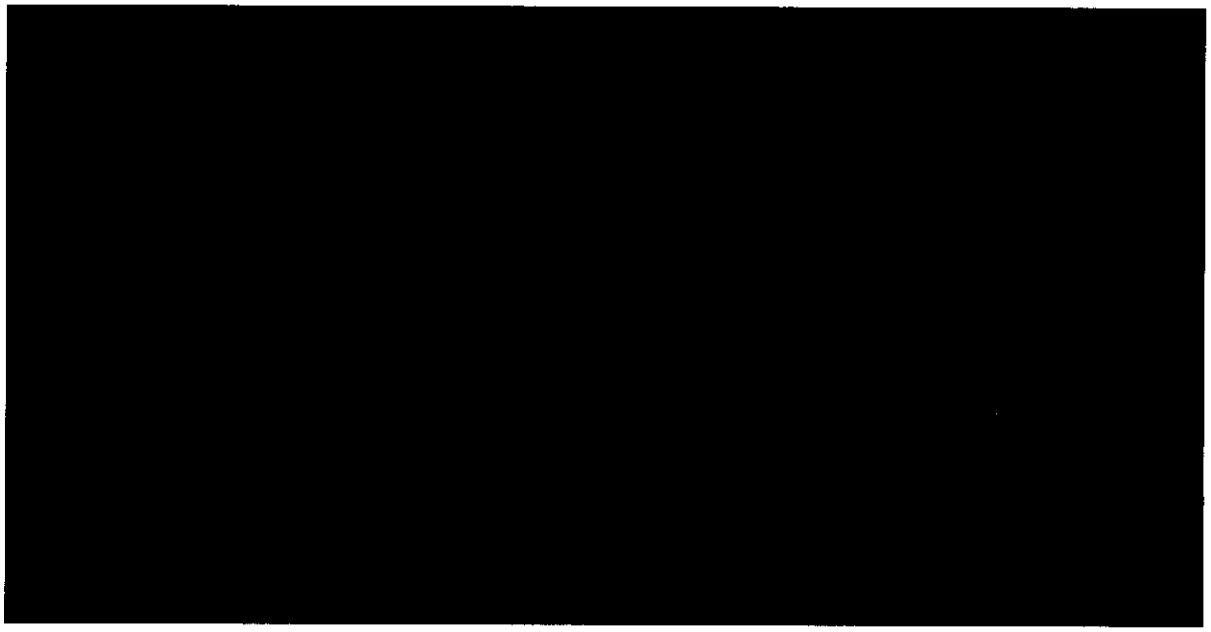


Table A.1 provides a summary of the Project information and Figure A.2 provides a map of the Project.

Table A.1: Project General Information

Project Location	[redacted]
Distribution Provider's Planning Area	North of Lugo Area
Number and Type of Generators	[redacted]
Interconnection Voltage	115 kV
Maximum Generator Output	[redacted]
Generator Auxiliary Load	0 MW
Maximum Net Output to Grid	[redacted]
Power Factor Range	[redacted]
Step-up Transformer(s)	**Main Transformer (x1 unit):** [redacted] **Padmount Transformer (50 units):** [redacted]
POI	Distribution Provider's Apple Valley-Cottonwood-Pluess-Savage 115 kV line with a CAISO delivery point at the Victor 115 kV Substation
IC Requested COD	December 1, 2018

Figure A.2: Map of the Project



B. Study Assumptions

For detailed assumptions, please refer to QC6 Phase I area report. Below are the assumptions specific to the Project in respect to the SCE Transmission/Subtransmission System.:

1. **The following facilities will be installed by SCE and <u>are included</u> in this Phase I Study:**
   - The 115 kV loop substation
   - The 115 kV loop in lines
   - The segment of the 115 kV generation tie-line inside the loop substation property line.
   - The segment of the telecommunication paths inside the loop substation property line.
   - The remote terminal units at the tap substation and at the generating facility.
   - The required retail load meters.

