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 2 of 5: Appendix 1

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.

Continuation of Tehachapi Collaborative Study

Study Plan #2

Purpose

The purpose of this continuation of the Tehachapi Collaborative Study is to formulate a plan for the transmission of 4,000MW of wind generation at Tehachapi and 500MW in the Antelope Valley to load centers in the PG&E and SCE service areas. It is assumed that half the 4,000 MW at Tehachapi will go to PG&E and half will go to SCE. The plan resulting from this study will be sufficient to initiate the preparation of Proponent's Environmental Assessments (PEAs) which will form the basis of CPCN applications for the facilities defined in the plan. The plan covers only the facilities from Tehachapi Substation 1 to the load centers and does not include the Tehachapi collector system. It is envisioned that this transmission plan may be fine-tuned to accommodate each (or each group of) specific wind plant projects as they move through the ISO Interconnection Process andas the Tehachapi collector loop beyond Tehachapi Substation 1 becomes more precisely defined.

Background

Pursuant to CPUC Decision 04-06-010, the Tehachapi Collaborative Study Group (TCSG) was formed to develop a comprehensive transmission development plan for the phased expansion of transmission capabilities in the Tehachapi area. The CPUC Staff coordinated the collaborative study group. As directed by the decision, TCSG completed a study that assumed there would be more than 4,000 MW of wind resources at Tehachapi Wind Area[1]. To conduct the study the TCGS further assumed that 50% of the 4,000 MW would be delivered to load centers in the transmission system North of Path 26 and the remaining 50% would be delivered to load centers in the system south of Path 26[2]. The Executive Director extended the original due date for filing the report, by one week by letter dated March 4, 2005. The report entitled, "Development Plan for the Phased Expansion of Transmission in the Tehachapi Wind Resource Area" (Report), was filed by Southern California Edison (SCE) on March 16, 2005.

As stated in the Report, the development plan prepared by the TCSG is a conceptual roadmap to the eventual Tehachapi transmission system rather than a

[1] Decision 04-06-010, at 6
[2] Study Plan, date July 14, 2004, at 18

definitive plan[3]. The Report recommended that further study be performed to select among the alternatives identified in the Report (and referred to herein with the same identification numbers as in the Report). These alternatives require further planning evaluation in order to formulate a single plan for implementation. To do this, additional studies (specific rather than generic) need to be performed and facility cost estimates refined. The final plan for the Tehachapi collector system requires information concerning actual wind project locations and capacities which are not available at this time, and therefore is not covered in the study. However, it is envisioned that the transmission plan may be fine-tuned in the future as each (or each group of) specific wind plant projects moves through the ISO Interconnection Process and the Tehachapi collector loop beyond Tehachapi Substation 1 becomes more precisely defined.

The CPUC Energy Division convened a study group consisting of CPUC Staff, CAISO, SCE and PG&E. The study group will be coordinated by the CPUC Staff. This new study plan will build on the earlier TCSG Study Plan, dated July 14, 2004 (Attachment A), and utilizes essentially the same study assumptions. As such, only exceptions to those earlier assumptions will be noted in this study plan.

1. Fresno 230 kV Tie: Big Creek – Fresno Interconnection

Establish a new 230 kV connection between PG&E and SCE by constructing a switching station at the crossing of PG&E-owned and SCE-owned transmission lines and installing a phase-shifting transformer to "push" power from the Big Creek corridor into the PG&E system. This study will investigate impacts on the SCE system and the PG&E system, the possible mitigation measures, and provide cost estimates for the connection and the mitigation measures associated with the amounts of power that would be "pushed" into the PG&E system. The studies will evaluate "pushing" 300 MW to 1,200 MW in successive increments. The study will consider PG&E Alternative 2, Plan A alone and in conjunction with PG&E Alternative 2, Plan B.

The cost per megawatt transferred will be evaluated to determine the optimum capacity of the connection.

Alternative 2: PG&E and SCE Fresno 230 kV Tie Plan A.

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[3] Report, at 3

Build a switching station at the crossing of PG&E's Helms – Gregg 230 kV lines and SCE's Big Creek – Rector 230 kV lines. Establish a 230 kV tie between PG&E and SCE. A phase shifter or power flow controller may be needed to control the tie line flow.

Alternative 2: PG&E and SCE Fresno 230 kV Tie Plan B.

Build a switching station at the crossing of PG&E's Haas-McCall and Balch-McCall 230 kV lines and SCE's Big Creek – Rector 230 kV lines. Establish a 230 kV tie between PG&E and SCE. A phase shifter or power flow controller may be needed to control the tie line flow.

A. SCE Studies

Base Case Assumptions

SCE will utilize the load forecast currently under development for the upcoming CAISO Controlled SCE Transmission Expansion Plan. Studies for evaluating the two plans will be conducted assuming both heavy summer and spring load forecast in order to ensure that system performance is maintained within allowable thermal limits. Heavy summer load forecast will include a 1-in-10 year heat wave adjustment consistent with CAISO Planning Standards. Light Spring conditions will be modeled with load at 50% of summer peak consistent with study assumptions utilized in performing generation interconnection studies in the Big Creek Corridor.

Power Flow Studies

Power flow studies will be conducted by systematically increasing the power transfer from SCE to PG&E through the phase-shifted system tie. The increment step size will be 100 MW.

a. North of Magunden study

   i. Increase power transfer into the PG&E system at the Fresno 230kV tie (Plan A and Plan A in conjunction with Plan B); investigate system performance under normal (all facilities in service) conditions and under NERC/WECC Category B (N-1) contingencies and 230 kV common corridor lines in the Big Creek Corridor. (See Appendix A for a list of contingencies to be studied.) Where the system does not meet the Planning Standards, develop mitigation measures, such as the addition of a transmission upgrade.

ii. Repeat step 1 until the power transfer reaches between 1,000 MW to 1,200 MW.

iii. Develop cost estimates corresponding to each power transfer level

b. South of Magunden study

i. Repeat the North of Magunden Study, for transmission system south of Magunden.

B. PG&E Studies

The study will include two different scenarios, namely, summer peak and off-peak conditions. The objectives for developing summer peak and off-peak cases are to identify transmission import and reliability concerns during both conditions. The following Table 1 describes the critical study assumption for the two scenarios proposed for this study.

Base Case Assumptions

For summer peak studies PG&E will use the summer peak base case developed for the 2005 PG&E Transmission Grid Assessment Study. This case is being developed. PG&E will send the PG&E case to the ISO for approval, but PG&E's work will not be delayed pending this approval. For the summer off peak case, the load for the Greater Fresno Area will be modeled at 50 % of the peak load from summer peak base case for the study area.

Study Scenarios

Study Scenarios	Summer peak	Summer Off peak
Starting base case	2005 PG&E Grid Expansion Study, 2010 Heavy Summer North Peak case	2005 PG&E Grid Expansion Study, 2010 Summer Off-peak case
Fresno load level	PG&E 1 in 5 year adverse weather load forecast for 500	50 % of 2010 summer peak case for the area.

	kV system studies, and 1 in 10 year adverse weather load forecast for Greater Fresno Area for 230 kV system studies	
Helms units	3 units generation	3 units pumping depending on the import level to find boundary conditions
Hydro dispatch	Summer peak average hydro level	Summer off-peak average hydro level
COI	4800 MW (n to s)	3650 MW (s to n)
Path 15 flow		5400 MW (s to n) or other relevant operating limit(s)
Path 26 flow	3700 MW (n to s)	<3000 MW (s to n)
Sensitive study	1. Spring hydro spill condition 2. Path 26 4000 MW N-S	Spring light load case with Helms PGP units Off line

Sensitivities may be run depending on the initial results.

Generation Assumptions in addition to those used in the earlier TCSG Study

Kingsburg and Sanger Qualifying Facility units will be assumed off for the summer off peak case as per the existing contracts for these units.

SCE will furnish the model to be used for the Tehachapi collector system in the absence of firm wind developer commitments. GE Wind generators will be used for the wind plant model and SVCs (at various locations) will be sized as required to provide voltage and transient stability.

Fresno 230 kV Tie Assumptions

SCE and CAISO will provide the necessary data for SCE load, network topology, generation level and pattern for the Big Creek facility. The data provided and approved by CAISO for the SCE system will be used in the base case. ISO will provide data on expected wind generation variations, such as, expected wind generation changes in MW/sec.

Technical Analyses

The technical analysis will include the following:

a. For each of the base case and study alternatives, Power Flow simulations will be carried out for the following CAISO contingency Categories in the Greater Fresno Area:

   i. ISO Category "B": B1, B2, B3 and overlapping line and generator outage in the study area. (See Appendix B for a list of contingencies).

   ii. ISO Category "C" list for 500 KV outages, 230 kV common tower line outages in the Greater Fresno Area, and 230 kV common corridor lines in the Big Creek Corridor, also listed in Appendix B.

b. Run Post Transient and Voltage Stability simulations for critical Categories B and C contingencies to assess the reactive support requirements and potential facility overloads on the more promising alternatives.
c. Run Transient stability simulations of critical Categories B and C contingencies .

