[redacted]

[redacted]

WDAT 1156

WDAT
SYSTEM IMPACT STUDY

October 24, 2014

SOUTHERN CALIFORNIA
EDISON
An *EDISON INTERNATIONAL*™ Company

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SOUTHERN CALIFORNIA EDISON COMPANY

EXECUTIVE SUMMARY

[redacted] applied to Southern California Edison ("SCE") for interconnection and wholesale distribution service for its proposed [redacted] and [redacted] pursuant to SCE's Wholesale Distribution Access Tariff ("WDAT"). SCE performed a System Impact Study as requested by [redacted] for a 12 kV interconnection from an existing 12 kV distribution circuit [redacted]. The interconnection point is at an applicant-owned 12 kV switchgear, which will be located approximately 1.4 circuit miles from [redacted] Substation on the [redacted] 12 kV circuit out of SCE's [redacted] 66/12 kV Substation. [redacted] The initial request is for service to commence by November 15, 2015.[1].

The new proposed generation, consisting of photovoltaic panels, battery modules, [redacted] will receive interconnection service from SCE's existing [redacted] 12 kV circuit out of [redacted] Substation via an underground line extension to the applicant owned 12 kV switchgear, where their protective device will be installed. The generated power would be delivered to the California Independent System Operator ("CAISO") grid at the 220 kV bus of SCE's [redacted] Substation.

The purpose of this System Impact Study is to determine the effect(s) of the proposed generating facility on the SCE distribution system and to identify the Interconnection Facilities, Distribution Upgrades, additions or modifications, and/or other facilities required to provide the requested service. The study was performed in two parts: Part A (performed by SCE's Distribution Field Engineering department) examines impacts related to the SCE distribution system and also briefly summarizes the results of Part B, while Part B (performed by SCE's Transmission & Interconnection Planning department) examines impacts and facilities related to the bulk power system. This is the Part A study report; a detailed report covering the Part B study results is included as Attachment B.

The Part A study was performed for expected year 2014 through 2023 projected peak load conditions as well as 2014 through 2023 minimum load conditions.

The Part A System Impact Study consisted of a power flow analysis, three-phase short circuit duty analysis and circuit voltage profile analysis. The analyses were performed to determine whether the energy associated with the [redacted] can be transmitted through SCE's distribution system to the ISO grid at the 220 kV bus of [redacted] Substation without creating the need for modifications to SCE's distribution system. The study showed that, with the [redacted] on-line:

- For both peak load and light load conditions, the addition of the [redacted] did not result in any violation of SCE's thermal loading criteria under both base case and

[1] Date as requested in the application. The actual operating date depends on design and construction requirements.

N-1 conditions for the SCE distribution system under peak loading and low loading conditions. However, due to the dynamic distribution system configurations, SCE may deem it necessary to isolate this project during N-1 conditions until the distribution system returns to normal conditions.

- The addition of the [redacted] did not result in a voltage rise exceeding allowable Rule 2 limits.

- With the addition of the [redacted], changes to the protection system of the SCE electrical system are deemed to not be required.

- The addition of the [redacted] did result in the increase of three-phase short-circuit duties of 0.1kA or more at one (1) distribution substation.

    - The circuit breaker interrupting capabilities were reviewed at this substation and it was determined that zero (0) circuit breakers will be required to be upgraded as a result of the [redacted]

- The addition of the [redacted] did not trigger any upgrades on the [redacted] 66 kV subtransmission system or the SCE metro bulk transmission system.

- The interconnection customer must understand that the [redacted] system may not charge during SCE system peak conditions. This report assumes the interconnection customer will have the necessary control system in place to prevent the energy storage system from charging during SCE's system peak. The energy storage system shall not increase SCE's peak loading on the [redacted] out of [redacted] SCE will review the interconnection customers control system to ensure the battery storage system will not charge during SCE's system peak. The interconnection customer must understand details as to how the energy storage system will not increase SCE's system peak are yet to be developed. Until some system is further developed, the storage system may not be able to operate.

Non-binding order of magnitude cost estimates[1,2] for the required interconnection facilities and 12 kV system upgrades are as follows

The following is the cost estimate for Interconnection Facilities which are required to interconnect the proposed project to [redacted]

Cost Estimate:

[1] The cost estimates do not include the costs required for civil work completed by the customer.
[2] The cost estimates are in 2014 constant dollars.

