[redacted]

WDAT 290
SYSTEM IMPACT RE-STUDY

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EXECUTIVE SUMMARY

[redacted] applied to Southern California Edison ("SCE") for distribution service for its proposed Solar Project pursuant to SCE's Wholesale Distribution Access Tariff ("WDAT") Small Generator Interconnection Procedures. The customer proposed to convert their existing generating facilities from solar thermal synchronous generator technology to solar PV inverter technology. SCE concluded that the proposed changes did not constitute a material modification and a System Impact Re-Study was required to determine the required scope of work and the adequacy of SCE's electrical system, including, but not limited to, the portion of SCE's electrical system that is part of the ISO Grid. SCE performed a System Impact Re-Study as requested by [redacted] for a 12 kV interconnection and distribution service from an existing 12 kV distribution line ("Oban 12 kV") to the existing generating facilities located on the [redacted] in the city of Lancaster. The point of interconnection is to be located approximately [redacted] miles from the Lancaster Substation on the Oban 12 kV circuit out of SCE's Lancaster 66/12 kV Substation. The request is for a WDAT photovoltaic ("PV") generation facility with a total capacity of 7.5 MW. The project will consist of two generating tenants: "A" and "B". Tenant "A" will generate 3 MW and tenant "B" will generate 4.5 MW.

The new generation, consisting of two generating units' tenant "A" and tenant "B". Tenant "A" will consist of photovoltaic panels, [redacted] transformers. Each generating unit will receive interconnection service from SCE's existing 12 kV circuitry on the Oban 12 kV out of Lancaster Substation. To accomplish this, the following interconnection facilities upgrades are needed: a 12 kV primary underground line extension, from the existing SCE line to a new SCE owned four way pad mounted gas switch. From the gas switch, two positions will feed two underground 12 kV feeders to the applicant's two 12 kV switchgears. The generated power would be delivered to the California Independent System Operator ("CAISO") grid at the 66 kV bus of SCE's Antelope Substation.

The purpose of this System Impact Study is to determine the effect of the proposed generation addition on the SCE distribution system and the portion of SCE's electrical system that is part of the CAISO controlled grid, and to identify in general additional Interconnection Facilities, Distribution Upgrades, additions or modifications, 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 that part of the SCE distribution system energized at less than 66 kV and also briefly summarizes the results of Part B, while Part B (performed by SCE's Generation Interconnection Planning Department) examines impacts and facilities related to the portion of the SCE distribution system energized at 66 kV (the bulk power system), and impacts and facilities associated with the CAISO controlled portion of the SCE grid.

This study was performed for historic year 2015 peak load conditions as well as low demand conditions.

The System Impact Re-Study consisted of a power flow analysis, three-phase short circuit duty analysis and circuit voltage profile analysis. The analysis 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 66 kV bus of Antelope Substation without creating the need for modifications to SCE's distribution system and/or to the ISO grid. The study showed that, with the [redacted] Project on-line:

- For both peak load and light load conditions, the addition of the 7.5 MW [redacted] did not result in any violation of SCE's thermal loading criteria under base case and N-1 condition.

- The addition of the 7.5 MW [redacted] did not result in in additional protection requirements.

- The addition of the 7.5 MW [redacted] did result in voltage rise exceeding allowable Rule 2 limits.

- The addition of the 7.5 MW [redacted] resulted in the increase of three-phase short-circuit duties of 0.1kA or more at zero (0) 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.

NON-BINDING ORDER OF MAGNITUDE COST ESTIMATE

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

Cost Estimate

Distribution Upgrades	$ 49.2 K
• Bi directional watt transducer	
Distribution Upgrades One Time Costs	$ 35.5 K
• RTU point addition and programing	
Interconnection Facilities	$ 192.9 K
• Approximately 250 feet of 1000 JCN underground cable • One (1) 4 way pad mounted gas switch with automation • Approximately 250 feet of 350 JCN underground cable • Approximately 250 feet of 350 JCN underground cable • Two (2) 12 kV primary metering and associated wiring	
Telemetry Requirements One Time Costs[1]	$ 12.2 K
• Centralized RTU for Tennant A & Tennant B	
Corporate Environmental Health and Safety Review	$ 7.01 K
Real Properties	$ 8.4 K
Subtotal	$ 305.2 K
ITCC (22%)	$ 56.8 K
Total non-binding order of magnitude cost estimate	**$ 362.0 K**

[1] Cost Estimate based on 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 Centralized RTU method is not feasible for this project.

