Application No.: 15-03-003
Exhibit No.:
Witness: Robert Sparks

In the Matter of the Application of Southern California Edison Company (U338E) for a Permit to Construct Electrical Substation Facilities with Voltage over 50 kV: Mesa 500 kV Substation Project	Application 15-03-003 (Filed March 13, 2015)

TESTIMONY OF ROBERT SPARKS
ON BEHALF OF THE
CALIFORNIA INDEPENDENT SYSTEM OPERATOR CORPORATION

Date: November 18, 2016

BEFORE THE PUBLIC UTILITIES COMMISSION OF THE STATE OF CALIFORNIA

In the Matter of the Application of Southern California Edison Company (U338E) for a Permit to Construct Electrical Substation Facilities with Voltage over 50 kV: Mesa 500 kV Substation Project	Application 15-03-003 (Filed March 13, 2015)

TESTIMONY OF ROBERT SPARKS ON BEHALF OF THE CALIFORNIA INDEPENDENT SYSTEM OPERATOR CORPORATION

Q. What is your name and by whom are you employed?

A. My name is Robert Sparks. I am employed by the California Independent System Operator Corporation (CAISO), 250 Outcropping Way, Folsom, California as Manager of Regional Transmission – South.

Q. Please describe your educational and professional background.

A. I am a licensed Professional Electrical Engineer in the State of California. I hold a Master of Science degree in Electrical Engineering from Purdue University, and a Bachelor of Science degree in Electrical Engineering from California State University, Sacramento.

Q. What are your job responsibilities?

A. I manage a group of engineers responsible for planning the CAISO controlled transmission system in southern California to ensure compliance with NERC, WECC, and CAISO Transmission Planning Standards in the most cost effective manner.

I. INTRODUCTION

Q. What is the purpose of your testimony?

A. The purpose of my testimony is to explain why the CAISO identified the Mesa 500 kilovolt (kV) substation project (Mesa Loop-In Project or Project) as a needed

project in the 2013-2014 transmission planning process and discuss its review of certain project alternatives identified in the Final Environmental Impact Report (FEIR). My testimony specifically addresses the following questions from the November 14, 2016 Scoping Memo and Ruling of Assigned Commissioner (Scoping Memo):

> 4. Are the mitigation measures and/or environmentally superior project alternatives infeasible?
>
> 7. If the Proposed Project is delayed past the 2020 timeframe, are there additional mitigation measures that may be required to maintain electrical reliability in Southern California?

Q. Please describe the Mesa Loop-In Project.

A. The Mesa Loop-In Project loops in the existing Vincent-Mira Loma 500 kV transmission line into the existing Mesa Substation and upgrades the existing substation with a 500 kV bus. Major components of the Mesa Loop-In Project include the following:

- Constructing a 500/220/66/16-kV Mesa Substation and demolishing the existing 220/66/16-kV Mesa Substation in the City of Monterey Park.
- Removing, relocating, modifying, and/or constructing transmission, subtransmission, and distribution structures within SCE-owned properties, rights-of-way (ROWs), and franchise areas in the cities of Monterey Park, Montebello, and Commerce, and in portions of unincorporated Los Angeles County to accommodate the new substation configuration.
- Installing two new telecommunications lines and rerouting one existing telecommunications line within the cities of Monterey Park, Montebello, and Rosemead, and in portions of unincorporated Los Angeles County.
- Rerouting existing telecommunications lines inside the perimeter fence lines of Vincent, Pardee, and Walnut Substations.
- Converting an existing distribution line from overhead to underground between three street lights within the City of Bell Gardens.

- Replacing a section of a Metropolitan Water District 72-inch-diameter water line within the Mesa Substation property and adjacent northern transmission ROW with an 84-inch-diameter water line.
- Installing a temporary 220-kV circuit loop-in at Goodrich Substation in Pasadena to allow for continued service to Pasadena during required outages for the 220-kV line.
- Replacing 220-kV line termination equipment at the existing Laguna Bell and Lighthipe Substations.
- Upgrading various 66-kV and 220-kV line protection relays and/or telecommunications equipment inside the existing Mechanical Electrical Equipment Rooms (MEERs) at 27 satellite substations across the Electrical Needs Area (ENA).[1]

