Alternatives Screening Report

1. Introduction

1.1 Purpose of the Alternatives Screening Report

On October 25, 2013, Southern California Edison (SCE) submitted Application A.13-10-020 seeking a Certificate of Public Convenience and Necessity (CPCN) from the California Public Utilities Commission (CPUC) for the West of Devers (WOD) Upgrade Project (Proposed Project). Because the proposed transmission line would cross approximately 3.5 miles of federal land managed by the Bureau of Land Management (BLM), the project would also require a Right-of-Way (ROW) Grant from the BLM for the portion of the project across BLM land. The Proposed Project is described in detail in Section B of the EIS. This document describes the alternatives screening analysis that has been conducted for the Proposed Project, supplementing the information presented in Section C of the EIS.

Alternatives to the Proposed Project were suggested (1) by SCE as part of the Proponent's Environmental Assessment (PEA), (2) by the EIS team based on identification of potentially significant environmental impacts, in past environmental documents in the proposed corridor, and (3) by public agencies and the general public during the two public scoping periods (May to July 2014). One additional alternative was suggested in comments on the Draft EIR/EIS. The alternatives screening analysis was completed in order to determine the range of alternatives that would be carried forward for analysis in the EIS. This report documents: (1) the range of alternatives that have been suggested and evaluated; (2) the approach and methods used by the BLM in screening the feasibility of these alternatives according to guidelines established under the National Environmental Policy Act (NEPA); and (3) the results of the alternatives screening process (i.e., which alternatives to analyze in the EIS).

This alternatives Screening Report (Appendix 5 to the EIS) provides the basis and rationale for why an alternative has been carried forward for full evaluation in the EIS. For each alternative that was eliminated from further consideration, this document explains in detail the rationale for elimination.

No Action Alternative. Full consideration of a No Action Alternative is also required by NEPA, as separately defined in Section C.6 of the EIS.

1.2 Background

1.2.1 Previously Proposed Devers–Palo Verde No. 2 Transmission Project

On April 11, 2005, SCE submitted an application (A.05-04-015) for a CPCN for a 500 kV interstate transmission line project, the Devers–Palo Verde No. 2 (DPV2). The project included three major components:

- A 500 kV line from the Palo Verde area in Arizona to a new substation near Blythe, California;
- A 500 kV line from the Blythe area substation to the Devers Substation; and
- Upgrades to SCE's lower voltage transmission system west of the Devers Substation.

The CPUC approved the DPV2 Project in January 2007 in Decision D.07-01-040, and a CPCN was issued. The approved Project included the SCE proposal except for the West of Devers upgrades, which were replaced by the Devers to Valley 500 kV No. 2 line. On May 14, 2008, SCE filed a Petition for Modification (PFM) of the CPCN approved per Decision D.07-01-040. In the PFM, SCE requested that the CPUC authorize SCE to construct DPV2 transmission facilities in only the California portion of DPV2 and the Midpoint Substation (later re-named as the Colorado River Substation) near Blythe, California. The CPUC approved SCE's PFM on

November 20, 2009 in Decision D.09-11-007. The BLM issued its Record of Decision approving the project on July 19, 2011.

The West of Devers upgrade components as proposed by SCE in 2005 could not be approved by the CPUC and BLM because by the time of agency decisions (January 2007), the Morongo Band of Mission Indians had not reached an agreement with SCE on terms of the right-of-way (ROW) renewal for the nearly 6 miles of the corridor that crosses tribal land. Therefore, the Devers Substation to Valley Substation (Devers-Valley No. 2 500 kV) alternative route was approved instead. Although the West of Devers upgrade components reviewed in 2006 were infeasible to build at the time, the 2006 Final EIR/EIS for DPV2 found the proposal to be environmentally superior to the Devers-Valley No. 2 500 kV alternative that was built and is now in use.

1.3 Summary of the Proposed Project

The Proposed West of Devers Upgrade Project is described in detail in Section B of this EIS. The Proposed Project would upgrade the existing WOD system in a number of ways. The upgrades to the existing 220 kV transmission lines would be the most visible components of the project. These upgrades would occur on approximately 30 miles of the Devers–El Casco line, 14 miles of the El Casco–San Bernardino line, 43 miles of the Devers–San Bernardino line, 45 miles of the Devers-Vista No. 1 and No. 2 lines, 3.5 miles of the Etiwanda–San Bernardino line, and 3.5 miles of the San Bernardino–Vista line.

The proposed transmission line elements have been divided into the following six segments, by milepost (MP):

- Segment 1 – San Bernardino (MP SB0 to MP SB3.5)
- Segment 2 – Colton, Grand Terrace and Loma Linda (MP 0 to MP 5.2)
- Segment 3 – San Timoteo Canyon (MP 5.2 to MP 15.2)
- Segment 4 – Beaumont and Banning (MP 15.2 to MP 27.4)
- Segment 5 – Morongo Tribal Lands and Surrounding Areas (MP 27.4 to MP 36.9)
- Segment 6 – Whitewater and Devers (MP 36.9 to MP 45)

The Proposed Project would primarily be constructed on a combination of 220 kV double-circuit lattice steel towers (LSTs), double-circuit tubular steel poles (TSPs), and single-circuit TSPs. Each of the proposed 220 kV transmission lines would consist of overhead wires (conductors), which form three electrical phases. Each phase would consist of double-bundled (bundle of two conductors for each phase) 1590 kcmil (one thousand circular mils) aluminum conductor steel reinforced (ACSR) conductor, which is made of aluminum strands with internal steel reinforcement and would have a non-specular finish.

Construction of the Proposed Project would upgrade the existing 220 kV transmission lines between Devers, El Casco, San Bernardino, and Vista Substations to increase the system transfer capacity from 1,600 MW to 4,800 MW (SCE, 2014a), which includes a scheme to trip off-line up to 1,400 MW of generation during certain emergency conditions (SCE Response to CPUC Data Request ALT-11). The power flow capability of each of the four proposed 220 kV circuits under normal conditions would be 1,292 MW (SCE Response to CPUC Data Request ALT-11) resulting in a total capability for the corridor with all lines in service under normal conditions of 5,168 MW combined.

In addition, the Proposed Project would require a series of changes to substations, subtransmission lines, distribution lines, and telecommunications facilities. These changes include:

- Upgrade substation equipment at Devers, El Casco, Etiwanda, San Bernardino, and Vista Substations to accommodate increased power transfer on 220 kV lines;
- Remove and relocate 2 miles of existing 66 kV subtransmission lines;

- Remove and relocate 4 miles of existing 12 kV distribution lines; and
- Install telecommunication lines and equipment for the protection, monitoring, and control of transmission lines and substation equipment.

2. Description of Alternatives Evaluation Process

The range of alternatives in this report was identified through the NEPA scoping processes, and through supplemental studies and consultations that were conducted during the course of this analysis. The range of alternatives considered in the screening analysis encompasses:

- Alternatives identified by SCE in the October 2013 PEA for the Proposed Project;
- Alternatives identified in 2006 Final EIR/EIS for the West of Devers portion of DPV2;
- Alternatives identified during the public scoping process held in 2014 in accordance with NEPA requirements; and
- Alternatives identified by the EIS team as a result of the independent review of the Proposed Project impacts and meetings with affected agencies and interested parties.

2.1 Alternatives Screening Methodology

The evaluation of the alternatives used a screening process that consisted of three steps:

Step 1: Clearly define each alternative to allow comparative evaluation

Step 2: Evaluate each alternative in comparison with the Proposed Project, using NEPA criteria (defined below)

Step 3: Based on the results of Step 2, determine the suitability of the each alternative for full analysis in the EIS. If the alternative is unsuitable, eliminate it from further consideration.

After completion of the steps defined above, the advantages and disadvantages of the alternatives are carefully weighed with respect to NEPA criteria for consideration of alternatives. NEPA provides guidance on selecting a reasonable range of alternatives for evaluation in an EIS, as described below.

According to the Council on Environmental Quality's (CEQ) NEPA Regulations (40 C.F.R. 1502.14), an EIS must present the environmental impacts of the proposed action and alternatives in comparative form, defining the issues and providing a clear basis for choice by decisionmakers and the public. The alternatives section shall:

(a) Rigorously explore and objectively evaluate all reasonable alternatives, and for alternatives which were eliminated from detailed study, briefly discuss the reasons for their having been eliminated.
(b) Devote substantial treatment to each alternative considered in detail including the proposed action so that reviewers may evaluate their comparative merits.
(c) Include reasonable alternatives not within the jurisdiction of the lead agency.
(d) Include the alternative of no action.
(e) Identify the agency's preferred alternative or alternatives, if one or more exists, in the draft statement and identify such alternative in the final statement unless another law prohibits the expression of such a preference.
(f) Include appropriate mitigation measures not already included in the proposed action or alternatives.

The CEQ has stated that reasonable alternatives include those that are practical or feasible from the technical and economic standpoint and using common sense rather than simply desirable from the standpoint of the applicant (CEQ, 1987).

In addition to the CEQ NEPA regulations, CEQ has issued a variety of general guidance memoranda and reports that concern the implementation of NEPA. One of the most frequently cited resources for NEPA practice is CEQ's *Forty Most Asked Questions Concerning CEQ's NEPA Regulations* (Forty Questions). Although a reviewing federal court does not always give the Forty Questions the same deference as it does the CEQ NEPA Regulations, in some situations the Forty Questions have been persuasive to the judiciary. For example in one decision, a federal court relied heavily on one of the Forty Questions in interpreting the treatment of alternatives under NEPA [*American Rivers et al. v. Federal Energy Regulatory Commission*, 187 F.3d 1007 (9th Cir. 1999)] (Bass et al., 2001).

In general, alternatives are discussed in Forty Questions Nos. 1 through 7. Question No. 5b asks if the analysis of the "proposed action" in an EIS is to be treated differently than the analysis of alternatives. The response states:

> *The degree of analysis devoted to each alternative in the EIS is to be substantially similar to that devoted to the "proposed action." Section 1502.14 is titled "Alternatives, including the proposed action" to reflect such comparable treatment. Section 1502.14(b) specifically requires "substantial treatment" in the EIS of each alternative including the proposed action. This regulation does not dictate an amount of information to be provided, but rather, prescribes a level of treatment, which may in turn require varying amounts of information, to enable a reviewer to evaluate and compare alternatives.*

2.1.1 Consistency with Purpose and Need

CEQ NEPA Regulations (40 C.F.R. 1502.13) require a statement to "briefly specify the underlying purpose and need to which the agency is responding in proposing the alternatives including the proposed action." In addition to SCE's project objectives listed above, the October 2013 PEA provides a full chapter on the Purpose and Need (PEA Chapter 1.0) for the West of Devers Upgrade Project, including the following six statements by SCE:

- The Proposed Project is Needed to Integrate and Interconnect Generation Resources within the Blythe and Desert Center Areas.
- The Proposed Project is Needed to Comply With Executed Large Generator Interconnection Agreements (LGIAs).
- The Proposed Project is Needed to Support Integration of Generation with Executed Power Purchase Agreements (PPAs).
- The Proposed Project is Needed to Facilitate Integration of Renewable Generation Resource Being Developed in the Coachella Valley Area.
- The Proposed Project is Needed to Comply with Reliability Standards.
- The Proposed Project Facilitates Progress Toward California's RPS Goals.

2.1.2 Feasibility

The environmental consequences of the alternatives, including the proposed action, are to be discussed in the EIS in accordance with CEQ NEPA Regulations (40 C.F.R. 1502.16). The discussion shall include "[p]ossible conflicts between the proposed action and the objectives of Federal, regional, State, and local (and in the case of a reservation, Indian tribe) land use plans, policies and controls for the area concerned." Other feasibility factors to be considered may include cost, logistics, technology, and social, environmental, and legal factors (Bass et al., 2001). Among the factors that may be taken into account when addressing the feasibility of alternatives include site suitability, economic viability, availability of infrastructure, general plan consistency, other plans or other regulatory limitations, jurisdictional boundaries, and proponent's control over alternative sites in determining the range of alternatives to be evaluated in the EIS. For the screening analysis, the feasibility of potential alternatives was assessed taking the following factors into consideration:

- **Economic Feasibility.** Is the alternative so costly that implementation would be prohibitive? Is there evidence that the additional costs or lost profitability are sufficiently severe as to render it impractical to proceed with project?
- **Environmental Feasibility.** Would implementation of the alternative cause substantially greater environmental damage than the Proposed Project, thereby making the alternative clearly inferior from an environmental standpoint? This issue is primarily addressed in terms of the alternative's potential to eliminate significant effects of the Proposed Project.
- **Legal Feasibility.** Does the alternative have the potential to avoid lands that have legal protection that may prohibit or substantially limit the feasibility of permitting a high-voltage transmission line?
- **Regulatory Feasibility.** Do regulatory restrictions substantially limit the likelihood of successful permitting of a high-voltage transmission line? Is the alternative consistent with regulatory standards for transmission system design, operation, and maintenance?

  Lands that are afforded legal protections that would prohibit the construction of the project, or require an act of Congress for permitting, are considered less feasible locations for the project. These land use designations include wilderness areas, wilderness study areas, restricted military bases, airports and Indian reservations. Information on potential legal constraints of each alternative has been compiled from laws, regulations, and local jurisdictions, as well as a review of federal, State, and local agency land management plans and policies.
- **Social Feasibility.** Would the alternative cause significant damage to the socioeconomic structure of the community and be inconsistent with important community values and needs? Similar to the environmental feasibility addressed above, this issue pertains to the alternative's potential to eliminate adverse economic and social effects of a physical change in the environment caused by the Proposed Project.

Technical Feasibility. Is the alternative feasible from a technological perspective, considering available technology? Are there any construction, operation, or maintenance constraints that cannot be overcome?

3. Overview of Alternatives Screening Results

3.1 Introduction

This section summarizes the determinations of the screening process. Alternatives found to meet the NEPA alternatives screening criteria have been retained for full analysis in the EIS.

3.2 Alternatives Retained for Full Analysis in the EIS

The following three alternatives are retained for full analysis in this EIS; each is described in detail in Section 4 (Alternatives Retained for Analysis). Figure Ap.5-1 shows all alternatives retained for analysis.

- Tower Relocation Alternative
- Iowa Street 66 kV Underground Alternative
- Phased Build Alternative

3.3 Alternatives Eliminated After Detailed Screening

Twelve additional alternatives were considered for EIS analysis, but eliminated from detailed analysis through the process described in Section 2. These alternatives are listed below and described in detail in Section 5 of this appendix (Alternatives Eliminated). Figures Ap.5-2a (Route Alternatives Eliminated) and Ap.5-2b (System Alternatives Eliminated) shows the alternatives eliminated from EIS analysis after detailed screening.

- 500 kV Towers Alternative
- Segment 4 Underground Alternatives in Calimesa, Beaumont, and Banning
- Segment 5 Morongo Central Route Alternative (original PEA Proposed Route)
- Segment 5 Morongo Existing 220 kV Route Alternative (Existing ROW)
- East Banning–Morongo Alternative
- Devers-Beaumont 500 kV Alternative (SCE System Alternative 1)
- Red Bluff–Valley-Serrano 500 kV Alternative (SCE System Alternative 2)
- Reduced Build Alternative Option 1
- Reduced Build Alternative Option 2a
- Reduced Build Alternative Option 2b
- High-Performance Conductor Alternative
- Retain WOD Interim Facility Alternative

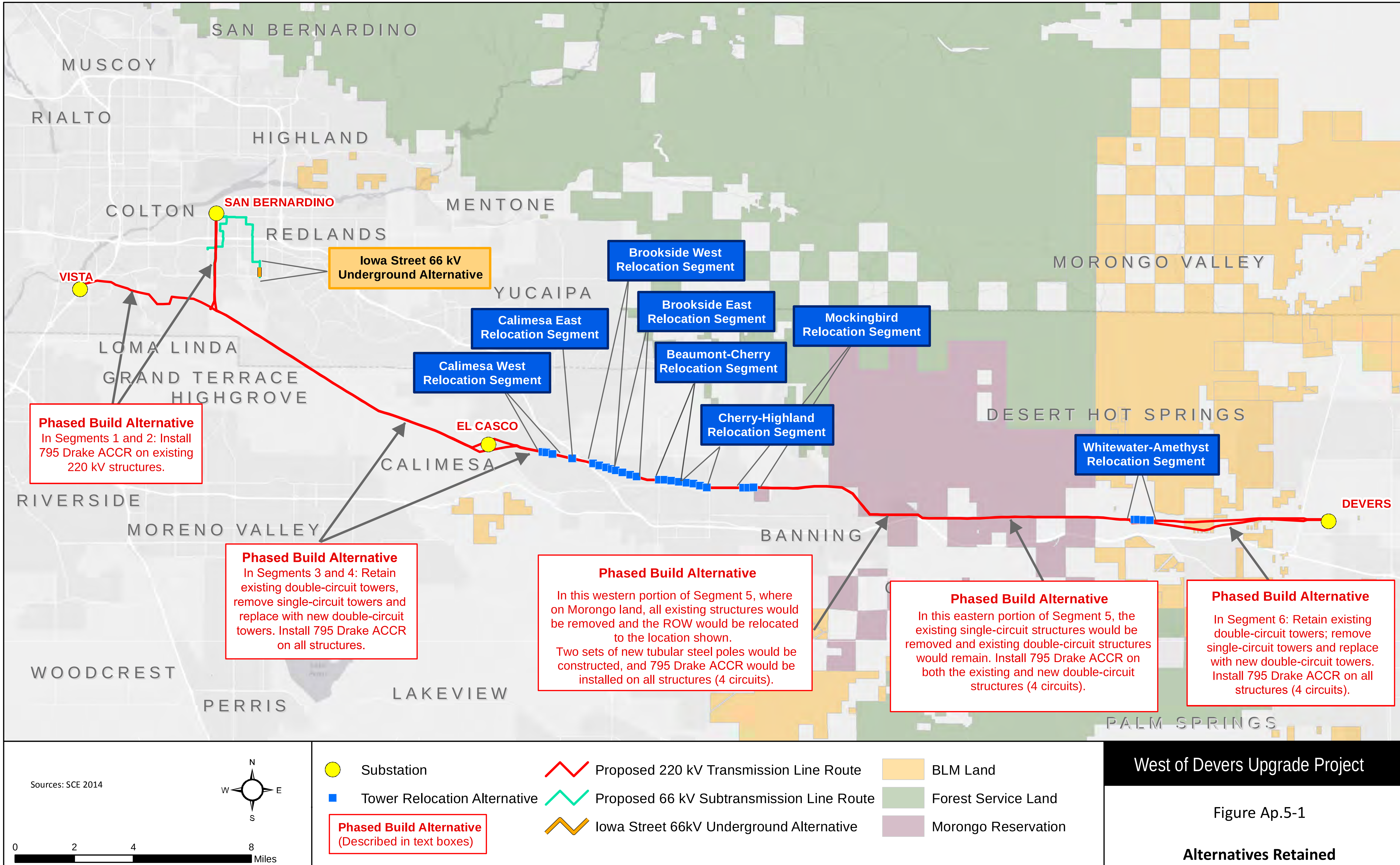
Two additional alternative concepts were considered, but not evaluated in the EIS because they clearly did not meet the alternatives screening criteria described in Section 2 (Description of Alternatives Evaluation Process), as described below and illustrated in Figure Ap.5-2c.

Segment 2 Underground Alternative: East of I-215. This 1.9-mile underground alternative was considered by the EIS team, because of the potential for replacement towers in the City of Colton to degrade views from residential properties in the City of Grand Terrace. The Segment 2 Underground Alternative would eliminate 1.5 miles of existing towers and 10 proposed and existing towers supporting the Devers-Vista No. 1 and No. 2 circuits just east of the overhead crossing of I-215 near Vista Substation and west of Reche Canyon Road. The underground line would be installed in Mount Vernon Avenue, East Washington Street, and Reche Canyon Road.

This alternative was not evaluated because during 2014, SCE revised its preliminary design to require only minor modifications of the specific towers in the most visible locations, rather than tower replacement. Therefore, the incremental visual change with the Proposed Project would be small and no significant impacts have been identified in this area. Therefore, development of an alternative in this area would not avoid or substantially lessen any significant effects of the Proposed Project (see Section 2.1, Alternatives Screening Methodology).

Segment 2 Underground Alternative: East of Vista Substation. This 2.5-mile underground alternative would be similar to the Segment 2 Underground Alternative, except this option but would extend the underground segment to the west side of I-215 as a 800- to 1,200-foot horizontal directional drill to the base of the hill north-northeast of Vista Substation. The Segment 2 Underground Alternative would eliminate 2 miles of existing towers and 13 proposed and existing towers supporting the Devers-Vista No. 1 and No. 2 circuits from north-northeast of Vista Substation by Mike Thompson's RV Super Stores parking lot to west of Reche Canyon Road.

This alternative was not further considered because SCE revised its preliminary design to require only minor modifications of these towers, rather than tower replacement. As a result, the incremental visual change with the Proposed Project would be small and no significant and unmitigable impacts have been identified in this area.



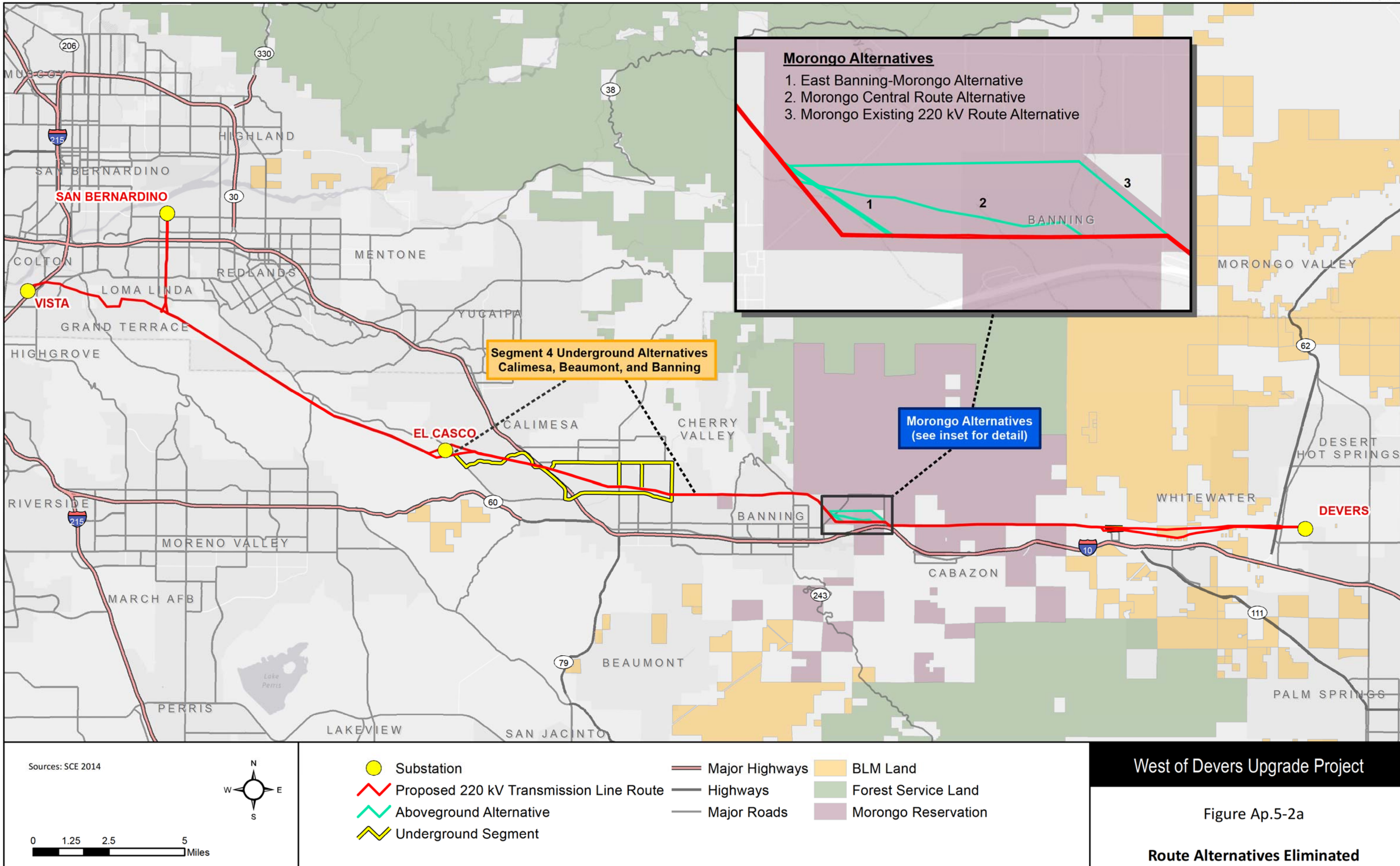
West of Devers Upgrade Project

Figure Ap.5-1

Alternatives Retained

July 2016

This page intentionally blank.

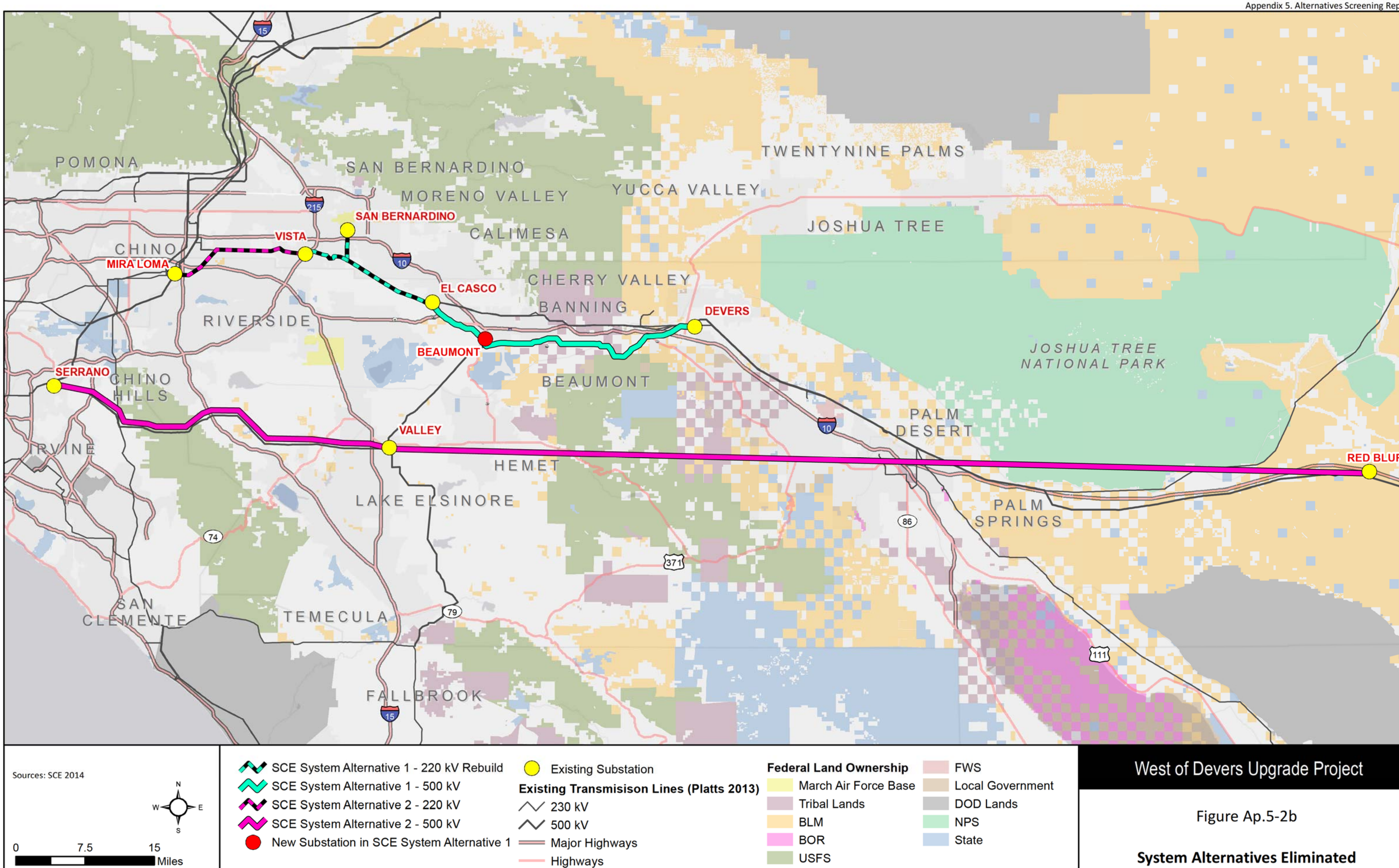


West of Devers Upgrade Project

Figure Ap.5-2a

Route Alternatives Eliminated

This page intentionally blank.

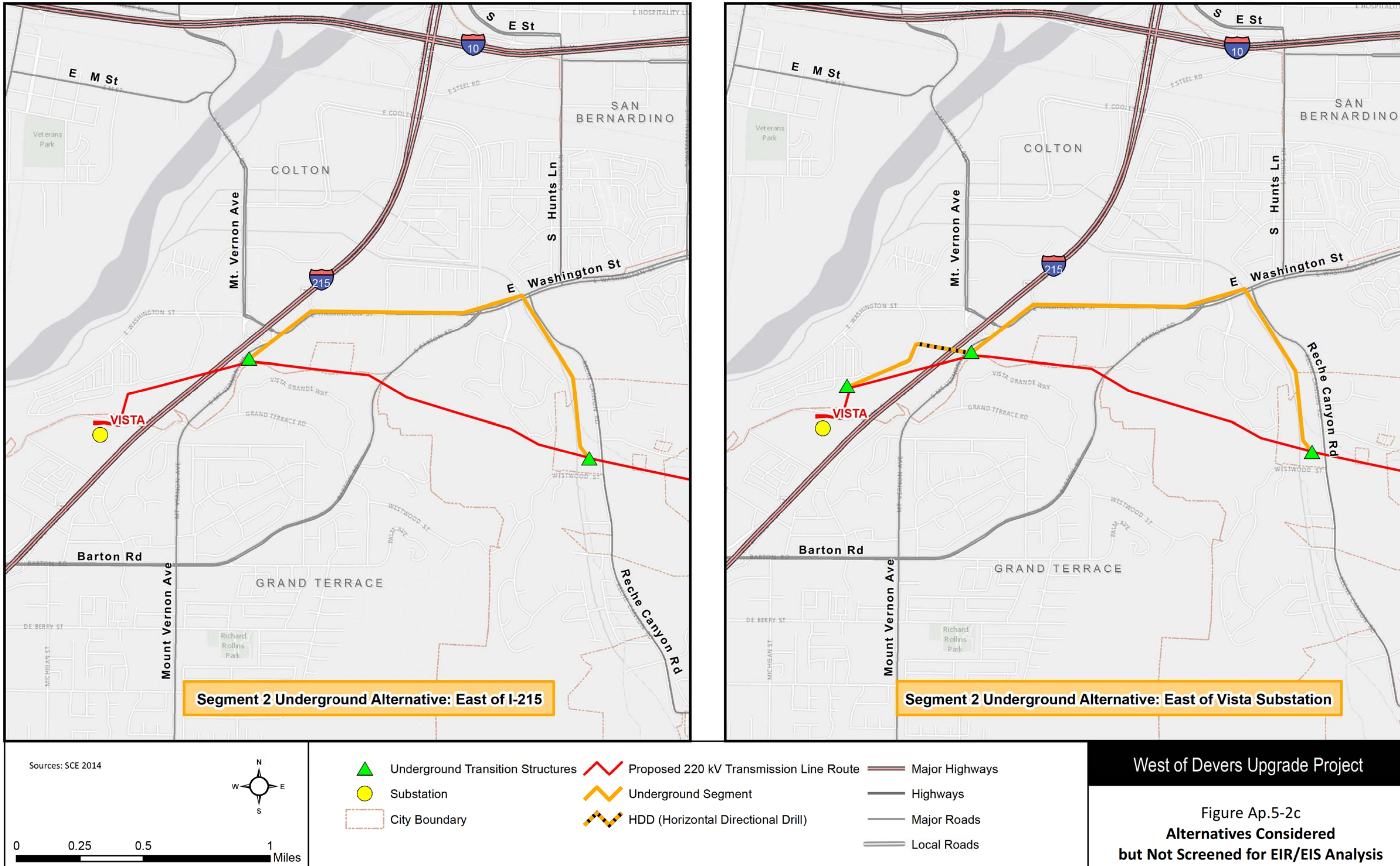


West of Devers Upgrade Project

Figure Ap.5-2b

System Alternatives Eliminated

This page intentionally blank.



West of Devers Upgrade Project

Figure Ap.5-2c
Alternatives Considered but Not Screened for EIR/EIS Analysis

This page intentionally blank.

4. Alternatives Retained for Analysis

4.1 Introduction

This section describes the three alternatives evaluated in detail in this EIS, and explains how they were considered through the alternatives screening process.

4.2 Tower Relocation Alternative

This alternative was developed in response to scoping comments of residents who expressed concerns that some proposed towers would be closer to their homes than the existing structures. Under the Proposed Project, some new tower centerlines in Segment 4 (Beaumont and Banning) and Segment 6 (Whitewater and Devers) would be about 50 feet from the edge of ROW, closer to residences than the existing structures and leaving the rest of the ROW empty. SCE would retain this vacant space in the ROW for future transmission expansion.

Alternative Description

The Tower Relocation Alternative would use about 50 feet of this vacant ROW width identified for future transmission lines to place towers farther away from adjacent residences. This alternative would change structure placement only in portions of Segment 4 and Segment 6 where the EIS team has identified potentially significant visual impacts.

Table Ap.5-1 identifies all of the locations along the Proposed Project where proposed towers would be closer to residences than the existing structures. Based on the data in Table Ap.5-1, the Tower Relocation Alternative has been developed to move these closer towers to positions that are farther from the nearest residences. In general, the alternative would relocate towers so they would be located at least as far away from residential property lines as the centerline of the existing towers is now. This would result in the new towers being approximately 50 feet to the north of the proposed tower locations. The Tower Relocation Alternative is illustrated in Figures Ap.5-3a through Ap.5-3h. Should this alternative be approved, the exact locations of the relocated towers may change from the positions shown in Figures Ap.5-3, based on final engineering. However, the Tower Relocation Alternative would ensure that the new towers affected by this alternative would be constructed at least as far away as the centerline of the existing structures are now from the edge of the residential property lines.

Table Ap.5-1. Tower Relocations Considered as a Project Alternative

Structure #s	Description/Location	Proximity of Proposed Towers and Details of Tower Relocation Alternative (if applicable)
Segment 1	**Redlands / San Bernardino**	
n/a	Towers follow existing centerline of current structures	Centerline of proposed towers would remain the same as existing structures. Towers move north and south along ROW. While some residences would have a structure closer to them than they do now, those residences would have the conductors at higher elevations (and therefore farther from the residences). – No alternative recommended.
Segment 2	**Grand Terrace / Loma Linda**	
2N04 to 2N06	Towers are upslope from homes in upper (southern) Loma Linda – homes are on upper ends of Weliber Street and Allen Way	Towers would move 45 feet north (closer to residences), but the new tower would remain about 80 feet south of the property line and about 200 feet south of the houses. – No alternative recommended.

Table Ap.5-1. Tower Relocations Considered as a Project Alternative

Structure #s	Description/Location	Proximity of Proposed Towers and Details of Tower Relocation Alternative (if applicable)
2N20	New tower (in area previously spanned) behind homes at west end of Prado Lane	Tower is 250 feet from back of home on Prado Lane and 60-70 feet from property line. Overall the conductors would move about 25-40 feet closer to the residences, but the lots are very deep and homes are more than 200 feet away from the ROW. There are lots in this area that are newly within the ROW; the project would need new easements of 25-80 feet across the southern portion of these lots. – No alternative recommended.
2N20 to 2N21	New span behind first house on Prado Lane (south side, east of Reche Canyon Road)	Conductors would move about 25 feet closer to a residence, which is located at the very back of the lot, adjacent to the ROW. Centerline of tower alignment would remain about 75 feet from this residence. – No alternative recommended.
Segment 3	**San Timoteo Canyon**	
3S25/3N25 to 3S26/3N26	San Timoteo Canyon just east of Viper Road	Northernmost tower moves 40 feet closer to residential area. However, residences are more than 100 feet from the ROW and proposed towers would remain 60 feet from the edge of ROW. – No alternative recommended
Segment 4	**Beaumont – El Casco to I-10**	
	West of Tower 4S53 / 4N53, the new towers are farther from the residences until San Timoteo Canyon Road.	North of Palmer Trail, Demaret Ave, Amour and Ventura Drives, the new structures would be farther from residences than the existing structures. – No alternative recommended.
4S50/4N50, 4S51/4N51, and 4S53/4N53	East of San Timoteo Canyon Road and West of Cherry Valley Blvd	**Calimesa West Relocation Segment.** Three proposed pairs of structures would be constructed closer to residences. – The alternative would move towers to the north (Figure Ap.5-3a).
4S46/4N46	Just west of the I-10 crossing, residences north of Cherry Tree Lane and Vineyard Avenue back up to ROW	**Calimesa East Relocation Segment.** Proposed pair of structures on the south side of the ROW would move 20 feet closer to homes. – The alternative would move towers to the north (Figure Ap.5-3b).
Segment 4	**Beaumont – Solara**	
4S40/4N40 to 4S43/4N43	From I-10 crossing through east end of Solara development; From Deodar Drive to Oak View Drive, through and west of Solara development	**Brookside Relocation West Segment.** Proposed pair of structures on the south side of the ROW would move 20 feet closer to homes. – The alternative would move towers to the north (Figure Ap.5-3c).
Segment 4	**Beaumont – East of Solara**	
4S36/4N36 to 4S39/4N39	East of Oak View Drive (and through and within park)	**Brookside Relocation East Segment.** One set of proposed structures on the south side of the ROW would move 20 feet closer to homes. – The alternative would move towers to the north (Figure Ap.5-3d)
4N27/4S27 to 4N31/4S31	West of Cherry Avenue to Palm Avenue	**Beaumont-Cherry Relocation Segment.** Two pairs of proposed structures on the south side of ROW would move 30 to 40 feet closer to homes. – The alternative would move towers to the north (Figure Ap.5-3e).
4N25/4S25 and 4N26/4S26	East of Cherry Avenue and west of Star Light Avenue	**Cherry-Highland Springs Relocation Segment.** Houses are under construction in this area just south of the ROW. Near Cherry Avenue, there are 14 houses existing (2014). Proposed structures would move about 50 feet closer to the southern edge of the ROW. – The alternative would move towers to the north (Figure Ap.5-3f).
4N23/4S23 and 4N24/4S24	Just west of Highland Springs Avenue and continuing west to Star Light Avenue	**Cherry–Highland Springs Relocation Segment.** The closer of the pair of proposed towers would be about 50 feet closer to the edge of ROW than the existing structures are. – The alternative would move towers to the north (Figure Ap.5-3f).

Table Ap.5-1. Tower Relocations Considered as a Project Alternative

Structure #s	Description/Location	Proximity of Proposed Towers and Details of Tower Relocation Alternative (if applicable)
Segment 4	**Banning**	
4N14/4S14 to 4N16/4S16	At north end of Mountain Avenue and north of Mockingbird Lane	**Mockingbird Lane Relocation Segment.** The proposed closest structures north of Mockingbird Lane would not be closer to residences than the existing ones; their locations are very similar with respect to distance from edge of ROW. However, the alternative is presented because a pair of proposed towers (Structures 14 and 15) will be much more visible from residences because they will be larger and closer together than the existing structures. – The alternative would move towers to the north (Figure Ap.5-3g).
Segment 5	**East Banning/Morongo**	
5N54/5S54	At north end of North Murray Street, residence adjacent to Morongo Tribal land	New pair of towers would be located over 200 feet closer to one residence. Implement on tribal land if acceptable to Morongo Band (Figure Ap.5-3i).
Segment 6	**Whitewater**	
6N38 to 6N41	Whitewater area, north of Amethyst Drive. About 10 existing homes on north side of street have ROW in/behind their backyards	**Whitewater–Amethyst Drive Relocation Segment.** Proposed new tower in separated northern ROW would move south of existing structures and closer to homes by about 55 feet [measured at Structure 6N38]. – The alternative would move towers to the north (Figure Ap.5-3h).
6S39 to 6S40	Whitewater area, behind (north of) houses on Calico Avenue. About 5 existing homes on north side of street have ROW behind their backyards	Two proposed towers in the separated southern ROW move south of existing structures and closer to homes by about 30 to 50 feet, but the new towers would remain more than 130 feet from the fence lines. – No alternative recommended.
Segment 6	**N. Palm Springs**	
6N16 to 6N17	Just west of Highway 62 – Existing home is between the two proposed towers	New northern conductors would move approximately 60 feet closer to one isolated residence, but the towers supporting the conductors would move about 200 feet farther away. – No alternative recommended.

The Tower Relocation Alternative would require the relocation of 7 areas of specific Proposed Project tower pairs. Five of these areas are in Segment 4, one area is in Segment 5, and one area is in Segment 6, as explained in the following descriptions. As shown in Table Ap.5-2, there are a few situations where new towers would be located closer to residences, but no alternative to move them is recommended. In these situations, either the new towers would remain more than 100 feet from the nearest residence, or the topography would result in the tower being more visible if it were moved farther away.

Tower Relocation Alternative: Segment 4

Calimesa West and Calimesa East Relocation Segments. In the City of Calimesa and the City of Beaumont, two relocation segments address the area west of I-10. On the east and west side of the Palmer Avenue crossing, the Calimesa West portion of the Tower Relocation Alternative would shift 3 pairs of towers approximately 50 to 55 feet to the north, as shown on Figure Ap.5-3a. The towers moved would be Structures 4S50, 4N51, and 4S53 and Structures 4N50, 4N51, and 4N53. This relocation would leave about 200 feet of vacant ROW to the north of the new towers, compared with the Proposed Project, which would retain about 255 feet to the north (at Structure 4N51).

Approximately 1,000 feet west of the I-10 crossing in Calimesa, the Calimesa East Relocation Segment of the Tower Relocation Alternative would shift one pair of towers (Structures 4S46 and 4N46) approximately 50 feet to the north, as shown in Figure Ap.5-3b. This would reduce the retained space for future transmission expansion to about 210 feet compared with about 270 feet under the Proposed Project.

Brookside, Beaumont-Cherry, and Cherry–Highland Springs Relocation Segments. The portion of the corridor east of Deodar Drive and west of Highland Springs Drive in the City of Beaumont would have the longest stretch of towers that would be located closer to residences under the Proposed Project as compared to current structure locations. The Tower Relocation Alternative would shift 19 pairs of towers approximately 50 feet to the north (from Structures 4S23 through 4S43 and Structures 4N23 through 4N43), as shown in Figures Ap.5-3c through Ap.5-3f. This alternative would leave about 210 feet of ROW vacant as compared to the Proposed Project, which would retain about 270 feet of vacant space on the north side of the ROW.

Mockingbird Lane Relocation Segment. As shown in Figure Ap.5-3g, this segment would shift 3 pairs of towers approximately 50 feet to the north (Structures 4S14 through 4S16 and 4N14 through 4N16). The alternative would reduce the retained space for future transmission expansion to approximately 240 feet, compared with approximately 290 feet under the Proposed Project.

Tower Relocation Alternative: Segment 5

East Banning Relocation Segment. As shown in Figure Ap.5-3i, this segment would shift a single pair of towers, Structures 5S54 and 5N54, approximately 50 feet to the north.

Tower Relocation Alternative: Segment 6

Whitewater–Amethyst Drive Relocation Segment. As shown in Figure Ap.5-3h, the Tower Relocation Alternative would shift 4 individual structures (Structures 6N38 to 6N41) approximately 65 feet to the north within the northern portion of the split ROW occurring in this segment. The transmission line ROW through the area by Haugen–Lehmann Way would remain separated into two ROW corridors (as it is currently). The shift would reduce the retained vacant space to about 175 feet, compared to the Proposed Project, which would retain about 240 feet to the north (at Structure 6N38).

Consideration of NEPA Criteria

Project Objectives, Purpose and Need

Basic Project Objective 1, Increase system deliverability: The Tower Relocation Alternative would meet this objective by providing the same transfer capability and deliverability as the Proposed Project. The resulting capacity of 4,800 MW would exceed the 2,200 MW of increased deliverability defined in this objective.

Basic Project Objective 2, Support renewable energy goals: Because the Tower Relocation Alternative would have the same transfer capacity as the Proposed Project, it would support renewable energy goals in the same manner. As discussed under "Feasibility" below, construction of the Tower Relocation Alternative would entail a similar construction approach as would occur under the Proposed Project. However, the overall construction schedule for the Tower Relocation Alternative could require a few additional months for additional outages and use of shoo-flies. In any event, this additional time would not affect California's meeting of the currently defined 33 percent RPS or the effective use of federal lands for renewable energy development.

Basic Project Objective 3, Maximize remaining space in the corridor: The Tower Relocation Alternative would be located within SCE's existing ROW. Even when shifting the structures 50 feet farther from residences in Segments 4 and 6, there would remain adequate space within the ROW (up to 175 feet) for transmission expansion, if needed by SCE in the future. Table Ap.5-2 shows the vacant space that would remain for future transmission expansion on either side of the corridor after implementing this alternative. Note that there is essentially no vacant space in the ROW in Segment 1, and in Segment 2 the potentially vacant space is not within the Proposed Project ROW, but in a nearby parallel SCE transmission ROW.

Table Ap.5-2. Vacant Space within ROW in the Tower Relocation Alternative

	Segment 1	Segment 2	Segment 3	Segment 4	Segment 5	Segment 6
Vacant space north side (feet)	n/a	n/a	At least 50	210	n/a	175
Vacant space south side (feet)	n/a	n/a	220	50	n/a	0
Room for Future 500 kV?	n/a	Unknown	Yes	Yes	Unknown	Yes

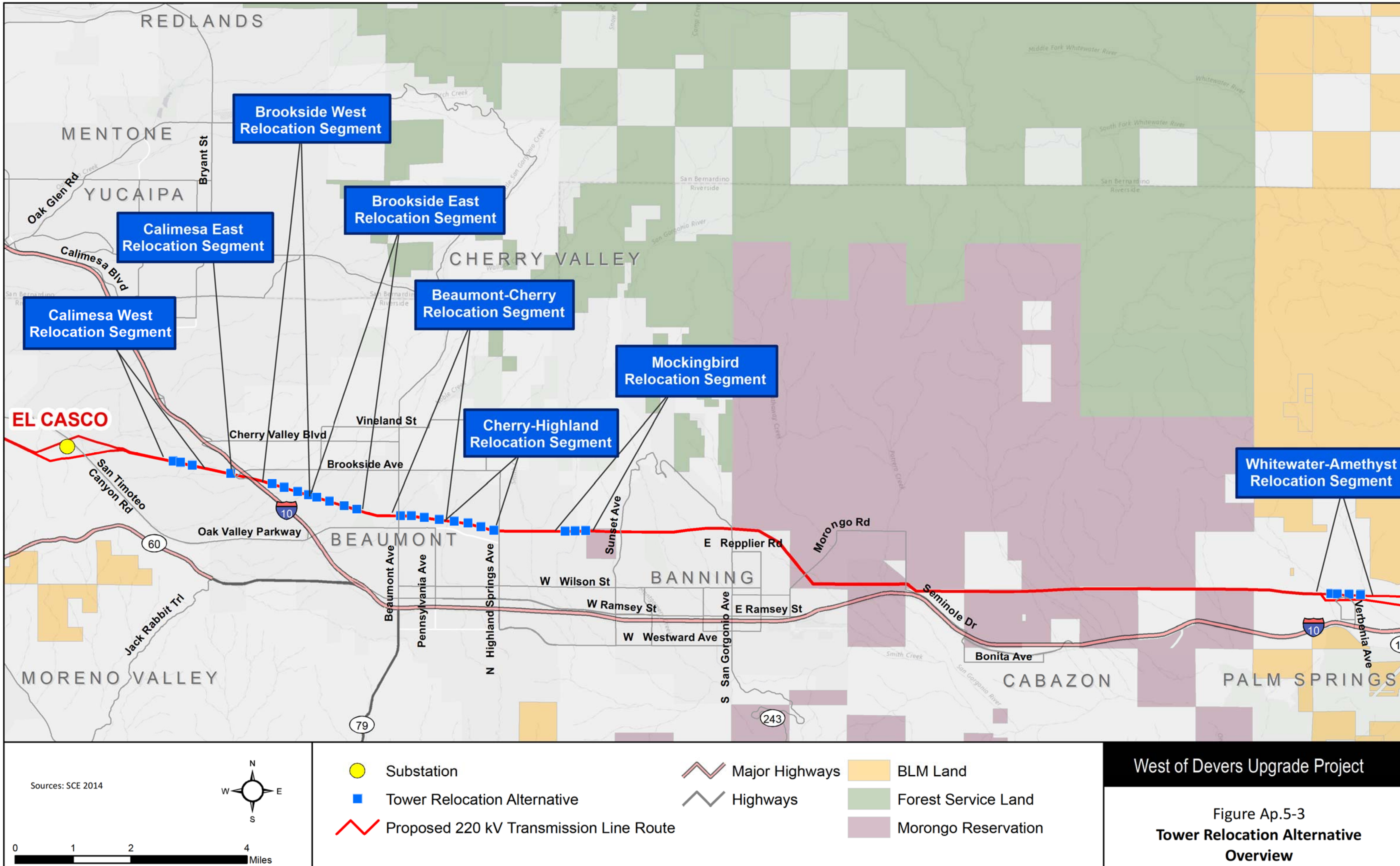


Figure Ap.5-3
Tower Relocation Alternative Overview

This page intentionally blank.

West of Devers Upgrade Project

Figure Ap.5-3a

Tower Relocation Alternative: Calimesa West Relocation Segment

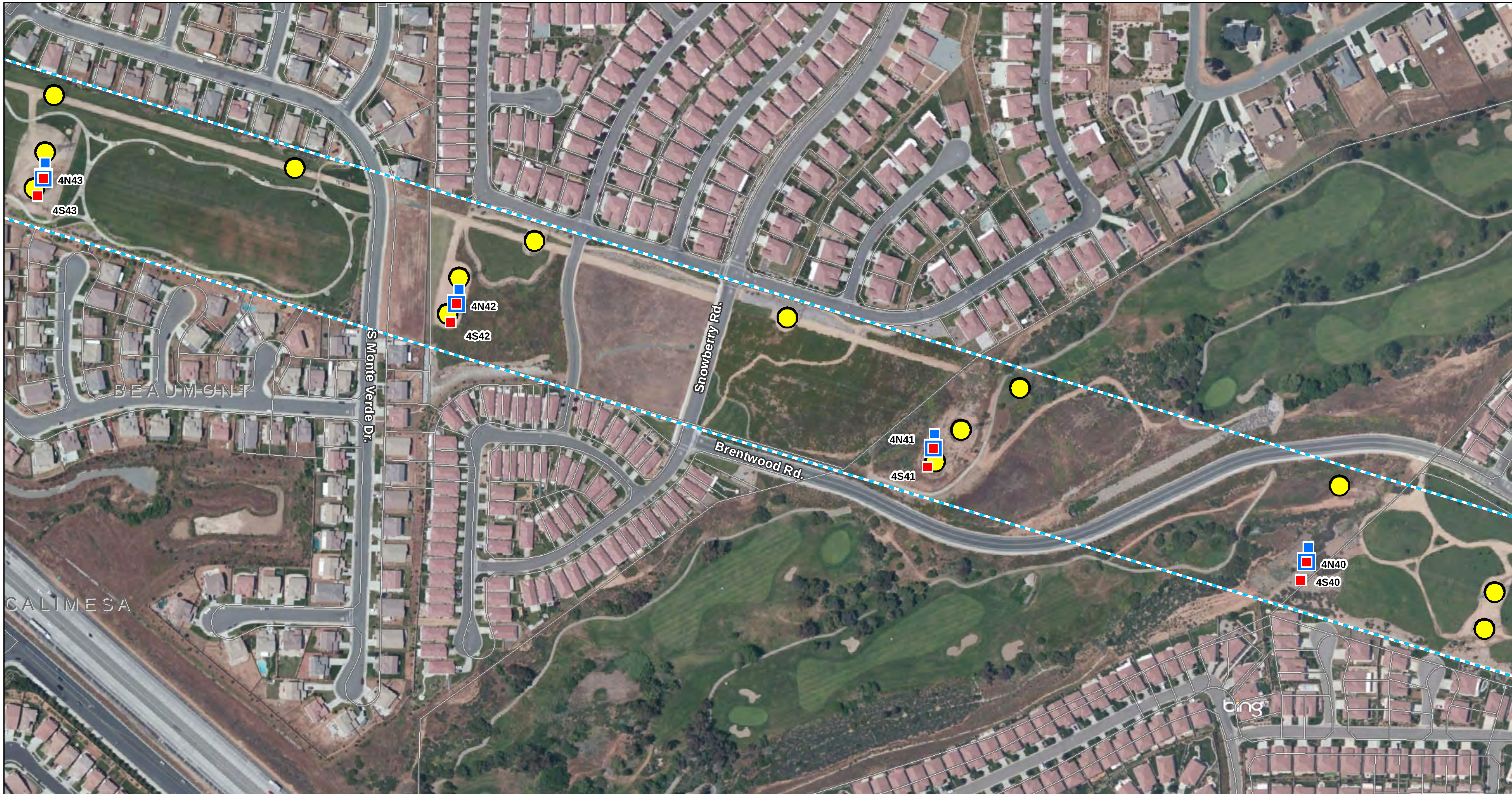
This page intentionally blank.

West of Devers Upgrade Project

Figure Ap.5-3b

Tower Relocation Alternative: Calimesa East Relocation Segment

This page intentionally blank.



Sources: SCE 2014

N
W E
S

0 125 250 500 Feet

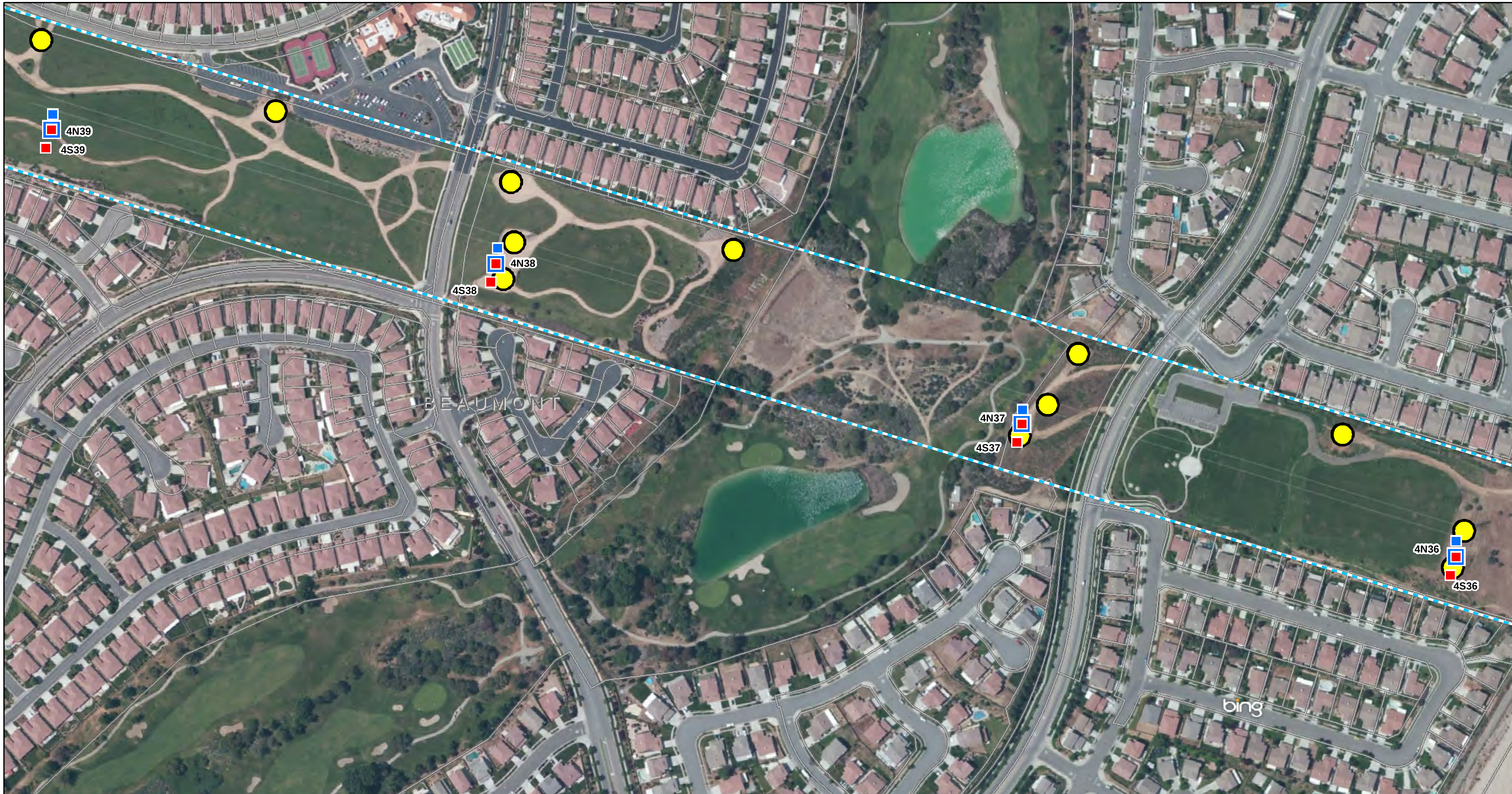
- Proposed Structures
- Alternative Structure
- Alternative Structure (in location of Proposed Structure)
- Structures to be Removed
- Approx. Existing 220kV T/L Corridor
- Parcels

West of Devers Upgrade Project

Figure Ap.5-3c

Tower Relocation Alternative: Brookside Relocation West

This page intentionally blank.



Sources: SCE 2014

N
W E
S

0 125 250 500 Feet

- Proposed Structures
- Alternative Structure
- Alternative Structure (in location of Proposed Structure)
- Structures to be Removed
- Approx. Existing 220kV T/L Corridor
- Parcels

West of Devers Upgrade Project

Figure Ap.5-3d
Tower Relocation Alternative: Brookside Relocation East

This page intentionally blank.

West of Devers Upgrade Project

Figure Ap.5-3e

Tower Relocation Alternative: Beaumont-Cherry Relocation Segment

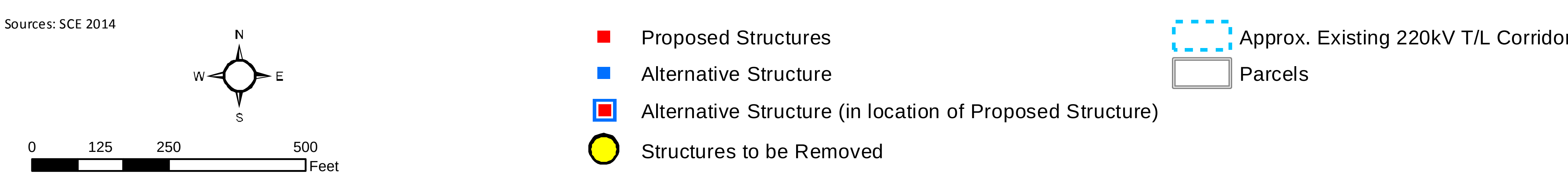
This page intentionally blank.

West of Devers Upgrade Project

Figure Ap.5-3f
Tower Relocation Alternative:
Cherry-Highland Springs Relocation Segment

This page intentionally blank.

Sources: SCE 2014



West of Devers Upgrade Project

Figure Ap.5-3g

Tower Relocation Alternative: Mockingbird Lane Relocation Segment

July 2016

This page intentionally blank.

West of Devers Upgrade Project

Figure Ap.5-3h

Tower Relocation Alternative: Whitewater-Amethyst Drive Relocation Segment

This page intentionally blank.

Feasibility

Legal and Regulatory Feasibility. This alternative is essentially the same as the Proposed Project, and would be equally feasible considering legal and regulatory factors.

Technical Feasibility. Construction of the 220 kV double-circuit towers is technical feasible, because they are the same structure types included in SCE's Proposed Project. This technical feasibility discussion therefore focuses on the availability of space in the ROW. The alternative has been evaluated for technical feasibility based on SCE's responses to CPUC data requests. Based on these responses, adequate space in the ROW for the upgraded towers and for future corridor expansion is considered to be available for tower relocations as follows:

- In Segments 4 and 6, the Proposed Project would leave a minimum of 175 feet and as much as 300 feet north of the proposed pairs of towers. In Segment 3, the Proposed Project would leave about 270 feet south of the proposed pairs of towers.
- SCE indicates that the minimum spacing required between a 220 kV double-circuit structure and a 500 kV double-circuit structure is 100 feet from center-to-center, with an additional 75 feet typically required from the center of the 500 kV tower to an edge of the ROW. This results in a total distance requirement of 175 feet from the center of the 220 kV structure to the edge of the ROW, sufficient to allow construction of a 500 kV line (SCE Response to CPUC Data Request ALT-15.A; SCE, 2014).
- Based on this information, this screening analysis assumes that the centers of the newly constructed 220 kV double-circuit structures must remain at least 175 feet from one edge of the ROW to allow possible future installation of double-circuit 500 kV tubular steel poles.

Construction Timeframe. Similar to the Proposed Project, this alternative would require construction activities near existing and operating circuits. As with the Proposed Project, this would require planned outages and use of shoo-flies due to the physical overlap between the new and existing towers. In the areas where this alternative would relocate structures toward the center of the ROW, SCE would need to use shoo-flies to provide adequate clearance for construction of the new double-circuit towers while keeping the neighboring existing circuits operational. In Segment 4, some locations would require a shoo-fly for two circuits over a short distance when installing the new tower near existing double-circuit structures. The additional outages and use of shoo-flies in these locations would add a few months to the construction duration. However, the alternative would achieve SCE's project objectives, which do not include specific in-service dates for the individual circuits (SCE Response to CPUC Data Request ALT-22; SCE, 2014). Therefore, this alternative would be feasible with regard to construction timeframes.

Reliability. Like the Proposed Project, the Tower Relocation Alternative would comply with all reliability requirements of NERC, FERC, and the CPUC.

Environmental Advantages

Visual Resources. Shifting structures away from residences would reduce potentially significant visual impacts. Because the views of existing structures vary from house to house, and the view of the proposed towers also would vary depending on the specific viewpoint, the visual resources analysis concludes that the Proposed Project would result in significant adverse visual impacts at about 30 percent of the residences along the ROW in Segments 4 and 6. This alternative would eliminate significant long-term visual impacts of the Proposed Project in the areas where relocation would occur. It would also reduce temporary visual impacts associated with construction by siting the towers farther from residences.

Land Use and Construction-Related Disturbance. Siting towers farther from residences would reduce construction-related impacts associated with noise and dust effects on sensitive receptors.

Environmental Disadvantages

Construction-Related Disturbance. The potential additional construction time required to build this alternative could extend the length of construction disturbances near residences and other sensitive receptors.

Alternative Conclusion

***Retained for Analysis*.** The Tower Relocation Alternative would meet all three basic project objectives and it would be feasible with respect to its constructability, reliability, and legal and regulatory factors. In addition, this alternative would reduce significant visual impacts of the Proposed Project and would reduce construction-related disturbance associated with the upgraded 220 kV lines by ensuring that relocated towers would be no closer to residences than the existing structures. Because this alternative would reduce potentially significant impacts of the Proposed Project, it has been retained for full evaluation in this EIS.

4.3 Iowa Street 66 kV Underground Alternative

This 1,600-foot underground alternative was developed by the EIS team to eliminate significant visual impacts of the proposed new 66 kV San Bernardino–Redlands-Tennessee subtransmission line to residences along Iowa Street in the City of Redlands.

Alternative Description

As illustrated in Figure Ap.5-4, under the Iowa Street 66 kV Underground Alternative, the 66 kV subtransmission line would transition from overhead to underground in Iowa Street just south of the single-lane bridge, approximately 275 feet north of Iowa Street's intersection with Orange Avenue. The subtransmission line would travel underground in new conduit in Iowa Street for approximately 1,600 feet before transitioning from underground to overhead on the south side of Barton Road in line with the existing overhead San Bernardino–Redlands-Tennessee 66 kV subtransmission line running east-west along Barton Road. This underground alternative would replace a similar length of proposed new overhead subtransmission line that is part of the Proposed Project.

Consideration of NEPA Criteria

Project Objectives, Purpose and Need

Basic Project Objective 1, Increase system deliverability: The Iowa Street 66 kV Underground Alternative would meet this objective by providing the same transfer capability and deliverability as the Proposed Project. The resulting capacity of 4,800 MW would exceed the 2,200 MW of increased deliverability defined in this objective.

Basic Project Objective 2, Support renewable energy goals: This alternative would facilitate progress toward achieving California's RPS goals in the same manner as the Proposed Project.

Basic Project Objective 3, Maximize remaining space in the corridor: This objective does not apply to the 66 kV subtransmission system.

West of Devers Upgrade Project

Figure Ap.5-4
Iowa Street 66 kV Underground Alternative

This page intentionally blank.

Feasibility

Legal and Regulatory Feasibility. This alternative appears to be feasible, considering legal and regulatory factors.

Technical Feasibility. Installation of 66 kV subtransmission lines underground is technically feasible, and is proposed by SCE in other segments of its WOD Upgrade Project. SCE has stated that, while it has not thoroughly investigated the existing underground utilities in Iowa Street, it does not have any reason to conclude that there would be insufficient space somewhere within the current roadway width to place a new subtransmission conduit system (SCE, 2014; SCE Response to CPUC Data Request ALT-28).

Construction Timeframe. Installation of 1,600 feet of the 66 kV subtransmission line underground, rather than overhead as proposed, would require more time to construct. However, this time would be substantially less than the time required to construct the 220 kV portions of the project, so it would not affect the overall timeframe for construction of the project as a whole.

Reliability. Underground subtransmission lines are more difficult to repair due to the required access to underground cables and splice vaults, so more time would be required for repair of outages. However, subtransmission lines are regularly installed underground by utilities in California, and they are considered to be reliable.

Environmental Advantages

Visual Resources. This underground alternative would eliminate potentially significant visual impacts associated with the new overhead 66 kV subtransmission route along Iowa Street, adjacent to the Cottage Lane residential subdivision in Redlands. Approximately 7 poles would be eliminated and 2 additional poles would be replaced with transition structures.

Biological Resources. An underground subtransmission line would eliminate the permanent loss of habitat at each pole footings that would result from the construction of the overhead line. In addition, underground transmission lines would reduce the potential for bird collision or electrocution.

Environmental Disadvantages

Traffic and Transportation. The underground route would be located for 1,600 feet within Iowa Street. Construction would require temporary lane closures on Iowa Street, Orange Avenue, and Barton Road, increasing the need for traffic control and resulting in possible delays.

Ground Disturbance. The underground alternative would require substantially more construction activity and ground disturbance due to the trenching required under the alternative. While construction of the overhead 66 kV subtransmission line as part of the Proposed Project would result in construction disturbance primarily at 7 individual structure sites along the alignment, the underground construction and trenching would involve much more extensive ground disturbance and more construction-related impacts (e.g., additional traffic, air quality and dust, and noise). There also is a greater potential to encounter contaminated soils and cultural resources due to the amount of ground disturbance required as compared to having the line overhead.

Construction and Repair Time. Construction of an underground subtransmission line would require more time than an equivalent length of overhead line because of the time required for excavating, cable splicing, backfilling, and paving. In addition, maintenance and restoration time in the event of an outage would be more difficult and could result in longer outages and repair times. Accessing manholes and performing required repairs would require traffic control and possible lane or roadway closure.

Alternative Conclusion

Retained for Analysis. This alternative would be meet the two project objectives applicable to the 66 kV subtransmission line component of the Proposed Project (Basic Project Objectives 1 and 2), and would be feasible. In addition, the Iowa Street 66 kV Alternative would eliminate significant visual impacts associated with the new overhead 66 kV subtransmission line. Therefore, this alternative has been retained for full evaluation in this EIS.

