# EXHIBIT 7

## TRANSMISSION SYSTEM IMPACT STUDY EXECUTIVE SUMMARY DATED MAY 13, 2005

- Letter from Southern California Edison to Calpine dated June 8, 2005
- Executive Summary Transmission System Impact Study dated May 13, 2005

SOUTHERN CALIFORNIA EDISON®
An EDISON INTERNATIONAL® Company

Robert J. Lugo
Mgr., Grid Interconnection
& Contract Development

June 8, 2005

Mr. Ali Amirali
Director of Transmission Management
Calpine Corporation – Pastoria Energy Facility, LLC
4160 Dublin Boulevard
Dublin, CA 94568

**Subject:** **Pastoria Expansion Project**
**Interconnection System Impact Study Results**

Dear Mr. Amirali:

Attached is a System Impact Study (Study) related to your Transmission Owners (TO) Tariff request for interconnection of an additional 157 MW simple cycle gas turbine generator at the existing Pastoria Energy Facility located near Lebec, California. A copy of the Study was also transmitted to you, in part, via email on May 13, 2005.

As identified in the Study, the existing transmission system is not adequate to accommodate the proposed 157 MW addition. A Facilities Study is necessary to determine the specific facilities, equipment modifications or additions that may be required as a result of the proposed generation increase and interconnection.

The Study results do not reflect any review or analysis by any third party. However, pursuant to Section 10.7 of the TO Tariff, a copy of this Study will be sent to the California Independent System Operator. If you elect to proceed with the interconnection process, copies may also be sent to the Western Electricity Coordinating Council and any transmission owner potentially impacted by the requested service. Review by these entities may necessitate modification to the Study. The cost of any Study revisions or mitigation requirements would be the responsibility of Calpine-Pastoria Energy Facility.

Within the next two weeks we intend to send you an executable Facilities Study Agreement. The Facilities Study Agreement will set forth the terms and conditions for SCE to perform the Facilities Study.

Please contact John Tucker at (626) 302-8623 if you have any questions regarding the Study or the forthcoming Facilities Study Agreement.

Sincerely,

John Tucker for

Robert J. Lugo

Attachment

c: Paul N. Steckley (CAISO) w/Attachment
Mark Willis (CAISO) w/Attachment
Judy Nickel (CAISO) w/o Attachment

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# PASTORIA ENERGY FACILITY, LLC
# PASTORIA ADDITION

## SYSTEM IMPACT STUDY

**May 13, 2005**

SOUTHERN CALIFORNIA
EDISON
An *EDISON INTERNATIONAL*℠ Company


Prepared by

Jorge Chacon

Southern California Edison Company


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for **Patricia L. Arons**
**Manager, Transmission**
**Interconnection Planning**

## EXECUTIVE SUMMARY

Pastoria Energy Facility (PEF) applied to the California Independent System Operator (CAISO) for Interconnection pursuant to Section 5.7 of the CAISO Tariff. Southern California Edison Company (SCE) performed a System Impact Study, as requested, for additional generation installation to the recently constructed Pastoria Energy Facility. The additional generation installation consists of a new gas fired generator with a net output of 157 MW (PEF Addition). The evaluations included study conditions with all generation projects in queue ahead of the Pastoria Addition.

The purpose of the System Impact Study is to determine the adequacy of SCE's transmission system to accommodate all or part of the requested capacity. This study identified that facility upgrades are necessary to mitigate thermal overload problems identified under base case, single outage, and double outage conditions. The results of the System Impact Study will be used to determine project cost allocation for facility upgrades. The study accuracy and the results from the assessment of the system adequacy are contingent on the accuracy of the technical data provided by the customer as shown in Figure 1 and Appendix H. Any changes to the attached data could invalidate the study results and may require reassessment.

The study includes power flow (steady-state and post-transient), transient stability and short-circuit duty analysis. The study was performed for two system conditions: (a) 2006 heavy summer load forecast (once-in-ten-year heat wave assumption) with very high internal northern area generation and high Midway-Vincent (Path 26) flow, and (b) 2007 spring load forecast (65% of 2006 heavy summer) with very high Big Creek Corridor generation and two Ventura area generation dispatch sensitivities in order to stress the Pardee and Antelope legs of the Big Creek Corridor. The following sections include discussion and study results of the System Impact Study for the PEF Addition.

### LOAD FLOW RESULTS

The study identified base case overload problems on the Antelope-Mesa 230 kV T/L, Antelope-Cottonwind 230 kV T/L, and Pardee-Pastoria-Warne 230 kV T/L triggered by a project(s) in queue ahead of the PEF Addition. Under heavy summer conditions with the PEF Addition, loading on the Antelope-Mesa 230 kV T/L and Antelope-Cottonwind 230 kV T/L were found to be 115% and 102% respectively. Under light spring conditions with the PEF Addition, loading on the Antelope-Mesa 230 kV T/L, Antelope-Cottonwind 230 kV T/L, and Pardee-Pastoria-Warne 230 kV T/L were found to be 114%, 112% and 110% respectively.

In addition, the study identified a total of eight single contingencies under heavy summer conditions and nine single contingencies under light spring conditions which resulted in thermal overload problems on transmission facilities in the Big Creek Corridor south of the SCE Magunden 230 kV substation. Under heavy summer conditions with the PEF Addition, five different 230 kV transmission lines were found to be impacted with loadings ranging from 109% to 123%. Under light spring conditions with the PEF

Addition, eight different 230 kV transmission lines were found to be impacted with loadings ranging from 108% to 148%.

Lastly, the study identified a total of fourteen double contingencies under heavy summer conditions and thirteen double contingencies under light spring conditions which resulted in thermal overload problems on transmission facilities in the Big Creek Corridor south of the SCE Magunden 230 kV substation or case non-convergence. Under heavy summer conditions with the PEF Addition, ten different 230 kV transmission lines were found to be impacted with loadings ranging from 102% to 187%. Under light spring conditions with the PEF Addition, nine different 230 kV transmission lines were found to be impacted with loadings ranging from 106% to 230%.

TRANSIENT STABILITY RESULTS

Transient stability studies determined that the system remained stable under both single and double contingency outage conditions with the existing Big Creek and Pastoria Energy Facility Special Protection Schemes (SPS). As a result, the need for the PEF Addition to participate in an SPS requires the entire PEF Addition to be tripped to mitigate the incremental contribution to thermal overload problems identified in this study.

Transient stability studies did not identify a violation of the recently WECC approved Generator Electric Grid Fault Ride-Through Capability Criteria.

SHORT-CIRCUIT DUTY RESULTS

Breakers at the following seven locations should be evaluated by SCE T/S Engineering to determine need for breaker replacement: Lugo 500 kV, Mammoth 230 kV, Magunden 230 kV, Pardee 230 kV, Pastoria 230 kV, Sylmar 230 kV, and Vincent 230 kV.

SPECIAL PROTECTION SCHEME REQUIREMENT

Due to SPS design limitations, the potential for system instability and gross thermal overloads identified under loss of two transmission facilities (N-2) in the Big Creek Corridor south of the Magunden Substation are currently mitigated by tripping the entire 750 MW Pastoria Energy Facility regardless of flow levels. This could result in a maximum potential generation trip of approximately 1,150 MW which corresponds to the sum total of the 750 MW Pastoria Energy Facility and the corresponding Big Creek Hydro Generation trip. In addition, all projects in queue ahead of the PEF Addition who contribute to the identified thermal overloads will need to participate in an SPS to mitigate their corresponding incremental loading contributions. As a result, the total amount of generation tripping potential under double outage contingencies with the inclusion of all queued projects could potentially increase in excess of 2,300 MW.

