Appendix D
System Engineering Reports

ESA

Appendix D Section 1
Supplemental Routing
Analysis

ESA

SAN JOAQUIN CROSS-VALLEY LOOP PROJECT
SUPPLEMENTAL ROUTING SENSITIVITY ANALYSIS

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EXECUTIVE SUMMARY

This document provides a summary of anticipated power flow implications of SJXVL Project routing decisions. This document was prepared to illustrate how the electrical effectiveness of the SJXVL Project depends in general on the SJXVL route selected, and in particular the location of the SJXVL tap point ("north" versus "south").

The findings illustrate a nonlinear relationship between routing and SJXVL project electrical effectiveness. Northern SJXVL routes are more effective than southern SJXVL routes at meeting the project electrical objectives. However, this relationship is non-linear; overall SJXVL electrical performance rapidly degrades as SJXVL routes proceed south, but there are only diminishing marginal returns in terms of improved electrical performance as SJXVL routes head north. This analysis has also identified one reliability criteria violation for the southern route (identified as "Alt 4" in the PEA) that would not exist with any of the other three routes identified in the PEA.

These results provide additional evidence in support of the conclusion that the SJXVL southern route ("Alt 4") would be the least effective at meeting the project electrical objectives and can be dismissed from further consideration since it does not meet reliability criteria requirements.

DETAILED RESULTS

The following pages summarize the anticipated power flow system performance of the SJXVL project as a function of approximate SJXVL tap point location. These results were derived using conceptual SJXVL routing assumptions, because detailed routes have not been developed for the entire spectrum of possible SJXVL tap point locations. As a result, while these results provide a convenient means by which the relative effectiveness of northern versus southern SJXVL routes can be illustrated, they are not intended to measure the specific electrical performance of any particular SJXVL route. However, if the analysis based on conceptual routing assumptions indicated potential violations of reliability criteria, then detailed analysis based on specific routes as identified in the PEA was also performed for validation purposes.

Results are provided for each of the following electrical performance categories:

- Base case 230-kV line loading (amps)
- Base case 230-kV line loading imbalance (amps and %)
- Base case 230-kV line losses (MW and MVAR)
- Big Creek RAS Generation Rejection under N-1 (MW)
- Anticipated Big Creek Hydro annual generation unavailability (MWH)
- Rector 230-kV bus voltages under base case and N-1 (% and per unit)

In each of the above performance categories listed above, the results show a clear pattern of degraded system electrical performance and under-utilization of the new SJXVL project as routes trend south. The results also show a clear pattern of diminishing marginal returns in terms of improved electrical performance as routes head north.

In addition, there was one reliability criteria violation for southern route(s) identified through this sensitivity analysis. This criteria violation was associated with system voltage drops that are allowable under N-1 line outage conditions. The analysis showed that as conceptual SJXVL routes terminate approximately 65 miles (or further) south of Big Creek Powerhouse 3, voltage drops at Rector Substation begin to exceed 7% under N-1 outage conditions. SCE Transmission Planning guidelines do not allow for voltage deviations in excess of 7% for N-1 contingency outages. As discussed below in pages 10 and 11, detailed analysis confirmed that the "Alt 4" route would in fact result in voltage drops in excess of 7% under N-1 conditions.

Please note that the "Alt 4" route details described in the PEA were defined several years ago and have not been field verified for engineering viability, public impacts, or environmental impacts because this route was dismissed in the PEA for electrical performance reasons. This document will refer to "Alt 4" as a route alternative, but use of this language is not intended to imply any conclusions regarding the viability of this route. This route was considered here as part of a planning exercise for relative electrical performance comparison purposes only.

Base case 230-kV line loading (amps)

The following is a chart showing the base case power flows on the four lines south of Big Creek, i.e. the three existing 230-kV lines (Big Creek 1-Rector, Big Creek 3-Rector and Big Creek 4-Springville) and the new post-SJXVL 230-kV line (Big Creek 3-Rector No. 2) as a function of SJXVL tap point location.

Big Creek 220-kV base case line loading (amps)
*as a function of approximate SJXVL tap point location*
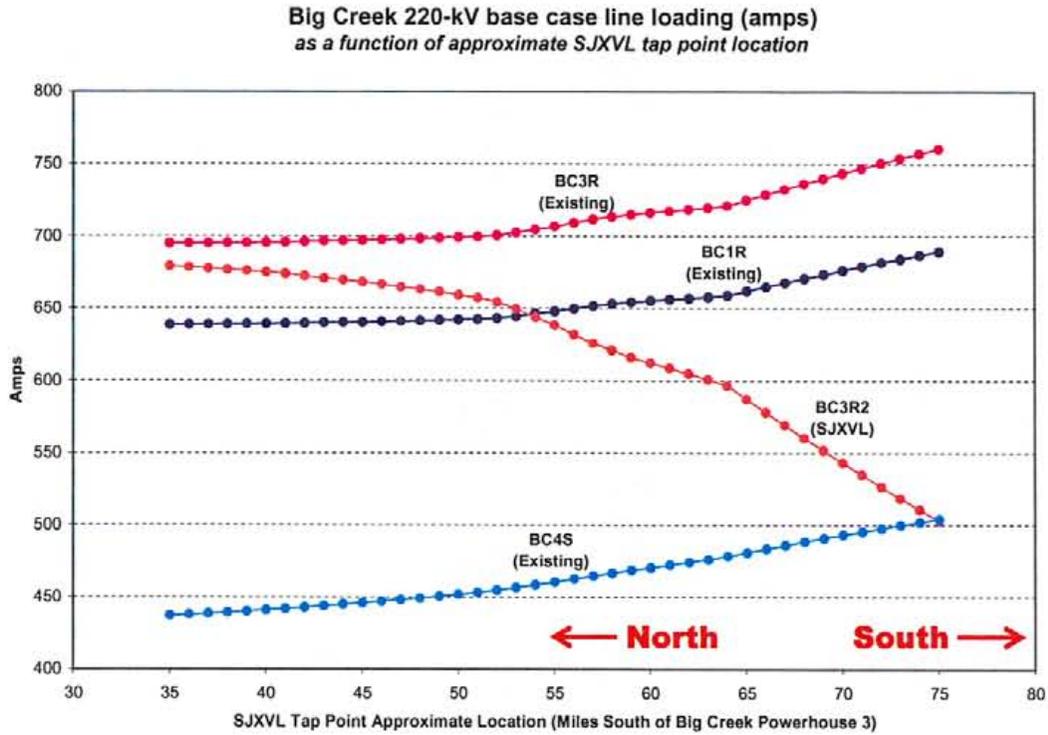
The chart above illustrates that as SJXVL routes head south there is increased under-utilization of the new SJXVL project capacity and increased loading on the existing constrained 230-kV lines in the corridor.