4.4 Phased Build Alternative

This alternative has been retained for analysis because it would avoid most of the environmental impacts associated with removal of the existing double-circuit towers and construction of new double-circuit towers, while still allowing import of generation from all the reasonably foreseeable generation projects defined by the CAISO. This was evaluated through independent power flow modeling to determine whether the alternative would satisfy the CAISO's 2024 Reliability Base Case, which includes the generation that was under construction or had received regulatory approval at the time of CAISO's 2013/2014 transmission planning process.[1] The alternative components are illustrated in Figure Ap.5-5a and Ap.5-5b.

Alternative Description

This alternative is derived from the project proposed by SCE in 2005 as the West of Devers System Upgrades. The purpose of this alternative is to reduce construction by retaining nearly all of the existing tower structures and installing lighter-weight but higher-performance conductors on the retained towers. The high-performance conductors would maximize power transfer and avoid structurally overloading the majority of existing towers. The alternative would:

- **Remove and replace existing single-circuit towers.** In most of the existing right-of-way (ROW), the two sets of existing single-circuit towers would be removed and one set of new double-circuit towers would be constructed to replace the removed towers. The new set of double-circuit towers would be constructed in the existing ROW paired with existing/retained structures, generally immediately north or south of the existing double-circuit towers, as detailed by segment below. The new set of double-circuit structures would be installed with an approximately 50-foot separation from the centerline of the existing (retained) structures, as defined for the Proposed Project.
- **Install interset towers where required.** Up to 110 interset structures would be required in Segments 3, 4, and 6. These structures would be required where the spans between retained towers exceed the strength of existing towers, and at locations where conductor blowout (where conductors could sway horizontally, potentially result in insufficient horizontal safety clearance to the adjacent line) could occur.
- **Ensure compliance with the requirements of the Tower Relocation Alternative** (as described in Final EIR Section 4.2). The Phased Build Alternative would retain (and not remove) most existing double-circuit structures near the center of the ROW. Constructing the second line adjacent to the retained structures ensures that no new structure would be located nearer to the edge of the ROW than is currently the case.

---

[1] The Phased Build Alternative would have capacity for all the generation included in the CAISO 2024 Reliability Base Case (see Attachment 2 to this Appendix, pages 5-6 and page 21, Table A4). This scenario includes 3,754 MW of Total Generation On-line and 6,901 MW of Total Generation Capacity), from renewable and conventional resources, as well as the power flow on the system resulting from import of 1,400 MW from the Imperial Irrigation District into the LA Basin.

- **Retain existing double-circuit towers**. Most of the existing double-circuit towers would be retained.
- **Install high-capacity conductors on all four circuits.** Both the new and existing 220 kV double-circuit towers would have the "795 Drake" Aluminum Conductor Composite Reinforced (ACCR) installed, with the exception of Segment 1, where only two of the existing four circuits would be modified.
- **Allow for future capacity expansion of the existing corridor** with several optional future phases. These phases would be implemented as generation projects become certain and capacity is clearly required. Because the Phased Build Alternative would accommodate projects now defined in the CAISO's 2024 Reliability Base Case, it may be 10 years before additional upgrades are needed. The configuration of future transmission expansion that may be required cannot now be predicted, and would depend on many factors, including type and location of future renewable generation, the type and location of future transmission upgrades by SCE or other parties, and the regulatory systems and policies in place to define prudent investment in transmission capacity for renewable energy (e.g., policies differentiating between energy only procurement versus full capacity deliverability). The future phases could include:
  - Reconductor the newly constructed 220 kV structures with higher capacity conductors;
  - If required (based on assessment of structure strength with added interset structures), replacing some of the retained 220 kV structures with new, stronger 220 kV structures in order to carry heavier, higher capacity conductors;

    And/or:
  - Installation of a single- or double-circuit 500 kV or 220 kV line in the vacant space remaining in the ROW.

In Appendix B of its Opening Brief in the CPUC's General Proceeding, SCE stated that installation of the Phased Build Alternative's 795 ACCR conductor would require modification of SCE's planned wire stringing plan. The EIS Team agrees that the use of ACCR conductor would require changes to SCE's existing wire stringing plan, and that the Phased Build Alternative would likely result in a larger overall number of wire stringing sites due to the lower bending angle that ACCR allows. The majority of the stringing sites that SCE has defined for the Proposed Project would still be usable for the ACCR used in the Phased Build Alternative. Some different wire stringing sites would likely be required for ACCR, which would replace sites originally defined for the Proposed Project (ACSR) conductor, and some new sites would also be required.

In Segment 5 on Morongo land, the Phased Build Alternative structures would be exactly the same as those of the Proposed Project, as illustrated in Figure Ap.5-5b, and would incorporate the Morongo relocation of a part of the ROW and use of tubular steel poles. Under the SCE-Morongo ROW agreement, the Morongo Band may conclude that the Phased Build Alternative does not satisfy SCE's obligation to timely obtain all required regulatory approvals of the Proposed Project. If the Morongo Band concludes that this alternative does not satisfy SCE's obligations, the Morongo Band could direct the Department of Interior to cancel the ROW, which would create a legal impediment to this project alternative.

The Phased Build Alternative would use a composite reinforced conductor in an appropriate size to allow import from all generation projects that are reasonably foreseeable (i.e., included in the CASIO's 2024 Reliability Base Case, as well as allowing import of an additional 1,400 MW from the Imperial Valley). A high-performance conductor weighs less and has lower thermal expansion than the SCE-standard ACSR conductor, resulting in less sag for an equivalent strength and durability as the ACSR conductor. Therefore, using an alternative conductor in conjunction with interest towers would satisfy the basic project objectives while simultaneously avoiding the need to rebuild towers in the corridor.

Configuration by Project Segment. The Phased Build Alternative would be configured differently in these the following segments:

Segment 1 would be configured to:

- Retain the existing double-circuit 220 kV towers and the San Bernardino–Vista and Etiwanda–San Bernardino circuits without change.
- Re-use the existing double-circuit 220 kV towers, and reconductor to replace the two existing circuits in the 220 kV positions nearest to the edges of the ROW so that Devers–San Bernardino and El Casco–San Bernardino use a new 795 Drake ACCR conductor.
- Either retain or relocate the existing 66 kV circuits, based on final design. If the 66 kV circuits are required to be relocated, the Iowa Street 66 kV Underground Alternative would still be required (as with the Proposed Project). If the 66 kV circuits are not relocated, the Iowa Street Underground Alternative would not be required.

Segment 2 would be configured to:

- Re-use the majority of existing double-circuit 220 kV towers (replacing approximately 6 towers), and reconductor so that both existing circuits between Devers–Vista use a new 795 Drake ACCR conductor.
- Retain all existing 115 kV circuits in Segment 2 in place and unmodified.

Segment 5 (including Morongo Land) would be configured as follows:

- All existing 220 kV structures on Morongo Land would be removed and replaced with two sets of new double-circuit tubular steel poles and double-circuit lattice steel tower structures (see description of tubular steel poles [TSPs] below) having the same strength capabilities and spacing as the Proposed Project double-circuit towers.
- In the westernmost 3 miles of tribal land, all transmission facilities in the existing ROW would be removed and relocated south to new ROW closer to I-10, as defined for the Proposed Project. For the 17 pairs of new structure pairs that SCE and Morongo have agreed would be TSPs in the Proposed Project, those would be TSPs in this alternative. The remaining structures on Morongo land would be lattice steel towers, as in the Proposed Project
- On private land in Segment 5, the existing double-circuit structures would be retained. The two sets of single-circuit 220 kV structures would be removed and replaced with a single set of new double-circuit lattice steel towers having the same strength capabilities and spacing as the Proposed Project double-circuit towers.
- All conductors in Segment 5 would be conductored with 795 Drake ACCR.
- The Morongo towers would be able to support 1590 kcmil conductors (if required in the future), so no future structure replacement would be required on Morongo land. On private land in Segment 5, the retained structures would have to be replaced with stronger structures in order to support the 1590 kcmil conductors (if they are determined to be needed).

Two options for Segment 5 are suggested for agency consideration, if the Phased Build Alternative is adopted:

Segment 5, Phased Build Alternative Option 1

Option 1 would have the same structures as the Proposed Project in all of Segment 5, but would be conductored with 795 Drake ACCR conductor at this time. All Segment 5 towers (not only the approximately 60 percent on Morongo land) would be removed and replaced with the Proposed Project tubular steel pole and double-circuit lattice steel tower structures, capable of supporting 1590 kcmil conductors. This would acknowledge the complex land ownership pattern in Segment 5, where the current ROW runs along tribal/private parcel boundaries. This option would ensure that no future tower construction would occur in Segment 5. However, there would be future construction activity related to reconductoring from Drake 795 to 1590 kcmil conductors.

Segment 5, Phased Build Alternative Option 2

Option 2 would have the same structures and conductor as the Proposed Project in all of Segment 5. All of Segment 5 (both Morongo and private land) would be initially conductored with 1590 conductor and not 795 Drake ACCR conductor. This would eliminate all possible future effects on Morongo lands, including use of access roads, pull sites, or shoo flies.

Segments 3, 4, and 6 would be configured as follows:

- As with the Proposed Project, reconfigure San Bernardino Junction to accommodate the new double-circuit tower line north of the existing double-circuit towers. This means that the Devers–San Bernardino and El Casco–San Bernardino circuits would be on the northern side of the existing ROW in Segment 3.
- The intent of the Tower Relocation Alternative (TRA) is incorporated into the Phased Build Alternative: For the 29 pairs of towers included in the TRA, the existing double circuit structures (which would be retained in the Phased Build Alternative) are located near the center of the ROW, so the new adjacent structures would be approximately 50 feet from the existing structures. In all cases, the new towers would be farther from the edge of the ROW than the now existing towers.
- Re-use most of the existing double-circuit 220 kV towers and reconductor those two circuits using new 795 Drake ACCR conductor.
- Remove the two single-circuit 220 kV structures and replace them with a single set of new double-circuit towers having the same strength capabilities and spacing as the Proposed Project double-circuit towers, and install new 795 Drake ACCR conductor for both circuits. The single set of new double-circuit towers would be north of the existing double-circuit towers in Segment 3 and in Segment 4 near El Casco Substation. In the remainder of Segment 4 and in Segment 6, the single set of new double-circuit towers would be south of the existing double-circuit towers.
- Reconfigure Banning Junction to eliminate individual 220 kV circuit crossings. To avoid circuit crossings at Banning Junction, the Devers–San Bernardino and Devers–El Casco circuits would be on the northern side of the ROW for all of Segments 4, 5, and 6, and both Devers–Vista circuits would be on the southern side of the ROW.

The new double-circuit towers that would be constructed would be located approximately 50 feet north of the existing double-circuit towers in Segment 3 and approximately 50 feet south of the existing double-circuit towers in Segments 4 and 6. The types of new double-circuit towers in Segments 3 through 6 would have the strength capabilities and spans of the Proposed Project double-circuit towers and would be capable of future upgrade to the Proposed Project conductors. The strength of the newly built towers would mean that the new double-circuit structures could be reconductored in the future with the SCE-proposed 2B-1590 kcmil conductor, although a double-bundled conductor is not part of the alternative considered here.

SCE reviewed the description of the Phased Build Alternative in comparison with the Proposed Project and found that the construction plan for the Phased Build Alternative would require either (a) several more multiple line outages, due to the removal of existing conductors from the retained double-circuit towers before new conductors could be installed, or (b) greater use of numerous temporary structures (shoo-flies) to carry existing energized conductors while new conductors are installed on the existing double-circuit towers (Response to Data Request ALT-29: SCE, 2014/2015). SCE evaluated alternative scenarios for construction of this alternative, and concluded that using shoo-flies to carry energized conductors (the second option) would be preferred in order to mitigate the need for multiple line outages. Because of the need to schedule and plan for outages, overall construction of this alternative would take about the same amount of time as the Proposed Project.

The Proposed Project would give the WOD corridor a large planning margin of capacity to handle power flow during all conditions and for future growth. Independent power flow modeling was conducted to assess the loading in each of the corridor's circuits, during normal operations and during times when one or more circuits are out of service. Attachment 1 to Appendix 5 presents data and discussion that compare the ability of the Proposed Project with the Phased Build Alternative to handle anticipated power flow loads.

Construction Disturbance. The Phased Build Alternative would result in at least 20 percent less overall construction activity taking place in the ROW than the Proposed Project. A reduction in the level of construction activity results in direct reductions in vehicle emissions, dust, noise, loss of habitat, erosion, and visual disruption. The specific construction differences are:

- Proposed Project would require 467 new standard structures (both lattice steel towers and tubular steel poles) to be constructed and 600 structures to be removed;
- Phased Build Alternative would require between 260 and 265 new standard structures to be constructed and approximately 360 to 365 structures to be removed. The Phased Build Alternative avoids the Proposed Project's need to remove approximately 160 existing double-circuit structures.
- Using very conservative (worst-case) estimates, the Phased Build Alternative would require installation of approximately 105 to 110 interset structures to be constructed. Use of interset towers eliminates the need to replace or strengthen most of the approximately 30 percent of retained towers (as was defined in the Final EIR).
- No interset structures would be required for the Proposed Project.
- Proposed Project would require 51 temporary shoo-fly structures to be constructed and then removed in the 220 kV segment; and the Phased Build Alternative would require 136 temporary shoo-fly structures to be constructed and then removed in the 220 kV segment. According to SCE's data (see Final EIR, Table B-13), the temporary ground disturbance for installation and removal of shoo-flies would be 125 acres for 300 shoo-flies, or 0.42 acres per shoo-fly, so the 85 additional shoo-flies would create 35 acres of additional temporary disturbance.

Overall, the reduced construction required for the Phased Build Alternative would result in 20 percent to 25 percent less new structure construction than the Proposed Project and it would avoid the need to demolish nearly 160 structures. Both permanent and temporary ground disturbance would also be reduced by 20 percent to 25 percent. In addition, the new double-circuit structures would be moved further from the edge of the ROW than the Proposed Project.

Consideration of NEPA Criteria

Project Objectives, Purpose and Need

Basic Project Objective 1, Increase system deliverability: The Phased Build Alternative would allow SCE to fully deliver about 3,000 MW of the output from new generation projects, so it fully achieves Basic Project Objective 1 by providing an increase in deliverability that is 1,400 MW over the present capability of 1,600 MW and at least 2,200 MW over the capability of the WOD 220 kV corridor before the Proposed Project was planned, which was limited to approximately 550 MW. Based on power flow modeling completed for this alternative (see results in Table A3 in Attachment 2 to this appendix), this alternative satisfies the CAISO's 2024 Reliability Base Case, which includes specific generation projects that the CAISO has determined to be most likely to be constructed plus a scenario of 1,400 MW from IID to the CAISO.

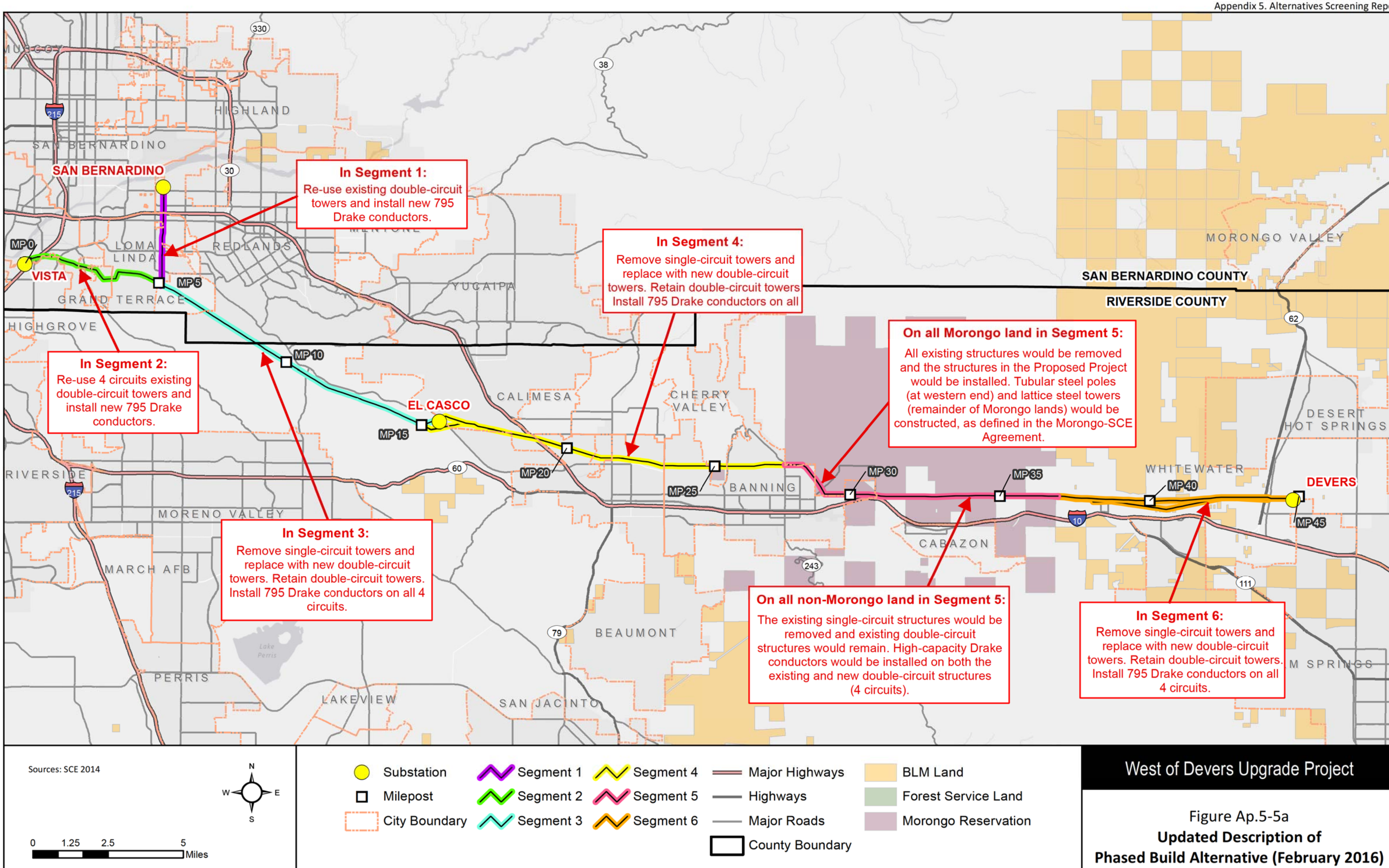


Figure Ap.5-5a
Updated Description of Phased Build Alternative (February 2016)

This page intentionally blank.

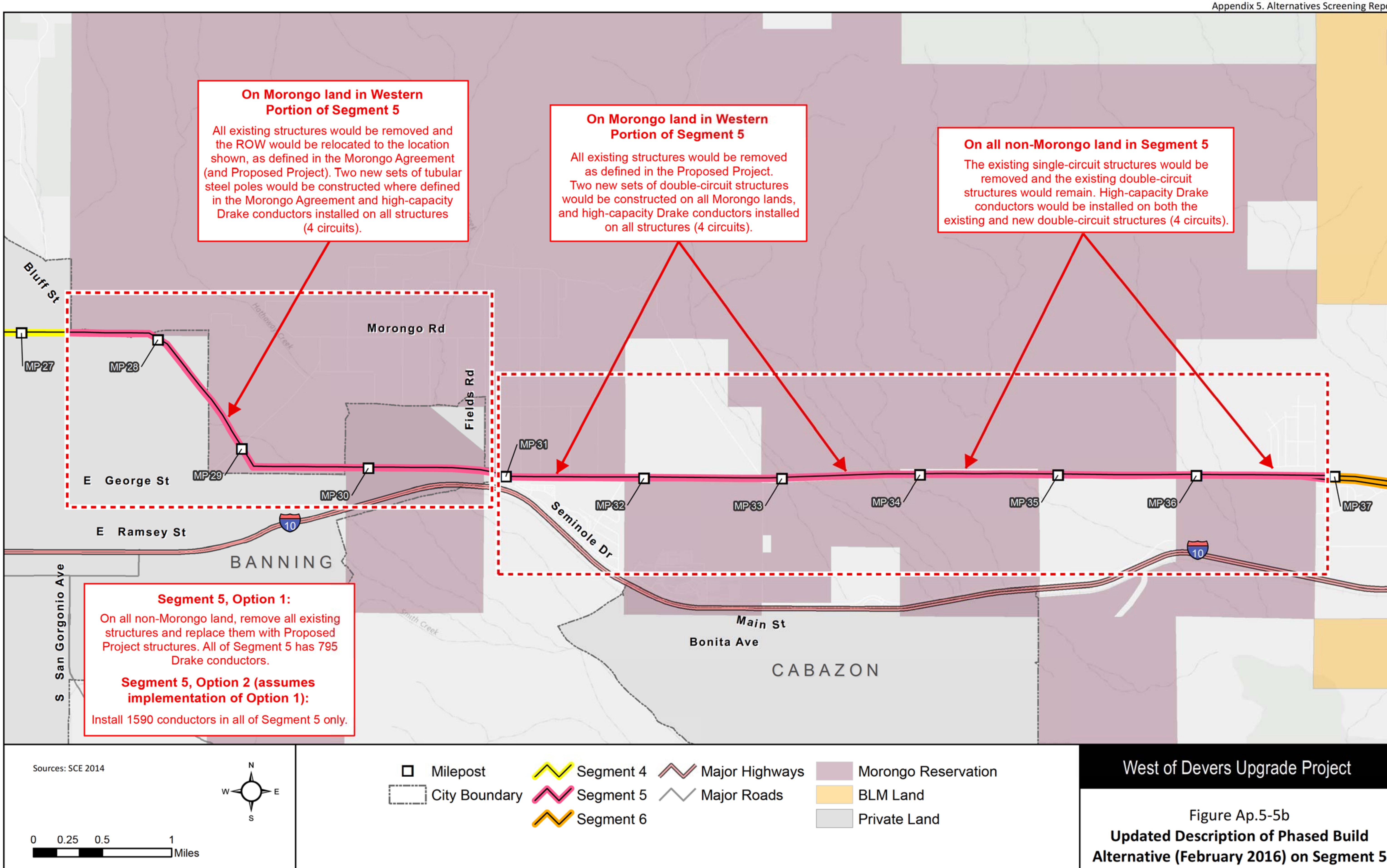


Figure Ap.5-5b
Updated Description of Phased Build Alternative (February 2016) on Segment 5

This page intentionally blank.

Section A.2.1.4.1 of this EIS describes the generation projects whose capacity is expected to be carried by the Proposed Project, and explains how these projects are categorized for the EIS. Table Ap.5-3 shows the projects accommodated and likely to be made deliverable by the Phased Build Alternative.

Basic Project Objective 2, Support renewable energy goals: This alternative would facilitate progress toward achieving California's RPS goals by adding more than 800 MW of transfer capacity for renewable energy projects located east of Devers Substation while accommodating at least 1,000 MW of future growth.[2] This would support increased import of renewable generation into the Los Angeles basin.

Table Ap.5-3. Projects Accommodated by the Phased Build Alternative

Projects Considered to be Connected Actions	Projects Considered to be Cumulative	Projects Considered to Fill Remaining Growth-Inducing Capacity
Analyzed in Section D, Environmental Analysis	**Analyzed in Section E, Cumulative Scenario and Impacts**	**Analyzed in Section F Other NEPA Requirements**
• Palen Solar Power Project (500 MW solar thermal, CAISO Queue 365) • EDF Desert Harvest (150 MW solar PV, CAISO Queue 643AE) • 50 MW Solar PV Project connecting to Blythe–Eagle Mountain 161 kV line (CAISO Queue 421) • 250 MW Solar PV Project Connecting at Red Bluff Substation 230 kV (CAISO Queue 1070) • 224 MW Solar PV Project connecting at Colorado River Substation 230 kV (CAISO Queue 576) • 150 MW Solar PV Project connecting at Colorado River Substation 230 kV (CAISO Queue 970) • 150 MW Solar PV Project Connecting at Colorado River Substation 230 kV (CAISO Queue 1071)	• Blythe Energy Project, Phase II (570 MW gas-fired combined cycle plant) • NextEra Genesis Project and NextEra McCoy Project (250 MW solar trough; 250 MW solar PV) • NextEra Blythe Project (485 MW solar PV) • IID Path 42 Upgrades (230 kV transmission line) • CAISO Queue 798 (221 MW solar PV connecting at Colorado River Substation; energy only)	• None accommodated by Phased Build Alternative

2 The Draft EIR/EIS preparers asked CPUC RPS Staff to test the "RPS Calculator" to show how future renewable resource portfolios might change with a smaller upgrade to WOD than SCE has proposed. With RPS Calculator V.5: there would be no additional transmission capacity needed elsewhere in the state to make up for generation decreased in Riverside East; and renewable generation in Westlands or other zones (including San Diego South and Solano) would replace the generation decreased in Riverside East, using existing transmission capacity available in the other zones. With RPS Calculator V.6.1: there would be no impact on the generation selected in Riverside East or elsewhere.

Table Ap.5-3. Projects Accommodated by the Phased Build Alternative

Projects Considered to be Connected Actions	Projects Considered to be Cumulative	Projects Considered to Fill Remaining Growth-Inducing Capacity
1,474 MW generation from Connected Actions accommodated by Phased Build Alternative (Same as the Proposed Project)	**1,776 MW generation from Cumulative Projects accommodated by Phased Build Alternative, plus additional power flow across Path 42 Upgrades** (Note: this does not include the Delaney–Colorado River 500 kV Transmission Line that could be accommodated by the Proposed Project.)	**0 MW generation to fill Growth-Inducing Capacity accommodated by Phased Build Alternative** (1,571 MW less than the Proposed Project)

Basic Project Objective 3, Maximize remaining space in the corridor: The Phased Build Alternative would meet this objective by removing the existing single-circuit towers to create space for future transmission lines, including a 500 kV line within the ROW, although less space would be available than with the Proposed Project. In this alternative, some new double-circuit towers in Segments 4 and 6 (as defined in the Tower Relocation Alternative) would be placed further from the south edge of the ROW, resulting in the structures being 50 feet farther from residences in Segments 4 and 6 than under the Proposed Project. There would remain adequate space within the ROW (up to 175 feet) for transmission expansion, if needed by SCE in the future, as shown in Table Ap.5-2. As with the Proposed Project, any future 500 kV line within the ROW would need to cross the 220 kV circuits at or near the El Casco Substation. See EIS Section E.2.3.2 for additional information on this Cumulative Transmission Scenario.

Feasibility

Legal and Regulatory Feasibility. While the Morongo Band has a conditional contractual right to terminate its ROW Agreement with SCE, the Phased Build Alternative appears to be preliminarily feasible considering legal and regulatory factors, because it is currently uncertain whether the Morongo Band may or will exercise that right, and particularly because on Morongo lands the alternative is entirely consistent with the Project (as defined in Exhibit A to the DCA). Although the alternative is designed to meet the same project objectives as the Project described in the ROW Agreement and DCA and the tower structures would be exactly the same as SCE's Proposed Project on Reservation lands, comments from the Morongo Band assert that this alternative may be legally infeasible given the right of the Morongo Band to terminate the ROW Agreement if the SCE does not secure approvals by January 1, 2017 for the project described in the DCA (which arguably differs from the Phased Build Alternative in the tower locations off the Morongo Band lands, but is wholly consistent on Morongo Band lands). That termination right, however, has not been exercised and thus no such legal infeasibility currently exists. If that right is properly and timely exercised by the Morongo Band in the future, no transmission upgrades could be constructed across the Reservation absent the subsequent execution of a replacement ROW Agreement.

Technical Feasibility. The technical feasibility of the alternative has been evaluated based on SCE's responses to CPUC data requests, augmented by independent reviews in two technical areas: the ability of the existing structures to be reused and reconductored, and the ability of the new alternative conductor to handle anticipated power flow loads. Based on these efforts, this alternative appears to be feasible based on the following considerations.

Using the lighter-weight Drake 795 conductors on the existing double-circuit towers would increase the capacity of the circuits and postpone the impacts of rebuilding the towers as proposed. These conductors are 70 percent as heavy as the existing 1033.5 kcmil ACSR used in the corridor.[3] SCE Response to Data Request ALT-18a indicates that up to 30 percent of the existing double-circuit structures would need to be replaced or modified to provide increased strength and/or heights increased in order to support the 795 Drake ACCR conductor in this alternative.

- Based on information provided by SCE subsequent to issuance of the Final EIR, the use of 795 Drake ACCR conductor and soldiering of new towers adjacent to the existing line, as called for in the Phased Build Alternative, will necessitate the addition of up to 110 interset towers to eliminate conductor blowout. The use of these interset towers will eliminate the need for replacement or modification of most of the 30 percent of existing double-circuit structures that SCE had previously identified in Data Requests[4], because it is assumed that the interset structures would utilize SCE's "new stronger" tower design and would greatly reduce the length of span supported by the retained structures, thereby keeping loads within the capability of the existing structures in nearly all cases.
- **Use of ACCR.** While ACCR is not one of SCE's typical conductor types, high capacity conductors are commonly used by major utilities. High Temperature Low Sag (HTLS) options exist to the proposed 1590 ACSR conductors; these HTLS conductors are commercially available and need to be explored further for feasibility. HTLS conductors are a proven and accepted technology in the electric utility industry for upgrading capacity in existing corridors and on existing structures as well as for new line construction. HTLS conductors can normally operate at much higher temperatures. Therefore, it is possible to greatly increase power transfer capacity, compared to an equivalent ACSR type of conductor, while maintaining required clearances, because of the low sag nature of HTLS conductors. ACCR conductor was first commercially installed in the United States in 2001 by Xcel Energy and at a 2005 test site operated by San Diego Gas & Electric (SDG&E) in Oceanside (CEC, 2008). since that time it has been used domestically by multiple utilities, such as Pacific Gas and Electric (PG&E) near Santa Clara, Western Area Power Administration, Arizona Public Service, Silicon Valley Power, Alabama Power and Platte River Authority at voltages up to 230 kV and for critical generation tie lines. This type conductor and the comparable aluminum conductor composite core (ACCC) conductor are also used internationally by utilities like British Columbia Transmission Corporation and Shanghai Power. Another common HTLS conductor used by PG&E is the aluminum conductor steel supported (ACSS) type, which is used in new circuits serving the San Francisco peninsula and East Bay area including the Eastshore, San Mateo, and Dumbarton Substations.
- **ACCR is not one of SCE's typical conductor types.** As a result, SCE would have to develop a new spare-parts inventory system and implement worker training for operation and maintenance of this conductor type.
- **Line losses:** ACCR material has higher electrical losses. These losses would result in economic consequences, but these would have to be compared to the reduced construction cost achieved from the reuse of the existing 220 kV towers. The actual level of electrical losses, which depends on line loading,

---

3 ACSR and ACCR weights and capacities are derived from vendor technical properties fact sheets. Rated ampacity at 75° C for ACSR and 210° C for ACCR. (3M, 2015) http://solutions.3m.com/wps/portal/3M/en_US/EMD_ACCR/ACCR_Home/TechnicalInfo/ProductDataSpecs/

4 SCE Response to Data Request ALT-18a indicated that up to 30 percent of the existing double-circuit structures would need to be replaced or modified to provide increased strength and/or heights increased in order to support the 795 Drake ACCR conductor in this alternative, but this need no longer exists due to the shortening of spans that occurs with the addition of interset towers.

and potential sources of energy that would need to change dispatch to overcome the losses have not been quantified. Incremental GHG emissions would be minimized because upstream electric generation facilities are primarily renewable.

- **Vacant space within ROW:** This alternative would result in adequate space in the ROW for future expansion by removing the existing single-circuit towers, although the amount of space remaining would be limited by the locations of the existing double-circuit towers that would be reused and reconductored. Based on the locations of the existing double-circuit towers, there would remain adequate space within the ROW (up to 175 feet) for transmission expansion, if needed by SCE in the future.

Construction Timeframe. Because this alternative would avoid near-term construction related to removing and re-building all towers, there would be less overall construction activity with the Phased Build Alternative than with the Proposed Project. However, the alternative would result in a need to install a greater number of temporary structures (shoo-flies) to minimize line outages, and this would require scheduling and sequencing that could slow the pace of construction activities. While the reuse and reconductoring of the existing double-circuit towers would result in less construction activity overall, SCE's review of the alternative (Response to Data Request ALT-29) shows that the duration of construction could be similar to that of the Proposed Project. The construction plan defined by SCE may be able to be condensed through final engineering, but the environmental analysis assumes similar overall timeframes.

Reliability. Like the Proposed Project, the Phased Build Alternative would comply with all reliability requirements of NERC, FERC, and the CPUC.

Environmental Advantages

The Phased Build Alternative would avoid many environmental impacts of the Proposed Project by retaining and reconductoring the existing double-circuit towers with high-performance conductor. In addition, by moving towers in residential areas farther from the south edge of the ROW, visual impacts are reduced.

If the relocation of the 66 kV line is found to be required in order to manage outages, then the Segment 1 impacts of the Phased Build Alternative related to this activity will be the same as those defined for the Proposed Project.

These advantages are summarized as follows:

- **Construction and Ground Disturbance.** This alternative would reduce construction impacts (noise, air emissions, ground disturbance, traffic) because the existing double-circuit towers would remain in place, rather than being removed and replaced. This alternative would avoid the Proposed Project impacts related to removing all towers by reusing existing double-circuit structures for as long as possible. The existing reconductored towers would be replaced only after this alternative reaches the electrical capacity of its configuration. Even with additional required interset towers and required changes to the wire stringing plan, the Phased Build Alternative would require 20 percent to 25 percent less new structure construction (and associated ground disturbance) in comparison with the Proposed Project.
- **Visual Resources.** This alternative would reduce significant visual impacts to residences on south side of corridor (Beaumont, Calimesa, Banning, Whitewater) because existing towers are closer to center of ROW than the Proposed Project towers. This alternative would achieve the same visual benefit of the Proposed Project from removing the single-circuit towers, resulting in a less cluttered ROW with similar tower styles. While approximately 105 to 110 interset towers may be required, the location of all structures nearer to the center of the ROW still provides an overall visual benefit. In addition, the

number of interset structures could likely be reduced through final design of this alternative, if it is selected by the CPUC and BLM. In final design, design of the alternative would not rely on the Proposed Project tower locations for interset towers. With a new design unconstrained by Proposed Project structure locations, the design could retain most existing double-circuit structures and develop a new layout for the soldiered (paired) new structures that incorporates appropriate engineering. This would almost certainly reduce the need for interset structures below the current estimate.

Environmental Disadvantages

There are two potential disadvantages of the Phased Build Alternative:

- **Later Construction of Phased Build Components.** One beneficial feature of this alternative is that it would reduce the amount of near-term construction activities required to removing the double-circuit towers (as required for the Proposed Project). The Phased Build Alternative may provide adequate capacity for 10 years or more (based on the CAISO's Reliability Scenario). However, depending on other transmission system upgrades, it is possible that over the longer-term, the implementation of this alternative could require future construction activities to increase system capacity.
- **Operations and Maintenance.** Using ACCR or other high-performance conductors would introduce new conductor materials that are not standard to SCE's routine operations. These conductors and spare parts, including specialized splices or connectors would require storage, and operating the system would involve additional training for SCE personnel.

Alternative Conclusion

Retained for Analysis. The Phased Build Alternative is retained for EIS analysis because it would reduce the environmental impacts of the Proposed Project. It would achieve all three Basic Project Objectives. In addition, this alternative is technically feasible. The alternative conductor type has been proven and is in use by other utilities.

See Figures Ap.5-5a and AP.5-5b.

5. Alternatives Eliminated from Detailed Consideration

5.1 Introduction

This section describes the 12 alternatives that were evaluated but eliminated as a result of the alternatives screening process (Section 2, Description of Alternatives Evaluation Process). The alternatives eliminated include the following:

- 500 kV Towers Alternative
- Segment 4 Underground Alternatives in Calimesa, Beaumont, and Banning
- Segment 5 Morongo Central Route Alternative (original PEA Proposed Route)
- Segment 5 Morongo Existing 220 kV Route Alternative (Existing ROW)
- East Banning–Morongo Alternative
- Devers-Beaumont 500 kV Alternative (SCE System Alternative 1)
- Red Bluff–Valley-Serrano 500 kV Alternative (SCE System Alternative 2)
- Reduced Build Alternative Option 1
- Reduced Build Alternative Option 2a
- Reduced Build Alternative Option 2b
- High-Performance Conductor Alternative
- Retain WOD Interim Facility Alternative

5.2 500 kV Towers Alternative

This alternative was developed to reduce the potential cumulative impacts resulting from construction of a future 500 kV transmission line in addition to the 220 kV upgrades that would be in place at that time. The alternative was eliminated because the Morongo Agreement specifically defines installation of 220 kV towers. Because the Tribe has not agreed to allow a 500 kV line across its land, the alternative would be infeasible.

Alternative Description

This alternative would place a future 500 kV line (requiring taller structures) near the center of the ROW, with the lower voltage 220 kV lines nearer to the outside edges of the ROW. This configuration could only be achieved if future ROW needs are anticipated and towers built in 2016-2020 are located accordingly.

In general, the Proposed Project would install pairs of 220 kV towers near one edge of the ROW. This positioning would leave space for future lines, including a 500 kV line, in the vacant portion of the ROW. However, this plan results in two significant impacts:

- The proposed 220 kV towers would be very near one side of the ROW, creating significant visual impacts; and
- Given the location of the 220 kV towers, a future 500 kV line would need to be located closer to the opposite edge of the ROW, creating additional significant visual impacts on that edge of the ROW.

The 500 kV Towers Alternative anticipates a future 500 kV line being developed in the ROW, and therefore suggests that the current construction process should include (a) erection of structures suitable for eventual use at 500 kV, and (b) those new taller towers should be located near the center of the ROW. In contrast to the pairs of 220 kV towers of the Proposed Project, the outer tower in this alternative would be a 220 kV tower, and the one nearer the center of the ROW would be a 500 kV structure. Initially, the lines on both structures would be energized at 220 kV, but when system requirements justify more capacity, the 500 kV structure would be energized at 500 kV.

The new 500 kV towers would be strung for 500 kV service using a double-circuit configuration with bundled conductors (2B-2156 kcmil) while being initially energized at 220 kV. This configuration would remain in 220 kV service until SCE is able to develop the remaining components of a 500 kV system in this corridor and at the affected substations. This could ultimately involve future 500 kV service between the Devers Substation and the Vista Substation or farther west to SCE's Rancho Vista Substation near Etiwanda, in Rancho Cucamonga.

At some future time when 500 kV service becomes needed in addition to the existing 220 kV service, SCE would presumably construct the second set of double-circuit 220 kV towers on the opposite side of the ROW from the initial 220 kV towers. This would leave the ultimate future configuration of the ROW under this alternative with the two lines of 220 kV towers on either side of the 500 kV line in the center of the ROW in Segments 2, 3, 4 and 6. This alternative would not facilitate adding 500 kV service through Segment 1 (San Bernardino Substation to San Bernardino Junction) where the potential for blow-out of lines over the edge of the ROW would preclude using taller and wider-spaced structures.

The configuration of this alternative by segment is described as follows:

Segment 1. This alternative would not affect Segment 1. This segment would remain as currently proposed by SCE.

Segment 2. In Segment 2 (Vista Substation to San Bernardino Junction), existing lower-voltage (115 kV) circuits would need to be relocated to allow placement of the 500 kV structures in the widest portions of the ROW, and existing 220 kV structures in the northern portion of the ROW would need to be retained and used by the relocated lower-voltage circuits.

Segments 3, 4, and 6. The 500 kV Tower Alternative would position the tallest structures farther from the edge of the ROW than would be the case in the future if the Proposed Project were to be developed with two pairs of 220 kV towers. The Proposed Project's positioning would preempt the ability to locate a future 500 kV line near the center of the ROW. This alternative would allow the future 500 kV line to be farther from the edge of the ROW in Segments 3, 4, and 6.The 500 kV structure line in this alternative would be located at least 75 feet from the edge of the ROW in the areas where the ROW is split (i.e., in Segment 6).

Segment 5. This alternative would not change the SCE Proposed Project for Segment 5 on the Morongo reservation, because only the Proposed Project has been approved by the Morongo Tribe in a ROW Agreement with SCE (see EIS Appendix 3). This alternative would proceed on the Morongo reservation only if it were approved by the Morongo Band of Mission Indians. A new ROW Agreement would need to be issued in order for this alternative to proceed.

Figure Ap.5-6a shows the portions of the WOD corridor that would be replaced with 500 kV components instead of the proposed 220 kV towers. Figures Ap.5-6b through Ap.5-6e illustrate an example of a double-circuit 500 kV structure design, which would be approximately 190 feet tall. For additional information and a discussion of the cumulative impacts of the future 500 kV transmission line, see EIS Section E.2.3 (Cumulative Impacts, Future 500 kV Transmission Line in WOD Corridor).

Consideration of NEPA Criteria

Project Objectives, Purpose and Need

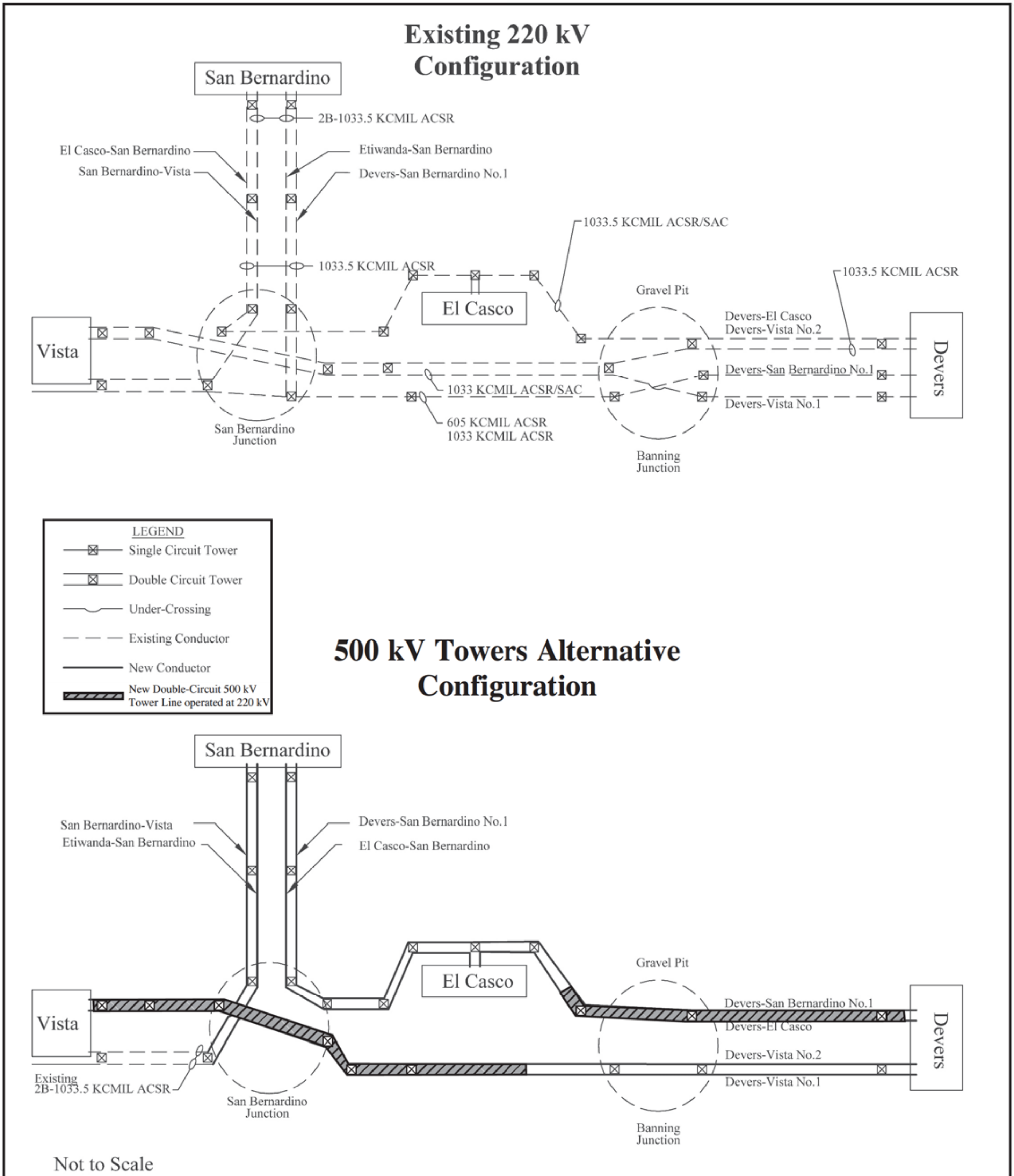
Basic Project Objective 1, Increase system deliverability: The 500 kV Towers Alternative would provide an increase in deliverability of more than 2,200 MW and would meet this objective. The deliverability would be the same as that of the Proposed Project.

Basic Project Objective 2, Support renewable energy goals: This alternative would facilitate progress toward achieving California's RPS goals.

Basic Project Objective 3, Maximize remaining space in the corridor: The 500 kV Towers Alternative would be located within and would maximize the effective and appropriate use of SCE's existing transmission ROW. The construction of 500 kV towers at this time as an alternative to one set of the Proposed Project's 220 kV towers, rather than in the future, would ensure that the placement of the 500 kV line could generally occur near the center of the ROW rather than be forced to occur on the ROW edge. Similar to the Proposed Project, this alternative would ensure that adequate space remains within the ROW for additional transmission expansion, if needed by SCE in the future.

Feasibility

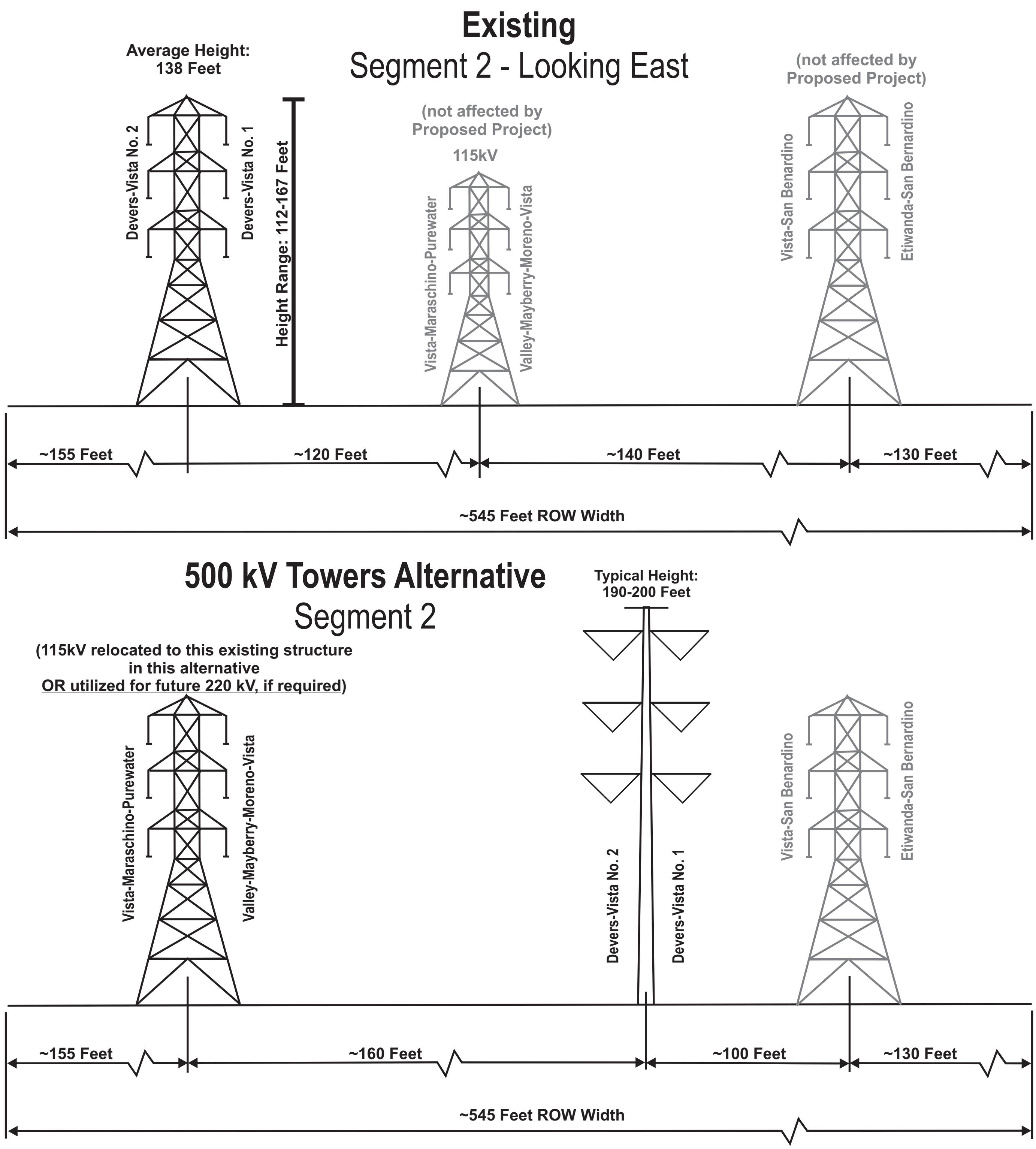
Legal Feasibility. The Proposed Project and its 220 kV configuration has been approved by the Morongo Tribe in a ROW Agreement with SCE (see EIS Appendix 3). Therefore, construction of 500 kV structures under this alternative would not be legally feasible within Segment 5. Installing 500 kV towers through the Morongo reservation in Segment 5 would require a new ROW agreement from the Morongo Band of Mission Indians. If SCE defines a future need for a 500 kV line and SCE is not able to obtain an agreement



Source: SCE, 2013.

West of Devers Upgrade Project

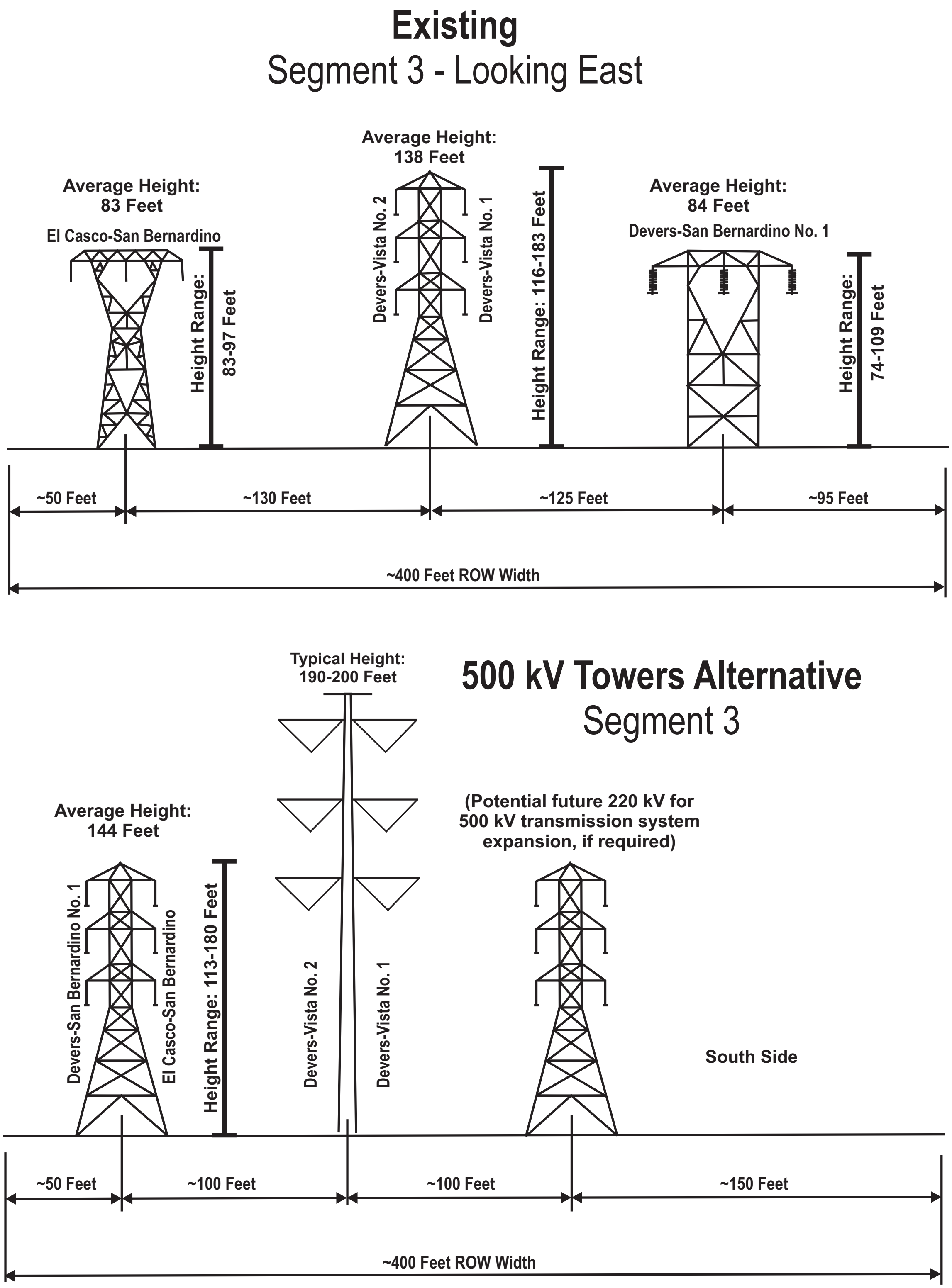
Figure Ap.5-6a
Existing and 500 kV Towers Alternative Configuration



Source: SCE, 2014.

West of Devers Upgrade Project

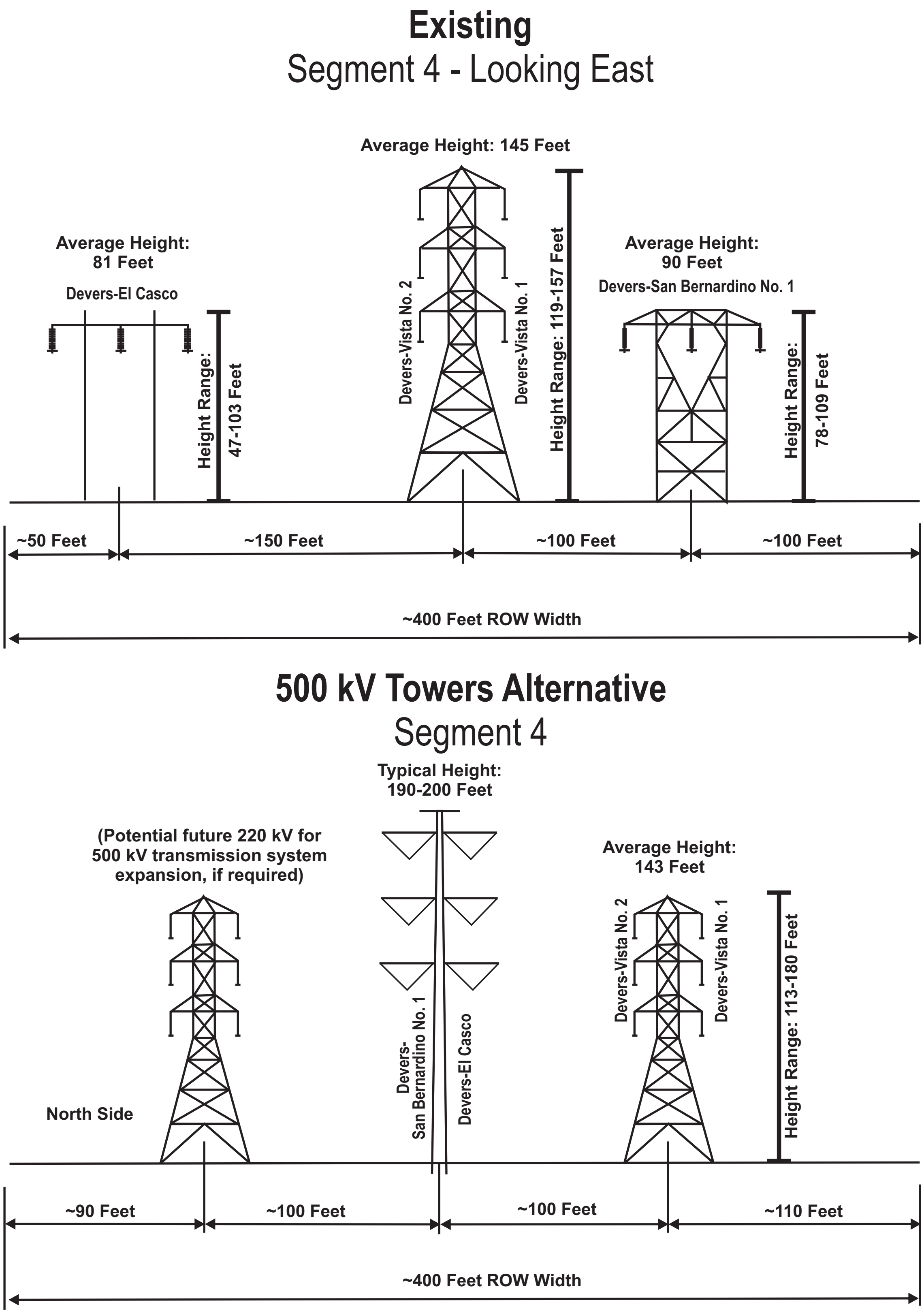
Figure Ap.5-6b
500 kV Towers Alternative Corridor Profile - Segment 2



Source: SCE, 2014.

West of Devers Upgrade Project

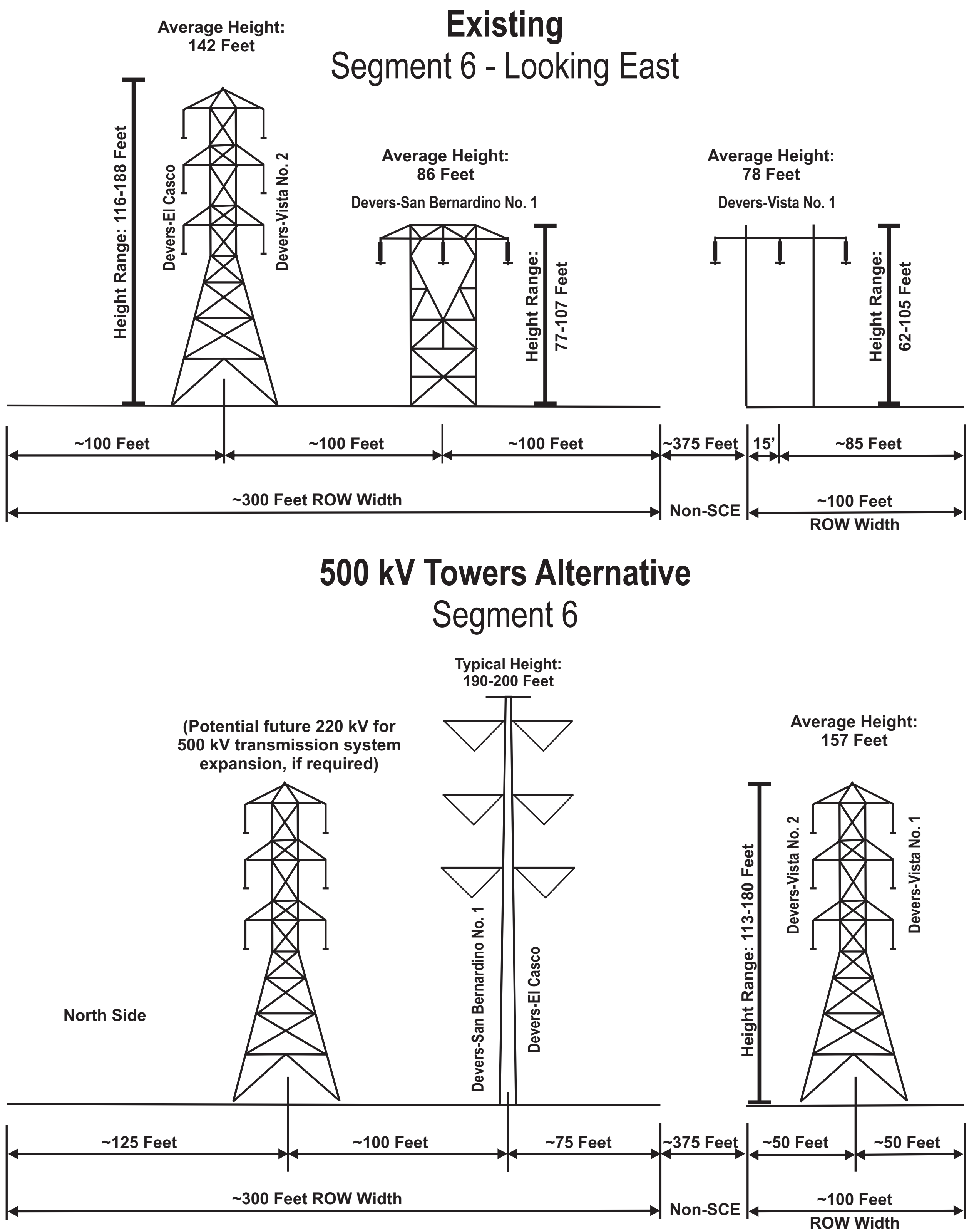
Figure Ap.5-6c
500 kV Towers Alternative
Corridor Profile - Segment 3



Source: SCE, 2014.

West of Devers Upgrade Project

Figure Ap.5-6d
500 kV Towers Alternative Corridor Profile - Segment 4



Source: SCE, 2014.

West of Devers Upgrade Project

Figure Ap.5-6e
500 kV Towers Alternative Corridor Profile - Segment 6

with the Morongo regarding routing such a line across the reservation, then SCE would have to explore other ways to meet its service requirements without crossing tribal land. As a result, some of the 500 kV structures installed under this alternative may not be useable if a future 500 kV line is never allowed on Morongo land.

Additionally, if SCE were successful in obtaining a future agreement with the Morongo on the routing of a future 500 kV line across the Morongo reservation, the location of that line may be different than the current corridor location. Significant changes in the location of routing a potential future 500 kV line across the reservation could impair SCE's ability to align that routing with the placement of 500 kV structures in Segments 4 and 6, requiring SCE to either move those structures or leave them in place and continue to operate the line at 220 kV (SCE Response to CPUC Data Request ALT-20a; SCE, 2014).

If the Morongo Tribe does not approve construction of a 500 kV line across tribal land, given the tribal land ownership layout and designated Wilderness in the area, there would be legal feasibility issues with finding a route around the reservation to connect to the 500 kV structures at the western and eastern ends of the reservation. The regulatory and technical feasibility issues with this 500 kV route are discussed below.

Regulatory Feasibility. This alternative appears to be feasible considering regulatory factors. However, as discussed above, if the Morongo Tribe does not approve construction of a 500 kV line across tribal land when it is needed by SCE in the future, a route around the reservation to connect to the 500 kV structures at the western and eastern ends of the reservation would need to be constructed. See also the discussion in EIS Section C.6.3 (No Action Alternative Scenario, Option 1) regarding the challenges of adding a new 500 kV circuit south of the Morongo reservation.

Technical Feasibility. SCE has existing 500 kV double-circuit structures in its system, so its ability to construct and operate these structures has been confirmed. While technically feasible to design a line for 500 kV service, it would not operate at 500 kV until SCE fully implements a 500 kV configuration within corridor, which could make this an impractical design if the need for 500 kV service never materializes. Detailed design of this alternative would need to address relocating existing circuits in Segment 2 as a means of avoiding expansion of the existing ROW (SCE Response to CPUC Data Request ALT-20c; SCE, 2014).

Construction Timeframe. The 500 kV Towers Alternative would require construction in a sequence different from that currently proposed by SCE. Given the need for SCE to take certain circuits out of service in order to construct the new towers in the ROW, the installation of the 500 kV structures near the center of the ROW would likely make construction sequencing more complex, adding a few months to the construction schedule.

Reliability. The installation structures for a future 500 kV line and use of those facilities at 220 kV would be as reliable as the installation of the conductors on the proposed 220 kV towers.

Economic Feasibility. The additional cost of double-circuit 500 kV structures raises concerns about the economic feasibility of this alternative. Installing 45 miles of 500 kV double-circuit structures would notably increase the cost of materials and design when compared with the Proposed Project; however, it could also avoid or delay the need for future upgrades and redesign of the corridor. Compared to the proposed 220 kV specifications, building part of the system at 500 kV specifications would result in approximately 40 percent more structure costs, 20 percent more foundation costs, and 25 percent more conductor costs for the two affected circuits. Other overall costs for engineering, labor, and construction contracting would not be substantially different.

While the need for future transmission expansion to 500 kV service in the WOD corridor would be the subject of a future CPUC review, SCE has identified various plans and proposals that rely on the corridor, including: a number of generation projects identified at the time of applying for the Proposed Project (in PEA Table 1.1; SCE, 2013), additional renewable generation projects that applied for service after 2013 (SCE Response to CPUC Data Request ALT-10; SCE, 2014), the Path 42 Upgrades that are in process by SCE and the Imperial Irrigation District (IID), and a planned 500 kV line from Delaney Substation in Arizona to SCE's Colorado River Substation (SCE Response to CPUC Data Request ALT-10; SCE, 2014). To install towers larger than those proposed, a finding would have to be made that the long-term need justifies the additional costs to facilitate orderly development of a 500 kV line for the corridor. If a CPUC review decides to allow SCE to recover the costs of building 500 kV towers in its rate base, this alternative would likely be economically feasible. Since such a determination has not yet been made, this analysis assumes that this alternative is potentially economically feasible at this time.

Environmental Advantages

Visual Resources. Because this alternative would be designed to maximize use of the center of the ROW, it would not require construction of the proposed structures as close to the ROW edge as they are currently designed under the Proposed Project. While there would be taller structures in the ROW under the 500 kV Towers Alternative, they would be located near the center of the ROW, and would not be as close to residences as the Proposed Project's 220 kV towers. The proximity of the nearest 220 kV towers to the edge of ROW in this alternative would be the same as in the Tower Relocation Alternative. In the future, a 220 kV line would be constructed in the vacant portion of the ROW. These 220 kV towers would be smaller than 500 kV structures, which may otherwise be constructed in this location the future under the Proposed Project.

Ground Disturbance. This alternative would potentially reduce some ground-disturbing impacts by increasing span lengths between the new 500 kV structures (to about 1,300 feet from 800-900 feet), reducing the number of new structures, and potentially delaying the need for future construction and reconstruction within the WOD corridor by providing 500 kV structures in advance of the need for a 500 kV circuit. In the future, 220 kV towers would be constructed in the vacant space instead of 500 kV structures as contemplated in the discussion of the cumulative impacts of the future 500 kV transmission line, see EIS Section E.2.3 (Future 500 kV Transmission Line in WOD Corridor).

Cumulative Impacts from Future Transmission Expansion. This alternative may avoid or delay the environmental impacts of future transmission expansion. If it becomes necessary to construct a single- or double-circuit 500 kV transmission line in the future, placement of the 500 kV lines near the center of the ROW would site them farther from residences than would occur if the Proposed Project is implemented. This structure placement near the center of the ROW would avoid the project cumulative impacts of future 500 kV lines being placed along the edge of the ROW. Therefore, the cumulative impacts associated with the Proposed Project of a 500 kV line would be reduced substantially. Although a future 220 kV line would need to be constructed, no additional 500 kV towers would be required for future expansion in the cumulative scenario under this alternative since the 500 kV towers would already be installed.

Environmental Disadvantages

Visual Resources. This alternative would require installation of 500 kV double-circuit structures in place of one set of proposed double-circuit 220 kV towers at this time and potential construction of a second set of 220 kV towers in the future. The 500 kV structures would be substantially taller and more massive, resulting in more visible structures than with the proposed 220 kV double-circuit structures. In addition, there would not be visual consistency of design since one set of structures would be 220 kV lattice towers and the other would likely be taller 500 kV lattice or monopole structures.

