



***WDAT 887 ISP***

***WDAT  
INDEPENDENT SYSTEM IMPACT STUDY***

***July 19, 2012***



**SOUTHERN CALIFORNIA  
EDISON**  
An EDISON INTERNATIONAL<sup>SM</sup> Company

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## EXECUTIVE SUMMARY

[REDACTED] applied to Southern California Edison ("SCE") for interconnection and wholesale distribution service for its proposed Ground-mounted Photovoltaic System pursuant to SCE's Wholesale Distribution Access Tariff ("WDAT") Generator Interconnection Procedures. SCE performed an Independent System Impact Study as requested by [REDACTED] for a 16kV interconnection and distribution service from an existing 16kV distribution line ("Tuba 16kV"). The interconnection is to be located approximately [REDACTED] from the [REDACTED] on the Tuba 16kV circuit out of SCE's [REDACTED] 66/16kV Substation. The request is for a WDAT Land-mounted Photovoltaic generating facility with a total AC capacity of 6.0 MW. The initial request is for service to commence by [REDACTED].

The new generation, consisting of Land-mounted Photovoltaic System, [REDACTED] inverters and [REDACTED] inverters. This generating facility would receive interconnection service from SCE's existing 16 kV circuitry on Tuba 16 kV out of [REDACTED] via an underground line extension to the applicant owned 16 kV switchgear. The generated power would be delivered to the California Independent System Operator ("CAISO") grid at the 220 kV bus of SCE's Pardee Substation.

The purpose of this Independent System Impact Study is to determine the effect of the proposed generation 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, 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 2012 through 2021 projected peak load conditions as well as 2012 through 2021 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 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 220 kV bus of Pardee 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] on-line:

- For both peak load and light load conditions, the addition of the [REDACTED] project resulted in no violations of SCE's thermal loading criteria under base case and N-1 conditions for the SCE distribution System.

- The addition of the [REDACTED] project resulted in no voltage rise exceeding allowable Rule 2 limits.
- The addition of the [REDACTED] project did not result in additional protection requirements.
- The addition of the [REDACTED] project resulted in the increase of three phase short circuit duties of .1kA or more at one (1) distribution substation.
- Non-binding order of magnitude cost estimates for the required interconnection facilities and system upgrades are as follows:

Interconnection Facilities	\$ 121.5 K
Distribution upgrades	\$ 11.5 K
Telemetry Requirements	\$ 14.5 K
ITCC (35%)	\$ 51.8 K
<hr/> Total non-binding order of magnitude cost estimate	\$ 199.3 K

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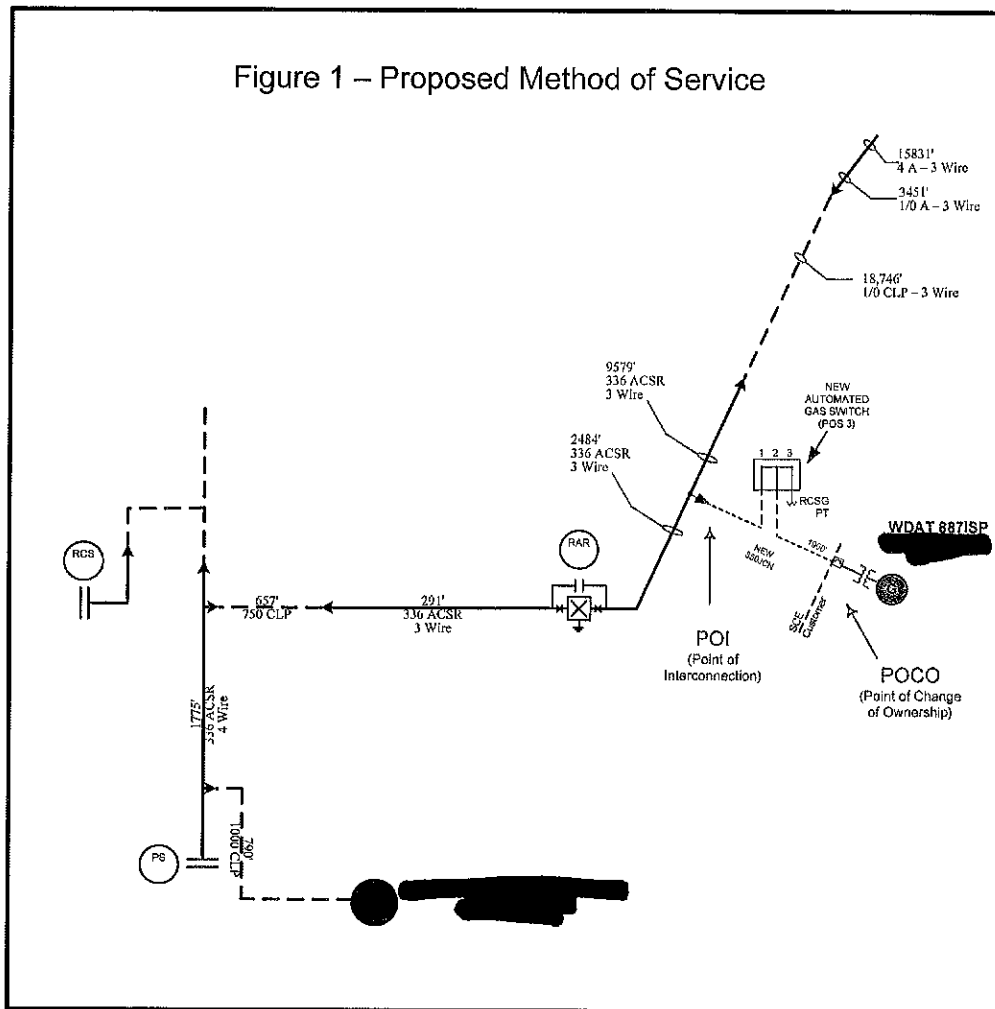
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# I. INTRODUCTION TO PART A

