Subject: FW: Victorville 2 Project Final SIS
Received: Fri, 16 May 2008 16:49:59 -0700
From: "You, Ruhua" <RYou@caiso.com>
To: "Arachchige, Sudath" <Sarachch@energy.state.ca.us>
Cc: "Brown, Judy" <jbrown@caiso.com>
Attachment Victorville 2 Interconnection System Impact Study-Final Report-10-16-2006.pdf

Sudath, per your request, I am forwarding the SIS approval letter to you.

DOCKET
07-AFC-1
DATE MAY 16 2008
RECD. MAY 19 2008

Ruhua You

Regional Transmission - South
CAISO
(916) 608-5721

-----Original Message-----
From: Sindelar, Paul
Sent: Monday, October 23, 2006 10:19 AM
To: Thomas Barnett; 'Frederick Redell'
Cc: Phillip.Leung@SCE.com; You, Ruhua; Nickel, Judy
Subject: Fw: Victorville 2 Project Final SIS

Attached is the final Victorville 2 System Impact Study.

The CAISO will now follow-up with Inland Energy for the Facility Study phase.

----- Forwarded by Paul Sindelar/SCE/EIX on 10/23/2006 10:15 AM -----

Phillip

Leung/SCE/EIX

To
10/16/2006 01:23 RYou@caiso.com,
JNickel@caiso.com,
PM Michael D Lopez/SCE/EIX@SCE,

Edgardo Romero/SCE/EIX@SCE, Paul

Sindelar/SCE/EIX@SCE

cc
Thanh Ninh/SCE/EIX@SCE

Subject
Victorville 2 Project Final SIS

(Embedded

image moved (Embedded image moved to file: pic04678.jpg)

to file:

pic22466.jpg) FOR INTERNAL USE ONLY

All,

The attached are the final Victorville 2 SIS and its attachments.

(See attached file: Victorville 2 Interconnection System Impact
Study-Final
Report-10-16-2006.pdf)
(See attached file: APPENDIX A.pdf)(See attached file: APPENDIX
F.pdf)(See
attached file: APPENDIX E.PDF)(See attached file: APPENDIX D.pdf)(See
attached file: APPENDIX C.pdf)
(See attached file: APPENDIX B.pdf)

Regards

Phillip Leung
Transmission & Interconnection Planning
Southern California Edison
Phone: (626) 302-0359 (20359)
Phillip.Leung@sce.com

INLAND ENERGY INC,
VICTORVILLE 2 PROJECT

SYSTEM IMPACT STUDY

October 16, 2006

EDISON

Prepared by
Phillip Leung

Southern California Edison Company

Approved by: Patricia L. Arons

EXECUTIVE SUMMARY

Southern California Edison Company ("SCE") under direction of the California Independent System Operator ("CAISO"), performed an Interconnection System Impact Study ("SIS") as requested by Inland Energy, Inc. for a proposed Victorville 2 ("VV2") project pursuant to the Interconnection System Impact Study Agreement. The VV2 project is a combine cycle and solar array heat input generating plant consist of two combustion turbines rated maximum 154.2 MW each, and one steam turbine rated maximum 268.3 MW. The plant auxiliary load is 14 MW and net output is 563 MW. The Project will interconnect to the SCE owned Victor 230-kV Substation and scheduled to be online by July, 2009. Inland Energy, Inc. was informed that a third Victor-Lugo 230-kV line will be required for VV2 project to interconnect to the CAISO controlled grid. Therefore a third Victor-Lugo 230-kV line is modeled in the base case.

The study was performed for two system conditions: a 2009 heavy summer one-in-ten load forecast and a 2010 light spring load forecast (65% of the heavy summer load).

The results of the System Impact Study will be used as the basis to determine project cost allocation for facility upgrades in the Facilities Study. ***The study accuracy and the results for the assessment of the system adequacy are contingent on the accuracy of the technical data provided by Inland Energy, Inc***. Any changes from the attached data could void the study results. The report provides detailed study assumptions and conditions of the system in which the study was conducted. Furthermore power flow contingencies , transient stability, post transient, and short-circuit duty assessments were completed for this study and summarized below.

Based on this analysis, existing SCE transmission facilities are not adequate to accommodate the VV2 project interconnecting at the SCE-owned Victor 230-kV substation for 2009 operation.

This revised system impact study included a sensitivity study to identify facility upgrade requirement if projects ahead in the queue and upgrades associated with these projects were not in service by 2009.

Power Flow Analysis

The study identified overloads on Victor-Lugo 230-kV lines No.1, No.2, under base case, N-1 and N-2 contingencies with addition of the VV2 project with and without any prior queue projects and associated system upgrades in service. Sensitivity study indicated that VV2 would trigger base case overloads on the Lugo 500/230-kV AA transformer banks No.1 and No.2 without the third Lugo 500/230-kV AA transformer bank. A third Victor-Lugo 230-kV line and a third Lugo 500/230-kV transformer bank have to be in service before VV2 project comes online.

A detail SPS study is also needed to determine if the existing High Desert SPS needs to be expanded to include VV2 project, under the outages of Victor-Lugo 230-kV No.3 and No.1 or No.2 lines.

Post-Transient Power Flow Analysis

The simultaneous outage of Kramer-Lugo 230-kV Line No.1 and No.2 (N-2) caused post transient voltage violations in the North of Lugo area. However, the post transient voltage violations would disappeared if the third Kramer-Lugo 230-kV line which triggered by prior queue projects were in-service. If those prior projects withdraw from the queue, the existing Kramer SPS will have to be revised in order to maintain the post transient voltage level.

Transient Stability Analysis

The simultaneous outage of Kramer-Lugo 230-kV Lines No.1 and No.2 (N-2) caused transient instability throughout the North of Lugo area. However, the transient instability would disappear if the third Kramer-Lugo 230-kV line which triggered by prior queue projects were in-service. If those prior projects withdraw from the queue, the existing Kramer SPS will have to be revised in order to maintain a stable system.

