DOCKETED

Docket Number:	15-RETI-02
Project Title:	Renewable Energy Transmission Initiative 2.0
TN #:	207199
Document Title:	The Nevada Hydro Company Comments: on Renewable Energy Transmission Initiative 2.0
Description:	N/A
Filer:	System
Organization:	The Nevada Hydro Company
Submitter Role:	Public
Submission Date:	1/6/2016 1:30:19 PM
Docketed Date:	1/6/2016

Comment Received From: The Nevada Hydro Company
Submitted On: 1/6/2016
Docket Number: 15-RETI-02

Comments of The Nevada Hydro Company

Additional submitted attachment is included below.

THE HYDRO COMPANY, INC.
DBA THE NEVADA HYDRO COMPANY, INC.

January 6, 2016

California Energy Commission
1516 Ninth Street
Sacramento, Ca 95814

RE: Comments on Renewable Energy Transmission Initiative 2.0

Dear Commissioners and Staff

The Nevada Hydro Company ("Nevada Hydro") was pleased to see the Energy Commission ("CEC"), the Public Utilities Commission ("PUC") and the California independent System Operator ("ISO") coordinating their efforts to meet the State's now formidable greenhouse gas goals by undertaking the Renewable Energy Transmission Initiative 2.0 ("RETI 2.0"). As always, Nevada Hydro is grateful to be able to contribute to this important joint effort.

For a number of years now, Nevada Hydro has had two projects under development that connect to the grid approximately 10 miles from the now closed San Onofre Nuclear facility ("SONGS") on Path 44 – South of SONGS, within the Southern California load pocket. (See the project location on Figure 1, below.) These projects are known as the Lake Elsinore Advanced Pumped Storage ("LEAPS") project and the Talega-Escondido/Valley-Serrano 500 kV Interconnect ("TE/VS Interconnect") project (together, the "Projects"). This letter is intended to provide information on these Projects so that the RETI 2.0 parties can include facts relating to them in their planning efforts. This letter also provides Nevada Hydro's comments on issues raised thus far in the proceedings.

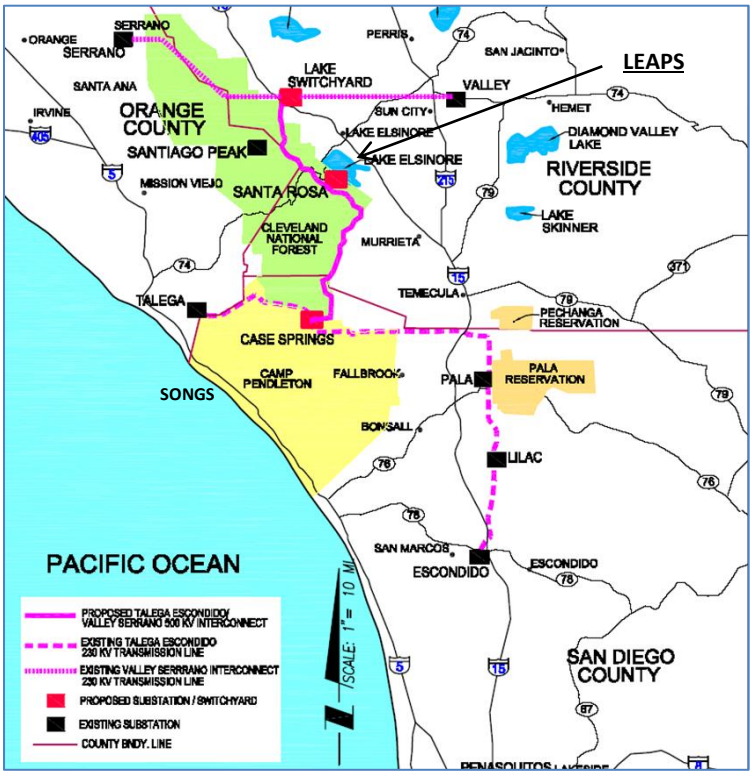
1.0. The Projects

LEAPS is a 500 MW generation/600 MW load advanced pumped storage facility. LEAPS was being licensed by Federal Energy Regulatory Commission (FERC) in Docket P–11858, and is now under limited additional review in FERC Docket P–14227. LEAPS has an advanced position in the CAISO queue (QP#72), and the system impacts of the project have been fully studied under the CAISO's Large Generator Interconnection Procedures. Nevada Hydro completed updates to the existing Large Generator Interconnect agreements (one each with SDG&E and SCE) for the facility and has fully executed Interconnect agreements with both area utilities.

The TE/VS Interconnect is a 500 kV, 32-mile transmission line that can connect LEAPS to the grid and will connect the service territories of both San Diego Gas & Electric Company (SDG&E) and Southern California Edison (SCE). Its value has been assessed by the Federal Energy Regulatory Commission ("FERC") which granted it an incentive rate of return under federal law in docket ER06–278 based upon

independent evidence demonstrating its ability to provide reliability benefits to the grid.[1] Equally important, however, this project will link the San Diego load pocket and the CAISO's 500 kV electrical backbone, which does not currently extend into SDG&E's service territory at 500 kV.

Figure 1 – Location of the LEAPS and TE/VS Projects



Nevada Hydro has been working diligently for a number of years to move the projects forward, including permitting for rights-of-way, environmental review, engineering and detailed technical planning (construction sites, staging areas, etc.). For example:

a) In January 2007, the FERC and the United States Forest Service[2] released their "Final Environmental Impact Statement – Lake Elsinore Advanced Pumped Storage Project"[3] ("Final EIS"), which addressed both LEAPS and a "transmission lines only project." The Final

---

[1] / Federal Energy Regulatory Commission, *Order on Rate Request*, Docket Nos. ER06-278-000 et seq., issued November 17, 2006.

[2] / As nearly 30 of the total 32 mile length of the TE/VS Interconnect traverses the Cleveland National Forest, the participation of the Forest Service has been instrumental in advancing the projects.

[3] / Federal Energy Regulatory Commission and United States Department of Agriculture – United States Forest Service, *Final Environmental Impact Statement – Lake Elsinore Advanced Pumped Storage Project*, FERC Project No. 11858, FERC/FEIS – 019F, January 2007.

EIS detailed the conditions under which the project could receive a license allowing for construction, none of which would have prevented construction. This Final EIS is now being updated.

b) The CPUC has completed an extensive analysis of both projects under the California Environmental Quality Act ("CEQA") in connection with its analysis of the Sunrise Powerlink project proposed by SDG&E.[4] That analysis included a review of the TE/VS Interconnect as a CEQA alternative to the Sunrise project. The TE/VS Interconnect was identified as the "environmentally superior transmission project" in that proceeding.

The benefits that the two projects bring to the region have been well studied and well documented in both Federal and State venues over the years. In addition to the overall system benefits that these two projects have demonstrated, the projects will help alleviate the resource constraints that are posed by the loss of SONGS in a more effective, more timely and less costly way than the other proposed resources that may be "on the table".

The TE/VS Interconnect is nearly fully engineered, and both LEAPS and the TE/VS Interconnect are far enough through permitting, that RETI 2.0 can be confident Nevada Hydro will be able to commence construction on these key resources on time to provide the desperately needed highly flexible new capacity to help address the growing challenge of integrating an increasing amount of variable renewable resources onto the grid in Southern California.

2.0. Attachments

Included with this letter, Nevada Hydro has provided copies of three Whitepapers it has prepared further describing the Projects and the potential benefits they offer the State relevant to many facets of the RETI 2.0 process and as described further in the remainder of this letter:

1. Nevada Hydro Whitepaper 1 – Building a Clean Energy State, June 2014
2. Nevada Hydro Whitepaper 2 – Moving to a 500 kV Grid
3. Nevada Hydro Whitepaper 3 – Making the Most of LEAPS, June 2015

Nevada Hydro is also including as additional attachments two filings from the ISO relative to the importance and value of large storage facilities like LEAPS.

4. On July 21, 2015, the ISO filed its "Notice of Ex Parte Communication by the California Independent System Operator Corporation" into the Long Term Procurement docket R–13–12–010 at the PUC. The notice provided a copy of a letter the ISO Chief Executive Officer and President sent to all five PUC Commissioners and their respective Chiefs of Staff and Energy Advisors. The letter stated, in relevant part:

> *. . . the ISO and the Commission must be prepared to implement solutions that will allow for the reliable operation of a highly dynamic grid. Energy storage, with its unique ability to both consume excess renewable energy and to quickly inject clean*

[4] / *In the Matter of the Application of San Diego Gas & Electric Company for a Certificate of Public Convenience and Necessity for the Sunrise Powerlink Transmission Project*, Application 06–08–010.

energy back onto the grid to meet ramping and peak demand needs, has the potential to be a cornerstone of the new electric network.

Pumped energy storage, in particular, can be constructed at large scale, with characteristics that are necessary to meet our grid's over-generation and ramping needs. The ISO has begun a preliminary analysis of the benefits of large-scale pumped storage in regards to ramping and curtailment risk based on our 2014 L TPP modeling, and the results are promising. The ISO intends to further incorporate this initial work into its 2015-2016 transmission planning process. The ISO would be pleased to present these results in the context of the Commission's current L TPP in order to move the discussion forward.

5. On November 17, 2015, the ISO filed "Presentation - A CAISO Bulk Energy Storage Case Study – Workshop" into the CPUC/CEC Joint Workshop on Bulk Energy Storage, November 20, 2015 (CEC Docket 15-MISC-05) ("ISO Case Study"). The presentation apparently reported on results of the referenced "preliminary analysis" the ISO implemented that assessed "a bulk storage resource's ability to reduce (i) production cost, (ii) renewable curtailment, (iii) CO2 emissions and (iv) renewable overbuild to achieve the 40% RPS target." The ISO modeled a resource that is identical to LEAPS (without mentioning it by name) and found that it is able to provide significant value to the grid in all of these areas.

3.0. Nevada Hydro's comments on RETI 2.0 goals, objectives and deliverables

In these comments, Nevada Hydro will describe how its Projects can help meet the identified objectives, goals and deliverables identified for RETI 2.0. These objectives, goals and deliverables were identified in in the following presentations:

- The November 2, 2015 "Renewable Energy Transmission Initiative 2.0 Organizational Structure and Work Plan" ("November 2 Presentation"), and
- The December 18, 2015 "Renewable Energy Transmission Initiative 2.0, Plenary Group Preliminary Work Plan" ("December 18 Presentation").

Nevada Hydro's comments appear in blue text and follow the description of each identified, goal, objective or deliverable which appears in *italic*.

3.1. How the Projects help meet the RETI 2.0 Objectives

RETI 2.0 identifies the following as objectives in the November 2 Presentation.

A. Explore combinations of renewable generation resources in California and throughout the West that can best meet goals.

Nevada Hydro Comment: As the attachments from the ISO attests, Nevada Hydro suggests that RETI consider the benefits of large storage like LEAPS managing and integrating the ever increasing quantity of renewable resources in a manner that does not also produce GHG emissions. As LEAPS can be linked to the TE/VS Interconnect, the two facilities can be used together to manage, integrate, and allow for the transfer of renewable resources located in Imperial Valley and throughout the State far more effectively that can other piecemeal solutions.

B. Identify land use and environmental opportunities and constraints to accessing these resources.

Nevada Hydro Comment: Both LEAPS and the TE/VS Interconnect have been assessed by resource agencies and provide the least intrusive solutions with the least environmental impact. Please see Nevada Hydro comments in Section 4.1B for additional details on the land use and environmental analyses already completed on these resources.

C. Build understanding of transmission implications of renewable scenarios, and support for "least regrets" transmission investments.

Nevada Hydro Comment: The TE/VS Interconnect can serve two goals: It can link LEAPS into the grid and it can also, independently, link San Diego into the rest of the State's high voltage grid, providing transferability and reliability benefits to the entire southern California region. As the route of the TE/VS Interconnect has already been assessed through a number of environmental permit processes over its roughly 32 mile length, it can provide a wide array of benefits at the lowest cost and least impact of any alternative under consideration. By providing the most benefits at the lowest cost and least impact, the line should be considered the most significant "real" "least regrets" investment that can be made to enhance the grid and meet the objectives of RETI 2.0.

4.0. Nevada Hydro's Comments for the Environmental and Land Use Technical Group

Again, Nevada Hydro's comments appear in blue text and follow the description of each identified, goal, objective or deliverable which appears in *italic*.

4.1. Goals and Objectives from the November 2 Presentation

A. The group is to work with REAT and "other agencies with relevant environmental and land use expertise."

Nevada Hydro Comment: Because of the extensive amount of analysis it has done in connection with our and other projects, Nevada Hydro suggests that the group reach out to the Cleveland National Forest. Nevada Hydro would be happy to provide contact information.

B. The group's goal is to assist in "assessing environmental and land use considerations related to possible locations for renewable energy development."

Nevada Hydro Comment: Nevada Hydro respectively suggests that the group consider including not just renewable generation resources, but that it also include consideration of resources, like LEAPS, that are essential for managing the new ever more complex grid. Because so much siting work has already been completed in connection with LEAPS and the TE/VS Interconnect, Nevada Hydro suggests that the group review the information developed by:

i) The Cleveland National Forest and FERC in their joint production of the Final EIS prepared for LEAPS.[5]

ii) The PUC, in its assessment of the Valley–Rainbow Interconnect project, particularly its "Interim Preliminary Report on Alternatives Screening".[6] This report extensively analyzed alternative routings for the proposed project (which, although rejected by the PUC previously, has apparently recently been resurrected by SDG&E), and concluded that there were limited alternatives that provided viable routings for the proposed connection. The routing for the TE/VS Interconnect (referred to as the "Forest route" in the report) was found to be the only viable route at the time the report was prepared (2002). Due to development in the region, siting a similar project today can only be more difficult.

iii) The PUC, in its assessment of the Sunrise Powerlink project and the final environmental documents it created, particularly its assessment of alternatives to the as proposed project.[7] The routing for the TE/VS Interconnect was evaluated as required by CEQA and found to be the "Overall Environmentally Superior Transmission Line Route Alternative due to its substantially shorter length and reduced environmental impacts."[8] LEAPS was also assessed in this document.

4.2. Deliverables/Methodology from the November 2 Presentation

A. Compile and vet the best available environmental and land use data and make recommendations on data use and additional data needs, while building on . . . other relevant planning processes."

Nevada Hydro Comment: As described herein, a wide array of agencies have participated in developing detailed environmental assessments of the Projects, led by the FERC, PUC and Cleveland National Forest. Nevada Hydro respectfully suggests that the group utilize this information in its assessment of the Projects and in it development of recommendations to RETI 2.0 stakeholders. Please see Section 4.1B for further details.

B. Support stakeholder and agency efforts to utilize this information in order to assist in identifying lower conflict areas for potential renewable energy development.

Nevada Hydro Comment: As described herein, a wide array of agencies have participated in developing detailed environmental assessments of the Project, led by the FERC, PUC and Cleveland National Forest. Nevada Hydro respectfully suggests that the group utilize this

---

[5] / See reference at Note 3.

[6] / The Valley–Rainbow was assessed by the PUC in Application A.01–03–036. This report and information about the proposed routing of the project may be found at http://www.cpuc.ca.gov/environment/info/dudek/valleyrainbow/valleyrainbow.htm

[7] / The Sunrise Powerlink project was assessed by the PUC in Applications A.05-12-014 and A.06-08-010. The referenced documents may be found at http://www.cpuc.ca.gov/Environment/info/aspen/sunrise/toc-feir.htm

[8] / The Sunrise EIR/EIS concluded that the project "would meet the reliability and economic project objectives and would allow import of renewable generation into the San Diego area from the SCE system . . ." See Section ES.7.4 for a summary of conclusions relative to the TE/VS Interconnect.

information in its assessment of the Projects and in it development of recommendations to RETI 2.0 stakeholders.

Nevada Hydro also respectfully suggests that the group incorporate the findings in the Projects' Final EIS as well as those prepared by the PUC in connection with its analysis of the Valley–Rainbow and Sunrise Powerlink projects described in Section 4.1B.

4.3. Issues pertaining to Interaction with Plenary Group from the November 2 Presentation

A. Work interactively with RETI Plenary Group to evaluate conceptual-level combinations of potential renewable energy generation areas, transmission and potential transmission corridors.

Nevada Hydro Comment: As described herein, Nevada Hydro respectfully suggests that in working with the Plenary Group, this group bring its view of the benefits of the combined LEAPS and TE/VS Interconnect, and reference the environmental assessments that have already be completed on the Projects.[9] Although permitting is not yet complete, enough work has been completed by various agencies, and mitigation has been put forth, which together demonstrate the siting feasibility and constructability of the Projects. .

5.0. Nevada Hydro's Comments for the Transmission Technical Input Group

Again, Nevada Hydro's comments appear in blue text and follow the description of each identified, goal, objective or deliverable which appears in *italic*.

5.1. Goals and Objectives from the November 2 Presentation

A. This group's goal is to "assemble relevant in-state and west-wide transmission capability and upgrade cost information to inform resource development conservations on the reasonably-needed transmission system implications and to assist in the developing potential corridor scenarios."

Nevada Hydro Comment: Nevada Hydro has modeled the grid extensively in connection with determining the value of, and integration benefits from the presence of its Projects operating in the southern California load pocket. Nevada Hydro suggests that this group review its Whitepaper #3 which contains output from powerflow modeling and assess the analyses already completed on capabilities of the TE/VS Interconnect transmission corridor, both with and without each of Nevada Hydro's projects operating.

Nevada Hydro had published its site specific information about its development and construction costs for both projects as well.[10]

---

[9] / Described more fully in Section 4.1B.

[10] /A cost estimate for the TE/VS Interconnect was prepared for the PUC in connection with permitting the project under PUC rules in 2012. This information is available at: http://www.cpuc.ca.gov/Environment/info/aspen/nevadahydro/toc-pea5.htm#revch3. FERC estimated these costs in its Final EIS for LEAPS, and Nevada Hydro is now updating this earlier estimate.

5.2. Deliverables/Methodology from the November 2 Presentation

A. Provide initial transmission input on likely in-state developments necessary to access potential renewable generation

Nevada Hydro Comment: Nevada Hydro respectfully suggests that the group include its assessment of Nevada Hydro's Projects in providing the requested input.

B. Provide planning level transmission cost estimates and any available information on environmental and other permitting issues for in-state requirements, using existing data to the greatest extent possible.

Nevada Hydro Comment: Nevada Hydro respectfully suggests that the group include its assessment of Nevada Hydro's Projects, as described herein, in providing the requested input. Nevada Hydro also respectfully suggests that the group include the existing data described herein in Section 4.1B and specifically the Final EIS prepared by FERC and the Cleveland National Forest (providing environmental information) and 5.1 (addressing cost), for the Projects.

5.3. Issues Pertaining to Interaction with Plenary Group, from the November 2 Presentation

A. Characterize existing transmission system capacity and planned improvements/changes and their implications for accessing additional renewable resources.

Nevada Hydro Comment: Nevada Hydro has modeled the grid extensively in connection with determining the value of, and integration benefits from the presence of its Projects operating in the southern California load pocket. Nevada Hydro suggests that this group review its Whitepaper #3 which contains output from powerflow modeling and assess the analyses already completed on capabilities of the TE/VS Interconnect transmission corridor, both with and without each of Nevada Hydro's projects operating.

B. Provide initial transmission input on likely in-state developments necessary to access potential renewable generation and refine the data as combinations of renewable resources are developed through other RETI groups' activities.

Nevada Hydro Comment: As Nevada Hydro has noted above, the TE/VS Interconnect can serve two goals: It can link LEAPS into the grid and it can also, and independently, link San Diego into the rest of the State's high voltage grid, providing transferability and reliability benefits to the entire southern California region. As the route of the TE/VS Interconnect has already been assessed through a number of environmental permit processes over its short, roughly 32 mile length, it can provide a wide array of benefits at the lowest cost and least impact of any alternative under consideration. By providing the most benefits at the lowest cost and least impact, the line can only been considered and the most significant "least regrets" investment that can be made to enhance the grid and meet the objectives of RETI 2.0.

Nevada Hydro also respectfully suggests that the group assess the ability of LEAPS to accommodate and integrate renewable generation resources.

Nevada Hydro respectfully suggests that the group review its Whitepapers which directly address the issue of grid capacity with and without Nevada Hydro's Projects.