Distribution Upgrades	**$84.1 k**
Electrical Facilities:	$ 79.2 k
• [redacted]	
• [redacted]	
Real Properties	$ 4.9 k
Interconnection Facilities	**$95.6 k**
Electrical Facilities:	$ 86.6k
• [redacted]	
• [redacted]	
• [redacted]	
• [redacted]	
Real Properties	$ 9.0 k
Telemetry Requirements	**$ 14.5 k**[1]
ITCC (35%)	**$ 62.9 k**
Total non-binding order of magnitude cost estimate	**$ 257.1 k**

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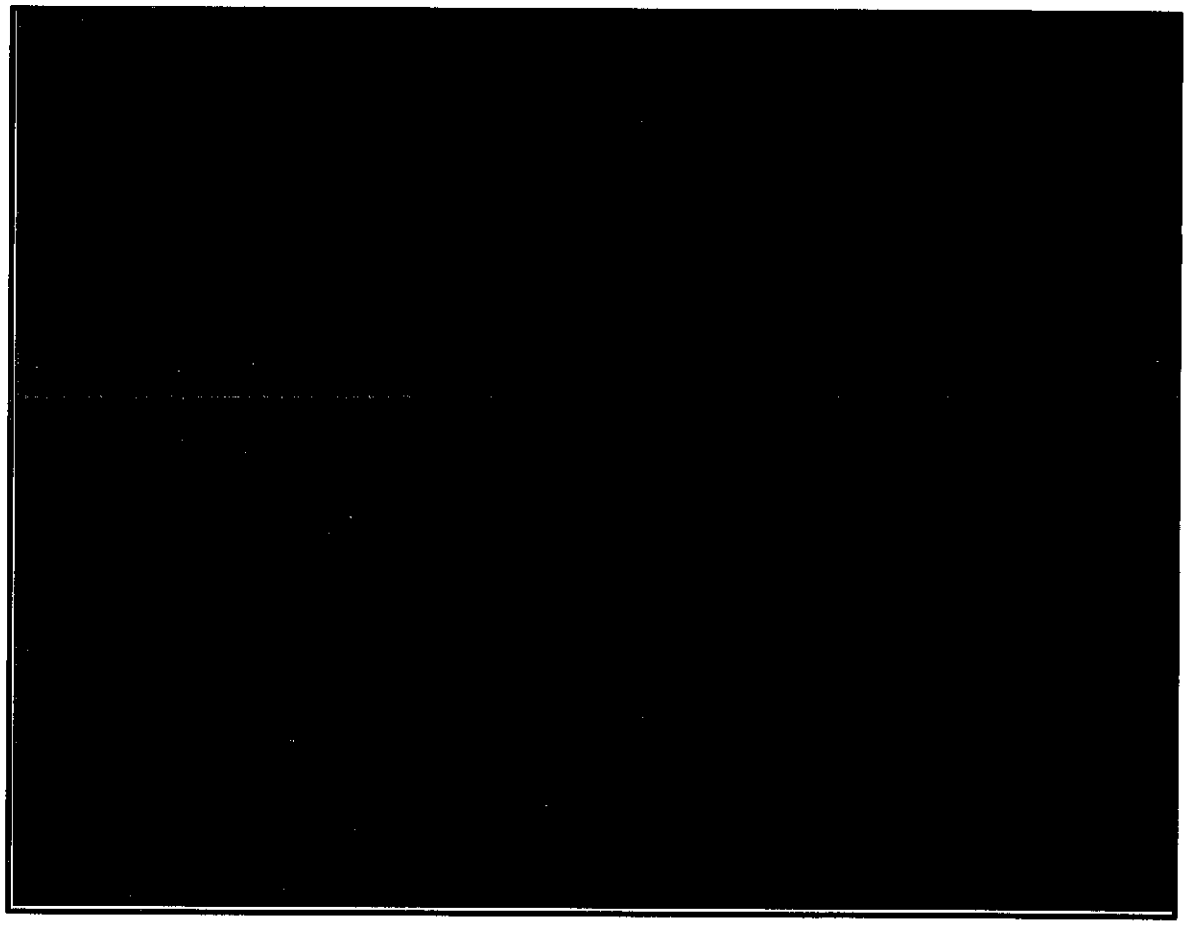
[1] The cost estimate is based on the centralized RTU method; the cost and scope of telemetry may significantly increase to include a dedicated RTU as required by SCE's Interconnection Handbook with an approximate cost of $155,000 in the event that the centralized RTU method is not feasible for this project.