Short-Circuit Analysis

In three-phase-to-ground and single-line-to-ground CB evaluation, the VV2 project did not trigger any circuit breakers upgrade. All replacement/upgrade circuit breakers were identified by generation projects ahead in the queue. Studies indicated that 68 SCE owned circuit breakers require replacement and 13 SCE owned circuit breakers require upgrades. It is estimated that circuit breaker replacement/upgrades will yield a total cost of $52.627 million.

Cost Responsibility

VV2 project triggers the need of one reliability upgrade - a third Victor-Lugo 230-kV line. All other identified upgrades are triggered by projects ahead in the queue. The ***Nonbinding*** estimate for VV2 project's ***maximum cost exposure**** for reliability upgrades is $124.327 million. Refer to the Scope of Work section of this report for work details and cost information.

If all projects ahead in the queue come on-line as scheduled, VV2 project would only be responsible for the cost of constructing the 230-kV gen-tie line from VV2 plant to Victor 230-kV substation, and the third Lugo-Victor 230-kV line. The ***Nonbinding minimum cost*** for VV2 project to interconnect to CAISO's grid is $23.7 million. However, a restudy must be performed to re-determine cost assignment if any projects ahead in the application queue withdraw.

The maximum exposure and minimum cost do not include direct assignment cost of the 230-kV gen-tie line from VV2 project to Victor substation and switchyard at VV2 project plant site.

* The maximum cost exposure is the potential cost that may be assignable to VV2 project should any higher queue project withdraw.

CONTENTS

CONTENTS

INLAND ENERGY INC, VICTORVILLE 2 PROJECT

SYSTEM IMPACT STUDY (REVISED)

October 16, 2006

INTRODUCTION

Southern California Edison Company ("SCE") under direction of the California Independent System Operator ("CAISO"), performed an Interconnection System Impact Study ("SIS") as requested by Inland Energy, Inc. for a proposed Victorville 2 ("VV2") project pursuant to the Interconnection System Impact Study Agreement. The VV2 project is a combine cycle and solar array heat input generating plant consist of two combustion turbines rated maximum 154.2 MW each, and one steam turbine rated maximum 268.3 MW. The plant auxiliary load is 14 MW and net output is 563 MW. The Project will interconnect to the SCE owned Victor 230-kV Substation and scheduled to be online by July, 2009. Inland Energy, Inc. was informed that a third Victor-Lugo 230-kV line will be required for VV2 project to interconnect to the CAISO controlled grid. Therefore a third Victor-Lugo 230-kV line is modeled in the base case.

The results of the System Impact Study will be used as the basis to determine project cost allocation for facility upgrades in the Facilities Study. ***The study accuracy and the results for the assessment of the system adequacy are contingent on the accuracy of the technical data provided by Inland Energy, Inc***. Any changes from the attached data could void the study results.

This revised system impact study supersedes the original SIS issued on August 30, 2006, because a sensitivity study has to be added to identify facility upgrade requirement if projects ahead in the queue and upgrades associated with these projects were not in service by 2009.

The study was performed for two system conditions: a 2009 heavy summer one-in-ten load forecast and a 2010 light spring load forecast (65% of the heavy summer load).

The report provides detailed study assumptions and conditions of the system in which the study was conducted. Furthermore power flow contingencies for the SCE 115, 230-kV system, post-transient governor power flow, transient stability for significant 115, 230-kV contingencies, and short-circuit duty assessments were completed for this study.

STUDY CONDITIONS AND ASSUMPTIONS

A. Planning Criteria

The study was conducted by applying the CAISO Reliability Criteria. More specifically, the main criteria applicable to this study are as follows:

Power Flow Assessment

The following contingencies are considered for transmission and sub-transmission lines and 500/230 kV transformer banks ("AA-Banks"):

- Single Contingencies (loss of one line or one AA-Bank)
- Credible Double Contingencies (loss of two lines or one line and one AA-Bank) (Outages of two AA-Banks are beyond the Planning Criteria)

The following reliability criteria are used:

Transmission Lines	Base Case	Limiting Component Normal Rating
	N-1	Limiting Component Emergency-Rating
	N-2	Limiting Component Emergency-Rating
AA-Banks	Base Case	Normal Loading Rating
	Long Term & Short Term	Bank Emergency-Rating

System upgrades for transmission lines are generally recommended for all reliability criteria violations. Special Protection Schemes (SPS) may be allowed for single contingency and credible double contingencies reliability criteria violation in place of system upgrade.

Congestion Assessment

The following principles were used in determining whether congestion management, special protection schemes, or facility upgrades are required to mitigate base case, single contingency, or double contingency overloads:

- Congestion management, as a means to mitigate base case overloads, can be used if it is determined to be manageable and the CAISO concurs with the implementation.

- Facility upgrades will be required if it is determined that the use of congestion management is unmanageable as defined in the congestion management section that follows.

- SPS, in lieu of facility upgrades, will be recommended if the scheme is effective, does not jeopardize system integrity, does not exceed the current CAISO single and double contingency tripping limitations, does not adversely effect existing or proposed special protection schemes in the area, and can be readily implemented.

- Facility upgrades will be required if use of protection schemes is determined to be ineffective, the amount of tripping exceeds the current CAISO single and double contingency tripping limitations, adverse impacts are identified on existing or currently proposed special protection schemes, or the scheme cannot be readily implemented.

- Congestion management in preparation for the next contingency will be required, with CAISO concurrence, if no facility upgrades or special protection schemes are implemented.

The following study method was implemented to assess the extent of possible congestion:

a) Under Base Case with all transmission facilities in service, the system was evaluated with all existing interconnected generation and all generation requests in the area that have a queue position ahead of this request (pre-project).

b) Under Base Case with all transmission facilities in service, the system was reevaluated with the inclusion of the VV2 project and a third Victor-Lugo 230-kV line (post-project).

If the normal loading limits of facilities are exceeded in (a), the overload is identified as an existing overload that was triggered by a project in queue ahead of the VV2 project. If the normal loading limits of facilities are exceeded in (b) and were not exceeded in (a), the overload is identified as triggered by the addition of the VV2 project. The VV2 project, assuming it is a market participant, and other market participants in the area may be subjected to congestion management, potential upgrade cost and/or participation of any proposed special protection scheme if the project addition aggravates or triggers the overload. Additionally, the VV2 project may have to participate in mitigation of overloads triggered by subsequent projects in queue, subject to FERC protocols and policies.