C. *Provide planning level transmission cost estimates and any available information on environmental and other permitting issues for in-state requirements, using existing data to the greatest extent possible.*

Nevada Hydro Comment: As Nevada Hydro has noted above, the TE/VS Interconnect can serve two goals: It can link LEAPS into the grid and it can also, and independently, link San Diego into the rest of the State's high voltage grid, providing transferability and reliability benefits to the entire southern California region. As the route of the TE/VS Interconnect has already been assessed through a number of environmental permit processes over its short, roughly 32 mile length, it can provide a wide array of benefits at the lowest cost and least impact of any alternative under consideration. By providing the most benefits at the lowest cost and least impact, the line can only been considered and the most significant "least regrets" investment that can be made to enhance the grid and meet the objectives of RETI 2.0.

Nevada Hydro respectfully suggests that the group include its assessment of Nevada Hydro's Projects, as described herein, in providing the requested input. Nevada Hydro also respectfully suggests that the group include the existing data described herein in Section 4.1B and specifically the Final EIS prepared by FERC and the Cleveland National Forest (providing environmental information) and 5.1 (addressing cost), for the Projects.

6.0. Information for the Plenary Group

Again, Nevada Hydro's comments appear in blue text and follow the description of each identified, goal, objective or deliverable which appears in *italic*.

6.1. Goals and Objectives from the November 2 Presentation

A. *Consider resource potential and environmental and land use information to assist with identifying lower conflict areas for potential renewable energy development.*

Nevada Hydro Comment: As described herein, Nevada Hydro's Projects have a Final EIS and have been subject to analysis by the PUC[11] that together demonstrate that even with the mitigation proposed by these agencies, these projects are constructible, with little conflict, especially when compared to alternative. Nevada Hydro respectively requests of the Plenary group that it consider the benefits of the Projects and the analysis already done when developing its recommendations.

B. *Construct and discuss combinations of renewable energy resource areas and associated transmission improvements that can help achieve California's 2030 climate and renewable energy goals.*

[11] /See Section 4.1B for references to the PUC's conclusions.

Nevada Hydro Comment: Nevada Hydro respectfully urges the Plenary Group to follow the ISO's lead and include consideration of the benefits large pumped storage can bring to achieving the 2030 goals. Nevada Hydro respectfully urges the Plenary Group to review the attached Whitepapers that document the benefits of the Projects toward the achievement of the State's renewable and GHG goals.

6.2. Deliverables/Methodology from the November 2 Presentation

A. Develop conceptual combinations of resources and transmission investments" that "meet energy needs with greatest potential economic, environmental benefits.

Nevada Hydro Comment: Nevada Hydro views this issue as the critical deliverable of the RETI 2.0 process. Coincidentally, it also happens to be the analysis that will demonstrate the true value of Nevada Hydro's Project's to the State's efforts to implement a greener grid!

To date, both FERC[12] and the ISO[13] have documented the economic potential of each of Nevada Hydro's projects contributing to the energy needs (including providing reliability and ancillary services to the grid). Argonne National Laboratories, in documents provided to the PUC, has also demonstrated these benefits in their analysis of pumped storage projects in California.[14] In addition, Nevada Hydro is prepared to provide information that demonstrates the significant synergistic economic benefits of the two projects combined.

In terms of environmental benefits, this letter has referenced the work of FERC and the PUC which together demonstrates the minimal environmental footprint of the Projects. What they have not addressed fully addressed is the benefits LEAPS can bring to using Lake Elsinore as a regional reclaimed water storage system, linking in real time the combined energy and water conservation benefits of the Projects with the Governor's policy mandates in energy, GHG reduction and water conservation. No other project, or combination of projects on the horizon, offers this stunning array of energy, economic, environmental and policy benefits. Nevada Hydro trusts that the group gives the Projects due consideration.

7.0. Issues Raised in the December 18 Presentation

Again, Nevada Hydro's comments appear in blue text and follow the description of each identified, goal, objective or deliverable which appears in *italic*.

---

[12] /See Note 1.

[13] /See reference to the ISO Case Study in Section 2, item number 5.

[14] / See Koritarov, V., Modeling and Analysis of Value of Advanced Pumped Storage Hydropower in the U.S. Argonne National Laboratory, 2014, January ("Argonne Report"), prepared for the PUC's Jan. 16, 2014 "Technical Workshop: Understanding Current State of Pumped Storage". Materials from the Workshop, including the referenced report and accompanying presentation may be accessed at: http://www.cpuc.ca.gov/PUC/energy/electric/Technical_Workshop_Understanding_Current_State_of_Pumped_Storage.htm

7.1. February timeline: Questions to explore relating to Resource Values

A. What do we know about the capacity, energy, ancillary service, and system value, and development cost, of individual resource areas and technologies?

Nevada Hydro Comment: There is extensive information available pertaining both generically and specifically to Nevada Hydro's Projects. Many parties have prepared analyses of the "capacity, energy, ancillary service, and system value" of advanced pumped storage facilities. Nevada Hydro would be happy to provide a bibliography and copies of relevant reports. Nevada Hydro's attached Whitepapers document how the Projects benefit "capacity, energy, ancillary service, and system value." Finally, Nevada Hydro had published its site specific information about its development and construction costs for both projects as well.[15]

B. What do we know about how different resources complement each other to provide system value?

Nevada Hydro Comment: With regard to its two Projects, Nevada Hydro suggests review of its attached Whitepapers, particular #3, where we discuss how the two projects together compliment and provide significant additional system value.

C. What do we know about building resource combinations?

Nevada Hydro Comment: With regard to its two Projects, Nevada Hydro suggests review of its attached Whitepapers, particularly #3, where we discuss how the two combined projects compliment and provide significant additional system value.

7.2. Questions for Stakeholders

A. How can we assemble conceptual resource combinations?

Nevada Hydro Comment: Modestly, Nevada Hydro suggests that the group start with obvious combinations, like its Projects! Nevada Hydro is pleased to offers it panel of experts to further assist in this endeavor. This panel includes:

- Ziad Alaywan, Present of ZGlobal, Inc.
- Mike Wood, formerly with Dominion Resources. Mike developed, built and operated the 2,500 MW Bath County Pumped Storage Station in Virginia.
- Fred Depenbrock, formerly with Siemens PTI. Fred is expert in utility planning, engineering and operational analysis.

B. What are the best examples of assembling resource combinations?

Nevada Hydro Comment: Again modestly, Nevada Hydro believes that its two projects represent the best combination of resources that combined offer a range of benefits to the

[15] /See Note 10.

grid at low cost, with minimal environmental impact. Simply, this package can help RETI 2.0 achieve its objectives reasonably and with no additional GHG emissions.

We hope that RETI 2.0 participants find this submittal of interest, and look forward to advancing the RETI 2.0 goals and objectives with other stakeholders.

Sincerely,

/s/ David Kates
David Kates
On behalf of The Nevada Hydro Company

List of Submitted Attachments

1. Nevada Hydro Whitepaper 1 – Building a Clean Energy State, June 2014.
2. Nevada Hydro Whitepaper 2 – Moving to a 500 kV Grid.
3. Nevada Hydro Whitepaper 3 – Making the Most of LEAPS, June 2015.
4. Notice of Ex Parte Communication by the California Independent System Operator Corporation, PUC Docket R–13–12–010, July 21, 2015.
5. Presentation - A CAISO Bulk Energy Storage Case Study – Workshop, CPUC/CEC Joint Workshop on Bulk Energy Storage, November 20, 2015 (CEC Docket 15-MISC-05).

Attachment 1

Nevada Hydro Whitepaper 1 – Building a Clean Energy State, June 2014.

Building a Clean Energy State Without SONGS:

The Lake Elsinore Advanced Pumped Storage
and
Talega–Escondido/Valley–Serrano 500 kV Interconnect Project
FERC Dockets: P-14227, ER06-278
The Nevada Hydro Company

I. Introduction

The state of California is facing two major problems with regard to energy. The first is implementing an aggressive clean energy policy and the second in learning to live without the roughly 2,200 MW once produced by the San Onofre Nuclear Generating Station (SONGS).

II. Building a clean energy state

California has among the most aggressive clean energy policies in the world. California law requires that 33% of all energy used in the state be derived from renewable energy sources by 2020, as well as that the emission of greenhouse gases (GHG) be reduced to 1990 levels by 2020. Beyond that, California policies call for an overall 80% reduction of 1990 GHG emission levels by 2050. This will, in turn demand that over time, California will necessarily rely on an ever-greater percentage of renewable energy resources (*i.e.*, well beyond the currently mandated renewable portfolio standard of 33%) to meet its electric power needs. On top of this, the State's projected transition to a transportation fleet that increasingly uses electricity rather than gasoline or diesel as its motive power means that California's electric power needs will continue to grow, even with the expected implementation of state-of-the-art energy efficiency programs throughout the state.

However, most renewable energy resources are intermittent. The sun rises in the morning and sets in the evening; the state's ample wind resources are often at their most productive during off-peak hours; and geothermal power operates 24/7, meaning that there are numerous hours during the year when the power from geothermal facilities is or will be surplus. California therefore faces a major challenge on its path to a clean and renewable energy future: it must start developing advanced technologies that can reliably and effectively buffer the intermittency of renewable generation with the variable demands of electricity customers over the course of a day.

There are only three available technologies that can effectively address this lack of fit between the times during the day when renewable resources are available and the times when electric power is demanded by society. The first of these is demand response, which can help buffer the demands on the system during periods of peak load. However, in a largely post-industrial California, demand response cannot be reasonably expected to meet much more than 5% of the power system's needs for resources that can balance the discrepancy between when renewable energy is generated and when it is consumed. Moreover, demand response

inevitably runs up against consumer resistance. People may be willing to cycle their air conditioners off for up to 10 or 15 minutes an hour on a hot day, but they will not be willing to shift their air conditioning load to the nighttime when it is over 100 degrees outside at 3 p.m.

The second available buffering technology would be to install a fleet of gas-fired turbines (essentially, stationary jet engines). However, the combustion of fossil fuel creates GHGs, which will ultimately limit the ability of the State to deploy this technology broadly. Moreover, although the price of gas is currently low, there is always a risk of significant gas price volatility: prices were as high as $12/MMBTu as recently as 7-8 years ago. Finally, gas turbines can operate and produce power when the system has insufficient renewable generation to meet power needs, but gas turbines simply cannot absorb excess power during those hours when there is an overabundance of renewable generation (which will be increasingly the case as California deploys more and more renewable resources over the next 5 to 10 years).

However, the third available buffering technology – advanced storage – has none of the limitations of demand response or the drawbacks of an increased reliance on gas generation. Storage is clean, green and cost-effective. Moreover, storage can easily absorb excess renewable generation at night when the wind blows and during the height of the day when solar generation will often exceed demand. Finally, the potential of storage is virtually limitless. California will be able to build as much electricity storage capacity as it needs with minimal environmental restrictions. Some of that storage, mostly in the form of batteries, will necessarily be located on the distribution grid to help buffer local distributed generation from rooftop photovoltaic systems.

Under the oversight of the California Public Utilities Commission (CPUC), the State's utilities have signed contracts for well over 10,000 MW of new renewable generation resources, the bulk of which have not yet come on line. When these new renewable projects start coming on line later in this decade, California will be faced with major challenges to the stability of its grid, especially in Southern California where the hydroelectric resources (which can provide supplemental power when renewables are not producing to their full capacity) are much less abundant than in the northern part of the State. Further, to deliver that needed energy in the south from the northern part of the state during high demand periods can, does, and will cause costly congestion issues on the main transmission paths linking the north to the south, such as Path 26 from the Midway substation (PG&E) to the Vincent substation (SCE).

There is only one technology that can accommodate the significant potential for over-generation that the added new renewables will create, while, at the same time, providing large and reliable amounts of power during periods of peak load, and in a manner that follows load precisely and can, as a major bonus, provide abundant ancillary services, including fast regulation and fast ramping. That technology is advanced bulk storage.

Storage has been a subject of much discussion in California over the past 5+ years. Assemblywoman Nancy Skinner led the fight to enact Assembly Bill 2514 in 2010. The CPUC has initiated a proceeding to evaluate the long-term role for storage, and the California Energy Commission (CEC) and the California Independent System Operator (CAISO) have all held

extended workshops looking into the long-term value of storage for California. Utility executives have characterized storage as the "Holy Grail" of the clean energy future.

In early 2013, all three of the State's energy agencies held a Summit on the future of resource adequacy in California, attended by most of the agencies' Commissioners and Board Members, as well as by a critical mass of the State's key stakeholders on major energy policy issues. A number of the speakers acknowledged the high value that electricity storage, as a clean, highly flexible and reliable resource, would bring to the grid of the future. Indeed, there was consensus on the part of the active participants at the Summit that California will need a dramatically greater amount of highly flexible new energy resources as soon as three years from now. But where are the large storage projects? Where is there any major new "steel in the ground" storage project anywhere in the State, and particularly those scaled to address the utility–scale issues?

In the 1970's, Pacific Gas & Electric Company started building the Helms Pumped Storage project to help buffer the over-generation from its Diablo Canyon nuclear power plant. Helms was a successful project, but now, when the need for storage in California is greater than ever, where are the major storage projects that will unquestionably be needed to help maintain grid reliability in a world increasingly reliant on variable renewable generation, and that will do so in a manner that is environmentally superior and that imposes no burdens on the customers of the utilities?

Fortunately, there is such a project (actually, two closely related projects) that bears serious consideration by everyone who is concerned about California's energy future and who cares about electric power that is clean, reliable and local: the Lake Elsinore Advanced Pumped Storage (LEAPS) and Talega–Escondido/Valley–Serrano 500 kV Interconnect (TE/VS Interconnect) Project. Section IV of this Paper will describe these projects, explain their current permitting status and the challenges they face, and demonstrate the significant benefits that these projects will provide both to the grid and the ratepayers of Southern California. Finally, this paper will show why these projects are superior to all other projects that are currently under consideration by the CAISO in order to meet the long-term needs of the grid in Southern California now that SONGS is gone.

III. Coping with the loss of SONGS

The landscape of electric power supply in Southern California has fundamentally changed with the retirement of SONGS. Compounding this impact is the impending effects of the restrictions of once-through-cooling for existing and future generating stations along the pacific coastline.

The retirement of both SONGS has removed 2,150 MW of generation from Southern California. Because of its many years of high operating factor, utility reliability and economic planners for the area had developed a system highly dependent on its presence at full output. With its retirement, system reliability in both San Diego and the Los Angeles basins has been significantly diminished.

Also, the cost of electricity to customers in this area has shown a spike upward. This is likely due to a combination of both the loss of the low cost of energy from SONGS itself and the loss of SONGS ability to backstop imports of less costly power from external resources rather than using more costly internal generation. Further, since the loss of SONGS, the consumption of natural gas has begun trending upward, likely due to increased use of gas–fired generation to make up for the loss of SONGS

Compounding this impact to reliability is the impact of the California Water Resource Control Board (CWRCB) performance criteria for mitigating the effects of the use of water for generation cooling that is discharged into the ocean. Compliance is scheduled to begin on January 1, 2018. At this point, it appears none of the generation plants in southern California that are using this "once-through-cooling" (OTC) process have found a cost-effective way to meet these criteria. Thus, all generation located along the coastline will likely have to shut down as of that date, unless the CWRCB develops a revised plan.

Some efforts are under way to build replacement generators on or near these sites. However, under the best of circumstances, there will be less replacement generation built than will be retired.

An important effect of these two decisions has been to put emphasis on the need for the use of transmission to bring lower cost power into the San Diego and Los Angeles basins. Fossil-fueled generation near the high population density coastal area will be both more difficult to permit and more expensive to operate than has been enjoyed from those existing units that had once-through-cooling. Also, a review of the proposed renewable generation in the CAISO generation queue shows that much of it is well back from the coast and will put additional stress on a transmission system that must be made more robust to accommodate it.

The problem is that the grid manager is going to have to operate the system to assure that the energy produced is able to get to the load when needed. This will require a lot of new transmission and a means to manage the various resources (load following, fast response to outages, quick start, black start, etc.). These renewable resources are widely diverse in the time and location of their energy production. Nevada Hydro's projects have been designed precisely to meet these needs; and meet them in a cost effective manner.

IV. The Projects

For a number of years now, The Nevada Hydro Company (Nevada Hydro) has had two projects under development that connect to the grid approximately 10 miles from SONGS on Path 44 – South of SONGS. See the project location on Figure 1, below. These projects are referred to as the Lake Elsinore Advanced Pumped Storage project and the Talega-Escondido/Valley-Serrano 500 kV Interconnect project. The powerhouse associated with the 500 MW pumped storage project is less than 25 miles from SONGS at Lake Elsinore, within the Southern California load pocket.

The benefits that the two projects bring to the region have been well studied and well documented in both Federal and State venues over the years. In addition to the overall system

benefits that these two projects have demonstrated, the projects will help alleviate the resource constraints that are posed by the loss of SONGS in a more effective, more timely and less costly way than the other proposed resources that may be "on the table".

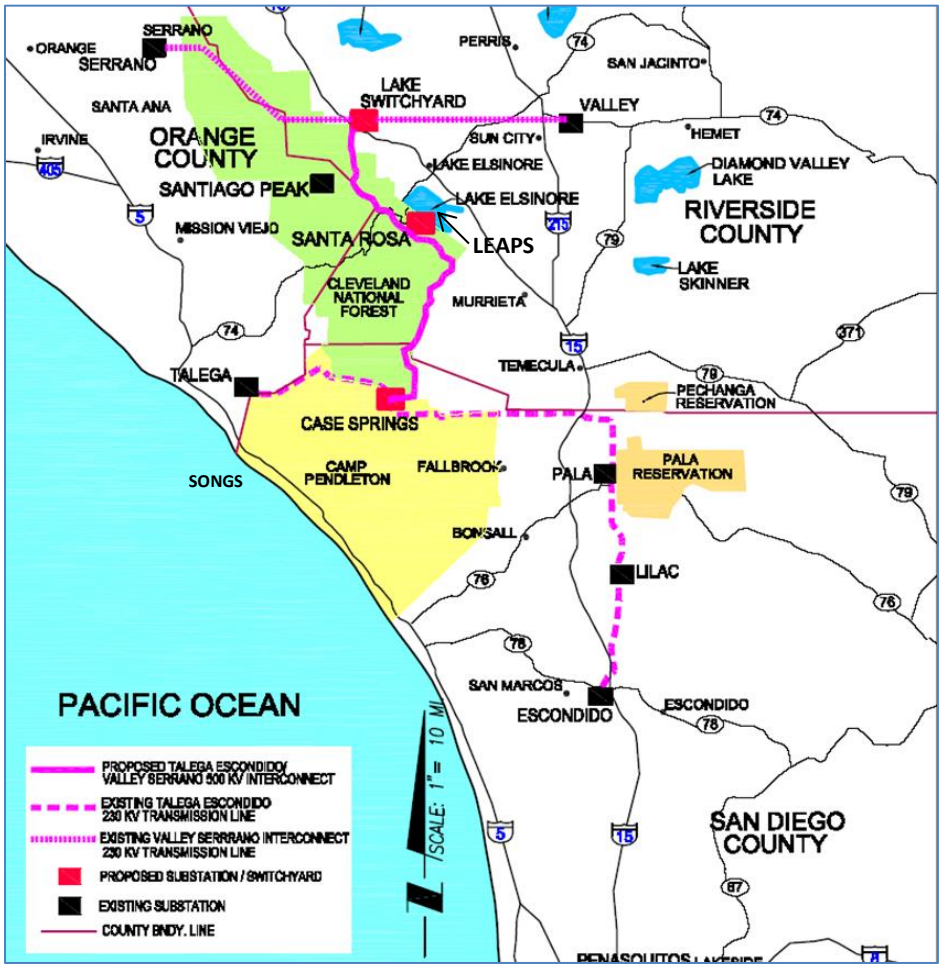


Figure 1 – Location of the LEAPS and TE/VS Projects

- The Lake Elsinore Advanced Pumped Storage (LEAPS) project is a 500 MW generation/600 MW load advanced pumped storage facility. The LEAPS project was being licensed by Federal Energy Regulatory Commission (FERC) in Docket P–11858, and is now under limited additional review in FERC Docket P–14227. LEAPS has an advanced position in the CAISO queue (QP#72), and the system impacts of the project have been fully studied under the CAISO's Large Generator Interconnection Procedures. Nevada Hydro completed updates to the existing Large Generator Interconnect Agreements (one each with SDG&E and SCE) for the facility.
- The Talega–Escondido/Valley–Serrano 500 kV Interconnect (the TE/VS Interconnect) is a 500 kV, 32-mile transmission line that will interconnect LEAPS to the grid and connect

the service territories of both San Diego Gas & Electric Company (SDG&E) and Southern California Edison (SCE). Equally important, however, this project will link the San Diego load pocket and the CAISO's 500 kV electrical backbone, which does not currently extend into SDG&E's service territory.

