Development Plan for the
Phased Expansion of

Electric Power Transmission Facilities
in the
Tehachapi Wind Resource Area

Second Report
of the
Tehachapi Collaborative Study Group

Volume 5 of 5: Appendix 4

California Public Utilities Commission

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The report is printed in 5 volumes or electronic files:

- **Volume 1 contains the Second Report;**
- **Volume 2 contains Study Plan #2 the basis for the Second Report (referred to in the Report as Appendix 1);**
- **Volume 3 contains the PG&E Studies (referred to as Appendix 2);**
- **Volume 4 contains the SCE Studies (referred to as Appendix 3);**
- **Volume 5 contains the CAISO Studies and all remaining Appendices 5, 6 and 7.**

Appendix 4

CAISO STUDIES

APPENDIX 4

CAISO STUDIES

Production Cost Simulation Methodology and Tool

ABB's GridView production cost simulation software was used to evaluate the relative ranking of the transmission alternatives under consideration. This tool provides an economic optimization of the generation dispatches to minimize the total hourly production cost for the transmission system that is subject to generation, transmission and operational constraints. The output of the production simulation tool is processed to estimate the comparative production cost, loss and congestion savings of each of the alternatives, to assist in determining differences, if any, of the transmission alternatives.

The program input data includes:

- Generation data such as capacity, fuel costs, heat rates, maintenance schedule, start up cost, shut down cost, up time, down time, forced outage rate and outage duration.
- Transmission data such as network topology, thermal limits and operational constraints.
- Hourly demand data and distribution.
- Hourly hydro and wind dispatch.

The program output result includes hourly dispatch for each generation unit, hourly production cost, hourly transmission line flows and Locational Marginal Prices (LMP) at each node.

The production cost simulation was performed to determine annual production costs of the entire WECC system for the various alternatives being considered to incorporate over 4000 MW of wind potential in the Tehachapi area. These simulations provide both economic and operational information to assist in determining a relative ranking of the transmission alternatives. The analysis was used to compare differences in the WECC production cost, power losses and congestion hours resulting from the alternative transmission configurations being considered. The analysis did not consider other potential benefits such as reduction in reliability-must-run generation cost, reduction in emission and increased operational flexibility. It should also be noted that potential concerns involved with the intermittency of wind and its potential impacts on system operation such as regulation and reserve are not part of this evaluation. The analysis is based on all lines in-service and does not consider any contingency or loss of facility conditions.

Base Case Assumptions

The 2008-SSG-WI (Seams Steering Group-Western Interconnection) base case developed by SSG-WI Planning Work Group (PWG) and also used in the recent is Imperial Valley Study[1] was used as a starting case to maintain consistent assumption between similar studies. Summarized below are the assumptions used in the starting base case that are common to both the Tehachapi and the Imperial Valley studies:

- The base case included the generation and transmission infrastructure that may be assumed to be in place by 2008. Generation units with official retirement dates prior to 2008 were modeled out of service.
- SSG-WI PWG developed approximate industrial figures for variable and non-variable operation and maintenance costs, minimum and incremental heat rates, forced outage rate and outage duration for different generation units based on fuel type, technology, size and age. SSG-WI generation assumptions also include start up/shut down costs, minimum up time/down time and maintenance duration for different generation units. Table 1 summarizes SSG-WI generation assumptions.
- SSG-WI base case assumed average hydro conditions. Hydro generation outputs were modeled as an hourly resource. Similarly, all wind generators were modeled as an hourly resource. Hourly resources are considered as must-take resource and are therefore not optimized. The existing wind generation dispatch was based on historical data.
- SSG-WI base case transmission representation model is based on the WECC 2008 HS2-SA approved case, dated February 2004. An updated case developed by the SSG-WI received 8/5/2005 was used for the analysis.
- SSG-WI PWG used publicly available data including WECC load and resources report to construct 2008 monthly peak and energy amounts for each of the power flow area. The area loads were then spatially spread to the entire WECC network using load distribution factors as used in power flow model.
- Average monthly fuel (Gas, Coal, Uranium) prices for generation plants were forecasted for 2008. The prices were adjusted to account for the cost of delivering the fuel to the generation plant. Detailed description of SSG-WI fuel pricing assumptions is available at http://www.ssg-wi.com/documents/.

The Tehachapi wind generation dispatch profile shown in Figure 3 was provided by National Renewable Energy Laboratory (NREL) and is based on 70 meter rotors, 7.5 m/s wind speed and a 2% unavailability (45% capacity factor). Based on a potential of 4500 MW in the area, this wind profile was scaled and assumed a total annual production of 17,209,942 MWH from the Tehachapi and Antelope wind. For simplicity the 4500 MW was modeled at the Tehachapi bus. The Tehachapi wind was dispatched as base load generation - modeled hourly and represented no fuel or maintenance cost.

[1] Development Plan for the Phased Expansion of Transmission to Access Renewable Resource in the Imperial Valley, dated September 30,2005

<table>
<tr><th>Fuel Type</th><th>Technology</th><th>Size/MW</th><th>Vintage</th><th>Min. Heat Rate (Btu/kWh)</th><th>Variable O&M Cost ($/MWh)</th><th>Forced Outage Rate</th><th>Forced Outage Duration (hrs)</th></tr>
<tr><td rowspan="4">Gas/Oil</td><td rowspan="4">Steam</td><td><100</td><td rowspan="2"><1960</td><td>12,194</td><td rowspan="3">5.001</td><td rowspan="4">0.071</td><td rowspan="4">55</td></tr>
<tr><td>>100</td><td>9,125</td></tr>
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<tr><td rowspan="5">Gas</td><td>SCCT</td><td>-</td><td rowspan="2"><1985</td><td>11,403</td><td>8.001</td><td>0.036</td><td>89</td></tr>
<tr><td>CCCT</td><td>-</td><td>9,600</td><td rowspan="3">5.001</td><td>0.055</td><td>22</td></tr>
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<tr><td>SCCT</td><td>>70</td><td>12,106</td></tr>
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<tr><td>>1985</td><td>10,695</td></tr>
<tr><td rowspan="2">Oil</td><td>IC</td><td>-</td><td>-</td><td>9,125</td><td>13.250</td><td rowspan="2">0.036</td><td rowspan="2">55</td></tr>
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<tr><td>Uranium</td><td>Nuclear</td><td>-</td><td>-</td><td>-</td><td>-</td><td>0.070</td><td>298</td></tr>
</table>

Table 1 SSG-WI Generation Assumptions

The SSG-WI base case was modified with the CAISO load level to reflect forecasted 2010 conditions. In addition, the following new transmission projects in southern California that are approved and planned to be online by 2010 were included in the model:

- Harquahala-Devers 500 kV line
- New 500 kV Substation to be located at the Midpoint of Palo Verde- Devers and Harquahala-Devers 500 kV lines
- Blythe I and II Combined Cycle plant (1000 MW) connecting to Midpoint Substation
- Reconductoring of four West of Devers 230 kV lines

Table 2 provides specific non-simultaneous interface limits enforced in the production cost optimization runs for interfaces within the immediate area of the study.

Table 2: Non-Simultaneous Interface Limits

Interface	North-South Flow (MW)	South-North Flow (MW)
COI	4800	3675
Path 15	3265	5000[1]
Path 26	3700[2]	3000

Notes:
1) Path 15: 5,000 MW S-N is supported by RAS that trips generation connected to Midway. The Path 15 limit will be decreased by 1 MW for every 2 MW decrease in Midway generation (La Paloma, Sunrise, Elk Hills).
2) Path 26: Power flow between 3,000 MW and 3,700 MW N-S is supported by a RAS that trips Midway area generation. The Path 26 limit will be decreased by 1 MW for every 2 MW decrease in Midway generation (La Paloma, Sunrise, Elk Hills). Assumed Path 26 capability N-S increased to for 4000 MW as provided SCE for Alternatives 1, 3 and 10 that include a new 500 kV Tehachapi-Midway line. Detail studies are required to determine actual capability with the new transmission.

In addition, the following transmission facility assumptions were simulated as part of the study.

- Transmission models and ratings used for alternatives were provided by SCE and PG&E.
- With a new Midway-Tehachapi 500 kV line, the Path 26 N-S thermal capability was assumed to be 4000 MW for production cost simulation studies.
- All WECC transmission paths were modeled according to 2005 Path rating catalog
- Limits for all 500 kV transmission facilities were enforced.
- Lower voltage (230 kV and below) limits were not enforced.
- SCIT limit was modeled at 17900 MW
- EOR limit was modeled at 9255 MW
- WOR limit was modeled at 11318 MW

- All AC transmission lines monitored were limited to 95% of their thermal capacity or applicable rating in order to accommodate reactive flows which are absent in this production simulation studies.
- Nomograms were used to reflect transmission system constraints.
- Transmission losses were modeled.
- Transmission line/Path limit violation penalty of $1000 per MWh was applied.

The following figures supplement the productions cost simulation analysis and are provided for informational purposes.

A The following Figure 1 illustrates the Path 15 and Path 26 interfaces with the existing and new transmission under the various alternatives Path 15 includes additional underlying 230 kV transmission not shown.

