[redacted]

[redacted]

WDAT 603

WDAT
SYSTEM IMPACT STUDY

January 27, 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] ("Project") pursuant to SCE's Wholesale Distribution Access Tariff ("WDAT") Small Generator Interconnection Procedures. SCE performed a System Impact Study as requested by [redacted] for a 66 kV interconnection and distribution service from an existing 66 kV bus. The interconnection is to SCE's Vestal 220/66 kV Substation at the 66 kV bus via an applicant owned 66 kV Interconnection Switchyard, which will be located approximately 3.6 miles northeast of the Vestal 220/66 kV Substation, and a 66 kV generation tie-line. The request is for a WDAT photovoltaic ("PV") generation facility with a total capacity of 15 MW. The assigned WDAT number for this project is WDAT 603, with a requested in-service date of January 1, 2015.

The new generation project consists of photovoltaic cell panels, [redacted] The proposed project would receive interconnection service from a new SCE 66 kV circuitry out of Vestal Substation via an underground and overhead line extension. The generated power would be delivered to the California Independent System Operator ("CAISO") grid at the 220 kV bus of SCE's Vestal 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 220 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 electrical system energized at 220 kV and above (the bulk power system), and impacts and facilities associated with the CAISO controlled portion of the SCE grid. This is the Part A study report; a detailed report of the Part B study results is included as Attachment B.

The Part A study was performed for expected year 2013 through 2022 projected peak load conditions as well as 2013 through 2022 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 Project can be transmitted through SCE's distribution system to the ISO grid at the 220 kV bus of Vestal Substation without creating the need for modifications to SCE's distribution system and/or to the ISO grid. The study showed that, with the Project on-line:

- Based on the requested 66 kV service line, the addition of the Project resulted in no inadequacies in the protection of the distribution system.

- Based on the new proposed method of service, under both peak load and light load conditions, the addition of the Project resulted in no violations of SCE's thermal loading criteria under base case and N-1 conditions for the SCE distribution system.

- Based on the new proposed method of service, the addition of the Project resulted in voltage rise. However, it did not exceed allowable Rule 2 limits.

- Based on the new proposed method of service, the addition of the Project resulted in increases of three phase short circuit duties by 0.1kA or more at one (1) distribution substation. Therefore, the circuit breaker interrupting capabilities were reviewed at that substation and it was determined that zero (0) circuit breakers are required to be upgraded as part of the Project.

- The Transmission Assessment has determined that under realistic minimum load conditions (based on historic load) at Vestal, Rector, and Springville substations, additional queued generation requesting interconnection in the North of Magunden area will cause excessive transmission congestion on the South of Magunden transmission facilities. Based on the current queue, curtailment of generation will be required. For more details see Attachment B.

- Non-binding order of magnitude cost estimates[1,2] for the required interconnection facilities and 66 kV system upgrades are as follows:

Case A is the cost estimate for interconnection facilities and distribution upgrades which are required to interconnect the proposed Project to the Vestal 66 kV bus taking into account the required interconnection facilities and distribution upgrades triggered by generation projects ahead in the queue.

Case B is the cost estimate for the interconnection facilities and distribution upgrades which could be triggered by this Project, **in addition to Case A**, in the event that changes to the queue (i.e. withdrawals by earlier-queued projects) occur. If changes in the queue occur, a re-study would be necessary, and such re-study may determine that this Project would be responsible for the Case B costs. Furthermore, the Case B cost includes the cost for interconnection facilities that are expected to be shared with the WDT390, WDT394 and/or WDT439 projects ahead in queue. This Project will be responsible for its pro-rata cost share of these common interconnection facilities.

Case A:

Distribution Upgrades	$ 35.5 k
Interconnection Facilities	$ 33.8 k
Real Properties	$ 29.9 k
Telemetry Requirements	$ 49.4 k

[1] Cost estimate does not include the costs required for civil work completed by the customer.
[2] Cost Estimates are in 2014 Constant dollars.

ITCC (35%)	$ 39.6 k
Total non-binding order of magnitude cost estimate	$188.1 k

Case B:

Higher queued Vestal 66 kV Substation and 66 kV lines upgrades	$7.866 M

Note: The Project may be required to advance the costs of the Case B facilities depending on the operation date of the Project and any queued project requiring such facilities.