Nevada Hydro has been working diligently for a number of years to move the projects forward, including permitting for rights-of-way, environmental review, engineering and detailed technical planning (construction sites, staging areas, *etc.*). For example:

1. In January 2007, the FERC and the United States Forest Service (USFS)[1] released their "Final Environmental Impact Statement – Lake Elsinore Advanced Pumped Storage Project"[2] (Final EIS), which addressed both LEAPS and a "transmission lines only project." In Appendix B of the Final EIS, FERC staff included a "Need Determination for the Lake Elsinore Advanced Pumped Storage (LEAPS) Project's Talega-Escondido/Valley-Serrano 500-kV Transmission Line." In this Appendix, FERC staff concluded that the TE/VS Interconnect would be "an appropriate long-term solution to southern California's transmission congestion bottlenecks as well as the transmission constrained, generation-deficient San Diego area."[3]
2. The CPUC has completed an extensive analysis of both projects under the California Environmental Quality Act (CEQA) in connection with its analysis of the Sunrise Powerlink project proposed by SDG&E.[4] That analysis included a review of the TE/VS Interconnect as a CEQA alternative to the Sunrise project. The TE/VS Interconnect was identified as the environmentally superior transmission project in that proceeding.
3. As ordered by the Administrative Law Judge (ALJ) at the CPUC, Nevada Hydro is preparing to refile its application for a Certificate of Public Convenience and Necessity (CPCN) for the TE/VS Interconnect. This refiling is expected to occur within the next month or so. As a result, Nevada Hydro can have the TE/VS Interconnect and LEAPS projects operating in real time prior to other proposed alternatives identified in the CAISO draft 2012-2013 Transmission Plan.

As the TE/VS Interconnect is nearly fully engineered and sited, LEAPS and the TE/VS Interconnect are nearly "shovel ready" during this critical period when time is of the essence in order to identify and start construction on the key resources that will be needed not only to replace the damaged SONGS facility, but just as importantly, to provide a significant amount of desperately needed, highly flexible new capacity on line in time to help address the growing

[1]/ As nearly 30 of the total 32 mile length of the TE/VS Interconnect traverses the Cleveland National Forest, the participation of the Forest Service has been instrumental in advancing the projects.

[2]/ Federal Energy Regulatory Commission and United States Department of Agriculture – United States Forest Service, *Final Environmental Impact Statement – Lake Elsinore Advanced Pumped Storage Project*, FERC Project No. 11858, FERC/FEIS – 019F, January 2007.

[3]/ Final EIS, at page B–2.

[4]/ *In the Matter of the Application of San Diego Gas & Electric Company for a Certificate of Public Convenience and Necessity for the Sunrise Powerlink Transmission Project*, Application 06–08–010.

challenge of integrating an increasing amount of variable renewable resources onto the grid in Southern California.

V. The Challenge

Going back at least 15 years, and with SONGS operating, officials have been aware of the vulnerability facing the Southern California grid. For example, in a March 2001 letter to the CAISO, SDG&E said, "We do not believe we can delay the permitting process [for their proposed Valley–Rainbow Project[5]] any longer without potentially jeopardizing reliability in 2004."[6] The CAISO confirmed this need in a filing to the CPUC that it considered Valley Rainbow as a "high priority" project "that is needed by 2004 in order to increase the transfer capability into the San Diego area to serve load".[7] Notwithstanding this need, the Valley-Rainbow project was ultimately unsuccessful. Since that time, only Nevada Hydro has proposed a project that can solve this continuing problem.

As system load grew over time in the San Diego and Los Angeles areas, system planners understood the regions' import requirements would increase commensurately because of the difficulty of installing new generation in the area. This difficulty was triggered by strict environmental regulations (especially air quality rules), but also by strenuous public opposition to any new industrial facilities. The Otay Mesa combined cycle plant was one of the few successful new projects, but the value of that project in diminishing the need for imports was substantially reduced by the expected retirement of the South Bay plant in 2010. As a result, the ability to use the northern 500 kV path from Palo Verde to Devers, together with the proposed 500 kV TE/VS Interconnect project, was seen as the way to bring a new major supply route into the coastal area between the SCE service area and the Southwest Power Link (SWPL) path, that comes into the SDG&E service area from the east.

In 2005, Congress directed, through Section 1221(a) of the Energy Policy Act of 2005, 119 Stat. 594, 946-951 (2005) (16 U.S.C. § 824p) (EPAct), that the Secretary of Energy identify "any geographic area experiencing electric energy transmission capacity constraints or congestion that adversely affects consumers" as a National Interest Electric Transmission Corridor (NIETC). On August 6, 2006, well before SONGS went dark, the United States Department of Energy (DOE) issued a preliminary National Electric Congestion Study (Congestion Study), designating the southern California region as a "critical congestion area" under Section 1221 of the EPAct. Although the Court of Appeal on unrelated procedural grounds ultimately overturned this designation, the underlying reliability challenges to the Southern California grid, as well as DOE's conclusions as to the critical congestion in the region, still describe the on–the–ground

[5]/ Described more fully in Section VI.C.1 below.

[6]/ March 22, 2001 Letter from James P. Avery, Senior Vice President Fuel and Power Operations to Terry M. Winter, President and Chief Executive Officer, CAISO.

[7]/ "Statement of The California Independent System Operator Corporation Regarding Priority Transmission Projects", March 20, 2001, filed in CPUC Proceeding I.00-11-001, "Order Instituting Investigation into implementation of Assembly Bill 970 regarding the identification of electric transmission and distribution constraints, actions to resolve those constraints, and related matters affecting the reliability of electric supply."

reality. Moreover, as the CAISO's draft 2012-2013 Transmission Plan and work since clearly shows, the shutdown of SONGS poses an equally serious challenge to the Southern California grid.

SDG&E has acknowledged the vulnerability of the area in the long-term resource plan that was submitted as part of its Sunrise Powerlink CPCN application. In that document, SDG&E itself identified a need for a second 500 kV transmission interconnection to meet the grid reliability requirements of the CAISO in 2010. SDG&E officials saw that planned new, renewable generation facilities that would interconnect at the Imperial Valley Substation would be an important new source of supply, and that the proposed Sunrise Powerlink Project, with its 500 kV line from Imperial Valley to an injection point nearby to the Miguel Substation (the terminus of the SWPL) would be a valuable, independent 500 kV supply path into the SDG&E system. However, because of the requirement that the Sunrise line have a shared right-of-way for over 30 miles with the SWPL line, the reliability officials at WECC classified the potential outage of both lines in that common corridor as a "Category C contingency". That is, if both lines in this common corridor were lost, system operation changes with controlled or planned loss of system load would be permitted, but cascading area failures would not be.[8] This NERC determination, while providing more import capability under many circumstances, had the effect of rendering the Sunrise Powerlink Project into a transmission line that was functionally and practically much less robust than the needed independent path for importing a growing power requirement into the SDG&E system. Thus, the now-built and operational Sunrise Powerlink Project was, ultimately, only a partially successful attempt at solving the import problem, which remains a challenge for the future that will necessarily require additional high voltage transmission feeding the SDG&E service area.

More recently still, the CAISO itself recognized the need for a new 500 kV connection, as was noted in recent CAISO testimony submitted to the CPUC in a case involving SDG&E's proposed procurement of new gas-fired resources:

> ***Q. Are there any feasible transmission mitigation solutions that can meet the 650MW to 950 MW need?***
>
> *A. As described above, the constraint driving these needs is the transmission system limitations between the SCE and SDG&E systems south of SONGS. During studies of the Sunrise Powerlink, the ISO studied transmission options to increase the transmission capability between these two systems in order to further reduce local generation needs in San Diego. However, the scope of the upgrades needed to meet a 650 MW to 950 MW need was essentially a new 500 kV line connecting the SDG&E system to the SCE system.*[9]

[8]/ Per NERC TPL 003-0a.

[9]/ Testimony of Robert Sparks on Behalf of The California Independent System Operator Corporation, Application of San Diego Gas & Electric Company (U902 E) for Authority to Enter into Purchase Power Tolling Agreements with Escondido Energy Center, Pio Pico Energy Center and Quail Brush Power, Application 11-05-023, (2012), page. 9.

Notably, this testimony did not address the ramifications of the SONGS retirement. Nor did it address the apparent vulnerability of the grid demonstrated, again with SONGS operating, on the afternoon of September 8, 2011, when an 11-minute "system disturbance" led to cascading outages (including the only 500 kV link from the East into the SDG&E system) and leaving approximately 2.7 million customers without power. This outage affected parts of Arizona, Southern California, and Baja California, Mexico. All of the San Diego area lost power, with nearly one-and-a-half million customers losing power, some for up to 12 hours. The disturbance occurred near rush hour, on a business day, snarling traffic for hours. Schools and businesses closed, some flights and public transportation were disrupted, water and sewage pumping stations lost power, and beaches were closed due to sewage spills. Millions went without air conditioning on a hot day.

While the Staff report[10] on the outage prepared by the FERC and the North American Electricity Reliability Corporation (NERC) did not recommend physical changes to the system in order to prevent a recurrence of such an outage, Nevada Hydro has concluded and can demonstrate that had its TE/VS Interconnect been on line that day, much if not all of the damage that did occur could have been avoided.

Now, with SONGS gone and with coastal power plants scheduled to shut down as well, this need for enhanced transmission between the SCE and SDG&E systems is a matter of urgency

VI. The Benefits of LEAPS and the TE/VS Interconnect

Nevada Hydro has demonstrated the reliability and economic benefits of its facilities on many occasions. Independent sources, including the CAISO have confirmed Nevada Hydro's own view. What follows is a summary of some of the existing independent analysis -- from FERC, from the State of California, and from the CAISO – that supports the conclusion that LEAPS and the TE/VS Interconnect can and will provide significant overall benefits to the grid in Southern California. This history of positive analytical results leads to the unmistakable conclusion that, by failing, to date, to approve the TE/VS Interconnect as a needed project, regulators may have been doing a disservice to the region and to its ratepayers.

A. FERC's Reliability Conclusions

In November 2006, under the provisions of Sections 1223 and 1241 of EPAct, the FERC identified LEAPS as an "advanced transmission technology," defined as a "technology that increases capacity, efficiency, or reliability of an existing or new transmission facility."[11] In its

[10] / *Arizona–Southern California Outages on September 8, 2011, Causes and Recommendations*. Prepared by the Staffs of the Federal Energy Regulatory Commission and the North American Electric Reliability Corp., April 2012.

[11] / Federal Energy Regulatory Commission, *Order on Rate Request*, Docket Nos. ER06-278-000 et seq., issued November 17, 2006 ("2006 Rate Order"), at ¶ 27.

decision, FERC stated that "Nevada Hydro has proposed a project that may help meet the needs of the CAISO in managing the grid and serving load."[12]

In March 2008, the FERC granted certain rate incentives for the TE/VS Interconnect. The premise for the FERC's action was its finding that, "Nevada Hydro, through independent evidence provided in this proceeding, has adequately demonstrated that its TE/VS Interconnect project will ensure reliability, consistent with the requirement of Order No. 679." [13]

In its application, Nevada Hydro relied on "independently supplied reliability studies," which were prepared by CAISO staff in connection with the CAISO-sponsored planning processes. At that time, the CAISO itself stated, "The transmission line proposed in association with the Lake Elsinore Pumped Storage project would allow the San Diego area to import substantially more power from surrounding areas and would greatly enhance electric system reliability."[14]

Based on the evidence submitted, the FERC concluded that the proposed TE/VS Interconnect

> *will add another major transmission path into the San Diego area with a potential for increasing San Diego's import capability including relief on currently limiting Path 43 (North of San Onofre) and 44 (South of San Onofre) while maintaining adequate system reliability and, therefore, satisfy the Commission's FPA section 219 requirement. In its initial application, NHC stated that the 2003 STEP Report 'concluded that a new high voltage electrical transmission line between Riverside and San Diego Counties is critically needed to serve future load growth.' If built, the TE/VS Interconnect would be the only 500 kV transmission line connecting SCE and SDG&E's transmission systems."*[15]

The FERC concluded that the "TE/VS Interconnect project will ensure reliability, consistent with the requirements of Order No. 679"[16] and that the proposed transmission project "is not routine in nature, but will provide a critical link between two major transmission corridors in California, linking the San Diego basin to the main CAISO grid."[17]

---

[12] / *Id.*, at ¶ 26.

[13] / Federal Energy Regulatory Commission, *Order on Rate Incentives and Compliance Filing*, Docket Nos. ER06-278-000 et seq., issued March 24, 2008 ("2008 Rate Order"), at ¶ 27.

[14] / *Motion to Intervene and Comments of the California Independent System Operator Corporation in Support of Lake Elsinore Advanced Pumped Storage Project*, Docket No. P-11858-002, at 3 (Apr. 2, 2004).

[15] / 2008 Rate Order, at ¶ 26.

[16] / *Id.*, at ¶ 27.

[17] / *Id.*, at ¶ 57.

B. Conclusions of the California Energy Commission

The State of California has also developed an independent view of the potential benefits of these projects. As required by state law, (Section 25324 of the State's Public Resources Code), the CEC (along with the CPUC and the CAISO) adopted a strategic plan for the state's electric transmission grid. This plan identified and recommended actions required to implement investments needed to ensure reliability, relieve congestion, and meet future load growth.

In the Joint Committees Report prepared by the CEC concerning the "Strategic Transmission Investment Plan" for the 2007 Integrated Energy Policy Report Proceeding (06-IEP-1F), the CEC Electricity Committee found that "[b]oth the transmission and generation that comprise the LEAPS project could provide significant benefits to California". The project (both LEAPS and TE/VS Interconnect) were among the five new transmission projects recommended for the 2007 Strategic Plan.

Indeed, the TE/VS Interconnect has been designated as a critical statewide transmission resource by the CEC since its 2007 Strategic Transmission Investment Plan, CEC-700-2007-018-CMF." In that report, the CEC advised that this, and other recommended projects "are strategic resources that require specific, swift, and priority consideration by state regulators."

More recently, in its December 2013 Integrated Energy Policy Report, the CEC noted that TE/VS Interconnect is under consideration for solving the dilemma caused by the SONGS shutdown.

C. CAISO Findings

Nevada Hydro's projects have been reviewed and have been found to have value in at least three separate CAISO-sponsored planning processes over nearly a decade. It is important to note that over this long period, the CAISO's view on the value of the projects has not changed. A summary of these findings follow.

1. The Valley-Rainbow Board Approval

In 2001, CAISO staff, in a memo and presentation to the Board, recommended approval of SDG&E's Valley-Rainbow transmission project. In this material provided to the CAISO Board, staff noted the controversy surrounding the route SDG&E proposed, and suggested that SDG&E pursue the TE/VS Interconnect route (referred to as "the forest route"). This shows that CAISO staff had concluded that the TE/VS Interconnect was (and remains) electrically identical to the Valley-Rainbow project. The CAISO Board approved the project, and its approval was not tied to a specific project or a specific sponsor. In it resolution, the Board noted that "a 500 kV project such as the Valley Rainbow project, is needed". SDG&E chose not to follow-up on this suggestion to pursue other routes. As Nevada Hydro cannot find a Tariff (or other provision) that causes Board decisions to "expire", Nevada Hydro believes that this Board action effectively approved the TE/VS Interconnect as well as Valley-Rainbow.

2. The Southwest Transmission Expansion Plan

A few years after the Board's action in connection with the Valley-Rainbow project, the Southwest Transmission Expansion Plan (STEP) was established to plan, coordinate, and implement "a robust transmission system among Arizona, Nevada, Mexico, and Southern California." Nevada Hydro was asked by the CAISO to participate in the STEP process, and Nevada Hydro agreed to do so.

Under the STEP, the CAISO was the focus for transmission planning activities for California projects. The two California projects of interest to STEP were the TE/VS Interconnect and Sunrise (then known as Imperial Valley-San Diego Expansion Plan or ISEP). In 2004, the CAISO Grid Planning Department published findings in which it detailed the reliability benefits of each project and the additional benefits to be realized if the two projects were combined.

Thus, the STEP study updated and reaffirmed the CAISO Board's earlier findings on the system benefits of Valley-Rainbow. The STEP study showed both reliability and economic benefits to the region of each project (i.e., the TE/VS Interconnect and SDG&E's ISEP, as well as the additional benefits to be realized if both projects are built.

3. CAISO South Regional Transmission Plan

In 2006, the CAISO commenced the CAISO South Regional Transmission Plan ("CSRTP"). CSRTP studied the three proposed southern California projects: Sunrise, Tehachapi, and both the LEAPS pumped storage facility and the TE/VS Interconnect separately. The three sponsors (SDG&E, SCE, and Nevada Hydro, respectively) were required to participate. Other interested parties participated as well.

An August 31, 2006 memo to the CAISO Board stated: "The LEAPS Project consists of a 500 kV transmission line project . . . that would connect SCE's transmission system with that of SDG&E's (LEAPS transmission line) and is accompanied by a 500 MW pumped storage power plant built next to Lake Elsinore (LEAPS power plant) and connecting to the LEAPS transmission line." A September 19, 2006 presentation demonstrated the economic benefits of the TE/VS Interconnect both as a stand-alone project and as part of a combines set of projects including Sunrise in the base case analysis. The studies performed under CSRTP, reaffirming the STEP findings, showed that the combined value of both the TE/VS Interconnect and Sunrise is higher than for each project individually. However, CAISO Staff chose not to take the TE/VS Interconnect project to the CAISO Board for approval at that time, because staff felt that it needed FERC to decide on the treatment of the LEAPS pumped storage facility (which FERC has since provided).

VII. Project Value Today

A detailed economic cost-benefit analysis that was performed on the two Nevada Hydro projects in 2010 by the well-respected energy engineering and economics consulting firm, ZGlobal, demonstrated that as a stand-alone project, the TE/VS Interconnect would provide a net benefit to California ratepayers of more than $38 million

per year. Specifically, the analysis demonstrated an annual savings in energy production, renewable portfolio compliance and local reliability costs resulting from the development of this project – approximately $191 million annually – would be substantially greater than the project's annualized costs – approximately $153 million. These benefits fall into three categories: (1) customer benefits, which are the savings that consumers will enjoy due to the lower cost of energy production resulting from the operation of the project; (2) producer benefits, which are the difference between the price at which energy is sold and the price that it costs sellers to create it; (3) reductions in transmission congestion revenue; and (4) societal benefits, which reflects the overall net change in the total benefits of the project to energy consumers, producers and transmission owners. ZGlobal's analysis estimated the total societal benefit of the TE/VS Interconnect Project to be approximately $68 million in 2015.

It is noteworthy that these estimated benefits relate only to the TE/VS Interconnect Project. When net benefits of the LEAPS Project are added, the overall total societal benefits of the projects – nearly $117 million per year – are almost twice as great. With LEAPS on-line, the system will benefit from much greater access to key ancillary services, including spinning and non-spinning reserves, quick start and fast ramping capabilities, improved integration of renewables, decreased potential of wind curtailments and substitution away from thermal generation during peak hours, thereby decreasing the emissions from gas-fired power plants in Southern California during the hours when those emissions are most likely to contribute to exceedances of health-based air quality standards.

Finally, it should be mentioned that ZGlobal is currently updating is cost/benefit analysis to reflect the shutdown of SONGS. Initial indications are that under the SONGS shutdown scenario, the net benefits of the Nevada Hydro projects will be substantially greater than they were shown to be in the ZGlobal analysis of several years ago. Depending on the metric applied, benefit-cost ratios from the construction of the TE/VS Interconnect alone are between 2.0 and 2.7.

VIII. The Advantages of Storage

LEAPS provides the State with a variety of cost-effective enhancements, including increased reliability and more efficient use of grid resources. Grid benefits include the full range of ancillary services, shifting on-peak to off-peak hours, providing 500 MW of generation near the load pocket and the storage of energy produced during off-peak hours for use during peak-demand hours. Most importantly, LEAPS will dramatically enhance the ability of the grid to effectively integrate, and make much better overall use of, a large amount of the variable energy production in Southern California. This can include off-peak power generated by efficient, baseload generation sources, (including geothermal generation located in the Imperial Valley) wind-generation located in the Tehachapi region, solar thermal generation in the Mojave area as well as other existing and planned renewable resources located throughout and beyond Southern California.

In terms of ancillary services, LEAPS provides 500 MW of regulation and fast responding spin to support grid operations the integration of intermittent renewable resources, and provides highly responsive load following capability. This, combined with the ability to provide voltage support, will help the grid manager effectively and efficiently operate an increasingly complex grid in the Southern California electrical region.