2. Further Studies on PG&E Alternatives 4 and 5

The earlier conceptual study results show that the cost estimates for PG&E Alternatives 4 and 5 are practically the same. To select the preferred alternative, more detailed studies using more specific information are needed.

A. PG&E Alternative 4

No voltage Stability study or transient stability study was conducted in the conceptual study. To form a more definitive selection of the alternatives, these studies need to be run based on selected Categories B and C contingencies in Appendix B.

B. PG&E Alternative 5

In the earlier conceptual study, Alternative 5 included a 500 kV line between Tehachapi and Gregg. This study will investigate if this Gregg – Tehachapi 500 kV line can be separated into two sections:

- Gregg – Midway 500 kV line
- Tehachapi – Midway 500 kV line

a. Run Power flow simulations for normal and single and double contingencies based on the list of ISO Categories B and C contingencies. (See Appendix B).

b. Run Post Transient and Voltage Stability simulations for critical Categories B and C contingencies to assess the reactive support requirements and potential facility overloads on the most promising alternatives..

c. Run Transient stability simulations critical Categories B and C contingencies on the most promising alternatives.

3. Further Studies on SCE Alternatives

SCE's Alternatives 1, 2, 3 and 10 will be studied as described above for PG&E Alternatives 4 and 5.

4. Production Simulation Study

The CAISO will run production simulation models to determine the production costs, congestion costs and system losses associated with the various transmission alternatives using the SSG-WI data base for study year 2008 after it is updated. The purpose of this portion of the study is to help in answering the following questions:

a. How would the Fresno 230 kV Tie be operated? How frequently would the angle change and how large would the flow be across the phase shifter?
b. How would the Helms pumped storage plant operation change with the addition of the Tehachapi generation?
c. Would the potential line additions north of Midway provide a substantial economic benefit?
d. If a line is constructed north of Midway, what is to preferred termination?
e. How would the addition of the Tehachapi generation impact the operation of the generators connected at Midway and in other areas of the system?
f. What is the optimum combination of the Fresno 230 kV Tie, PG&E's Alternatives 4 and 5 and SCE's Alternatives 1, 2, 3 and 10.

g. Would the adding a line between Tehachapi and Midway instead of from Tehachapi south help transmit Tehachapi generation to PG&E? If so, at what level of Tehachapi generation?

h. Would adding a line between Tehachapi and Midway benefit the transmission system more than adding a line from Tehachapi south? If so, identify the party or parties that benefit(s).

A. Assumptions:

Hydro conditions: Initially average and high hydro will be studied. Additional studies to examine high and low hydro scenarios will be conducted as necessary. For Fresno 230 kV Tie, PG&E will need to consider high hydro conditions, since this alternative would inject power into a generating system. SCE considers all hydro conditions as valid conditions that need to be explored.

Gas cost: Modeled per SSG-WI base case assumptions.

Coal cost: Modeled per SSG-WI base case assumptions.

Wind modeling: The wind generation will be modeled as non-dispatchable, fixed hourly generation quantities. Two wind generation output models will be studied. One that has been developed by NREL and others and a second that is simply a scaling up of the existing Tehachapi historical output. The production simulation runs will determine the megawatthours of wind generation used. The cost assigned to wind generation will be determined as part of this study and will be applied to the wind generation quantity determined in each run to yield the total production cost.

New resources will be included as modeled by SSG-WI, which will be consistent with each LSE's filed Long Term Plans.

Path ratings, line ratings, and nomograms: Modeled per SSG-WI base case assumptions.

Selected non-simultaneous Ratings:
COI: 4,800 MW N-S; 3,675 MW S-N
Path 15: 3,265 MW N-S; 5,400 MW S-N
Path 26: 3,700 MW N-S; 3,000 MW S-N

Additional limits to be modeled:

a. 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 1 MW decrease in Midway generation (La Paloma, Sunrise, Elk Hills)

b. Path 15: 5,400 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).
c. Run power flow and stability studies to see if there is a simultaneous interaction between the Fresno 230 kV Tie and Path 26. If there is, model the nomogram in the production simulation.

d. SCIT nomogram: Either from existing SCIT nomogram studies or assume no more than 60% of SCE's load would be supplied from imports into Southern California.

B. Study Scenarios

Tehachapi and Antelope Valley wind generation = 0 MW

a. Existing system after completion of SCE's Phase 1 Facilities, Segments 1, 2 and 3

b. Same as (a) but with the Fresno 230 kV Tie
   Phase shifter setting to be determined.

Tehachapi and Antelope Valley wind generation = 1600 MW

c. Existing system plus SCE Phase 1 and Phase 2 facilities.
d. Same as a, but with the Fresno 230 kV Tie.

Tehachapi and Antelope Valley wind generation = 4,500 MW without Fresno 230kV tie

e. Existing System after completion of SCE's Phase 1 and Phase 2 facilities.
f. PG&E Alternative 4 with SCE Alternative 1, i.e., Tesla-Los Banos-Gates-Midway-Tehachapi, Tehachapi-Antelope, Antelope-Vincent and Antelope-Pardee. (Total of two lines between Tehachapi-Antelope)
g. PG&E Alternative 4, modified to remove Tehachapi-Midway line, and SCE Alternative 2, i.e., Tesla-Los Banos-Gates-Midway, and Tehachapi-Antelope-Vincent, Tehachapi-Vincent and Antelope-Pardee (Two lines between Tehachapi-Antelope and one Tehachapi-Vincent)
h. PG&E Alternative 5 with SCE Alternaitve 1

i. PG&E Alternative 5 modified to replace Gregg-Tehachapi with Gregg-Midway with SCE Alternative 1, i.e., Tesla-Los Banos-Gregg-Midway-Tehachapi-Antelope–Vincent and Antelope-Pardee. (Total of two lines between Tehachapi-Antelope)
j. PG&E Alternative 5, modified to replace Gregg-Tehachapi with Gregg-Midway line and SCE Alternative 2, i.e., Tesla-Los Banos-Gregg-Midway; and Tehachapi-Antelope-Vincent, Tehachapi-Vincent and Antelope-Pardee (Total of two lines between Tehachapi-Antelope).

Tehachapi and Antelope Valley wind generation = 3,300 MW

k. Same as f, above.
l. Same as h, above.
m. Tesla-Gregg, with Fresno 230kV tie, two 500kV lines Tehachapi-Antelope.
n. Tesla-Los Banos-Gates-Midway, with Fresno 230kV tie, two 500kV lines Tehachapi-Antelope

Based on the above, choose the best PG&E alternative.

o. Fresno 230 kV Tie with SCE Alternative 2

p. Best PG&E alternative with SCE Alternative 3

q. Best PG&E alternative with SCE Alternative 10

5. Cost Estimation of Facilities

All costs associated with the Fresno 230 kV Tie, PG&E Alternatives 4 and 5 and SCE Alternatives 1, 2, 3 and 10, including engineering and permitting, purchase of equipment and rights-of way, construction, interest during construction, contract administration, etc. will be estimated in 2005 dollars

6. Determination of Recommended Plan

The present value of the costs given by the production simulation runs in Section 4, above, plus the wind generation costs, over 30 years, at a discount rate to be established in the study, will be added to the costs of the facilities, determined in Section 5, above, to obtain the least cost combination of alternatives. This total present value cost will also be expressed as a series of annual costs.

This combination of alternatives will be the recommended plan.

7. Study Schedule

WORK ITEM	START	FINISH	2005 May	June	July	Aug	Sep	Oct	Nov	Dec	2006 Jan	Feb
SCE: Fresno 230 kV Tie PG&E Plan A, N of Magunden power flow	5/1/05	6/1/05										
SCE: Fresno 230 kV Tie PG&E Plan A, S of Magunden power flow	6/1/05	7/1/05										
SCE: Fresno 230 kV Tie PG&E Plan A with Plan B power flow	7/1/05	8/1/05										
PG&E: Base Case Available	6/1/05			o								
PG&E: Fresno 230 kV Tie power flow	6/1/05	7/1/05										
Meeting of Participants at PG&E	6/28/05				o							
SCE & PG&E: Fresno facilities cost estimate	6/1/05	9/1/05										
CA ISO: first results of production simulations	7/1/05	9/1/05										
All: determine optimum capacity of Fresno Tie: Plan A or A & B	9/1/05	10/1/05										
SCE & PG&E: cost of facilities for all alternatives	6/1/05	11/1/05										
CA ISO final report on results of production simulations	9/1/05	11/1/05										
CPUC: calculates ranking of combinations of alternatives	11/1/05	11/15/05										
Meeting of Participants	11/15/05								o			
CA ISO operator report on compatibility of Fresno Intertie	10/1/05	12/15/05										
CPUC: Develop Table of Contents	10/1/05	11/1/05										
ALL: draft report	11/1/05	12/15/05										
CPUC: Final Report	12/15/05	3/1/06										

ERRATA: CAISO 12/15/05 operator report topic should read "system operability with 4500MW of wind generation at Tehachapi/Antelope Valley".