[REDACTED] applied to Southern California Edison ("SCE") for interconnection and wholesale distribution service for its proposed Land-mounted Photovoltaic System pursuant to SCE's Wholesale Distribution Access Tariff ("WDAT") Generator Interconnection Procedures. SCE performed an Independent System Impact Study as requested by Newhall Land and Farming Company for a 16kV interconnection and distribution service from an existing 16kV distribution line ("Tuba 16kV"). The interconnection is to be located approximately [REDACTED] on the Tuba 16kV circuit out of SCE's Elizabeth Lake 66/16kV Substation. The request is for a WDAT [REDACTED] generating facility with a total capacity of 6.0 MW. The initial request is for service to commence by [REDACTED].

The new generation, consisting of [REDACTED] inverters and [REDACTED] inverters. This generating facility would receive interconnection service from SCE's existing 16 kV circuitry on Tuba 16 kV out of [REDACTED] via an underground line to the applicant owned 16kV switchgear. The generated power would be delivered to the California Independent System Operator ("CAISO") grid at the 220 kV bus of SCE's Pardee Substation.

Figure 1 – Proposed 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 2012 through 2021 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 2012 - 2021 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.

## **III. PART A: SYSTEM IMPACT STUDY RESULTS**

### **Short Circuit Analysis**

Using the short circuit models from the inverter systems being utilized in this [REDACTED] [REDACTED] it was calculated that the short circuit contribution at one (1) 16 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) 16 kV breaker replacements are required as part of this project.

### **System Protection Considerations**

No equipment changes to the protection system of the SCE electrical system are required due to the additional generation. However, revisions to existing protection settings will be required.

### **Thermal Loading**

The line section of the Tuba 16 kV between the customer's facility and the 16kV Point of Interconnection is expected to experience an incremental reverse power flow of approximately 6.0 MW during minimum loading. Of that 6.0 MW, approximately 5.4 MW will be back into the 16 kV bus at [REDACTED] 56/16 kV Substation during minimum loading.

### **Distribution Voltage Control**

The 16kV distribution line is expected to be within the CPUC Rule 2 Voltage requirements under the generating facilities condition of maximum generation and 95% power factor. However, an overvoltage is expected under N-1 conditions. In the event of an N-1 condition, the [REDACTED] Project will be switched off if SCE deems it necessary.

### **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 require 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 are required to interconnect this generation facility. This upgrade will include installing a new bi-directional watt transducer to monitor watt and VAR flow going back to [REDACTED]

### **Interconnection Facilities**

Interconnection Facilities will be required to interconnect the system. Interconnection facilities include the installation of a new 3 way pad mounted gas switch with automation, a 16 kV line extension of approximately 1900 feet of 350 JCN between existing 16kV line extension and applicant's 16 kV switchgear, metering CTs, meters, and associated wiring.

### **Telemetry requirements**

Real-time telemetry will be required. Utilizing SCE's centralized RTU method of telemetry, the cost estimate required by PSC and Telecom is \$14.5 k. Cost estimate does not include 35% ITCC. Additional information on the proposed method of telemetry will be provided during the 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 16 kV circuit breaker which is to be installed on an applicant-owned 16 kV 3-phase switchgear.

Drawings required by the Electrical Service Requirement (ESR) shall be 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.