Because LEAPS can store off-peak power, including wind, solar and geothermal energy, the facility's operation will further the objectives of California's Renewable Portfolio Standards (RPS) and greenhouse gas (GHG) emission-reduction standards. LEAPS can also eliminate the need to construct new fossil fuel-burning power plants. Moreover, the Project's dispatchable pumping load will enable the most efficient and renewable generation sources on the Southern California grid to operate more hours each day. The efficient baseload energy generated during non-peak hours that LEAPS will absorb and store for later use can then be used to displace the operation during peak periods of those generation plants that are the least efficient and most costly to operate.

Finally, advanced pumped storage facilities like LEAPS are able to respond rapidly to continuously changing conditions and, thereby, enhance the maintenance of system-wide reliability. Pumped storage generation provides unique strategic, operational, and economic benefits, resulting in reduced operating risks, increased total efficiency, increased critical system control and reliability, and providing more value to the ratepayers. Pumped storage is widely accepted as a mature technology with proven reliability and effectiveness. It is currently the only proven technology available for storage of large quantities of energy and is the most efficient form of energy storage available.

IX. The CAISO's Plans for Addressing the loss of SONGS is Uncertain and Expensive

The CAISO has described its thoughts on actions needed to address the loss of SONGS.

In a July 2013 presentation by CAISO for a meeting held by the CPUC and CEC[18], a number of possible transmission alternatives were presented to address the reliability needs of the southern California electric system due to the retirement of the SONGS. These alternatives also addressed the present understanding of the needed response to the requirement of the "once-through-cooling" mitigation and future load growth in the San Diego and Los Angeles basin areas. These alternatives can be summarized as follows:

1. The TE/VS Interconnect perhaps including LEAPS.
2. Addition of new generation:

	2018	**2022**
L.A. Basin		3,800 MW
SDG&E	1,120 MW	785-920 MW

[18] CEC/CPUC Joint Workshop Electricity Infrastructure Issues Resulting from SONGS Closure, ISO 2013 Transmission Plan Nuclear Generation Backup Plan Studies (SONGS), July 15, 2013 PowerPoint Presentation.

3. New Transmission Projects:
    - Alberhill – Suncrest (Central) 500 kV
    - Valley–Alberhill–Viejo–new Cougar 500 kV
    - Imperial Valley – Songs HVDC Line
    - Sycamore – Penasquitos 230 kV line
    - Alamitos (or SONGS) – South Bay area HVDC Submarine Cable

While there is no one solution that will be able to resolve the extensive needs identified by the CAISO, the selection of proposals to provide the required solution must consider both timeliness and cost. The timeliness issues will be driven by the ability to get the necessary sites, rights-of-way, air quality studies, permits of various types and construction duration. Cost effectiveness will require the evaluation of the generation types and fuel costs that can be sited and installed versus delivery of resources located outside the area via the transmission system.

Since the TE/VS Interconnect has most of its permitting activities already completed and is seeking its final CEQA and CPCN approval from the Commission, it can be constructed and operating by late 2015 or early 2016. For its base configuration, this would provide 1,100 MW of increased import capability under normal conditions and 1,800 MW under contingency situations. If a cooperative effort were undertaken by SCE and SDG&E to use a portion of the Talega – Escondido 230 kV line path at 500 kV (and Nevada Hydro understands the corridor is already permitted for 500 kV), the full capability of the 500 kV line from Alberhill to Case Springs (2,600 to 3,400 MW) could be available to meet the needs of both the utilities.

The other theoretical (at best) proposals presented by the CAISO as “solutions” appear to Nevada Hydro to be largely speculative. Moreover, they appear be much more costly than the proposed TE/VS Interconnect, which has its detailed engineering and costing complete. Notwithstanding this, the CAISO was not, and could not be, specific as to how it proposes to fill these gaps within the timeframe in which the SONGS replacement resources will be needed. Given that another Southern California area blackout could be the consequence of delay, that planning process must be fully transparent and public process.

As mentioned, the resolution of the SONGS problem must also be carried out while existing gas-fired generators along the coastline are to be revamped to meet once-through cooling (OTC) regulation requirements imposed by the State Water Resources Control Board. This will, in some cases, involve shutting down existing power plants in the area in order to remove them and build replacements. Additionally, there is no promise or absolute determination that the total of generation from any of these plants, whether new or re-powered, will add up to the total that existed prior to the beginning of the SONGS shutdown.

Another issue that has not been addressed in the CAISO’s presentations, but should be, involves the ratings for Path 43 and Path 44. In Nevada Hydro’s view, in the absence of SONGS, the present ratings for these paths are of no value. Both Path 43 and 44 have ratings that are largely dependent on the presence of SONGS operating at full output. With SONGS being a strongpoint in the transmission system, because large amounts of power from it could flow

either north on Path 43 or south on Path 44, these import channels were quite important and useful. However, with SONGS not operating, the performance of these paths is quite different and much weaker. A recalibration of the measurements of the capability for importing power that uses these path ratings is required, and that recalibration must reflect current realities. A correct understanding of the actual transfer capabilities between the two utilities, which will result from a proper recalibration of import capabilities, will further underscore the uncertainty of the tentative plan that the CAISO is looking at in order to replace the capacity and energy that was, in the past, provided by SONGS. Furthermore, such a recalibration will underscore the value that LEAPS and the TE/VS Interconnect will bring to the system.

X. The Nevada Hydro Projects Are the ONLY Real Solution to the SONGS Crisis

LEAPS is a key project that will help alleviate the resource constraints that are posed by the loss of SONGS in a more effective, more timely and less costly way than the other proposed resources that were suggested in the CAISO's draft plan.

State officials looking for a solution to the SONGS dilemma should know that LEAPS and TE/VS Interconnect projects will provide numerous system benefits including:

- 500 MW of highly flexible and fast-ramping generation;
- A dramatic increase in the ability of the Southern California grid to absorb and integrate variable renewable generation, especially the absorption of off-peak resources and surplus wind energy that would otherwise have to be curtailed as the LEAPS project also provides 600 MW of load for off-peak renewable wind generation;
- 500 MW of carbon-free on-peak electrons;
- High quality MVARs at a cost that would be roughly half that of static VAR compensators;
- Local capacity in that portion of the SCE load pocket that would be most highly impacted by the loss of SONGS;
- Potential congestion relief on Path 26
  - That would not trigger the limitations of the SCIT nomogram; and
  - At a cost that would be significantly less than the Delany-Colorado River line that the CAISO proposed to approve as part of the current transmission plan;
- A new 500 kV line connecting the SCE and SDG&E service territories that the CAISO has long recognized as being needed; and,
- A dramatic enhancement in overall system reliability in southern California.

LEAPS and the TE/VS interconnect will provide major reliability improvements at both its north and south connection points. However, the far more important value-added of LEAPS is its electrical proximity to the existing SONGS substation. Talega is only a few miles north of SONGS. Thus, in terms of real power (megawatts) and reactive power (megavars), LEAPS and the TE/VS Interconnect are THE replacement for SONGS.

Moreover, as discussed above, advanced pumped storage is, and as more and more variable renewable resources are interconnected, will increasingly be, a valuable system asset. There is no such capability in Southern California. Fast starting, quick reversal between pumping and generating, and very high ramp rate capability provides grid operators with a tool for system control like none other. The location of LEAPS in the grid is also a significant advantage when coupled with the TE/VS transmission. Moreover, the project's phase shifters will provide discrete flow control.

One of the major problems with the disappearance of SONGS is the lack of voltage support in a critical area of the LA Basin. The increased flows on the 230 kV system from north to south, running at a high percentage of the area's line ratings during high load periods, causes significant increases in reactive power loss. The TE/VS Interconnect, at 500 kV, has much lower reactive power loss for the same flow rate than do the equivalent 230 kV line(s). In addition, LEAPS provides reactive support along the way.

There is no existing high voltage connection between the SCE and SDG&E systems. The September 2011 blackout clearly shows a need for power transfers under major contingencies that cannot be managed by the existing 230 kV lines. 500 kV interconnections are needed to handle problems caused by 500 kV contingencies. The size of both the SCE and SDG&E systems has grown to such a point that 230 kV lines are no longer adequate for the task of inter-utility flow management. The limit of flow management efforts or capability at 230 kV has now been exceeded. This situation has become even more tenuous with the need to push the supply locations back from the coastal areas, where the existing generation is likely to be significantly reduced because of once through cooling regulation limits.

As Nevada Hydro has stressed in a variety of venues, with or without SONGS operating, these projects can bring 1,100 MW of reliability to San Diego under normal operating conditions and can transfer 1,800 MW during emergencies. In addition, the projects can:

- Provide a reliability substitute for most of the SONGS facility (1,800 MW); and
- Prevent system collapse during usual NERC and CAISO testing requirements.

In addition to these benefits, the CAISO should note that LEAPS, like all advanced pumped storage facilities:

- Is dispatchable in 15 seconds (with units spinning);
- Provides black start in 10 minutes;
- Provides full range of ancillary services; and
- Provides regulation, load following and voltage support.

Finally, Nevada Hydro will construct LEAPS and its associated transmission for roughly $1.5 billion, whereas as the CAISO has noted, the alternatives that it has described would cost at least twice as much to construct and face unknown approval paths. Further, LEAPS can be operating by 2018 or 19.

XI. Conclusion

Given the State's exacting clean energy policies, there is an unquestionable need for the electric power system in California to move toward an environmentally sustainable future, while still maintaining highly reliable and efficient service at the least possible cost. Given this policy imperative, as well as the demonstrated history that the LEAPS and TE/VS Interconnect projects are needed and valuable assets to meet Southern California's mid- and long-term power system needs, there can be no doubt in the mind of anyone who is serious about meeting the State's policies that the LEAPS and TE/VS Interconnect projects are the very best projects that could be developed in that region in order to meet the challenges of:

(1) the ever-increasing need for highly flexible resources;

(2) the ever-expanding reliance in the region on variable renewable resources;

(3) the evident and hidden limitations on power flows into the region;

(4) the long-term imperative for California to move away from carbon-based energy resources; and

(5) the permanent shutdown of SONGS.

Despite the roadblocks they have faced to date on the road to being approved, these projects have a demonstrated history being accepted by regulatory and system-planning authorities that they are needed assets for the region. Moreover, these projects are a near perfect fit with the overall mid-term and long-term needs of the system in Southern California. As a result, regulators should embrace these projects and do everything within their power to help smooth their path forward. Not to do so would be a shame, both for the reliability and the flexibility of the grid of the future and for the ratepayers who depend on their leaders to plan for and oversee the implementation of an electric power system that is the cleanest, most reliable and most cost-effective system achievable.

For additional Information or to discuss, please contact:
David Kates at
DKates@sonic.net

Attachment 2

Nevada Hydro Whitepaper 2 –
Moving to a 500 kV Grid.

Future Transmission Needs in Southern California

Thoughts on the CAISO's Draft 2013–2014 Transmission Plan

The Nevada Hydro Company
February, 2014

This is the second in a series of Whitepapers providing the views of The Nevada Hydro Company and its experts on issues relating to the state of the high voltage grid in Southern California.

I. "The Perfect Storm"

Long-term system planning requires persistent diligence to the many details to keep the electric power system of Southern California operating reliably and cost-effectively. However, even with the best intentions, there are times when well-developed plans do not produce the needed results. Usually this is due to reasons beyond the planner's control. Just such a situation began to unfold in 2008 and continues today.

The first event that marked this gradually developing problem was the decision by the Arizona Corporation Commission to deny Southern California Edison ("SCE") permission to build the second Palo Verde-Devers 500 kV transmission Line. This reduced the ability of the system to move power from Arizona to Southern California by over a thousand megawatts. A secondary outcome of this action was the likely denial of adding a second 500 kV line from North Gila to Imperial Valley.

The next event to affect the system's development was the decision that disallowed the 500 kV Sunrise Powerlink to follow a route that would widely separate it from the Southwest Power Link as it leaves the Imperial Valley Substation. While the need for both lines to traverse west from Imperial Valley into San Diego's load area was desirable, the close location of the two lines' right-of-way for their first 33 miles increases the likelihood of both lines being out of service at the same time.

The next factor in causing reduced reliability in the area was the decision of the California Water Resource Control Board to require mitigation of once-through-cooling water flows for generation on the Pacific Ocean coast. This mitigation is essentially impossible, so by approximately 2020, several currently operating generating stations will have been retired. There will be some replacement generation built for these plants, but, for the most part, the net reduction in generation will be in the order of five thousand megawatts. Most of this soon-to-disappear power supply will be along the western edge of the Los Angeles Basin. Thus, for the L.A. Basin, a major increase in power needed to serve the area will have to come from the east. In addition, with the shutdown of Encina Station in San Diego and at best only partial replacement coming from the new Carlsbad Energy Center, San Diego Gas & Electric ("SDG&E") will have its generation within the San Diego load area reduced by about twenty percent. This will also require more power from the east.

Then came the retirement of the San Onofre Nuclear Generation Station ("SONGS"). The SONGS units had served as a linchpin of support and low-cost electricity for decades. Now they are gone. This has reduced the strong system reliability support the units previously provided. Having served somewhat like a clothesline pole keeping the laundry from dragging on the ground, now there is a point of difficulty where once there was stalwart support.

Overall, this collection of events has left the southern California area well below the level of reliability required by NERC and WECC. While the load in SDG&E and SCE continues to grow, the level of generation has already declined, and will decline even further in the next half decade.

II. What to do to meet the need

No longer can the region's utilities lean with easy dependence on a few assets. Building replacement generation on the western edge of the area is virtually impossible besides being expensive to build and operate. In addition, most of the utility-level renewable power supplies are located well to the east of the area. Testing what new transmission may do to bring system reliability back to compliance shows that continued expansion of the area's 230 kV transmission is not up to the task. Testing of the reactive power losses that result from major contingencies show that the reactive power losses on the 230 kV lines far exceed the normal reactive power these lines naturally produce. The California ISO has hinted at this situation in the Forward of its draft 2013-2014 Transmission Plan.

> *The 2013-2014 Transmission Plan has a number of unique challenges due to the issues being addressed in this year's plan that are requiring some additional flexibility in the presentation of this year's draft transmission plan:*
>
> *1. Unprecedented levels of uncertainty about the development of non-transmission resources*
>
> *2. Transmission solutions that are pushing the boundaries of optimizing existing assets and require extensive implementation coordination with neighboring systems.*
>
> *3. Tackling new issues in hardening the system for extreme events in response to growing concerns over wider ranges of risks the transmission system may be exposed to.*[1]

CAISO's second point is especially important with regard to the need for new thinking on a broader scale than has been evident in recent years. While CAISO recommends in this plan a limited number of what are called "Group I" projects, all of these projects are admitted to not be able to bring the system into reliability compliance in the next five to seven years.[2] Nor are

[1]/ CAISO, "Draft 2013-2014 Transmission Plan", February 3, 2014

[2]/ CAISO Draft Transmission Plan 2013-2014, p. 104, "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

they particularly timely or inexpensive. The ISO estimates that two of the three recommendations are to enter service in 2018 and the third in 2020. The CAISO has estimated the total cost for these projects to be between $870 million to $1.08 billion. And its proposals for the "Group II" and Group III" projects with the exception of Nevada Hydro's Talega–Escondido/Valley–Serrano 500 kV Interconnect Project are vague and couched in terms of long-term fruition. The problem is that the area needs solutions to its reliability problems now, and denials, no matter how fervent or well-articulated, is not a good engineering or political solution.

III. System Blackout of September 8, 2011

The system blackout of September 8, 2011 was an important wakeup call to WECC, CAISO area utilities and those they serve. In its report, "FERC/NERC Staff Report on the September 8, 2011 Blackout", the staff of these national regulatory bodies conducted an intensive review of the operating and planning practices of the responsible bodies in southern California and WECC. The report draws parallels between the August 2003 blackout in the northeastern U.S. and this event. The report states,

> *"Similarly, this inquiry's report found that several entities' operational and long-term studies did not adequately ensure the reliable operation of their systems. Specifically, both reports described relevant planning studies that: (1) did not adequately identify and study critical external facilities; (2) did not adequately analyze potential contingency scenarios; and (3) were based on inaccurate models and invalid system operating limits (SOLs)."*[3]

An important finding highlighted by this report was that the system fell victim to a single (N-1) loss of a 500 kV facility, the 500 kV line between Hassayampa and North Gila. The line's loss was not the entire story, but in the process, it exposed a multi-layered set of other issues that had not been properly addressed. That event should have been handled with no loss of customer load is obvious, but that event uncovered a long string of poorly managed incipient problems resulting in a system collapse.

An important consideration is the balance between the responsibilities of the planners and those of the operators. It is possible to design a system that with perfect operation could survive the vagaries of chance events. However, that places a huge burden on the operators of such a system. Make any mistake and it will appear on the headlines of tomorrow's newspaper. Conversely, one could plan and install a system, at possibly huge expense, that could survive almost any operator's competence. Some balance must be struck.

One of the interesting considerations in the northeast blackout of 2003 was where the breakpoints between areas with and without service occurred. The system broke down at 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."

[3]/ "FERC/NERC Staff Report on the September 8, 2011 Blackout", P. 125

transition points from the AEP 765 kV system and the underlying 345 kV system. Although this is not exactly true in the case of the 2011 southern California blackout, it has become evident through power flow studies that the same issue of transmission voltage level applies to California as well. The 230 kV transmission system, while an extensive and robust system for real power flow, has serious limitations in its ability to maintain voltage under adverse conditions. Thus, CAISO has recommended the addition of large blocks of capacitive reactance (capacitors) in order to support voltage under high reactive power (Var) consumption situations, or flow controls which are expensive at best and hazardous otherwise. This is part of its efforts to manage performance with existing system elements rather than take steps to move beyond "managing the status quo". CAISO has hinted at its concern about this form of system control, but has not stepped up to an updated view. The FERC/NERC study hints at the need to move toward a new look at how to deliver power from source to consumer.

IV. The Future Scene in Power Delivery

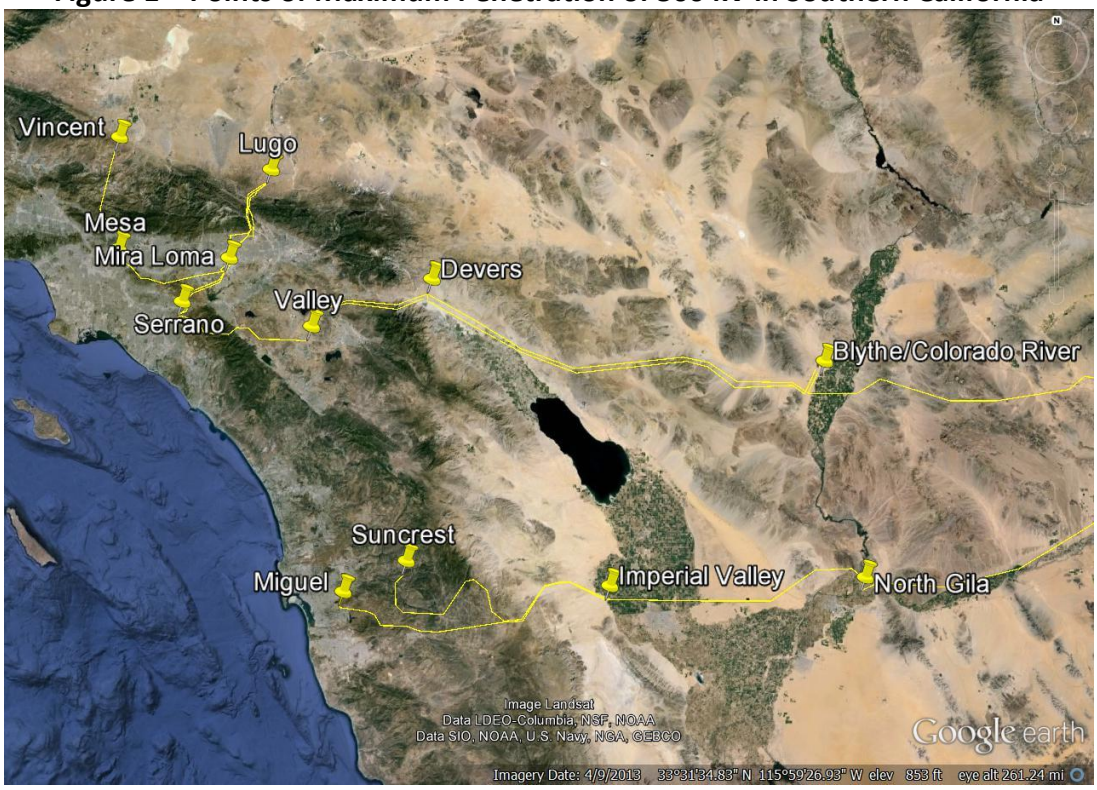
The actions of SCE in retiring SONGS and the State's Water Board on once-through-cooling mitigation will push large amounts of power production away from the coast over the next five to eight years. This will move the resources to provide for Southern California back from the Pacific coast and make their delivery more dependent on adequate and more flexible transmission. The primary issue will be the need for more 500 kV transmission further into the region coming from the areas where new renewable and gas-fired generation will be built. CAISO has identified these transmission needs in their draft 2013–2014 Transmission Plan ("Draft Plan"), but has come away with no firm plans on how to meet the needs found. For example, many of the mitigation plans in Appendix C of the Draft Plan describe a "Post-SONGS Transmission Strengthen Plan TBD", which leaves the solution unknown or hopeful at best. Further, there are missed system performance changes coming as part of the SONGS retirement that the planners have not grasped. As an example of this missed limitation is the inclusion of the ratings of WECC Paths 43 and 44 near SONGS at their levels before the retirement of SONGS as shown in Table 2.3-5. This is an example of the complexity of planning in this area, with the prospect of missed understandings of limits, which could lead to the kind of disaster noted in the FERC/NERC report.