With the addition of new transmission facilities south of Antelope, Phase 1 and Phase 2 of the Antelope Transmission Project, the total amount of generation tripping could be

reduced down to approximately 1,700 MW which is still in excess of the 1,400 MW CAISO Spinning Reserve limit. As such, SCE will require CAISO Operational approval to exceed the currently established 1,400 MW N-2 generation tripping limit if use of an SPS for the PEF Addition is to be considered. Arming studies necessary to support the SPS design and approval by the WECC RAS Task Force will determine the exact amount of generation tripping requirements once they are completed. However, due to design limitations, the PEF Addition may require complete redesign of the recently installed PEF SPS.

LIMITED OPERATION STUDIES

The proposed in-service date for the PEF Addition is earlier than a number of generation and transmission projects ahead in queue. Due to system limitations, the PEF Addition will not be allowed to generate prior to these upgrades being in service without additional studies. Operational studies will be necessary to identify if the PEF Addition can be placed in-service on a temporary basis, under limited condition (output and period), prior to constructing the currently planned transmission upgrades, except for the Pastoria-Pardee Reconductor Project, and any new transmission upgrades identified for this project during the Facilities Study. The operation of the PEF Addition prior to the in-service date of the transmission projects identified in the Facilities Study will be subject to CAISO approval.

FACILITY STUDY

A **Facilities Study** will be required to determine the facilities and upgrades necessary to interconnect the proposed PEF Addition. The study should:

1. Investigate feasibility and develop cost associated with upgrading the existing Pastoria-Pardee-Warne 230 kV T/L. Thermal base case overload on this transmission line was triggered by a project in queue ahead of the PEF Addition. Prior to the inclusion of the PEF Addition, the overload was found to be marginal and therefore upgrade was not recommended. The transmission upgrade that should be evaluated is the reconductoring with new ACSS/TW class conductor such as a 1334.6 ACSS/TW or other conductor with mechanical properties similar to the existing 1033 ACSR in order to avoid tear-down of existing tower infrastructure.

2. If reconductor with new ACSS/TW class conductor is not feasible, develop cost associated with the complete tear-down and rebuild of the Pastoria-Pardee-Warne 230 kV T/L with bundled 1590 ACSR conductor.

3. For loss of two transmission lines in the Big Creek Corridor south of Magunden, investigate with the CAISO the possibility of tripping generation in excess of the current 1,400 MW limit.

4. If the CAISO does not allow tripping in excess of the current 1,400 MW N-2 Spinning Reserve limit, investigate feasibility and develop costs associated with a new 230 kV T/L from Pastoria to Pardee.

5. Perform Technical Assessments with the following upgrades modeled in the case in order to determine if sufficient capacity is made available with the upgrades in place:

   a. Upgrade to the existing Antelope-Mesa 230 kV T/L. This transmission upgrade was identified in a System Impact Study performed for a project in queue ahead of the PEF Addition. The project upgraded should involve complete tear-down and rebuild with

      i. 500 kV single-circuit construction standards between the SCE Antelope and SCE Rio Hondo substations

      ii. 230 kV double-circuit construction standards with a single bundled 1590 ACSR conductor between the SCE Rio Hondo and SCE Mesa 230 kV substations

   b. Upgrade the existing section of the Antelope-Magunden No.2 230 kV T/L south of the newly proposed Cottonwind 230 kV substation. This transmission upgrade was identified in a System Impact Study performed for a project in queue ahead of the PEF Addition. The project upgraded should involve complete tear-down and rebuild with bundled 1590 ACSR conductor.

   c. Upgrade to the existing Pardee-Pastoria-Warne 230 kV T/L with 1334.6 ACSS/TW.

   d. Path 26 dispatch at 3,700 MW consistent with May 2, 2005 upgraded Path Rating.

6. If the initial technical studies determine that operating the new 500 kV facilities at 230 kV is insufficient, then perform additional studies to reevaluate system operating 500 kV facilities at 500 kV.

7. Determine if a Special Protection Scheme can be utilized to mitigate any remaining single and double contingency overloads.

   a. If a special protection scheme is feasible, develop appropriate remedial action scheme, identify necessary protection requirements and develop cost.

   b. If a special protection scheme is found to be infeasible, identify additional transmission upgrades necessary to mitigate any remaining impacts and develop cost.

8. Evaluate circuit breakers at the seven locations identified in Table 5 and develop costs for any breaker replacements as applicable.

9. Reevaluate single-phase-to-ground and three-phase-to-ground short-circuit duty including transmission upgrades listed in Item 5, review any additional substation locations, and develop cost.

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May 13, 2005

## I. INTRODUCTION

Pastoria Energy Facility (PEF) applied to the California Independent System Operator (CAISO) for Interconnection pursuant to Section 5.7 of the CAISO Tariff. Southern California Edison Company (SCE) performed a System Impact Study, as requested, for additional generation installation to the recently constructed Pastoria Energy Facility. The additional generation installation consists of a new gas fired generator with a total net output of 157 MW (PEF Addition). The evaluations included study conditions with all generation projects in queue ahead of the Pastoria Addition.

The purpose of the System Impact Study is to determine the adequacy of SCE's transmission system to accommodate all or part of the requested capacity. This study will identify the extent of any congestion and determine if there are any negative impacts to reliability. New special protection schemes (SPS), facilities, or system upgrades will be recommended to maintain system reliability in accordance with the California Independent System Operator's (CAISO) Reliability Criteria. The existing system cannot accommodate the PEF Addition without transmission upgrades.

The results of the System Impact Study will be used to determine project cost allocation for facility upgrades. The study accuracy and the results for the assessment of the system adequacy are contingent on the accuracy of the technical data provided by the customer as shown in Figure 1 and Appendix H. Any changes to the attached data could invalidate the study results and may require reassessment.

The study includes power flow (steady-state and post-transient), transient stability, and short-circuit duty analysis. The study was performed for two system conditions: (a) 2006 heavy summer load forecast (once-in-ten-year heat wave assumption) with very high internal northern area generation and high Midway-Vincent (Path 26) flow, and (b) 2007 spring load forecast (65% of 2006 heavy summer) with very high Big Creek Corridor generation and two Ventura area generation dispatch sensitivities in order to stress the Pardee and Antelope legs of the Big Creek Corridor. The following sections include discussion and study results of the System Impact Study for the PEF Project Addition.

## II. STUDY CONDITIONS AND ASSUMPTIONS

### A. Planning Criteria

The supplemental study was conducted by applying the California Independent System Operator (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 subtransmission lines and 500/230 kV transformer banks ("AA-Banks"):

Assuming the largest unit (San Onofre Unit 2 or 3) initially off and then:

- Single Contingencies (loss of one line **or** one AA-Bank)

Assuming both San Onofre Units in service and then:

- Single Contingencies (loss of one line **or** one AA-Bank)

- 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 loading criteria are used:

| | | |
|---|---|---|
| Transmission Lines | Base Case | Limiting Component Normal Rating |
| | N-1 | Limiting Component A-Rating |
| | N-2 | Limiting Component B-Rating |
| 500/230 kV Transformer Banks | Base Case | Normal Loading Limit |
| | Long-Term & Short-Term | As defined by SCE Operating Bulletin No.33 |

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.