Figure 1 – Interface Definitions

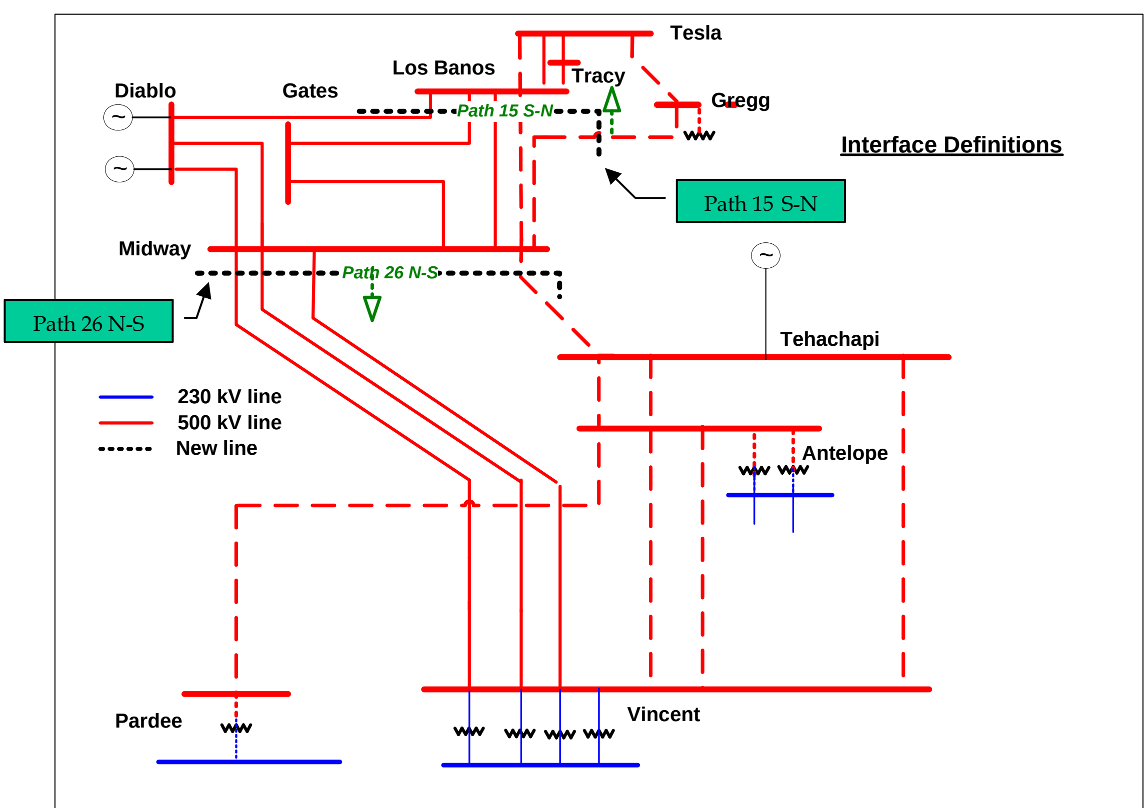


Figure 2 – Path 15 and Path 26 Historical

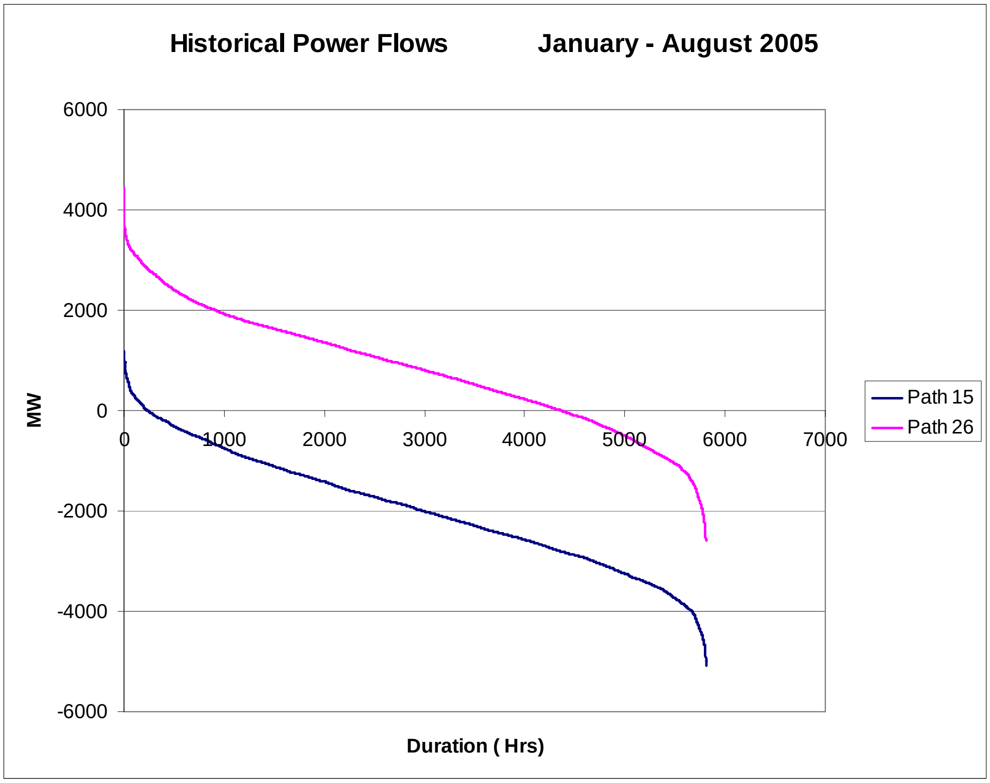


Figure 3 – Tehachapi Wind Load Duration Curve

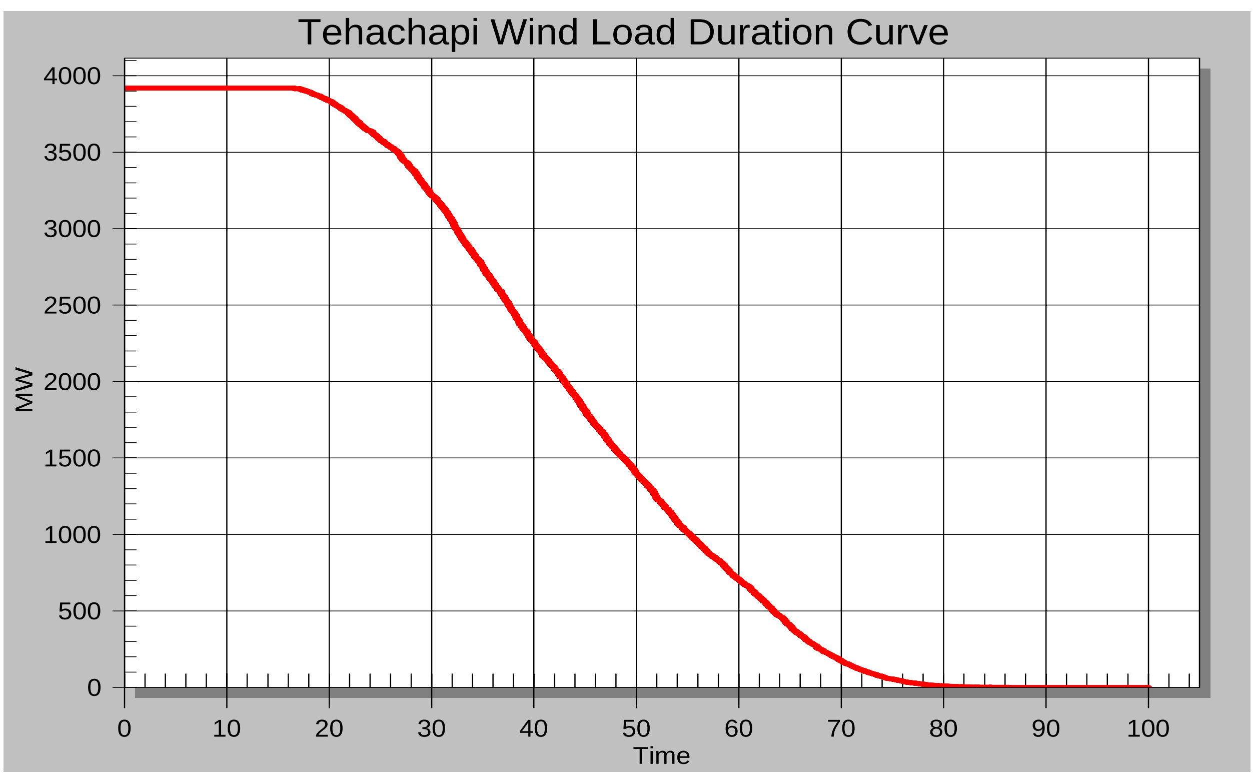


Figure 4 – Flows During a Peak Summer Day With Tehachapi Wind

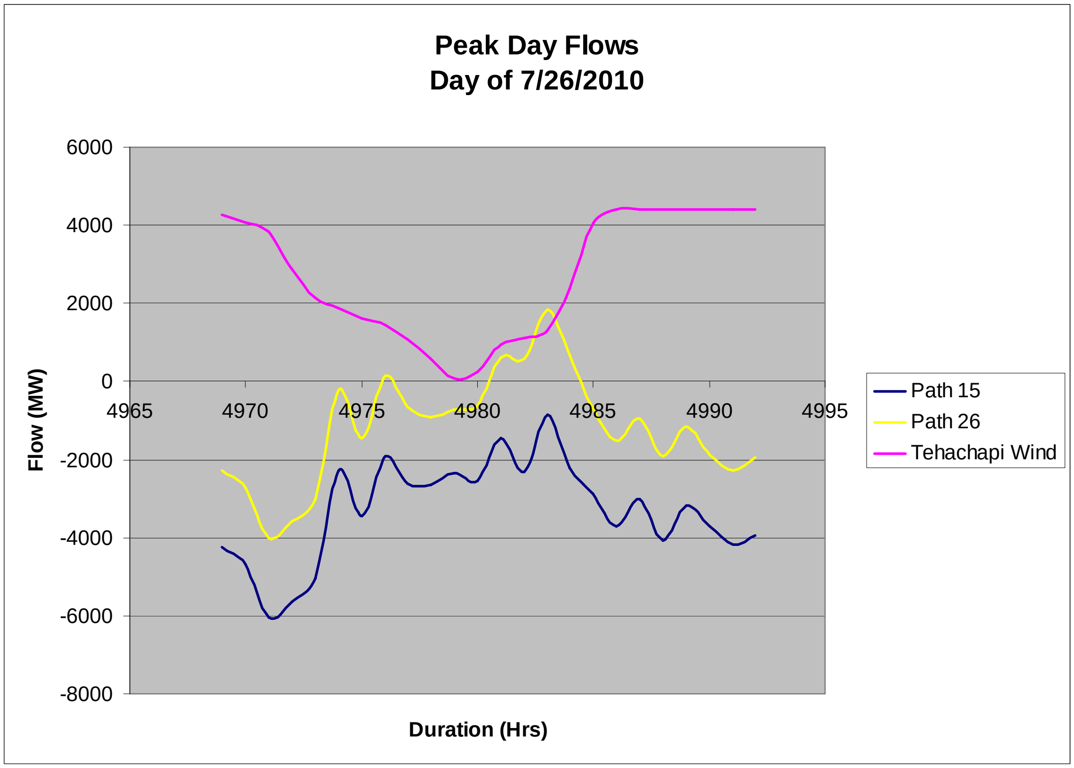