Land Use and Construction-Related Disturbance. The primary difference between this alternative and the Proposed Project would be the installation of the 500 kV structures in place of one set of proposed 220 kV towers. Although fewer towers would be needed overall, due to the longer spans between 500 kV structures, the higher-voltage structures would be taller and would require greater levels of ground disturbance for each pole. The overall level of construction under this alternative would be comparable to that of the Proposed Project. Disturbances related to removing the existing 220 kV structures and installing one set of proposed double-circuit 220 kV towers would occur as they would with the Proposed Project. Additional access roads could be needed to reach the 500 kV structures that would be sited at different intervals and spans than the 220 kV towers.

Future Impacts from Moving Future Transmission Expansion Around the Morongo reservation. If SCE does not reach an agreement with the Morongo Tribe allowing placement of a future 500 kV line across tribal land, construction of a new 500 kV line from the existing endpoints of the 500 kV structures on the western and eastern ends of the reservation (Segments 4 and 6) would result in extensive ground disturbance from a longer transmission line. As described for the No Action Alternative (Option 1), installing an additional 500 kV circuit south of I-10 in the San Bernardino National Forest and existing residential areas could create extensive impacts to sensitive land uses, and to biological and cultural resources. If a new separate 500 kV corridor is constructed by SCE west of the Devers Substation to avoid the reservation, then the existing WOD corridor would have larger 500 kV structures installed that would not be utilized.

Alternative Conclusion

Eliminated. This alternative would meet all three Basic Project Objectives. It is potentially economically feasible, although a future determination would need to be made as to the cost allocation. Installation of 500 kV structures and operation at 500 kV in the future would require a new agreement between SCE and the Morongo Tribe to be legally feasible. If an agreement for the 500 kV line is reached with the Morongo Tribe, the cumulative impacts of future transmission expansion would be reduced with the implementation of the alternative now. However, if the Morongo Tribe does not approve a 500 kV line when it is needed in the future, then it would not be legally feasible to construct a 500 kV line across tribal land. Because future use of the corridor at 500 kV would not be legally feasible without approval by the Morongo Tribe, this alternative has been eliminated from full evaluation in this EIS.

5.3 Segment 4 Underground Alternatives in Calimesa, Beaumont, and Banning

This alternative was developed in response to scoping comments requesting consideration of underground segments. It was eliminated because construction impacts would be substantially more severe, and the impacts of the overhead Proposed Project can be mitigated with other overhead alternatives (see Section 4 of this appendix, Alternatives Retained for Analysis).

Alternative Description

An underground alternative was considered by the EIS team in response to public comments made during the scoping periods to consider undergrounding the transmission lines in the Cities of Calimesa, Beaumont, and Banning (Segment 4). Three underground route options were considered to reduce visual impacts to residences in these areas, as shown in Figure Ap.5-7.

- **Underground in Transmission Corridor.** Within the vicinity of residences in the Cities of Calimesa, Beaumont, and Banning, the transmission line would transition from overhead to underground and would be installed underground within SCE's existing ROW.
- **Underground North of Transmission Corridor (Beaumont).** This underground route option would transition from overhead to underground at North Deodar Drive near MP 19.2. From there the route

would travel north in North Deodar Drive to Brookside Avenue where it would turn east and be installed within Brookside Avenue. At Beaumont Avenue, Cherry Avenue or Highland Springs Avenue the route would turn south within the roadway until it rejoins the proposed transmission corridor. At this point, the line would transition from underground to overhead within the transmission corridor on the eastern side of Beaumont Avenue, Cherry Avenue or Highland Springs Avenue.

- **Underground South of Transmission Corridor (Calimesa and Beaumont).** The alternative route option would transition from overhead to underground near MP 16.0. It would travel southeast in Oak Valley Parkway, east in Palmer Drive and east then southeast in Desert Lawn Drive to Oak Valley Parkway. From Oak Valley Parkway, the lines would be horizontally directional drilled for 800 to 1,200 feet to cross under I-10 to the east. The route would continue for 3.3 miles in Oak Valley Parkway to Highland Springs Avenue. At Highland Springs Avenue the route would turn north for 0.2 miles until it would rejoin the proposed transmission corridor and would transition from underground to overhead just east of Highland Springs Road (MP 23.3).

Two separate alignments of concrete duct banks would need to be installed in continuous trenches at least 8 feet wide, and underground vaults would be required approximately every 1,500 feet, in order to place the four 220 kV circuits in Segment 4 underground.

Once the alternative is energized, SCE would remove the conductors from the existing overhead towers and may choose to remove the existing towers, but retain its ROW for future use, or have the towers remain in place for other uses within the ROW.

Consideration of NEPA Criteria

Project Objectives, Purpose and Need

Basic Project Objective 1, Increase system deliverability: The Segment 4 Underground Alternative would meet this objective by providing the same transfer capability and deliverability as the Proposed Project. The resulting capacity of 4,800 MW would exceed the 2,200 MW of increased deliverability defined in this objective.

Basic Project Objective 2, Support renewable energy goals: This alternative would meet this objective by supporting renewable energy goals.

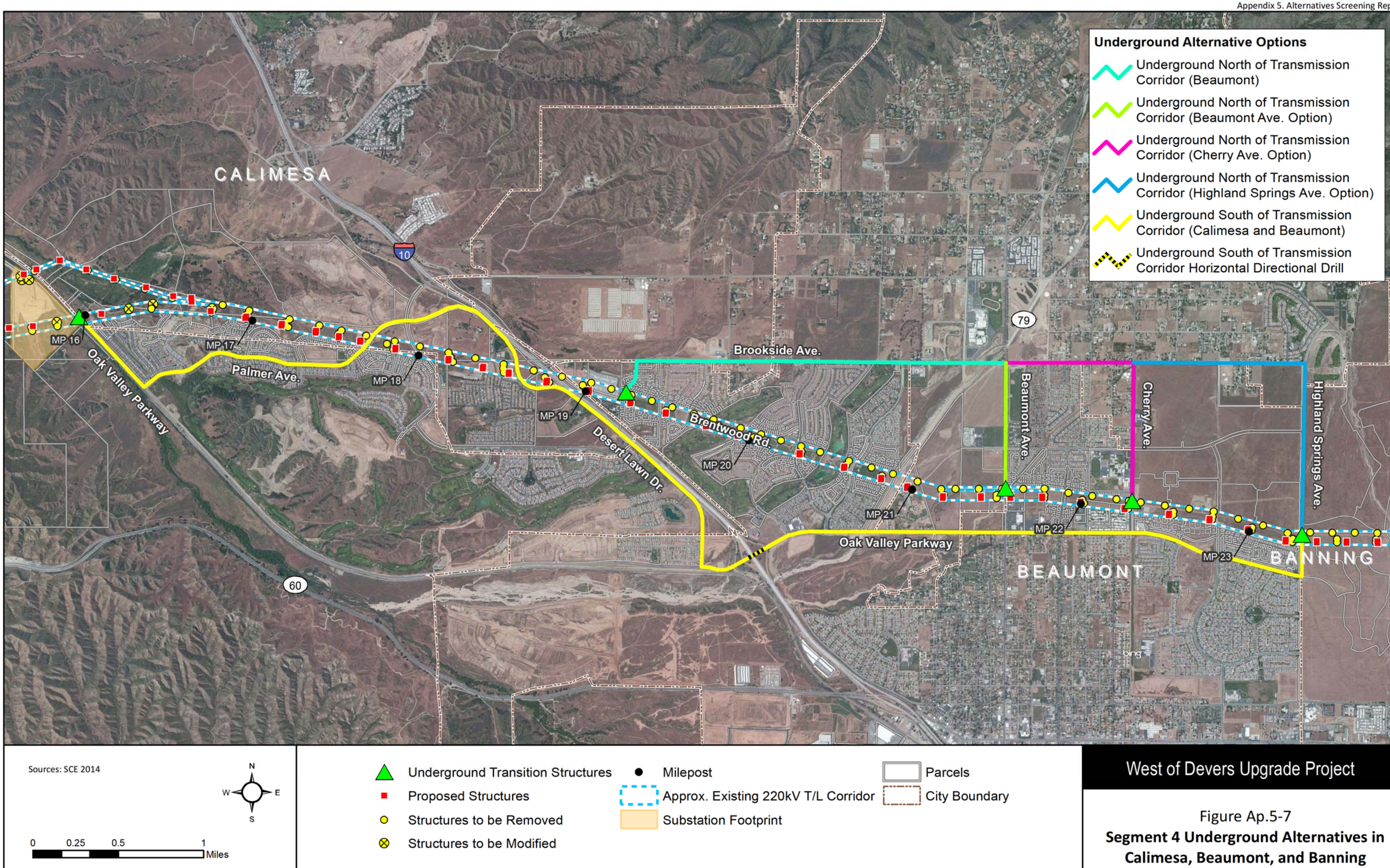
Basic Project Objective 3, Maximize remaining space in the corridor: This alternative would place a segment of the project underground, which would increase the space available in the ROW for other uses when compared with the Proposed Project. Also, depending on the route option being considered, the Segment 4 Underground Alternative may be installed in roadways and not within the existing ROW.

This alternative would meet most or all of the stated objectives and purpose and need of the Proposed Project.

Feasibility

Technical, Regulatory and Legal Feasibility. This alternative appears to be feasible considering technical, legal, and regulatory factors.

Construction Timeframe. The installation of underground transmission lines would require more time than construction of an equivalent length of overhead lines because of the time required for excavating the trench. However, given that the project would be constructed in segments and some of these alternative segments would be outside of the existing corridor, which must remain in service, construction of this alternative would not affect the overall schedule and online date of the Proposed Project.



West of Devers Upgrade Project

Figure Ap.5-7
Segment 4 Underground Alternatives in Calimesa, Beaumont, and Banning

This page intentionally blank.

Reliability. Maintenance and restoration time in the event of an outage would also be more difficult with an underground transmission line and could result in longer outages and repair times, but this alternative would comply with applicable Reliability Standards and Regional Business Practices developed by NERC, WECC, and CAISO. Furthermore, the alternative would be designed and constructed in conformance with SCE's approved engineering, design, and construction standards for substation, transmission, subtransmission, and distribution system projects. Therefore, the reliability of this alternative on SCE's transmission system would be similar to the Proposed Project.

Environmental Advantages

Visual Resources. This underground alternative would eliminate visual impacts associated with the new overhead 220 kV transmission route in Calimesa, Beaumont, and Banning.

Biological Resources. An underground transmission line located within a roadway would eliminate the permanent loss of habitat at each pole footings that would result from the construction of the overhead line. In addition, underground transmission lines would reduce the potential for bird electrocution.

Future Transmission Expansion. By moving the proposed 220 kV upgrades outside of SCE's existing transmission corridor, the available space in the ROW for future transmission expansion would be increased, which could reduce cumulative impacts from the construction of new line(s) in the future by allowing more siting flexibility within the ROW.

Environmental Disadvantages

Traffic and Transportation. The underground route may be located in roadways, which would result in temporary lane closures during construction, increasing the need for traffic control and possible roadway closures.

Land Use. The alternative route option in Brookside Avenue would cross behind residences and in front of Brookside Elementary School and Beaumont High School, which would increase construction disturbances and EMF-related concerns such as induced currents and shocks and radio/television/electrical equipment impacts on these sensitive receptors. Additionally, depending on the route option, Mountain View Middle School is located on Beaumont Avenue and San Gorgonio Middle School is located on Cherry Avenue in Beaumont.

Ground Disturbance and Hazards. Construction of this underground alternative would require substantially more construction activity and ground disturbance due to the continuous trenching that would be required. Construction of overhead 220 kV transmission lines results in construction disturbance primarily at individual structure sites along the alignment. Construction of underground lines requires continuous trenching that would result in much greater ground disturbance and construction-related impacts (traffic, air quality and dust, and noise). The underground segment in Brookside Avenue may introduce the hazard of trenching through a sub-surface natural methane area. There is also a greater potential to encounter contaminated soils and cultural resources.

Biological Resources. If an underground line is installed within the ROW, there would be a much greater level of ground disturbance and associated habitat disturbance from continuous trenching outside of a roadway.

Construction and Repair Time. The installation of an underground transmission line would require more time than construction of an equivalent length of overhead line because of the time required for excavating the trench. In addition, maintenance and restoration time in the event of an outage would also be more difficult and could result in longer outages and repair times. Accessing manholes and performing required repairs will require traffic control and possible lane or roadway closure.

Alternative Conclusions

Eliminated. This alternative would meet all three Basic Project Objectives and would be feasible considering technical, legal, and regulatory factors. Undergrounding the proposed 220 kV lines would reduce or avoid visual impacts, but it would result in much more severe construction impacts related to dust, ground disturbance, and traffic and would pass by two schools. Maintenance and repair times would also be increased. Furthermore, this segment of the ROW for the Proposed Project is 400 feet wide. Therefore, there is room within the ROW to modify structure locations to reduce impacts to residences, as has been considered under the Tower Relocation Alternative (see Section 4.2). Due to a greater level of environmental impacts and because another alternative, the Tower Relocation Alternative, has been identified to reduce significant visual impacts in these areas, the Segment 4 Underground Alternative has been eliminated from consideration in this EIS.

The Tower Relocation Alternative, which is discussed in Section 4.2 and retained for evaluation in this EIS, would meet all project objectives, would be feasible, and would reduce the significant visual impacts in this area without creating new impacts of its own.

5.4 Segment 5 Morongo Central Route Alternative (Original PEA Proposed Route)

This alternative segment was evaluated because it was the original route presented in SCE's PEA. The route segment across tribal land was eliminated because the Morongo Tribe indicated its preference for the Proposed Project route, so this segment would not be feasible.

Alternative Description

This alternative was proposed by SCE in its PEA (PEA Section 2.2.1.1; SCE, 2013). The Segment 5 Morongo Central Route Alternative would depart from the Proposed Project immediately west of the Morongo reservation at North Hathaway Street (MP 27.4). The alternative route would continue to the southeast on a diagonal route, south of the existing transmission corridor and approximately 500 to 1,500 feet north of the currently proposed route, for approximately 3 miles. It would rejoin the Proposed Project west of Malki Road on the Morongo reservation land (see Figure Ap.5-8). The alternative route would be approximately 0.13 miles shorter than the Proposed Project.

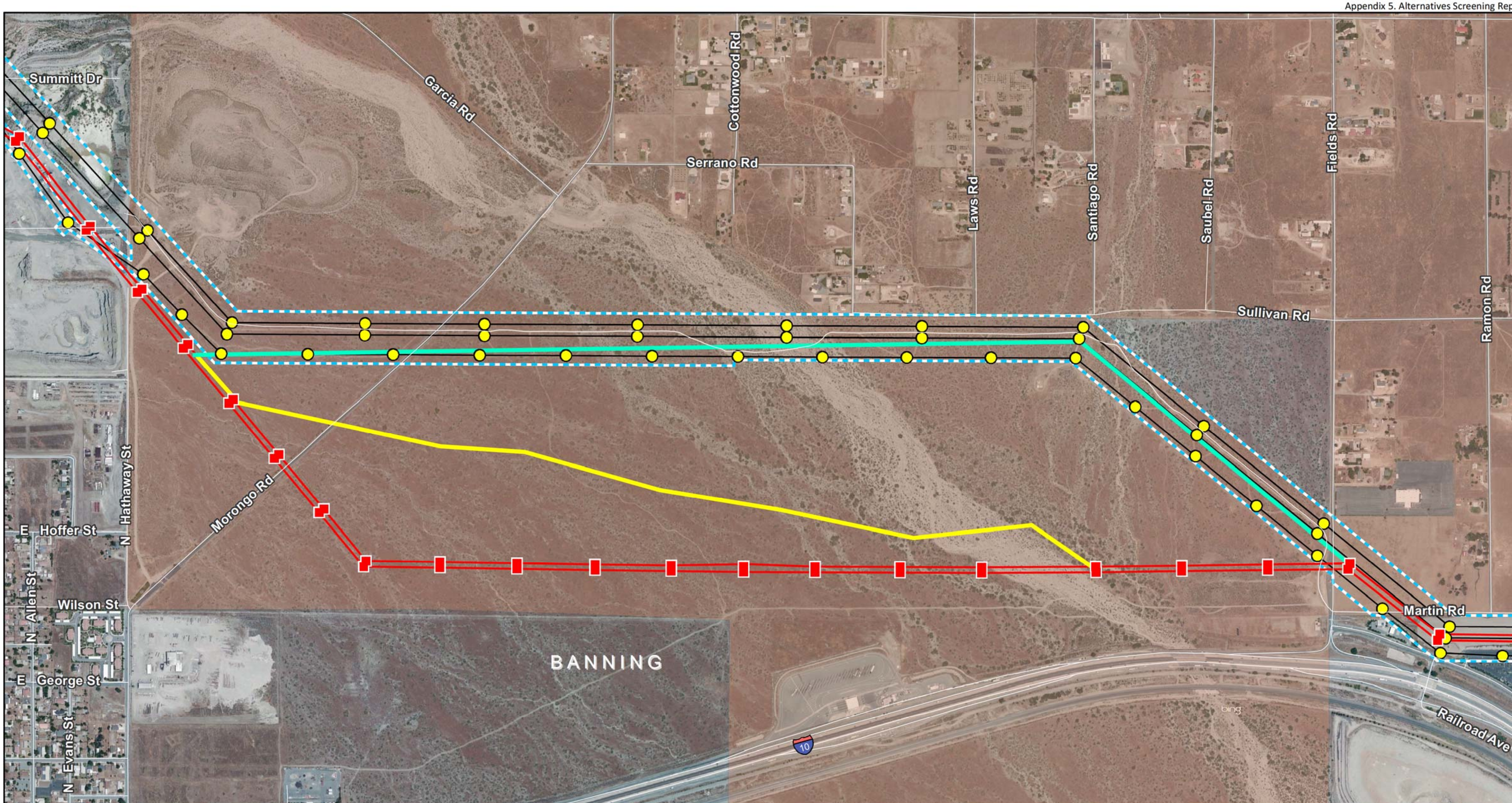
Consideration of NEPA Criteria

Project Objectives, Purpose and Need

Basic Project Objective 1, Increase system deliverability: This alternative would meet this objective by providing the same transfer capability and deliverability as the Proposed Project. The resulting capacity of 4,800 MW would exceed the 2,200 MW of increased deliverability defined in this objective.

Basic Project Objective 2, Support renewable energy goals: This alternative would support renewable energy goals by allowing a substantial increase in import capacity.

Basic Project Objective 3, Maximize remaining space in the corridor: This alternative would result in the same amount of space being available in the ROW as with the Proposed Project.



Sources: SCE 2014

N W E S

0 375 750 1,500 Feet

- Proposed Structures
- Structures to be Removed
- Proposed Transmission Line
- Morongo Central Route Alternative
- Morongo Existing 200 kV Route Alternative
- Existing Transmission Line
- Approx. Existing 220kV T/L Corridor
- Morongo Reservation

West of Devers Upgrade Project

Figure Ap.5-8

Morongo Alternatives

July 2016

This page intentionally blank.

The Segment 5 Morongo Central Route Alternative would allow SCE to fully deliver the output of new generation projects, would facilitate progress toward achieving California's RPS goals, and would comply with reliability standards. Although, the alternative would not be located within the existing ROW, this portion of the Proposed Project is also proposed for relocation under the ROW Agreement with the Morongo Tribe. Therefore, this alternative would meet all three Basic Project Objectives.

Feasibility

Technical Feasibility. This alternative is technically feasible.

Regulatory Feasibility. Because this route would be near the Banning Municipal Airport, SCE coordinated with the FAA to determine the feasibility of this alternative. The FAA stated the route is feasible with installation of hazard marker balls and lighting (SCE, 2013).

Legal Feasibility. This alternative could proceed only if it were recommended and approved by the Morongo Band of Mission Indians. A new ROW Agreement would need to be signed by SCE and the Morongo in order for it to move forward. In response to a CPUC Data Request No. 1 (dated May 2014), the Morongo Tribe stated that "[t]he General Membership of the Morongo Band has approved SCE's proposed route through the Morongo reservation. That is the only route through the Morongo reservation that is available to SCE, unless the Morongo Band's General Membership were to approve a different route. Therefore, no other routes through the Morongo reservation need to be evaluated" (Morongo, 2014). As a result, this alternative is considered to be legally infeasible.

Construction Timeframe. The Morongo Band's General Membership would need to vote and approve this alternative route, which could result in project delays. Although the project would be constructed in the non-tribal segments while awaiting a revised Agreement, given the length of time it took for SCE and the tribe to agree on in the terms of the ROW Agreement (see EIS Appendix 3), project delays are considered to be likely under this alternative.

Reliability. This alternative would comply with applicable Reliability Standards and Regional Business Practices developed by NERC, WECC, and CAISO. Furthermore, the alternative would be designed and constructed in conformance with SCE's approved engineering, design, and construction standards for substation, transmission, subtransmission, and distribution system projects. Therefore, the reliability of this alternative on SCE's transmission system would be similar to the Proposed Project.

Environmental Advantages

Transportation and Traffic. The nearest runway at Banning Municipal Airport is approximately 4,530 feet from this alternative route**,** compared to 3,750 feet from the Proposed Project ROW. This alternative would be farther from the Banning Airport, which would reduce potential navigational and air safety impacts.

Visual Resources. This alternative would be farther from the Banning Airport, and therefore may have fewer FAA requirements for tower lighting, which would reduce operational visual resources impacts of the Proposed Project.

Ground Disturbance. Construction of this alternative would be 0.13 miles shorter, which would require slightly less construction activity and ground disturbance, decreasing impacts in air quality, noise, transportation and traffic, hazardous materials related to environmental contamination, and geologic resources related to soil erosion. The potential to disturb unknown cultural resources and impact vegetation and wildlife is also decreased with less ground disturbance. Decreased disturbance and removal of vegetation would decrease the chance of noxious weed introduction as well as the removal of more native vegetation.

Environmental Disadvantages

Visual Resources. This alternative would increase operational visual impacts, as well as temporary visual impacts associated with construction, by siting the towers closer to residences on the Morongo reservation.

Land Use and Construction-Related Disturbance. Siting towers closer to residences would increase construction-related disturbance impacts associated with noise and dust to sensitive receptors.

Alternative Conclusions

Eliminated. This alternative would meet all three Basic Project Objectives and would be feasible considering technical and regulatory factors. However, given the stated preference and approval by the Morongo Tribe for the proposed southern route and that approval of this alternative by the Morongo Tribe would be required, this alternative appears to be infeasible and it has been eliminated from consideration in this EIS.

5.5 Segment 5 Morongo Existing 220 kV Route Alternative (Existing ROW)

This alternative segment was evaluated because it is the existing ROW across the westernmost portion of Morongo tribal land. It was eliminated because the Morongo Tribe indicated its preference for the Proposed Project route, so this segment would not be feasible.

Alternative Description

Under this alternative, SCE's proposed 220 kV transmission upgrades would occur within the existing SCE ROW and the 3 miles of new structures would not be relocated on the Morongo reservation. The Segment 5 Morongo Existing 220 kV Route Alternative would depart from the Proposed Project immediately west of the Morongo reservation at North Hathaway Street (MP 27.4). The alternative route would continue to the southeast then east for 1.6 miles before turning southeast on a diagonal to rejoin the Proposed Project west of Malki Road on the Morongo reservation land (see Figure Ap.5-8). The alternative route would be approximately the same length as the Proposed Project.

Consideration of NEPA Criteria

Project Objectives, Purpose and Need

Basic Project Objective 1, Increase system deliverability: This alternative would meet this objective by providing the same transfer capability and deliverability as the Proposed Project. The resulting capacity of 4,800 MW would exceed the 2,200 MW of increased deliverability defined in this objective.

Basic Project Objective 2, Support renewable energy goals: This alternative would support renewable energy goals by allowing a substantial increase in import capacity.

Basic Project Objective 3, Maximize remaining space in the corridor: This alternative would result in the same amount of space being available in the ROW as with the Proposed Project.

The Segment 5 Morongo Existing 220 kV Route Alternative would allow SCE to fully deliver the output of new generation projects, would facilitate progress toward achieving California's RPS goals, and would comply with reliability standards. Furthermore, the Segment 5 Morongo Existing 220 kV Route Alternative would be located within and would maximize the use of SCE's existing transmission ROW. Therefore, this alternative would meet all of the Basic Project Objectives and purpose and need of the Proposed Project.

Feasibility

Technical and Regulatory Feasibility. This alternative appears to be feasible considering technical and regulatory factors.

Legal Feasibility. This alternative would proceed only if it were recommended and approved by the Morongo Band of Mission Indians. A new ROW Agreement would need to be approved in order for it to move forward. In response to a CPUC Data Request No. 1 (dated May 2014), the Morongo Tribe stated that "[t]he General Membership of the Morongo Band has approved SCE's proposed route through the Morongo reservation. That is the only route through the Morongo reservation that is available to SCE, unless the Morongo Band's General Membership were to approve a different route. Therefore, no other routes through the Morongo reservation need to be evaluated" (Morongo, 2014). As a result, this alternative is considered to be legally infeasible.

Construction Timeframe. The Morongo Band's General Membership would need to vote and approve this alternative route, which would most likely result in project delays. Although the project could still be constructed in non-tribal segments while awaiting a Morongo decision, given the length of time it took for SCE and the Morongo to come to agreement on ROW terms (see EIS Appendix 3), project delays are considered to be likely under this alternative.

Reliability. This alternative would comply with applicable Reliability Standards and Regional Business Practices developed by NERC, WECC, and CAISO. Furthermore, the alternative would be designed and constructed in conformance with SCE's approved engineering, design, and construction standards for substation, transmission, subtransmission, and distribution system projects. Therefore, the reliability of this alternative on SCE's transmission system would be similar to the Proposed Project.

Environmental Advantages

Transportation and Traffic. The nearest runway at Banning Municipal Airport is approximately 6,000 feet from this alternative route in the existing ROW**,** compared to 3,750 feet from the Proposed Project ROW. This alternative would be farther from the Banning Airport and within an existing known corridor, which would reduce potential navigational and air safety impacts.

Visual Resources. This alternative would be farther from the Banning Airport, and therefore may have fewer FAA requirements for marker balls and tower lighting, which would reduce operational visual resources impacts of the Proposed Project.

Ground Disturbance. This alternative would utilize an existing corridor, which has been previously disturbed and has access and spur roads in place.

Environmental Disadvantages

Visual Resources. This alternative would increase operational visual impacts as well as temporary visual impacts associated with construction by siting the upgraded towers closer to residences on the Morongo reservation.

Land Use and Construction-Related Disturbance. Siting towers closer to residences would increase construction-related disturbance impacts associated with noise and dust to sensitive receptors.

Alternative Conclusions

Eliminated. This alternative would meet all three Basic Project Objectives and would be feasible considering technical and regulatory factors. However, given the stated preference and approval by the Morongo Tribe for the proposed southern route, this alternative not considered to be legally feasible. As a result, it has been eliminated from consideration in this EIS.

5.6 East Banning–Morongo Alternative

This alternative segment was developed by the EIS Team to reduce significant visual impacts to residences in Banning. It was eliminated because the Morongo Tribe indicated its preference for the Proposed Project route, so this segment would not be feasible.

Alternative Description

The EIS Team defined significant visual impacts that would result from installation of the new tubular steel poles (TSPs) due to their visibility from residences on North Hathaway Street and North Evans Street in the City of Banning. The existing lattice towers are located 2,500 feet away from these residences. The proposed towers would be 1,700 feet away and would be TSPs at the Tribe's request, which have greater bulk, so would be much more visible.

As shown in Figure Ap.5-9, this 0.6-mile alternative would replace 0.7 miles of the proposed route and would involve moving the TSPs farther from residences. The alternative would begin at approximately Milepost 28.8 where the route would diverge from the Proposed Project by continuing in a southeast direction to the east and north of the proposed route. The alternative would continue in a straight line rejoin the Proposed Project at MP 29.5 after the proposed route would turn from southeast to east on Morongo land.

Consideration of NEPA Criteria

Project Objectives, Purpose and Need

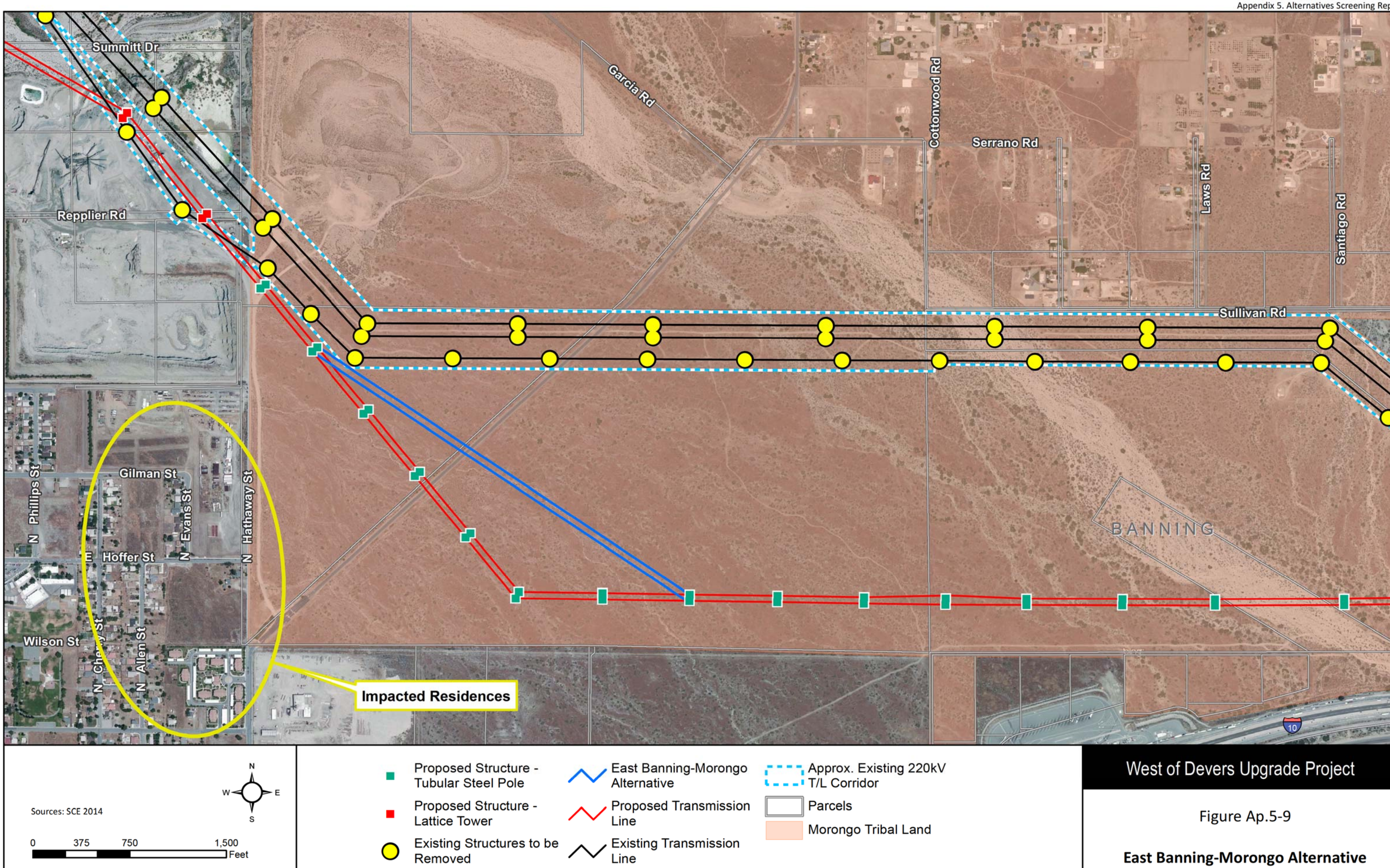
Basic Project Objective 1, Increase system deliverability: This alternative would meet this objective by providing the same transfer capability and deliverability as the Proposed Project. The resulting capacity of 4,800 MW would exceed the 2,200 MW of increased deliverability defined in this objective.

Basic Project Objective 2, Support renewable energy goals: This alternative would support renewable energy goals by allowing a substantial increase in import capacity.

Basic Project Objective 3, Maximize remaining space in the corridor: This alternative would not affect the amount of space available in the ROW that would be available with the Proposed Project.

The East Banning–Morongo Alternative would allow SCE to fully deliver the output of new generation projects, would facilitate progress toward achieving California's RPS goals, and would comply with reliability standards. This portion of the Proposed Project is proposed for relocation under the ROW Agreement[5] with the Morongo Tribe. Therefore, this alternative would meet all three of the Basic Project Objectives and purpose and need of the Proposed Project.

[5] Under the Agreement Related to Grant Easements and Rights-of-Way for Electric Transmission Lines and Appurtenant Fiber-Optic Telecommunications Lines and Access Roads On and Across Lands of the Morongo Indian Reservation (the "ROW Agreement") entered into November 27, 2012, by and between the Morongo Band of Mission Indians ("Morongo") and SCE, Morongo consented to the grants to SCE by the United States of America ("federal grants") of certain easements and rights of way on and across the lands of the Morongo Indian Reservation. Pursuant to the Agreement, Morongo consented to the federal grants to SCE of the rights of way and easements necessary for SCE to continue operating its existing 220 kV facilities on the Morongo Reservation and to replace and upgrade those facilities with the WOD Project for 50 years.



West of Devers Upgrade Project

Figure Ap.5-9

East Banning-Morongo Alternative

July 2016

This page intentionally blank.

Feasibility

Technical Feasibility. This alternative appears to be feasible considering technical and regulatory factors.

Legal Feasibility. This alternative is located on the Morongo Band of Mission Indians' tribal land, and a relocated transmission line would require Morongo Tribe approval. The Morongo Tribe stated the following in response to CPUC Data Request No. 2 (dated September 23, 2014), "the General Membership of the Morongo Band approved Southern California Edison's (SCE's) proposed route through the Morongo reservation as the only route through the Morongo reservation that is available to SCE, unless the Morongo Band's General Membership were to approved a different route, and thus, any alternative route would not be legally feasible and need not be considered" (Morongo, 2014).

Construction Timeframe. The Morongo Band's General Membership would need to vote and approve this alternative route, which would most likely result in project delays. Although the project would be constructed in segments and SCE could proceed with construction of other portions of the project while awaiting a Morongo decision, given the length of time it took for SCE to reach agreement with the tribe in the ROW Agreement with SCE (see EIS Appendix 3), project delays are likely under this alternative.

Reliability. This alternative would comply with applicable Reliability Standards and Regional Business Practices developed by NERC, WECC, and CAISO. Furthermore, the alternative would be designed and constructed in conformance with SCE's approved engineering, design, and construction standards for substation, transmission, subtransmission, and distribution system projects. Therefore, the reliability of this alternative on SCE's transmission system would be similar to the Proposed Project.

Environmental Advantages

Visual Resources. Moving the 220 kV structures farther from residences in eastern Banning would reduce significant visual impacts from residences in eastern Banning when viewing of new TSPs on Morongo land.

Ground Disturbance. Construction of this alternative would be 0.1 miles shorter, which would require slightly less construction activity and ground disturbance, decreasing impacts in air quality, noise, transportation and traffic, hazardous materials related to environmental contamination, and geologic resources related to soil erosion. The potential to disturb unknown cultural resources and impact vegetation and wildlife is also decreased with less ground disturbance. Decreased disturbance and removal of vegetation would decrease the chance of noxious weed introduction as well as the removal of more native vegetation.

Environmental Disadvantages

No environmental disadvantages compared to the proposed route have been identified for this alternative.

Alternative Conclusion

Eliminated. This alternative would meet all of the Basic Project Objectives and would be feasible considering technical and regulatory factors. However, given the stated preference and approval by the Morongo Tribe for the proposed route and that approval of this alternative by the Morongo Tribe would be required, the East Banning–Morongo Alternative is highly unlikely to be legally feasible. As a result, it has been eliminated from consideration in this EIS.

5.7 Devers-Beaumont 500 kV Alternative (SCE System Alternative 1)

This alternative was evaluated because SCE presented it as a potential alternative in its PEA. It has been eliminated because it would have substantially more severe environmental impacts than the Proposed

Project. Note that this alternative is described in Section C.6.3.1 as the No Action Alternative, Option 1 because it is one of the likely actions that SCE would take if the Proposed Project were not approved. Impacts of the No Action Alternative are analyzed in Section D.

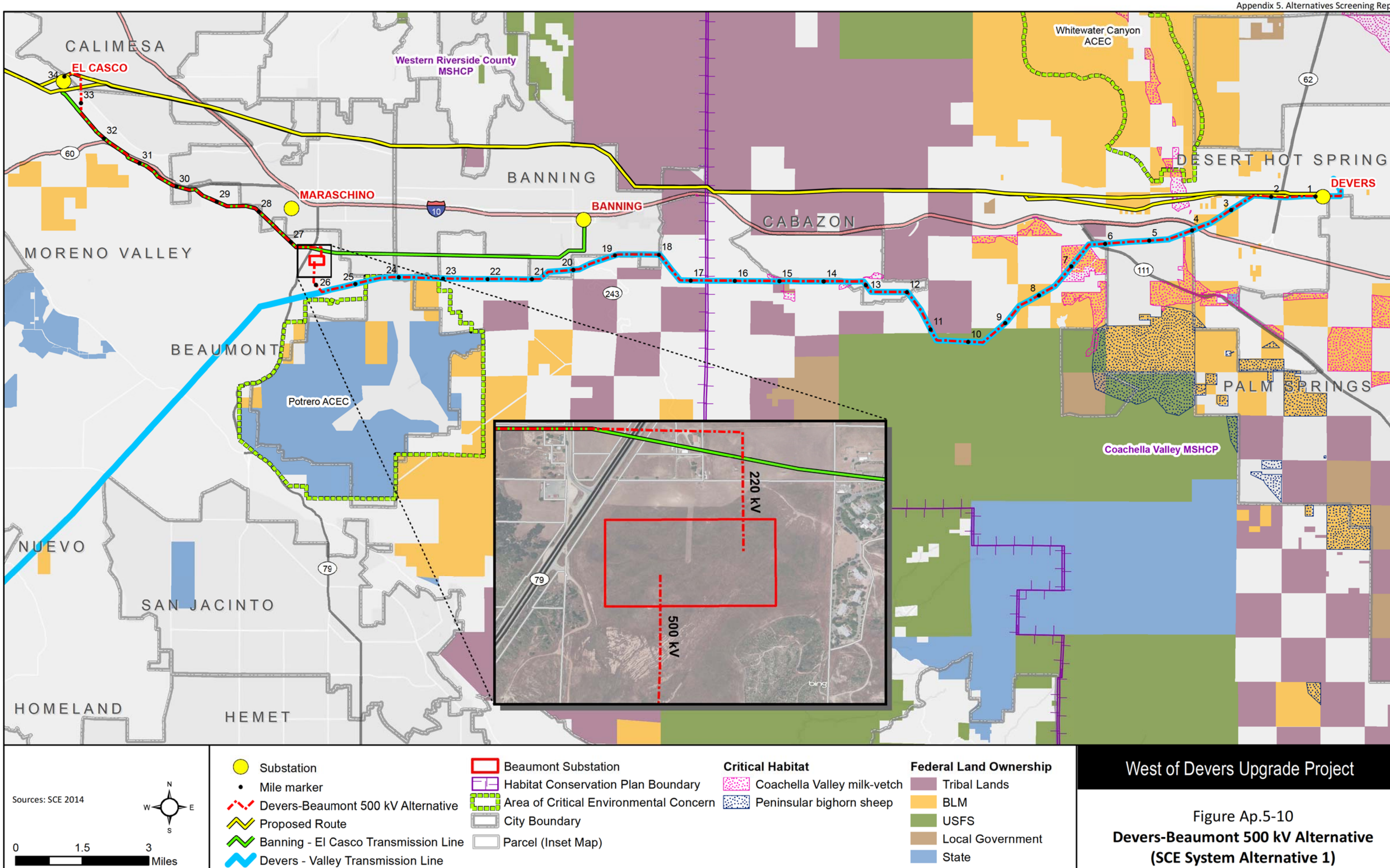
Alternative Description

This alternative was proposed by SCE in its PEA as System Alternative 1, New 500/220 kV Substation and New 500 and 220 kV Transmission Lines (PEA Section 2.1.2.2; SCE, 2013). This alternative would include removal of approximately 30 miles of existing 220 kV lines and structures in the WOD corridor between Devers and El Casco Substations, which would eliminate impacts of the existing transmission lines and the Proposed Project to the Morongo Tribe, and the cities and communities from Beaumont to the eastern end of the project. SCE states that this alternative transmission system upgrade, involving a new Devers-to-Beaumont 500 kV system, is the most likely option that would be proposed by SCE if the proposed WOD Upgrade Project does not occur (SCE, 2014; Response to ALT-6), as described in EIS Section C.6.3, No Action Alternative Scenario.

The Devers-Beaumont 500 kV Alternative would require construction of a new 500/220 kV substation near the City of Beaumont, a new 500 kV transmission line in new and existing ROW between Devers Substation and the new 500/220 kV substation, four new 220 kV transmission lines in a new ROW between the new 500/220 kV substation to the existing WOD corridor, and upgrades to the existing WOD 220 kV transmission lines and associated existing substations between El Casco, San Bernardino, and Vista Substations (see Figure Ap.5-10). The Devers-Beaumont 500 kV Alternative would also require acquisition of property to construct the new 500/220 kV substation near the City of Beaumont.

According to SCE, the Devers-Beaumont 500 kV Alternative would include the following components:

- Acquire approximately 23.5 miles of ROW for the new 500 kV transmission lines, approximately 7 miles of ROW for the new 220 kV transmission lines, and property rights for a new 500/220 kV substation near the City of Beaumont.
- Construct a new 500/220 kV substation near the City of Beaumont.
- Construct approximately 23.5 miles of new 500 kV single-circuit transmission line in new ROW, and approximately 5 miles of new 500 kV double-circuit transmission lines in existing ROW, between Devers Substation and the new 500/220 kV Beaumont Substation.
- Construct four new 220 kV transmission lines using double-circuit transmission towers in approximately 7 miles of new ROW between the new 500/220 kV Beaumont Substation and the existing WOD corridor near the El Casco Substation.
- Loop-in one of the existing Devers-Valley 500 kV transmission lines into the new 500/220 kV substation.
- Tear down and rebuild approximately 15 miles of existing 220 kV transmission lines and structures within the existing WOD corridor between the existing El Casco and Vista Substations.
- Tear down and rebuild approximately 13 miles of existing 220 kV transmission lines and structures within the existing WOD corridor between the existing El Casco and San Bernardino Substations.
- Tear down and rebuild approximately 3.5 miles of existing 220 kV transmission lines and structures within the existing WOD corridor between San Bernardino Substation and the San Bernardino Junction.
- Remove approximately 30 miles of existing 220 kV transmission lines and structures within the existing WOD corridor between El Casco and Devers Substations.
- Remove and relocate approximately 11 miles of existing 115 kV subtransmission lines.



West of Devers Upgrade Project

Figure Ap.5-10

Devers-Beaumont 500 kV Alternative (SCE System Alternative 1)

This page intentionally blank.

- Install telecommunication lines and equipment for protection, monitoring, and control of transmission and substation facilities.
- Upgrade utility equipment within Devers, El Casco, San Bernardino, Vista, Timoteo, Etiwanda, and Tennessee Substations.
- Remove and relocate approximately 2 miles of existing 66 kV subtransmission lines.
- Remove and relocate approximately 4 miles of existing 12 kV distribution lines.

Consideration of NEPA Criteria

Project Objectives, Purpose and Need

Basic Project Objective 1, Increase system deliverability: This alternative would provide a similar increase in system deliverability as the Proposed Project. Therefore, this alternative would exceed the 2,200 MW of increased deliverability defined in this objective.

Basic Project Objective 2, Support renewable energy goals: This alternative would support renewable energy goals in the same manner as would the Proposed Project.

Basic Project Objective 3, Maximize remaining space in the corridor: The Devers-Beaumont 500 kV Alternative would relocate the new transmission facilities to a different ROW. The removal of existing 220 kV transmission structures from the existing WOD corridor would increase the space available in the WOD ROW for other uses.

This alternative would allow SCE to fully deliver the output of new generation projects, would facilitate progress toward achieving California's RPS goals, and would comply with reliability standards. Therefore, this alternative would meet all of the Basic Project Objectives and purpose and need of the Proposed Project.

Feasibility

Technical Feasibility. The Devers-Beaumont 500 kV Alternative would require construction within the Devers-Valley and El Casco System ROWs. The Devers-Valley ROW includes extremely steep slopes with only helicopter access. However, given that the Devers-Valley No. 2 line was recently constructed in that corridor, this additional circuit is considered to be technical feasible to construct.

Regulatory Feasibility. Constructing a new 500 kV line from Devers to a new Beaumont Substation would require a route that would affect both the San Bernardino Forest's San Jacinto Wilderness and the BLM's Potrero ACEC.

Potrero Area of Critical Environmental Concern (ACEC) – BLM Land and Resource Management Plan Amendment. The Potrero ACEC is a 1,030-acre area under the jurisdiction of the BLM. At least five species of wildlife that are listed as threatened or endangered may occur within the Potrero ACEC, including the least Bell's vireo (*Vireo bellii pusillus*), southwestern willow flycatcher (*Empidonax traillii extimus*), coastal California gnatcatcher (*Polioptila californica californica*), Stephens' kangaroo rat (*Dipodomys stephensi*), and arroyo toad (*Bufo californicus*).

A Plan Amendment may be required for the proposed transmission line across BLM lands, if the route is located outside of the designated utility corridor and within the ACEC. The requirement for a plan amendment may not make the alternative infeasible, but it would require a series of additional regulatory requirements: (a) NEPA clearance of the plan amendment would be required; (b) public noticing would be required by filing in the Federal Register; (c) an extension of the Draft EIR/EIS public review period to 90 days; and (d) a 60-day Governor's Consistency Review following the publishing of the Final

EIS. The Final EIS would also have to identify in its title that the EIS also evaluates a proposed Plan Amendment. It is not known at this time whether BLM would approve the required plan amendment; therefore, regulatory feasibility is not certain.

- *San Bernardino National Forest – San Jacinto Wilderness.* With the San Jacinto Wilderness, the new line would have to be constructed within the Congressionally designated transmission corridor, where the Devers-Valley No. 1 and No. 2 lines are currently located.

Legal Feasibility. While this route would face regulatory challenges due to the protective land uses along the potential route, it appears that use of the existing Devers-Valley ROW through protected lands would be feasible as long as the new 500 kV circuit remains within the Congressionally approved ROW.

Construction Timeframe. The regulatory and construction challenges discussed above may cause delays to the in-service date.

Reliability. This alternative would comply with applicable Reliability Standards and Regional Business Practices developed by NERC, WECC, and CAISO. Furthermore, the alternative would be designed and constructed in conformance with SCE's approved engineering, design, and construction standards for substation, transmission, subtransmission, and distribution system projects. Therefore, the reliability of this alternative on SCE's transmission system would be similar to the Proposed Project.

Environmental Advantages

This alternative would remove approximately 30 miles of existing 220 kV transmission lines and structures within the existing WOD corridor between El Casco and Devers Substations, which would eliminate impacts of the existing transmission lines. In addition, the impacts of the Proposed Project would not occur on the Morongo Tribal land and from Banning and Beaumont to the eastern end of the project area. However, impacts of the Proposed Project would be transferred to different locations, where the impacts would likely be more severe.

Environmental Disadvantages

Biological Resources. The areas around the San Jacinto Wilderness and Potrero ACEC have greater potential for impacts to sensitive habitats and species than construction of the Proposed Project within an existing transmission corridor.

Recreation and Wilderness. The alternative would traverse the San Jacinto–Santa Rosa National Monument, the San Jacinto Wilderness, and the Potrero ACEC, although in an existing transmission corridor.

Land Use. Construction of a new transmission corridor and substation through the populated areas of Cabazon, Banning, and Beaumont (along the existing Devers-Valley corridor) would create construction disturbance and severe visual impacts to residences and sensitive receptors.

Visual Resources. Construction of a new 500 kV line with taller double-circuit towers, as well as construction of a new 500 kV/220 kV substation near the City of Beaumont, would likely create more severe significant and unmitigable visual resources impacts.

Alternative Conclusions

Eliminated. This alternative would meet all three Basic Project Objectives and has the potential to be technically and legally feasible. Construction of a new corridor and 500 kV/220 kV substation in the sensitive environment of the San Jacinto-Santa Rosa National Monument and the San Bernardino National

Forest, as well as through the developed areas of Banning and Beaumont would create construction disturbance and greater visual impacts to residences and sensitive receptors in these areas without providing any environmental advantages over the Proposed Project. Therefore, this alternative was eliminated from full consideration in this EIS.

5.8 Red Bluff–Valley-Serrano 500 kV Alternative (SCE System Alternative 2)

This alternative considered because it was presented as a potential alternative in SCE's PEA. It was eliminated because it would have substantially more severe environmental impacts than the Proposed Project, and may be infeasible to permit given the federal and tribal jurisdictions it would likely have to cross. Note that one segment of this alternative, the addition of a second 500 kV circuit from SCE's Valley Substation to its Serrano Substation, is considered as a component of the No Action Alternative, Option 2. This alternative is described in Section C.6.3.2, and impacts analyzed in Section D.

Alternative Description

This alternative was proposed by SCE in its PEA as System Alternative 2, New 500 kV Transmission Line (PEA Section 2.1.2.3; SCE, 2013) and is shown in Figure Ap.5-11. Under the Red Bluff–Valley-Serrano 500 kV Alternative, a new 500 kV transmission line would be constructed on new ROW between the existing Red Bluff, Valley, and Serrano Substations. The alternative would also require reconfiguration of the existing 220 kV circuits between El Casco, Vista, and San Bernardino Substations. Finally, the Red Bluff–Valley-Serrano 500 kV Alternative would require construction of 220 kV transmission line between Mira Loma and Vista Substations, and would require upgrades to Serrano Substation to increase the substation transfer capability. Specifically, this system alternative would include the following components:

- Acquire approximately 162 miles of ROW for a new 500 kV single-circuit transmission line.
- Acquire approximately 16 miles of ROW for a new 220 kV single-circuit transmission line.
- Construct approximately 120 miles of single-circuit 500 kV transmission line in a new ROW between Red Bluff and Valley Substations.
- Construct approximately 42 miles of single-circuit 500 kV transmission line in a new ROW between Valley and Serrano Substations.
- Construct approximately 16 miles of single-circuit 220 kV transmission line in a new ROW between Mira Loma and Vista Substations.
- Reconfigure the existing 220 kV system between El Casco, Vista, and San Bernardino Substations to form the following lines:
  - El Casco–Vista 220 kV transmission line
  - San Bernardino–Vista No. 2 220 kV transmission line
- Remove approximately 30 miles of existing 220 kV transmission lines and structures within the existing WOD corridor between El Casco and Devers Substations.
- Remove and relocate approximately 2 miles of existing 66 kV subtransmission lines.
- Remove and relocate approximately 4 miles of existing 12 kV distribution lines.
- Install telecommunication lines and equipment for protection, monitoring, and control of transmission and substation facilities.
- Upgrade utility equipment within Devers, El Casco, San Bernardino, Valley, and Vista Substations.
- Install a new 500/220 kV transformer bank at Serrano Substation and modify the 220 kV switchyard configuration.

Consideration of NEPA Criteria

Project Objectives, Purpose and Need

Basic Project Objective 1, Increase system deliverability: This alternative would provide a similar increase in system deliverability as the Proposed Project. Therefore, this alternative would exceed the 2,200 MW of increased deliverability defined in this objective.

Basic Project Objective 2, Support renewable energy goals: This alternative would support renewable energy goals in the same manner as would the Proposed Project.

Basic Project Objective 3, Maximize remaining space in the corridor: The Red Bluff–Valley-Serrano 500 kV Alternative would establish miles of new ROW and would also follow existing established ROWs. This configuration would increase the space available in the WOD ROW for other uses when compared with the Proposed Project.

As discussed above, the majority the Red Bluff–Valley-Serrano 500 kV Alternative would establish a new ROW, when SCE's existing ROW could be rebuilt. Therefore, it would not follow the Garamendi Principles for prudent transmission planning to maximize the use of existing transmission line ROWs to the maximum extent practicable. Approximately 42 miles of the route would be the addition of a second 500 kV circuit between the Valley and Serrano Substations, passing through about 8 miles of the Cleveland National Forest (in an energy corridor designated by the Energy Policy Act's Westwide Corridors program). However, the alternative would allow SCE to fully deliver the output of new generation projects, would facilitate progress toward achieving California's RPS goals, and would comply with reliability standards. Therefore, this alternative would all of the Basic Project Objectives and purpose and need of the Proposed Project.

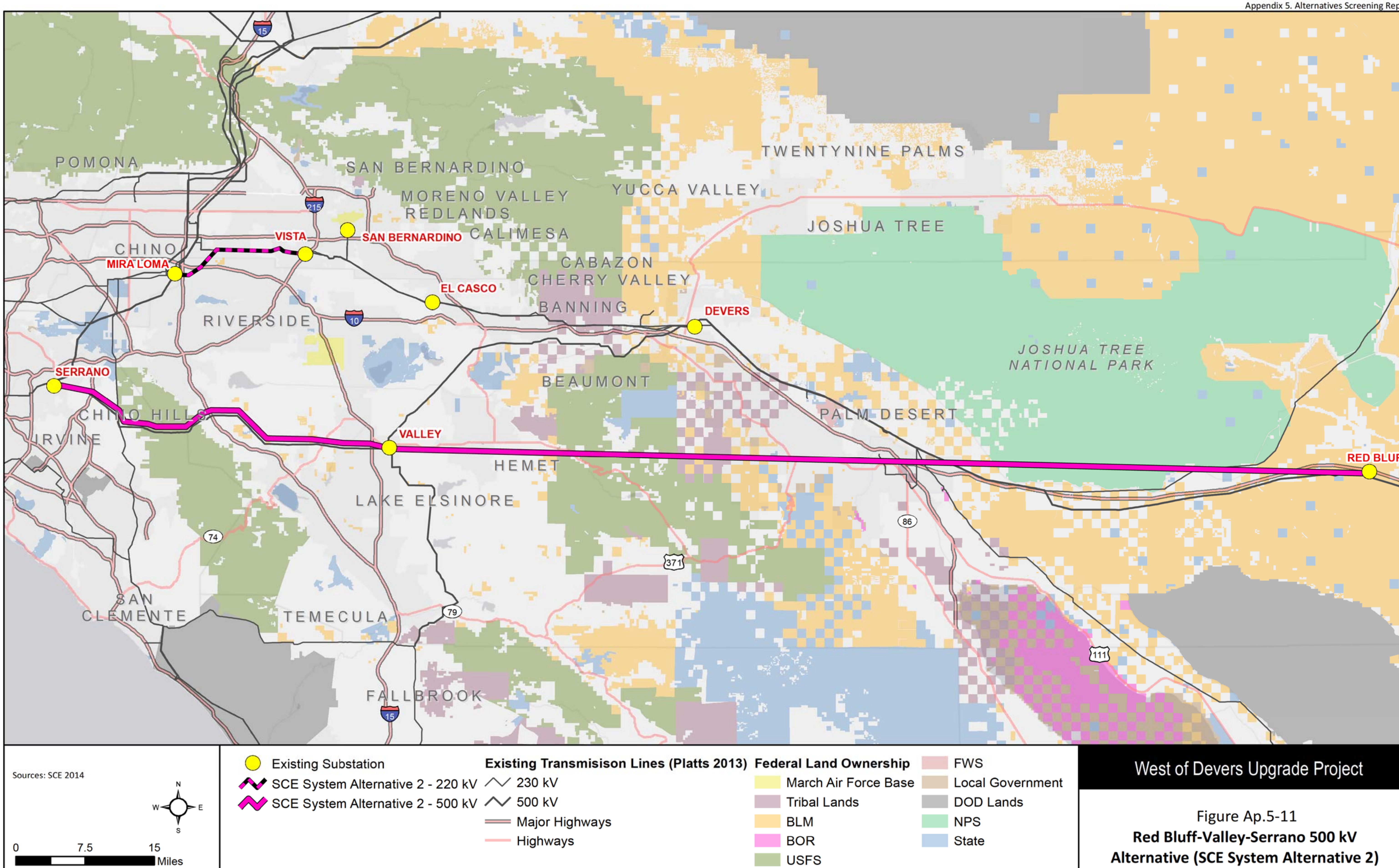
Feasibility

Technical Feasibility. The specific route of the Red Bluff–Valley-Serrano 500 kV Alternative between Red Bluff and Valley Substations has not been defined, and would have to cross the San Jacinto Mountains. Construction over rugged mountains is generally feasible, so this route could likely be constructed.

Regulatory Feasibility. SCE's map of this alternative implies that the Devers-Valley corridor would not be used and that this potential route would cross the Santa Rosa/San Jacinto Mountains south of Mount San Jacinto. As a result, it would face a large number of permitting challenges that would likely make it infeasible. As illustrated on Figure Ap.5-11, the route would likely pass through Congressionally designated wilderness areas (within the San Bernardino National Forest and on BLM land) and tribal land. In addition, the illustrated route would pass through the urban areas of the Cities of Palm Springs and Palm Desert. As a result, this alternative would face extensive regulatory and legal infeasibilities and strong public opposition.

Construction Timeframe. The regulatory challenges discussed above may make this alternative impossible to permit, but if a legal route were found, the permitting process would most likely cause extensive delays to the in-service date.

Reliability. This alternative would create a new, separate transmission corridor and would comply with applicable Reliability Standards and Regional Business Practices developed by NERC, WECC, and CAISO. Furthermore, the alternative would be designed and constructed in conformance with SCE's approved engineering, design, and construction standards for substation, transmission, subtransmission, and distribution system projects. Therefore, the reliability of this alternative on SCE's transmission system would be similar to the Proposed Project.



West of Devers Upgrade Project

Figure Ap.5-11
Red Bluff-Valley-Serrano 500 kV Alternative (SCE System Alternative 2)

July 2016

This page intentionally blank.

Environmental Advantages

Although all impacts within the existing WOD corridor would be eliminated, no environmental advantages compared to the proposed route have been identified for this alternative since similar types of impacts would be transferred to a different, new location with generally much higher resource values.

Environmental Disadvantages

Biological Resources. The areas around the San Jacinto Wilderness and Potrero ACEC have the greater potential for impacts to sensitive habitats and species than construction of the Proposed Project, which would be located within an existing, already-disturbed transmission corridor.

Recreation and Wilderness. The alternative would most likely traverse the Forest and BLM wilderness areas and tribal lands in Riverside County.

Land Use. Construction of a new and much longer transmission corridor through the populated areas of the Inland Empire would likely create greater construction disturbance impacts to residences and sensitive receptors.

Visual Resources. Construction of a new 500 kV line with taller towers in a new, longer corridor through sensitive land uses and protected federal and tribal lands would likely create greater significant and unmitigable visual resources impacts.

Ground Disturbance. This route would be much longer than the proposed route and would include construction of new 500 kV and 220 kV lines within new corridors, which will affect the length and intensity of short-term construction impacts and ground disturbance, increasing impacts in air quality, noise, transportation and traffic, hazardous materials related to environmental contamination, and geologic resources related to soil erosion. The potential to disturb unknown cultural resources and impact vegetation and wildlife is also increased with more ground disturbance. Increased disturbance and removal of vegetation could increase the chance of noxious weed introduction as well as the removal of more native vegetation.

Alternative Conclusions

Eliminated. This alternative would meet all three Basic Project Objectives and has the potential to be technically feasible. If the route were proposed through the wilderness areas and tribal lands (which would be very difficult to avoid based on SCE's schematic map), the regulatory and legal feasibility of this alternative would be highly questionable. In addition, construction of new, much longer corridors especially in the developed areas of the Inland Empire would create greater construction disturbance and visual impacts to residences and sensitive receptors in these areas without providing any environmental advantages over the Proposed Project. Therefore, this alternative was eliminated from full consideration in this EIS.

5.9 Reduced Build Alternative Option 1

This alternative was developed to consider the feasibility of the West of Devers project as proposed in 2005. The alternative would reduce the impacts of the Proposed Project by retaining the existing double-circuit towers rather than removing and rebuilding them. However, the Reduced Build Alternative Option 1 is eliminated because the double-bundled 1033.5 kcmil conductors proposed in 2005 could not now be safely supported on these towers given SCE's updated wind loading criteria. Due to the tower replacement and strengthening required for 60 percent of existing structures, the alternative would require nearly as much construction as the Proposed Project. As a result, it would not significantly reduce the environmental impacts of the project as proposed.

Alternative Description

This alternative is similar to the project proposed by SCE in the 2005 West of Devers System Upgrades and analyzed as the Proposed Project in the DPV2 EIR/EIS (CPUC and BLM, 2006). In this option:

- The two sets of existing single-circuit towers would be removed and one set of new double-circuit towers would replace those towers; and,
- The existing double-circuit towers would be retained and reconductored, with double-bundled 1033.5 kcmil ACSR. Reconductoring the 40 miles of existing double-circuit towers would involve tower replacement and strengthening for 60 percent of existing structures (SCE, 2015).

When compared with the Proposed Project, each of the four circuits would consist of smaller double-bundled 1033.5 kcmil ACSR (2B-1033.5 ACSR) for their entire length, which was SCE's design for the corridor in 2005. SCE Response to Data Request ALT-18a indicates that under this alternative, 60 percent of the existing double-circuit structures would need to be replaced (SCE, 2015).

The Reduced Build Option 1 would be configured as follows:

Reduced Build Option 1, Segments 1 and 2: would be configured as follows:

- Re-use the existing double-circuit 220 kV towers (as proposed in 2005), and replace existing single-conductor circuits where they occur with a two-conductor bundle of 1033.5 kcmil ACSR (as proposed in 2005).

Reduced Build Option 1, Segment 5 would be configured as follows:

- In the westernmost 3 miles of tribal land, all transmission facilities in the existing ROW would be removed and relocated to the south.
- In this westernmost segment, 19 pairs of new double-circuit tubular steel poles would be installed and double-bundled 1033.5 kcmil ACSR conductors would be installed on the new tubular steel poles.
- On the eastern portion of the Morongo land, 30 pairs of lattice steel towers would replace the existing single-circuit towers; these towers would also be conductored the double-bundled 1033.5 kcmil ACSR conductor.

Reduced Build Option 1, Segments 3, 4, and 6 would be configured as follows:

The new double-circuit towers that would be constructed would be located at least 50 feet north of the existing double-circuit towers in Segment 3 and at least 50 feet south of the existing double-circuit towers in Segments 4 and 6. Specifically, the towers would be as follows:

- Reconfigure San Bernardino Junction to result in six individual 220 kV circuit crossings (as proposed in 2005).
- Re-use the existing double-circuit 220 kV towers (as proposed in 2005), and reconductor those two circuits using a two-conductor bundle of 1033.5 kcmil ACSR.
- Remove the two single-circuit 220 kV structures and replace them with a single set of new double-circuit towers, using a two-conductor bundle of 1033.5 kcmil ACSR (as proposed in 2005).
- Reconfigure Banning Junction to eliminate individual 220 kV circuit crossings (as proposed in 2005).

Consideration of NEPA Criteria

Project Objectives, Purpose and Need

Basic Project Objective 1, Increase system deliverability: The Reduced Build Alternative Option 1 Alternative would achieve Basic Project Objective 1 by exceeding 2,200 MW of increased deliverability. This alternative would result in a corridor system rating of about 3,400 MW.

Basic Project Objective 2, Support renewable energy goals: This alternative would facilitate progress toward achieving California's RPS goals by increasing the capacity of the WOD corridor by roughly 1,800 MW. This would support increased import of renewable generation into the Los Angeles basin.

Basic Project Objective 3, Maximize remaining space in the corridor: This alternative would retain adequate space within the ROW (up to 175 feet) for transmission expansion, if needed by SCE in the future, as shown in Table Ap.5-2 because the new double-circuit towers could be placed as described in the Tower Relocation Alternative.

Feasibility

Legal Feasibility. This alternative appears to be consistent with the Morongo ROW Agreement based on the tower placement defined for Segment 5 (as described above).

Technical Feasibility. This alternative would reconductor some existing double-circuit towers in the corridor while requiring substantial modification or reconstruction of most other existing double-circuit towers to accommodate the double-bundled 1033.5 kcmil ACSR conductor.

This alternative would differ from the Phased Build Alternative (described in Section 4.4), which would use a single 795 Drake ACCR. The Reduced Build Alternative Option 1 would install double-bundled 1033.5 kcmil conductors, which are larger and heavier than 795 Drake ACCR. The installation of the heavier conductors would require the replacement of large numbers of the existing towers and creating greater environmental impacts from construction and demolition of towers. Although technically feasible, new wind loading criteria and ground clearance issues would require strengthening or replacement of 60 percent of the retained structures if they were to be reconductored with double-bundled 1033.5 kcmil ACSR (SCE, 2015).

Regulatory Feasibility. This alternative appears to be feasible considering regulatory factors.

Construction Timeframe. Although this alternative would avoid near-term construction activities related to removing all towers, the alternative would require replacing or retrofitting 60 percent of the existing structures. The overall construction duration could be somewhat extended when compared to that of the Proposed Project.

Reliability. Like the Proposed Project, the Reduced Build Alternative Option 1 would comply with all reliability requirements of NERC, FERC, and the CPUC.

Environmental Advantages

Ground Disturbance. This alternative would avoid the need to remove and rebuild all towers by reusing many of the existing double-circuit structures. However, to reconductor the existing double-circuit towers with a two-conductor bundle of 1033.5 kcmil ACSR would warrant replacing or retrofitting 60 percent of the existing structures, which would create additional ground disturbance and require complex workarounds that could extend the duration of construction when compared with the Proposed Project.

Environmental Disadvantages

Construction of a Reduced Build Configuration. One beneficial feature of this alternative is that it would reduce the amount of near-term construction activities in comparison with the Proposed Project (which requires removal and replacement of all of the double-circuit towers). The Reduced Build Alternative Option 1 provides 3,400 MW of corridor capacity (more than adequate for all of the CAISO's reliability projects for 2024). However, depending on other transmission system upgrades, it is possible that over the longer-term, the implementation of this alternative could require future transmission system construction activities in the WOD corridor to further increase system capacity.

Alternative Conclusion

Eliminated. The Reduced Build Alternative Option 1 meets all three Basic Project Objectives and it is technically and legally feasible. It is eliminated from detailed analysis because the required replacement of 60 percent of existing towers would not substantially avoid or reduce the environmental impacts of the Proposed Project.

5.10 Reduced Build Alternative Option 2a

The Reduced Build Alternative Option 2a was developed to maximize the conventional conductor size that could be installed on the new and existing towers, while minimizing the need for new construction in Segments 3 through 6. However, it was eliminated because data from SCE indicated that the larger conductors could not be supported on the existing towers, requiring approximately 60 percent of them to be replaced or strengthened. As a result, the alternative would not significantly reduce the environmental impacts of the project as proposed.

Alternative Description

This alternative would reuse and reconductor the existing double-circuit towers with a two-conductor bundle of 1033.5 kcmil ACSR (as proposed in 2005), and install one set of new double-circuit towers with 2B-1590 ACSR, as in the Proposed Project.

Reduced Build Option 2a, Segments 1 and 2 would be configured as follows:

- Implement the currently Proposed Project for Segments 1 and 2 with a two-conductor bundle of 1590 kcmil ACSR on each circuit.

Reduced Build Option 2a, Segment 5 would be configured as follows:

- In the westernmost 3 miles of tribal land, all transmission facilities in the existing ROW would be removed and relocated to the south.
- In this westernmost segment, 19 pairs of new double-circuit tubular steel poles would be installed and double-bundled 1033.5 kcmil ACSR conductors would be installed on the new tubular steel poles.
- On the eastern portion of the Morongo land, 30 pairs of lattice steel towers would replace the existing single-circuit towers; these towers would also be conductored the double-bundled 1033.5 kcmil ACSR conductor.