Appendix A
SCE list of on Contingencies

Table 1
Single Contingency Outage List

Outage Number	From Bus No.	To Bus No.	From Bus Name	From Bus Voltage	To Bus Name	To Bus Voltage	Circuit ID
N1-1	24301	24302	BIG CRK1	230	BIG CRK2	230	1
N1-2	24301	24320	BIG CRK1	230	EASTWOOD	230	1
N1-3	24302	24303	BIG CRK2	230	BIG CRK3	230	1
N1-4	24302	24305	BIG CRK2	230	BIG CRK8	230	1
N1-5	24304	24303	BIG CRK4	230	BIG CRK3	230	1
N1-6	24305	24303	BIG CRK8	230	BIG CRK3	230	1
N1-7	24316	24303	MAMMOTH	230	BIG CRK3	230	1
N1-8	24303	24235	BIG CRK3	230	RECTOR	230	2
N1-9	24301	25900	BIG CRK1	230	FRSNOSCE	230	1
N1-10	24303	25900	BIG CRK3	230	FRSNOSCE	230	1
N1-11	30820	39000	HELMS PP	230	FRSNOPGE	230	1
N1-12	30820	39000	HELMS PP	230	FRSNOPGE	230	2
N1-13	30810	39000	GREGG	230	FRSNOPGE	230	1
N1-14	30810	39000	GREGG	230	FRSNOPGE	230	2
N1-15	24235	25900	RECTOR	230	FRSNOSCE	230	1
N1-16	24235	25900	RECTOR	230	FRSNOSCE	230	2
N1-17	24141	24304	SPRINGVL	230	BIG CRK4	230	1
N1-18	24141	24235	SPRINGVL	230	RECTOR	230	1
N1-19	24153	24235	VESTAL	230	RECTOR	230	1
N1-20	24235	24153	RECTOR	230	VESTAL	230	2
N1-21	24235	24087	RECTOR	230	MAGUNDEN	230	1
N1-22	24087	24141	MAGUNDEN	230	SPRINGVL	230	1
N1-23	24087	24141	MAGUNDEN	230	SPRINGVL	230	2
N1-24	24087	24153	MAGUNDEN	230	VESTAL	230	1
N1-25	24087	24153	MAGUNDEN	230	VESTAL	230	2
N1-26	24142	24101	SYC CYN	230	OMAR	230	1
N1-27	24087	24101	MAGUNDEN	230	OMAR	230	1
N1-28	24087	24115	MAGUNDEN	230	PASTORIA	230	1
N1-29	24087	24115	MAGUNDEN	230	PASTORIA	230	2

N1-30	24087	24115	MAGUNDEN	230	PASTORIA	230	3
N1-31	24087	24401	MAGUNDEN	230	ANTELOPE	230	2
N1-32	24087	27020	MAGUNDEN	230	TEHACH_5	230	1
N1-33	24401	27020	ANTELOPE	230	TEHACH_5	230	1
N1-34	24401	27000	ANTELOPE	230	TEHACH_6	230	1
N1-35	24115	25613	PASTORIA	230	EDMONSTN	230	1
N1-36	24115	28050	PASTORIA	230	LEBEC	230	1
N1-37	24114	24115	PARDEE	230	PASTORIA	230	1
N1-38	24114	24217	PARDEE	230	WARNETAP	230	1
	24115	24217	PASTORIA	230	WARNETAP	230	1
	24218	24217	WARNE	230	WARNETAP	230	1
N1-39	24403	24115	BAILEY	230	PASTORIA	230	1
N1-40	24114	24403	PARDEE	230	BAILEY	230	1
N1-41	24114	24155	PARDEE	230	VINCENT	230	1
N1-42	24155	24091	VINCENT	230	MESA CAL	230	1
N1-43	24155	24126	VINCENT	230	RIOHONDO	230	1
N1-44	24155	24126	VINCENT	230	RIOHONDO	230	3
N1-45	24091	24126	MESA CAL	230	RIOHONDO	230	1
N1-46	24091	24126	MESA CAL	230	RIOHONDO	230	2
N1-47	24076	24126	LAGUBELL	230	RIOHONDO	230	1
N1-48	24114	24147	PARDEE	230	SYLMAR S	230	1
N1-49	24114	24147	PARDEE	230	SYLMAR S	230	2
N1-50	24036	24114	EAGLROCK	230	PARDEE	230	1
N1-51	24147	24089	SYLMAR S	230	GOULD	230	1
N1-52	24036	24147	EAGLROCK	230	SYLMAR S	230	1
N1-53	24086	24156	LUGO	500	VINCENT	500	1
N1-54	24086	24156	LUGO	500	VINCENT	500	2
N1-55	24156	24092	VINCENT	500	MIRALOMA	500	1
N1-56	24500	24156	ANTELOPE	500	VINCENT	500	1
N1-57	24500	24156	ANTELOPE	500	VINCENT	500	2
N1-58	24500	24510	ANTELOPE	500	PARDEE	500	1
N1-59	24520	24500	TEHACHPI	500	ANTELOPE	500	1
N1-60	24520	24500	TEHACHPI	500	ANTELOPE	500	2
N1-61	24520	30060	TEHACHPI	500	MIDWAY	500	1
N1-62	30060	24156	MIDWAY	500	VINCENT	500	1
N1-63	30060	24156	MIDWAY	500	VINCENT	500	2
N1-64	30060	24156	MIDWAY	500	VINCENT	500	3
T1-1	25900	39000	FRSNOSCE	230	FRSNOPGE	230	1
T1-2	24156	24155	VINCENT	500	VINCENT	230	1
T1-3	24092	24093	MIRALOMA	500	MIRALOMA	230	1
T1-4	24500	24401	ANTELOPE	500	ANTELOPE	230	1
T1-5	24510	24114	PARDEE	500	PARDEE	230	1

Table 2
Double Contingency Outage List

Outage Number	From Bus No.	To Bus No.	From Bus		To Bus		Circuit ID
			Name	Voltage	Name	Voltage	
N2-1	24301	25900	BIG CRK1	230	FRSNOSCE	230	1
	24303	25900	BIG CRK3	230	FRSNOSCE	230	1
N2-2	24235	25900	RECTOR	230	FRSNOSCE	230	1
	24235	25900	RECTOR	230	FRSNOSCE	230	2
N2-3	24303	24235	BIG CRK3	230	RECTOR	230	2
	24141	24304	SPRINGVL	230	BIG CRK4	230	1
N2-4	24303	24235	BIG CRK3	230	RECTOR	230	2
	24141	24235	SPRINGVL	230	RECTOR	230	1
N2-5	24141	24304	SPRINGVL	230	BIG CRK4	230	1
	24141	24235	SPRINGVL	230	RECTOR	230	1
N2-6	30820	39000	HELMS PP	230	FRSNOPGE	230	1
	30820	39000	HELMS PP	230	FRSNOPGE	230	2
N2-7	30810	39000	GREGG	230	FRSNOPGE	230	1
	30810	39000	GREGG	230	FRSNOPGE	230	2
N2-8	24153	24235	VESTAL	230	RECTOR	230	1
	24235	24153	RECTOR	230	VESTAL	230	2
N2-9	24153	24235	VESTAL	230	RECTOR	230	1
	24235	24087	RECTOR	230	MAGUNDEN	230	1
N2-10	24235	24153	RECTOR	230	VESTAL	230	2
	24235	24087	RECTOR	230	MAGUNDEN	230	1
N2-11	24087	24141	MAGUNDEN	230	SPRINGVL	230	1
	24087	24141	MAGUNDEN	230	SPRINGVL	230	2
N2-12	24087	24153	MAGUNDEN	230	VESTAL	230	1
	24087	24153	MAGUNDEN	230	VESTAL	230	2
N2-13	24087	24115	MAGUNDEN	230	PASTORIA	230	1
	24087	24115	MAGUNDEN	230	PASTORIA	230	2
N2-14	24087	24115	MAGUNDEN	230	PASTORIA	230	1
	24087	24115	MAGUNDEN	230	PASTORIA	230	3
N2-15	24087	24115	MAGUNDEN	230	PASTORIA	230	2
	24087	24115	MAGUNDEN	230	PASTORIA	230	3
N2-16	24087	24401	MAGUNDEN	230	ANTELOPE	230	2
	24087	27020	MAGUNDEN	230	TEHACH_5	230	1
N2-17	24087	24401	MAGUNDEN	230	ANTELOPE	230	2
	24401	27020	ANTELOPE	230	TEHACH_5	230	1

