Appendix A – WDT285

[redacted]

Final Report

July 23, 2010

This study has been completed in coordination with Southern California Edison Cluster Large Generator Interconnection Procedures (CLGIP) for Interconnection Requests in a Queue Cluster Window

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1. Executive Summary

Southern California Edison Company ("SCE") received an interconnection request from [redacted] for the interconnection of its [redacted] pursuant to the Cluster Large Generator Interconnection Procedures ("CLGIP") under the SCE Wholesale Distribution Access Tariff ("WDAT"). The Project is a photovoltaic PV solar plant with an output of 100 MW to the primary Point of Interconnection (POI) which is at Southern California Edison Company's (SCE) Cottonwood-Savage 115 kV via a new 115 kV substation that would tap the line, forming the new Cottonwood-PV25-Savage 115 kV line. This new 115 kV substation will become the physical interconnection point for the [redacted] The customer requested Commercial Operation Date of the Project is December 1, 2013.

In accordance with Federal Energy Regulatory Commission (FERC) approved Cluster Large Generator Interconnection Procedures ("CLGIP"), SCE Transmission and Interconnection Planning has performed a Phase II Interconnection Study to determine the impacts of the group as well as impacts of the Project on the CAISO controlled grid and SCE Distribution System.

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; and

3. A list of required facilities and a non-binding, good faith estimate of (a) the Project's cost responsibility, and (b) the required to permit, engineer, design, procure and construct these facilities.

The Phase II study has determined that the Project contributes to the overloading of transmission facilities for which mitigation plans have been proposed. These mitigation plans include the use of congestion management for base case overloads and Special Protection System (SPS) to trip the Project under identified contingency outage conditions.

In addition, the Project is partly responsible for overstressing circuit breakers at the Kramer 220 kV buses.

The non-binding costs to interconnect the Project are:

Interconnection Facilities[1]	**$26,085,000** including ITCC[2];
Network Upgrades[3]	**$238,000**
Distribution Upgrades[4]	**$13,923,000**

The anticipated time to construct the facilities associated with the Project is approximately 36 months from the signing of the Large Generator Interconnection Agreement (LGIA). In addition there may be operational constraints related to the construction of upgrades to accommodate projects ahead in queue. See Section 9 "Operational Studies" for additional details.

2. Project and Interconnection Information

During the period between the Transition Cluster Phase I and Phase II technical analysis, The IC submitted a revised Appendix B to SCE CLGIP which requested modifications to the Project's original technical data. Specifically, the IC requested to move the geographic location of the project approximately 7 miles east and one mile south of the original geographic location used for the Phase I Studies. In addition, the IC identified a change to the originally requested in-service date of May 1, 2012. The Phase II studies updated the project specifics to reflect the new information as provided by the IC.

Table 2-1 provides general information about the Project as modeled in the Phase II Study.

[1] The transmission facilities necessary to physically and electrically interconnect the Project to the CAISO Controlled Grid at the point of interconnection. These costs are not reimbursable.
[2] Income Tax Component of Contribution.
[3] The additions, modifications, and upgrades to the CAISO Controlled Grid required at or beyond the Point of Interconnection to accommodate the interconnection of the Generating Facility to the CAISO Controlled Grid. Network Upgrades shall consist of Delivery Network Upgrades and Reliability Network Upgrades.
[4] These upgrades are not part of the CAISO tariff and are not reimbursable

Table 2-1: [redacted]

Project Location	[redacted]
SCE Planning Area	[redacted]
Number and Type of Generators	[redacted]
Interconnection Voltage	[redacted]
Maximum Generator Output	[redacted]
Generator Auxiliary Load	[redacted]
Maximum Net Output to Grid	[redacted]
Power Factor Range	[redacted]
Step-up Transformer	[redacted]
Point of Interconnection	[redacted]
Commercial Operation Date	[redacted]
Individual Project Appendix B Changes between Phase I and Phase II	[redacted]

Figure 2-1 provides the map for the Project and the transmission facilities in the vicinity. Figure 2-2 shows the conceptual single line diagram of the Project as modeled in the Phase II Study.