I. INTRODUCTION TO PART A

[redacted] applied to Southern California Edison ("SCE") for interconnection and wholesale distribution service for its proposed [redacted] pursuant to SCE's Wholesale Distribution Access Tariff ("WDAT"). SCE performed a System Impact Study as requested by [redacted] for a 12 kV interconnection from an existing 12 kV distribution circuit [redacted] 12 kV"). The interconnection point is at an applicant-owned 12 kV switchgear, which will be located approximately 1.4 circuit miles from [redacted] Substation on the [redacted] 12 kV circuit out of SCE's [redacted] 66/12 kV Substation. The request is for a WDAT with [redacted] for a total capacity of 3.0 MW. The initial request is for service to commence by November 15, 2015.[1].



The new proposed generation, consisting of [redacted] will receive

[1] Date as requested in the application. The actual operating date depends on design and construction requirements.

interconnection service from SCE's existing [redacted] 12 kV circuit out of [redacted] Substation via an underground line extension to the applicant owned 12 kV switchgear, where their protective device will be installed. The generated power would be delivered to the California Independent System Operator ("CAISO") grid at the 220 kV bus of SCE's [redacted] Substation.

The purpose of this study is to determine the impact of the proposed generation addition on the SCE distribution system and to identify in general additional Interconnection Facilities, Distribution Upgrades, additions or modifications, or other facilities required to provide the requested service. This study was performed for expected year 2014 through 2023 peak load conditions as well as low demand conditions.

II. PART A: SYSTEM IMPACT STUDY CONDITIONS & METHODOLOGY

Planning Criteria

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.

System Conditions

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 2014 -2023 plan was used.

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.

Distributed Generation resources connected to the distribution system are analyzed offline and online during peak load and minimum load conditions during the day as to determine worst case scenario.

The short circuit contribution of 1.25 p.u. for the [redacted] and 1.75 p.u. for the [redacted] was determined using inverter manufacturer datasheets.

III. PART A: SYSTEM IMPACT STUDY RESULTS

Short Circuit Analysis
Using the short circuit models from the inverter systems being utilized in this solar generation and energy storage system it was calculated that the addition of the [redacted] did result in the increase of three phase short circuit duties of 0.1 kA or more at one (1) distribution substation.

The circuit breaker interrupting capabilities were reviewed at the substation and it was determined that zero (0) circuit breakers will be required to be upgraded as a result of the [redacted].

System Protection Considerations
With this proposed method of service, changes to the protection system of the SCE electrical system are deemed to not be required.

Thermal Loading
With the [redacted] on the [redacted] 12 kV circuit, the line section of the [redacted] 12 kV circuit between the applicant's 12 kV point of interconnection and the 12 kV bus at [redacted] 66/12 kV Substation, during minimum load conditions, is expected to experience an aggregate total reverse power flow of approximately 3.0 MW. Of that 3.0 MW, approximately 2.4 MW is expected to flow back into the bus at [redacted] Substation. However, no thermal overloads were triggered by the [redacted]

Under emergency (N-1) conditions, no thermal overloads were triggered by the [redacted] However, due to the dynamic distribution system configurations, SCE may deem it necessary to isolate this project during N-1 conditions until the distribution system returns to normal conditions.

Distribution Voltage Control
The section of 12 kV distribution circuit near the project area is expected to experience a voltage rise of 0.6%, which is within the allowable CPUC Rule 2 requirements, as a result to the addition of the 3.0 MW [redacted] under the generating facility conditions of maximum generation and unity power factor. However, future distribution system configurations may require the generation facility to operate at a ± 0.95 power factor as required by the WDAT Tariff. In the event of an N-1 condition, the [redacted] will be switched off, if SCE deems it necessary, until the distribution system returns to normal.