II. BACKGROUND

Q. Please describe the CAISO's review and approval of the Mesa Loop-In Project.

A. The CAISO conducted an in-depth analysis of the evolving transmission needs in the Los Angeles Basin and San Diego area as a part of the 2013-2014 transmission planning process. As part of this process, the CAISO determined that a number projects were necessary to address the retirement of the San Onofre Nuclear Generating Station (SONGS) and planned retirements of once-through-cooled (OTC) generation based on State Water Resource Control Board regulations. The CAISO conducted the 2013-2014 transmission plan consistent with the assumptions set out in the Commission's 2012-2013 LTPP Track 4 scoping memo.[2]

The CAISO's 2013-14 transmission plan specifically noted that the Mesa Loop-In Project was designed to optimize the use of existing transmission lines and facilities

[1] http://www.cpuc.ca.gov/environment/info/ene/mesa/mesa.html.
[2] *See* Commission Rulemaking 13-12-010, Assigned Commissioner's Ruling on Updates to the Planning Assumptions and Scenarios for Use in the 2014 Long-Term Procurement Plan and the California Independent System Operator's 2015-2016 Transmission Planning Process issued October 28, 2015, Attachment 1, p. 18.

without requiring new rights of way. The CAISO found that the Mesa Loop-In Project "allow[ed] SCE to bring a new 500 kV electric service into its metropolitan load center, delivering power from Tehachapi wind resources area or resources located in PG&E service territory or the Northwest via the 500kV bulk transmission network system."[3] The CAISO found that the Mesa Loop-In Project, in conjunction with other transmission system improvements and Commission approved capacity additions, would meet the majority of the long-term local capacity needs in the LA Basin and San Diego areas.[4]

III. FEASIBILITY OF PROJECT ALTERNATIVES

Q. Please provide a summary of the project alternatives identified in the FEIR.

A. The FEIR identifies three alternatives to the Mesa Loop-In Project that it claims are capable of meeting project objectives and are feasible and environmentally superior to the Mesa Loop-In Project. Alternatives 1 and 2 present electrical variations to the proposed Project that would potentially reduce the physical footprint of the Mesa Substation and the associated environmental impacts. Alternative 3 is electrically similar to the proposed Project, but proposes a gas-insulated substation (GIS) instead of an air-insulated substation at Mesa Substation.

Q. Please provide an overview of the CAISO's analysis of the FEIR alternatives.

A. The CAISO conducted a detailed power flow analysis of each of the three alternatives to the proposed Project. The CAISO's analysis shows that Alternatives 1 and 2 fail to maintain compliance with mandatory transmission planning standards promulgated by the North American Electric Reliability Corporation (NERC) and CAISO Planning Standards. As a result, these alternatives are electrically and technologically infeasible. Alternative 3 meets the transmission planning standards but may cause significant project delays that would frustrate the purpose of the

[3] 2013-14 CAISO Transmission Plan, p. 98.
[4] 2013-14 CAISO Transmission Plan, p. 108. An excerpt from the 2013-14 transmission plan is included as Attachment A to this testimony.

project, namely, enabling the timely retirement of OTC generation in the Los Angelis Basin.

Q. Did the CAISO provide comments on the Draft Environmental Impact Report (DEIR) regarding these concerns?

A. Yes, the CAISO provided detailed comments on the DEIR regarding the electrical infeasibility of Alternatives 1 and 2. In response, the FEIR noted that these alternatives were designed to address specific NERC violations that occur under peak load conditions. The specific NERC violations were generated based on SCE's response to data requests and analysis of power flow data provided by SCE. The FEIR also noted that "[t]he power flow data are the data used for SCE's 2014 annual reliability assessment."[5] Based on this, the FEIR modified Project Objective 2 to read as follows (new language underlined):

> Therefore, one of the CPUC-defined objectives of the proposed project is to avoid introduction of new violations of NERC, WECC, and CAISO reliability <u>when using SCE's 2014 annual reliability assessment power flow data</u>.

This language implicitly recognizes that the FEIR project alternatives may create new violations of NERC, WECC, and CAISO reliability standards based on updated power flow data.

Q. Does the CAISO's have concerns with the FEIR's approach?

A. Yes. The CAISO understands that the FEIR based its electrical analysis on information supplied by SCE, but the CAISO is concerned that this analysis was based on a single, outdated base case and is not sufficient to identify transmission solutions in a highly integrated electric grid. In this case, the 2014 reliability assessment data fails to account for additional renewable generation that is currently online and operational. Properly modeling these renewable generation additions results in observed overloads under P0 conditions (*i.e.*, all elements in service).