Figure 5 – Flows During a Off-Peak Summer Day With Tehachapi Wind

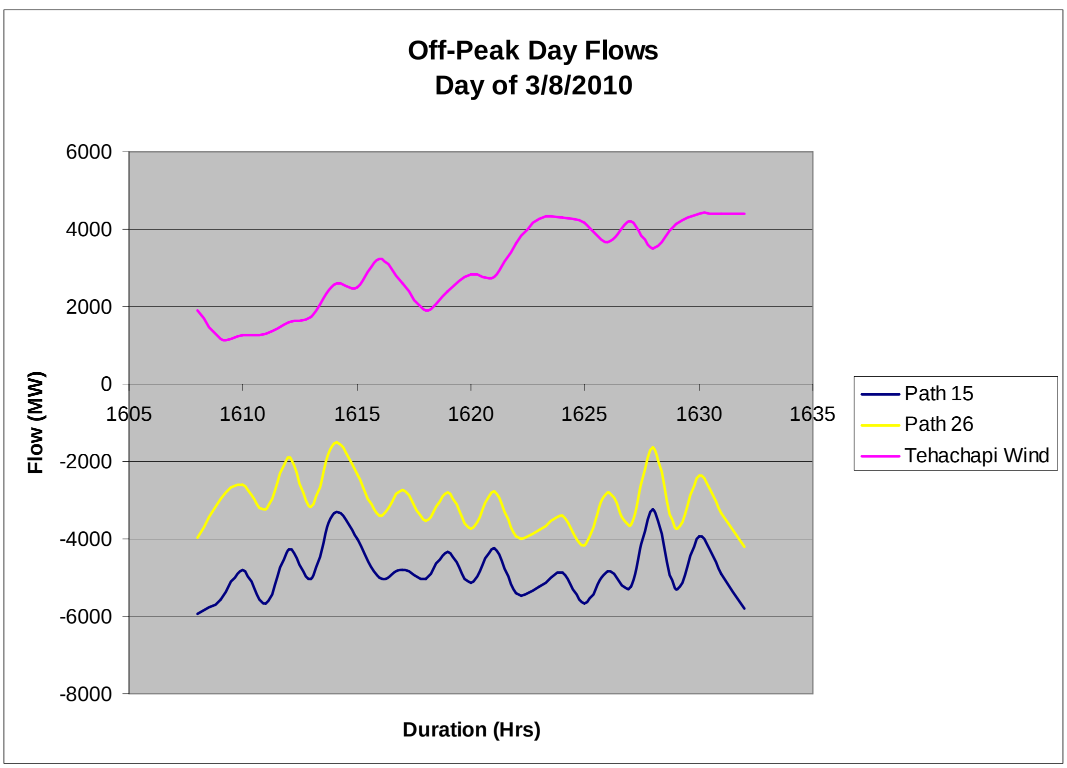


Figure 6 – Comparison of Path 26 Flows With 4500 MW Tehachapi Wind

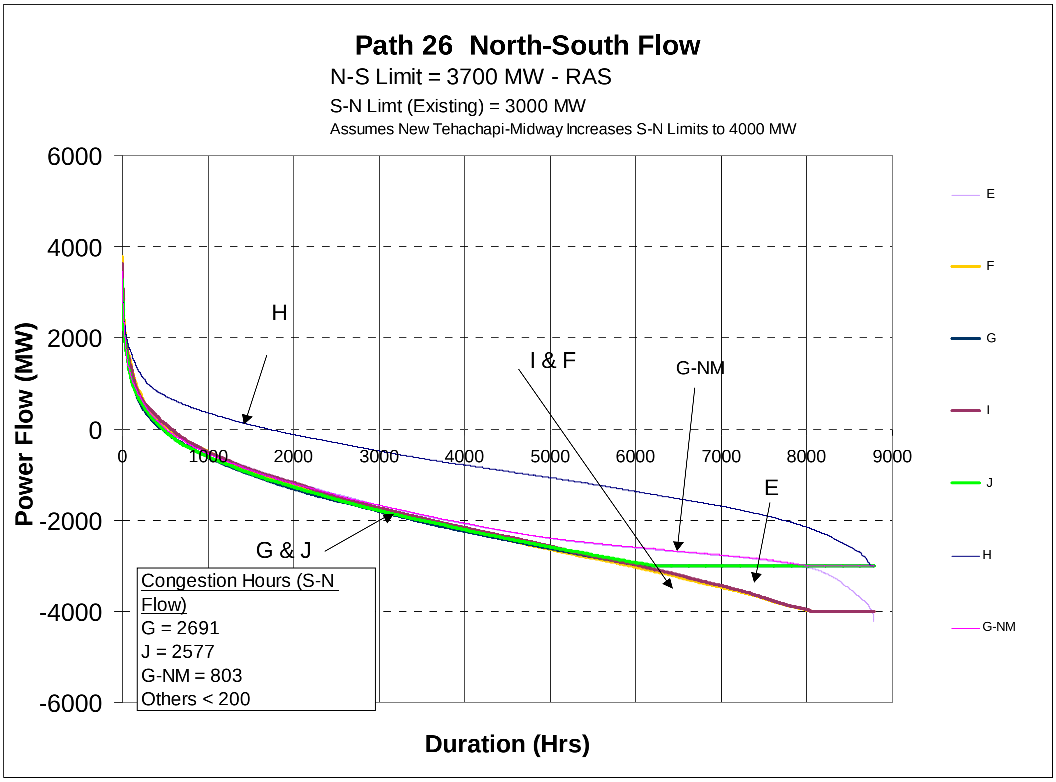


Figure 7 – Comparison of Path 15 Flows With 4500 MW Tehachapi Wind

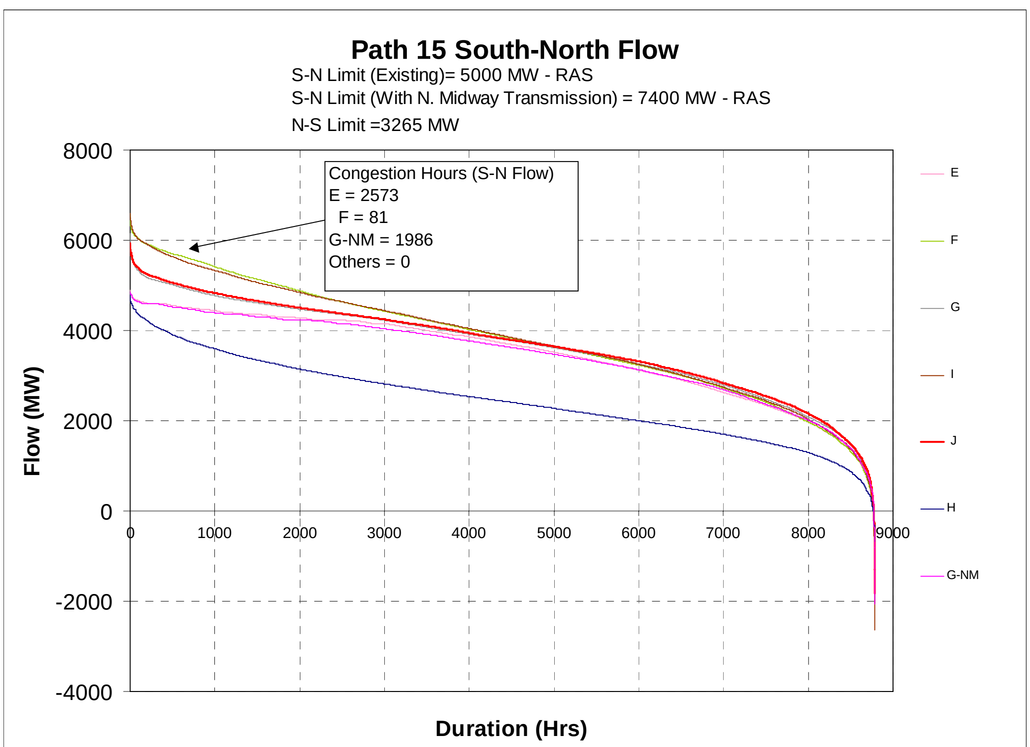


Figure 8 – +/- 600 MW Fresno Phase Shifter Power Flow With 1600 MW Tehachapi Wind

