

WDAT 761 ISP

***WDAT
INDEPENDENT SYSTEM IMPACT STUDY***

December 13, 2011



SOUTHERN CALIFORNIA
EDISON
An EDISON INTERNATIONALSM Company

Prepared by:

*Edgar Ramirez
Roger Salas, P.E.
Distribution Field Engineering*

Approved by:

*By Email
Russ Ragsdale
Distribution Field Engineering Manager*

SOUTHERN CALIFORNIA EDISON COMPANY

EXECUTIVE SUMMARY

[REDACTED] applied to Southern California Edison ("SCE") for interconnection and wholesale distribution service for its proposed Solar Project pursuant to SCE's Wholesale Distribution Access Tariff ("WDAT") Generation Interconnection Procedures.

On March 8, 2010, SCE completed and issued a System Impact Study to [REDACTED] for [REDACTED]. The SIS study was for a 3.0 MW generation facility connecting to an existing 12 kV distribution line ("Warm Creek 12 kV"). The generation facility will be interconnected to SCE's distribution system on [REDACTED].

On May 24, 2011, SCE completed and issued a Facility Study to [REDACTED] for [REDACTED]. The Facility study was for a 3.0 MW generation facility connecting to an existing 12 kV distribution line ("Warm Creek 12 kV").

On March 31, 2011, [REDACTED] applied for an expansion of [REDACTED]. The expansion is for 0.5 MW ([REDACTED] ISP) for a total of 3.5 MW that was requested to be studied under SCE's WDAT Independent Study Process.

SCE performed an Independent System Impact Study as requested by [REDACTED] for the expansion of 0.5 MW to its existing [REDACTED] generation project. This interconnection will utilize the existing 12 kV switchgear currently serving [REDACTED] SPVP 028 which is planning to be connected to the existing Warm Creek 12 kV distribution line out of Cardiff 66/12 kV Substation. The request is for service to commence by [REDACTED].

The expansion in generation, consisting of photovoltaic panels, [REDACTED] inverters, and [REDACTED] transformers, would receive interconnection service from SCE's existing 12 kV circuitry on the Warm Creek 12 kV out of Cardiff Substation via an underground line extension to the interconnection facility. The generated power would be delivered to the California Independent System Operator ("CAISO") grid at the 220 kV bus of SCE's San Bernardino Substation.

The purpose of this Independent 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 electrical system energized at 66 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 2011 through 2020 projected peak load conditions as well as 2011 through 2020 minimum load conditions.

The Part A Independent System Impact Study consisted of a power flow analysis, three-phase short circuit duty analysis based on most current thevenin equivalents and circuit voltage profile analysis. The analyses were performed to determine whether the energy associated with the [REDACTED] project can be transmitted through SCE's distribution system to the ISO grid at the 220 kV bus of San Bernardino 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 expansion of the 0.5 MW [REDACTED] project resulted in no violations of SCE's thermal loading criteria under base case conditions for the SCE distribution System.
- The expansion of the 0.5 MW [REDACTED] to [REDACTED] project resulted in minimal voltage rise not exceeding allowable Rule 2 limits.
- The expansion of the 0.5 MW [REDACTED] to [REDACTED] project resulted in the increase of three phase short circuit duty at one (1) distribution substation. The circuit breaker interrupting capabilities were reviewed at these substation and it was determined that zero (0) circuit breakers will be required to be upgraded based on most current thevenin equivalents. The final results and financial responsibilities will be determined on the Cluster study process in accordance to the WDAT ISP study procedures.
- Since the project is connecting on the SCE distribution system and the project consist of inverter facilities which have limited short-circuit duty contribution, the SCD analysis determined there were no impacts on SCE's transmission-voltage bulk power system due to the addition of this generation project.
- The power flow study results did not identify any impact on SCE bulk system serving the subtransmission system where the project is interconnected. In addition, the study identified that the inclusion of the project did not require any modification to existing Special Protection System (SPS).

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

Distribution Upgrades

Bi-directional Transducer	\$65.0 K ^{1,2}
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Interconnection Facilities

No Interconnection Facilities Requires	\$0 K
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<u>Total non-binding order of magnitude cost estimate</u>	\$65.0 K
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¹ Final breaker analysis and cost responsibility will be conducted under the cluster process in accordance with WDAT ISP

² This requirement will not prevent the project for being interconnected to the distribution system if adequate arrangements are made in the interconnection agreement to fund this scope of work