N2-18	24403	24115	BAILEY	230	PASTORIA	230	1
	24114	24217	PARDEE	230	WARNETAP	230	1
	24115	24217	PASTORIA	230	WARNETAP	230	1
	24218	24217	WARNE	230	WARNETAP	230	1
N2-19	24403	24115	BAILEY	230	PASTORIA	230	1
	24114	24217	PARDEE	230	WARNETAP	230	1
	24115	24217	PASTORIA	230	WARNETAP	230	1
	24218	24217	WARNE	230	WARNETAP	230	1
N2-20	24114	24115	PARDEE	230	PASTORIA	230	1
	24114	24217	PARDEE	230	WARNETAP	230	1
	24115	24217	PASTORIA	230	WARNETAP	230	1
	24218	24217	WARNE	230	WARNETAP	230	1
N2-21	24114	24403	PARDEE	230	BAILEY	230	1
	24114	24217	PARDEE	230	WARNETAP	230	1
	24115	24217	PASTORIA	230	WARNETAP	230	1
	24218	24217	WARNE	230	WARNETAP	230	1
N2-22	24114	24155	PARDEE	230	VINCENT	230	1
	24036	24114	EAGLROCK	230	PARDEE	230	1
N2-23	24114	24147	PARDEE	230	SYLMAR S	230	1
	24114	24147	PARDEE	230	SYLMAR S	230	2
N2-24	24147	24089	SYLMAR S	230	GOULD	230	1
	24036	24147	EAGLROCK	230	SYLMAR S	230	1
N2-25	24155	24126	VINCENT	230	RIOHONDO	230	1
	24155	24126	VINCENT	230	RIOHONDO	230	3
N2-26	24156	24092	VINCENT	500	MIRALOMA	500	1
	24155	24126	VINCENT	230	RIOHONDO	230	1
N2-27	24156	24092	VINCENT	500	MIRALOMA	500	1
	24155	24126	VINCENT	230	RIOHONDO	230	3
N2-28	24091	24126	MESA CAL	230	RIOHONDO	230	1
	24091	24126	MESA CAL	230	RIOHONDO	230	2
N2-29	24091	24126	MESA CAL	230	RIOHONDO	230	1
	24076	24126	LAGUBELL	230	RIOHONDO	230	1
N2-30	24091	24126	MESA CAL	230	RIOHONDO	230	2
	24076	24126	LAGUBELL	230	RIOHONDO	230	1
N2-31	24086	24156	LUGO	500	VINCENT	500	1
	24086	24156	LUGO	500	VINCENT	500	2
N2-32	24500	24156	ANTELOPE	500	VINCENT	500	1
	24500	24156	ANTELOPE	500	VINCENT	500	2
N2-33	24520	24500	TEHACHPI	500	ANTELOPE	500	1
	24520	24500	TEHACHPI	500	ANTELOPE	500	2
N2-34	30060	24156	MIDWAY	500	VINCENT	500	1
	30060	24156	MIDWAY	500	VINCENT	500	2

Appendix B
PG&E list of Contingencies

"B" contingencies for 500 kV system:

- Tesla – Los Banos 500 kV line outage,
- Los Banos – Gates 500 kV line outage,
- Los Banos – Midway 500 kV line outage,
- Gates – Midway 500 kV line outage,
- Tesla – Gregg 500 kV line outage (Alt. 5),
- Gregg – Midway 500 kV line outage (Alt. 5),
- PDCI Bi-pole Outage.

"C" contingencies for 500 kV system:

- Tesla – Los Banos and Tracy – Los Banos 500 kV double line outage (Los Banos north),
- Los Banos – Midway and Los Banos – Gates #3 500 kV double line outage (Los Banos south),
- Los Banos – Midway and Gates – Midway 500 kV double line outage (Midway north),
- Los Banos – Midway #1 and #2 (new) 500 kV double line outage (Midway north for Alt. 4),
- Tesla – Los Banos and Tesla – Gregg (new) 500 kV double line outage (Alt. 5),
- Two Palo Verde generation units outage,
- Two Diablo Canyon generation units outage.

Attachment C
July 14, 2004 Study Plan

Phased Transmission Development Plan for Interconnecting Over 4,000 MW of Wind Generation In North Los Angeles and Kern Counties Referred to as the "Tehachapi Area"

Study Plan

July 14, 2004

SOUTHERN CALIFORNIA EDISON
An EDISON INTERNATIONAL[SM] Company

For information or questions regarding this Study Plan, please contact Jorge Chacon via phone at (626) 302-9637 or e-mail at jorge.chacon@sce.com

Summary of Revisions

A number of participants provided comments to the Tehachapi Collaborative Study Plan date June 21, 2004. The following is a summary of the revision made to the Study Plan.

A new section that discusses the purpose of the Tehachapi Conceptual Transmission Plan was added.

Objective No.2 was expanded to include the goal of a single phased conceptual transmission plan and what happens if consensus is not reached.

Objective No.7e was expanded to include determination of how much spacing between transmission lines is required to consider the lines to be on "separate" right-of-way.

Objective No.9 was added to address whether regional transmission approach should be adopted for other renewable areas in the State.

CPUC Staff responsibilities were added to the responsibility section.

The section covering currently proposed projects was expanded to include electrical characteristics and thermal ratings so that the collaborative group can effectively model these projects into any study case.

A new section was added to cover electrical characteristics and thermal ratings for each of the Alternative Tehachapi Area Conceptual Plans.

A new element was added to the power flow base case assumptions section to cover the generation displacement assumptions as provided by the CAISO

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CONTENT

Introduction

The Tehachapi area has been categorized as the largest wind resource area in the State of California. This area, if more fully developed, could meet a significant portion of the goals for the renewable energy development in California. In order to tap this energy resource area, large-scale transmission upgrades are required as the existing transmission facilities in the area, the Antelope-Bailey 66-kV subtransmission network and the Big Creek 230-kV Corridor, are already fully utilized.

Transmission constraints into the Tehachapi area have been discussed as part of the ongoing Assembly Bill (AB) 970 Investigation 00-11-001 with Phase 6 of the proceeding devoted to Tehachapi. The outcome of AB 970 Phase 6 is an Interim Opinion on Transmission Needs in the Tehachapi Wind Resource Area which orders (CPUC Decision 04-06-010) the formation of a collaborative study group to be convened to develop a comprehensive transmission development plan for the phased expansion of transmission capabilities into the Tehachapi area.

The CPUC Staff will coordinate the collaborative study group with assistance by the California Independent System Operator (CAISO) as needed. The collaborative study group will include participation by Southern California Edison Company (SCE), Pacific Gas and Electric Company (PG&E), wind developers, and any other interested parties including the California Energy Resources Conservation and Development Commission (CEC), Department of Defense, the counties of Kern and Los Angeles, the Los Angeles Department of Water and Power (LADWP), and the owners of the independently owned Sagebrush line. It is envisioned that the collaborative study group will function in a manner similar to the Southwest Transmission Expansion Plan (STEP) process.

This Study Plan provides a proposed guideline for the Tehachapi Comprehensive Transmission Development Assessment. The study plan is divided into fourteen sections: (1) Introduction, (2) Background, (3) Purpose of Tehachapi Conceptual Transmission Plan, (4) Objectives, (5) Responsibilities, (6) Currently Proposed Projects in Area, (7) Alternative Tehachapi Area Conceptual Plans, (8) Electrical Characteristics and Thermal Ratings of Alternate Conceptual Plans, (9) Assessment Process Outline, (10) Study Areas and Study Conditions, (11) Power Flow Base Case Assumptions, (12) Power Flow Screening Level Preliminary Assessment, (13) Final Report, and (14) Schedule of Major Milestones. The study plan will be followed by the Collaborative Study Group in completing the order set forth which requires Edison, acting on behalf of the study group, to file a report in the AB 970 proceeding containing the study group's findings and recommendations within nine months of the effective date of CPUC Decision 04-06-010 which is March 9, 2005.

Background

Southern California Edison has performed a number of conceptual studies for interconnecting renewable wind generation in the Tehachapi area. These conceptual studies were performed for the purpose of identifying conceptual transmission facilities necessary to meet future delivery needs for wind generation in the Tehachapi area. The initial conceptual study was done with participation of ten wind developers who collectively identified, on a conceptual basis, a total of 2,500 MW of potential wind development in the Tehachapi area.

A subsequent conceptual study (Phase 2) was performed with participation of eight wind developers. The purpose for this subsequent conceptual study was to perform preliminary substation site selection studies in the Cal Cement, Monolith, and Jawbone areas as well as identify potential line routes for new transmission into the Tehachapi area. Total wind generation considered was unchanged at the 2,500 MW level. Testimony was filed by SCE in the AB 970 Phase VI proceeding based on the study results of this conceptual study. The CAISO interjected testimony suggesting a different project alternative to interconnect Tehachapi area wind generation.

