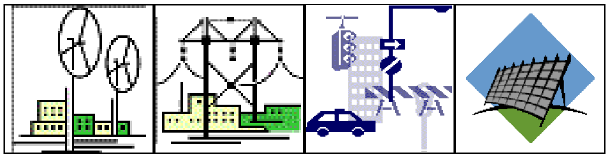

California ISO
Your Link to Power

CAISO South Regional Transmission Plan for 2006

(CSRTP-2006)

PART II:
Findings and Recommendation on the Tehachapi Transmission Project

Prepared by:

Regional Transmission – South

Planning and Infrastructure Development

California ISO

December 29, 2006

CAISO South Regional transmission Plan for 2006 (CSRTP-2006) Report
--- The Tehachapi Study ---

EXECUTIVE SUMMARY

INTRODUCTION AND SUMMARY CONCLUSIONS

The California ISO (CAISO) was asked to review and approve three proposals by the project proponents for new transmission projects in the Southern California region. The three projects are:

- **Sunrise Powerlink / Green Path (Sun Path) Project:** The project combines Sunrise Powerlink Project sponsored by San Diego Gas & Electric Company (SDG&E) and Phase 2 of Green Path Project sponsored by Citizens Energy and Imperial Irrigation District (IID) connecting Imperial Valley to the San Diego area and is intended to help meet the reliability and economic needs of the ISO Controlled Grid as well as to integrate renewable resources in the Salton Sea and southern Imperial Valley areas.
- **Tehachapi Transmission Project:** This project presents the transmission network infrastructure necessary to reliably interconnect generation resources (mainly wind generation) in the Tehachapi Wind Resource Area (TWRA) and, at the same time, to provide reliability and economic value for the ISO Controlled Grid. Southern California Edison Company (SCE) has voluntarily sponsored this project pursuant to the terms of the CAISO's Large Generator Interconnection Procedures (LGIP). The TWRA lies at the southern end of the San Joaquin Valley in the mountainous region between Bakersfield and Mohave and is California's largest wind resource area.
- **Lake Elsinore Advanced Pumped Storage (LEAPS) Project:** This project includes a 500 kV transmission line project (LEAPS Transmission Line) that connects SCE's transmission system with that of SDG&E and is accompanied by a 500 MW pumped storage power plant built next to Lake Elsinore itself (LEAPS Power Plant) and interconnected to the middle of the line. This project is intended to improve the reliability and economics of the ISO Controlled Grid and is sponsored by The Nevada Hydro Company (TNHC) and Elsinore Valley Municipal Water District (EVMWD).

Figure 1 presents the general location of the three proposed transmission projects against the backdrop of the 500 kV network in the same general geographic areas.

In this report, we focus on findings and recommendations for the Tehachapi Transmission Project. The Sun Path Project, which the CAISO Board of Governors previously approved, has been incorporated into the Base Case used for evaluating the Tehachapi Transmission Project.[1] However, given the novel and unprecedented proposed treatment of the Generating Facility of the LEAPS Project as a transmission asset, the CAISO's final findings and recommendation on the LEAPS Project can only follow the FERC determination on the operational control and related ratemaking aspects of the project.[2]

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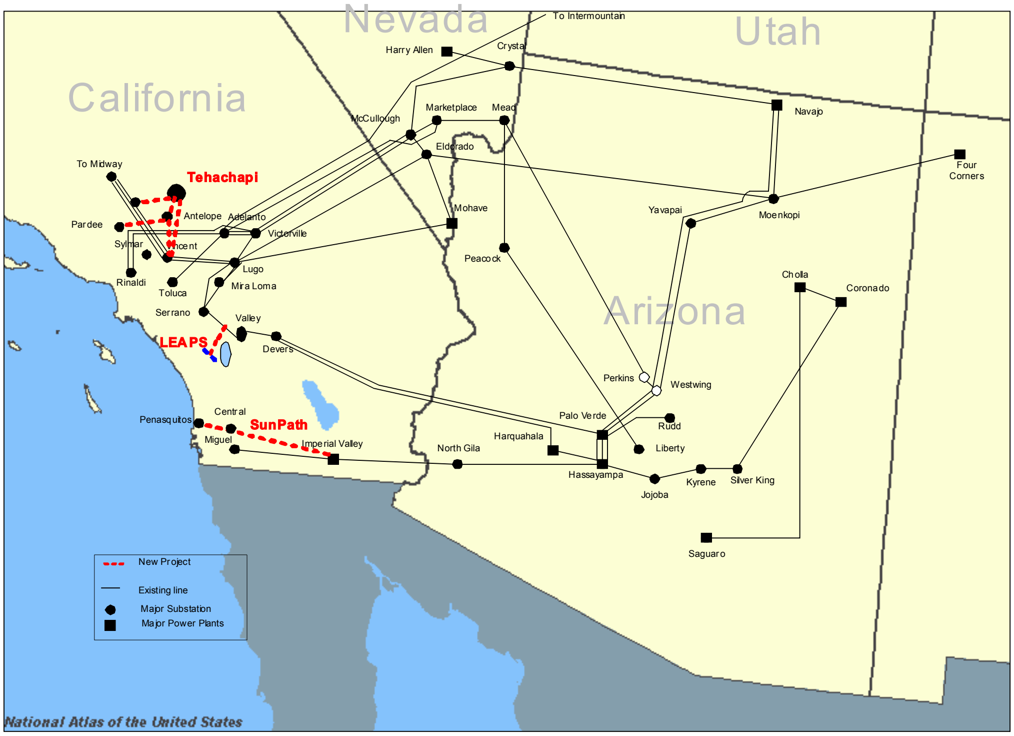
[1] However, the Sun Path Project does not have any direct impact on the results of this evaluation.
2 FERC has directed CAISO to investigate this matter based on a stakeholder process.

Figure 1: General Location of Three Proposed Transmission Projects in Southern California



The origin of the Tehachapi Transmission Project is the Tehachapi Collaborative Study Group, coordinated by the California Public Utilities Commission (CPUC), which was formed in 2004 to develop a comprehensive transmission development plan for the phased expansion of transmission capabilities in the TWRA. The TCSG issued two study reports to the CPUC in March 2005 and in April 2006. The outcome of the collaborative study group process was the identification of a number of alternatives for the transmission infrastructure and a recommendation to further study of these alternative schemes by the CAISO. The CAISO studied the Tehachapi Transmission Project as part of its CAISO South Regional Transmission Plan for 2006 (CSRTP-2006) in full collaboration with SCE and other CSRTP-2006 participants[3] and developed a least-cost solution for the network component of the transmission infrastructure that will interconnect planned generation projects in TWRA to the ISO Controlled Grid.

Under its federally approved tariff, the CAISO is responsible for ensuring open and non-discriminatory access to the ISO Controlled Grid for new Generating Facilities. The CAISO satisfies this obligation, in cooperation with the Participating Transmission Owners (PTOs), through its Large Generator Interconnection Procedures (LGIP). Because the primary purpose of the Tehachapi Transmission Project is to provide for the interconnection and delivery of generation in the TWRA, the CAISO has applied its LGIP within the context of its

3 CSRTP-2006 was launched on April 11, 2006. The CSRTP-2006 team included the CAISO, impacted Participating Transmission Owners (Pacific Gas and Electric Company (PG&E), SCE and SDG&E), technical representatives from all Project Sponsors (TNHC, Citizens Energy, IID, Oak Creek Energy System/Tehachapi Holdings), and technical representatives from the California Energy Commission (CEC) and the California Electricity Oversight Board (EOB). This team has provided and will continue to provide the CAISO with necessary technical data and advice needed to conduct its analyses.

CSRTP-2006 process to determine the least-cost transmission solution for integrating 4,350 MW[4] of generating resources in the Tehachapi Area Generation Queue (TGQ). Under the LGIP, once the CAISO has identified the transmission facilities associated with interconnecting generation, the discretion whether to proceed with the associated Network Upgrades as well as pursuing the required siting approvals lies with the Interconnection Customer and the affected PTO. However, given the substantial investment embodied by the Tehachapi Transmission Project, the CAISO has elected to seek approval from the CAISO Board in order to facilitate the subsequent regulatory processes.

Specifically, the CAISO's determinations and findings on the Tehachapi Transmission Project, as presented in this report, are as follows:

1. The Tehachapi Transmission Project is the least-cost solution that reliably interconnects 4,350 MW of generating resources in TGQ;
2. The Tehachapi Transmission Project also addresses the reliability needs of the ISO Controlled Grid due to projected load growth in Antelope Valley area as well as helps to address South of Lugo (SOL) transmission constraints – an ongoing source of reliability concern for the Los Angeles (LA) Basin;[5]
3. The Tehachapi Transmission Project facilitates the ability of California utilities to comply with the state mandated Renewable Portfolio Standard (RPS) by providing access to planned renewable resources in the TWRA – also see points 6 and 7 below;
4. The Tehachapi Transmission Project is expected to provide economic benefits to the CAISO ratepayers mainly by providing access to wind and other efficient generating resources under development in TWRA;
5. The Tehachapi Transmission Project makes it possible to expand the transfer capability of Path 26 in the near future with a low cost upgrade of PG&E's portion of Midway-Vincent Line 3;
6. The Tehachapi Transmission Project will be used by other projects in TGQ queued beyond the start date of the CSRTP-2006 for low-cost interconnection to the ISO Controlled Grid;[6] and
7. Although the detailed planning has not yet been performed, the Tehachapi Transmission Project lays the groundwork for the integration of large amounts of planned geothermal, solar, and wind generation in Inyo and northern San Bernardino counties with potential future 500 kV additions from the WindHub Substation (one of Tehachapi Transmission Project's substations) to the Kramer Substation.

PROJECT DESCRIPTION

Table 1 presents the entire Tehachapi Transmission Project plan of service.[7] Figure 2 depicts the entire plan of service for the Tehachapi Transmission Project. The Tehachapi

[4] 4,350 MW of generation projects correspond to the capacity of all generation projects in the TGQ up to the start date of the CSRTP-2006 process - 3,570 MW of this total consists of wind generation that will be developed to allow compliance with the California mandated Renewable Portfolio Standard program.

[5] Concerns with the SOL transmission constraints are expected to increase as additional generation resources are sited outside the LA Basin. Delivery of this new generation to LA Basin load will require significant transmission additions as identified in this plan.

[6] Around 1260 MW of such generation was already in the TGQ as of December 1, 2006.

