Application No.	07-06-031	
Exhibit No.	SCE-	
Witnesses:	Charles Adamson	Jennifer Leung
	Thomas A. Burhenn	Mark Murray
	Jorge Chacon	Monica Quiroga
	John Cooper	Glenn G. Sias
	David Guder	Marc Ulrich
	Dean Heiss	Roman Vazquez
	Peter L. Hlapcich	

SOUTHERN CALIFORNIA EDISON

An *EDISON INTERNATIONAL* Company

(U 338-E)

Southern California Edison Company's Testimony in Response to the Assigned Commissioner's Ruling on the Tehachapi Renewable Transmission Project (TRTP)

Before the

Public Utilities Commission of the State of California

Rosemead, California
January 10, 2012

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LIST OF COMMONLY USED ACRONYMS AND ABBREVIATIONS

ACR	Assigned Commissioner's Ruling
AEIC	Association of Edison Illumination Company
Aerojet	Aerojet-General Corporation
Alternative 4CM	Alternative 4C Modified
ANF	Angeles National Forest
Approved Route	The Commission-Approved Alternative 2 Route in the Chino Hills area
BiOp	Biological Opinion
CDFG	California Department of Fish and Game
CEQA	California Environmental Quality Act
CESA	California Endangered Species Act
CHSP	Chino Hills State Park
CHSP Plan	Chino Hills State Park Plan
Chino Hills	City of Chino Hills
COD	Commercial Operation Date
CPCN	Certificate of Public Convenience and Necessity
CPUC	California Public Utilities Commission
CWA	Clean Water Act
Draft EIR/EIS	Draft Environmental Impact Report/Environmental Impact Statement
DTSC	Department of Toxic Substances Control
EMF	Electric and Magnetic Fields
EPRI	Electric Power Research Institute
ESA	Endangered Species Act
FAA	Federal Aviation Administration
Final EIR	Final Environmental Impact Report
FERC	Federal Energy Regulatory Commission
FMP	Field Management Plan
FWS	U.S. Fish and Wildlife Service
GIL	Gas insulated transmission line
GIS	Gas insulated switchgear
GWh	Gigawatt hour

HCP	Habitat Conservation Plan
HPFF	High-Pressure Fluid Filled Cable Systems
IP	Individual Permit
ITP	Incidental Take Permit
KOP	Key Observation Point
kV	Kilovolt
LEDPA	Least Environmentally Damaging Practicable Alternative
LGIA	Large Generator Interconnection Agreement
LST	Lattice Steel Tower
LWCF	Land and Water Conservation Fund
MEC	Munitions and Explosives of Concern
Mitigation Plan	Mitigation Monitoring Plan
MW	Megawatts
MWh	Megawatt hour
NEPA	National Environmental Policy Act
NPS	U.S. National Park Service
NTP	Notice to Proceed
NWP	Nationwide Permit
PEA	Proponent's Environmental Assessment
PPA	Power Purchase Agreement
RCRA	Resource Conservation and Recovery Act
ROW	Right-of-Way
RPS	Renewables Portfolio Standards
SAA	Streambed Alteration Agreement
SCE	Southern California Edison Company
SCFF	Self-Contained Fluid-Filled Cable
Segment 8A	SCE's Proposed Segment 8A of TRTP
South of Vincent	South of SCE's Vincent Substation
SWRCB	State Water Resources Control Board
TRTP Project	Tehachapi Renewable Transmission Project
TSP	Tubular Steel Pole
USACE	U.S. Army Corps of Engineers

WQC	Water Quality Certification
XLPE	Cross-Linked Polyethylene (Solid dielectric or extruded dielectric cable systems)

I. INTRODUCTION AND BACKGROUND [C. ADAMSON]

The Tehachapi Renewable Transmission Project (TRTP or Project) is a critically important high-voltage transmission infrastructure project, the timely completion of which is essential for California's progress toward its aggressive renewable energy goals and greenhouse gas reduction requirements. Once completed, TRTP will deliver up to 4,500 megawatts (MW) of new generation, the vast majority of which will be renewable, in the Tehachapi area to load centers in Los Angeles and San Bernardino Counties.

A. Brief Procedural History [C. Adamson]

On June 29, 2007, Southern California Edison Company (SCE) submitted Application No. A.07-06-031 to the California Public Utilities Commission (Commission) for a Certificate of Public Convenience and Necessity (CPCN) to allow the construction, operation, and maintenance of the proposed Project. SCE also submitted a Proponent's Environmental Assessment (PEA) for the proposed Project to the CPUC at that time. The Commission approved the Project and issued a CPCN for TRTP on December 24, 2009, in D.09-12-044 (CPCN Decision).

The appropriate route for TRTP was considered in an extensive review before the Commission, largely focused on the appropriate route in the Chino Hills area. During the California Environmental Quality Act (CEQA) scoping process, the Commission and SCE worked with the City of Chino Hills (Chino Hills) to develop a mutually-agreeable and feasible alternative route for TRTP. The Commission explored alternative routes in the Chino Hills area, and also considered undergrounding the transmission line within the existing right-of-way (ROW).

On February 13, 2009, the Commission issued a Draft Environmental Impact Report/Environmental Impact Statement (Draft EIR/EIS) that described in detail four alternatives for routing Segment 8A of TRTP (Segment 8A) outside of Chino Hills (referred to as

Alternatives 4A, 4B, 4C, and 4D).[1] Each of these alternatives routed the transmission line through the Chino Hills State Park (CHSP) and surrounding properties.[2] The Draft EIR/EIS also evaluated an alternative that would place the transmission line underground in the existing SCE ROW in Chino Hills (Alternative 5). The Draft EIR/EIS identified Alternative 2 as the Environmentally Superior Alternative.[3] Alternative 2 routed Segment 8A through SCE's existing ROW in Chino Hills. Chino Hills submitted extensive comments on the Draft EIR/EIS, including a proposal for another alternative, Alternative 4C Modified (Alternative 4CM).

The Commission also considered evidence presented in hearings and briefings. The Commission accepted hundreds of pages of testimony and evidence submitted by the parties, including Chino Hills.[4] During ten days of evidentiary hearings, over 25 witnesses testified about the Project's route in the Chino Hills area.[5] In addition, the Commission held an *en banc* Commission meeting and final oral argument, in which Chino Hills participated, before the Commission approved TRTP.[6]

On October 30, 2009, the Commission issued an approximately 1,500 page Final Environmental Impact Report. The Final EIR evaluated the potential impacts of numerous alternatives in the Chino Hills area and identified Alternative 2 as the Environmentally Superior Alternative.[7] The Final EIR found that on balance, routing Segment 8A of TRTP through the existing ROW in Chino Hills was environmentally superior because this route would minimize new environmental impacts and would avoid the need for new infrastructure through new ROW.[8]

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[1] The Final EIR incorporates the Draft EIR/EIS by reference. The Final EIR is available at ftp://ftp.cpuc.ca.gov/gopher-data/environ/tehachapi_renewables/TRTP_Final%20EIR-EIS/TOC.htm.

[2] *See* D.09-12-044 at 30-32.

[3] *See* Draft EIR/EIS at 4-48.

[4] D.09-12-044 at 6.

[5] *Id.*

[6] D.09-12-044 at 79, n. 181.

[7] Final EIR at 4-63 to 4-64.

[8] *Id.*

The Final EIR evaluated Alternative 4CM, and ultimately concluded that Alternative 4CM created substantial environmental impacts and risks of regulatory and environmental delays that Alternative 2 did not.[9] The Final EIR also examined Alternative 5, which would follow SCE's existing ROW through Chino Hills but require the installation of 3.5 miles of transmission line underground rather than on above-ground transmission structures.[10] When compared to Alternative 2, the Final EIR concluded undergrounding would result in the greatest adverse short-term and long-term impacts, including increased greenhouse gas emissions, potential to destroy cultural resources, potential for ground disturbance that could result in damage to overlying structures, and permanent displacements of existing commercial land uses.[11]

On December 24, 2009, the Commission issued its decision granting a CPCN for TRTP. The CPCN Decision evaluated seven different routes in the Chino Hills area, including Alternative 4CM, Alternative 5, and Alternative 2. The CPCN Decision adopted Alternative 2 based on several key considerations: (1) the Final EIR's recommendation of Alternative 2 as the Environmentally Superior Route after an extensive CEQA review; (2) California's Renewables Portfolio Standards (RPS) goals and the Project's critical role in progress towards those goals; and (3) the use of existing ROW consistent with statutory principles that call for utilities to route transmission projects through existing ROW where technically feasible and economically justifiable in order to minimize new environmental impacts.[12]

On January 25, 2010, Chino Hills filed an Application for Rehearing and a Motion for Partial Stay of the CPCN Decision. There are 18 towers either already constructed or proposed to be constructed in Chino Hills within SCE's existing ROW. While the Commission has not yet acted on Chino Hills' Application, the Commission granted the Motion for Partial Stay on November 10, 2011, to the extent that it applies to Segment 8A of TRTP, pending the Commission's resolution of Chino Hills' Application for Rehearing. Also on

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[9] *Id.*

[10] Final EIR at 2-101.

[11] Final EIR at 4-58.

[12] D.09-12-044 at 19-20, 45-46.

November 10, 2011, President Peevey issued an Assigned Commissioner's Ruling (ACR), directing SCE to prepare testimony on alternatives for routing the portion of Segment 8 that traverses Chino Hills by January 10, 2012.

SCE's testimony responds to the ACR, which directs "SCE to prepare testimony on alternatives or solutions to the current approved route for the transmission line" that includes "the feasibility, cost, and timing for each alternative."[13] The ACR specifically requires an analysis of:

1. Alternative 4CM (City's preferred route).
2. Alternate 5 (Partial undergrounding).
3. Other alternate routes through the City and/or Chino Hills State Park (CHSP).
4. Utilizing the existing ROW with shorter/more frequent towers.
5. Mitigation for impacts of TRTP line.[14]

Because of the extensive information and analysis already developed, the ACR states that "reviewing known alternatives with up-dated cost, viability, and timing data should prove sufficient."[15] The ACR also invites the parties to suggest additional routes or solutions to be considered by the Commission.[16]

In Section I of this Response to the ACR, SCE will first provide the status of its efforts to construct Segment 8. Sections II and III will discuss the costs SCE has incurred to date constructing the approved route through Chino Hills, will update the need for the Project to interconnect renewable electricity generators, and will discuss the methodology SCE used to estimate the costs to renewable electricity generators and/or electricity customers should completion of TRTP be delayed. Section IV will then present updated feasibility, cost, regulatory, and timing data on each of the alternative routes previously evaluated by the Commission routing the Project through the CHSP. Section V will then present data on an

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[13] *See* ACR at 2-3.

[14] *See* ACR at 3.

[15] *Id.*

[16] *Id.*

additional nine optional routes that were not considered during the Commission proceedings, four of which involve shorter towers through SCE's existing ROW in Chino Hills, and five of which involve an underground route through SCE's existing ROW or through local city streets. Section V will also present updated data on Alternative 5, an undergrounding route previously evaluated by the Commission. Finally, Section VI will provide testimony on the sufficiency of mitigation in connection with the TRTP line.

To meet the ACR's short two-month deadline, certain assumptions were made in the preparation of this cost testimony and are enumerated throughout the testimony. SCE's ordinary cost analysis process would be much more extensive, but to comply with the schedule set forth in the ACR, SCE necessarily had to make simplifying assumptions in order to provide the information contained in this testimony. The Commission should be aware that the cost estimates contained herein necessarily are not the result of detailed analysis, comparable to what would today be used in a new application for a CPCN.

B. Status of Construction in Chino Hills [C. Adamson]

SCE has made substantial progress constructing the approved Alternative 2 route that runs through the Chino Hills area (Approved Route). SCE commenced construction in Chino Hills early in the TRTP construction process because work in the Chino Hills area was not constrained by additional regulatory approvals from other federal or state agencies and was not hampered by seasonal restrictions to sensitive species. SCE began constructing the portion of Segment 8A in the existing 150-foot ROW in Chino Hills in August 2010, upon receiving a Notice to Proceed (NTP) from the Commission.

The Approved Route involves removing existing 220 kV transmission structures that have been located in the Chino Hills ROW since the 1940s, and replacing these structures with double-circuit 500 kV structures. To date, SCE has removed the existing 220 kV transmission line and structures, and has completed construction of 12 of the 18 transmission structures in Chino Hills. The six remaining structures have been partially constructed. Construction on the six remaining structures in Chino Hills was underway before the Commission stayed construction in its November 10, 2011 Decision. If construction were to resume, it would take approximately two weeks to complete structure construction, and approximately three months to string the conductor in the Chino Hills area.

II. TRTP'S ROLE IN RENEWABLES DEVELOPMENT [J. CHACON]

Once complete, TRTP will provide the transmission upgrades needed to interconnect and deliver up to 4,500 MW of new generation under development in the renewable resource-rich Tehachapi area for delivery to the load centers in the Los Angeles Basin. The transmission upgrades proposed as part of TRTP are necessary to reliably interconnect and deliver up to 4,500 MW of new renewable generation to the grid. The southern segments of TRTP (including Segment 8 through Chino Hills) are particularly critical, because these upgrades must be complete in order to deliver up to 3,400 MW of new generation to load centers in the Los Angeles basin south of SCE's Vincent Substation (south of Vincent).

Upgrades to the northern segments of TRTP, located north of SCE's Vincent Substation, will increase the amount of power that can be reliably delivered to Vincent Substation. However, current transmission capacity limitations south of Vincent limit the amount of power that can actually be delivered to the load centers south of Vincent. Without the completion of TRTP Segments 6, 7, 8, and 11, only 1,100 MW can be delivered south of Vincent. The transmission upgrades in Segments 6, 7, 8, and 11 must be completed to increase the new generation deliveries from 1,100 MW up to 4,500 MW.

Among the segments south of Vincent, Segment 8 is a critical link. Segment 8 consists primarily of a rebuild of approximately 33 miles of an existing 220 kV transmission line to 500 kV standards from the San Gabriel Junction (located approximately two miles east of the existing Mesa substation) to the Mira Loma substation. Approximately five miles of Segment 8 traverse Chino Hills through an existing SCE ROW that supported 220 kV infrastructure for many years. Segment 8 is necessary because it contains the necessary 500 kV upgrades to the portions of the Mira Loma-Vincent line located between the San Gabriel Junction and Mira Loma Substation. A delay in completing Segment 8 would therefore delay the in-service date of the entire Mira Loma-Vincent 500 kV transmission line. Up to 3,400 MW of new generation that can be reliably delivered to the load centers south of Vincent will be curtailed until the entire Mira Loma-Vincent 500 kV line is placed into service when Segment 8 is completed.

III. POTENTIAL COSTS ASSOCIATED WITH A CHANGE IN THE APPROVED ROUTE IN THE CHINO HILLS AREA

A. Costs to Date on Segment 8 East [D. Heiss]

In response to the ACR, SCE has prepared preliminary cost estimates for alternatives and options for the Project in the Chino Hills area. These costs are in 2011 constant dollars. Before presenting the costs of alternatives and options, the following paragraph provides a status of costs for the Project as approved by the Commission in the Chino Hills area.

As of November 2011, SCE has spent approximately $59 million to construct the portion of Segment 8A through Chino Hills in SCE's existing ROW. These costs include the costs of (1) removing the existing 220 kV transmission structures; (2) designing the new structures; (3) constructing the new structures; (4) implementing the environmental mitigation measures required by the Final EIR; and (5) installing the 500 kV upgrades at the Mira Loma Substation. SCE estimates the remaining costs to complete this portion of the project to be approximately $97 million, which implies that the total forecast for this portion of the project is estimated at $156 million.[17]

B. Comparison of Estimated Construction Costs for Alternatives and Options [D. Heiss]

Table 1 compares the total estimated costs associated with each alternative and option, including the approved Project. The scopes of the various alternatives and options are explained in Sections IV and V. It is important to note that the alternatives and options may not be comparable in scope. Per Sections IV and V, the alternatives and options vary in capacity and the rationale for the difference is explained in Sections IV and V. The estimates developed for the alternatives and options in this testimony are preliminary and based on a conceptual scope.

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[17] These dollar amounts exclude corporate overheads and contingency. SCE acknowledges that these cost numbers slightly differ from those presented in SCE's Response to Chino Hills Petition for Modification, filed November 28, 2011. The changes to the cost estimates are minor, and are based on a more refined analysis since the November 28 filing.

SCE should be entitled to file a separate regulatory filing with more detailed scope and updated cost estimates if the Commission adopts an alternative or option in this proceeding that differs from the approved Project. The costs illustrated in Table 1 in this section are neither intended nor complete for ratepayer revenue requirement calculation.[18] Depending on the alternative and option, the portion of inception-to-date recorded costs that would be abandoned is estimated to range from $15 million to $59 million, and the amount of removal costs is estimated to range from $1 million to $11 million.[19]

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[18] In addition to the total project cost, the ratepayer revenue requirement calculation should also include CWIP in Ratebase and/or AFUDC, return and taxes, impacts of lost bonus depreciation, analysis of replacement energy, impact of curtailment costs on ratepayers, and other relevant analysis.

[19] Dollars exclude corporate overheads. The $11 million in removal costs includes $3 million (35%) in contingency on top of $8 million referenced within Table 1.

Table 1: Estimated Costs

$ in Millions (2011 Constant Dollars)		ITD recorded Costs			Costs To Go				Corp OH	Total Cost (w/o future scope)	Estimate Class
		Useable	To Abandon	Total	Removal	Install (HMC)	Contingency	Total			
		A	B	C=A+B	D	E	F=(D+E)*Cont%	G=D+E+F	H=(C+G)*6.5%	I=C+G+H	J
Approved Route 15% Contingency		59	0	59	0	84	13	97	10	166	2
State Park Alternatives 35% Contingency (ACR Item 1 and 3)	Alternative 4A	0	59	59	8	246	89	343	26	428	4
	Alternative 4B	0	59	59	8	243	88	339	26	424	4
	Alternative 4C	0	59	59	8	303	109	420	31	510	4
	Alternative 4CM	0	59	59	8	358	128	494	36	589	4
	Alternative 4D	0	59	59	8	298	107	413	31	503	4
Shorter Structure Options 15% Contingency (ACR Item 4)	Option 1	44	15	59	1	100	15	116	11	186	3
	Option 2	44	15	59	2	103	16	121	12	192	3
	Option 3	44	15	59	0	90	14	104	11	174	3
	Option 4	44	15	59	0	103	15	118	11	188	3
Underground Alternatives and Options 50% Contingency (ACR item 2)	Alt 5 GIL UG	44	15	59	1	661	331	993	68	1120	5
	UG Opt. 5	44	15	59	1	572	286	859	60	978	5
	UG Opt. 6	44	15	59	2	354	178	534	39	632	5
	UG Opt. 7	44	15	59	2	347	175	524	38	621	5
	UG opt. 8	44	15	59	1	336	168	505	37	601	5
	UG Opt. 9	44	15	59	1	343	172	516	37	612	5

Both the Association for the Advancement of Cost Engineering (AACE)[20] and the Electric Power Research Institute (EPRI) proposes guidelines for setting contingency. In addition to considering the AACE's and EPRI's guidelines, SCE's contingency standards are based on the professional judgment and experience of SCE's engineering and construction professionals.

Table 2 summarizes SCE's contingency assumptions and shows that these assumptions are reasonable relative industry accepted standards. Given the limited time to respond to the ACR, the scopes of the alternatives and options are not equally defined and the amount of feasibility analyses performed differs between alternatives and options, and thus vary in stage of project development. As such, SCE applied contingency percentages based on the quality of scoping information for each alternative and option. Column J of Table 1 correlates the estimate class with SCE's contingency guidelines in Table 2.

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[20] Formerly known as the American Association of Cost Engineers (AACE).

Table 2: Application of Contingency

SCE		AACEI*		EPRI**	
Project Stage	**Contingency Assumption**	**Estimate Class/Usage**	**Potential Overrun**	**Project Stage**	**Suggested Contingency**
System Planning	40-50%	Class 5/Screening or Feasibility	40-200%	NA	NA
Conceptual/Preliminary Plan (CPCN Filing w/Optional Scopes)	30-40%	Class 4/Concept Study or Feasibility	30-120%	Simplified Estimate	30-50%
Licensed Project (Selected Scope)	15-25%	Class 3/Budget or Control	20-60%	Preliminary Estimate	15-30%
		Class 2/Control or Bid	10-30%	Detailed Estimate	10-20%
Final Engineering Design Spec	10-20%	Class 1/Bid or Check Estimate	10%	Finalized Estimate	5-10%

* AACE International Recommended Practice No. 17R-97, 2003

**EPRI, "Technology Assessment Guide," 1993

C. Costs Associated with Renewable Electricity Generators

1. Potential Impacts to Large Generator Interconnection Agreements in the Tehachapi Area [J. Chacon]

To SCE's knowledge, there are 17 renewable generator interconnection requests from developers that have executed Large Generator Interconnection Agreements (LGIAs) or are actively negotiating LGIAs. Taken together, these 17 interconnection requests represent 4,555 MW of new renewable generation in the Tehachapi area.

Table 3: Large Generator Interconnection Agreements

No.	Queue No.	Project Name	Size (MW)	FERC Docket
1	20	Manzana Wind Project	300	ER11-2067
2	73	Pacific Wind Project	250	ER12-362
3	79	Coram Brodie Wind Project (Coram Brodie I & II)	51	ER11-2322
4	91		51	
5	93	Alta 2012 Project (formerly Suncreek and Alta6) - Alta Wind VII, X, and XI PPAs	220	ER12-712
6	119		500	
7	95	CPC East Project - Alta Wind IV, V, VIII and IX PPAs	600	ER10-1112
8	96	CPC West Project - Alta Wind I, II, III, and VI PPAs	550	ER10-805
9	100	Aero Energy Windstar I Project	120	ER10-103
10	132	North Sky River Project	297	ER11-4255
11	297	Alta Vista SunTower	66	ER11-4108
12	407	Antelope Valley PV 1 Project - Solar Star California XIX PPA	325	ER12-486
13	408	Antelope Valley PV 2 Project - Solar Star California XX PPA	325	ER12-538
14	412	AV Solar One Project	250	ER11-2411
15	602	Catalina Solar Project	150	ER12-680
16	188	Confidential at This Time	200	Negotiation
17	506	Confidential at This Time	300	Negotiation
		Total MW	**4,555**	

In addition, there are more than 200 MW of additional small projects seeking to interconnect to the grid and make deliveries to load centers utilizing TRTP that are not included in Table 3. A delay in the completion of Segment 8 would potentially hinder the ability of generation projects with executed LGIAs to deliver their renewable energy to serve load centers south of Vincent.

2. Potential Impacts to Power Purchase Agreements in the Tehachapi Area [M. Ulrich]

SCE and other utilities have power procurement contracts with numerous interconnecting generators in the Tehachapi area, some of which are yet to be synched to the grid. SCE itself has power purchase agreements (PPAs) with a number of the large generators described above. In addition, SCE has a number of contracts with smaller generators in the Tehachapi area. In total, SCE has 22 active, executed PPAs with various large and small renewable energy developers in the Tehachapi area for a total of 2,492 MW under contract. These PPAs are listed below in Table 4.

Table 4: Power Purchase Agreements in Tehachapi Area

Developer	Technology	Project Name	Project Size (MW)	Guaranteed COD
Alta	Wind	Alta Wind II, LLC	150	1/1/11
Alta	Wind	Alta Wind I, LLC	150	1/6/11
Alta	Wind	Alta Wind III, LLC	150	2/14/11
Alta	Wind	Alta Wind IV, LLC	**102**	3/15/11
Alta	Wind	Alta Wind V, LLC	168	4/22/11
Alta	Wind	Alta Wind VI, LLC	150	1/1/12
Alta	Wind	Alta Wind VIII, LLC	150	1/1/12
Alta	Wind	Alta Wind VII, LLC	168	1/1/13
Alta	Wind	Alta Wind IX, LLC	132	1/1/13
Alta	Wind	Alta Wind X, LLC	138	1/4/13
Alta	Wind	Alta Wind XI, LLC	90	1/4/13
Amonix	Solar	Littlerock Solar Power Generation Station	5	4/3/13
Fotowatio (FRV)	Solar	FRV Mojave Solar 4, L.P.	20	12/31/13
NRG Solar	Solar	Desert View SunTower	141	1/1/14
Palm Valley Solar, Inc.	Solar	SEPV1, LLC	2	12/31/11
Recurrent Energy	Solar	RE Rio Grande, LLC.	5	12/1/12
Recurrent Energy	Solar	RE Rosamond Two LLC	20	1/1/13
Recurrent Energy	Solar	RE Columbia Three LLC	10	1/1/14
Silverado Power	Solar	Lancaster Dry Farm Ranch B, LLC	20	4/30/14
Sunpower	Solar PV	Solar Star California XIX, LLC	325	10/31/16
Sunpower	Solar PV	Solar Star California XX, LLC	276	10/31/16
Western Wind Energy Corp.	Wind	Windstar Energy, LLC	120	12/31/11
			2,492	

A delay in the completion of Segment 8 could trigger significant congestion and attendant curtailment of renewable generation. Utilities and developers negotiated these PPAs with the understanding that TRTP would be completed commensurate with the generation projects' various commercial online dates. Utilities and electricity generators typically negotiate PPA provisions that determine to what extent each party bears the risk of curtailment, which occurs when a generator cannot transfer all available power on the transmission grid due to unavailable transmission capacity. If Segment 8 is delayed, SCE's transmission system may not have the capacity to handle expected electricity generation in the Tehachapi area during the delay, and some electricity generators in the Tehachapi area may not be able to deliver all of their contracted power to their counterparties as set forth in their PPAs, potentially triggering any applicable curtailment provisions. One can construct an estimate of the amount of renewable energy that potentially would be curtailed using simplified analysis.[21]

The simplified analysis used here to estimate the renewable energy curtailed was prepared on an hourly basis (i.e., 8,760 hours/year) for each of the years analyzed and illustrated in Table 5. Column A and B show the hour of the assumed year and the quarter of the year. Column C shows a normalized solar photovoltaic generation profile for the location of the subject projects while column D shows the solar capacity anticipated to interconnect to TRTP. Similarly, columns E and F represent a normalized generation profile for wind generators and concurrent expected wind capacity, respectively. Column G shows the composite renewable generation and is calculated as the sum of the products of each generation type. Column H represents TRTP's capacity for each hour in the analysis, assuming TRTP Segment 8 is not completed, limiting TRTP's capacity rating to 2,200 MW.