Base case 230-kV line loading imbalance (amps and %)

The graph above shows that the southern route(s) result in the most unequal loading on the three lines serving Rector load from Big Creek, particularly between the (existing) Big Creek 3-Rector line and the (new) Big Creek 3-Rector No. 2 line. One way to quantify the amount of unequal line loading between the two Big Creek 3-Rector lines is to calculate line "imbalance" using the following definition:

$$\text{Line Imbalance} := \frac{(\text{BC3 - Rector No. 1 line flow}) - (\text{BC3 - Rector No. 2 line flow})}{\text{Sum of both BC3 - Rector line flows}}$$

This formula defines the unequal loading between the two Big Creek 3-Rector lines as a percentage of the total flow on these lines. Larger percentages of line imbalance reflect more significant under-utilization of the new SJXVL transmission capacity. See the chart below for results as a function of approximate SJXVL tap point location.

Big Creek to Rector 220-kV Line Imbalance
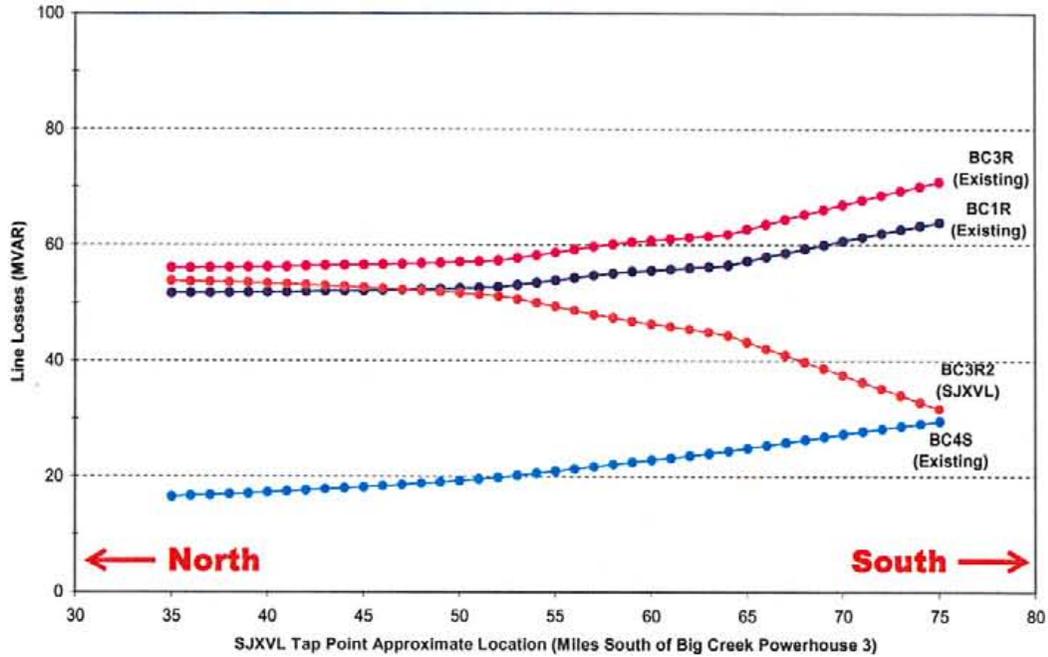*as a function of approximate SJXVL tap point location*
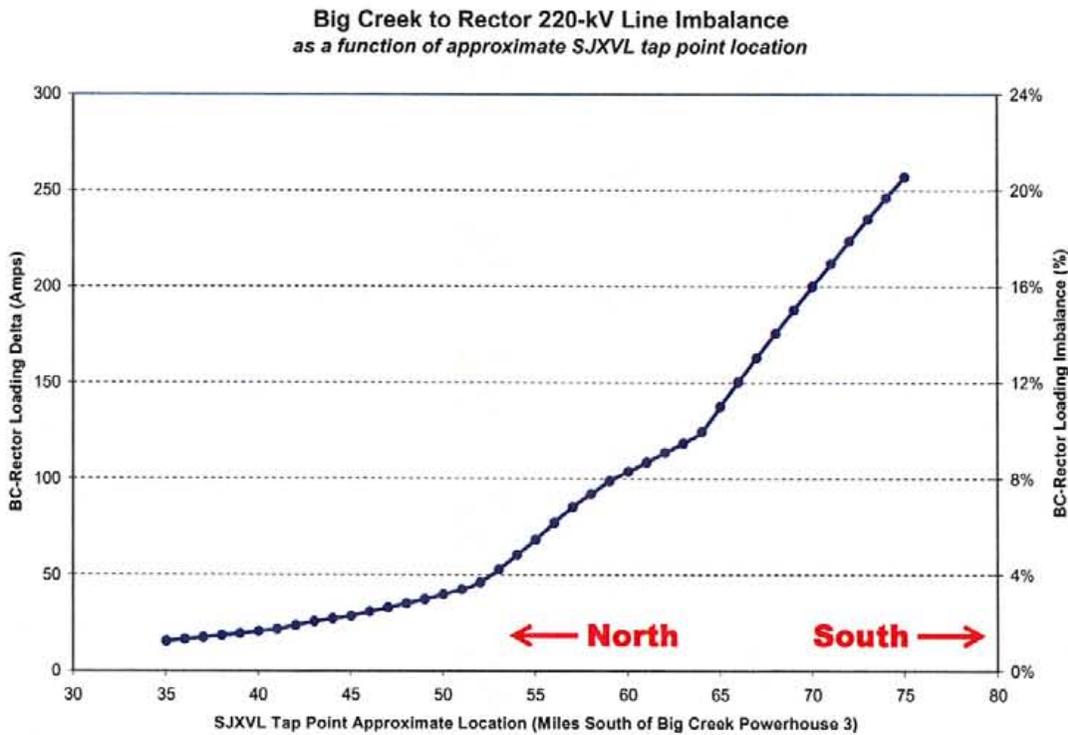
Base case 230-kV line losses (MW and MVAR)

Real and reactive transmission line losses are a function of the square of line current; therefore system losses typically increase faster than line loadings. The following chart shows real (MW) base case line losses as a function of approximate SJXVL tap point location among the four lines south of Big Creek, i.e. the three existing 230-kV lines (Big Creek 1-Rector, Big Creek 3-Rector and Big Creek 4-Springville) and the new post-SJXVL 230-kV line (Big Creek 3-Rector No. 2).