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3. Study Assumptions

For details about the Transition Cluster interconnection information and the group study assumptions, including relevant changes between the Phase I and Phase II studies, see the group report Sections 2 and 4.

The following design assumptions are applicable to the Project:

A. The following Facilities were estimated and included in the Phase II Study:

- The second telecommunication path from the generating facility to the SCE tapped substation.
- It is assumed SCE would be required to install [redacted] additional dead-end structure and a total of [redacted] spans of line to reach the proposed 115 kV line position.
- The required revenue metering cabinet and retail load meters to be installed at the generating facility will be installed by SCE.
- The required remote terminal unit (RTU) to be installed at the generating facility will be installed by SCE.

B. The following facilities needed to support the 115 kV gen tie are to be installed by the Interconnection Customer and are not estimated or included in this Phase II Study:

- The [redacted] gen tie line from the generating facility to the last structure outside the SCE tapped substation property line will be installed by [redacted]. The 115 kV gen tie line right of way should extend up to the edge of the SCE Substation property line.
- The [redacted] gen tie line must be equipped with fiber optic cable to provide [redacted] telecommunication paths required for the line protection scheme and the special protection system (SPS).
- All required CAISO metering equipment at the generating facility will be provided by the customer.
- All required revenue metering equipment to meter the generating facility retail load will be specified by SCE and installed by the customer at their end of the Project 115 kV gen tie line
- The following 115 kV gen tie line protection to be installed at the generating facility will be specified by SCE and provided by the customer. The interconnection customer and SCE will coordinate protection facilities after the completion of the Phase II Interconnection Study.
  - [redacted] current differential relay with dual dedicated digital communication channels to the SCE tapped substation.
  - [redacted] current differential relay with dual dedicated digital communication channels to the SCE tapped substation.
  - [redacted] voltage transformers
  - [redacted] relays to support the SPS

4. Power Flow Analysis

The group study indicated that this project is contributing to overloading of the following transmission facilities. The details of the analysis and overload levels are provided in the group study.

4

4.2 [illegible]

None

4.3 Recommended Mitigations

A combination of congestion management for base case overloads and SPS to trip the project under identified contingency outage conditions is required to mitigate the power flow impacts of the project described above. See the group report for additional details.

5. Short Circuit Analysis

Short circuit studies were performed to determine the fault duty impact of adding the Transition Cluster projects to the transmission system. The fault duties were calculated with and without the projects to identify any equipment overstress conditions. Once overstressed circuit breakers were identified, the cost responsibility of each individual project was determined pro rata on the basis of the maximum megawatt electrical output of each proposed new Large Generating Facility or the amount of megawatt increase in the generating capacity of each existing Generating Facility based on the rules set forth in CAISO Tariff Appendix Y.

5.1 Short Circuit Study Input Data

The following input data provided by the IC was used in this study:

Satcon Inverter Short Circuit Data @ 1 MVA Base:

- Positive Sequence subtransient reactance (X"1) = ∞ p.u.
- Negative Sequence subtransient reactance (X"2) = ∞ p.u.

- Zero Sequence subtransient reactance (X"0) = ∞ p.u.

Station Step-up Transformers (total of two)

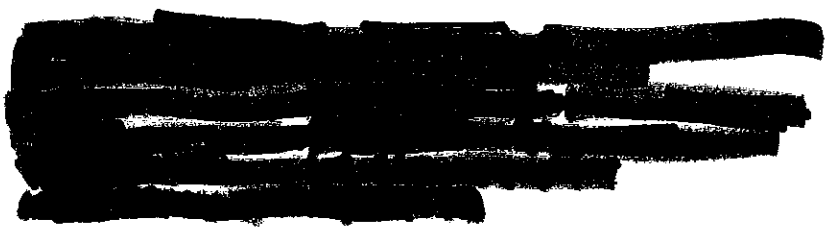
- This transformer is a three-phase 115/34.5/Buried kV rated for 60/90/100 MVA OA/FA/FA @ 65 degree C temperature rise with 8% impedance on a 60 MVA base.