[21] The analysis shown here is a sample congestion estimate for the year 2015.

Table 5: Renewable Energy Curtailment By Hour

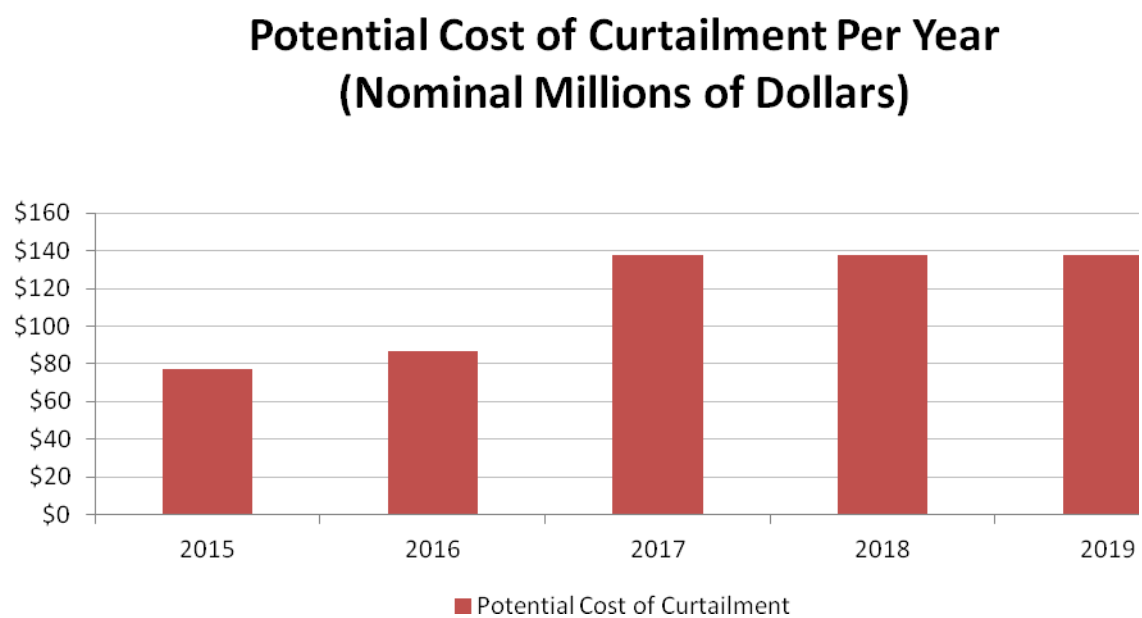
A	B	C	D	E	F	G	H	I	J	K
		Solar PV Tracker High Desert Normalized	Solar Capacity	Wind Profile Normalized	Wind Capacity	Composite TRTP Generation	TRTP Capacity	Energy Curtailed For This Hour	Solar Curtailed	Wind Curtailed
Hour	Qrtr	Capacity Factor	MW	Capacity Factor	MW	MW	MW	MWh	MWH	MWH
1	Q1	0.000	250	0.002	2742	6	2200	0	0	0
2	Q1	0.000	250	0.002	2742	7	2200	0	0	0
3	Q1	0.000	250	0.001	2742	3	2200	0	0	0
4	Q1	0.000	250	0.001	2742	4	2200	0	0	0
5	Q1	0.000	250	0.001	2742	2	2200	0	0	0
6	Q1	0.000	250	0.001	2742	2	2200	0	0	0
7	Q1	0.000	250	0.002	2742	5	2200	0	0	0
…		…	…	…	…	…	…	…	…	…
295	Q1	0.000	250	0.353	2742	969	2200	0	0	0
296	Q1	0.316	250	0.621	2742	1,782	2200	0	0	0
297	Q1	0.705	250	0.649	2742	1,957	2200	0	0	0
298	Q1	0.928	250	0.710	2742	2,180	2200	0	0	0
299	Q1	1.001	250	0.770	2742	2,361	2200	161	17	144
300	Q1	0.940	250	0.787	2742	2,393	2200	193	19	174
301	Q1	0.927	250	0.754	2742	2,300	2200	100	10	90
302	Q1	0.880	250	0.758	2742	2,298	2200	98	9	89
303	Q1	0.878	250	0.727	2742	2,212	2200	12	1	11
304	Q1	0.751	250	0.737	2742	2,208	2200	8	1	7
305	Q1	0.396	250	0.698	2742	2,012	2200	0	0	0
306	Q1	0.000	250	0.735	2742	2,017	2200	0	0	0

When the total composite renewable generation exceeds TRTP's capacity (i.e., column G > column H), generation must be curtailed. This is shown in column I. Columns J and K show the proportion of the curtailed energy that comes from either solar or wind, respectively. Table 5 is a sample of 2015's base congestion analysis for the first 306 hours of the year and the results show zero congestion for the first 298 hours but in hours 299-304 renewable generation exceeds the TRTP line capacity and renewable generation must be curtailed. Extending this analysis for all hours in a potentially-impacted year under both a base case and a delayed case yields an estimate of the incremental congestion that would be anticipated with a delay in the TRTP schedule. The resulting, assumed congestion can then be converted into a projected financial impact associated with a delay in the completion of TRTP.

For example, assuming a price of $100 per megawatt hour (MWh) for each megawatt hour of congestion and taking into consideration only generators with existing PPAs, there would be more than $100 million, on average, per year, of potential costs to utility customers and/or generators (depending upon which contracting party bears the curtailment risk) as a result of a delay on TRTP.[22] This cost represents either lost revenue to sellers, payments made by buyers for no electricity, or some combination of both, depending on contract provisions.

Table 6 demonstrates the potential costs associated with any delay to the completion of Segment 8.[23]

Table 6



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[22] The $100/MWh assumption is a generic assumption that mirrors the CPUC's market price referent and is an easy conversion from GWh to dollar damage (e.g., 1,000 GWh of curtailed energy times $100/MWh cost is $100 million of lost value).

[23] Table 6 assumes 11 interconnection customers with executed PPAs, executed LGIAs, or LGIAs in negotiation, and that the generators interconnect on their expected Commercial Operation Date (COD), when the COD is known, or the requested interconnected date when the COD is unknown. If TRTP is delayed beyond 2019, the 2019 cost of curtailment will continue to be incurred annually. If all 17 large generator interconnecting projects reached the point being able to deliver power to the grid, the potential cost would be much greater, from $200 million to close to $400 million per year.

If all 17 large generator interconnecting customers came online the potential cost would be much greater, from $200 million in the early years of the analysis to close to $400 million per year in the later periods.[24]

The allocation of costs resulting from curtailments is a fact-specific inquiry based on numerous factors, including the terms of the relevant PPA. There is, however, risk that utility ratepayers would be required to bear some of the congestion or curtailment costs associated with delays in the completion of TRTP Segment 8, depending on the specific terms and conditions of the PPAs held by impacted projects.

The Alternatives and Options outlined below in Sections IV and V result in lost renewable generation due to the delay to permit and construct the Alternatives and Options. The cost of this lost renewable energy can be quantified, and ranges from approximately $10 million for Option 5 to $585 million to $1.4 billion for Alternatives 4C and 4CM, as shown in Table 7.

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[24] Some generators selected in the curtailment analysis are different than those described in Table 3. SCE's Renewable and Alternative Poewr group selected generators for this analsysis was based on several factors, including, market knowledge, SCE's experience, and PPA and and interconnection status, and total 4,459 MW.

Table 7: Potential Costs Associated with Renewable Electricity Generation

	Interconnections with PPA	Interconnections with and without PPA	Interconnections with PPA	Interconnections with and without PPA
Best Schedule Case	**Cumulative GWh Curtailed**	**Cumulative GWh Curtailed**	**Cumulative Curtailment Cost ($ millions)**	**Cumulative Curtailment Cost ($ millions)**
Options 1,2,3,4	101	324	$10	$32
Option 6	1,739	5,540	$174	$553
Alts. 4B, 4D and Options 7,8,9	3,114	9,503	$311	$949
Alt 4A	4,488	13,465	$448	$1,345
Alts. 4C, 4CM, 5, Option 5	5,862	17,428	$585	$1,741
Worst Schedule Case	**Cumulative GWh Curtailed**	**Cumulative GWh Curtailed**	**Cumulative Curtailment Cost ($ millions)**	**Cumulative Curtailment Cost ($ millions)**
Option 3 (only one schedule case)	101	324	$10	$32
Options 1,2,4	873	2,347	$87	$234
Option 6 (only one schedule case)	1,739	5,540	$174	$553
Options 7,8,9 (only one schedule case)	3,114	9,503	$311	$949
Alt 4B	4,488	13,465	$448	$1,345
Alt 4A	5,862	17,428	$585	$1,741
Alt. 4D	9,984	29,316	$996	$2,929
Alts. 4C, 4CM	14,107	41,204	$1,407	$4,117

IV. ALTERNATIVE ROUTES OUTSIDE OF CHINO HILLS

A. Potential Delays Associated with Review, Permitting, and Restrictions on Construction of the State Park Alternatives [C. Adamson]

This testimony describes the potential for new and/or revised environmental permits (and related additional environmental review), potential restrictions on the construction of each route, and the potential associated delay to Segment 8's completion. The following testimony outlines the steps that would need to occur before construction could begin on Alternatives 4A, 4B, 4C, 4C Modified (4CM), and 4D (collectively referred to as the State Park Alternatives).

Some of these time estimates are greater than the time estimates offered in the original proceeding. Over the past two years, SCE has gained a better understanding of the regulatory and engineering processes required for large transmission projects since the Commission first approved TRTP in December 2009. SCE has found that it is taking longer than initially estimated to receive the necessary permits from other regulatory agencies than realized in 2009, in part due to the large influx of infrastructure projects in the Southwest in response to renewable energy goals stressing the limited resources of numerous state and federal agencies. The timeframes contained herein are realistic, best-case estimates of the time needed to conduct engineering, procure materials, complete construction, while also gaining access to the property and obtaining needed information for the alternatives and options for routing TRTP in the Chino Hills area.[25]

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[25] "Alternatives" refer to routes analyzed in TRTP's Final EIR. "Options" refer to different approaches to the construction of TRTP within Chino Hills.

1. The Engineering, Procurement and Construction Process

a. Overview [C. Adamson]All of the State Park Alternatives require additional transmission line work and the construction of a new switching station. This work will require engineering, procurement, and construction with the following approximate durations summarized below.

b. Engineering [R. Vazquez]The first step would be preliminary engineering to identify specific structure locations and access road designs. The second step would be final engineering for material specification and construction bid requests. The final engineering cannot take place until the structure and switching station sites are cleared for construction and geotechnical investigations, including soil sample borings, are completed. This means that all state and federal environmental clearance must be complete, as well as property rights obtained, to allow for access to conduct invasive geotechnical investigation. SCE currently estimates that the preliminary engineering for the transmission line would take approximately eight months, and approximately 21 months for the switching station. The detailed engineering for the transmission line would take approximately 21 months, and 19 months for the switching station.[26]

c. Procurement [C. Adamson]Transmission line procurement of materials and construction labor would be performed as soon as the detailed engineering work for each aspect of work is complete. SCE would first prepare the bidding documents, which takes approximately three months. Because SCE would be unable to reuse any significant portion of the structures constructed in Chino Hills, procuring new transmission line materials would take approximately seven months and award of a construction contract would take approximately six months. Because these processes necessarily overlap, the total procurement time for the transmission line would be approximately ten months.[27]

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[26] *See* Attachment F, Consolidated Project Schedules at Alternatives 4A through 4D.

[27] *See id.*

Switching station procurement would also take place after detailed engineering for each aspect of work is complete. Switching station procurement is constrained by the gas insulated switchgear (GIS) lead time. Switching station procurement would take approximately 17 months to bid, engineer, and fabricate.[28]

d. Construction [C. Adamson]Transmission line construction would take approximately 10 months. Switching station construction would take approximately 28 months. Including environmental permitting, engineering, procurement, and through construction, each of the State Park Alternatives would delay the Project by approximately 36 to 125 months.[29]

2. SCE Would Need to Obtain Access to Perform Biological and Geotechnical Surveys Needed for Final Engineering and Environmental Review

a. Acquisition of Access for Surveys on Private Land [M. Quiroga]

Several tasks must occur before final engineering, procurement and construction can be undertaken. Unlike the Approved Project route, most of the State Park Alternatives require new ROW, most notably through the CHSP and through property owned by the Aerojet General Corporation (Aerojet). SCE currently lacks the property rights to perform necessary geotechnical and biological surveys of the State Park Alternatives, including on private lands affected by those routes. Because SCE does not have access to these properties, SCE currently lacks the permission to enter these properties and perform critical pre-construction survey work on private lands along the ROW for the State Park Alternatives. Should SCE choose to petition the Superior Court to acquire the properties through eminent domain, California Code of Civil Procedure Sections 1245.010–1245.060 govern the process of obtaining rights of entry for testing and surveying land. Under Section 1245.030, the entity seeking permission to enter the property shall provide notice to the owner "as the court determines is appropriate under the

[28] *See id.*

[29] *See id.*

circumstances of the particular cases." It is estimated that the process of providing notice and obtaining a court order could take up to four months.

b. Acquisition of Access for Surveys on CHSP [M. Murray]

SCE would need to also obtain authorization from the California Department of Parks and Recreation (State Parks) for access to complete surveys on CHSP. For non-invasive surveys, efforts to obtain approval from State Parks could take at least 45 days.[30] It is likely that CHSP would allow SCE to perform biological surveys prior to the completion of its review of TRTP; however, whether SCE could proceed with geotechnical surveys in CHSP would be reviewed by State Parks on a case by case basis, and may potentially require additional environmental review.

c. Geotechnical Surveys [R. Vazquez]

Before SCE can complete final engineering on any one of the State Park Alternatives, SCE must perform geotechnical surveys to examine subsurface conditions for the safe design and construction of the transmission structures. Once the route is selected and SCE obtains access rights along the ROW, it would take approximately 5.5 months to complete geotechnical surveys of the ROW, depending on the alternative selected.

d. Biological Surveys [J. Leung]

Prior to submitting environmental approvals for a State Park Alternative, SCE must complete biological surveys for the relevant route. SCE's ability to complete these biological surveys would be affected by the relevant seasonal survey windows for potential species along the ROW alignment. For example, one of the species likely present in the area of the State Park Alternatives is the least Bell's vireo, with a seasonal survey window of March 15 to August 20. Assuming that access negotiations take two to four weeks and that any additional Commission proceedings would not be complete by March 1, SCE would likely miss the 2012 survey window for this species for the State Park Alternatives. Therefore, SCE could not start surveys until 2013. Once started, biological surveys take approximately 8 months to complete. SCE must

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[30] *See* Attachment C, Letter from Steven Musillami at Department of Parks and Recreation, dated January 6, 2012 (Musillami Letter) at 2, 5.

complete these surveys before it can submit any relevant amended permit applications to U.S. Fish and Wildlife Service (FWS), California Department of Fish and Game (CDFG), State Water Resources Control Board (SWRCB), and U.S. Army Corps of Engineers (USACE).

3. Detailed Engineering Required for Permit Review by Many Federal and State Agencies [J. Leung]

Based on SCE's experience to date, many resource agencies with jurisdiction over the Project will not review any Project permit applications until SCE completes not only the surveys but also detailed engineering. While SCE consults with these agencies early, before accepting SCE's application, the agencies require SCE to include precise calculations of the Project's potential environmental impacts based on detailed engineering. With respect to Segment 8A, resource agencies with jurisdiction over the Project that require detailed engineering to be completed potentially include, but are not limited to, (1) USACE; (2) CDFG; (3) the Federal Aviation Administration (FAA); (4) FWS; (5) SWRCB; and (6) the National Park Service (NPS).

Once detailed engineering is complete, SCE can analyze the scope of potential impacts and prepare the relevant applications. Accordingly, several agencies' review of the Project would not begin until after required surveys and detailed engineering is complete and the relevant applications are submitted.

B. Potential Regulatory Issues Common to All State Park Alternatives [C. Adamson]

There are several other issues that are common to many, if not all, of the State Park Alternatives. The following key issues may act as pacing items (depending on the outcome of several factors) with respect to the completion of any State Park Alternative. The following timelines do not include potential delays associated with litigation based on any stakeholders seeking to stop the Project from being routed through the CHSP:

1. State Parks Approvals [M. Murray]

As evaluated during the original proceeding, each of the State Park Alternatives require approvals from State Parks, including an amendment to the Chino Hills State Park Plan (CHSP

Plan).[31] The record in the original proceeding discusses the process for SCE to obtain the necessary approvals from State Parks, indicating that the entire process may take up to over a year before construction could begin in CHSP.[32] In addition, State Parks has recently issued a letter clarifying the process and timeline.[33]

In summary, seeking an amendment to the CHSP Plan would take at least a year.[34] In testimony before the Commission, State Parks estimated that amending the Anza Borrego Desert State Park General Plan to accommodate San Diego Gas & Electric's (SDG&E) Sunrise Powerlink Project would require a process lasting approximately eight to twelve months, if not longer.[35] Due to staff reduction, State Parks is now estimating that it would take 12 to 18 months, if not longer, to complete a plan amendment.[36]

The process would begin after the Commission selects a route for the Project that passes through CHSP. First, SCE must pass a pre-application process consisting of an application for a Right of Entry (ROE) permit and review by the State Parks Planning Policy and Programming Committee (PPPC) of whether the Project is consistent with the CHSP Plan. If the PPPC determines that the Project is inconsistent with the CHSP Plan—which would likely be the case for a project of this magnitude within the Park boundaries—SCE must make a written request to initiate the amendment process.[37]

The actual planning process itself consists of several additional steps. SCE must submit proposals, environmental documents, and any supplemental information to State Parks for

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[31] In a comment letter to the Draft EIR/EIS dated April 3, 2009, State Parks outlined the plan amendment process, initially estimating that it would take 8 to 15 months—and possibly longer—to complete a plan amendment. *See* Attachment A, Department of Parks and Recreation Comment Letter to Draft EIS dated April 3, 2009 (Department of Parks and Recreation Letter), *see also* Final EIR at H.A-60.

[32] *See* Adamson, Ex. SCE-04 at 32:12-14.

[33] *See* Attachment C, Musillami Letter.

[34] *See* Adamson, Ex. SCE-04 at 31:20-21.

[35] *See* Adamson, Ex. SCE-04 at 31:21 to 32:2 and Ex. H thereto at 2:1-3; D.08-12-058 at 207.

[36] *See* Attachment C, Musillami Letter at 2.

[37] *Id.* at 2.

consideration. SCE and State Parks would develop a Project Agreement, likely in the form of a Memorandum of Understanding between State Parks and SCE, and the State Parks project team would draft a proposed general plan amendment. Consultation with other agencies, such as CDFG, FWS, and the Native American Heritage Commission, would also occur at this stage. In addition, public review and comment would occur, tied to any public review requirements under CEQA, and, if applicable, the National Environmental Policy Act (NEPA). State Parks estimates that it would take 8 to 12 months to complete these pre-application and planning steps.

Getting through the General Plan amendment process does not ensure success because any amendment would need to be voted on by the State Parks Commissioners, which may ultimately decide to deny the petition.[38] The Commission must approve the route, and SCE must complete all required environmental consultations before the State Parks Commissioners would vote on an amendment. As observed by the State Park Foundation in its Reply Brief to Chino Hills' Petition to Modify, "[p]otential amendments to the [CHSP Plan] still have no certainty."[39] In addition, State Parks staff has met with Commissioner Peevey to speak about the importance of protecting CHSP from utility infrastructure placement.[40] State Parks estimates that it would take four to six months for the State Parks Commissioners to make a determination.

In the event that the proposed plan amendment is approved by the State Parks Commission, State Parks must then issue a ROE permit to SCE before construction could begin. The process for acquiring a ROE permit from State Parks is approximately 60 days.[41] Before the ROE permit can be issued, however, SCE must satisfy the requirements of the federal Land and Water Conservation Fund (LWCF), through which State Parks obtained much of the funding to

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[38] Adamson, Ex. SCE-04 at 32:3-6.

[39] State Park Foundation Reply Brief at 3. The State Park Foundation first raised this concern in its comments to the Draft EIR/EIS, dated April 6, 2009, stating that each of the State Park Alternatives were inconsistent with the CHSP Plan, and that approval by the State Parks Commission was uncertain. *See* Attachment B, California State Parks Foundation Comment Letter to Draft EIS dated April 6, 2009 (State Parks Foundation Letter), *see also* Final EIR at H.B-63 to H.B-64.

[40] *See* Attachment D, California Department of Parks and Recreation Notice of Ex Parte Communication at 2.

[41] *See* Attachment C, Musillami Letter at 5.

acquire the CHSP.[42] Under LWCF, the NPS requires a project applicant to obtain lands to offset any conversion of recreational lands purchased with federal funds with similar property of at least similar fair market value that can become part of the affected park.[43] Considering the amount of acreage of recreational lands that may be converted to utility use, it may take SCE substantial time to obtain suitable lands in the vicinity of CHSP to offset TRTP-related impacts and meet federal conversion requirements. Both federal law and individual LWCF agreements contain restrictions on the conversion of LWCF lands.[44] Thus, even if State Parks approves a plan amendment, the NPS must also approve the conversion. This process triggers review under NEPA, and typically would require, at a minimum, an Environmental Assessment. A federal appraisal process would also be conducted to determine fair market value and ensure that the property proposed for replacement is of equivalent value, in addition to being of reasonably equivalent usefulness and location as that being converted.[45] It is estimated that the process of obtaining NPS approval is approximately 12 to 24 months. State Parks would not allow SCE to start construction until these lands are obtained and approved by both the NPS and CHSP.[46] In total, SCE expects the entire process of obtaining permission to build in CHSP to take at least two to four years (and likely more) before construction could begin.

2. Endangered Species Act [J. Leung]

SCE received a Biological Opinion (BiOp) from the FWS on July 31, 2010, under the Endangered Species Act (ESA). Unlike CEQA, the ESA does not require the FWS to consider alternatives to a proposed project if the proposed project would not result in jeopardy to a federally-listed species. Accordingly, while the BiOp addresses the Project route as approved by the Commission, the BiOp does *not* analyze any of the State Park Alternatives. Many of the State Park Alternatives (including but not limited to Alternative 4CM) potentially would impact

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[42] *Id*. at 4.

[43] 36 C.F.R. § 59.3(b)(9).

[44] *See* Attachment E, Sample Land and Water Conservation Fund Agreement (LWCF Agreement).

[45] 36 C.F.R. § 59.3.

[46] *See* Attachment C, Musillami Letter at 4.

several federally-listed species, including the California gnatcatcher, the least Bell's vireo, and the southwestern willow flycatcher. Additionally, Alternative 4C and 4CM would impact designated critical habitat for California gnatcatcher.[47] Constructing the State Park Alternatives likely would require SCE to reinitiate consultation with the FWS to address these potential impacts.

Under a best case scenario, where the Angeles National Forest (ANF) would maintain jurisdiction over the entire Project for ESA purposes, reinitiation of consultation under Section 7 would take 12 to 24 months.[48] In light of the distance between the ANF boundary and the Alternative 4 routes, however, the ANF may decide to not retain jurisdiction over this portion of the Project for the purpose of reinitiating consultation. Under this worst case scenario, SCE could obtain take authorization only by preparing a Habitat Conservation Plan (HCP) for the FWS and navigating the ESA Section 10 process, which could take as long as three years to complete.