2. **The following facilities are to be installed by the IC and <u>are not included</u> in this Phase I Study:**
   - The 115 kV generation tie-line from the Generating Facility to the last structure outside the tap substation property line.
   - The 115 kV generation tie-line fiber optic cable (FO) path to provide two diversely routed telecommunication paths required for the Line Protection Relays, and SCADA.
   - The required CAISO Metering Equipment (Voltage and Current Transformers) and CAISO Meters.
   - The metering cabinet to house the required SCE retail meters.

     NOTE: The metering voltage and current transformers installed for the CAISO Metering will also be used for the SCE owned retail meters. The SCE Meters will be connected to the generator – owned voltage and current transformers to be installed for their CAISO metering.
   - The 115 kV line protection relays to be installed at the Generating Facility end of the Project 115 kV generation tie-line:

- [redacted] or its equivalent successor, with dual dedicated digital communication channels to WDAT1039 Substation.
- [redacted] or its equivalent successor, with dual dedicated digital communication channels to WDAT1039 Substation.
- [redacted] or its equivalent successor, (One each for SPS A and B) to trip the main generator breaker.
- [redacted] or its equivalent successor.

3. Other Items Considered

The Project will need to participate [3] in the proposed Cottonwood Corridor SPS and existing High Desert Power Plant SPS's. It is important to note that if the prior queued projects that triggered the need for these SPSs do not materialize before this Project, this Project may choose to advance the costs of these SPSs or wait for the triggering project to move forward.

C. Reliability Standards, Study Criteria and Methodology

The generator interconnection studies will be conducted to ensure the CAISO-controlled-grid is in compliance with the North American Electric Reliability Corporation (NERC) reliability standards, WECC regional criteria, and the CAISO planning standards. Refer to Section C of the area report for details of the applicable reliability standards, study criteria and methodology.

D. Reliability Assessment Results

1. Subtransmission System (Non-CAISO Controlled) Steady State Power Flow Analysis Results

Transmission System – 220 kV and 500 kV

(a) Thermal Overloads

The group 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 area study.

- **Category "A"**
  - N/A – Case does not solve without facility upgrades
- **Category "B"**
  - Lugo No.1 500/220 kV Transformer AA-Bank
  - Lugo No.2 500/220 kV Transformer AA-Bank
  - Kramer-Lugo No.1 220 kV Transmission Line
  - Kramer-Lugo No.2 220 kV Transmission Line
  - Kramer No.1 500/220 kV Transformer AA-Bank
  - Lugo-Pisgah 220 kV Transmission Line
  - Jasper-Pisgah 220 kV Transmission Line
  - Coolwater-Dunn Siding 115 kV Line
  - Dunn Siding-Baker 115 kV Line
  - Lugo-Victor No.1 220 kV Transmission Line

[3] NOL Projects will be required to participate in the Llano SPS, should the ADNU move forward.

- Lugo-Victor No.2 220 kV Transmission Line
- **Category "C"**
  - Lugo-Victor No.1 & Lugo-Victor No.2 220 kV Transmission Lines
  - Lugo No.1 & No.2 500/220 kV Transformer AA-Banks

(b) Power Flow Non-Convergence

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

- Case divergence under loss of two elements (N-2) Lugo-Victor No.1 & No.2 220 kV Transmission Lines
- Case divergence under loss of two elements (N-2) Lugo No.1 & No.2 500/220 kV AA-Banks

(c) Voltage Performance

With the generators providing the required power factor regulation capability (0.95 lead/lag at POI), no voltage performance issues were identified beyond pre-existing low voltage conditions at the Coso 115 kV Bus that are exacerbated with the inclusion of all QC6 P1 Projects driving the need for a new [redacted] at Coso 115kV.

(d) Required Mitigations

A combination of congestion management, the Project providing 0.95 leading/lagging power factor regulation capability at the POI, and SPS to trip the Project under identified contingency outage conditions is required to mitigate the power flow impacts of the Project described above. The Reliability Network Upgrades discussed in the area report and assigned to the Project are as follows:

1) **Add project to existing High Desert Power Plant (HDPP) SPS.**

   This Project will be added as a participant to the HDPP SPS. The existing SPS is an SEL based SPS and is not able to be expanded to incorporate the additional tripping of the QC6 – Ph,I Generators. The SPS will need to be replaced with a G.E. N60 based SPS. Include the new Q950, Q953, Q986, and WDAT1039 interconnection to the existing (Pre-QC6) HDPP SPS to trip the new generation tripping signals under the following outages:

   - Loss of the Lugo-Victor No.1 or No.2 220kV Transmission Lines
   - Loss of the Lugo No.1 or No.2 500/220 kV AA-Banks
   - Loss of the Lugo-Victor No.1 or No.2 220 kV Transmission Lines
   - Loss of the Lugo No.1 & No.2 500/220 kV AA-Banks

   The IC should note that any structural modifications to the HDPP SPS will need to be presented to the WECC RASRS for approval prior to interconnection.