CONTENTS

I. INTRODUCTION TO PART A

[redacted] applied to Southern California Edison ("SCE") for distribution service for its proposed [redacted] pursuant to SCE's Wholesale Distribution Access Tariff ("WDAT") Small Generator Interconnection Procedures. The customer proposed to convert their existing generating facilities from solar thermal synchronous generator technology to solar PV inverter technology. SCE concluded that the proposed changes did not constitute a material modification and a System Impact Re-Study was required to determine the required scope of work and the adequacy of SCE's electrical system, including, but not limited to, the portion of SCE's electrical system that is part of the ISO Grid. SCE performed a System Impact Re-Study as requested by [redacted] for a 12 kV interconnection and distribution service from an existing 12 kV distribution line ("Oban 12 kV") to the existing generating facilities located on the [redacted] in the city of Lancaster. The interconnection is to be located approximately [redacted] miles from the Lancaster Substation on the Oban 12 kV circuit out of SCE's Lancaster 66/12 kV Substation. The request is for a WDAT photovoltaic ("PV") generation facility with a total capacity of 7.5 MW. The project will consist of two generating tenants: "A" and "B". Tenant "A" will generate 3 MW and tenant "B" will generate 4.5 MW.

CONCEPTUAL METHOD OF SERVICE

[redacted]

The new generation, consisting of two generating units' tenant "A" and tenant "B". Tenant "A" will consist of [redacted] Each generating unit will receive interconnection service from SCE's existing 12 kV circuitry on the Oban 12 kV out of Lancaster Substation. To accomplish this, the following interconnection facilities upgrades are needed: a 12 kV primary underground line extension, from the existing SCE line to a new SCE owned four way pad mounted gas switch. From the gas switch, two positions will feed two underground 12 kV feeders to the applicant's two 12 kV switchgears. The generated power would be delivered to the California Independent System Operator ("CAISO") grid at the 66 kV bus of SCE's Antelope Substation.

The purpose of this System Impact Study is to determine the effect of the proposed generation addition on the SCE distribution system and the portion of SCE's electrical system that is part of the CAISO controlled grid, and to identify in general additional Interconnection Facilities, Distribution Upgrades, additions or modifications, 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 that part of the SCE distribution system energized at less than 66 kV and also briefly summarizes the results of Part B, while Part B (performed by SCE's Generation Interconnection Planning Department) examines impacts and facilities related to the portion of the SCE distribution system energized at 66 kV (the bulk power system), and impacts and facilities associated with the CAISO controlled portion of the SCE grid.

This study was performed for historic year 2015 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 should not exceed 100% of its normal rated capacity with all facilities in service (base case).

The thermal rating of any conductor, connector, or apparatus should 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 improved to within WDAT requirements of 0.95 lagging or leading, except as specifically enumerated herein.

Expected loading on the distribution system as projected by the SCE 2015 plan year was used.

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.

Short circuit contribution from generation system provided by applicant includes contribution from inverter system.

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 system it was calculated that the short circuit contribution at 12 kV substation bus resulted in increases of three-phase and/or single-line-ground short-circuit duties by 0.1 kA or more at zero (0) distribution substations. The circuit breaker interrupting capabilities were reviewed at these substations and it was determined that zero (0) circuit breakers will be required to be upgraded as a result of the Project.

System Protection Considerations
With this proposed method of service, no changes to the protection system of the SCE electrical system are required.

Thermal Loading
The line section between the customer's facility and the 12 kV Point of Interconnection is expected to experience a reverse power flow of approximately 7.5 MW during minimum loading. Of that 7.5 MW, approximately 5.7 MW will flow back into the 12 kV bus at the Lancaster 66/12 kV Substation during minimum loading. No thermal overloads were calculated due to this reverse power flow under base case

Under emergency (N-1) conditions (loss of circuit), SCE may deem it necessary to isolate this project during N-1 conditions until the distribution system returns to normal conditions.

Under emergency (N-1) conditions (loss of B-bank), 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 12 kV Oban distribution line is expected to exceed the CPUC Rule 2 Voltage requirements under the generating facilities condition of maximum generation and unity power factor. The addition of the [redacted] project increased the voltage of the distribution system by 3.2%, which caused the system to exceed Rule 2 by 0.3%. This voltage rise could be mitigated by having the generator operate at a power factor of 0.99 lagging (consuming VARs) at the point

of interconnection as required by the WDAT tariff. A VAR schedule will be given once a Generating Interconnect Agreement is completed.