3. Clean Water Act Permitting [J. Leung]

Section 404 of the Clean Water Act (CWA) requires SCE to obtain authorizations from the USACE for discharges into waters of the United States.[49] There are two ways a project applicant may obtain authorization from the USACE: (1) an authorization from the USACE under a General Permit, typically a Nationwide Permit (NWP) if the impacts to jurisdictional waters are minimal (usually less than 0.5 acre permanent impacts per crossing) and meet the

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[47] Specifically, Alternative 4C would traverse approximately 1.9 linear miles in designated critical habitat. Alternative 4CM would traverse approximately 1.1 linear miles in designated critical habitat.

[48] SCE acknowledges that there is a shorter time frame outlined within the ESA regulations. *See, e.g.,* 50 C.F.R. § 402.14. Based on SCE's recent experience on major transmission lines (including TRTP), SCE has found that the Section 7 consultations often exceed the regulatory time limits.

[49] *See* 33 U.S.C. § 1344.

NWP conditions; and (2) an Individual Permit (IP) for projects resulting in 0.5 acre or more permanent impacts or whenever the District Engineer determines an IP to be necessary.[50]

While a NWP authorization does not require additional review under NEPA because such review has already been completed programmatically, issuance of an IP does require NEPA review. Regardless of whether the USACE issues an authorization under a NWP or issues an IP, SCE must also obtain a Water Quality Certification (WQC) pursuant to Section 401 of the CWA from the SWRCB before the USACE can issue its authorization.[51] Each of the State Park Alternatives would require amended CWA permits and a WQC from both the USACE and the SWRCB, respectively. Whether SCE needs an authorization under a NWP or an IP varies depending on the State Park Alternative, as outlined below. The process for obtaining a WQC from the SWRCB generally takes 5 to 12 months and the process for obtaining a NWP authorization is approximately 6 months and an IP generally takes between 14 and 24 months.[52]

4. California Endangered Species Act [J. Leung]

SCE received an incidental take permit (ITP) issued by CDFG on November 15, 2010, under the California Endangered Species Act (CESA) Section 2081. Unlike CEQA, CESA does not require the CDFG to consider alternatives to a proposed project. While the ITP addresses the Project route as approved by the Commission, the ITP does *not* analyze any of the Alternative 4 routes. The Alternative 4 routes (including Alternative 4CM) may potentially impact several state listed species, including the least Bell's vireo and the willow flycatcher. Constructing the Alternative 4 routes would likely require additional consultation with CDFG to address these potential impacts. An amendment to the ITP can take 3 to 10 months to complete assuming a new ITP is not required.

C. State Park Alternatives Reviewed During Proceeding [C. Adamson]

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[50] *See* 33 U.S.C. § 1344(e); 33 C.F.R. pt. 330.1(d); *Id.* pt. 325 (Individual Permits). *See also infra*, Section IV.C.3.c. (discussing IP's Least Environmentally Damaging Practicable Alternative requirement).

[51] *See* 33 U.S.C. § 1341; Cal. Water Code § 13160.

[52] *See* Attachment F, Consolidated Project Schedules at Alternatives 4A through 4D.

The State Park Alternatives (Alternatives 4A, 4B, 4C, 4CM, and 4D) were described and evaluated in the Final EIR, and this testimony will not restate what was contained in the Final EIR. It will briefly describe each alternative for reference, and then provide current information on feasibility, cost and schedule based on SCE's experience since the Commission approved TRTP.

All of the State Park Alternatives diverge from the approved TRTP route at Segment 8A, Mile Post 19.2. Each one then follows the existing double-circuit Mira Loma – Walnut/Olinda 220 kV line to near the boundary of CHSP. The State Park Alternatives then take different paths to the various proposed switching station sites where they terminate at the switching station. The various versions also require various amounts of construction and relocation of the existing Mira Loma-Serrano and Rancho Vista-Serrano 500 kV lines to connect them into the switching station. In addition, Alternatives 4C and 4CM re-route the existing double-circuit Mira Loma – Walnut/Olinda 220 kV line to the north around the switching station.

The following testimony presents a short description of each alternative, and an assessment of the technical feasibility, cost, regulatory approvals, and potential timing.

1. Alternative 4A

a. Description [C. Adamson]

Starting at Mile Post 19.2, SCE would construct the new Mira Loma-Vincent 500 kV transmission line turning southeast, remaining parallel and south of the existing Mira Loma – Walnut/Olinda 220 kV double-circuit transmission line for approximately 6.2 miles, traversing Los Angeles, Orange, and San Bernardino Counties.[53]

Along this route, the new double-circuit 500 kV infrastructure would travel through approximately 2.3 miles of CHSP, where SCE will have to acquire approximately 150 feet of new ROW to accommodate the new 500 kV double-circuit structures.[54] At the junction of the existing Mira Loma – Walnut/Olinda 220 kV transmission lines and the existing Mira Loma –

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[53] The Final EIR undertook a thorough discussion of Alternative 4A. *See* Final EIR at 2-79 to 2-83; Figure 2.4-1.

[54] *See* Final EIR at 2-79.

Serrano and Rancho Vista – Serrano 500 kV transmission lines, the new Mira Loma-Vincent 500 kV transmission line would terminate into a new 500 kV gas-insulated switching station, located on four to five acres within CHSP. The switching station would be approximately 42-feet high and the dead-end structures on either side of the building would be approximately 65-feet high.[55]

New permanent access and spur roads would be required to access the transmission structures and switching station within CHSP constructed as part of Alternative 4A. Additionally, construction of the switching station would require substantial cut and fill as the area identified for the switching station consists mostly of steep hilly terrain.

Alternative 4A would also necessitate the installation of a bridge or box culvert over potentially jurisdictional waters located in the proximity of Telegraph Canyon, which may require an IP from the USACE to comply with the CWA.

From Mile Post 19.2 to the new switching station in the CHSP (6.2 miles), approximately 21 new double-circuit 500 kV structures would be required, of which approximately 8 to 10 structures would be located within CHSP.[56] A map of Alternative 4A is included in Attachment G.[57]

b. Engineering and Technical Feasibility [R. Vazquez][58]

It is unknown whether Alternative 4A would be technically feasible from an engineering standpoint due to the potential instability of the switching station site. The area of the switching station site appears to have suffered past landslides. SCE would have to undertake a thorough

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[55] *See id*. at 2-80.

[56] *See id.*

[57] *See* Attachment G, Consolidated Map Figures at Figures M-3a and M-3b.

[58] The "Engineering and Technical Feasibility" analysis of this testimony addresses the engineering feasibility of each of these alternatives and options taking into consideration a number of factors. An alternative or option that is not considered feasible from an engineering or technical perspective does not mean that constructing that alternative is impossible, but rather is difficult or presents novel engineering, maintenance, or operational issues that introduces an unacceptable level of risk to the completion and operation of the Project. Likewise, this analysis is not intended to analyze the feasibility of each alternative or option as defined by CEQA. *Compare* CEQA Guidelines § 15364.

geotechnical investigation to determine if the underlying ground is stable or if it could be stabilized using reasonable measures.

Also, the access road for this switching station site would need to be improved from its current trail-like state to a paved, all-weather road. Access would also necessitate crossing a riparian area with a bridge or box culvert.

c. Regulatory Issues [J. Leung]

In addition to the general regulatory considerations outlined in Section IV.B, Alternative 4A may require an IP from the USACE to satisfy the CWA due to the waterway crossing that would require the construction of a bridge or box culvert potentially exceeding greater than 0.5 acres of permanent impact at the crossing.[59]

d. Timing [C. Adamson]

The schedule for Alternative 4A is provided in Attachment F.[60] Assuming that: (1) no supplemental CEQA review is required; (2) the CHSP Plan can be amended in approximately 18 months; (3) an IP would be needed to comply the CWA; and (4) the ANF will reinitiate consultation under the ESA pursuant to Section 7, the best-case schedule for this alternative would place Segment 8 of TRTP in-service in March of 2018. This best case scenario does *not* include the time necessary to obtain NPS approvals for conversion of CHSP lands pursuant to the LWCF, which will take at least 12 to 24 months to complete.[61]

e. Estimated Construction Costs [D. Heiss]

Alternative 4A would cost approximately an additional $343 million to construct.[62] An estimated $59 million of cost spent to date on Segment 8A would be abandoned.[63]

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[59] *See supra* Section IV.B.3. for comparison of IP and NWP. *See also infra* Section IV.C.3.c. (discussing IP Least Environmentally Damaging Practicable Alternative).

[60] *See* Attachment F, Consolidated Project Schedules at Alternative 4A Theoretical Best Case, Alternative 4A Best Case, and Alternative 4A Worst Case.

[61] This additional time is not included in each of the Alternative 4 routes, because SCE received notice of this potential requirement on Friday, January 6. *See* Attachment C, Musillami Letter at 4 to 5. This requirement may apply to all of the State Park Alternatives. *Id.*

[62] *See supra* Table 1, Estimated Costs.

[63] *See id.*

f. **Potential Costs Associated with Lost Renewable Generation [M. Ulrich]**

There would be an estimated cost of $448 to $585 million in lost renewable generation due to the projected delay associated with permitting and constructing Alternative 4A.[64]

2. **Alternative 4B**

a. **Description [C. Adamson]**

Alternative 4B is a refinement to the Chino Hills Alternative 4A, with the primary difference of locating the switching station on the east side of CHSP, rather than in the middle of CHSP.[65] Like Alternative 4A, Alternative 4B would deviate from the Approved Project beginning at Mile Post 19.2, at which point the new Mira Loma-Vincent 500 kV transmission line would turn southeast, remaining parallel and north of the existing Mira Loma – Walnut/Olinda 220 kV double-circuit transmission line for approximately 4.2 miles, traversing Los Angeles, Orange, and San Bernardino Counties. Alternative 4B would then enter CHSP, continuing to parallel the existing 220 kV double-circuit transmission line for approximately 4.9 miles, at which point the new Mira Loma-Vincent 500 kV transmission line would exit the east side of the CHSP. The new transmission line would continue parallel to the existing 220 kV double-circuit transmission line for another approximately 0.6 mile outside of CHSP before turning south, crossing the existing transmission lines, to terminate at a new 500 kV gas-insulated switching station located on 4 to 5 acres just south of the existing 500 kV transmission lines. The switching station would be constructed similar to the switching station described in Alternative 4A.

Approximately 150 feet of additional ROW would be required to accommodate the new 500 kV double-circuit structures along the 9.7-mile re-route associated with Alternative 4B.[66]

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[64] *See supra* Table 7, Potential Costs Associated with Renewable Electricity Generation.

[65] The Final EIR undertook a thorough discussion of Alternative 4B starting at page 2-83. A map of Alternative 4B can be found in the Final EIR, Figure 2.4-2 and also in Attachment G, Consolidated Map Figures at Figures M-4a and M-4b.

[66] *See* Final EIR at 2-84.

New permanent access and spur roads would be required to access the transmission structures and switching station.

From the point of deviation (S8A MP 19.2) to the new switching station, approximately 37 new double-circuit 500 kV structures would be required, of which approximately 18 to 21 structures would be within CHSP.[67] A map of Alternative 4B is included in Attachment G.[68]

b. Engineering and Technical Feasibility [R. Vazquez]

It is unknown at this time whether Alternative 4B would be technically feasible from an engineering standpoint, and whether the switching station site is stable and can be reliably developed. The area of the switching station site appears to be hilly, but not as hilly as the switching station sites proposed for Alternatives 4A, 4C or 4CM. SCE would be required to undertake a thorough geotechnical investigation to determine if the underlying ground is stable or if it could be stabilized using reasonable measures.

The access road for this switching station site would need to be improved from its current trail-like state to a paved, all-weather road. This alternative would require the shortest new paved road to the switching station.

c. Regulatory Issues [J. Leung]

Alternative B has no unique regulatory concerns other than the common issues outlined above in Section IV.B.[69]

d. Timing [C. Adamson]

The schedule for Alternative 4B is provided in Attachment F.[70] Assuming that (1) no supplemental CEQA review is required; (2) the CHSP Plan can be amended in approximately 18 months; (3) an authorization under a NWP from the USACE would be sufficient to comply with the CWA; and (4) the ANF will reinitiate consultation under the ESA pursuant to Section 7, the

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[67] *See id.*

[68] *See* Attachment G, Consolidated Map Figures at Figures M-4a and M-4b.

[69] *See supra* at Section IV.B., Potential Issues Common to All State Park Alternatives.

[70] *See* Attachment F, Consolidated Project Schedules at Alternative 4B Theoretical Best Case, Alternative 4B Best Case, and Alternative 4B Worst Case.

best-case schedule for Alternative 4B would place Segment 8 of TRTP in-service in September of 2017. This best case scenario does *not* include the time necessary to obtain NPS approvals for conversion of CHSP lands pursuant to the LWCF, which will take at least 12 to 24 months to complete.[71]

e. Estimated Construction Costs [D. Heiss]

Alternative 4B would cost an additional $339 million to construct.[72] $59 million of cost spent to date on the approved project would be abandoned.[73]

f. Potential Costs Associated with Lost Renewable Generation [M. Ulrich]

There would be an estimated cost of $311 to $488 million in lost renewable generation due to the projected delay associated with permitting and constructing Alternative 4B.[74]

3. Alternative 4C

a. Description [C. Adamson]

Alternative 4C is a refinement to the Chino Hills Alternative 4A, modified to circumvent Raptor Ridge and to locate the switching station just outside the northern boundary of CHSP.[75] Like Alternatives 4A and 4B, Alternative 4C would deviate from the proposed Project at Mile Post 19.2, where the new Mira Loma-Vincent 500 kV transmission line would turn southeast, and remain parallel and south of the existing Mira Loma – Walnut/Olinda 220 kV double-circuit transmission line up to CHSP boundary (approximately 4.2 miles). Along this portion of the alignment, approximately 150 feet of new ROW would be required to accommodate the new 500 kV double-circuit structures.

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[71] *See* Attachment C, Musillami Letter at 4 to 5.

[72] *See supra* Table 1, Estimated Costs.

[73] *Id.*

[74] *See supra* Table 7, Potential Costs Associated with Renewable Electricity Generation.

[75] The Final EIR undertook a thorough discussion of Alternative 4C starting at page 2-88. A map of Alternative 4C can be found in the Final EIR, Figure 2.4-3, and also in Attachment G, Consolidated Map Figures at Figures M-5a and M-5b.

At the boundary of CHSP, Alternative 4C would turn east along a new approximately 300-foot-wide ROW for approximately 1.5 miles, remaining just north of CHSP boundary, to a new 500 kV gas-insulated switching station located on approximately 6.2 acres.[76] Approximately 19 double-circuit 500 kV structures would be required for this approximately 5.7-mile re-route to the new switching station.[77] The switching station would be constructed similar to the switching station described in Alternative 4A, and would require substantial cut and fill as the area identified for the switching station consists mostly of steep hilly terrain. New permanent access and spur roads would be required to access the transmission structures and switching station constructed as part of this alternative. The area of the switching station site appears to be hilly, and stability is unknown.

Upon exiting the east side of the switching station, Alternative 4C would require approximately 3.6 miles of new ROW to re-route the existing single-circuit 500 kV transmission lines in and out of the new switching station. This new ROW would be between 330 and 480 feet wide to support approximately 30 new single-circuit 500 kV structures, approximately 25 of which would be placed within CHSP. Alternative 4C would also re-route a portion of the existing 220 kV transmission line within CHSP to parallel the new 500 kV double-circuit structures along the northern boundary of CHSP to the switching station. To complete the re-route, approximately 17 new double-circuit 220 kV structures would be required (with approximately 5 to 7 new structures within CHSP), and approximately 14 existing 220 kV double-circuit structures would be removed (including approximately 12 removed from CHSP). A map of Alternative 4C is included in Attachment G.[78]

b. Engineering and Technical Feasibility [R. Vazquez]

It is not known whether Alternative 4C would be technically feasible due to the potential instability of the switching station site. The area of the switching station site appears to be hilly, and stability is unknown. SCE must complete a thorough geotechnical investigation to

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[76] *See* Final EIR at 2-88 to 2-89 (Description of Chino Hills Route C Alternative).

[77] *See id.* at 2-94.

[78] *See* Attachment G, Consolidated Map Figures at Figures M-5a and M-5b.

determine if the underlying ground is stable or if it could be stabilized using reasonable measures. Although not on the Aerojet Property, the areas of the switching station and access roads are within the Department of Toxic Substances Control (DTSC) jurisdiction. Therefore DTSC clearance is required before the geotechnical investigation can take place.

Also, the access road for this switching station site would need to be improved from its current trail-like state to a paved, all-weather road. This alternative would require a long road through additional land owned by other property owners.

c. Regulatory Issues [J. Leung]

The potential delays associated with Alternative 4C from regulatory issues are consistent with the issues raised by Alternative 4CM.[79] The potential delay associated with Alternative 4CM was thoroughly examined during the original proceeding in 2009, and discussed in the Commission's Decision approving TRTP.[80]

DTSC Approvals: In the 2009 CPCN Decision, the Commission acknowledged the risk for delay associated with DTSC review and approval of Alternative 4CM, and the same risk exists for Alternative 4C as well. Both of these Alternatives involve placing TRTP infrastructure Aerojet Property and a private land owned by a second party that from approximately 1954 to 1995 had been used for research and development of explosives, and for loading, assembling, and testing of ordnance for the U.S. Department of Defense. Per a 1994 Consent Agreement, DTSC is currently supervising the Aerojet Property under the federal Resource Conservation and Recovery Act (RCRA) for the cleanup of explosive chemicals, perchlorate, uranium, and ordnance. Because the areas proposed for Project access roads, transmission towers, and the Alternative 4C and 4CM switching station sites could be subject to further corrective action, SCE would have to work with DTSC and Aerojet to obtain the necessary regulatory and private permissions to proceed with either route. Obtaining these permissions could significantly delay completion of TRTP.

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[79] *See* discussion *infra* at Section IV.C., State Park Alternatives Reviewed During Proceeding, subsection 4, Alternative 4CM.

[80] *See* D.09-12-044 at 60-62.

In the original proceeding, Aerojet estimated that navigating the DTSC approval process could take at least two years, and possibly longer, depending on whether additional munitions and explosives of concern (MEC) were found on the property.[81] Although Aerojet has implemented a substantial portion of the corrective measures imposed, there are numerous areas of the Aerojet Property with gaps in data about the presence of MEC. In the two years since the Commission approved TRTP, the only action DTSC has taken is approving the Data Gap Investigation Report in January 2010 and approving Aerojet's Corrective Measures Study Workplan in July 2011.[82] Because neither DTSC nor Aerojet has made any significant progress toward filling the data gaps or completing remediation of the Aerojet Property, Aerojet's initial two year estimate is still accurate to SCE's knowledge.

Under a best case scenario, there remains the chance that DTSC could remove from the RCRA facility that portion of the Aerojet Property that SCE would use for transmission infrastructure and access roads for Alternatives 4C and 4CM. As detailed in the original proceeding, it would take SCE at least 12 months to obtain this "carve out."[83] While this best case scenario assumes that no MEC remain on the Aerojet Property, DTSC has not definitively resolved this issue. The 12-month estimate does not include the time required to implement any additional corrective measures in the carve-out area should DTSC determine that further corrective measures are required. Additionally, during the original proceedings, Aerojet submitted a letter from DTSC acknowledging that unknown contingencies, such as the discovery of MEC or additional contaminants, could delay the project by weeks or months.[84]

Finally, prior to seeking DTSC approval, SCE would first need to negotiate for, and possibly condemn, the land for the switching station for Alternative 4C or 4CM. Access negotiations could add an additional 7 to 15 months to the process.

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[81] *See* Supplemental Testimony of Scott Goulart, Aerojet-03 at 4.

[82] A summary of the Aerojet Corrective Action can be found on the DTSC EnviroStor database at http://www.envirostor.dtsc.ca.gov/public/profile_report.asp?global_id=80001476.

[83] *See* Supplemental Testimony of Scott Goulart, Aerojet-03 at 4 to 5.

[84] *See* Letter from Robert Romero to Doug LaBelle, Aerojet-01 at Exhibit 3.

The estimated cost associated with clearing any potential munitions is unknown until such time a full remediation analysis can be completed. Accordingly, these potential costs are not included in the cost estimates presented herein.

Clean Water Act: Because Alternative 4C would likely disturb more than 0.5 acres of Waters of the United States, largely due to the civil work needed to prepare the switching station site, SCE likely would need to obtain an IP from the USACE. Issuing an IP would likely require supplemental NEPA review. Importantly, CWA regulations require the USACE to examine the Least Environmentally Damaging Practicable Alternative (LEDPA). The USACE is prohibited from issuing an IP if there is a practicable alternative that would have less adverse impact on the aquatic ecosystem (including alternatives that do not require the discharge to Waters of the United States).[85] The likely overall timeframe for USACE's evaluation of the IP application would be approximately 14 to 24 months for Alternative 4C. It is important to note that the USACE may determine that an alternative other than Alternative 4C is the LEDPA, and therefore would be prohibited from issuing an IP for Alternative 4C.

Endangered Species Act: Alternative 4C likely would require reinitiation of consultation because of its potential impacts on listed species, as discussed above.[86] In particular, the Alternative 4C route would traverse designated critical habitat for the California gnatcatcher, and potentially impact riparian areas with suitable habitat for the least Bell's vireo and the Southwestern willow flycatcher.

d. Timing [C. Adamson]

The schedule for Alternative 4C is provided as Attachment F.[87] Assuming that (1) no supplemental CEQA review is required; (2) the CHSP Plan can be amended in approximately 18 months; (3) an IP is needed to comply the CWA; and (4) the ANF will reinitiate consultation

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[85] *See* 40 C.F.R. § 230.10 (Guidelines for Specification of Disposal Sites for Dredged or Fill Material, Restrictions on Discharge).

[86] *See supra* at Section IV.B., Potential Issues Common to All State Park Alternatives, subsection 2, Endangered Species Act.

[87] *See* Attachment F, Consolidated Project Schedules at Alternative 4C Theoretical Best Case, Alternative 4C Best Case, Alternative 4C Worst Case.

under the ESA pursuant to Section 7, the best-case schedule for this alternative would place Segment 8 of TRTP in-service in May 2019. This best case scenario does *not* include the time necessary to obtain NPS approvals for conversion of CHSP lands pursuant to the LWCF, which will take at least 12 to 24 months to complete.[88]

e. Estimated Construction Costs [D. Heiss]

Alternative 4C would cost an additional $420 million to construct. $59 million of cost spent to date on the Approved Project would be abandoned.[89]

f. Potential Costs Associated with Lost Renewable Generation [M. Ulrich]

There would be an estimated cost of $585 million to $1.4 billion in lost renewable generation due to the projected delay associated with permitting and constructing Alternative 4C.[90]

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88 Attachment C, Musillami Letter at 4 to 5.

89 *See supra* Table 1, Estimated Costs.

90 *See supra* Table 7, Potential Costs Associated with Renewable Electricity Generation.

4. Alternative 4CM

a. Description [C. Adamson]

Alternative 4CM is similar to Alternative 4C.[91] However, in Alternative 4CM the switching station and 500 kV transmission line relocation locations are moved, placing the switching station approximately 2,500 feet northwest of the location described for the original Alternative 4C.[92] This moves the switching station onto property owned by Aerojet, and would require constructing a longer access road across Aerojet Property to access the switching station, creating an even larger footprint for the Project on Aerojet Property and implicating greater MEC concerns. Re-routing of the existing single-circuit 500 kV towers in CHSP to the new switching station would require utilizing double-circuit 500 kV towers.

The Alternative 4CM switching station location would be approximately 6.2 acres in size and be located on an easterly facing slope angled approximately 12-20 degrees. Due to the presence of unsupported siltstone, shale beds, and incised drainage features, the area is highly prone to landslides.

To transfer construction materials to the site, SCE would need to improve approximately 3.6 miles of existing access road on Aerojet Property, and construct approximately 0.3 miles of new access road to reach the switching station site. Widening the existing access road implicates the same landslide concerns, and as noted above, a longer access road on Aerojet Property implicates greater MEC concerns.

In order to maintain the Lugo/Mira Loma-Serrano connections, a new 500 kV double-circuit transmission line accommodating both of the existing 500 kV single-circuit transmission lines would be connected through the new switching station. In total, the 500 kV re-routes include approximately 3.7 miles of new 500 kV double-circuit structures, 3.0 miles of which would be within CHSP; and 3.3 miles of new ROW. Approximately 0.4 miles of the

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[91] The Final EIR undertook a thorough discussion of Alternative 4CM starting at 2-90. *See* Final EIR at 2-90 to 2-96. A map of Alternative 4CM can be found in the Final EIR, Figure 2.4-3a and also in Attachment G, Consolidated Map Figures at Figures M-6a and M-6b.