- Special protection schemes (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.

*Congestion Assessment*

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 PEF Addition (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 PEF Addition. 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 PEF Addition. The PEF Addition 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 PEF Addition 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).

*The results of these studies should be able to identify:*

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

b). if congestion still exists in the area with the inclusion of the PEF Addition and all projects ahead in queue under single and double element outage conditions assuming no new special protection schemes are in place

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

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

The range of base case congestion will be determined by reducing market generation projects in the various areas within the SCE northern system (i.e. Big Creek corridor, Ventura Area, Path 26, etc.). For single and double element outage conditions, the same methodology will be used to determine how much generation tripping is required in order to determine if use of special protection schemes is appropriate. Use of special protection schemes will be deemed inappropriate if the total amount of generation reduction is found to exceed 1,150 MW under loss of one transmission element and 1,400 MW under loss of two transmission elements. These limits are established by the CAISO utilizing the current Spinning Reserve Criteria.

## B. Pastoria Energy Facility Addition

The Pastoria Energy Facility is geographically located east of Interstate 5 north of Lebec, California. The Project Addition is to be connected to the recently constructed Lebec 230 kV Substation. Figure 1 below provides the single line diagram showing the proposed PEF Addition.

The inclusion of the PEF Addition is anticipated to impact flows on the Big Creek Corridor transmission lines south of Magunden. There are currently eleven 230 kV transmission lines south of Magunden that will increase to twelve with the addition of another project in queue ahead of the PEF Addition. Existing amp ratings for these transmission lines are provided below in Table 1.

**FIGURE 1**
**PASTORIA ENERGY FACILITY ADDITION**

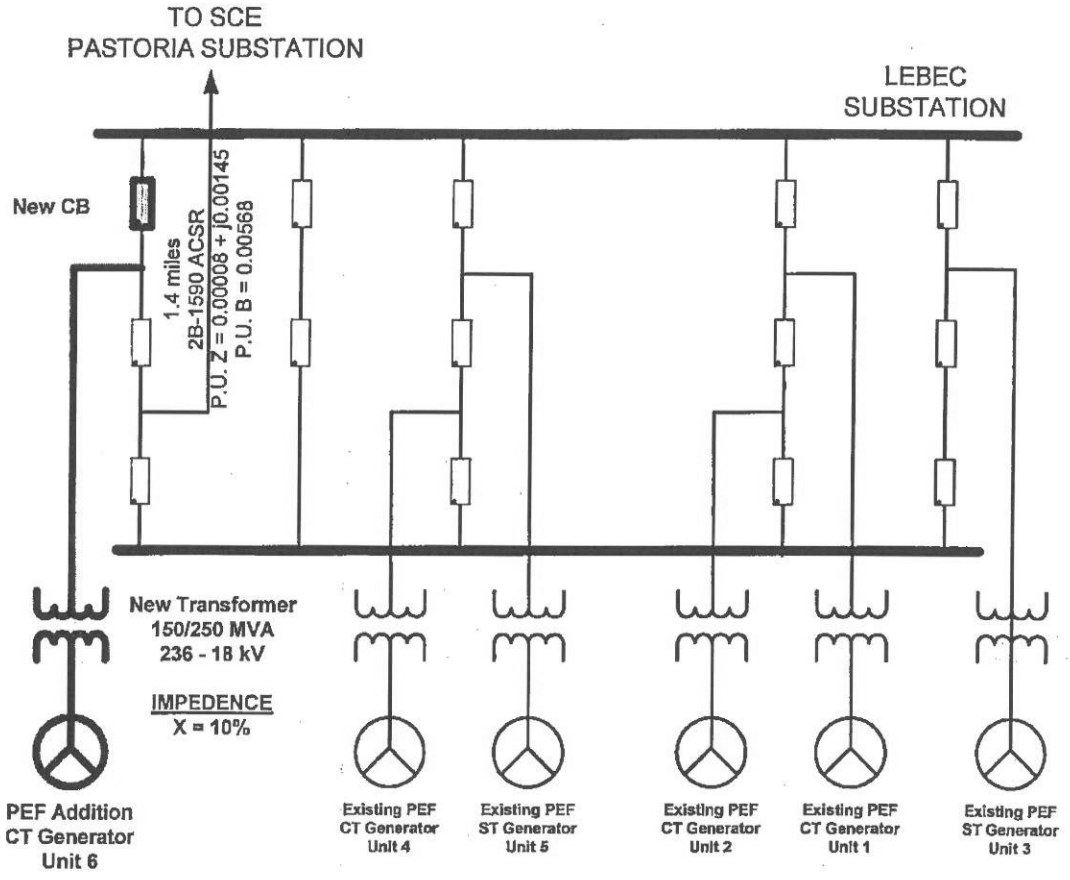


**TABLE 1**
**SOUTH OF MAGUNDEN TRANSMISSION LINE AMPACITY VALUES**

| Transmission Line | Normal | Long-Term Emergency | Short-Term Emergency |
|---|---|---|---|
| Antelope Magunden No.1 230 kV | 895 | 945 | 945 |
| Antelope-Mesa 230 kV | 895 | 1020 | 1190 |
| Antelope-Vincent 230 kV | 1240 | 1342 | 1342 |
| Antelope-Cottonwind 230 kV | 1240 | 1320 | 1342 |
| Cottonwind-Magunden 230 kV | 1240 | 1342 | 1342 |
| Magunden-Pastoria No.1 230 kV | 825 | 936 | 936 |
| Magunden-Pastoria No.2 230 kV | 825 | 936 | 936 |
| Magunden-Pastoria No.3 230 kV | 1150 | 1320 | 1342 |
| Bailey-Pardee 230 kV | 1500 | 1500 | 1500 |
| Pardee-Pastoria 230 kV | 1500 | 1500 | 1500 |
| *Pardee*-Pastoria-Warne 230 kV | 1240 | 1342 | 1342 |
| Pardee-*Pastoria*-Warne 230 kV | 1240 | 1342 | 1342 |
| Bailey-Pastoria 230 kV | 1500 | 1500 | 1500 |

## C. Currently Planned Transmission Projects

Wind generation interconnection requests in the Antelope Valley and Tehachapi Area ahead of the PEF Addition have triggered the need for additional transmission projects or upgrades in the Big Creek Corridor. These upgrades include the new transmission facilities from the SCE Antelope Substation to the SCE Pardee and SCE Vincent substations as outlined below. An application for a Certificate of Public Convenience and Necessity (CPCN) has been filed for these upgrades by SCE with the California Public Utilities Commission (CPUC). The following transmission facilities for which a CPCN application was filed were modeled into the starting power flow cases:

- Segment 1 of the Antelope Transmission Project - a new 500 kV transmission line (bundled 2156 ACSR) initially energized at 230 kV from the Antelope substation to Pardee substation (approved by the CAISO)

- Segment 2 of the Antelope Transmission Project - a new 500 kV transmission line (bundled 2156 ACSR) initially energized at 230 kV from the Antelope substation to Vincent substation (not yet approved by the CAISO)

- Segment 3 of the Antelope Transmission Project (not yet approved by the CAISO):

    - a new radial 500 kV transmission line (bundled 2156 ACSR) initially energized at 230 kV from the Antelope substation to the potential location of a conceptual substation hub referred to as Tehachapi Substation #1 near Cal Cement

    - a new 230 kV transmission line (bundled 1590 ACSR) from the location of the Tehachapi Substation #1 to the location of a second conceptual substation referred to as Tehachapi Substation #2 near Monolith

    - a new substation near Monolith with two line positions (one for line to Antelope and one for line to the Barren Ridge I Wind Project which then continues to the Barren Ridge II Wind Project) referred to as Tehachapi Substation #2.