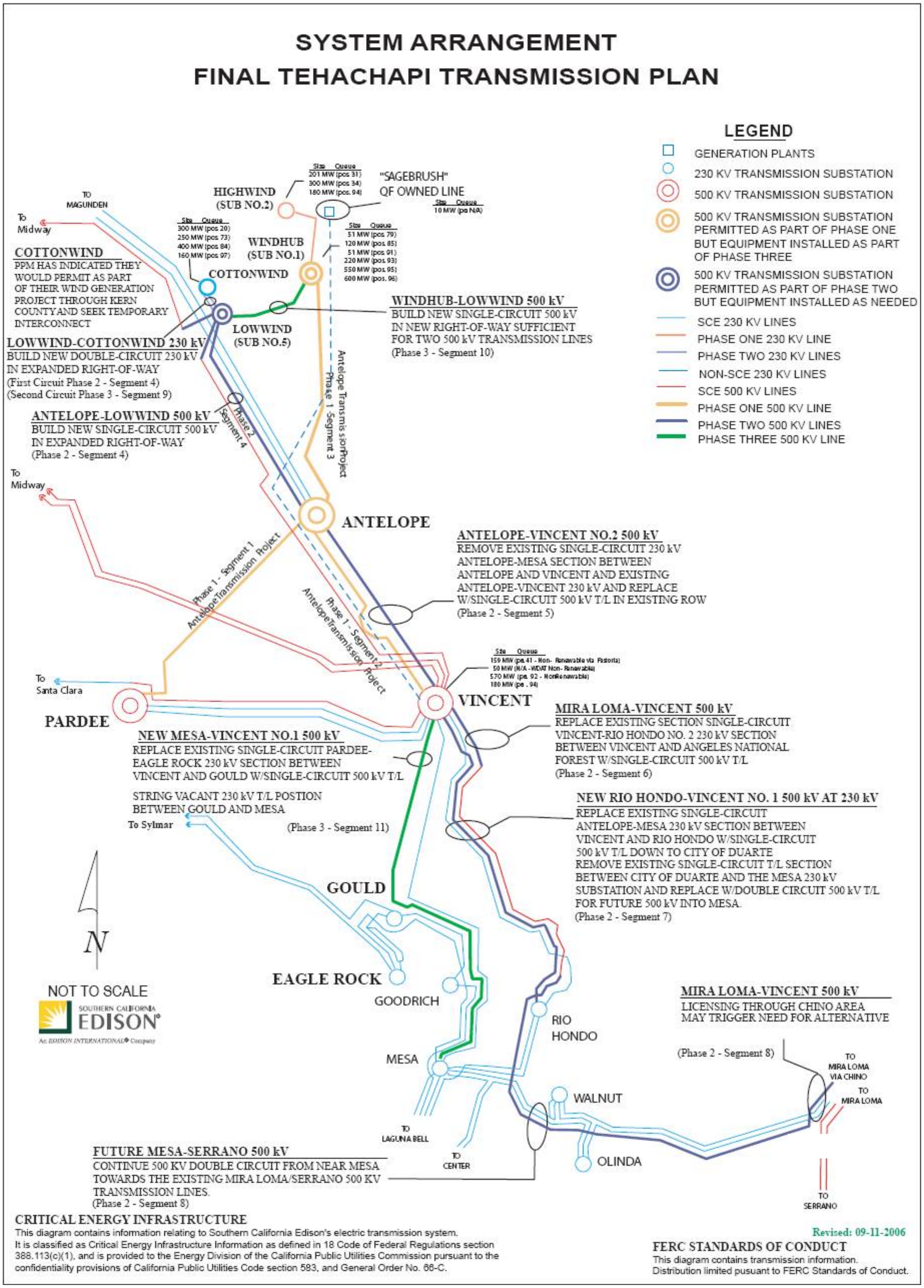
Transmission Project will accommodate all targeted generation projects in the TGQ. However, sufficient flexibility is built into the rollout of the Tehachapi Transmission Project to reasonably respond to changes in the magnitude and the location of generation resources in the area.

Table 1: Tehachapi Transmission Project Plan of Services

Major Transmission Facilities	Planned In-Service Date
Antelope – Pardee 230 kV Line (500 kV Specifications) & Antelope Substation Expansion	Dec 2008
Antelope – Vincent 230 kV Line #1 (500 kV Specifications)	Mar 2009
WindHub Substation	Mar 2009
Antelope – WindHub (also known as Substation 1) 230 kV Line (500 kV Specifications)	Mar 2009
Antelope – Vincent 230 kV Line #2 (500 kV Specifications)	Mar 2011
LowWind 500/230 kV Substation (also known as Substation 5) with Loop in of Midway – Vincent #3 500 kV line	Aug 2011
Antelope – LowWind 500kV line	Aug 2011
WindHub Substation 500 kV Upgrade	Mar 2011
Antelope Substation 500 kV Upgrade	Mar 2011
Vincent Substation 500 kV & 220 kV Upgrade	Sep 2011
LowWind – WindHub 500 kV line	Oct 2011
Replacement of Vincent – Rio Hondo No. 2 230kV line	Nov 2011
Vincent – Mira Loma 500 kV line	Apr 2012
Vincent – Mesa 500/220 kV Line and Mesa Substation Work	Nov 2013

[7] The planned in service dates are based on receiving all permits by January 2007 for the Antelope Transmission Project (segments 1 to 3) and the Tehachapi Renewable Transmission Project (segments 4 to 11) by January 2009.

Figure 2: Tehachapi Transmission Project (Routes shown on this diagram are for illustration purposes only)



PUBLIC PROCESS IN DEVELOPING RECOMMENDATION

Table 2 lists the CAISO's public outreach initiatives for this project. In addition to several outreach programs intended to familiarize the public with the CSRTP-2006 process and studies assumptions that the CAISO held as part of the Sun Path project, the CAISO held two days of open houses on the CSRTP-2006 planning process and the Tehachapi Transmission Project in the Tehachapi area. The CAISO established additional outreach programs to local agencies and local community organizations and provided several presentations about the CSRTP-2006 process and the CAISO's findings at workshops sponsored by the California Public Utilities Commission (CPUC) and the Southwest Transmission Expansion Plan (STEP). As a result of these public outreach programs, the CAISO received several valuable comments and suggestions from stakeholders that triggered modifications of study assumptions and approach and, eventually, the CAISO's findings and conclusions. Table 2 below lists the outreach activities and their results.

Table 2: Stakeholder and Public Outreach for the CSRTP-2006 Process

Outreach Activity	Date
Open house in San Diego on CSRTP-2006 process	- May 19-20, 2006
Created tailored distribution lists to reach affected parties, including those wishing not to be on master communications lists.	- May 2006 through present
Hosted conference call to discuss assumptions and comments	- June 22, 2006
Collected written stakeholder comments on assumptions.	- Through June 29, 2006
Initiated 1:1 outreach to individuals and interested groups.	- May through present
Published and re-posted updated study assumptions	- July 17, 2006
Held joint Tehachapi Transmission Workshop with CPUC	- August 23, 2006
Presented the CSRTP-2006 process and interim findings on all projects, including the Tehachapi Transmission Project, at multiple Southwest Transmission Expansion Plan (STEP) meetings.	- May 5, 2006 - July 24, 2006 - September 21, 2006 - November 17, 2006 (planned)
Hosted an Open House in Tehachapi to display CAISO's role in transmission planning and the Tehachapi Transmission Project final plan of service.	- September 25, 2006 - September 26, 2006
Presentation at CPUC Workshop on the Tehachapi Transmission	- November 21, 2006

COMPLIANCE WITH THE LGIP REQUIREMENTS

CAISO Management's recommendations on the Tehachapi Transmission Project are primarily based on the CAISO's obligation to identify least-cost transmission solutions to reliably interconnect generation projects in accordance with provisions of the CAISO's LGIP. The CAISO worked with the project sponsor (SCE) and other participants in the CSRTP-2006 process to plan the Tehachapi Transmission Project in a manner that reliably interconnects all generating projects in the TGQ (4,350 MW) as of the commencement date of the CSRTP-2006 process (April of 2006).[8] Accordingly, the CAISO has utilized the efforts of the CSRTP-2006 as a foundation to efficiently comply with its obligations under the LGIP. It has done so by accounting for all LGIP provisions related to "clustered" Interconnection System Impact Studies (SIS) in the CSRTP-2006 study process.

[8] Around 1460 MW of TGQ projects queued beyond April 2006 will be studied individually or in additional clusters according to their Queue Position in accordance with the LGIP.

"Clustering" permits the CAISO to collectively study the system impacts of a group of Interconnection Requests, rather than evaluate each potential Generation Facility one-at-a-time. The principal benefit of studying Interconnection Requests in clusters is that it allows the CAISO to better coordinate Interconnection Requests with its overall transmission planning process, and, as a result, achieves greater efficiency in the design of needed Network Upgrades.[9] Indeed, the reasoning that resulted in adoption of a Clustering study process option in the LGIP is strongly applicable to the situation faced by the CAISO with respect to the TWRA involving the interconnection of multiple projects in a proximate geographic location such that incremental study and transmission expansion would be inefficient in the design of the necessary Network Upgrades. By pursuing an integrated solution, the Clustering approach will result in substantial capital cost savings for Network Upgrades when compared to the probable outcome of any piecemeal solution associated with the traditional, sequential SIS approach.

However, the CAISO has deviated in several respects from a typical clustered Interconnection Study. First, unlike the product of a typical Interconnection Study, this report identifies only the network components or Network Upgrades of the transmission infrastructure necessary to interconnect the planned generation projects in TWRA to the ISO Controlled Grid.[10] It excludes Interconnection Facilities, including radial wind collector transmission systems that interconnect the individual generation projects to the grid and are the responsibility of generation developers. Needed Interconnection Facilities, and their cost responsibilities, will be identified through a separate, more narrow Interconnection Study for each particular Generating Facility in the TGQ.[11] Second, an element of Clustering is the selection of a time window for determining which generation projects in the queue will be included in the clustered SIS, i.e., the "Queue Cluster Window." For the Tehachapi Transmission Project the Queue Cluster Window was defined to encompass the first project in the TGQ up through the start date of the CSRTP-2006 process or from August 19, 2003 through April 11, 2006.[12] The

[9] Order No. 2003-A, *Standardization of Generator Interconnection Agreements and Procedures*, 106 FERC ¶ 61,220 (2004) at P 120.

[10] Network Upgrades are defined in the ISO Tariff as "[t]he additions, modifications, and upgrades to the ISO Controlled Grid required at or beyond the Point of Interconnection to accommodate the interconnection of the Large Generating Facility to the ISO Controlled Grid. Network Upgrades shall consist of Delivery Network Upgrades and Reliability Network Upgrades." (ISO Tariff, Appendix A, at 515.) Delivery Network Upgrades are "[t]ransmission facilities at or beyond the Point of Interconnection, other than Reliability Network Upgrades, identified in the Interconnection Studies to relieve constraints on the ISO Controlled Grid." (*Id.* at 489.) Reliability Network Upgrades are "[t]he transmission facilities at or beyond the Point of Interconnection necessary to interconnect a Large Generating Facility safely and reliably to the ISO Controlled Grid, which would not have been necessary but for the interconnection of the Large Generating Facility, including Network Upgrades necessary to remedy short circuit or stability problems resulting from the interconnection… [or] to mitigate any adverse impact that Large Generating Facility's interconnection may have on a path's WECC rating." Interconnection Facilities, on the other hand, are "all facilities and equipment between the Generating Facility and the Point of Interconnection, including any modification, additions, or upgrades that are necessary to physically and electrically interconnect the Generating Facility to the ISO Controlled Grid."

[11] As shown in Figure 2, the broader Tehachapi Transmission Project includes the 230 kV Highwind and Cottonwind substations as well as the radial transmission lines to these two substations. The costs for these facilities are not intended to be covered as part of this project.