Shown on Figure 1 – Points of Maximum Penetration of 500 kV in Southern California are the present points of maximum penetration of 500 kV delivery into the L.A. Basin and San Diego extracted from Google Earth. The yellow pushpins represent the 500 kV substations and 500 kV lines are shown in yellow.

As Figure 1 shows, there are no 500 kV substations or lines between Valley and Serrano on the north, and Miguel and Suncrest to the south. Approximately 25,000 MW of heavy summer load lies between Serrano and Valley in the north and Suncrest and Miguel on the south. The direct distance between Valley and Suncrest is 70 miles.

There is no 500 kV path between the northern and southern 500 kV substations except via the path that extends back to Palo Verde in Arizona. The proposed Mesa Substation loop-in is shown, even though it is not to be in service until 2020.

Figure 1 – Points of Maximum Penetration of 500 kV in Southern California



Source: The Nevada Hydro Company

With the absence of the real and reactive power supply from SONGS, there is now a gap in transmission service that had been supplied by a combination of 230 kV transmission and generation located along the Pacific Coast. While the load continues to grow, the ability to supply power to that load has decreased and will decrease even more over the remainder of this decade as a result of once-through-cooling-driven retirements. Some replacement central station generation will be added and distributed generation and load management actions will increase, but will not match that which is going away. A review of the WECC power flow system summary for SCE shows system reactive power losses (MVAR) compared to the line charging, even under normal, no contingency conditions, and shows how much reactive power losses impacts the ability to manage voltage. Moreover, there is some question about whether the SCE system load at 66 kV does in fact have a positive power factor on peak as modeled in the CAISO's future load flow cases. Noting that reactive power losses increase with the square of the current flow, and that the ratio of reactive impedance to resistive impedance is about eight to one, contingency conditions consume very large amounts of reactive power. The reactive power losses versus charging on 230 kV lines compared to 500 kV lines is much higher.

The need for new 500 kV transmission into the L.A. Basin and San Diego has now reached a critical point. The system cannot meet its reliability requirements now, as it has not since SONGS shut down. Only the absence of a critical outage has permitted the lights to stay on. But that is not satisfactory planning. While CAISO, SCE and SDG&E have been avoiding speaking about this dilemma in public, for a range of economic, public safety and prospective

embarrassment issues, they have proposed a collection of solutions that do not meet their own reliability standards. They are seeking further plans that meet their own internal vision while seemingly holding the areas they serve unaware of the potential of another system failure.

V. Prospective Solutions from Inside and Outside the Utility Bubble

The ability to bring the southern California area electric utility system back into its required reliability standards will be a multi-step process. There have been a number of unsuccessful attempts to provide the 500 kV system integration needed. One was the Valley-Rainbow Project proposed approximately 15 years ago. A second was the Green Path North Project, and there have been other ideas that have not gained access to discussion by the wider utility community. But, the fact that these two projects were considered, reflect the growing awareness that closer integration of the system at 500 kV was needed. The situation is even more urgent now.

There is a need to move as quickly as reasonably possible on those projects that can be set in place first. What follows moves from the most quickly implementable to the more "Blue sky" following the assumption that all of CAISO's Group I projects are in place.

A. Talega-Escondido/Valley-Serrano Interconnect Project

1. Base Project

The first step of the Talega-Escondido/Valley Serrano (TE/VS Interconnect) Project is a 500 kV line proposed between SCE's proposed Alberhill Substation (or near its location if the proposal is not approved) and a point on the existing 230 kV Talega-Escondido line in SDG&E's territory above Camp Pendleton. The southern end of this part of the Project is at the proposed Case Springs Substation. This is about 32 miles, and passes the site of the proposed 500 MW Lake Elsinore Advanced Pumped Storage Project.

At the case Springs Substation, there are three steps:

1. Install three strings of 500/230 kV transformers and phase shifting transformers.
2. Reconductor the existing 230 kV line from Talega to Escondido for double-bundled service.
3. Add a second 230 kV double-bundled circuit on the same existing towers between Talega, Case Springs and Escondido

This is the well-studied base TE/VS Interconnect configuration. Under this option, in-service is early summer 2016.

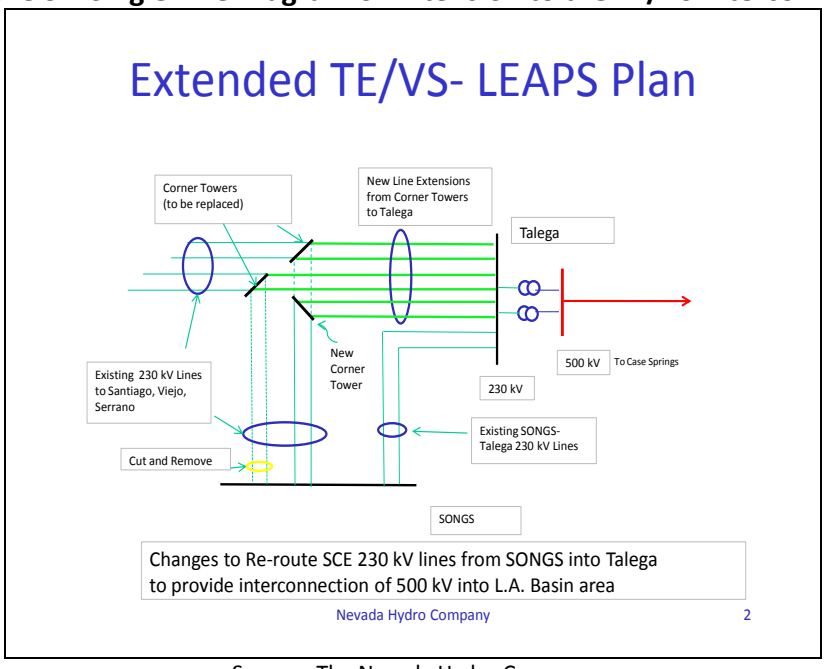
2. Extensions to the TE/VS Interconnect

The corridor between Talega and Escondido has long been permitted for use at 500 kV. This alternative involves the development of the corridor for that voltage. SCE and/or SDG&E will likely undertake this project. Case Springs Substation on the TE/VS Interconnect would become essentially a tee-point. This alternative involves four suggested incremental phases shown in Figures 2 and 3:

Figure 2 – Talega Substation Alternative

Source: The Nevada Hydro Company

Figure 3 – Single Line Diagram of Extension to the TE/VS Interconnect



Source: The Nevada Hydro Company

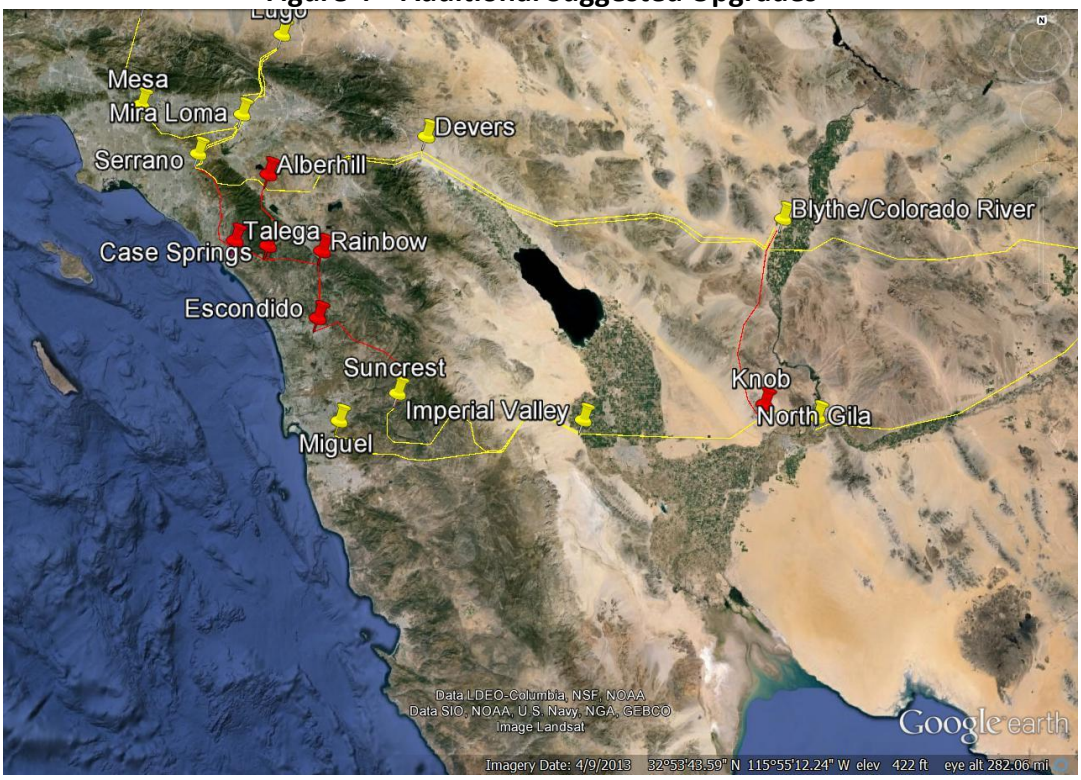
1. Extend a 500 kV line from Case Springs to Talega Substation.
2. Install two 500/230 kV transformers in a new area to the west of the existing Talega Substation. Figure 2 – Talega Substation Alternative shows a Google Earth view of the area with this reconfiguration shown.

3. Loop in SCE's four 230 kV lines from SONGS to Viejo, Serrano, and Santiago (2 circuits). Figure 3 – Single Line Diagram of Extension to the TE/VS Interconnect shows this revision.
4. Extend a 500 kV line from Case Springs to Escondido. Install two 500/230 kV transformers. Additional study will be required to determine the size of the transformers and whether phase shifters may be required.

B. Additional Upgrades that should be considered

Beyond the TE/VS Interconnect with its various options, Nevada Hydro has other suggestions. Figure 4 – Additional Suggested Upgrades shows these suggested additional upgrades.

Figure 4 – Additional Suggested Upgrades



Source: The Nevada Hydro Company

1. Inclusion of a 500 kV substation at SDG&E's proposed Rainbow Site

An expansion to the 500 kV build–out of the TE/VS Interconnect would be to add a 500/230 kV stepdown at Rainbow. This would also provide a prospective interconnection point for gas-fired combined cycle generation in that vicinity.

2. Construct a 500 kV line from Escondido to Suncrest

This line would complete the connection at 500 kV from the Valley area to the Imperial Valley area. Consequently, any N-1-1 contingency event would still keep at least one 500 kV supply into the San Diego load area.

3. Rebuild the 230 kV line from Serrano to Talega for 500 kV

The present 230 kV from Serrano to Talega was originally considered as an alternative to the Valley-Rainbow Project for rebuilding at 500 kV. However, by integrating such a rebuild with the option of having 500 kV at Talega as part of the TE/VS Interconnect, a second 500 kV circuit would exist into Talega. This would provide 500 kV service into the interface between SCE and SDG&E at Talega under any N-1 contingency and more robust supply to the San Diego and L.A. Basin in general. If this addition happens after completion of the suggested Escondido-Suncrest 500 kV line, there will be at least one 500 kV line into Case Springs for any N-1-1 contingency and one 500 kV substation supplying power into the two basins.

4. Convert the 161 kV line from Blythe to Knob to 500 kV

While the Alberhill-Case Springs-Escondido-Suncrest series of lines would close the gap between the 500 kV system in the Devers-Valley-Serrano area on the north, and the Miguel, Suncrest, Imperial Valley area on the south, the loss of one of those interconnecting segments would cause a large angular difference between them. It also puts the need for any loop flow on the 500 kV system to have to go back to Palo Verde-Hassayampa. This has high losses effects besides the problem of reclosing across a large angular difference. The problems of renewable and other resource flows would be reduced by rebuilding the Western Area Power Administration's 161 kV line between Blythe and Knob on the west side of the Colorado River for 500 kV service. In 1998, NRG Energy approached WAPA about making such a conversion. WAPA was agreeable at that time with the conditions that its load responsibilities along that right-of-way be met.

VI. Conclusion

The above outlined projects provide considerable reinforcement to the transmission system into the L.A. Basin and San Diego. They are likely to be enough to meet the delivery needs well into the next decade. This will offer the utilities and CAISO enough breathing space to develop plans that have yet to be uncovered, but are likely to exist if there is enough time to think through the options before the next crisis strikes.

For additional Information or to discuss, please contact:

David Kates at
DKates@sonic.net

Making the Most
of the
Lake Elsinore Advanced Pumped Storage (LEAPS) Project

The Nevada Hydro Company

June 2015

This is the third in a series of Whitepapers providing the views of The Nevada Hydro Company and its experts on issues relating to the state of the high voltage grid in Southern California.

The **Lake Elsinore Advanced Pumped Storage** (LEAPS) project was visionary when conceived roughly 20 years ago. The perfect geography adjacent to Lake Elsinore makes for a world class energy storage project. Further, the location at the juncture of high voltage transmission lines from east to west and out of the San Onofre Nuclear Generating Station (SONGS) into southern California makes it ideal for distributing energy throughout Southern California. With the demise of SONGS, LEAPS is even more important today.

I. Background

Since its conception, the design of LEAPS has remained largely unchanged while much has changed in the world in which the project sits. For example:

- California is now implementing compliance with a 33% Renewable Portfolio Standard by 2020 for its investor owned utilities, publicly owned utilities, and other retail sellers of electricity that will shift a large portion of future generation (largely solar and wind resources) to the east. Previously, most of the area's electricity had been produced along the Pacific coast.
- In 2008, the California State Water Resources Control Board implemented a regulation that has required electric generating stations using ocean water for their cooling requirements to either remediate the impacts of such use or to cease operations by the end of 2017. As much of the present generation for southern California is coastal, this will result in a major loss of existing generation in southern California, causing

large changes in the flow of energy in the region. Where energy flows had largely been west to east, it is now shifting to become east to west.[1]

- The high voltage electric grid in the area where LEAPS connects has been radically changed by the retirement of the SONGS facility. This retirement has caused two major issues:
  - The reliability of the transmission system to import power into San Diego load has been significantly diminished; and,
  - The ability of the system to maintain voltage has been significantly reduced because the power to serve load must be delivered from further away.

II. Southern California Reliability Problems

As a result of the above changes, southern California is facing significant reliability problems. The California Independent System Operator (CAISO), responsible for developing and operating the high voltage grid, has published three plans over the last few years in which it has addressed this reliability issue:

- The 2012-13 Transmission Plan lists the reliability shortfalls stemming from the shutdown of SONGS, before any remediation steps have been implemented.
- The 2013-14 Transmission Plan included some remediation plans, but did not provide definitive plans that would bring the area into reliability compliance.
- The Draft 2014-15 Transmission Plan has continued to move the system toward compliance[2] by including a remediation package known as the "South of SONGS Safety Net". The plan relies on "load shedding",[3] designed to maintain operation of the overall system at the expense of selected areas which would have their power switched off. The plan also proposed the installation of a specialized power flow controlling transformer in Imperial Valley designed to moderate line flows through the electric system in Mexico. Together, this "Safety Net" will provide reliable operation

---

[1] / For further information, the California Energy Commission is tracking this continuing process addressing coastal power plants using "once–through–cooling". See, for example, http://www.energy.ca.gov/renewables/tracking_progress/documents/once_through_cooling.pdf.

[2] / System reliability standards are imposed on operators like the CAISO by the North American Electric Reliability Corporation (NERC) and by the Western Electricity Coordinating Council (WECC).

[3] / As it sounds, "load shedding" is intended to keep the electric system stable and running during emergencies by cutting off power to consumers in selected areas, thereby reducing demand on the system.

within southern California area until the Encina power plant[4] is retired at the end of 2017, not even 2 years off.

III. How LEAPS and its interconnecting 500 kV transmission line[5] fit in

The original plans for LEAPS, dating from 2008, include two connection points. First, a connection to the SCE system to the north of the facility. The southern terminus, which is the interface with the San Diego Gas & Electric (SDG&E) system at a point to be called Case Springs, is located on the existing Talega-Escondido 230 kV line right-of-way roughly 14 miles from the Talega substation, just up the hill from SONGS. Thus, as originally proposed, LEAPS connects to SCE's system at 500 kV and to SDG&E's system at only 230 kV to match the voltage of the existing Talega-Escondido line.

Because the original proposed connection with SDG&E at Case Springs was to be at 230 kV, the LEAPS 500 kV connection to the south terminated in a substation consisting of a set of three transformer trains[6] to move power from the 500 kV line coming from LEAPS to the lower voltage, 230 kV SDG&E system. Studies SDG&E conducted for this connection found that the present single circuit 230 kV line from Talega to Escondido would be inadequate for the potential power flows that would result from the connection with LEAPS. So, SDG&E included a requirement for the connection that the 51 miles of 230 kV line between Talega and Escondido be reconstructed for two circuits, each with two conductors per phase to better accommodate LEAPS.

It turns out that this design, although created decades ago, allows the grid to remain in compliance with the NERC/WECC reliability criteria both before and after SONGS was retired, but only while Encina is still in service. With both SONGS and Encina retired, this original configuration for the southern connection (along with the CAISO approved phase shifting transformer at Imperial Valley) is only just barely able to provide reliability to the system. The CAISO's proposed South of SONGS Safety Net could still be a potentially useful tool to meet unplanned problems, as southern California found out in the blackout of September 2011. But

---

[4] / The Encina Power Station is an old, large natural gas fueled power plant located on the coast at Carlsbad, California. The facility is owned by NRG Energy and produces nearly 1,000 MW.

[5] / Note that LEAPS could connect to just the SCE system, just the SDG&E system or to both systems. LEAPS has valid agreements with each utility allowing for these connection combinations. LEAPS could also connect to the grid through a proposed high voltage (500 kV) transmission line that mirrors the routes of each individual connection for LEAPS, but which would also directly tie the SCE and SDG&E systems for the first time at this voltage level. This transmission line would need to be separately approved by regulators.

[6] / Each transformer set included a "step–down" transformer to convert the voltage coming from LEAPS to the lower 230 kV of the Talega–Escondido corridor. Each set was to also include a phase-shifting transformer that could control the power flow across the connection. This specialized transformer can change the effective phase displacement between the input voltage and the output voltage, thus controlling the amount of active power that can flow in the line.

of course this plan requires that areas be disconnected (blacked out) from the grid to keep the remaining grid functioning. This is obviously not an optimal solution for the California economy or for individuals who could have their power shut off.

As demand in Southern California continues to grow and the once-through cooling generation retirements take effect, the need for either additional transmission into or local generation within the L.A. Basin and San Diego load pocket increases. In its 2013-14 Transmission Plan, CAISO described a number of large transmission projects as potentially helping to alleviate the reliability concerns.

However, in its plan for the following year (2014-15), the CAISO dropped most of the proposed transmission projects it had identified, explaining that it is expecting generation additions approved by the Public Utilities Commission (PUC), in combination with the few small transmission projects it approved in the previous plan, will meet all reliability needs for the area. As CAISO noted however, there is no assurance as to whether it will be possible to complete the generation additions the PUC authorized. Potential obstacles to such completion include obtaining required permits and approvals. Significantly, (i) a head–to–head comparison of the financial and environmental cost of reliability fixes through additions of transmission or generation resources has not been done and, (ii) the CAISO continues to consider the use of the Talega-Escondido right-of-way as part of LEAPS and as a 230 kV corridor, as shown in its diagram of the Project in the draft 2014-15 Transmission Plan.