[5] FEIR, p. 1-7.

Q. Please explain the CAISO's analysis of DEIR Alternative 1.

A. Alternative 1 replaces the three 500/230 kV 1120 MVA transformers specified in the proposed Project with a single, larger 500/230 kV 1600 MVA transformer. To test the effectiveness of Alternative 1, the CAISO conducted power flow studies based on the most recently documented long-term local capacity requirement studies for the LA Basin.[6] Based on these studies, the CAISO identified thermal overloads under both normal system conditions (NERC category P0) and N-1-1 conditions (NERC category P6). The CAISO-identified overloads are indicated in Table 1 below for the transformer connection to the "left-hand side" bus (aka north Mesa 230 kV bus):

Table 1

Summary of CAISO Power Flow Analysis of Alternative 1 with Transformer Connected to the "left-hand side" bus (aka the north Mesa 230 kV bus)

Contingency Type	Specific Contingency	Affected Facilities	Percent Loading of Applicable Rating
P0	None, normal conditions	Mesa-Laguna Bell 230 kV line	161%
P0	None, normal conditions	Mesa 500/230kV transformer bank	• 111% (if transformer impedance is at 10%) or • 94% (if transformer impedance is 14.66%)[7].
P6	Vincent-Mesa 230kV No.1, followed by No. 2 outage	Mesa 500/230kV transformer	104%
P6	Mira Loma-Serrano 500kV line, followed by Mira Loma	Mira Loma 500/230kV transformer No. 1	103%

[6] 2015-2016 CAISO Transmission Plan, p. 153-170.
[7] The ISO uses 14.66% for impedance value assumption for the proposed 500/230kV 1600 MVA transformer for the rest of the contingency analyses for Alternative 1.

Contingency Type	Specific Contingency	Affected Facilities	Percent Loading of Applicable Rating
	500/230kV Bank No. 2 outage		
P6	Mesa-Laguna Bell 230kV line, followed by Mesa-Lighthipe 230kV line outage	Mesa-Redondo 230kV line	138%
P6	Serrano-Villa Park 230kV No. 2, followed by Serrano-Lewis 230kV No. 1 line	Serrano-Villa Park No. 1 230kV loading is near its emergency rating	95% - this has only 5% of margin left on emergency rating; this is not as robust as Alternative 3 or the original alternative as those have 13% margin on their emergency ratings.

As indicated in Table 1, two of the CAISO-identified thermal overloads occur during normal system conditions (P0). Because these overloads occur during normal system conditions, the CAISO cannot rely on a RAS to mitigate the overloads.[8]

Based on the CAISO's review of the DEIR power flow analysis, it appears that the thermal overloads identified by the CAISO were not identified because the DEIR used an outdated study case. The CAISO's analysis incorporates the study cases used in the 2015-2016 transmission planning process, which include the modeling of renewable resources to meet the state's 33% renewable portfolio standard at their Net Qualifying Capacity (NQC) values for local reliability assessments. Many of

[8] Under normal system conditions NERC TPL-001-4 disallows any interruption of firm transmission service or non-consequential load loss.

these renewable resources are located north of the Mesa Loop-In Project and east of the Los Angeles Basin. The CAISO modeled the outputs of the renewables at the NQC values or based on peak impact value for corresponding technology (*i.e.*, solar and wind) as indicated in the Assigned Commissioner Ruling on assumptions and scenarios promulgated by the Commission for use in the CAISO transmission planning process.[9] The CAISO described the impact of higher renewable output on Los Angeles Basin local capacity requirements in the 2015-2016 transmission plan:

> The increase in the Western LA Basin sub-area LCR need for the 2025 time frame is due to a higher dispatch of renewable resources. Renewable resource dispatch was based on the CPUC provided technology factors (for Net Qualifying Capacity), for renewable generation north and east of the LA Basin LCR area. This higher level of renewable generation dispatch (about 2,000 MW higher) reflects updated modeling for centralized photovoltaic solar farms located outside north and east of the LA Basin LCR area. In addition, the updated modeling also includes wind generation resources located north of the LA Basin LCR area. The increase in renewable generation dispatch level to reflect net qualifying capacity (NQC)-level outputs contributes to further thermal loading concerns for the 230kV lines south of newly upgraded Mesa Substation under contingency conditions. This reflects the benefit of the upgraded Mesa Substation to facilitate delivering more renewable generation into the LA Basin load centers when it's upgraded to 500 kV voltage level and having additional 230 kV lines in the Western LA Basin looped into it.[10]

Alternative 1 does not meet NERC transmission planning standards when taking into account expected increases in renewable resources' outputs outside the LA Basin. As a result, Alternative 1 does not meet the basic project objectives of addressing identified NERC reliability criteria violations and avoiding the creation of new NERC reliability violations. Accordingly, the Commission should reject it.