In order for congestion management to be a feasible alternative to system facilities, all of the following factors need to be satisfied:

- Time requirements for necessary coordination and communication between the CAISO operators, scheduling operators and SCE operators.

- Distinct Path/Corridor rating should be well defined so monitoring and detecting congestion and implementing congestion of the contributing generation resources can be performed when limits are exceeded.

- Sufficient amount of market generation in either side of the congested path/corridor should be available to eliminate market power.

- Manageable generation in the affected area is necessary so that operators can implement congestion management if required (i.e. the dispatch schedule is known and controllable).

Results of these studies should identify:

a. if capacity is available to accommodate the proposed VV2 project and all projects ahead in queue without the need for congestion management, special protection schemes, or facility upgrades

b. if overloads exist in the area after the addition of all projects in queue ahead of the VV2 project and all facilities in service

c. if congestion exists in the area with the addition of the VV2 project and all projects ahead in queue under single and double element outage conditions assuming no new special protection schemes are in place

d. if sufficient capacity is maintained to accommodate all Must-Run and Regulatory Must-Take generation resources with all facilities in service

e. if sufficient capacity is maintained to accommodate the total output of any one generation resource which is not classified as Must-Run.

Transient Stability Analysis

WECC currently is in the process of adopting The Generator Electrical Grid Fault Ride-Through Capability Criteria. SCE currently supports a Low Voltage Ride-Through Criteria to ensure continued reliable service. A proposed Criteria that SCE supports, is as follows:

1. Generator is to remain in-service during system faults (three phase faults with normal clearing and single-line-to-ground with delayed clearing) unless clearing the fault effectively disconnects the generator from the system.

2. During the transient period, generator is required to remain in-service for the low voltage and frequency excursions specified in WECC Table W-1 (provided below) as applied to load bus constraint. These performance criteria are applied to the generator interconnection point, not the generator terminals.

3. Generators may be tripped after the fault period if this action is intended as part of a special protection scheme.

4. This Standard will not apply to individual units or to a site where the sum of the installed capabilities of all machines is less than 10 MVA, unless it can be proven that reliability concerns exist.

5. The performance criteria of this Standard may be satisfied with performance of the generators or by installing equipment to satisfy the performance criteria.

6. The performance criterion of this Standard applies to any generation independent of the interconnected voltage level.

7. No exemption from this Standard will be given because of minor impact to the interconnected system.

8. Existing generators that go through any refurbishments or any replacements are then required to meet this Standard.

In addition to the Low Voltage Ride-Through Criteria, the following criterion was applied for the transient stability analysis:

a.) All machines in the system shall remain in synchronism as demonstrated by their relative rotor angles.

b.) All stability simulation cases will be run for a minimum of 10 seconds.

c.) Generators with a base load flag of zero will not respond to contingencies.

d.) System stability is evaluated based on the damping of the relative rotor angles and the damping of the voltage magnitude swings.

Other transient voltage dips must meet the following CAISO Reliability Criteria:

Performance Level	Disturbance	Transient Voltage Dip Criteria
B	N-1	Transient Voltage Dip: Not to exceed 25% at load buses or 30% at non-load buses. Also, not to exceed 20% for more than 20 cycles at load buses. Minimum Transient Frequency: Not below 59.6 Hz for 6 cycles or more at a load bus.
C	N-2	Transient Voltage Dip: Not to exceed 30% at any bus. Also, not to exceed 20% for more than 40 cycles at load buses. Minimum Transient Frequency: Not below 59.0 Hz for 6 cycles or more at a load bus.
D	N-3	Not Specified

Short-Circuit Analysis

The following study assumptions were used for conducting the short-circuit analysis:

a) Shunt capacitor banks will be omitted at all stations. Normally, shunt capacitors produce a minimal effect on fault currents. When they are large enough to be significant, their effect is to reduce total fault current. Results are more conservative to neglect them altogether.

b) Shunt reactors will also be neglected since their contribution is minimal.

c) Reactors connected to autotransformer delta tertiary windings will be neglected since they cannot contribute fault current to the system.

d) Phase shifting transformers will be by-passed as this would be the worst case from the fault current standpoint.

e) If zero sequence data is not available, the assumption will be made that Xo=3X1 and Ro=0 or R1.

Circuit breakers exposed to fault currents in excess of 100 percent of their interrupting capacities will be replaced or upgraded, whichever is appropriate.

Sub-synchronous Resonance Analysis (SSR)

It is not anticipated that there will be any SSR impacts. Hence, the SSR studies are not required.

B. Victorville 2 Project

The project is scheduled to be in service by July 2009.

Proposed Victorville 2 Project ("VV2")

Interconnection of the VV2 project will be achieved with construction of a new 10 miles single circuit from VV2 plant site to Victor substation. The first 3 miles of this circuit will be hung on newly constructed transmission towers. The rest of the 7 miles circuit will be hung on the Caldwell-Victor 230-kV double circuit towers. Unless otherwise agreed to by SCE, such line will be constructed by Inland Energy, Inc. The project will have a gross output of 577 MW, plant auxiliary load of 14 MW and a net project output of 563 MW.

- A third Victor-Lugo 230-kV line was assumed to be in-service for all post-project cases. VV2 project can not operate without this line. See table below for the Victor-Lugo 230-kV lines No.1 and No.2 loading pre and post VV2 project without the third Victor-Lugo 230-kV line.

	2009 Heavy Summer		2010 Light Spring	
	Pre-Project Loading	Post-Project Loading	Pre-Project Loading	Post-Project Loading
Victor-Lugo 230-kV line No.1	1017Amps/82%	1764Amps/142%	1185Amps/95%	1911Amps/154%
Victor-Lugo 230-kV line No.2	1017Amps/82%	1764Amps/142%	1185Amps/95%	1911Amps/154%

Figure 1 illustrates the conceptual one-line schematic of the proposed VV2 project and **Figure 2** illustrates the one line diagram of the Victor/Kramer System.