Reduced Build Option 2a: Segments 3, 4, and 6 would be configured as follows:

The new double-circuit towers that would be constructed would be located at least 50 feet north of the existing double-circuit towers in Segment 3 and at least 50 feet south of the existing double-circuit towers in Segments 4 and 6. Specifically, the towers in Segments 3, 4, and 6 would be as follows:

- Reconfigure San Bernardino Junction to result in 4 individual 220 kV circuit crossings (as in the Proposed Project).
- Re-use the existing double-circuit 220 kV towers (as proposed in 2005), and reconductor those 2 circuits using a two-conductor bundle of 1033.5 kcmil ACSR.
- Remove the 2 single-circuit 220 kV structures and replace them with a single set of new double-circuit towers, using a two-conductor bundle of 1590 kcmil ACSR (as in the Proposed Project).
- Reconfigure Banning Junction to result in four individual 220 kV circuit crossings.

Consideration of NEPA Criteria

Project Objectives, Purpose and Need

Basic Project Objective 1, Increase system deliverability: The Reduced Build Alternative Option 2a would achieve Basic Project Objective 1 and would exceed 2,200 MW of increased deliverability. This alternative would result in a corridor system rating of about 3,400 MW.

Basic Project Objective 2, Support renewable energy goals: This alternative would facilitate progress toward achieving California's RPS goals. The alternative would meet this objective by increasing the capacity of the WOD corridor by roughly 1,800 MW. This would support increased import of renewable generation into the Los Angeles basin.

Basic Project Objective 3, Maximize remaining space in the corridor: This alternative would retain adequate space within the ROW (up to 175 feet) for transmission expansion, if needed by SCE in the future, as shown in Table Ap.5-2 because the new double-circuit towers could be placed as described in the Tower Relocation Alternative.

Feasibility

Legal Feasibility. This alternative appears to be consistent with the Morongo ROW Agreement based on the tower placement defined for Segment 5 (as described above).

Technical Feasibility. While this alternative would be technically feasible, new wind loading criteria and ground clearance issues would require strengthening or replacement of 60 percent of the retained structures if they were to be reconductored with double-bundled 1033.5 kcmil ACSR (SCE, 2015). The remaining 40 percent of the existing towers in the corridor could simply be reconductored.

In addition, this alternative would result in mismatching conductors across the four primary circuits in the corridor: the two circuits placed on the existing double-circuit towers would have 1033.5 kcmil conductor, and the two circuits installed on newly constructed towers would have 1590 kcmil conductors. Mismatched conductors are not inherently infeasible, but create transmission system management challenges that are undesirable. In addition, this alternative would retain existing line crossings at Banning Junction, which are undesirable in transmission system design but not infeasible to accommodate.

Regulatory Feasibility. This alternative appears to be feasible considering regulatory factors.

Construction Timeframe. Although this alternative would avoid near-term construction related to removing all towers, the reuse and reconductoring of some existing double-circuit towers would warrant replacing or retrofitting the remaining 60 percent of the existing structures. The overall construction duration could be somewhat extended when compared to that of the Proposed Project.

Reliability. Like the Proposed Project, the Reduced Build Alternative Option 2a would comply with all reliability requirements of NERC, FERC, and the CPUC.

Environmental Advantages

Ground Disturbance. This alternative would avoid the need to remove and rebuild all towers by reusing many of the existing double-circuit structures. However, to reconductor the existing double-circuit towers with a two-conductor bundle of 1033.5 kcmil ACSR it would be necessary to replace or retrofit 60 percent of the retained structures. This would create additional ground disturbance and require complex workarounds that could extend the duration of construction when compared with the Proposed Project.

Environmental Disadvantages

Construction of a Reduced Build Configuration. One beneficial feature of this alternative is that it would reduce the amount of near-term construction activities in comparison with the Proposed Project (which requires removal and replacement of all of the double-circuit towers). The Reduced Build Alternative Option 2a provides 3,400 MW of corridor capacity (more than adequate for all of the CAISO's reliability projects for 2024). However, depending on other transmission system upgrades, it is possible that over the longer-term, the implementation of this alternative could require future transmission system construction activities in the WOD corridor to further increase system capacity.

Alternative Conclusion

Eliminated. The Reduced Build Alternative Option 2a would meet all three Basic Project Objectives and is technically and legally feasible. It is eliminated from detailed analysis because the requirement to rebuild 60 percent of existing structures results in it being unlikely to avoid or eliminate the significant environmental impacts of the Proposed Project.

5.11 Reduced Build Alternative Option 2b

The Reduced Build Alternative Option 2b was developed to maximize the size of conventional conductors that could be installed on the new and existing towers while still staying within SCE's new wind loading guidelines. It was eliminated because SCE's wind guidelines would allow only smaller (1033.5 kcmil) and single-bundled conductors on the existing towers, and this conductor scheme would not carry enough electricity to meet the first basic project objective's minimum deliverability requirements.

Alternative Description

This alternative would retain the existing 1033.5 kcmil conductors on existing double-circuit towers without modification, and install one set of new double-circuit towers with 2B-1590 ACSR, as in the Proposed Project.

Reduced Build Option 2b, Segments 1 and 2 would be configured as follows:

- Segment 1: Retain all towers and conductors without modification
- Segment 2: Implement Proposed Project with new and modified towers and 1590 kcmil ACSR conductors.

Reduced Build Option 2b, Segment 5 would be configured as follows:

- In the westernmost 3 miles of tribal land, all transmission facilities in the existing ROW would be removed and relocated to the south.
- In this westernmost segment, 19 pairs of new double-circuit tubular steel poles would be installed and single-bundled 1033.5 kcmil ACSR conductor would be installed on the new tubular steel poles.

- On the eastern portion of the Morongo land, 30 pairs of lattice steel towers would replace the existing single-circuit towers; these towers would also be conductored with single-bundled 1033.5 kcmil ACSR conductor.

Reduced Build Option 2b: Segments 3, 4, and 6 would be configured as follows:

The new double-circuit towers that would be constructed would be located at least 50 feet north of the existing double-circuit towers in Segment 3 and at least 50 feet south of the existing double-circuit towers in Segments 4 and 6. Specifically, the towers in Segments 3 through 6 would be as follows:

- Reconfigure San Bernardino Junction to result in four individual 220 kV circuit crossings (as in the Proposed Project).
- Re-use the existing double-circuit 220 kV towers without modification and retain the existing 1033.5 kcmil ACSR.
- Remove the two single-circuit 220 kV structures and replace them with a single set of new double-circuit towers, using a two-conductor bundle of 1590 kcmil ACSR (as in the Proposed Project).
- Reconfigure Banning Junction to result in four individual 220 kV circuit crossings.

Consideration of NEPA Criteria

Project Objectives, Purpose and Need

Basic Project Objective 1, Increase system deliverability: The Reduced Build Alternative Option 2b would only partially achieve Basic Project Objective 1 due to the small conductor size on the retained double-circuit towers. This alternative would result in a corridor system rating of about 2,300 MW, which would not sufficiently increase deliverability, as defined in this objective.

Basic Project Objective 2, Support renewable energy goals: This alternative would partially meet this objective, by adding roughly 700 MW of capacity for renewable projects. This would only partially support increased import of renewable generation into the Los Angeles basin.

Basic Project Objective 3, Maximize remaining space in the corridor: This alternative would retain adequate space within the ROW (up to 175 feet) for transmission expansion, if needed by SCE in the future, as shown in Table Ap.5-2 because the new double-circuit towers could be placed as described in the Tower Relocation Alternative.

Feasibility

Legal Feasibility. This alternative appears to be consistent with the Morongo Agreement and would therefore be legally feasible.

Technical Feasibility. This alternative would not require reconductoring of any existing towers in the corridor; the existing conductors would remain, which is a feasible option. It is noted that this alternative would not allow correction of the existing corridor operation limitations that are driven by wind loading criteria and potential ground clearance issues (SCE, 2015).

In addition, this alternative would result in mismatching conductors across the four primary circuits in the corridor: the two circuits placed on the existing double-circuit towers would have 1033.5 kcmil conductor, and the two circuits installed on newly constructed towers would have 1590 kcmil conductors. Mismatched conductors are not inherently infeasible, but create transmission system management challenges that are undesirable. In addition, this alternative would retain existing line crossings at Banning Junction, which are undesirable in transmission system design but not infeasible to accommodate.

Regulatory Feasibility. This alternative appears to be feasible considering regulatory factors.

Construction Timeframe. Because this alternative would avoid near-term construction related to removing all towers, the reuse and reconductoring of the existing double-circuit towers would result in the overall construction duration being shorter than that of the Proposed Project.

Reliability. Like the Proposed Project, the Phased Build Alternative would comply with all reliability requirements of NERC, FERC, and the CPUC.

Environmental Advantages

Ground Disturbance. This alternative would avoid the need to remove and rebuild all towers by reusing the existing double-circuit structures to support two circuits in the corridor. This would substantially shorten the duration of construction.

Environmental Disadvantages

Construction of a Reduced Build Configuration. One beneficial feature of this alternative is that it would reduce the amount of near-term construction activities in comparison with the Proposed Project (which requires removal and replacement of all of the double-circuit towers). However, due to the smaller transmission capacity of this alternative, it is more likely that over the longer-term, the implementation of Reduced Build Alternative Option 2b could require future construction within the ROW to increase system capacity as additional generation is developed.

Alternative Conclusion

Eliminated. The Reduced Build Alternative Option 2b would only partially meet Basic Project Objective 1 (increase deliverability of generation), and it would only partially meet Basic Project Objective 2. It would meet Basic Project Objective 3. The alternative is feasible, and it has the potential to reduce the environmental impacts of the Proposed Project. It is eliminated from detailed analysis because it would not meet most of the Basic Project Objectives.

5.12 High-Performance Conductor Alternative

This alternative was developed to evaluate the potential use of 4 circuits of double-bundled high-performance conductors of a similar size to SCE's proposed ACSR conductors. It is eliminated because it would not reduce or avoid the impacts of the Proposed Project.

Alternative Description

This alternative was originally considered for the WOD corridor in the DPV2 Final EIR/EIS (CPUC, 2006; Appendix 1, Section 4.3.3) in response to a comment letter filed in the CPUC's General Proceeding (A.05-04-015) prior to the DPV2 EIR/EIS public scoping period (filed: May 16, 2005 by 3M Composite Conductor Program).

The High-Performance Conductor Alternative would upgrade the 220 kV corridor by replacing the existing towers as proposed by SCE, and installing aluminum conductor composite reinforced (ACCR) or aluminum conductor composite core (ACCC) conductors instead of the proposed ACSR conductors. The conductors in this alternative would be double-bundled conductors of comparable physical size to those in the Proposed Project. The alternative conductor for the four primary circuits in this case would be 2B-1590 Lapwing ACCR, which would be capable of achieving 158% of Proposed Project electrical capacity. When compared with construction of the Proposed Project, which would upgrade the existing 220 kV transmission lines to carry 5,168 MW under normal conditions (with all lines in service) for the four primary circuits combined, this alternative would carry 8,163 MW, as shown in Table Ap.5-4.

Table Ap.5-4. High-Performance Conductor Alternative, Capacity of Individual 220 kV Circuits

Circuit	Existing Line Rating (Amperes)	Proposed Project Normal Line Rating [1] (Amperes)	High-Performance Conductor Alternative Normal Line Rating [2] (Amperes)	Proposed Project Normal Power Flow Capacity [1] (MW)	High-Performance Conductor Alternative Normal Power Flow Capacity [2] (MW)
Devers-Vista No. 1	1,150	3,230	5,102	1,292	2,041
Devers-Vista No. 2	1,240	3,230	5,102	1,292	2,041
Devers–San Bernardino	796	3,230	5,102	1,292	2,041
Devers–El Casco & El Casco–SB	1,150	3,230	5,102	1,292	2,041
WOD Corridor: Four Circuits Total	4,336	12,920	20,408	5,168	8,163

1 - Under normal conditions and SCE standard conditions, with all lines in service. Using Proposed Project 2B-1590. Each phase would consist of double-bundled (bundle of two conductors for each phase) 1,590 kcmil (one thousand circular mils) aluminum conductor steel reinforced (ACSR) conductor. (SCE Response to Data Request ALT-12.)
2 - Under normal conditions and vendor standard conditions, with all lines in service. Using alternative double-bundled Lapwing (2B-1590 kcmil) aluminum conductor composite reinforced (ACCR) conductor. (3M, 2014.)

Consideration of NEPA Criteria

Project Objectives, Purpose and Need

Basic Project Objective 1, Increase system deliverability: This alternative would provide an increase of more than 2,200 MW to achieve higher levels of transmission capability and deliverability when compared with the Proposed Project.

Basic Project Objective 2, Support renewable energy goals: This alternative would provide comparable support for renewable energy goals as the Proposed Project, although costs would be higher.

Basic Project Objective 3, Maximize remaining space in the corridor: This alternative would retain the same amount of vacant space in the corridor as with the Proposed Project.

The High-Performance Conductor Alternative would meet all project objectives.

Feasibility

Legal Feasibility. This alternative would proceed only if it were recommended and approved by the Morongo Band of Mission Indians and a new ROW Agreement would need to be issued in order for it to move forward.

Technical Feasibility. This alternative would be feasible at greater costs than Proposed Project. Similar to the Phased Build Alternative (see Section 4.4), there would be economic consequences of greater electrical losses annually due to using the ACCR material when compared to the SCE-standard ACSR, and the unique components would require specialized spare-parts inventories and worker training for operation and maintenance.

Regulatory Feasibility. Installation of high-performance conductor appears to be feasible considering regulatory factors.

Construction Timeframe. The construction timeframe of this alternative would be comparable to that of the Proposed Project.

Reliability. The ultimate reliability of this alternative would be somewhat less than that of the Proposed Project because of the unique components that would be involved, requiring specialized spare-parts inventories and worker training for operation and maintenance. Additionally, the emergency rating of the electrical carrying capacity on ACCR conductors tends to be closer to the continuous rating, when compared with ACSR, which allows a relatively high emergency rating. This may limit or constrain how system operators use the conductors during grid emergencies.

Environmental Advantages

Ground Disturbance. Construction-related disturbance would be comparable to Proposed Project, and the greater electrical capacity of the high-performance conductors would delay the cumulative scenario impacts of installing a future 500 kV line in the corridor.

Environmental Disadvantages

Operations and Maintenance. Using ACCR or other high-performance conductors would add operation and maintenance activities by introducing conductor materials that are not standard to SCE's routine operations. These conductors and spare parts, including specialized splices or connectors that are not standardized within the SCE territory, would require storage, and operating the system would involve specialized training.

Alternative Conclusion

Eliminated. The High-Performance Conductor Alternative is eliminated from detailed analysis because it would be unlikely to reduce or avoid any project-related impacts. Additionally, it would incur higher costs than the Proposed Project without having any potential to avoid or substantially lessen the environmental impacts of the Proposed Project.

5.13 Retain WOD Interim Facility Alternative

This alternative was suggested in a comment on the Draft EIR/EIS by the CPUC's Office of Ratepayer Advocates (ORA). ORA requested evaluation of a smaller capacity alternative than those retained for analysis in Section 4 of this appendix. ORA believes there is no need for system capacity in California to justify a major transmission expansion to increase the pool of capacity resources.

Alternative Description

This alternative would retain the existing SCE 220 kV system between Devers Substation and the Vista and San Bernardino Substations, with no removal or upgrades to existing transmission circuits. However, rather than removing the WOD Interim Facility as proposed by SCE, this facility would remain in place. As described in Section B.1.1, the West of Devers Interim Project was constructed in response to requests from several generators for interconnection earlier than the Proposed Project's estimated completion date in 2020. Therefore, SCE constructed the interim facility, which added approximately 1,050 MW of additional transfer capability, yielding a total of approximately 1,600 MW of capability for the WOD 220 kV corridor. This facility is located in a separately fenced yard, just west of the Devers Substation.

ORA suggests that this alternative would also include the 3-mile transmission line relocation defined by the Morongo Band in the area just west of the Outlet Mall, where the existing ROW would be relocated to the south, paralleling the I-10 freeway. This relocation includes installation of tubular steel poles rather than lattice towers in some locations.

Consideration of NEPA Criteria

Project Objectives, Purpose and Need

Basic Project Objective 1, Increase system deliverability: This alternative would provide no increase of transmission capability and deliverability above currently available levels.

Basic Project Objective 2, Support renewable energy goals: This alternative would not provide additional transmission capacity to support future renewable energy development.

Basic Project Objective 3, Maximize remaining space in the corridor: This alternative would retain the existing amount of vacant space in the transmission corridor, but would not create the consolidated vacant space in the ROW as would the Proposed Project.

The Retain WOD Interim Facility Alternative would not meet any of the three Basic Project Objectives.

Feasibility

Legal Feasibility. This alternative would proceed only if a revised ROW Agreement were developed and approved by the Morongo Band of Mission Indians. While the alternative does include the relocation of the 3-mile segment specifically required by the Morongo, the Agreement would have to be revised to allow retention of the existing 220 kV transmission system on the remainder of the tribal land.

Technical Feasibility. This alternative would be feasible and would eliminate the cost of constructing the Proposed Project.

Regulatory Feasibility. Retaining the WOD Interim Facility equipment appears to be feasible considering regulatory factors.

Construction Timeframe. This alternative would require no new construction.

Reliability. The ultimate reliability of this alternative would be somewhat less than that of the Proposed Project because the older single-circuit structures in the WOD corridor would remain. The wind loading constraints defined by SCE would likely require replacement of individual structures to ensure appropriate clearances.

Environmental Advantages

Ground Disturbance. Construction would be eliminated, so no new ground disturbance would occur.

Environmental Disadvantages

Operations and Maintenance. Retaining use of the old structures and conductors would increase required maintenance and could drive the need for structure repair or replacement.

Visual Resources. The visual benefits of removal of the older existing structures and consolidation of structures in the ROW that would occur with the Proposed Project would not be attained.

Alternative Conclusion

Eliminated. The Retain WOD Interim Facility Alternative is eliminated from detailed analysis because it would not meet any project objectives. While it would eliminate short-term construction impacts, it would create the need for increased system maintenance.

6. References

3M. 2014. Fact Sheet. 3M™ Aluminum Conductor Composite Reinforced (ACCR) High-capacity transmission conductor; English (U.S.) Units. http://solutions.3m.com/wps/portal/3M/en_U.S./EMD_ACCR/ACCR_Home/TechnicalInfo/ProductDataSpecs/. Accessed October 24, 2014. February 2014.

Bass, et al. (Ronald E. Bass, Albert I. Herson, and Kenneth M. Bogdan). 2001. The NEPA Book: A Step-By-Step Guide on How to Comply With the National Environmental Policy Act. Solano Press Books. April.

CEC (California Energy Commission). 2008. *Demonstration of Advanced Conductors for Overhead Transmission Lines*. Prepared by EPRI, Palo Alto, CA: 2008. 1017448. CEC-500-2013-030. July.

CEQ (Council on Environmental Quality). 1987. Forty Most Asked Questions Concerning CEQ's National Environmental Policy Act Regulations. 40 CFR Parts 1500-1508. https://ceq.doe.gov/ceq_regulations/guidance.html. Accessed March, 2, 2015.

Morongo (Morongo Band of Mission Indians). 2014. Morongo Band of Mission Indians' Responses to CPUC Data Requests #1 and #2. Dated May and September 2014. http://www.cpuc.ca.gov/environment/info/aspen/westofdevers/westofdevers.htm. Accessed February 23, 2015.

SCE (Southern California Edison). 2013. Proponent's Environmental Assessment. http://www.cpuc.ca.gov/environment/info/aspen/westofdevers/westofdevers.htm. Accessed November 7, 2014.

_____. 2014/2015. SCE Responses to CPUC Data Requests 1 through 17 (dated December 2013 through November 2015) http://www.cpuc.ca.gov/environment/info/aspen/westofdevers/westofdevers.htm.

Southwire. 2012. Southwire Company, LLC. ACSR Product Specifications. http://www.southwire.com/products/ACSR.htm. Accessed November 6, 2014.

Alternatives Screening Report

Attachment 1 to Appendix 5

Phased Build Alternative Supporting Data

This attachment presents supporting data for the Phased Build Alternative, including the following:

- Tables Ap5.1-1 and Ap5.1-2 present ampacity ratings for the existing system, the Proposed Project, and the Phased Build Alternative.
- Tables Ap5.1-3 and Ap5.1-4 present power flow capacities for the existing system, the Proposed Project, and the Phased Build Alternative.
- Tables Ap5.1-5 and Ap5.1-6 present power flows for the Proposed Project and the Phased Build Alternative under different modeled scenarios.

Figure 1 of this attachment illustrates the line segments of the WOD corridor that would be reconductored with 795 Drake ACCR and where existing 220 kV towers would be retained.

Capabilities of the Phased Build Alternative

Electrical Capabilities of Retaining and Reconductoring the Existing Double-Circuit Towers

The Phased Build Alternative aims to avoid many environmental impacts of the Proposed Project by retaining and reconductoring the existing double-circuit towers with high-performance conductor. The use of high-capacity conductors would maximize the power flow carried on this portion of the transmission system while minimizing the need to tear down and rebuild towers. The Phased Build Alternative would carry the generation of all projects in the CAISO's 2024 Reliability Base Case plus the flow associated with 1,400 MW from the Imperial Irrigation District, but it would have less capacity than the Proposed Project. The following tables provide background information on the electrical capabilities of the individual circuits and power flow capacities that could be achieved with the Phased Build Alternative.

Comparing the normal ampacity ratings between the Proposed Project in Table Ap5.1-1 and the Phased Build Alternative in Table Ap5.1-2 shows that approximately 59 percent of the electrical current could normally be carried by the Phased Build Alternative.

Table Ap5.1-1. Ampacity Ratings for Individual 220 kV Circuits, Existing and Proposed Project

Circuit	Existing Line Rating (Amperes)	Proposed Project Normal Line Rating [1] (Amperes)	Proposed Project Emergency Rating [2] (Amperes)
Devers–Vista No. 1	1,150	3,230	4,360
Devers–Vista No. 2	1,240	3,230	4,360
Devers–San Bernardino	796	3,230	4,360
Devers–El Casco & El Casco–SB	1,150	3,230	4,360
WOD Corridor: Four Circuits Total	**4,336**	**12,920**	**17,440**

1 - Under normal conditions and SCE standard conditions, with all lines in service. Using proposed 2B-1590: Each phase would consist of double-bundled (bundle of two conductors for each phase) 1,590 kcmil (one thousand circular mils) aluminum conductor steel reinforced (ACSR) conductor. (SCE Response to Data Request ALT-12 and ALT-19.)

2 - Under SCE emergency conditions. (SCE Response to Data Request ALT-19.)

Table Ap5.1-2. Ampacity Ratings for Individual 220 kV Circuits, Existing and Phased Build Alternative

Circuit	Existing Line Rating (Amperes)	Phased Build Alternative Normal Line Rating [1] (Amperes)	Phased Build Alternative Emergency Rating [2] (Amperes)
Devers–Vista No. 1	1,150	1,902	2,037
Devers–Vista No. 2	1,240	1,902	2,037
Devers–San Bernardino	796	1,902	2,037
Devers–El Casco & El Casco–SB	1,150	1,902	2,037
WOD Corridor: Four Circuits Total	**4,336**	**7,608**	**8,148**

1 - Under normal conditions and SCE standard conditions, with all lines in service. Using new 795 Drake ACCR, single conductor per phase. (SCE Response to Data Request ALT-19.)
2 - Under SCE emergency conditions. (SCE Response to Data Request ALT-19.)

The WOD corridor presently achieves a system transfer rating of 1,600 MW by relying on the WOD Interim Project facilities, which would be removed with the Proposed Project. Comparing the power flow capacities between the Proposed Project in Table Ap5.1-3 and the Phased Build Alternative in Table Ap5.1-4 shows that the Phased Build Alternative would improve the transfer rating of the corridor to roughly 3,000 MW rather than the 4,800 MW that could be achieved by the Proposed Project.

Table Ap5.1-3. Power Flow Capacity of Individual 220 kV Circuits, Existing and Proposed Project

Circuit	Existing Est. Power Flow Capacity (MW)	Proposed Project Normal Capacity[1] (MW)	Proposed Project Emergency Capacity[2] (MW)
Devers–Vista No. 1	460	1,292	1,744
Devers–Vista No. 2	496	1,292	1,744
Devers–San Bernardino	318	1,292	1,744
Devers–El Casco & El Casco–SB	460	1,292	1,744
WOD Corridor: Four Circuits Total	**1,794**	**5,168**	**6,976**
System Transfer Rating	**1,600**	**4,800**	

Note: Existing system transfer rating (1,600 MW) with the WOD Interim Project facilities, which would be removed with the Proposed Project.

Table Ap5.1-4. Power Flow Capacity of Individual 220 kV Circuits, Existing and Phased Build Alternative

Circuit	Existing Est. Power Flow Capacity (MW)	Phased Build Alternative Normal Capacity[1] (MW)	Phased Build Alternative Emergency Capacity[2] (MW)
Devers–Vista No. 1	460	761	815
Devers–Vista No. 2	496	761	815
Devers–San Bernardino	318	761	815
Devers–El Casco & El Casco–SB	460	761	815
WOD Corridor: Four Circuits Total	**1,794**	**3,043**	**3,259**
System Transfer Rating	**1,600**	**3,000**	

Note: Existing system transfer rating (1,600 MW) with the WOD Interim Project facilities, which would be removed with the Proposed Project.

Comparison of Proposed Project Power Flows with Phased Build Alternative

The Proposed Project would give the WOD corridor a large margin of capacity to handle power flow during all conditions and for future growth. This discussion compares the ability of the Proposed Project with the Phased Build Alternative in light of handling anticipated power flow loads. Independent power flow modeling was conducted to assess the loading in each of the corridor's circuits, during normal operations and during times when one or more circuits are out of service. The modeled outages are called contingencies, and the results of the modeling indicate the amount of loading during the worst single contingency. The following tables show the margin during the single contingency to illustrate the amount of capacity that remains on the highest-loaded circuit, in terms of the fraction not loaded. This is used as a proxy for the level of future growth that could hypothetically be accommodated after implementation of the Proposed Project or the alternative.

Table Ap5.1-5 shows the amount of power flows carried by the highest-loaded circuits and the remainder level of margin provided by the Proposed Project in two modeled scenarios. This table shows that during the worst-case scenario of all foreseeable generation projects (the Cluster 7, Phase I case plus importing an additional 1,400 MW from the Imperial Valley) and the single contingency, the Proposed Project would be loaded to about 63 percent of its capability, leaving a margin of 37 percent.

Table Ap5.1-5. Proposed Project Conductors and Resulting Flows Under N-1 Contingency

Resulting Flows in N-1 Contingency	Highest-Loaded WOD Circuit (% load)	WOD Corridor during N-1 (MW flow)	Planning Margin (% not loaded)
2024 Reliability Base Case	36 %	2,200	64 %
2019 CAISO Queue Cluster 7, Phase I	63 %	3,300	37 %

Source: Single contingency loading from Tables A2 and B2 of Attachment 2 to EIR/EIS Appendix 5.

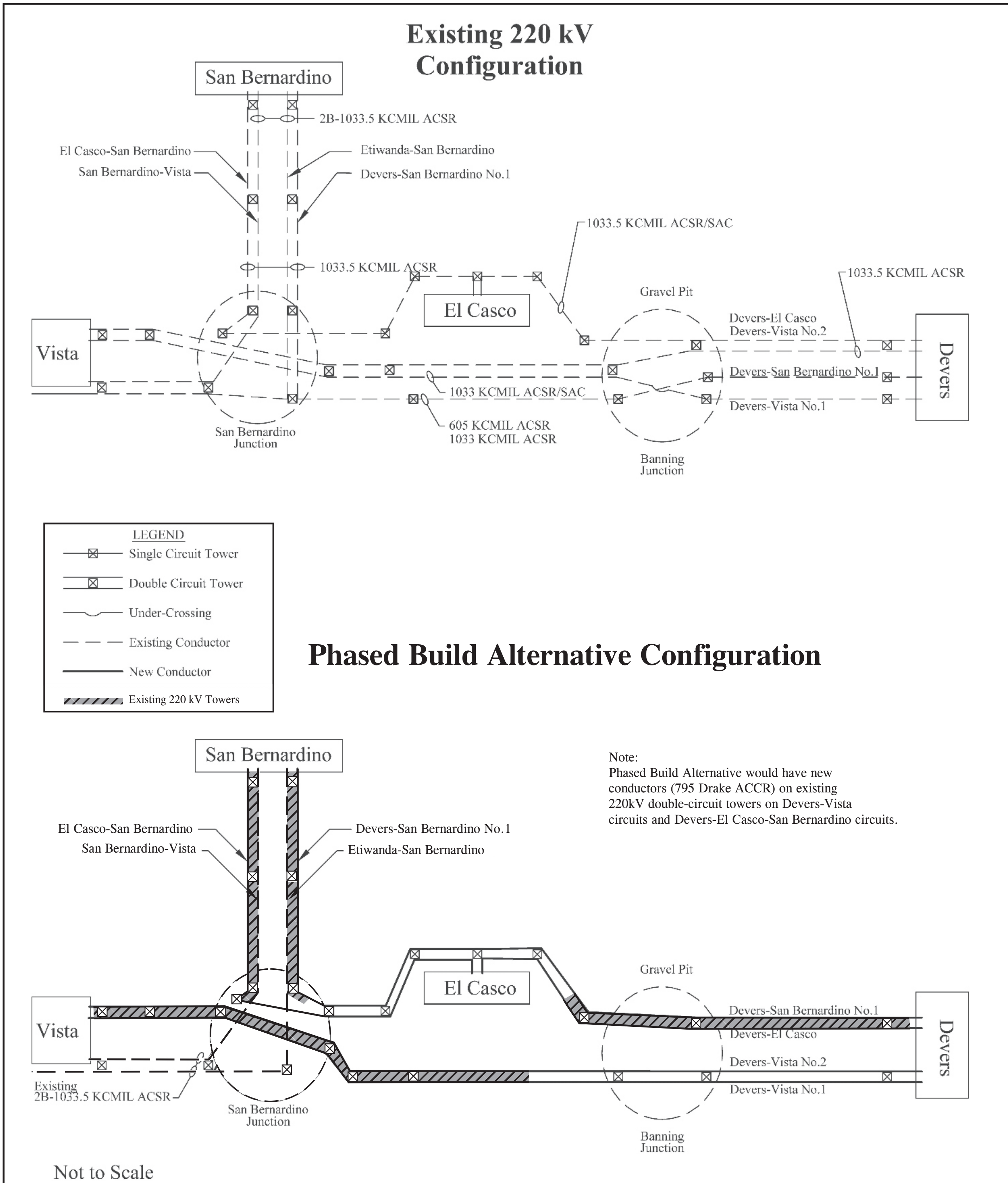
Table Ap5.1-6 shows the amount of power flows carried by the highest-loaded circuits and the remainder level of margin provided by the Phased Build Alternative. The corridor would have lower power flows and also a much lower margin under the Phased Build Alternative with four circuits of 795 Drake ACCR. The alternative conductors in the WOD corridor would reduce the ability for power to flow in the corridor when compared to the Proposed Project conductors, and this forces more flow into the Devers-Valley corridor under normal conditions. This alternative would allow SCE to deliver about 3,000 MW of output from new generation projects, through a rating that would be roughly 1,800 MW lower than that of the Proposed Project (comparing Tables A3 and A4). The lower rating translates into less ability to deliver generation and accommodate future growth. During the worst-case scenario of all foreseeable generation projects (the Cluster 7, Phase I case plus an additional 1,400 MW from the Imperial Valley) and the single contingency, the generation would overload the Phased Build Alternative. The power flow analysis and Table Ap5.1-6 shows that this alternative would successfully accommodate the scenario of the 2024 Reliability Base Case, which includes specific generation projects that the CAISO has determined to be most realistic, plus 1,400 MW from the Imperial Valley.

Table Ap5.1-6. Phased Build Alternative (795 Drake ACCR Conductors) and Resulting Flows, Under N-1 Contingency

Resulting Flows in N-1 Contingency	Highest-Loaded WOD Circuit (% load)	WOD Corridor during N-1 (MW flow)	Planning Margin (% not loaded)
2024 Reliability Base Case	67%	~2,000	33%
2019 CAISO Queue Cluster 7, Phase I	104% (overloaded)	~2,900 (overloaded)	None

Source: Single contingency loading from Tables A3 and B3 of Attachment 2 to EIR/EIS Appendix 5.

In the scenario of the 2024 Reliability Base Case, which includes specific generation projects that the CAISO has determined to be most realistic, plus an additional 1,400 MW from the Imperial Valley, a margin of 33 percent would be provided by this alternative. This is a much lower margin when compared to the margin of 64 percent provided by the Proposed Project in the same scenario (Table Ap5.1-5).



Source: SCE, 2013.

West of Devers Upgrade Project

Figure 1

Existing and Phased Build Alternative Configuration

ZGLOBAL
Power Engineering & Energy Solutions

"An innovative power engineering consulting firm staffed by industry-leading experts"

West of Devers Upgrade Project

CPCN Application - A.13-10-020

Project Alternatives Assessment
A Power Flow Analysis

For
Aspen Environmental Group

By
ZGlobal, Inc.

Northern California
604 Sutter Street, Suite 250, Folsom, CA 95630
Phone: (916) 985.9461

Southern California
750 W. Main Street, El Centro, CA 92243
Phone: (760) 355.0288

www.zglobal.biz

May 4th, 2015

Table of Contents

West of Devers Upgrades—an Independent Review

By

ZGlobal Power Engineering and Energy Solutions

ASPEN Environmental Group (ASPEN) engaged ZGlobal Engineering and Energy Solutions (ZGlobal) to perform an independent review of Southern California Edison's (SCE) West of Devers (WOD) upgrade project (Project) which is currently going through a CEQA process (Application A.13-10-020) by the CPUC. The ZGlobal's key assignment was to conduct the following:

a. Review the project application, PEA, official data requests and subsequent responses, and conduct an independent evaluation of the project needs and objectives
b. Identify potential alternatives
c. Conduct a power flow analysis to assess the feasibility of potential alternatives

Project Definition

Briefly, the proposed Project[1] is to upgrade (remove and/or rebuild) the existing four (4) 230 kV[2] circuits west of Devers, identified as:

1) Devers – El Casco
2) El Casco - San Bernardino
3) Devers – San Bernardino
4) Devers – Vista #1 and #2
5) Etiwanda – San Bernardino
6) San Bernardino – Vista

The proposed project includes required upgrades to affected substation, HV towers/structures, and some existing 66 kV and 12 kV distribution circuits and associated communications.

The Project proposes to replace the existing circuit conductors (1033 kcm ACSR) with larger, 2 conductor per phase or bundled 1590 kcm ACSR conductors to significantly enhance the West of Devers (WOD) corridor power carrying capacity (MW). One of the Devers – San Bernardino circuit is looped in and out of the new El Casco substation and one of the Devers – Vista circuits is proposed to be looped in and out of the planned generation project TOT185HS substation. This configures these four circuits into six segments of the transmission corridor. The Project as

[1] Project Description - http://www.cpuc.ca.gov/environment/info/aspen/westofdevers/pea/3.0_project_description_part1.pdf

[2] Southern California Edison (SCE) utilizes a 220 kV voltage reference in lieu of the normal 230 kV classification. The 230 kV reference is used as this the general ISO reference for these high voltage circuits within the CAISO Controlled Grid.

proposed requires a complete dismantling of the existing towers and the installation of new taller stronger towers to support the higher capacity conductors.

Alternative Definition

In consultation with ASPEN and the CPUC, it was determined that there was only one practical alternative that will maximize the use of existing towers and minimize tower replacement and thus minimize the environmental impact. This alternative, referred to as the "Phased Build" alternative, incorporates current technology and the use of low weight, high temperature, high capacity Aluminum Conductor Composite Reinforced (ACCR) conductors. Specifically, the alternate conductor size, 795 Drake, with approximately 2000 ampere rating was selected to support the chosen alternative for test; the modeled alternate conductor rating was 1902 / 2037 amperes (normal / emergency). This alternative conductor essentially doubles the existing corridor's MW capacity. All other sizes and/or materials considered to more closely match the proposed Project's objectives would essentially require tear down and replacement of nearly all of the existing high voltage towers.

The rational for selecting this particular alternative to the proposed Project, aside from the reduced environmental impacts as determined by others, is based on what is believed to be a more viable and realistic level of new generating facility development in the east Riverside County region. The premise for this position or opinion is based on the following key findings:

1. The original WOD upgrade project was triggered by the generation level studied in the CAISO's Generation Interconnection Transition Cluster (TC) completed in July 2010 (*nearly five (5) years ago*). The project was identified as a Delivery Network upgrade to support 2199.5 MW of new generation in SCE's Eastern Bulk System seeking Full Capacity or "Deliverability" status. Refer to Table 2.1 from the TC Phase II study below.

Table 2.1: SCE Transition Cluster Projects (Eastern Bulk System)

CAISO Queue	Point of Interconnection	Full Capacity Energy Only	Fuel	Max MW	Proposed On-Line Date (as requested by IC)
193	Colorado River 220 kV	FC	Solar	500	07/01/2013
421	Blythe-Eagle Mountain 161 kV Line	FC	Solar	49.5	02/01/2012
294	Colorado River 220 kV	FC	Solar	1,000	07/01/2013
365	Red Bluff 220 kV	FC	Solar	500	07/01/2013
431	Colorado River 220 kV	FC	Solar	150	07/01/2014
Total Phase II Transition Cluster Generation				**2,199.5**	

The original 2199.5 MW has been reduced due to either project withdrawal (Q431) or project size reduction (Q294 reduced from 1000 MW to 485 MW). The revised MW for the identified TC projects is 1534.5 MW, a reduction of 665 MW.

2. Presently, through Queue Cluster #7, the same region as reported by the CAISO Generation Interconnection Queue contains 2460 MW (10 projects) of Full Capacity projects (Q798 is an Energy Only project). Note that five (5) years after the TC study, there is an increase of only 260 MW beyond the level of generation that triggered the project originally (2200 MW). Refer to the excerpt from the CAISO's Generation Interconnection Queue below.

Queue Position	Study Process	Type-1	Fuel-1	MW Total	Full Capacity, Partial or Energy Only (FC/P/EO)	County	State	Utility	Station or Transmission Line	Current On-line Date	Interconnection Agreement Status
193	TC	ST	S	500	FC	RIVERSIDE	CA	SCE	Colorado River Substation 500kV	4/1/2014	Executed
294	TC	PV	S	485	FC	RIVERSIDE	CA	SCE	Colorado River Substation 500kV	7/1/2017	Executed
365	TC	ST	S	500	FC	RIVERSIDE	CA	SCE	Red Bluff Substation 230kV	6/1/2019	Executed
421	TC	ST	S	49.5	FC	RIVERSIDE	CA	SCE	Blythe-Eagle Mountain 161 kV line	2/1/2012	In Progress
576	C2	PV	S	224	FC	RIVERSIDE	CA	SCE	Colorado River Sub 230kV Bus	10/1/2016	In Progress
588	C2	PV	S	1	FC	RIVERSIDE	CA	SCE	Red Bluff Substation 230kV	11/1/2017	In Progress
643AE	C3	PV	S	150	FC	RIVERSIDE	CA	SCE	Red Bluff Sub 230kV Bus	9/1/2019	Executed
798	C4	PV	S	221	EO	RIVERSIDE	CA	SCE	Colorado River Substation 230kV	5/31/2017	In Progress
970	C6	PV	S	150	FC	RIVERSIDE	CA	SCE	Colorado River Substation 230kV bus	12/31/2016	
1070	C7	PV	S	250	FC	RIVERSIDE	CA	SCE	Red Bluff Substation 230 kV	12/1/2018	
1071	C7	PV	S	150	FC	RIVERSIDE	CA	SCE	Colorado River Substation 230 kV	5/1/2019	

3. Higher queued projects (Serial processed interconnections prior to the Transition Cluster) totaled 3037 MW (refer to Table 4.3.2 from the TC Phase II study report).

Table 4.3.2
Eastern Bulk Serial Interconnection Requests

CAISO Queue Position	Type	Project Size (MW)
1	Wind	16.5
3	N-Gas	850
17	N-Gas	520
49	Wind	100.5
72	Hydro	500
136	N-Gas	300
138	Wind	150
146	Solar	150
147	Solar	400
219	N-Gas	50
	Total	**3,037**

This has been reduced to 2737 MW due to withdrawal of Q136 (300 MW). From the higher queued serial projects, three have come on-line to date totaling 1400 MW (Q3, Q146, Q147). From the original higher queued project volume (3037 MW) only 1337 MW remain to come on-line (including Q72, which is closer to the San Diego and LA Basin load pocket (a potential Alberhill connection). Assuming Q72 does not progress leaves 837 MW of pre-cluster process (serial) generation projects remaining to interconnect (MW already deemed to be deliverable without the WOD upgrades).

4. The CAISO's 2024 Reliability base case, from the CAISO's 2013/2014 transmission planning process (one of the base cases used in the alternative analysis) represents the view from the CAISO's and SCE's perspective (a collaborative effort) of the level of

generation deemed viable (based on a number of criteria) and to be in place and operational in 2024. The generation level within the Eastern Bulk system for the region under analysis (refer to Table A4 in Appendix A) is:

- Total Generation On-line: 3754 MW
- Total Generation Capacity: 6901 MW

This indicates that the level of available capacity, as viewed in 2024 by the CAISO, is ~ 3147 MW. The proposed WOD Project is modeled in the 2024 reliability base case.

5. In the CAISO's response to the first set of data requests to the CAISO from the CPUC (December 30, 2014, letter to Billie Blanchard), the CAISO identified all the projects active in the generation interconnection queues of both the CAISO and SCE (SCE maintains a Wholesale Distribution Access Tariff or WDAT interconnection queue). In the CAISO's response letter, Table 1: Projects Requiring WOD Upgrades the CAISO identifies a total from both interconnection queues of 2206.78 MW. This is only 6.78 MW greater than the TC Study generation level of 2200 MW - 4.5 years later. We also note that Q798 (221 MW) is an Energy Only project and not eligible or included in deliverability or full capacity assessments; and Q1072 (100 MW) has withdrawn from the queue. This leaves approximately 1881 MW requiring the WOD upgrades – a greater than 300 MW decrease from the original TC Study requirement of 2200 MW

6. And finally, a review of the CAISO's Generation Interconnection Queue[3] provides an indication of the potential level of generation that may actually come on-line at some point in the future. Many generators enter the interconnection queue; however, most do not carry their project to completion or commercial operation. Costs for utility interconnection and network upgrades, financial security commitments, permitting issues, lack of acquiring a Power Purchase Agreement (PPA) and other issues drive a majority of projects to withdraw. The CAISO queue overall, through Cluster #7, had approximately 1179 projects submitted. The number of projects withdrawn is 892. That represents a nearly 76% drop out rate. Of the 1179 projects submitted for study by the CAISO, 97 have gone commercial, or ~ 8%.

The purpose of providing the above key findings is to set a context that underscores the basis for selecting the ***Phased Build*** alternative as a viable option. As the TC Phase 2 study indicated a need to provide deliverability for ~ 2200 MW of new queued generation projects; and whereas the CAISO response to the first set of Data Requests indicates a level of 1881 MW (nearly five years later); and whereas the PEA for the proposed Project is designed to provide deliverability for up to 4800 MW (an increase of 3200 MW); reasonable consideration should be given to a project alternative that can provide the required capacity increase including some level of

[3] http://www.caiso.com/planning/Pages/GeneratorInterconnection/Default.aspx

growth, minimizes or reduces the environmental impact, and reduces the overall cost of the upgrades.

Power Flow Analysis Approach

After reviewing the application material posted on the CPUC website, various CPUC data requests and responses provided by SCE, and results of various California Independent System Operator's (CAISO) studies posted on the ISO website, ZGlobal sought concurrence from ASPEN and the CPUC regarding the Power Flow study base cases and contingency files to be used consistently for the Project alternative evaluation. It was decided by CPUC, ASPEN and ZGlobal that the following base cases and associated data files would be used for this study:

1. CAISO's 2024 Summer Peak Reliability base case (Reliability base case) and contingency files
2. ISO's Generation Cluster 7 Phase I - 2019 base case (Cluster 7 base case) and contingency files

The Reliability base case was the latest or most up-to-date base case available on the ISO's secure website. It was the most authentic and related base case created by the ISO in cooperation with the three PTOs (PG&E, SCE and SDG&E), and with input from ISO Stakeholders as well. The ISO used the case as a foundation to prepare its 2014-2015 Transmission Plan. The future generation modeled in this base case represents the level of generation deemed viable and presumed on-line by the ISO and IOUs in 2024. It is established utilizing a set of weighed criteria such as power purchase agreements (PPAs), permitting status, executed interconnection agreements, construction status, etc. to screen out speculative generation.

The Generator Cluster 7 Phase 1 base case was also created by the ISO but with a focus on the reliability and deliverability of all generation projects that had applied under Cluster 7 as well as higher queued generation still active in the ISO's interconnection queue. Whether these generators will actually be built was not a concern at this first stage of analysis. The purpose of using this base case for study was to test the system under a more extreme generation resource level case scenario. The level of generation injected in the east Riverside County CREZ region (Colorado River Switching Station, Red Bluff Switching Station, and Devers substation) is a key variable affecting the need determination for the WOD upgrade. Refer to the key observations listed in section **Alternative Definition**.

Power Flow Sensitivities or Scenarios

A number of sensitivities were conducted within the scope of this analysis. The purpose was to establish a set of boundaries or "book ends" to directly compare the proposed Project with the alternative ***Phased Build*** project with regards to power flow capability and limits. As the study progressed, another important sensitivity analysis was added to the scope of work. This sensitivity was to increase Imperial Irrigation District (IID) exports to ISO from about 700 MW as modeled in the base cases to about 1400 MW as expected after completion of all the Path 42 upgrades (summer 2015). Summer off-peak season was also included for one additional scenario of this scope of work to determine system performance under a greater spectrum of loading conditions.

The matrix below summarizes various base cases and sensitivities evaluated:

Case or Scenario No.	Power flow case	Brief description
1	ISO 2024 Summer Peak Reliability	Latest posted ISO Reliability base case jointly developed by ISO and PTOs for Reliability analysis of ISO system
2	**Case 1** + IID export to ISO of 1400 MW	Sensitivity case to determine the thermal and voltage impact on WOD circuits of increasing IID-ISO exports to 1400 MW
3	**Case 2** + Replace project conductor with 795 Drake ACCR	Same as Case 2 above except WOD 230 kV conductors replaced with 795 Drake ACCR
4	ISO Cluster 7 Phase I (2019)	ISO posted base case to determine the flow impact on WOD circuits from the active queued generation through the Cluster 7
5	**Case 4** + IID export to ISO of 1400 MW	Sensitivity case to determine the thermal and voltage impact on WOD circuits of increasing IID-ISO exports to 1400 MW
6	**Case 5** + Replace Project conductor with 795 Drake ACCR	Same as Case 4 above except WOD 230 kV conductors replaced with 795 Drake ACCR
7	ISO Summer off-peak Cluster 7 Phase I (2019)	Cluster 7 Summer off-peak case with load level less than 50% of Summer Peak and minimum imports.

Summary of Analyses

The entire analyses are summarized in a tabular format shown in Appendix A. Tables A1 through A4 represent results for the 2024 Reliability scenarios and sensitivities. Tables B1 through B8 represent results for Cluster 7 scenarios and sensitivities. The Summer Off-Peak results are also listed (Table B8). Following a number of the tables in Appendix A are "Power Flow" plots or system diagrams to assist the reader in getting a better picture of how various substations are interconnected through transmission lines and the amount of power flowing on these transmission circuits. Refer to Appendix C for a complete listing of applicable Power Flow plots.

Case #1—ISO 2024 Summer Peak Reliability

The results of normal operating conditions (Category A), single contingency conditions (Category B) and double contingency conditions including N-1-1 (Category C) are shown in Table A1 (see Appendix A). The focus in this analysis is on the four (4) 230 kV West of Devers (WOD) circuits (six segments). This case contains WOD 230 kV circuits modeled with the proposed Project conductor size (2B-1590 kcmil ACSR). The Project conductor is rated for 3230 / 4360 amperes (normal / emergency) which are equivalent to 1287 / 1737 MVA (normal / emergency). For the common reader or non-engineer, MVA (mega volt-amps) may be assumed as approximately equal to MW (megawatts).

The left 8 columns of Table A1 describe the facility connections, voltages and acceptable current or amp rating. The right 6 columns describe the outage or contingency (base = no outage), the facility loading under that outage and the description of the worst case outage that causes the highest loading on that facility. About 70 single contingencies and 2300 double contingencies were tested using the CAISO posted contingency files.

The results show that the highest loading occurs on Devers – Vista lines and it is about 31% and 39% of the line rating under single (Alberhill-Valley 500 kV) and double (Devers-Valley 500 kV #1 and #2) contingencies respectively. This would indicate there is a significant capacity margin available on these lines.

The voltage analysis indicated that all voltages around Devers, Red Bluff and Colorado River areas are within their applicable and acceptable ratings.

Conclusion for Case #1: The proposed Project satisfies this case (*i.e.* the operational and reliability objectives are met).

Case #2—ISO 2024 Summer Peak Reliability + IID to CAISO exports of 1400 MW

IID (Imperial Irrigation District) – CAISO exports of 1400 MW is an important sensitivity as IID is delivering most of its power at the Mirage substation which is directly connected to the Devers 230 kV substation as can be seen in the power flow plot (diagram). Hence, any increase in IID delivery to Mirage would increase delivery at Devers which will increase loading on the WOD circuits. It is necessary to be sure there are no adverse thermal or voltage impacts due to this increased MW transfers from IID.

Table A2 summarizes the normal, single contingency and double contingency results. The description on how to read the table is in the preceding paragraphs. The highest loading is on Devers–Vista lines and is 36% and 46% of the line rating under single and double contingencies respectively. It is an increase of approximately 7% as compared to Case #1; however, the line loadings are still well below the line capacity. Note that we are still using the Project conductor (2B-1590 kcmil ACSR) in this case.

The voltage analysis indicated that all voltages around Devers, Red Bluff and Colorado River areas are within their applicable ratings.

Conclusion for Case #2: The proposed Project satisfies this case (*i.e.* the operational and reliability objectives are met).

Case #3 - ISO 2024 Summer Peak Reliability + IID to CAISO exports of 1400 MW + Replace Project conductor with alternate conductor (795 Drake ACCR).

This is the first test case to see if the alternate conductor can serve the same load without overloading or without causing any voltage violations.

The same 70 and 2300 contingencies for single contingency and double contingency respectively were applied to test this scenario. The results are shown in Table A3.

Results indicate there are no overloads (>100% of capacity ratings), however, the worst loading on the Devers – Vista line went up to 67% and 84% under single and double contingencies respectively. This result was fully anticipated as the conductor size, ampacity and impedance characteristics dictate higher conductor utilization.

From a planning perspective the focus needs to be on loading under single contingency conditions, not for double contingencies as NERC, WECC and ISO criteria allow generation dropping and load dropping under double contingencies. However, if the facility has additional capacity even after double contingency occurs, this is considered a bonus. This capacity will likely increase if any generation dropping is associated with that double contingency.

If this scenario is viewed as a balanced and viable alternative from a future generation modeling perspective, then the alternate conductor provides satisfactory performance. It also provides additional capacity to accommodate a level of future growth as well.

No voltage violations were found around the Devers, Red Bluff and Colorado River areas. The analysis and contingencies picked up a significantly wide area for monitoring. If there are any violations (voltage or thermal) outside of this area, it may be considered an existing problem not caused by the alternate conductor.

Conclusion for Case #3: The ***Phased Build*** alternate conductor satisfies this case (*i.e.* the operational and reliability objectives are met).

Case #4— CAISO Cluster 7 Phase I (2019)

This case is developed by the CAISO according to its Deliverability rules or guidelines, wherein all queued generators desiring full capacity deliverability status (FCDS) are modeled at full output level (renewables – *wind & solar* - are dispatched per CAISO guidelines[4]) and their

[4] http://www.caiso.com/Documents/TechnicalPaper-GeneratorInterconnection-DeliverabilityStudyMethodology.pdf

combined impact on the system is determined. Consequently, the future generation modeled in this case is about 2000 MW more than what is modeled in the Reliability case. Tables A4 (Reliability case generation level) and B7 (QC7-Ph1 case generation level) in Appendix A show the total generation modeled in the two cases.

The purpose of evaluating this case and associated sensitivities was to establish and determine an upper end of the loading spectrum. If the proposed 795 Drake ACCR conductors can withstand the extra loading imposed by the higher penetration of generation modeled in this base case, then the other less stressed scenarios will pass the test.

The results of this scenario are shown in Table B1 of Appendix A. The explanation of the various columns in this table is provided under Case #1. The results indicate no overloading of facilities and the worst loading is on the Devers–Vista circuit at 56% and 68% under single and double contingencies respectively. Again, the larger size proposed Project conductor (2B-1590 kcmil ACSR) is modeled in this case. The contingency files posted by the CAISO for this case contained approximately 200 single contingencies and approximately 3000 double contingencies which were all evaluated.

No voltage violations were identified under this scenario.

Conclusion for Case #4: The proposed Project satisfies this case.

Case #5— CAISO Cluster 7 Phase I (2019) + IID export to ISO of 1400 MW

The results for this scenario are shown in Table B2 and Table B4. Table B2 shows the thermal impacts and Table B4 shows the voltage impacts. This scenario still uses the larger size proposed Project conductor (2B-1590 kcmil ACSR). Notice the highlighted red (Overload) under normal operating conditions. This overloading means the system cannot support excessive generation arriving at Devers substation. Overloading of the Alberhill–Valley 500 kV line under normal operating conditions is a Reliability Criteria violation and must be mitigated. One solution is to curtail generation arriving at Devers until the overload goes away.

Assuming the IID export of 1400 MW to CAISO is real, the generation modeled in the Cluster 7 Phase 1 case is excessive and would need to be decreased.

Table B4 shows voltage criteria violations under single contingency conditions. Voltage deviation should not exceed 5% from the pre-contingency level. This violation is an indication of excessive reactive power loss which may be mitigated by installing shunt capacitors at the affected substations.

Conclusion for Case #5: The proposed Project conductor results in overloading the Alberhill–Valley 500 kV line under normal operating conditions.

Case #6— CAISO Cluster 7 Phase I (2019) + IID export to ISO of 1400 MW + Replace project conductor with 795 Drake ACCR

This is considered **the worst case** scenario. The results are shown in Tables B3, B5 and B6 in Appendix A. Table B3 shows that in addition to normal overloads, there are overloaded circuits under single and double contingencies. Double contingencies are not as big of a concern because generation and / or load dropping can mitigate those overloads. Overloading under a single contingency is a significant concern as the system must be designed to withstand any single contingency without mitigation. Although generation dropping is allowed, it is not a preferred mitigation under single contingencies.

A deeper look into the analysis indicated that the most severe contingency "Alberhill–Valley 500 kV" outage did not converge and the power flow failed to solve. In order to solve that contingency, about 600 MVARs of capacitors or reactive support was needed to compensate for excessive reactive power losses. The solved case indicated that the overloading under that most severe contingency would have been about 6% higher than what is shown in Table B3. [The contingency shown in Table B3 is essentially the second worst].

Thus, this case with excessive generation and a sensitivity of 1400 MW IID – CAISO export is unstable and creates thermal and voltage problems.

Tables B5 and B6 show violation of both types of voltage criteria. Table B5 shows the "voltage deviation" criteria violation. Voltage should not deviate more than 5% from the pre-contingency level for a single contingency. Table B6 shows "voltage" violation. Voltage should not dip below 90% under single or double contingencies.

Both of these violations confirm that there is a significant deficiency of reactive power (VARs) which may be compensated by installing shunt capacitors at appropriate locations.

Regarding the overloading under single contingencies, a normal method is to insert a properly designed "series reactor" in the overloaded line to reduce flow to an acceptable level.

That method was tried in this scenario but it caused more voltage violations and still did not reduce loading to an acceptable level.

Conclusion for Case #6: The ***Phased Build*** alternate conductor is not technically feasible under this scenario.

Case #7-- CAISO Summer Off-Peak Cluster 7 Phase I (2019)

This scenario was evaluated to determine the impact of a high level of solar and wind generation while the load level is less than 50% of the summer peak. Typically, a Saturday morning load level is assumed. In this Case, SCE is essentially generating as much as its load and importing only about 6% from neighboring areas. The results are summarized in Table B8.

The results indicate unacceptable system performance due to overloading of facilities under normal operating conditions. Transmission lines and transformers highlighted in red are overloaded. The overload level can be seen under the “%” column. This case has the proposed Project conductor size (2B-1590 kcmil ACSR) modeled and yet there are overloaded facilities. The same Alberhill–Valley 500 kV line which was overloaded in the summer peak case (Case #5) is also overloaded in this case. In addition, all three Devers transformers are overloaded. Since the system cannot be allowed to operate with facilities overloaded, some generation must be curtailed.

The Summer Peak case evaluated under Case #5 and this Summer Off-Peak case developed for Cluster 7 Phase I study clearly indicate excessive generation arriving at Devers substation which ultimately causes some facilities to become overloaded.

Clearly, the proposed alternate conductor which has about half the capacity of the project conductor cannot deliver all this generation arriving at Devers substation which is not handled even by the larger proposed Project conductor.

Conclusion for Case #7: The proposed Project conductor results in overloaded facilities, including the Alberhill–Valley 500 kV line and all three Devers transformers, under normal operating conditions.

APPENDIX A

Analysis Results

Tables & Power Flow Plots

TABLE A1

Preliminary analysis of WOD 230 KV circuits - CAISO 2024 Summer Peak case - Normal operating conditions - No outage (Category A)

See Case #1 Power Flow Plot

Facility							Rated Amps	Outage	Loading				Outage description
From	Name	kV	To	Name	kV	ck			%	MW	MVAR	AMPS	
24804	DEVERS	230	25666	EL CASCO	230	1	3230	base	25.8%	327	52	829	Base system (n-0)
24804	DEVERS	230	24901	VSTA	230	2	3230	base	27.8%	351	63	893	Base system (n-0)
25666	EL CASCO	230	24132	SANBRDNO	230	1	3230	base	14.2%	177	27	457	Base system (n-0)
24132	SANBRDNO	230	24804	DEVERS	230	1	3230	base	22.2%	-277	-33	719	Base system (n-0)
28311	TOT185HS	230	24804	DEVERS	230	1	3230	base	27.7%	-351	-56	895	Base system (n-0)
28311	TOT185HS	230	24901	VSTA	230	1	3230	base	27.8%	351	56	895	Base system (n-0)

Preliminary analysis of WOD 230 KV circuits - CAISO 2024 Summer Peak case - Single Contingency analysis (Category B)

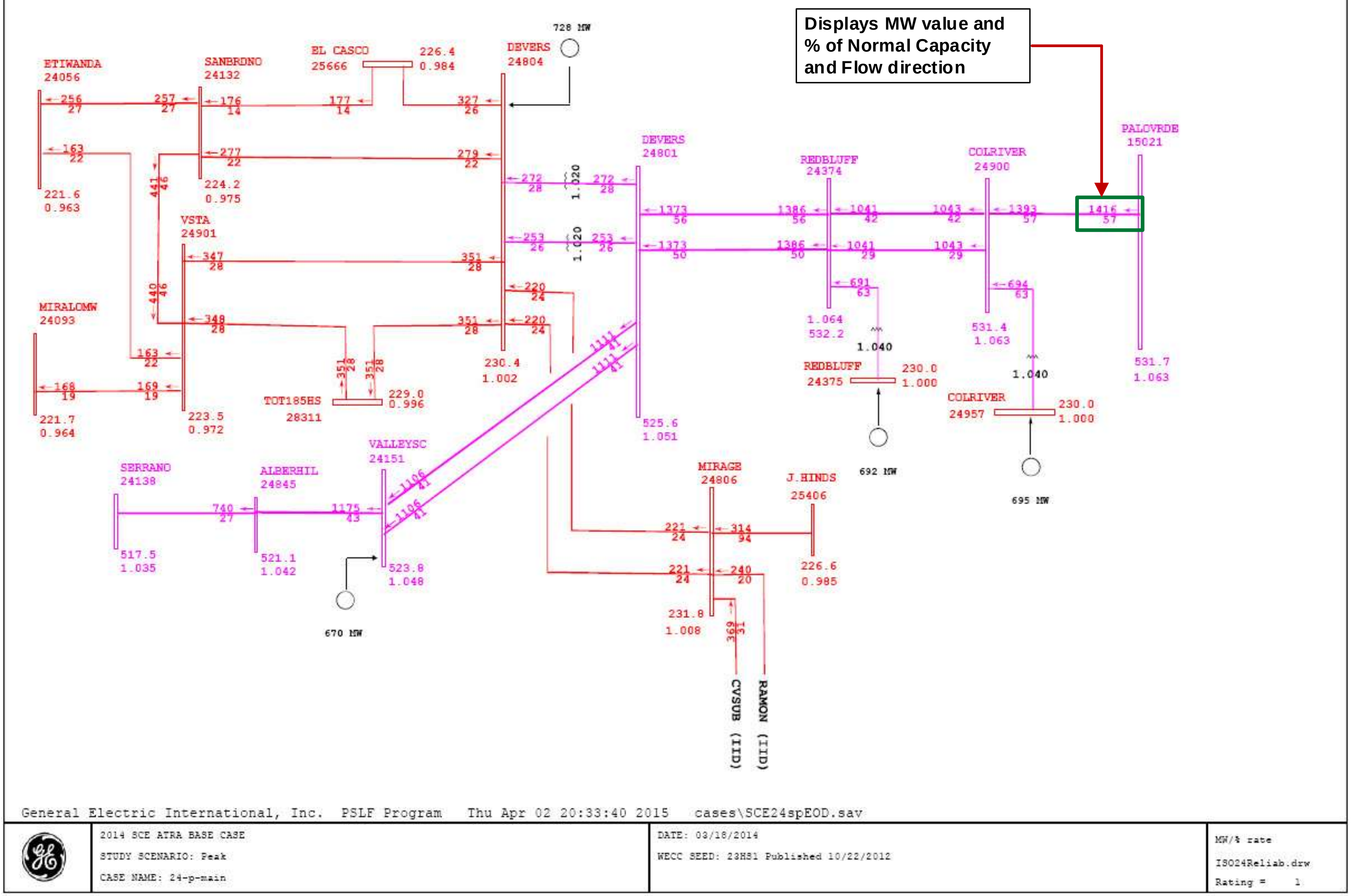
Facility							Rated Amps	Worst Outage	Loading				Worst Outage description
From	Name	kV	To	Name	kV	ck			%	MW	MVAR	AMPS	
24804	DEVERS	230	25666	EL CASCO	230	1	4360	line_36	27.5%	469	93	1196	Line ALBERHIL - VALLEYSC 500 kV Ckt 1
24804	DEVERS	230	24901	VSTA	230	2	4360	line_36	30.7%	520	117	1333	Line ALBERHIL - VALLEYSC 500 kV Ckt 1
25666	EL CASCO	230	24132	SANBRDNO	230	1	4360	line_36	18.9%	318	35	821	Line ALBERHIL - VALLEYSC 500 kV Ckt 1
24132	SANBRDNO	230	24804	DEVERS	230	1	4360	line_36	25.4%	-425	-26	1109	Line ALBERHIL - VALLEYSC 500 kV Ckt 1
28311	TOT185HS	230	24804	DEVERS	230	1	4360	line_36	30.6%	-519	-100	1335	Line ALBERHIL - VALLEYSC 500 kV Ckt 1
28311	TOT185HS	230	24901	VSTA	230	1	4360	line_36	30.7%	519	100	1335	Line ALBERHIL - VALLEYSC 500 kV Ckt 1

Preliminary analysis of WOD 230 kV circuits - CAISO 2024 Summer Peak case - N-2 and N-1-1 contingencies analysis (Category C)

Facility							Rated Amps	Worst Outage	Loading				Worst Outage description
From	Name	kV	To	Name	kV	ck			%	MW	MVAR	AMPS	
24804	DEVERS	230	25666	EL CASCO	230	1	4360	line_201251	35.3%	601	133	1535	Line DEVERS - SANBRDNO 230 kV ckt 1,Line ALBERHIL - VALLEYSC 500 kV Ckt 1
24804	DEVERS	230	24901	VSTA	230	2	4360	line_201751	39.4%	654	154	1714	Line DEVERS - VALLEYSC 500 kV Ckt 1,Line DEVERS - VALLEYSC 500 kV Ckt 2
25666	EL CASCO	230	24132	SANBRDNO	230	1	4360	line_201251	26.5%	447	35	1157	Line DEVERS - SANBRDNO 230 kV ckt 1,Line ALBERHIL - VALLEYSC 500 kV Ckt 1
24132	SANBRDNO	230	24804	DEVERS	230	1	4360	line_201113	34.2%	-569	-1	1492	Line DEVERS - EL CASCO 230 kV,Line ALBERHIL - VALLEYSC 500 kV Ckt 1
28311	TOT185HS	230	24804	DEVERS	230	1	4360	line_201751	39.4%	-653	-123	1716	Line DEVERS - VALLEYSC 500 kV Ckt 1,Line DEVERS - VALLEYSC 500 kV Ckt 2
28311	TOT185HS	230	24901	VSTA	230	1	4360	line_201751	39.4%	653	123	1716	Line DEVERS - VALLEYSC 500 kV Ckt 1,Line DEVERS - VALLEYSC 500 kV Ckt 2

CASE #1--ISO 2024 Summer Peak Reliability Base Case

Normal Conditions



ZGLOBAL Power Engineering & Energy Solutions

TABLE A2

Sensitivity case #1 - IID-CAISO exports of 1400 MW

Preliminary analysis of WOD 230 KV circuits - CAISO 2024 Summer Peak case - Normal Operating conditions - No outage (Category A)

See Case #2 Power Flow Plot

Facility							Rated Amps	Outage	Loading				Outage description
From	Name	kV	To	Name	kV	ck			%	MW	MVAR	AMPS	
24804	DEVERS	230	25666	EL CASCO	230	1	3230	base	29.8%	375	50	961	Base system (n-0)
24804	DEVERS	230	24901	VSTA	230	2	3230	base	32.6%	409	64	1050	Base system (n-0)
25666	EL CASCO	230	24132	SANBRDNO	230	1	3230	base	18.0%	225	15	582	Base system (n-0)
24132	SANBRDNO	230	24804	DEVERS	230	1	3230	base	26.5%	-328	-15	855	Base system (n-0)
28311	TOT185HS	230	24804	DEVERS	230	1	3230	base	32.6%	-409	-54	1052	Base system (n-0)
28311	TOT185HS	230	24901	VSTA	230	1	3230	base	32.6%	409	54	1052	Base system (n-0)

Sensitivity case #1 - IID-CAISO exports of 1400 MW

Preliminary analysis of WOD 230 KV circuits - CAISO 2024 Summer Peak case - Single Contingency analysis (Category B)

Facility							Rated Amps	Worst Outage	Loading				Worst Outage description
From	Name	kV	To	Name	kV	ck			%	MW	MVAR	AMPS	
24804	DEVERS	230	25666	EL CASCO	230	1	4360	line_36	32.0%	538	105	1392	Line ALBERHIL - VALLEYSC 500 kV Ckt 1
24804	DEVERS	230	24901	VSTA	230	2	4360	line_36	36.0%	602	137	1565	Line ALBERHIL - VALLEYSC 500 kV Ckt 1
25666	EL CASCO	230	24132	SANBRDNO	230	1	4360	line_36	23.2%	386	25	1009	Line ALBERHIL - VALLEYSC 500 kV Ckt 1
24132	SANBRDNO	230	24804	DEVERS	230	1	4360	line_36	30.1%	-496	-4	1313	Line ALBERHIL - VALLEYSC 500 kV Ckt 1
28311	TOT185HS	230	24804	DEVERS	230	1	4360	line_36	36.0%	-600	-112	1568	Line ALBERHIL - VALLEYSC 500 kV Ckt 1
28311	TOT185HS	230	24901	VSTA	230	1	4360	line_36	36.0%	600	112	1568	Line ALBERHIL - VALLEYSC 500 kV Ckt 1