A third conceptual study (Phase 3) was performed to evaluate an additional 770 MW of wind generation development increasing the total Tehachapi wind generation potential from 2,500 MW to 3,270 MW. This conceptual study resulted in two conceptual transmission alternatives (230-kV and 500-kV conceptual alternative) for integrating Tehachapi area wind generation. The 500-kV transmission alternative plan was further refined to accommodate increased Tehachapi area wind generation potential as identified by the CEC in their Electric Transmission Plan for Renewable Resources in California Report to the Legislature dated December 1, 2003. The new Tehachapi area wind generation potential as identified by the CEC is now in excess of 4,000 MW. The CPUC adopted the 500-kV transmission alternative in their report to the Legislature for interconnecting over 4,000 MW of wind generation.

This increased MW potential and the identification of a 500-kV transmission alternative has resulted in the presentation of yet another transmission alternative to the SCE Conceptual Study Plan. The alternative, as presented by Oak Creek Energy Systems and CalWea, includes the development of a fourth Midway-Vincent (via Tehachapi)
500-kV transmission line.

These project alternatives resulted in a number of outstanding issues that need to be addressed by the Tehachapi Collaborative Study Group. The outstanding issues include the determination if the CAISO proposed PG&E-SCE interconnection alternative provides statewide benefits and allow wind generation development to proceed, identification of expected demarcation between gen-ties and network transmission facilities, and consideration of regional benefits when developing revised Tehachapi Phased Conceptual Transmission plan.

<u>Purpose of Tehachapi Conceptual Plan</u>

Conceptual studies are no substitute for System Impact or Facilities Studies, which will be required prior to interconnecting any new wind generation in the area. The results of the conceptual studies are to be used as a roadmap in developing transmission facilities into the Tehachapi area. The roadmap will serve as a means to avoid the piecemeal transmission additions associated with construction of facilities to interconnect only each year's winning RPS bidders or to interconnect only the projects which request interconnection (incremental requests). The actual timing of construction of transmission facilities will be driven by actual interconnection requests. However, instead of sizing the facility to accommodate the requested interconnection amount, the facilities will be developed in a way that is consistent with the conceptual transmission plan.

It should be noted that conceptual transmission plans should not be viewed as a permanent plan. Modifications to the conceptual transmission plan may be necessary as a result of actual need. In other words, the plan needs to be flexible so that future changes can be made if actual generation locations turn out to be different than what is assumed in developing this conceptual transmission plan.

Objectives

Edison, PG&E and the collaborative study group, in coordination with the CPUC Staff and the CAISO, will:

a. assess the amount of resources available in the Tehachapi Area that can be accommodated using existing transmission system capacity

b. develop a comprehensive Tehachapi transmission development plan in order for upgrades in the Tehachapi area to be most cost effective, least environmentally disruptive, orderly, and logical based on the magnitude of the wind resource identified by the CEC

   i. The study group should cooperatively work on developing a single phased conceptual transmission plan, at least for the initial portions of the phased upgrades

   ii. If consensus among the participants is not reached, the study group should explain clearly factors that would influence a choice among any alternative proposals

c. incorporate the transmission facilities for the Tehachapi Upgrades necessary to interconnect the PPM Project into the conceptual plan

   i. the PPM Project has completed the System Impact and Facilities Studies, has priority over conceptual projects, is ready to pursue as a Market Participant, and should not be held-up by the Collaborative Study Group

   ii. approval of System Impact and Facilities Studies should follow the FERC Interconnection Process

d. identify viable transmission alternatives, taking a statewide approach, for systematically phasing transmission into the Tehachapi area to ultimately interconnect the full Tehachapi wind resource potential identified by the CEC (over 4,000 MW)

e. assess the extent to which each transmission alternative configuration would assist in the transport of power to companies other than Edison in order to meet their corresponding RPS goals

f. develop phasing and priority of each transmission alternative

  i. develop a list of short lead time transmission upgrades can be pursued on a fast-track schedule

  ii. identify phase development of each transmission alternative in an orderly, rational and cost effective manner

  iii. determine the amount of wind generation that can be accommodated with each phase of each transmission alternative

  iv. determine if any additional transmission elements should be included into a subsequent CPCN filing

  v. identify all new conceptual transmission facilities (e.g. lines, substations, and upgrades to existing lines and substations) required to transmit the power from Tehachapi to the various load centers (PG&E, Edison, and SDG&E)

  vi. identify the expected demarcation between gen-ties and network transmission facilities to the extent feasible

  vii. develop recommendations regarding the procedures whereby each phase of the upgrades would be trigger after the first phase

g. perform preliminary feasibility analysis for the transmission facilities identified

  i. perform preliminary "screening-level" power flow analysis

  ii. perform preliminary engineering review to identify transmission elements that may be problematic

  iii. perform preliminary environmental review of transmission facilities based on available information contained in currently available environmental data bases in order to identify potential significant environmental constraints

iv. develop a preliminary list of licensing and environmental requirements for the transmission line right-of-way and potential substation sites

v. resolve with the Department of Defense any critical issues surrounding transmission line routes and heights and minimum distance between lines to consider lines as different corridor

vi. address how long it would take for the anticipated transmission owner to prepare and file each of the needed certificate applications based on the study group recommendations

vii. identify the maximum reasonably foreseeable build-out for the utility-owned assets in order to comply with CEQA requirements

h. identify estimates of the transmission costs, including substation costs and land acquisition costs, based on standard, off-the-shelf, general unit cost basis

i. determine if the regional transmission planning approach should be adopted for other renewable areas in the State

<u>Responsibilities</u>

The following are assignments for the supply of information to the Study Group to facilitate the development of a Collaborative Transmission Development Plan

a. The CPUC Staff will coordinate the collaborative study group with assistance by the California Independent System Operator (CAISO) as needed.

b. Edison is responsible for completing the aforementioned objectives for identifying

   a. conceptual facilities required within SCE's service territory to interconnect additional Tehachapi wind generation into SCE's existing network

   b. potential transmission upgrades needed to deliver energy to SCE's load center or to the first interconnection point with PG&E and/or SDG&E,

   c. potential impacts to SCE's network as a result of new facilities that are proposed to interconnect the SCE system with the PG&E system,

d. potential impacts to SCE's existing network as a result of implementing third party transmission expansion.

c. PG&E is responsible for completing the aforementioned objectives for

a. Identifying new facilities within PG&E's service territory required to deliver Tehachapi wind generation from SCE's first interconnection point to PG&E's load center in the Bay area,

b. evaluating new facilities that are proposed to directly interconnect additional Tehachapi wind generation into PG&E's existing network

c. evaluating potential impact to PG&E's network as a result of new facilities that are proposed to interconnect the SCE system with the PG&E system

d. potential impacts to SCE's existing network as a result of implementing third party transmission expansion

d. The CAISO is responsible for conducting cost analysis for

a. quantifying any new RMR exposure identified in either SCE's or PG&E's system as a result of the proposed alternatives,

b. quantifying any additional congestion exposure on Path 26, Path 15, and other parts of the ISO Grid as a result of either connecting the SCE system with the PG&E system, delivering Tehachapi area wind generation to SDG&E, or delivering Tehachapi area wind generation to PG&E

e. Third Parties who may wish to participate (such as LADWP and the Sagebrush Owners) in the study process are responsible for

a. identifying whether they are interested in participating in conceptual studies to support Tehachapi,

b. providing the specifics on how any facilities currently owned by those entities or new proposed facilities to be owned by those entities can be used to integrate additional Tehachapi area wind generation

If active participation of these third parties does not evolve or is of limited input, the study group should dispense in evaluating how these non-CAISO controlled assets could be utilized since they are outside the jurisdiction of the CAISO and CPUC and therefore should not be rolled into the final plan.

<u>Currently Proposed Projects in the Area</u>

The following are transmission projects that have been identified in a different forum and should be included into the starting base cases. The Collaborative Tehachapi Study Group should base transmission development plans with these projects included into the starting cases.