12. It should be noted that the duration of the Queue Cluster Window is generally intended to extend for only 180 days. This 180-day limit was adopted by FERC, in large part, to protect Interconnection Customers from undue delay in processing their study requests by transmission owners. This risk is not present in the context where the CAISO conducts the study. Nevertheless, in an abundance of

Tehachapi Transmission Project will also provide low cost integration into the ISO Controlled Grid for additional TGQ projects queued beyond April 11, 2006 (around 1,260 MW).

Finally, due to the specific circumstances presented by this project, CAISO will file a petition with FERC for approval to proceed with the proposed study approach on a one-time basis.

ECONOMIC, RELIABILITY AND ENVIRONMENTAL BENEFITS

In addition to interconnecting the TGQ generation projects, the Tehachapi Transmission Project offers System Reliability and efficiency (economy) benefits and facilitates compliance with the California's mandated RPS requirements. The CAISO is not relying on such reliability or economic benefits or RPS compliance to justify approval of the Tehachapi Transmission Project. Therefore, while significant, the CAISO does not attempt to quantify these or the following benefits of the Tehachapi Transmission Project for purposes of this study:

- Provision for the future low cost expansion capability for Path 26;
- Provision for the future expansion of transmission capability to integrate planned renewable resources in Inyo and northern San Bernardino counties area;
- Reduction in nitrogen oxides (NOx) and sulfur oxides (SOx) and other pollutant emissions from displaced fossil fuel generation;
- Potential reduction in natural gas prices stemming from lower fuel consumption by the natural gas generators that are displaced by the wind generation in TWRA - the benefits here would be both due to lower generation cost as well as other societal benefits stemming from lower natural gas costs;
- Augmentation of competitive wholesale Energy markets for California; and
- Further diversification of Energy resources.

PROJECT COST

The total cost of the Tehachapi Transmission Project is $1.8 billion dollars in nominal terms. This cost includes the cost of the Antelope-Pardee line segment ($90 million) previously approved by the CAISO Board, but excludes the cost of Interconnection Facilities, i.e., radial wind collector transmission systems that interconnect the individual generation projects to the grid and are the responsibility of generation developers. The full cost and ownership of the facilities associated with this project will be assigned to SCE. SCE will recover such costs, including the commensurate rate-of-return, directly through the CAISO transmission Access Charge (TAC).

RECOMMENDATION

Pursuant to CAISO's obligation to plan for least-cost transmission solutions to interconnect generation projects, as delineated in the LGIP, the CAISO Management recommends that CAISO Board approve the project and direct SCE, as the Project Sponsor, to proceed with the necessary permitting and construction of the project.

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caution, the CAISO will file with FERC a petition requesting an explicit one-time waiver of the 180-day Queue Cluster Window to ensure expansion of the transmission grid in the TWRA can be accomplished in the most efficient manner reasonably achievable.

Furthermore, given the CAISO's pending petition before FERC for a one-time waiver of the 180-day Queue Cluster Window, Management recognizes that the Board's approval may be affected by the outcome of the CAISO's pending petition before FERC. Hence, CAISO Management recommends that the Board consider the "substance" of the report and approve the Tehachapi Transmission Project contingent upon FERC consent to the CAISO's implementation its Clustering authority in the present circumstances.

List of Acronyms

Acronyms	Definition
AFUDC	Allowance for Funds Used During Construction
CAISO	California Independent System Operator Corporation
CCCT	Combined Cycle Combustion Turbine
CEC	California Energy Commission
CPCN	Certificate of Public Convenience and Necessity
CPUC	California Public Utilities Commission
CSRTP	California Southern Region Transmission Plan
DT	Diesel Turbine
EPAct 2005	Energy Policy Act of 2005
FERC	Federal Energy Regulatory Commission
FOD	Forced Outage Duration
FOR	Forced Outage Rate
IID	Imperial Irrigation District
IOU	Investor Owned Utility
LARS	Local Area Reliability Service
LCR	Local Capacity Requirement
LEAPS	Lake Elsinore Advanced Pumped Storage
LGIP	Large Generator Interconnection Procedures
LSE	Load Serving Entity
MRTU	Market Redesign & Technology Upgrade
NERC	North American Electric Reliability Council
NREL	National Renewable Energy Laboratory
NWPP	Northwest Power Pool
PAR	Phase Angle Regulator
PG&E	Pacific Gas and Electric Company
PTO	Participating Transmission Owner
PV	Present Value
PVD2	Palo Verde-Devers Line No. 2
QF	Qualifying Facility
RAS	Remedial Action Scheme
RMR	Reliability Must-Run
RPS	Renewables Portfolio Standard
RSI	Residual Supply Index
RTO	Regional Transmission Organization
SCCT	Simple Cycle Combustion Turbine
SCE	Southern California Edison Company
SDG&E	San Diego Gas & Electric Company
SPS	Special Protection System
SSG-WI	Seams Steering Group - Western Interconnection
STEP	Southwest Transmission Expansion Plan
TCSG	Tehachapi Collaborative Study Group
TEAM	Transmission Economic Assessment Methodology
TAC	Transmission Access Charge
TGQ	Tehachapi Generation Queue
TNHC	The Nevada Hydro Company
TPT	Technical Project Team
TWRA	Tehachapi Wind Resource Area
UPFC	Unified Power Flow Controller
WECC	Western Electricity Coordinating Council

CAISO South Regional Transmission Plan for 2006 (CSRTP-2006) Report
Part II: The Tehachapi Transmission Project

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CAISO South Regional Transmission Plan for 2006 (CSRTP-2006) Report
Part II: The Tehachapi Transmission Project

1 Introduction

1.1 Overall Objectives

The CAISO is responsible for coordinating, reviewing and approving the transmission expansion for its service area. In April 2006, the CAISO initiated its South Regional Transmission Planning process for 2006 (CSRTP-2006) to assess on a regional basis three major transmission expansion projects located in southern California. These projects are:

- Sun Path Project: Combination of the San Diego Gas and Electric (SDG&E) Sunrise Powerlink Project and Citizens Energy (Citizens) and Imperial Irrigation District (IID) Green Path Project;
- Tehachapi Transmission Project: Tehachapi Wind Resource Area (TWRA) transmission infrastructure project, and
- LEAPS Project covering the Lake Elsinore Advanced Pumped Storage (LEAPS) plant and the associated transmission line.

This report is the second of three coordinated reports that will comprise the CSRTP-2006 and provides results and recommendations for the Tehachapi Transmission Project. The first report provided the findings and recommendations for the Sun Path Project.[13]The third pending report will cover LEAPS.[14]

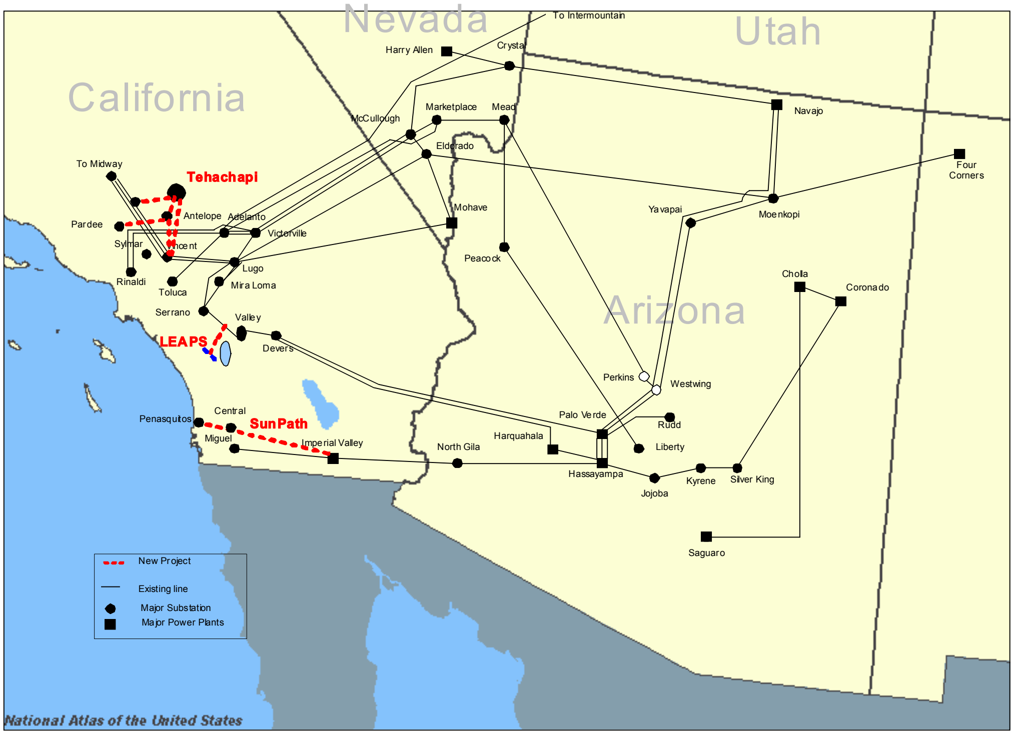
The CAISO's CSRTP-2006 assessment team included technical representatives from the three sponsoring and/or impacted Participating Transmission Owners (PTOs) (Pacific Gas and Electric Company (PG&E), Southern California Edison Company (SCE) and SDG&E), other project sponsors (The Nevada Hydro Company, Citizens, IID, Oak Creek Energy System/Tehachapi Holdings), the California Energy Commission (CEC), and the California Electricity Oversight Board (EOB). The CSRTP-2006 process was not intended as a stakeholder process, but rather was intended to provide technical focus and "real-time" technical advice for the analyses needed to study these projects.

Figure 1.1 presents the general location of the three proposed transmission projects against the backdrop of the 500kV network in the same general geographic areas.

[13] Additional information and details of the Sun Path Project may be found at http://www.caiso.com/1841/1841b1925a320.pdf.

[14] The CAISO has taken a phased approach for the CSRTP-2006 process to enhance study efficiency and flexibility, including the timing of study review and approval. The CAISO completed the assessment of the Sun Path Project in the first phase and received CAISO Board of Governors approval for that project on August 3, 2006. Evaluation of the LEAPS and the Tehachapi Transmission Projects continued following the Sun Path approval. The CAISO is currently awaiting guidance from FERC on the operational and rate treatment aspects of LEAPS' power plant. A separate report for the LEAPS Project (Part 3 and the final CSRTP-2006 report) will be prepared at that time.

Figure 1.1: Locations of the Projects Studied under CSRTP 2006



For additional details on the CSRTP-2006 process, please refer to Part I of the CSRTP-2006 report.

1.2 Public Participation in the CSRTP-2006 Process Focusing on the Tehachapi Transmission Project

While CSRTP-2006 participation was mainly limited to technical representation from the project sponsors, the impacted PTOs, the CEC, and the EOB for practical considerations, the CAISO launched several initiatives to share information with and receive input from the public. The CAISO's public outreach initiatives are listed in detail in Table 1.1 below.