[92] *See* Final EIR at 2-90 to 2-92.

transmission lines would be located in common new ROW. A map of Alternative 4CM is included in Attachment G.[93]

b. Engineering and Technical Feasibility [R. Vazquez]

Alternative 4CM likely is not technically feasible based on available information indicating that the switching station site is geologically unstable and therefore cannot be reasonably developed. The area of the switching station site is on a steep hill, and its stability is questionable at best based on surface observations.[94] A thorough geotechnical investigation would be required to determine if the underlying ground could be stabilized using reasonable measures. The switching station would require level area about four times the size of a football field. Excessive grading would be required to level and prepare the switching station site, which would take over a year to complete. SCE approximates that three quarters of a million cubic yards of soil would need to be removed to complete this grading work, which would fill up a football stadium.

The switching station site and access roads are on Aerojet Property and under DTSC jurisdiction. Therefore, DTSC clearance would be required before the geotechnical investigation can take place, which would add significant delay to the schedule. During the course of such geotechnical investigations and subsequent grading, because of the property's past history, SCE's exposure and liability due to contamination from exploded and unexploded ordinances make this site impractical to develop, even more so than the other Alternative 4 switching station sites.

Also, the 3.6 mile-access road needed to access this switching station site would need to be significantly improved from its current trail-like state to a paved all-weather road suitable for heavy construction equipment. The access road work would also require substantial grading, which would also take several months to complete.

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[93] *See* Attachment G, Consolidated Map Figures at Figures M-6a and M-6b.

[94] Evidence supporting the geological issues related to Alternative 4CM's switching station site was considered by the Commission in the original proceedings. *See* Testimony of Jack Collendar, SCE-04 at 28-29.

c. Regulatory Issues [J. Leung]

Alternative 4CM has the same substantial permitting concerns as Alternative 4C, which are discussed above.[95]

d. Timing [C. Adamson]

The schedule for Alternative 4CM is provided as Attachment F.[96] Assuming that: (1) no supplemental CEQA review is required; (2) the CHSP Plan can be amended in approximately 18 months; (3) an IP is needed to comply the CWA; and (4) the ANF will reinitiate consultation under the ESA pursuant to Section 7, the best-case schedule for this alternative would place Segment 8 of TRTP in service in May 2019. This best case scenario does *not* include the time necessary to obtain NPS approvals for conversion of CHSP lands pursuant to the LWCF, which will take at least 12 to 24 months to complete.[97]

e. Estimated Construction Costs [D. Heiss]

Alternative 4CM would cost an additional $494 million to construct. $59 million of cost spent to date on the Approved Project would be abandoned.[98]

f. Potential Costs Associated with Lost Renewable Generation [M. Ulrich]

There would be an estimated cost of $585 million to $1.4 billion in lost renewable generation due to the projected delay associated with permitting and constructing Alternative 4CM.[99]

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[95] *See supra* at Section IV.C., State Park Alternatives Reviewed During Proceeding, subsection 3, Alternative 4C.

[96] *See* Attachment F, Consolidated Project Schedules at Alternative 4CM Theoretical Best Case, Alternative 4CM Best Case, Alternative 4CM Worst Case.

[97] Attachment C, Musillami Letter, at 4 to 5.

[98] *See supra* Table 1, Estimated Costs.

[99] *See supra* Table 7, Potential Costs Associated with Renewable Electricity Generation.

5. Alternative 4D

a. Description [C. Adamson]

Alternative 4D is a refinement to the Chino Hills Alternative 4A, with the primary difference of routing the new double-circuit 500 kV transmission line just outside the northern and western edges of CHSP and locating the new switching station outside the eastern edge of CHSP.[100] Like Alternatives 4A, 4B, 4C and 4CM, Alternative 4D would deviate from the proposed Project beginning at Mile Post 19.2, where the new Mira Loma-Vincent 500 kV transmission line would turn southeast, remaining parallel and north of the existing Mira Loma – Walnut/Olinda 220 kV double-circuit transmission line for approximately 4.2 miles, up to CHSP boundary. Along this portion of the alignment, SCE would need to obtain approximately 150 feet of additional ROW.

Upon nearing CHSP boundary, the new Mira Loma-Vincent 500 kV transmission line would turn east within a new 200-foot wide ROW and follow the northern boundary of CHSP for approximately 3.7 miles to just east of Bane Canyon. At this point, Alternative 4D's alignment would turn southeast, traversing the northeast corner of CHSP for approximately 1.4 miles through new ROW in CHSP. After exiting CHSP, the new 500 kV transmission line would turn northeast, again parallel and north of the existing transmission line for approximately 0.5 mile, before terminating at a new 500 kV gas-insulated switching station located on 4 to 5 acres outside of CHSP. The switching station would be very similar to that described in Alternative 4A.[101]

New permanent access and spur roads would be required to access the transmission structures and switching station. For the approximately 9.8 mile re-route, approximately 47 new double-circuit 500 kV structures would be required, of which approximately 5 to 8 would be

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[100] The Final EIR undertook a thorough discussion of Alternative 4D starting at 2-96. *See* Final EIR at 2-96 to 2-100. A map of Alternative 4D can be found in the Final EIR, Figure 2.4-4, and also in Attachment G at Figures M-7a and M-7b.

[101] *See supra* at Section IV.C., State Park Alternatives Reviewed During Proceeding, subsection 1, Alternative 4A.

within the northeast corner of CHSP.[102] A map of Alternative 4D is included in Attachment G.[103]

b. Engineering and Technical Feasibility [R. Vazquez]

It is unknown at this time whether Alternative 4D would be technically feasible from an engineering standpoint, and if the switching station site is stable and can be reliably developed. The area of the switching station site appears to be hilly, but not as hilly as the switching station site proposed for Alternatives 4A, 4C or 4CM. SCE would be required to undertake a thorough geotechnical investigation to determine if the underlying ground is stable or if it could be stabilized using reasonable measures. Also, the access road for this switching station site would need to be improved from its current trail-like state to a paved all-weather road. This alternative would require the shortest new paved road to the switching station of all other State Park Alternatives.

The transmission line in this alternative traverses the southern edge of the Aerojet Property and as a result will require DTSC clearance before construction work, including geotechnical investigation for final design, can occur. SCE believes the timing for this clearance could be shorter that for Alternative 4C and 4CM since Alternative 4D involves a smaller area with only the transmission structures and access road to "carve out" of the Aerojet RCRA site.

c. Regulatory Issues [J. Leung]

In addition to the common issues outlined above in Section III.B.[104] Alternative 4D also requires approvals from DTSC because it would require constructing approximately six transmission structures on the Aerojet Property. Because Alternative 4D would not require construction of a switching station or switching station access road on the Aerojet Property, the scope of potential infrastructure on the Aerojet Property is more limited than Alternatives 4C and 4CM

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[102] *See* Final EIR at 2-97 (Description of Chino Hills Route D Alternative).

[103] *See* Attachment G, Consolidated Map Figures at Figures M-7a and M-7b.

[104] *See supra* at Section IV.B., Potential Issues Common to All State Park Alternatives.

d. Timing [C. Adamson]

The schedule for Alternative 4D is provided in Attachment F.[105] Assuming that: (1) no supplemental CEQA review is required; (2) the CHSP Plan can be amended in approximately 18 months; (3) an authorization under a NWP from the USACE is sufficient for compliance with CWA; and (4) the ANF will reinitiate consultation under the ESA pursuant to Section 7, the best-case schedule for this alternative would place Segment 8 of TRTP in-service in September 2017. This best case scenario does *not* include the time necessary to obtain NPS approvals for conversion of CHSP lands pursuant to the LWCF, which will take at least 12 to 24 months to complete.[106]

e. Estimated Construction Costs [D. Heiss]

Alternative 4D would cost an additional $413 million to construct. $59 million of cost spent to date on the Approved Project would be abandoned.[107]

f. Potential Costs Associated with Lost Renewable Generation [M. Ulrich]

There would be an estimated cost of $311 to $996 million in lost renewable generation due to the projected delay associated with permitting and constructing Alternative 4D.[108]

V. OPTIONS AND ALTERNATIVE WITHIN CHINO HILLS

A. Common Regulatory Issues For Options and Alternatives Within Chino Hills [J. Leung]

There are several regulatory and permitting issues that are common to most, if not all, of the optional and alternative routes within Chino Hills.

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[105] *See* Attachment F, Consolidated Project Schedules at Alternative 4D Theoretical Best Case, Alternative 4D Best Case, Alternative 4D Worst Case.

[106] Attachment C, Musillami Letter, at 4 to 5.

[107] *See supra* Table 1, Estimated Costs.

[108] *See supra* Table 7, Potential Costs Associated with Renewable Electricity Generation.

Endangered Species Act: SCE received a BiOp from the FWS on July 31, 2010, for the Project route. Modifications to the engineering design or construction methodology likely would be consistent with the analysis in the BiOp.

California Endangered Species Act: SCE received an ITP issued by CDFG on November 15, 2010, under Section 2081 of CESA for the Project route. Modifications to the engineering design or construction methodology likely will not require an amendment to the ITP if the changes to impacts to listed species are consistent with the analysis in the ITP. However, if CDFG determines that impacts are not consistent with the ITP, the process to amend the ITP takes three to six months.

B. Overhead Options Utilizing Existing ROW Within SCE's ROW In Chino Hills

1. Option 1: Shorter Structures

a. Description [R. Vazquez]

Option 1 would use the existing ROW (the Approved Route) in Chino Hills. From Mile Post 22.7 to 26.4, the existing double-circuit 500 kV tubular steel poles (TSPs) within Chino Hills would be modified and made shorter.[109] SCE would lower their heights by modifying the bottom of the structures, reducing their maximum height of 198 feet to approximately 165 feet. Visual simulations of Option 1 are provided in Attachment I.[110]

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[109] *See* Attachment G, Consolidated Map Figures at Figures M-9a and M-9b; *see also* Attachment H, Overhead Structure Height Guide.

[110] *See* Attachment I, Consolidated Visual Simulations at V-20, V-25, V-30, and V-35. SCE commissioned visual simulations of the various Options for purposes of this testimony. Photographs were taken in December 2011 from KOPs selected to balance a diversity of issues, including having views that depict the scalar relationships between towers and nearby Chino Hills residences, having views that capture a sufficient portion of the alignment to provide an understanding of the effect of increasing the numbers of towers, and including views from different areas along the alignment. For purposes of comparison, the visual simulations of the Approved Project prepared for the Final EIR and the character photographs prepared for the PEA are also provided. The Option 1 visual simulations were created from photographs taken from KOP 8, KOP 9, KOP 10, and KOP 11, respectively. *See also* Attachment G, Consolidated Map Figures at Figure M-1 for an overview map marking the location of each of the KOPs for this response.

To comply with GO 95, however, SCE would be required to install an additional 12 TSPs in the Chino Hills ROW to maintain proper ground clearance for the conductors. The additional TSPs would be designed and fabricated by the manufacturer to be the shorter height. The Chino Hills' portion of Segment 8 would therefore have a total of 23 double-circuit 500 kV TSPs. A map of Option 1 is included in Attachment G.[111]

b. Engineering and Technical Feasibility [R. Vazquez]

SCE has already demonstrated the technical feasibility of constructing 500 kV double-circuit TSPs. Option 1 would modify or replace the already-fabricated bottom portions of the TSPs with shorter sections, requiring the complete disassembly of the structures within the ROW to gain access to the bottom portion of the structure. The disassembly would be accomplished by reversing the assembly process of the poles. The additional TSPs would be designed and fabricated by the manufacturer to be the shorter height.

c. Regulatory Issues [J. Leung]

Potential impacts to jurisdictional drainages for the additional TSPs would likely require amendments to the CWA Section 404 NWP authorization as impacts would be less than 0.5 permanent acres at each project crossing. In order to obtain an amendment to the Section 404 NWP authorization, SCE must submit a request for an amendment including engineering details, impact analysis and mitigation requirements to the USACE for review. The USACE would then review the request and issue the amendment in the form of a written letter. In addition, amendments to the Section 401 WQC and Streambed Alteration Agreement (SAA) would likely be required for the additional TSPs. The process for obtaining amendments to these permits from the applicable agencies takes approximately three to six months.

d. Timing [C. Adamson]

The schedule for Option 1 is provided in Attachment F.[112] The best-case schedule for this option would place Segment 8 of TRTP in service in November 2014.

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[111] *See* Attachment G, Consolidated Map Figures at Figures M-9a and M-9b.

[112] *See* Attachment F, Consolidated Project Schedules at Option 1 Best Case, Option 1 Worst Case.

e. Estimated Construction Costs [D. Heiss]

Option 1 would cost an additional $116 million to construct. $15 million of cost spent to date on the Approved Project would be abandoned.[113]

f. Potential Costs Associated with Lost Renewable Generation [M. Ulrich]

There would be an estimated cost of $10 to $87 million in lost renewable generation due to the projected delay associated with permitting and constructing Option 1.[114]

g. EMF Considerations [G. Sias]

SCE uses a computer program titled "MFields"[115] to model the magnetic field characteristics of various transmission designs options. All magnetic field models and the calculated results of magnetic field levels presented in this document are intended only for purposes of identifying the relative differences in magnetic field levels among various transmission line design alternatives under a specific set of modeling assumptions and determining whether particular design alternatives can achieve magnetic field level reductions of 15 percent or more. The calculated results are not intended to be predictors of the actual magnetic field levels at any given time or at any specific location if and when the project is constructed.

Typical two-dimensional magnetic field modeling assumptions applied throughout this document for the alternatives and options include:

- All transmission lines were modeled using forecasted peak loads presented in the Field Management Plan (FMP) filed in 2007. For options which loads were split among multiple conductors, load values were divided evenly and rounded accordingly.
- All conductors were assumed to be straight and infinitely long.
- Average conductor heights accounting for line sag were used in the calculation.

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113 *See supra* Table 1, Estimated Cost.

114 *See supra* Table 7, Potential Costs Associated with Renewable Electricity Generation.

115 SCE, MFields for Excel, Version 2.0, 2007.

- Magnetic field strength was calculated at a height of three feet above ground.
- Resultant magnetic fields values were presented in this testimony.
- All line currents were assumed to be balanced (i.e., neutral or ground currents are not considered).
- Terrain was assumed to be flat.
- Project dominant power flow directions were used.
- All calculations are based on preliminary engineering.

The calculated magnetic field values at both the north and south edges of the ROW for Option 1 are approximately 28.0 milliGauss (mG), which are approximately 104% of the calculated values of 27.0 mG presented in the 2007 FMP for the Project as constructed.[116] The reason that the change in calculated fields is small is due to the conservative assumptions used in the 2007 FMP calculations. While most structures were taller, the 2007 FMP used the minimum structure height of 150 feet in the magnetic field calculation for the Chino Hills area as stated in the FMP. Option 1 also has a minimum structure height of 150 feet but with 36.5 feet of minimum ground clearance compared to 39 feet used in the 2007 FMP calculation. For a comparison of calculated EMF values for all the alternative options identified in this Section, please refer to Attachment J.

2. Option 2: Single-circuit with LSTs

a. Description [R. Vazquez]

Option 2 would use the existing ROW (the Approved Route) in Chino Hills. From Mile Post 22.7 to 26.4, the double-circuit 500 kV TSPs already constructed in Chino Hills would instead be replaced with new 500 kV single-circuit Lattice Steel Towers (LSTs).[117] Because single-circuit structures are typically shorter than double-circuit structures, Option 2 would lower

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[116] *See* Attachment J, Calculated EMF Values.

[117] *See* Attachment G, Consolidated Map Figures at Figures M-10a and M-10b.

structure height from a maximum of 198 feet to approximately 120 feet. Visual simulations of Option 2 are provided in Attachment I.[118]

Due to the shortened height, however, compared to the Approved Route, Option 2 would require an additional 12 structures inline in the Chino Hills ROW, to control wire swing due to the wind. Because LSTs are wider than TSPs, the replacement LSTs would locate the conductors closer to the edges of the ROW. Option 2 would include a total of 23 new single-circuit 500 kV LSTs.[119] For Option 2, SCE proposes to use the standard single-circuit lattice structures used throughout SCE's 500 kV transmission network.

While Option 2 would create a single-circuit 500 kV line, it should be noted that all other portions of Segment 8 that are currently designed as double-circuit structures shall remain as such. A map of Option 2 is included in Attachment G.[120].

b. Transmission Planning Implications of Changing to Single Circuit Design [J. Chacon]

SCE performs technical assessments of its transmission system to evaluate the integrity, reliability, and capability of the transmission system to identify the need for transmission expansion projects and to evaluate the interconnection of new generators and customers to SCE's system. The performance of SCE's Transmission System is assessed against North American Electric Reliability Corporation (NERC), Western Electric Coordinating Council (WECC), and CAISO Reliability Standards and Regional Criteria. For TRTP, the assessments identified the need for additional transmission facilities to increase transfer capability south of SCE's Vincent Substation. Specifically, the assessments identified for the need for 500 kV transmission in order to increase capability beyond the Vincent 500/220 kV transformation limitations that would otherwise exist if all upgrades south of Vincent would have been designed for 220 kV capability.

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[118] *See* Attachment I, Consolidated Visual Simulations at V-21, V-26, V-31, and V-36. The Option 2 visual simulations were created from photographs taken from KOP 8, KOP 9, KOP 10, and KOP 11, respectively.

[119] *See* Attachment G, Consolidated Map Figures at Figures M-10a and M-10b.

[120] *Id.*

Once a specific project upgrade is defined, the design of the upgrade is determined by considering both power flow requirements now and into the future. For the Mira Loma-Vincent 500 kV transmission line which includes Segment 8, the power flow requirements associated with the 4,500 MW TRTP Project Objectives are dictated by considering the maximum flows expected under outage conditions as required by the NERC, WECC, and CAISO Reliability Standards and Regional Criteria. Such outage conditions require the Mira Loma-Vincent 500 kV transmission line, including Segment 8, to be able to support at least 3,500 amps.

Additional considerations were taken into account in defining portions of the Mira Loma-Vincent 500 kV transmission line, including Segment 8, as double-circuit construction. These considerations include maximizing the use of existing transmission line ROWs in order to minimize effects on previously undisturbed land and resources, consistent with the Garamendi Principles. Implementing these principles, specifically in urbanized areas, facilitates future expansion without having to acquire additional transmission line ROW for a future transmission line if a single-circuit design were utilized instead of a double-circuit design or without having to bear the increased environmental impacts and cost associated with a tear-down of the single-circuit to rebuild with a double-circuit in the future.[121]

Drivers that would necessitate the second circuit can be increased generation interconnections in the Tehachapi area beyond 4,500 MW or in-basin generation unit retirements driven by policy such as costs associated with Once-Through Cooling Unit Retirements. Both generation interconnections in the Tehachapi area beyond 4,500 MW or in-basin unit retirements can result in increased south of Vincent power flow beyond the capacity provided with TRTP. While generation interconnections in the Tehachapi area beyond 4,500 MW can be scheduled to the north, actual power flow may ultimately flow south of Vincent thus adversely impacting system reliability. Such a condition was identified in the completed Queue Cluster 3 Phase 1

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[121] *See* D.09-12-044 at 98, Conclusion of Law No. 4 (finding that SCE's proposal to build 500 kV is reasonable and prudent in light of, among other things, the benefit of relatively simple access to additional transmission capacity compared to the difficulties of tearing down and rebuilding lines).

studies where the need for additional south of Vincent transmission that would utilize the second circuit was identified.

In contrast, in-basin unit retirements will also drive increased south of Vincent power flow to replace the retired resources if new additional in-basin generation units are not constructed. The current design of TRTP will facilitate providing the additional transmission capability without the need for acquiring new transmission line ROW in urbanized areas.

If TRTP's approved double-circuit design were modified to single-circuit design in the Chino Hills area, SCE would be limited to the two following options to provide a second 500 kV circuit in the Chino Hills area: (1) a new 500 kV transmission line in new ROW, most likely through CHSP (assuming this route could be approved by State Parks and the NPS), due to the lack of other options because of in the congested nature of the Chino Hills area; or (2) rebuilding the single-circuit transmission line constructed as part of TRTP in Chino Hills back to a double-circuit design, resulting in additional costs, potential environmental impacts, and disruption to Chino Hills residents during construction of the second circuit.

c. Engineering and Technical Feasibility [R. Vazquez]

SCE has already demonstrated the technical feasibility of constructing within the Chino Hills ROW. For Option 2, SCE proposes to disassemble and remove the existing TSPs and use the standard single-circuit E-series lattice structures used throughout TRTP and the SCE 500 kV transmission network. The disassembly of the TSPs would be accomplished by reversing the assembly process.

d. Regulatory Issues [J. Leung]

Potential impacts to jurisdictional drainages for the additional TSPs would likely require amendments to the CWA Section 404 NWP authorization as impacts would be less than 0.5 permanent acres at each project crossing. In addition, amendments to the Section 401 WQC and SAA would likely be required for the additional TSPs. The process for obtaining amendments to these permits from the applicable agencies generally takes three to six months.

e. **Timing [C. Adamson]**

The schedule for Option 2 is in Attachment F.[122] The best-case schedule for this option would place Segment 8 of TRTP in service in November 2014.

f. **Estimated Construction Costs [D. Heiss]**

Option 2 would cost an additional $121 million to construct. $15 million of cost spent to date on the approved project would be abandoned.[123]

g. **Potential Costs Associated with Lost Renewable Generation [M. Ulrich]**

There would be an estimated cost of $10 to $87 million in lost renewable generation due to the projected delay associated with permitting and constructing Option 2.[124]

h. **EMF Considerations [G. Sias]**

The calculated magnetic field values at the north and south edges of the ROW for Option 2 are approximately 100.4 mG, which are approximately 372% of the calculated values of 27.0 mG presented in the 2007 FMP for the Approved Project.[125]

3. **Option 3: Single-circuit with TSPs**

a. **Description [R. Vazquez]**

Option 3 would use the existing ROW through Chino Hills. From Mile Post 22.7 to 26.4, the existing 500 kV double-circuit TSPs would be modified and made into shorter 500 kV single-circuit TSPs. SCE would modify the top sections of the TSPs to remove a circuit and lower the overall height of the structure from a maximum of 198 feet to a maximum of 160 feet.[126] The top of the existing TSPs have six cross arms spaced in three horizontal rows. Three cross arms would be removed, including the two cross arms in the top row and one cross arm in

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[122] *See* Attachment F, Consolidated Project Schedules at Option 2 Best Case, Option 2 Worst Case.

[123] *See supra* Table 1, Estimated Costs.

[124] *See supra* Table 7, Potential Costs Associated with Renewable Electricity Generation.

[125] *See* Attachment J, Calculated EMF Values.

[126] *See* Attachment H, Overhead Structure Height Guide.

the middle row. Option 3 would include a total of 11 shorter, single-circuit 500 kV TSPs. Visual simulations of Option 3 are provided in Attachment I.[127]

While Option 3 would create a single-circuit 500 kV line, it should be noted that all other portions of Segment 8 that are currently designed as double-circuit structures shall remain as such. A map of Option 3 is included in Attachment G.[128]

b. Transmission Planning Implications of Changing to Single Circuit Design [J. Chacon]

The transmission planning implications of changing to single-circuit design are consistent with that discussion above for Option 2.[129]

c. Engineering and Technical Feasibility [R. Vazquez]

SCE has already demonstrated the technical feasibility of constructing 500 kV double-circuit TSP structures, as many are already constructed on other portions of TRTP. Option 3 would lower the overall heights of the TSPs by eliminating one of the circuits on the existing structure. Since the existing TSPs have six cross arms, three would be removed: two from the top and one from the middle as well as their corresponding pole sections, thus lessening the overall load the rest of the structure would see. This change would require the modification or replacement of the top sections of the existing TSPs. The disassembly would be accomplished by reversing the assembly process of the TSPs.

d. Regulatory Issues [J. Leung]

Amendments to the CWA Section 404 NWP authorization, Section 401 WQC, and SAA likely would not be required for Option 3 because no new or additional project work areas will likely be required under this Option.

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[127] *See* Attachment I, Consolidated Visual Simulations at V-22, V-27, V-32, and V-37. The Option 3 visual simulations were created from photographs taken from KOP 8, KOP 9, KOP 10, and KOP 11, respectively.

[128] *See* Attachment G, Consolidated Map Figures at Figures M-11a and M-11b.

[129] *See* discussion *supra* at Section V.B., Overhead Options Utilizing Existing ROW Within SCE's ROW In Chino Hills, subsection 2, Option 2: Single-circuit with LSTs.

e. Timing [C. Adamson]

The schedule for Option 3 is provided in Attachment F.[130] The best-case schedule for this option would place Segment 8 of TRTP in service in October 2014.

f. Estimated Construction Costs [D. Heiss]

Option 3 would cost an additional $104 million to construct. $15 million of cost spent to date on the approved project would be abandoned.[131]

g. Potential Costs Associated with Lost Renewable Generation [M. Ulrich]

There would be an estimated cost of $10 million in lost renewable generation due to the projected delay associated with permitting and constructing Option 3.[132]

h. EMF Considerations [G. Sias]

The calculated magnetic field value of Option 3 at the north edge of the ROW is approximately 66.5 mG, which is approximately 246% of the calculated value of 27.0 mG presented in the 2007 FMP for the Project as constructed. The calculated magnetic field value of Option 3 at the south edge of the ROW is approximately 72.2 mG, which is approximately 267% of the calculated value of 27.0 mG presented in the 2007 FMP for the Approved Project.[133]

4. Option 4: Single-circuit with Additional Structures

a. Description [R. Vazquez]

Option 4 would use the existing ROW through Chino Hills. Similar to Option 1, from Mile Post 22.7 to 26.4, SCE would shorten the bottom section of the TSPs already constructed in Chino Hills. Similar to Option 3, SCE would also modify the top sections of the TSPs already constructed in Chino Hills to remove a circuit and lower the overall height of the structure. The

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[130] *See* Attachment F, Consolidated Project Schedules at Option 3.