Big Creek 220-kV base case line losses (MW)
*as a function of approximate SJXVL tap point location*
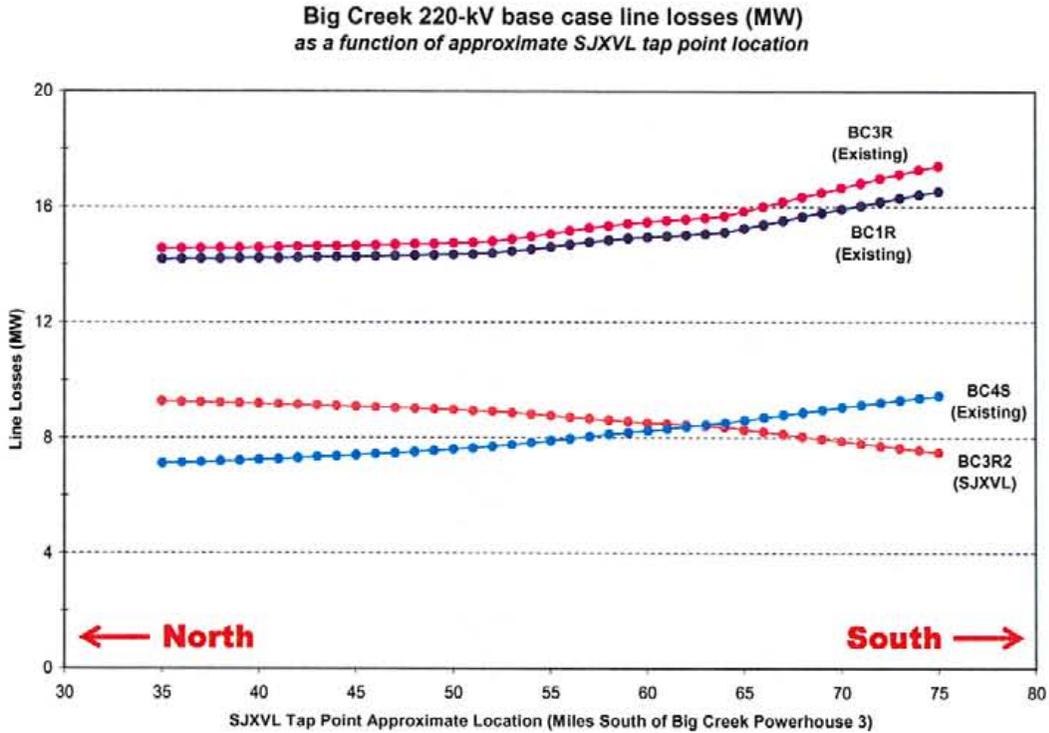
Likewise, the following chart shows reactive (MVAR) base case line losses as a function of approximate SJXVL tap point location among the four lines south of Big Creek, i.e. the three existing 230-kV lines (Big Creek 1-Rector, Big Creek 3-Rector and Big Creek 4-Springville) and the new post-SJXVL 230-kV line (Big Creek 3-Rector No. 2).

Big Creek 220-kV base case line losses (MVAR)
*as a function of approximate SJXVL tap point location*

The results in the charts above indicate that real and reactive losses on the three existing lines increase (and real and reactive losses on the new Big Creek 3-Rector No. 2 230-kV line decrease) as SJXVL routes proceed south. When the sum of losses among all four transmission lines is calculated, the net result is an overall increase in total system losses as SJXVL routes trend south. This is shown in the chart below which shows the net MW line losses and MVAR line losses among all four lines south of Big Creek as a function of approximate SJXVL tap point location.

Big Creek 220-kV total base case line losses (MW and MVAR)
*as a function of approximate SJXVL tap point location*
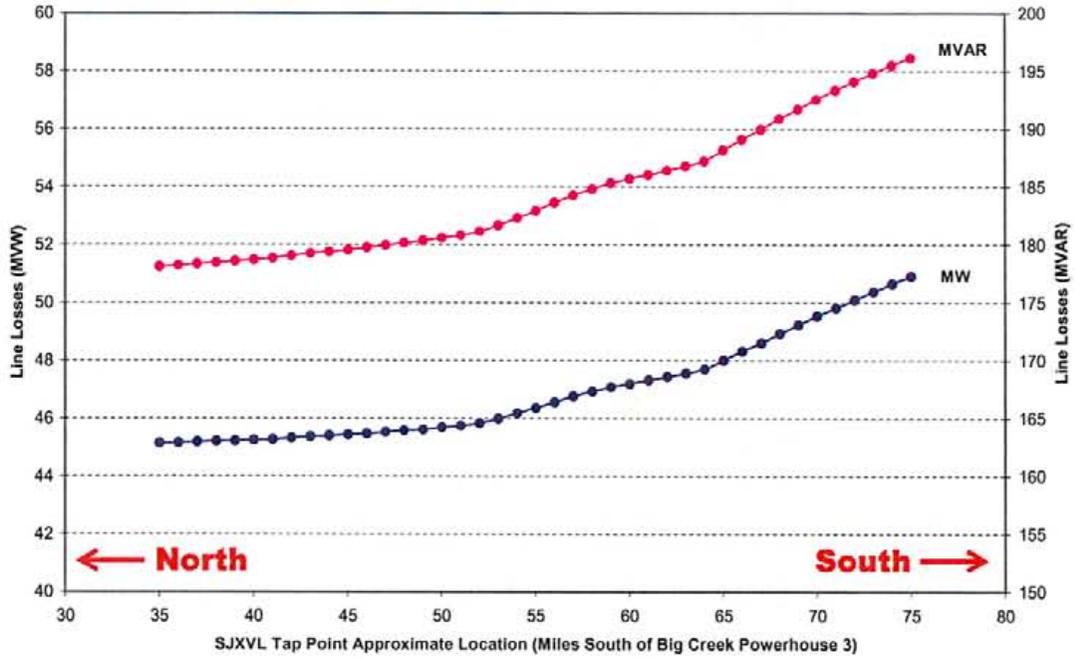
Big Creek RAS Generation Rejection under N-1 (MW)

Following the completion of the SJXVL project, use of Big Creek Remedial Action Scheme (RAS) rejection of Big Creek Hydro generation will still be required upon certain N-1 outage conditions to maintain 230-kV line loadings within acceptable limits. The following chart shows the anticipated generation rejection requirements (MW) as a function of SJXVL approximate tap point location for N-1 outages of the four lines south of Big Creek, i.e. the three existing 230-kV lines (Big Creek 1-Rector, Big Creek 3-Rector and Big Creek 4-Springville) and the new post-SJXVL 230-kV line (Big Creek 3-Rector No. 2).