Figure 1. One-line Victorville 2 ("VV2") Project bus Configuration (without the third Victor-Lugo 230-kV line).

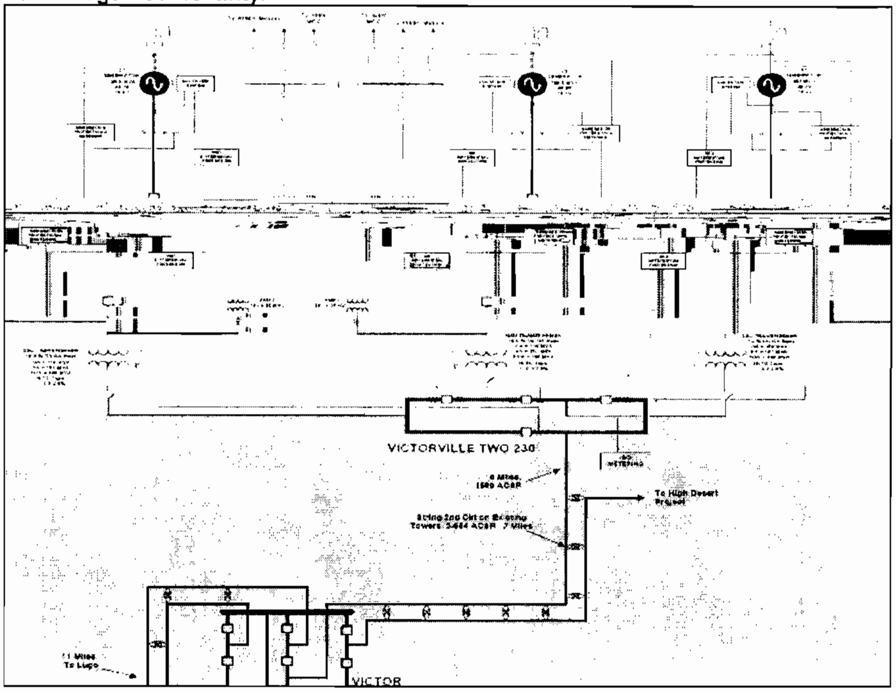
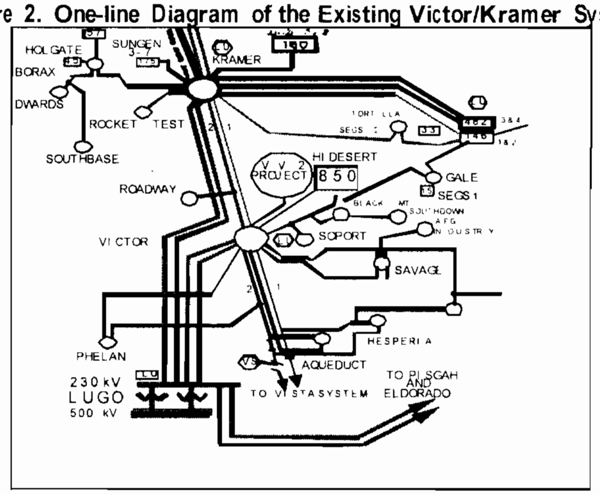


Figure 2. One-line Diagram of the Existing Victor/Kramer System.



Interconnection Points:

Two interconnection points have been identified for connecting the VV2 project. The preferred point is Victor 230-kV bus (Primary). The alternate point of interconnection is Caldwell 230-kV bus. SCE and Inland Energy, Inc. do not anticipate needing the alternate interconnection point and it was not studied in the System Impact Study (SIS).

C. Kramer Remedial Action Scheme

The Kramer Remedial Action Scheme is designed to prevent transmission line or transformer bank overloads as well as system instability. These problems could occur during high generation conditions under certain transmission component outages. The following outlines the outages that can result in the potential operation of the Kramer RAS:

Single Outages

1. Loss of Kramer-Inyokern-Randsburg No.1 115-kV Line
2. Loss of Kramer-Lugo No.1 230-kV Transmission Line
3. Loss of Kramer-Lugo No.2 230-kV Transmission Line

Double Outages

1. Loss of Kramer-Lugo No.1 and No.2 230-kV Transmission Lines
2. Loss of Lugo 500/230-kV No.1 and No.2 Transformer Banks (Safety Net)

In addition to tripping generation under outage conditions, SCE System Operating Bulletin No.209 allows for curtailment of generation in the Inyokern Area when the 115-kV portion of the Remedial Action Scheme is inoperative. SCE System Operating Bulletin No.209 also allows for curtailment of generation in the Kramer area when the 230-kV portion of the Remedial Action Scheme is inoperative.

Arming of the 115-kV Kramer RAS portion is based on Kramer-Inyokern-Randsburg No.3 115-kV line flow while arming of the 230-kV Kramer RAS portion is based on Kramer-Lugo No.1 and No.2 230-kV line flows. The "Safety Net" is armed based on the sum flows of the two Lugo AA-Banks. Adding generation north of Lugo may result in changes to existing line flows and may adversely affect the current arming levels.

D. High Desert Power Project Remedial Action Scheme

The High Desert Power Project (HDPP) Remedial Action Scheme is designed to prevent transmission line or transformer bank overloads as well as system instability. These problems could occur during high generation conditions under certain transmission component outages. The following outlines the outages that can result in the potential operation of the HDPP RAS:

Single Outages

1. Loss of Lugo-Victor No.1 230-kV Transmission Line
2. Loss of Lugo-Victor No.2 230-kV Transmission Line
3. Loss of Lugo 500/230 No.1 Transformer Bank (AA-Bank)
4. Loss of Lugo 500/230 No.2 Transformer Bank (AA-Bank)

Double Outages

A. Loss of Lugo-Victor No.1 and No.2 230 kV Transmission Lines
B. Loss of Lugo 500/230-kV No.1 and No.2 Transformer Banks ("Safety Net")

In addition to tripping generation under outage conditions, SCE System Operating Bulletin No.283 allows for curtailment of generation in the Victor Area when the Remedial Action System is inoperative.