[131] *See supra* Table 1, Estimated Costs.

[132] *See supra* Table 7, Potential Costs Associated with Renewable Electricity Generation.

[133] *See* Attachment J, Calculated EMF Values.

existing TSPs would be lowered from a maximum height of 198 feet to a maximum 130 feet. Visual simulations of Option 4 are provided in Attachment I.[134]

To comply with GO 95, SCE would be required to install an additional 12 TSPs (11 have already been installed) in the Chino Hills ROW to maintain ground clearance for the conductors. These additional TSPs would be designed and fabricated by the manufacturer at the shorter height. This portion of Segment 8 in Chino Hills would therefore have a total of 23 shorter single-circuit 500 kV TSPs.

While Option 4 would create a single-circuit 500 kV line, it should be noted that all other portions of Segment 8 that are currently designed as double-circuit structures shall remain as such. A map of Option 4 is included in Attachment G.[135]

b. Transmission Planning Implications of Changing to Single Circuit Design [J. Chacon]

The transmission planning implications of changing to single-circuit design are consistent with that discussed for Option 2.[136]

c. Engineering and Technical Feasibility [R. Vazquez]

SCE has already demonstrated the technical feasibility of constructing 500 kV double-circuit TSP structures as many are already constructed on other portions of TRTP, and there are no expected differences with respect to construction of single-circuit 500 kV structures in the Chino Hills ROW. Option 4 would lower the overall heights of the TSPs by: (1) eliminating one of the circuits on the structures; (2) requiring the complete disassembly of the structures within the ROW to gain access to the bottom portion of the structure; and (3) adding more structures inline in order to maintain GO 95 ground clearance. On the existing TSPs, three cross arms would be removed: two from the top and one in the middle. The already-fabricated bottom

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[134] *See* Attachment I, Consolidated Visual Simulations at V-23, V-28, V-33, and V-38. The Option 4 visual simulations were created from photographs taken from KOP 8, KOP 9, KOP 10, and KOP 11, respectively.

[135] *See* Attachment G, Consolidated Map Figures at Figures M-12a and M-12b.

[136] *See supra* at Section V.B., Overhead Options Utilizing Existing ROW Within SCE's ROW In Chino Hills, subsection 2, Option 2: Single-circuit with LSTs.

portions of the TSPs would be modified or replaced with shorter sections, requiring the complete disassembly of the structures within the ROW to gain access to the bottom portion of the structure. The disassembly would be accomplished by reversing the assembly process of the TSPs. The additional TSPs would be designed and fabricated by the manufacturer at the shorter height.

d. Regulatory Issues [J. Leung]

Potential impacts to jurisdictional drainages for the additional TSPs would likely require amendments to the CWA Section 404 NWP authorization as impacts would be less than 0.5 permanent acres at each project crossing. In addition, amendments to the Section 401 WQC and SAA would likely be required for the additional TSPs. The process for obtaining amendments to these permits from the applicable agencies takes three to six months.

e. Timing [C. Adamson]

The schedule for Option 4 is provided In Attachment F.[137] The best-case schedule for this option would place Segment 8 of TRTP in service in November 2014.

f. Estimated Construction Costs [D. Heiss]

Option 4 would cost an additional $118 million to construct. $15 million of cost spent to date on the Approved Project would be abandoned.[138]

g. Potential Costs Associated with Lost Renewable Generation [M. Ulrich]

There would be an estimated cost of $10 to $87 million in lost renewable generation due to the projected delay associated with permitting and constructing Option 4.[139]

h. EMF Considerations [G. Sias]

The calculated magnetic field value of Option 4 at the north edge of the ROW is approximately 68.9 mG, which is approximately 255% of the calculated value of 27.0 mG presented in the 2007 FMP for the Approved Project. The calculated magnetic field value of

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[137] *See* Attachment F, Consolidated Project Schedules at Option 4.

[138] *See supra* Table 1, Estimated Costs.

[139] *See supra* Table 7, Potential Costs Associated with Renewable Electricity Generation.

Option 4 at the south edge of the ROW is approximately 75.1 mG, which is approximately 278% of the calculated value of 27.0 mG presented in the 2007 FMP for the Approved Project.[140]

C. Alternative 5 and Underground Options Within the Chino Hills Areas

1. Introduction [P. Hlapcich]

SCE has investigated underground alternatives to the conventional overhead construction methods for the Mira Loma-Vincent 500 kV transmission line. In addition to the underground gas insulated transmission line (GIL) described in the EIR as Alternative 5, SCE has developed five additional underground construction options for the portion of the Project in the Chino Hills area. These five potential options are referred to as Option 5, 6, 7, 8 and 9.[141] A more thorough analysis of the options would be needed if the Commission were to determine that one of the options was desirable for the project being addressed.

In support of developing this response to the ACR, SCE has retained Power Delivery Consultants, Inc. (PDC) and its Principal Consultant, John Cooper, to review the proposed alignment for the TRTP transmission line within Chino Hills, assist in determining the feasibility of constructing 500 kV lines using underground cables for a portion of the route, and prepare a conceptual design constructing the underground alternative.[142] Mr. Cooper and PDC have extensive knowledge and experience relating to underground transmission facilities.[143] PDC's report relating to an overview of the underground transmission industry and particular information relating to the Chino Hills underground alternatives are provided in Attachment K as sponsored testimony from John Cooper. In conjunction with Mr. Cooper and PDC, SCE has developed a summary chart providing an overview of the state of the practice for underground transmission, as well as Chino Hills specifics in Attachment L.

This testimony describes the following: (1) SCE's prior experience with underground transmission lines; (2) the state of the practice for 500 kV underground; (3) electrical capacity

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[140] *See* Attachment J, Calculated EMF Values.

[141] *See* discussion *infra* at Sections V.C., subsections 7 through 10.

[142] *See* Attachment K, PDC Report at 4.

[143] *See id.*

requirement; (4) engineering attributes for 500 kV underground installations; and (5) an overview of the potential options for Chino Hills.

2. SCE's Experience with Underground Sub-transmission and Transmission Lines [P. Hlapcich]

SCE has established methods and a successful history relating to undergrounding sub-transmission lines (66 kV and 115 kV). SCE started undergrounding 66 kV circuits in 1946 with a Low Pressure Fluid Filled (LPFF) cable system. In 1967, SCE started undergrounding 66 kV circuits using High Pressure Fluid Filled (HPFF) cable systems. In 1971, SCE used an extruded dielectric cable system to energize a 66 kV circuit. From that point on, SCE has undergrounded hundreds of miles of subtransmission lines (66 kV and 115 kV) using extruded dielectric, more specifically cross-linked polyethylene (XLPE) insulation. SCE has acquired extensive engineering, operational, and maintenance knowledge about the undergrounding of 66 kV and 115 kV systems which aided the development of this investigation of 500 kV underground options.

In the early 1980s, SCE was required to underground the El Nido-El Segundo and the Chevmain-El Nido 220 kV transmission lines. However, the cost of this effort was paid for by Chevron, the entity requesting that the line be placed underground. The underground lengths of these HPFF circuits are 2,500 feet, and run underneath a golf course in Manhattan Beach.

3. The State of 500 kV Underground Construction [J. Cooper]

The number of overhead transmission lines (above 66 and 115 kV) greatly exceeds the number of underground transmission lines that have been constructed in North America and the rest of the world.[144] This is, in general, due to economic considerations (i.e., the costs for overhead transmission lines, in most cases, are significantly less than those for similar capacity underground transmission lines).[145]

There are advantages and disadvantages for both overhead and underground transmission lines. The primary advantage of underground transmission line construction could be reduced

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[144] *See* Attachment K, PDC Report at 4.

[145] *Id.*

visual impact, except where the underground transmission lines convert to an overhead construction at the transition station.[146] The disadvantages to underground construction would be higher installed costs, land disturbances during construction, difficult maintenance accessibility after installation, and longer outages for repair.[147]

The technology that can be utilized for 500 kV underground transmission lines can generally be classified into four categories. These are:

- **High-pressure fluid-filled (HPFF) cable systems**: HPFF cable systems are designed so that all three phases of the cable reside in a steel pipe pressurized with dielectric fluid (synthetic oil). The pipe has a minimum diameter of 10 inches and more than one pipe per circuit would be required. A pumping plant with an oil storage reservoir is required to maintain proper pressure on the circuit. There is currently only one HPFF transmission cable supplier in the world, and no commercial 500 kV cable installations have been constructed.
- **Self-contained fluid-filled (SCFF) cable**: A SCFF cable system typically consists of a hollow conductor, which is filled with dielectric fluid, high quality kraft paper insulation (special paper used for high voltage insulation), outer shielding, and a metallic sheath that is covered by a polyethylene (PE) jacket. Stop joints and fluid reservoirs at splice vaults are required to maintain proper pressure. The cable can either be direct buried or installed in conduit.
- **Gas Insulated Transmission Line (GIL):** A GIL system consists of an epoxy spacer insulator assembly holding the tubular conductor in place inside an aluminum enclosure filled with sulfur hexafluoride (SF_6) or a mixture of SF_6 and nitrogen (N_2). While this cable system can match the power transfer capabilities of any overhead line, its use has been limited to relatively short installations due to its relatively high cost. With the exception of a directly buried GIL system in

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[146] *Id.*

[147] *Id.* at 4-5.

Germany, direct burial is usually not considered for GIL due to potential corrosion of the aluminum enclosure.

- **Solid dielectric or extruded dielectric cable systems (XLPE):** In XLPE systems, each phase consists of a stranded conductor (aluminum or copper[148]), semi-conducting shields, XLPE insulation, metallic sheath, and polyethylene (PE) jacket. Each cable will be pulled into a separate duct in a common ductbank, placed in a trench and directly buried, or installed inside a tunnel.[149]

Of the four available types of cable systems, XLPE is the present industry choice for undergrounding sub-transmission and transmission underground facilities. HPFF and SCFF are older technologies that are being replaced with XLPE technology.[150] GIL technology tends to be the choice for electrical connections in gas insulated substations.[151] However, GIL technology has been used only in limited occasions on transmission applications.[152]

Only three known long-length underground installations of 500 kV XLPE cable exist in the world. In 2000, Tokyo Electric Power Company completed an installation of 24.7 miles of double-circuit 500 kV in tunnel and through bridges. In 2010, Shanghai Municipal Electric Power Company completed an installation of 21.2 circuit miles of double-circuit 500 kV in 10.6 miles of tunnel. Currently, there is a 7.1 mile stretch of double-circuit 500 kV project under construction in Skolkovo, Russia, in which the cable will be directly buried in city street and in other ROW.

There are a dozen or more hydroelectric generation installations that have used 500 kV XLPE transmission cables. These installations are generally less than 1,000 feet in length, do not

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[148] For TRTP, any XLPE installation would require copper conductors to meet SCE's power transfer requirements.

[149] *See* Attachment K, PDC Report at 6-8.

[150] *Id.* at 11.

[151] *See* Attachment K, PDC Report at 8-10.

[152] Manufacturing capabilities for 500 kV GIL exist in the United States and in Europe and Asia. *Id.* at 10. Manufacturing capabilities for 500 kV XLPE cable currently exist, but outside of the United States. There are six known potential manufacturers in Europe and Asia that may be qualified to manufacture XLPE cable for 500 kV applications.

require any cable splices, and have a transmission capacity of 600 MVA or less. The only 500 kV XLPE cable installation in the Western Hemisphere, commissioned in 2010 in Columbia, is this type of installation.

The expansion of underground installation from lower voltages to 500 kV has many technological challenges. Transitioning to the next higher voltage class is not a simple matter of increasing cable size. The most important components to an underground installation are the splices and terminations. Each cable manufacturer custom designs and supplies the splices and terminations. The material and procedures for splicing and terminating cables require extremely clean material production and detailed process installation techniques.[153] With only three long-length 500 kV underground installations in the world, cable splice technology for 500 kV applications is not yet mature. Splicing for the 500 kV cable must be performed by highly-trained personnel from the relevant cable supplier, which may create long term maintenance issues.[154] For example, there is a risk that expertise may not be available if a splice needs to be replaced 20 years from the installation of the underground transmission line. Also, as voltage increases for underground material the purity of material components of the cable and splices increases. This requires increased manufacturing control for all material components and precise centering of the conductor within the XLPE insulation.

4. Electrical Capacity Requirements [P. Hlapcich]

The Mira Loma-Vincent 500 kV transmission line is designed for bundled 2156 kcmil ACSR "bluebird" conductor. The conductor thermal rating for bundled "bluebird" conductor is 3,950 amps under normal conditions, and 5,330 amps emergency operation for four hours. The underground cable alternatives will be required to match the thermal rating for the overhead conductor, particularly because the underground transmission line will be much more difficult to upgrade if additional electrical capacity is later needed.

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[153] *See* Attachment K, PDC Report at 8 (noting that a disadvantage of XLPE was the special skills and equipment required for cable splicing).

[154] *See id.* at 13 ("Most utilities in North America rely on the cable system manufacturer to provide skilled splicers and special tools to perform repairs . . . .").

Generally, underground cable cannot match the ampacity of an overhead conductor of the same size, because the conductor of a cable is covered with a thick layer of insulation and placed either in a duct or directly buried in ground or installed in a tunnel. The heat generated from the flow of electricity in underground transmission lines is more difficult to dissipate than overhead transmission lines. As many as three cables per phase, if using XLPE, are required to match the ampacity of the bundled "bluebird" overhead conductor.[155]

In addition to meeting the ampacity of the overhead conductor, multiple cables per phase have the added benefit of increasing reliability in the event of a failure along the underground cable. For example, Option 5 (explained below)[156] would place XLPE cable in a tunnel. SCE has determined that two cables per phase could be used. In the event there is a failure of the underground cable, half of the circuit potentially could remain energized, providing an ampacity of 1975 amps, while repair is made to the other half of the circuit. Similarly, SCE has ascertained that for the other options, as many as three cables per phase are needed. One benefit of utilizing three cables is that in the event there is a failure of the underground cable, 66% of the circuit potentially could remain energized, providing an ampacity of 2633 amps, while repair is made to the failed cable, or cable accessories (splices and terminations).[157]

5. Engineering Processes Leading Towards Construction for the 500 kV Underground Alternatives [P. Hlapcich]

The following engineering processes must occur before underground construction could begin in the Chino Hills area. The engineering processes for all options are similar and consist of the following general elements:

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[155] *See also* Attachment K, PDC Report at 31 ("PDC determined that three cables per phase would be required to meet the rating of each overhead circuit.").

[156] *See* discussion *infra* at Section V.C., Underground Options Within Existing Chino Hills ROW, subsection 8, Option 5: Underground Construction with XLPE in Tunnel in ROW.

[157] *See also* Attachment K, PDC Report at 14 ("In the case of the potential TRTP extruded-dielectric cables, three cables per phase would be installed to meet power transfer requirements, and approximately 67 percent of the total power transfer would be available if there were a failure on one of the cables.").

Ground Evaluation: SCE would need to (1) first perform soil assessments, which include assessing existing soil, thermal resistivity, and geological data, and collecting and analyzing soil borings. SCE would need to (2) verify the seismic assessment for the affected areas, and then develop underground excavation details. At this point, SCE would (3) develop a plan for how to handle excess spoils from the extensive excavations needed along the ROW. SCE also would need to (4) identify the backfill material assessment and develop the design needed for material protection and heat dissipation.

Engineering and Material: Engineering design, cable or GIL, ductbanks, vaults, transition stations, and shunt compensation material would generally follow the same basic process; as follows: SCE would need to (1) identify and evaluate potential cable engineering design companies to supplement SCE's engineering efforts which would lead towards entering a contract with SCE; and (2) identify and evaluate potential material suppliers which would lead towards a variety of contracts to supply material. During this process, SCE would (a) develop design specifications, (b) develop material specifications, (c) develop installation specifications, (d) develop maintenance procedures, (e) develop emergency restoration plans, and (f) prepare maintenance manual and perform training for the maintenance organization.

Construction Labor: Construction labor for each type of component and work would generally follow the same basic process. SCE would need to identify and evaluate potential construction companies which would result in construction contracts. The unique part of the construction for the XLPE cable is that the supplier of the cable will be performing the cable installation, splicing and termination operations during construction.

Commissioning Tests: Commissioning tests are electrical system tests, which occur after all cable and accessories are installed. Typically, higher than rated voltage partial discharge tests are performed to determine if there are workmanship issues for the cable splices and terminations.

Consultation with Affected Local Jurisdictions: Underground construction would be highly disruptive to affected communities in the Chino Hills area. SCE would therefore need to develop a traffic and transportation plan to coordinate all material and construction activities in consultation with the relevant local agencies.[158] Undergrounding would also impact existing underground utilities. SCE would need to consult with affected local agencies, utilities, and other parties that have facilities that would need to be relocated.

6. Overview of the Initial Undergrounding Alternative and Five Additional Options for Chino Hills [P. Hlapcich]

In addition to the GIL construction analyzed as Alternative 5 in the Final EIR, SCE has conducted conceptual studies of five additional options for a portion of the Mira Loma-Vincent 500 kV underground construction through Chino Hills, all six of which are discussed below. These options are referred to as Option 5, 6, 7, 8 and 9. Option 5 is similar to Alternative 5, with the exception that two XLPE cable per phases are required as opposed to one GIL cable per phase. Option 6 would consist of three XLPE cables per phase in ductbank in the existing ROW. Option 7 would use three XLPE cables per phase directly buried in the existing ROW. Option 8 would be constructed using three XLPE cables per phase in ductbank under nearby streets, primarily Eucalyptus Avenue in Chino Hills. Option 9 would be constructed in the same city streets; however, the three XLPE cables per phase would be directly buried rather than placed in a duct bank. The following sections describe these options, including the description of cable size and configuration, route details, installation description, operation and maintenance considerations, cost, schedule, regulatory issues, and technical feasibility.

7. Alternative 5: GIL Undergrounding

a. Description [P. Hlapcich]

The proposed route for Alternative 5 would follow the same route as the Approved Route, but SCE would install an approximately 3.5 mile portion of the Alternative 5 route underground.[159] Under Alternative 5, at approximately Mile Post 21.9, the proposed transmission line would shift from overhead to underground and would continue underground

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[158] *Id.* at 24 ("In the case of public right-of-way installations, the utility must apply to the appropriate government agencies for any necessary construction permits.").

[159] *See* Final EIR at 2-100 to 2-111 (Final EIR's thorough discussion of Alternative 5).

through Chino Hills to approximately Mile Post 25.4, where the underground line would shift back to overhead.

Primary components of the proposed underground segment include GIL system infrastructure, aboveground transition stations, an underground tunnel, and vertical access shafts. Components of the GIL system would include bellows for expansion and contraction, bus/conductors, insulation (solid dielectric insulators to support the bus/conductor within the enclosure tube and insulating gases composed of SF_6 and pipe enclosure to house the bus/conductors and insulation. A total of three GIL assemblies are required to accommodate one three-phase circuit at the 500 kV voltage level; therefore, because Alternative 5 includes double-circuit transmission lines, the GIL system would require six individual GIL assemblies (three for each circuit) along the entire approximately 3.5-mile length through Chino Hills.

The GIL system would be placed in 18-foot external diameter underground tunnels lined with one-foot thick pre-cast concrete wall sections. Aside from supporting the six GIL assemblies, the underground tunnel would include a center walkway for operations and maintenance purposes. At approximately one-mile intervals along the Chino Hills ROW, SCE must construct ventilation units at least 25 feet long by 20 feet wide and 10 feet in height to provide oxygen and to remove excess heat from the tunnel. The diameter of each ventilation shaft would be between 10 and 20 feet.

Transition stations would also be required at each terminus of the underground GIL system. Each transition station would be approximately 220 feet wide and 320 feet, located partially within existing ROW and partially on land that SCE would have to own in fee. Permanent aboveground features at each transition station would include a 90-foot tall A-frame overhead dead-end structure to transition the transmission lines from the LST structures to the GIL system. Another permanent aboveground feature of the transition station would be a housing structure to enclose the entrance to the vertical access shaft that leads down to the underground tunnel. Additional equipment may include cranes and environmental monitoring equipment. Buildings constructed around the access shafts would be approximately 100-feet long by 75-feet wide and at least as high as the permanently installed gantry cranes (possibly

25-feet tall).[160] At the eastern transition station, the tunnel would be about 100 feet deep, while at the western transition station, the tunnel would be about 420 feet deep.

Moving the large amount of earth required for Alternative 5 will require a considerable construction effort, including a large marshaling yard between 20 and 30 acres in size. Construction of the transition station at the eastern terminus would require additional ROW. A map of Alternative 5 is included in Attachment G, Figures M-8a and M-8b.

b. Engineering and Technical Feasibility [P. Hlapcich]

Due to the tunnel requirements, it is unknown whether it is feasible to install 500 kV GIL in a tunnel along the TRTP ROW. Additional geological investigations would be required to determine the actual feasibility of the tunnel construction. Because of the uniqueness of a tunnel system, SCE's operating procedures must be amended to reduce any risk to SCE personnel in the event of a failure during performance of maintenance in the tunnel. Furthermore, Alternative 5 would require expanding the ROW in the Chino Hills area for the transition stations.

c. Regulatory Issues [J. Leung]

Potential impacts to jurisdictional waterway may require amendment to the CWA Section 404 NWP authorization as impacts would be less than 0.5 permanent acres at each project crossing. In addition, amendments to the Section 401 WQC and SAA may be required. The process for obtaining amendment to these relevant permits from the applicable agencies can take three to six months. Additionally, there is a potential to yield significant subsurface cultural and paleontological resources that could be impacted by construction.

d. Timing [C. Adamson]

The schedule for Alternative 5 is provided in Attachment F.[161] The schedule for this option would place Segment 8 of TRTP in service in June 2019.

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[160] *See* Final EIR at 2-102 to 2-103, Figures 2.5-1, 2.5-3 and 2.5-4 (describing and depicting features of GIL transition station); *see also* Attachment N, Transition Station Diagrams.

[161] *See* Attachment F, Consolidated Project Schedules at Alternative 5.

e. Estimated Construction Costs [D. Heiss]

Alternative 5 would cost an additional estimated $993 million to construct. $15 million of cost spent to date on the approved project would be abandoned.[162]

f. Potential Costs Associated with Lost Renewable Generation [M. Ulrich]

There would be an estimated cost of $585 million in lost renewable generation due to the projected delay associated with permitting and constructing Alternative 5.[163]

g. EMF Considerations [G. Sias]

For double-circuit GIL in tunnel, the calculated magnetic field values at both the north and south edges of the ROW are approximately 0.2 mG, which is 0.7% of the calculated value of 27.0 mG presented in the 2007 FMP for the Approved Project.[164] While this underground option results in significant reduction in magnetic field levels compared with the overhead design, the cost to underground the proposed transmission line in the Chino Hills area would not be "low-cost" as defined by the Commission's EMF Policies.[165]

8. Option 5: Underground Construction with XLPE in Tunnel in ROW

a. Description [P. Hlapcich]

Option 5 would place XLPE cable in tunnel in the existing ROW. Option 5 requires installing two cables per phase in a tunnel underneath the existing ROW with forced ventilation and cooling to maintain safe temperature levels. The tunnel would be the same as described in Alternative 5 of the Final EIR, with the requirement for additional air conditioning as the result of XLPE cable creating more heat than GIL. Option 5 would include two transition stations,

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[162] *See supra* Table 1, Estimated Costs.

[163] *See supra* Table 7, Potential Costs Associated with Renewable Electricity Generation.

[164] *See supra* Section V.B., Alternative 5 and Underground Options Within the Chino Hills Areas, subsection 1.g., EMF Considerations, for assumptions on calculated magnetic field values. In addition, all underground conductors are assumed to have no sag, and no conductor shielding is considered. *See* Attachment J, Calculated EMF Values.

[165] As explained by the Commission in approving the Project, the "benchmark established for low-cost measures is 4% of the total budgeted project cost that results in an EMF reduction of at least 15% (as measures at the edge of the utility right-of-way)." D.09-12-044 at 66.

approximately 2.4 acres in size, which would include terminations structures, lightning arresters, and additional shunt compensation reactors (if needed).