Big Creek MW RAS Rejection (N-1)
as a function of approximate SJXVL tap point location
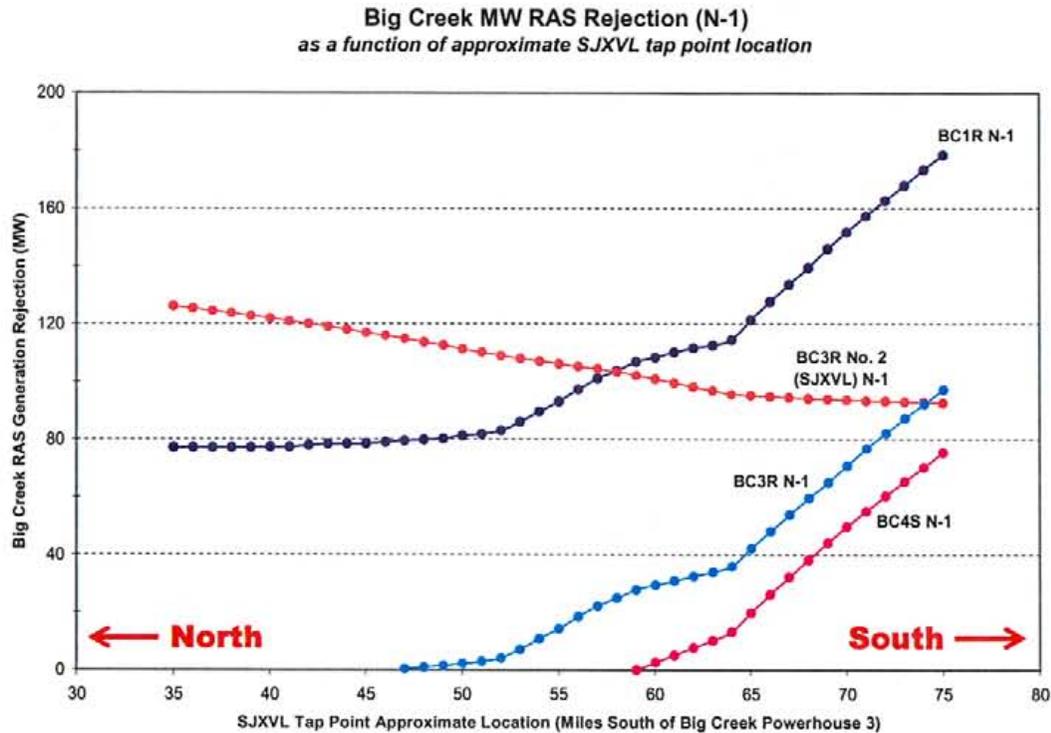
It is noted that the generation rejection requirements increase for three of the four N-1 outages (the three existing lines) and decrease for N-1 outage of the new line as SJXVL routes trend south. In order to estimate the anticipated hydro generation rejection via RAS as a function of SJXVL tap point location, line outage rates based on a ten-year outage history were used. Based on this outage history, the anticipated annual hydro generation unavailability for N-1 outages south of Big Creek was calculated as a function of SJXVL approximate tap point location. The results are presented in the chart below.

Anticipated Hydro MWH Unavailability (Annual)
as a function of approximate SJXVL tap point location
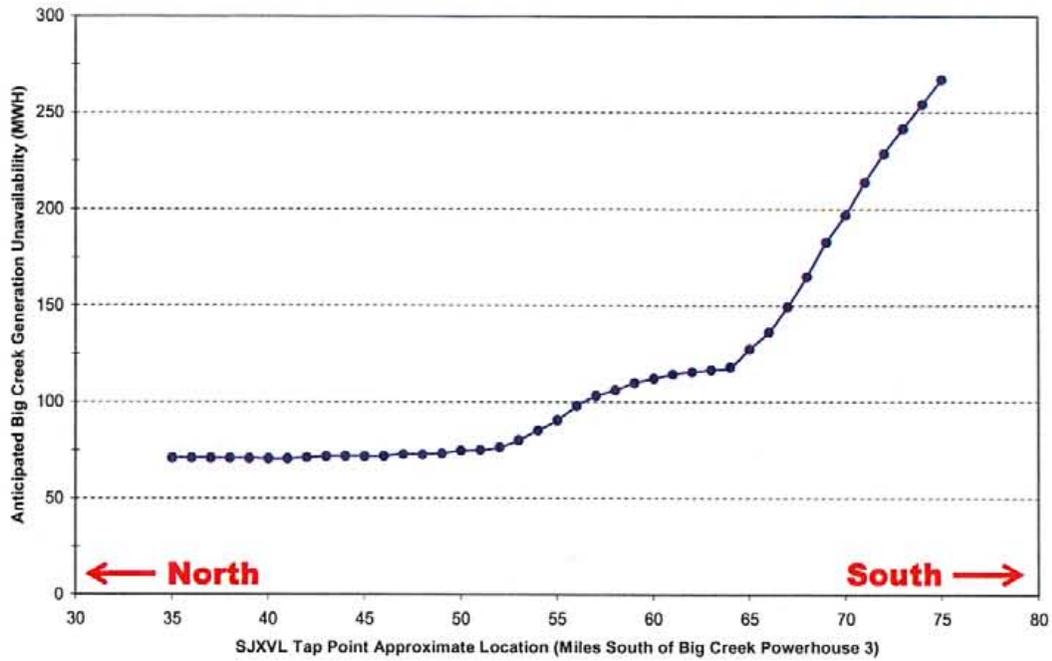
These results indicate that as SJXVL routes proceed south, there will be an increased reliance on Big Creek hydro generation rejection via RAS for N-1 outages.