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 high 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 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. Since the THD values which were provided are for individual inverters and not for the total generation requested, it will be required to determine the total harmonic contribution for the entire generation facility prior to approving the generation to interconnect to the SCE distribution system. Given the amount of generation and the strength of the distribution system, SCE will not require a harmonic study but strongly encourages that the applicant completes a harmonic study during the Facility Study Phase. During the commissioning test of the generation system, SCE will be part of the commissioning test, install power quality equipment to verify that the total harmonic contribution from the generation system to the SCE meets the required standards. If during the commissioning test, it is found that the projects do not meet the harmonic standards, the project will not be allowed to interconnect to the SCE system until the harmonic deviations are rectified. Therefore, it is encouraged that the applicant completes a harmonic study during the Facility Study to insure that the harmonic requirements are met. 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. The distribution upgrades includes the installation of a bi directional watt transducer at the Lancaster substation in order to measure reverse real and reactive power flow (MW/MVAR).

Interconnection Facilities

Electrical Systems

Interconnection facilities will be required to interconnect the system. The interconnection facilities include the installation of the following: approximately 250 feet of 1000 JCN underground cable, a one (1) four way pad mounted gas switch with automation, one underground feeder with 250 feet of 350 JCN, one underground feeder with 250 feet of 350 JCN onto the applicant's two generating 12 kV switchgear, and 12 kV metering CT's and associated wiring to each of the customer switchgear.

Telemetry requirements

Real-time telemetry will be required utilizing SCE's centralized RTU method of Telemetry. Additional information on the proposed method of telemetry will be provided during results meeting. In the event that the centralized RTU method is not feasible for this project, the cost and scope of telemetry may increase significantly to include a

dedicated RTU as required by SCE's Interconnection Handbook. This alternate method of telemetry has an approximate cost of $155.0 k, including ITCC.

Customer Equipment

The interface protection will be provided by the applicant and will include a 12 kV circuit breaker which is to be installed on an applicant owned 12 kV switchgear. The applicant's protection must be coordinated with SCE's Lancaster Substation circuit breaker controls 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 switchgear must meet SCE's published Electrical Service Requirements ("ESR") to the extent applicable. Drawings required by the ESR shall be submitted, reviewed, modified, 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 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.

System Study

A Facilities Study can be performed at the customer's request 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 for the required interconnection facilities and 12 kV system upgrades are as follows

Cost Estimate

Distribution Upgrades	$ 49.2 K

- Bi directional watt transducer

Distribution Upgrades One Time Costs	$ 35.5 K

- RTU point addition and programing

Interconnection Facilities	$ 192.9 K

- Approximately 250 feet of 1000 JCN underground cable
- One (1) 4 way pad mounted gas switch with automation
- Approximately 250 feet of 350 JCN underground cable

- Approximately 250 feet of 350 JCN underground cable
- Two (2) 12 kV primary metering and associated wiring

Telemetry Requirements One Time Costs[1]	$ 12.2 K
• Centralized RTU for Tennant A & Tennant B	
Corporate Environmental Health and Safety Review	$ 7.01 K
Real Properties	$ 8.4 K
Subtotal	$ 305.2 K
ITCC (22%)	$ 56.8 K
Total non-binding order of magnitude cost estimate	**$ 362.0 K**

VI. PART A: SUMMARY

The System Impact Study showed:

1. Distribution upgrades include the installation of a bi directional watt transducer.

2. The interconnection facilities include the installation of the following: approximately 250 feet of 1000 JCN underground cable, one (1) four way pad mounted gas switch with automation, one underground feeder with 250 feet of 350 JCN, one underground feeder with 250 feet of 350 JCN onto the applicant's two generating 12 kV switchgear, and 12 kV metering, CT's and associated wiring to each of the customer switchgear.

3. Real time telemetry is required for this project.

4. The preliminary, non-binding estimated time to complete the construction of the required interconnection facilities and distribution upgrades is 18 months of executing a Small Generator Interconnection Agreement ("SGIA") and associated Distribution Service Agreement.

5. Upgrades identified are general and preliminary descriptions only. The costs indicated are non-binding order of magnitude only. The schedule is projected and preliminary.

6. A facilities Study can be performed at the customer's request to conclusively determine the detailed scope and cost of facilities required to interconnect the project.

7. This System Impact Re-Study is based on various technical data previously provided by

[1] Cost Estimate based on 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 Centralized RTU method is not feasible for this project.

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.

8. 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.

9. The final design of the proposed method of service in this report may change to comply with the updated distribution design standards.