Generation Tie Line

The generation tie line was assumed to be 2.3 miles of 1113 ACSR conductor.

5.2 Results

All bus locations where the Transition Cluster 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 Appendix H of the Group Report. These values have been used to determine if any equipment is overstressed as a result of the Transition Cluster interconnections and corresponding network upgrades, if any. The Transition Cluster Phase II breaker evaluation identified the following overstressed circuit breakers:

- 

Based on the cost assignment methodology applied in the Phase II Study, the Project will have the assigned cost responsibility for mitigation of the short-circuit duty results described above. The total cost responsibility allocated to the Project is provided in Attachment 6.

5.3 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 2-2.

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

5.4 Additional SCD Discussion

The Phase II Study has shown significant increases in Single-Line-Ground (SLG) short-circuit duty with the addition of numerous grounded interconnection transformers. For details, see Appendix H.

6. Reactive Power Deficiency Analysis

Reactive power deficiency analysis was performed. The power flow studies for Category "B" and Category "C" contingencies indicated that this Phase II project did not 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.

7. Transient Stability Evaluation

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 Phase II projects begin operation. The generator dynamic data used in the study for this Project is shown in Attachment 1.

7.1 Transient Stability Study Scenarios

Disturbance simulations were performed for a study period of 10 seconds to determine whether the Transition Cluster Phase II 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 Lugo Hub Sub-area were evaluated. For the list of specific line and generator outages evaluated, see the group report.

7.2 Results

In the stability analysis performed in the Lugo Hub Sub-area with the addition of Transition Cluster projects and upgrades in place to mitigate base case and outage related overload problems, no significant transmission system stability problems relative to existing stability criteria were identified. The study concluded that the Project would not cause the transmission system to go unstable under Category "B" and Category "C" outages. For a more detailed discussion on the stability analysis see the group report. Stability plots are shown in Appendix F of the group report.

8. Deliverability Assessment

8.1 On Peak Deliverability Assessment

CAISO performed an On-Peak Deliverability Assessment. The power flow study results for Category "A", "B", and "C" are detailed in Attachment 5.

9. Operational Studies

9.1 IC Proposed Project Timelines

The latest information provided by the IC has indicated that the proposed date for the generator step-up transformer to receive back feed power is February 26, 2013 and the proposed Commercial Operation Date for the entire 100 MW project is December 1, 2013. Due to the modular nature of photovoltaic facilities, the IC has indicated that construction of this project will commence on November 8, 2012 with the initial block to be ready for testing on March 12, 2013.

9.2 System Upgrade Timelines

The Project involves the installation of the following Interconnection Facilities:

1. A new single circuit breaker 115 kV tapped substation. To support terminating the generation tie line, [redacted] dead-end structures at the substation will be required. In addition, the existing protection on the Cottowood-Savage 115 kV line will need to be converted at both ends of the line to become a [redacted] terminal operation for the proposed Cottonwood-PV25- Savage 115 kV line;
2. An RTU at the Project Facility; and
3. The installation of telecommunications equipment to provide diverse protection and data transfer capability to the RTU, SCADA data recording equipment, and implementation of an SPS.