2) **Coso 115kV Shunt Cap: Reactive Support**

   Expand the existing Coso 115kV substation The shunt capacitor banks to be installed at Coso 115 kV substation will provide reactive support in the North of Lugo Area.

3) Kramer-Llano 500kV Upgrade

Kramer- Llano 500kV Upgrade

Expand the existing Kramer 220kV substation to 500kV. Construct a new Llano 500kV Switching Station that loops into the Lugo-Vincent #2 500 transmission line. Construct a new 48 mile, 500kV transmission line from Kramer 500kV to Llano 500kV.

Llano 500kV SPS[4]

The SPS monitors the following lines and trip off generation under the following contingencies:

- N-1: Kramer 500/230 No.1 AA-Bank
- N-2: Kramer 500/230 No.1 AA-Bank & Kramer-Llano 500 kV transmission line
- N-1: Kramer-Llano 500 kV transmission line
- N-1: Vincent-Llano 500kV transmission line

Please note that should this project's interconnection materialize and come on line before the completion of SCE's Coolwater-Lugo Transmission Project is completed; this project may experience prolonged outages and/or increased curtailment exposure required in order to safely and reliably complete construction of the Coolwater-Lugo Transmission Project.

The IC should note that an energy only interconnection would require participation in the Llano SPS and will need to be presented to the WECC RASRS for approval prior to interconnection.

Subtransmission System – 66 kV and 115 kV

The QC6 study indicated that the Project did contribute to subtransmission system overloads.

(a) Thermal Overloads

The group 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 area study.

- **Category "A"**
  - N/A – Case does not solve without facility upgrades
- **Category "B"**
  - Savage-WDAT642 115 kV Line
  - Apple Valley-Savage-WDAT1039 115 kV Line
- **Category "C"**
  - Savage-WDAT642 115 kV Line & Apple Valley-Savage-WDAT1039 115 kV Line

(b) Power Flow Non-Convergence

There were no non-convergence issues under certain contingencies identified by the addition of this project.

[4] NOL Projects will be required to participate in the Llano SPS, should the ADNU move forward.

(c) Voltage Performance

With the generators providing the required power factor regulation capability (0.95 lead/lag at POI), no voltage performance issues were identified beyond pre-existing low voltage conditions at the Coso 115 kV Bus that are exacerbated with the inclusion of all QC6 P1 Projects driving the need for a new [redacted] at Coso 115 kV.

(d) Required Mitigations

A combination of congestion management, the Project providing 0.95 leading/lagging power factor regulation capabilities at the POI, and SPS to trip the Project under identified contingency outage conditions is required to mitigate the power flow impacts of the Project described above. The Reliability Network Upgrades discussed in the area report and assigned to the Project are as follows:

1) **Add project to new Cottonwood Corridor Subtransmission SPS**

   This Project will be added as a participant to the triggered Cottonwood Corridor SPS. Include the new WDAT1039 interconnection to the triggered (QC6) Cottonwood Corridor to trip the new generation tripping signals under the following outages:

   - Loss of the Apple Valley-Cottonwood- Pluess-Savage 115 kV Line
   - Loss of the Cottonwood- Savage- WDAT642 115kV Line
   - Simultaneous outages of both the Apple Valley-Cottonwood- Pluess-Savage 115kV Line and Cottonwood- Savage- WDAT642 115 kV Line

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:

Generator Data for each generation unit (total of 50 units):

[redacted]		
[redacted]		
[redacted]		

Generation Step-up Transformers (total of 1 units):

[redacted]	
[redacted]	
[redacted]	
[redacted]	
[redacted]	
[redacted]	
[redacted]	
[redacted]	
[redacted]	
[redacted]	

Individual Pad-mount Transformer (total of NA units):

[redacted]	
[redacted]	
[redacted]	
[redacted]	
[redacted]	
[redacted]	
[redacted]	
[redacted]	
[redacted]	
[redacted]	

Generation Tie-Line:

[redacted]	
[redacted]	
[redacted]	

This generation tie-line impedance was based on Distribution Provider calculation of generation tie-line electrical parameters utilizing tower and line conductor characteristics provided by the IC.