10. This study does not include analysis related to the power output rate of change that may occur due to the following or other conditions;

    1. System morning start up for solar systems. That is when each morning the generating facility commences to generate and export electrical energy to the distribution system.
    2. Cloud Cover. Solar generating facilities have significant generation output variation (***Variability***) which can have an impact on distribution system voltage profiles.

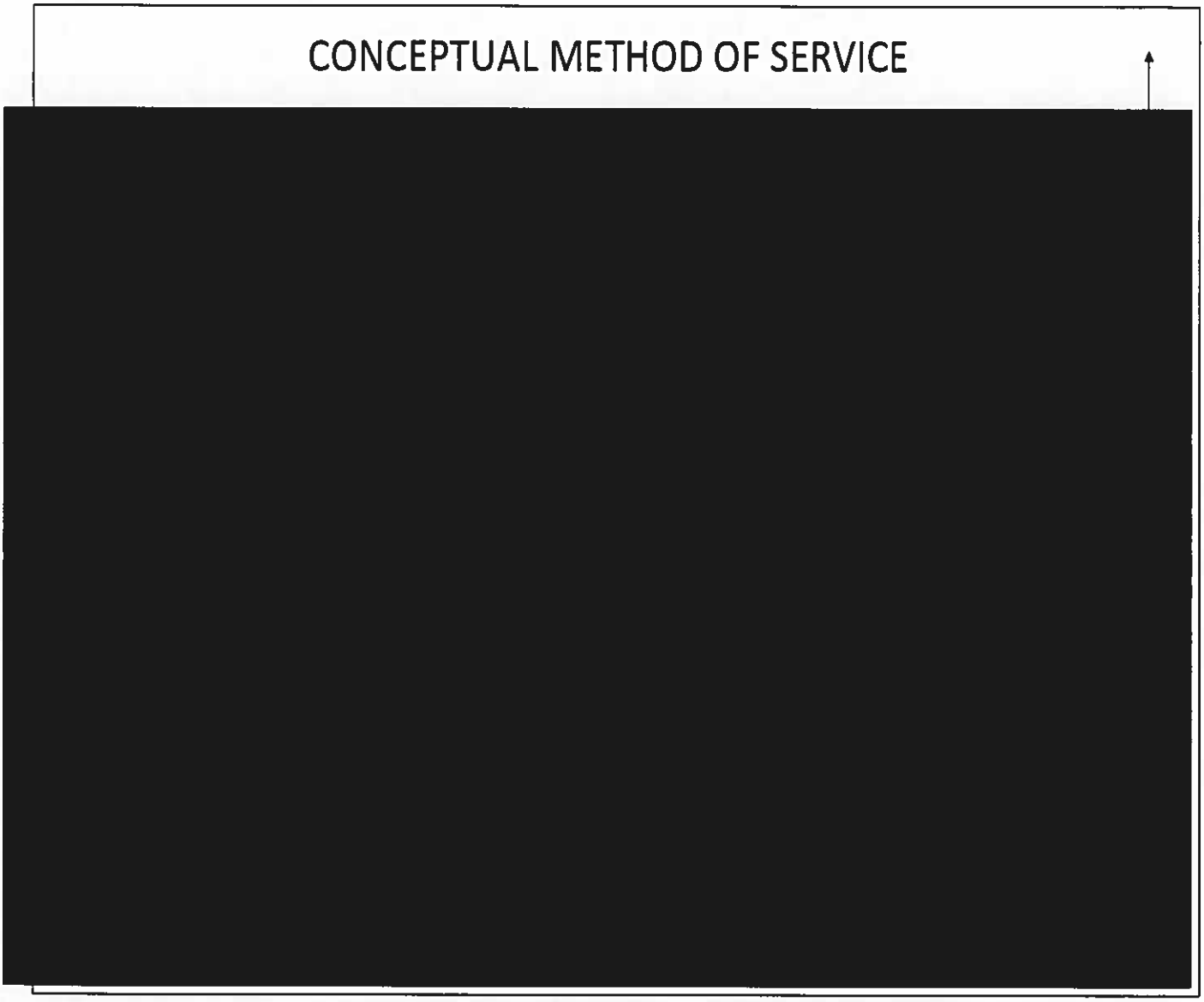
    The study assumes the customer's generating facility will have equipment, software and the appropriate controls in place to be able to control the generation output rates of change as specified by SCE in order to maintain appropriate voltage levels under all conditions including, but not limited to, the conditions identified above. Upon execution of the appropriate Generation Interconnection Agreement, SCE will provide the Interconnection Customer 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 but other parameters may be considered. Therefore, changes to the ramp rate control scheme may be required from time to time as required by increases in generation, changes in the distribution system topology, or other changes in the distribution system.