In addition to several outreach programs held as part of the Sun Path project review intended to familiarize the public with the CSRTP-2006 process and general study assumptions, the CAISO held two days of "open house" on the CSRTP-2006 planning process and the Tehachapi Transmission Project in TWRA. The CAISO established additional outreach programs for local agencies and local community organizations and made several presentations regarding the CSRTP-2006 process and preliminary findings at workshops sponsored by the California Public Utilities Commission (CPUC) and the Southwest Transmission Expansion Plan (STEP). As a result of these public outreach programs, the CAISO received valuable comments and suggestions from stakeholders that resulted in modifications to study assumptions and methodology and, eventually, to the CAISO's findings and conclusions. Finally, this report will be posted on the CAISO website prior to the January 2007 Board of Governors meeting to facilitate public comment at that meeting.

Table 1.1 below lists the outreach activities and their results.

Table 1.1: Stakeholder and Public Outreach for the CSRTP-2006 Process

Outreach Activity	Date
Open house in San Diego on CSRTP-2006 process	- May 19 – 20, 2006
Created tailored distribution lists to reach affected parties, including those wishing not to be on master communications lists.	- May 2006 through present
Hosted conference call to discuss assumptions and comments	- June 22, 2006
Collected written stakeholder comments on assumptions.	- Through June 29, 2006
Initiated 1:1 outreach to individuals and interested groups.	- May through present
Published and re-posted updated study assumptions	- July 17, 2006
Held joint Tehachapi Transmission Workshop with CPUC	- August 23, 2006
Presented the CSRTP-2006 process and interim findings on all projects, including the Tehachapi Transmission Project, at multiple Southwest Transmission Expansion Plan (STEP) meetings.	- May 5, 2006 - July 24, 2006 - September 21, 2006 - November 17, 2006
Hosted an Open House in Tehachapi to display ISO's role in transmission planning and the Tehachapi Transmission Project final plan of service.	- September 25, 2006 - September 26, 2006
Presentation at CPUC Workshop on the Tehachapi Transmission	- November 21, 2006

1.3 Overview of the Findings

The CAISO's determinations and findings on the Tehachapi Transmission Project as presented in this report are as follows:

i. The Tehachapi Transmission Project is the least-cost solution that reliably interconnects 4,350 MW of generating resources in TGQ;

ii. The Tehachapi Transmission Project also addresses the reliability needs of the CAISO Controlled Grid due to projected load growth in Antelope Valley area as well as helps to address South of Lugo (SOL) transmission constraints – an ongoing source of reliability concern for the Los Angeles (LA) Basin;[15]

iii. The Tehachapi Transmission Project facilitates the ability of California utilities to comply with the state mandated Renewable Portfolio Standard (RPS) by providing access to planned renewable resources in the TWRA – also see points 6 and 7 below;

iv. The Tehachapi Transmission Project is expected to provide economic benefits to the CAISO ratepayers mainly by providing access to wind and other efficient generating resources under development in TWRA;

v. The Tehachapi Transmission Project makes it possible to expand the transfer capability of Path 26 in the near future with a low cost upgrade of the PG&E's portion of Midway-Vincent Line 3;

[15] Concerns with the SOL transmission constraints are expected to increase as additional generation resources are sited outside the LA Basin. Delivery of this new generation to LA Basin load will require significant transmission additions as identified in this plan.

vi. The Tehachapi Transmission Project will be used by other projects in TGQ queued beyond the start date of the CSRTP-2006 for low-cost interconnection to the CAISO transmission grid;[16] and

vii. Although the detailed planning is not yet performed, the Tehachapi Transmission Project lays the groundwork for the integration of large amounts of planned geothermal, solar, and wind generation in Inyo and northern San Bernardino counties with potential future 500 kV additions from the WindHub Substation (one of Tehachapi Transmission Project's substations) to the Kramer Substation.

1.4 Project Cost

Based on estimates provided by SCE, the total cost of the Tehachapi Transmission Project is $1.8 billion dollars in nominal terms. This cost includes the cost of the Antelope-Pardee line segment ($90 million) previously approved by the CAISO Board of Governors, but excludes the cost of Interconnection Facilities, i.e., radial wind collector transmission systems that interconnect the individual generation projects to the grid and are the responsibility of generation developers.

The Tehachapi Transmission Project cost estimate has been developed by SCE based on planning level cost studies that include a typical twenty five percent (25%) contingency uplift to cover potential future cost increases. These planning level cost figures can still vary by as much as +/- 40% from those calculated through full scale engineering studies.

As noted above, there will also be Interconnection Facilities or generation collector systems (substations and lines) outside the scope of the Tehachapi Transmission Project presented here that will radially interconnect generators in the Tehachapi Area Generation Queue (TGQ) to the Tehachapi Transmission Project infrastructure. Such Interconnection Facilities as well as their costs and cost responsibilities are directly assigned to generation developers and will be determined based on individual System Impact Studies (SISs) for each TGQ project.[17]

1.5 Project Description and Schedule

Figure 1.2 depicts the major components of the Tehachapi Transmission Project at full build-out in 2013. Table 1.2 sets forth the schedule for the rollout of the major components of the Tehachapi Transmission Project. Due the expansive nature of the Tehachapi Transmission Project, the components of this infrastructure will be developed and put into service over a five-year period starting from 2008. The addition of each component allows added access to TGQ generation as well as ensures compliance with reliability standards given projected load growth in the area. This schedule is intended to be flexible and subject to change in response to actual wind generation development in the TWRA.

[16] Around 1260 MW of such generation is already in TGQ as of December 1, 2006.

[17] Special rate treatment for such radial collectors systems may be provided from both the CAISO and the CPUC consistent with their respective regulatory authority.

Figure 1.2: Tehachapi Transmission Project Configuration in 2013 and Beyond

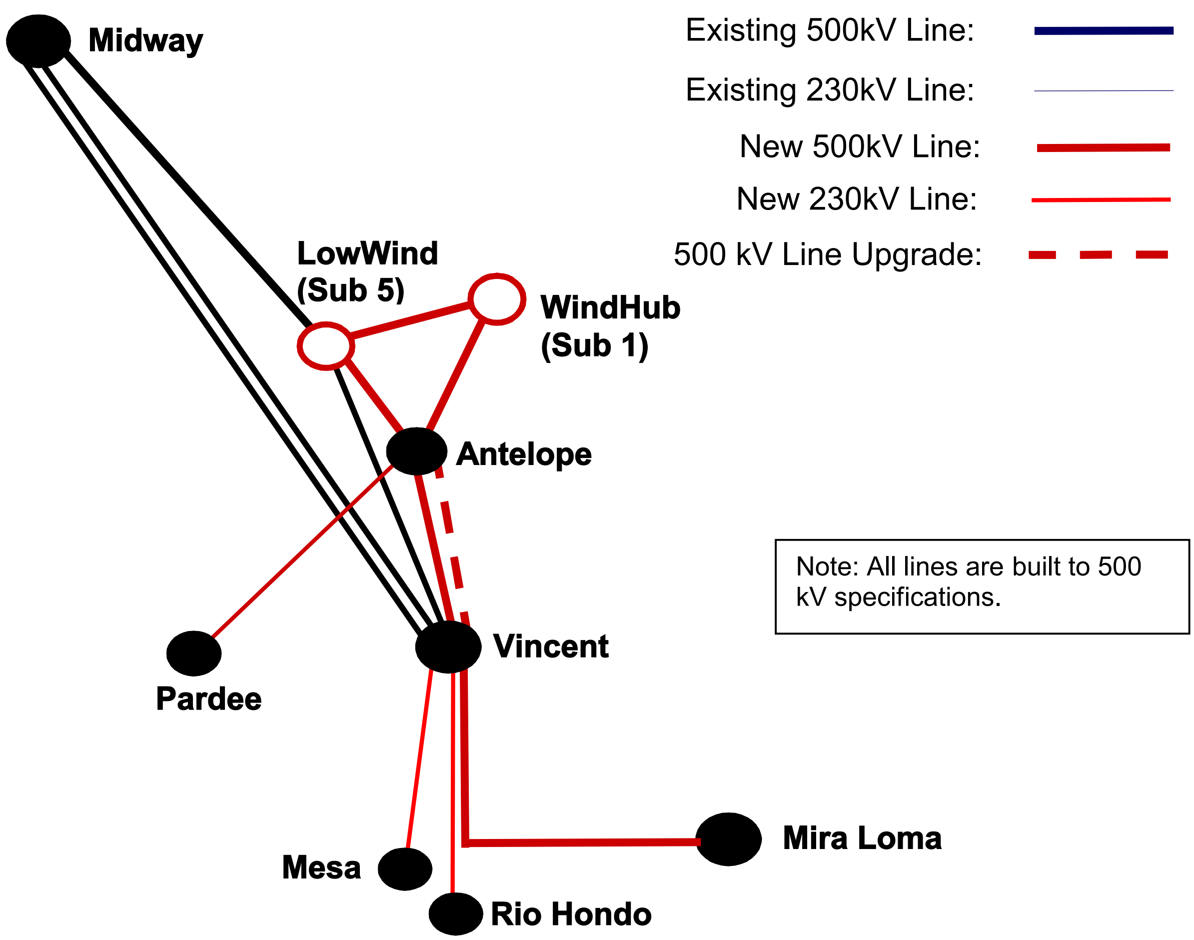


Table 1.2: Tehachapi Transmission Project Schedule

Major Transmission Facilities	Planned In-Service Date
Antelope – Pardee 230 kV Line (500 kV Specifications) & Antelope Substation Expansion*	Dec 2008
Antelope – Vincent 230 kV Line #1 (500 kV Specifications)	Mar 2009
WindHub Substation	Mar 2009
Antelope – WindHub (also known as Substation 1) 230 kV Line (500 kV Specifications)	Mar 2009
Antelope – Vincent 230 kV Line #2 (500 kV Specifications)	Mar 2011
LowWind 500/230 kV Substation (also known as Substation 5) with Loop in of Midway – Vincent #3 500 kV line	Aug 2011
Antelope – LowWind 500kV line	Aug 2011
WindHub Substation 500 kV Upgrade	Mar 2011

Antelope Substation 500 kV Upgrade	Mar 2011
Vincent Substation 500 kV & 220 kV Upgrades	Sep 2011
LowWind – WindHub 500 kV line	Oct 2011
Replacement of Vincent – Rio Hondo No. 2 230kV line	Nov 2011
Vincent – Mira Loma 500 kV line	Apr 2012
Vincent – Mesa 500/220 kV Line and Mesa Substation Work	Nov 2013

* This line segment was approved by the CAISO Board on July 29, 2004.

2 Description of the Tehachapi Transmission Project

The TWRA lies at the southern end of the San Joaquin Valley in the mountainous region between Bakersfield and Mohave. The TWRA is California's largest wind resource area. The primary goal of the Tehachapi Transmission Project is to provide transmission infrastructure to allow the wind generation potential in Tehachapi, estimated at a minimum of 4,500 MW, to reach California consumers.[18]

The Tehachapi Collaborative Study Group (TCSG) was formed to develop a comprehensive transmission development plan for the phased expansion of transmission capabilities in the TWRA. The CPUC Staff coordinated the TCSG. The TCSG issued the first study report to the CPUC in March 2005. The TCSG report identified a number of alternatives for the transmission infrastructure and recommended further study in order to select the best expansion plan. This second TCSG report, issued on April 2006, narrows and refines the alternatives submitted in the first report. In addition, the second TCSG report makes further recommendations to facilitate completion of the planning process and detailed technical studies.