Arming of the HDPP RAS is based on Lugo-Victor No.1 and No.2 230-kV line flows as well as Lugo AA-Bank flows. The "Safety Net" is armed based on the sum flows of the two Lugo AA-Banks. Adding generation north of Lugo may result in changes to existing line flows and may adversely affect the current arming levels.

E. Bishop Remedial Action Scheme

The Bishop Remedial Action Scheme is designed to prevent system instability in the Bishop area by tripping local generation for the loss of both the Control-Haiwee-Inyokern No.1 and No.2 115-kV lines or for the loss of a single Control-Haiwee-Inyokern 115-kV line when the SCE/LADWP Inyo 230-kV Intertie is opened.

In addition to tripping local generation under outage condition, SCE System Operating Bulletin No.214 allows for curtailment of generation in the Bishop Area to minimize flows on the Inyo phase-shift transformer or to eliminate overloads.

The Bishop RAS arming is based on Control-Haiwee-Inyokern No.1 and No.2 115-kV line flows. Adding generation in the area may result in changes to existing line flows and may adversely affect the current arming levels.

F. System Conditions

To simulate the SCE transmission system for analysis, the study used a SCE internal planning case that modeled 2009 heavy summer. In addition, an additional SCE internal planning case modeled 2010 light spring conditions. Both starting base cases were updated to represent system conditions in 2009 and 2010. Most significantly, SCE's 2009 heavy summer load was escalated to a one-in-ten load forecast. System generation is based upon the application queue. That is, all projects ahead in SCE's queue regardless of the in-service date of such prior projects are modeled. The 2010 light spring scenario assumes 65% of the heavy summer load.

G. Load Flow Study

Load flow studies were conducted under 2009 heavy summer and 2010 light spring conditions. Refer to **Appendix F** for a list of SCE Queue projects in the North of Lugo area modeled in all base cases. Further descriptions of each base case follow:

a). 2009 Heavy Summer without the VV2 project, Case 1.

Case 1 includes a 2009 heavy summer load level. Generation patterns were maximized in the North of Lugo area to fully stress the Victor/Kramer system.

b). 2009 Heavy Summer with the VV2 Project, Case 2.

Case 2 modified to include the VV2 project with a net generation of 563 MW. The generation connected at Alamitos generation was reduced by 563 MW to accommodate project generation.

c). 2010 Light Spring without the VV2 project, Case 3.

Case 3 includes a 2010 light spring load level. Generation patterns were maximized in the North of Lugo area to fully stress the Victor/Kramer system.

d). 2010 Light Spring with the VV2 project, Case 4.

Case 4 modified to include the VV2 project with a net generation of 563 MW. The generation connected at Alamitos generation was reduced by 563 MW to accommodate project generation.

Table 1 summarizes SCE area system demand and resources for both the 2009 heavy summer and 2010 light spring cases.

Table 1. Summary of case attributes.

SOUTHERN CALIFORNIA IMPORT TRANSMISSION ("SCIT"), EAST-OF-RIVER ("EOR") AND WEST-OF-RIVER ("WOR") FLOWS SCE AREA TOTAL GENERATION, IMPORT, LOAD AND LOSSES (MW)				
	2009 Heavy Summer		2010 Light Spring	
	Case 1 Pre-project	Case 2 Post-Project	Case 3 Pre-Project	Case 4 Post-Project
SCIT	15,545	16,815	13,320	13,279
EOR	6,402	6,407	7,418	7,421
WOR	7,760	7,757	7,965	7,960
Generation*	16,787	16,815	10,679	10,708
Import	-9,590	-9,590	-6,434	6,434
Load	25,027	25,027	16,497	16,497
Losses	724	752	617	646

*Changes in generation can be attributed to swing bus adjustments compensating for loss increases.

H. Post-Transient Governor Power Flow Study

Most critical 115, 230-kV contingencies were simulated with the post-transient governor power flow methodology. The governor power flow methodology utilizes Special Protection Systems ("SPS") for loss of bulk system contingencies. In addition, loss of a significant amount of generation would be spread throughout the system instead of at the system swing bus.

I. Transient Stability Study

Transient stability studies were performed for 2010 light load base cases to ensure that the transmission system remains in operating equilibrium through abnormal operating conditions after the new facility begins operation.

J. Short Circuit Duty Study

Short circuit studies were conducted to determine fault duties on existing SCE facilities before and after proposed project additions. Fault duty results were used to identify overstressed equipment, if any, that results solely from addition of the proposed facility.

STUDY RESULTS

A. Load Flow Study

I. *2009 Heavy Summer(without proposed upgrades from prior queue projects)*

1. Base Case

Affected Elements	*Normal/ Emergency Ratings*	*Pre-Project Loading*	*Post-Project Loading*	*Impact/ Percentage*	*Contingency Description*
ELDORDO 230/115-KV BANK No.1	102/110*	114	117	3/3%	Base system (n-0)
LUGO 500/230-KV BANK No. 1	1120/1230*	1243	1514	271/22%	Base system (n-0)
LUGO 500/230-KV BANK No. 2	1120/1230*	1252	1525	273/22%	Base system (n-0)
ELDORADO-MOUNTAIN PASS 115-KV LINE No.1	415/530**	541	559	18/3%	Base system (n-0)

* MVA
** Amps

2. N-1 Contingency

Without existing SPS, VV2 project increased the loading on the following facilities. See the complete N-1 overloads table in Appendix A.

- Eldorado 230/115-kV Bank No.1 by 4 MVA/4% to a maximum of 134 MVA.
- Lugo 500/230-kV Bank No.1 by 287 MVA/23% to a maximum of 1572 MVA.
- Lugo 500/230-kV Bank No.2 by 290 MVA/24% to a maximum of 1583 MVA.
- Eldorado-Mountain Pass 115-kV Line No.1 by 20 Amps/4% to a maximum of 640 Amps.
- Inyo 115-kV Phase Shifter by 3 MVA/5% to a maximum of 73 MVA.