(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 Interconnection Requests in that Group Study pro rata on the basis of short circuit duty contribution of each project.

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
WDAT1039	2.00	$30	0.70	$125	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
WDAT1039	2.00	$16	0.70	$36	61.30	$590	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. Transient Stability Evaluation

Limited transient stability studies were conducted using full loop base cases to ensure that the transmission system remains in operating equilibrium, as well as operating in a coordinated fashion, through abnormal operating conditions after the QC6 Phase I projects begin operation. The generator dynamic data used in the study for the Project is shown in Attachment 6.

Transmission System – 220 kV and 500 kV

(a) Transient Stability Study Scenarios

Transient stability analysis was conducted using both the peak and off-peak full loop base cases to ensure that the transmission system remains stable with the addition of QC6 Phase I generation projects. The generator dynamic data used for the study is confidential in nature and is provided with each individual project report. More detailed stability analysis needs to be performed as part of the Phase II Study. These transient stability results are not sufficient to make definite conclusions regarding the final stability implications of QC6 projects. For example:

- The simulations relied extensively on user-written and non-validated PSLF custom models with continued model performance issues

Disturbance simulations were performed for a study period of 10 seconds to determine whether the QC6 Phase I projects will create any system instability during a variety of line and generator outages. For SCE's North of Lugo Bulk System, selected line and generator outages within the North of Lugo Bulk System were evaluated. The outages were consistent with Category B and Category C requirements (single element and multiple element outages).

(b) Results

Stability analysis was performed for the North of Lugo Bulk System to identify "relative" as opposed to "absolute" conclusions regarding the stability impacts of the Project. With all proposed system upgrades listed above and in Section F, the QC6 Phase I projects in SCE's North of Lugo Bulk System would not cause the transmission system to go unstable under Category B and Category C outages.

The transient stability studies conducted as part of Phase I are consistent with the power flow findings described earlier in this report. These results illustrate that there will be significant limitations in the North of Lugo System with the addition of QC6 for both N-1 and N-2 outage conditions unless additional area export transmission facilities and associated special protection systems are constructed. With additional area export upgrades, North of Lugo System stability performance with QC6 projects will significantly improve under both N-1 and N-2 outage conditions. Stability plots are shown in Appendix F of the area report.

Subtransmission System – 66 kV and 115 kV

(a) Transient Stability Study Scenarios

Disturbance simulations were performed for a study period of 10 seconds to determine whether the QC6 Phase I 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 North of Lugo Subtransmission System were evaluated. For the list of specific line and generator outages evaluated, see the area report.

(b) Results

Stability analysis was performed for the North of Lugo Subtransmission System to identify "relative" as opposed to "absolute" conclusions regarding the stability impacts of this QC6 Phase I queued generation project. With all proposed system upgrades listed above and in Section F, the projects in SCE's North of Lugo System would not cause the transmission system to go unstable under Category B and Category C outages. Stability plots are shown in Appendix F of the area report.