1. Transmission requirements to interconnect the 201 MW PPM project (Antelope-Pardee)

   I. transmission requirements to interconnect the PPM project includes a new transmission line from the SCE Antelope substation to the SCE Pardee substation and substation expansions at Pardee and Antelope to accommodate the new line

   II. the CAISO has reviewed the System Impact and Facilities studies for this project and will present to their governing board on July 29 for approval

   III. electrical characteristics (per-unit) for this transmission line are as follows:

      a. 100 MVA / 230-kV base R=0.00124 X=0.02812 B=2.0699
      b. 100 MVA / 500-kV base R=0.00026 X=0.00595 B=0.4380

   IV. transmission ratings are as follows:

      a. Normal Rating = 3950 amps
      b. Long-Term Emergency Rating = 4540 amps
      c. Short-Term Emergency Rating = 5330 amps

2. Pastoria-Pardee Transmission Line Reconductor

   This project is an infrastructure replacement project which was identified in the 2004-2008, 2013 CAISO Controlled SCE Transmission Expansion plan. The scope of the project is to replace the existing 605 ACSR conductor on the Pastoria-Bailey, Pastoria-Pardee, and Bailey-Pardee 230-kV transmission lines with 666.6 ACSS/TW. This conductor type is the largest conductor that can be utilized on the existing transmission towers without requiring tear-down and rebuild. The project is not driven by Tehachapi wind generation needs.

The CAISO has reviewed the studies for this project and provided conditional concurrence pending receiving any input from the Collaborative Study Group.

SCE has presented this project to the Collaborative Study Group for informational purposes only and did not receive any opposition

V. electrical characteristics (per-unit) for this upgrade provided on 100 MVA / 230-kV base are as follows:

a. Pastoria-Pardee R=0.0109 X=0.0587 B=0.1085
b. Pastoria-Bailey R=0.0035 X=0.0187 B=0.0346
c. Pardee-Bailey R=0.0073 X=0.0398 B=0.0737

VI. ratings for the Pastoria-Bailey and Pardee-Bailey lines are as follows:

a. Normal Rating = 1240 amps
b. Long-Term Emergency Rating = 1426 amps
c. Short-Term Emergency Rating = 1500 amps

VII. ratings for the Pastoria- Pardee line is 1500 amps under all conditions

3. San Joaquin Valley Rector Loop and SVC

This project is a reliability driven project first identified in the 2002-2006, 2011 CAISO Controlled SCE Transmission Expansion plan and validated over the last two expansion plans. The project consists of constructing a new 15-20 mile double-circuit 230-kV transmission line so that the existing Big Creek3-Springville 230-kV line can be looped in and out of the Rector 230-kV substation and adding a 175 MVAR static VAR compensator (SVC) at Rector. This project has been approved by the CAISO governing board on June 24, 2004.

electrical characteristics (per-unit) for this upgrade provided on 100 MVA / 230-kV base are as follows:

a. New Big Creek3-Rector R=0.0106 X=0.0889 B=0.1711
b. New Rector-Springville R=0.0079 X=0.0660 B=0.1277

ratings for the New Big Creek3-Rector line will be as follows:

c. Normal Rating = 1200 amps (wave trap)
d. Long-Term Emergency Rating = 1200 amps (wave trap)
e. Short-Term Emergency Rating = 1284 amps (wave trap)

ratings for the New Rector-Springville line will be as follows:

f. Normal Rating = 1200 amps (wave trap)
g. Long-Term Emergency Rating = 1200 amps (wave trap)
h. Short-Term Emergency Rating = 1284 amps (wave trap)

Alternative Tehachapi Area Conceptual Plans

The following is a discussion of the currently proposed Tehachapi Area Conceptual Transmission Alternatives:

Revised SCE Conceptual Transmission Plan

New 500-kV Transmission line from Pardee to the Tehachapi area via Antelope. The line section between Antelope and Pardee (25 miles) should be included into the starting cases (initially energized at 230-kV) for reasons identified above. This line section will replace an existing 66-kV transmission line between Antelope and Pardee requiring expansion of existing right-of-way (ROW). New ROW will be required between Tehachapi and Antelope
(30 miles).

New 500-kV Transmission line from Vincent to the Tehachapi area via Antelope. The line section between Vincent and Antelope will replace existing 230-kV transmission line(s). New ROW will be required between Tehachapi and Antelope that is distinct from the ROW required above (30 miles).

Second new 500-kV Transmission line from Vincent to the Tehachapi area via different route due to right-of-way restrictions. This line will require new ROW between Vincent and Tehachapi.

Additional capacity between Vincent and the Los Angeles Basin in order to deliver output from the Tehachapi area wind generation to the SCE or SDG&E load centers.

New 500/230-kV substation(s) located near the Tehachapi Pass with several (up to four) 230/66-kV substations located in the various wind regimes.

220-kV transmission lines from the new 500/230-kV substation(s) to the 230/66-kV substations.

66-kV transmission lines from the new 230/66-kV substation(s) to the windfarms to collect the wind generation from the various sites.

Substation Expansion at Pardee and Vincent.

SCE-PG&E Phase-shifted System-Tie (CAISO Suggestions)

New phase-shifted system-tie in the Fresno Area

New phase-shifted system-tie in the Bakersfield Area

New 500-kV or 230-kV transmission line from the Tehachapi area to existing transmission facilities (to be determined). New ROW will be required between Tehachapi and the existing transmission facilities.

New 500/230-kV substation(s) located near the Tehachapi Pass with several (up to four) 230/66-kV substations located in the various wind regimes.

220-kV transmission lines from the new 500/230-kV substation(s) to the 230/66-kV substations.

66-kV transmission lines from the new 230/66-kV substation(s) to the windfarms to collect the wind generation from the various sites.

Midway-Vincent No.4 via Tehachapi

New 500-kV Transmission line from Midway to the Tehachapi area. Some new ROW may be required.

New 500-kV Transmission line from Vincent to the Tehachapi area via Antelope. This line will replace existing 230-kV transmission line(s) between Vincent and Antelope. New ROW will be required between Tehachapi and Antelope.

New 500/230-kV substation(s) located near the Tehachapi Pass with several (up to four) 230/66-kV substations located in the various wind regimes.

220-kV transmission lines from the new 500/230-kV substation(s) to the 230/66-kV substations.

66-kV transmission lines from the new 230/66-kV substation(s) to the windfarms to collect the wind generation from the various sites.

Substation Expansion at Midway and Vincent.

Electrical Characteristics and Thermal Ratings of Alternative Conceptual Plans

The following are the corresponding electrical characteristics and corresponding thermal ratings for each Tehachapi Area Conceptual Transmission Alternative. The transmission line parameters are provided in percent per mile and the transformer parameters are provided in percent.

Revised SCE Conceptual Transmission Plan

New 500-kV Transmission lines based on 100 MVA / 230-kV Base
Bundled 2156 ACSR R=0.00496 X=0.11250 B=8.2798

New 500-kV Transmission lines based on 100 MVA / 500-kV Base
Bundled 2156 ACSR R=0.00105 X=0.02380 B=1.7520

New 230-kV Transmission lines based on 100 MVA / 230-kV Base
Bundled 1590 ACSR R=0.00627 X=0.10330 B=0.4060

New 66-kV Transmission lines based on 100 MVA / 66-kV Base
954 SAC R=0.28 X=1.49 B=0.0280

Transmission Line Ratings (amps)
500-kV: Normal-3,950 Long-Term Emergency-4,540 Short-Term Emergency-5,330
230-kV: Normal-3,230 Long-Term Emergency-3,710 Short-Term Emergency-4,360
66-kV: Normal-1,090 Long-Term Emergency-1,470 Short-Term Emergency-1,470

Transformer Parameters
500/230-kV: 15.0 percent based on 1120 MVA with V_{from} of 525 and V_{to} of 230
230/66-kV : 19.7 percent based on 280 MVA with V_{from} of 230 and V_{to} of 70.5
230/34.5-kV : 11.5 percent based on 100 MVA with V_{from} of 230 and V_{to} of 34.5
34.5/0.545kV : 5.75 percent based on 1.5 MVA with V_{from} of 34.5 and V_{to} of 0.545

Transformer Ratings
500/230-kV: 1120 MVA
230/66-kV : 280 MVA
230/34.5-kV : 100 MVA
34.5/0.545kV : 1.5 MVA

SCE-PG&E Phase-shifted System-Tie (CAISO Suggestions)

New switching station north of Rector at the crossing of Helms/Big Creek lines

Loop existing Big Creek-Rector lines into new switching station (FresnoTie)

i. Big Creek1-FresnoTie R=0.0079 X=0.0403 B=0.0760
j. Big Creek3-FresnoTie R=0.0049 X=0.0250 B=0.0470
k. Rector-FresnoTie No.1 R=0.0139 X=0.0707 B=0.1330
l. Rector-FresnoTie No.2 R=0.0139 X=0.0707 B=0.1330
m. Normal Rating = 885 amps Emergency Rating = 936 amps on all lines

Loop existing Gregg-Helms lines into new switching station (FresnoTie)

n. Helms-FresnoTie No.1 R=0.0025 X=0.0313 B=0.1110
o. Helms-FresnoTie No.2 R=0.0025 X=0.0313 B=0.1110
p. Gregg-FresnoTie No.1 R=0.0025 X=0.0313 B=0.1110
q. Gregg-FresnoTie No.2 R=0.0025 X=0.0313 B=0.1110
r. Normal Rating = 1,910 amps Emergency Rating = 2,264 amps on all lines

Assume SCE 230-kV transmission line characteristics provided above for new line from Bakersfield (PG&E) to Magunden (SCE)

Assume same electrical parameters as the Crystal 230-kV phase-shifter shown in WECC Base Case for new phase shifters at Bakersfield and new switching station

Midway-Vincent No.4 via Tehachapi

SCE 500-kV transmission lines are discussed above in Item 1b

PG&E 500-kV transmission lines (100 MVA / 500-kV Base)
Bundled 2300 AAL R=0.00102 X=0.02470 B=1.7440

Transmission Line Ratings (amps)
Summer Normal-2,478 Summer Emergency-2,964

Assume parameters discussed above in item for Tehachapi localized 230-kV and 66-kV Facilities

Assessment Process Outline

The following is the process outline for developing the phased Tehachapi Transmission Plan.