2.1 Tehachapi Study Reliability Concerns

Path 26

Path 26 is the major interface between northern and southern California (specifically the PG&E and SCE systems) and is also a measure of the power flow between northern and southern California. Path 26 is comprised of three 500 kV lines between PG&E's Midway Substation and SCE's Vincent Substation. TWRA lies geographically and electrically between these two points. Path 26 has interface limits for both North to South (N-S) and South to North (S-N) flow. The Path 26 N-S flow rating is 4000 MW, which is limited by the double line outage of Midway-Vincent #1 and #2 500 kV lines. Path 26 N-S is supported with a Special Protection Scheme (SPS) that protects for this contingency and when armed, trips 1400 MW of local generation at Midway and 500 MW of load on the SCE system. The Path 26 S-N limit is 3000 MW.

One objective of interconnection studies is to identify Network Upgrades that prevent an adverse impact of any proposed interconnection on a path's WECC rating. Thus, the Tehachapi studies were evaluated based on maintaining the existing Path 26 limits.

Antelope Valley Area Load

The Antelope Valley area has seen continued growth and is forecast to grow at about 5% per year. The 2006 summer peak load was about 700 MW and is projected to increase to 1100 MW by 2016. SCE has identified reliability concerns in meeting the Antelope area load from the sub-transmission system by 2008 and on the bulk transmission system by year 2011. Today, existing operating procedures are used to mitigate problems on the 230 kV system that occur during heavy load conditions under both normal and contingency conditions.

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[18] Second Report of the Tehachapi Collaborative Study Group: Development Plan for the Phased Expansion of Electric Power Transmission Facilities in the Tehachapi Wind Resource Area, ftp://ftp.cpuc.ca.gov/tehachapi.

South of Lugo Transmission Constraint

Similar to the Antelope Valley area, load in eastern Los Angeles and San Bernardino Counties served by SCE substations of Mesa, Rio Hondo, Laguna Bell, Walnut, Chino, Mira Loma, Vista, etc., has also experienced rapid growth in recent years that is expected to continue in the future. This area South of Vincent is currently served via 230 kV transmission from Pardee and Vincent, and three 500 kV lines South of Lugo. A new Rancho Vista 500/230 kV substation was approved by the CAISO Board of Governors on January 27, 2005, to help supply the local area and will be served via one of the existing 500 kV lines from Lugo and Mira Loma substations. The local 230 kV transmission system in the area will become heavily stressed during conditions with heavy Path 26 N-S flows, high Ventura generation west of Pardee, high generation from North of Lugo and high deliveries from El Dorado, and with low generation south of the Mesa area. Current limit on the South of Lugo path is 6,100 MW, and is expected to be 6,400 MW with the completion of Rancho Vista 500/230kV Substation in 2009. However, under the CAISO's Local Capacity Requirements (LCR) study, South of Lugo flow is projected to be the limitation under a double-line contingency[19] beyond 2011. The transmission upgrades, identified in the plan of service, are expected to mitigate these South of Lugo reliability problems.

2.2 Tehachapi Transmission Project Plan of Service

A list of the facilities constituting the Tehachapi Transmission Project plan of service is presented in the following. Table 2.1 presents the planned in-service date and the overall cost of these components. The timing of complete build-out of the facilities will be eventually influenced by the actual generation development in the area. However, the cost impact of the schedule change is expected to be very small.

New or Upgraded Substations:

- Three new substations used as collector stations for the wind farms in the TWRA: WindHub, LowWind and HighWind Substations. The first two of the three new substations are part of the network component of the overall plan of service. The cost of the third substation is the responsibility of the wind developers and not included in the Tehachapi Transmission Project plan.
    - WindHub 500/230/66 kV will include up to four 500/230 kV transformer banks, four breaker-and-half 500 kV bus positions, six initial breaker-and-half 230 kV bus positions, static voltage support devices, and dynamic voltage support if necessary. Additional equipment will be added as wind generation develops in the region.
    - LowWind 500/230 kV will include up to two 500/230 kV transformer banks, four breaker-and-half 500 kV bus positions, three initial breaker-and-half 230 kV bus positions, static voltage support devices, and dynamic voltage support if necessary. Also includes loop in of Midway-Vincent #3 line to connect substation to grid. Additional equipment will be added as wind generation develops in the region.

[19] Double-line contingency of Palo Verde – Devers 500kV # 1 & 2 lines

- Upgrades to existing substations:
  - The Pardee 230/66 kV substation will be upgraded by outfitting existing 230 kV line position.
  - The existing Mira Loma 500/230/66 kV substation will be upgraded by outfitting existing 500 kV line position.
  - The existing 230/66 kV Antelope Substation will be expanded to include a new 500 kV switchyard, additional 230 kV line positions and static and dynamic voltage support.
  - The existing 500/230 kV Vincent Substation will be expanded to include additional 500 kV and 230 kV line positions, additional static and dynamic voltage support and additional 500/230 kV bank capacity.
  - The Mesa 230/66 kV substation will be upgraded by outfitting existing 230 kV line position.
  - The Gould 230/66 kV substation will be upgraded by outfitting existing 230 kV line position.

New or Upgraded Transmission Lines:

- New 25.6-mile 500 kV transmission line between Antelope and Pardee substations initially operated at 230 kV. This line is also known as Phase 1-Segment 1 of the original Antelope Transmission Project. Construction to 500 kV specifications with initial operation at 230 kV is required to maximize the capability of limited transmission corridors and minimize environmental impacts associated with multiple 230 kV lines and/or multiple tear-down and rebuild activities. Actual operation of 500 kV will be determined by the amount of generation build out in the system and changes to system conditions.[20]
- New 25.6-mile 500 kV transmission line between WindHub and Antelope substations. This line is also known as Phase 1-Segment 3 of the original Antelope Transmission Project and will initially operate at 230 kV.
- Two new 500 kV transmission lines between Antelope and Vincent substations.
  - The initial 500 kV transmission line will be approximately 21.0 miles built on new right-of-way mostly adjacent to the existing right-of-way. This line is also known as the Phase 1-Segment 2 of the original Antelope Transmission Project and will initially operate at 230 kV. This new transmission line is primarily required to meet the reliability needs of the CAISO controlled grid due to projected load growth in Antelope Valley.
  - The second 500 kV transmission line will be approximately 18.0 miles built on existing right-of-way replacing the existing Antelope-Vincent and Antelope-Mesa 230 kV transmission lines. This transmission line will also be initially operated at 230 kV.
- New 75-mile 500 kV transmission line between Vincent and Mira Loma substations. This transmission line is required to eliminate the South of Lugo transmission constraints, which have been a source of ongoing reliability concern for the LA Basin, especially in light of

[20] The CAISO Board of Governors approved the line on July 29, 2004; however, the CAISO included it as part of the proposed comprehensive solution for the Tehachapi and surrounding areas as presented in this report.

projected load growth in Mira Loma area, and is planned to go into service by 2012 timeframe. This line will utilize the existing Vincent-Rio Hondo No.2 230 kV transmission line (portion already built to 500 kV standards), portion of the existing Antelope-Mesa 230 kV South of Vincent, portions of existing idle 230 kV transmission line segments, and portions of new construction between the Mesa area and Mira Loma area. Between Vincent and the northern boundary of the City of Duarte (adjacent to Angeles National Forest), the transmission line will be constructed as single-circuit 500 kV specifications. From this point to the Mira Loma area, the transmission line will be constructed as double-circuit 500 kV specifications to maximize the capability of limited corridors and to minimize environmental impacts associated with multiple 230 kV lines and/or multiple tear-down and rebuild activities.

- New 32.5-mile 500/230 kV transmission line between Vincent and Rio Hondo is required to replace the existing Vincent-Rio Hondo No.2 230 kV transmission line that was utilized for the new Vincent-Mira Loma 500 kV transmission line. This line will utilize portion of existing Antelope-Mesa 230 kV transmission line and will be built to 500 kV specifications to maximize capability of limited transmission corridors avoid waste and numerous minimize environmental impacts associated with multiple 230 kV transmission lines and/or multiple tear-down and rebuild activities. As discussed above, such construction standard will allow for a future low cost upgrade to 500 kV operation.
- New 14-mile 500 kV transmission line between proposed LowWind and upgraded Antelope substations.
- New 42-mile 500/230 kV transmission line between Vincent and Mesa substations. Between Vincent and the Gould substation areas, this line will be built to 500 kV specifications to maximize capability of limited transmission corridors and minimize environmental impacts associated with multiple 230 kV transmission lines and/or multiple tear-down and rebuild activities and to allow for future low cost upgrade to 500 kV operation.

Table 2.1: Tehachapi Transmission Project Plan of Service

Segment	Major Transmission Facilities	Planned In-Service Date
1	New Antelope – Pardee 230 kV Line (500 kV Specifications)[1] & Antelope Substation Expansion	Dec 2008
2 & 3	New Antelope – Vincent 230 kV Line #1 (500 kV Specifications)	Mar 2009
	WindHub Substation	Mar 2009
	New Antelope – WindHub (also known as Substation 1) 230 kV Line (500 kV Specifications)	
5	New Antelope – Vincent 230 kV Line #2 (500 kV Specifications)	Mar 2011
4	New LowWind 500/230 kV Substation (also known as Substation 5) with Loop in of Midway – Vincent #3 500 kV line	Aug 2011
	Antelope – LowWind 500kV line	Aug 2011