Harmonic Impact
The harmonic impact of the subject inverter based generation was not part of this System Impact Study. Despite the relatively low THD (<3%) of the equipment, impacts on voltage distortion levels may be significant due to the penetration level of the generation facility with respect to the local distribution grid strength. As with all equipment connected to the SCE distribution system, the generation project will be subject to the provisions of CPUC Rule 2.E, allowing SCE to require customer mitigation of interference with SCE service, including harmonic impacts, if harmonic interference is caused by the customer. Given the amount of generation and the strength of the

distribution system, SCE will not require a harmonic study but encourages that the applicant completes a harmonic study during the Facility Study Phase to insure that the generation facility complies with the harmonic studies outlined in CPUC Rule 2.E. If the applicant chooses to complete a harmonic study, SCE will then provide the required SCE distribution system data that are to be used as part of the harmonic study.

IV. PART A: GENERAL DESCRIPTION OF IDENTIFIED UPGRADES

Distribution Upgrades

Distribution Upgrades will be required to interconnect the system. They include the installation of one [redacted] and approximately [redacted]

Interconnection Facilities

Electrical Systems

Interconnection Facilities will be required to interconnect the system. Interconnection facilities include the installation of approximately [redacted]

Telemetry Requirements

Real-time telemetry will be required. In order to meet the telemetry requirements SCE is planning to utilize a telemetry method which utilizes a centralized RTU concept. The cost estimate to comply with the telemetry requirements using this method is $14.5 k[1,2].

Customer Equipment

The interface protection will be provided by the applicant and will include a [redacted] which is to be installed in an applicant-owned [redacted] The applicant's protection must be coordinated with SCE's protective device(s) to provide adequate protection for the distribution system. The relay settings are subject to SCE approval prior to setting and certified timed trip testing report results using primary injection will need to be provided to SCE to verify relay and circuit breaker performance prior to energizing the service.

The applicant owned switchgear must meet SCE's published Electrical Service Requirements ("ESR") to the extent applicable. Drawings required by the ESR shall be submitted, reviewed, and approved by SCE prior to release for fabrication/purchase of the equipment. Each medium voltage service is an individually engineered application at SCE.

Applicant generation interconnection equipment must comply with SCE's Interconnection Handbook in regards to generation protection and lockable, visible open disconnecting means at the point of interconnection. Additionally, the applicant will be responsible for the installation and costs of certain underground facilities (i.e. ducts, structures, etc.) to the extent required by the final design. The construction of the underground facilities will be as per SCE's project drawings.

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[1] The cost estimate does not include 35% ITCC.

[2] The cost estimate is based on the centralized RTU method; the cost and scope of telemetry may significantly increase to include a dedicated RTU as required by SCE's Interconnection Handbook with an approximate cost of $155,000 in the event that the centralized RTU method is not feasible for this project.

System Study
A Facilities Study may be performed to conclusively determine the detailed scope and cost of facilities required to interconnect the project.

V. NON-BINDING ORDER OF MAGNITUDE COST ESTIMATE

Non-binding order of magnitude cost estimates[1,2] for the required interconnection facilities and system upgrades are as follows:

The following is the cost estimate for Interconnection Facilities which are required to interconnect the proposed project to the [redacted] 12 kV circuit.

Cost Estimate:

Distribution Upgrades	**$84.1 k**
Electrical Facilities:	$ 79.2 k
• [redacted]	
• [redacted]	
Real Properties	$ 4.9 k
Interconnection Facilities	**$95.6 k**
Electrical Facilities:	$ 86.6k
• [redacted]	
• [redacted]	
• [redacted]	
• [redacted]	
Real Properties	$ 9.0 k
Telemetry Requirements	**$ 14.5 k[3]**
ITCC (35%)	**$ 62.9 k**
Total non-binding order of magnitude cost estimate	**$ 257.1 k**

VI. PART A: SUMMARY

[1] The cost estimate does not include the costs required for civil work completed by the customer.
[2] The cost estimate is in 2014 constant dollars.
[3] The cost estimate is based on the centralized RTU method; the cost and scope of telemetry may significantly increase to include a dedicated RTU as required by SCE's Interconnection Handbook with an approximate cost of $155,000 in the event that the centralized RTU method is not feasible for this project.