4. Subtransmission System (Non-CAISO Controlled) Reactive Power Deficiency Analysis

(a) Area Study Reactive Power Deficiency Results

With all of the generation resources up to and including QC6 generation projects dispatched in the North of Lugo Bulk Area, the power flow studies for North of Lugo base cases did not solve indicating potential system deficiencies. To determine the cause of the base case non-convergence, a detailed assessment was performed. This assessment dispatched all QC6 resources with the assumption that they could all provide reactive voltage support, up to 0.95 power factor boost, to support 1.0 p.u. voltage at their POI. The QC6 resources were dispatched in step increments and concluded that QC6 generation will be required to provide reactive voltage support to minimize system voltage degradation associated with increased power flow transfers. In addition, the installation of reactive support will be required at SCE's Coso 115 kV Substation, which is approximately 35 miles north of SCE's Inyokern Substation located in the Ridgecrest area. With the inclusion of the shunt capacitor bank at Coso 115 kV Substation needed to provided additional voltage support beyond the generation projects maximum power factor requirement of 0.95 power factor boost, the preliminary power flow analysis identified that the addition of the QC6 Projects also trigger numerous base case (Category "A") thermal overloads on several CAISO controlled facilities within the Kramer-Victor, Kramer-Lugo, Lugo-Victor transmission corridors, two 220/115 kV Kramer Transformer Banks, and two 500/220 kV Lugo Transformer Banks. In addition, the power flow analysis identified adverse system impacts to all facilities before being able to fully dispatch all QC6 NOL projects without further upgrades. These results are consistent with prior Cluster studies which previously identified the need for power factor correction as well as new transmission facilities to support generation interconnections into SCE's Kramer Substation. All prior queued projects, except for one, have since withdrawn from the interconnection queue thus obviating the need for all of the upgrades south of Inyokern Substation. The new transmission facilities triggered by QC6 would provide another path with adequate transfer capability to transport power southbound to SCE's Lugo Substation and onto the Los Angeles Basin load center to support the QC6 generation projects.

The study concluded that the reactive power requirements for the NOL system is acceptable with the combination of all network upgrades identified along with all generating facilities in QC6P1 in the North of Lugo are required to be designed to provide [redacted] at their Point of Interconnection.

(b) 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.

E. Deliverability Assessment Results

1. On Peak Deliverability Assessment

The Project contributes to the Lugo #1 AA, Lugo #2 AA, Barre-Lewis #1 220 kV, Barre-Villa Park #1 220 kV, and Villa Park-Lewis #1 220 kV area constraints as shown in the area report Section E.1 Table E.1.2.

The project also contributes to the overloads listed in Section E.1 Table E.1.1 for the following contingencies:

- N-1: Outage of Lugo #1 or #2 500/220 kV Transformer Bank
- N-1: Outage of Lugo-Victor #2 or #1 220 kV Transmission Lines
- N-2: Lugo-Victor #1 220 kV and Lugo-Victor #2 220 kV Transmission Lines

2. Off- Peak Deliverability Assessment

For off-peak condition studies, see Section D.1.1 Table D-2 and Section D.1.3 Table D-4 in the area report.

3. Required Mitigations

For area constraints, conceptual ADNU's are proposed to increase the generation deliverability. For additional details, see the area report Section E.1.3.

For contingency concerns, the Project is required to participate in the existing High Desert Power Plant SPS.

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

Queue # WDT1039

	NU Cost (2013 $1000)	Cost Share (%)	Allocated Cost (2013 $1000)	Allocated Cost (Escalated $)
RNU				
Vista 220kV substation CB upgrade	$943	2.00%	$19	$20
Barre 220kV substation CB upgrade	$16,309	0.70%	$114	$123
Rio Hondo 220kV substation CB upgrade	$915	0.20%	$2	$2
Expand High Desert Power Plant SPS One Time Cost: RTU	$69	100.00%	$69	$86
Expand High Desert Power Plant SPS One Time Cost: Test	$135	100.00%	$135	$167
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
Expand High Desert Power Plant SPS [HDPP SPS] (fka Victor) - Add Q950, Q953, WDAT1039, and Q986 to the SPS	$461	100.00%	$461	$569
Grand Total	**$18,863**		**$832**	**$1,002**

	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	$3,770	$4,069	$1,545	$2	$3	$293	$316
Kramer-Llano 500 kV Upgrade: Expand Kramer substation to 500kV with one AA bank. Build new Llano 500kV switching station that loops in to the Lugo - Vincent 500kV No. 1 line. Install new Kramer - Llano 500kV line.	$564,317	$734,504	$961	$587	$764	$70,466	$91,717
Grand Total	**$568,087**	**$738,573**				**$70,759**	**$92,033**

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

Customer Provided Project Dynamic Data

The following data was submitted by the IC for Dynamic simulation:

C6P1 - WDAT1039 [redacted] 120MWs into [redacted] This is a .dyd file for Nordex WTG PSLF model provided by the IC
#
#epcgen 96431 "W1039 G1" 00.66: #4 mva=2.75 "NX17CDe.p" 3 "rsrc" 0 "xsrc" 0.0 "a" 1 "b" 1 "c" 1 "d" 0 "e" 1 "f" 0 "g" 1 "h" 1 "i" 0 "j" 1 "k1" 1 "l" 0 "m" 1 "n" 0 "uwv"
#epcgen 96432 "W1039 G2" 00.66: #4 mva=2.75 "NX17CDe.p" 3 "rsrc" 0 "xsrc" 0.0 "a" 1 "b" 1 "c" 1 "d" 0 "e" 1 "f" 0 "g" 1 "h" 1 "i" 0 "j" 1 "k1" 1 "l" 0 "m" 1 "n" 0 "uwv"
#epcgen 96433 "W1039 G3" 00.66: #4 mva=2.75 "NX17CDe.p" 3 "rsrc" 0 "xsrc" 0.0 "a" 1 "b" 1 "c" 1 "d" 0 "e" 1 "f" 0 "g" 1 "h" 1 "i" 0"j" 1 "k1" 1 "l" 0 "m" 1 "n" 0 "uwv"
#epcgen 96434 "W1039 G4" 00.66 : #4 mva=2.75 "NX17CDe.p" 3 "rsrc" 0 "xsrc" 0.0 "a" 1 "b" 1 "c" 1 "d" 0 "e" 1 "f" 0 "g" 1 "h" 1 "i" 0 "j" 1 "k1" 1 "l" 0 "m" 1 "n" 0 "uwv"
#
C6P1 - WDAT1039 [redacted] 120MWs into [redacted] (Substituted model)
#
gewtg 96431 "W1039 G1" 00.66 "1 " : #9 mva=30.0000 0.550000 -0.150000 -0.250000 -0.700000 0.100000 0.150000 0.300000 10.0000 1.000000 0.150000 1.000000 0.100000 0.020000 30.0000 0.0 0.0
wndtge 96431 "W1039 G1" 00.66 "1 " : #9 mwcap=30.0000 1.5000 14.0000 0.300000 0.050000 150.00 25.0000 3.0000 0.600000 3.0000 30.0000 27.0000 0.0 10.0000 1.1200 0.100000 0.450000 4.3900 1.000000 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0
exwtge 96431 "W1039 G1" 00.66 "1 " "1 " 1 : #9 1.000000 1.000000 0.050000 20.0000 1.000000 1.1000 0.900000 0.290000 -0.436000 0.150000 -0.150000 0.050000 0.150000 3.0000 1.5000 0.900000 1.1000 0.100000 0.500000 0.100000 1.000000 0.0 0.0 0.0 0.0 0.0 0.0 0.050000 0.0 1.000000 0.0 0.0 1.1000
#
gewtg 96432 "W1039 G2" 00.66 "1 " : #9 mva=30.0000 0.550000 -0.150000 -0.250000 -0.700000 0.100000 0.150000 0.300000 10.0000 1.000000 0.150000 1.000000 0.100000 0.020000 30.0000 0.0 0.0
wndtge 96432 "W1039 G2" 00.66 "1 " : #9 mwcap=30.0000 1.5000 14.0000 0.300000 0.050000 150.00 25.0000 3.0000 0.600000 3.0000 30.0000 27.0000 0.0 10.0000 1.1200 0.100000 0.450000 4.3900 1.000000 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0
exwtge 96432 "W1039 G2" 00.66 "1 " "1 " 1 : #9 1.000000 1.000000 0.050000 20.0000 1.000000 1.1000 0.900000 0.290000 -0.436000 0.150000 -0.150000 0.050000 0.150000 3.0000 1.5000 0.900000 1.1000 0.100000 0.500000 0.100000 1.000000 0.0 0.0 0.0 0.0 0.0 0.0 0.050000 0.0 1.000000 0.0 0.0 1.1000
#
gewtg 96433 "W1039 G3" 00.66 "1 " : #9 mva=30.0000 0.550000 -0.150000 -0.250000 -0.700000 0.100000 0.150000 0.300000 10.0000 1.000000 0.150000 1.000000 0.100000 0.020000 30.0000 0.0 0.0
wndtge 96433 "W1039 G3" 00.66 "1 " : #9 mwcap=30.0000 1.5000 14.0000 0.300000 0.050000 150.00 25.0000 3.0000 0.600000 3.0000 30.0000 27.0000 0.0 10.0000 1.1200 0.100000 0.450000 4.3900 1.000000 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0
exwtge 96433 "W1039 G3" 00.66 "1 " "1 " 1 : #9 1.000000 1.000000 0.050000 20.0000 1.000000 1.1000 0.900000 0.290000 -0.436000 0.150000 -0.150000 0.050000 0.150000 3.0000 1.5000 0.900000 1.1000 0.100000 0.500000 0.100000 1.000000 0.0 0.0 0.0 0.0 0.0 0.0 0.050000 0.0 1.000000 0.0 0.0 1.1000
#
gewtg 96434 "W1039 G4" 00.66 "1 " : #9 mva=30.0000 0.550000 -0.150000 -0.250000 -0.700000 0.100000 0.150000 0.300000 10.0000 1.000000 0.150000 1.000000 0.100000 0.020000 30.0000 0.0 0.0
wndtge 96434 "W1039 G4" 00.66 "1 " : #9 mwcap=30.0000 1.5000 14.0000 0.300000 0.050000 150.00 25.0000 3.0000 0.600000 3.0000 30.0000 27.0000 0.0 10.0000 1.1200 0.100000 0.450000 4.3900 1.000000 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0

```
exwtge  96434 "W1039 G4"  00.66 "1 "  "1 "  1 : #9 1.000000 1.000000 0.050000  20.0000 1.000000  1.1000
0.900000 0.290000 -0.436000 0.150000  -0.150000 0.050000 0.150000  3.0000  1.5000 0.900000  1.1000
0.100000 0.500000 0.100000  1.000000 0.0 0.0 0.0 0.0 0.0 0.0 0.050000 0.0 1.000000  0.0 0.0  1.1000
#
```