Rector 230-kV bus voltages under base case and N-1 (% and per unit)

The base case and N-1 voltages at Rector Substation (expressed in per unit) as a function of approximate SJXVL tap point location are shown in the chart below. The three N-1 outages shown are the three N-1 outages between Big Creek and Rector, as these are the three outages with the greatest impact on Rector Substation 230-kv bus voltage.

Rector 230 kV Bus Voltage (pu) under Base Case and N-1
as a function of approximate SJXVL tap point location
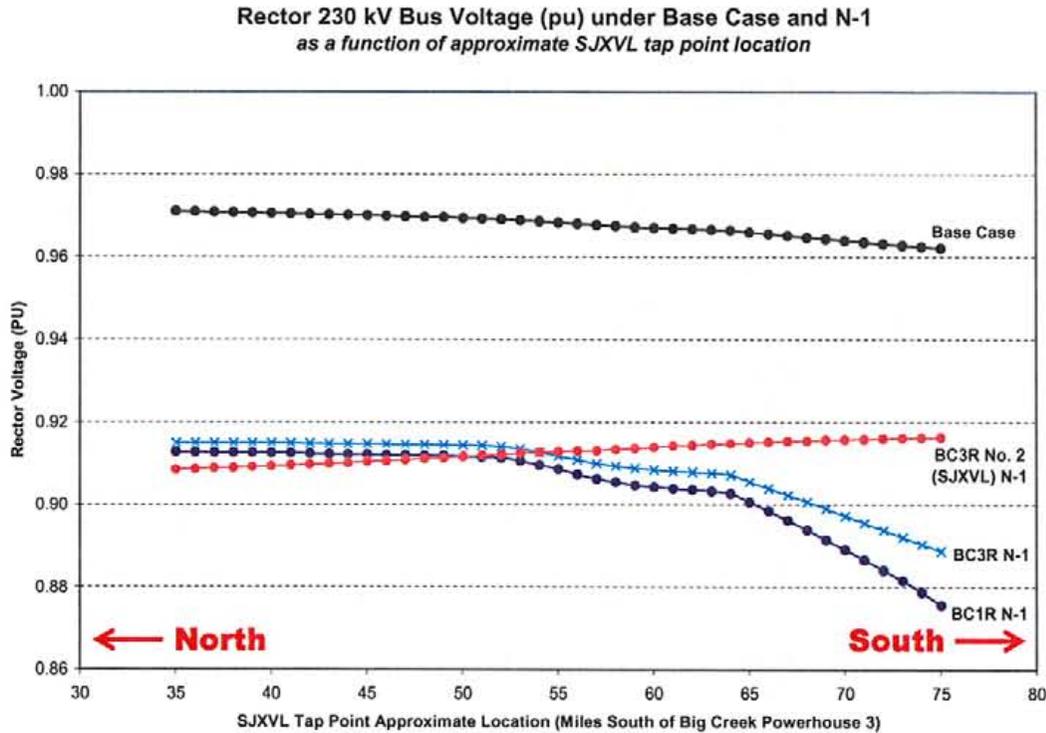
From the above results, it is clear that base case voltages at Rector Substation are impacted by SJXVL routing, with lower system voltages for southern routes and higher system voltages under northern routes. Furthermore, under two of the three N-1 outage conditions (i.e. N-1 outage of the existing Big Creek 1-Rector line or N-1 outage of the existing Big Creek 3-Rector line) the degradation of Rector 230-kV bus voltages is significantly more pronounced as SJXVL routes proceed south.

SCE Transmission Planning guidelines do not allow for voltage deviations in excess of 7% for N-1 contingency outages. *The above results indicate that N-1 voltage deviations in excess of the 7% maximum limit will occur for SJXVL routes approximately 65 miles or more south of Big Creek Powerhouse 3.* See the chart below for details.

Rector 230 kV Percent Voltage Drop Under N-1
as a function of approximate SJXVL tap point location
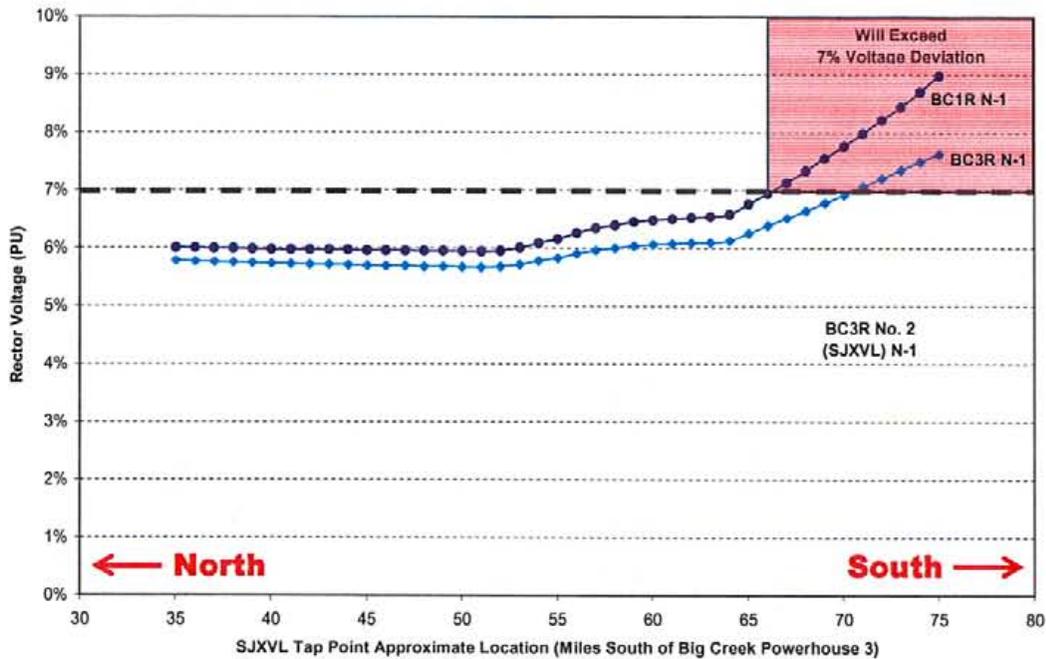
Based on the fact that these results were derived using conceptual routing assumptions, and because of the fact that the geographical location of the SJXVL southern route ("Alt 4" in the PEA) is very close to this limit, detailed review of "Alt 4" was performed. To determine whether or not the "Alt 4" route as defined would in fact result in voltage drops in excess of 7%, a solution for Big Creek 1-Rector 230-kV N-1 line outages was obtained using governor power flow analysis. The solution for the "Alt 1" route was also calculated for comparison purposes. The results of this detailed review are shown below.