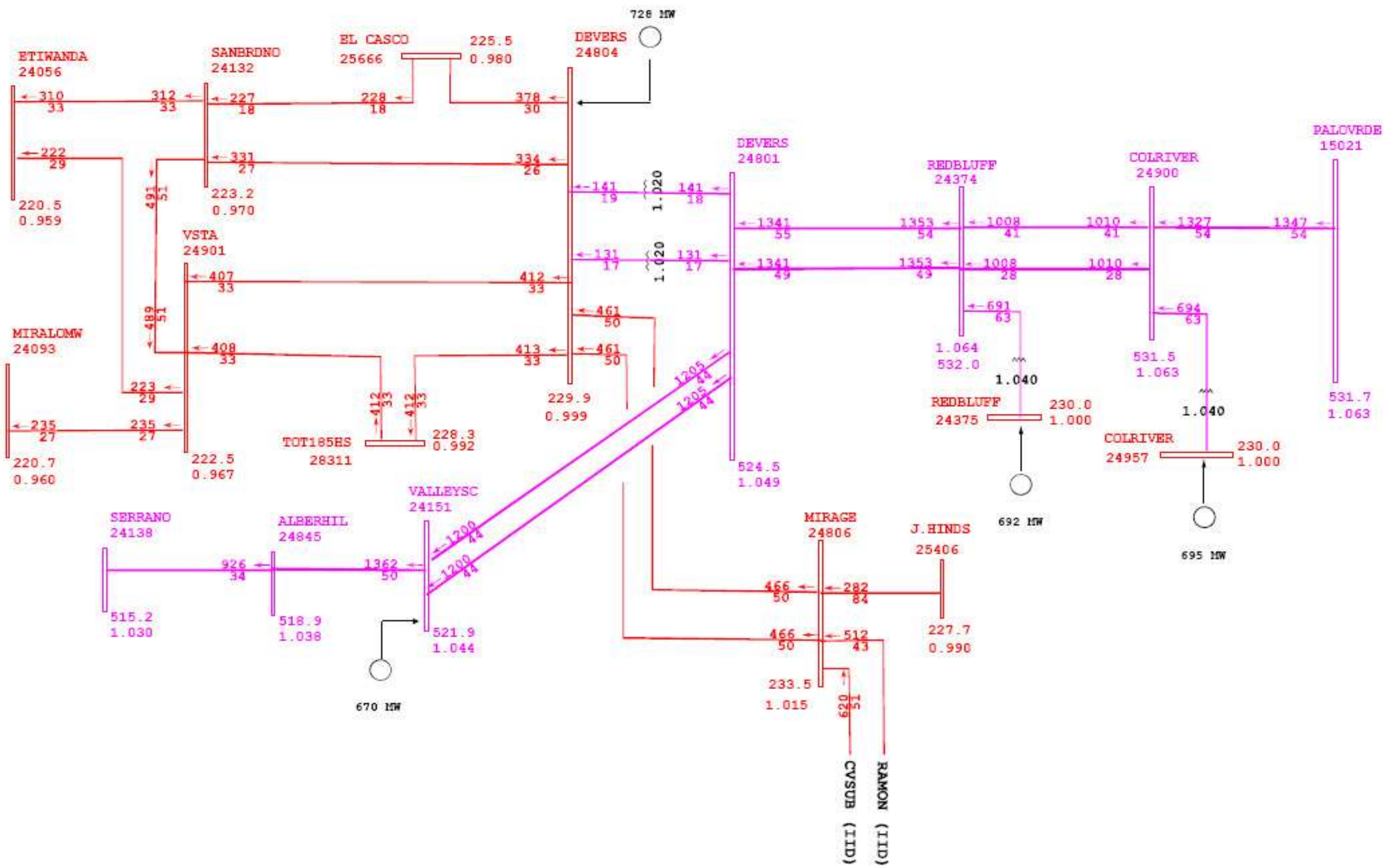
Sensitivity case #1 - IID-CAISO exports of 1400 MW

Preliminary analysis of WOD 230 KV circuits - CAISO 2024 Summer Peak case - N-2 and N-1-1 Contingency analysis (Category C)

Facility							Rated Amps	Worst Outage	Loading				Worst Outage description
From	Name	kV	To	Name	kV	ck			%	MW	MVAR	AMPS	
24804	DEVERS	230	25666	EL CASCO	230	1	4360	line_201251	41.2%	691	155	1794	Line DEVERS - SANBRDNO 230 kV ckt 1, line ALBERHIL - VALLEYSC 500 kV Ckt 1
24804	DEVERS	230	24901	VSTA	230	2	4360	line_201751	45.0%	732	191	1961	Line DEVERS - VALLEYSC 500 kV Ckt 1, line DEVERS - VALLEYSC 500 kV Ckt 2
25666	EL CASCO	230	24132	SANBRDNO	230	1	4360	line_201251	32.3%	534	19	1408	Line DEVERS - SANBRDNO 230 kV ckt 1, line ALBERHIL - VALLEYSC 500 kV Ckt 1
24132	SANBRDNO	230	24804	DEVERS	230	1	4360	line_201113	40.4%	-659	38	1760	Line DEVERS - EL CASCO 230 kV, line ALBERHIL - VALLEYSC 500 kV Ckt 1
28311	TOT185HS	230	24804	DEVERS	230	1	4360	line_201295	45.9%	-760	-163	2003	Line DEVERS - VISTA 230 kV Ckt 2, line ALBERHIL - VALLEYSC 500 kV Ckt 1
28311	TOT185HS	230	24901	VSTA	230	1	4360	line_201295	46.0%	760	163	2003	Line DEVERS - VISTA 230 kV Ckt 2, line ALBERHIL - VALLEYSC 500 kV Ckt 1

CASE #2--ISO 2024 Reliability + IID-ISO Export of 1400 MW

Normal Conditions



General Electric International, Inc. PSLF Program Thu Apr 02 20:38:05 2015 cases\SCE24spIID1400.sav

	2014 SCE ATRA BASE CASE STUDY SCENARIO: Peak CASE NAME: 24-p-main	DATE: 03/18/2014 WECC SEED: 23HS1 Published 10/22/2012	MW/% rate ISO24Reliab+IID1400.d Rating = 1

TABLE A3

WOD upgrades with Drake 795 ACCR conductor--CAISO 2024 Reliability case, 1400 MW IID-ISO export

Normal Operating conditions (Category A)

See Case #3 Power Flow Plot

Facility								Outage	Loading				Outage Description
From	Name	kV	To	Name	kV	ck	Rated Amps	Outage	%	MW	MVAR	AMPS	Outage Description
24804	DEVERS	230	25666	EL CASCO	230	1	1902	base	46.0%	347	46	873	Base system (n-0)
24804	DEVERS	230	24901	VSTA	230	2	1902	base	46.7%	354	39	889	Base system (n-0)
25666	EL CASCO	230	24132	SANBRDNO	230	1	1902	base	25.8%	188	-6	490	Base system (n-0)
24132	SANBRDNO	230	24804	DEVERS	230	1	1902	base	40.4%	-293	11	769	Base system (n-0)
28311	TOT185HS	230	24804	DEVERS	230	1	1902	base	46.8%	-352	-28	890	Base system (n-0)
28311	TOT185HS	230	24901	VSTA	230	1	1902	base	46.8%	352	28	890	Base system (n-0)

WOD upgrades with Drake 795 ACCR conductor--CAISO 2024 Reliability case, 1400 MW IID-ISO export

Single Contingency (Category B)

Facility								Worst Outage	Loading				Worst Outage Description
From	Name	kV	To	Name	kV	ck	Rated Amps	Worst Outage	%	MW	MVAR	AMPS	Worst Outage Description
24804	DEVERS	230	25666	EL CASCO	230	1	2037	line_36	64.6%	518	106	1313	Line ALBERHIL - VALLEYSC 500 kV Ckt 1
24804	DEVERS	230	24901	VSTA	230	2	2037	line_36	67.3%	542	104	1371	Line ALBERHIL - VALLEYSC 500 kV Ckt 1
25666	EL CASCO	230	24132	SANBRDNO	230	1	2037	line_36	45.3%	345	-16	922	Line ALBERHIL - VALLEYSC 500 kV Ckt 1
24132	SANBRDNO	230	24804	DEVERS	230	1	2037	line_36	59.7%	-450	46	1216	Line ALBERHIL - VALLEYSC 500 kV Ckt 1
28311	TOT185HS	230	24804	DEVERS	230	1	2037	line_36	67.4%	-536	-75	1372	Line ALBERHIL - VALLEYSC 500 kV Ckt 1
28311	TOT185HS	230	24901	VSTA	230	1	2037	line_36	67.4%	536	75	1372	Line ALBERHIL - VALLEYSC 500 kV Ckt 1

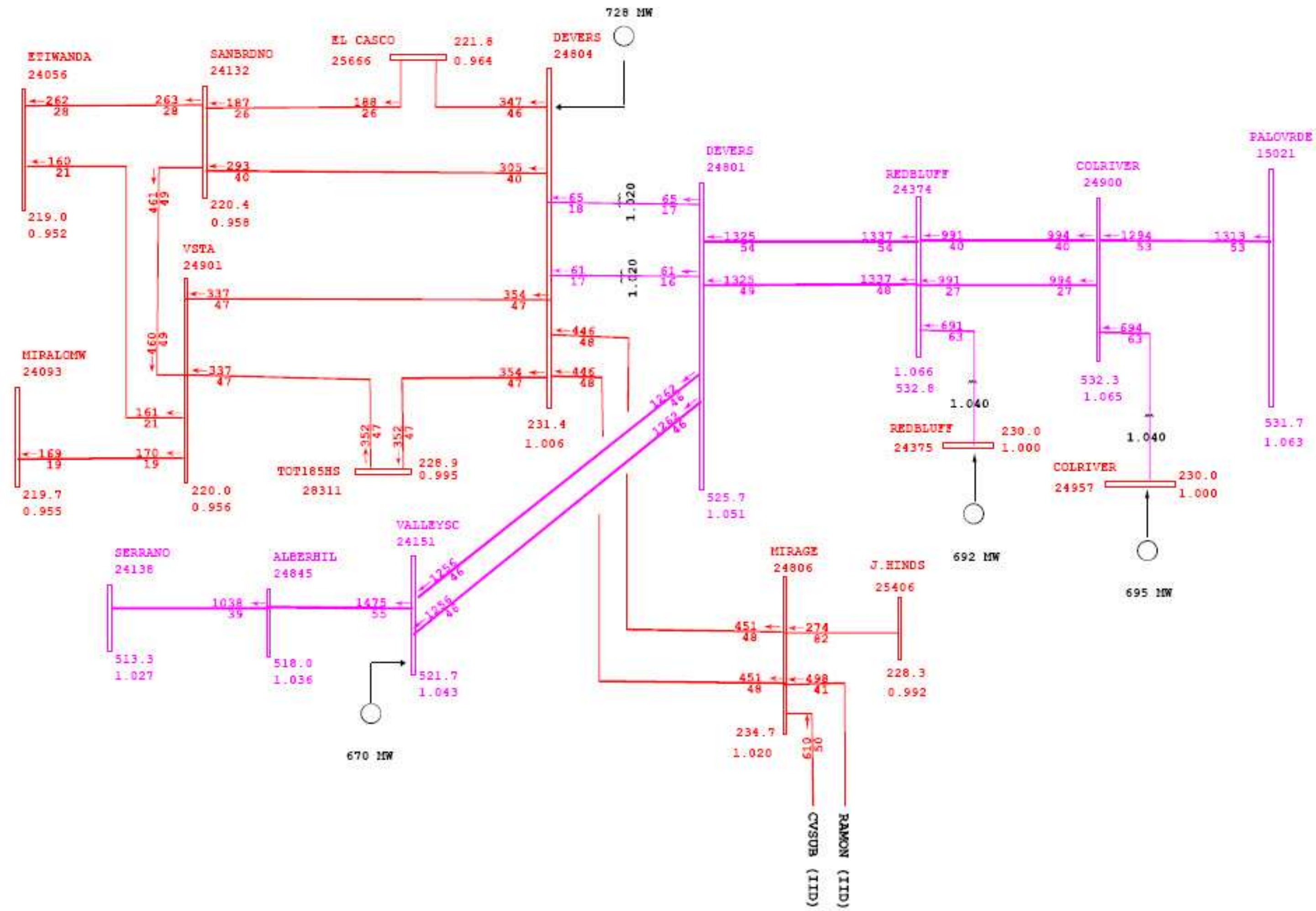
WOD upgrades with Drake 795 ACCR conductor--CAISO 2024 Reliability case, 1400 MW IID-ISO export

Double Contingency, N-2 and N-1-1 (Category C)

Facility								Worst Outage	Loading				Worst Outage Description
From	Name	kV	To	Name	kV	ck	Rated Amps	Worst Outage	%	MW	MVAR	AMPS	Worst Outage Description
24804	DEVERS	230	25666	EL CASCO	230	1	2037	line_201251	80.5%	645	143	1638	Line DEVERS - SANBRDNO 230 kV ckt 1,Line ALBERHIL - VALLEYSC 500 kV Ckt 1
24804	DEVERS	230	24901	VSTA	230	2	2037	line_201751	84.3%	659	162	1717	Line DEVERS - VALLEYSC 500 kV Ckt 1,Line DEVERS - VALLEYSC 500 kV Ckt 2
25666	EL CASCO	230	24132	SANBRDNO	230	1	2037	line_201251	61.1%	459	-47	1244	Line DEVERS - SANBRDNO 230 kV ckt 1,Line ALBERHIL - VALLEYSC 500 kV Ckt 1
24132	SANBRDNO	230	24804	DEVERS	230	1	2037	line_201113	77.2%	-569	107	1573	Line DEVERS - EL CASCO 230 kV,Line ALBERHIL - VALLEYSC 500 kV Ckt 1
28311	TOT185HS	230	24804	DEVERS	230	1	2037	line_201751	84.4%	-650	-115	1719	Line DEVERS - VALLEYSC 500 kV Ckt 1,Line DEVERS - VALLEYSC 500 kV Ckt 2
28311	TOT185HS	230	24901	VSTA	230	1	2037	line_201751	84.4%	650	115	1719	Line DEVERS - VALLEYSC 500 kV Ckt 1,Line DEVERS - VALLEYSC 500 kV Ckt 2

CASE #3--ISO 2024 Reliability + IID-ISO Export of 1400 MW + Alternate Conductor

Normal Conditions



General Electric International, Inc. PSLF Program Thu Apr 02 20:41:13 2015 cases\SCE24spUP1IID1400.sav

GE	2014 SCE ATRA BASE CASE STUDY SCENARIO: Peak CASE NAME: 24-p-main	DATE: 03/18/2014 WECC SEED: 23HS1 Published 10/22/2012	MW/% rate ISO24Reliab+IID1400+A Rating = 1

ZGLOBAL
Power Engineering & Energy Solutions

TABLE A4

CAISO 2024 Summer Peak Reliability Base case

Generation modeled in Colorado River, Red Bluff and Devers area

Total Generation On-line: 3754 MW - Total Generation Capacity: 6901 MW

BUS-NO	NAME	KV	ID	ST	PGEN	PMAX	PMIN	QGEN	QMAX	QMIN	AREA	ZONE	Major Point of Interconnection
24957	COLRIVER	230	F2	1	185.4	515	0	23.9	169.3	-169.3	24	944	Colorado River 230 kV Sub
24957	COLRIVER	230	F0	1	54	150	0	23.9	72.6	-72.6	24	944	Colorado River 230 kV Sub
24957	COLRIVER	230	F3	1	90	250	0	23.9	82.2	-82.2	24	944	Colorado River 230 kV Sub
24999	DEVRSVC1	500	1	1	0	0	0	-100	100	-100	24	940	Devers 500 kV sub
29041	IEEC-G1	19.5	1	1	335	405	203	169.4	280	-200	24	940	Valley 500 kV sub
29042	IEEC-G2	19.5	2	1	335	405	203	169.4	280	-200	24	940	Valley 500 kV sub
24921	MNTV-CT1	18	1	1	129.7	185	0	40.7	115	-61	24	940	MNTVIEW 230 kV sub
24922	MNTV-CT2	18	1	1	129.7	185	0	40.7	115	-61	24	940	MNTVIEW 230 kV sub
24924	MNTV-CT3	18	1	1	129.7	185	0	40.6	115	-61	24	940	MNTVIEW 230 kV sub
24925	MNTV-CT4	18	1	1	129.7	185	0	40.6	115	-61	24	940	MNTVIEW 230 kV sub
24923	MNTV-ST1	18	1	1	225.1	321	0	55.9	200	-100	24	940	MNTVIEW 230 kV sub
24926	MNTV-ST2	18	1	1	225.1	321	0	56.3	200	-100	24	940	MNTVIEW 230 kV sub
24375	REDBLUFF	230	F1	1	192.2	534	0	53.2	175.5	-175.5	24	943	Red Bluff 230 kV sub
24375	REDBLUFF	230	F0	1	82.4	229	0	53.2	75.3	-75.3	24	943	Red Bluff 230 kV sub
24963	RPSEOD04	0.32	1	1	46.7	129.8	0	13.4	71.8	0	24	943	Red Bluff 230 kV sub
24964	RPSEOD05	0.32	1	1	56.5	156.9	0	14.6	86.8	0	24	943	Red Bluff 230 kV sub
24965	RPSEOD06	0.32	1	1	46.7	129.8	0	13.4	71.8	0	24	943	Red Bluff 230 kV sub
24966	RPSEOD07	0.32	1	1	56.5	156.9	0	14.6	86.8	0	24	943	Red Bluff 230 kV sub
24976	RPSEOD13	0.34	1	1	90	250	0	13.2	150	0	24	944	Colorado River 230 kV Sub
24977	RPSEOD14	13.8	1	1	50.4	140	0	8.7	87.3	0	24	944	Colorado River 230 kV Sub
24978	RPSEOD15	13.8	1	1	50.4	140	0	9.1	87.3	0	24	944	Colorado River 230 kV Sub
24982	RPSEOD28	0.34	1	1	45	125	0	30	60.5	-60.5	24	944	Colorado River 230 kV Sub
24983	RPSEOD29	0.34	2	1	45	125	0	30	60.5	-60.5	24	944	Colorado River 230 kV Sub
24984	RPSEOD34	0.34	3	1	45	125	0	30.1	60.5	-60.5	24	944	Colorado River 230 kV Sub
24985	RPSEOD35	0.34	4	1	39.6	110	0	28.5	53.3	-53.3	24	944	Colorado River 230 kV Sub
94465	RPSEOD40	21	1	1	61.6	171	0	0.1	130	-43.3	24	943	Red Bluff 230 kV sub
94466	RPSEOD41	21	1	1	61.6	171	0	0.1	130	-43.3	24	943	Red Bluff 230 kV sub
95315	RPSEOD43	0.31	1	1	88.2	245	0	2.1	58.8	-100	24	943	Red Bluff 230 kV sub
29101	TOT032G1	13.8	1	1	91	107	0	28.8	56	-44	24	940	Devers 500 kV sub
29102	TOT032G2	13.8	1	1	91	107	0	28.8	56	-44	24	940	Devers 500 kV sub
29103	TOT032G3	13.8	1	1	91	107	0	28.8	56	-44	24	940	Devers 500 kV sub
29104	TOT032G4	13.8	1	1	91	107	0	28.8	56	-44	24	940	Devers 500 kV sub
29105	TOT032G5	13.8	1	1	91	107	0	28.8	56	-44	24	940	Devers 500 kV sub
29106	TOT032G6	13.8	1	1	91	107	0	28.8	56	-44	24	940	Devers 500 kV sub
29107	TOT032G7	13.8	1	1	91	107	0	28.8	56	-44	24	940	Devers 500 kV sub
29108	TOT032G8	13.8	1	1	91	107	0	28.8	56	-44	24	940	Devers 500 kV sub

ZGLOBAL

TABLE B1

Preliminary analysis of WOD 230 KV circuits - CAISO Cluster 7 Phase I, 2019 Summer Peak case - Normal operating conditions - No outage (Category A)

See Case #4 Power Flow Plot

Facility							Rated Amps	Outage	Loading				Outage description
From	Name	kV	To	Name	kV	ck			%	MW	MVAR	AMPS	
24804	DEVERS	230	25666	EL CASCO	230	1	3230	base	37.6%	475	51	1214	Base system (n-0)
24804	DEVERS	230	24901	VSTA	230	2	3230	base	44.6%	559	85	1438	Base system (n-0)
25666	EL CASCO	230	24132	SANBRDNO	230	1	3230	base	28.2%	353	-8	912	Base system (n-0)
24132	SANBRDNO	230	24804	DEVERS	230	1	3230	base	38.4%	-477	30	1242	Base system (n-0)
28311	TOT185HS	230	24804	DEVERS	230	1	3230	base	18.7%	-233	-19	605	Base system (n-0)
28311	TOT185HS	230	24901	VSTA	230	1	3230	base	30.7%	383	6	992	Base system (n-0)

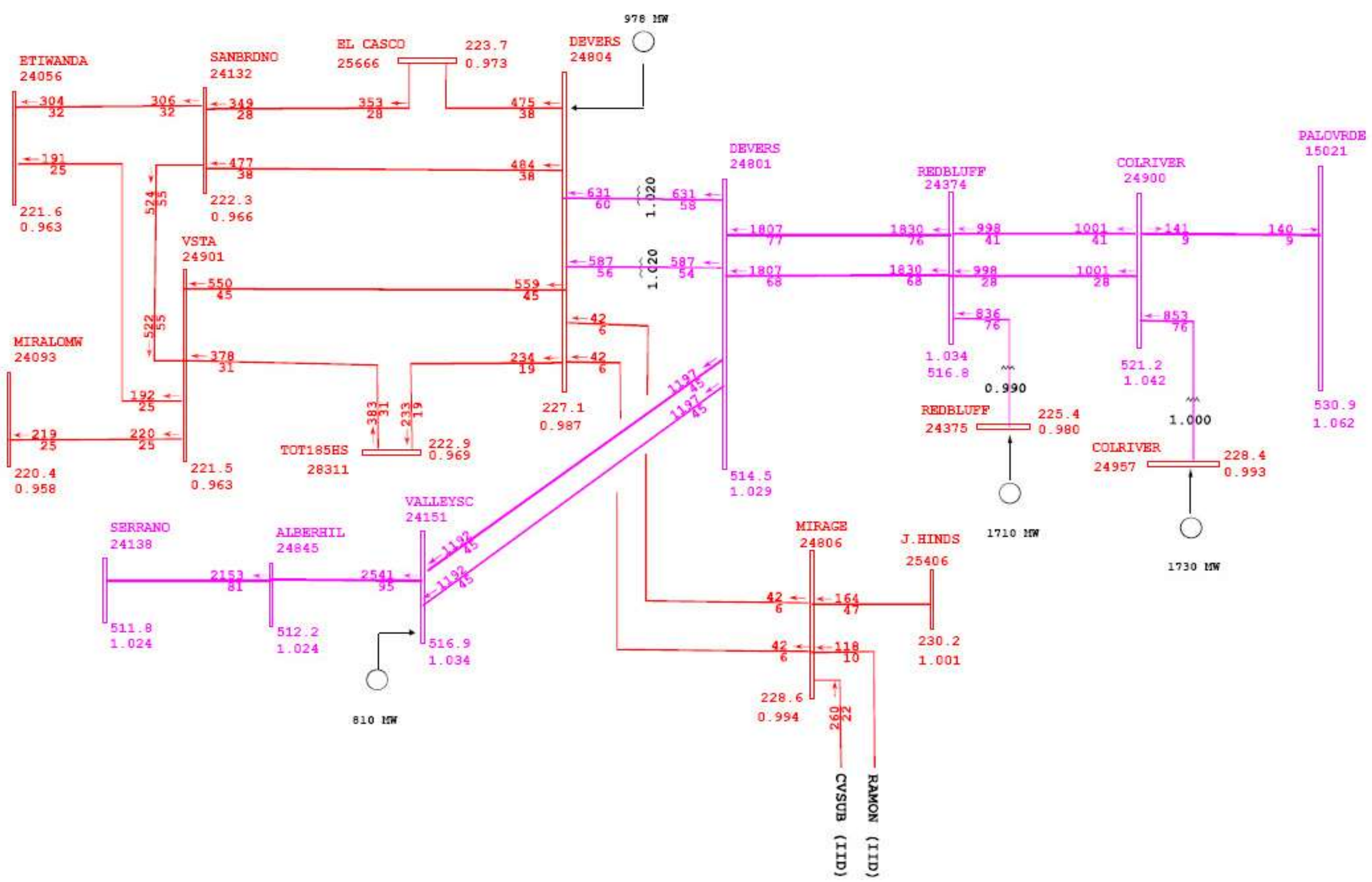
Preliminary analysis of WOD 230 KV circuits - CAISO Cluster 7 Phase I, 2019 Summer Peak case - Single contingency conditions (Category B)

Facility							Rated Amps	Worst Outage	Loading				Worst Outage description
From	Name	kV	To	Name	kV	ck			%	MW	MVAR	AMPS	
24804	DEVERS	230	25666	EL CASCO	230	1	4360	line_238	45.9%	744	164	1998	Line ALBERHIL 500.0 to VALLEYSC 500.0 Circuit 1
24804	DEVERS	230	24901	VSTA	230	2	4360	line_238	56.4%	902	249	2457	Line ALBERHIL 500.0 to VALLEYSC 500.0 Circuit 1
25666	EL CASCO	230	24132	SANBRDNO	230	1	4360	line_238	38.5%	615	-5	1680	Line ALBERHIL 500.0 to VALLEYSC 500.0 Circuit 1
24132	SANBRDNO	230	24804	DEVERS	230	1	4360	line_238	49.1%	-771	113	2142	Line ALBERHIL 500.0 to VALLEYSC 500.0 Circuit 1
28311	TOT185HS	230	24804	DEVERS	230	1	4360	line_238	26.3%	-417	-19	1146	Line ALBERHIL 500.0 to VALLEYSC 500.0 Circuit 1
28311	TOT185HS	230	24901	VSTA	230	1	4360	line_238	35.7%	567	23	1558	Line ALBERHIL 500.0 to VALLEYSC 500.0 Circuit 1

Preliminary analysis of WOD 230 KV circuits - CAISO Cluster 7 Phase I, 2019 Summer Peak case - N-2 and N-1-1 contingency conditions (Category C)

Facility							Rated Amps	Worst Outage	Loading				Worst Outage description
From	Name	kV	To	Name	kV	ck			%	MW	MVAR	AMPS	
24804	DEVERS	230	25666	EL CASCO	230	1	4360	line_202310	61.1%	971	286	2662	Line SANBRDNO 230.0 to DEVERS 230.0 Circuit 1, line ALBERHIL 500.0 to VALLEYSC 500.0 Circuit 1
24804	DEVERS	230	24901	VSTA	230	2	4360	line_202310	68.3%	1070	370	2976	Line SANBRDNO 230.0 to DEVERS 230.0 Circuit 1, line ALBERHIL 500.0 to VALLEYSC 500.0 Circuit 1
25666	EL CASCO	230	24132	SANBRDNO	230	1	4360	line_202310	53.6%	835	-19	2336	Line SANBRDNO 230.0 to DEVERS 230.0 Circuit 1, line ALBERHIL 500.0 to VALLEYSC 500.0 Circuit 1
24132	SANBRDNO	230	24804	DEVERS	230	1	4360	line_202807	64.8%	-988	230	2827	Line DEVERS 230.0 to EL CASCO 230.0 Circuit 1, line ALBERHIL 500.0 to VALLEYSC 500.0 Circuit 1
28311	TOT185HS	230	24804	DEVERS	230	1	4360	line_202778	35.6%	-545	-30	1552	Line DEVERS 230.0 to VSTA 230.0 Circuit 2, line ALBERHIL 500.0 to VALLEYSC 500.0 Circuit 1
28311	TOT185HS	230	24901	VSTA	230	1	4360	line_202778	45.4%	695	31	1978	Line DEVERS 230.0 to VSTA 230.0 Circuit 2, line ALBERHIL 500.0 to VALLEYSC 500.0 Circuit 1

CASE #4--ISO Cluster 7 Phase I (2019) case **Normal Conditions**



General Electric International, Inc. PSLF Program Thu Apr 02 20:44:14 2015 cases\C7PI19.sav

2014 SCE ATRA BASE CASE
STUDY SCENARIO: Peak
CASE NAME: 19-p-main

DATE: 03/18/2014
WECC SEED: 19HS2 Published 9/10/2013

MW/% rate
C7PhI.drw
Rating = 1

TABLE B2

Sensitivity case #2 - IID-CAISO exports of 1400 MW

Preliminary analysis of WOD 230 KV circuits - CAISO Cluster 7 Phase I Summer Peak case - Normal Operating conditions - No outage (Category A)

See Case #5 Power Flow Plot

Facility									Loading				
From	Name	kV	To	Name	kV	ck	Rated Amps	Outage	%	MW	MVAR	AMPS	Outage description
24804	DEVERS	230	25666	EL CASCO	230	1	3230	base	42.2%	531	51	1361	Base system (n-0)
24804	DEVERS	230	24901	VSTA	230	2	3230	base	50.4%	631	96	1629	Base system (n-0)
25666	EL CASCO	230	24132	SANBRDNO	230	1	3230	base	32.8%	409	-24	1059	Base system (n-0)
24132	SANBRDNO	230	24804	DEVERS	230	1	3230	base	43.7%	-541	61	1412	Base system (n-0)
28311	TOT185HS	230	24804	DEVERS	230	1	3230	base	21.9%	-272	-12	707	Base system (n-0)
28311	TOT185HS	230	24901	VSTA	230	1	3230	base	33.9%	422	1	1096	Base system (n-0)
24845	ALBERHIL	500	24151	VALLEYSC	500	1	3000	base	103.0%	-2744	-75	3090	Base system (n-0)

Sensitivity case #2 - IID-CAISO exports of 1400 MW

Preliminary analysis of WOD 230 KV circuits - CAISO Cluster 7 Phase I Summer Peak case - Single Contingency analysis (Category B)

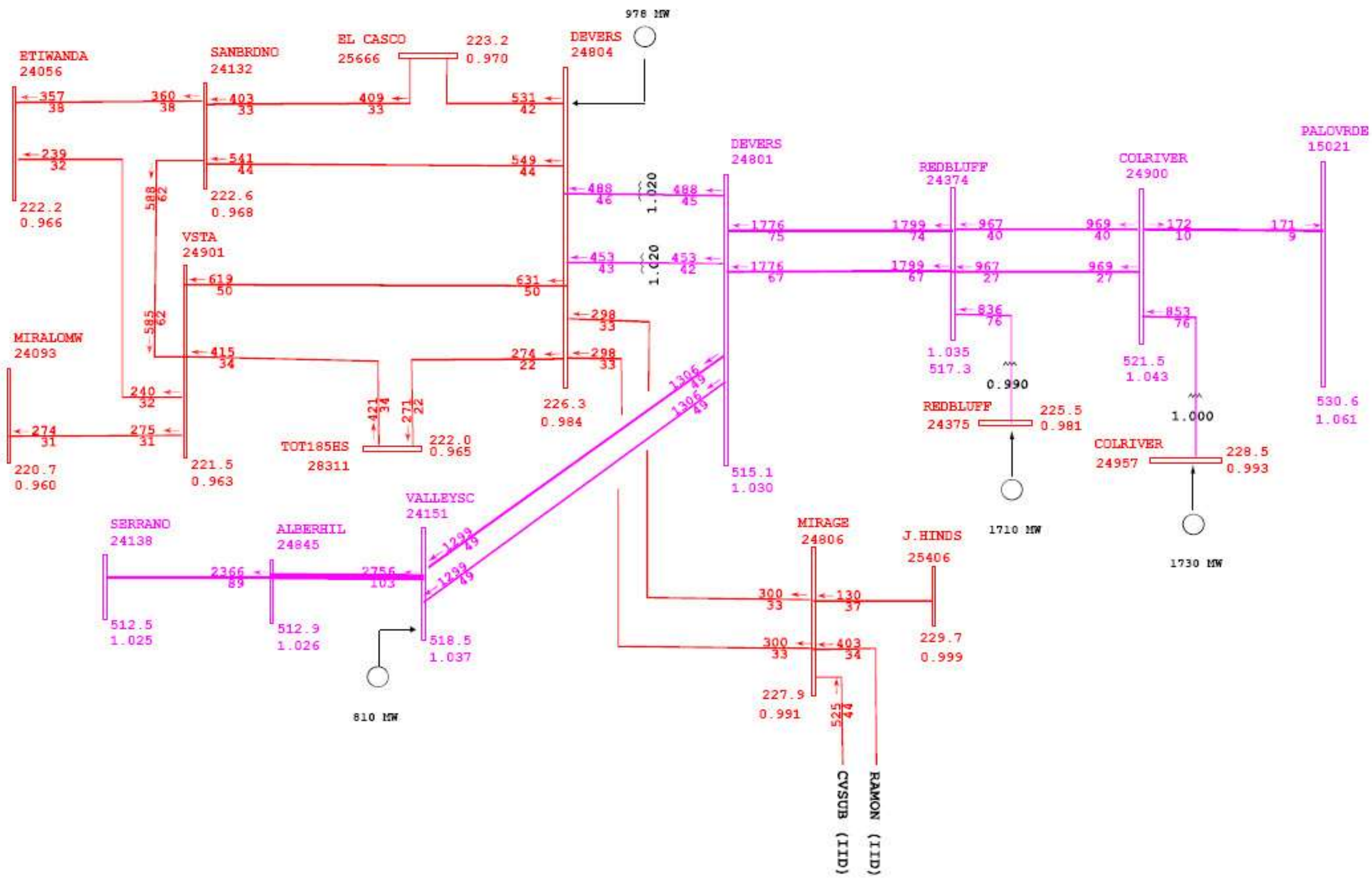
Facility									Loading				
From	Name	kV	To	Name	kV	ck	Rated Amps	Worst Outage	%	MW	MVAR	AMPS	Worst Outage description
24804	DEVERS	230	25666	EL CASCO	230	1	4360	line_238	51.3%	821	210	2234	Line ALBERHIL 500.0 to VALLEYSC 500.0 Circuit 1
24804	DEVERS	230	24901	VSTA	230	2	4360	line_238	63.3%	996	320	2759	Line ALBERHIL 500.0 to VALLEYSC 500.0 Circuit 1
25666	EL CASCO	230	24132	SANBRDNO	230	1	4360	line_238	43.8%	690	-4	1911	Line ALBERHIL 500.0 to VALLEYSC 500.0 Circuit 1
24132	SANBRDNO	230	24804	DEVERS	230	1	4360	line_238	55.3%	-854	147	2413	Line ALBERHIL 500.0 to VALLEYSC 500.0 Circuit 1
28311	TOT185HS	230	24804	DEVERS	230	1	4360	line_238	30.0%	-466	-26	1307	Line ALBERHIL 500.0 to VALLEYSC 500.0 Circuit 1
28311	TOT185HS	230	24901	VSTA	230	1	4360	line_238	39.6%	616	28	1727	Line ALBERHIL 500.0 to VALLEYSC 500.0 Circuit 1

Sensitivity case #2 - IID-CAISO exports of 1400 MW

Preliminary analysis of WOD 230 KV circuits - CAISO Cluster 7 Phase I Summer Peak case - N-2 and N-1-1 Contingency analysis (Category C)

Facility									Loading				
From	Name	kV	To	Name	kV	ck	Rated Amps	Worst Outage	%	MW	MVAR	AMPS	Worst Outage description
24804	DEVERS	230	25666	EL CASCO	230	1	4360	line_202310	68.9%	1065	376	3000	Line SANBRDNO 230.0 to DEVERS 230.0 Circuit 1, line ALBERHIL 500.0 to VALLEYSC 500 Circuit 1
24804	DEVERS	230	24901	VSTA	230	2	4360	line_202310	77.1%	1169	485	3360	Line SANBRDNO 230.0 to DEVERS 230.0 Circuit 1, line ALBERHIL 500.0 to VALLEYSC 500 Circuit 1
25666	EL CASCO	230	24132	SANBRDNO	230	1	4360	line_202310	61.1%	924	-14	2665	Line SANBRDNO 230.0 to DEVERS 230.0 Circuit 1, line ALBERHIL 500.0 to VALLEYSC 500 Circuit 1
24132	SANBRDNO	230	24804	DEVERS	230	1	4360	line_202807	73.3%	-1080	291	3197	Line DEVERS 230.0 to EL CASCO 230.0 Circuit 1, line ALBERHIL 500.0 to VALLEYSC 500 Circuit 1
28311	TOT185HS	230	24804	DEVERS	230	1	4360	line_202777	37.8%	-579	-29	1648	Line DEVERS 230.0 to VSTA 230.0 Circuit 2, line ALBERHIL 500.0 to VALLEYSC 500 Circuit 1
28311	TOT185HS	230	24901	VSTA	230	1	4360	line_202777	47.6%	729	30	2074	Line DEVERS 230.0 to VSTA 230.0 Circuit 2, line ALBERHIL 500.0 to VALLEYSC 500 Circuit 1

CASE #5--ISO Cluster 7 Phase I + IID-ISO Export of 1400 MW **Normal Conditions**



General Electric International, Inc. PSLF Program Thu Apr 02 20:48:58 2015 cases\C7PI19IID1400.sav

GE	2014 SCE ATRA BASE CASE STUDY SCENARIO: Peak CASE NAME: 19-p-main	DATE: 03/18/2014 WECC SEED: 19HS2 Published 9/10/2013	MW/% rate C7PhI+IID1400.drw Rating = 1

TABLE B3

WOD upgrades with Drake 795 ACCR conductor--Cluster 7 Phase I, 1400 MW IID-ISO export
Normal Operating conditions (Category A)

See Case #6 Power Flow Plot

Facility									Loading				
From	Name	kV	To	Name	kV	ck	Rated Amps	Outage	%	MW	MVAR	AMPS	Outage description
24804	DEVERS	230	25666	EL CASCO	230	1	1902	base	64.8%	484	37	1232	Base system (n-0)
24804	DEVERS	230	24901	VSTA	230	2	1902	base	66.8%	499	38	1271	Base system (n-0)
25666	EL CASCO	230	24132	SANBRDNO	230	1	1902	base	48.7%	345	-68	927	Base system (n-0)
24132	SANBRDNO	230	24804	DEVERS	230	1	1902	base	61.0%	-429	99	1158	Base system (n-0)
28311	TOT185HS	230	24804	DEVERS	230	1	1902	base	49.9%	-368	-35	949	Base system (n-0)
28311	TOT185HS	230	24901	VSTA	230	1	1902	base	70.0%	518	18	1331	Base system (n-0)
24845	**ALBERHIL**	**500**	**24151**	**VALLEYSC**	**500**	**1**	**2598**	**base**	**107.1%**	**-2844**	**-108**	**3213**	**Base system (n-0)**

WOD upgrades with Drake 795 ACCR conductor--Cluster 7 Phase I, 1400 MW IID-ISO export
Single Contingency (Category B)

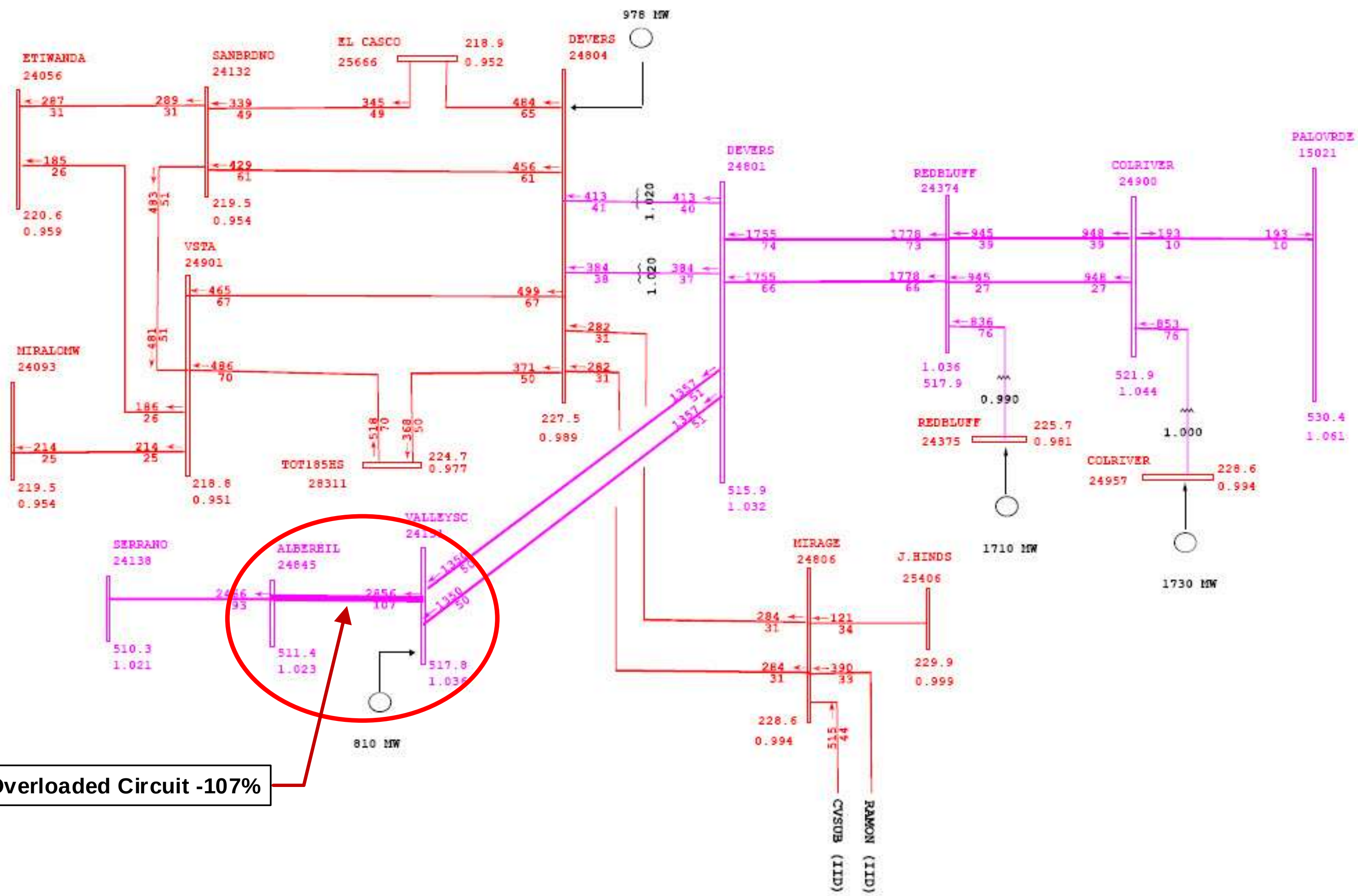
Facility									Loading				
From	Name	kV	To	Name	kV	ck	Rated Amps	Worst Outage	%	MW	MVAR	AMPS	Worst Outage description
24804	DEVERS	230	25666	EL CASCO	230	1	2037	line_237	95.8%	732	177	1949	ALBERHII 500.0 to SERRANO 500.0 #1
24804	DEVERS	230	24901	VSTA	230	2	2037	line_237	**100.7%**		191	2051	ALBERHII 500.0 to SERRANO 500.0 #1
25666	EL CASCO	230	24132	SANBRDNO	230	1	2037	line_237	79.6%	560	-94	1621	ALBERHII 500.0 to SERRANO 500.0 #1
24132	SANBRDNO	230	24804	DEVERS	230	1	2037	line_237	92.6%	-637	191	1885	ALBERHII 500.0 to SERRANO 500.0 #1
28311	TOT185HS	230	24804	DEVERS	230	1	2037	line_237	84.4%	-629	-134	1720	ALBERHII 500.0 to SERRANO 500.0 #1
28311	TOT185HS	230	24901	VSTA	230	1	2037	line_237	**103.8%**	779	135	2114	ALBERHII 500.0 to SERRANO 500.0 #1

WOD Upgrades with Drake 795 ACCR conductor--Cluster 7 Phase I, 1400 MW IID-ISO export
Double Contingency N-2 and N-1-1 (Category C)

Facility									Loading				
From	Name	kV	To	Name	kV	ck	Rated Amps	Worst Outage	%	MW	MVAR	AMPS	Worst Outage description
24804	DEVERS	230	25666	EL CASCO	230	1	2037	line_202309	**120.9%**	902	288	2461	SANBRDNO 230.0 to DEVERS 230.0 #1 ALBERHIL 500.0 to SERRANO 500 #1
24804	DEVERS	230	24901	VSTA	230	2	2037	line_202841	**119.3%**	897	277	2431	ALBERHIL 500.0 to SERRANO 500.0 #1 TOT185HS 230 to DEVERS 230 #1
25666	EL CASCO	230	24132	SANBRDNO	230	1	2037	line_202309	**104.2%**	697	-145	2122	SANBRDNO 230.0 to DEVERS 230.0 #1 ALBERHIL 500.0 to SERRANO 500 #1
24132	SANBRDNO	230	24804	DEVERS	230	1	2037	line_202851	**114.1%**	-752	297	2323	ALBERHIL 500.0 to SERRANO 500.0 #1 EL CASCO 230.0 to SANBRDNO 230 #1
28311	TOT185HS	230	24804	DEVERS	230	1	2037	line_202309	**102.1%**	-737	-204	2080	SANBRDNO 230.0 to DEVERS 230.0 #1 ALBERHIL 500.0 to SERRANO 500 #1
28311	TOT185HS	230	24901	VSTA	230	1	2037	line_202309	**121.7%**	887	209	2479	SANBRDNO 230.0 to DEVERS 230.0 #1 ALBERHIL 500.0 to SERRANO 500 #1

CASE #6--ISO Cluster 7 Phase I + IID-ISO 1400 MW + Alternate Conductor

Normal Conditions



General Electric International, Inc. PSLF Program Thu Apr 02 20:51:38 2015 cases\C7PI19UP1IID1400.sav

	2014 SCE ATRA BASE CASE STUDY SCENARIO: Peak CASE NAME: 19-p-main	DATE: 03/18/2014 WECC SEED: 19HS2 Published 9/10/2013	MW/% rate C7PhI+IID1400+AltCond Rating = 1

TABLE B4

Proposed Project - Cluster 7 Phase 1, IID-ISO 1400 MW

Voltage deviation violations*

Bus	Name	kV	Voltage deviation criteria	Voltage deviation	Outage description
24132	SANBRDNO	230	≤ 5%	-6.7%	Line ALBERHIL 500.0 to VALLEYSC 500.0 Circuit 1
24901	VSTA	230	≤ 5%	-6.4%	Line ALBERHIL 500.0 to VALLEYSC 500.0 Circuit 1
25666	EL CASCO	230	≤ 5%	-6.5%	Line ALBERHIL 500.0 to VALLEYSC 500.0 Circuit 1

*** Voltage deviation is the difference in voltage at a particular bus before and after contingency**

TABLE B5

WOD Upgrades w/Drake 795 ACCR--Cluster 7 Phase 1, IID-ISO 1400 MW

Voltage deviation violations*

Bus	Name	kV	Voltage deviation criteria	Voltage deviation	Outage description
24132	SANBRDNO	230	≤ 5%	-6.8%	Line ALBERHIL 500.0 to SERRANO 500.0 Circuit 1
24901	VSTA	230	≤ 5%	-6.5%	Line ALBERHIL 500.0 to SERRANO 500.0 Circuit 1
25666	EL CASCO	230	≤ 5%	-7.2%	Line ALBERHIL 500.0 to SERRANO 500.0 Circuit 1

*** Voltage deviation is the difference in voltage at a particular bus before and after contingency**

TABLE B6

WOD Upgrades w/Drake 795 ACCR--Cluster 7 Phase 1, IID-ISO 1400 MW

Voltage violations

Bus	Name	kV	Voltage Criteria	Voltage	Outage description
25666	EL CASCO	230	90% - 110%	88.0%	Line ALBERHIL 500.0 to SERRANO 500.0 Circuit 1
24132	SANBRDNO	230	90% - 110%	88.6%	Line ALBERHIL 500.0 to SERRANO 500.0 Circuit 1
24901	VSTA	230	90% - 110%	88.6%	Line ALBERHIL 500.0 to SERRANO 500.0 Circuit 1

ZGLOBAL
Power Engineering & Energy Solutions

TABLE B7
CAISO Queue Cluster 7 Phase I, 2019 Summer Peak Base case
Generation modeled in Colorado River, Red Bluff and Devers area

BUS-NO	NAME	KV	ID	ST	PGEN	PMAX	PMIN	QGEN	QMAX	QMIN	ZONE	Major Point of Interconnection
24999	DEVRSVC1	500	1	1	0	0	0	100	100	-100	940	Devers 230 kV Sub
29041	IEEC-G1	19.5	1	1	405	405	203	220.4	280	-200	940	Valley 500 kV Sub
29042	IEEC-G2	19.5	2	1	405	405	203	220.4	280	-200	940	Valley 500 kV Sub
24921	MNTV-CT1	18	1	1	164	185	0	56	115	-61	940	MNTVIEW 230 kV Sub
24922	MNTV-CT2	18	1	1	164	185	0	56	115	-61	940	MNTVIEW 230 kV Sub
24924	MNTV-CT3	18	1	1	164	185	0	55.8	115	-61	940	MNTVIEW 230 kV Sub
24925	MNTV-CT4	18	1	1	164	185	0	55.8	115	-61	940	MNTVIEW 230 kV Sub
24923	MNTV-ST1	18	1	0	208	321	0	53.2	200	-100	940	MNTVIEW 230 kV Sub
24926	MNTV-ST2	18	1	0	208	321	0	53.6	200	-100	940	MNTVIEW 230 kV Sub
29101	TOT032G1	13.8	1	1	91	107	0	45.2	56	-44	940	Devers 230 kV Sub
29102	TOT032G2	13.8	1	1	91	107	0	45.2	56	-44	940	Devers 230 kV Sub
29103	TOT032G3	13.8	1	1	91	107	0	38.3	56	-44	940	Devers 230 kV Sub
29104	TOT032G4	13.8	1	1	91	107	0	38.3	56	-44	940	Devers 230 kV Sub
29105	TOT032G5	13.8	1	1	91	107	0	38.3	56	-44	940	Devers 230 kV Sub
29106	TOT032G6	13.8	1	1	91	107	0	31.4	56	-44	940	Devers 230 kV Sub
29107	TOT032G7	13.8	1	1	91	107	0	31.4	56	-44	940	Devers 230 kV Sub
29108	TOT032G8	13.8	1	1	91	107	0	45.2	56	-44	940	Devers 230 kV Sub
28313	TOT185GN	1	1	1	150	150	0	32.4	55.3	-55.3	248	Devers 230 kV Sub
24963	TOT198G1	0.32	1	1	226	129.8	0	57	84	-84	943	Red Bluff 230 kV Sub
24965	TOT198G2	0.32	1	1	22.7	129.8	0	11	11	-11	943	Red Bluff 230 kV Sub
24964	TOT199G1	0.32	1	1	233.1	156.9	0	47.7	86	-86	943	Red Bluff 230 kV Sub
24966	TOT199G2	0.32	1	1	80	156.9	0	40.3	86.8	0	943	Red Bluff 230 kV Sub
24976	TOT223_G	0.34	1	1	250	250	0	42	150	0	944	Colorado River 230 kV Sub
24977	TOT223L1	13.8	1	1	125	140	0	20.7	87.3	0	944	Colorado River 230 kV Sub
24978	TOT223L2	13.8	1	1	125	140	0	21.4	87.3	0	944	Colorado River 230 kV Sub
24982	TOT276G1	0.34	1	1	125	125	0	38.1	60.5	-60.5	944	Colorado River 230 kV Sub
24983	TOT276G2	0.34	2	1	125	125	0	38.1	60.5	-60.5	944	Colorado River 230 kV Sub
24984	TOT276G3	0.34	3	1	125	125	0	38.2	60.5	-60.5	944	Colorado River 230 kV Sub
24985	TOT276G4	0.34	4	1	110	110	0	35.5	53.3	-53.3	944	Colorado River 230 kV Sub
94465	TOT321L1	21	1	1	250	171	0	52	130	-43.3	943	Red Bluff 230 kV Sub
94466	TOT321L2	21	1	1	250	171	0	52	130	-43.3	943	Red Bluff 230 kV Sub
95330	TOT446G1	0.26	EQ	1	100	161.5	0	12.3	56	-100	248	Colorado River 230 kV Sub
95331	TOT446G2	0.26	EQ	1	124	161.5	0	13.3	56	-100	248	Colorado River 230 kV Sub
95332	TOT446G3	0.26	EQ	0	162	162	0	0	54.5	-100	248	Colorado River 230 kV Sub
95315	TOT453L	0.31	1	1	250	245	0	49.5	58.8	-100	943	Red Bluff 230 kV Sub
95426	TOT486L1	0.26	1	1	75	75	0	34.9	37	-37	943	Red Bluff 230 kV Sub
95427	TOT486L2	0.26	2	1	73	75	0	34.5	37	-37	943	Red Bluff 230 kV Sub
95829	TOT528G1	0.27	1	1	216	216	0	0	0	0	248	Colorado River 230 kV Sub
95830	TOT528G2	0.27	1	1	5	5	0	0	0	0	248	Colorado River 230 kV Sub
96416	TOT670_G	0.32	1	1	150	150	0	-6.7	61.3	-61.3	248	Colorado River 230 kV Sub
96713	TOT708G	0.39	1	1	250	250	0	-37	37	-37	943	Red Bluff 230 kV Sub
96717	TOT721_G	0.32	1	1	150	150	0	-7.4	61.3	-61.3	248	Colorado River 230 kV Sub
96721	TOT725G	0.36	1	1	100	100	0	-37	37	-37	943	Devers 230 kV Sub

Note: Only on-line Generation is counted in the total (Generation with "0" in the "ST" column is off-line).
578 MW generation is off-line.

Total Generation On-line: 5884 MW
Total Generation Capacity: 6075 MW

TABLE B8

Summer Off-Peak case--Cluster 7 Phase 1 - Normal Operating conditions (Category A)

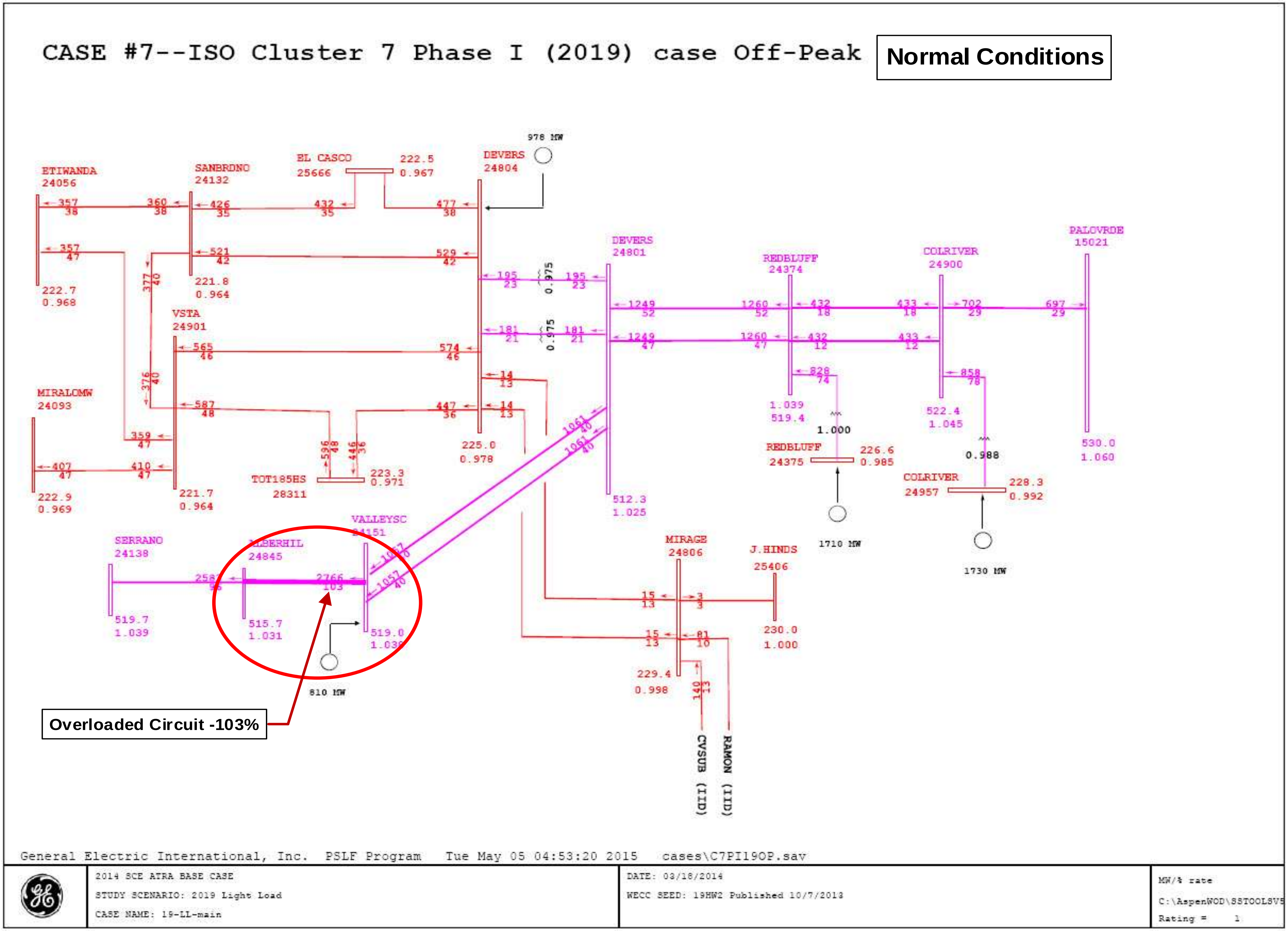
Facility									Loading				
From	Name	kV	To	Name	kV	ck	Rated Amps	Outage	%	MW	MVAR	AMPS	Outage Description
24845	**ALBERHIL**	**500**	**24151**	**VALLEYSC**	**500**	**1**	**3000**	**base**	**102.8%**	**-2754**	**53**	**3084**	**Base system (n-0)**
24804	DEVERS	230	25666	EL CASCO	230	1	3231	base	38.0%	477	37	1228	Base system (n-0)
24804	DEVERS	230	24901	VSTA	230	2	3231	base	46.0%	574	69	1485	Base system (n-0)
24805	**DEVERS**	**115**	**24804**	**DEVERS**	**230**	**1**	**280**	**base**	**116.3%**	**275**	**-111**	**1494**	**Base system (n-0)**
24805	**DEVERS**	**115**	**24804**	**DEVERS**	**230**	**3**	**280**	**base**	**111.2%**	**263**	**-106**	**1429**	**Base system (n-0)**
24805	**DEVERS**	**115**	**24804**	**DEVERS**	**230**	**4**	**280**	**base**	**109.4%**	**259**	**-104**	**1406**	**Base system (n-0)**
25666	EL CASCO	230	24132	SANBRDNO	230	1	3231	base	34.8%	432	-22	1123	Base system (n-0)
24132	SANBRDNO	230	24804	DEVERS	230	1	3231	base	42.2%	-521	60	1364	Base system (n-0)
28311	TOT185HS	230	24804	DEVERS	230	1	3231	base	36.0%	-446	-64	1164	Base system (n-0)
28311	TOT185HS	230	24901	VSTA	230	1	3231	base	47.8%	596	50	1545	Base system (n-0)

Summer Off-Peak case - Cluster 7 Phase 1 - Single contingency conditions (Category B)

Facility									Loading				
From	Name	kV	To	Name	kV	ck	Rated Amps	Worst Outage	%	MW	MVAR	AMPS	Worst Outage Description
24804	DEVERS	230	25666	EL CASCO	230	1	4360	line_238	45.5%	730	146	1981	Line ALBERHIL 500.0 to VALLEYSC 500.0 Circuit 1
24804	DEVERS	230	24901	VSTA	230	2	4360	line_238	56.4%	899	215	2459	Line ALBERHIL 500.0 to VALLEYSC 500.0 Circuit 1
25666	EL CASCO	230	24132	SANBRDNO	230	1	4360	line_238	42.9%	679	-19	1871	Line ALBERHIL 500.0 to VALLEYSC 500.0 Circuit 1
24132	SANBRDNO	230	24804	DEVERS	230	1	4360	line_238	51.2%	-797	150	2234	Line ALBERHIL 500.0 to VALLEYSC 500.0 Circuit 1
28311	TOT185HS	230	24804	DEVERS	230	1	4360	line_238	48.6%	-768	-153	2121	Line ALBERHIL 500.0 to VALLEYSC 500.0 Circuit 1
28311	TOT185HS	230	24901	VSTA	230	1	4360	line_238	57.9%	918	159	2524	Line ALBERHIL 500.0 to VALLEYSC 500.0 Circuit 1

Summer Off-Peak case - Cluster 7 Phase 1 - Double contingency conditions (Category C)

Facility									Loading				
From	Name	kV	To	Name	kV	ck	Rated Amps	Worst Outage	%	MW	MVAR	AMPS	Worst Outage Description
24804	DEVERS	230	25666	EL CASCO	230	1	4360	line_202310	59.9%	944	245	2609	Line SANBRDNO 230.0 to DEVERS 230.0 Circuit 1, Line ALBERHIL 500.0 to VALLEYSC 500 Circuit 1
24804	DEVERS	230	24901	VSTA	230	2	4360	line_202869	71.8%	1116	342	3131	Line ALBERHIL 500.0 to VALLEYSC 500.0 Circuit 1, Line TOT185HS 230 to VSTA 230 Circuit 1
25666	EL CASCO	230	24132	SANBRDNO	230	1	4360	line_202310	57.3%	885	-46	2497	Line SANBRDNO 230.0 to DEVERS 230.0 Circuit 1, Line ALBERHIL 500.0 to VALLEYSC 500 Circuit 1
24132	SANBRDNO	230	24804	DEVERS	230	1	4360	line_202807	65.4%	-991	279	2853	Line DEVERS 230.0 to EL CASCO 230.0 Circuit 1, Line ALBERHIL 500.0 to VALLEYSC 500 Circuit 1
28311	TOT185HS	230	24804	DEVERS	230	1	4360	line_202778	63.6%	-977	-241	2775	Line DEVERS 230.0 to VSTA 230.0 Circuit 2, Line ALBERHIL 500.0 to VALLEYSC 500 Circuit 1
28311	TOT185HS	230	24901	VSTA	230	1	4360	line_202778	72.9%	1127	245	3181	Line DEVERS 230.0 to VSTA 230.0 Circuit 2, Line ALBERHIL 500.0 to VALLEYSC 500 Circuit 1


CASE #7--ISO Cluster 7 Phase I (2019) case Off-Peak
Normal Conditions
Overloaded Circuit -103%
ETIWANDA 24056
SANBRDNO 24132
EL CASCO 25666
222.5 0.967
DEVERS 24804
978 MW
DEVERS 24801
REDBLUFF 24374
COLRIVER 24900
PALOVRDE 15021
VSTA 24901
MIRALOMW 24093
TOT185HS 28311
REDBLUFF 24375
COLRIVER 24957
1710 MW
1730 MW
SERRANO 24138
VALLEYSC 24151
MIRAGE 24806
J.HINDS 25406
810 MW
CVSUB (IID)
RAMON (IID)
General Electric International, Inc. PSLF Program Tue May 05 04:53:20 2015 cases\C7PI19OP.sav
2014 SCE ATRA BASE CASE
STUDY SCENARIO: 2019 Light Load
CASE NAME: 19-LL-main
DATE: 03/18/2014
WECC SEED: 19HW2 Published 10/7/2013
MW/% rate
C:\AspenWOD\SSTOOLSV5
Rating = 1

Appendix B

"No Project" Options Analysis and Results

Alternative Option 1A, 1B, and 2

Additional Alternatives Assessed

Following the analysis and assessment of the proposed Project and ***Phased Build*** alternative, at the request of ASPEN and the CPUC, ZGlobal conducted additional Normal and Single contingency analysis for “No Project” alternatives identified and defined as follows:

Transmission System Alternative: “No Project” Options

“No Project” Option #1 would remove all the 220 kV lines interconnecting Devers to El Casco; Devers to Vista; and Devers to San Bernardino; and would retain all the portions between El Casco and San Bernardino, and into Vista. Option #1 is subdivided into two sub-configurations:

Option #1A: Add a new 500 kV circuit with bundled 2156 kcmil ACSR conductor (2B-2156) between Devers and a new substation located in the city of Beaumont (Beaumont 500/220 kV Station) between Devers and El Casco. Loop-in one of the existing Devers-Valley 500 kV circuits into the new Beaumont Substation. Add four (4) new 220 kV circuits emanating from Beaumont; one to El Casco, one to San Bernardino, and two to Vista using 2B-1590 ACSR conductors as proposed.

Option #1B: In lieu of adding a new 500 kV circuit between Devers and Beaumont, loop in the two existing Devers-Valley 500 kV circuits into Beaumont and similar to Option #1A, add four (4) new 220 kV circuits emanating from Beaumont; one to El Casco, one to San Bernardino, and two to Vista using 2B-1590 ACSR conductors as proposed.

“No Project” Option #2: Retain the existing 220 kV circuits and configuration from Devers to El Casco, San Bernardino and Vista. Add a new, 2^{nd} 500 kV, 2B-2156 circuit from Valley to Serrano.

Figure B1A displays the single-line diagram or power flow plot for the Option #1A circuit arrangement and power flow conditions under Normal conditions using the same 2024 Peak Summer Reliability base case used in assessing the proposed Project and ***Phased Build*** alternative.

Figure B1B displays the single-line diagram or power flow plot for the Option #1B circuit arrangement and power flow conditions under Normal conditions using the same 2024 Peak Summer Reliability base case used in assessing the proposed Project and ***Phased Build*** alternative.

Figure B2 displays the single-line diagram or power flow plot for the Option #2 circuit arrangement and power flow conditions under Normal conditions using the same 2024 Peak Summer Reliability base case used in assessing the proposed Project and ***Phased Build*** alternative.

“No Project” Option #1A, #1B, and #2 results tables and summaries follow the Figures B1A, B1B, and B2. Refer to Appendix C for complete list of applicable Power Flow plots.