Attachment 7

SCE Northern Hemisphere Import Nomogram

Please refer to separate document.

Queue Cluster 6 Phase I Interconnection Study - Attachment 1 to Appendix A

[redacted]

Interconnection Facilities, Network Upgrades, and Distribution Upgrades

Interconnection Facilities, Network Upgrades, and Distribution Upgrades

To determine the cost responsibility of each generation project in QC6, the California Independent System Operator Corporation (CAISO) developed cost allocation factors (Attachment 3) 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:

INTERCONNECTION FACILITIES

1. **Subtransmission**

   115 kV Generation Tie Line

   Install one (1) tubular steel pole and 200 circuit feet of overhead conductor.

2. **Substations**

   WDAT1039 Substation

   Install a 115 kV three circuit breaker ring bus substation:

   - One (1) deadend structure
   - Two (2) voltage transformers
   - One [redacted]
   - One [redacted]

3. **Telecommunications**

   a. Extend both diverse Fiber Optic (FO) paths provided by the customer to the WDT1039 communication room to meet the diverse routing requirements for the 115 kV generation tie line protection relays.

   b. Install all required lightwave, channel, and related terminal equipment at WDT1039 generating facility line protection and the Special Protection Scheme (SPS).

4. **Metering Services Organization**

   a. Install revenue meters required to meter the retail load at the generating facility.

   b. The customer will provide the required metering equipment (voltage and current transformers and metering cabinet).

5. Power System Controls

a. Install one (1) RTU 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.

b. Point additions to the RTU for SPS requirements.