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



## 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:

<b>Interconnection Facilities/Automation</b>	\$ 121.5K
• Primary Riser Pole	
• 1900' 350JCN UG 16kV Line Extension	
• Switch Automation	
• 3 Way Padmounted Gas Switch	
• Metering	
• Associated Wiring	
<b>16kV Distribution Upgrades</b>	\$ 11.5K
• bi-directional watt transducer	
<b>Telemetry Requirements</b>	\$ 14.5K
• RTU	
• Telecomm	
• Add the generation data points into the Energy Management system	
ITCC (35%)	\$ 51.8K
<hr/> <b>Total non-binding order of magnitude cost estimate</b>	<b>\$ 199.3K</b>

## VI. PART A: SUMMARY

The Part A Independent System Impact Study showed:

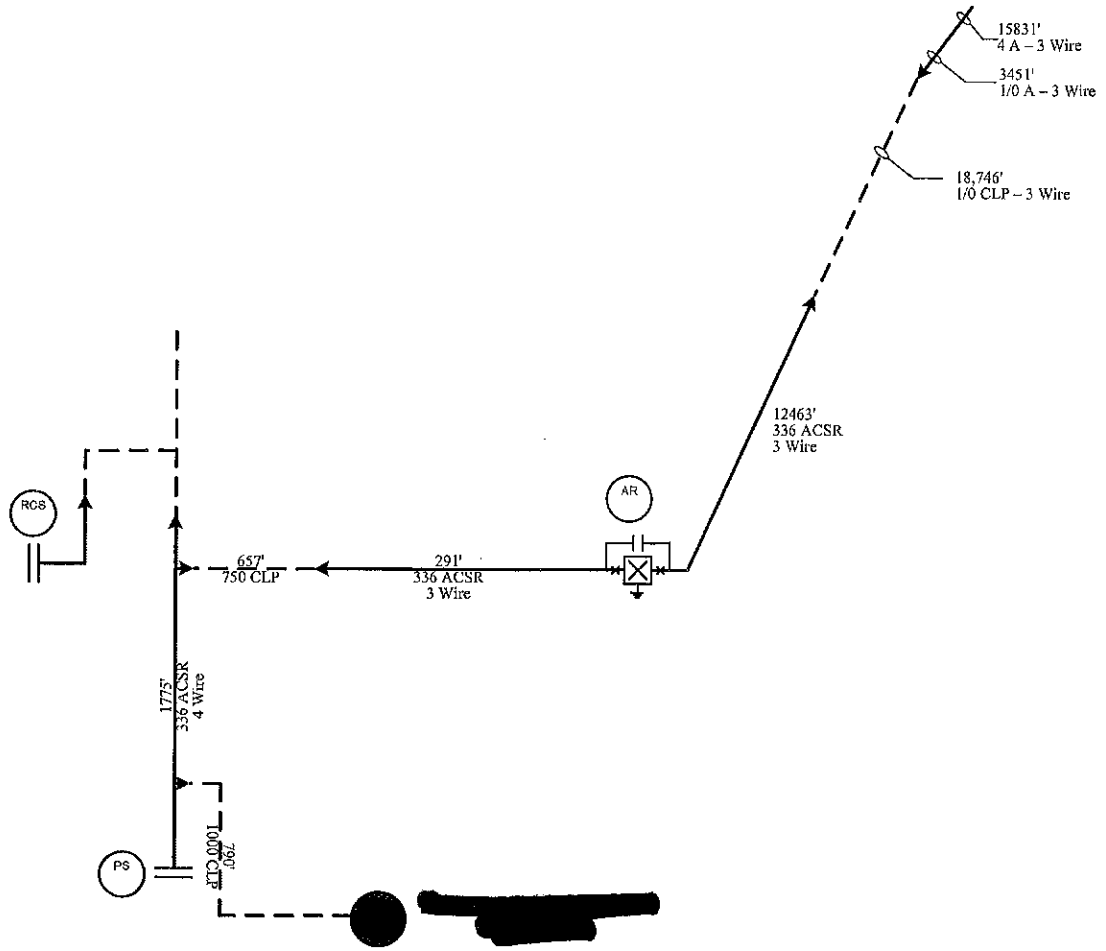
1. Distribution Upgrades are required to interconnect this generation facility. This upgrade will include installing a new bi-directional watt transducer to monitor watt and VAR flow going back to [REDACTED]
2. Interconnection Facilities will be required to interconnect the system. Interconnection facilities include the installation of a new 3 way pad mounted gas switch with automation, a 16 kV line extension of approximately 1900 feet of 350 JCN between existing 16kV line extension and applicant's 16 kV switchgear, metering CTs, meters, and associated wiring.
3. Real time telemetry will be required for this project. Utilizing SCE's centralized RTU method of telemetry to provide watts and VARs flow from the generating facility to the SCE distribution system.
4. The System Impact Report does not include cost associated with environmental studies which may be required for the licensing or permitting of the proposed generating facility.