Figure B1A – Option #1A Power Flow Plot

Option1A-ISO 2024 Summer Peak Reliability Base Case with Beaumont 230/500kV Subst

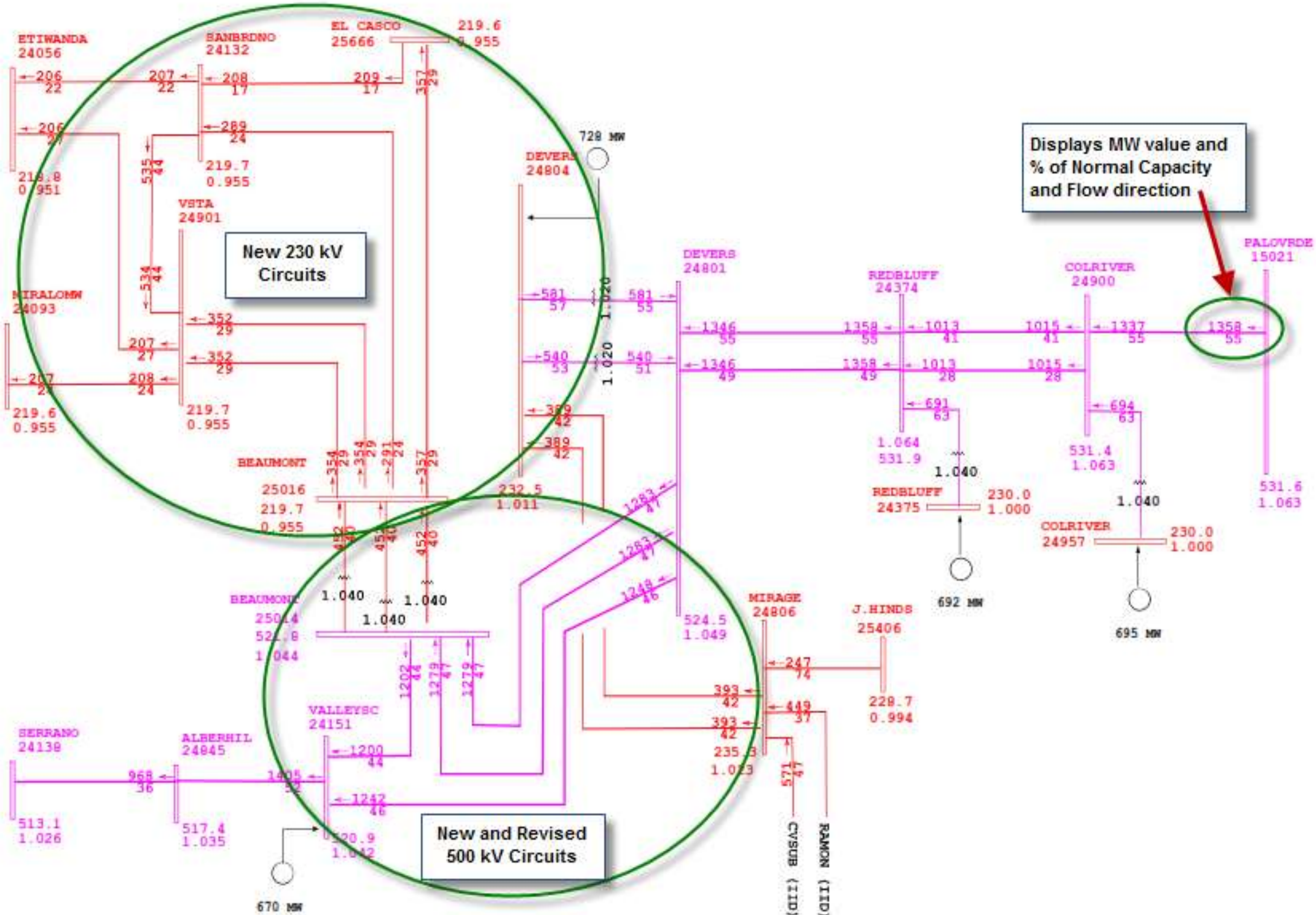
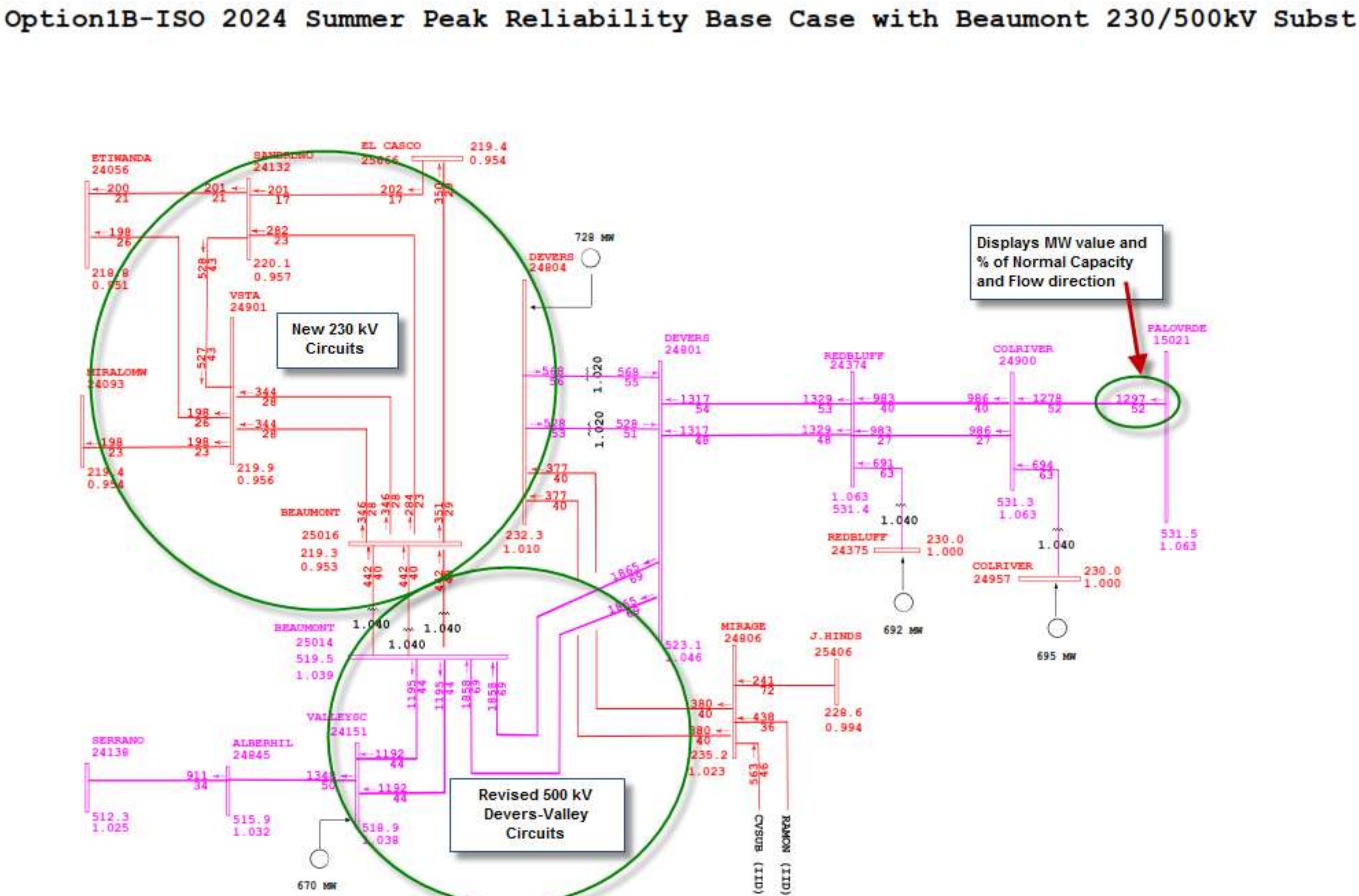
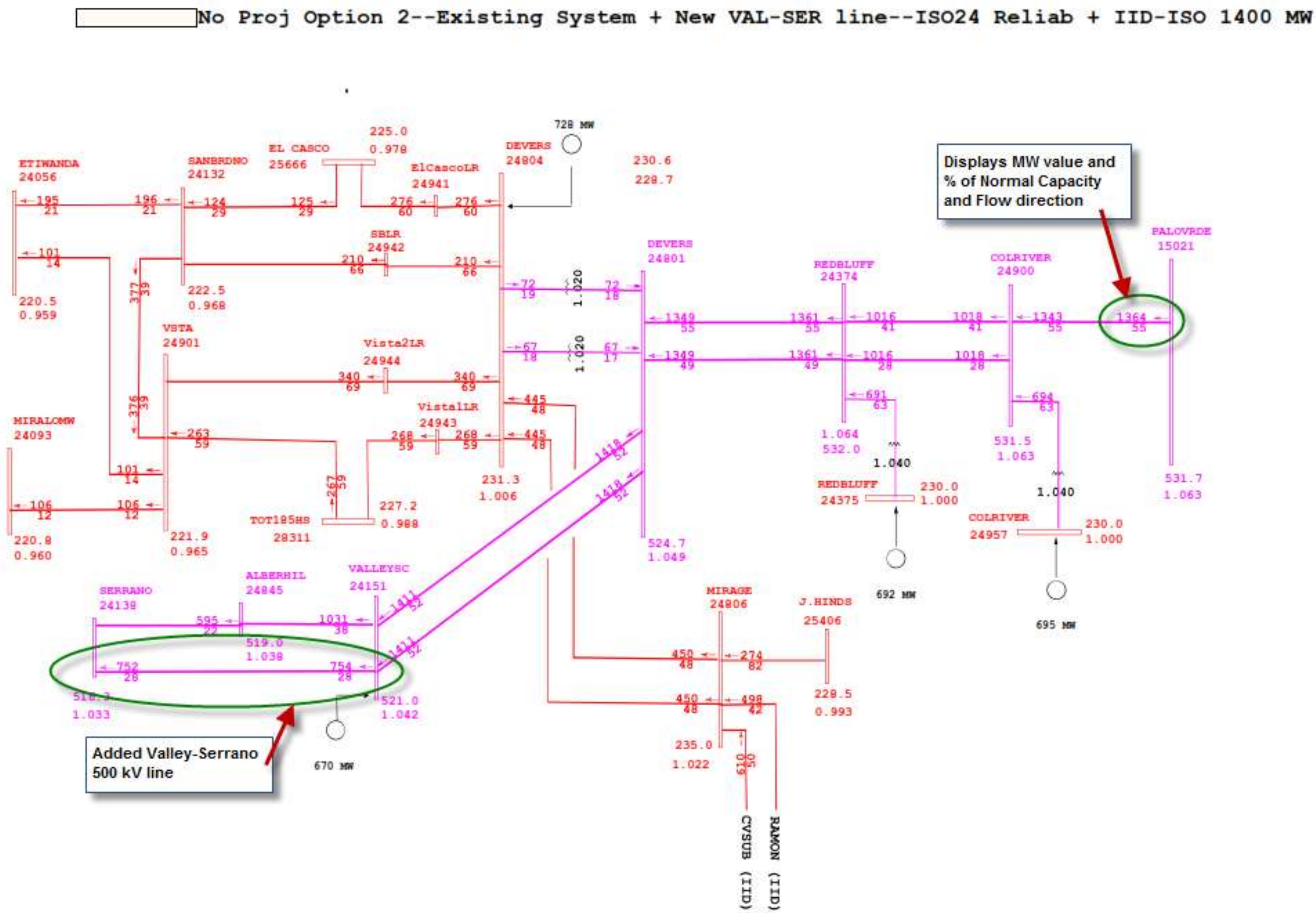


Figure B1B – Option #1B Power Flow Plot



ZGLOBAL
Power Engineering & Energy Solutions

Figure B2 – Option #2 Power Flow Plot



Option #1A Results

Option 1A provided very positive results. Both the ISO 2024 Reliability case with IID to ISO export of 1400 MW and Cluster 7 Phase I with IID to ISO export of 1400 MW were evaluated.

A. **ISO 2024 Reliability case**:

1. No overloaded facilities were found in the study area (West of Devers) under normal operating conditions. All transformers and transmission lines were operating within their normal ratings.

Option 1A--ISO24Reliability + IID - ISO 1400 MW export
New 500 kV Devers - Beaumont line, loop DV #1 into Beaumont, four new 230 kV Beaumont West circuits
Normal Operating conditions

Facility									Loading				
From Bus #	Name	kV	To Bus #	Name	kV	ck	Rated Amps	Outage	%	MW	MVAR	AMPS	Outage Description
24845	ALBERHIL	500	24138	SERRANO	500	1	3000	base	36.4%	968	97	1086	Base system (n-0)
24845	ALBERHIL	500	24151	VALLEYSC	500	1	3000	base	52.3%	-1402	-116	1570	Base system (n-0)
25014	BEAUMONT	500	24151	VALLEYSC	500	1	3000	base	44.3%	1202	6	1330	Base system (n-0)
24801	DEVERS	500	25014	BEAUMONT	500	1	3000	base	47.2%	1283	61	1413	Base system (n-0)
24801	DEVERS	500	25014	BEAUMONT	500	2	3000	base	47.2%	1283	61	1413	Base system (n-0)
25014	BEAUMONT	500	25016	BEAUMONT	230	1	1120 MVA	base	40.4%	452	19	501	Base system (n-0)
25014	BEAUMONT	500	25016	BEAUMONT	230	2	1120 MVA	base	40.4%	452	19	501	Base system (n-0)
25014	BEAUMONT	500	25016	BEAUMONT	230	3	1120 MVA	base	40.4%	452	19	501	Base system (n-0)
25016	BEAUMONT	230	25666	EL CASCO	230	1	3231	base	29.1%	357	-10	940	Base system (n-0)
25016	BEAUMONT	230	24132	SANBRDNO	230	1	3231	base	23.7%	291	-10	764	Base system (n-0)
25016	BEAUMONT	230	24901	VSTA	230	1	3231	base	28.8%	354	-8	931	Base system (n-0)
25016	BEAUMONT	230	24901	VSTA	230	2	3231	base	28.8%	354	-8	931	Base system (n-0)
25666	EL CASCO	230	24132	SANBRDNO	230	1	3231	base	17.1%	209	-25	554	Base system (n-0)

2. No overloaded facilities were found in the study area under Single contingency conditions. About 80 contingencies identified in the ISO-posted contingency file were evaluated. The highest loading was ~75% on the Beaumont–Valley 500 kV line when Devers–Valley #2 was taken out of service. This indicates there is about 25% of unused capacity to accommodate future generation and load growth.

Option 1A--ISO24Reliability + IID - ISO 1400 MW export
New 500 kV Devers - Beaumont line, loop DV #1 into Beaumont, four new 230 kV Beaumont West circuits
Single Contingency conditions

Facility									Loading				
From Bus #	Name	kV	To Bus #	Name	kV	ck	Rated Amps	Worst Outage	%	MW	MVAR	AMPS	Worst Outage Description
24845	ALBERHIL	500	24138	SERRANO	500	1	4800	line_55	26.0%	1106	99	1243	MIRALOMA - SERRANO 500 kV Ckt 2
24845	ALBERHIL	500	24151	VALLEYSC	500	1	4800	line_55	36.0%	-1539	-118	1729	MIRALOMA - SERRANO 500 kV Ckt 2
25014	BEAUMONT	500	24151	VALLEYSC	500	1	3300	line_44	75.3%	2223	36	2484	DEVERS - VALLEYSC 500 kV Ckt 2
24801	DEVERS	500	25014	BEAUMONT	500	1	3300	line_1401	71.6%	2130	164	2360	DEVERS - BEAUMONT 500 kV Ckt 2
24801	DEVERS	500	25014	BEAUMONT	500	2	3300	line_1400	71.6%	2130	164	2360	DEVERS - BEAUMONT 500 kV Ckt 1
24801	DEVERS	500	24151	VALLEYSC	500	2	3300	line_1402	69.7%	2074	189	2300	BEAUMONT - VALLEYSC 500 kV Ckt 1
25014	BEAUMONT	500	25016	BEAUMONT	230	1	1680 MVA	line_36	44.2%	733	125	817	ALBERHIL - VALLEYSC 500 kV Ckt 1
25014	BEAUMONT	500	25016	BEAUMONT	230	2	1680 MVA	line_36	44.2%	733	125	817	ALBERHIL - VALLEYSC 500 kV Ckt 1
25014	BEAUMONT	500	25016	BEAUMONT	230	3	1680 MVA	line_36	44.2%	733	125	817	ALBERHIL - VALLEYSC 500 kV Ckt 1
25016	BEAUMONT	230	25666	EL CASCO	230	1	4360	line_36	32.7%	539	19	1425	ALBERHIL - VALLEYSC 500 kV Ckt 1
25016	BEAUMONT	230	24132	SANBRDNO	230	1	4360	line_36	30.2%	497	30	1316	ALBERHIL - VALLEYSC 500 kV Ckt 1
25016	BEAUMONT	230	24901	VSTA	230	1	4360	line_36	35.3%	581	39	1538	ALBERHIL - VALLEYSC 500 kV Ckt 1
25016	BEAUMONT	230	24901	VSTA	230	2	4360	line_36	35.3%	581	39	1538	ALBERHIL - VALLEYSC 500 kV Ckt 1
25666	EL CASCO	230	24132	SANBRDNO	230	1	4360	line_36	23.7%	390	-11	1034	ALBERHIL - VALLEYSC 500 kV Ckt 1

B. ISO Cluster 7 Phase I 2019 case:

1. No overloaded facilities were found in the study area (West of Devers) under Normal operating conditions. All transformers and transmission lines were operating within their normal ratings. One key observation here is that Alberhill–Valley 500 kV line is loaded to 98.8%. This line was previously overloaded (103%) in the SCE proposed Project scenario.

Option 1A--Cluster 7 Phase I + IID - ISO 1400 MW export
New 500 kV Devers - Beaumont line, loop DV #1 into Beaumont, four new 230 kV Beaumont West circuits
Normal Operating conditions

Facility									Loading				
From Bus #	Name	kV	To Bus #	Name	kV	ck	Rated Amps	Outage	%	MW	MVAR	AMPS	Outage Description
24845	ALBERHIL	500	24138	SERRANO	500	1	3000	base	84.6%	2245	45	2537	Base system (n-0)
24845	ALBERHIL	500	24151	VALLEYSC	500	1	3000	base	98.8%	-2623	-64	2965	Base system (n-0)
25014	BEAUMONT	500	24151	VALLEYSC	500	1	3000	base	41.7%	1091	-214	1252	Base system (n-0)
24801	DEVERS	500	25014	BEAUMONT	500	1	3000	base	60.4%	1613	20	1813	Base system (n-0)
24801	DEVERS	500	25014	BEAUMONT	500	2	3000	base	60.4%	1613	20	1813	Base system (n-0)
24801	DEVERS	500	24151	VALLEYSC	500	2	3000	base	52.3%	1396	-62	1570	Base system (n-0)
25014	BEAUMONT	500	25016	BEAUMONT	230	1	1120 MVA	base	63.4%	708	27	798	Base system (n-0)
25014	BEAUMONT	500	25016	BEAUMONT	230	2	1120 MVA	base	63.4%	708	27	798	Base system (n-0)
25014	BEAUMONT	500	25016	BEAUMONT	230	3	1120 MVA	base	63.4%	708	27	798	Base system (n-0)
25016	BEAUMONT	230	25666	EL CASCO	230	1	3231	base	36.8%	442	-50	1188	Base system (n-0)
25016	BEAUMONT	230	24132	SANBRDNO	230	1	3231	base	39.1%	470	-52	1262	Base system (n-0)
25016	BEAUMONT	230	24901	VSTA	230	1	3231	base	50.1%	606	-27	1618	Base system (n-0)
25016	BEAUMONT	230	24901	VSTA	230	2	3231	base	50.1%	606	-27	1618	Base system (n-0)
25666	EL CASCO	230	24132	SANBRDNO	230	1	3231	base	27.3%	324	-70	881	Base system (n-0)

2. No overloaded facilities were found in the study area under Single contingency conditions. About 200 contingencies were evaluated. This larger number of contingencies was identified in the ISO-posted contingency file used for the Cluster 7 interconnection study. The Alberhill–Valley loading of 98.8% actually went down to 65% under the worst Single contingency condition (outage of the Beaumont–Vista line). The highest loading was 91% on Devers-Beaumont line when the second Devers–Beaumont line was taken out of service.

Option 1A--Cluster 7 Phase I + IID - ISO 1400 MW export
New 500 kV Devers - Beaumont line, loop DV #1 into Beaumont, four new 230 kV Beaumont West circuits
Single Contingency conditions

Facility									Loading				
From Bus #	Name	kV	To Bus #	Name	kV	ck	Rated Amps	Worst Outage	%	MW	MVAR	AMPS	Worst Outage Description
24845	ALBERHIL	500	24138	SERRANO	500	1	4800	line_1405	56.3%	2383	54	2702	BEAUMONT - VSTA 230 kV Ckt 1
24845	ALBERHIL	500	24151	VALLEYSC	500	1	4800	line_1405	65.2%	-2761	-73	3131	BEAUMONT - VSTA 230 kV Ckt 1
25014	BEAUMONT	500	25016	BEAUMONT	230	1	1680 MVA	line_238	72.2%	1170	320	1388	ALBERHIL 500.0 to VALLEYSC 500.0 Circuit 1
25014	BEAUMONT	500	25016	BEAUMONT	230	2	1680 MVA	line_238	72.2%	1170	320	1388	ALBERHIL 500.0 to VALLEYSC 500.0 Circuit 1
25014	BEAUMONT	500	25016	BEAUMONT	230	3	1680 MVA	line_238	72.2%	1170	320	1388	ALBERHIL 500.0 to VALLEYSC 500.0 Circuit 1
25014	BEAUMONT	500	24151	VALLEYSC	500	1	3300	line_225	77.4%	2219	-324	2554	DEVERS 500.0 to VALLEYSC 500.0 Circuit 2
25016	BEAUMONT	230	25666	EL CASCO	230	1	4360	line_238	44.9%	696	8	1957	ALBERHIL 500.0 to VALLEYSC 500.0 Circuit 1
25016	BEAUMONT	230	24132	SANBRDNO	230	1	4360	line_238	51.6%	800	37	2250	ALBERHIL 500.0 to VALLEYSC 500.0 Circuit 1
25016	BEAUMONT	230	24901	VSTA	230	1	4360	line_238	65.2%	1006	99	2842	ALBERHIL 500.0 to VALLEYSC 500.0 Circuit 1
25016	BEAUMONT	230	24901	VSTA	230	2	4360	line_238	65.2%	1006	99	2842	ALBERHIL 500.0 to VALLEYSC 500.0 Circuit 1
24801	DEVERS	500	25014	BEAUMONT	500	1	3300	line_1401	91.3%	2662	120	3013	DEVERS - BEAUMONT 500 kV Ckt 2
24801	DEVERS	500	25014	BEAUMONT	500	2	3300	line_1400	91.3%	2662	120	3013	DEVERS - BEAUMONT 500 kV Ckt 1
24801	DEVERS	500	24151	VALLEYSC	500	2	3300	line_1402	73.7%	2149	-61	2433	BEAUMONT - VALLEYSC 500 kV Ckt 1
25666	EL CASCO	230	24132	SANBRDNO	230	1	4360	line_238	37.3%	576	-46	1627	ALBERHIL 500.0 to VALLEYSC 500.0 Circuit 1

This scenario satisfies the operational requirements under the highest queued generation level that could be possible (but determined to be improbable) in 2019 and beyond.

Double contingencies were not run for the "No Project" Options; however, expected results would show overloading of facilities for which the common mitigation is to drop generation as well as load if necessary. This mitigation is allowed under NERC planning criteria for double contingencies.

Option #1B Results

A. **ISO 2024 Reliability Case**

1. Normal Operating Conditions results. No overloaded facilities were found under normal operating conditions in the West of Devers study area. All transformers and transmission lines were operating within their normal ratings. Key observations:
    a. Four (4) Valley 500/115 kV banks are loaded to 75-78%.
    b. Two (2) Devers-Beaumont 500 kV lines loaded to 69%.
    c. Redbluff-Devers No. 1 500 kV line is loaded to 53%.
    d. Redbluff-Devers No. 2 500 kV line is loaded to 48%.

Option 1B--ISO24Reliability + IID - ISO 1400 MW export

Devers - Valley 500 kV circuits #1 and # 2 loop into Beaumont 500 kV

Normal Operating conditions

Facility									Loading				
From Bus #	Name	kV	To Bus #	Name	kV	ck	Rated Amps	Outage	%	MW	MVAR	AMPS	Outage Description
24845	ALBERHIL	500	24138	SERRANO	500	1	3000	base	34.3%	911	73	1023	Base system (n-0)
24845	ALBERHIL	500	24151	VALLEYSC	500	1	3000	base	50.3%	-1345	-92	1509	Base system (n-0)
25014	BEAUMONT	500	24151	VALLEYSC	500	1	3000	base	44.3%	1195	-11	1328	Base system (n-0)
25014	BEAUMONT	500	24151	VALLEYSC	500	2	3000	base	44.3%	1195	-11	1328	Base system (n-0)
24801	DEVERS	500	25014	BEAUMONT	500	1	3000	base	68.8%	1865	119	2063	Base system (n-0)
24801	DEVERS	500	25014	BEAUMONT	500	2	3000	base	68.8%	1865	119	2063	Base system (n-0)
25014	BEAUMONT	500	25016	BEAUMONT	230	1	1120 MVA	base	39.5%	442	2	491	Base system (n-0)
25014	BEAUMONT	500	25016	BEAUMONT	230	2	1120 MVA	base	39.5%	442	2	491	Base system (n-0)
25014	BEAUMONT	500	25016	BEAUMONT	230	3	1120 MVA	base	39.5%	442	2	491	Base system (n-0)
25016	BEAUMONT	230	25666	EL CASCO	230	1	3231	base	28.7%	351	-22	926	Base system (n-0)
25016	BEAUMONT	230	24132	SANBRDNO	230	1	3231	base	23.2%	284	-25	750	Base system (n-0)
25016	BEAUMONT	230	24901	VSTA	230	1	3231	base	28.2%	346	-18	912	Base system (n-0)
25016	BEAUMONT	230	24901	VSTA	230	2	3231	base	28.2%	346	-18	912	Base system (n-0)
25666	EL CASCO	230	24132	SANBRDNO	230	1	3231	base	16.8%	202	-37	542	Base system (n-0)

2. Single Contingency Operating Conditions results
    a. Worst Single Outage Condition. An outage of the Devers–Beaumont 500 kV #1 or #2 line resulted as the worst single contingency (N-1) outage. The remaining circuit will be **Over-loaded** by 18.4% of its emergency rating.
    b. An outage of any of the four (4) Valley 500/115 kV causes an overload on the remaining transformer banks.

Option 1B--ISO24Reliability + IID - ISO 1400 MW export														
Devers - Valley 500 kV circuits #1 and # 2 loop into Beaumont 500 kV														
Single Contingency Conditions														
Facility									Loading					
From Bus #	Name	kV	To Bus #	Name	kV	ck	Rated Amps	Worst Outage	%	MW	MVAR	AMPS	Worst Outage description	
24845	ALBERHIL	500	24138	SERRANO	500	1	4800	line_55	24.8%	1055	75	1188	MIRALOMA - SERRANO 500 kV Ckt 2	
24845	ALBERHIL	500	24151	VALLEYSC	500	1	4800	line_55	34.9%	-1488	-95	1676	MIRALOMA - SERRANO 500 kV Ckt 2	
25014	BEAUMONT	500	24151	VALLEYSC	500	1	3300	line_1402a	75.2%	2223	42	2481	BEAUMONT - VALLEYSC 500 kV Ckt 2	
25014	BEAUMONT	500	24151	VALLEYSC	500	2	3300	line_1402	75.2%	2223	42	2481	BEAUMONT - VALLEYSC 500 kV Ckt 1	
24801	DEVERS	500	25014	BEAUMONT	500	1	3300	line_1401	118.4%	3492	410	3906	DEVERS - BEAUMONT 500 kV Ckt 2	
24801	DEVERS	500	25014	BEAUMONT	500	2	3300	line_1400	118.4%	3492	410	3906	DEVERS - BEAUMONT 500 kV Ckt 1	
25014	BEAUMONT	500	25016	BEAUMONT	230	1	1680 MVA	line_36	43.3%	719	106	801	ALBERHIL - VALLEYSC 500 kV Ckt 1	
25014	BEAUMONT	500	25016	BEAUMONT	230	2	1680 MVA	line_36	43.3%	719	106	801	ALBERHIL - VALLEYSC 500 kV Ckt 1	
25014	BEAUMONT	500	25016	BEAUMONT	230	3	1680 MVA	line_36	43.3%	719	106	801	ALBERHIL - VALLEYSC 500 kV Ckt 1	
25016	BEAUMONT	230	25666	EL CASCO	230	1	4360	line_36	32.1%	530	7	1401	ALBERHIL - VALLEYSC 500 kV Ckt 1	
25016	BEAUMONT	230	24132	SANBRDNO	230	1	4360	line_36	29.6%	488	15	1290	ALBERHIL - VALLEYSC 500 kV Ckt 1	
25016	BEAUMONT	230	24901	VSTA	230	1	4360	line_36	34.6%	570	29	1507	ALBERHIL - VALLEYSC 500 kV Ckt 1	
25016	BEAUMONT	230	24901	VSTA	230	2	4360	line_36	34.6%	570	29	1507	ALBERHIL - VALLEYSC 500 kV Ckt 1	
25666	EL CASCO	230	24132	SANBRDNO	230	1	4360	line_36	23.2%	381	-22	1011	ALBERHIL - VALLEYSC 500 kV Ckt 1	

B. Option 1B ISO Cluster 7 Phase I Case

1. Normal operating conditions results. No overloaded facilities were found under normal operating conditions in the West of Devers study area. All transformers and transmission lines were operating within their normal ratings. Key observations:
   a. Alberhill–Valley 500 kV line is loaded to 94%.
   b. (2) Devers-Beaumont 500 kV lines loaded to 85%.
   c. Redbluff-Devers No. 1 500 kV line is loaded to 75%.
   d. Redbluff-Devers No. 2 500 kV line is loaded to 67%.

Option 1B--Cluster 7 Phase I + IID - ISO 1400 MW export													
Devers - Valley 500 kV circuits #1 and # 2 loop into Beaumont 500 kV													
Normal Operating conditions													
Facility									Loading				
From Bus #	Name	kV	To Bus #	Name	kV	ck	Rated Amps	Outage	%	MW	MVAR	AMPS	Outage Description
24845	ALBERHIL	500	24138	SERRANO	500	1	3000	base	79.8%	2118	-7	2393	Base system (n-0)
24845	ALBERHIL	500	24151	VALLEYSC	500	1	3000	base	94.0%	-2496	-12	2820	Base system (n-0)
25014	BEAUMONT	500	24151	VALLEYSC	500	1	3000	base	45.8%	1177	-294	1374	Base system (n-0)
25014	BEAUMONT	500	24151	VALLEYSC	500	2	3000	base	45.8%	1177	-294	1374	Base system (n-0)
24801	DEVERS	500	25014	BEAUMONT	500	1	3000	base	85.2%	2258	49	2556	Base system (n-0)
24801	DEVERS	500	25014	BEAUMONT	500	2	3000	base	85.2%	2258	49	2556	Base system (n-0)
25014	BEAUMONT	500	25016	BEAUMONT	230	1	1120 MVA	base	64.1%	714	78	814	Base system (n-0)
25014	BEAUMONT	500	25016	BEAUMONT	230	2	1120 MVA	base	64.1%	714	78	814	Base system (n-0)
25014	BEAUMONT	500	25016	BEAUMONT	230	3	1120 MVA	base	64.1%	714	78	814	Base system (n-0)
25016	BEAUMONT	230	25666	EL CASCO	230	1	3231	base	36.0%	447	-20	1163	Base system (n-0)
25016	BEAUMONT	230	24132	SANBRDNO	230	1	3231	base	38.1%	473	-12	1231	Base system (n-0)
25016	BEAUMONT	230	24901	VSTA	230	1	3231	base	49.2%	611	19	1590	Base system (n-0)
25016	BEAUMONT	230	24901	VSTA	230	2	3231	base	49.2%	611	19	1590	Base system (n-0)
25666	EL CASCO	230	24132	SANBRDNO	230	1	3231	base	26.6%	328	-39	859	Base system (n-0)

2. Single Contingency operating conditions results.

   a. Worst Single Outage Condition. An outage of the Devers – Beaumont 500 kV #1 or #2 resulted to be the worst single outage. The remaining circuit will be **Over-loaded** by 45.3% of its emergency rating.

Option 1B--Cluster 7 Phase I + IID - ISO 1400 MW export Devers - Valley 500 kV circuits #1 and # 2 loop into Beaumont 500 kV Single Contingency conditions														
Facility								Worst Outage	Loading				Worst Outage description
From Bus #	Name	kV	To Bus #	Name	kV	ck	Rated Amps		%	MW	MVAR	AMPS	
24845	ALBERHIL	500	24138	SERRANO	500	1	4800	line_1405	53.4%	2262	9	2564	BEAUMONT - VSTA 230 kV Ckt 1
24845	ALBERHIL	500	24151	VALLEYSC	500	1	4800	line_1405	62.3%	-2640	-28	2992	BEAUMONT - VSTA 230 kV Ckt 1
25014	BEAUMONT	500	24151	VALLEYSC	500	1	3300	line_1402b	77.5%	2187	-477	2556	BEAUMONT - VALLEYSC 500 kV Ckt 2
25014	BEAUMONT	500	24151	VALLEYSC	500	2	3300	line_1402	77.5%	2187	-477	2556	BEAUMONT - VALLEYSC 500 kV Ckt 1
24801	DEVERS	500	25014	BEAUMONT	500	1	3300	line_1401	145.3%	4178	343	4796	DEVERS - BEAUMONT 500 kV Ckt 2
24801	DEVERS	500	25014	BEAUMONT	500	2	3300	line_1400	145.3%	4178	343	4796	DEVERS - BEAUMONT 500 kV Ckt 1
25014	BEAUMONT	500	25016	BEAUMONT	230	1	1680 MVA	line_238	73.6%	1184	355	1412	ALBERHIL 500.0 to VALLEYSC 500.0 Circuit 1
25014	BEAUMONT	500	25016	BEAUMONT	230	2	1680 MVA	line_238	73.6%	1184	355	1412	ALBERHIL 500.0 to VALLEYSC 500.0 Circuit 1
25014	BEAUMONT	500	25016	BEAUMONT	230	3	1680 MVA	line_238	73.6%	1184	355	1412	ALBERHIL 500.0 to VALLEYSC 500.0 Circuit 1
25016	BEAUMONT	230	25666	EL CASCO	230	1	4360	line_238	43.8%	704	33	1909	ALBERHIL 500.0 to VALLEYSC 500.0 Circuit 1
25016	BEAUMONT	230	24132	SANBRDNO	230	1	4360	line_238	50.4%	808	72	2196	ALBERHIL 500.0 to VALLEYSC 500.0 Circuit 1
25016	BEAUMONT	230	24901	VSTA	230	1	4360	line_238	63.9%	1020	137	2785	ALBERHIL 500.0 to VALLEYSC 500.0 Circuit 1
25016	BEAUMONT	230	24901	VSTA	230	2	4360	line_238	63.9%	1020	137	2785	ALBERHIL 500.0 to VALLEYSC 500.0 Circuit 1
25666	EL CASCO	230	24132	SANBRDNO	230	1	4360	line_238	36.5%	584	-17	1590	ALBERHIL 500.0 to VALLEYSC 500.0 Circuit 1

Option #2 Results

Option #2, wherein the existing 220 kV circuits and configuration from Devers to El Casco, San Bernardino and Vista were retained, added a 2nd 500 kV, 2B-2156 circuit from Valley to Serrano (refer to Figure B2). The following tables display the result line flows for Normal conditions and Single contingency power flow runs. Note that the power flow analysis assumed a 1400 MW energy import from the Imperial Irrigation District.

Existing WOD circuits w/reactors--IID exports to ISO 1400 MW--2024 Reliability case Normal Operating conditions													
Facility								Worst Outage	Loading				Worst Outage Description
From Bus #	Name	kV	To Bus #	Name	kV	ck	Rated Amps		%	MW	MVAR	AMPS	
24804	DEVERS	230	24941	ElCascoLR	230	1	1150	base	60.2%	276	22	692	Base system (n-0)
24804	DEVERS	230	24942	SBLR	230	1	798	base	66.4%	210	29	529	Base system (n-0)
24804	DEVERS	230	24943	Vista1LR	230	1	1150	base	59.3%	268	51	682	Base system (n-0)
24804	DEVERS	230	24944	Vista2LR	230	1	1240	base	69.4%	340	58	861	Base system (n-0)
25666	EL CASCO	230	24132	SANBRDNO	230	1	1150	base	29.2%	124	37	333	Base system (n-0)
24941	ElCascoLR	230	25666	EL CASCO	230	1	1150	base	61.5%	276	0	692	Base system (n-0)
24942	SBLR	230	24132	SANBRDNO	230	1	798	base	66.5%	210	13	529	Base system (n-0)
28311	TOT185HS	230	24901	VSTA	230	1	1150	base	59.4%	267	24	682	Base system (n-0)
24943	Vista1LR	230	28311	TOT185HS	230	1	1150	base	59.3%	268	30	682	Base system (n-0)
24944	Vista2LR	230	24901	VSTA	230	2	1240	base	69.6%	340	47	861	Base system (n-0)

Existing WOD circuits w/reactors--IID exports to ISO 1400 MW--2024 Reliability case													
Single Contingency conditions													
Facility									Loading				
From	Name	kV	To	Name	kV	ck	Rated Amps	Worst Outage	%	MW	MVAR	AMPS	Worst Outage Description
24804	DEVERS	230	24941	ElCascoLR	230	1	1150	line_27	69.4%	318	35	798	Line DEVERS - VISTA (LR) 230 kV Ckt 2
24804	DEVERS	230	24942	SBLR	230	1	798	line_20	80.2%	252	41	638	Line DEVERS - EL CASCO (LR) 230 kV
24804	DEVERS	230	24943	Vista1LR	230	1	1150	line_27	70.2%	317	65	807	Line DEVERS - VISTA (LR) 230 kV Ckt 2
24804	DEVERS	230	24944	Vista2LR	230	1	1240	line_43	80.5%	392	70	998	Line DEVERS - VALLEYSC 500 kV Ckt 1
25666	EL CASCO	230	24132	SANBRDNO	230	1	1150	line_27	37.7%	165	31	432	Line DEVERS - VISTA (LR) 230 kV Ckt 2
24941	ElCascoLR	230	25666	EL CASCO	230	1	1150	line_27	70.5%	318	6	798	Line DEVERS - VISTA (LR) 230 kV Ckt 2
24942	SBLR	230	24132	SANBRDNO	230	1	798	line_20	80.2%	252	16	638	Line DEVERS - EL CASCO (LR) 230 kV
28311	TOT185HS	230	24901	VSTA	230	1	1150	line_27	70.2%	315	27	807	Line DEVERS - VISTA (LR) 230 kV Ckt 2
24943	Vista1LR	230	28311	TOT185HS	230	1	1150	line_27	70.2%	317	36	807	Line DEVERS - VISTA (LR) 230 kV Ckt 2
24944	Vista2LR	230	24901	VSTA	230	2	1240	line_43	80.6%	392	55	998	Line DEVERS - VALLEYSC 500 kV Ckt 1

The results using CAISO's 2024 Reliability case, with 1400 MW IID to ISO export, indicate no overloads under Normal as well as under Single contingency conditions. The highest loading under single contingency is on the Devers (Vista2LR)–Vista and Devers–San Bernardino lines, shown to be ~ 80% to 81% This means there is about 19% of additional capacity available to accommodate future growth.

The results using Cluster 7 Phase I base case, with 1400 MW IID to ISO export, shows some WOD overloaded circuits, the highest being 113% on one of the Devers–San Bernardino lines under Single contingency conditions. However, the 500 kV system shows no overloads under Normal as well as under Single contingency conditions. The following Tables display the resulting line flows for Normal conditions and single contingency power flow runs.

Existing WOD circuits w/reactors--IID exports to ISO 1400 MW--Cluster 7 Phase I case													
Normal Operating conditions													
Facility									Loading				
From Bus #	Name	kV	To Bus #	Name	kV	ck	Rated Amps	Worst Outage	%	MW	MVAR	AMPS	Worst Outage Description
24804	DEVERS	230	24941	ElCascoLR	230	1	1150	base	81.5%	369	19	937	Base system (n-0)
24804	DEVERS	230	24942	SBLR	230	1	798	base	94.5%	295	22	752	Base system (n-0)
24804	DEVERS	230	24943	Vista1LR	230	1	1150	base	59.9%	267	48	689	Base system (n-0)
24804	DEVERS	230	24944	Vista2LR	230	1	1240	base	93.6%	453	58	1160	Base system (n-0)
25666	EL CASCO	230	24132	SANBRDNO	230	1	1150	base	54.6%	244	-11	628	Base system (n-0)
24941	ElCascoLR	230	25666	EL CASCO	230	1	1150	base	81.5%	369	-21	937	Base system (n-0)
24132	SANBRDNO	230	24942	SBLR	230	1	798	base	94.5%	-284	61	749	Base system (n-0)
28311	TOT185HS	230	24901	VSTA	230	1	1150	base	93.5%	416	7	1075	Base system (n-0)
24943	Vista1LR	230	28311	TOT185HS	230	1	1150	base	59.9%	267	27	689	Base system (n-0)
24944	Vista2LR	230	24901	VSTA	230	2	1240	base	93.6%	453	38	1160	Base system (n-0)

Existing WOD circuits w/reactors--IID exports to ISO 1400 MW--Cluster 7 Phase I case														
Single Contingency conditions														
Facility								Worst Outage	Loading					
From Bus #	Name	kV	To Bus #	Name	kV	ck	Rated Amps		%	MW	MVAR	AMPS		Worst Outage Description
24804	DEVERS	230	24941	ElCascoLR	230	1	1150	line_36	93.5%	420	44	1075		Line ALBERHIL - VALLEYSC 500 kV Ckt 1
24804	**DEVERS**	**230**	**24942**	**SBLR**	**230**	**1**	**798**	**line_20**	**112.7%**	**350**	**39**	**897**		**Line DEVERS - EL CASCO (LR) 230 kV**
24804	DEVERS	230	24943	Vista1LR	230	1	1150	line_27	73.9%	328	66	849		Line DEVERS - VISTA (LR) 230 kV Ckt 2
24804	**DEVERS**	**230**	**24944**	**Vista2LR**	**230**	**1**	**1240**	**line_36**	**108.4%**	**520**	**88**	**1345**		**Line ALBERHIL - VALLEYSC 500 kV Ckt 1**
25666	EL CASCO	230	24132	SANBRDNO	230	1	1150	line_27	66.5%	295	-23	765		Line DEVERS - VISTA (LR) 230 kV Ckt 2
24941	ElCascoLR	230	25666	EL CASCO	230	1	1150	line_36	93.5%	420	-8	1075		Line ALBERHIL - VALLEYSC 500 kV Ckt 1
24132	**SANBRDNO**	**230**	**24942**	**SBLR**	**230**	**1**	**798**	**line_20**	**112.7%**	**-334**	**84**	**893**		**Line DEVERS - EL CASCO (LR) 230 kV**
28311	**TOT185HS**	**230**	**24901**	**VSTA**	**230**	**1**	**1150**	**line_27**	**107.6%**	**476**	**11**	**1237**		**Line DEVERS - VISTA (LR) 230 kV Ckt 2**
24943	Vista1LR	230	28311	TOT185HS	230	1	1150	line_27	73.9%	328	33	849		Line DEVERS - VISTA (LR) 230 kV Ckt 2
24944	**Vista2LR**	**230**	**24901**	**VSTA**	**230**	**2**	**1240**	**line_36**	**108.4%**	**520**	**61**	**1345**		**Line ALBERHIL - VALLEYSC 500 kV Ckt 1**

Regarding overloading under single contingency conditions for Cluster 7 Phase I base case with 1400 MW of IID export (a worst case scenario), potential mitigation for the single contingency overload(s) may consist of the following:

1. Add more series reactors to reduce flow on the overloaded circuits
2. Add series “capacitors” in 500 kV lines to shift power away from the 230 kV system and on to 500 kV system
3. Use alternative conductor 795 DRAKE ACCR, remove series reactors, keep the new Valley–Serrano 500 kV line

Mitigation #1 may not be a good option as it is likely to cause voltage problems on the downstream system. From a planning perspective, adding series reactors should be avoided as much as possible as they weaken the system.

Mitigation #2 is a highly viable solution; however, it will not work in our situation because the Devers–Valley circuits get loaded to 98% of capacity when one of the two circuits is in an outage condition. Thus, there is no capacity available to transfer power from the 230 kV system. The third plot in the attachment shows the loading on Devers – Valley circuits after this outage takes place.

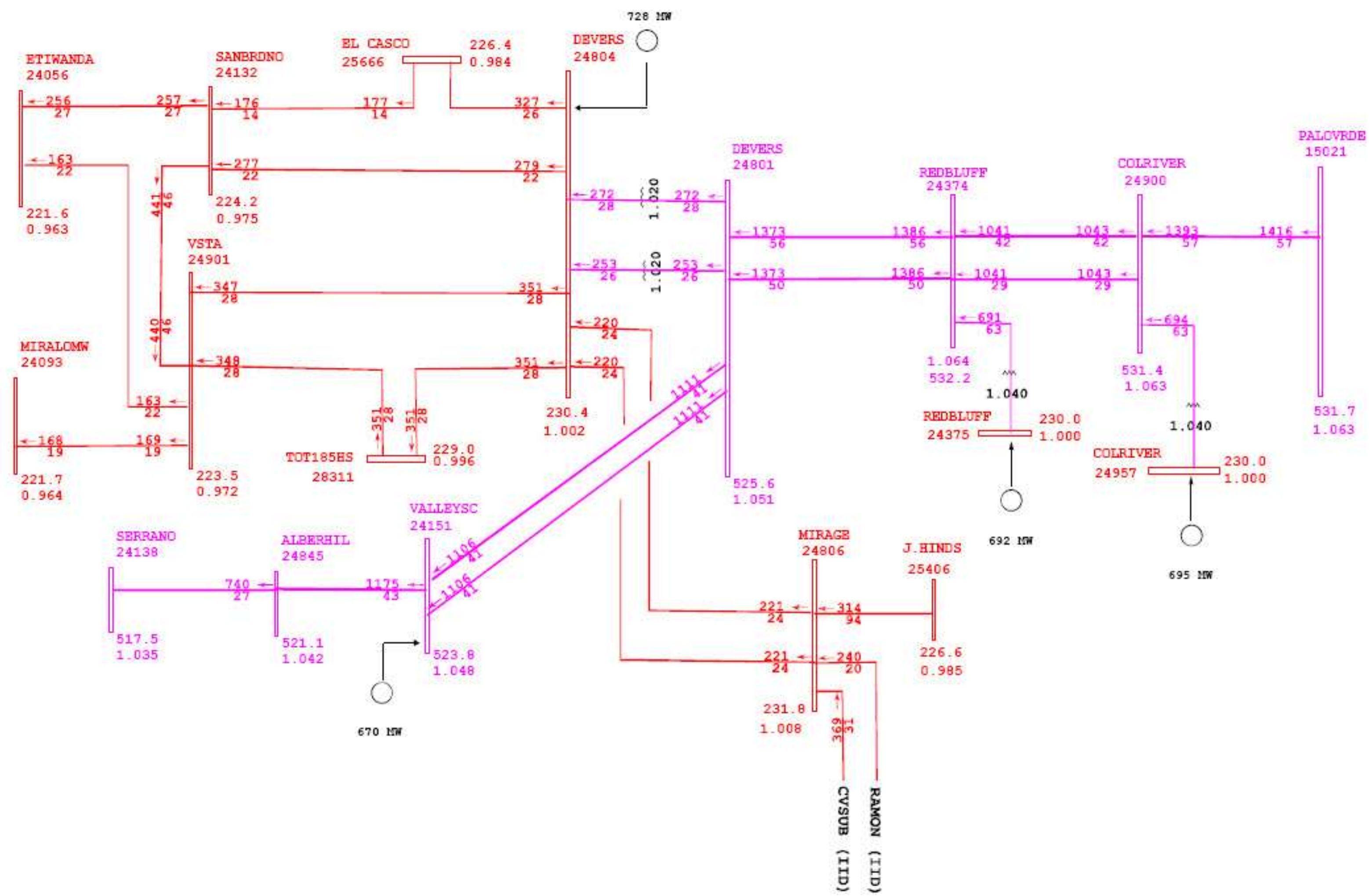
Mitigation #3 is a viable option and worth consideration.

Appendix C

Power Flow Plots

ZGLOBAL
Power Engineering & Energy Solutions

CASE #1--ISO 2024 Summer Peak Reliability Base Case

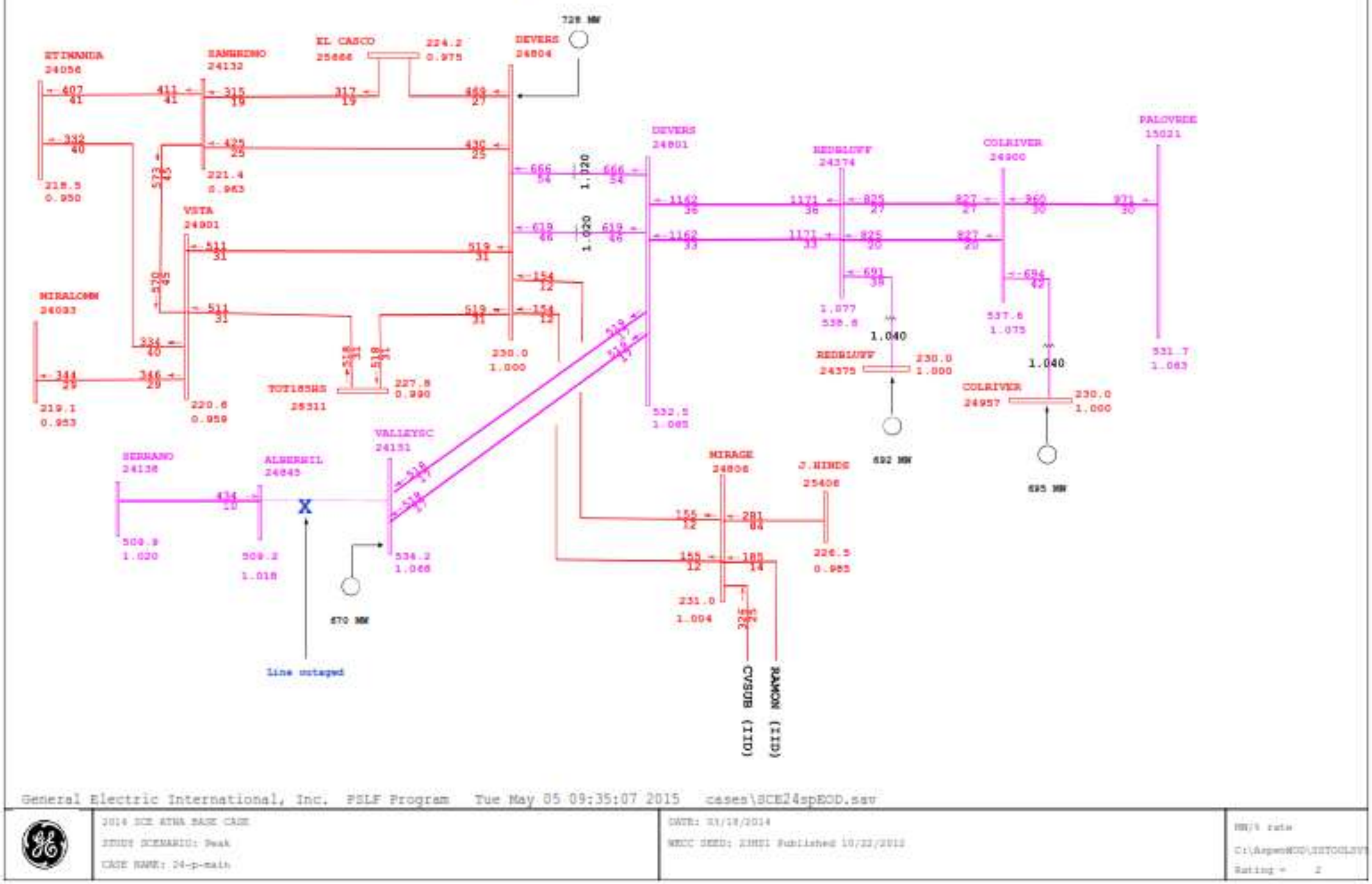


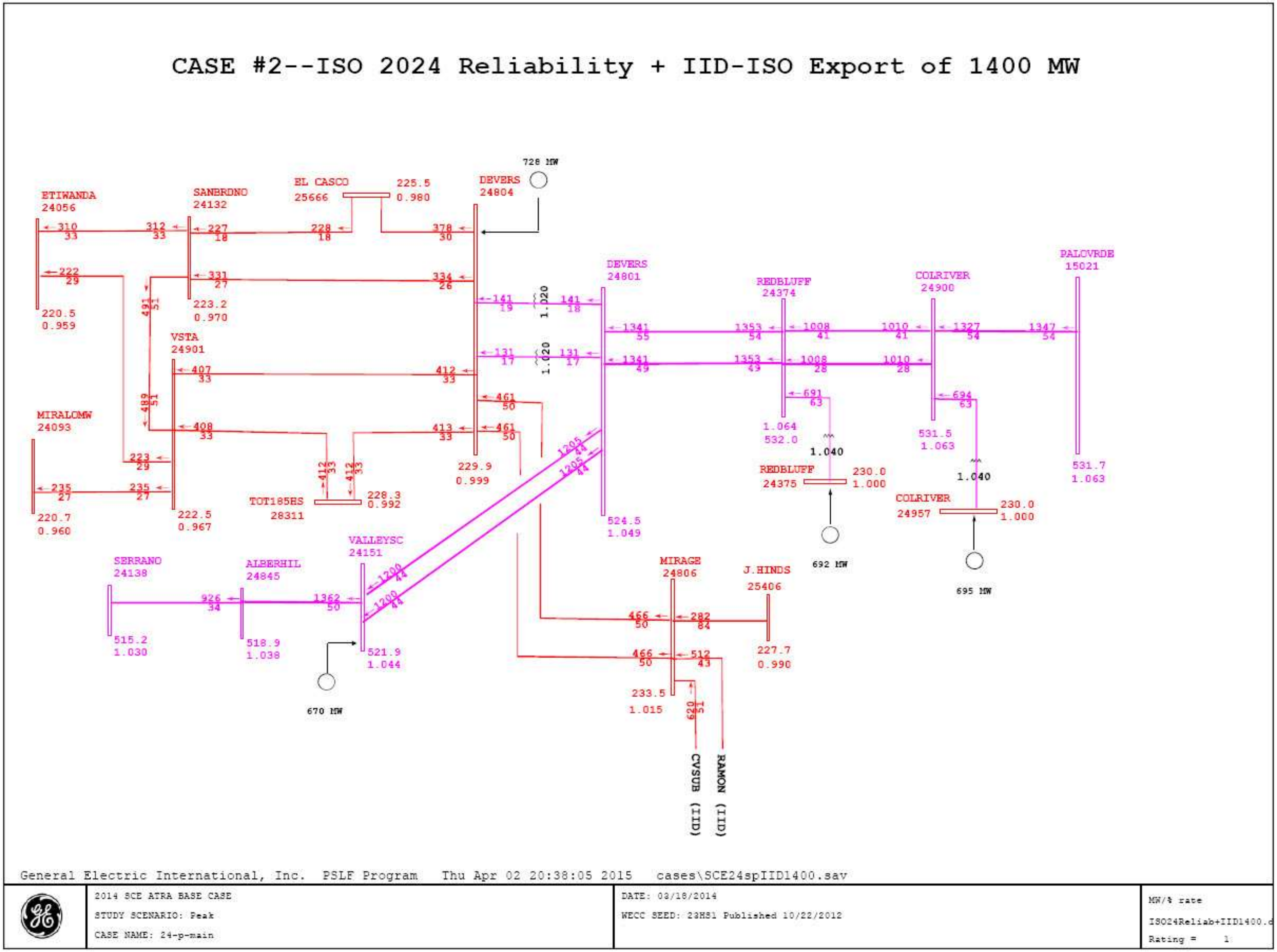
General Electric International, Inc. PSLF Program Thu Apr 02 20:33:40 2015 cases\SCE24spEOD.sav

GE	2014 SCE ATRA BASE CASE STUDY SCENARIO: Peak CASE NAME: 24-p-main	DATE: 03/18/2014 WECC SEED: 23HS1 Published 10/22/2012	MW/% rate ISO24Reliab.drw Rating = 1

CASE #1--ISO 2024 Summer Peak Reliability Base Case

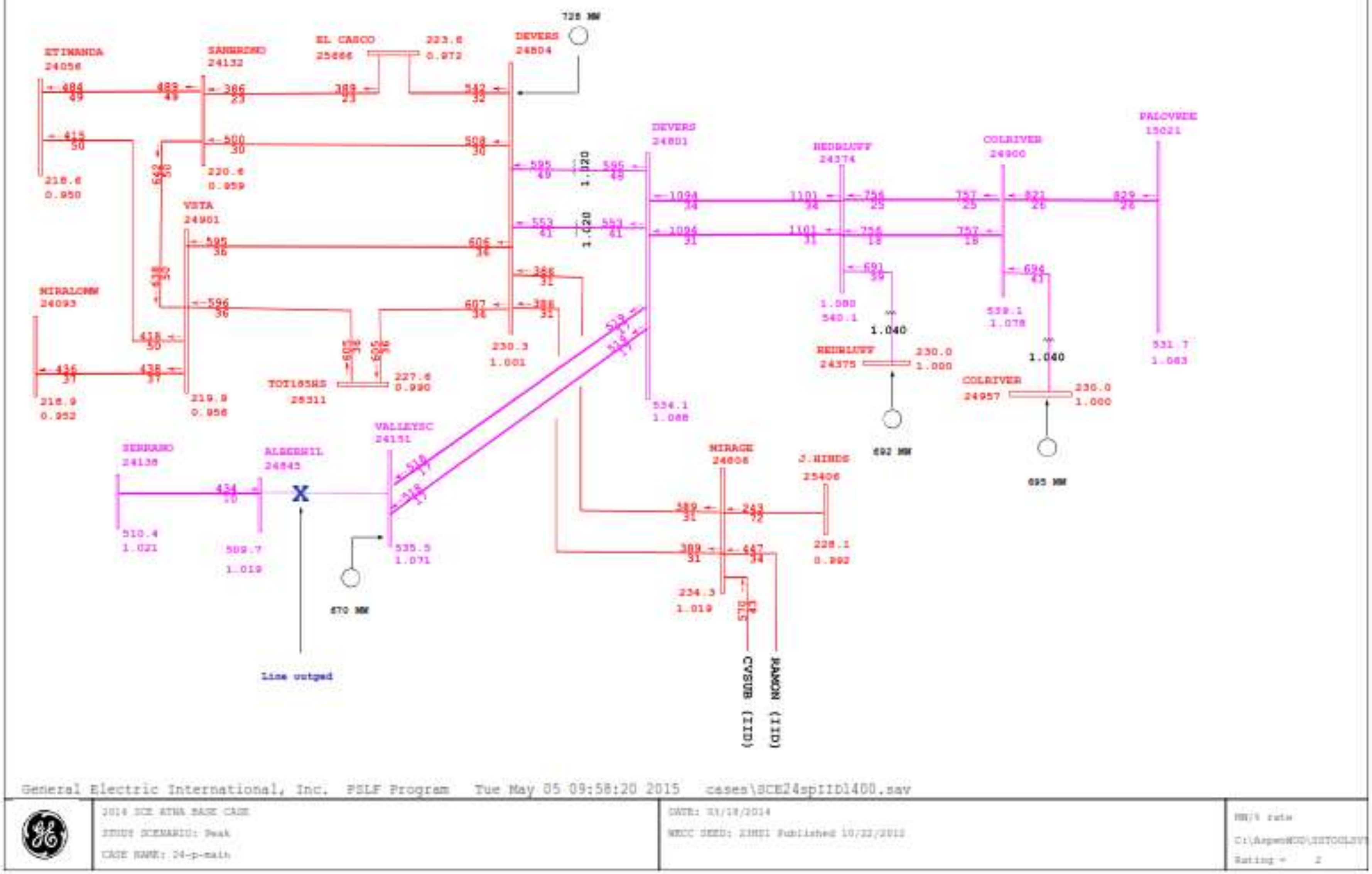
Alberhill - Valley 500 kV line out



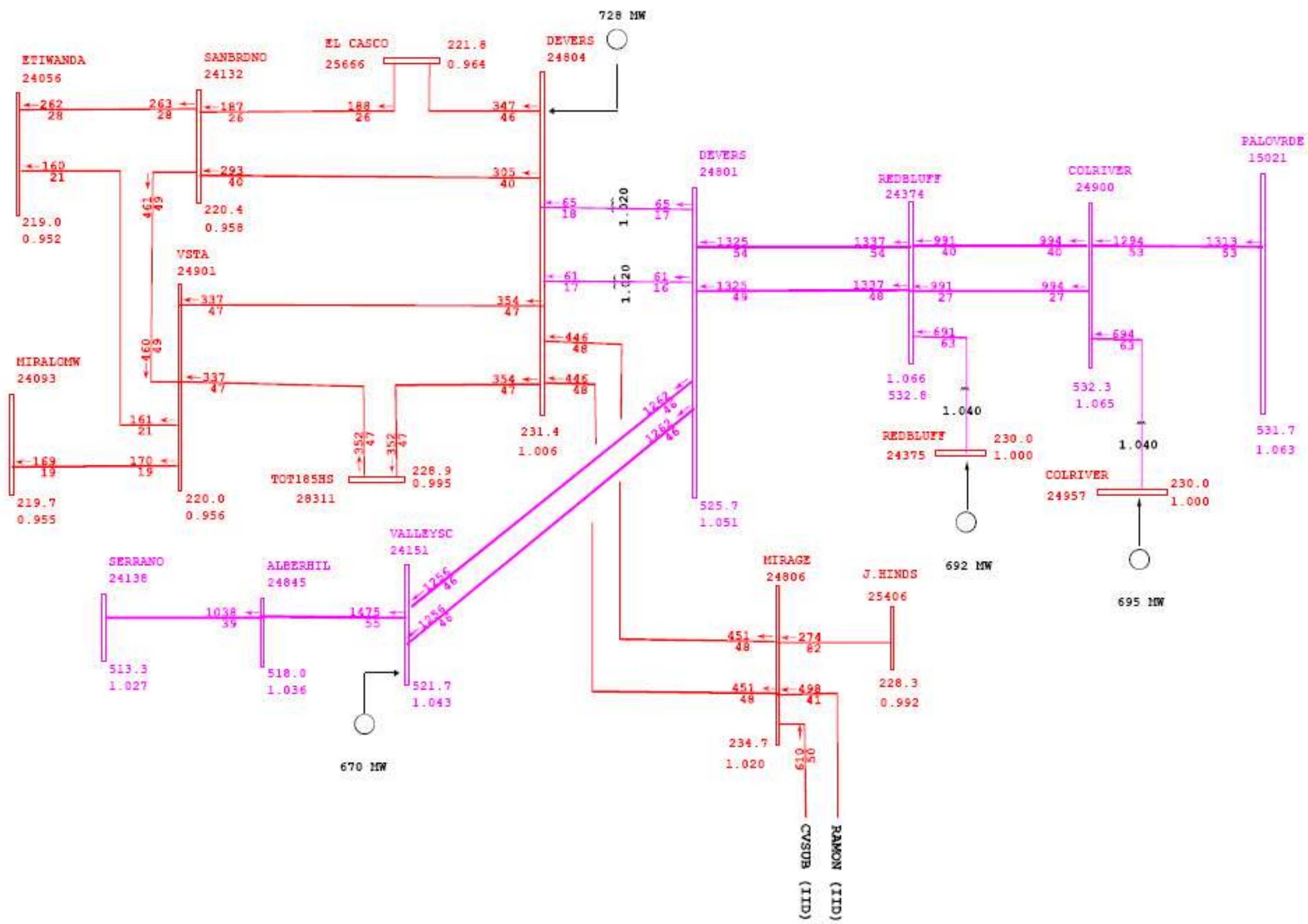

CASE #2--ISO 2024 Reliability + IID-ISO Export of 1400 MW
ETIWANDA 24056
SANBRDNO 24132
EL CASCO 25666
225.5 0.980
DEVERS 24804
728 MW
DEVERS 24801
REDBLUFF 24374
COLRIVER 24900
PALOVRDE 15021
VSTA 24901
MIRALOMW 24093
TOT185SS 28311
228.3 0.992
229.9 0.999
220.5 0.959
223.2 0.970
220.7 0.960
222.5 0.967
1.020
1.064 532.0
1.040
REDBLUFF 24375
230.0 1.000
692 MW
531.5 1.063
COLRIVER 24957
230.0 1.000
695 MW
531.7 1.063
524.5 1.049
SERRANO 24138
ALBERHIL 24845
VALLEYSC 24151
515.2 1.030
518.9 1.038
521.9 1.044
670 MW
MIRAGE 24806
J.HINDS 25406
233.5 1.015
227.7 0.990
CVSUB (IID)
RAMON (IID)
General Electric International, Inc. PSLF Program Thu Apr 02 20:38:05 2015 cases\SCE24spIID1400.sav
2014 SCE ATRA BASE CASE
STUDY SCENARIO: Peak
CASE NAME: 24-p-main
DATE: 03/18/2014
WECC SEED: 23HS1 Published 10/22/2012
MW/% rate
ISO24Reliab+IID1400.d
Rating = 1

CASE #2--ISO 2024 Reliability + IID-ISO Export of 1400 MW

Alberhill - Valley 500 kV line out



CASE #3--ISO 2024 Reliability + IID-ISO Export of 1400 MW + Alternate Conductor

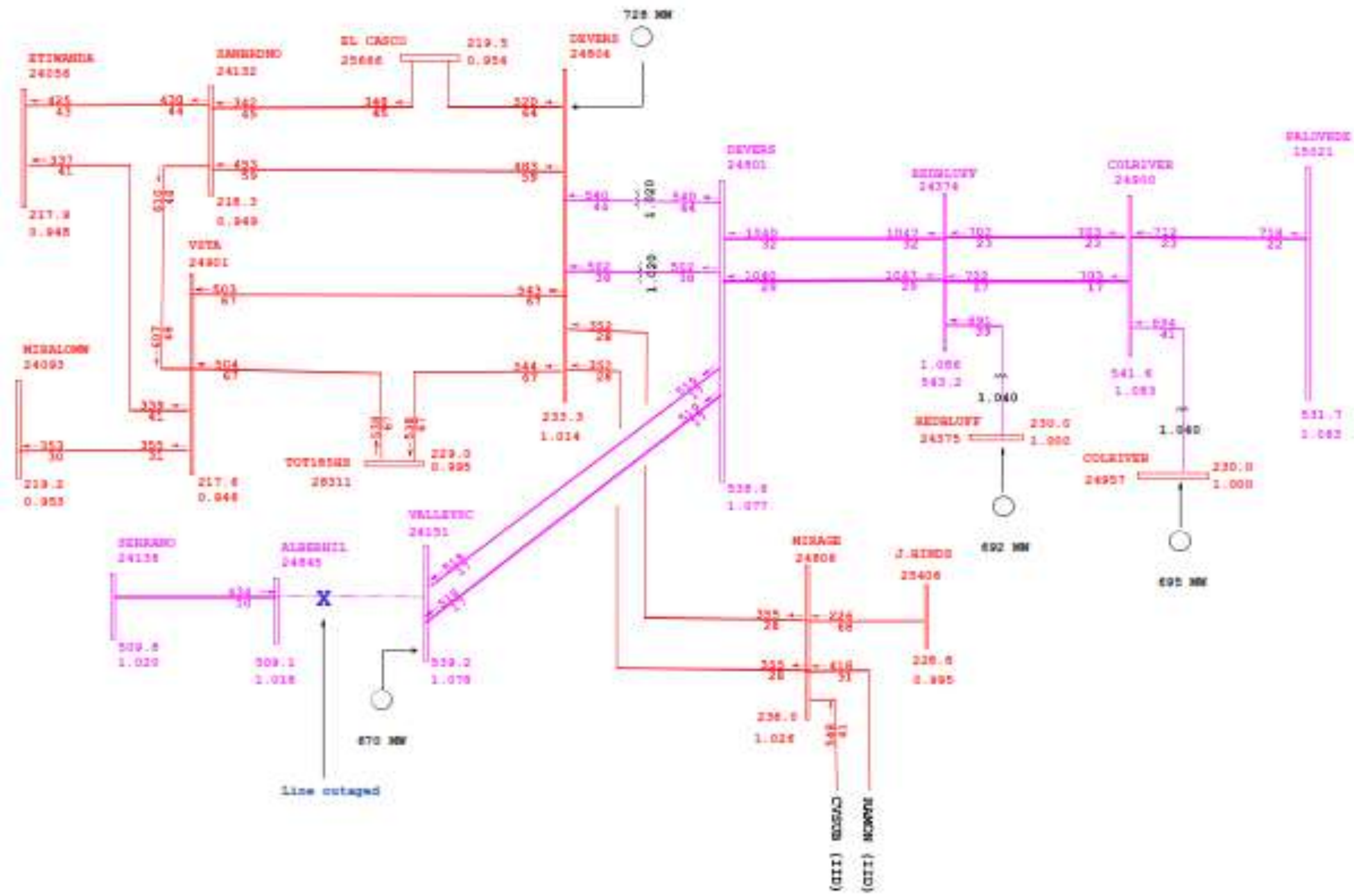


General Electric International, Inc. PSLF Program Thu Apr 02 20:41:13 2015 cases\SCE24spUP1IID1400.sav