[9] *See* Commission Rulemaking 13-12-010, Assigned Commissioner's Ruling on Updates to the Planning Assumptions and Scenarios for Use in the 2014 Long-Term Procurement Plan and the California Independent System Operator's 2015-2016 Transmission Planning Process issued October 28, 2015, Attachment 1, p. 18.
[10] 2015-2016 CAISO Transmission Plan, p. 156-157.

Q. The FEIR indicated that the CAISO's analysis used a different substation configuration than the FEIR model which may have caused the overloading concerns identified by the CAISO. Did the CAISO review this issue?

A. Yes, the CAISO conducted additional analysis with the alternative configuration suggested in the FEIR comments.[11] This alternative configuration connects the single 1600 MVA transformer to the "right-hand side" bus (aka Mesa south 230 kV bus), as indicated in the FEIR. With this alternative configuration, however, the CAISO continued to observe overloaded system elements, including during P0 conditions. Table 2 below indicates the overloaded elements.

Table 2

Summary of CAISO Power Flow Analysis of Alternative 1 (connecting to "right-hand side" bus (aka Mesa south 230 kV bus))

Contingency Type	Specific Contingency	Affected Facilities	Percent Loading of Applicable Rating
P0	None, normal conditions	Mesa 500/230kV transformer	Mesa 500/230kV Bank (110%) based on impedance value of 14.66% (1600 MVA base). Using similar sized transformer (i.e., LADWP Rinaldi 500/230kV 1593 MVA transformer) having an actual impedance of 11.33% (1600 MVA base), the loading would be 123% (or 23% overloads).
P1	Mesa-Mira Loma 500 kV line	Mesa 500/230kV transformer	Mesa 500/230kV Bank (100%) based on impedance value of 14.66%. Using similar sized transformer (i.e., LADWP Rinaldi 500/230kV 1593 MVA transformer) having an actual impedance of 11.33%, the loading would be 109% (or 9% overloads).
P3	G-1 (Alamitos CCGT), followed by	Mesa 500/230kV transformer	Mesa 500/230kV Bank (102%) based on impedance value of 14.66%. Using similar sized

[11] FEIR Response to CAISO Comments, p. 291.

Contingency Type	Specific Contingency	Affected Facilities	Percent Loading of Applicable Rating
	Mesa-Mira Loma 500kV line		transformer (i.e., LADWP Rinaldi 500/230kV 1593 MVA transformer) having an actual impedance of 11.33%, the loading would be 112% (or 12% overloads).
P7	Mesa - Rio Hondo 230 kV #1 and #2 lines	Mesa 500/230kV transformer	Mesa 500/230kV Bank (100%) based on impedance value of 14.66%. Using similar sized transformer (i.e., LADWP Rinaldi 500/230kV 1593 MVA transformer) having an actual impedance of 11.33%, the loading would be 110% (or 10% overloads).
P7	N-2 of Vincent 2 - Mesa 230kV lines #1 & 2	Mesa 500/230kV transformer	Mesa 500/230kV Bank (108%) based on impedance value of 14.66%. Using similar sized transformer (i.e., LADWP Rinaldi 500/230kV 1593 MVA transformer) having an actual impedance of 11.33%, the loading would be 121% (or 21% overloads).

Based on this analysis, the CAISO identified several overloads, including overloads in P0 (normal conditions), P1 (single contingency), P3 (loss of generator, system adjusted, followed by a single contingency) and P7 (common-tower contingency) conditions. As a result, the Commission should reject Alternative 1 as technologically infeasible.