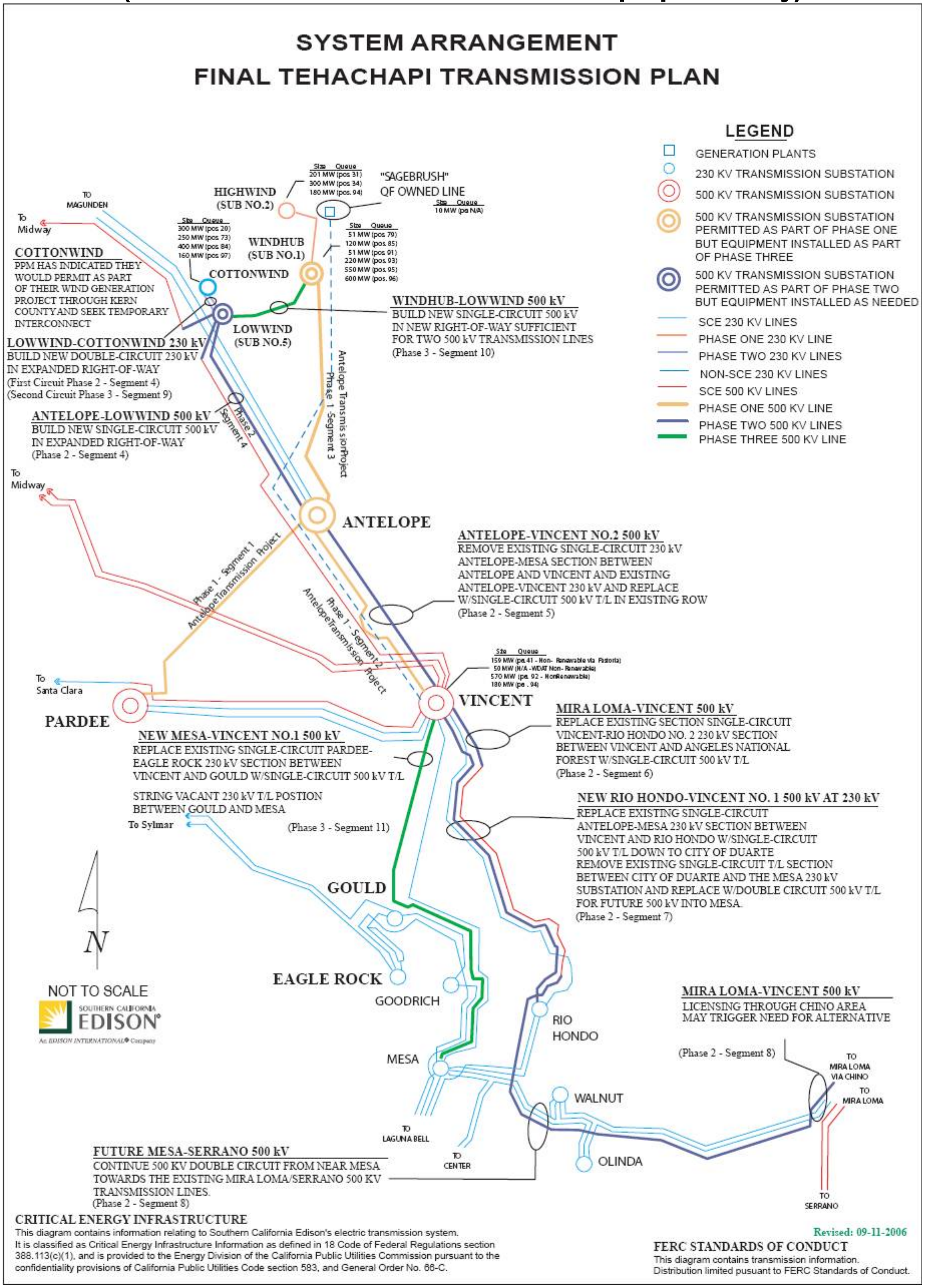
Segment	Major Transmission Facilities	Planned In-Service Date
9	WindHub Substation 500 kV Operation	Mar 2011
	Antelope Substation 500 kV Operation	Mar 2011
	Vincent Substation 500 kV & 220 kV Upgrades	Sep 2011
10	New LowWind – WindHub 500 kV line	Oct 2011
6	Replacement of Vincent – Rio Hondo No. 2 230kV line	Nov 2011
7 & 8	New Vincent – Mira Loma 500 kV line	Apr 2012
11	New Vincent – Mesa 500/220 kV Line and Mesa Substation Work	Nov 2013
Total Cost Estimate for the Tehachapi Transmission Project (Nominal dollars)		$1,800M

It must be noted that the project schedule and cost figures presented here are all planning level estimates developed based on best available information of SCE on the constructability of the facilities and the actual cost of procurement of necessary material and construction of the facilities in the years that the actual construction takes place. Some of the costs are based on detailed engineering analysis (around +/-10% accurate) and others are based on planning studies (around +/- 40% accurate).[21] The CAISO estimates that the total cost is also accurate within 40%. The CAISO realizes that the actual schedule and cost may vary once detailed engineering analysis of the entire Tehachapi Transmission Project plan of service is complete – expected by mid-2007.

Figure 2.1 presents the overall Tehachapi Transmission Project plan of service upon completion.

[21] All cost figures include a 25% contingency markup.

Figure 2.1: Tehachapi Transmission Project Plan of Service
(Routes shown below are for illustration purposes only)



3 System Impact Study

The CAISO worked with the project sponsor (SCE) and other participants in the CSRTP-2006 process to plan the Tehachapi Transmission Project in a manner that reliably interconnects and allows delivery of all generating projects (4,350 MW) in the TGQ up to the date the CSRTP-2006 process was launched (April of 2006). Table 3.1 provides the list of such targeted generation in the TGQ.

Table 3.1 – Tehachapi Generation Queue through April 2006

Project	Queue Date	Queue Position	Type	Capacity (MW)
Project 1	9/4/2003	20	WT	300
Project 2	5/11/2004	31	WT	201
Project 3	7/19/2004	34	WT	300
Project 4	11/18/2004	41	CT	158.8
Project 5	6/17/2005	WDAT	CT	49.9
Project 6	6/27/2005	73	WT	250
Project 7	9/7/2005	79	WT	51
Project 8	12/1/2005	84	WT	400
Project 9	12/28/2005	85	WT	120
Project 10	1/20/2006	86A	WT	33.1
Project 11	1/20/2006	86B	WT	34
Project 12	2/22/2006	91	WT	51
Project 13	2/24/2006	92	CC	570
Project 14	3/1/2006	93	WT	220
Project 15	3/1/2006	94	WT	180
Project 16	3/1/2006	95	WT	550
Project 17	3/1/2006	96	WT	600
Project 18	3/1/2006	97	WT	160
Project 19	4/5/2006	100	WT	120
TOTAL				**4,350**

* WT: Wind Turbine; CT: Combustion Turbine; CC: Combined Cycle

The CAISO utilized the efforts of the CSRTP-2006 in order to efficiently comply with its obligations under the LGIP. It did so by accounting for all the LGIP provisions for System Impact Studies (SIS) into the CSRTP-2006 study process. As such, the study that was performed was type of "clustered" system impact study to interconnect all targeted generation in the TGQ.

3.1 Reliability Analysis

3.1.1 Starting Power Flow Base Case

The CAISO provided a power flow case based on 2015 summer peak load condition. In addition to the power flow basecase, the power flow case was adjusted to reflect possible stress on the ISO Controlled Grid. The emphasis was on the northern SCE area with full network representation of the SCE's proposed transmission upgrades required for connecting the Tehachapi generation projects in the queue position through April 2006. The adjusted power flow case was tested along with dynamic data for system stability, and was determined to be stable.

3.1.2 Contingency Analysis

Based on the targeted generation projects of 4,350 MW in Tehachapi area, the study results indicated no facility overload and voltage issue for normal (N-0) and contingency (N-1 and N-2) conditions. Table 3.2 provides the summary listing of the critical contingencies that were evaluated for the study.

Table 3.2 – List of Contingencies for the Tehachapi Transmission Project Study

	Contingencies	NERC/WECC Category
1	WindHub (Sub.1) – Antelope 500kV Line	B
2	WindHub (Sub.5) – LowWind (Sub.5) 500kV Line	B
3	LowWind (Sub.5) – Midway 500kV Line	B
4	Vincent – Mesa 230kV Line	B
5	Vincent – Mira Loma 500kV Line	B
6	Vincent – Rio Hondo 230kV Line	B
7	Lugo – Vincent 500kV Line	B
8	Vincent – Antelope 500kV Line	B
9	Lugo – Mira Loma 500kV Double Lines	C
10	Lugo – Vincent 500kV Double Lines	C
11	Midway – Vincent 500kV Double Lines (with SPS for 4000 MW Path 26 flow)	C
12	LowWind (Sub.5) – South 500kV Double Lines (Sub.5 – Antelope & Sub.5 – Vincent 500kV Lines)	C
13	Vincent – Antelope 500kV Double Lines	C
14	Vincent – Mesa 230kV Double Lines	C
15	Vincent – North 500kV Double Lines (Vincent – Antelope & Vincent – LowWind (Sub.5) 500kV Lines)	C
16	Vincent – Rio Hondo 230kV Double Lines	C

Table 3.3 shows the results of the post-transient governor power flow studies with the Tehachapi Transmission Project modeled in the study power flow case. With the proposed plan of service for the Tehachapi Transmission Project, up to 4,350 MW of new generation in the Tehachapi area can be connected to the ISO Controlled Grid.

Table 3.3 – Line Loading under Basecase and Contingency conditions (Post-transient Governor Power Flow Study Results Summary)

Equipment	Normal Rating Amps/MVA	Emergency Rating Amps/MVA	Loading	N	Contingency Description
Lugo - Ranchvst 500 Ckt 1	3950	5330	4980.3*	N-2	Lugo-Miraloma-DLO
Vincent - Riohondo 230 Ckt 1	2480	3300	2213.2	N-0	Basecase
			2923.1*	N-1	Vincent-Riohondo-SLO
			N/A	N-2	Vincent-South-DLO (Vincent-Mesa & Vincent-Serrano 500kV)

* Above normal but below emergency rating.

3.1.3 Transient Stability Study Results

Transient stability with 10-second run was performed for the proposed Tehachapi Transmission Project under the assumptions of 4,000 MW flow for Path 26 (Midway – Vincent 500kV lines) in the North – South direction and with 4,350 MW of new generation additions in the TWRA. With the proposed plan of service for the Tehachapi Transmission Project, the study results met the NERC/WECC Planning Standards and the criteria of the WECC Disturbance Performance Table. Since many of these generation projects have not completed the LGIP process, typical dynamic data for the wind generating units were modeled. In addition, typical dynamic data for the combined and simple cycle generating units in the area were modeled for the proposed thermal generation projects. As more detailed and accurate dynamic data for these new generation units become available, additional further transient analyses will be required to ensure that there are no transient stability concerns with the new data.

Table 3.4: Transient Voltage and Frequency Study Results Category B - Loss of Single Element

	Contingency	Transient Voltage Dip (%) and Damping	Lowest Transient Frequency at Load Bus (Hz)	Comments
1	Lugo-Vincent 500kV	Rio Hondo 66kV, ΔV= 0.9%, Rio Hondo 230kV, ΔV= 0.9%, Damping >0	Gold Hills 115kV, f=59.99 Hz	Meet WECC Planning Standards
2	Sub.1 – Antelope 500kV	Marshall 92kV, ΔV= 1.3%, MRedwtp 69kV, ΔV= 1.2%, Damping >0	Wilsona 66kV, f=59.42 Hz for t < 6 cycles	Meet WECC Planning Standards
3	Sub.1 – Sub.5 500kV	Marshall 92kV, ΔV= 1.3%, Shields 92kV, ΔV= 1.3%, Damping >0	Wilsona 66kV, f=59.42 Hz for t < 6 cycles	Meet WECC Planning Standards
4	Sub.5 – Midway 500kV	Northcst 69kV, ΔV= 2.1%, MRedwtp 69kV, ΔV= 2.0%, Damping >0	Wilsona 66kV, f=59.28 Hz for t < 6 cycles	Meet WECC Planning Standards