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

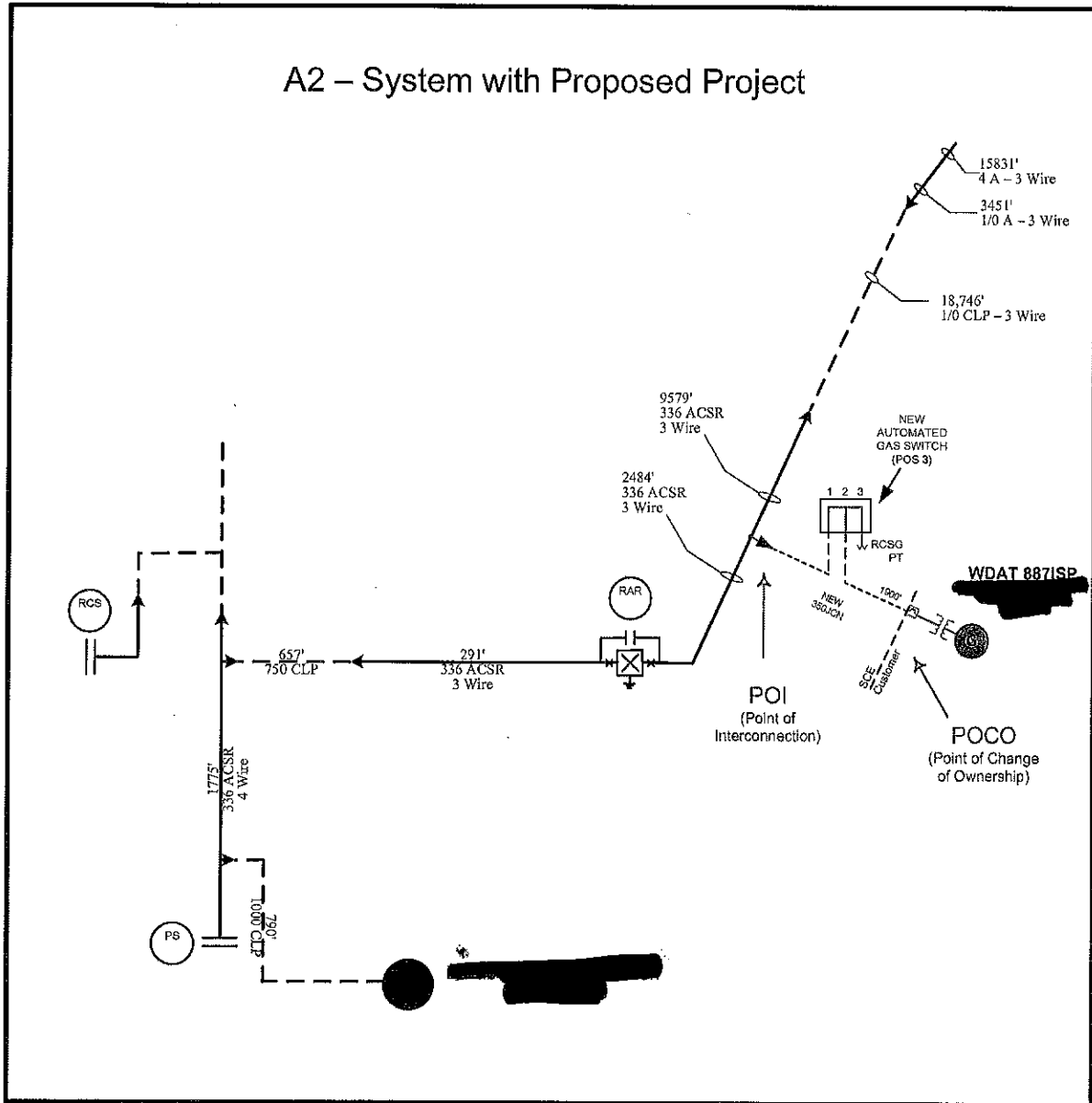
Interconnection Facilities	\$ 121.5 K
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ITCC (35%)	\$ 51.8 K
<hr/>	
Total non-binding order of magnitude cost estimate	\$ 199.3 K

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.

# A1 – System without Propped project



# A2 – System with Proposed Project



## **ATTACHMENT B – BULK POWER SYSTEM IMPACT STUDY REPORT**

### **CAISO Controlled Bulk System**

#### **Short Circuit Duty:**

Since the project is connecting on low voltage 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 focused on identifying system thermal overload problems within SCE bulk system. The power flow study results identified that the project in connection with SCE's Pardee 220 kV A Station didn't provide system impact to SCE's bulk power system.