6. Real Properties, Transmission Project Licensing, and Corporate Environmental Health and Safety

Obtain licensing, permits, land rights and perform all required environmental activities for the installation of the following project elements if applicable:

- 115 kV three circuit breaker ring bus substation
- 115 kV generation tie line
- Two (2) segments of fiber optics within WDT1039 Substation property
- Access Easements

RELIABILITY NETWORK UPGRADES (RNU)

1. Short Circuit Duty (SCD) Mitigation - RNU[i]

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

2. Expand Previously Proposed HDPP SPS

Refer to applicable QC6 P1 NOL Area Report for specific details.
The timing for the inclusion of the Generating Facility into this SPS is tied to actual development of generation projects seeking interconnection to the North of Lugo Area. Additional review of this SPS will be performed as projects execute interconnection agreements to identify the timing for the need of the inclusion of this project into the SPS.

LOCAL DELIVERY NETWORK UPGRADES (LDNU)

No Local Delivery Network Upgrades were identified as part of this QC6 Phase I study for Project.

AREA DELIVERY NETWORK UPGRADES (ADNU) AND ASSOCIATED DISTRIBUTION UPGRADES USED TO DERIVE DOLLAR-PER-MW VALUE

1. Kramer–Llano 500 KV Upgrade

2. Barre-Lewis T/Ls Capacity Increase

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

DISTRIBUTION UPGRADES (DU)

1. WDAT1039 associated Distribution Upgrades

a. Subtransmission

115 kV Loop In Lines

Install four (4) steel structures and four (4) spans of overhead 115 kV circuit.

b. Substations

WDT1039 Substation

Install a 115 kV three circuit breaker ring bus substation:

- One (1) (1) 115 kV box rack steel structure
- Three (3) 115 kV circuit breakers
- Seven (7) sets of 115 kV disconnect switches
- Six (6) voltage transformers
- Mechanical electrical equipment room

Apple Valley Substation

Install one [redacted]

Cottonwood Substation

Install one [redacted]

c. Telecommunications

- Install new fiber optic cable routes between WDT1039 and Apple Valley Substations and between WDT1039 and Cottonwood Substations.
- Install all required lightwave, channel, and related terminal equipment at Apple Valley, Cottonwood, and WDT1039 Substations for line protection.

d. Power System Controls

Install one (1) RTU at WDT1039 Substation 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.

e. **Real Properties, Transmission Project Licensing, and Corporate Environmental Health and Safety**

Obtain licensing, permits, land rights and perform all required environmental activities for the installation of the following project elements if applicable:

- 115 kV three circuit breaker ring bus substation
- 115 kV loop in lines
- Fiber optic cable required between WDT1039 and Apple Valley Substations and WDT1039 and Cottonwood Substations.

2. **New Cottonwood Corridor SPS**

This Project will be added as a participant to the QC6 triggered Cottonwood Corridor SPS. Include the new WDT1039 interconnection to the triggered (QC6) Cottonwood Corridor to trip the new generation tripping signals under the following outages:

- N–1 Outage of Apple Valley-Cottonwood- Pluess-Savage 115kV Line
- N–1 Outage of Cottonwood- Savage- WDT642 115kV Line
- N–2 Outage of Apple Valley-Cottonwood- Pluess-Savage 115kV Line and Cottonwood- Savage- WDT642 115kV Line

New Cottonwood Corridor SPS associated Interconnection Facilities

a. Telecommunications

Install all required channel and related terminal equipment at WDT1039 generating facility for the Special Protection Scheme (SPS).

b. Power System Controls

Point additions to the RTU at WDT1039 Substation for SPS required for the SPS.

New Cottonwood Corridor SPS associated Distribution Upgrades

a. Substations

Savage Substation: Install two [redacted] and one [redacted]

b. Telecommunications

Install channel, cross connects and associated equipment at Savage, Cottonwood, and Apple Valley Substations for the SPS.

c. Power System Controls

Install two (2) RTUs at Savage Substation required for the SPS.

The timing for the inclusion of the Generating Facility into this SPS is tied to actual development of generation projects seeking interconnection to the North of Lugo Area. Additional review of this SPS will be performed as projects execute interconnection agreements to identify the timing for the need of the inclusion of this project into the SPS.

3. New Coso 115 kV Shunt Capacitor

4. Short Circuit Duty (SCD) Mitigation[i]

Refer to Section D and F of corresponding Area Report for additional details on #3 and #4 mentioned above.

[i] Network and Distribution system SCD mitigations (ie. circuit breaker upgrades) have costs allocated based on project short circuit duty contribution at each location.