	Contingency	Transient Voltage Dip (%) and Damping	Lowest Transient Frequency at Load Bus (Hz)	Comments
5	Vincent-Antelope 500kV	La Cienega 66kV, ΔV= 6.5%, Tehachmm 66kV, ΔV= 12.1%, Damping >0	Rio Hondo 66kV, f=59.07 Hz for t < 6 cycles, Searles 34.5kV, f<59.6 Hz for 9 cycles	Meet WECC Planning Standards
6	Vincent-Mesa 230kV	Rector 66kV, ΔV=10.9%, Rector 230kV, ΔV=12.7%, Damping >0	Rio Hondo 66kV, f=59.15 Hz for t < 6 cycles	Meet WECC Planning Standards
7	Vincent – Mira Loma 500kV	Goldhills 115kV, ΔV=4.5%, Tehachmm 66kV, ΔV=4.2%, Damping >0	Mira Loma 66kV, f=59.06 Hz for t < 6 cycles, Searles 34.5kV, f<59.6 Hz for 9 cycles	Meet WECC Planning Standards
8	Vincent – Rio Hondo 230kV	Rector 66kV, ΔV=4.5%, Rector 230kV, ΔV=4.2%, Damping >0	Rio Hondo 66kV, f=59.15 Hz for t < 6 cycles	Meet WECC Planning Standards

Table 3.5: Transient Voltage and Frequency Study Results Category C Events (Loss of Two or More Elements)

	Contingency	Highest Transient Voltage Dip (%) and Damping	Lowest Transient Frequency at Load Bus (Hz)	Comments
1	Lugo-Mira Loma 500kV Double Line	Goldhills 115kV, ΔV= 9%, Tap604 115kV, ΔV= 8.7%, Damping >0	Searles 34.5kV, f=59.68 Hz	Meet WECC Planning Standards
2	Lugo-Vincent 500kV Double Line	Rio Hondo 66kV, ΔV= 4%, Rio Hondo 230kV, ΔV= 3.7%, Damping >0	Aurora 69kV, f=59.95 Hz	Meet WECC Planning Standards
3	Midway-Vincent 500kV DLO with SPS	Lakeview 69kV, V=8.2% Hackamor 69kV, ΔV=7.9% Damping >0	Wilsona 66kV, f=59.15 Hz	Meet WECC Planning Standards
4	Sub.5-Antelope & Sub.5-Vincent 500kV Double Line (aka Sub.5-South Double Line)	Goldhills 115kV,□V=2.5%, Tap601 115kV, □V=2.4%, Damping >0	Wilsona 66kV, f=59.28 Hz	Meet WECC Planning Standards
5	Vincent-Antelope 500kV Double Line	La Cienega 66kV, ΔV=21.8%, La Cienega 230kV, ΔV=15.9%, Damping >0	Rio Hondo 66kV, f=59.07 Hz Searles 34.5kV, f<59.6 Hz for 6.8 cycles	Meet WECC Planning Standards, except for Searles 34.5kV (this is an existing pre-project concern)
6	Vincent-Mesa 230kV Double Line	Rio Hondo 66kV, ΔV=4.9%, Rio Hondo 230kV, ΔV=4.6%, Damping >0	Rio Hondo 66kV, f=59.15 Hz	Meet WECC Planning Standards,

	Contingency	Highest Transient Voltage Dip (%) and Damping	Lowest Transient Frequency at Load Bus (Hz)	Comments
7	Vincent-Antelope & Vincent-Sub.5 500kV Double Line (aka Vincent – North 500kV DLO)	La Cienega 66kV, ΔV=20.1%, La Cienega 230kV, ΔV=14.5%, Damping >0	Rio Hondo 66kV, f=59.07 Hz Searles 34.5kV, f<59.6 Hz for 6.8 cycles	Meet WECC Planning Standards, except for Searles 34.5kV (existing pre-project concern)
8	Vincent – Rio Hondo 230kV Double Line	Rector 66kV, ΔV=5.1%, Rector 230kV, ΔV=4.7%, Damping >0	Rio Hondo 66kV, f=59.15 Hz	Meet WECC Planning Standards

3.2 Transmission Alternatives

The CSRTP-2006 process reviewed and investigated several major project alternatives in order to optimize the recommended plan of service. This section presents the five most promising alternatives that were considered and studied in some detail for this project. Figures 5.1 To 5.5 show alternative configurations considered and the related estimated costs.[22] In all these alternatives, South of Vincent upgrades are common with those identified in the Tehachapi Transmission Project plan of service as presented in this report.

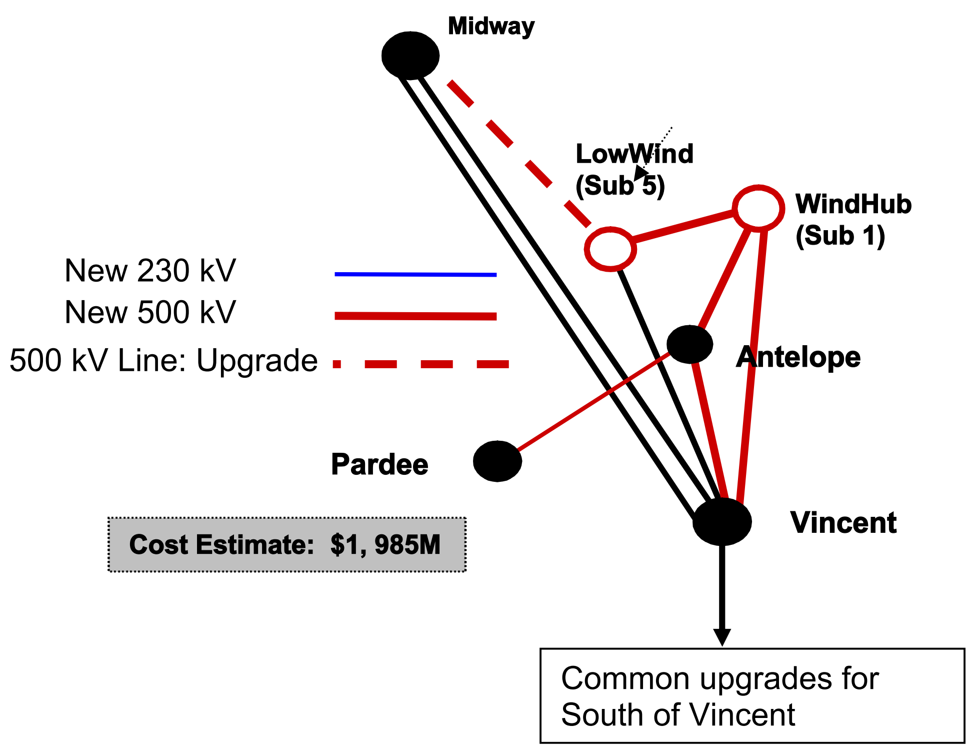
As shown below, all the alternatives considered were more expensive than the selected plan of service for the Tehachapi Transmission Project. At the same time, all alternatives are comparable with the selected method of service in regards to integrating TGQ generation projects, addressing load growth in Antelope Valley area, and mitigating South of Lugo constraints.

3.2.1 Alternative 1

Alternative 1 was the first alternative considered by the CSRTP-2006 team and was studied to a great extent. It was shown to provide the same level of benefits as the proposed Tehachapi Transmission Project, however, at a higher cost.

[22] The cost estimates are planning level estimates based on unit costs. Cost Estimates do not include Right-of-way (R/W) for transmission lines and land use for substations.

Figure 4.1: Alternative 1



3.2.2 Alternatives 2 through 4

Alternatives 2 through 4 were recommended by the Tehachapi Collaborative Study Group (TCSG). All these alternatives cost more than the proposed Tehachapi Transmission Project.