The Part A System Impact Study showed:

1. Distribution upgrades will be required to interconnect the system. They include the installation of one [redacted] and approximately 540 feet of [redacted]

2. Interconnection Facilities will be required to interconnect the generation facility to the SCE system. Interconnection facilities include the installation of 250 feet of [redacted]

3. Real time telemetry will be required for this project to provide Watts and VARs flow data from the generation facility to the SCE distribution system.

4. Non-binding order of magnitude cost estimates[1] for the required interconnection facilities and system upgrades are as follows:

Cost Estimate:

Distribution Upgrades	**$84.1 k**
Electrical Facilities:	$ 79.2 k
• [redacted]	
• [redacted]	
Real Properties	$ 4.9 k
Interconnection Facilities	**$95.6 k**
Electrical Facilities:	$ 86.6k
• [redacted]	
• [redacted]	
• [redacted]	
• [redacted]	
Real Properties	$ 9.0 k
Telemetry Requirements	**$ 14.5 k**[2]
ITCC (35%)	**$ 62.9 k**
Total non-binding order of magnitude cost estimate	**$ 257.1 k**

5. The time required to design and construct the Interconnection Facilities directly assigned to this project is approximately 9 months from execution of Generation Interconnection Agreement ("GIA") and the completion of the required milestones within it.

6. Upgrades identified are general and preliminary descriptions only. The costs indicated are

[1] The cost estimate does not include the costs required for civil work completed by the customer.
[2] The cost estimate is based on the centralized RTU method; the cost and scope of telemetry may significantly increase to include a dedicated RTU as required by SCE's Interconnection Handbook with an approximate cost of $155,000 in the event that the centralized RTU method is not feasible for this project.

non-binding order of magnitude only. The schedule is projected and preliminary.

7. Applicant is responsible for the installation of Underground Structures and conduits needed for the interconnection in accordance with SCE design.

8. A Facilities Study detailing required scope and cost of the identified upgrades may be completed prior to proceeding with the project.

9. This System Impact Study is based on various technical data previously provided by the applicant. If any of that information changes significantly, as determined by SCE, the results of this study may no longer be appropriate and may necessitate a new study.

10. Current distribution standards are being updated to address generation interconnection systems. The proposed method of service on this report may change according on final design to comply with the updated distribution design standards.

11. This report does not include all Real Properties evaluations and cost estimates. Where formal rights of way, easements, land leases, or permits are required by SCE for installation of facilities, on or over Applicant's property, or the property of others, the Applicant shall grant SCE the rights of way and easements for the electrical facilities.

12. For SCE facilities and scope of work not subject to CPUC's GO 131-D, SCE will follow the requirements of all applicable environmental laws and regulations and issue an in-house Environmental Clearance before commencement of construction activities. The cost estimates provided assume that SCE will provide oversight on facilities and scope of work on the customer's property and/or SCE will perform all required environmental activities for SCE facilities and scope of work, located outside of the customer's property, from the siting through the post-construction phases. However, it is recommended for SCE facilities and scope of work to be included in the Generator's Environmental Licensing and Permitting documents to streamline the environmental process and avoid unnecessary delays in construction. The responsibilities for performing certain environmental activities may be negotiated during or after the Interconnection Agreement process.

13. This study does not include costs associated with environmental studies which may be required for the licensing or permitting of the proposed generating facility.

14. This study does not consider potential milestone setbacks that could result from the local jurisdiction requiring underground construction of distribution facilities. SCE encourages the Interconnection Customer to consult with the local jurisdiction to identify existing underground ordinance to reduce the risk of complication associated with said ordinance.