CONTENTS

I. INTRODUCTION TO PART A

[redacted] applied to Southern California Edison ("SCE") for interconnection and wholesale distribution service for its proposed [redacted] ("Project") pursuant to SCE's Wholesale Distribution Access Tariff ("WDAT") Small Generator Interconnection Procedures. SCE performed a System Impact Study as requested by [redacted] for a 66 kV interconnection and distribution service from an existing 66 kV bus. The interconnection is to SCE's Vestal 220/66 kV Substation at the 66 kV bus via an applicant owned 66 kV Interconnection Switchyard, which will be located approximately 3.6 miles northeast of Vestal 220/66 kV Substation, and a 66 kV generation tie-line. The request is for a WDAT photovoltaic ("PV") generation facility with a total capacity of 15 MW. The assigned WDAT number for this project is WDAT 603, with a requested in-service date of January 1, 2015.

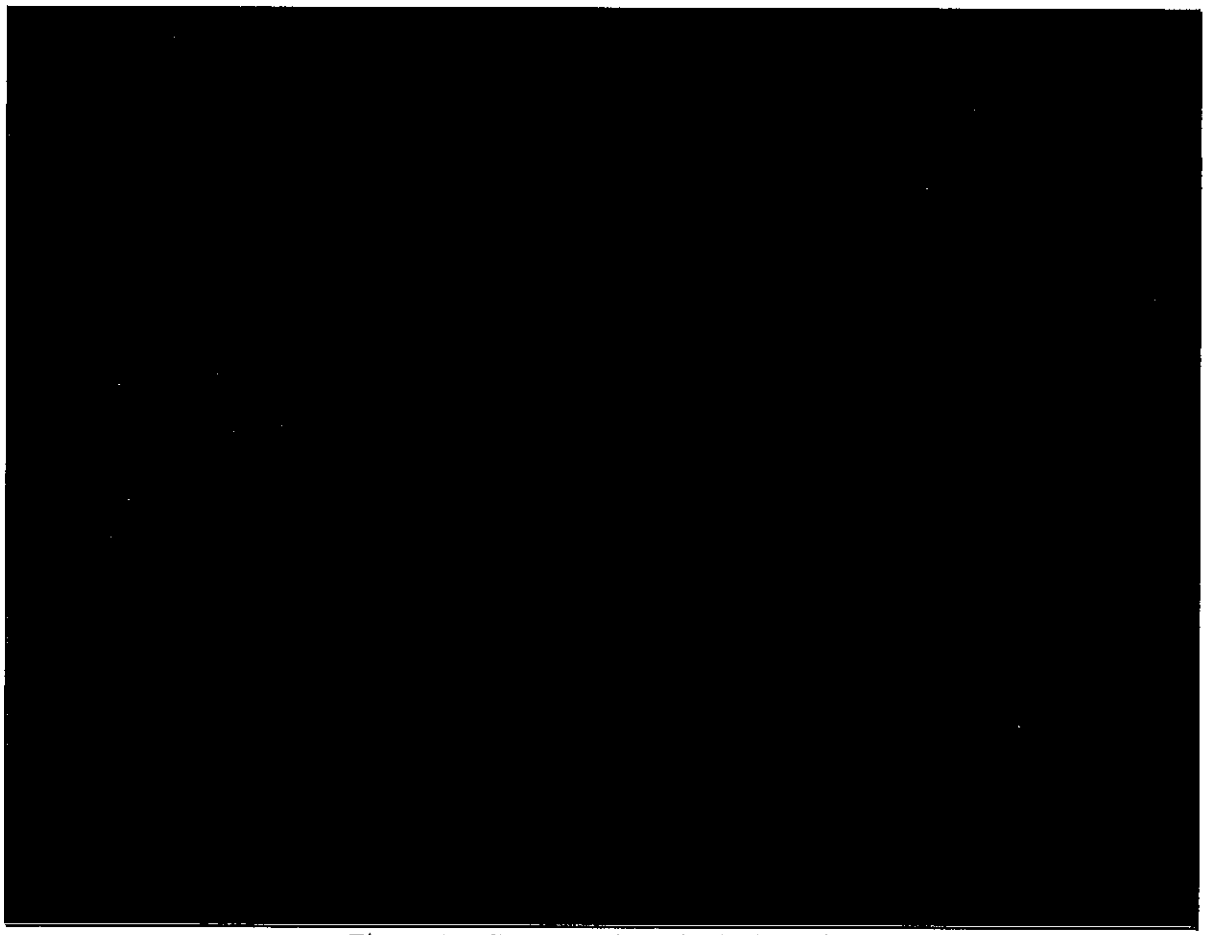

Figure 1 – Conceptual Method of Service

The new generation project consists of [redacted] The proposed project would receive interconnection service from a new SCE 66 kV circuitry out of Vestal Substation via an underground and overhead line extension. The generated power would be delivered to the California Independent System Operator ("CAISO") grid at the 220 kV bus of SCE's Vestal Substation.

The purpose of this System Impact 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 2013 through 2022 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 2013 - 2022 plan was used.

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

The Short circuit contribution from the inverter systems was determined using inverter manufacturer datasheets.

Upgrades previously identified as required by higher queued projects are assumed to be in service. Specifically, the completion of the source line identified on WDAT 390 Facility Report will have to be in-service prior to the completion of this project.

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 one (1) 66 kV substation buses were more than 0.1kA thus a breaker analysis was required due to this generation. The circuit breaker analysis concluded that zero (0) 66 kV breakers replacements are required as part of the Project.

System Protection Considerations

The study did not identify in any inadequacies in the protection system of the SCE electrical system, with the addition of the Project. Further analysis during the Facility Study and or

engineering may identify additional protection requirements in order to interconnect the proposed project to the SCE 66 kV distribution system.

Thermal Loading