3. N-2 Contingency

Without existing SPS, VV2 project increased the loading on the following facilities. See the complete N-2 overloads table in Appendix B.

- Eldorado 230/115-kV Bank No:1 by 4 MVA/3% to a maximum of 131 MVA.
- Lugo 500/230-kV Bank No.1 by 287 MVA/23% to a maximum of 1572 MVA.
- Lugo 500/230-kV Bank No.2 by 293 MVA/24% to a maximum of 1596 MVA.
- Eldorado-Mountain Pass 115-kV Line No.1 by 20 Amps/4% to a maximum of 640 Amps.
- Inyo 115-kV Phase Shifter would not converge without existing Bishop SPS.

Appendix B tabulates all power flow contingency results.

The study focused on identifying system thermal overloads within the SCE service territory. Reported thermal overloads were limited to the condition where a modeled transmission component was loaded over 98% of its appropriate normal rating (as entered in the power flow database). In addition, only element loadings greater than 1% between the pre and post-project cases were reported.

II. *2010 Light Spring (without proposed upgrades from prior queue projects)*

1. Base Case

Affected Elements	*Normal/ Emergency Ratings*	*Pre-Project Loading*	*Post-Project Loading*	*Impact/ Percentage*	*Contingency Description*
ELDORDO 230/115-kV BANK No 1	102/110*	124	127	3/3%	Base system (n-0)
LUGO 500/230-kV BANK No 1	1120/1230*	1337	1603	266/22%	Base system (n-0)
LUGO 500/230-kV BANK No. 2	1120/1230*	1347	1614	267/22%	Base system (n-0)
INYO 115-KV PHASE SHIFTER	56/62*	80	83	3/5%	Base system (n-0)
ELDORADO-MOUNTAIN PASS 115-kV LINE No 1	415/530**	587	602	15/3%	Base system (n-0)

* MVA
** Amps

2. N-1 Contingency

Without existing SPS, VV2 project increased the loading on the following facilities. See the complete N-1 overloads table in **Appendix B**.

- Eldorado 230/115-kV Bank No.1 by 8 MVA/7% to a maximum of 144 MVA.
- Lugo 500/230-kV Bank No.1 by 623 MVA/51% to a maximum of 3214 MVA.
- Lugo 500/230-kV Bank No.2 by 621 MVA/50% to a maximum of 3212 MVA.
- Eldorado-Mountain Pass 115-kV Line No.1 by 43 Amps/8% to a maximum of 689 Amps.
- Inyo 115-kV Phase Shifter by 2 MVA/3% to a maximum of 110 MVA.

3. N-2 Contingency

Without existing SPS, VV2 project increased the loading on the following facilities. See the complete N-2 overloads table in **Appendix B**.

- Eldorado 230/115-kV Bank No.1 by 3 MVA/3% to a maximum of 141 MVA.
- Lugo 500/230-kV Bank No.1 by 279 MVA/23% to a maximum of 1669 MVA.
- Lugo 500/230-kV Bank No.2 by 281 MVA/23% to a maximum of 1681 MVA.
- Eldorado-Mountain Pass 115-kV Line No.1 by 20 Amps/4% to a maximum of 640 Amps.
- Inyo 115-kV Phase Shifter by 4 MVA/6% to a maximum of 97 MVA.

Appendix B tabulates all power flow contingency results.

The study focused on identifying system thermal overloads within the SCE service territory. Reported thermal overloads were limited to the condition where a modeled transmission component was loaded over 98% of its appropriate normal rating (as entered in the power flow database). In addition, only element loadings greater than 1% between the pre and post-project cases were reported.

III. *2009 Heavy Summer (with proposed system upgrades from prior queue projects)*

1. Base Case

No base case overloads were found.

2. N-1 Contingency

No N-1 overloads were found with existing RAS deployed.

3. N-2 Contingency

No N-2 overloads were found with existing RAS deployed. But a detail SPS study will be needed in the Facility Study to determine if the existing High Desert SPS needs to be expanded to include VV2 project, under the outages of Victor-Lugo 230-kV No.3 and No.1 or No.2 lines.

IV. *2010 Light Spring (with proposed system upgrades from prior queue projects)*

1. Base Case

No base case overloads were found.

2. N-1 Contingency

No N-1 overloads were found with existing RAS deployed.

3. N-2 Contingency

No N-2 overloads were found with existing RAS deployed. But a detail SPS study will be needed in the Facility Study to determine if the existing High Desert SPS needs to be expanded to include VV2 project, under the outages of Victor-Lugo 230-kV No.3 and No.1 or No.2 lines.

V. Sensitivity Study

With all proposed upgrades identified in the prior queue projects in service, VV2 project would only required a third 230-kV line from Victor sub to Lugo sub. A sensitivity study was performed to determine what other transmission facilities may be required if all projects ahead in the queue withdraw and system upgrades are not in service. Below are the study results.

2009 Heavy Summer

1. Base Case

Lugo 500/230-kV Bank No.1 and No.2 were overloaded to 1121/101%.

2. N-1 Contingency

Lugo 500/230-kV Bank No.1 or No.2 was overloaded to 2217/189% with the outage of Lugo 500/230-kV Bank No.2 or No.1 without deploying existing RAS

3. N-2 Contingency

No N-2 overloads were found. But a detail SPS study will be needed in the Facility Study to determine if the existing High Desert SPS needs to be expanded to include VV2 project, under the outages of Victor-Lugo 230-kV No.3 and No.1 or No.2 lines.

2010 Light Spring

4. Base Case

Lugo 500/230-kV Bank No.1 and No.2 were overloaded to 1434/128%.

5. N-1 Contingency

Lugo 500/230-kV Bank No.1 or No.2 was overloaded to 2691/240% with the outage of Lugo 500/230-kV Bank No.2 or No.1 without deploying existing RAS

6. N-2 Contingency

No N-2 overloads were found. But a detail SPS study will be needed in the Facility Study to determine if the existing High Desert SPS needs to be expanded to include VV2 project, under the outages of Victor-Lugo 230-kV No.3 and No.1 or No.2 lines.