Q. Please explain the CAISO's analysis of DEIR Alternative 2.

A. Alternative 2 removes one of the three 500/230 kV 1120 MVA transformers specified in the Proposed Project for installation at the Mesa Substation. The DEIR claims that Alternative 2 will meet all project objectives if a RAS is implemented to address thermal overload of the Chino–Mira Loma 220-kV No. 3 Transmission Line. To test the effectiveness of Alternative 2, the CAISO conducted the same power flow analysis that it conducted for Alternative 1. Based on these studies, the CAISO identified thermal overloads under both normal system conditions (NERC category P0) and N-1-1 conditions (NERC category P6). The CAISO-identified overloads are indicated in Table 3 below:

Table 3

Summary of CAISO Power Flow Analysis of Alternative 2 for A Transformer Connecting to the "right-hand side" bus (aka Mesa 230 kV south) and the Other Transformer Connecting to the "left-hand side" bus (Mesa 230 kV north)

Contingency Type	Specific Contingency	Affected Facilities	Percent Loading of Applicable Rating
P0	None, normal conditions	Mesa 500/230kV transformer No. 2 (connecting to Mesa South 220kV bus)	Mesa 500/230kV Bank No. 2 (107%) based on typical impedance value of 14.66%
P0	None, normal conditions	Mesa-Laguna Bell 230kV line	Mesa-Laguna Bell 230kV line (108%)
P6	Mesa-Laguna Bell 230kV line, followed by Mesa-Lighthipe 230kV line outage	Mesa-Redondo 230kV line	106%

As indicated in Table 3, two of the CAISO-identified thermal overloads occur during normal system conditions (P0). Because these overloads occur during normal system conditions, the CAISO cannot rely on a RAS to mitigate the overloads.

As with Alternative 1 above, it appears that the FEIR's power flow analysis does not incorporate the updated modeling of renewable resources north of the Mesa Loop-In Project and east of the LA Basin with their outputs modeled at NQC values. The overloads occurring during normal system conditions result from the increase in renewable capacity, which the CAISO's updated analysis takes into account. Alternative 2 does not meet NERC transmission planning standards when taking into account expected increases in renewable resources outside the LA Basin. As a result, the Commission should reject Alternative 2 because it fails to meet the basic project objectives: it does not address NERC reliability criteria concerns and avoid creating new NERC reliability violations.

Q. The FEIR indicated that the CAISO's analysis used a different substation configuration than the FEIR model which may have caused the overloading concerns identified by the CAISO. Did the CAISO review this issue?

A. Yes, the CAISO conducted additional analysis of the alternative configuration suggested in the FEIR comments.[12] This alternative configuration connects the two 1120 MVA transformers to the "right-hand side" bus (aka Mesa 230 kV south), as indicated in the FEIR. With this alternative configuration, the CAISO continued to observe overloaded system elements, including during P1, P3 and P6 conditions. Table 4 below indicates the overloaded elements.

[12] FEIR Response to CAISO Comments, p. 291.

Table 4

Summary of CAISO Power Flow Analysis of Alternative 1 (connecting to "right-hand side" bus (aka Mesa 230 kV south))

Contingency Type	Specific Contingency	Affected Facilities	Percent Loading of Applicable Rating
P1	Either Mesa 500/230kV transformer	The remaining Mesa 500/230kV transformer	Mesa 500/230kV Bank (106%)
P3	G-1 (Alamitos CCGT), followed by T-1 of either Mesa 500/230kV transformer	The remaining Mesa 500/230kV transformer	Mesa 500/230kV Bank (110%)
P6	N-1 of Mesa-Mira Loma 500kV, followed by T-1 of either Mesa 500/230kV transformer	The remaining Mesa 500/230kV transformer	Mesa 500/230kV Bank (115%)

Based on this analysis, the CAISO identified several overloads resulting from this alternate configuration. As a result, the Commission should reject Alternative 1 as technologically infeasible.

Q. The FEIR also suggested that the two 1120 MVA transformers installed in Alternative 2 should be operated and switched as one transformer. Does the CAISO have concerns with this configuration?

A. Yes, the CAISO has the following concerns regarding this proposed configuration:

- This is a non-standard design that none of the transmission owners within the CAISO planning area or other transmission owners within California use;
- An outage on one 1120 MVA transformer would remove both transformers from service. This would result in 2240 MVA of capacity to the load centers in the western Los Angeles Basin being lost instead of 1120 MVA for SCE-proposed three-bank alternative;

- This configuration would reduce operational flexibility by negating the ability to remove a single transformer from service for maintenance purposes (*i.e.*, instead of separate switching that would remove one transformer, two transformers would be impacted due to sharing common circuit breakers for switching);
- Because the two 1120 MVA transformers would operate as a single transmission element, removing the additional transformer bank to mitigate overloading concern would cause further reliability concerns for the next N-1 contingency. Table 5 summarizes the overloading concern related to the next N-1 contingency after both Mesa 1120 MVA transformers are switched out of.