Cable Size and Configuration: Primary components of Option 5's XLPE system would include the following for each circuit: (1) six cables constructed with 5000 kcmil segmental copper conductor with XLPE insulation and metallic moisture barrier, (2) six splices every 1,500 feet, (3) link boxes with sheath voltage limiters or ground connection at every splice location, (4) cable clamps at approximately every 10 feet, (5) six dielectric fluid or SF_6 filled terminations, and (6) lightning arresters. The XLPE cable has an outside diameter between 5.5 to 6 inches, and weighs about 27 pounds a foot. The cable would be installed on racks in pair in the tunnel.

Route Details: Option 5 would utilize the existing SCE ROW in Chino Hills. SCE would install an approximately 3.5-mile portion of the Project underground in the Chino Hills area. Specifically, the Project would shift from overhead to underground at approximately Mile Post 21.9, and would continue underground through Chino Hills to approximately Mile Post 25.4, where the underground line would shift back to overhead.[166]

Installation Description: To complete installation of Option 5, the following construction and installation activity must be completed: (1) construct a tunnel system and the two transition stations, (2) pull cables into the tunnel, (3) install splices, terminations, sheath voltage limiters, grounds, surge and lightning arrester at the transition stations; and (4) perform commissioning tests. Any necessary shunt compensation reactors and switching devices would have to be installed in the transition stations and/or the Mira Loma and Vincent substations.

Underground Tunnel: As with Alternative 5, the tunnel would be circular, with a 16-foot internal diameter and an 18-foot external diameter.[167] The tunnel construction for Option 5, including the requirement for monitoring systems, ventilation, lightning system, communication system, power source, electrical distribution system, telemetry, and vertical access shaft would involve the same considerable construction efforts described in the Final EIR for Alternative 5. However, Option 5 also would require the installation of a cooling system,

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[166] *See* Attachment G, Consolidated Map Figures at Figures M-13a and M-13b.

[167] *See* Final EIR at 2-103 (describing the underground tunnel required for Alternative 5).

because XLPE cable creates more heat than GIL. A sensor inside the tunnel would monitor elevated temperature, and deploy the cooling system if the temperature exceed a predetermine set point. Moving the large amount of earth required for Alternative 5 will require a considerable construction effort, including a large marshaling yard between 20 and 30 acres in size.

Transition Stations: Similar to Alternative 5, transition stations are required at each terminus of the underground XLPE cable systems.[168] While location and layout would be identical to the transition stations contemplated as part of Alternative 5, the size of both transition stations for Option 5 is larger than needed for Alternative 5.[169] Option 5 requires larger transition stations due to the requirement of two cables per phase for each circuit to meet the overhead conductor rating, which in turn requires an additional termination structure.[170] If Mira Loma and Vincent Substations do not have space for installation of shunt compensation reactors, any needed shunt compensation reactors would be located at the transition stations, also likely resulting in larger transition stations and the need for additional ROW.

Cable Pulling: Option 5 requires approximately 150 reels of cable that would be transported from an SCE storage yard to the ROW. Each reel holds 1,550 feet of cable, and is approximately 13 feet in diameter by 8 feet wide weighing approximately 45,000 pounds. Because of the size and weight, only one reel can be transported on a truck.[171]

As shown in Figure 2.5-5 of the Final EIR, the shallowest tunnel access chamber would be approximately 125 feet deep.[172] The eastern access chamber would be located at approximately Mile Post 25.4. This area would be the best location to set up the reels of cable to be fed into the tunnel. The subsequent western ventilation shaft could be set up for the pulling

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[168] *See id*. at 2-102 to 2-103 (describing Alternative 5's transition stations).

[169] Specifically, Alternative 5 requires a transition station of approximately 220 feet wide by 320 feet long (1.6 acres), while transition stations for Option 5 would need to be approximately 330 feet wide by 320 feet long (2.4 acres).

[170] *See* Attachment N, Transition Station Diagrams.

[171] *See* Attachment K, PDC Report at 32.

[172] *See* Final EIR at Figure 2.5-5.

location. One reel after another, 1,550 feet of cable is pulled from a feed point into the tunnel, ready for splicing.

Accessories Installation: In addition to the construction of the tunnel, installation of the accessories is critically important. The accessories include splices, terminations, grounding boxes, and link boxes with sheath voltage limiters. The most critical and labor intensive work is on the splices and terminations. In fact, the work is so critical that cable manufacturers recommend building a temporary clean room to make cable splices. Likewise, scaffolding will be erected at the transition stations and barrier put up so that the terminations can be installed without being contaminated from the external environment.[173] Three splices or terminations take approximately seven to twenty days working around the clock to complete.[174] Because of the level of complexity of the work, one manufacturer suggested that no more than two crews be used on the same job.

Operation and Maintenance: There are no available specifications for predicting the useful operating life of 500 kV underground cables. The projected XLPE cable life up to 345 kV, however, is 40 years.[175] This projection assumed that the various industry specifications are followed, installations are performed error free, and routine maintenances are performed on the system. As 40 years of operation approaches, SCE would need to perform an evaluation of the underground system to determine if the cable and subsequent accessories must be replaced.

Qualified electrical workers must routinely inspect the tunnel and tunnel infrastructure to ensure that the ventilation and cooling systems and power to the ventilation and cooling systems are in working condition. If the ventilation systems are not working properly, the tunnel would heat up, much like an oven, causing the cable to operate hotter than normal. Operating the cable

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[173] *See* Attachment K, PDC Report at 40 ("At 345 kV and higher voltages, a "clean room" housing may be placed over the termination area to avoid any contamination that might cause electrical failure of the termination when it is in operation.").

[174] *See* Attachment K, PDC Report at 31.

[175] *See* Association of Edison Illuminating Companies' (AEIC) *Specification for Extruded Insulation Power Cables and Their Accessories Rated Above 46 kV through 345 kVac* (CS9-06).

at an above normal operating temperature for a continuous period could cause premature cable and accessories failures.

Besides maintenance on the tunnel and its infrastructure, SCE's qualified electrical workers must also check on the condition of the sheath voltage limiters, grounding connections, cable and splice supports, splices, terminations, lightning arresters, and condition of the cable.[176] A map of Option 5 is included in Attachment G, Figures M-13a and M-13b.

b. Engineering and Technical Feasibility [P. Hlapcich]

It is unknown whether the installation of 500 kV XLPE cable in a tunnel along the TRTP ROW is technically feasible due to the tunnel requirements. Additional geological investigations would be required to determine the actual feasibility of the tunnel construction. The ampacity requirement of the overhead conductor can be matched by installing two cables per phase in a tunnel with forced ventilation and cooling. It is not known whether there is the potential for a fire inside the tunnel resulting from cable or splice failures. Because of the uniqueness of a tunnel system, SCE's operating procedures must be amended to reduce any risk to SCE personnel in the event of a failure during performance of maintenance in the tunnel. The transition stations would require an expansion of the existing ROW.

c. Regulatory Issues [J. Leung]

Potential impacts to jurisdictional waterways may require amendment to the CWA Section 404 NWP authorization as impacts would be less than 0.5 permanent acres at each project crossing. In addition, amendments to the Section 401 WQC and Streambed Alteration Agreement may be required. The process for obtaining amendments to relevant permits from the applicable agencies can take three to six months. Additionally, there is a potential to yield significant subsurface cultural and paleontological resources that could be impacted by construction.

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176 *See* Attachment K, PDC Report at 30.

d. Timing [C. Adamson]

Because few installation of 500 kV transmission underground exist in the world, SCE relied on information gathered from various manufacturers, industry experts, and SCE's experience with installation of underground transmission lines at the 69 kV and 115 kV levels. The schedule for Option 5 is provided in Attachment F.[177] The schedule for this option would place Segment 8 of TRTP in service in June 2019.

e. Estimated Construction Costs [D. Heiss]

Option 5 would cost an additional estimated $859 million to construct. $15 million of cost spent to date on the approved project would be abandoned.[178]

f. Potential Costs Associated with Lost Renewable Generation [M. Ulrich]

There would be an estimated cost of $585 million in lost renewable generation due to the projected delay associated with permitting and constructing Option 5.[179]

g. EMF Considerations [G. Sias]

The calculated magnetic field levels for double-circuit XLPE in tunnel in ROW at both the north and south edges of the ROW are less than 0.1 mG, which are less than 0.4% of the calculated values of 27.0 mG presented in the 2007 FMP for the Approved Project.[180] While this underground option results in significant reduction in magnetic field levels compared with the overhead design, the cost to underground the transmission line in the Chino Hills area would not be "low-cost" as defined by the Commission's EMF Policies.

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[177] *See* Attachment F, Consolidated Project Schedules at Option 5.

[178] *See supra* Table 1, Estimated Costs.

[179] *See supra* Table 7, Potential Costs Associated with Renewable Electricity Generation.

[180] *See supra* Section V.B.1.g. for assumptions on calculated magnetic field values. In addition, all underground conductors are assumed to have no sag, and no conductor shielding is considered. *See* Attachment J, Calculated EMF Values.

9. Option 6: Underground: XLPE in Conduit in ROW

a. Description [P. Hlapcich]

Option 6 consists of installing XLPE cable in ductbank in the existing ROW in the Chino Hills area. Option 6 would include the installation of three cables per phase in a ductbank. Option 6 also requires construction of two transition stations, approximately 2.4 acres in size, for the terminations structures, lightning arresters, and possible additional shunt compensation reactors.

Cable Size and Configuration: Primary components of Option 6's XLPE system likely would include the following for each circuit: (1) nine cables constructed with 4000 kcmil segmental copper conductor with XLPE insulation and metallic moisture barrier,[181] (2) nine splices every 1,500 feet, (3) link boxes with sheath voltage limiters or ground connection at every splice location, (4) cable clamps at approximately 4 to 5 feet in the splice vaults,[182] (5) nine dielectric fluid or SF_6 filled terminations, and (6) lightning arresters. Additional equipment would be installed at both transition stations.

The XLPE cable has an outside diameter between 5.5 to 6 inches, and weighs about 25 pounds a foot. Each circuit will have a total of 12 8-inch ducts encased in concrete. However, only 9 of the 12 ducts will be filled with cable with the other ducts as maintenance spares.[183]

Route Details: Option 6 would utilize the existing SCE ROW in Chino Hills.[184] SCE would install an approximately 3.5-mile portion of the Project underground in the Chino Hills area. Specifically, the Project would shift from overhead to underground at approximately Mile Post 21.9, and would continue underground through Chino Hills to approximately Mile Post 25.4, where the underground line would shift back to overhead.[185]

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[181] *See* Attachment K, PDC Report at 35 (discussing three cables per phase times three phases for ductbank installation).

[182] *Id.* at 33.

[183] *See id.* at 35; Figure 5.3.

[184] *See* Attachment M, Underground Alternatives and options, Option 6 at Sheets 1-14.

[185] *See* Attachment G, Consolidated Map Figures at Figures M-13a and M-13b.

Every 1,500 feet, three sets of splice vaults would be installed. As shown in the PDC Report, Figure 5.6, the splice vaults are staggered with two vaults side by side and the third vault in front of the two side by side vaults.[186] The approximate area requirement of the three sets of vaults is 80 feet long by 33 feet wide.[187] Each circuit would require its own set of three splice vaults.[188]

Installation of Option 6: Option 6 likely would result in the following construction and installation activities: (1) construction of the ductbank systems and two transition stations; (2) pulling of the cables from one vault to the next; (3) installation of splices, terminations; sheath voltage limiter, grounds, surge and lightning arrester inside the vaults and the transition stations; and (4) perform commissioning tests. Shunt compensation reactors likely will be installed either in transition stations or at the Mira Loma and Vincent Substations. The existing ROW might not be suitable for the transportation of heavy cable reels, vaults, or equipment, and the construction of access road for the transportation of heavy equipment may be required.

Ductbank Systems: Option 6's ductbank systems likely would be comprised of two separate sets of ductbank, one for each circuit. A ductbank is comprised of twelve 8-inch schedule 40 PVC duct installed in a rectangular configuration of two rows of six ducts, which are encased in concrete.[189] The dimension of the ducts encased in concrete is approximately 72 inches wide by 24 inches high.[190] The depth from grade to top of encasement is approximately 42 inches.[191]

To install these ductbanks, several hundred feet of trench would first be dug up.[192] Twenty foot lengths of the PVC conduits would be glued together, and the ductbank assembled using duct spacers at 5-foot intervals, which is a time-consuming task. An on-site inspector must

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[186] *See* Attachment M, Underground Alternatives and options at Option 7, Sheets 1-14.
[187] *Id.*
[188] *Id.*
[189] *See* Attachment K, PDC Report at 33-35.
[190] *Id.*
[191] *Id.*
[192] *Id.*

be present to witness that the conduits and conduit joints are installed correctly and free of foreign material that may damage the cables. Afterward, a cement truck slowly drives by the trench opening and pours concrete backfill into the trench, enough for at least three inches of encasement for all of the outside conduits. Several inches of thermal backfill is poured into the trench to ensure uniform thermal soil property around the ductbank. Afterward, the original soil is compacted back into the trench to the proper grade if the original soil has suitable thermal properties.[193]

Certain areas in the ROW have a slope greater than seven degrees, or require placing cable under existing infrastructure, and would therefore require either horizontal direction drilling or a restraining vault (larger slopes create instability of the cable and the cable would creep downhill during thermal expansion and contraction causing displaced splices which would lead towards splice failure). This approach would require six bores approximately 42 inches in diameter, spaced 10 feet edge to edge are required.[194] The bores are installed between 30 to 40 feet below grade.[195] There are some areas where the slope is above 7 degrees and the terrain does not allow directional boring. These areas would require SCE to develop and use cable restraints.

Because of cable length and shipping weight restriction limiting the length of the cable, a vault would be placed every 1,500 feet to facilitate the splicing of the cable together. The splice vault has an internal dimension of 35 feet long by 7 feet high by 8 feet wide and comes in two sections.[196] Each section weighs between 60,000 and 80,000 pounds.[197] To install these vaults, SCE must construct a hole at least 40 feet by 10 feet by 12 feet. Heavy cranes would be utilized to lower the first section of the vault into the pit. The second section of the vault is then lowered into the same pit, ensuring that all seams line up.

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[193] *Id.*

[194] *Id.* at 36.

[195] *Id.*

[196] *See* Attachment K, PDC Report at 32, Figure 5.3.

[197] *See id.* at 32.

Transition Stations: Similar to Alternative 5, transition stations are required at each terminus of the underground XLPE cable systems.[198] While location and layout would be similar to those described in Alternative 5, the size of both transition stations for Option 6 is larger. Instead of 220 feet wide by 320 feet long (1.6 acres), the transition stations for Option 5 are approximately 330 feet wide by 320 feet long (2.4 acres).[199] The reason for the larger size is to accommodate the requirement of three cables per phase to meet the overhead conductor rating, which in turn requires additional termination structures. Furthermore, if room does not permit installation of shunt compensation reactors at the Mira Loma and Vincent substation, the reactors and switching equipment will have to be located at the transition stations. This will most likely require a bigger transition station.

Cable Pulling: Approximately 240 reels of cable are required for the installation of Option 6, which would be transported from a SCE storage yard to the ROW in Chino Hills. Each reel, holding approximately 1,550 feet of cable, is approximately 13 feet in diameter by 8 feet wide, and weighs approximately 45,000 pounds.[200] Because of the size and weight, only one reel at a time can be transported on a truck.

The cable reel will be loaded onto a reel stand located adjacent to the vault (the feed point).[201] A pulling winch is located in the vicinity of the next vault (the pull point), spaced approximately 1,500 feet apart. The pulling winch slowly pulls the cable from one vault to the next. This operation is repeated for all of the reels of cable. Splicing of the cables is generally started after cable has been pulled between several splice vaults.

Accessories Installation: The accessories installation for Option 6 would be consistent with that described for Option 5.[202]

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[198] *See* Final EIR at 2-102 to 2-103 (providing a thorough description of Alternative 5's transition stations).

[199] *See* Attachment N, Transition Station Diagrams.

[200] *See* Attachment K, PDC Report at 27, 32.

[201] *See id.* at Figure 5.5.

[202] *See supra* Section V.C., Alternative 5 and Underground Options Within Existing Chino Hills ROW, subsection 8, Option 5: Underground Construction with XLPE in Tunnel in ROW.

Operation and Maintenance: The projected XLPE cable life of Option 6 is consistent with that described in Option 5.[203] Qualified electrical workers must routinely inspect the vault to ensure the structurally integrity of that vault as well as the cable and splice supports. If the vault is filled with water, the water must be pumped out. Furthermore, the ROW must be routinely patrolled for intrusions and potential dig-in.

In addition to routine check and maintenance to the vaults, SCE's qualified electrical workers must also check on the condition of the voltage limiting arresters, grounding connection, splices, terminations, lightning arresters, and condition of the cable. From time to time, a jacket integrity test is performed on the cable.[204] This is accomplished by applying 5 kV direct voltage across the cable jacket for one minute. The DC Hi-Pot test set will trip out if the cable jacket has been damaged. If cable damage is identified the cable must be exposed by excavation the surrounding material and the cable repaired. If the cable is damaged, repairing the cable involves excavating surrounding material. A map of Option 6 is included in Attachment G, Figures M-13a and M-13b.

b. Engineering and Technical Feasibility [P. Hlapcich]

It is unknown whether Option 6 is technically feasible. The ampacity requirement of the overhead conductor can be matched by installing three cables per phase. Because of the hilly terrain of the ROW in Chino Hills, directional drilling through certain areas cannot be avoided. At the locations where horizontal directional drilling is required, the ductbanks will be buried much deeper than the depth used for the preliminary ampacity calculation. At lower depths, heat caused by the loading of the cable dissipates more slowly. Further ampacity calculations at horizontal directional drilling sites would need to be performed. The transition stations would require an expansion of the existing ROW

c. Regulatory Issues [J. Leung]

Potential impacts to jurisdictional waterways may require an IP from the USACE for permanent impacts greater than 0.5 acres to waters of the US due to potential impacts at

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[203] *See id.*

[204] *See* Attachment K, PDC Report at 30.

trenching locations. It is anticipated that an IP could be obtained from the USACE in about 14 to 24 months. In addition, amendments to the Section 401 WQC and SAA likely would be required, which would likely take three to six months to obtain. Additionally, there is a potential to yield significant subsurface cultural and paleontological resources that could be impacted by construction.

d. Timing [C. Adamson]

Because few installations of 500 kV transmission underground exist in the world, SCE relied on information gathered from various manufacturers, industry experts, and SCE's experience with installation of underground transmission lines at the 69 kV and 115 kV levels. The schedule for Option 6 is provided in Attachment F.[205] The schedule for this option would place Segment 8 of TRTP in service in September 2016.

e. Estimated Construction Costs [D. Heiss]

Option 6 would cost an additional estimated $534 million to construct. $15 million of cost spent to date on the Approved Project would be abandoned.[206]

f. Potential Costs Associated with Lost Renewable Generation [M. Ulrich]

There would be an estimated cost of $174 million in lost renewable generation due to the projected delay associated with permitting and constructing Option 6.[207]

g. EMF Considerations [G. Sias]

For double-circuit XLPE in conduit in the ROW, the calculated magnetic field levels at both the north and south edges of the ROW are approximately 1.3 mG, which are 4.8% of the calculated value of 27.0 mG presented in the 2007 FMP for the Approved Project.[208] While this underground option results in significant reduction in magnetic field levels compared with the

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[205] *See* Attachment F, Consolidated Project Schedules at Option 6.

[206] *See supra* Table 1, Estimated Costs.

[207] *See supra* Table 7, Potential Costs Associated with Renewable Electricity Generation.

[208] *See supra* Section V.B.1.g. for assumptions on calculated magnetic field values. In addition, all underground conductors are assumed to have no sag. *See also* Attachment J, Calculated EMF Values.

overhead design, the cost to underground the proposed transmission line in the Chino Hills area would not be "low-cost" as defined by the Commission's EMF Policies.

10. Option 7: Underground: XLPE directly buried in ROW

a. Description [P. Hlapcich]

Option 7 would require three cables per phase to be directly buried in the existing ROW. Two transition stations, approximately 2.4 acres in size, are required for the terminations structures, lightning arresters, and possible additional shunt compensation reactors.

Cable Size and Configuration: The primary components of the XLPE system for Option 7 would be consistent with those described in Option 6, above. In Option 7, each circuit would have a total of nine cables running parallel to each other, separated by 10 inches center to center. The nine cables would be laid between 4 and 10 feet below grade, and would follow the contour of the ROW.[209]

Route Details: The route for Option 7 would be consistent with the route described above for Option 6.[210] Configuration of the splice vaults for Option 7, however, would be different than for Option 6. The buried splice vaults are arranged in rows of three per circuit. The approximate area requirement of the three set of vault is 166 feet long by 8 feet wide. At a minimum, the two circuits will be separated by 20 feet edge of cable to edge of cable.[211]

Installation Description: To complete installation of the directly buried 500 kV cable system, the following construction and installation activity must be completed: (1) build the two transition stations, (2) open the trench along the existing ROW, (3) install the vault needed for the installation of the cable splices, (4) pull the cables through the vault, (5) install splices, terminations, voltage limiter, grounds, surge and lightning arrester both inside the vaults and in the transition stations, and (6) perform commissioning tests. Shunt compensation reactors and

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[209] *See* Attachment K, PDC Report, Figure 4.2 (depicting example of direct bury with six cables).

[210] *See* Attachment G, Consolidated Map Figures at Figures M-13a and M-13b.

[211] *See* Attachment M, Underground Alternatives and options, Option 7 at Sheets 1-14.

switching equipment likely would need to be installed in both transition stations or at the Mira Loma and Vincent Substations.

The existing ROW might not be suitable for the transportation of heavy cable reels, vaults, or equipment. It could be necessary to construct access road for the transportation of heavy equipment.

Direct Buried Cables: For each circuit, nine cables would be laid in an open trench. The approximate width of this trench would be 98" to accommodate all nine cables spaced 10 inches apart, center to center. Because of cable length and shipping weight restriction, a buried splice box is placed every 1,500 feet to facilitate the splicing of the cable together. The splice box for the direct burial method has an internal dimension of 36 feet long by 3 feet high by 8 feet wide. Each complete vault weighs between 60,000 to 80,000 pounds. To install these vaults, a hole at least 40 feet long by 6 feet high by 12 feet wide is dug up. A heavy crane would be utilized to lower the vault into the pit.

Installing cable using the direct burial method is different than installing cable in ductbanks. To lay cable, a long trench, at least the distance between vaults, must be open.[212] The entire length of the trench, approximately 1500 feet, must stay open until the cable is completely laid in the trench.[213] The process for laying cable in the trench typically consists of: (1) preparation of the bottom of the trench with bedding sand, (2) installing rollers in the bottom of the trench, (3) pulling the nine cables between splice boxes, remove the trench rollers, (4) filling the trench with engineered thermal backfill, (5) pouring a six inches thick concrete cap, and (6) backfilling the remainder of the trench with compacted native soil or a fluidized thermal backfill.[214] This process could require the trench to remain open for several weeks or longer.

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[212] *See* Attachment K, PDC Report at 16.

[213] *Id.*

[214] *Id.*

Transition Stations: The transition stations required for Option 7 are consistent with those described in Option 6.[215]

Cable Laying/Pulling: For the direct buried installation of XLPE cable, approximately 240 reels of cable are required to be transported from a SCE's storage yard to the job side. Each reel, holding 1,550 feet of cable, is approximately 13 feet in diameter by 8 feet wide, and weighs approximately 45,000 pounds.[216] Because of the size and weight, only one reel can fit on a truck.

The cable reel will be loaded onto a cable reel stand positioned just outside of a splice box. A pulling winch would be located at the next splice box. The pulling machine would slowly pull the cable from one splice box to the next, taking care that cable jackets are not damaged during the pulling process. This operation is repeated until all cables are pulled into all the vaults and into the transition stations.

Accessories Installation: The accessories installation for Option 7 would be consistent with that described for Option 5.[217]

Operation and Maintenance: The projected XLPE cables life of Option 7 is consistent with that described in Option 5.[218]

Typically, a small handhole with an internal dimension of 4 feet wide by 4 feet long by 4 feet high is installed adjacent to the buried splice box. The sheath voltage limiters and grounding connections are installed in the handhole. SCE's qualified electrical workers must check on the condition of the voltage limiting arresters and grounding connection in the handhole. However, cable splices cannot be checked as they will be buried in the splice boxes.

The biggest risk associated with a direct burial method is that it could be difficult, if not impossible, to monitor cable condition. Also, repair to this type of installation could require a

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[215] *See supra* Section V.C., Alternative 5 and Underground Options Within Existing Chino Hills ROW, subsection 9, Option 6: Underground: XLPE in Conduit in ROW.

[216] *See* Attachment K, PDC Report at 27, 32.

[217] *See supra* Section V.C., Alternative 5 and Underground Options Within Existing Chino Hills ROW, subsection 8, Option 5: Underground Construction with XLPE in Tunnel in ROW.