B. Transient Stability and Post Transient Study

The simultaneous outage of Kramer-Lugo 230-kV Lines No.1 and No.2 (N-2) caused transient and post transient voltage violation throughout the North of Lugo area by only deploying the existing Kramer SPS. However, these violation would disappear if the third Kramer-Lugo 230-kV line which triggered by prior queue projects was in-service. If the prior projects withdraw from the queue, the existing Kramer SPS will have to be revised in order to maintain system stability and the post transient voltage level

.

Refer to **Appendix D** for all simulated contingency plots. A detail SPS study will be needed in the Facility Study phase to determine the appropriate generator, its arming level and tripping details for the Kramer-Lugo 230-kV Lines No.1 and No.2 simultaneous outage.

The VV2 project met the Low Voltage Ride-Through criterion; since, none of the VV2 project generators tripped due to the adverse contingencies that were simulated. Phase-to-ground faults were not simulated in this SIS since previously studied projects that had a larger output did not reveal any problems.

Summary of Post Transient Voltage Deviations.

Outages	Bus	Voltage Deviation
Lugo 500/230-kV Bank STO	No bus exceed more than 5%	
Lugo 500/230-kV Bank DTO	No bus exceed more than 10%	
Victor-Lugo 230-kV lines SLO	No bus exceed more than 5%	
Victor-Lugo 230-kV lines DLO	No bus exceed more than 10%	
Control-Inyokern 115-kV lines DLO	BSPHYD26 2.2	6.4%
	CONTROL 55.0	5.5%
	OXBOW B 230.0	-5.8%
Kramer-Inyokern-Randsburg 115-kV SLO	No bus exceed more than 5%	
Kramer-Lugo 230-kV line SLO	No bus exceed more than 5%	
Kramer-Lugo 230-kV lines DLO (Modified existing Kramer SPS by tripping additional generator)	No bus exceed more than 10%	
Kramer-Lugo 230-kV lines DLO (Without modifying existing Kramer SPS	AFG IND	13.50%
	APPLEVAL115.0	13.6%
	AQUEDUCT115.0	13.4%
	COTNWD 115.0	13.9%
	HESPERIA115.0	13.5%
	PHELAN 115.0	13.3%
	PLEUSS 115.0	13.6%
	ROADWAY 115.0	16.8%
	SAVAGE 115.0	13.5%
	SOPPORT 115.0	12.2%
	TAP601 115.0	16.8%
	TAP602 115.0	12.2%
	TAP603 115.0	10.1%
	TAP604 115.0	13.6%
	TAP605 115.0	13.6%
	TAP606 115.0	13.5%
	TAP607 115.0	13.4%
	TAP608 115.0	13.3%
	TAP709 115.0	5.6%
	VICTOR 115.0	13.2%
	PERMANTE115.0	14%
	GOLDHILS115.0	13.9%

C. Short Circuit Duty Study

In three-phase-to-ground and single-line-to-ground CB evaluation, the VV2 project did not trigger any circuit breakers upgrade. All replacement/upgrade circuit breakers were identified by generation projects ahead in the queue. Studies indicated that 68 SCE owned circuit breakers require replacement and 13 SCE owned circuit breakers require upgrades. It is estimated that circuit breaker replacement/upgrades will yield a total cost of $52.627 million.

Summary of Short-Circuit Duties, 3-Phase-to-Ground.

			PRE CASE		POST CASE		
Bus No.	Bus Name	Bus KV	X/R	KA	X/R	KA	DELTA KA
34066	ELDORADO	500	19.8	43	19.8	43.1	0.1
34128	LUGO	500	22	47.3	22.1	48.1	0.8
34146	MIRALOMA	500	24.8	36.6	24.8	36.8	0.2
34192	SERRANO	500	25.7	31.2	25.7	31.3	0.1
34210	VINCENT	500	18.5	41.1	18.5	41.3	0.2
34039	CHINO	230	17	49.8	17	49.9	0.1
34078	ETIWANDA	230	25.5	60.2	25.6	60.3	0.1
34213	JURUPA	230	12.9	24.8	12.9	24.9	0.1
34114	KRAMER	230	15.5	19.9	15.3	20.1	0.2
34127	LUGO	230	31.2	46.9	29.9	49.5	2.6
34143	MESA CAL	230	19.7	66.8	19.7	66.9	0.1
34147	MRLOMA E	230	23.3	64.4	23.3	64.6	0.2
34148	MRLOMA W	230	20.1	51.9	20.1	52	0.1
34167	PARDEE	230	17.6	55.9	17.6	56	0.1
34801	R VISTA	230	25.8	60.2	25.8	60.4	0.2
34191	SERRANO	230	25.8	53.7	25.8	53.8	0.1
34201	SYLMAR S	230	19.5	58.8	19.5	58.9	0.1
34207	VICTOR	230	15	25.7	16.6	30	4.3
34208	VILLA PK	230	22.7	46.8	22.7	46.9	0.1
34212	VISTA	230	19.3	49.5	19.3	49.6	0.1
34113	KRAMER	115	15	22.2	15	22.4	0.2
34866	SOPPORT	115	2.6	8.1	2.6	8.2	0.1
34864	TAP602	115	2.6	8.2	2.6	8.3	0.1
34206	VICTOR	115	15.2	18.2	16.2	18.8	0.6

Summary of Short-Circuit Duties, Single-Line-to-Ground.

			PRE CASE		POST CASE		
Bus No.	Bus Name	Bus KV	X/R	KA	X/R	KA	DELTA KA
142	Lugo	525	13.2	39.7	13.2	40.1	0.4
156	Mira Loma	525	14	32.5	13.9	32.6	0.1
388	Eldorado	230	16	54.6	16	54.7	0.1
396	Etiwanda	230	17	56.2	17	56.3	0.1
478	Lugo	230	26.4	49.4	25.4	51.4	2
498	Mesa	230	18.1	64.4	18.1	64.5	0.1
508	Mira Loma A	230	13.1	54.3	13.1	54.4	0.1
509	Mira Loma B	230	12.2	61.5	12.2	61.6	0.1
548	Pisgah	230	28.4	28.6	28.4	28.7	0.1
582	Serrano	230	18.6	55.3	18.6	55.4	0.1
603	Sylmar (SCE)	230	12.7	64.4	12.7	64.5	0.1
616	Victor	230	11.7	21.7	13	26.2	4.5

CONCLUSIONS

A. Power Flow Analysis

A third Victor-Lugo 230-kV line was assumed in-service in all post project cases. VV2 project would not be able to operate without this line.