The CAISO has also initiated a process to deliver up to an additional 1,500 MW of renewable energy from the Imperial Valley area to the L.A. Basin and San Diego over and above what is already flowing. This appears to be in conflict with the conclusion that the PUC–approved generation will fill the reliability requirement, even if it is important to be able achieve maximum renewable generation delivery. The conflict over how to manage the use of renewables, conventional generation and preferred resources appears to be a work in progress.

Since shortly after SONGS was shut down but before its retirement was announced, the LEAPS project developer has been suggesting[7] that the Talega-Escondido corridor should be upgraded to 500 kV, rather than kept at its existing 230 kV level. Recognizing that the LEAPS developer only has the power to <u>suggest</u> how the system beyond the LEAPS interconnection points might be developed, the following includes these suggestions in high level form, with a technical addendum to support these ideas attached.

---

[7] / See, "Summary of Future Transmission Needs in Southern California", a whitepaper prepared by The Nevada Hydro Company, June 27, 2014.

IV. What can be done?

If one were to consider the 500 kV line extending from LEAPS to the SDG&E system as a giant extension cord with the plug at the southern end (Case Springs) to be designed to integrate with whatever transmission SDG&E and the CAISO may plan for the Talega-Escondido corridor, what might be done with this cord that would improve system reliability at low cost and in a short time?

The following presents some suggestions:

A. Talega-Escondido Corridor Upgrade

Upgrade the Talega-Escondido corridor to a 500 kV 4,000 amperes line, with the Talega and Escondido substations upgraded to 500/230 kV step-down points with each having at least two 1120 MVA transformers. This single simple change will more than mitigate the reliability issues in the San Diego area. This change will also provide a major building block for transmission additions in the SCE L.A. Basin.

The cost to implement this plan is minimal: The incremental cost to SDG&E for moving elements of the planned changes is relatively low. Case Springs substation would now be a three terminal 500 kV substation without transformers, a major cost reduction. The addition of large transformers at Talega and Escondido, the rebuilding of the existing towers and wires for 500 kV operation between Talega, Case Springs, and Escondido, and expanding Talega to reconnect the SCE 230 kV lines coming out of SONGS and going to Santiago, Viejo, and Serrano would be the major cost elements. The Talega-Escondido corridor would need to be re–permitted to allow for this higher voltage.

B. Escondido-Suncrest 500 kV line

As the CAISO shows in its draft 2014-15 Transmission Plan[8], it has anticipated a new transmission connection between Escondido and Suncrest. This path appears to be planned as a 230 kV line(s), but could be built as a high capacity 500 kV line, connecting at 500 kV to the Talega-Escondido upgrade described in the previous subsection.

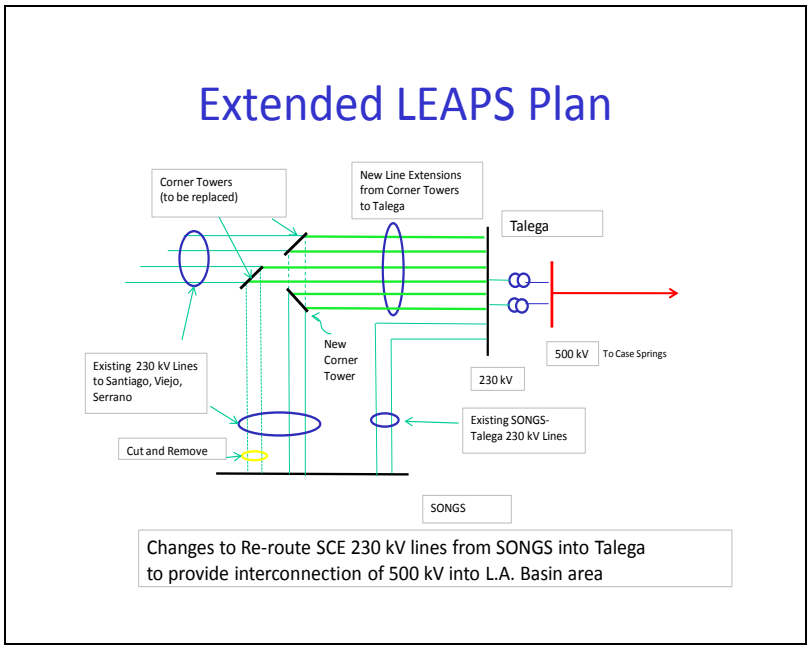
C. Talega Substation Expansion

The suggested 500 kV addition to the Talega Substation provides considerable import capability to SDG&E. Also, as a first step toward being able to improve delivery capability into SCE's L.A. Basin service area, the advantageous location of several of SCE's 230 kV high capacity lines very near the Talega Substation on their path to SONGS provides an

[8] / See Figure. 2.6-5 (High-level Illustrations of Potential Backup Transmission Solutions) in the CAISO 2014-15 Transmission Plan.

opportunity to reconnect them to a new strong source. This change is illustrated conceptually in Figure 1 – Suggested changes to the Talega Substation.

Figure 1 – Suggested changes to the Talega Substation



As can be seen in Figure 2 – Aerial View of Talega Substation Area, the distances for this change of transmission line routings is quite short, only about 0.4 miles. And there seems to be adequate land between the existing Talega Substation and the SCE 230 kV lines to develop the substation expansion.

Figure 2 – Aerial View of Talega Substation Area

D. Felicity-Colorado River 500 kV Line

The CAISO has noted[9] the need to be able to move power from the area along the Southwest Power Link (SWPL) to the path of the Palo Verde-Colorado River-Devers 500 kV lines, and vice versa. Arizona does not appear to wish to allow California-based utilities the ability to double circuit those 500 kV paths in Arizona. Yet, there is a strong need to be able to move large blocks of power between the northern 500 kV route in California and the SWPL path. California utilities, CAISO and the California regulators have made past attempts to close this gap but have not yet been successful.

Yet, there appears a relatively short (60 miles, +/-) easy-to-permit path already existing. This is a 500 kV line from the area just inside the California border west of North Gila (32° 46'N, 114° 50'W), dubbed "Felicity" in the local area, to the Colorado River Substation. This line would use an existing right-of-way for most of its length presently used by WAPA at 161 kV. WAPA has expressed willingness for such a use in the past as long as it was able to deliver its requirements to its customers through an underbuild on the new line or other arrangement. The area of the line is largely empty desert, as can be seen in Figure 3 – Suggested line from Felicity to Colorado River Substation.

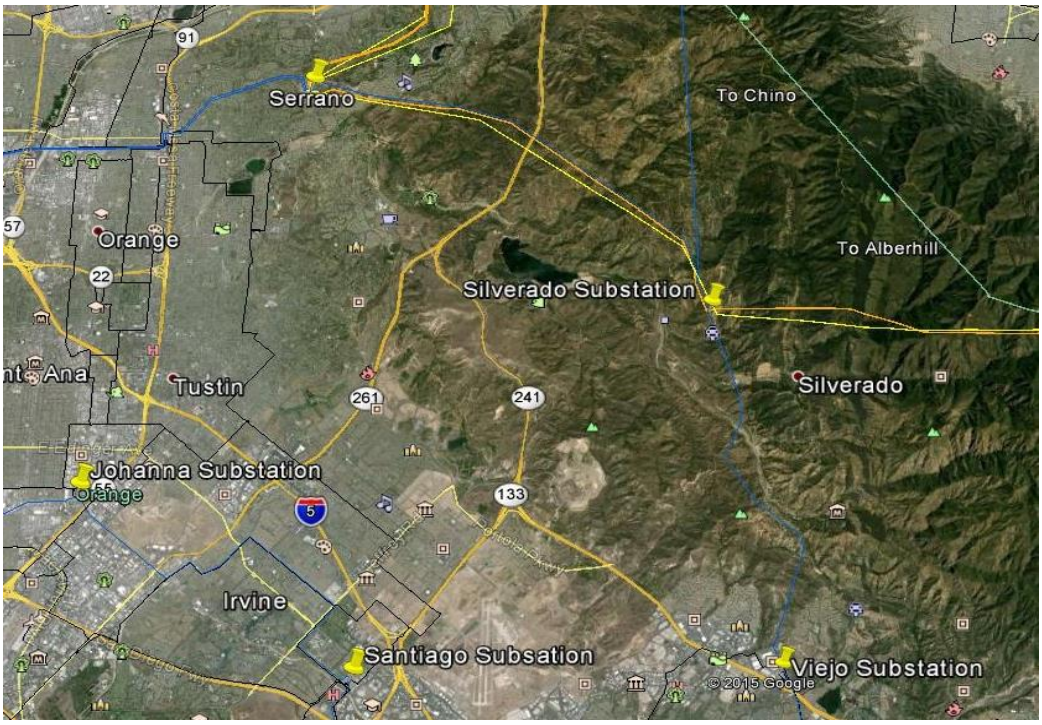
Figure 3 – Suggested line from Felicity to Colorado River Substation

[9] / CAISO Draft 2014-15 Transmission Plan, page 99.

E. Silverado 500/230 kV Substation

The existing Valley-Alberhill-Serrano 500 kV line passes through a point (33°45'55"N, 117°39'52"W) where two 230 kV lines also pass, the Serrano-SONGS line and the Viejo-Chino line. This area is shown on Figure 4 – Proposed Silverado Substation and Interconnecting 230 kV Substations.

Figure 4 – Proposed Silverado Substation and Interconnecting 230 kV Substations



The proposed development of a substation at this point could include the following:

- Establish a 500/230 kV stepdown substation with two or three transformers (SCE/CAISO's choice)
- Replace the existing 230 kV line from Serrano to SONGS north of Silverado with a new 500 kV line from Serrano to Silverado
- Replace the existing 230 kV line from Serrano to SONGS south of Silverado with a new 500 kV line from Silverado to Talega
- Loop the Chino-Viejo 230 kV line into Silverado and add a second 230 kV circuit from Silverado to Viejo

- Extend a double circuit 230 kV line from Silverado to the junction point with the Santiago-Johanna 230 kV line at the turn at Jeffrey Road (33°41'04"N, 117°46'22"), split the existing Santiago-Johanna line and tie each open end into the new lines from Silverado
- Tie the 230 kV line from Ellis to Santiago that passes through the Johanna Substation into the Johanna 230 kV bus
- Optionally, add a second 500 kV line from Valley to Alberhill to Silverado

There appears to be an existing right of way along Jeffrey Road that goes from the junction point noted above to the edge of any development on the way to Silverado. The Silverado site is quite open, and may have been planned to be a substation someday.

F. Additional Combined Cycle Generation

The U.S. Environmental Protection Agency and California have a strong preference for replacement of gas-fired steam generation with gas-fired combined cycle generators, renewable resources and energy storage. However, with the addition of the suggested 500 kV line from Case Springs to Escondido, which passes through the CAISO-proposed Inland site (formerly the proposed Rainbow site), the potential siting of 1,000 to 1,500 MW of combined cycle generation now is feasible from a transmission perspective and a gas supply perspective.

V. Conclusion

The timing to complete the LEAPS 500 kV line and its interconnecting substation additions at Talega and Escondido would be at about the time Encina must retire and before the summer peak season of 2018, approximately three years. The timing of these follow-on additions to the LEAPS and Talega-Escondido 500 kV line and substations is a matter for further discussion. Some of these projects can be carried out in time parallel with LEAPS-Talega-Escondido, others will require more coordination and planning.

In short, we urge consideration of converting the Talega-Escondido line corridor to 500 kV, not keeping it at its now out–of–date 230 kV level.

For additional Information or to discuss, please contact:

David Kates at

DKates@sonic.net

Attachment 3

Nevada Hydro Whitepaper 3 – Making the Most of LEAPS, June 2015

Making the Most
of the
Lake Elsinore Advanced Pumped Storage (LEAPS) Project

Technical Addendum

Power Flow modeling and results

This addendum is intended to provide the technical backup supporting the specific changes suggested in the main document.

Section I provides a description of the modeling undertaken and conclusions drawn therefrom. Section II describes the situation shown by the modeling undertaken. Section III provides detailed instructions for setting up and running the power flow models and Section IV provides the results, in graphic format, of the modeling undertaken.

I. Load flow modeling in support of conclusions

We undertook extensive load flow modeling that support our conclusions. This modeling was based, as the starting point, the electric load flow case developed by WECC for the 2018 Summer Heavy Load condition. This base case was then modified to take the San Onofre Nuclear Generating Station ("SONGS") out of service with SCE's system generation modified to replace its output. SCE's net tie flows were maintained at -7,231 MW.

Initial tests of this system showed that the N-1-1 loss of the Imperial Valley-Miguel 500 kV line followed by system generation adjustments and then the loss of the Imperial Valley-Suncrest 500 kV line resulted in voltage collapse in the entire San Diego load area and a large percentage of the SCE L.A. Basin area. The primary boundary point between the areas within SCE where service continued and where it was blacked out was at the Serrano Substation. This finding is consistent with the actual blackout event's results of September 2011.

A. CAISO 2013–2014 proposals adopted

The CAISO offered four proposals to improve reliability for this area in its 2013-14 Transmission plan:

- A phase shifting transformer added to the 230 kV line that runs from Imperial Valley Substation in SDG&E to Rosarita Substation in the CFE system in Mexico. This is planned to limit the flow over the CFE system in order to keep CFE's lines within rating while still providing some power delivery through CFE into the San Diego load area

- 450 MVAR of reactive power supplies be added in the northern SDG&E area or at the SONGS 230 kV bus
- Addition of the Mesa Substation 500 kV loop-in, using the Vincent Mira Loma 500 kV line that is part of the Tehachapi Transmission Project
- Conversion of two of the Huntington Beach power plant's units (#'s 3 & 4) to act as synchronous condensers, since they cannot be operated as real power generators for lack of emissions credits, which had been transferred to the new Walnut Gas turbine plant.

All of these CAISO proposals are assumed completed and in service by 2018, and have been included in modeling.

B. The LEAPS Interconnection Agreements

The Lake Elsinore Advanced Pumped Storage ("LEAPS") has 2 agreements allowing it to connect to the state's high voltage grid, one each with SCE and San Diego Gas & Electric ("SDG&E"). The connection consists of a 500 kV line from SCE's proposed Alberhill Substation (before Alberhill's development, this interconnection point was to be a tee-point Substation called "Lake" in the same vicinity), through the LEAPS powerplant at Lake Elsinore, and then to a 500 kV substation in the SDG&E service area. This substation is to be called "Case Springs".

The project developer and SDG&E agreed to an interconnection plan at the Case Springs Substation in 2008. The substation's configuration was to include a set of three 500 kV to 230 kV transformers and three 230 kV phase shifting transformers that would tie into SDG&E's Talega-Escondido 230 kV ("T–E") line. Analysis to support the Interconnection Agreement showed that it would be necessary to upgrade the existing 230 kV T–E line, which uses one side of a set of double-circuit towers, to double bundle the conductor, essentially doubling the line's capability, and to add a second circuit, also double bundled, on the other side of the towers. There were also other associated changes included in both the SCE and SDG&E interconnection agreements, which should be re-visited because the system has changed since the original connection configurations were created.

II. Current Situation

A few years after these connection configurations had been agreed to; the electrical landscape changed dramatically and permanently, first, with the shutdown of SONGS and then its retirement. Suddenly (in the timeframe of large scale generation and transmission planning), the southern California area, which is especially the entire SDG&E load area and the Los Angeles Basin area of SCE, was short of over 2,000 MW of what had been considered a rock-solid power source.

In addition, and perhaps more importantly, in 2008, the California State Water Resources Control Board began discussions on use of ocean and estuarine water for power plant cooling. A multi-agency policy on what became known as "Once-through-cooling" ("OTC") regulation was approved by the Office of Administrative Law and became effective on October 1, 2010.

The consequences of these two events are that the SDG&E and SCE L.A. Basin load areas were short of generation and would become more so when the full effects of the OTC regulations came into play beginning at the end of 2017. The OTC compliance plan for the 946 MW Encina Station in SDG&E's load area envisions full retirement by the end of 2017. The owners of the Alamitos Station in SCE's L.A. Basin, which has a required compliance date of December 31, 2020, have plans to meet compliance.[1] The owners of Huntington Beach, which still has units 1 and 2 (452 MW) operating has requested postponement of compliance from the end of 2020 to the end of 2022.

There are other generators in the L.A. Basin, some of which have already been repowered as air-cooled, or plan to do so, such as El Segundo units 3 and 4, and others, such as Long Beach, that have retired. SCE will also have generators not in the L.A. Basin area be retired, such as Mandalay (430 MW).

The consequences of the OTC regulations is that by the summer heavy load period of 2018, the SDG&E and L.A. Basin load areas will have lost at least 1,000 MW of generation in addition to the 2,150 MW from the SONGS retirement. By the summer heavy load period of 2021, the loss from OTC regulatory requirements will be over 2,000 MW (plus the 2,150 MW from the loss of SONGS), with the final number yet to be finalized.

As one might expect, there has been a major push to add new generation in the two areas. One project that has been proposed is the Carlsbad Project. Carlsbad was initially conceived as a combined cycle plant that would occupy part of the present Encina site. Now, it is to be a peaking power plant.

In CPUC proceedings known as the Long Term Procurement Plan (LTPP)[2], SDG&E has been authorized to procure 800 to 1,100 MW of new generation, of which a minimum amount of 175 MW must be preferred resources including energy storage, and a minimum of 25 MW must be storage resources. 600 MW to 900 MW may be from other resources. In that same proceeding SCE was authorized to procure 1,900 MW to 2,500 MW of new resources, of which a minimum of 50 MW must be from storage, 550 MW must be from preferred resources, up to 400 MW

---

[1]/ Units # 5 and 6 (993 MW) to be retired at the end of 2019, changes to units 1 and 2 (350 MW) are delayed until the end of 2027 and changes to units 3 and 4 (668 MW) are delayed until the end of 2023.

[2]/ "Decision Authorizing Long-Term Procurement for Local Capacity Requirements Due to Permanent Retirement of The San Onofre Nuclear Generations Stations", Rulemaking R.12-03-14, Decision 14–03–004, March 13, 2014.

from optional additional preferred resources/energy storage, 1,000 MW from gas-fired generation, and 300 to 500 MW of any type resource.

The procurement authorizations for SDG&E and SCE were predicated on there not being adequate time for consideration of non-generation solutions for power to be delivered from outside the SDG&E and SCE L.A. Basin areas.[3] However, the order requires the utilities to follow the CPUC's loading order requirement. "[T]his clarified Loading Order is a departure from the Commission's previous position of procuring energy efficiency and demand response, then renewable energy, and then allowing "additional clean, fossil-fuel, central-station generation," because "preferred resources require both sufficient investment and adequate time to 'get to scale.'" Instead of procuring a fixed amount of preferred resources and then procuring fossil-fuel resources, the IOUs are required to continue to procure the preferred resources "to the extent that they are feasibly available and cost effective."[4]

Given this articulated time constraint, the order sets the activity in motion to procure whatever generation, within the constraints provided, can be built to fill the growing shortage.

In our view, there is a serious conflict between the two articulated goals:

1. Meet the reliability needs of the system; and,
2. Provide operational control of the system adequate to the high variability of the large amount of renewable generation.

The CAISO responded by submitting its "deterministic studies of the existing trajectory and 40% Renewable Portfolio Standards scenarios with no renewable curtailment."[5] The filing offers the following conclusions:

> *"With no curtailment of renewable resources, the CAISO identified upward and downward reserve and load following shortfalls and unsolved over-generation in both the Trajectory and 40% RPS in 2024 scenarios. The unsolved over-generation is significant in the 40% RPS in 2024 scenario. Simply adding more flexible generation resources cannot solve the problem. The frequency and magnitude of the reserve shortfalls and unsolved*

---

[3]/ *Id.* at page 11: "As discussed herein, we determine that it is necessary to authorize additional procurement at this time. The 2013/2014 TPP results are expected to be complete by March 2014. However, further procedural activities in this docket would necessitate at least several months to fully develop a record to incorporate the new TPP results. With long lead-time resources requiring several years of effort, and potential reliability issues surfacing starting in 2018, we cannot wait for further information at this point."

[4]/ *Id.* at page 15.

[5]/ California Independent System Operator Corporation, Deterministic Studies, Rulemaking R.12-03-14, May 10, 2014.

over-generation reflect conditions that do not support reliable grid operations. As a result alternative options must be explored, including:

1) improving time of use rates to match with the pattern of over-generation;
2) targeting energy efficiency at hours without over-generation;
3) decarbonizing transportation fuels to create flexible load;
4) increasing demand response and storage;
5) allowing additional economic dispatch of renewables;
6) retrofitting of existing power plants to increase fleet flexibility; and
7) deepening regional collaboration through participating in the CAISO Energy Imbalance Market and increasing the CAISO operating footprint."