Develop Tehachapi conceptual transmission plans for the various alternatives in order to interconnect the magnitude of the wind resource identified by the CEC.

From each conceptual transmission plan, identify the short-lead time project elements that can be pursued on a fast-track schedule

Determine if any of the short-lead time project elements should be included into a Phase 1b CPCN filing so that SCE can amend CPCN filing as needed

Perform necessary conceptual studies in order to identify phase development of each transmission alternative in an orderly, rational and cost effective manner

determine the amount of wind generation that can be accommodated with each phase of each transmission alternative on a conceptual basis

identify all new conceptual transmission facilities (e.g. lines, substations, and upgrades to existing lines and substations) required to transmit the power from Tehachapi to the various load centers (PG&E, Edison, and SDG&E)

validate potential impacts associated with (a) and (b) above by performing screening level power flow studies and determine if project element(s) should be further evaluated

Perform preliminary feasibility analysis for the transmission facilities identified in the various alternatives that pass the screening level study

i. perform preliminary engineering review to identify transmission elements that may be problematic

ii. perform preliminary environmental review of transmission facilities based on available information contained in currently available environmental data bases in order to identify potential significant environmental constraints

iii. resolve with the Department of Defense any critical issues surrounding transmission line routes and heights

Determine how long it would take for the anticipated transmission owner to prepare and file each of the certificate applications based on the outcome of the preferred alternative

develop a preliminary list of licensing and environmental requirements for the transmission line right-of-way and potential substation sites

identify the maximum reasonably foreseeable buildout for the utility-owned assets in order to comply with CEQA requirements

Develop appropriate transmission cost estimates, including substation costs and land acquisition costs, based on standard, off-the-shelf, general unit cost basis

<u>Study Areas and Study Conditions</u>

Edison proposes the following study areas and study conditions in developing the transmission facilities necessary to interconnect the full potential of renewable resources in the Tehachapi area as identified by the CEC:

CAISO Controlled SCE Transmission System Areas

Edison will utilize the latest heavy summer and light spring power flow cases developed for the 2004-2008, 2013 Annual CAISO Assessment recently completed. The cases will be adjusted as necessary to accommodate the additional wind generation modeled in the Tehachapi area in order to reflect maximum anticipated stress conditions on SCE transmission facilities consistent with the ISO Grid Planning Criteria assuming delivery of wind generation to either PG&E or SCE/SDG&E. The adjustment will be made by displacing either import generation into SCE from the north to capture delivery of wind generation to PG&E via Path 26 or displacing SCE and/or SDG&E internal generation to capture delivery into SCE and/or SDG&E. The displacement will be made as identified in Section XI Item 6. The cases will include transmission projects identified and approved by the CAISO as part of the annual expansion plan.

4. Main 500-kV and 230-kV System – Heavy Summer Load Conditions

Summer peak load conditions requiring high internal SCE generation dispatch and high imports result in maximum stress on the system.

Although historical data indicates that under peak load conditions the Tehachapi area wind generation levels are relatively low, the study will be performed assuming maximum wind generation dispatch to cover those instances when wind generation actually produces at a high generation levels during high system load conditions.

Studies will be performed to cover fifty percent delivery to the north and remaining fifty percent delivered to the south. These studies will address the conditions where power from wind generation resources are partially delivered to the north with remaining output delivered to the south. Sensitivity studies may be performed to evaluate full deliveries to the south and full deliveries to the north. Actual deliveries resulting from actual RPS contracts may be different and therefore additional transmission facilities not identified by this study may be required to deliver to the load centers.

5. Main 500-kV and 230-kV System – Spring Peak Load Conditions

Spring peak load conditions, with high import levels, high Big Creek corridor generation and reduced main system generation (sufficient generation on-line to maintain adequate voltages in the Los Angeles Basin) will be examined. Studies will be performed to cover fifty percent delivery to the north and remaining fifty percent delivered to the south. These studies will address the conditions where power from wind generation resources are partially delivered to the north with remaining output delivered to the south. Sensitivity studies may be performed to evaluate full deliveries to the south and full deliveries to the north. Actual deliveries resulting from actual RPS contracts may be different and therefore additional transmission facilities not identified by this study may be required to deliver to the load centers.

6. Big Creek and San Joaquin Valley 230-kV System – Under heavy summer load with maximum generation, light spring load with maximum generation, and off-peak load summer with maximum hydro pumping conditions

This portion of the system, which is served practically radial from the Main Transmission system, has been identified to be transmission deficient under both maximum load with maximum generation and minimum load with maximum generation. The system includes two Special Protection Schemes (Big Creek and Pastoria Energy Facility) that could be affected by additional wind generation. Studies will be performed to evaluate corridor under both heavy summer load and light spring load conditions.

CAISO Controlled PG&E Transmission System Areas

PG&E will utilize the latest heavy summer and light autumn power flow cases developed for the 2004-2008, 2013 Annual CAISO Assessment recently completed. The cases will be adjusted as necessary to accommodate the additional wind generation modeled in the Tehachapi area in order to reflect maximum anticipated stress conditions on the PG&E transmission facilities consistent with the ISO Grid Planning Criteria assuming delivery of wind generation at the existing Midway substation or the proposed new 230 kV tie at Big Creek and Magunden. Old and less efficient generation units in the NP15 will be displaced to accommodate the import of wind generation into the PG&E system. The cases will include transmission projects identified and approved by the CAISO as part of the annual expansion plan

Heavy Summer Load Conditions

Summer peak load conditions with maximum North to South flow on Path 26 will be evaluated to assess impact of delivering Tehachapi area wind generation to the Bay area via Path 26 and Path 15

Autumn or Winter Off-Peak Load Conditions

Autumn or Winter Off-peak load conditions, with maximum South to North flow on Path 15 will be evaluated to assess impact of delivering Tehachapi area wind generation to the Bay area via Path 26 and Path 15.

Fresno and Bakersfield Area Studies

Studies will be performed to evaluate the impact of the proposed Big Creek-Helms Interconnection on the Fresno area transmission system. The studies will be based on the Fresno area summer peak base cases modeling three Helms units generating and Fresno area summer off-peak base cases modeling two Helms units pumping.

Studies will also be performed to evaluate the impact of the proposed Magunden Interconnection on the Kern area transmission system. The studies will be based on the summer peak base cases modeling 3400 MW of north-to-south flow on Path 26 and the autumn off-peak base cases modeling 5400 MW of south-to-north flow on Path 15.

Power Flow Base Case Assumptions

Edison proposes the following key assumptions in developing the conceptual transmission facilities necessary to interconnect the full potential of renewable resources in the Tehachapi area as identified by the CEC:

Load Related Assumptions

Loads will be modeled in load flow studies as follows:

Peak summer load conditions for SCE or PG&E will represent maximum anticipated loads based on a coincident load forecast, which will include consideration of a one-in-ten-year heat wave. Three cases will be used to represent coincident Control Area Peak, Northern California Peak and Southern California Peak.

Peak summer load conditions for RMR analysis within SCE and PG&E will represent maximum anticipated loads based on a localized coincident load forecast, which will include consideration of a one-in-five-year heat wave.

Spring Peak representing typical daily Spring Season load will be assumed for the main SCE 500-kV and 230-kV system. This load assumption represents approximately 65% of the summer normal peak loads through the main SCE network and approximately 50% of the summer normal peak for the Big Creek Corridor.

Autumn or Winter Off-Peak load will be assumed for the main SCE 500-kV and 230-kV system. This load assumption represents approximately 50% of the summer normal peak loads through the main SCE network and approximately 40% of the summer normal peak for the Big Creek Corridor. For PG&E, this load assumption represents approximately 45% of the summer normal peak. Both systems experience maximum pumping under this load condition.

Loads located within the service area of a Non-Participating Transmission Owner that is directly interconnected to a transmission or distribution facility owned by SCE or PG&E will be modeled based on the most recent forecast that the Non-Participating TO has provided.