In addition to the above transmission projects, the Pastoria-Pardee Reconductor Project was also included into the starting power flow cases. This project was identified as an infrastructure replacement project and consists of reconductoring two of the three lines south of Pastoria (Pastoria-Bailey, Bailey-Pardee and Pastoria-Pardee 230 kV 605 ACSR conductored transmission lines) with a new 666.6 ACSS/TW conductor. The new conductor will increase the thermal conductor rating of these two lines from 885 amps up to 1500 amps. The third transmission line south of Pastoria (Pastoria-Pardee-Warne 230 kV) is not part of this project and therefore will be limited to a maximum conductor rating of 1240 amps based on conductor

type. This project is currently under construction with the Pastoria-Bailey 230 kV line already upgraded. Upgrades to the remaining lines will be done commencing on October 2005 and be completed by April 2006.

Need for additional transmission upgrades have been identified in System Impact Studies performed for projects ahead in queue of the PEF Addition. These upgrades are currently being explored as part of the corresponding Facilities Study and may provide additional capacity for the PEF Addition. These potential upgrades include complete tear-down and rebuild of the existing Antelope-Mesa 230 kV transmission line. Neither a CPCN application has not been filed with the CPUC for this transmission upgrade nor has the CAISO granted approval for such an upgrades. As such, these projects were not included into the starting base cases.

## D. System Conditions

To simulate the SCE transmission system for analysis, the study used databases that were used to conduct the SCE Annual CAISO Controlled Facilities Expansion Program. The bulk power study considered scenarios that evaluated maximum Midway-Vincent[1] imports[2] and maximum generation from the Big Creek hydro units, Qualified Facilities, and market generation in the Big Creek and Ventura areas. Pump loads were assumed off for both the heavy summer and light spring conditions. These conditions were examined to identify loading scenarios that would stress the SCE 500 kV transmission system network and the 230 kV Big Creek corridor. In addition, the study considered three load conditions: 2006 heavy summer, 2007 light spring stressing the Pardee leg of the Big Creek corridor, and 2007 light spring stressing the Antelope leg of the Big Creek Corridor.

## E. Big Creek Remedial Action Scheme

The Big Creek system has several existing remedial action schemes (RAS) for single and double element outage conditions. The relevant elements of the existing Big Creek RAS that may be impacted by the proposed PEF Addition are as follows:

1. An overload of the following lines will initiate an automatic runback of the generation units at Mammoth Pool and/or Eastwood. Eastwood will not runback if in pump mode.

    - Magunden-Pastoria No.1 230-kV
    - Magunden-Pastoria No.2 230-kV
    - Magunden-Pastoria No.3 230-kV

[1] Midway-Vincent lines interconnect Northern California with Southern California and are referred to as Path 26. Maximizing Midway-Vincent flow increases imports through the SCE 500 kV network.
[2] Imports were set to 3,400 MW in accordance with the existing WECC Path Rating at time of application. It should be noted that Path rating studies are currently underway to evaluate further increasing path rating to 3,700 and 4,000 MWs.

2. An SEL-68 stability relay located at Magunden will run-back the generation units at Mammoth Pool and/or Eastwood for growing oscillations and trip for unstable power swings. Eastwood will not be tripped if in pump mode.

3. At any time that the Big Creek and San Joaquin Valley RAS is inoperative or if the SEL-68 stability trip relay at Magunden is unavailable, the following limitation will apply:

   - Big Creek Project (Big Creek 1, 2, 3, 4, 8, Mammoth Pool, Portal PH, and Eastwood) net generation output is limited as defined by System Operating Bulleting No.204.
   - The power flow south of the SCE Magunden substation is limited to 1180 MW with all five lines in service.

## F. New PEF Special Protection Schemes

The initial Pastoria Energy Facility 750 MW project required a new Special Protection Scheme (PEF SPS) for loss of one or two transmission facilities. This new SPS has been approved by the WECC RAS Task Force and has already been placed in service. The following outlines the outages that can result in the potential operation of the new PEF SPS:

Single Outages

1. Loss of Antelope-Magunden No.1 230 kV
2. Loss of Antelope-Magunden No.2 230 kV
3. Loss of Pastoria-Edmonston 230 kV
4. Loss of Pastoria-Pardee 230 kV
5. Loss of Pastoria-Pardee-Warne 230 kV
6. Loss of Pardee-Bailey 230 kV
7. Loss of Pastoria-Bailey 230 kV

Double Outages

1. Loss of Antelope-Magunden No.1 and No.2 230 kV lines
2. Loss of Antelope-Vincent and Antelope-Mesa 230 kV lines
3. Loss of Pastoria-Pardee-Warne and Pastoria-Pardee 230 kV lines
4. Loss of Pastoria-Pardee-Warne and Pastoria-Bailey 230 kV lines
5. Loss of Pastoria-Pardee-Warne and Pardee-Bailey 230 kV lines
6. Loss of Pastoria-Pardee and Pastoria-Bailey 230 kV lines
7. Loss of Pastoria-Pardee and Pardee-Bailey 230 kV lines

Maintenance Outages

Under maintenance conditions, the proposed PEF SPS will arm the entire Pastoria Energy Facility (750 MW) to trip for the next outage condition.

The PEF SPS design is by far the most complicated Special Protection Scheme in service to protect the SCE network. The scheme has a total of 28 arming points, which is the current maximum number of arming points that SCE will consider in implementing an SPS. Twenty-seven of the twenty-eight arming points are utilized to trip individual units at the Pastoria Energy Facility (five units) under the outages outlined above. The design of the scheme groups the seven single outages into five arming categories in order to limit the number of arming points required for single outages to twenty-five (5 arming buckets x 5 units = 25) in a fashion that provides the most flexibility. For loss of two transmission lines, the entire PEF project is tripped thereby requiring only one arming point. An additional arming point is utilized to handle maintenance outages and overlapping outages.

Generation projects in queue ahead of the PEF addition were identified to potentially require implementation of special protection schemes. Since the PEF SPS cannot be expanded beyond the current design, complete redesigned of the RAS may be necessary. Such redesign may involve tripping the proposed project addition for each of the outages previously identified. New facility upgrades will be required if it is determined that use of SPS cannot be implemented for the PEF addition. Results of the study will be used to determine if redesigned of the PEF RAS may be used to accommodate the additional generation unit.

## G. Power Flow Study

The system impact studies evaluated a total of six different power flow study scenarios. Transmission projects were included in order to identify if the need for additional delivery upgrades are necessary. Further description of the additional case assumptions follows:

1. Big Creek Corridor under 2006 heavy summer with all currently planned transmission upgrades and generation projects in queue ahead of the PEF Addition, Case 1.