Table 5

Summary of CAISO Power Flow Analysis of Alternative 2 with Switching both Mesa 500/230kV Transformers Operating as One Transformer

Contingency Type	Specific Contingency	Affected Facilities	Percent Loading of Applicable Rating
P6	Both Mesa 500/230kV transformers switched out, followed by the Mesa-Lighthipe 230kV line outage	Mesa-Laguna Bell 230kV line	Mesa-Laguna Bell 230kV line (100.1%)

Q. Please explain the CAISO's concerns with Alternative 3 to the proposed Project.

A. Alternative 3 is electrically similar to the proposed project, but it proposes a gas-insulated substation (GIS) instead of an air-insulated substation at Mesa Substation. Alternative 3 meets NERC, WECC and ISO transmission planning criteria by mitigating all known reliability concerns and not creating any new reliability concerns. As a result, the CAISO agrees that Alternative 3 meets the basic project objectives outlined in the DEIR.

However, the CAISO has concerns whether GIS substation design, construction, and electrification can be completed prior to the retirement of LA Basin OTC generation in December 2020. The CAISO believes that SCE is in the best position to comment on the potential scheduling impacts presented by Alternative 3. If Alternative 3 cannot be completed and placed in-service to facilitate timely retirement of the LA Basin OTC generation, the Commission should reject it as infeasible because it is not "capable of being accomplished in a successful manner within a reasonable period of time" as required by CEQA Guidelines.[13]

In addition to the potential delay in the in-service date, the CAISO is also concerned about the materially higher costs typically incurred to install and maintain GIS equipment. The CAISO expects these costs will be material, and the Commission should carefully consider whether the increase renders the project economically infeasible.

Q. Please summarize your testimony.

A. The Commission should approve the Mesa Loop-In Project as proposed by SCE. Alternatives 1 and 2 do not meet all NERC, WECC and CAISO planning standards and therefore are technologically infeasible. Alternative 3 will cause additional delay that will frustrate the purpose of the project, namely, the timely retirement of OTC generation in the Los Angeles Basin.

Q. Does this conclude your testimony?

A. Yes, it does.

[13] CEQA Guidelines § 15364.

Attachment A

(Excerpt from the CAISO's 2013-2014 Transmission Plan)

2013-2014 TRANSMISSION PLAN

California ISO
Shaping a Renewed Future

July 16, 2014

Prepared by: Infrastructure Development
Approved by: ISO Board of Governors

- Most effective locations for mitigating post transient voltage instability due to the critical contingency were determined to be in the San Diego local capacity area and the southwest LA Basin sub-area. The resources in the southwest LA Basin are approximately 50% as effective as resources located in San Diego due to the southwest LA Basin's close proximity to San Diego local capacity area. The resources located in the northwest LA Basin were determined not to be effective for mitigating the post transient voltage instability concern due to the critical N-1-1 contingency.

Pumped Storage:

In addition to the preferred resource scenarios submitted by SCE, the ISO also received one proposal for a pumped storage facility (the Lake Elsinore Advanced Pumped Storage project discussed earlier in association with the TE-VS transmission submission) which was also submitted as a generation alternative. This pumped storage would requires the transmission line to be advanced either as a network upgrade (which was discussed above) or as an interconnection facility. The ISO assessed the pumped storage facility to verify that if the storage facility proceeded as a market-based resource and the transmission proceeded as a generator interconnection facility the pumped storage facility would nominally meet 500 MW of the total local resource needs.

2.6.3.2 *Recommendations*

The ISO is recommending specific transmission development in this planning cycle. The recommendations form part of a larger recommended strategy for further analysis and input into future processes, including future transmission planning cycles.

Overarching strategy:

This strategy consists of three tracks:

- Recommend approval of "optimizing existing transmission" projects to address a portion of the residual needs and as a more certain hedge against other resources failing to develop on schedule. (Group I – set out below) These mitigations provide material reductions in local capacity requirements, without the addition of new transmission rights of way. This provides the best use of existing transmission lines and transmission rights of way, as well as minimizing risk about permitting and the timing of permitting.
- Initiate longer term analysis (10 to 20 year) in 2014-2015 or 2015-2016 cycle to assess the need for potential LA/San Diego connector projects (Group II) in light of evolving load forecasts and the potential for preferred resources and storage.
- Feed analysis of potential "policy" transmission lines (Group III) into the LA Basin/San Diego area into state policy discussions, recognizing that those may obviate the need to advance a future Group II project.