In our view, this somewhat academic and distant set of option recommendations does not recognize that the problem is upon California already and will grow into greater difficulties and unreliability as each year passes. This is in notable contrast to the urgency conveyed by Wellhead Electric Company for example, in its filing of May 10, 2015. Its conclusions in that filing are as follows.

"Our analysis shows an undisputed OG problem is likely to occur in 2019 (or perhaps earlier); much sooner than assumed in the traditional LTPP paradigm that is the basis of discontinuing Phase 1A. The Commission needs to acknowledge that a potentially serious renewable integration/OG problem could occur in 2019 (or even earlier) which has not been accounted for in the traditional LTPP paradigm. The time to act is now."

A. Suggestions for solutions to the "over-generation" problem

The reader may wonder what reasonably can be done. The first suggestion is that the CPUC should move aggressively to have storage facilities built as soon as possible. These facilities will allow management of the over-generation problem. It appears that the utilities operated by CAISO need a minimum of 1,000 MW of storage and eventually as much as 5,000 MW. This type of facility should have the advanced performance capabilities that offer short-term output control, such as can be seen already in the Dinorwig Project in Wales, and as proposed for the LEAPS Project.

The second suggestion is that additional transmission be added as soon as possible to provide supply to the San Diego and L.A. Basin load area from a much broader area, including out-of-state generation. This would mean increasing and integrating the 500 kV system supplying these two critically deficient areas. A first step in this process would be for CAISO, SDG&E, and SCE to take advantage of the 500 kV line proposed to interconnect the LEAPS Project so that would it connect to the SDG&E system and SCE's L.A. Basin system. This would change the long-discussed TE/VS line from being a generation interconnection line to being a

utility-owned line that happens to have LEAPS interconnecting at the utility interface. The potential of using the Talega-Escondido right-of-way as a 500 kV path and interconnection with a 500 kV line coming from LEAPS cannot be stressed enough, and the remainder of this Addendum addresses the use and benefits this plan provides.

1. Developments by Summer 2018

As a result of modeling and understanding of the operation of the southern California grid, we suggest that the following projects be undertaken before the summer of 2018:

- Develop the Talega-Case Springs-Escondido corridor for 500 kV with a rating of 4000 amperes.
- Build an expansion of Talega Substation designed to allow two 500 kV lines and eight 230 kV lines, with at least two 1120/1680 MVA 500/230 kV transformers
- Build an expansion of Escondido Substation designed to allow two 500 kV lines and four 230 kV lines, with at least two 1120/1680 MVA 500/230 kV transformers (If there is inadequate site space for such an expansion at the existing location, build a new 500/230 kV substation at an appropriate location north on the existing right-of-way of the existing Talega-Escondido 230 kV line, which already has the capability of connecting two high capacity 230 kV lines between the new location and Escondido.)
- Build a 500 kV line from The SCE Colorado River Substation south along the existing WAPA 161 kV line right-of-way to an intersection point with the Southwest Power Link 500 kV line in the Felicity area in California. The northern terminus of the line will require one additional position on the 500 kV bus at the Colorado River Substation. The southern terminus will require a new substation with three 500 kV line positions, and whatever stepdown/interconnection plans may come from new renewable energy projects located in the area requiring interconnection points.

We have prepared a set of computer files to be used with the PSS®E load flow program to add the several components suggested above to the WECC 2018 Heavy Summer load flow case after SONGS has been retired. Encina Station has been left operating in the case, and can be shut down as part of the performance testing of the proposed additions. These computer files, called “idv” files will accomplish the following:

- Install the 230 kV phase shifting transformer at Imperial Valley to control flow on the Imperial Valley-Rosarita line
- Install the Mesa 500/230 kV stepdown in SCE

- Install the LEAPS Project and the associated 500 kV lines from Alberhill to LEAPS to Case Springs.
- Install the 500 kV line from Talega to Case Springs to Escondido, and add the 500/230 kV equipment at each substation.
- Install the 500 kV line from Colorado River to Felicity Substation and the Felicity Substation, leaving the 53% series compensation on all 500 kV lines affected.

Subsequent to these additions, testing of the system's performance was conducted. Encina Station was shut down, with the generation replaced mostly from the Palo Verde area combined cycle plants and the rest from plants near Las Vegas. Then, tests of several N-1-1 contingency conditions were conducted. The pre-contingency conditions are shown in Section IV.A. The system performance with the N-1-1 losses of the Imperial Valley-Miguel and Imperial Valley-Suncrest 500 kV lines are shown in Section IV.B. A review of these test conditions shows that with both SONGS and Encina shut down there is no need for several years for either the Carlsbad or Pio Pico projects.

2. Developments by Summer 2021

By making the additions to the system for 2018 described above, system planners could move on to assess needs for upgrades/additions needed by summer 2021, as we have done. This testing consisted of using the same WECC 2018 heavy summer case with SONGS and Encina out of service and the several additions planned for 2018 also installed. Testing of this system condition found that there was need to find additional support for the 230 kV substations in the L.A. Basin. The LTPP process resulted in this case of adding four generation packages at Santiago (750 MW), Viejo (750 MW), Johanna (750 MW) and Ellis (500 MW). The need for these generation additions was apparently caused by the potential overload of one of the two 230 kV line from Serrano to Villa Park for the N-1-1 loss of one of the 230 kV lines from Serrano to Lewis and the loss of the other line from Serrano to Villa Park. After researching possible transmission options it was found that a new 500/230 substation would relieve the problem for an extended period of time. This new substation, dubbed "Silverado", is located at the junction of the 500 kV line from Serrano to Alberhill and the 230 kV lines from Viejo to Chino and Serrano to SONGS. An aerial view of this location is included above, along with longitude and latitude coordinates.

Again, the system equipment additions and changes for adding and integrating this new substation, as well as a 500 kV line from Suncrest to Escondido are included in "idv" files we can provide and are described in Section III. The base conditions after this set of additions are shown in Section IV. After adding this new substation and its associated lines, contingency testing was conducted. These tests showed that this upgrade of the

transmission system relieved the need for the four generation packages noted above. The limiting N-1-1 condition before the addition of Silverado was found to be fully relieved.

III. File Modification

This section provides the file modifications required to insert data for 2018 System Developments to run the cases discussed herein. The additions shown are "idv" files to be used with PSS®E, or the data can be converted to be used in PSLF. Electronic copies of these files are available upon request.

A. Add Alberhill Substation if not already in starting case

```
@! "ALBERHILL_Add.idv", generated on FRI, APR 17 2015
@!
BAT_BUS_DATA_2,24845,,24,240,74, 500.0,,,'ALBERHILL'
BAT_BUS_DATA_2,24845,,,,,,,-17.0,'ALBERHILL'
BAT_BRANCH_DATA,24138,24151,'1',0,,,,,,,,,,,,,,,,,,;
BAT_BRANCH_DATA,24138,24845,'1',,,,74,,,, 0.0002900, 0.0065400, 0.48180, 3421.0, 4616.0, 3421.0,,,,, 31.0,,,,,;
BAT_BRANCH_DATA,24151,24845,'1',,,,74,,,, 0.0001600, 0.0036900, 0.27156, 3421.0, 4616.0, 3421.0,,,,, 13.0,,,,,;
```

B. Add Mesa Cal 500/230 kV Substation Upgrade

```
@! Mesa 500/230 Add
@! Loop in Vincent-Mira Loma 500 kV to Mesa
@! Loop into Mesa the existing Rio Honda-Laguna Bell 230 kV line
@! Loop into Mesa the existing Goodrich-Laguna Bell 230 kV line
@! Install three 500/230 kV transformers (1120/1680/1120 MVA)
@!
@! This idv file set up for 2018 heavy summer load flow case, following years may have different starting
configurations
@!
@! Add Mesa 500 kV Bus
BAT_BUS_DATA_2,24990,,24,240,140, 500.0,,-17.0,'MESA'
@!
@! Remove Mira Loma-Vincent 500 kV line
BAT_BRANCH_DATA,24092,24156,'1',0,,,,,,,,,,,,,,,,,,;
@!
@! Remove Laguna Bell-Goodrich 230 kV Line
BAT_BRANCH_DATA,24076,25001,'1',0,,,,,,,,,,,,,,,,,,;
@!
@! Remove Laguna Bell-Rio Hondo 230 kV Line
BAT_BRANCH_DATA,24076,24126,'1',0,,,,,,,,,,,,,,,,,,;
@!
@! Add Mira Loma-Mesa 500 kV Line
BAT_BRANCH_DATA,24092,24990,'1',,,74,,,, 0.0003420, 0.007900, 0.56770, 3464.0, 4616.0, 3464.0,,,,, 34.0,,,,,;
@! Add Vincent-Mesa 500 kV Line
BAT_BRANCH_DATA,24156,24990,'1',,,74,,,, 0.0004280, 0.009900, 0.71130, 3464.0, 4616.0, 3464.0,,,,, 42.6,,,,,;
@!
@! Mesa 500/230 kV transformers (set transformer voltage ratios after running idv file, set nominal to begin)
BAT_TWO_WINDING_DATA,24990,24091,'1',1,24091,74,,,,17,,24990,24090,,0,2,2,, 0.00000,
0.01319,1120.0,500.0,500.0,,230.0,230.0,1120.0,1680.0,,,,,,,,,,,,,'Mesa1'
BAT_TWO_WINDING_DATA,24990,24091,'2',1,24091,74,,,,17,,24990,24090,,0,2,2,, 0.00000,
0.01319,1120.0,500.0,500.0,,230.0,230.0,1120.0,1680.0,,,,,,,,,,,,,'Mesa2'
BAT_TWO_WINDING_DATA,24990,24091,'3',1,24091,74,,,,17,,24990,24090,,0,2,2,, 0.00000,
0.01319,1120.0,500.0,500.0,,230.0,230.0,1120.0,1680.0,,,,,,,,,,,,,'Mesa3'
```

```
@!
@! Laguna Bell-Mesa 230 kV Line 1
BAT_BRANCH_DATA,24076,24091,'1',,,74,,,, 0.0004520, 0.005539, 0.02092, 988.0, 988.0, 988.0,,,,, 5.2,,,,,;
@! Laguna Bell-Mesa 230 kV Line 2
BAT_BRANCH_DATA,24076,24091,'2',,,74,,,, 0.0004520, 0.005539, 0.02092, 988.0, 988.0, 988.0,,,,, 5.2,,,,,;
@!
@! Rio Hondo-Mesa 230 kV Line 2
BAT_BRANCH_DATA,24091,24126,'2',,,74,,,, 0.0009400, 0.012130, 0.04074, 988.0, 988.0, 988.0,,,,,10.6,,,,,;
@!
@! Goodrich-Mesa 230 kV line 1
BAT_BRANCH_DATA,25001,24091,'1',,,74,,,, 0.0007480, 0.009161, 0.03460, 988.0, 988.0, 988.0,,,,, 8.6,,,,,;
```

C. Add Colorado River Substation

```
@! text   Colorado River Substation and associated Colorado River 500 kV lines Add generated on FRI, APR 26
2015
@! text
@!  Remove 500 kV line section between first series comp bus 15023 and second series comp bus 15024
BAT_BRANCH_DATA,15023,15024,'1',0,,,,,,,,,,,,,,,,,,;
BAT_PURGBRN,15023,15024,'1'
@!
@!  Add Colorado River Sub bus
BAT_BUS_DATA,24900,1,24,248,74,,, 500.0,1.05,4.0,'Colo River'
@!
@!  Add Colo River lines to series comp buses 15023 and 15024
BAT_BRANCH_DATA,15023,24900,'1',1,24900,74,,,,0.0007100,0.016100,1.18260,3420.8,4615.9,3420.8,,,,,1,,,,;
BAT_BRANCH_DATA,24900,15024,'1',1,24900,74,,,,0.0003500,0.010390,0.76738,3950.0,4540.0,3950.0,,,,,1,,,,;
@!
@!  Restore buses 15022,15023,15024 and 15025 to service
BAT_BUS_DATA,15022,1,,,;
BAT_BUS_DATA,15023,1,,,;
BAT_BUS_DATA,15024,1,,,;
BAT_BUS_DATA,15025,1,,,;
@!
@!  Restore lines in multi-section PV-Devers 500 kV lines to service
BAT_BRANCH_DATA,15021,15022,'1',1,,,,,,,,,,,,,,,,,,;
BAT_BRANCH_DATA,15022,15023,'1',1,,,,,,,,,,,,,,,,,,;
BAT_BRANCH_DATA,15024,15025,'1',1,,,,,,,,,,,,,,,,,,;
BAT_BRANCH_DATA,15025,24801,'1',1,,,,,,,,,,,,,,,,,,;
@!
@!  Add Multi section lines for PV-Colo River and Colo River-Devers
BAT_MULTI_SECTION_LINE_DATA,15021,24900,"&1",15021,15022,15023,,,,,,,,;
BAT_MULTI_SECTION_LINE_DATA,24900,24801,"&1",24900,15024,15025,,,,,,,,;
```

D. Add Felicity Substation and Felicity-Colorado River 500 kV line

```
@! text   Felicity_Substation_ and Felicity-Colorado River 500 kV line Add generated on FRI, APR 24 2015
@! text             Series Compensation set at 53% on all three lines
@! text
@! text   Remove 500 kV line and series compensation from N.Gila to Imperial Valley
@! text       line - 22536 to 22537  Comp - 22360 to 22537
BAT_PURGBRN,22536,22537, '1'
BAT_PURGBRN,22360,22537, '1'
@! text
BAT_BUS_DATA,22890,1,22,225,136,,, 500.0,1.05,4.0,'Felicity'
BAT_BUS_DATA,22891,1,22,225,136,,, 500.0,1.05,3.9,'Felcty&1'
BAT_BUS_DATA,22892,1,22,225,136,,, 500.0,1.05,3.8,'Felcty&2'
```

```
@! text
BAT_BRANCH_DATA,22536,22891,'1',1,22536,136,,,,0.000257,0.006609,0.49295,2598.0,2598.0,2598.0,,,,,1,,,,;
BAT_BRANCH_DATA,22891,22890,'1',1,22891,136,,,,0.000000,-0.00351,0.00000,1905.0,2572.0,1905.0,,,,,1,,,,;
BAT_BRANCH_DATA,22890,22537,'1',1,22890,136,,,,0.000493,0.012671,0.94511,2598.0,2598.0,2598.0,,,,,1,,,,;
BAT_BRANCH_DATA,22537,22360,'1',1,22537,136,,,,0.000000,-0.00673,0.00000,1905.0,2572.0,1905.0,,,,,1,,,,;
BAT_BRANCH_DATA,22890,22892,'1',1,22890,136,,,,0.000567,0.014573,1.08697,2598.0,2598.0,2598.0,,,,,1,,,,;
BAT_BRANCH_DATA,22892,24900,'1',1,22892,136,,,,0.000000,-0.00774,0.00000,1905.0,2572.0,1905.0,,,,,1,,,,;
@! text
BAT_MULTI_SECTION_LINE_DATA,22536,22890,"&1",22536,22891,,,,,,,,,
BAT_MULTI_SECTION_LINE_DATA,22890,22360,"&1",22890,22537,,,,,,,,,
BAT_MULTI_SECTION_LINE_DATA,22890,24900,"&1",22890,22892,,,,,,,,,
```

E. Add Imperial Valley – Rosarita 230 kV line phase shifter

```
@!     Add phase shifting transformer on Imperial Valley-Rosarita 230 kV line, APR 17 2015
@!
@!     Add new bus for phase shifter with assumed -4 degree angular position
BAT_BUS_DATA_2,22357,,22,225,136, 230.0,,,'Imp Val PS'
BAT_BUS_DATA_2,22357,,,,,,,-4.0,'Imp Val PS'
@!     take Imperial Valley-Rosarita line out of service and relocate IV end bus to Phase shifter bus
BAT_BRANCH_DATA,20118,22356,'1',0,,,,,,,,,,,,,,,,,,;
BAT_BRANCH_DATA,20118,22357,'1',,,136,,,, 0.001000, 0.0099100, 0.03828, 786.7, 850.0, 796.7,,,,, 9.5,,,,,;
@!     Add phase shifting transformer with 10 degree phase angle offset as base condition, control flow in base
condition to 190-200 MW
BAT_TWO_WINDING_DATA,22356,22357,'P1',,22357,,,,,,15,,22357,,3,2,2,, 0.00071, 0.02663,, 230.0, 230.0,-10.0,
230.0, 230.0, 500.0, 620.0,,,,,,,, 32.0,-32.0, 200.0, 190.0,,,'IVPS1'
```

F. LEAPS and Enhanced TE-VS with Talega-Escondido 500 kV after Alberhill already in place as bus 24845

```
@! LEAPS and TE/VS Add
@! Updated to ADD EnhancedTE/VS-LEAPS with Alberhill 500 already in case as bus 24845
@! Updated to add enhanced Telega to Case Springs to Escondido 500 kV line with Rainbow Sub  3/11/15
@! Updated to add reconfiguration of SCE 230 kV lines into Talega with two 500/230 Xfmrs 3/11/15
@! For use in 2018 case and thereafter 3/11/15
BAT_OWNER_DATA,140,'TNHC'
BAT_BUS_DATA_2,99104,,24,240,140, 500.0,,-17.0,'LEAPS'
BAT_BUS_DATA_2,99110,2,24,240,140, 20.0, 1.05,-5.0,'ELSNORE1'
BAT_BUS_DATA_2,99112,2,24,240,140, 20.0, 1.05,-5.0,'ELSNORE2'
BAT_BUS_DATA_2,99115,,24,240,140, 500.0,,-18.0,'CASESPGS500'
BAT_Bus_Data_2,22845,,22,226,136, 500.0,,-18.0,'Talega500'
BAT_BUS_DATA_2,99130,,22,226,136, 500.0,,-18.0,'Rainbow500'
BAT_BUS_DATA_2,99131,,22,226,136, 500.0,,-18.0,'Escondido'
@! Alberhill-LEAPS 500 kV
BAT_BRANCH_DATA,24845,99104,'1',,,140,,,, 0.0001270, 0.0028867, 0.21258, 3464.0, 4616.0, 3464.0,,,,, 11.4,,,,,;
@! LEAPS-Case Springs 500 kV
BAT_BRANCH_DATA,99104,99115,'1',,,140,,,, 0.0002205, 0.0050138, 0.36922, 3464.0, 4616.0, 3464.0,,,,, 19.8,,,,,;
@! Remove Talega-Escondido 230 kV
BAT_BRANCH_DATA,22260,22844,'1',0,,,,,,,,,,,,,,,,,,;
@! Case Springs-Talega 500 kV
BAT_BRANCH_DATA,22845,99115,'1',,,136,,,, 0.0001599, 0.0035451, 0.26107, 3464.0, 4616.0, 3464.0,,,,, 14.0,,,,,;
@! Case Springs-Rainbow 500 kV
BAT_BRANCH_DATA,99115,99130,'1',,,136,,,, 0.0001893, 0.0043047, 0.31701, 3464.0, 4616.0, 3464.0,,,,, 17.0,,,,,;
@! Rainbow-Escondido 500 kV
BAT_BRANCH_DATA,99130,99131,'1',,,136,,,, 0.0002228, 0.0050644, 0.37295, 3464.0, 4616.0, 3464.0,,,,, 20.0,,,,,;
@! LEAPS Generator stepup transformers
```