	2014 SCE ATRA BASE CASE STUDY SCENARIO: Peak CASE NAME: 24-p-main	DATE: 03/18/2014 WECC SEED: 23HS1 Published 10/22/2012	MW/% rate ISO24Reliab+IID1400+A Rating = 1

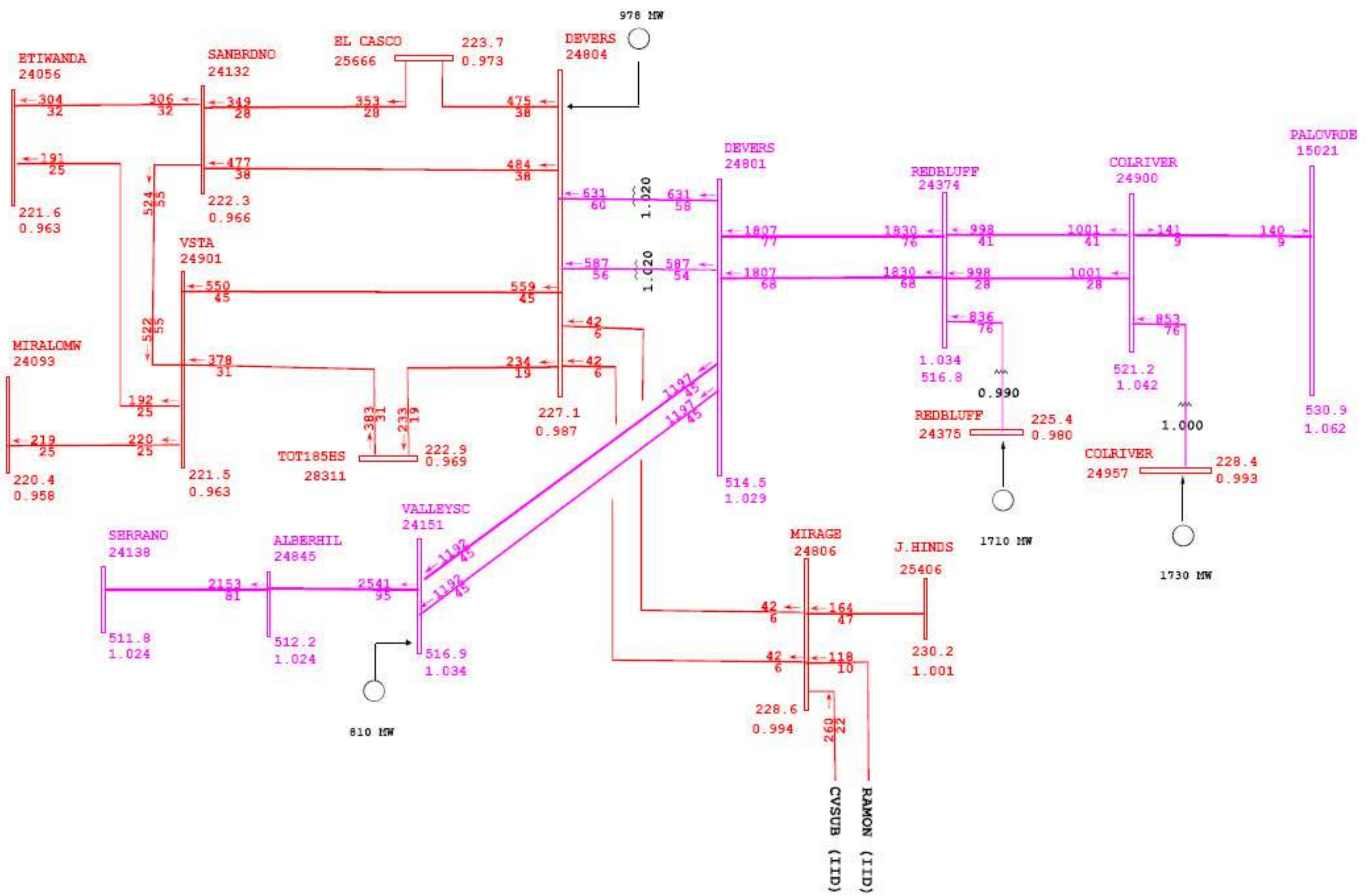
CASE #3--ISO 2024 Reliability + IID-ISO Export of 1400 MW + Alternate Conductor

Alberhill - Valley 500 kV line out



General Electric International, Inc. PSLF Program Tue May 05 10:54:18 2015 cases\SCE24spUP1IID1400.sav

CASE #4--ISO Cluster 7 Phase I (2019) case

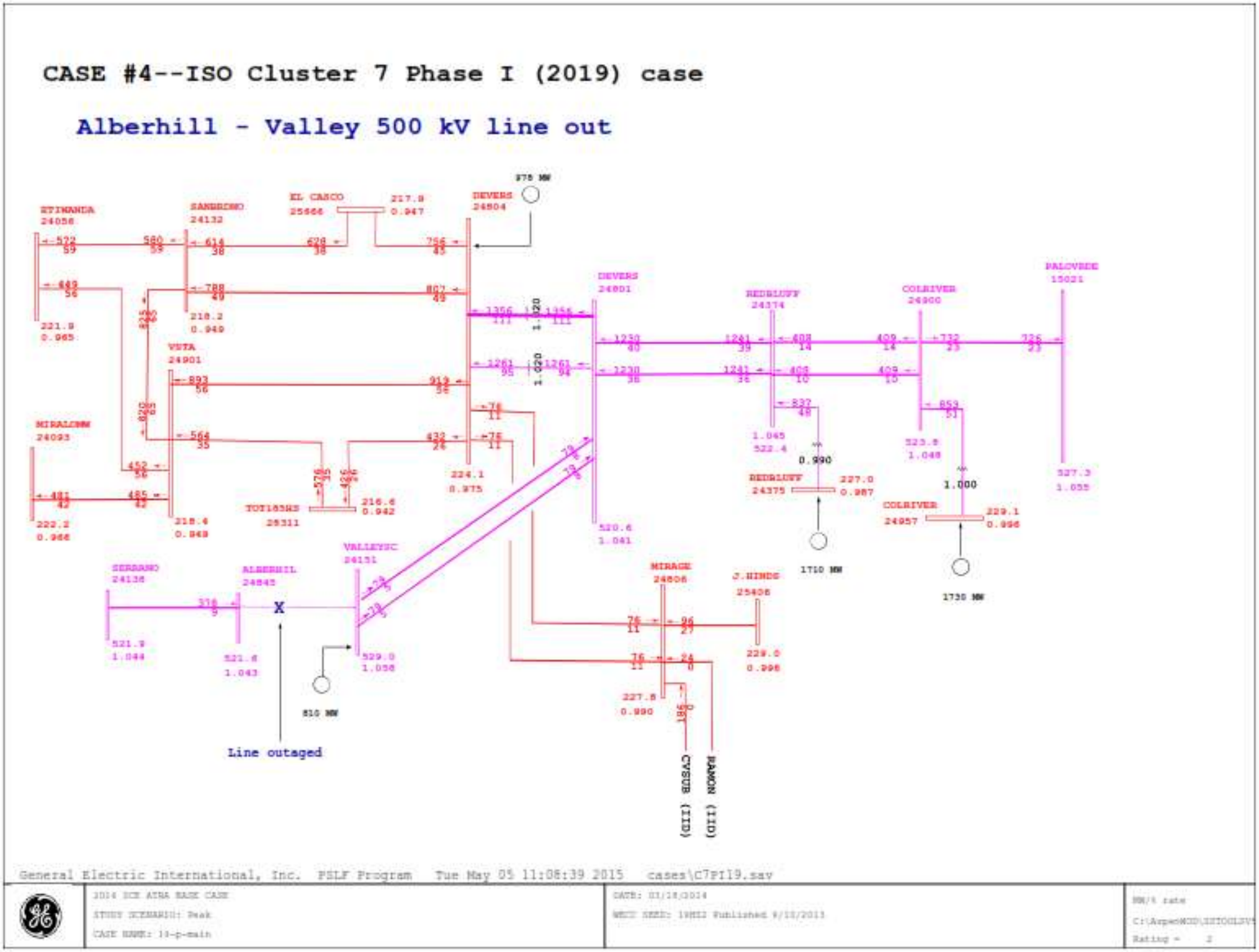


General Electric International, Inc. PSLF Program Thu Apr 02 20:44:14 2015 cases\C7PI19.sav

2014 SCE ATRA BASE CASE
STUDY SCENARIO: Peak
CASE NAME: 19-p-main

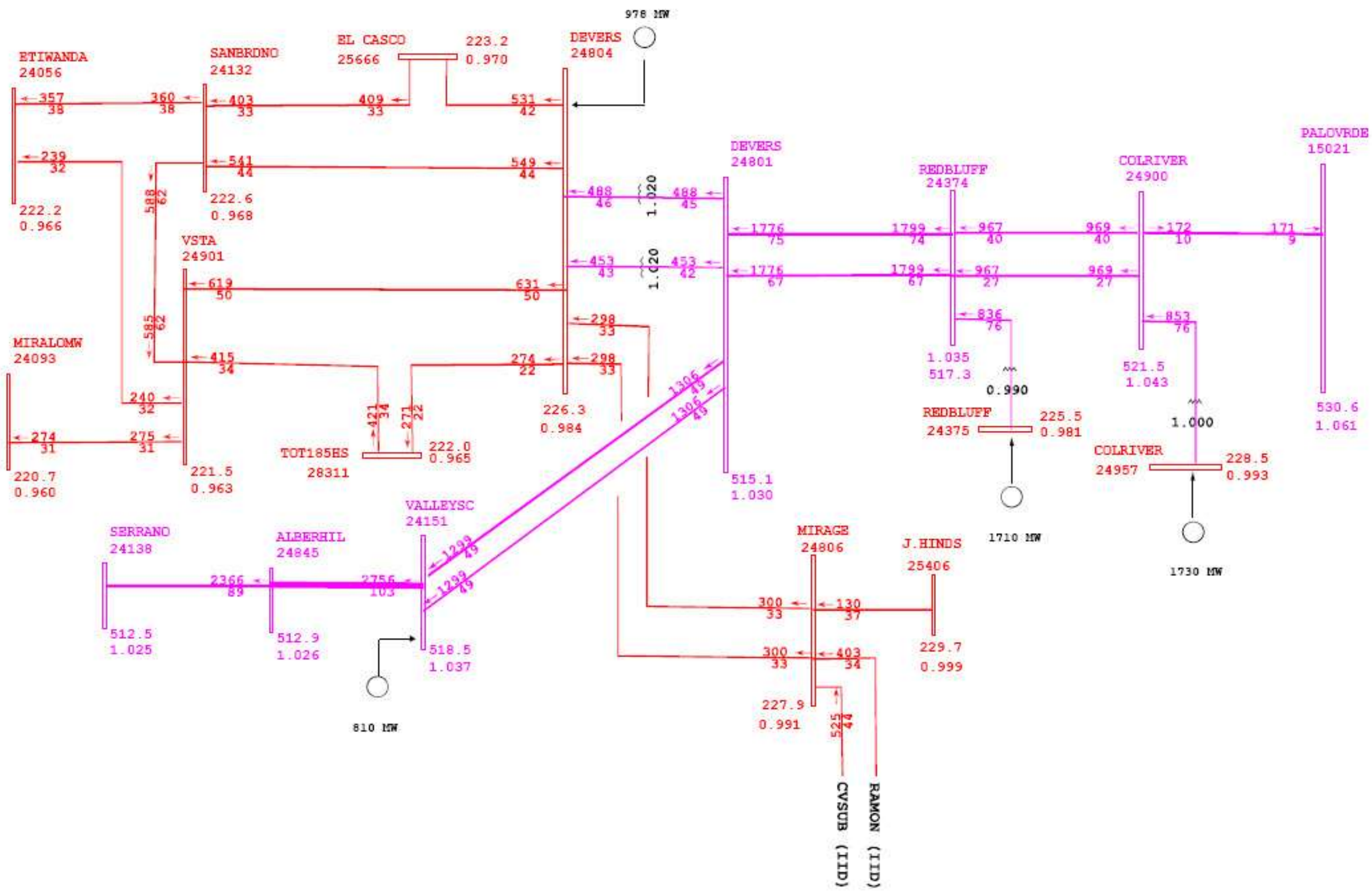
DATE: 03/18/2014
WECC SEED: 19HS2 Published 9/10/2013

MW/% rate
C7PhI.drw
Rating = 1


CASE #4--ISO Cluster 7 Phase I (2019) case
Alberhill - Valley 500 kV line out
ETIWANDA
24056
SANBRDNO
24132
EL CASCO
25666
DEVERS
24804
DEVERS
24801
REDBLUFF
24374
COLRIVER
24900
PALOVRDE
15021
VSTA
24901
MIRALOMA
24093
TOT185MS
25311
VALLEYSC
24151
SERRANO
24138
ALBERHIL
24845
MIRAGE
24806
J.HINDS
25406
REDBLUFF
24375
COLRIVER
24957
1710 MW
1730 MW
810 MW
0.990
1.000
Line outaged
X
CVSUB (IID)
RAMON (IID)
General Electric International, Inc. PSLF Program Tue May 05 11:08:39 2015 cases\C7PI19.sav

ZGLOBAL
Power Engineering & Energy Solutions

CASE #5--ISO Cluster 7 Phase I + IID-ISO Export of 1400 MW

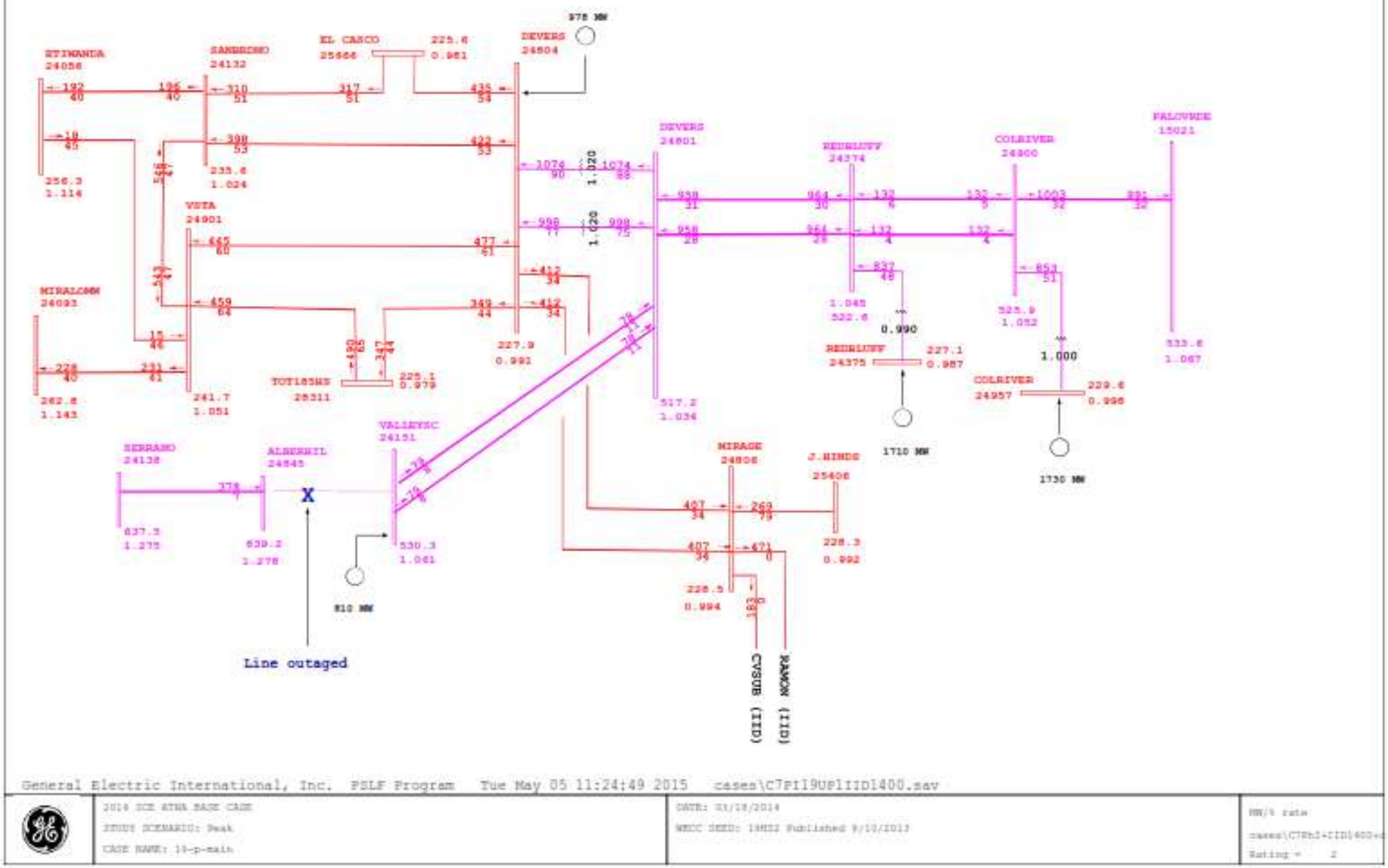


General Electric International, Inc. PSLF Program Thu Apr 02 20:48:58 2015 cases\C7PI19IID1400.sav

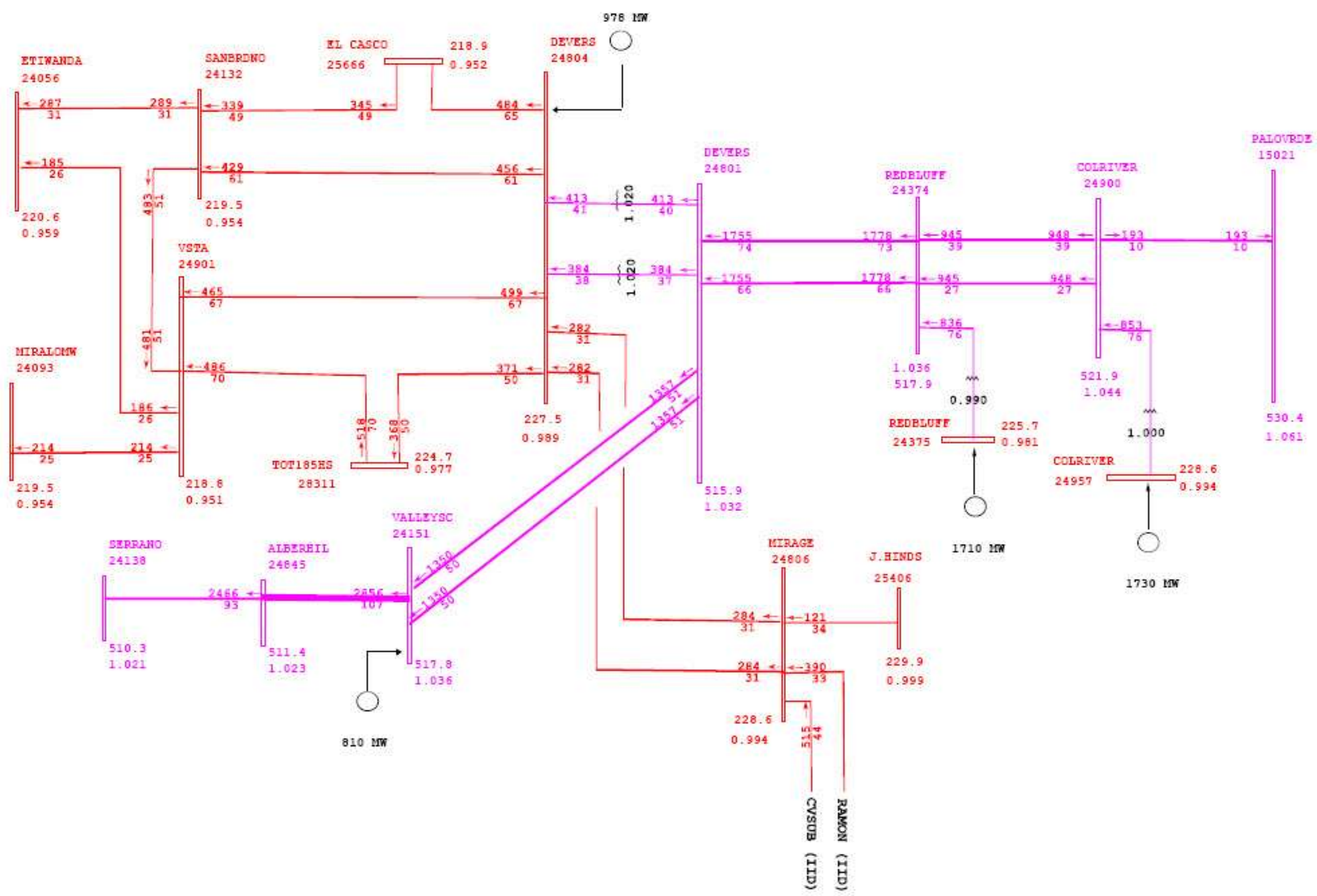
	2014 SCE ATRA BASE CASE STUDY SCENARIO: Peak CASE NAME: 19-p-main	DATE: 03/18/2014 WECC SEED: 19HS2 Published 9/10/2013	MW/% rate C7PhI+IID1400.drw Rating = 1

CASE #5--ISO Cluster 7 Phase I + IID-ISO Export of 1400 MW

Alberhill - Valley 500 kV line out



CASE #6--ISO Cluster 7 Phase I + IID-ISO 1400 MW + Alternate Conductor

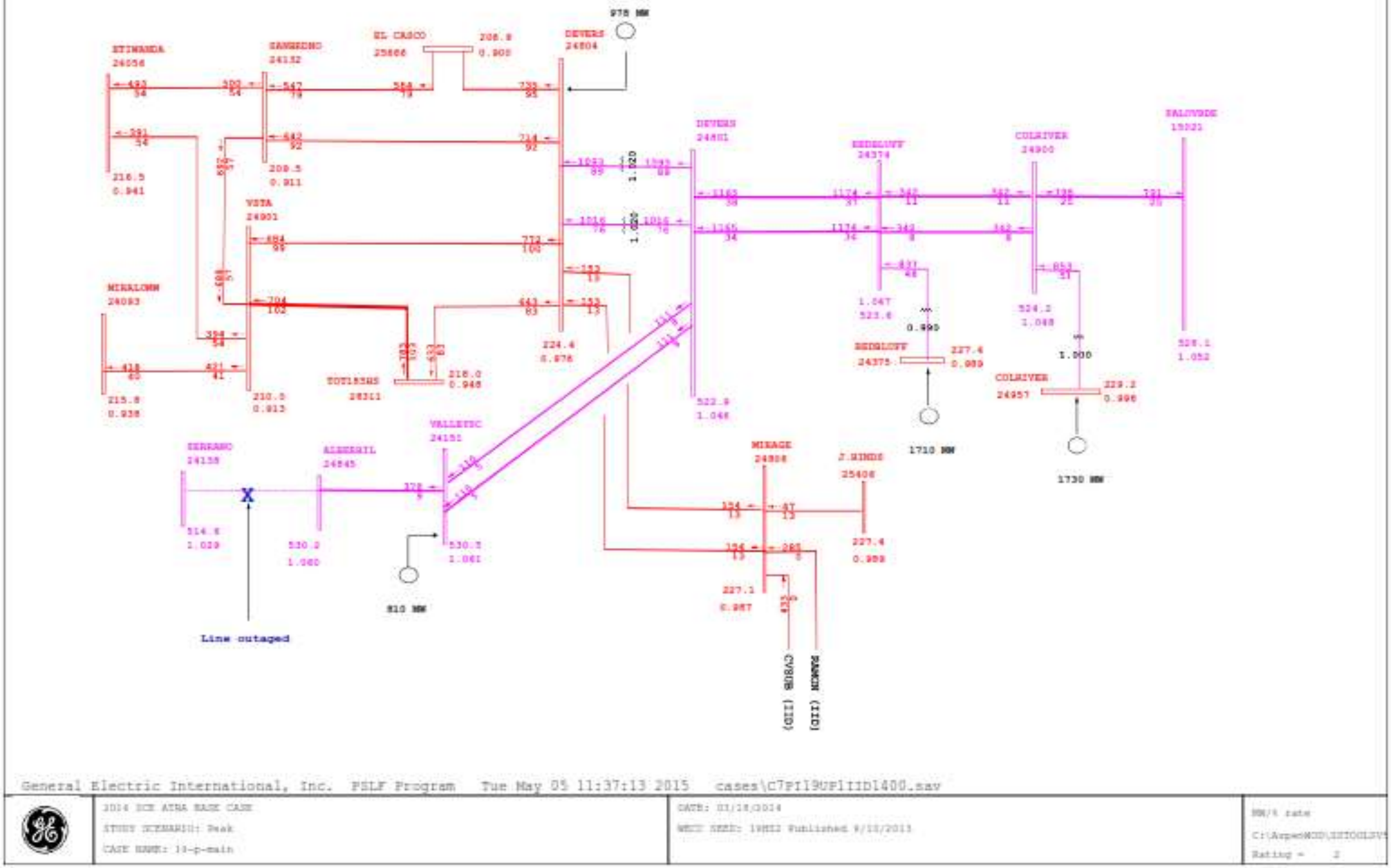


General Electric International, Inc. PSLF Program Thu Apr 02 20:51:38 2015 cases\C7PI19UP1IID1400.sav

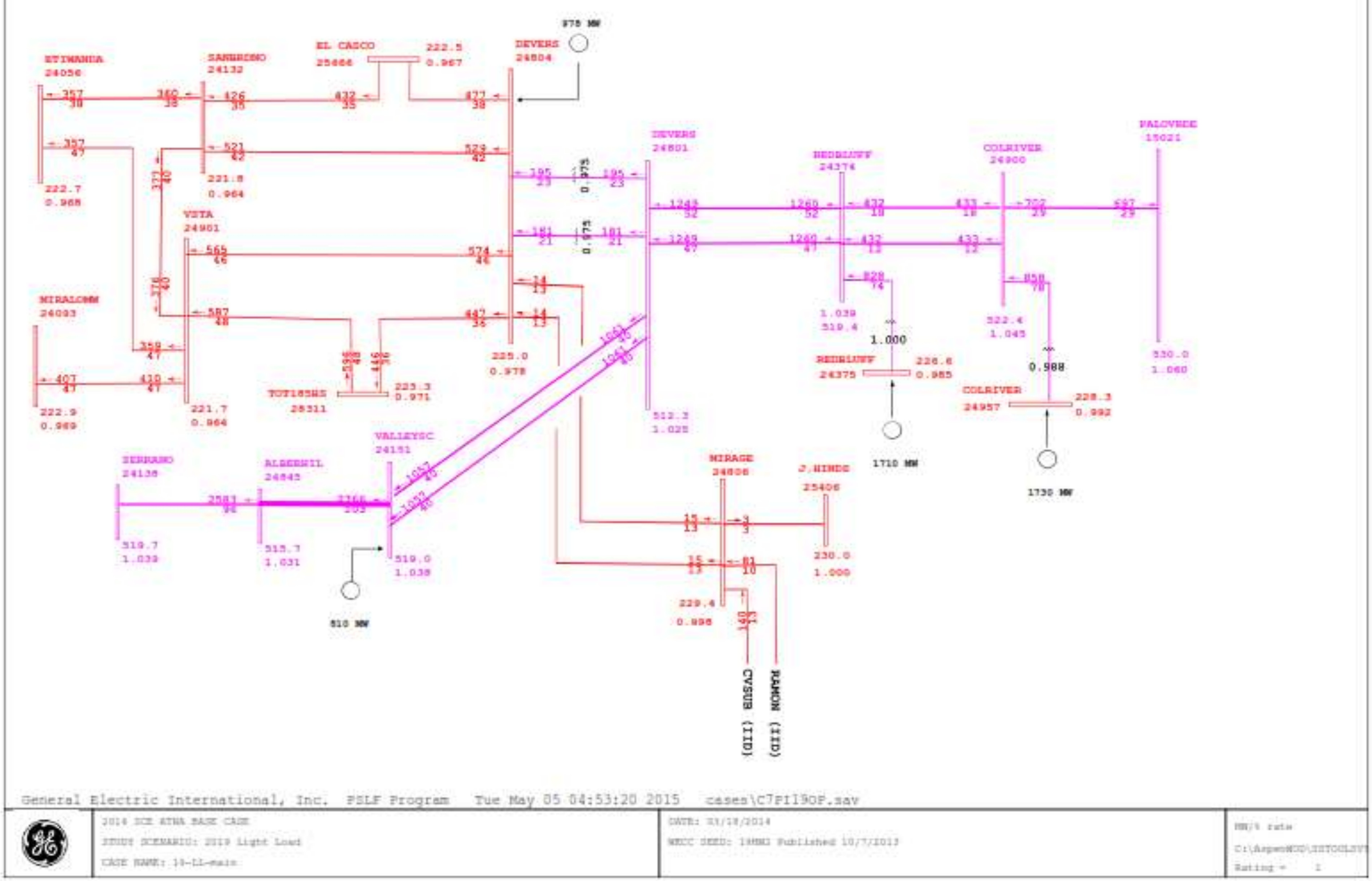
2014 SCE ATRA BASE CASE STUDY SCENARIO: Peak CASE NAME: 19-p-main	DATE: 03/18/2014 WECC SEED: 19HS2 Published 9/10/2013	MW/% rate C7PhI+IID1400+AltCond Rating = 1

CASE #6--ISO Cluster 7 Phase I + IID-ISO 1400 MW + Alternate Conductor

Alberhill - Serrano 500 kV line out

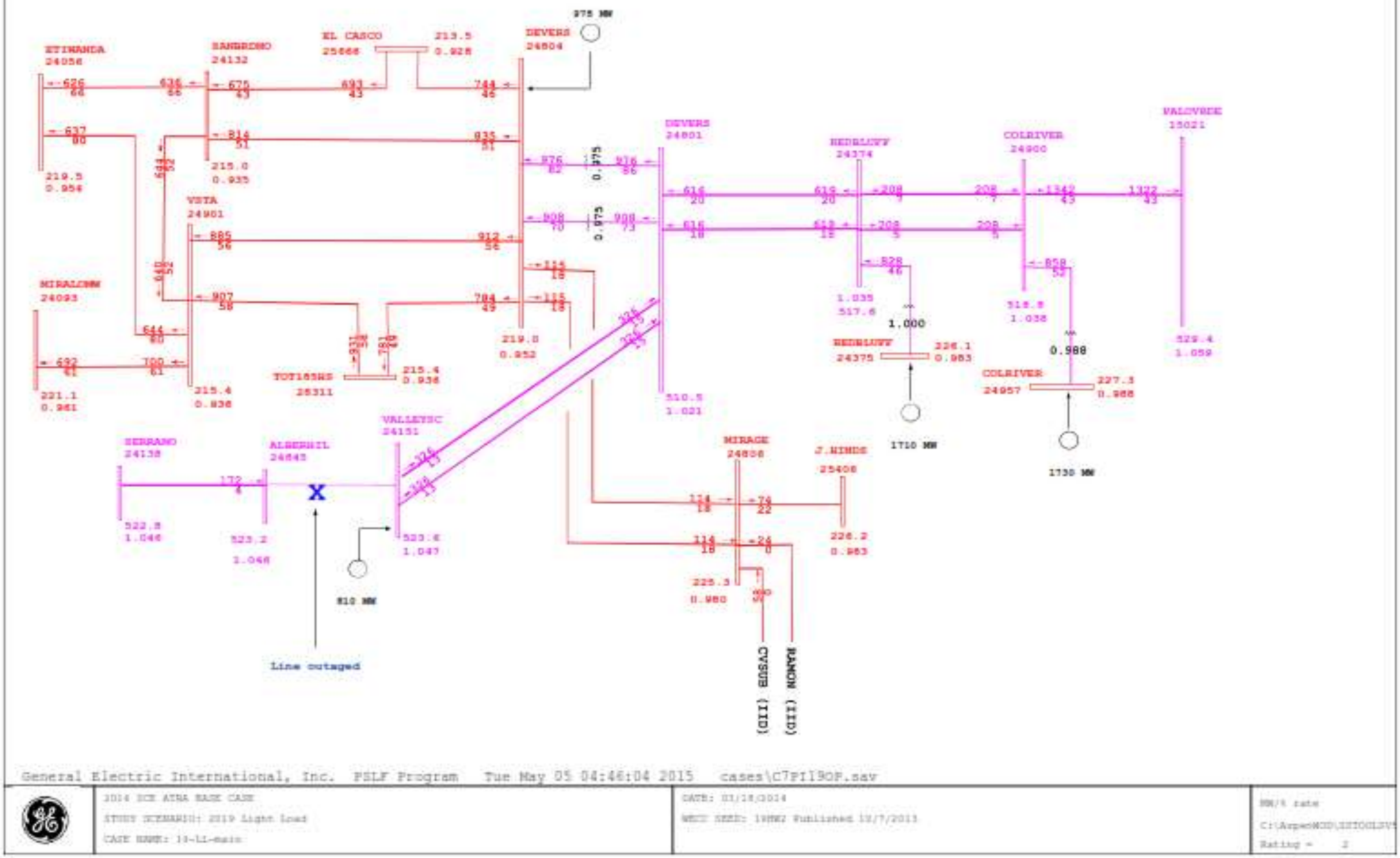


CASE #7--ISO Cluster 7 Phase I (2019) case Off-Peak

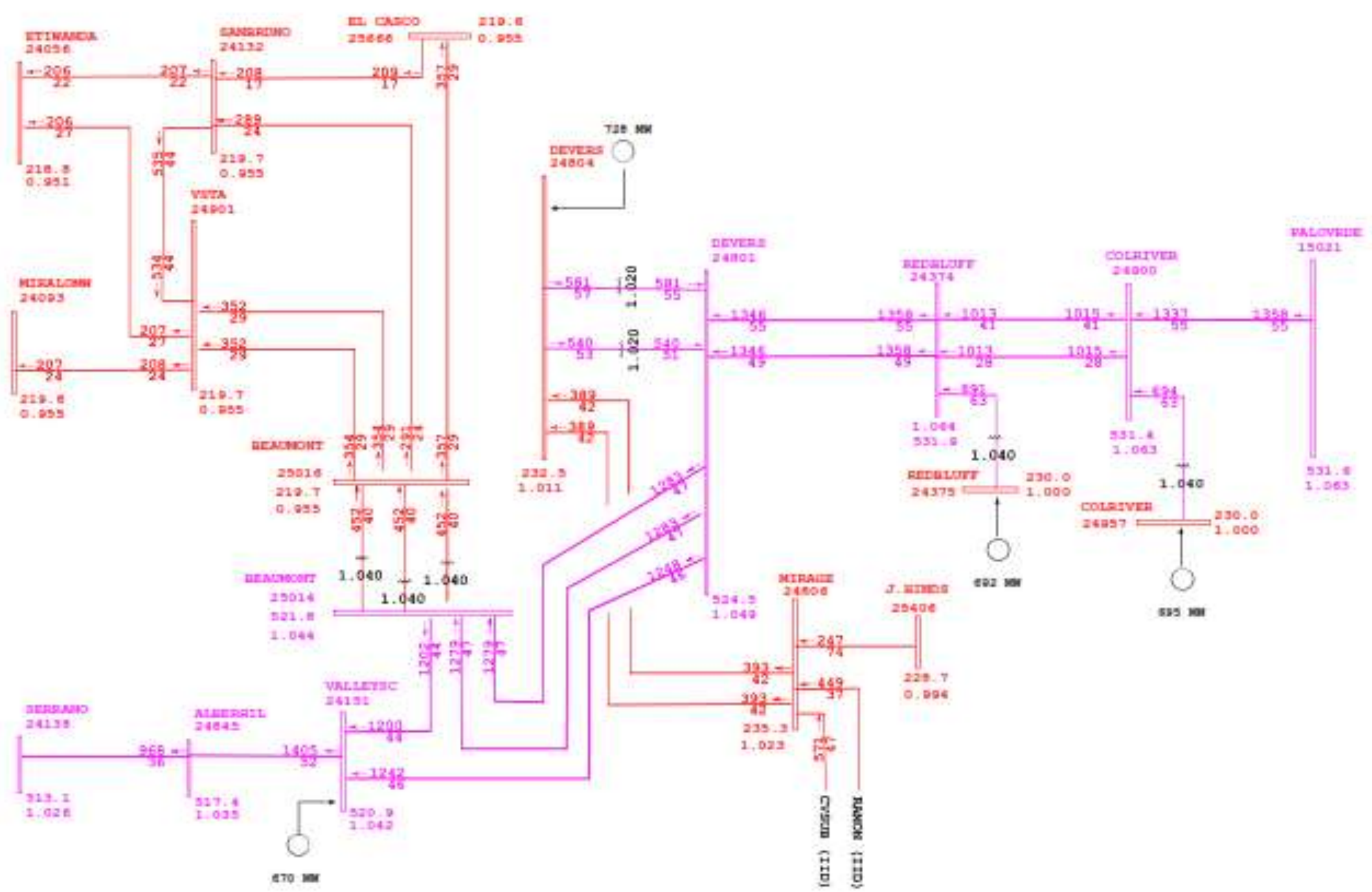


CASE #7--ISO Cluster 7 Phase I (2019) case Off-Peak

Alberhill - Valley 500 kV line out



Option1A-ISO 2024 Summer Peak Reliability Base Case with Beaumont 230/500kV Subst



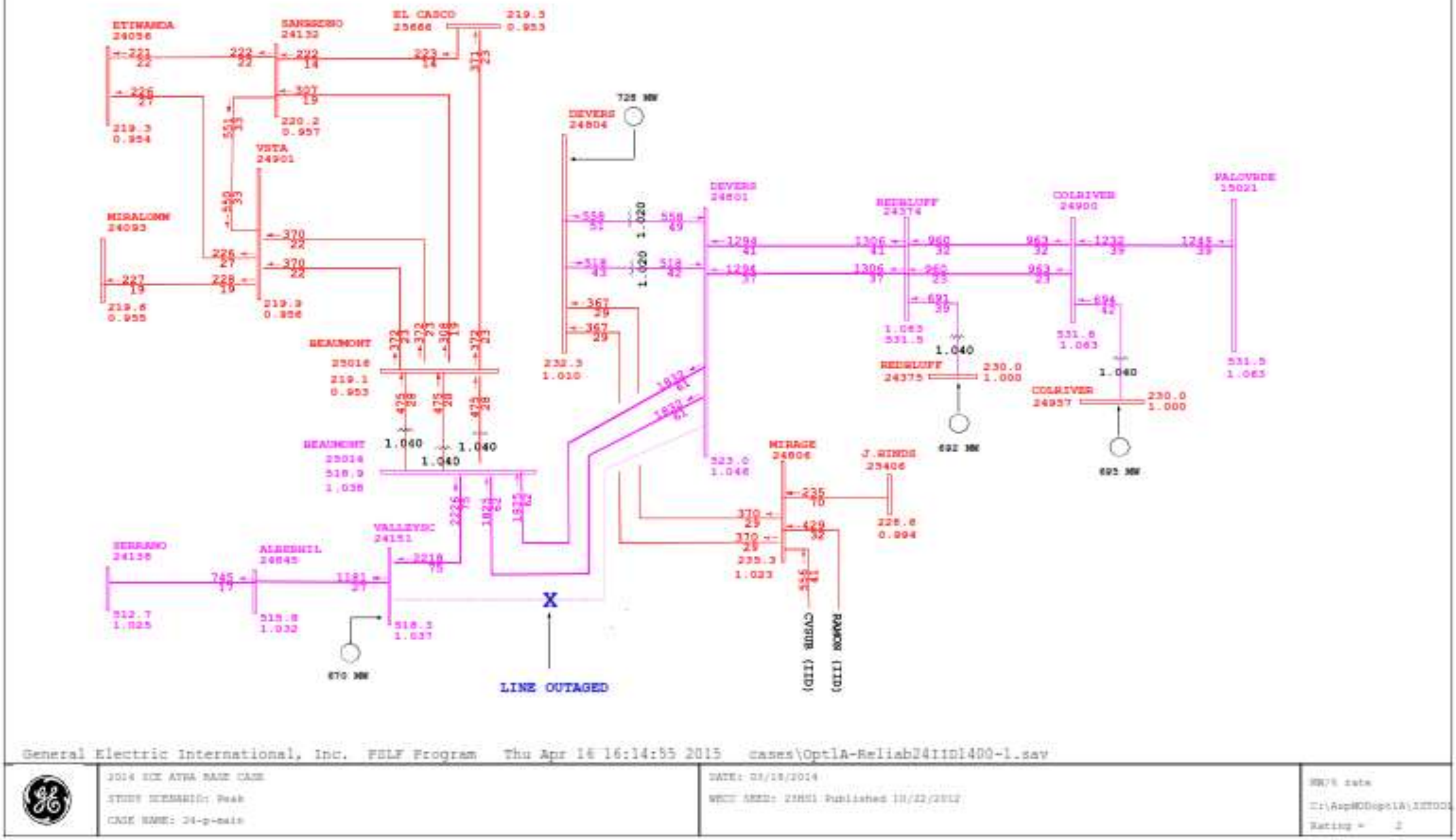
General Electric International, Inc. PSLF Program Thu Apr 16 16:05:44 2015 cases\Opt1A-Reliab24IID1400-1.sav

2014 SCE ATRA BASE CASE
STUDY SCENARIO: Peak
CASE NAME: 24-p-main

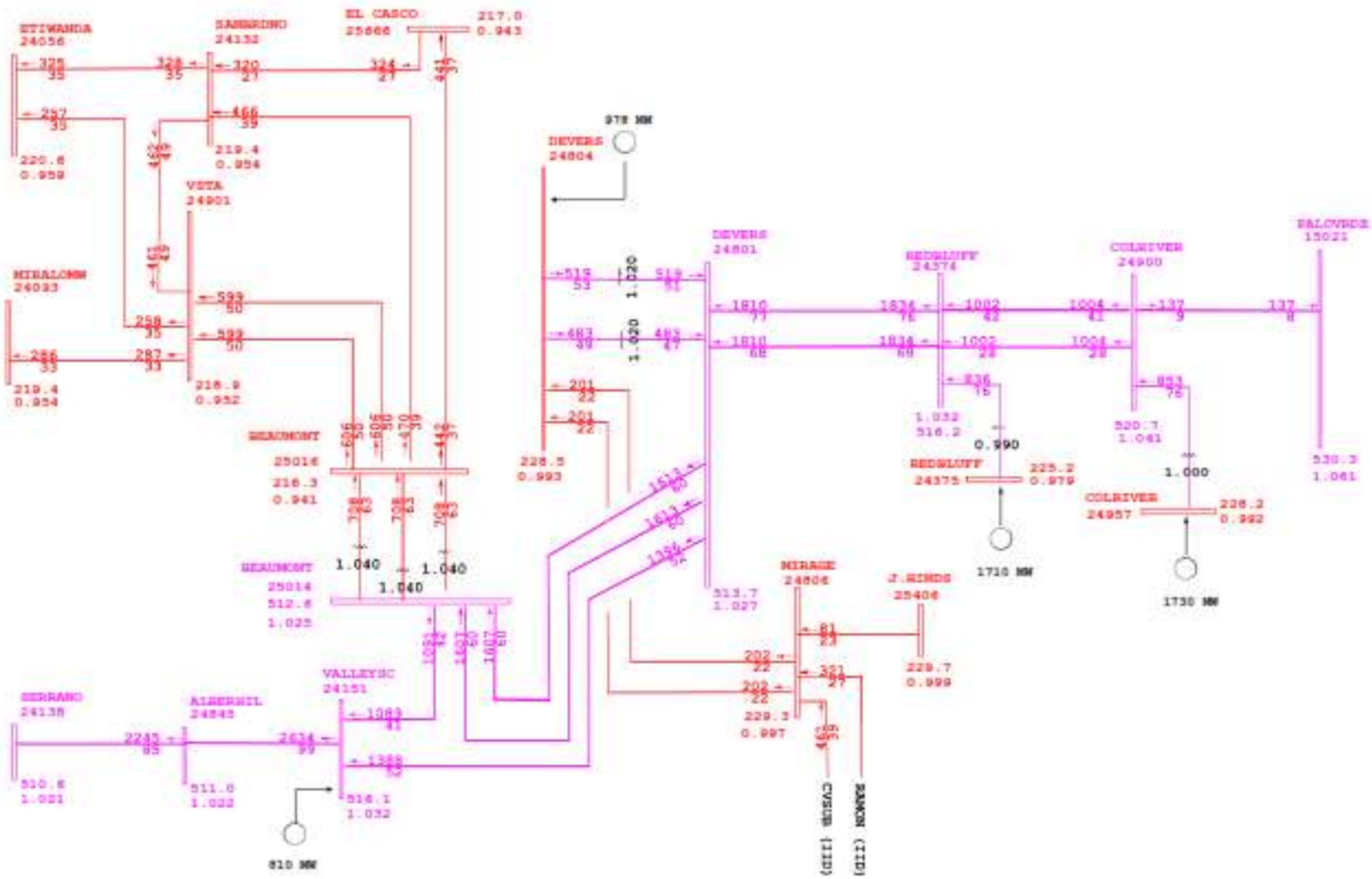
DATE: 03/19/2014

Option1A-ISO 2024 Summer Peak Reliability Base Case with Beaumont 230/500kV Subst

Devers - Valley 500kV line #2 out



Option1A--ISO Cluster 7 Phase I (2019) case with Beaumont 230/500kV Substation

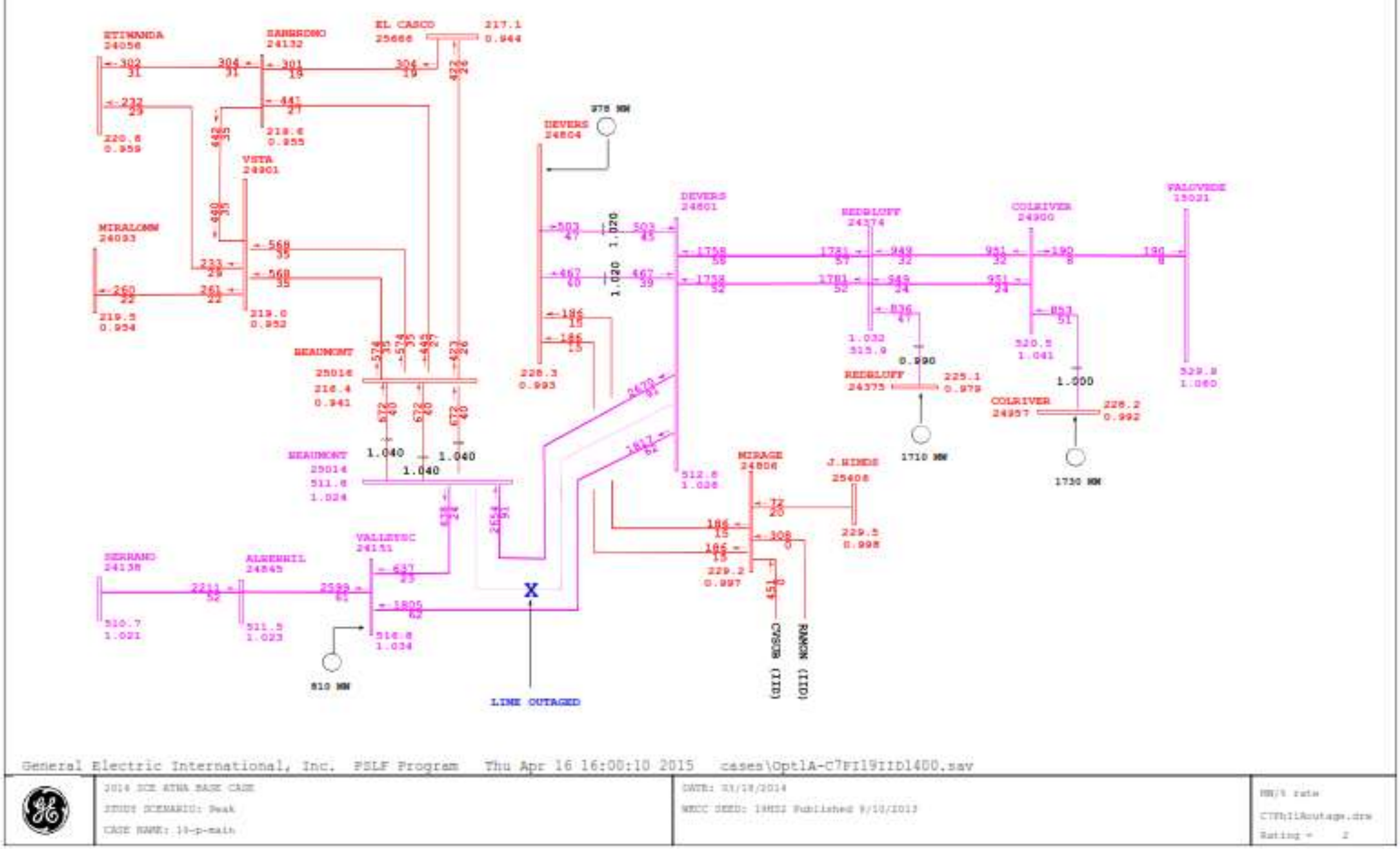


General Electric International, Inc. PSLF Program Thu Apr 16 15:58:14 2015 cases\Opt1A-C7P119IID1400.sav

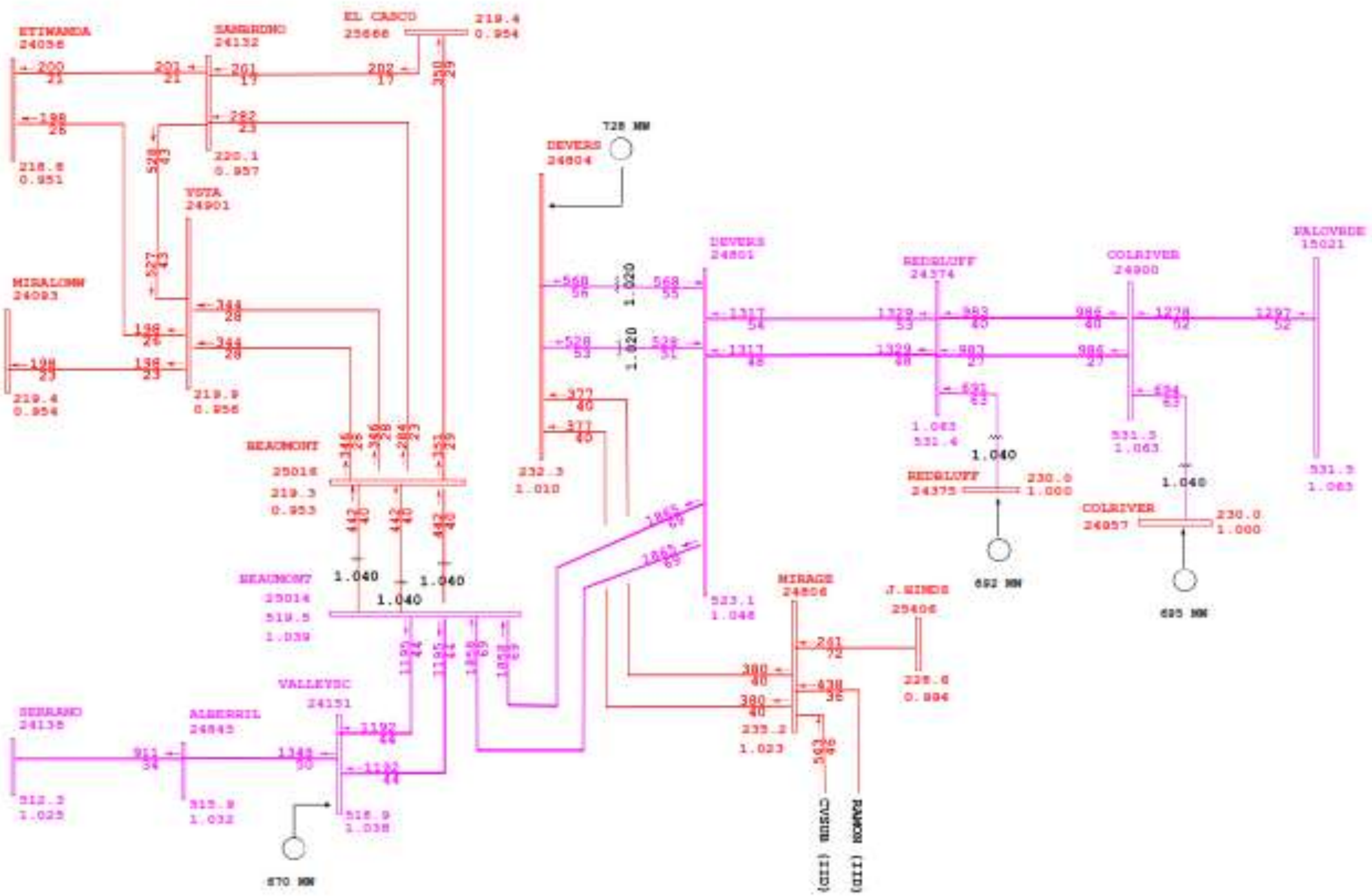
	2014 SCE ATRA BASE CASE STUDY SCENARIO: Peak CASE NAME: 19-p-main	DATE: 03/18/2014 WECC SEED: 19HS2 Published 9/10/2013	MW/% rate C7Ph1IA.drw Rating = 1

Option1A--ISO Cluster 7 Phase I (2019) case with Beaumont 230/500kV Substation

Devers - Beaumont 500k kV line #2 out



Option1B-ISO 2024 Summer Peak Reliability Base Case with Beaumont 230/500kV Subst

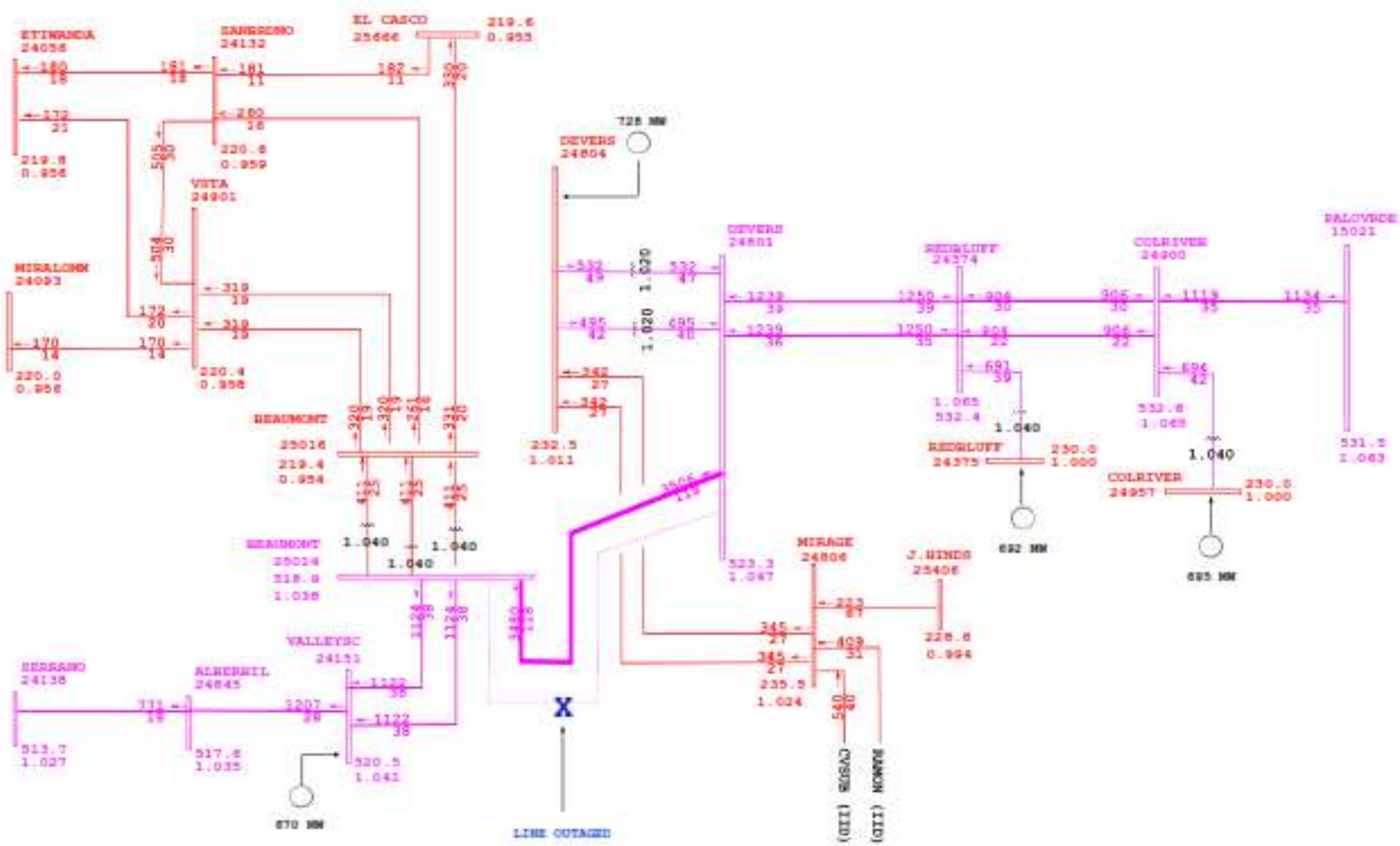


General Electric International, Inc. PSLF Program Fri Apr 24 13:41:49 2015 cases\Opt1B-Reliab24IID1400-2.sav

ZGLOBAL

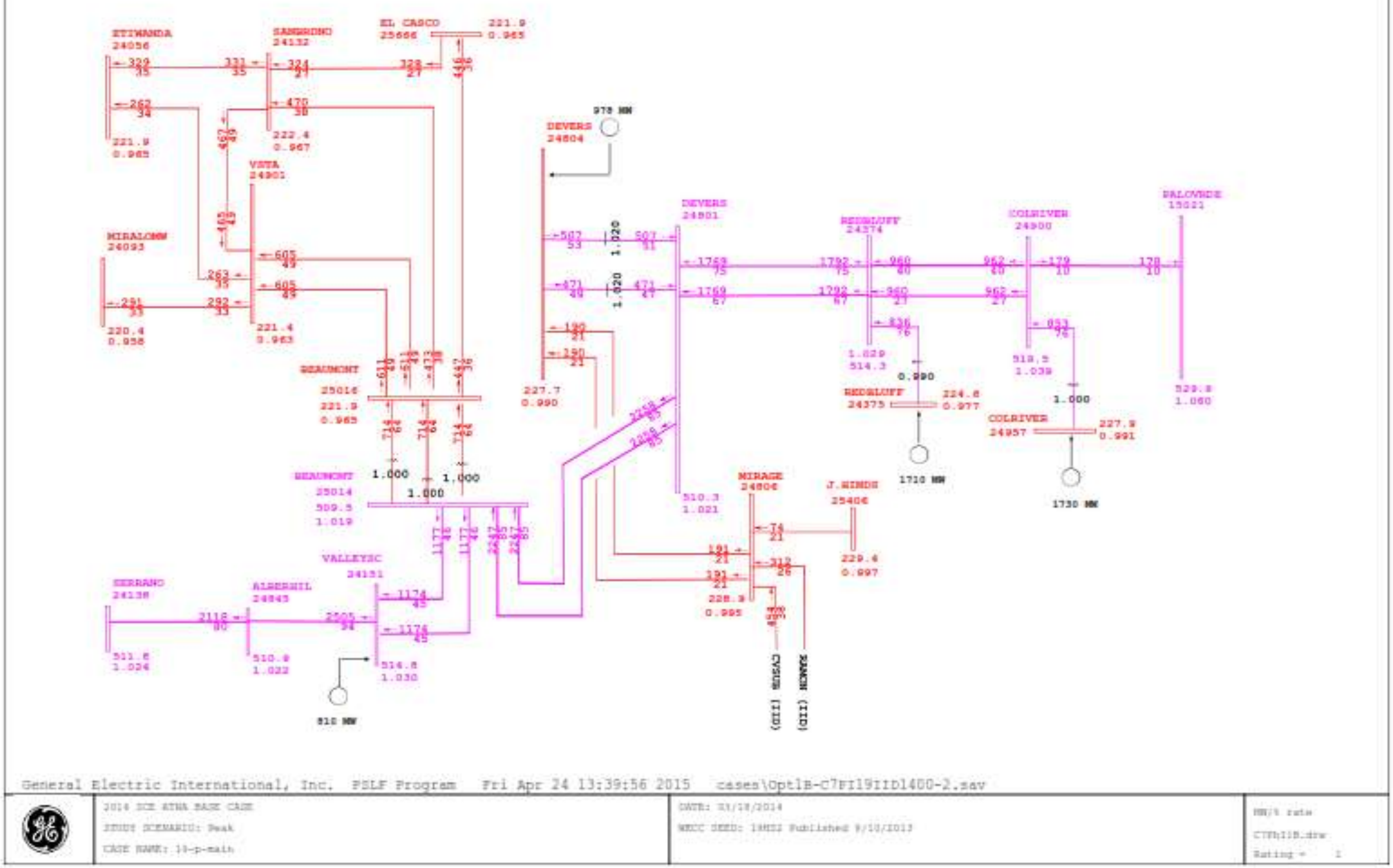
Option1B-ISO 2024 Summer Peak Reliability Base Case with Beaumont 230/500kV Subst

Devers - Beaumont 500 kV line #2 out



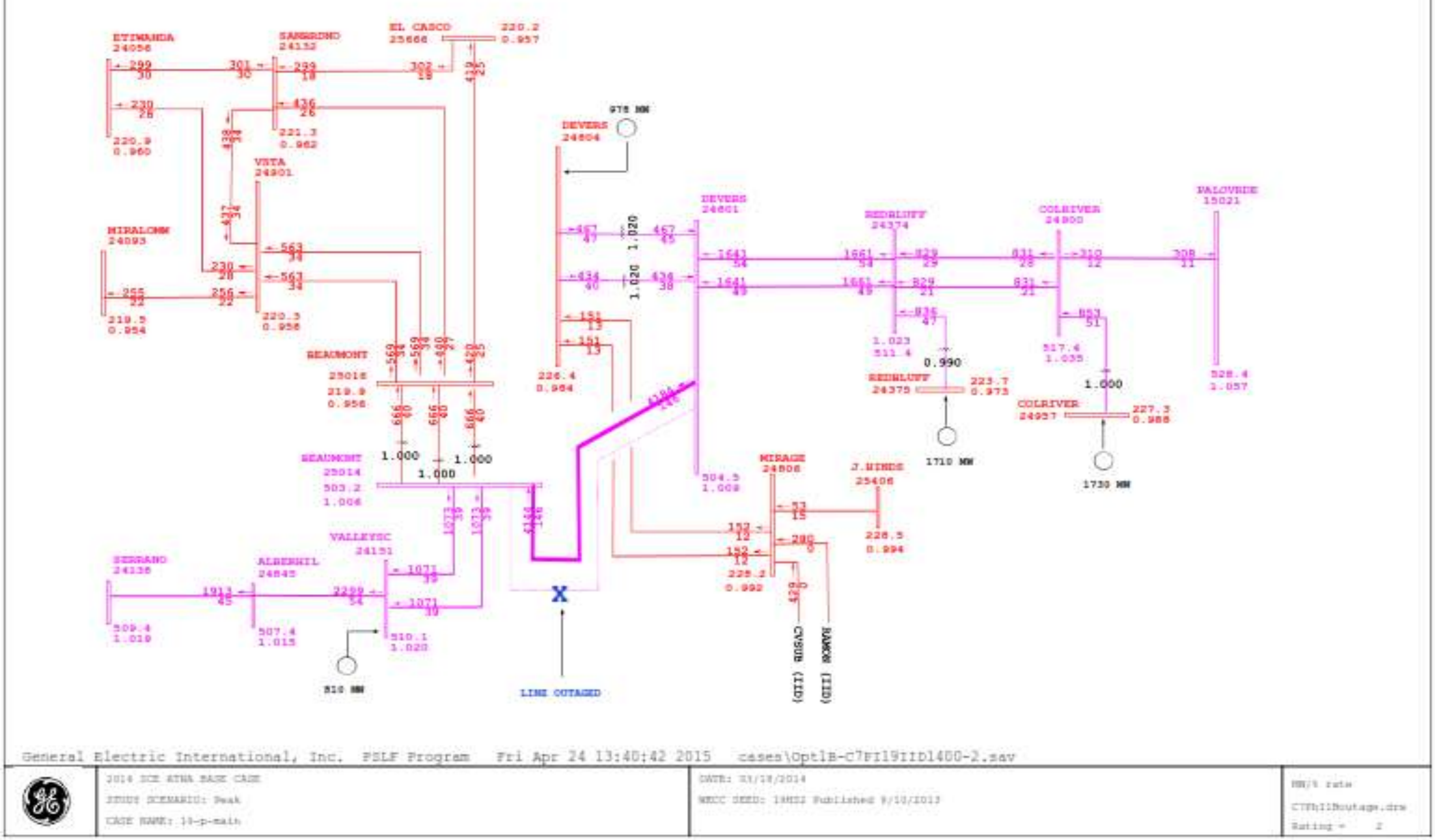
General Electric International, Inc. PSLF Program Fri Apr 24 13:42:49 2015 cases\Opt1B-Reliab24IID1400-2.sav