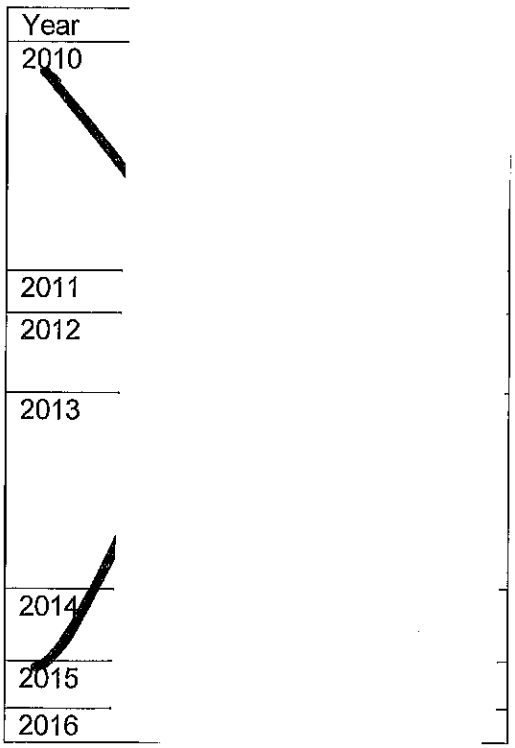
The anticipated time to construct these Interconnection Facilities is 36 months upon execution of LGIA. However, start of construction of such Interconnection Facilities cannot commence until SCE receives all appropriate permitting approvals and licenses for the Substation and telecommunication facilities.

This Phase II Study assumed that all previously triggered short-circuit duty impacts would be mitigated by the corresponding triggering project. Consequently, this study evaluated the incremental impacts associated with the addition of the Transition Cluster projects, including appropriate transmission upgrades as identified in this study, in an effort to cost allocate the incremental upgrades associated with the addition of the Transition

Cluster projects. However, it should be clear that for reliability reasons it may be necessary to implement mitigation upgrades previously triggered by queued ahead generation projects prior to allowing interconnection of Transition Cluster generation projects.

The circuit breaker upgrades that were triggered by queued-ahead projects are identified in Section 4.6 of the group report. The Operational Study undertaken as part of this Phase II Study identified the required timing for circuit breaker upgrades triggered by queued-ahead generation projects based on the generation interconnection request dates as provided by the ICs. The Table below identifies the first year that circuit breaker upgrades triggered by queued-ahead projects were found to be required in this Operational Study at each substation location. Facility upgrades will be constructed prior to allowing the interconnection of triggering queued ahead projects.

Table 9-1: Circuit Breaker Upgrades Triggered by Queued-ahead Projects



This Phase II Study assumed that the timelines for construction of the upgrades listed in Table 9-1 to accommodate queued-ahead projects will also be sufficient to accommodate the operational requirements for the Transition Cluster projects. In the event that the Transition Cluster projects will need to accelerate these upgrades, the projects will need to do so via a separate agreement. Operational studies will be conducted on an annual basis or more frequently as needed to identify such requirements.

The circuit breaker upgrades that were triggered by Transition Cluster projects and required mitigation measures are identified in Section 8.2 and Section 8.3, respectively, of the group report. The Operational Study undertaken as part of this Phase II Study identified the required timing for circuit breaker upgrades triggered by Transition Cluster projects. The Table below identifies the first year that mitigation measures triggered by Transition Cluster projects were found to be required in this Operational Study at each substation location.

Table 9-2: Locations Requiring Mitigation Measures Triggered by Transition Cluster Projects

Year
2013
2014
2015
2016

9.2.1 Reliability Network Upgrade Timelines

The Project will need to be added to an expanded HDPP SPS to maintain system reliability. All network facilities necessary to implement such a SPS expansion is already in place. However, telecommunication facilities from SCE's Victor Substation to the 115 kV tapped substation to support the SPS will be required. These telecommunication facilities are defined as Distribution Facilities and establish the timelines for adding the Project as an SPS participating project. The anticipated time to expand the HDPP is therefore linked to the timeframes necessary to construct the telecommunication facilities.

9.2.2 Delivery Network Upgrade Timelines

The Phase II Study concluded that the Project was not allocated any Delivery Network Upgrades.