11. 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.

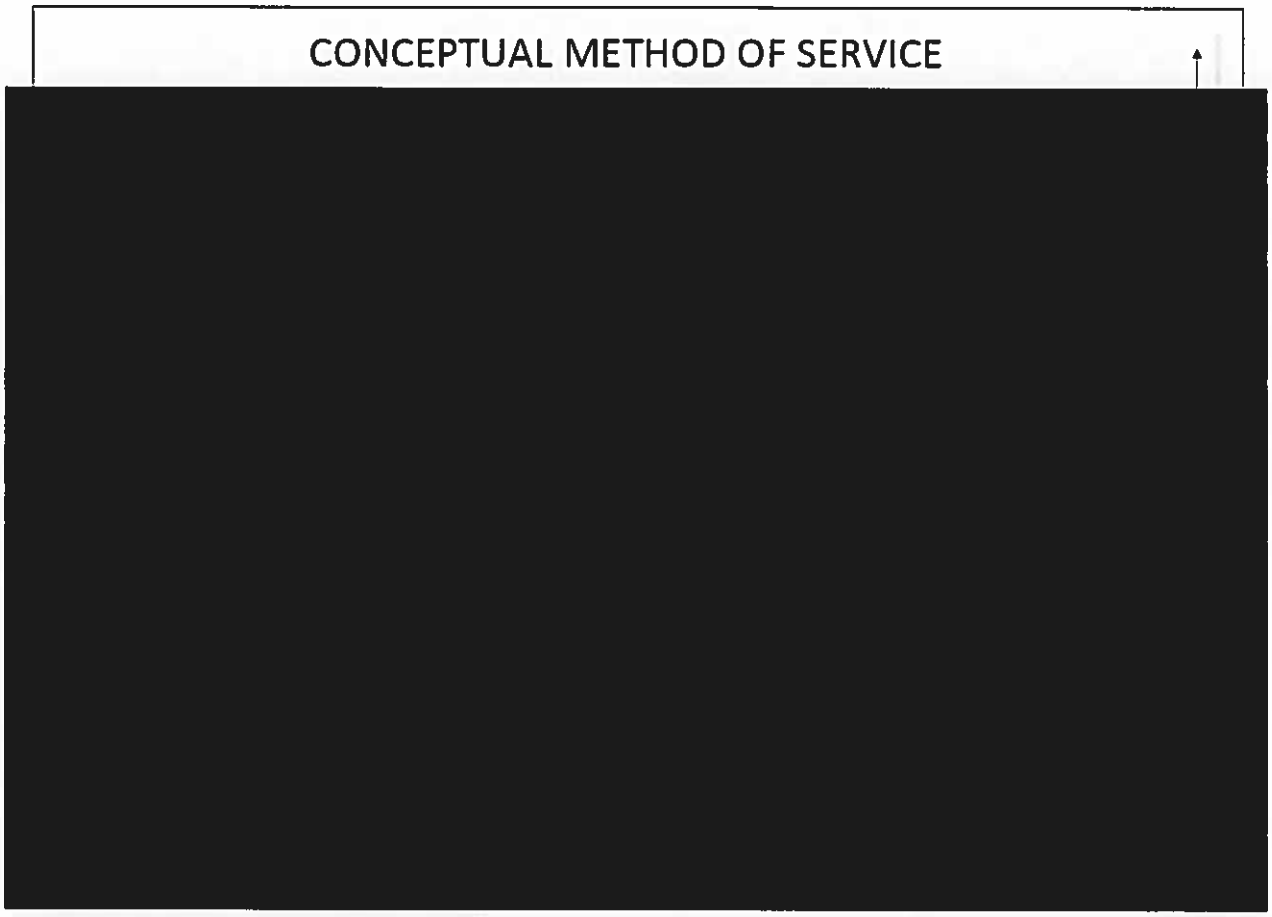
12. This study does not consider potential milestone setbacks that could result from the local jurisdiction requiring underground construction of distribution facilities. SCE encourages the Interconnection Customer to consult with the local jurisdiction to identify existing underground ordinance to reduce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

13. 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.

A1 - System without Proposed Project



A2 - System with Proposed Method of Service



ATTACHMENT B

(Transmission Assessment)

CAISO Controlled Bulk System

- Short Circuit Duty

Based on the technical data provided, the project results in a reduction to SCD contributions. Consequently, the project does not have a material impact on SCE's Subtransmission or Transmission System.