With the addition of the Project, the sections of the new 66 kV line and the 66 kV bus at Vestal 220/66 kV Substation is expected to experience an aggregate total, of all generation, reverse power flow of approximately 74.7 MW, during minimum loading and unity power factor. No overload is calculated due to this reversal of power flow under base case and N-1 conditions.

With the inclusion of the Project, there is total of 338.7 MW of generation interconnection requests at the Vestal System. The Project study results indicated that without both SCE sponsored 220/66 kV A-bank replacement upgrades at Vestal Substation to provide the capacity needed to accommodate the Project's interconnection requests, the maximum Vestal 66 kV system capability is limited to less than 200 MW. The SCE replacement program is scheduled to upgrade one A-Bank in 2014 and the other in 2016. Therefore, generation curtailments would be required due to this system capacity limitation until the A-bank replacements are complete and in-service.

Distribution Voltage Control

The 66 kV distribution lines network and the bus at Vestal are expected to experience voltage rise. However, the voltage rise would not exceed the allowable CPUC Rule 2 requirements as a result to the addition of the Project under the generating facilities conditions of maximum generation and unity power factor. However, the Project must have the ability to operate at power factor range of 95% leading and lagging as required in the WDAT tariff.

Harmonic impact

The harmonic impact of the subject inverter based generation was not studied, however, despite the relatively low THD (<3%) of the equipment, impacts on voltage distortion levels are believed to be possibly 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 installation will be subject to the provisions of Rule 2.E, allowing SCE to require customer mitigation of interference with SCE service, including harmonic impacts, should interference occurs. The provided THD values are for individual inverters and not for the total generation requested. In order to better establish whether mitigation will be required in this case, a harmonic impact study is encouraged to be provided to SCE by the Interconnection Customer. Interconnection Customer is encouraged to commission such a study, discuss study structure with SCE prior to commencing study, and provide results to SCE with adequate lead time for SCE to direct any needed mitigation prior to detailed project design and construction.

SCE notes that the allowed harmonic voltage distortion limits on the distribution system are the product of the impacts of all customers' equipment, not the limit to be applied to each individual installation.

IV. PART A: GENERAL DESCRIPTION OF IDENTIFIED UPGRADES

Distribution Upgrades

Distribution Upgrades include point additions at Vestal Substation. The cost estimate for the required interconnection facilities is $35.5 k.