9.2.3 Distribution Upgrade Timelines

To provide for the requested "Full Delivery", the Phase II Study identified the need for adding Distribution Telecommunication facilities in order to add the project to the existing HDPP SPS. The anticipated time to expand the HDPP is estimated to require 36 months upon execution of LGIA.

9.3 Conclusion

Based on information available at this time, assuming an anticipated LGIA execution date of September 2010, there are potential operational constraints

to the Project associated with the construction of the facilities needed to interconnect the project.

As discussed above, the current schedule for the construction of the Interconnection Facilities indicate a 36-month time duration to permit and construct the new 115 kV facilities, including the connection to the existing Cottonwood-Savage 115 kV Line. Consequently, SCE may not be able to provide the facilities needed for back-feed service to enable the IC to undertake the appropriate project testing and in-service date of the initial block within the timelines requested.

10. Environmental Evaluation/Permitting

Please see Section 12 of group report.

11. Upgrades, Cost Estimates and Construction schedule estimates

To determine the cost responsibility of each generation project in Transition Cluster, the CAISO developed cost allocation factors based on the individual contribution of each project (Attachment 6). The cost allocation for the Interconnection Facilities and Network Upgrades for which the Project is solely responsible is as follows:

PTO's INTERCONNECTION FACILITIES

1. **Sub - Transmission**
   Project 115 kV Generation Tie Line
   - Install [redacted] new TSP with foundations
   - [redacted] LWS poles
   - [redacted] pole top switches

2. **Tapped Substation**
   Construct a single circuit breaker 115 kV tapped substation to terminate the new Project 115 kV gen tie line:

   - [redacted] Switch Support Structure
   - [redacted] 1200A disconnect switches
   - [redacted] 115 kV metering units
   - [redacted] relay
   - [redacted] relay
   - [redacted] voltage transformers

3. **Telecommunications**
   Install lightwave, channel, and associated equipment supporting diverse protection and SCADA requirements and FO cables to support the RTU for the Project interconnection.

4. **Metering Services Organization**

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

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

5. **Power System Control**
   Install [redacted] 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 regional grid control center.

6. **Real Properties, Transmission Project Licensing, and Environmental Health and Safety**
   Obtain easements and / or acquire land, obtain licensing and permits and perform all required environmental activities for the installation of 13.8 miles of new fiber optic cable and the SCE portion of the project gen tie line.

PLAN OF SERVICE RELIABILITY NETWORK UPGRADES

No Plan of Service Reliability Network upgrades identified.

RELIABILITY NETWORK UPGRADES

- Modify Victor SPS Algorithm
- Short-Circuit Duty (SCD) Mitigation
  - Replace five CBs to achieve 50 kA rating on overstressed Kramer 220 kV CBs

DELIVERY NETWORK UPGRADES

No Delivery Network upgrades identified.

DISTRIBUTION UPGRADES

Tapped Substation

- [redacted] dead-end structures
- [redacted] 115 kV CB
- [redacted] sets of disconnect switches
- [redacted] relay
- [redacted] w/RFL
- [redacted] VTs

Cottonwood Substation

- Convert existing RFL 9745 to three terminal operation on the PV25 – Savage 115 kV line.

Savage Substation

- Convert existing RFL 9745 to three terminal operation on the Cottonwood – PV25 115 kV line.

Telecommunication necessary to include project into Modified Victor SPS:

- Line tap to WDT285 (1.4 miles) and Cottonwood Sub to Line tap (14.6 miles) FO by ECS for WDT285 SPS;
- Lightwave and channel equipment to be installed at various locations to support SPS.

Power System Control

- Install [redacted] RTU at the tapped susbstation.