Reactive load WATT/VAR ratios for the transmission substation loads represented in the base cases will reflect reasonable values for the operating conditions being studied.

Generation Related Assumptions

a. Edison and PG&E will incorporate the generation resources required to meet the WECC Minimum Operating Reliability Criteria (MORC): 1% for regulation plus 7% or the largest generation unit. The required generation will include all existing generation: 2004 Reliability Must Run (RMR), regulatory must-take resources (QF), Hydro, and Nuclear and all existing market generation resources.

b. Future market generation proposed through the FERC Interconnection Process for which has an active request will be incorporated into the completed phased development plan if those projects can impact the study results since these projects have priority over conceptual resources.

c. Hydro generation located within the Edison and PG&E CAISO Controlled Grid will be modeled at an output level that provides the maximum anticipated stress conditions on the corresponding transmission systems.

d. Nuclear generation will be assumed at the maximum capability consistent with the ISO Grid Planning Criteria.

e. All QF generation will be modeled in the base case consistent with the ISO Grid Planning Criteria and study practices for transient stability analysis, provided data is available to simulate actual machine characteristics.

f. All QF generation explicitly represented in the power flow base cases will have their reactive capabilities modeled according to contractual requirements, otherwise historical operating data will be used. Actual reactive power capabilities (i.e. manufacturer data or field test data) will be modeled for dynamic stability analysis as available.

g. All generation connected to Edison's or PG&E's distribution system (at 12, 16, or 33-kV) will be netted with the transmission substation loads on the low side of the transformers. Other generation connected to the subtransmission systems will be represented with equivalent generators at the low side of the transmission substation transformers, when these systems are not CAISO controlled.

Imports into SCE

The generation import for SCE will be scheduled at the present 2004 maximum Southern California Import Transfer limit (SCIT), 14,300 MW for the summer and 13,600 MW for the spring, with Path 26 (Midway-Vincent) north-to-south flows modeled at maximum (3,400 MW) in order to stress the SCE 500-kV system and the 500/230-kV transformer banks

Edison will perform studies for delivering wind generation output to either SCE and/or SDG&E by assuming maximum north-to-south flow on Path 26 (Midway-Vincent). Edison will perform studies for delivering wind generation output to PG&E by reducing exchanges between Edison and

PG&E, which will result in lowering north-to-south flow on Path 26 (Midway-Vincent).

Imports into PG&E

The generation import for PG&E in the Autumn/Winter off-peak cases will be scheduled at the maximum allowable south-to-north flow on Path 26 (Midway-Vincent). Path 15 will be stressed to the south-to-north rating of 5400 MW.

PG&E will perform studies for receiving wind generation output at Midway by increasing exchanges between Edison and PG&E and displacing older and less efficient generation units in the NP15, which will result in increasing south-to-north flow on Path 26 (Midway-Vincent) and Path 15.

Generation Displacement

In order to assess the impacts on the bulk system when performing the power flow simulations it is important to schedule the 4,000+ MW to "reasonable" locations. To perform the necessary conceptual studies which would identify the facilities necessary to interconnect and deliver renewable resources to the load centers, 50% of the Tehachapi area wind generation will be assumed to be delivered to the system north of Path 26 and the remaining 50% delivered to the system south of Path 26. This will be accomplished by reducing generation as follows:

COI by 7.5 % (import north of Path 26)
NP-15 by 42.5% (north of Path 26)
SCE by 17.5% (south of Path 26)
SDG&E by 17.5% (south of Path 26)
CFE by 2.5% (south of Path 26)
West-of-River by 12.5% (import south of Path 26)

These estimates are subject to change based on feedback from the study group. The feedback should be provided no later than the second meeting (August 18th) since last minute changes to the assumptions will result in failure to meet the scheduled milestones.

Other Assumptions

The Tehachapi Comprehensive Transmission Development Assessment will comply with the CAISO Grid Planning Standards which incorporate the NERC/WECC Planning Standards.

Existing or proposed special protection schemes in the Big Creek Corridor will be operational.

Comply with the CAISO guidelines on the use of Special Protection Schemes to integrated Tehachapi area generation. In particular, limit the tripping of generation to 1,150 MW for the loss of one transmission line and 1,400 MW for the loss of two transmission lines.

Major Path Flows will be modeled at reasonable and expected patterns.

For the long-term, include the generation projects identified by the CEC.

The existing Path 15 RAS and Path 26 RAS will be modeled in the studies.

Power Flow Screening Level Preliminary Assessment

To assess the performance of the CAISO Controlled Grid owned by Edison and PG&E, screening-level preliminary power flow analysis will be performed under base case and contingency conditions for both summer and spring/autumn/winter load assumptions. Contingency analysis will follow the requirements of the ISO Grid Planning Criteria. Contingency evaluation will include selective single contingencies (e.g. loss of a transmission line, generating unit, or transformer bank) and selective multiple-contingencies (e.g. overlapping outage of two transmission lines), consistent with the ISO Grid Planning Criteria.

If the loading of a transmission component of the CAISO Controlled Grid owned by Edison is determined to exceed its thermal rating during normal or contingency conditions, Edison will identify the corrective action(s) necessary to address the reliability concern (e.g. facility addition, special protection scheme, etc.) and will provide one project alternative. There may be other alternative solutions that may not be identified in these conceptual studies which would be evaluated in the future system impact studies.

If the loading of a transmission component of the CAISO Controlled Grid owned by PG&E is determined to exceed its thermal rating during normal or contingency conditions, PG&E will identify the corrective action(s) necessary to address the reliability concern (e.g. facility addition, special protection scheme, etc.) and will provide one project alternative. There may be other alternative solutions that may not be identified in these conceptual studies which would be evaluated in the future system impact studies.

Final Report

The final report, to be filed by SCE with the CPUC, will contain all criteria, assumptions, methodologies, simulation results, conclusion, and recommendations for "master plan", and any other pertinent information necessary to comply with CPUC Order #04-06-010. A draft report will be made available for comments to the Collaborative Study Group four weeks prior to filing with the CPUC. The results and recommendations will be presented to all interested parties for discussion three weeks prior to filing with the CPUC. Final comments are due one week prior to filing with the CPUC.

Schedule of Major Milestones

The schedule of the Major Milestones of the Tehachapi Comprehensive Transmission Development Assessment is as follows:

Ref. #	Milestone	Target Date
1.	**Milestone Meeting #1** at CPUC for presentation and discussion of the Tehachapi Comprehensive Transmission Development Assessment Study Plan	06/23/2004
2.	Written comments on Tehachapi Comprehensive Transmission Assessment Study Plan including identification of additional project alternatives are due to Edison via e-mail (jorge.chacon@sce.com)	07/06/2004
3.	Edison posts revised Study Plan	07/12/2004
4.	Development of preliminary conceptual transmission plans for the various transmission alternatives and identification of additional fast-track project elements using the top-down approach	07/21/2004 to 08/11/2004
5.	**Milestone Meeting #2** at CPUC to discuss fast-track project elements, additional project alternatives (if any), and progress of the phased assessment and solicit input	08/18/2004
6.	Written comments on project alternatives and requests for sensitivity studies due to Edison via e-mail (jorge.chacon@sce.com)	08/25/2004
7.	Commence development of transmission phasing prioritization for each conceptual transmission plan (Edison, PG&E, CAISO, and other project alternatives)	08/26/2004
8.	**Milestone Meeting #3** at CPUC to discuss progress of the phased assessment	10/27/2004
9.	Written comments on progress of the phased assessment and requests for last sensitivity studies due to Edison via e-mail (jorge.chacon@sce.com)	11/03/2004
10.	Finalize development of transmission phasing prioritization for each conceptual transmission plan (Edison, PG&E, CAISO, and other project alternatives)	11/05/2004
11.	Commence preliminary feasibility analysis for the conceptual transmission facilities identified in finalized transmission alternative	11/08/2005
	NOTE: Edison Files CPCN for Phase 1	12/09/2004
	VACATION ANYONE?	12/18/2004 to 01/02/2004
12.	**Milestone Meeting #4** at CPUC to discuss progress of the preliminary feasibility analysis for the conceptual transmission facilities identified in finalized transmission alternative	01/05/2004
13.	Written comments on preliminary feasibility analysis due to Edison via e-mail (jorge.chacon@sce.com)	01/11/2005
14.	Finalize preliminary feasibility analysis	01/25/2004
15.	Commence draft report of complete Tehachapi Transmission Phased Development Plan	01/26/2005
16.	Edison makes draft report of complete Tehachapi Transmission Phased Development available	02/09/2005
17.	**Milestone Meeting #5** at CPUC for study group to present final study	02/16/2005

	report of complete transmission phased development	
18.	Final comments due to Edison via e-mail (jorge.chacon@sce.com)	02/23/2005
19.	Edison files final draft report of complete Tehachapi Transmission Phase Development Plan with Commission	03/09/2005