Interconnection Facilities
Interconnection facilities include installing a SCE revenue meter. The cost estimate for the required interconnection facilities is $33.8 k.

Real Properties
Real Properties include Access Easement for the Interconnection Facilities. The cost estimate for Real Properties is $29.9 k.

Telemetry requirements
Real-time telemetry will be required. In order to meet the telemetry requirements, an RTU will be installed at the Project's Interconnection Switchyard. The cost estimate required by PSC and Telecom is $49.4 k.

Customer Equipment
The interface protection will be provided by the applicant and will include a 66 kV Interconnection Switchyard. The applicant's protection must be coordinated with SCE's System 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 service.

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 is required 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[3,4] for the required interconnection facilities and 66 kV system upgrades are as follows:

Case A is the cost estimate for interconnection facilities distribution upgrades which are required to interconnect the proposed Project to the Vestal 66 kV bus taking into account the required interconnection facilities and distribution upgrades triggered by generation projects ahead in the queue.

Case B is the cost estimate for the interconnection facilities and distribution upgrades which could be triggered by this Project, **in addition to Case A**, in the event that changes to the queue (i.e. withdrawals of earlier-queued projects) occur. If changes in the queue occur, a re-study would be necessary, and such re-study may determine that this Project would be responsible for the Case B costs. Furthermore, the Case B cost includes the cost for interconnection facilities that are expected to be shared with the WDT390, WDT394 and/or

[3] Cost estimate does not include the costs required for civil work completed by the customer.
[4] Cost Estimates are in 2014 Constant dollars.

WDT439 projects ahead in queue. This Project will be responsible for its pro-rata cost share of these common interconnection facilities.

Case A:

Distribution Upgrades	$ 35.5 k
Interconnection Facilities	$ 33.8 k
Real Properties	$ 29.9 k
Telemetry Requirements	$ 49.4 k
ITCC (35%)	$ 39.6 k
Total non-binding order of magnitude cost estimate	$188.1 k

Case B:

Higher queued Vestal 66 kV Substation and 66 kV lines upgrades	$7.866 M

Note: The Project may be required to advance the costs of the Case B facilities depending on the operation date of the Project and any queued project requiring such facilities.

VI. PART A: SUMMARY

The Part A System Impact Study showed:

1. Distribution Upgrades include point additions at Vestal Substation.
2. Interconnection facilities include installing a SCE Revenue meter.
3. Real time telemetry will be required.
4. Non-binding order of magnitude cost estimates[5,6] for the required interconnection facilities and 66 kV system upgrades are as follows:

Case A:

Distribution Upgrades	$ 35.5 k
Interconnection Facilities	$ 33.8 k
Real Properties	$ 29.9 k
Telemetry Requirements	$ 49.4 k

[5] Cost estimate does not include the costs required for civil work completed by the customer.
[6] Cost Estimates are in 2014 Constant dollars.

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Case B:

Higher queued Vestal 66 kV Substation and 66 kV lines upgrades	$7.866 M

5. Interconnection service and distribution service pursuant to the WDAT would be expected to commence within 24-30 months of executing a Small Generator Interconnection Agreement ("SGIA") and associated Distribution Service Agreement.

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

7. A Facilities Study detailing required scope and cost of the identified upgrades is required to proceed with the project.

8. 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.

9. The System Impact Study is based on applicant's queue position. Additional studies may be needed if any changes occur in the projects ahead in the queue.

10. Current distribution standards are being updated to address generation interconnection systems. The proposed method of service in this report is subject to change during final design to comply with the updated distribution design standards.

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

12. This study assumes that all easements required for the construction of Distribution Upgrades and/or Interconnection Facilities will be secured in a timely manner to accommodate the requested in-service date.

13. This report 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.

14. This study does not include analysis related to the following system variability conditions, et. al.

    a. Generator ramp rate: Solar photovoltaic generator's increasing output profile during sunrise, i.e. system start-up

    b. Generator output variability: Solar photovoltaic generator's output variation correlated with weather conditions, i.e. cloud cover

15. 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. 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 with Proposed Method of Service

Attachment B

Transmission Assessment