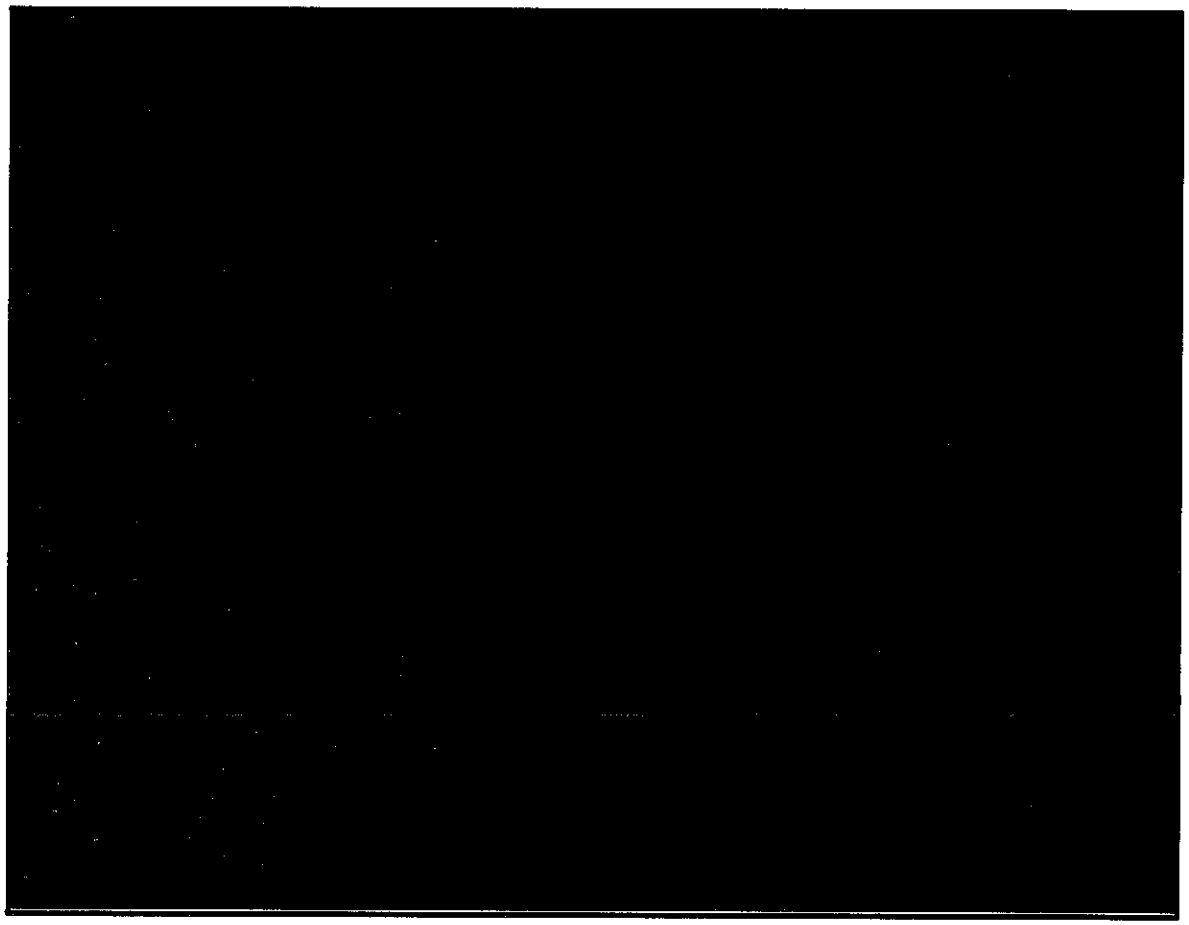
15. This study does not include analysis related to the following system variability conditions, et. al.
    a. Generator system start-up: Solar photovoltaic generator's increasing output profile during sunrise

b. Generator return-to-service: Solar photovoltaic generator's output profile following a system outage (faulted condition)
c. Generator output variability: Solar photovoltaic generator's output variation correlated with weather conditions, i.e. cloud cover

This study assumes that the Interconnection Customer's generating facility will include all equipment, software, and appropriate controls necessary to maintain the generator output profile per SCE requirements. The Interconnection Customer will be responsible for maintaining designated voltage levels under all conditions, including but not limited to the conditions identified above. Upon execution of the GIA, SCE will provide the Interconnection Customer with the required ramp rate control parameters. The ramp rate controls will be a function of the generation penetration on the distribution system, as well as SCE's distribution system configuration (additional parameters maybe considered, as need). Changes to the ramp rate control scheme may be required as determined by increased generation, changes in the distribution system topology, or other changes in the distribution system.