RECTOR SUBSTATION N-1 BUS VOLTAGE DEVIATIONS VIA GOVERNOR POWER FLOW
(COMPARISON OF "ALT 4" VERSUS "ALT 1" ROUTE)

ROUTE	BUS	KV	PRE KV	POST KV	DELTA	PERCENT
"ALT 4"	RECTOR	66.0	66.61	61.81	-4.80	-7.20(*)
"ALT 4"	RECTOR	230.0	222.03	206.20	-15.84	-7.13(*)
"ALT 1"	RECTOR	66.0	66.73	62.34	-4.40	-6.59
"ALT 1"	RECTOR	230.0	222.45	207.92	-14.53	-6.53

(*) VOLTAGE DEVIATION IN EXCESS OF 7%

The detailed results confirm that the SJXVL project as proposed ("Alt 1") would result in system performance within planning criteria, and that the southern route ("Alt 4") as described in the PEA would result in system performance outside of planning criteria. Consequently, the "Alt 4" route does not meet the project electrical objectives and should be dismissed from further consideration.

CONCLUSION

The results of the analysis provide additional evidence in support of the conclusion that the SJXVL southern route (identified as "Alt 4" in the PEA) would be the least effective at meeting the project electrical objectives and can be dismissed from further consideration since it does not meet reliability criteria requirements.

Appendix D Section 2
System Strength and SCD/SCR Analysis

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SAN JOAQUIN CROSS-VALLEY LOOP PROJECT
SYSTEM STRENGTH & SCD/SCR ANALYSIS

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BACKGROUND

As stated in the Proponent's Environmental Assessment (PEA) of Southern California Edison Company's (SCE) proposed San Joaquin Cross-Valley Loop (SJXVL) Project, the purpose of SJXVL is "to build electrical facilities necessary to maintain safe and reliable electric service to customers, and to serve the forecasted electrical demand in the southeastern portion of the San Joaquin Valley"[1].

Furthermore, as part of the SJXVL Certificate of Public Convenience and Necessity licensing process through the California Public Utilities Commission, there have been several CPUC data requests received by SCE with questions that suggest SJXVL system alternatives involving various forms of reconductoring of existing 220-kV transmission lines serving Rector Substation. SCE has provided responses to all CPUC SJXVL data requests received as of this date.

This document is provided to further clarify the problems related to Rector Substation service to load requirements and provides sufficient information necessary to dismiss non-effective system alternatives from further consideration.

TRANSMISSION SYSTEM STRENGTH & SCD/SCR ANALYSIS

There are traditionally four factors that measure the adequacy or sufficiency of a transmission system to provide safe and reliable service to load (or overall transmission system "strength") in transmission planning studies. These factors include:

- System thermal capacity
- System post-transient voltage stability
- System dynamic stability
- System Short Circuit Duty (SCD)

All of the above factors need to be evaluated to determine whether a transmission system is sufficient to provide safe and reliable service to customers connected to the system. These factors are not independent of each other; a system that is prone to classical dynamic stability problems (i.e. growing oscillations) due to insufficient transmission infrastructure is likely to also have thermal capacity problems and/or post-transient

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[1] SJXVL PEA, Page 1-1.

voltage stability problems for the exact same reason, i.e. insufficient transmission infrastructure. It is common for systems to exhibit problems and not satisfy one or more of the above factors when load demand on the system is in excess of the system's capability. It is also common for such systems to experience other operational problems such as power quality problems (i.e. flicker, voltage sags and swells, fault-induced delayed voltage recovery events, and so forth).

System Strength as measured by Short Circuit Duty (SCD)

The fourth factor listed above, SCD, is perhaps the most useful method for measuring transmission system strength. SCD analysis provides two extremely convenient units of measure of a transmission system's strength: (1) system Thevenin equivalent impedance and (2) short circuit value.

The techniques for SCD analysis involve calculation of the amount of fault current that would be supplied by the transmission network under faulted conditions. Systems with greater overall transmission capability (i.e. "strong systems") will have higher levels of calculated fault current than systems with less overall transmission capability (i.e. "weak systems"). Fault current values at locations in the network are often expressed either as short circuit MVA value or as a Thevenin equivalent impedance. See Figure 1 below.

Figure 1.
Thevenin's Theorem Illustrated
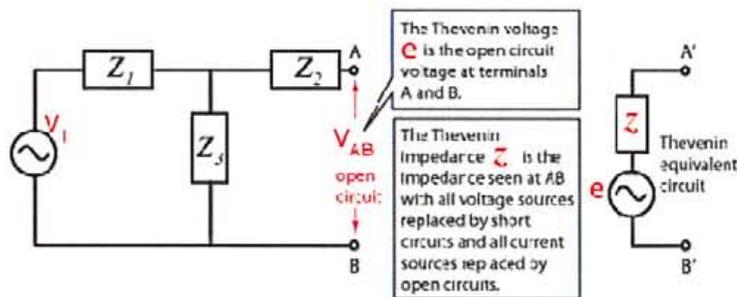
Short Circuit Ratio (SCR)

Closely related to SCD analysis is Short Circuit Ratio (SCR) analysis which provides a means of *relative* comparison of transmission system strength to serve load. There are various ways to define SCR depending on context; in this case, SCR will be defined as the ratio of three-phase fault current at a particular bus (MVA) to the amount of customer load served at that bus (MW).
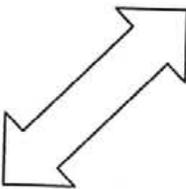
In Figure 1, the Thevenin equivalent impedance Z reflects the total "effective" impedance of the entire transmission system serving point A. Note that this

impedance Z is not the impedance of any one specific transmission line, but the equivalent impedance of the total entire transmission system as seen at point A. Larger fault current levels ("strong" systems) correspond to a smaller Z, and conversely smaller fault current levels ("weak" systems) correspond to a larger Z.