CONTENTS

	<u>PAGE</u>
I. INTRODUCTION TO PART A	6
II. PART A: INDEPENDENT SYTEM IMPACT STUDY CONDITIONS & METHODOLOGY	7
III. PART A: INDEPENDENT SYSTEM IMPACT STUDY RESULTS	7
IV. PART A: GENERAL DESCRIPTION OF IDENTIFIED UPGRADES	9
V. PART A: NON-BINDING ORDER OF MAGNITUDE COST ESTIMATE	10
VI. PART A: SUMMARY	11
Attachment A: Part A: SYSTEM DIAGRAMS	
• A1 – System without proposed project	
• A2 – System with proposed method of service	

I. INTRODUCTION TO PART A

[REDACTED] applied to Southern California Edison ("SCE") for interconnection and wholesale distribution service for its proposed Solar Project pursuant to SCE's Wholesale Distribution Access Tariff ("WDAT") Generator Interconnection Procedures.

On March 8, 2010, SCE completed and issued a System Impact Study to [REDACTED] for [REDACTED]. The SIS study was for a 3.0 MW generation facility connecting to an existing 12 kV distribution line ("Warm Creek 12 kV"). The generation facility will be interconnected to SCE's distribution system on [REDACTED].

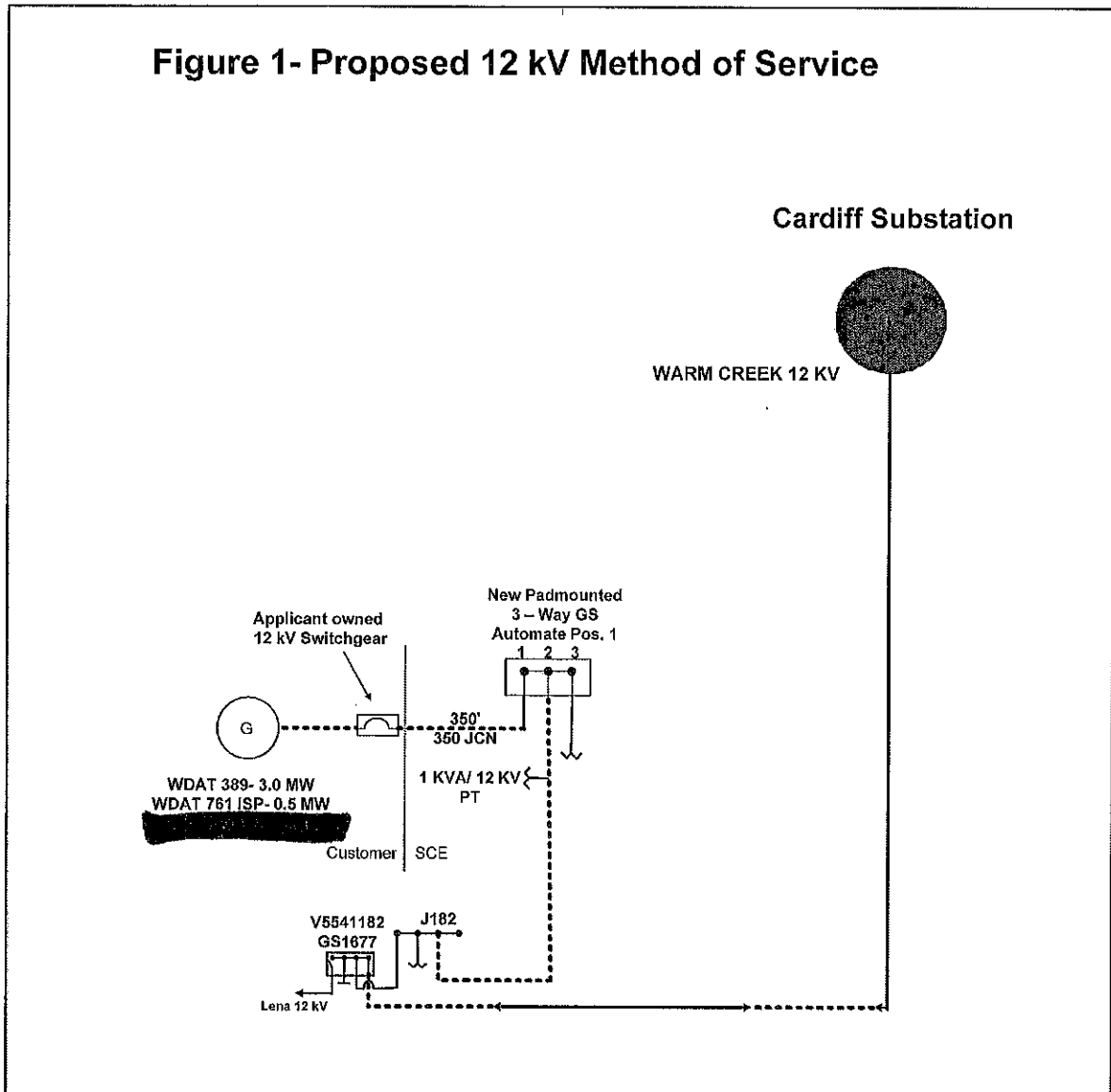
On May 24, 2011, SCE completed and issued a Facility Study to [REDACTED] for [REDACTED]. The Facility study was for a 3.0 MW generation facility connecting to an existing 12 kV distribution line ("Warm Creek 12 kV").