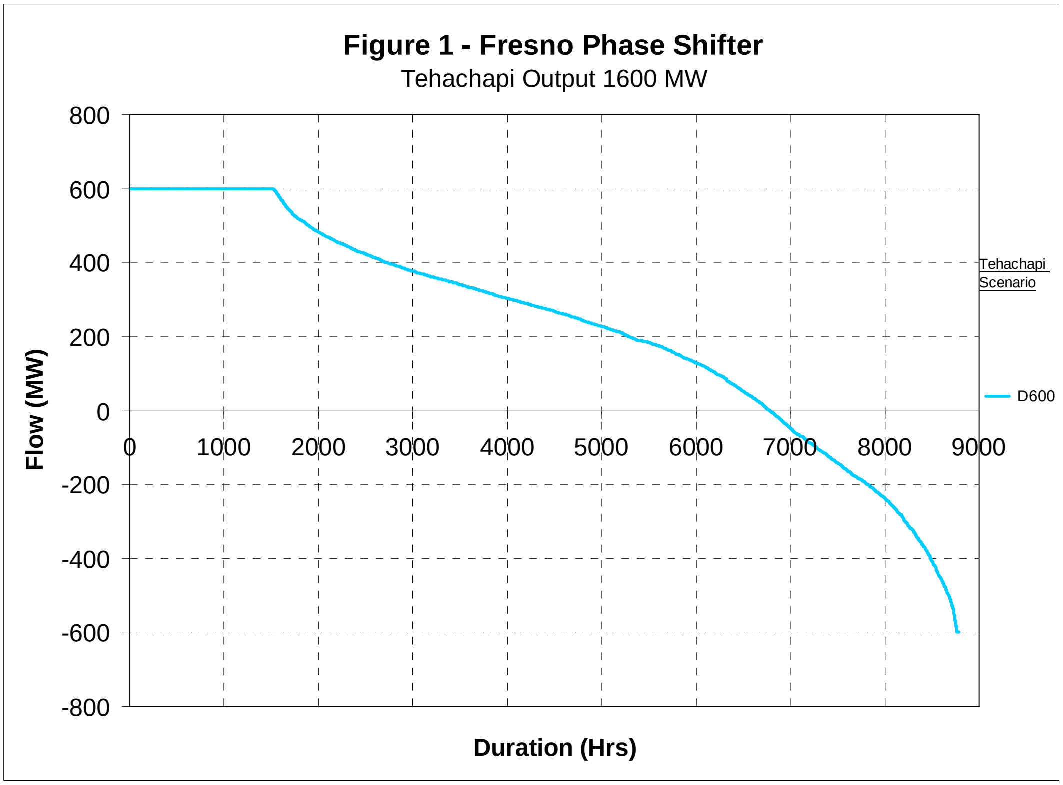


Figure 9 – +/- 600 MW Fresno Phase Shifter Angle Range With 1600 MW Tehachapi Wind