Load current is neglected when classical SCD calculations are conducted, because load current magnitudes are substantially smaller than fault current magnitudes. However, from an actual system operational perspective, real-time voltage variations occur with real-time changes in load current. From the Thevenin equivalent circuit (Figure 1), it can be seen that voltage variations at A' due to changes in load current will be less severe when Z is small and will be more severe when Z is large. This causes weak systems with high Z to exhibit more instability and degraded system performance than strong systems with low Z.

These problems are made worse under systems that serve large and growing load. This motivates the use of SCR analysis based on the ratio of three-phase SCD (MVA) to customer load (MW). As illustrated in Figure 2 below, high SCR values correspond to strong systems serving small loads. Relatively lower SCR values will occur under weak systems serving small loads as well as under strong systems serving large loads. The lowest SCR values, i.e. the worst-case scenario, will occur under weak systems serving large loads. The SCR calculation is intended to provide a *relative* comparison of transmission system strength and load serving capability for multiple locations.

Figure 2.
Short Circuit Ratio (SCR) Analysis Illustrated

SCD/SCR SENSITIVITY STUDY RESULTS

Base Case SCR Analysis

A short circuit duty base case that reflects current system conditions in the San Joaquin Valley was selected for this study. Using this base case, three-phase (3PH) SCD was calculated at each 230-kV bus in the SCE system that serves customer load. SCR values were then calculated utilizing the latest 2008 SCE Expansion Plan load forecast. Rector was found to have 3PH SCD of ████ ████ and a SCR of ██. A summary of the SCR results are tabulated below.

Table 1.
SCE System SCR Results (pre-SJXVL)

SUBSTATION	2008 Load (MW)	3PH SCD (A)	3PH SCD (MVA)	Short Circuit Ratio (MVA SCD/MW Load)
Rector 220/66	██	██	██	██
Other Geographic Areas in SCE System (for comparison purposes only)				**SCR Range (typical)**
Big Creek Corridor South of Magunden & Ventura Area Big Creek (North of Magunden) *other than Rector* Inland Empire Orange County LA Basin North of Lugo				██████
Other substations w/loads comparable to Rector ██████				██████

The existing Rector Substation was found to have the lowest SCR of all load-serving substations throughout the SCE service territory. In fact, Rector's SCR of ██ is 59% less than the "second lowest" SCR in the SCE system and 73% less than the lowest SCR among substations with load levels comparable to Rector. From a SCR perspective, Rector Substation is the "weakest" load serving substation in the entire SCE service territory. Furthermore, since Rector Substation is one of the fastest load growth areas in SCE service territory, the Rector SCR will get worse over time unless the transmission system serving the area is effectively strengthened by reducing overall system Thevenin equivalent impedance Z.

Base Case SCD Analysis

Next, a comparison of Rector SCD was performed under the various SJXVL alternatives that were suggested or discussed in CPUC Data Requests 1-4. For the purpose of this sensitivity analysis, the system alternatives suggested in the various CPUC data requests were all assumed to be viable. The validity of these

alternatives (i.e. capability of existing towers, environmental impacts, outage requirements for construction, impacts to cost, impacts to schedule, etc...) was not considered in this study. Thus, whenever this document refers to reconductoring/rebuilding "alternatives" this language is not intended to imply any conclusions about the viability of these options as SJXVL Project alternatives. These options were modeled as a planning exercise for relative electrical performance comparison purposes only.

The short circuit duty base case was modified to model "reconductor alternatives" utilizing ACSR, ACSS/TW, or ACCR conductors, or "new wires alternatives" using bundled ACSR conductors or the proposed SJXVL Project. The 3PH SCD at Rector was calculated for each alternative. The results of this SCD analysis are presented in the table below.

Table 2.
SCD Comparison of System Upgrade Alternatives
(Base Case Analysis – All Lines in Service)

Type of Upgrade	System Alternative	System Thevenin Equivalent R	System Thevenin Equivalent X	3PH SCD (kA)	% change
No Upgrades	Existing system	███	███	██	-
Reconductor Options ("no new wires")	Recon - 666 ACSS/TW (note 1)				-0.4%
	Recon - 795 ACCR (note 2)	███	███	██	0.4%
	Recon - 1033 ACSR (note 3)				1.0%
New wires Options	SJXVL (proposed project)	███	███	██	28.6%
	Rebuild - entire corridor 2B-1033 (note 3)				55.3%

Note 1: As discussed in CPUC Data Request #1 and CPUC Data Request #3
Note 2: As discussed in CPUC Data Request #4
Note 3: As discussed in CPUC Data Request #3

The 3PH SCD at the existing Rector substation was found to be ████. As the various reconductor options were simulated (666 ACSS/TW, 795 ACCR, 1033 ACSR) the three-phase SCD at Rector remained essentially unchanged. This is due to the fact that the total Thevenin equivalent impedance Z under each of these various reconductor alternatives remained virtually identical to the impedance of the existing system. The conclusion of these studies is that reconductor options, regardless of the conductor selected (i.e. standard ACSR or non-standard ACSS/TW or ACCR) and regardless of the conductor thermal rating, will not improve system strength serving Rector Substation. With any reconductor option, continued growth in the electrical needs area will continue to degrade the ability of SCE to provide safe and reliable service to load. Therefore, all reconductor options should be dismissed as non-viable alternatives to meet the SJXVL Project objectives.

The study identified that the "new wires" options would result in a substantial increase in system SCD and decrease in Thevenin equivalent impedance Z.

Under SJXVL, the Rector 3PH SCD increases to ███████, a 28.6% increase over the existing system. This "new wires" option increases the number of transmission lines serving the electric needs area increases from four to six. Likewise, if the entire west leg of the corridor is rebuilt with a double-circuit 230-kV transmission line and both circuits are strung with 2B-1033 ACSR conductors, the Rector 3PH SCD increases to ███████, a 55.3% increase over the existing system. This "new wires" option does not increase the number of 230-kV transmission circuits serving the electric needs area, but increases the number of conductors serving the area due to the bundling of conductors (four transmission lines each with two conductors per phase equals eight physical wires per phase). Because of the increase in the number of wires, the "new wires" options will result in a significant improvement in system strength serving the area.

Contingency (N-1 and N-2) SCD Analysis

While the base-case SCD analysis as discussed above assumed all transmission lines in service, real-time system stability problems that would compromise reliable service to load are most likely under transmission line outage conditions. These are the conditions where system strength is even more important for maintaining safe and reliable service to load. Under NERC Transmission Planning Standards[2], loss of load demand is not permitted for category B disturbances (i.e. N-1), and uncontrolled loss of load demand is not permitted for category C disturbances (i.e. N-2). NERC Transmission Planning Standards also require that the system remain stable under both Category B and Category C disturbances.