   Upgraded Big Creek Corridor to include all transmission projects and a 2006 heavy summer load forecast with high internal generation in the SCE northern area electrical system. Generation included: Year 2004 reliability must-run, regulatory must-take, all existing generation in the basin area, and all other proposed generation projects in queue ahead of the proposed Pastoria Addition. Generation patterns were maximized in the SCE northern area, with the South of Lugo limit enforced, in order to identify extent of potential congestion after the in-service of the proposed project

2. Big Creek Corridor under 2006 heavy summer with all currently planned transmission upgrades and the inclusion of the PEF Addition, Case 2.

   Case 1 was modified to include the PEF Addition. South of Lugo flow was not enforced in order to determine project contribution to the South of Lugo loading problem.

3. Big Creek Corridor under 2007 light spring with all currently planned transmission upgrades and generation projects in queue ahead of the PEF Addition while stressing the Pardee leg of the Big Creek corridor, Case 3

   Upgraded Big Creek Corridor to include all transmission projects and a 2007 light spring load forecast with high internal generation in the SCE northern area electrical system. Generation included: Year 2004 reliability must-run, regulatory must-take, all existing generation in the basin area, and all other proposed generation projects in queue ahead of the proposed PEF Addition. Generation patterns were maximized in the SCE northern area, except for Ventura Area generation which was assumed off-line, in order to identify the extent of potential congestion after the in-service of the proposed project when stressing the Pardee leg of the Big Creek corridor.

4. Big Creek Corridor under 2007 light spring with all currently planned transmission upgrades and the inclusion of the PEF Addition while stressing the Pardee leg of the Big Creek Corridor, Case 4

   Case 3 was modified to include the PEF Addition.

5. Big Creek Corridor under 2007 light spring with all currently planned transmission upgrades and generation projects in queue ahead of the PEF Addition while stressing the Antelope leg of the Big Creek corridor, Case 5.

   Case 3 was modified to adjust interchanges between Arizona and California so that Ventura area generation can be dispatched to reflect 35% of total nameplate capacity available in order to stress the Antelope leg of the Big Creek corridor.

6. Big Creek Corridor under 2007 light spring with all currently planned transmission and the inclusion of the PEF Addition while stressing the Antelope leg of the Big Creek Corridor, Case 6

   Case 5 was modified to include the PEF Addition.

**TABLE 2**
**POWER FLOW STUDY ASSUMPTIONS (MW)**

| | Heavy Summer | | Light Spring Stress Pardee | | Light Spring Stress Antelope | |
|---|---|---|---|---|---|---|
| **Area Assumptions** | **Case 1 Pre** | **Case 2 Post** | **Case 3 Pre** | **Case 4 Post** | **Case 5 Pre** | **Case 6 Post** |
| Generation | 15,679 | 15,702 | 7,299 | 7,322 | 8,106 | 8,128 |
| Import | 7,462 | 7,462 | 6,828 | 6,827 | 6,027 | 6,028 |
| Load | 22,553 | 22,553 | 13,625 | 13,625 | 13,625 | 13,625 |
| System Losses | 588 | 611 | 502 | 524 | 508 | 531 |
| | | | | | | |
| **Major Flows** | | | | | | |
| Path 26 | 3,390 | 3,388 | 3,391 | 3,389 | 3,371 | 3,367 |
| East-of-River | 3,121 | 3,121 | 2,287 | 2,483 | 1,785 | 1,782 |
| West-of-River | 3,940 | 3,944 | 3,737 | 3,735 | 3,069 | 3,067 |
| South of Magunden | 716 | 716 | 1,077 | 1,077 | 1,077 | 1,077 |
| North of Lugo | 967 | 967 | 28 | 27 | 26 | 26 |
| South of Lugo | 5,799 | 5,853 | 4,542 | 4,597 | 4,574 | 4,630 |
| South of Pardee & Vincent | 3,400 | 3,509 | 3,007 | 3,119 | 3,468 | 3,579 |
| SCIT | 12,787 | 12,785 | 10,187 | 10,181 | 9,498 | 9,495 |

## H. Transient Stability Study

The following study conditions were utilized in conducting the transient stability assessment:

- An SEL-68 stability relay located at Magunden that is part of the Big Creek Remedial Action Scheme (RAS) could result in either run back or tripping of the Big Creek hydro generation depending on stable or unstable power swings, which occur under extremely high south of Magunden flows. To examine potential impacts to the existing Special Protection Schemes, all single contingency conditions were evaluated with south of Magunden power flows adjusted prior to adding the PEF Addition so that loss of any one line did not trigger the Big Creek RAS.

- For double contingency conditions, south of Magunden power flows were maximized to determine if additional wind generation adversely aggravates the existing special protection schemes (SPS) in the Big Creek Corridor and triggers need to include additional generation units into the existing Special Protection Schemes.

- Standard fault clearing times were applied for single outage contingencies assuming three-phase-to-ground faulted conditions. These times include 6-cycle fault clearing for 230 kV faults in the Big Creek corridor, 5-cycle fault clearing for 230 kV faults in the main LA Basin (south of the Vincent and Pardee substations), and 4-cycle fault clearing for 500 kV faults.

- Standard fault clearing times were applied for double outage contingencies assuming single-phase-to-ground faulted conditions.

- Delayed fault clearing times were applied for single contingencies assuming single-line-to-ground faulted conditions.

### I. Short -Circuit Duty

To determine the impact on short-circuit duty after inclusion of the PEF Addition, the study calculated the maximum symmetrical three-phase-to-ground short-circuit duties at the most critical locations. Bus locations where short-circuit duty is increased with the PEF Addition by at least 0.1 KA and the duty is in excess of 60% of the minimum breaker nameplate rating are flagged for further review in the Facilities Study. Generator and transformer data as provided by the customer was used according to the generator and transformer data sheets.

## III. GENERATOR ELECTRIC GRID FAULT RIDE-THROUGH CAPABILITY CRITERIA

WECC has recently adopted a Generator Electrical Grid Fault Ride-Through Capability Criteria. The purpose of this Low Voltage Ride-Through Criteria is to ensure continued reliable service. The Criteria is summarized as follows:

1. Generators are required 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. This requirement does not apply to faults that would occur between the generator terminals and the high side of the generator step-up transformer or to faults that would result in a voltage lower than 0.15 per unit as measured on the high side of the generator step up transformer.

2. In the post-fault transient period, generators are required to remain in-service for the low voltage 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 does not apply to a site where the sum of the installed capabilities of all machines is less than 10MVA, unless it can be proven that reliability concerns exist.

5. This Standard applies to any generation independent of the interconnected voltage level.

6. This standard can be met by the performance of the generators or by installing additional equipment (e.g. SVC, etc.).

7. Existing individual generator units that are, or have been, interconnected to the network at the same location at the time of the adoption of this Standard are exempt from meeting this Standard for the remaining life of the existing generation equipment. Existing individual generator units that are replaced are required to meet this Standard.