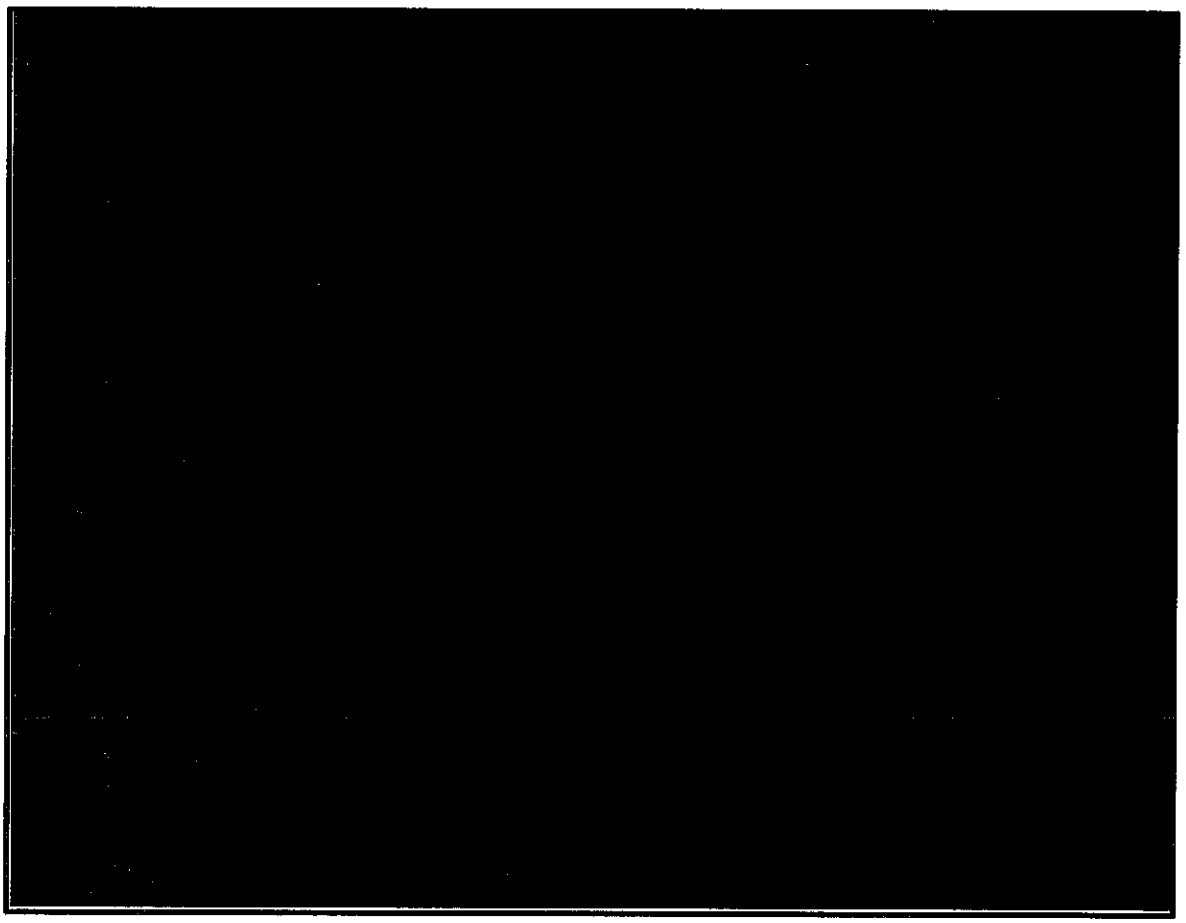
16. Applicable to projects requesting primary service: This study does not include analysis related to coordination of system protection equipment. A coordination study may be required during final engineering. The coordination study may identify additional interconnection requirements such as installing new protection equipment, reprogramming and/or relocating existing protection equipment. The additional scope of work may have an effect on the Interconnection Customer's requested in-service date.

Attachment A – A1



System without proposed project

Attachment A – A2



System with proposed method of service

Attachment B – B1

Transmission Assessment

ATTACHMENT B – BULK POWER SYSTEM IMPACT STUDY REPORT

CAISO Controlled Bulk System

Short Circuit Duty

Since the project [redacted] is connecting on the SCE distribution system [redacted] 12 kV circuit out of Carmenita 66 kV Substation on [redacted] 220/66 kV system) and the project consist of inverter facilities which have limited short-circuit duty contribution, the SCD analysis determined no impact on SCE's Metro Area bulk power system after inclusion of the project.

Power Flow Study

This project individually will not contribute to any power flow issues in the Metro Area bulk power system. The existing system has sufficient transmission capability to accommodate the project without any significant upgrades or modification to existing Special Protection Systems (SPS).