Figure 4.2: Alternative 2

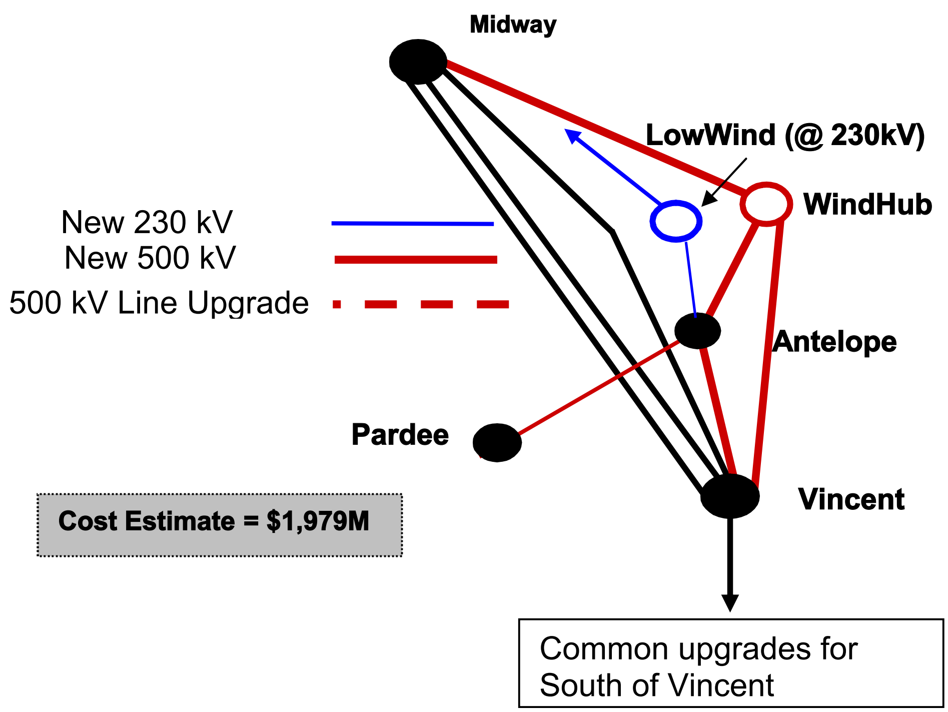


Figure 4.3: Alternative 3

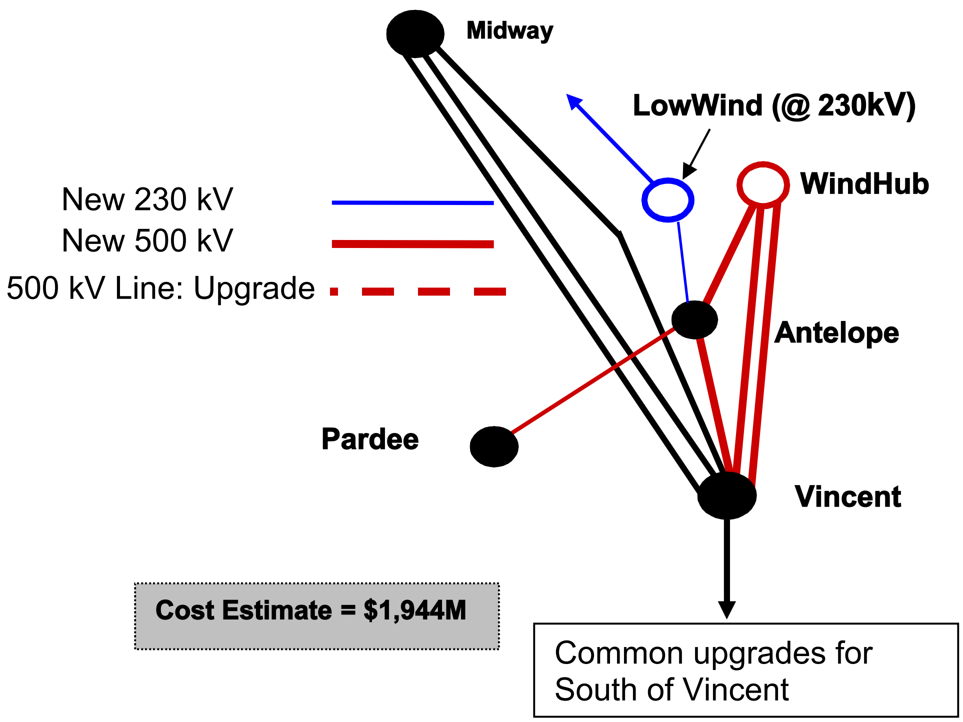
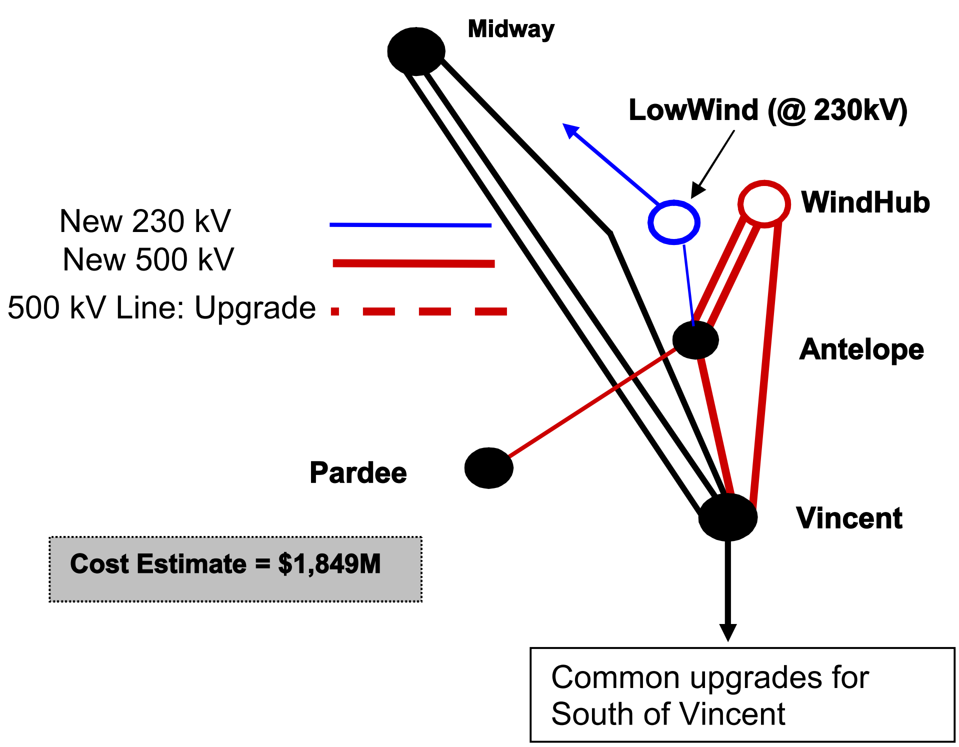


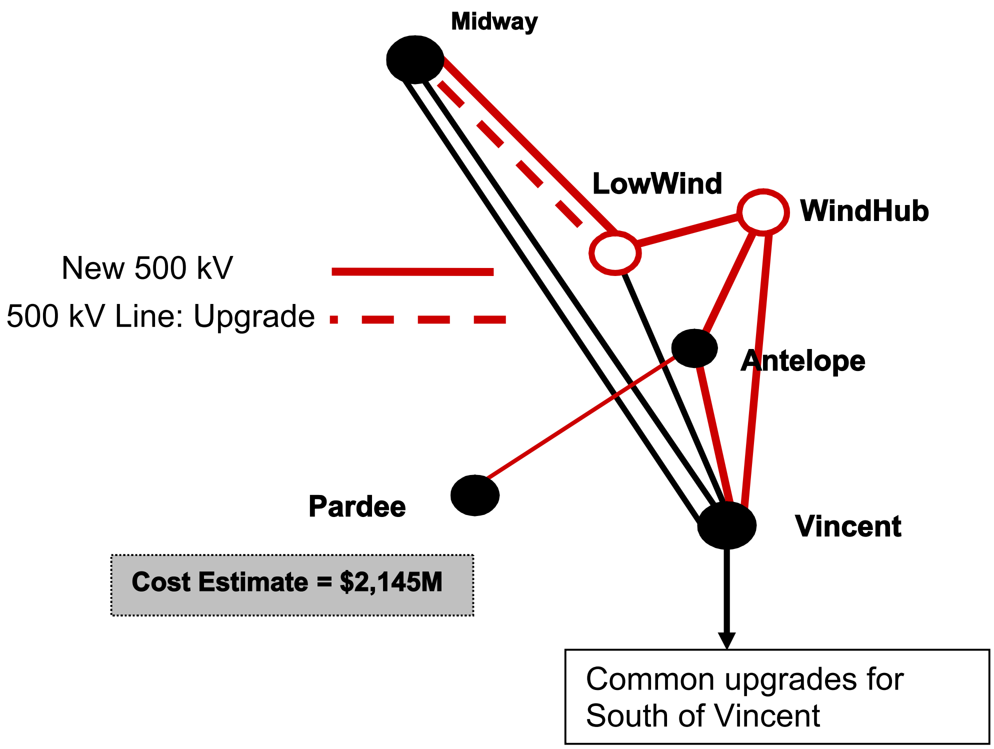
Figure 4.4: Alternative 4



3.2.3 Alternatives 5

Alternative 5 was an interim alternative proposed by SCE which would provide additional benefits compared to that of the proposed Tehachapi Transmission Project but at higher cost.

Figure 4.5: Alternative 5



3.3 Major Findings

1. The Tehachapi Transmission Project is the least cost network transmission solution to reliably interconnect a total of 4,350MW capacity of the TGQ generation projects under the 2015 summer peak load condition.

2. Even though the LGIP "clustering" study was performed to determine the total network upgrade to connect a total of 4,350MW new generation additions in the Tehachapi area, individual System Impact Studies will still be needed for these projects to determine direct facility assignment requirements to connect these projects to the ISO Controlled Grid.

3. Detailed dynamic data will still be required from the generation developer for accurate dynamic model in future WECC power flow base cases. At this time, only typical General Electric (GE) new wind model is used for the study.

4 Other Non-Quantified Benefits

In the course of CSRTP-2006 studies, the CAISO quantified Tehachapi Transmission Project benefits based on the quantifiable energy saving, green house gas (GHG) reduction benefits, and additional regulation costs. The CAISO also accounted for the reliability benefits of this project. However, many other operational and strategic benefits for the proposed Tehachapi Transmission Project are presently difficult to quantify. In the following, the sources of these benefits are discussed qualitatively.

4.1 RPS Program

Senate Bill 1078 established the California Renewables Portfolio Standard (RPS) program, which requires an annual increase in renewable generation by CPUC-jurisdictional utilities equivalent to at least 1 percent of sales, with an aggregate goal of 20 percent by 2017. The CPUC is aggressively implementing this policy, with the intention of accelerating the completion date to 2010. The CPUC is also considering ways to achieve 33 percent renewable energy by 2020. Other load serving entities (LSEs), including municipal and other public utilities, are also required to adopt RPS standards.

According to the CPUC[23], actual renewable deliveries in 2005 were:

- PG&E – 13.5 % (9,801 GWh)
- SCE – 17.7% (13,195 GWh)
- SDG&E - 5.5% (830 GWh)

In 2005, renewable resources consumption in California is about 23,800 GWh, which amounts to about 14.6% of total energy consumption.

The Tehachapi Transmission Project provides needed access to the renewable resources in the TWRA. The Tehachapi Transmission Project allows California LSEs to tap into the renewable power sources in this area. Because of the lack of sufficient transmission infrastructure to the TWRA, the renewable resources potential of the area cannot be readily available or developed without the Tehachapi Transmission Project. Although the renewable resources potential cannot be the only consideration for the proposed transmission investments, it is indeed one of the key concerns for optimizing statewide transmission capacity and accommodating renewable energy potentials.

4.2 Expected Economic Benefits

Significant economic benefits are expected as the Tehachapi Transmission Project provides access to renewable and efficient generation projects slated in the TWRA.

4.3 Infrastructural Improvement Benefits

The Tehachapi Transmission Project helps improve the robustness of the California's aging electric transmission system. It mitigates grid congestion and brings new renewable and conventional power plants online. Without transmission infrastructure upgrades, Californian may face negative impacts on the future economy in the region when frequent outages or disturbances might occur due to equipment degradation. The specific infrastructural

[23] http://www.cpuc.ca.gov/Static/energy/electric/renewableenergy/060224_rpssummary.htm

improvement benefits that the Tehachapi Transmission Project will bring include the followings:

- Provide the potential to expand Path 26 capability at a low cost in the near future with the upgrade of PG&E's portion of Midway-Vincent Line 3;
- Provide more options for future transmission expansions and realize the long-term vision of California's transmission infrastructure; and
- Integrate large amount of planned renewable resources (mainly solar generation) in Inyo and northern San Bernardino counties by future addition of a 500 kV line from WindHub Substation (one of Tehachapi Transmission Project's substations) and the Kramer Substation.

4.4 Other Non-Quantified Benefits

The Tehachapi Transmission Project provides the following additional listed benefits:

- Reduction in NOx and SOx and other pollutant emissions from displaced fossil fuel generation;
- Potential reduction in gas prices stemming from lower fuel consumption by the gas generators that are displaced by the wind generation in TWRA - the benefits here would be both due to lower generation cost as well as other societal benefits stemming from lower gas costs;
- Augmentation of competitive wholesale energy markets for California; and
- Further diversification of energy resources.

The CAISO has not attempted to quantify these additional benefits.

5 Conclusions

The CSRTP-2006 assessment of the Tehachapi Transmission Project leads to the following major findings regarding the project:

- The Tehachapi Transmission Project is the least-cost solution that reliably interconnects 4,350 MW of generating resources in TGQ;
- The Tehachapi Transmission Project also addresses the reliability needs of the CAISO controlled grid due to projected load growth in Antelope Valley area as well as helps to address the South of Lugo (SOL) transmission constraints, an ongoing source of reliability concern for the Los Angeles (LA) Basin;
- The Tehachapi Transmission Project facilitates California utilities to comply with the state mandated Renewable Portfolio Standard (RPS) by providing access to planned renewable resources in the TWRA;
- The Tehachapi Transmission Project is expected to provide significant economic benefits to the CAISO ratepayers by providing access to wind and other efficient generating resources under development in TWRA;
- The Tehachapi Transmission Project makes it possible to expand the transfer capability of Path 26 in the near future with a low cost upgrade of the PG&E’s portion of Midway-Vincent Line 3;
- The Tehachapi Transmission Project will be used by other projects in TGQ queued beyond the start date of the CSRTP-2006 for low-cost interconnection to the CAISO transmission grid; and
- Although the detailed planning is not yet performed, the Tehachapi Transmission Project lays the groundwork for the integration of large amounts of planned geothermal, solar, and wind generation in Inyo and northern San Bernardino counties with potential future 500 kV additions from the WindHub Substation (one of Tehachapi Transmission Project’s substations) to the Kramer Substation.

Based on the aforementioned findings, the CAISO Management has concluded that the build out of the entire Tehachapi Transmission Project by SCE should move forward effective immediately.