Table W-1
WECC DISTURBANCE-PERFORMANCE TABLE
OF ALLOWABLE EFFECTS ON OTHER SYSTEMS

| NERC and WECC Categories | Outage Frequency Associated with the Performance Category (Outage/Year) | Transient Voltage Dip Standard | Minimum Transient Frequency Standard | Post-Transient Voltage Deviation Standard (See Note 2) |
|---|---|---|---|---|
| A | Not Applicable | Nothing in Addition to NERC | | |
| B | ≥ 0.33 | Not to exceed **25%** at load buses or **30%** at non-load buses.<br>Not to exceed **20% for more than 20 cycles** at load buses. | Not below **59.6 Hz** for 6 cycles or more at a load bus | Not to exceed **5%** at any bus |
| C | 0.033 – 0.33 | Not to exceed 30% at any bus.<br>Not to exceed **20% for more than 40 cycles** at load buses. | Not below **59.0 Hz** for 6 cycles or more at a load bus | Not to exceed **10%** at any bus |
| D | < 0.033 | Nothing in Addition to NERC | | |

Note 2: As an example in applying the WECC Disturbance-Performance Table, Category B disturbance in one system shall not cause a transient voltage dip in another system that is greater than 20% for more than 20 cycles at load buses, or exceed 25% at load buses or 30% at non-load buses at any time other than during the fault.

## IV. DYNAMIC MODELS

GE PSLF Version 14.2, adopted by WECC, supports the generation models proposed by for the PEF Addition.

genrou

This model is used for a solid rotor generator that is represented by equal mutual inductance rotor modeling.

ggovl

This model is used to represent a general governor model that is proposed to be used with this generator.

exst4b

This model is used to represent an IEEE type ST4b excitation system proposed to be used with this generator.

pss2a

This model is used to represent a dual input power system stabilizer (IEEE type PSS2A) proposed to be used with this generator.

## V. POWER FLOW RESULTS

The need for additional transmission line upgrades south of Antelope was identified with the addition of previous generation projects in queue ahead of the PEF Addition. SCE was ordered to file an application for a Certificate for Public Convenience and Necessity (CPCN) with the California Public Utility Commission (CPUC) for transmission facilities necessary to integrate wind generation pursuing interconnection via the FERC mandated CAISO Interconnection process as well as other conceptual wind generation projects located in the Antelope Valley and Tehachapi Region[3]. As a result, these studies were performed with the assumption that transmission upgrades south of Antelope as discussed in the Assumptions Section were in service prior to inclusion of the PEF Addition. These upgrades are part of the Antelope Transmission Project (ATP) and involve new transmission from the Antelope Substation to the Pardee Substation located in Santa Clarita, from Antelope to Vincent. The Antelope, Pardee, and Vincent Substations are located in the Lancaster area, Santa Clarita, and Acton area respectively.

The following presents the power flow study results. Power flow plots are provided in Appendix A (Heavy Summer), Appendix B (Light Spring w/o Ventura area generation) and Appendix C (Light Spring with 35% Ventura area generation). Details of heavy summer results are provided in Table 7-1 while Light Spring results stressing the Antelope and Pardee Legs of the Big Creek Corridor are provided in Table 7-2 and Table 7-3 respectively.

BASE CASE

With the addition of generation at the existing Pastoria Energy Facility, the study identified two transmission lines with base case overloads during summer conditions and three transmission lines with base case overloads during spring conditions. These overloads are summarized below in Table 3-1.

[3] CPUC Decision 04-06-010

Table 3-1
Base Case Thermal Overloads

| Impacted Transmission Lines | Heavy Summer | | Light Spring | |
|---|---|---|---|---|
| | Pre | Post | Pre | Post |
| Antelope-Cottonwind 230 kV | 97.0% | 101.7% | 107.4% | 112.0% |
| Antelope-Mesa 230 kV | 112.5% | 114.7% | 111.0% | 114.3% |
| Pardee Leg of Pardee-Pastoria-Warne 230 kV | - | - | 101.2% | 109.7% |

It should be noted that the Pardee-Pastoria-Warne 230 kV T/L is not part of the Pastoria-Pardee Reconductor Project and therefore will require mitigation of identified overload problem. In addition, this line is limited due to line clearance so congestion management protocols need to be established such that the loading can be decreased in a short period.

SINGLE OUTAGE CONTINGENCY (N-1)

Under heavy summer conditions, eight single contingencies were identified to result in line loadings that are in excess of the maximum allowable limit on five different transmission lines. Two of the five impacted transmission lines were also identified to experience base case condition thermal loadings in excess of maximum allowable limit. Two of the three single contingency outage impacted transmission lines that are not identified to be a base case overload are triggered by a project in queue ahead of the PEF Addition but are aggravated with the PEF Addition. The remaining transmission line overload identified under heavy summer load conditions is triggered with the PEF Addition. Highest loading on impacted transmission line is summarized below in Table 3-2 with a more detailed summary provided in Table 7-1 located in the Table Section.

Table 3-2
Heavy Summer Thermal Overloads
Under Loss of One Transmission Facility

| **Impacted Transmission Line** | **Worst Single Contingency** | **Pre** | **Post** |
|---|---|---|---|
| Antelope-Cottonwind 230 kV | Antelope-Magunden 230 kV T/L | 114.3% | 120.4% |
| Antelope-Magunden 230 kV | Antelope-Cottonwind 230 kV T/L | 114.9% | 122.6% |
| Antelope-Mesa 230 kV | Mesa-Vincent 230 kV T/L | 130.4% | 134.3% |
| Antelope-Vincent 230 kV (Existing) | New Antelope-Vincent 230 kV T/L | 102.3% | 108.9% |
| Pardee-Pastoria-Warne 230 kV | Bailey-Pastoria 230 kV T/L | 110.5% | 122.0% |

Under light spring conditions, a total of nine single contingencies were identified to impact eight transmission lines. Three of these eight impacted transmission lines were also identified as base case overload problems. Overloads on the remaining five impacted transmission lines were found to be triggered by a project in queue ahead of the PEF Addition and are aggravated with the inclusion of the PEF Addition. Of these five transmission lines, two involve overloads on south of Pastoria transmission facilities that are currently being upgraded from 605 ACSR conductor (885 amps) to 666.6 ACSS/TW conductor (1500 amps). The 666.6 ACSS/TW conductor transmission lines do not have

emergency capability due to conductor limitations (normal rating is equal to emergency rating). Since the inclusion of the PEF Addition adversely increases the tripping potential for the 750 MW Pastoria Energy Facility, the PEF Addition will be required to mitigate such incremental impact by either adding new facilities or participating in a new Special Protection Scheme (SPS) that trips the PEF Addition if use of such SPS is found to be acceptable.

Highest loading on impacted transmission line is summarized below in Table 3-3 with a more detailed presentation provided in Table 7-2 and Table 7-3 located in the Table Section

Table 3-3
Light Spring Thermal Overloads
Under Loss of One Transmission Facility

| Impacted Transmission Line | Worst Single Contingency | Pre | Post |
|---|---|---|---|
| Antelope-Cottonwind 230 kV | Pardee-Pastoria 230 kV T/L | 120.6% | 138.1% |
| Antelope-Magunden 230 kV | Antelope-Cottonwind 230 kV T/L | 133.7% | 141.4% |
| Antelope-Mesa 230 kV | Mesa-Vincent 230 kV T/L | 127.0% | 130.5% |
| Antelope-Vincent 230 kV (Existing) | New Antelope-Vincent 230 kV T/L | 120.6% | 126.8% |
| Bailey-Pardee 230 kV | Pardee-Pastoria 230 kV T/L | 99.2% | 107.9% |
| Bailey-Pastoria 230 kV | Pardee-Pastoria 230 kV T/L | 106.7% | 116.1% |
| Pardee-Pastoria 230 kV | Bailey-Pastoria 230 kV T/L | 102.4% | 111.8% |
| Pardee-Pastoria-Warne 230 kV | Bailey-Pastoria 230 kV T/L | 136.4% | 148.2% |

DOUBLE OUTAGE CONTINGENCY (N-2)

The studies identified a total of fourteen "likely" double contingencies impacting ten different 230 kV transmission lines. All impacted ten different transmission lines were found to be impacted by projects in queue ahead of the PEF Addition. The inclusion of the PEF Addition aggravates these overloads and therefore will be required to participate in mitigation measures. Most incremental impacts are in the order of 10 to 20 percent. In addition, several double outage contingencies did not result in a converging solution indicating a potential voltage collapse. The use of a special protection scheme will only be considered if the CAISO concurs that the current 1,400 MW N-2 maximum generation trip limit can be exceeded. The details of these double outage contingencies are provided in Table 7-1, Table 7-2, and Table 7-3.