Table 10.1: Upgrades, Estimated Costs, and Estimated Time to Construct Summary

Type of Upgrade	Upgrade (May include the following)	Description	Estimated Cost x 1000	Estimated Time to Construct *(Note 3)*
PTO's Interconnection Facilities *(Note 1)*	Transmission, Substations, Metering Services Organization, Power System Control, Telecommunications, Environmental Health and Safety, Project Licensing, Real Properties	Non-network facilities needed to enable interconnection	$26,085	36 Months
Plan of Service Reliability Network Upgrades	None	Direct Assigned Network upgrades needed to enable interconnection.	N/A	N/A
Reliability Network Upgrades	Substation	Allocated Network upgrades needed to maintain system Reliability	$238	24 Months
Delivery Network Upgrades	None	Network upgrades needed to support Full Delivery, if requested	N/A	N/A
Distribution Upgrades *(Note 2)*	Transmission, Substations, Metering Services Organization, Power System Control, Telecommunications, Environmental Health and Safety, Project Licensing, Real Properties	Non-CAISO SCE Distribution Facilities	$13,923	36 Months
Total			**$40,246**	**36 Months**

Note 1: The Interconnection Customer is obligated to fund these upgrades and will not be reimbursed.

Note 2: These upgrades are not identified in ISO tariff, and are not reimbursable.

Note 3: The estimated time to construct (ETC) is for a typical project; schedules duration may change due to number of projects approved and release dates. Stacked projects impact resources, system outage availability, and environmental windows of construction. Assumption is SCE will need to obtain CPUC licensing and regulatory approvals prior to design, procurement and construction of the proposed facilities required to serve the interconnection customer and prerequisite facilities are in service.

12. Items not covered in this study

12.1 Plan of Service

The Plan of Service developed for the Project is based on the data submittals provided for each specific project in the cluster group and will serve as the basis for developing the LGIA and for permitting purposes. However, the final Plan of Service is subject to change based upon completion of preliminary and final engineering, identification of field conditions, and compliance with applicable environmental and permitting requirements.

12.2 Customer's Technical Data

The study accuracy and results for the Phase II 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.

12.3 Study Impacts on Neighboring Utilities

Results or consequences of this 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).

12.4 Relocations and Other Use of SCE Facilities

The Interconnection Customer is responsible for all costs associated with necessary relocation of any SCE facilities as a result of this project and acquiring all property rights necessary for the Interconnection Customer's Interconnection Facilities, including those required to cross SCE facilities and property. The relocation of SCE facilities or use of SCE property rights shall only be permitted upon written agreement between SCE and the Interconnection Customer. Any proposed relocation of SCE facilities or use of SCE property rights may require a separate study and/or evaluation to determine whether such use may be accommodated, and any associated cost would be non-refundable..

12.5 SCE Interconnection Handbook

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

12.6 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.

12.7 System Protection Coordination

Adequate Protection coordination will be required between SCE-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

12.8 Standby Power and Temporary Construction Power

The Phase II 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 SCE prior to the in-service date of the Interconnection Facilities, the IC is responsible to make appropriate arrangements with SCE to receive and pay for such retail service.

12.9 Construction Schedule

The estimated time to construct (ETC) is for a typical project; schedules duration may change due to number of projects approved and release dates. Stacked projects impact resources, system outage availability, and environmental windows of construction. Assumption is SCE will need to obtain CPUC licensing and regulatory approvals prior to design, procurement and construction of the proposed facilities required to serve the interconnection customer and prerequisite facilities are in service.

12.10 Telecommunication Assumptions

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 SCE as opposed to the IC doing this work. 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 SCE substation. Any changes in these assumptions may affect the cost and schedule for the identified telecommunication facilities.

Attachment 1

Generator Machine Dynamic Data

Attachment 2

Dynamic Stability Plots

Please Refer to Appendix F of the Group Report

Attachment 3

SCE Interconnection Handbook

Attachment 4

Short Circuit Calculation Study Results

Please Refer to Appendix H of the Group Report

Attachment 5

Deliverability Assessment Results

Please Refer to Appendix I of the Group Report

Attachment 6

Allocation of Network Upgrades for Cost Estimates