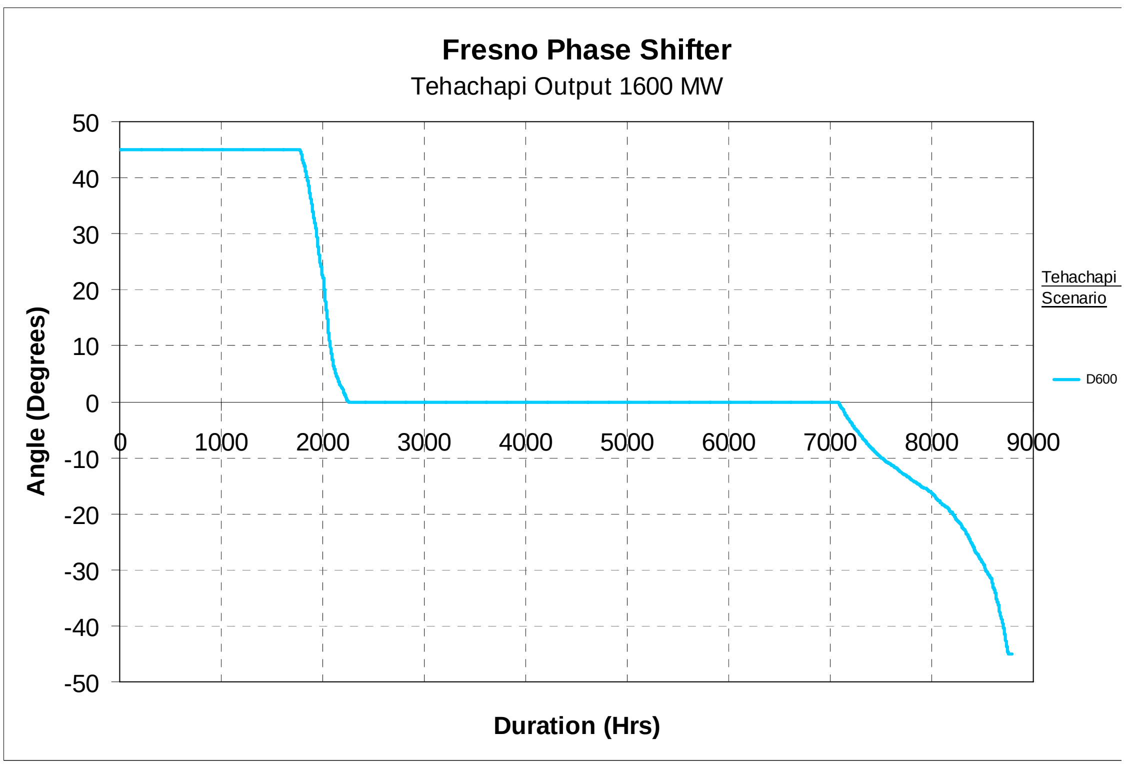


Figure 10 – Scenario E Oneline

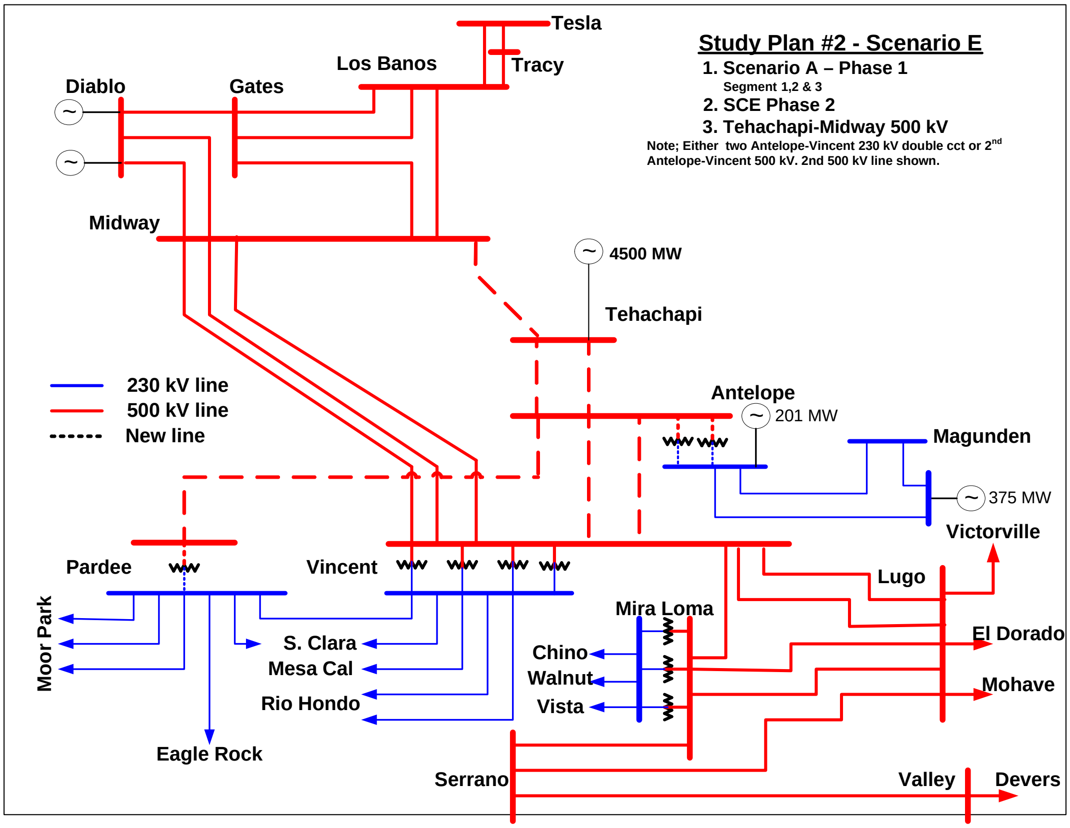


Figure 11 – Scenario F Oneline

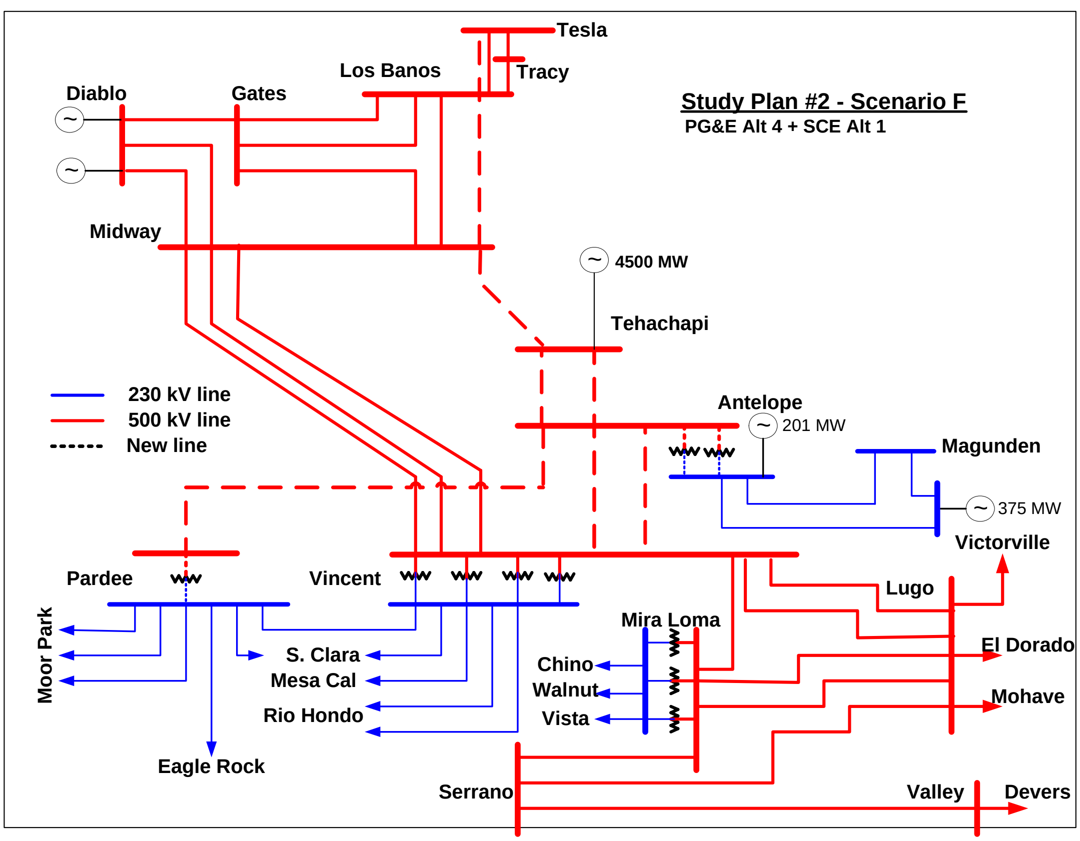


Figure 12 – Scenario G Oneline

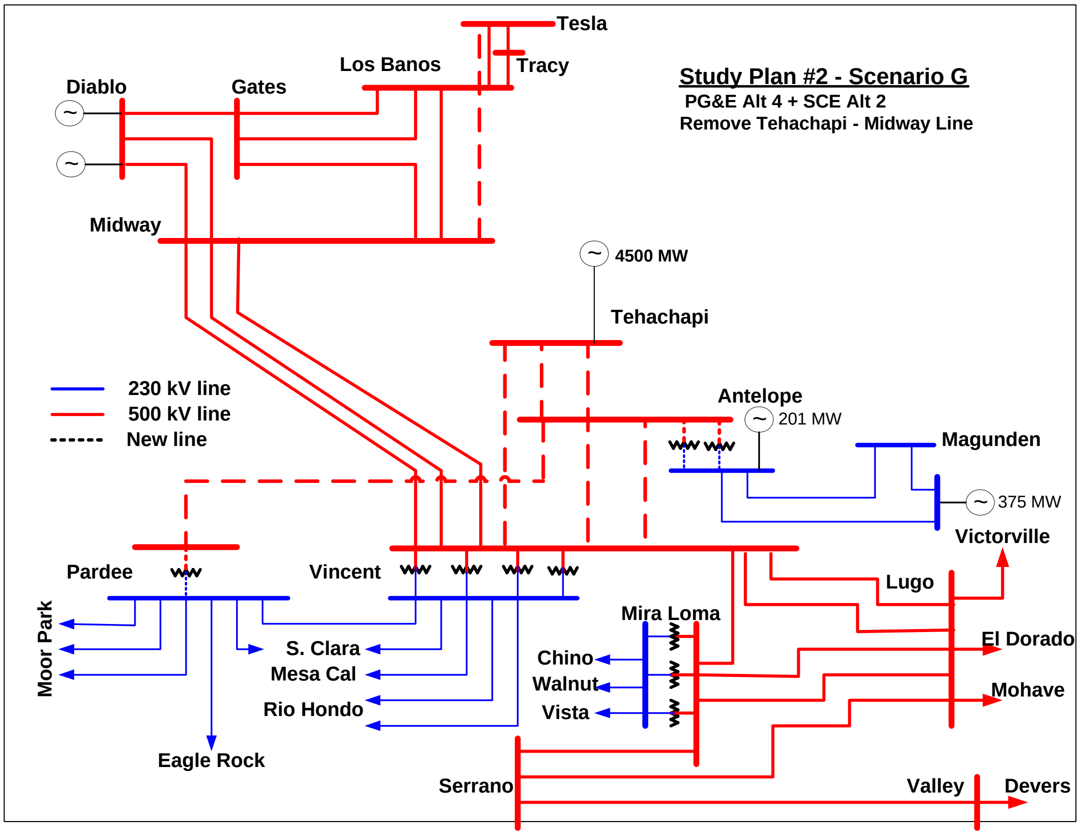


Figure 13 – Scenario H Oneline

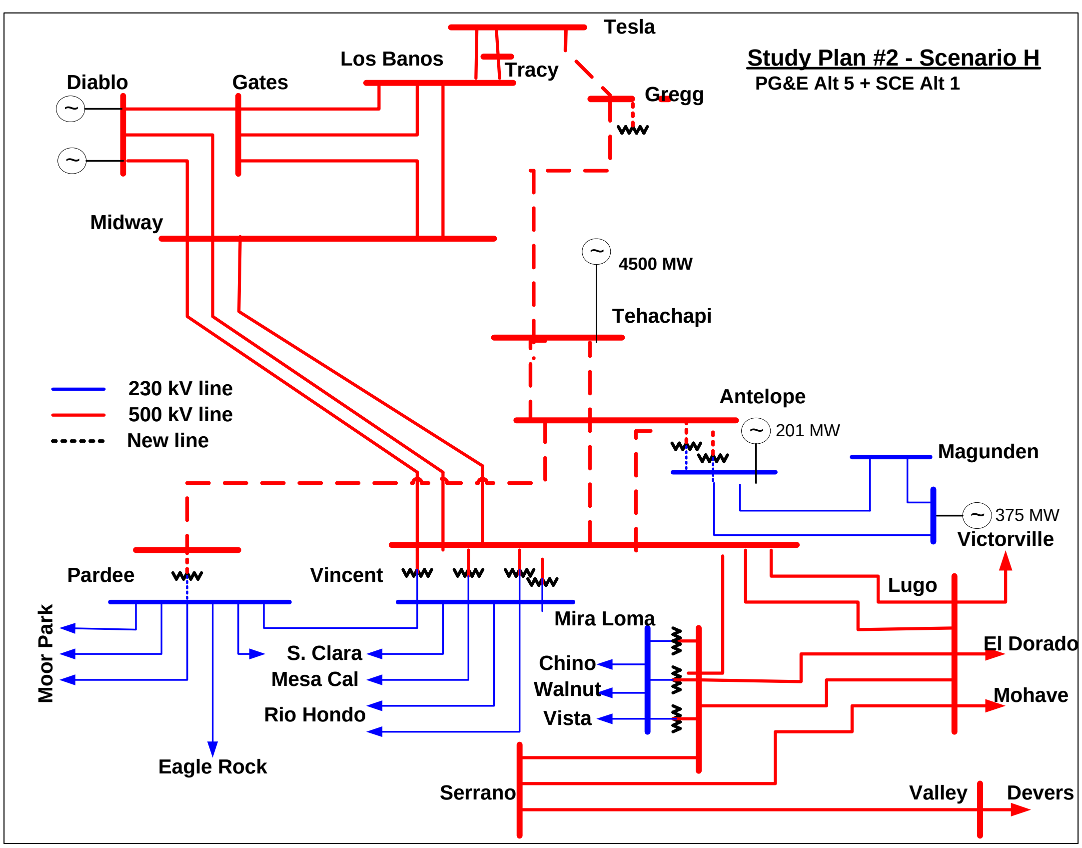


Figure 14 – Scenario I Oneline

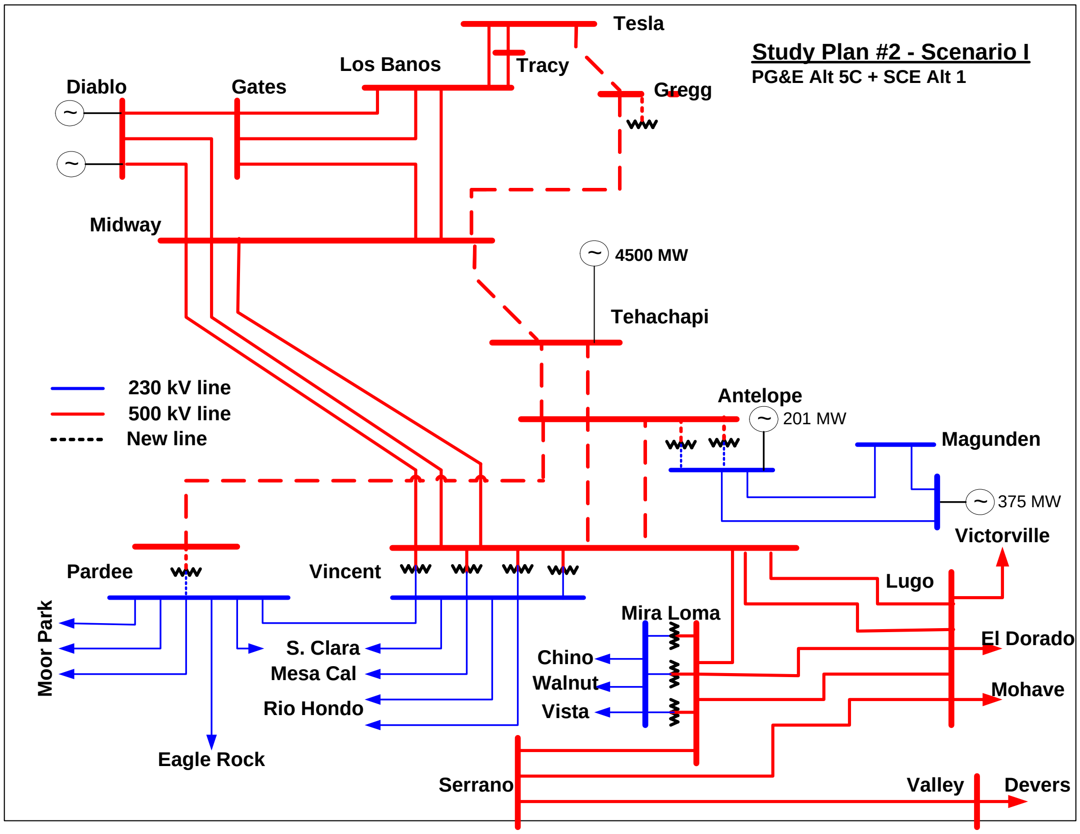
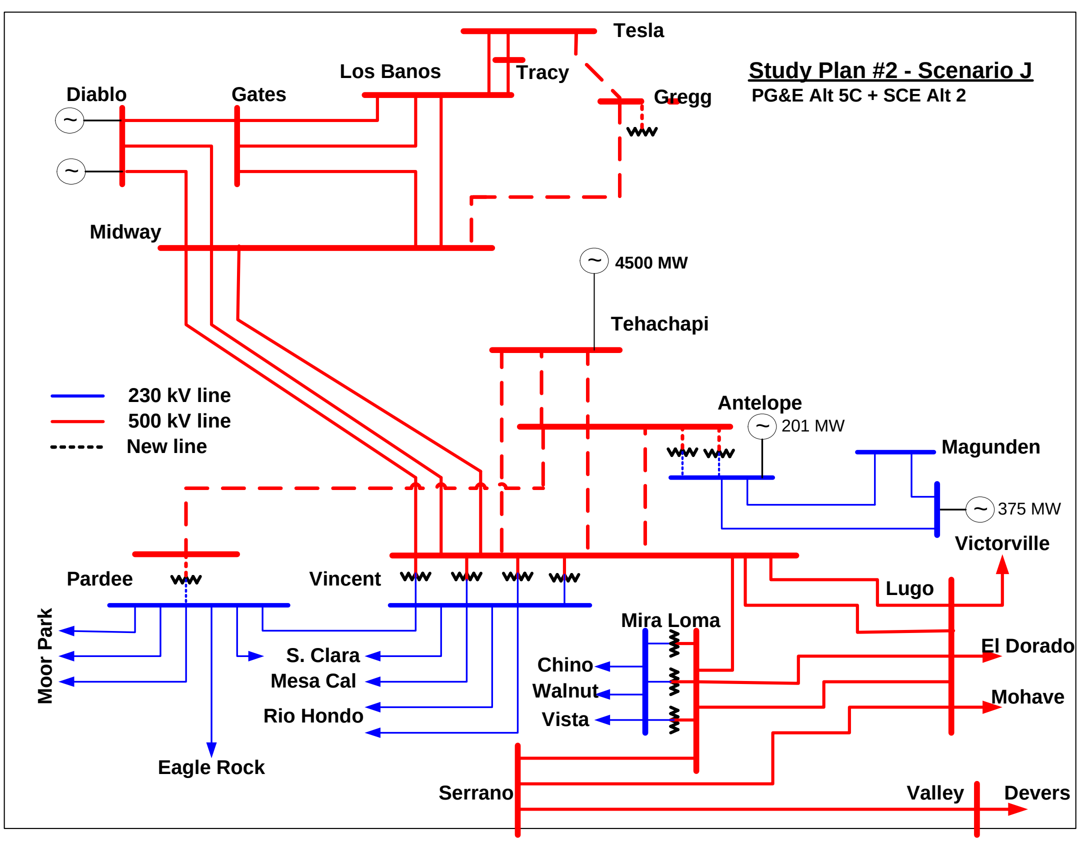


Figure 15 – Scenario J Oneline



APPENDIX 5
Fresno 230 kV Tie

APPENDIX 5

Fresno 230kV Tie

A5.1 Purpose
If the output of the Tehachapi Wind Farm were to be in the order of 2000MW with half of that to be transmitted to PG&E, a low cost tie that would require a minimum investment, supplemented by flow over Path 26 would be cheaper than any EHV alternative. As indicated in the Executive Summary, the likely development of Tehachapi is now in the order of 3500MW and, as shown in Chapter 1, power bought by PG&E does not have to be delivered into the PG&E service area. The evaluation of the Fresno 230kV Tie was a blind alley which the TCSG went up and the following description is presented for academic interest only.

A5.2 Description, Figure A5
Two 230kV lines connect SCE's Antelope Substation with Magunden and four such circuits connect Magunden with the Big Creek hydroelectric plants. Two 230kV circuits connect PG&E's Helms pumped storage plant with Gregg Substation. These lines run west to east and cross the four Magunden to Big Creek lines which run south to north. A connection between the Helms-Gregg lines and two of the Magunden-Big Creek lines would transmit Tehachapi generation to PG&E with little modification to the grids. Because of the difference in the power angle between the two systems in this area, the connection would have to include a phase shifter, which could be a fixed or variable phase shifting transformer, or a solid state device. With a capacity of 300MW, no upgrade of the networks would have to be made other than voltage support. At higher capacities, varying levels of upgrade to the highly loaded SCE network would be needed depending on the incremental capacity of the tie and the loading of the lines at the time the Tehachapi generation was available. Power flow computer runs to determine the relationship between the amount of Tehachapi power flowing over the lines to the tie and line loading due to loads in the Fresno area were not made, so that it was not possible to determine the optimum capacity of the tie.

A5.3 Production Cost Study
Production cost simulation runs were made modeling variable phase shifting transformers of 300MW, 500MW and 1000MW capacities. The 300MW transformer reduced the production cost by a small amount, but with the two larger capacities the cost actually increased over the cost of identical conditions without the tie. The fact that the addition of a network component would

increase production cost is hard to understand and leads to the question of whether the program is correctly modeling the device. The limitations of the program in modeling the performance of the pumped storage, which in the real world would be coordinated with the wind generation, also contributes to the perception that the effect of the phase shifting transformer was short shrifted by the program.