[218] *See id.*

longer timeframe than the ductbank or tunnel method. Upgrading this type of installation for future expansion is nearly impossible as the cable would need to be removed and new cable would need to be installed.[219] A map of Option 7 is included in Attachment G, Figures M-13a and M-13b.

b. Engineering and Technical Feasibility [P. Hlapcich]

It is unknown whether installation of the directly buried 500 kV XLPE cable system in the ROW is technically feasible, particularly because there are no active direct buried 500 kV transmission lines in the world.[220] This type of installation poses the risk from an operation and maintenance perspective, because of the difficulty monitoring cable condition, potential dig-in from foreign equipment, and longer repair time in the event of failure. Transition stations would require an expansion of the existing ROW. The ampacity requirement of the overhead conductor could potentially be matched by installing three cables per phase. Because of the hilly terrain of the ROW in Chino Hills, however, directional drilling through certain areas cannot be avoided. At the locations where horizontal directional drilling is required, the ductbanks will be buried much deeper than the depth used for the preliminary ampacity calculation. At lower depth, heat caused by the loading of the cable dissipates more slowly. Further ampacity calculations at horizontal directional drilling sites would need to be performed. The transition stations would require an expansion of the existing ROW.

c. Regulatory Issues [J. Leung]

Potential impacts to jurisdictional waterways may require an IP from the USACE for permanent impacts greater than 0.5 acres due to potential impacts at trenching locations. It is anticipated that an IP could be obtained from the USACE in about 14 to 24 months. In addition, amendments to the Section 401 WQC and SAA likely would be required, which would likely take three to six months to obtain. Finally, there is a potential to yield significant subsurface cultural and paleontological resources that could be impacted by construction.

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[219] *See* Attachment K, PDC Report at 17.

[220] *See* Attachment L, Technical Overview at 2.

d. Timing [C. Adamson]

Because few installation of 500 kV transmission underground exist in the world, SCE relied on information gathered from various manufacturers, industry experts, and SCE's experience with installation of underground transmission lines at the 69 kV and 115 kV levels. The schedule for Option 7 is provided in Attachment F.[221] The schedule for this option would place Segment 8 of TRTP in service in February 2017.

e. Estimated Construction Costs [D. Heiss]

Option 7 would cost an additional estimated $524 million to construct. $15 million of cost spent to date on the Approved Project would be abandoned.[222]

f. Potential Costs Associated with Lost Renewable Generation [M. Ulrich]

There would be an estimated cost of $311 million in lost renewable generation due to the projected delay associated with permitting and constructing Option 7.[223]

g. EMF Considerations [G. Sias]

For double-circuit XLPE direct bury in ROW, the calculated magnetic field levels at both the north and south edges are approximately 0.7 mG, which are 2.6% of the calculated value of 27.0 mG presented in the 2007 FMP for the Approved Project.[224] While this underground option results in significant reduction in magnetic field levels compared with the overhead design, the cost to underground the proposed transmission line in the Chino Hills area would not be "low-cost" as defined by the Commission's EMF Policies.

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[221] *See* Attachment F, Consolidated Project Schedules at Option 7.

[222] *See supra* Table 1, Estimated Costs.

[223] *See supra* Table 7, Potential Costs Associated with Renewable Electricity Generation.

[224] *See supra* Section V.B.1.g. for assumption on calculated magnetic field values. In addition, all underground conductors are assumed to have no sag. *See also* Attachment J, Calculated EMF Values.

D. Other Optional Routes Within Chino Hills

1. Option 8: Underground: XLPE in Conduit in Street

a. Description [P. Hlapcich]

Option 8 would consist of installing three XLPE cables per phase in ductbanks under city streets in Chino Hills, primarily following under Eucalyptus Avenue. Option 8 would also require the construction of two transition stations, approximately 2.4 acres in size, for the terminations structures, lightning arresters, and possible additional shunt compensation reactors.

Cable Size and Configuration: The primary components and configuration of the XLPE system for Option 8 would be consistent with Option 6.[225]

Route Details: As shown in Attachment H, the proposed transmission line would shift from overhead to underground at approximately Mile Post 21.9.[226] The underground route would leave the existing ROW approximately 1,000 feet west of Rancho Hills Drive and continue onto Eucalyptus Avenue. The transmission lines would continue underground along Eucalyptus Avenue for approximately 3.5 miles until Eucalyptus Avenue turns into Pipeline Avenue. From that point, the underground trenches would head east into the existing ROW. The trench lines continue to approximately Mile Post 25.4, where the underground line would shift back to overhead.[227]

Every 1,500 feet, a set of three splice vaults would be installed. As shown in Attachment M, the three splice vaults would be in-line with sufficient spacing to allow the ductbank to swing into and out of each splice vault. The approximate area requirement of the three set of vault is 200 feet long by 14 feet wide for each circuit. The two circuits require 20 feet separation.[228]

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[225] *See* discussion *supra* at Section V.C., Alternative 5 and Underground Options Within Existing Chino Hills ROW, subsection 9, Option 6: Underground: XLPE in Conduit in ROW.

[226] *See* Attachment G, Consolidated Map Figures at Figures M-14a and M-14b.

[227] *See id.*

[228] *See* Attachment M, Underground Alternatives and options at Options 8 & 9, Sheets 1 to 6, A and B.

Installation Description: The construction and installation activity that must be completed for Option 8 is consistent with that described in Option 6. Because construction activity on Option 8 is performed on paved streets, however, additional construction of an access road may not be needed. Existing utilities within the city street would have to be relocated or otherwise accommodated during the construction and installation of Option 8.[229]

Ductbank Systems: The ductbank systems and installation description for Option 8 is consistent with that described in Option 6.[230] To minimize traffic disruption, however, only one trench will be constructed at a time.

Horizontal direction drilling could be required in two locations to avoid trenching through a channel crossing and busy streets, i.e., Chino Hills Parkway. In this construction method, six bores approximately 42 inches in diameter, spaced 10 feet edge to edge are required. The bores could potentially be installed between 30 to 40 feet below grade.

Transition Stations: As with the previous underground options, the transition stations required for Option 8 are consistent with those described in Option 6.[231]

Cable Pulling: The pulling of XLPE cable for Option 8 into ductbank is consistent with that described for Option 6. It is anticipated that at least half of the road will be blocked while cable is being handled and pulled.

Accessories Installation: The accessories installation for Option 8 would be consistent with that described for Option 5.[232]

Operations and Maintenance: The operation and maintenance requirements for Option 8 are consistent with those described for Option 6.[233] However, structural integrity of vaults

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[229] *See* Attachment K, PDC Report at 32.

[230] *See* discussion *supra* at Section V.C., Alternative 5 and Underground Options Within Existing Chino Hills ROW, subsection 9, Option 6: Underground: XLPE in Conduit in ROW.

[231] *See id.*

[232] *See* discussion *supra* at Section V.C., Alternative 5 and Underground Options Within Existing Chino Hills ROW, subsection 8, Option 5: Underground Construction with XLPE in Tunnel in ROW.

become much more critical as they are located in city streets and could pose danger to the public. A map of Option 8 is included in Attachment G, Figures M-14a and M-14b.

b. Engineering and Technical Feasibility [P. Hlapcich]

It is unknown whether installation of the 500 kV XLPE cable system in a ductbank in the city street is technically feasible, particularly because there are no active direct buried 500 kV transmission lines in the world, and impact on city facilities is unknown. The ampacity requirement of the overhead conductor can be matched by installing three cables per phase. Because of the hilly terrain of the ROW in Chino Hills, however, directional drilling through certain areas cannot be avoided. At the locations where horizontal directional drilling is required, the ductbanks will be buried much deeper than the depth used for the preliminary ampacity calculation. At lower depth, heat caused by the loading of the cable dissipates more slowly. Further ampacity calculations at horizontal directional drilling sites would need to be performed. Another particular concern for installing cable in city streets is the co-mingling of the 500 kV cable and other public utilities and facilities that are likely buried beneath the streets. Locating adequate area for the splice vaults in city streets may also be a problem. The transition stations would require acquisition of additional ROW.

c. Regulatory Issues [J. Leung]

Potential impacts to jurisdictional waterways may require amendment to the CWA Section 404 NWP authorization if construction methods cannot avoid impacts to the channel crossing. In addition, amendments to the Section 401 WQC and Streambed Alteration Agreement may be required. In addition, amendments to the Section 401 WQC and SAA likely would be required. The process for obtaining amendment s to relevant permits from the applicable agencies can take three to six months. Additionally, there is a potential to yield significant subsurface cultural and paleontological resources that could be impacted by construction.

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[233] *See* discussion *supra* at Section V.C., Alternative 5 and Underground Options Within Existing Chino Hills ROW, subsection 9, Option 6: Underground: XLPE in Conduit in ROW.

d. Timing [C. Adamson]

Because few installation of 500 kV transmission underground exist in the world, SCE relied on information gathered from various manufacturers, industry experts, and SCE's experience with installation of underground transmission lines at the 69 kV and 115 kV levels. The schedule for Option 8 is provided in Attachment F.[234] The schedule for this option would place Segment 8 of TRTP in service in April 2017.

e. Estimated Construction Costs [D. Heiss]

Option 8 would cost an additional estimated $505 million to construct. $15 million of cost spent to date on the Approved Project would be abandoned.[235]

f. Potential Costs Associated with Lost Renewable Generation [M. Ulrich]

There would be an estimated cost of $311 million in lost renewable generation due to the projected delay associated with permitting and constructing Option 8.[236]

g. EMF [G. Sias]

Because this option would not be built in the existing ROW, calculated magnetic field values at the ROW edge cannot be reported as was done in the 2007 FMP and for other options. Instead, the calculated peak values are presented here because the areas directly above the underground lines are in public areas. The calculated peak values are not intended to be compared directly with calculated ROW edge values of other options to be built within the ROW.[237] For double-circuit XLPE in conduit in street, the calculated peak magnetic field is 35.9 mG.[238]

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[234] *See* Attachment F, Consolidated Project Schedules at Option 8.

[235] *See supra* Table 1, Estimated Costs.

[236] *See supra* Table 7, Potential Costs Associated with Renewable Electricity Generation.

[237] *See supra* Section IV.B.1.g. for assumption on calculated magnetic field values. In addition, all underground conductors are assumed to have no sag. *See also* Attachment J, Calculated EMF Values.

[238] *Id.*

2. Option 9: Underground: XLPE Directly Buried in the Street

a. Description [P. Hlapcich]

Option 9 would require three cables per phase to be directly buried beneath city streets. Two transition stations, approximately 2.4 acres in size, would be required for the terminations structures, lightning arresters, and possible additional shunt compensation reactors.

Cable Size and Configuration: The primary components and configuration of the XLPE system for Option 9 would be consistent with Option 7.

Route Details: The route for Option 9 would be consistent with the route described for Option 8. Every 1,500 feet, three sets of buried splice vaults are installed. The buried splice vaults are arranged in rows of three per circuit.[239] The approximate area requirement of the three set of vault is 166 feet long by 8 feet wide. At a minimum, the two circuits will be separated by 20 feet edge of cable to edge of cable.

Installation Description: The required construction and installation activity for Option 9 is consistent with that described above for Option 7. Additionally, existing utilities within the city street would have to be relocated or otherwise accommodated during the construction and installation of Option 9.[240]

Direct Buried Cables: The description on direct buried cables configuration and installation is consistent with that described for Option 7.[241] Because having open trench in the street could significantly disturb normal traffic flows, however, coordination with Chino Hills and proper traffic control plans would be important.

Transition Stations: As with the previous underground options, the transition stations required for Option 9 are consistent with those described in Option 6.[242]

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239 *See* Attachment M, Underground Alternative/Options, Option 8-9 at Sheets 1-14.

240 *See* Attachment K, PDC Report at 32.

241 *See* discussion *supra* at Section V.C., Alternative 5 and Underground Options Within Existing Chino Hills ROW, subsection 10, Option 7: Underground: XLPE direct bury in ROW.

242 *See* discussion *supra* at Section V.C., Alternative 5 and Underground Options Within Existing Chino Hills ROW, subsection 9, Option 6: Underground: XLPE in Conduit in ROW.

Cable Laying/Pulling: The XLPE cable that would be directly buried for Option 9 is consistent with that described for Option 7, and would be transported to the site in Chino Hills in the same manner.[243]

Accessories Installation: The accessories installation for Option 9 would be consistent with that described for Option 5.[244]

Operation and Maintenance: The operation and maintenance requirement for Option 9 are consistent with those described for Option 7.[245] A map of Option 9 is included in Attachment G, Figures M-14a and M-14b.

b. Engineering and Technical Feasibility [P. Hlapcich]

It is unknown whether installation of the directly buried 500 kV XLPE cable system in City streets is technically feasible, particularly because there are no active direct buried 500 kV transmission lines in the world. This type of installation poses risks from an operation and maintenance perspective, because of the difficulty of monitoring cable condition, potential dig-in from foreign equipment, and longer repair time in the event of failure. Also, having long trenches opened in city streets can cause serious disruption to normal traffic flow during the three year construction period. The ampacity requirement of the overhead conductor can be matched by installing three cables per phase. Because of the hilly terrain of the ROW in Chino Hills, however, directional drilling through certain areas cannot be avoided. At the locations where horizontal directional drilling is required, the ductbanks will be buried much deeper than the depth used for the preliminary ampacity calculation. At lower depth, heat caused by the loading of the cable dissipates more slowly. Further ampacity calculations at horizontal

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[243] *See* discussion *supra* at Section V.C., Alternative 5 and Underground Options Within Existing Chino Hills ROW, subsection 10, Option 7: Underground: XLPE direct bury in ROW

[244] *See* discussion *supra* at Section V.C., Alternative 5 and Underground Options Within Existing Chino Hills ROW, subsection 8, Option 5: Underground Construction with XLPE in Tunnel in ROW.

[245] *See* discussion *supra* at Section V.C., Alternative 5 and Underground Options Within Existing Chino Hills ROW, subsection 10, Option 7: Underground: XLPE direct bury in ROW.

directional drilling sites would need to be performed. The transition station requirement of 320 feet by 330 feet expands beyond the ROW.

c. Regulatory Issues [J. Leung]

Potential impacts to jurisdictional waterways may require amendment to the CWA Section 404 NWP authorization if construction methods cannot avoid impacts to the channel crossing. In addition, amendments to the Section 401 WQC and Streambed Alteration Agreement may be required. In addition, amendments to the Section 401 WQC and SAA would likely be required. The process for obtaining amendments to relevant permits from the applicable agencies can take three to six months. Additionally, there is a potential to yield significant subsurface cultural and paleontological resources that could be impacted by construction.

d. Timing [C. Adamson]

Because few installation of 500 kV transmission underground exist in the world, SCE relied on information gathered from various manufacturers, industry experts, and SCE's experience with installation of underground transmission lines at the 69 kV and 115 kV levels. The schedule for Option 9 is provided in Attachment F.[246] The schedule for this option would place Segment 8 of TRTP in service in May 2017.

e. Estimated Construction Costs [D. Heiss]

Option 9 would cost an additional estimated $516 million to construct. $15 million of cost spent to date on the Approved Project would be abandoned.[247]

f. Potential Costs Associated with Lost Renewable Generation [M. Ulrich]

There would be an estimated cost of $311 million in lost renewable generation due to the projected delay associated with permitting and constructing Option 9.[248]

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[246] *See* Attachment F, Consolidated Project Schedules at Option 9.

[247] *See supra* Table 1, Estimated Costs.

[248] *See supra* Table 7, Potential Costs Associated with Renewable Electricity Generation.

g. EMF [G. Sias]

In addition to the assumptions outlined above,[249] it is assumed that all underground conductors are assumed to have no sag. Because this option would not be built in the existing ROW, calculated magnetic field values at the ROW edge cannot be reported as was done in the 2007 FMP and for other options. Instead, the calculated peak values are presented here because the areas directly above the underground lines are in public areas. The calculated peak values are not intended to be compared directly with calculated ROW edge values of other options to be built within the ROW. For double-circuit XLPE in conduit in street, the calculated peak magnetic field is 62.8 mG.[250]

VI. MITIGATION FOR TRTP WITHIN CHINO HILLS [T. BURHENN]

A. The Commission Imposed the Appropriate Scope of Mitigation on the Project Under CEQA

The ACR requests information concerning potential mitigation for impacts of the Project.[251] The Final EIR carefully analyzed the potential environmental impacts of the Project and proposed an array of mitigation measures to address those impacts. In approving the Project and adopting the Final EIR, the Commission required SCE to implement a 112-page Mitigation Monitoring Plan (Mitigation Plan) consisting of 89 Applicant-proposed Measures and 127 individual mitigation measures identified by the Final EIR, each carefully designed to avoid or reduce the severity and magnitude of potentially significant environmental impacts associated with TRTP implementation across 16 study areas.

The Final EIR and comprehensive Mitigation Plan contain numerous mitigation measures designed to address concerns raised by Chino Hills including:

- Visual Resources;[252]

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[249] *See* discussion *supra* Section V.B.1.g. regarding assumptions in EMF calculations.

[250] *See* Attachment J, Calculated EMF Values.

[251] *See* ACR at 3.

[252] For those areas like Segment 8A where SCE proposed replacing an existing transmission line with one utilizing increased structured sizes and new materials, the Commission required, where feasible, the use of TSPs instead of LSTs and required treatment of surfaces with

- Noise;[253]
- Construction Impacts.[254]

To date, Chino Hills has not identified feasible mitigation measures that have not already been implemented by the Commission.

B. Monetary Compensation for the Project's Alleged Impacts to Property Values is Inappropriate Under CEQA

The Final EIR explains that mitigation measures imposed on a project must be designed to avoid or minimize project-associated environmental impacts.[255] The Final EIR also notes that "any potential effects on private property values are not considered impacts on the environment under CEQA, although it is an issue that can be considered by the CPUC in its decision making process."[256] The Commission recognized this concept in its Decision approving the Project finding that "CEQA requires a lead agency to identify and study potentially feasible alternatives

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appropriate colors, textures, and finishes to most effectively blend the structures with the visible backdrop landscape. *See* Final EIR at G-78 to G-79. The Commission also required SCE, where feasible, to match existing structure spacing and spans as close as possible in order to reduce visual complexity from sensitive receptor locations. *Id.*

[253] The Commission imposed various mitigation measures to reduce Project noise impacts including installation of noise reduction features (e.g., mufflers and engine shrouds) on construction equipment, installation of temporary sound walls or acoustic blankets around stationary noise sources, minimization of unnecessary vehicle idling time, restrictions on diesel engine idling, and routing all construction traffic and helicopter flight away from residences, schools, and recreational facilities to the maximum extent feasible. *See* Final EIR at G-70 to G-71.

[254] Examples of construction mitigation measures imposed by the Commission include the implementation of a fugitive dust control plan and an erosion control plan (*see* Final EIR at G-5, G-65), implementation of a construction traffic management plan (*id.* at G-75 to G-76), the provision of a construction liaison for residents, advance notification of certain construction activities to residents, and provision of quarterly construction updates to residents (*id.* at G-68).

[255] *See* Final EIR at 1-1.

[256] *See* Final EIR at H.A-321 (Response to City of Chino Hills Draft EIR Comment Letter). The Commission, in accepting testimony during the Project proceedings "regarding those elements of [Public Utilities Code Section] § 1002 not otherwise considered under CEQA, i.e., community value," did in fact properly consider impacts on property values under § 1002 (as opposed to CEQA) and concluded that the Environmentally Superior Alternative best satisfied the "totality of the criteria under § 1002 . . . ." D.09-12-044 at 18, 51.

and mitigation measures to reduce a project's significant *environmental* impacts."[257] The Commission also concluded that measures that do not reduce or avoid any significant adverse impacts caused by the implementation of a project do not constitute mitigation[258] and that mitigation measures designed to improve existing conditions, as well as provide compensatory benefits unrelated to Project impacts, are outside the scope of CEQA.[259] As explained below, because the Commission-adopted Final EIR determined that the Project would not have significant environmental impacts on property values, compensation for alleged diminution of property values is inappropriate under CEQA.

1. The Commission Concluded That The Project Does Not Have Significant Environmental Impacts on Property Values

In adopting the Final EIR and approving the Project, the Commission acknowledged the Final EIR conclusion that there were no significant impacts on property values as the result of the construction of TRTP.[260] The Final EIR undertook a thorough review of this issue before reaching its conclusions, surveying numerous available studies on the impacts of infrastructure that concluded impacts to nearby home prices is very small and typically disappears within five years.[261] Specifically, the Final EIR concluded that:

- Proximity to a transmission line does not necessarily cause a reduction in value of surrounding private properties, and any decrease is usually small.[262]

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257 D.09-12-044 at 4 (emphasis added).

258 For example, the City of Chino Hills proposed as part of the "21st Century Proposal" a $50 million payment to CHSP as a slush fund for future improvements to the Park not necessarily tied to Project impacts. The Commission concluded that the City's proposed $50 million payment did not "constitute mitigation as defined by CEQA because the measures do not reduce or avoid any significant adverse impacts caused by the implementation of the Proposed Project." D.09-12-044 at 74.

259 *See* D.09-12-044 at 34, 99 (Conclusion of Law No. 12: "Compensatory benefits unrelated to project benefits are outside the scope of CEQA").

260 There are approximately 206 parcels abutting the ROW within Chino Hills. This number includes parcels that are directly abutting the ROW as well as those that have a small buffer. Of that number, approximately 175 parcels directly abut the ROW.

261 *See* Final EIR at 3.12-28.

262 Final EIR at 3.12-20.

- Other physical and neighborhood qualities have a greater impact on property value determination.[263]
- Any effects of a transmission line on sale prices of properties diminish over time and all but disappear in five years.[264] ("In addition, across the board, studies have generally concluded that over time, potential adverse effects to property value tend to diminish to a point of being negligible within five years.").
- There are many factors involved in purchasing a new home, including affordability, age, size, and schools; it has not been demonstrated that a view obstruction would be a major factor in a property value decline.[265]

The Final EIR also determined that "[i]t is reasonable to assume that some aspect of the Project construction and/or operation and maintenance would potentially affect private property values . . . . However . . . the effects of transmission lines on property value are generally smaller in comparison to other relevant factors."[266]

2. Because The Commission Concluded That The Project Does Not Have Significant Environmental Impacts On Property Values, Mitigation Is Inappropriate

The Commission properly concluded, citing the United States Supreme Court, that "a 'rough proportionality' or 'nexus' must exist between the project's impact and the mitigation imposed by the public agency."[267] Because the Commission found that there were no significant impacts on property values as the result of the construction of TRTP,[268] it would be inappropriate to impose mitigation for unsubstantiated claims of declining property values in Chino Hills as a result of TRTP.[269] Since approval of the Project, no parties to the proceedings

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[263] *Id.*

[264] *Id.* at 3.12-28.

[265] *Id.* at 3.12-27.

[266] *Id.* at 3.12-29.

[267] *See* D.09-12-044 at 48.

[268] *See* Final EIR at 3.12-25 to 3.12-29.

[269] *See* D.09-12-044 at 42-44.

have provided any new facts demonstrating that the Project has significantly impacted property values and any additional mitigation for each of these factors remains improper.[270]

C. Potential Additional Actions to Reduce Visible Electrical Infrastructure in the Chino Hills Area

The ACR states that solutions in addition to those enumerated in the ACR would also be considered by the Commission.[271] SCE has worked to identify actions that could be taken within Chino Hills to potentially enhance the overall appearance of the electrical system infrastructure within the Chino Hills area. The concept would be for SCE to potentially underground, reconfigure, or remove existing 66 kV and 12 kV facilities within Chino Hills. This concept would reduce visible infrastructure within the Chino Hills community. SCE continues to explore the details of implementing this approach.

Lastly, SCE suggests that it would be most expedient for the Commission to consider asking SCE and Chino Hills to participate in the Commission's Alternative Dispute Resolution (ADR) program as a means of determining whether these options or others would serve to resolve the issues in the City's pending Application for Rehearing. SCE notes that use of the ADR program was suggested by both the City of Chino Hills and Administrative Law Judge at the Prehearing Conference on December 5, 2011.[272]

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[270] SCE has previously presented testimony in this proceeding that there is no evidence that TRTP, as opposed to general economic conditions, is the cause of any diminished property values in Chino Hills and other areas along the Commission-approved route. *See* Attachment O, Declaration of David Guder (Guder Decl.) at ¶ 18.

[271] *See* ACR at 3.

[272] Prehearing Conference Transcript at 80-82.

APPENDIX A

WITNESS QUALIFICATIONS

SOUTHERN CALIFORNIA EDISON COMPANY

QUALIFICATIONS AND PREPARED TESTIMONY OF CHARLES ADAMSON

Q. Please state your name and business address for the record.

A. My name is Charles Adamson, and my business address is 6 Pointe Drive, Brea, California 92821.

Q. By whom are you employed?

A. I am employed by Southern California Edison Company (SCE).

Q. Briefly describe your present responsibilities at SCE.

A. I am a Manager of Large Transmission Projects in the Transmission and Distribution Business Unit at SCE. I am also currently the acting Project Manager of licensing for the Tehachapi Renewable Transmission Project (TRTP) Segments 4-11. As Project Manager, I have been responsible for all licensing aspects of the TRTP including siting, preliminary engineering, cost, schedule, and environmental analysis.