Option1B--ISO Cluster 7 Phase I (2019) case with Beaumont 230/500kV Substation

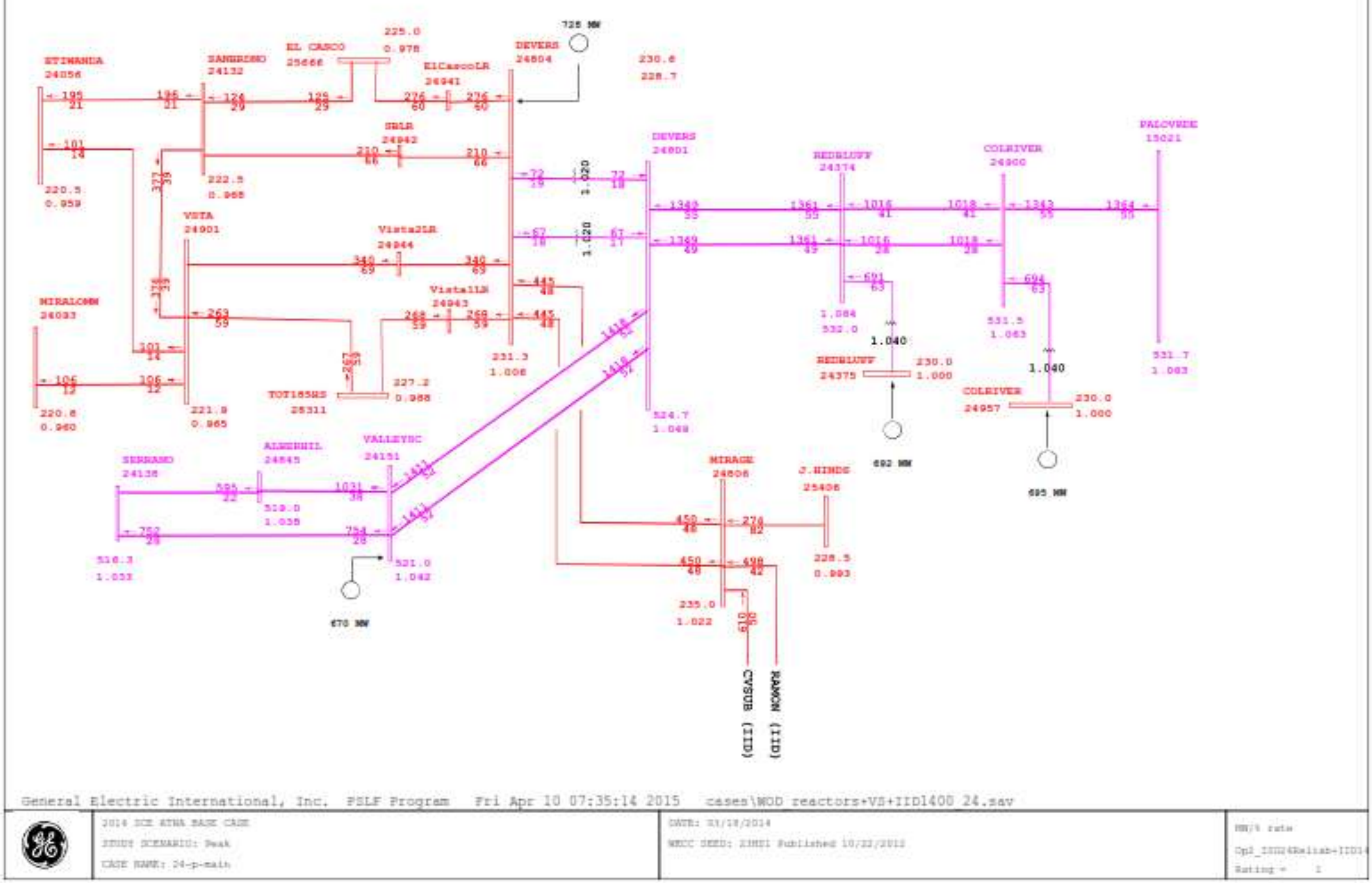


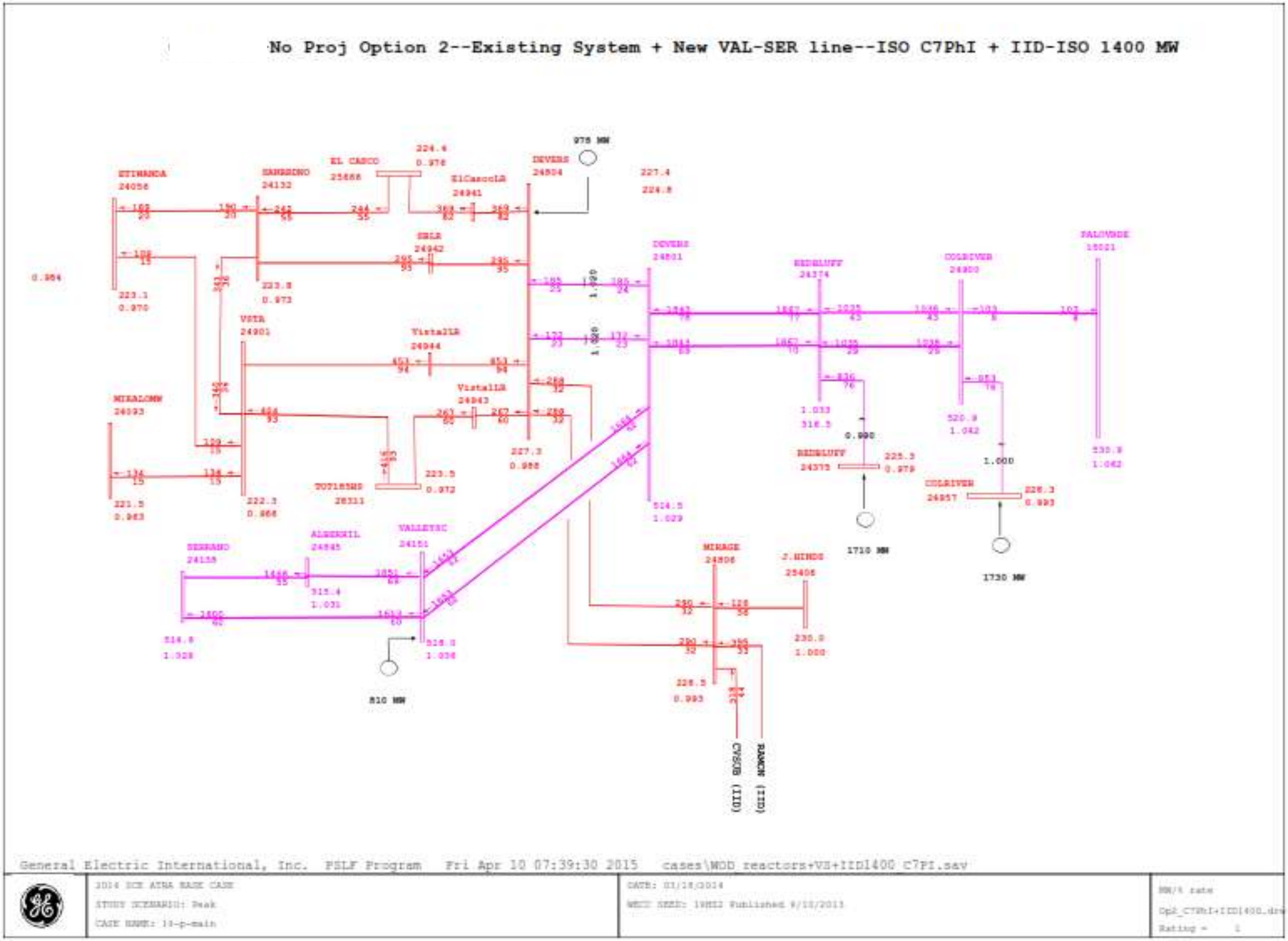
Option1B--ISO Cluster 7 Phase I (2019) case with Beaumont 230/500kV Substation

Devers - Beaumont 500kV line #2 out



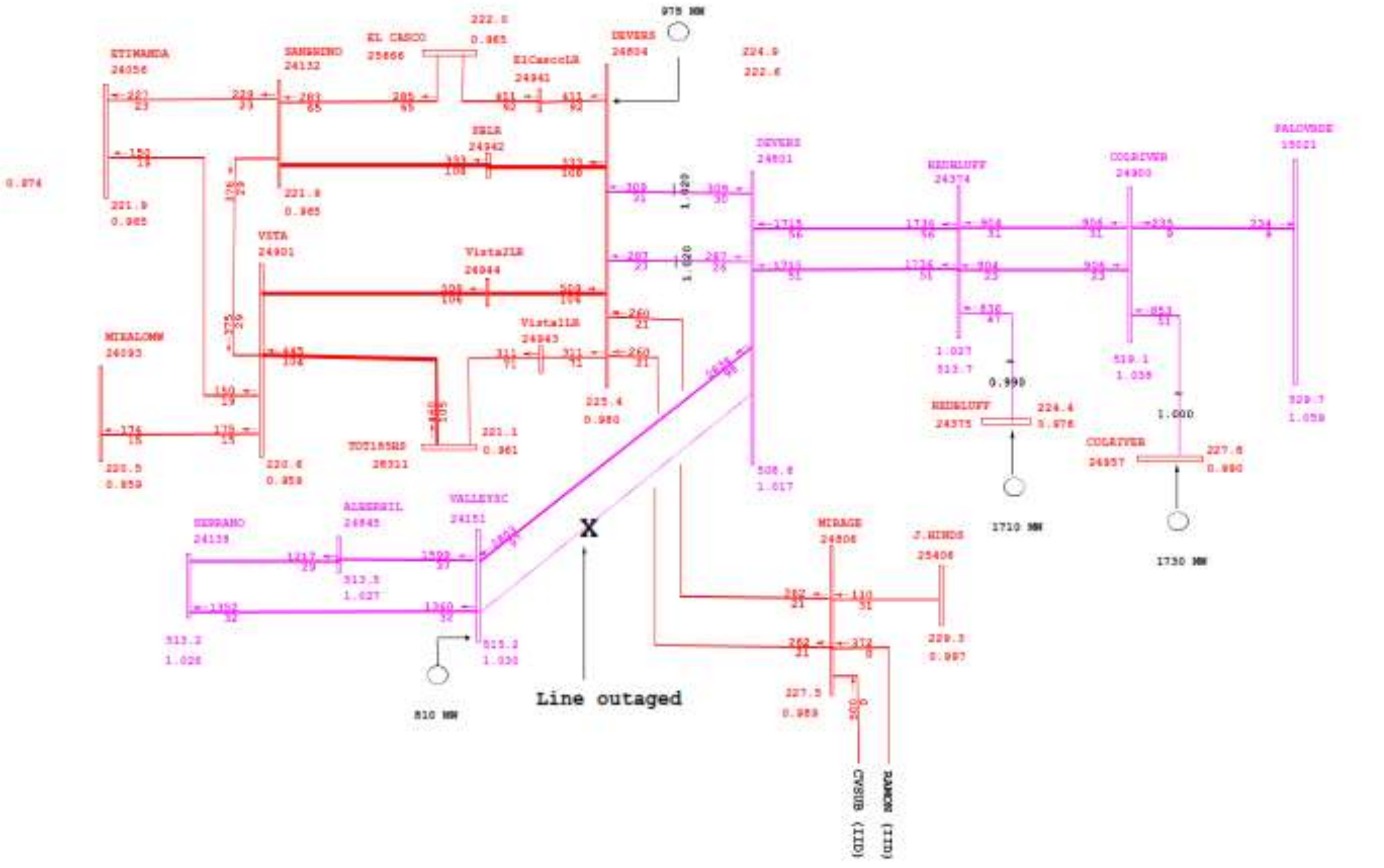
No Proj Option 2--Existing System + New VAL-SER line--ISO24 Reliab + IID-ISO 1400 MW




No Proj Option 2--Existing System + New VAL-SER line--ISO C7PhI + IID-ISO 1400 MW
978 MW
EL CASCO
DEVERS
24804
ElCascoLR
24941
VSTA
24901
Vista2LR
24944
Vista1LR
24943
REDBLUFF
24374
COLRIVER
24900
PALOVRDE
15021
REDBLUFF
24375
COLRIVER
24857
1710 MW
1730 MW
810 MW
CVSUB (IID)
RAMON (IID)
General Electric International, Inc. PSLF Program Fri Apr 10 07:39:30 2015 cases\WOD reactors+VS+IID1400 C7PI.sav
2014 SCE ATRA BASE CASE
STUDY SCENARIO: Peak
CASE NAME: 10-p-main
WECC SEED: 19HS2 Published 9/10/2013

No Proj Option 2--Existing System + New VAL-SER line--ISO C7PhI + IID-ISO 1400 MW

Devers - Valley 500 kV line #2 out



General Electric International, Inc. PSLF Program Fri Apr 10 08:02:22 2015 cases\WOD reactors+VS+IID1400 C7PI.sav

PhaseLine LLC
phaselinellc@gmail.com · 206.313.3663
Engineering Concepts & Options

Memorandum

To: Brewster Birdsall
Susan Lee

From: Chuck Williams

Subject: WODUP Existing Line Design Review Comments

Date: March 27, 2015

Following are comments from my review and comparison of information provided by SCE related to the design of the existing double circuit transmission line and the potential use of the existing structures to support alternative conductors. The review considered the use of three potential alternative High-Temperature Low-Sag (HTLS) conductors that can be operated at 464º F in order to maximize power flow under emergency operating conditions (N-2). This review evaluated Dove 557 ACCR, Drake 795 ACCR and Curlew 1033 ACCR to determine how they would perform if installed on the existing towers.

Existing Conductor Clearance Review

SCE indicates that the rated normal and emergency operating temperature for the existing lines is 201º F (response ALT-21b) and they note that at this temperature the existing single-conductor Curlew 1033.5 ACSR has two spans with existing clearance infractions that were identified and reported in 2010 (response ALT-21c). The sag-tension information provided by SCE for the 201º F condition was used as the basis of the clearance review of the alternative conductors.

Alternative Conductor Clearance Review

To simplify the analysis, the clearance review evaluated the sag in each of the ruling spans within the existing line, as opposed to reviewing the actual ground clearance in each individual existing span. This approach is expected to provide somewhat conservative results since some existing spans may have ground clearance in excess of code requirements.

Referring to Table-1 Sag-Clearance Comparison, it appears that of the three conductors evaluated, only the Drake 795 ACCR would be a suitable alternative conductor that could be installed on the existing towers with minimal clearance issues. This scenario results in a potential 3 spans with clearance violations, the two existing violations noted in SCE response ALT-21c and possibly a violation for the 356 ft. Ruling Span.

Table-1 further illustrates that Dove 557 ACCR is not a suitable alternative conductor as the analysis indicates a significant number of ruling spans where Dove exceeds the existing conductor sag by half a foot or more. This may be counter intuitive since Dove is a smaller and lighter conductor than the existing Curlew ACSR, however, Dove's weight to strength characteristics appear to be less favorable.

Curlew 1033 ACCR exceeds the existing conductor sag by multiple feet for most spans. For even larger ACCR conductors, such as Bittern 1272 ACCR, their sags exceed the existing conductor sag by five feet or more.

Original Design, Strength Review:

SCE indicates that the existing line design was based upon the GO 95 Light Loading condition that was in effect in 1975. This design utilized a physical loading condition of 25° F conductor temperature and an 8 pounds-per-square-foot (PSF) wind loading for all segments of the line.

SCE's original line design condition results in a maximum tension for the Curlew ACSR of approximately 12,000 pounds. Since over 70% of the existing line structures are tangent structures, the strength review focused on these structures. Table-2, Tangent Original Design, summarizes the capability of SCE's standard tangent structure types to support various conductors, for the ruling spans in the existing line.

Tangent tower types "O" and "N/NE" are utilized on segments 1 & 2 with tangent tower types "WC" & "WB" utilized on segments 2 and 3 through 6.

A review of existing structure data determined that tower types O and N/NE in segments 1 and 2 had sufficient strength to support the single 1033.5 ACSR conductor when the line was constructed. Similarly, tower types WC and WB were okay for all ruling spans in segments 3 through 6, except the long Whitewater crossing, which was supported by deadend towers.

From a further review of Table-2, Tangent Original Design, it appears that the double-bundle Curlew ACSR proposed as a part of the original DPV2 Project would have been suitable on the majority of the existing structures under an 8 PSF design condition. A cursory review of information from SCE on the actual structure types in the existing line, finds that approximately 3 to 4 Type O towers and 3 to 4 Type NE towers could have been overloaded in Segments 1 and 2 under this scenario.

SCE Updated Design Requirements, Strength Review:

SCE's response for ALT-18a indicates that a Project-specific meteorological study was performed in 2011 and as a result, any new construction or any re-conductor of the existing towers would be subject to greater design wind conditions than were used for the original design. These new design conditions are 12 PSF for Segments 1, 4, 5, and 6, 18 PSF for Segment 2, and 16 PSF for Segment 3.

SCE's proposed project utilizes double-bundle Lapwing 1590 ACSR conductor. Based on the sag-tension data provided by SCE and the analysis of conductors smaller than 2B-1590 it is readily inferred that the existing towers do not have sufficient height to maintain required ground clearances and are not sufficiently strong to support the larger conductor.

Alternative Design Strength Review:

Tables 3, 4 and 5 summarize the strength review for Tangent structures for 12 PSF, 16 PSF and 18 PSF wind loadings respectively. From these tables there are many ruling spans where the existing structures would be overloaded. However, combining the information in these tables with the information from SCE on the actual structure types in the existing line yields the following results:

1. It appears that the many of existing structures generally have sufficient strength to support a single Drake 795 ACCR conductor for all line segments. Under this scenario at least a dozen tangent structures in Segment 2 would likely need to be replaced. This seems consistent with the information in SCE's response to ALT-18a that indicates roughly 30% of all structure types in the existing line would be overloaded.

2. The use of a larger single alternative conductor such as Curlew 1033 ACCR or double-bundle Drake 795 ACCR conductor was found infeasible due to the large number of structures that would be overloaded. Again this is consistent with the information in SCE's response to ALT-18a that indicates roughly 45% of all structure types in the existing line would be overloaded with double-bundle Drake 795 ACCR.

When considering an alternative that utilizes the existing line with some structure modifications or replacements it should be noted that this construction would likely include shoo-flies and other arrangements to help brace structures or to temporarily support conductors. Therefore, the ground disturbance associated with each tower replacement will be greater than that for a new tower. A very rough approximation is that replacement of an existing tower could result in 150% to 175% of the disturbance related to a new structure installation. Based on this relative difference in ground disturbance it may be reasonable to utilize an alternative that entails 30-35% structure replacements as this will still have an overall less impact than constructing an entirely new line. For alternatives with higher percentages of replacements this concept becomes more tenable.

WODUP Existing Line/Alternative Use Review **TABLE-1 Sag-Clearance Check**

Sag Comparison

Exisiting 1033.5 ACSR "Curlew" Conductor
Alternative New 795 ACCR "Drake" Conductor

Exisiting 1033.5 ACSR "Curlew" Conductor
Alternative New 557 ACCR "Dove" Conductor

Exisiting 1033.5 ACSR "Curlew" Conductor
Alternative New 1033 ACCR "Curlew" Conductor

33 Different Ruling Span sections in existing line.

Drake

Ruling Span Ft.	Exist 1033.5 ACSR 201 F Max Sag Ft.	New 795 ACCR 464 F Max Sag Ft.	Max Sag Difference
1165	32.80	32.52	0.28
1428	44.62	44.14	0.48
4119	285.83	257.92	27.91
1656	56.80	55.45	1.35
1384	42.49	42.09	0.40
1263	36.94	36.67	0.27
1434	44.92	44.42	0.50
1630	55.33	54.1	1.23
1596	53.44	53.36	0.08
1568	51.91	50.95	0.96
1286	37.95	37.68	0.27
1328	39.84	39.54	0.30
1557	51.31	50.39	0.92
1544	50.61	49.75	0.86
1823	66.66	64.48	2.18
1792	64.77	62.76	2.01
1868	69.45	67.02	2.43
1874	69.83	67.37	2.46
1609	54.16	53.02	1.14
527	11.00	10.96	0.04
1477	47.07	46.47	0.60
853	21.07	20.97	0.10
1199	34.21	33.94	0.27
2222	93.39	88.67	4.72
1045	28.03	27.79	0.24
1313	39.14	38.87	0.27
665	15.04	14.95	0.09
1145	31.98	31.7	0.28
972	25.28	25.12	0.16
972	25.28	25.12	0.16
962	24.92	24.76	0.16
674	15.31	15.22	0.09
356	6.18	6.57	-0.39

Dove

Ruling Span Ft.	Exist 1033.5 ACSR 201 F Max Sag Ft.	New 557 ACCR 464 F Max Sag Ft.	Max Sag Difference
1165	32.80	33.36	-0.56
1428	44.62	45.37	-0.75
4119	285.83	269.15	16.68
1656	56.80	57.1	-0.30
1384	42.49	43.25	-0.76
1263	36.94	37.65	-0.71
1434	44.92	45.67	-0.75
1630	55.33	55.7	-0.37
1596	53.44	53.9	-0.46
1568	51.91	52.43	-0.52
1286	37.95	38.69	-0.74
1328	39.84	40.62	-0.78
1557	51.31	51.86	-0.55
1544	50.61	51.19	-0.58
1823	66.66	66.48	0.18
1792	64.77	64.69	0.08
1868	69.45	69.12	0.33
1874	69.83	69.48	0.35
1609	54.16	54.58	-0.42
527	11.00	11.14	-0.14
1477	47.07	47.79	-0.72
853	21.07	21.24	-0.17
1199	34.21	34.83	-0.62
2222	93.39	91.66	1.73
1045	28.03	28.42	-0.39
1313	39.14	39.92	-0.78
665	15.04	15.17	-0.13
1145	31.98	32.52	-0.54
972	25.28	25.57	-0.29
972	25.28	25.57	-0.29
962	24.92	25.18	-0.26
674	15.31	15.45	-0.14
356	6.18	6.68	-0.50

Curlew

Ruling Span Ft.	Exist 1033.5 ACSR 201 F Max Sag Ft.	New 1033 ACCR 464 F Max Sag Ft.	Max Sag Difference
1165	32.80	35.29	-2.49
1428	44.62	47.94	-3.32
4119	285.83	283.31	2.52
1656	56.80	60.28	-3.48
1384	42.49	45.71	-3.22
1263	36.94	39.81	-2.87
1434	44.92	48.25	-3.33
1630	55.33	58.81	-3.48
1596	53.44	56.91	-3.47
1568	51.91	55.36	-3.45
1286	37.95	40.9	-2.95
1328	39.84	42.93	-3.09
1557	51.31	54.76	-3.45
1544	50.61	54.06	-3.45
1823	66.66	70.15	-3.49
1792	64.77	68.26	-3.49
1868	69.45	72.93	-3.48
1874	69.83	73.3	-3.47
1609	54.16	57.63	-3.47
527	11.00	11.61	-0.61
1477	47.07	50.48	-3.41
853	21.07	22.44	-1.37
1199	34.21	36.83	-2.62
2222	93.39	96.63	-3.24
1045	28.03	30.07	-2.04
1313	39.14	42.2	-3.06
665	15.04	15.87	-0.83
1145	31.98	34.4	-2.42
972	25.28	27.07	-1.79
972	25.28	27.07	-1.79
962	24.92	26.67	-1.75
674	15.31	16.16	-0.85
356	6.18	6.94	-0.76

ACCR sag less than existing conductor, no clearance issues
ACCR sag very nearly the same as existing conductor, within 6 inches, clearance issues less likely
ACCR Sag greater than existing conductor likely clearance issues

WODUP Existing Line/Alternative Use Review **TABLE-2 Tangent Original Design (8PSF)**

StructureTransverse Load from Conductor

	Dove ACCR	Drake ACCR	Curlew ACSR	Curlew ACCR	OPGW
Dia inches	0.941	1.128	1.244	1.247	0.69
Weight lbs	0.65	0.93	1.33	1.13	
Wind area, sq ft	0.078	0.094	0.104	0.104	0.058
Max Ten, lbs	8,085	11,270	12,810	12,000	

Transverse loading is calculated at each phase position

Wind Pressure = 8 Wind Speed 56 mph

	Transverse Wind Load, Lbs.						
Ruling Span Ft.	Exist 1033.5 ACSR Curlew	2B-1033.5 ACSR Curlew	New 557 ACCR Dove	New 795 ACCR Drake	New 2B-557 ACCR Dove	New 2B-795 ACCR Drake	New 1033.5 ACCR Curlew
1165	966	1,932	731	876	1,462	1,752	969
1428	1,184	2,369	896	1,074	1,792	2,148	1,187
4119	3,416	6,832	2,584	3,097	5,168	6,195	3,424
1656	1,373	2,747	1,039	1,245	2,078	2,491	1,377
1384	1,148	2,296	868	1,041	1,736	2,082	1,151
1263	1,047	2,095	792	950	1,585	1,900	1,050
1434	1,189	2,379	900	1,078	1,799	2,157	1,192
1630	1,352	2,704	1,023	1,226	2,045	2,452	1,355
1596	1,324	2,647	1,001	1,200	2,002	2,400	1,327
1568	1,300	2,601	984	1,179	1,967	2,358	1,304
1286	1,067	2,133	807	967	1,614	1,934	1,069
1328	1,101	2,203	833	999	1,666	1,997	1,104
1557	1,291	2,583	977	1,171	1,954	2,342	1,294
1544	1,280	2,561	969	1,161	1,937	2,322	1,284
1823	1,512	3,024	1,144	1,371	2,287	2,742	1,516
1792	1,486	2,972	1,124	1,348	2,248	2,695	1,490
1868	1,549	3,098	1,172	1,405	2,344	2,809	1,553
1874	1,554	3,108	1,176	1,409	2,351	2,818	1,558
1609	1,334	2,669	1,009	1,210	2,019	2,420	1,338
527	437	874	331	396	661	793	438
1477	1,225	2,450	927	1,111	1,853	2,221	1,228
853	707	1,415	535	641	1,070	1,283	709
1199	994	1,989	752	902	1,504	1,803	997
2222	1,843	3,686	1,394	1,671	2,788	3,342	1,847
1045	867	1,733	656	786	1,311	1,572	869
1313	1,089	2,178	824	987	1,647	1,975	1,092
665	552	1,103	417	500	834	1,000	553
1145	950	1,899	718	861	1,437	1,722	952
972	806	1,612	610	731	1,220	1,462	808
972	806	1,612	610	731	1,220	1,462	808
962	798	1,596	603	723	1,207	1,447	800
674	559	1,118	423	507	846	1,014	560
356	295	590	223	268	447	535	296

2.5 Line Angle Transverse Load, Lbs.						
Exist 1033.5 ACSR Curlew	2B-1033.5 ACSR Curlew	New 557 ACCR Dove	New 795 ACCR Drake	New 2B-557 ACCR Dove	New 2B-795 ACCR Drake	New 1033.5 ACCR Curlew
559	1,118	353	492	705	983	524

	Tran Limit	Vert Limit	
Type O TAN Twr, Segments 1 & 2	1400	2400	**TABLE-2 Tangent Original Design (8PSF)**

	Wind Transverse Load Check													
	ACSR Curlew		ACSR 2B-Curlew		ACCR Dove		ACCR Drake		ACCR 2B-Dove		ACCR 2B-Drake		ACCR Curlew	
Ruling Span Ft.	Transverse	Vertical	Transverse	Vertical	Transverse	Vertical	Transverse	Vertical	Transverse	Vertical	Transverse	Vertical	Transverse	Vertical
1165	Y	Y	N	N	Y	Y	Y	Y	N	Y	N	Y	Y	Y
1428	Y	Y	N	N	Y	Y	Y	Y	N	Y	N	N	Y	Y
4119	N	N	N	N	N	N	N	N	N	N	N	N	N	N
1656	Y	Y	N	N	Y	Y	Y	Y	N	Y	N	N	Y	Y
1384	Y	Y	N	N	Y	Y	Y	Y	N	Y	N	N	Y	Y
1263	Y	Y	N	N	Y	Y	Y	Y	N	Y	N	Y	Y	Y
1434	Y	Y	N	N	Y	Y	Y	Y	N	Y	N	N	Y	Y
1630	Y	Y	N	N	Y	Y	Y	Y	N	Y	N	N	Y	Y
1596	Y	Y	N	N	Y	Y	Y	Y	N	Y	N	N	Y	Y
1568	Y	Y	N	N	Y	Y	Y	Y	N	Y	N	N	Y	Y
1286	Y	Y	N	N	Y	Y	Y	Y	N	Y	N	Y	Y	Y
1328	Y	Y	N	N	Y	Y	Y	Y	N	Y	N	N	Y	Y
1557	Y	Y	N	N	Y	Y	Y	Y	N	Y	N	N	Y	Y
1544	Y	Y	N	N	Y	Y	Y	Y	N	Y	N	N	Y	Y
1823	N	N	N	N	Y	Y	Y	Y	N	Y	N	N	N	Y
1792	N	Y	N	N	Y	Y	Y	Y	N	Y	N	N	N	Y
1868	N	N	N	N	Y	Y	N	Y	N	N	N	N	N	Y
1874	N	N	N	N	Y	Y	N	Y	N	N	N	N	N	Y
1609	Y	Y	N	N	Y	Y	Y	Y	N	Y	N	N	Y	Y
527	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
1477	Y	Y	N	N	Y	Y	Y	Y	N	Y	N	N	Y	Y
853	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
1199	Y	Y	N	N	Y	Y	Y	Y	N	Y	N	Y	Y	Y
2222	N	N	N	N	Y	Y	N	Y	N	N	N	N	N	N
1045	Y	Y	N	N	Y	Y	Y	Y	Y	Y	N	Y	Y	Y
1313	Y	Y	N	N	Y	Y	Y	Y	N	Y	N	N	Y	Y
665	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
1145	Y	Y	N	N	Y	Y	Y	Y	N	Y	N	Y	Y	Y
972	Y	Y	N	N	Y	Y	Y	Y	Y	Y	N	Y	Y	Y
972	Y	Y	N	N	Y	Y	Y	Y	Y	Y	N	Y	Y	Y
962	Y	Y	N	N	Y	Y	Y	Y	Y	Y	N	Y	Y	Y
674	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
356	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y

	Tran Limit	Vert Limit	**TABLE-2 Tangent Original Design (8PSF)**
Type N/NE TAN Twr, Segments 1 & 2	2800	3000	Wind Pressure = 8

	Wind Transverse Load Check													
	ACSR Curlew		ACSR 2B-Curlew		ACCR Dove		ACCR Drake		ACCR 2B-Dove		ACCR 2B-Drake		ACCR Curlew	
Ruling Span Ft.	Transverse	Vertical	Transverse	Vertical	Transverse	Vertical	Transverse	Vertical	Transverse	Vertical	Transverse	Vertical	Transverse	Vertical
1165	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
1428	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
4119	N	N	N	N	Y	Y	N	N	N	N	N	N	N	N
1656	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	N	Y	Y
1384	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
1263	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
1434	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
1630	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	N	Y	Y
1596	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
1568	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
1286	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
1328	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
1557	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
1544	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
1823	Y	Y	N	N	Y	Y	Y	Y	Y	Y	Y	N	Y	Y
1792	Y	Y	N	N	Y	Y	Y	Y	Y	Y	Y	N	Y	Y
1868	Y	Y	N	N	Y	Y	Y	Y	Y	Y	N	N	Y	Y
1874	Y	Y	N	N	Y	Y	Y	Y	Y	Y	N	N	Y	Y
1609	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
527	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
1477	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
853	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
1199	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
2222	Y	Y	N	N	Y	Y	Y	Y	Y	Y	N	N	Y	Y
1045	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
1313	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
665	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
1145	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
972	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
972	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
962	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
674	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
356	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y

Types WC & WB TAN Twr, Segments 3 thru 6

Tran Limit	Vert Limit
4400	9000

TABLE-2 Tangent Original Design (8PSF)

	Wind + 2.5 Angle Transverse Load Check													
	ACSR Curlew		ACSR 2B-Curlew		ACCR Dove		ACCR Drake		ACCR 2B-Dove		ACCR 2B-Drake		ACCR Curlew	
Ruling Span Ft.	Transverse	Vertical	Transverse	Vertical	Transverse	Vertical	Transverse	Vertical	Transverse	Vertical	Transverse	Vertical	Transverse	Vertical
1165	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
1428	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
4119	Y	Y	N	N	Y	Y	Y	Y	N	Y	N	Y	Y	Y
1656	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
1384	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
1263	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
1434	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
1630	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
1596	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
1568	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
1286	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
1328	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
1557	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
1544	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
1823	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
1792	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
1868	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
1874	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
1609	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
527	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
1477	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
853	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
1199	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
2222	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
1045	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
1313	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
665	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
1145	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
972	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
972	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
962	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
674	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
356	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y

WODUP Existing Line/Alternative Use Review **TABLE-3 Tangent Design 12 PSF**

StructureTransverse Load from Conductor

	Dove ACCR	Drake ACCR	Curlew ACSR	Curlew ACCR	OPGW
Dia inches	0.941	1.128	1.244	1.247	0.69
Weight lbs	0.65	0.93	1.33	1.13	
Wind area, sq ft	0.078	0.094	0.104	0.104	0.058
Max Ten, lbs	8,085	11,270	12,810	12,000	

Transverse loading is calculated at each phase position

Wind Pressure = 12 Wind Speed 68 mph

	Transverse Wind Load, Lbs.						
Ruling Span Ft.	Exist 1033.5 ACSR Curlew	2B-1033.5 ACSR Curlew	New 557 ACCR Dove	New 795 ACCR Drake	New 2B-557 ACCR Dove	New 2B-795 ACCR Drake	New 1033.5 ACCR Curlew
1165	1,449	2,899	1,096	1,314	2,193	2,628	1,453
1428	1,776	3,553	1,344	1,611	2,687	3,222	1,781
4119	5,124	10,248	3,876	4,646	7,752	9,292	5,136
1656	2,060	4,120	1,558	1,868	3,117	3,736	2,065
1384	1,722	3,443	1,302	1,561	2,605	3,122	1,726
1263	1,571	3,142	1,188	1,425	2,377	2,849	1,575
1434	1,784	3,568	1,349	1,618	2,699	3,235	1,788
1630	2,028	4,055	1,534	1,839	3,068	3,677	2,033
1596	1,985	3,971	1,502	1,800	3,004	3,601	1,990
1568	1,951	3,901	1,475	1,769	2,951	3,537	1,955
1286	1,600	3,200	1,210	1,451	2,420	2,901	1,604
1328	1,652	3,304	1,250	1,498	2,499	2,996	1,656
1557	1,937	3,874	1,465	1,756	2,930	3,513	1,942
1544	1,921	3,841	1,453	1,742	2,906	3,483	1,925
1823	2,268	4,536	1,715	2,056	3,431	4,113	2,273
1792	2,229	4,458	1,686	2,021	3,373	4,043	2,235
1868	2,324	4,648	1,758	2,107	3,516	4,214	2,329
1874	2,331	4,663	1,763	2,114	3,527	4,228	2,337
1609	2,002	4,003	1,514	1,815	3,028	3,630	2,006
527	656	1,311	496	594	992	1,189	657
1477	1,837	3,675	1,390	1,666	2,780	3,332	1,842
853	1,061	2,122	803	962	1,605	1,924	1,064
1199	1,492	2,983	1,128	1,352	2,257	2,705	1,495
2222	2,764	5,528	2,091	2,506	4,182	5,013	2,771
1045	1,300	2,600	983	1,179	1,967	2,358	1,303
1313	1,633	3,267	1,236	1,481	2,471	2,962	1,637
665	827	1,655	626	750	1,252	1,500	829
1145	1,424	2,849	1,077	1,292	2,155	2,583	1,428
972	1,209	2,418	915	1,096	1,829	2,193	1,212
972	1,209	2,418	915	1,096	1,829	2,193	1,212
962	1,197	2,393	905	1,085	1,810	2,170	1,200
674	838	1,677	634	760	1,268	1,521	840
356	443	886	335	402	670	803	444

2.5 Line Angle Transverse Load, Lbs.						
Exist 1033.5 ACSR Curlew	2B-1033.5 ACSR Curlew	New 557 ACCR Dove	New 795 ACCR Drake	New 2B-557 ACCR Dove	New 2B-795 ACCR Drake	New 1033.5 ACCR Curlew
559	1,118	353	492	705	983	524

Type O TAN Twr, Segments 1 & 2

Tran Limit*	Vert Limit
1260	2400

TABLE-3 Tangent Design 12 PSF

*Transverse load limit at phase positions adjusted due to additional wind on structure.

	Wind Transverse Load Check													
	ACSR Curlew		ACSR 2B-Curlew		ACCR Dove		ACCR Drake		ACCR 2B-Dove		ACCR 2B-Drake		ACCR Curlew	
Ruling Span Ft.	Transverse	Vertical	Transverse	Vertical	Transverse	Vertical	Transverse	Vertical	Transverse	Vertical	Transverse	Vertical	Transverse	Vertical
1165	N	Y	N	N	Y	Y	N	Y	N	Y	N	Y	N	Y
1428	N	Y	N	N	N	Y	N	Y	N	Y	N	N	N	Y
4119	N	N	N	N	N	N	N	N	N	N	N	N	N	N
1656	N	Y	N	N	N	Y	N	Y	N	Y	N	N	N	Y
1384	N	Y	N	N	N	Y	N	Y	N	Y	N	N	N	Y
1263	N	Y	N	N	Y	Y	N	Y	N	Y	N	Y	N	Y
1434	N	Y	N	N	N	Y	N	Y	N	Y	N	N	N	Y
1630	N	Y	N	N	N	Y	N	Y	N	Y	N	N	N	Y
1596	N	Y	N	N	N	Y	N	Y	N	Y	N	N	N	Y
1568	N	Y	N	N	N	Y	N	Y	N	Y	N	N	N	Y
1286	N	Y	N	N	Y	Y	N	Y	N	Y	N	Y	N	Y
1328	N	Y	N	N	Y	Y	N	Y	N	Y	N	N	N	Y
1557	N	Y	N	N	N	Y	N	Y	N	Y	N	N	N	Y
1544	N	Y	N	N	N	Y	N	Y	N	Y	N	N	N	Y
1823	N	N	N	N	N	Y	N	Y	N	Y	N	N	N	Y
1792	N	Y	N	N	N	Y	N	Y	N	Y	N	N	N	Y
1868	N	N	N	N	N	Y	N	Y	N	N	N	N	N	Y
1874	N	N	N	N	N	Y	N	Y	N	N	N	N	N	Y
1609	N	Y	N	N	N	Y	N	Y	N	Y	N	N	N	Y
527	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
1477	N	Y	N	N	N	Y	N	Y	N	Y	N	N	N	Y
853	Y	Y	N	Y	Y	Y	Y	Y	N	Y	N	Y	Y	Y
1199	N	Y	N	N	Y	Y	N	Y	N	Y	N	Y	N	Y
2222	N	N	N	N	N	Y	N	Y	N	N	N	N	N	N
1045	N	Y	N	N	Y	Y	Y	Y	N	Y	N	Y	N	Y
1313	N	Y	N	N	Y	Y	N	Y	N	Y	N	N	N	Y
665	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	Y
1145	N	Y	N	N	Y	Y	N	Y	N	Y	N	Y	N	Y
972	Y	Y	N	N	Y	Y	Y	Y	N	Y	N	Y	Y	Y
972	Y	Y	N	N	Y	Y	Y	Y	N	Y	N	Y	Y	Y
962	Y	Y	N	N	Y	Y	Y	Y	N	Y	N	Y	Y	Y
674	Y	Y	N	Y	Y	Y	Y	Y	N	Y	N	Y	Y	Y
356	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y

TABLE-3 Tangent Design 12 PSF

	Tran Limit*	Vert Limit
Type N/NE TAN Twr, Segments 1 & 2	2520	3000

*Transverse load limit at phase positions adjusted due to additional wind on structure.

	Wind Transverse Load Check													
	ACSR Curlew		ACSR 2B-Curlew		ACCR Dove		ACCR Drake		ACCR 2B-Dove		ACCR 2B-Drake		ACCR Curlew	
Ruling Span Ft.	Transverse	Vertical	Transverse	Vertical	Transverse	Vertical	Transverse	Vertical	Transverse	Vertical	Transverse	Vertical	Transverse	Vertical
1165	Y	Y	N	N	Y	Y	Y	Y	Y	Y	N	Y	Y	Y
1428	Y	Y	N	N	Y	Y	Y	Y	N	Y	N	Y	Y	Y
4119	N	N	N	N	N	Y	N	N	N	N	N	N	N	N
1656	Y	Y	N	N	Y	Y	Y	Y	N	Y	N	N	Y	Y
1384	Y	Y	N	N	Y	Y	Y	Y	N	Y	N	Y	Y	Y
1263	Y	Y	N	N	Y	Y	Y	Y	Y	Y	N	Y	Y	Y
1434	Y	Y	N	N	Y	Y	Y	Y	N	Y	N	Y	Y	Y
1630	Y	Y	N	N	Y	Y	Y	Y	N	Y	N	N	Y	Y
1596	Y	Y	N	N	Y	Y	Y	Y	N	Y	N	Y	Y	Y
1568	Y	Y	N	N	Y	Y	Y	Y	N	Y	N	Y	Y	Y
1286	Y	Y	N	N	Y	Y	Y	Y	Y	Y	N	Y	Y	Y
1328	Y	Y	N	N	Y	Y	Y	Y	Y	Y	N	Y	Y	Y
1557	Y	Y	N	N	Y	Y	Y	Y	N	Y	N	Y	Y	Y
1544	Y	Y	N	N	Y	Y	Y	Y	N	Y	N	Y	Y	Y
1823	Y	Y	N	N	Y	Y	Y	Y	N	Y	N	N	Y	Y
1792	Y	Y	N	N	Y	Y	Y	Y	N	Y	N	N	Y	Y
1868	Y	Y	N	N	Y	Y	Y	Y	N	Y	N	N	Y	Y
1874	Y	Y	N	N	Y	Y	Y	Y	N	Y	N	N	Y	Y
1609	Y	Y	N	N	Y	Y	Y	Y	N	Y	N	Y	Y	Y
527	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
1477	Y	Y	N	N	Y	Y	Y	Y	N	Y	N	Y	Y	Y
853	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
1199	Y	Y	N	N	Y	Y	Y	Y	Y	Y	N	Y	Y	Y
2222	N	Y	N	N	Y	Y	Y	Y	N	Y	N	N	N	Y
1045	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
1313	Y	Y	N	N	Y	Y	Y	Y	Y	Y	N	Y	Y	Y
665	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
1145	Y	Y	N	N	Y	Y	Y	Y	Y	Y	N	Y	Y	Y
972	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
972	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
962	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
674	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
356	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y

	Tran Limit*	Vert Limit	**TABLE-3 Tangent Design 12 PSF**
Types WC & WB TAN Twr, Segments 3 thru 6	3960	9000	*Transverse load limit at phase positions adjusted due to additional wind on structure.

	Wind + 2.5 Angle Transverse Load Check													
	ACSR Curlew		ACSR 2B-Curlew		ACCR Dove		ACCR Drake		ACCR 2B-Dove		ACCR 2B-Drake		ACCR Curlew	
Ruling Span Ft.	Transverse	Vertical	Transverse	Vertical	Transverse	Vertical	Transverse	Vertical	Transverse	Vertical	Transverse	Vertical	Transverse	Vertical
1165	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
1428	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	Y
4119	N	Y	N	N	N	Y	N	Y	N	Y	N	Y	N	Y
1656	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	Y
1384	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	Y
1263	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
1434	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	Y
1630	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	Y
1596	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	Y
1568	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	Y
1286	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
1328	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	Y
1557	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	Y
1544	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	Y
1823	Y	Y	N	Y	Y	Y	Y	Y	N	Y	N	Y	Y	Y
1792	Y	Y	N	Y	Y	Y	Y	Y	N	Y	N	Y	Y	Y
1868	Y	Y	N	Y	Y	Y	Y	Y	N	Y	N	Y	Y	Y
1874	Y	Y	N	Y	Y	Y	Y	Y	N	Y	N	Y	Y	Y
1609	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	Y
527	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
1477	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	Y
853	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
1199	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
2222	Y	Y	N	Y	Y	Y	Y	Y	N	Y	N	Y	Y	Y
1045	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
1313	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
665	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
1145	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
972	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
972	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
962	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
674	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
356	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y

WODUP Existing Line/Alternative Use Review **TABLE-4 Tangent Design 16 PSF**

StructureTransverse Load from Conductor

	Dove ACCR	Drake ACCR	Curlew ACSR	Curlew ACCR	OPGW
Dia inches	0.941	1.128	1.244	1.247	0.69
Weight lbs	0.65	0.93	1.33	1.13	
Wind area, sq ft	0.078	0.094	0.104	0.104	0.058
Max Ten, lbs	8,085	11,270	12,810	12,000	

Transverse loading is calculated at each phase position

Wind Pressure = 16 Wind Speed 79 mph

	Transverse Wind Load, Lbs.						
Ruling Span Ft.	Exist 1033.5 ACSR Curlew	2B-1033.5 ACSR Curlew	New 557 ACCR Dove	New 795 ACCR Drake	New 2B-557 ACCR Dove	New 2B-795 ACCR Drake	New 1033.5 ACCR Curlew
1165	1,932	3,865	1,462	1,752	2,923	3,504	1,937
1428	2,369	4,737	1,792	2,148	3,583	4,295	2,374
4119	6,832	13,664	5,168	6,195	10,336	12,390	6,849
1656	2,747	5,494	2,078	2,491	4,155	4,981	2,753
1384	2,296	4,591	1,736	2,082	3,473	4,163	2,301
1263	2,095	4,190	1,585	1,900	3,169	3,799	2,100
1434	2,379	4,757	1,799	2,157	3,598	4,313	2,384
1630	2,704	5,407	2,045	2,452	4,090	4,903	2,710
1596	2,647	5,294	2,002	2,400	4,005	4,801	2,654
1568	2,601	5,202	1,967	2,358	3,935	4,717	2,607
1286	2,133	4,266	1,614	1,934	3,227	3,868	2,138
1328	2,203	4,405	1,666	1,997	3,332	3,995	2,208
1557	2,583	5,165	1,954	2,342	3,907	4,683	2,589
1544	2,561	5,122	1,937	2,322	3,874	4,644	2,567
1823	3,024	6,047	2,287	2,742	4,575	5,484	3,031
1792	2,972	5,945	2,248	2,695	4,497	5,390	2,979
1868	3,098	6,197	2,344	2,809	4,687	5,619	3,106
1874	3,108	6,217	2,351	2,818	4,702	5,637	3,116
1609	2,669	5,338	2,019	2,420	4,038	4,840	2,675
527	874	1,748	661	793	1,322	1,585	876
1477	2,450	4,900	1,853	2,221	3,706	4,443	2,456
853	1,415	2,830	1,070	1,283	2,140	2,566	1,418
1199	1,989	3,977	1,504	1,803	3,009	3,607	1,994
2222	3,686	7,371	2,788	3,342	5,576	6,684	3,694
1045	1,733	3,467	1,311	1,572	2,622	3,143	1,737
1313	2,178	4,356	1,647	1,975	3,295	3,950	2,183
665	1,103	2,206	834	1,000	1,669	2,000	1,106
1145	1,899	3,798	1,437	1,722	2,873	3,444	1,904
972	1,612	3,224	1,220	1,462	2,439	2,924	1,616
972	1,612	3,224	1,220	1,462	2,439	2,924	1,616
962	1,596	3,191	1,207	1,447	2,414	2,894	1,599
674	1,118	2,236	846	1,014	1,691	2,027	1,121
356	590	1,181	447	535	893	1,071	592

2.5 Line Angle Transverse Load, Lbs.						
Exist 1033.5 ACSR Curlew	2B-1033.5 ACSR Curlew	New 557 ACCR Dove	New 795 ACCR Drake	New 2B-557 ACCR Dove	New 2B-795 ACCR Drake	New 1033.5 ACCR Curlew
559	1,118	353	492	705	983	524

Type O TAN Twr, Segments 1 & 2

Tran Limit*	Vert Limit
1260	2400

TABLE-4 Tangent Design 16 PSF

*Transverse load limit at phase positions adjusted due to additional wind on structure.

	Wind Transverse Load Check													
	ACSR Curlew		ACSR 2B-Curlew		ACCR Dove		ACCR Drake		ACCR 2B-Dove		ACCR 2B-Drake		ACCR Curlew	
Ruling Span Ft.	Transverse	Vertical	Transverse	Vertical	Transverse	Vertical	Transverse	Vertical	Transverse	Vertical	Transverse	Vertical	Transverse	Vertical
1165	N	Y	N	N	N	Y	N	Y	N	Y	N	Y	N	Y
1428	N	Y	N	N	N	Y	N	Y	N	Y	N	N	N	Y
4119	N	N	N	N	N	N	N	N	N	N	N	N	N	N
1656	N	Y	N	N	N	Y	N	Y	N	Y	N	N	N	Y
1384	N	Y	N	N	N	Y	N	Y	N	Y	N	N	N	Y
1263	N	Y	N	N	N	Y	N	Y	N	Y	N	Y	N	Y
1434	N	Y	N	N	N	Y	N	Y	N	Y	N	N	N	Y
1630	N	Y	N	N	N	Y	N	Y	N	Y	N	N	N	Y
1596	N	Y	N	N	N	Y	N	Y	N	Y	N	N	N	Y
1568	N	Y	N	N	N	Y	N	Y	N	Y	N	N	N	Y
1286	N	Y	N	N	N	Y	N	Y	N	Y	N	Y	N	Y
1328	N	Y	N	N	N	Y	N	Y	N	Y	N	N	N	Y
1557	N	Y	N	N	N	Y	N	Y	N	Y	N	N	N	Y
1544	N	Y	N	N	N	Y	N	Y	N	Y	N	N	N	Y
1823	N	N	N	N	N	Y	N	Y	N	Y	N	N	N	Y
1792	N	Y	N	N	N	Y	N	Y	N	Y	N	N	N	Y
1868	N	N	N	N	N	Y	N	Y	N	N	N	N	N	Y
1874	N	N	N	N	N	Y	N	Y	N	N	N	N	N	Y
1609	N	Y	N	N	N	Y	N	Y	N	Y	N	N	N	Y
527	Y	Y	N	Y	Y	Y	Y	Y	N	Y	N	Y	Y	Y
1477	N	Y	N	N	N	Y	N	Y	N	Y	N	N	N	Y
853	N	Y	N	Y	Y	Y	N	Y	N	Y	N	Y	N	Y
1199	N	Y	N	N	N	Y	N	Y	N	Y	N	Y	N	Y
2222	N	N	N	N	N	Y	N	Y	N	N	N	N	N	N
1045	N	Y	N	N	N	Y	N	Y	N	Y	N	Y	N	Y
1313	N	Y	N	N	N	Y	N	Y	N	Y	N	N	N	Y
665	Y	Y	N	Y	Y	Y	Y	Y	N	Y	N	Y	Y	Y
1145	N	Y	N	N	N	Y	N	Y	N	Y	N	Y	N	Y
972	N	Y	N	N	Y	Y	N	Y	N	Y	N	Y	N	Y
972	N	Y	N	N	Y	Y	N	Y	N	Y	N	Y	N	Y
962	N	Y	N	N	Y	Y	N	Y	N	Y	N	Y	N	Y
674	Y	Y	N	Y	Y	Y	Y	Y	N	Y	N	Y	Y	Y
356	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y

Tran Limit* Vert Limit **TABLE-4 Tangent Design 16 PSF**

Type N/NE TAN Twr, Segments 1 & 2 2520 3000

*Transverse load limit at phase positions adjusted due to additional wind on structure.

	Wind Transverse Load Check													
	ACSR Curlew		ACSR 2B-Curlew		ACCR Dove		ACCR Drake		ACCR 2B-Dove		ACCR 2B-Drake		ACCR Curlew	
Ruling Span Ft.	Transverse	Vertical	Transverse	Vertical	Transverse	Vertical	Transverse	Vertical	Transverse	Vertical	Transverse	Vertical	Transverse	Vertical
1165	Y	Y	N	N	Y	Y	Y	Y	N	Y	N	Y	Y	Y
1428	Y	Y	N	N	Y	Y	Y	Y	N	Y	N	Y	Y	Y
4119	N	N	N	N	N	Y	N	N	N	N	N	N	N	N
1656	N	Y	N	N	Y	Y	Y	Y	N	Y	N	N	N	Y
1384	Y	Y	N	N	Y	Y	Y	Y	N	Y	N	Y	Y	Y
1263	Y	Y	N	N	Y	Y	Y	Y	N	Y	N	Y	Y	Y
1434	Y	Y	N	N	Y	Y	Y	Y	N	Y	N	Y	Y	Y
1630	N	Y	N	N	Y	Y	Y	Y	N	Y	N	N	N	Y
1596	N	Y	N	N	Y	Y	Y	Y	N	Y	N	Y	N	Y
1568	N	Y	N	N	Y	Y	Y	Y	N	Y	N	Y	N	Y
1286	Y	Y	N	N	Y	Y	Y	Y	N	Y	N	Y	Y	Y
1328	Y	Y	N	N	Y	Y	Y	Y	N	Y	N	Y	Y	Y
1557	N	Y	N	N	Y	Y	Y	Y	N	Y	N	Y	N	Y
1544	N	Y	N	N	Y	Y	Y	Y	N	Y	N	Y	N	Y
1823	N	Y	N	N	Y	Y	N	Y	N	Y	N	N	N	Y
1792	N	Y	N	N	Y	Y	N	Y	N	Y	N	N	N	Y
1868	N	Y	N	N	Y	Y	N	Y	N	Y	N	N	N	Y
1874	N	Y	N	N	Y	Y	N	Y	N	Y	N	N	N	Y
1609	N	Y	N	N	Y	Y	Y	Y	N	Y	N	Y	N	Y
527	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
1477	Y	Y	N	N	Y	Y	Y	Y	N	Y	N	Y	Y	Y
853	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	Y
1199	Y	Y	N	N	Y	Y	Y	Y	N	Y	N	Y	Y	Y
2222	N	Y	N	N	N	Y	N	Y	N	Y	N	N	N	Y
1045	Y	Y	N	Y	Y	Y	Y	Y	N	Y	N	Y	Y	Y
1313	Y	Y	N	N	Y	Y	Y	Y	N	Y	N	Y	Y	Y
665	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
1145	Y	Y	N	N	Y	Y	Y	Y	N	Y	N	Y	Y	Y
972	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	Y
972	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	Y
962	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	Y
674	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
356	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y

Types WC & WB TAN Twr, Segments 3 thru 6

Tran Limit*	Vert Limit
3960	9000

TABLE-4 Tangent Design 16 PSF

*Transverse load limit at phase positions adjusted due to additional wind on structure.

	Wind + 2.5 Angle Transverse Load Check													
	ACSR Curlew		ACSR 2B-Curlew		ACCR Dove		ACCR Drake		ACCR 2B-Dove		ACCR 2B-Drake		ACCR Curlew	
Ruling Span Ft.	Transverse	Vertical	Transverse	Vertical	Transverse	Vertical	Transverse	Vertical	Transverse	Vertical	Transverse	Vertical	Transverse	Vertical
1165	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	Y
1428	Y	Y	N	Y	Y	Y	Y	Y	N	Y	N	Y	Y	Y
4119	N	Y	N	N	N	Y	N	Y	N	Y	N	Y	N	Y
1656	Y	Y	N	Y	Y	Y	Y	Y	N	Y	N	Y	Y	Y
1384	Y	Y	N	Y	Y	Y	Y	Y	N	Y	N	Y	Y	Y
1263	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	Y
1434	Y	Y	N	Y	Y	Y	Y	Y	N	Y	N	Y	Y	Y
1630	Y	Y	N	Y	Y	Y	Y	Y	N	Y	N	Y	Y	Y
1596	Y	Y	N	Y	Y	Y	Y	Y	N	Y	N	Y	Y	Y
1568	Y	Y	N	Y	Y	Y	Y	Y	N	Y	N	Y	Y	Y
1286	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	Y
1328	Y	Y	N	Y	Y	Y	Y	Y	N	Y	N	Y	Y	Y
1557	Y	Y	N	Y	Y	Y	Y	Y	N	Y	N	Y	Y	Y
1544	Y	Y	N	Y	Y	Y	Y	Y	N	Y	N	Y	Y	Y
1823	Y	Y	N	Y	Y	Y	Y	Y	N	Y	N	Y	Y	Y
1792	Y	Y	N	Y	Y	Y	Y	Y	N	Y	N	Y	Y	Y
1868	Y	Y	N	Y	Y	Y	Y	Y	N	Y	N	Y	Y	Y
1874	Y	Y	N	Y	Y	Y	Y	Y	N	Y	N	Y	Y	Y
1609	Y	Y	N	Y	Y	Y	Y	Y	N	Y	N	Y	Y	Y
527	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
1477	Y	Y	N	Y	Y	Y	Y	Y	N	Y	N	Y	Y	Y
853	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
1199	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	Y
2222	N	Y	N	Y	Y	Y	Y	Y	N	Y	N	Y	N	Y
1045	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	Y
1313	Y	Y	N	Y	Y	Y	Y	Y	N	Y	N	Y	Y	Y
665	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
1145	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	Y
972	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
972	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
962	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
674	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
356	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y

WODUP Existing Line/Alternative Use Review **TABLE-5 Tangent Design 18 PSF**

StructureTransverse Load from Conductor

	Dove ACCR	Drake ACCR	Curlew ACSR	Curlew ACCR	OPGW
Dia inches	0.941	1.128	1.244	1.247	0.69
Weight lbs	0.65	0.93	1.33	1.13	
Wind area, sq ft	0.078	0.094	0.104	0.104	0.058
Max Ten, lbs	8,085	11,270	12,810	12,000	

Transverse loading is calculated at each phase position

Wind Pressure = 18 Wind Speed 84 mph

	Transverse Wind Load, Lbs.						
Ruling Span Ft.	Exist 1033.5 ACSR Curlew	2B-1033.5 ACSR Curlew	New 557 ACCR Dove	New 795 ACCR Drake	New 2B-557 ACCR Dove	New 2B-795 ACCR Drake	New 1033.5 ACCR Curlew
1165	2,174	4,348	1,644	1,971	3,289	3,942	2,179
1428	2,665	5,329	2,016	2,416	4,031	4,832	2,671
4119	7,686	15,372	5,814	6,969	11,628	13,939	7,705
1656	3,090	6,180	2,337	2,802	4,675	5,604	3,098
1384	2,583	5,165	1,954	2,342	3,907	4,683	2,589
1263	2,357	4,714	1,783	2,137	3,565	4,274	2,362
1434	2,676	5,352	2,024	2,426	4,048	4,853	2,682
1630	3,042	6,083	2,301	2,758	4,601	5,516	3,049
1596	2,978	5,956	2,253	2,700	4,506	5,401	2,985
1568	2,926	5,852	2,213	2,653	4,426	5,306	2,933
1286	2,400	4,799	1,815	2,176	3,630	4,352	2,405
1328	2,478	4,956	1,874	2,247	3,749	4,494	2,484
1557	2,905	5,811	2,198	2,634	4,395	5,269	2,912
1544	2,881	5,762	2,179	2,612	4,359	5,225	2,888
1823	3,402	6,803	2,573	3,085	5,146	6,169	3,410
1792	3,344	6,688	2,529	3,032	5,059	6,064	3,352
1868	3,486	6,971	2,637	3,161	5,273	6,321	3,494
1874	3,497	6,994	2,645	3,171	5,290	6,342	3,505
1609	3,002	6,005	2,271	2,722	4,542	5,445	3,010
527	983	1,967	744	892	1,488	1,783	986
1477	2,756	5,512	2,085	2,499	4,170	4,998	2,763
853	1,592	3,183	1,204	1,443	2,408	2,887	1,596
1199	2,237	4,475	1,692	2,029	3,385	4,057	2,243
2222	4,146	8,293	3,136	3,760	6,273	7,519	4,156
1045	1,950	3,900	1,475	1,768	2,950	3,536	1,955
1313	2,450	4,900	1,853	2,222	3,707	4,443	2,456
665	1,241	2,482	939	1,125	1,877	2,250	1,244
1145	2,137	4,273	1,616	1,937	3,232	3,875	2,142
972	1,814	3,628	1,372	1,645	2,744	3,289	1,818
972	1,814	3,628	1,372	1,645	2,744	3,289	1,818
962	1,795	3,590	1,358	1,628	2,716	3,255	1,799
674	1,258	2,515	951	1,140	1,903	2,281	1,261
356	664	1,329	502	602	1,005	1,205	666

2.5 Line Angle Transverse Load, Lbs.						
Exist 1033.5 ACSR Curlew	2B-1033.5 ACSR Curlew	New 557 ACCR Dove	New 795 ACCR Drake	New 2B-557 ACCR Dove	New 2B-795 ACCR Drake	New 1033.5 ACCR Curlew
559	1,118	353	492	705	983	524

Type O TAN Twr, Segments 1 & 2

Tran Limit*	Vert Limit
1260	2400

TABLE-5 Tangent Design 18 PSF

*Transverse load limit at phase positions adjusted due to additional wind on structure.

	Wind Transverse Load Check													
	ACSR Curlew		ACSR 2B-Curlew		ACCR Dove		ACCR Drake		ACCR 2B-Dove		ACCR 2B-Drake		ACCR Curlew	
Ruling Span Ft.	Transverse	Vertical	Transverse	Vertical	Transverse	Vertical	Transverse	Vertical	Transverse	Vertical	Transverse	Vertical	Transverse	Vertical
1165	N	Y	N	N	N	Y	N	Y	N	Y	N	Y	N	Y
1428	N	Y	N	N	N	Y	N	Y	N	Y	N	N	N	Y
4119	N	N	N	N	N	N	N	N	N	N	N	N	N	N
1656	N	Y	N	N	N	Y	N	Y	N	Y	N	N	N	Y
1384	N	Y	N	N	N	Y	N	Y	N	Y	N	N	N	Y
1263	N	Y	N	N	N	Y	N	Y	N	Y	N	Y	N	Y
1434	N	Y	N	N	N	Y	N	Y	N	Y	N	N	N	Y
1630	N	Y	N	N	N	Y	N	Y	N	Y	N	N	N	Y
1596	N	Y	N	N	N	Y	N	Y	N	Y	N	N	N	Y
1568	N	Y	N	N	N	Y	N	Y	N	Y	N	N	N	Y
1286	N	Y	N	N	N	Y	N	Y	N	Y	N	Y	N	Y
1328	N	Y	N	N	N	Y	N	Y	N	Y	N	N	N	Y
1557	N	Y	N	N	N	Y	N	Y	N	Y	N	N	N	Y
1544	N	Y	N	N	N	Y	N	Y	N	Y	N	N	N	Y
1823	N	N	N	N	N	Y	N	Y	N	Y	N	N	N	Y
1792	N	Y	N	N	N	Y	N	Y	N	Y	N	N	N	Y
1868	N	N	N	N	N	Y	N	Y	N	N	N	N	N	Y
1874	N	N	N	N	N	Y	N	Y	N	N	N	N	N	Y
1609	N	Y	N	N	N	Y	N	Y	N	Y	N	N	N	Y
527	Y	Y	N	Y	Y	Y	Y	Y	N	Y	N	Y	Y	Y
1477	N	Y	N	N	N	Y	N	Y	N	Y	N	N	N	Y
853	N	Y	N	Y	Y	Y	N	Y	N	Y	N	Y	N	Y
1199	N	Y	N	N	N	Y	N	Y	N	Y	N	Y	N	Y
2222	N	N	N	N	N	Y	N	Y	N	N	N	N	N	N
1045	N	Y	N	N	N	Y	N	Y	N	Y	N	Y	N	Y
1313	N	Y	N	N	N	Y	N	Y	N	Y	N	N	N	Y
665	Y	Y	N	Y	Y	Y	Y	Y	N	Y	N	Y	Y	Y
1145	N	Y	N	N	N	Y	N	Y	N	Y	N	Y	N	Y
972	N	Y	N	N	N	Y	N	Y	N	Y	N	Y	N	Y
972	N	Y	N	N	N	Y	N	Y	N	Y	N	Y	N	Y
962	N	Y	N	N	N	Y	N	Y	N	Y	N	Y	N	Y
674	Y	Y	N	Y	Y	Y	Y	Y	N	Y	N	Y	N	Y
356	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y

Type N/NE TAN Twr, Segments 1 & 2

Tran Limit*	Vert Limit
2520	3000

TABLE-5 Tangent Design 18 PSF

*Transverse load limit at phase positions adjusted due to additional wind on structure.

	Wind Transverse Load Check													
	ACSR Curlew		ACSR 2B-Curlew		ACCR Dove		ACCR Drake		ACCR 2B-Dove		ACCR 2B-Drake		ACCR Curlew	
Ruling Span Ft.	Transverse	Vertical	Transverse	Vertical	Transverse	Vertical	Transverse	Vertical	Transverse	Vertical	Transverse	Vertical	Transverse	Vertical
1165	Y	Y	N	N	Y	Y	Y	Y	N	Y	N	Y	Y	Y
1428	N	Y	N	N	Y	Y	Y	Y	N	Y	N	Y	N	Y
4119	N	N	N	N	N	Y	N	N	N	N	N	N	N	N
1656	N	Y	N	N	Y	Y	N	Y	N	Y	N	N	N	Y
1384	N	Y	N	N	Y	Y	Y	Y	N	Y	N	Y	N	Y
1263	Y	Y	N	N	Y	Y	Y	Y	N	Y	N	Y	Y	Y
1434	N	Y	N	N	Y	Y	Y	Y	N	Y	N	Y	N	Y
1630	N	Y	N	N	Y	Y	N	Y	N	Y	N	N	N	Y
1596	N	Y	N	N	Y	Y	N	Y	N	Y	N	Y	N	Y
1568	N	Y	N	N	Y	Y	N	Y	N	Y	N	Y	N	Y
1286	Y	Y	N	N	Y	Y	Y	Y	N	Y	N	Y	Y	Y
1328	Y	Y	N	N	Y	Y	Y	Y	N	Y	N	Y	Y	Y
1557	N	Y	N	N	Y	Y	N	Y	N	Y	N	Y	N	Y
1544	N	Y	N	N	Y	Y	N	Y	N	Y	N	Y	N	Y
1823	N	Y	N	N	N	Y	N	Y	N	Y	N	N	N	Y
1792	N	Y	N	N	N	Y	N	Y	N	Y	N	N	N	Y
1868	N	Y	N	N	N	Y	N	Y	N	Y	N	N	N	Y
1874	N	Y	N	N	N	Y	N	Y	N	Y	N	N	N	Y
1609	N	Y	N	N	Y	Y	N	Y	N	Y	N	Y	N	Y
527	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
1477	N	Y	N	N	Y	Y	Y	Y	N	Y	N	Y	N	Y
853	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	Y
1199	Y	Y	N	N	Y	Y	Y	Y	N	Y	N	Y	Y	Y
2222	N	Y	N	N	N	Y	N	Y	N	Y	N	N	N	Y
1045	Y	Y	N	Y	Y	Y	Y	Y	N	Y	N	Y	Y	Y
1313	Y	Y	N	N	Y	Y	Y	Y	N	Y	N	Y	Y	Y
665	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
1145	Y	Y	N	N	Y	Y	Y	Y	N	Y	N	Y	Y	Y
972	Y	Y	N	Y	Y	Y	Y	Y	N	Y	N	Y	Y	Y
972	Y	Y	N	Y	Y	Y	Y	Y	N	Y	N	Y	Y	Y
962	Y	Y	N	Y	Y	Y	Y	Y	N	Y	N	Y	Y	Y
674	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
356	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y

Types WC & WB TAN Twr, Segments 3 thru 6

Tran Limit*	Vert Limit
3960	9000

TABLE-5 Tangent Design 18 PSF

*Transverse load limit at phase positions adjusted due to additional wind on structure.

	Wind + 2.5 Angle Transverse Load Check													
	ACSR Curlew		ACSR 2B-Curlew		ACCR Dove		ACCR Drake		ACCR 2B-Dove		ACCR 2B-Drake		ACCR Curlew	
Ruling Span Ft.	Transverse	Vertical	Transverse	Vertical	Transverse	Vertical	Transverse	Vertical	Transverse	Vertical	Transverse	Vertical	Transverse	Vertical
1165	Y	Y	N	Y	Y	Y	Y	Y	N	Y	N	Y	Y	Y
1428	Y	Y	N	Y	Y	Y	Y	Y	N	Y	N	Y	Y	Y
4119	N	Y	N	N	N	Y	N	Y	N	Y	N	Y	N	Y
1656	Y	Y	N	Y	Y	Y	Y	Y	N	Y	N	Y	Y	Y
1384	Y	Y	N	Y	Y	Y	Y	Y	N	Y	N	Y	Y	Y
1263	Y	Y	N	Y	Y	Y	Y	Y	N	Y	N	Y	Y	Y
1434	Y	Y	N	Y	Y	Y	Y	Y	N	Y	N	Y	Y	Y
1630	Y	Y	N	Y	Y	Y	Y	Y	N	Y	N	Y	Y	Y
1596	Y	Y	N	Y	Y	Y	Y	Y	N	Y	N	Y	Y	Y
1568	Y	Y	N	Y	Y	Y	Y	Y	N	Y	N	Y	Y	Y
1286	Y	Y	N	Y	Y	Y	Y	Y	N	Y	N	Y	Y	Y
1328	Y	Y	N	Y	Y	Y	Y	Y	N	Y	N	Y	Y	Y
1557	Y	Y	N	Y	Y	Y	Y	Y	N	Y	N	Y	Y	Y
1544	Y	Y	N	Y	Y	Y	Y	Y	N	Y	N	Y	Y	Y
1823	N	Y	N	Y	Y	Y	Y	Y	N	Y	N	Y	Y	Y
1792	Y	Y	N	Y	Y	Y	Y	Y	N	Y	N	Y	Y	Y
1868	N	Y	N	Y	Y	Y	Y	Y	N	Y	N	Y	N	Y
1874	N	Y	N	Y	Y	Y	Y	Y	N	Y	N	Y	N	Y
1609	Y	Y	N	Y	Y	Y	Y	Y	N	Y	N	Y	Y	Y
527	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
1477	Y	Y	N	Y	Y	Y	Y	Y	N	Y	N	Y	Y	Y
853	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
1199	Y	Y	N	Y	Y	Y	Y	Y	N	Y	N	Y	Y	Y
2222	N	Y	N	Y	Y	Y	N	Y	N	Y	N	Y	N	Y
1045	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	Y
1313	Y	Y	N	Y	Y	Y	Y	Y	N	Y	N	Y	Y	Y
665	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
1145	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	Y
972	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	Y
972	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	Y
962	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	Y
674	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
356	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y