A5.4 Conclusions

1. With the level of production presently expected from Tehachapi and the fact that it does not need to be delivered into the PG&E system, the 230kV tie is not needed.
2. The ABB GridView production simulation program needs to be improved to correctly simulate the phase shifting transformer and to optimize the performance of pumped storage.

Appendix 6
Path 26 Impacts

Path 26 Impacts

Introduction

When wind geneation in Tehachapi is connected to the grid with new transmission lines, wind power will flow on existing lines as well. Since Path 26 is a vital transmission link between Northern and Southern California, the TCSG investigated how power flows from Tehachapi will affect Path 26.

The ability of Southern California to import power from the North through Path 26 on hot summer days, when air conditioning loads are highest, is especially important. The TCSG's analysis therefore focused on Path 26 flows and Southern California imports during this peak period.

Since wind generation is variable, the amount of Tehachapi power flowing on Path 26 will also be variable. As discussed in Chapter XXX, grid operators will have be able to adjust other flows on Path 26 to ensure reliability limits will not be exceeded. However, the TCSG did not attempt to analyze the impact of Tehachapi wind generation on grid operations for any of the alternatives studied.

Summary of findings

The TCSG examined the effects on Path 26 for two alternative ways of connecting Tehachapi to the grid: the Expanded Path 26 option (Alternative 1) and the Gen-tie option (Alternative 2). The Expanded Path 26 option adds a fourth 500 kV tie between Northern and Southern California; the Gen-tie configuration connects Tehachapi only to Southern California and provides no additional connection between the regions.

The Expanded Path 26 option increases the transfer capacity between Northern and Southern California above the amount existing today, under all conditions. The Gen-tie option does not increase the transfer capacity between the regions.

Alternative 2 (Gen-tie option) – south-to-north flows

When power is flowing from Southern California to Northern California, i.e., south-to-north on Path 26 (generally during off-peak periods), some power from Tehachapi will also flow north on this path. At the present time, south-to-north flows are limited by the capacity of Path 15 (north of PG&E's Midway substation) rather than by the capacity of Path 26. Therefore, although some of the capacity of Path 26 will be used by Tehachapi generation, system impacts are minimal.

Alternative 2 (Gen-tie option) –north-to-south flows

When Southern California is importing power, i.e., power is flowing north-to-south on Path 26 (generally during on-peak periods), this path is unaffected by Tehachapi generation. Power from Tehachapi simply adds to power flowing south on Path 26.

Alternative 1 (Expanded Path 26 option) – south-to-north flows

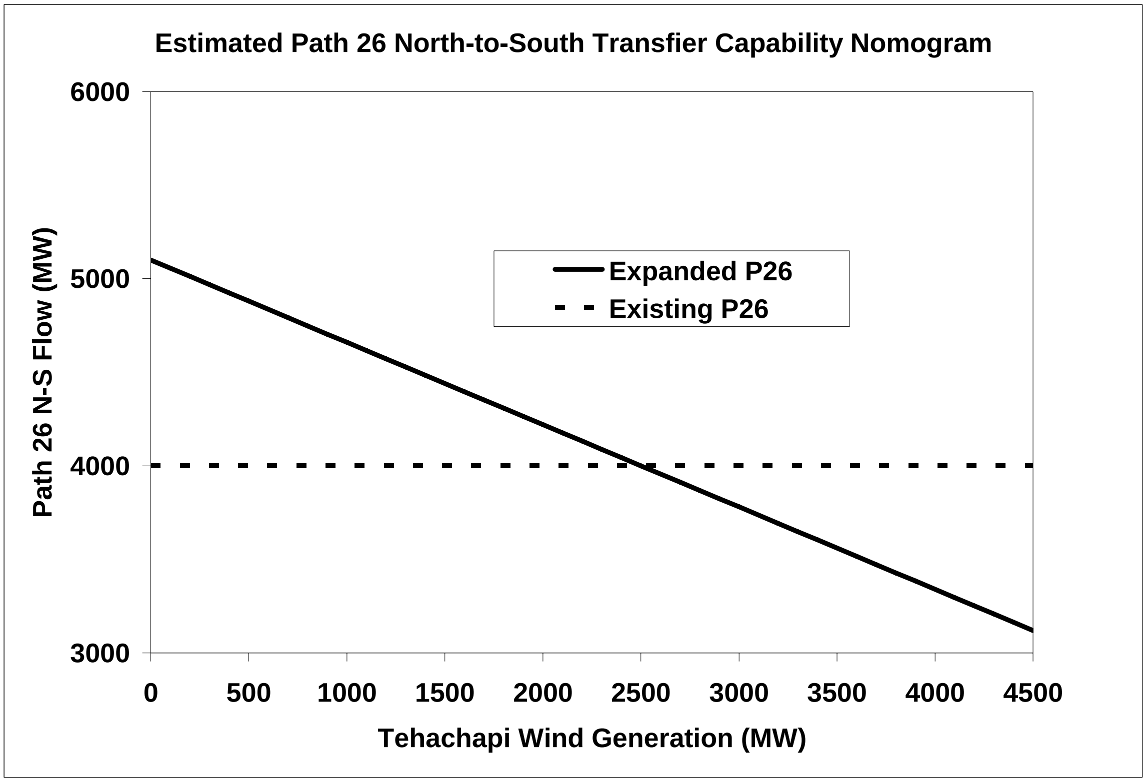
When power is flowing south-to-north in the Expanded Path 26 configuration, Tehachapi generation flows on Path 26, but as mentioned above, south-to-north flows are limited by the capacity of Path 15 at the present time. The system impacts of Tehachapi generation therefore are expected to be minimal, as with the Gen-tie option.