On March 31, 2011, [REDACTED] applied for an expansion of [REDACTED]. The expansion is for 0.5 MW (WDAT761 ISP) for a total of 3.5 MW that was requested to be studied under SCE's WDAT Independent Study Process.

SCE performed an Independent System Impact Study as requested by [REDACTED] for the expansion of 0.5 MW to its existing [REDACTED] generation project. This interconnection will utilize the existing 12 kV switchgear currently serving [REDACTED] SPVP 028 which is planning to be connected to the existing Warm Creek 12 kV distribution line out of Cardiff 66/12 kV Substation. The request is for service to commence by [REDACTED].

The expansion in generation, consisting of photovoltaic panels, [REDACTED] inverters, and [REDACTED] kV transformers, would receive interconnection service from SCE's existing 12 kV circuitry on the Warm Creek 12 kV out of Cardiff Substation via an underground line extension to the interconnection facility. The generated power would be delivered to the California Independent System Operator ("CAISO") grid at the 220 kV bus of SCE's San Bernardino Substation.

Figure 1- Proposed 12 kV Method of Service



The purpose of this Independent 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 2011 through 2020 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 within WDAT requirements of 0.95 lagging or leading.

Expected loading on the distribution system as projected by the SCE 2011 - 2020 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.

Thevenin equivalents for this study are based on most current thevenin equivalents. Final Short circuit study and cost responsibilities for breaker upgrades will be conducted in the cluster process in accordance with WDAT ISP.

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) 12 kV substation bus was more than 0.1 kA; thus a breaker analysis was required due to this generation. The circuit breaker analysis concluded that zero (0) 12 kV breakers replacements are required as part of this 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 0.5 MW during minimum loading. Of that 0.5MW, approximately 0 MW will flow back into the 12 kV bus at Cardiff 66/12 kV Substation during minimum loading due to the absorption of the power flow by the local load. In aggregate to existing generation projects ahead of the queue, approximately 1.6 MWs of generation will flow into the 12 kV bus at Cardiff 66/12kV substation. Thus, due to power flow going back to the 12 kV bus at Cardiff, the installation of one 3-Phase Bi-directional WATT Transducer will be required to monitor this reverse power¹.

¹ This requirement will not prevent the project for being interconnected to the distribution system if adequate arrangements are made in the interconnection agreement to fund this scope of work

Distribution Voltage Control

The Warm Creek 12 kV circuit is not expected to experience a voltage rise exceeding allowable Rule 2 requirements, from the controlled voltage at Cardiff 12 kV bus.

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 prior to interconnection.

IV. PART A: GENERAL DESCRIPTION OF IDENTIFIED UPGRADES

Distribution Upgrades

Distribution Upgrades are not required to interconnect this generation facility. Distribution upgrades include the installation of one 3-phase Bi-directional Transducer. The cost estimate for the required distribution upgrades are \$65.0 K.

Interconnection Facilities

Interconnection Facilities are not required to interconnect this generation facility.

Customer Equipment

The interface protection will be provided by the applicant and will include a 12 kV circuit breaker which is to be installed at the applicant-owned 12 kV switchgear. The applicant's protection has been coordinated with SCE's Cardiff Substation circuit breaker controls to provide adequate protection for the distribution system. The relay settings have been reviewed and approved by SCE and a certified timed trip testing report was provided to SCE prior to energizing the switchgear.

The switchgear met SCE's published Electrical Service Requirements ("ESR. Drawings required by the ESR shall where submitted, reviewed, modified, and approved by SCE prior to release for fabrication/purchase of the equipment.

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.

The applicant was responsible for the installation and costs of underground facilities (i.e., ducts, structures, etc.) to the extent required by the final design. The construction of the underground facilities were constructed per SCE's project drawings.

Independent System Study

An Independent Facilities Study will NOT be required as there are no additional facilities needed to be installed in order to allow the expansion project to interconnect.