Therefore contingency SCD analysis was also performed to compare system strength upon N-1 and N-2 line outage conditions. This contingency SCD analysis was performed by removing either one line (N-1) or two lines (N-2) between Big Creek and Rector and recalculating the three-phase SCD at Rector. The results are summarized below.

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[2] NERC Transmission Planning Standards TPL-001-2 and TPL-003-0

Table 3a.
SCD Comparison of System Upgrade Alternatives
(Single Contingency Analysis – One Line Removed)

Type of Upgrade	System Alternative	System Thevenin Equivalent R	System Thevenin Equivalent X	3PH SCD (kA)	% change
No Upgrades	Existing system	██████	██████	██	-
Reconductor Options ("no new wires")	Recon - 666 ACSS/TW (note 1)	██████	██████	██	-0.3%
	Recon - 795 ACCR (note 2)				0.5%
	Recon - 1033 ACSR (note 3)				0.8%
New wires Options	**SJXVL (proposed project)**	██████	██████	██	**44.5%**
	Rebuild - entire corridor 2B-1033 (note 3)				62.6%

Note 1: As discussed in CPUC Data Request #1 and CPUC Data Request #3
Note 2: As discussed in CPUC Data Request #4
Note 3: As discussed in CPUC Data Request #3

Table 3b.
SCD Comparison of System Upgrade Alternatives
(Double Contingency Analysis – Two Lines Removed)

Type of Upgrade	System Alternative	System Thevenin Equivalent R	System Thevenin Equivalent X	3PH SCD (kA)	% change
No Upgrades	Existing system	██████	██████	██	-
Reconductor Options ("no new wires")	Recon - 666 ACSS/TW (note 1)	██████	██████	██	-0.2%
	Recon - 795 ACCR (note 2)				0.2%
	Recon - 1033 ACSR (note 3)				0.0%
New wires Options	**SJXVL (proposed project)**	██████	██████	██	**75.3%**
	Rebuild - entire corridor 2B-1033 (note 3)				64.6%

Note 1: As discussed in CPUC Data Request #1 and CPUC Data Request #3
Note 2: As discussed in CPUC Data Request #4
Note 3: As discussed in CPUC Data Request #3

The results of the contingency SCD analysis were consistent with the results of the base case SCD analysis. Specifically, system strength under contingency conditions is not improved under the reconductor options but is substantially improved under the new wires options.

It is important to recognize that Table 2 showed the rebuild option (entire corridor rebuild to 2B-1033) as the most effective "new wires" option for increasing Rector SCD under base case. However, Tables 3a and 3b shown that this effectiveness diminishes as outage conditions are considered. This is because the system loses the equivalent capability of two circuits under every N-1 outage and four circuits under every N-2 outage under the rebuild option (due to the bundled conductors). The final result is that the SJXVL project is closer to the rebuild option under N-1 outage conditions and stronger than the rebuild option under N-2 outage conditions.

<u>Implications Related to Line Outage Availability for Construction</u>

The above SCD results have implications in terms of outage requirements for construction for the proposed SJXVL project.

In general, the length of time between the beginning of October and the end of March is sometimes referred to by SCE as the "outage availability window" for the Big Creek Corridor because it does not overlap with spring runoff conditions (typically April-June) or summer load conditions (typically June-September). However, approval of all transmission line outages must be obtained by the California Independent System Operator (CAISO) which has a statutory obligation to maintain the transmission system in a safe operating mode **at all times**. Transmission line outages - even if requested by SCE for constructing system upgrades - will be denied by CAISO whenever real-time operating conditions (i.e. higher than anticipated load levels, local area generation unavailability, system stability needs, system generation resource needs, substation equipment failures, scheduled or unforeseen maintenance needs, etc...) are such that system operational integrity could be compromised.

In the Big Creek Corridor, whenever one line is taken out of service for a prolonged period of time, system operators must plan for the "next" contingency outage and make sure that the system integrity will still be maintained under that condition. In other words, during the "outage availability window" described above, scheduling a transmission line outage means that the N-1 condition becomes the new operational base case. The N-2 condition therefore becomes the new operational N-1 (i.e. "highly likely") condition and the N-3 condition (not even considered in traditional planning studies) becomes the new operational N-2 condition.

The data in Tables 2, 3a and 3b shows that the existing system, without upgrades, would experience at a minimum a significant 40% reduction in 3PH SCD between pre-construction base-case conditions (████) and mid-construction N-1 outage conditions (████). Furthermore, the SCD under mid-construction N-2 outage conditions has not been investigated but would be significantly lower and would correspond to a planning-study N-3 scenario. Prolonged outages to rebuild the entire west leg of the corridor would severely compromise system strength and operational integrity. Therefore, rebuilding the west leg of the corridor is not a viable SJXVL Project alternative.

CONCLUSIONS

The existing corridor serving Rector Substation is both power flow and stability limited, essentially due to the combination of an extremely weak transmission system and an area of high load and rapid load growth. The existing system has currently reached the limits of its capability to provide safe and reliable electrical service to load. Continued load

growth in the electrical needs area, without corresponding improvements in transmission system strength, will further degrade system electrical performance and jeopardize safe and reliable service to load.

Reconductoring the existing Big Creek Corridor 230-kV lines will not strengthen the system serving the electrical needs area. This is true regardless of the wire type selected (ACSR, ACSS/TW, ACCR, etc…) and regardless of the conductor thermal rating. Reconductoring the existing 230-kV lines is non-effective and therefore not a viable SJXVL Project alternative.

Both rebuilding existing infrastructure (to support 2B-1033 ACSR) as suggested in CPUC Data Request #3 and the proposed SJXVL Project are upgrades that would strengthen the system serving the electrical needs area. Under base case conditions, rebuilding existing infrastructure (to support 2B-1033 ACSR) results in an increase in system strength greater than that associated with the proposed SJXVL Project. However, that advantage over the proposed SJXVL Project diminishes or disappears under transmission line outage conditions, which are the conditions that most rely on system strength to maintain safe and reliable service to load. In addition, prolonged outages to rebuild the entire west leg of the corridor would severely compromise system strength and operational integrity. Therefore, rebuilding the west leg of the corridor is not a viable SJXVL Project alternative.