2009 Heavy Summer and 2010 Light Spring (*without* system upgrades proposed by prior queue projects under Base Case, N-1 and N-2 Conditions:

Existing SCE facilities are not adequate to accommodate the VV2 project interconnecting at the SCE owned Victor 230 kV Substation for 2009 and 2010 operation. VV2 project will aggravate overloads to Lugo 500/230-kV transformer No.1 and No.2, Eldorado 230/115-kV transformer, Inyo 115-kV phase shifter, and Eldorado-Mountain Pass 115-kV line.

2009 Heavy Summer and 2010 Light Spring *with* system upgrades proposed by prior queue projects under Base Case, N-1 and N-2 Conditions:

With all system upgrades proposed by prior queue projects in service, no overloads were identified.

Sensitivity Study in 2009 Heavy Summer and 2010 Light Spring conditions under Base Case, N-1, N-2 conditions:

Without projects ahead in the application queue and system upgrades associated with these projects in service, Victor-Lugo 230-kV lines No.1, No.2, Lugo 500/230-kV transformer banks No.1 and No.2 were overloaded in base case and N-1 conditions. A third Victor-Lugo 230-kV line and a third Lugo 500/230-kV transformer bank will be needed before VV2 project comes in service. A detail SPS study will also be needed in the Facility Study to determine if the existing High Desert SPS needs to be expanded to include VV2 project, under the outages of Victor-Lugo 230-kV No.3 and No.1 or No.2 lines.

B. Short-Circuit Analysis

In three-phase-to-ground and single-line-to-ground CB evaluation, the VV2 project did not trigger any circuit breakers upgrade. All replacement/upgrade circuit breakers were identified by generation projects ahead in the queue. Studies indicated that 68 SCE owned circuit breakers require replacement and 13 SCE owned circuit breakers require upgrades. It is estimated that circuit breaker replacement/upgrades will yield a total cost of $52.627 million.

C. Transient and Post Transient

The simultaneous outage of Kramer-Lugo 230-kV Lines No.1 and No.2 (N-2) caused transient and post transient voltage violation throughout the North of Lugo area by only deploying the existing Kramer SPS. However, these violation would disappear if a third Kramer-Lugo 230-kV line which triggered by prior queue projects was in-service. If the prior projects withdraw from the queue, the existing Kramer SPS will have to be revised in order to maintain system stability and post transient voltage level.

FACILITIES STUDY

1. Develop cost and detail to modify the existing Kramer SPS in case of prior projects in the application queue withdraw.
2. Develop the detail cost for SCE system and direct assignment facilities that are required to interconnect the VV2 project.
   - Construct a third Victor-Lugo 230-kV line and ROW acquisition
   - Construct RTU, relay protection, metering and communication equipment
3. Perform a detail study to develop cost and generation arming level if the existing High Desert SPS needs to be expanded to include VV2 project, under the outages of Victor-Lugo 230-kV No.3 and No.1 or No.2 lines.

SCOPE OF WORK

Substation Components

<u>Victor Sub</u>

- Equip existing 230-kV position #2 as a double breaker position. $2.7 million.
- Relocate Victor-Lugo 230-kV line No.1 from pos. 3 to pos. 2S. $0.5 million.
- Terminate new 230-kV gen-tie at existing pos. 3N. $0.5 million.

<u>Lugo Sub</u>

- Add a third Lugo 500/230-kV transformer bank and protective equipment. $48 million.

ORDER of MAGNITUDE" SUBSTATION COST: $51,700,000

Transmission Components

- Construct a third line from Victor 230-kV bus to Lugo 230-kV bus, including terminal equipment at both Victor and Lugo substations. $20 million.

ORDER of MAGNITUDE" TRANSMISSION COST: $20,000,000

Note: Corporate real estate cost was not included in this "order of magnitude" estimate.

Circuit Breaker Upgrade/Replacement for three-phase-to-ground and single-line-to-ground SCD results

TRANSMISSION SYSTEM

CASE A - Triggered by Victorville 2 Project

All Circuit Breakers adequate. No replacements or upgrades required

CASE B - Triggered by earlier Projects ahead of Victorville 2 in Application Queue and aggravated by the Project

STATION	System	Replace	Upgrade	Sets of TRV's required	Cost of CB	Cost of TRV set of 3	Sub-Total CB	Sub-Total TRV	GRAND TOTAL
Etiwanda	220kV	24			$ 629,000		$ 15,096,000	$ -	$ 15,096,000
Lugo	220kV	3	2	2	$ 476,000	$ 144,000	$ 1,428,000	$ 288,000	$ 1,716,000
Mesa	220kV	23			$ 629,000		$ 14,467,000	$ -	$ 14,467,000
Mira Loma	220kV	12			$ 629,000		$ 7,548,000	$ -	$ 7,548,000
Mira Loma	500kV	2			$ 1,948,000		$ 3,896,000	$ -	$ 3,896,000
Pardee	220kV		7	9		$ 144,000	$ -	$ 1,296,000	$ 1,296,000
Vincent	500kV	4	4	4	$ 1,948,000	$ 204,000	$ 7,792,000	$ 816,000	$ 8,608,000
		68	13	15			$ 50,227,000	$ 2,400,000	$ 52,627,000

NOTES:
All costs in 2006 Dollars
ITCC Tax not included
Costs of upgrading the Etiwanda, Mesa and Mira Loma 220kV Switchyards to 83kA is not included

Notes: All cost estimates are rough order of magnitude, and are non binding cost estimates.

The transmission schedule would be the controlling element of the Project. All other elements would be well within the 30-Month time frame shown below.