The strategy is based on the principles of least regrets transmission development, focusing on maintaining reliability, supporting preferred resources and minimizing or delaying new transmission lines by focusing first on the Group I solutions that do not require new transmission lines. It provides the maximum opportunity for preferred resources to develop in lieu of new

transmission lines (Group II or Group III transmission proposals) which represent higher cost, new transmission right of way, possibly lengthier development timelines, and higher regulatory uncertainty that the Group I projects. The recommended strategy also provides the least risk of the need for delay in compliance with OTC generation requirements. Further, the ISO's analysis demonstrates that the recommended resources perform complementary to many of the Group II and Group III proposals should those be developed to address needs beyond this transmission plan's scope.

In setting out the second track of this strategy, the ISO recognizes the value that further reinforcement of the transmission corridors between the LA Basin and San Diego may provide in meeting the remaining residual need, or future needs beyond the current planning horizon. Additional analysis and process will be required to determine which of these in fact may prove to be the superior next addition, as environmental considerations and the future of storage projects such as LEAPS evolve. However, it is not necessary or reasonable to seek approval of these more expensive alternatives, especially on timelines that are extremely aggressive and potentially unlikely to be met given the need for reliability and the higher than usual degree of uncertainty with many of the inputs into this analysis.

The third track of this strategy focuses on ensuring state policy discussions are informed about the potential benefits of the Group III projects in meeting the LA Basin and San Diego area needs. The benefits of the projects bringing additional resources into the LA Basin and San Diego study area were also assessed. These projects provide in general an increased level of overall benefit, but generally at a significantly increased cost and increased challenges in siting and permitting over Group II projects. A major benefit of these projects in general was other potential policy benefits they could bring in accessing renewable generation sources. The need for those additional resources is not supported by clear federal or state policy direction at this time such that more expensive alternatives can be pursued as policy-driven enhancements. The ISO expects such support could enable this type of project to supplant the overall less costly LA Basin/San Diego connector projects, which provide reliability value but without the level of policy benefits of the Group III projects.

Specific Recommendations:

The specific immediate solutions the ISO recommends for approval in this transmission plan are set out below. The recommended transmission solutions help reduce local resource needs by about 800 MW to 1680 MW for 2023 summer peak load conditions. These solutions optimize the use of the existing transmission lines in the San Diego and LA Basin study area by reducing local capacity needs without requiring new transmission lines:

1. For the post transient voltage instability and the contingency overloading concerns on the Otay Mesa – Tijuana 230kV line, the following are proposed solutions:

    a. The ISO recommends the installation of a flow controller (i.e., back-to-back DC or phase shifting transformer) at Imperial Valley Substation. Back-to-back DC flow controller is a more robust option that is effective under various studied load and resource scenarios. The cost, however, is about three to four times more

expensive than the phase shifting transformer as it includes a small switchyard installation, as well as DC components that offer precise flow control between SDG&E and CFE. Both of these options do allow loop flow through CFE's system under the critical overlapping Category C3 (N-1-1) contingency to provide resources from the Imperial Valley to SDG&E system to help mitigate voltage instability concern under post-transient conditions. With the phase shifter, the loop flow through CFE system results from the "natural" flow due to blocked phase angle on the phase shifter for the N-1-1 contingency. Nevertheless this loop flow, under contingency condition, is critical in "wheeling" resources from Imperial Valley to SDG&E system to mitigate post transient voltage instability. The back-to-back DC flow controller can be programmed to control this loop flow, under an overlapping N-1-1 contingency, with precision and with high speed (in the range of milliseconds).

Additional coordination with CFE will be necessary before a final determination can be made if the less costly phase shifting transformer will suffice, or if the more expensive back-to-back HVDC converter technology is required. It will be necessary to pursue both solutions recognizing that only one solution will ultimately be selected. The ISO has concluded that the installation of a phase shifting transformer constitutes an upgrade to an existing substation facility due to the nature of the equipment and would therefore not be eligible for the competitive procurement process. The ISO has noted that due to the large number of facilities eligible for competitive solicitation process identified in this plan, that it will be necessary to stage or stagger the receipt and processing of all applications into the competitive solicitation process. The ISO will stage the receipt and consideration of the back-to-back HVDC converter technology (if selected as the preferred technology) towards the end of the staging process.