## VI. TRANSIENT STABILITY STUDY RESULTS

*Single Contingencies (N-1)*

As discussed in the assumptions section, all single contingency transient stability studies were conducted by applying a three-phase-to-ground bus fault at critical locations. These locations involved substations in the Big Creek corridor between Magunden, Pardee, and Vincent. Results of the transient stability analysis indicate that the system remains stable

under loss of one transmission line and operation of any corresponding special protection schemes. Single contingency transient stability plots prior to including the PEF Addition and after including the PEF Addition are provided in Appendix D and Appendix E respectively. Table 4 below summarizes the critical outages examined and provides study results.

Table 4-1
Single Contingency
Transient Stability Study Results

| Type of Outage | Fault Type | Fault Duration | Transmission Line Outage | Stability Results |
|---|---|---|---|---|
| Single | 3Ø | 6 cycles | Antelope-Magunden No.1 230 kV | Stable |
| Single | 3Ø | 6 cycles | Antelope-Mesa 230 kV | Stable |
| Single | 3Ø | 6 cycles | New Antelope-Pardee 230 kV | Stable |
| Single | 3Ø | 6 cycles | New Antelope-Vincent 230 kV | Stable |
| Single | 3Ø | 6 cycles | Proposed Antelope-Cottonwind 230 kV | Stable |
| Single | 3Ø | 6 cycles | Bailey-Pastoria 230 kV | Stable |
| Single | 3Ø | 6 cycles | Magunden-Pastoria No.3 230 kV | Stable |
| Single | 3Ø | 6 cycles | Proposed Magunden-Cottonwind 230 kV | Stable |
| Single | 3Ø | 6 cycles | Pardee-Bailey 230 kV | Stable |
| Single | 3Ø | 6 cycles | Pardee-Pastoria 230 kV | Stable |
| Single | 3Ø | 6 cycles | Pastoria-Pardee-Warne 230 kV | Stable |

*Double Contingencies (N-2)*

As discussed in the assumptions section, all double contingency studies were conducted by applying a single-phase-to-ground bus fault at critical locations. These locations involved substations in the Big Creek corridor between Magunden, Pardee, and Vincent. Results of the double contingency transient stability analysis indicate that the inclusion of the PEF Addition does not adversely impact system stability. All identified transient stability problems are mitigated by either existing special protection schemes (Big Creek RAS and PEF SPS) or by previously identified need for additional SPS triggered by a project in queue ahead of the PEF Addition. As a result, the need for tripping the PEF Addition is dictated by the incremental thermal loading contribution associated with the PEF Addition. Double contingency transient stability plots prior to the PEF Addition and after including the PEF Addition are provided in Appendix F and Appendix G respectively. Table 4-2 below summarizes the critical outages examined and provides study results.

Table 4-2
Double Contingency
Transient Stability Study Results

| Type of Outage | Fault Type | Fault Duration | Transmission Line Outage | Stability Results |
|---|---|---|---|---|
| Double | 1Ø | 6 cycles | Antelope-Magunden No.1 230 kV<br>Proposed Antelope-Cottonwind 230 kV | Stable |
| Double | 1Ø | 6 cycles | Antelope-Mesa 230 kV<br>Antelope-Vincent 230 kV | Stable |
| Double | 1Ø | 6 cycles | New Antelope-Vincent 230 kV<br>Antelope-Vincent 230 kV | Stable |
| Double | 1Ø | 6 cycles | Antelope-Magunden No.1 230 kV<br>Proposed Magunden-Cottonwind 230 kV | Stable |
| Double | 1Ø | 6 cycles | Magunden-Pastoria No.2 230 kV<br>Magunden-Pastoria No.3 230 kV | Stable |
| Double | 1Ø | 6 cycles | Bailey-Pastoria 230 kV<br>Pardee-Pastoria 230 kV | Stable |
| Double | 1Ø | 6 cycles | Pardee-Pastoria 230 kV<br>Pardee-Pastoria-Warne 230 kV | Stable |
| Double | 1Ø | 6 cycles | Pardee-Bailey 230 kV<br>Pardee-Pastoria 230 kV | Stable |
| Double | 1Ø | 6 cycles | Pardee-Bailey 230 kV<br>Pardee-Pastoria-Warne 230 kV | Stable |

## VII. SHORT CIRCUIT DUTY STUDY RESULTS

The results of the maximum symmetrical three-phase-to-ground short circuit duty at the critical buses in the SCE bulk transmission system are summarized below in Table 6. The study results indicate that the PEF Addition increases short-circuit duties by an amount equal or greater than 0.1kA at seven locations were duty is in excess of 60% of the minimum breaker nameplate rating. The following summarizes the impact of the PEF addition:

- At Pastoria 230kV substation bus, the short-circuit duty is increased by 1.8kA from 31.4 to 33.2kA

- Breakers at the seven locations listed below in Table 5 should be evaluated by SCE T/S Engineering to determine need for breaker replacement.

Table 5
Three-Phase-to-Ground Short-Circuit Duty Results

| Substation | Bus KV | Pre-Project | | Post-Project | | DELTA |
|---|---|---|---|---|---|---|
| | | X/R | KA | X/R | KA | KA |
| Pastoria | 230 | 14.1 | 31.4 | 14.8 | 33.2 | 1.8 |
| Magunden | 230 | 10 | 21.2 | 10 | 21.5 | 0.3 |
| Pardee | 230 | 17.3 | 54.5 | 17.2 | 54.7 | 0.2 |
| Lugo | 500 | 21.7 | 43.7 | 21.7 | 43.8 | 0.1 |
| Mammoth | 230 | 10.5 | 7.6 | 10.5 | 7.7 | 0.1 |
| Sylmar S. | 230 | 19.5 | 57.7 | 19.4 | 57.8 | 0.1 |
| Vincent | 230 | 19.5 | 54 | 19.5 | 54.1 | 0.1 |

## VIII. CONCLUSION

LOAD FLOW RESULTS

The study identified base case overload problems on the Antelope-Mesa 230 kV T/L, Antelope-Cottonwind 230 kV T/L, and Pardee-Pastoria-Warne 230 kV T/L triggered by a project(s) in queue ahead of the PEF Addition. Under heavy summer conditions with the PEF Addition, loading on the Antelope-Mesa 230 kV T/L and Antelope-Cottonwind 230 kV T/L were found to be 115% and 102% respectively. Under light spring conditions with the PEF Addition, loading on the Antelope-Mesa 230 kV T/L, Antelope-Cottonwind 230 kV T/L, and Pardee-Pastoria-Warne 230 kV T/L were found to be 114%, 112% and 110% respectively.