Q. Briefly describe your educational and professional background.

A. I received a Certificate in Project Management from the University of California Irvine in 2000. My experience includes project management, engineering, technical training, and technical support. From 1990 to 1997 my responsibilities included technical training and support, as well as engineering, design, and process improvement. From 1997 to 2001, I managed substation automation and generation divestiture projects. From 2001 to 2006, I managed both licensing and construction of transmission and substation projects. From 2006 to 2010, I managed the licensing of large transmission projects. From 2010 to present I manage both the licensing and construction of large transmission and substation projects.

Q. What is the purpose of your testimony in this proceeding?

A. The purpose of my testimony in this proceeding is to sponsor portions of *Southern California Edison Company's Testimony in Response to the Assigned Commissioner's Ruling on the Tehachapi Renewable Transmission Project (TRTP)*, as identified in the Table of Contents thereto.

Q. Was this material prepared by you or under your supervision?
A. Yes, it was.
Q. Insofar as this material is factual in nature, do you believe it to be correct?
A. Yes, I do.
Q. Insofar as this material is in the nature of opinion or judgment, does it represent your best judgment?
A. Yes, it does.
Q. Does this conclude your qualifications and prepared testimony?
A. Yes, it does.

SOUTHERN CALIFORNIA EDISON COMPANY

QUALIFICATIONS AND PREPARED TESTIMONY OF THOMAS A. BURHENN

Q. Please state your name and business address for the record.

A. My name is Thomas A. Burhenn, and my business address is 2244 Walnut Grove Avenue, Rosemead, California 91770.

Q. By whom are you employed?

A. I am employed by Southern California Edison Company (SCE).

Q. Briefly describe your present responsibilities at SCE.

A. I am Director of Regulatory Affairs in the External Relations Department. My responsibilities include the management of the regulatory staff responsible for the licensing of transmission and generation facilities, regulatory issues related to the California Environment Quality Act (CEQA), and the sale or encumbrance of real property and utility assets.

Q. Briefly describe your educational and professional background.

A. I received a Bachelor of Science Degree in Economics from California Polytechnic State University, San Luis Obispo, in 1980. I joined SCE in 1980 and worked in SCE's System Planning Division. My duties entailed preparing demand forecasts for Edison's wholesale and retail customer groups, project licensing support, resource planning and scenario planning. I joined the Regulatory Policy and Affairs Department in 1989. I have been responsible for the regulatory aspects of numerous proceedings including: transmission and generation project licensing, the EMF and LEV investigations, the sales of utility generation assets, P.U. Code Section 851 applications, and the SONGS Steam Generator Replacement Project, while holding a series of positions with increasing responsibilities. I assumed my present position in 2008.

Q. What is the purpose of your testimony in this proceeding?

A. The purpose of my testimony in this proceeding is to sponsor portions of *Southern California Edison Company's Testimony in Response to the Assigned Commissioner's*

Ruling on the Tehachapi Renewable Transmission Project (TRTP), as identified in the Table of Contents thereto.

Q. Was this material prepared by you or under your supervision?

A. Yes, it was.

Q. Insofar as this material is in the nature of opinion or judgment, does it represent your best judgment?

A. Yes, it does.

Q. Does this conclude your qualifications and prepared testimony?

A. Yes, it does.

SOUTHERN CALIFORNIA EDISON COMPANY

QUALIFICATIONS AND PREPARED TESTIMONY OF JORGE CHACON

Q. Please state your name and business address for the record.

A. My name is Jorge Chacon and my business address is 2244 Walnut Grove Avenue, Rosemead, California 91770.

Q. By whom are you employed?

A. I am employed by Southern California Edison Company (SCE).

Q. Briefly describe your present responsibilities at SCE.

A. I am the manager of the Generation Interconnection Planning Group in SCE's Transmission and Distribution Business Unit. In that capacity, I am responsible for, among other things, managing the planning of high voltage transmission systems for SCE, including the Tehachapi Renewable Transmission Project (TRTP).

Q. Briefly describe your educational and professional background.

A. I obtained my Bachelor of Science degree in Electrical Engineering, from California State Polytechnic University, Pomona, in 1997. I am presently pursuing a Master in Business Administration from the University of La Verne. Over the past twelve years, I have performed transmission planning studies regarding transmission capability in the Tehachapi area to accommodate new generation.

Q. What is the purpose of your testimony in this proceeding?

A. The purpose of my testimony in this proceeding is to sponsor portions of *Southern California Edison Company's Testimony in Response to the Assigned Commissioner's Ruling on the Tehachapi Renewable Transmission Project (TRTP)*, as identified in the Table of Contents thereto.

Q. Was this material prepared by you or under your supervision?

A. Yes, it was.

Q. Insofar as this material is factual in nature, do you believe it to be correct?

A. Yes, I do.

Q. Insofar as this material is in the nature of opinion or judgment, does it represent your best judgment?
A. Yes, it does.
Q. Does this conclude your qualifications and prepared testimony?
A. Yes, it does.

SOUTHERN CALIFORNIA EDISON COMPANY

QUALIFICATIONS AND PREPARED TESTIMONY OF JOHN COOPER

Q. Please state your name and business address for the record.

A. My name is John Cooper, and my business address is 23 Rancho Verde, Tijeras, New Mexico 87059.

Q. Briefly describe your present relationship with Southern California Edison Company (SCE).

A. I have been retained by SCE as a consultant to address issues raised by the potential undergrounding of a portion of Segment 8A of the Tehachapi Renewable Transmission Project (TRTP) that crosses through the City of Chino Hills.

Q. Briefly describe your educational and professional background.

A. I am currently the co-founder and Principal Consultant at Power Delivery Consultants, Inc. My field of expertise is underground transmission cable engineering and power frequency magnetic fields. I received a BS in Electrical Engineering from Texas A&M University in 1967 and a Master of Science in Electrical Engineering from the University of Pittsburgh in 1968. I have authored chapters of the Electric Power Research Institute's (EPRI) 2006 Underground Transmission Systems Reference Book about Cable Testing and Utility System Considerations. Before co-founding Power Delivery Consultants, I worked as an engineer at Westinghouse Electric and as Manager of the EPRI Waltz Mill Underground Transmission Test Facility. I also have worked at Power Technologies, Inc. as a Senior Consultant specializing in underground transmission cable engineering and the design of electrical testing facilities. I am a Life Fellow member of the Institute of Electrical and Electronic Engineers (IEEE).

Q. What is the purpose of your testimony in this proceeding?

A. The purpose of my testimony in this proceeding is to sponsor portions of *Southern California Edison Company's Testimony in Response to the Assigned Commissioner's Ruling on the Tehachapi Renewable Transmission Project (TRTP)*, as identified in the Table of Contents thereto.

Q. Was this material prepared by you or under your supervision?
A. Yes, it was.
Q. Insofar as this material is factual in nature, do you believe it to be correct?
A. Yes, I do.
Q. Insofar as this material is in the nature of opinion or judgment, does it represent your best judgment?
A. Yes, it does.
Q. Does this conclude your qualifications and prepared testimony?
A. Yes, it does.

SOUTHERN CALIFORNIA EDISON COMPANY

QUALIFICATIONS AND PREPARED TESTIMONY OF DAVID GUDER

Q. Please state your name and business address for the record.

A. My name is David Guder, and my business address is 2131 Walnut Grove Avenue, Rosemead, CA 91770.

Q. By whom are you employed?

A. I am employed by Southern California Edison Company (SCE).

Q. Briefly describe your present responsibilities at SCE.

A. I am the Lead Appraiser in the Real Properties Valuation Department at SCE. I am responsible for, among other things, managing valuation work for major transmission projects and all new electrical facility needs, consulting and financial analysis of planning and project licensing, and valuation related research.

Q. Briefly describe your educational and professional background.

A. I received a Bachelor of Arts degree in Sociology with an emphasis in Demography/Statistical Research from University of California, Los Angeles, in 1985. From 1986 to 1988 I worked as a Staff Appraiser at Security Pacific National Bank. From 1998 to 1992, I worked as a Right of Way Agent and Appraiser for the California Department of Transportation. In 1992, I joined SCE's Real Properties Department. I hold a number of professional certificates related to property and right-of-way appraisal. I have been a Certified General Real Estate Appraiser in California since 1993. I have been a General Associate Member of the Appraisal Institute since 2000. I am a Senior Member of the International Right of Way Association.

Q. What is the purpose of your testimony in this proceeding?

A. The purpose of my testimony in this proceeding is to sponsor portions of *Southern California Edison Company's Testimony in Response to the Assigned Commissioner's Ruling on the Tehachapi Renewable Transmission Project (TRTP)*, specifically real estate information provided in Section IV.

Q. Was this material prepared by you or under your supervision?

A. Yes, it was.

Q. Insofar as this material is factual in nature, do you believe it to be correct?

A. Yes, I do.

Q. Insofar as this material is in the nature of opinion or judgment, does it represent your best judgment?

A. Yes, it does.

Q. Does this conclude your qualifications and prepared testimony?

A. Yes, it does.

SOUTHERN CALIFORNIA EDISON COMPANY QUALIFICATIONS AND PREPARED TESTIMONY OF DEAN HEISS

Q. Please state your name and business address for the record.

A. My name is Dean Heiss, and my business address is 6 Pointe Drive, Brea, California 92821.

Q. By whom are you employed?

A. I am employed by Southern California Edison Company (SCE).

Q. Briefly describe your present responsibilities at SCE.

A. I am a Project Manager assigned to manage the development and implementation of assigned Project Controls initiatives supporting SCE's Major Project Organization.

Q. Briefly describe your educational and professional background.

A. I received my undergraduate degree in Aeronautical Science from Embry-Riddle Aeronautical University in 2003 and earned my Project Management Certificate from California Institute of Technology in 2011. I joined SCE in 2009 as a Project Cost Engineer for the Tehachapi Renewable Transmission Project (TRTP). Prior to assuming this position, I worked as a Project Controls consultant with SCE - Real Properties and with Pfizer.

Q. What is the purpose of your testimony in this proceeding?

A. The purpose of my testimony in this proceeding is to sponsor portions of *Southern California Edison Company's Testimony in Response to the Assigned Commissioner's Ruling on the Tehachapi Renewable Transmission Project (TRTP)*, as identified in the Table of Contents thereto.

Q. Was this material prepared by you or under your supervision?

A. Yes, it was.

Q. Insofar as this material is factual in nature, do you believe it to be correct?

A. Yes, I do.

Q. Insofar as this material is in the nature of opinion or judgment, does it represent your best judgment?

A. Yes, it does.

Q. Does this conclude your qualifications and prepared testimony?

A. Yes, it does.

SOUTHERN CALIFORNIA EDISON COMPANY QUALIFICATIONS AND PREPARED TESTIMONY OF PETER L. HLAPCICH

Q. Please state your name and business address for the record.

A. My name is Peter L. Hlapcich, and my business address is 2244 Walnut Grove Avenue, Rosemead, California 91770.

Q. By whom are you employed?

A. I am employed by Southern California Edison Company (SCE).

Q. Briefly describe your present responsibilities at SCE.

A. I am the Manager of SCE's Transmission Group and the Civil/Structural/Geotechnical Group, and work with both the overhead and underground groups.

Q. Briefly describe your educational and professional background.

A. I received a BS in Civil Engineering from California State University at Long Beach in 1971, a MS in Civil Engineering from California State University at Long Beach in 1976, and a MS in Organization Development from Pepperdine University in 1998. I am a Registered Civil Engineer in the State of California. I have worked for Southern California Edison for 41 years. I have been an engineer in and have managed various engineering groups within SCE including: Apparatus (major utility equipment), Substation (engineering of substation additions), Transmission (engineering of transmission facilities both overhead and underground), Civil (grading and other facility designs), Structural (substation and transmission structures), and Geotechnical (soils engineering).

Q. What is the purpose of your testimony in this proceeding?

A. The purpose of my testimony in this proceeding is to sponsor portions of *Southern California Edison Company's Testimony in Response to the Assigned Commissioner's Ruling on the Tehachapi Renewable Transmission Project (TRTP)*, as identified in the Table of Contents thereto.

Q. Was this material prepared by you or under your supervision?

A. Yes, it was.

Q. Insofar as this material is factual in nature, do you believe it to be correct?

A. Yes, I do.

Q. Insofar as this material is in the nature of opinion or judgment, does it represent your best judgment?

A. Yes, it does.

Q. Does this conclude your qualifications and prepared testimony?

A. Yes, it does.

SOUTHERN CALIFORNIA EDISON COMPANY QUALIFICATIONS AND PREPARED TESTIMONY OF JENNIFER LEUNG

Q. Please state your name and business address for the record.

A. My name is Jennifer Leung, and my business address is 2244 Walnut Grove Avenue, Rosemead, California 91770.

Q. By whom are you employed?

A. I am employed by Southern California Edison Company (SCE).

Q. Briefly describe your present responsibilities at SCE.

A. I am a biologist in SCE's Corporate, Environment, Health & Safety Unit. I am responsible for environmental compliance and permitting associated with biological resource management.

Q. Briefly describe your educational and professional background.

A. I obtained a Bachelor of Science degree in Applied Ecology from the University of California, Irvine in 2011. Over the past eleven years, I have been involved in transportation and utility project permitting, compliance and mitigation responsibilities.

Q. What is the purpose of your testimony in this proceeding?

A. The purpose of my testimony in this proceeding is to sponsor portions of *Southern California Edison Company's Testimony in Response to the Assigned Commissioner's Ruling on the Tehachapi Renewable Transmission Project (TRTP)*, as identified in the Table of Contents thereto.

Q. Was this material prepared by you or under your supervision?

A. Yes, it was.

Q. Insofar as this material is factual in nature, do you believe it to be correct?

A. Yes, I do.

Q. Insofar as this material is in the nature of opinion or judgment, does it represent your best judgment?

A. Yes, it does.

Q. Does this conclude your qualifications and prepared testimony?

A. Yes, it does.

SOUTHERN CALIFORNIA EDISON COMPANY

QUALIFICATIONS AND PREPARED TESTIMONY OF MARK MURRAY

Q. Please state your name and business address for the record.

A. My name is Mark Murray and my business address is 2131 Walnut Grove Avenue, Rosemead, California 91770.

Q. By whom are you employed?

A. I am employed by Southern California Edison Company (SCE).

Q. Briefly describe your present responsibilities at SCE.

A. I am the Manager of Government and Tribal Lands within SCE's Operations Support Business Unit.

Q. What is your function as the Manager of Government and Tribal Lands?

A. As Manager of Government and Tribal Lands, I assume responsibility for the state, federal and tribal licensing component of a project once it has been approved by Southern California Edison's management.

Q. Briefly describe your educational and professional background.

A. My academics include a Bachelor of Arts in Business Administration from the College of Santa Fe, Master of Science in Computer Information Systems from Webster University and a Master of Science in Industrial Engineering from New Mexico State University. I am a Registered Land Surveyor in the State of New Mexico. My experience includes electrical utility engineering and maintenance and land management positions. From 1981 to 1999, I was the engineering and maintenance manager with Plains Electric Generation and Transmission Cooperative, Inc. in Albuquerque, New Mexico. From 1999 to 2009, I directed the permitting and lands department for Tri-State Generation and Transmission Association Inc. in Westminster, Colorado. In 2009, I joined SCE, where I manage staff to maintain and manage the relationship between SCE and federal, state, and tribal land management entities. In this position I also obtain the necessary state, federal, and tribal regulatory approvals needed for construction of new facilities and for existing facilities with expiring approvals on federal, state, and tribal lands. In addition, I produce filings, write responses, and advocate SCE's position on a myriad of legislative and regulatory issues as they affect the acquisition and administration of right of ways associated with existing and potential future Southern California Edison facilities on federal, state, and tribal lands.

Q. What is the purpose of your testimony in this proceeding?

A. The purpose of my testimony in this proceeding is to sponsor portions of *Southern California Edison Company's Testimony in Response to the Assigned Commissioner's Ruling on the Tehachapi Renewable Transmission Project (TRTP)*, as identified in the Table of Contents thereto.

Q. Was this material prepared by you or under your supervision or reviewed by you?

A. Yes, it was.

Q. Insofar as this material is factual in nature, do you believe it to be correct?

A. Yes, I do.

Q. Insofar as this material is in the nature of opinion or judgment, does it represent your best judgment?

A. Yes, it does.

Q. Does this conclude your qualifications and prepared testimony?

A. Yes, it does.

SOUTHERN CALIFORNIA EDISON COMPANY

QUALIFICATIONS AND PREPARED TESTIMONY OF MONICA QUIROGA

Q. Please state your name and business address for the record.

A. My name is Monica Quiroga, and my business address is 6 Pointe Drive, Brea, California 92821.

Q. By whom are you employed?

A. I am employed by Southern California Edison Company (SCE).

Q. Briefly describe your present responsibilities at SCE.

A. I am a Project Manager of Real Properties within SCE's Operations Support Business Unit. I am also currently the Project Manager of acquisition for Tehachapi Renewable Transmission Project (TRTP) Segments 4-11. As Project Manager, I assume responsibility for acquiring land and land rights of a project once it has been approved by SCE's management.

Q. Briefly describe your educational and professional background.

A. I received Bachelor's Degrees in Political Science and Spanish from California State University, Fullerton in May 2000. In January 2002, I received a Master's Degree in International Administration from the University of Miami, Coral Gables. In 2009, I received a certificate in Project Management from the University of California, Irvine. I am currently pursuing a Masters in Leadership and Management from the University of La Verne and expect to complete this degree by 2013.

Q. What is the purpose of your testimony in this proceeding?

A. The purpose of my testimony in this proceeding is to sponsor portions of *Southern California Edison Company's Testimony in Response to the Assigned Commissioner's Ruling on the Tehachapi Renewable Transmission Project (TRTP)*, as identified in the Table of Contents thereto.

Q. Was this material prepared by you or under your supervision?

A. Yes, it was.

Q. Insofar as this material is factual in nature, do you believe it to be correct?

A. Yes, I do.

Q. Insofar as this material is in the nature of opinion or judgment, does it represent your best judgment?

A. Yes, it does.

Q. Does this conclude your qualifications and prepared testimony?

A. Yes, it does.

SOUTHERN CALIFORNIA EDISON COMPANY

QUALIFICATIONS AND PREPARED TESTIMONY OF GLENN G. SIAS

Q. Please state your name and business address for the record.

A. My name is Glen G. Sias, and my business address is 1218 South 5th Avenue, Monrovia, California 91016.

Q. By whom are you employed?

A. I am employed by Southern California Edison Company (SCE).

Q. Briefly describe your present responsibilities at SCE.

A. My permanent position is the Manager of SCE's Electric and Magnetic Fields (EMF) Issues Management Group in the Corporate Environmental Health and Safety Department though at the present time I am on a temporary assignment as the Corporate Safety Manager of Transmission Distribution Business Unit and Customer Service Business Unit programs. As the EMF and Energy Group Manager, I oversee SCE's activities related to EMF, including the preparation of studies on EMF reduction techniques for new electrical facilities, responding to customer and employee EMF inquiries, and supporting EMF research projects. I also oversee the preparation of Field Management Plans for SCE's transmission and substation projects.

Q. Briefly describe your educational and professional background.

A. I received a Bachelor of Science Degree in electrical engineering from University of California, Los Angeles (UCLA) and my Master of Science degree in Environmental Health Sciences from UCLA's School of Public Health. I am currently pursuing my doctorate in Environmental Science and Engineering at UCLA. I began my career at SCE in its EMF research group from 1991 to 1993. I continued my employment at SCE as an EMF technical specialist from 1993 until I moved to my current position in 2007. My experience with magnetic fields created by electrical facilities includes developing the first version of FIELDS, SCE's 2-D magnetic field modeling software, characterizing fields created by power lines and substations using computer models and measurements, conducting well over a thousand customer magnetic field surveys including many at homes near transmission lines, and preparation of field management plans (FMPs) for SCE's projects. I participated in the 2006 workshop to develop the current California EMF Design Guidelines for Electrical Facilities.

Q. What is the purpose of your testimony in this proceeding?

A. The purpose of my testimony in this proceeding is to sponsor portions of *Southern California Edison Company's Testimony in Response to the Assigned Commissioner's Ruling on the Tehachapi Renewable Transmission Project (TRTP)*, as identified in the Table of Contents thereto.

Q. Was this material prepared by you or under your supervision?

A. Yes, it was.

Q. Insofar as this material is factual in nature, do you believe it to be correct?

A. Yes, I do.

Q. Insofar as this material is in the nature of opinion or judgment, does it represent your best judgment?

A. Yes, it does.

Q. Does this conclude your qualifications and prepared testimony?

A. Yes, it does.

SOUTHERN CALIFORNIA EDISON COMPANY

QUALIFICATIONS AND PREPARED TESTIMONY OF MARC ULRICH

Q. Please state your name and business address for the record.

A. My name is Marc Ulrich, and my business address is 2244 Walnut Grove Avenue, Rosemead, California 91770.

Q. By whom are you employed?

A. I am employed by Southern California Edison Company (SCE).

Q. Briefly describe your present responsibilities at SCE.

A. I am the Vice President of the Renewable and Alternative Power Department at Southern California Edison Company (SCE). I assumed the position of Director of the Renewable and Alternative Power Department in August 2009, and was promoted to Vice President on September 3, 2009. I am responsible for the management and growth of SCE's portfolio of renewable and alternative power contracts. I am also responsible for policy matters related to renewable and alternative resources.

Q. Briefly describe your educational and professional background.

A. I earned a Bachelor of Science degree in 1992 and a Master of Science degree in Economics in 1995 from San Jose State University. In 1999, I earned a Doctorate in Economics from Auburn University. In 1998, I began working for Southern Company Services in Atlanta and later took a supervisory role in load forecasting and general quantitative analytics for Georgia Power, a subsidiary of Southern Company. In 2001, I joined Enron Energy Services, in Utility Risk Management and developed extensive forecasts and risk management hedging strategies for various retail tariffs across the nation. Subsequent to Enron, I spent a year at Econ One Research, Inc. establishing an energy consulting practice until I joined SCE. In December 2002, I took the role of Energy, Supply & Management (ES&M) Risk Control manager at SCE and created a group responsible for forward curve development, mark-to-market valuation, deal confirmations, and risk reporting. In December 2004, I was promoted to Director of Energy Planning. In that role my responsibilities included electric generation unit commitment and dispatch planning, power and natural gas procurement planning, contract valuation and analysis, portfolio valuation and risk analysis, transmission planning for wholesale generation activities, resource adequacy planning and reporting, and power and natural gas price forecasting.

Q. What is the purpose of your testimony in this proceeding?

A. The purpose of my testimony in this proceeding is to sponsor portions of *Southern California Edison Company's Testimony in Response to the Assigned Commissioner's Ruling on the Tehachapi Renewable Transmission Project (TRTP)*, as identified in the Table of Contents thereto.

Q. Was this material prepared by you or under your supervision?

A. Yes, it was.

Q. Insofar as this material is factual in nature, do you believe it to be correct?

A. Yes, I do.

Q. Insofar as this material is in the nature of opinion or judgment, does it represent your best judgment?

A. Yes, it does.

Q. Does this conclude your qualifications and prepared testimony?

A. Yes, it does.

SOUTHERN CALIFORNIA EDISON COMPANY

QUALIFICATIONS AND PREPARED TESTIMONY OF ROMAN VAZQUEZ, P.E.

Q. Please state your name and business address for the record.

A. My name is Roman Vazquez, and my business address is 6 Pointe Drive, Brea, California 92821.

Q. By whom are you employed?

A. I am employed by Southern California Edison Company (SCE).

Q. Briefly describe your present responsibilities at SCE.

A. I am the Principal Project Engineer of the Tehachapi Renewable Transmission Project (TRTP) at SCE and responsible for all technical and design aspects of the bulk power transmission lines and substations of the TRTP.

Q. Briefly describe your educational and professional background.

A. I obtained my Bachelor of Science degree in Civil Engineering, from California State University, Los Angeles, in 1999. I am a Licensed Professional Engineer in the State of California. Over the past 12 years, I have been working on transmission engineering projects for SCE, including production of all the preliminary engineering on Segments 1, 2 and 3 of TRTP.

Q. What is the purpose of your testimony in this proceeding?

A. The purpose of my testimony in this proceeding is to sponsor portions of *Southern California Edison Company's Testimony in Response to the Assigned Commissioner's Ruling on the Tehachapi Renewable Transmission Project (TRTP)*, as identified in the Table of Contents thereto.

Q. Was this material prepared by you or under your supervision?

A. Yes, it was.

Q. Insofar as this material is factual in nature, do you believe it to be correct?

A. Yes, I do.

Q. Insofar as this material is in the nature of opinion or judgment, does it represent your best judgment?

A. Yes, it does.

Q. Does this conclude your qualifications and prepared testimony?

A. Yes, it does.