Alternative 1 (Expanded Path 26 option) – north-to-south flows

When Southern California is importing power and flows are north-to-south on Path 26, the effects of Tehachapi generation on Path 26 become important. As described below in a report by the TCSG Path 26 subcommittee, these effects differ depending on whether Tehachapi generation is high or low, i.e., whether the wind is blowing hard in Tehachapi or not.

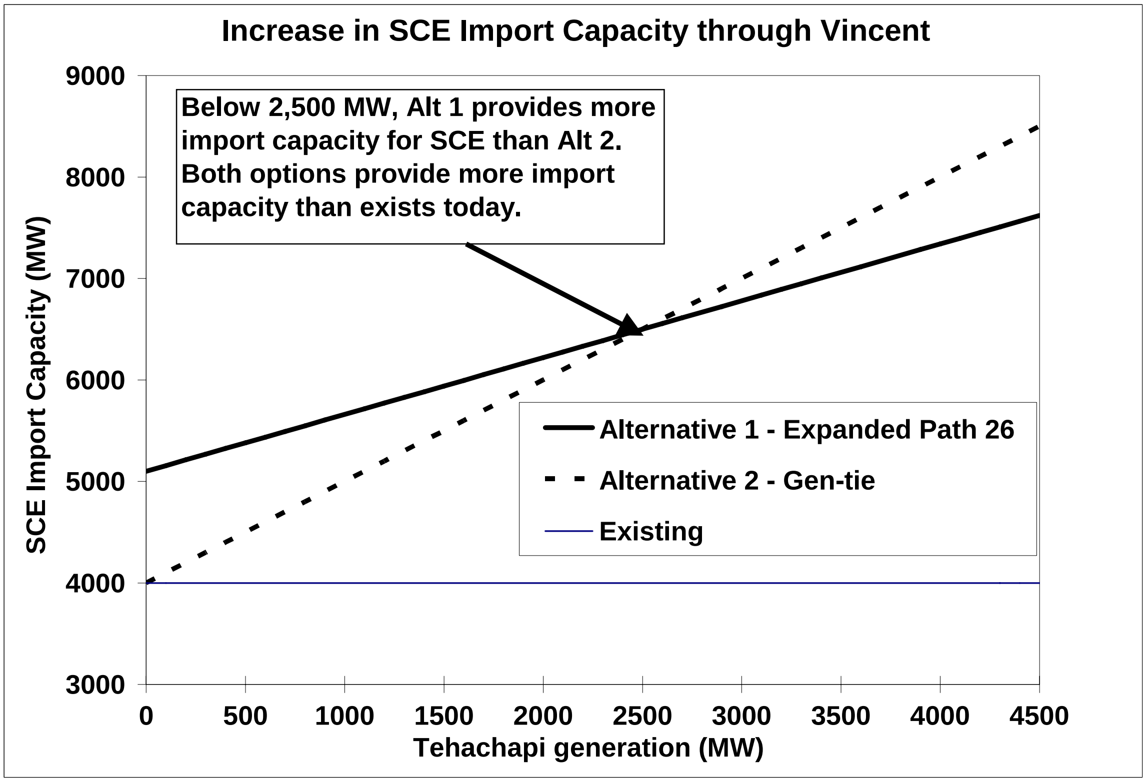
When Tehachapi wind generation is low, the additional link between Northern and Southern California provided by the Expanded Path 26 configuration allows more power to flow between the regions than can be accommodated today. Even though some Tehachapi power flows north-to-south on Path 26 (see figure 5 in the subcommittee report below), there is a net increase in transfer capability due to the additional 500 kV link. When Tehachapi wind generation is high, the power transfer from Northern California to Southern California is less than when wind generation is low. This is because the amount of Tehachapi power flowing on Path 26 is enough to reduce the net thermal transfer capacity of the Path. Even in this case, however, the net power delivered to Southern California is higher than is possible today, because of the new generation added at Tehachapi. The transfer capacity of Path 26 as a function of Tehachapi generation is shown in the following chart[2]:

[2] The data shown in this chart assumes 70% series compensation on the Midway-Tehachapi line.



The decline in Path 26 transfer capability for the Expanded Path 26 shown in Figure XXX indicates that as Tehachapi wind generation increases and uses some of the capacity in Path 26, the amount of power that can be exported from Northern California south through Path 26 decreases.

However, the import capacity into Southern California *increases* over existing levels for both options, as shown in the following chart:



Concerns over the variability of wind generation are often expressed as "What happens when the wind doesn't blow?" As the above chart indicates, even when Tehachapi wind generation is zero, the Expanded Path 26 option provides Southern California with additional import capacity while the Gen-tie option does not. When Tehachapi generation is above 2,500 MW, the Gen-tie option provides Southern California with more import capacity than does the Expanded Path 26 option.

The key conclusion is that both alternatives provide more import capacity than exists at present, because of the addition of new generation at Tehachapi and new 500 kV lines to connect it.

TCSG Path 26 Subcommittee Report

`Comparison of the Effects on the Transfer Capability of Path 26 of Alternatives 1 and 2 for Delivering Tehachapi Power to the Grid Taking Into Account the Variability of Wind Generation

Conclusions

1. Alternative 1 consists of one 500kV line between Tehachapi and Midway and two 500kV lines between Tehachapi and Antelope, see Figure 1. Alternative 2 consists of three 500kV lines between Tehachapi and Antelope, see Figure 2.
2. During off-peak hours when the power flow is from South to North across Path 26, Path 26 transfer capability is limited by Path 15 capability, therefore there is no difference between Alternative 1 and Alternative 2 under this condition.
3. During peak hours when the power flow is from North to South, when the wind is not blowing, the transfer capability with Alternative 1 will be increased from 4000MW to 5100MW and 4500MW given 70% and no series compensation, respectively, on the Tehachapi- Midway line. However, the usefulness of this capability is dependent on an increase in generation at north of Midway. With Alternative 2, the transfer capability is unchanged by the level of generation at Tehachapi and remains at 4000MW.
4. During peak hours when the power flow is from North to South and the wind is blowing, the transfer capability of Path 26 with Alternative 1 will decrease from 4000MW to 3400MW and 3700MW with 4000MW at Tehachapi, and 70% and no series compensation, respectively. The transfer capability as a function of varying levels of Tehachapi generation is shown on Figure 3. With Alternative 2, the transfer capability is unchanged by the level of Tehacahpi generation and remains at 4000MW.
5. Alternative 1 would provide benefit during scheduling clearance for maintenance by providing additional transmission facilities over the interface assuming wind generation at Tehachapi are off-line compared to the existing system or Alternative 2.