In addition, the study identified a total of eight single contingencies under heavy summer conditions and nine single contingencies under light spring conditions which resulted in thermal overload problems on transmission facilities in the Big Creek Corridor south of the SCE Magunden 230 kV substation. Under heavy summer conditions with the PEF Addition, five different 230 kV transmission lines were found to be impacted with loadings ranging from 109% to 123%. Under light spring conditions with the PEF Addition, eight different 230 kV transmission lines were found to be impacted with loadings ranging from 108% to 148%.

Lastly, the study identified a total of fourteen double contingencies under heavy summer conditions and thirteen double contingencies under light spring conditions which resulted in thermal overload problems on transmission facilities in the Big Creek Corridor south of the SCE Magunden 230 kV substation or case non-convergence. Under heavy summer conditions with the PEF Addition, ten different 230 kV transmission lines were found to be impacted with loadings ranging from 102% to 187%. Under light spring conditions with the PEF Addition, nine different 230 kV transmission lines were found to be impacted with loadings ranging from 106% to 230%.

## TRANSIENT STABILITY RESULTS

Transient stability studies determined that the system remained stable under both single and double contingency outage conditions with the existing Big Creek and Pastoria Energy Facility Special Protection Schemes (SPS). As a result, the need for the PEF Addition to participate in an SPS requires the entire PEF Addition to be tripped to mitigate the incremental contribution to thermal overload problems identified in this study.

Transient stability studies did not identify a violation of the recently WECC approved Generator Electric Grid Fault Ride-Through Capability Criteria.

## SHORT-CIRCUIT DUTY RESULTS

Breakers at the following seven locations should be evaluated by SCE T/S Engineering to determine need for breaker replacement: Lugo 500 kV, Mammoth 230 kV, Magunden 230 kV, Pardee 230 kV, Pastoria 230 kV, Sylmar 230 kV, and Vincent 230 kV.

## SPECIAL PROTECTION SCHEME REQUIREMENT

Due to SPS design limitations, the potential for system instability and gross thermal overloads identified under loss of two transmission facilities (N-2) in the Big Creek Corridor south of the Magunden Substation are currently mitigated by tripping the entire 750 MW Pastoria Energy Facility regardless of flow levels. This could result in a maximum potential generation trip of approximately 1,150 MW which corresponds to the sum total of the 750 MW Pastoria Energy Facility and the corresponding Big Creek Hydro Generation trip. In addition, all projects in queue ahead of the PEF Addition who contribute to the identified thermal overloads will need to participate in an SPS to mitigate their corresponding incremental loading contributions. As a result, the total amount of generation tripping potential under double outage contingencies with the inclusion of all queued projects could potentially increase in excess of 2,300 MW.

With the addition of new transmission facilities south of Antelope, Phase 1 and Phase 2 of the Antelope Transmission Project, the total amount of generation tripping could be reduced down to approximately 1,700 MW which is still in excess of the 1,400 MW CAISO Spinning Reserve limit. As such, SCE will require CAISO Operational approval to exceed the currently established 1,400 MW N-2 generation tripping limit if use of an SPS for the PEF Addition is to be considered. Arming studies necessary to support the SPS design and approval by the WECC RAS Task Force will determine the exact amount of generation tripping requirements once they are completed. However, due to design limitations, the PEF Addition may require complete redesign of the recently installed PEF SPS.

LIMITED OPERATION STUDIES

The proposed in-service date for the PEF Addition is earlier than a number of generation and transmission projects ahead in queue. Due to system limitations, the PEF Addition will not be allowed to generate prior to these upgrades being in service without additional studies. Operational studies will be necessary to identify if the PEF Addition can be placed in-service on a temporary basis, under limited condition (output and period), prior to constructing the currently planned transmission upgrades, except for the Pastoria-Pardee Reconductor Project, and any new transmission upgrades identified for this project during the Facilities Study. The operation of the PEF Addition prior to the in-service date of the transmission projects identified in the Facilities Study will be subject to CAISO approval.

FACILITY STUDY

A **Facilities Study** will be required to determine the facilities and upgrades necessary to interconnect the proposed PEF Addition. The study should:

1. Investigate feasibility and develop cost associated with upgrading the existing Pastoria-Pardee-Warne 230 kV T/L. Thermal base case overload on this transmission line was triggered by a project in queue ahead of the PEF Addition. Prior to the inclusion of the PEF Addition, the overload was found to be marginal and therefore upgrade was not recommended. The transmission upgrade that should be evaluated is the reconductoring with new ACSS/TW class conductor such as a 1334.6 ACSS/TW or other conductor with mechanical properties similar to the existing 1033 ACSR in order to avoid tear-down of existing tower infrastructure.

2. If reconductor with new ACSS/TW class conductor is not feasible, develop cost associated with the complete tear-down and rebuild of the Pastoria-Pardee-Warne 230 kV T/L with bundled 1590 ACSR conductor.

3. For loss of two transmission lines in the Big Creek Corridor south of Magunden, investigate with the CAISO the possibility of tripping generation in excess of the current 1,400 MW limit.

4. If the CAISO does not allow tripping in excess of the current 1,400 MW N-2 Spinning Reserve limit, investigate feasibility and develop costs associated with a new 230 kV T/L from Pastoria to Pardee.

5. Perform Technical Assessments with the following upgrades modeled in the case in order to determine if sufficient capacity is made available with the upgrades in place:

    a. Upgrade to the existing Antelope-Mesa 230 kV T/L. This transmission upgrade was identified in a System Impact Study performed for a project in queue ahead of the PEF Addition. The project upgraded should involve complete tear-down and rebuild with

i. 500 kV single-circuit construction standards between the SCE Antelope and SCE Rio Hondo substations

ii. 230 kV double-circuit construction standards with a single bundled 1590 ACSR conductor between the SCE Rio Hondo and SCE Mesa 230 kV substations

b. Upgrade the existing section of the Antelope-Magunden No.2 230 kV T/L south of the newly proposed Cottonwind 230 kV substation. This transmission upgrade was identified in a System Impact Study performed for a project in queue ahead of the PEF Addition. The project upgraded should involve complete tear-down and rebuild with bundled 1590 ACSR conductor.

c. Upgrade to the existing Pardee-Pastoria-Warne 230 kV T/L with 1334.6 ACSS/TW.

d. Path 26 dispatch at 3,700 MW consistent with May 2, 2005 upgraded Path Rating.

6. If the initial technical studies determine that operating the new 500 kV facilities at 230 kV is insufficient, then perform additional studies to reevaluate system operating 500 kV facilities at 500 kV.

7. Determine if a Special Protection Scheme can be utilized to mitigate any remaining single and double contingency overloads.

   a. If a special protection scheme is feasible, develop appropriate remedial action scheme, identify necessary protection requirements and develop cost.

   b. If a special protection scheme is found to be infeasible, identify additional transmission upgrades necessary to mitigate any remaining impacts and develop cost.

8. Evaluate circuit breakers at the seven locations identified in Table 5 and develop costs for any breaker replacements as applicable.

9. Reevaluate single-phase-to-ground and three-phase-to-ground short-circuit duty including transmission upgrades listed in Item 5, review any additional substation locations, and develop cost.