b. The ISO has identified the need of additional 450 - 700 MVAR of dynamic reactive support at future SONGS Mesa Substation or electrically equivalent location in the vicinity. To address this need:
    i. The ISO recommends installing two synchronous condensers at the San Luis Rey substation totaling 450 MVAR. In addition to the long term benefits, this location and capability provides the further benefit of providing coverage for the possible delay of the SONGS Mesa SVC approved in the 2012-2013 transmission plan and can obviate the potential interim need for converting a SONGS generator into a synchronous condenser.
    ii. The potential need for 250 MVAR of additional dynamic reactive support at SONGS Mesa or an electrically equivalent location will be reviewed in future planning cycles. This will allow the ISO to factor in the CPUC's potential decisions on LTPP Track 4, as well as final selection of the flow controller at the Imperial Valley Substation.

c. The ISO recommends proceeding with the Mesa loop-in project in the LA Basin. With this project, a new 500/230/66kV substation will be rebuilt on the property of the existing Mesa 230/66kV substation. With the addition of 500kV voltage, a new source from bulk transmission will be established in the LA Basin to bring power from Tehachapi renewables or power transfer from PG&E via WECC Path 26.

d. The ISO has identified the potential need for further installation of additional dynamic reactive support up to about 540 MVAR in the southern Orange County if Huntington Beach power plant is retired and not repowered. This will be reviewed in future planning cycles.

2. The ISO proposes to revisit in the 2014-2015 transmission planning cycle the need for the Ellis Corridor Upgrade. To mitigate potential overloading concerns on the Ellis – Johanna or Ellis – Santiago 230kV line under a Category C.3 outage (i.e., overlapping N-1-1 contingency), either (a) SDG&E is allowed to fulfill its LTPP Track 1 authorization for local resources (308 MW) and its request for Track 4 (i.e., 500 – 550 MW), or (b) SCE is allowed to fulfill some of its Track 4 request for local resources at either Johanna or Santiago substation; or (c) if either Option 3(a) or (b) does not materialize, then the Ellis Corridor Upgrade transmission project would be needed. Based on SCE's proposed Ellis Corridor Upgrade submittal to the ISO Request Window, it appears that it would take approximately two years from the approval date to implement this potential project. This can be implemented rather quickly because the upgrades would involve line terminating equipment located at the substation and line clearance mitigation. Due to short lead time required for this transmission upgrade, and the status of the SDG&E and SCE requests for local resources related to LTPP Track 4, the ISO recommends that this issue is to be revisited in the 2014/2015 transmission planning process after the CPUC decisions for Track 4 are issued.

Table 2.6-5 provides a summary of proposed transmission solutions, high level estimated costs and estimated local resource reduction benefits due to each transmission solution.

Table 2.6-5: Summary of Proposed Transmission Solutions, Cost Estimates and Local Resource Reduction Benefits

No.	Transmission Upgrade Option	Proposed In-Service Date	Estimated Cost ($ Million)	Local Resources Reduction Benefits (MW)
1	Additional 450 MVAR of dynamic reactive support at San Luis Rey (i.e., two 225 MVAR synchronous condensers)	June 2018 for permanent installation at SONGS Mesa or near vicinity (San Luis Rey)	~$80 M	-100 to -200 (benefits in 2018; when coupled with other projects (i.e., items 2 and 3 below, it will be part of the benefits of those projects)
2	Imperial Valley Flow Controller (IV B2BDC or Phase Shifter) – for emergency flow control to prevent overloading on CFE line and voltage collapse under Category C.3 contingency	May 2017	$55 - $300 M	-400 to -840
3	Mesa Loop-In Project	December 2020	$464 - $614 M	-300 to -640
TOTAL			$599 - $994 M	-800 to -1680

These recommendations do not address all of the requirement identified for the San Diego and LA Basin area; they result in a residual need of up to 900 MW overall for those areas, assuming conservative estimates for their overall effectiveness and based on the resource assumptions discussed earlier. The residual need leaves room in future planning and procurement cycles to take into account changes in load forecasting as well as anticipated increases in forecasts for preferred resources – energy efficiency in particular. Further analysis in the 2014-2015 transmission planning cycle will be necessary to assess residual need in light of new load forecast information and further clarity on the specifics of conventional and preferred resources and storage.

By applying “least regrets” transmission mitigations in this plan, the residual need becomes a more manageable amount for procurement measures to address, and ensures ample opportunity for further development of preferred resources.