Alternative 1

Power flow with One Tehachapi-Midway and Two Tehachapi – Antelope lines

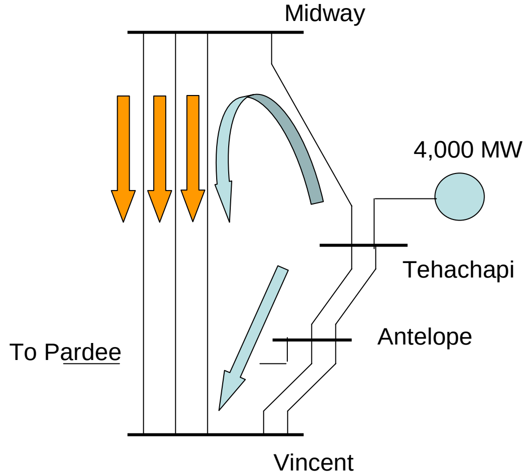


Figure 1

Alternative 2

Power flow with Three Tehachapi – Antelope lines

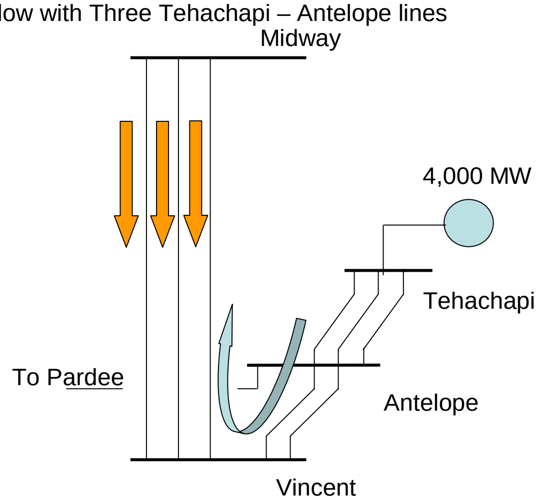
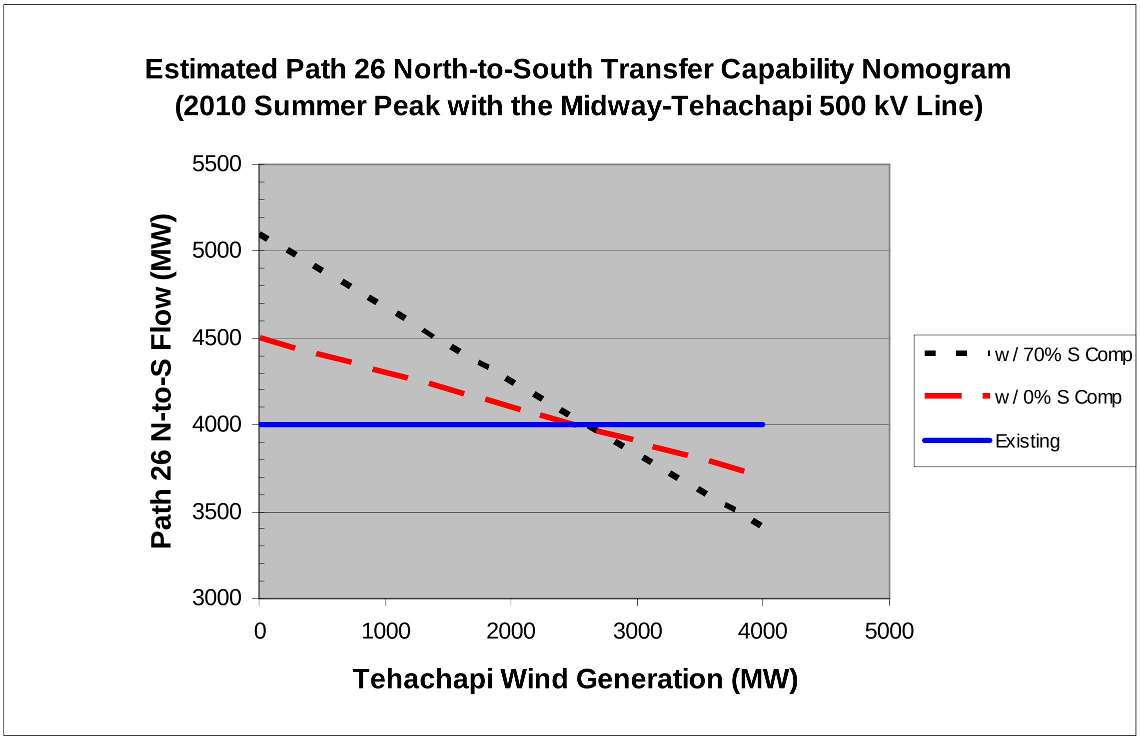


Figure 2

Fig. 3
Estimated Path 26 North-to-South Transfer Capability Nomogram



The Alternatives

The only existing transmission link between northern and southern California are the three 500 kV lines between PG&E's Midway Substation and SCE's Vincent Substation which define the Path 26 interface. The existing Path 26 transfer capability in either the North to South (N-S) or South to North (S-N) direction is determined by normal and emergency loading on the Midway – Vincent #3 500 kV line or voltage criteria violations. The limiting facilities are the existing 3500 A emergency rating of the series capacitor banks on the Midway-Vincent #3 line and the 1736A summer normal rating of the #3 line conductors. The worst contingency is the loss of both the Midway-Vincent #1 and #2 lines.

The existing maximum Path 26 N-S transfer limit of 4000 MW is based on heavy summer conditions and requires a Remedial Action Scheme (RAS) to trip 1400

MW[3] of Midway area generation and 500 MW of loads in southern California following the loss of the Midway-Vincent #1 and #2 lines. Without the RAS, existing maximum Path 26 N-S transfer limit is 3000 MW. The maximum existing Path 26 S-N transfer limit is 3000 MW and does not require RAS to support this limit. Path 26 S-N flows are typically limited to below 3000 MW due to congestion on Path 15.

With the Tehachapi wind generation electrically near the Path 26 interface, there is a potential to impact the transfer capability depending on the 500 kV transmission reinforcements selected. Figure 1 shows SCE's proposed Alternative 1, which provides two 500kV circuits from Tehachapi Substation 1 to Antelope Substation and a 500 kV line from Midway to Tehachapi, thereby creating a 4th path from Midway to Vincent in parallel with the existing Path 26 interface. As such, the Path 26 interface would need to be redefined to include this new transmission path. The transfer capability of this path would be dependent on the level of Tehachapi wind power injected into the new Midway-Tehachapi-Vincent line at Tehachapi and also by the level of series compensation on the line. Due to the variability of the wind, the wind generation output may range from 0 to the maximum of 4000 MW. Under peak load conditions, when the prevailing power flow is from North to South, part of the Tehachapi power would flow North to Midway, then use the existing N-S transfer capability to back South over the existing Path 26 lines. That would decrease the available N-S transfer capability for transporting power from north of Midway to southern California.

Figure 2 shows SCE's proposed Alternative 2, which consists of three 500kV lines from Tehachapi Substation 1 to Antelope/Vincent. This alternative would not affect the present Path 26 thermal transfer capability in either the N-S or S-N direction.

[3] Maximum amount of generation rejection for loss of two elements under CAISO Planning Guidelines

Comparison of the Effects of the Alternatives

The following table provides a comparison of the estimated Path 26 thermal transfer capability. Detailed thermal, voltage and stability studies are needed to definitively determine actual capabilities.

TABLE: Estimated Path 26 Thermal Transfer Capability

SCE Alternative	Tehachapi Wind Output (MW)	Path 26 N-S (MW)	Path 26 S-N (MW)
Existing System	-	4000[1]	3000[2]
Alt. 1 – 500 kV, one Midway-Tehachapi, two Tehachapi-Antelope-Vincent	0	4500[1] –5100[3]	3000[2]
	4000	3400-3700[1]	3000[2]
Alt. 2 – Three 500 kV Tehachapi-Antelope-Vincent	0	4000[1]	3000[2]
	4000	4000[1]	3000[2]

Notes:

1) Path 26 RAS will trip 1400 MW of Midway generation and 500 MW of southern California loads for Midway – Vincent #1 and #2 500 kV double-line outage.
2) No RAS required. Path 26 S-N transfers may be limited by Path 15 capability.
3) Range indicates without series compensation and with a high level of series compensation (70%) on the Midway-Tehachapi 500 kV line. Appropriate series compensation needs to be determined through additional studies. New Midway-Tehachapi rating assumed appropriately sized to avoid thermal constraints.
4) Does not consider any limitation resulting from SCIT transfer capability.

Alternative 1 would provide a significant increase in the N-S capability of Path 26 when there is no generation at Tehachapi. However, it would also decrease the existing N-S capability when Tehachapi is at full output, see Figure 3 for the transfer capability as a function of varying levels of Tehachapi generation. However, in order to take advantage of any increased capability, CAISO Operations would need sufficient advance forecast of the wind generation output. This may be problematic until better forecasting methods are implemented.
The upper range of this capability depends on use of the Midway RAS. Since the existing Path 26 interface RAS arms the maximum amount of generation for rejection for the limiting N-2 contingency, no additional generation, such as

Tehachapi wind, may be armed unless it is accompanied with an equivalent amount of load rejection on the SCE system.
Alternative 1 S-N: Without an upgrade of Path 15, no increase in Path 26 S-N capability is expected since Path 26 would be limited by the existing Path 15 capability
Alternative 1 would provide benefit during scheduling clearance for maintenance by providing additional transmission facilities over the interface assuming wind generation at Tehachapi are off-line compared to the existing system or Alternative 2.

Alternative 2 would not provide any new transfer capability for Path 26, as it does not involve reinforcement or upgrade of the existing path.

Appendix 7

Midway-Tehachapi Costs

Tehachapi-Midway Cost Estimate

for TCSG Report, April 7, 2006

One major export path for Tehachapi generation is to connect to the state backbone grid at the Vincent substation at the southern end of Path 26. The TCSG has relied on the cost estimates for the Tehachapi-Vincent connections contained in SCE's CPCN Applications for the Antelope-Pardee (Application No. 04-12-007), and Antelope-Vincent and Antelope-Tehachapi Transmission Projects (Application No. 04-12-008).

Another major transmission alternative for connecting Tehachapi generation to the grid considered by the TCSG, outside of Tehachapi-Vincent corridor routings, is a line from Tehachapi to the Midway substation, at the southern end of Path 15, west of Bakersfield.

The Midway substation is roughly 90 miles west of the proposed Tehachapi substation #1. At this point, Tehachapi-Midway is only a conceptual routing. Neither SCE nor PG&E has yet identified any physical routings for such a connection. Without a physical routing, line distance can only be roughly estimated; no environmental studies have been performed. With so many factors unknown, any such conceptual cost estimate can only be roughly approximate.

PG&E estimates the cost of acquiring the land, doing the permitting work and building the line to be $508 million. SCE estimates this cost to be $315 million. This large disparity in conceptual cost estimates led the TCSG to appoint a subcommittee to better understand the basis of each company's estimate. The subcommittee held several meetings via conference call with the land and permitting experts of both utilities. Notes of the subcommittee conference call meeting of January 10, 2006 explain the components of each, and document the basis for cost estimate. These notes are available from the CPUC coordinator of the TCSG.

For purposes of evaluating a Tehachapi-Midway conceptual routing, the subcommittee recommended that the TCSG use the SCE estimate of $315 million for the 90-mile project.

The SCE estimate is in line with the cost estimates of the other components of the Tehachapi transmission projects proposed to date.

Tehachapi-Midway Conceptual Cost Estimates
$, millions

	PG&E	SCE
Land Acquisition, Planning and Permitting (includes PEA, CPUC CPCN process)	$245.9	$90.4
Construction	$262.1	$225.0
Total Conceptual Cost Estimate	$508.0	$315.4