V. 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:

Distribution Upgrades

Bi-directional Transducer	\$65.0 K ^{1,2}
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Interconnection Facilities

No Interconnection Facilities Required	\$ 0.0 K
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Total non-binding order of magnitude cost estimate	\$65.0 K
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¹ Final breaker analysis and cost responsibility will be conducted under the cluster process in accordance with WDAT ISP

² This requirement will not prevent the project for being interconnected to the distribution system if adequate arrangements are made in the interconnection agreement to fund this scope of work

VI. PART A: SUMMARY

The Part A Independent System Impact Study showed:

1. Distribution upgrades will be required for this project. Distribution upgrades include the installation of one 3-phase Bi-directional Transducer.
2. Interconnection facilities will not be required to interconnect the generation system.
3. Real time telemetry will be required. RTU and DGP installed under WDAT 389 will be used to provide the telemetry requirements.
4. Non-binding order of magnitude cost estimates for the required interconnection facilities and system upgrades are as follows:

System Upgrades and Interconnection Facilities are as follows:

Distribution Upgrades	\$65.0 K ^{1,2}
Interconnection Facilities	\$ 0.0 K
<hr/>	
Total non-binding order of magnitude cost estimate	\$65.0 K

5. This Independent 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.
6. The Independent 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.
7. Final breaker analysis and cost responsibility will be conducted under the cluster process in accordance with WDAT ISP

¹ Final breaker analysis and cost responsibility will be conducted under the cluster process in accordance with WDAT ISP

² This requirement will not prevent the project for being interconnected to the distribution system if adequate arrangements are made in the interconnection agreement to fund this scope of work

ATTACHMENT B – BULK POWER SYSTEM IMPACT STUDY REPORT

CAISO Controlled Bulk System

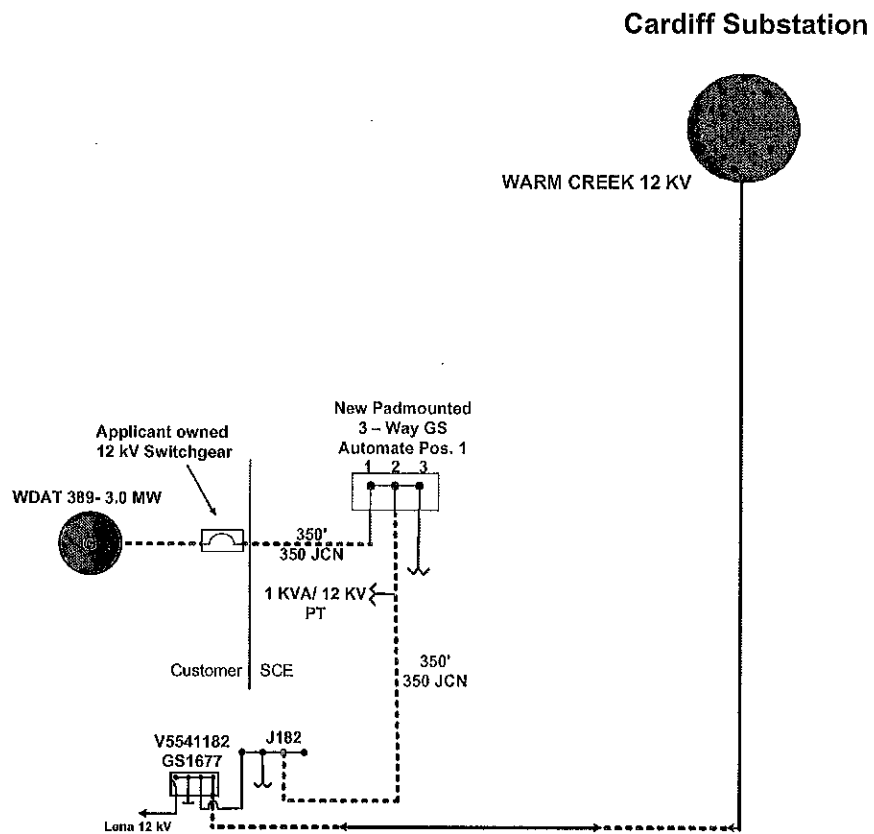
Short Circuit Duty

Since the project is connecting on the SCE distribution system and the project consist of inverter facilities which have limited short-circuit duty contribution, the SCD analysis determined no impact on SCE's high-voltage bulk power system after inclusion of the project.

Power Flow Study

The power flow study analysis focus on identifying system thermal overload problems within SCE bulk system due to the project addition. The power flow study results showed no system thermal loading impact to SCE bulk system serving the subtransmission system where the project is interconnected. In addition, the study identified that the inclusion of the project didn't require any modification to existing Special Protection System (SPS).

System without Proposed Method of Service



System with Proposed Method of Service

Cardiff Substation