BAT_TWO_WINDING_DATA,99104,99110,'1',,99110,140,,,,17,,,,,0,2,2,, 0.00541, 0.13,, 500.0, 500.0,, 20.0, 20.0,375.0,375.0,,,,,,,,,,,,'LEAPS1'
BAT_TWO_WINDING_DATA,99104,99112,'1',,99112,140,,,,17,,,,,0,2,2,, 0.00541, 0.13,, 500.0, 500.0,, 20.0, 20.0,375.0,375.0,,,,,,,,,,,,'LEAPS2'
@! Talega 500/230 kV transformers
BAT_TWO_WINDING_DATA,22844,22845,'1',,22845,136,,,,17,,22845,22844,,0,2,2,, 0.0, 0.01413,1120.0,525.0,525.0,,230.0,230.0,1120.0,1344.0,1680.0,1,,,,,,,,,,'Tal1'
BAT_TWO_WINDING_DATA,22844,22845,'2',,22845,136,,,,17,,22845,22844,,0,2,2,, 0.0, 0.01413,1120.0,525.0,525.0,,230.0,230.0,1120.0,1344.0,1680.0,1,,,,,,,,,,'Tal2'
@! Escondido 500/230 kV transformers
BAT_TWO_WINDING_DATA,22260,99131,'1',,99131,136,,,,17,,99131,22260,,0,2,2,, 0.0, 0.01413,1120.0,525.0,525.0,,230.0,230.0,1120.0,1344.0,1680.0,1,,,,,,,,,,'Esc1'
BAT_TWO_WINDING_DATA,22260,99131,'2',,99131,136,,,,17,,99131,22260,,0,2,2,, 0.0, 0.01413,1120.0,525.0,525.0,,230.0,230.0,1120.0,1344.0,1680.0,1,,,,,,,,,,'Esc2'@! LEAPS generation data
BAT_PLANT_DATA,99110,, 1.05,,;
BAT_PLANT_DATA,99112,, 1.05,,;
BAT_MACHINE_DATA_2,99110,'1',0,140,,,,, 0.0, 0.0, 122.0,-122.0, 250.0,-300.0, 360.0,, 0.22,,,,,,,,;
BAT_MACHINE_DATA_2,99112,'1',0,140,,,,, 0.0, 0.0, 122.0,-122.0, 250.0,-300.0, 360.0,, 0.22,,,,,,,,;
BAT_LOAD_DATA,99110,'1',,,,, 1.166, 0.723,,,,,;
BAT_LOAD_DATA,99112,'1',,,,, 1.166, 0.723,,,,,;
@! Talega 230 kV bus realignment
@! SONGS-Serrano, Santiago, Viejo lines switched off
BAT_BRANCH_DATA,24131,24137,'1',0,,,,,,,,,,,,,,,,,,;
BAT_BRANCH_DATA,24131,24134,'1',0,,,,,,,,,,,,,,,,,,;
BAT_BRANCH_DATA,24131,24134,'2',0,,,,,,,,,,,,,,,,,,;
BAT_BRANCH_DATA,24131,25654,'1',0,,,,,,,,,,,,,,,,,,;
@! New SONGS-Talega 230 kV lines added
BAT_BRANCH_DATA,22844,24131,'3',,,, 24,,,, 0.000365, 0.006613, 0.025997, 1195.0, 1315.0, 1315.0,,,,, 6.9,,,,,;
BAT_BRANCH_DATA,22844,24131,'4',,,, 24,,,, 0.000365, 0.006613, 0.025997, 1195.0, 1315.0, 1315.0,,,,, 6.9,,,,,;
@! New Talega-Serrano, Santiago, Viejo lines added
BAT_BRANCH_DATA,22844,24137,'1',,,, 24,,,, 0.002280, 0.041320, 0.162480, 1195.0, 1315.0, 1315.0,,,,,33.2,,,,,;
BAT_BRANCH_DATA,22844,24134,'1',,,, 24,,,, 0.001630, 0.029470, 0.115880, 1195.0, 1315.0, 1315.0,,,,,21.5,,,,,;
BAT_BRANCH_DATA,22844,24134,'2',,,, 24,,,, 0.001630, 0.029470, 0.115880, 1195.0, 1315.0, 1315.0,,,,,21.5,,,,,;
BAT_BRANCH_DATA,22844,25654,'1',,,, 24,,,, 0.001260, 0.028300, 0.089720, 1195.0, 1315.0, 1315.0,,,,,16.8,,,,,;

G. Add Suncrest-Escondido 500 kV line

@! Add new 500 kV line from Suncrest to Escondido
@!
@!
BAT_BRANCH_DATA,22737,99131,'1',,,136,,,, 0.000562, 0.0099341, 0.78865, 2598.0, 2598.0, 2598.0,,,,, 42.0,,,,,;

H. Add Silverado 500/230 kV Substation Upgrade

@! Silverado 500/230 kV Substation Add
@!
@! For use in 2018 case and thereafter 6/8/15
@! Use after running LEAPS_Enhanced_TE-VS_Add_After_Alberhill_Talega_Escondido_6-9-15.idv
@!
@! Add Silverado 500 and 230 kV buses
BAT_BUS_DATA_2,24980,,24,240,74, 500.0,,-14.0,'SILVRADO500'
BAT_BUS_DATA_2,24981,,24,240,74, 230.0,,-18.0,'Silvrado230'
@!
@! Remove Alberhill-Serrano 500 kV line
BAT_BRANCH_DATA,24845,24138,'1',0,,,,,,,,,,,,,,,,,,;
@!
@! Remove Serrano-Talega 230 kV

```
BAT_BRANCH_DATA,22844,24137,'1',0,,,,,,,,,,,,,,,,,,;
@!
@!  Add Alberhill-Silverado 500 kV and Serrano-Silverdo 500 KV (2 lines)
BAT_BRANCH_DATA,24845,24980,'1',,,74,,,, 0.0001840, 0.0041500, 0.305550, 3464.0, 4616.0, 3464.0,,,,, 16.6,,,,,;
BAT_BRANCH_DATA,24138,24980,'1',,,74,,,, 0.0001000, 0.0022480, 0.165480, 3464.0, 4616.0, 3464.0,,,,,  9.0,,,,,;
BAT_BRANCH_DATA,24138,24980,'2',,,74,,,, 0.0001000, 0.0022480, 0.165480, 3464.0, 4616.0, 3464.0,,,,,  9.0,,,,,;
@!
@!  Add Talega-Silverado 500 kV
BAT_BRANCH_DATA,22845,24980,'1',,,74,,,, 0.0001730, 0.0039000, 0.287150, 3464.0, 4616.0, 3464.0,,,,, 15.6,,,,,;
@!
@!  Add three Silverado 500/230 kV transformers
BAT_TWO_WINDING_DATA,24980,24981,'1',,24980,74,,,,17,,24980,24981,,0,2,2,, 0.0,
0.01413,1120.0,525.0,525.0,,230.0,230.0,1120.0,1344.0,1680.0,1,,,,,,,,,,'Silv1'
BAT_TWO_WINDING_DATA,24980,24981,'2',,24980,74,,,,17,,24980,24981,,0,2,2,, 0.0,
0.01413,1120.0,525.0,525.0,,230.0,230.0,1120.0,1344.0,1680.0,1,,,,,,,,,,'Silv2'
BAT_TWO_WINDING_DATA,24980,24981,'3',,24980,74,,,,17,,24980,24981,,0,2,2,, 0.0,
0.01413,1120.0,525.0,525.0,,230.0,230.0,1120.0,1344.0,1680.0,1,,,,,,,,,,'Silv3'
@!
@!  Remove Ellis-Santiago 230 kV line
BAT_BRANCH_DATA,24044,24134,'1',0,,,,,,,,,,,,,,,,,,;
@!
@!  Remove Chino-Viejo 230 kV line
BAT_BRANCH_DATA,24025,25654,'1',0,,,,,,,,,,,,,,,,,,;
@!
@!  Add Two Silverado-Viejo 230 kV Lines (one existing, one new)
BAT_BRANCH_DATA,24981,25654,'1',,,74,,,, 0.0004610, 0.0081270, 0.031950, 1195.0, 1339.0, 1195.0,,,,,,,,,,;
BAT_BRANCH_DATA,24981,25654,'2',,,74,,,, 0.0004610, 0.0081270, 0.031950, 1195.0, 1339.0, 1195.0,,,,,,,,,,;
@!
@!  Add Silverado-Santiago 230 kV
BAT_BRANCH_DATA,24134,24981,'1',,,74,,,, 0.0007980, 0.0146000, 0.057460, 1195.0, 1279.0, 1195.0,,,,,,,,,,;
@!
@!  Add Silverado-Johanna 230 kV
BAT_BRANCH_DATA,24072,24981,'1',,,74,,,, 0.0009680, 0.0177800, 0.069680, 1195.0, 1279.0, 1195.0,,,,,,,,,,;
@!
@!  Add Silverado-Chino 230 kV
BAT_BRANCH_DATA,24025,24981,'1',,,74,,,, 0.0010390, 0.0183100, 0.071990, 1195.0, 1339.0, 1195.0,,,,,,,,,,;
@!
@!  Add Ellis-Johanna Ckt 2 230 kV
BAT_BRANCH_DATA,24044,24072,'2',,,74,,,, 0.0003600, 0.0061000, 0.028000, 1195.0, 1279.0, 1195.0,,,,,,,,,,;
@!
@!  Add Johanna-Santiago 230 kV
BAT_BRANCH_DATA,24044,24072,'1',,,74,,,, 0.0004700, 0.0086000, 0.033850, 1195.0, 1279.0, 1195.0,,,,,,,,,,;
```

IV. Power Flow Diagrams

This section provides copies of power flow diagrams illustrating the cases described herein.

A. Power flow diagrams for 2018 system heavy load conditions

1. Under System Normal Conditions, the following projects have been added:

a) Mesa Cal 500/230 kV Substation

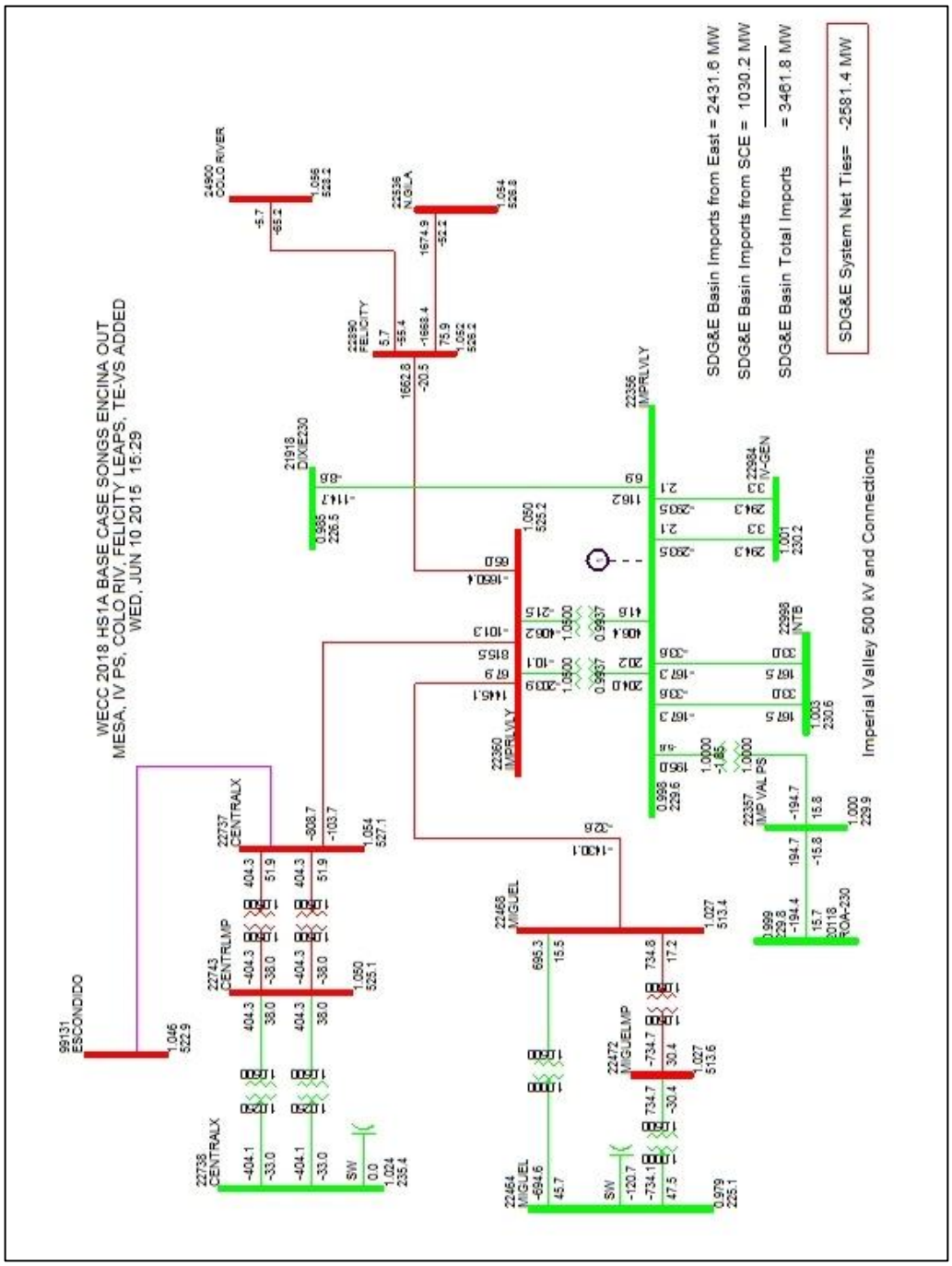
b) Colorado River Substation

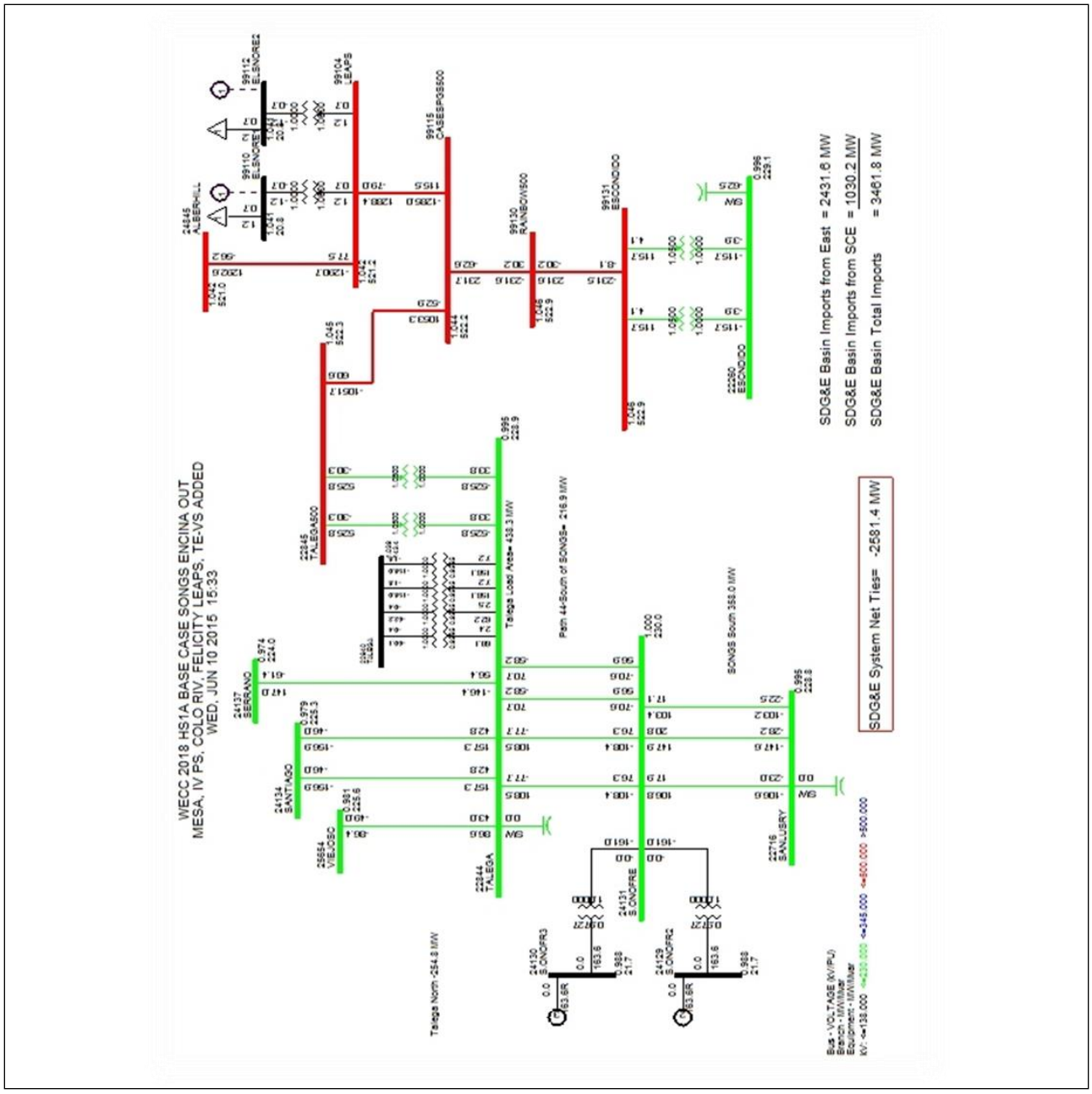
c) Felicity Substation and Felicity-Colorado River 500 kV line

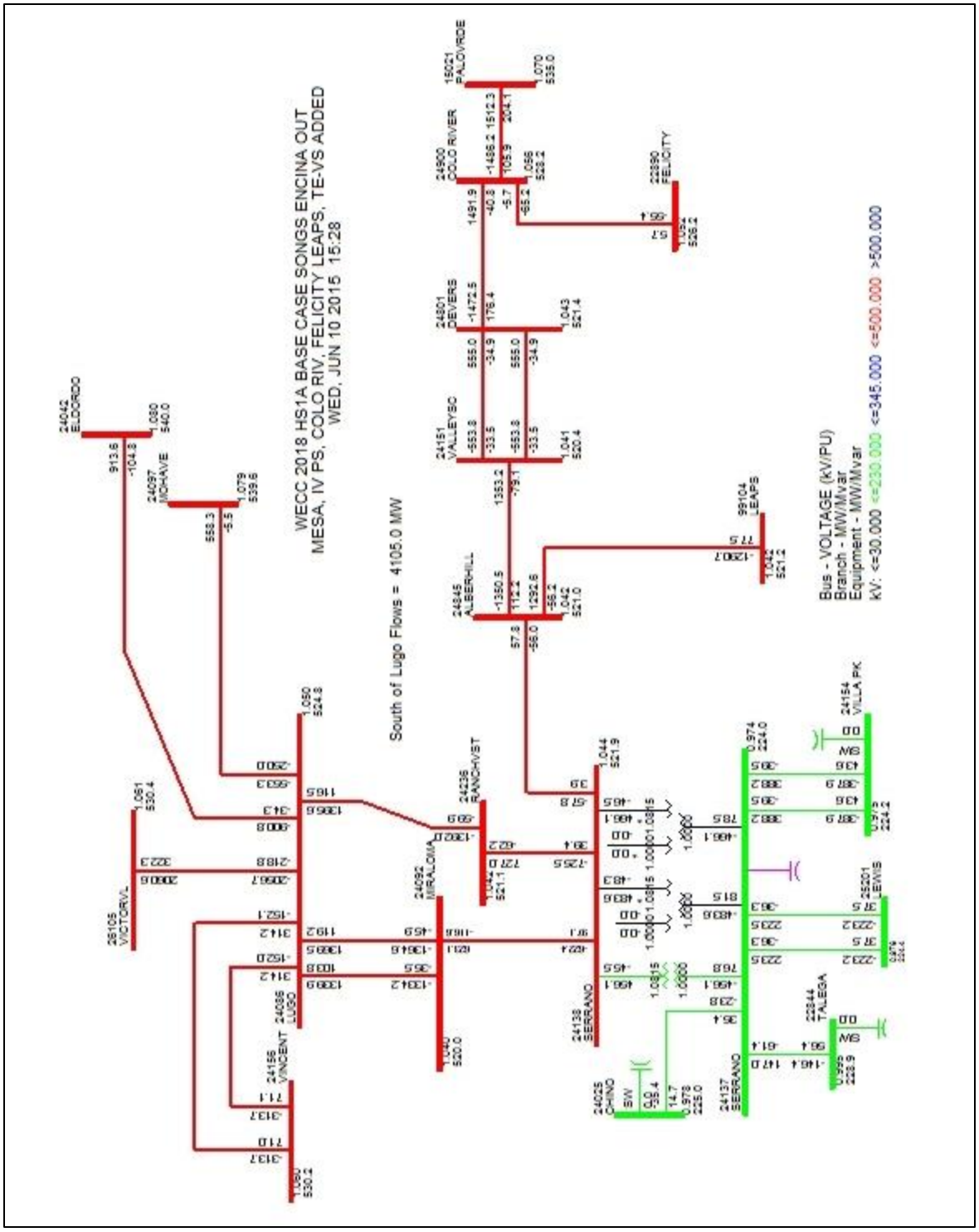
d) Imperial Valley-Rosarita 230 kV Line Phase Shifter

e) LEAPS

f) Enhanced TE-VS




WECC 2018 HS1A BASE CASE SONGS ENCINA OUT
MESA, IV PS, COLO RIV, FELICITY LEAPS, TE-VS ADDED
WED, JUN 10 2015 15:33
SDG&E Basin Imports from East = 2431.6 MW
SDG&E Basin Imports from SCE = 1030.2 MW
SDG&E Basin Total Imports = 3461.8 MW
SDG&E System Net Ties= -2581.4 MW
Talega Load Area= 438.3 MW
Path 44-South of SONGS= 216.9 MW
SONGS South 368.0 MW
Talega North -254.8 MW

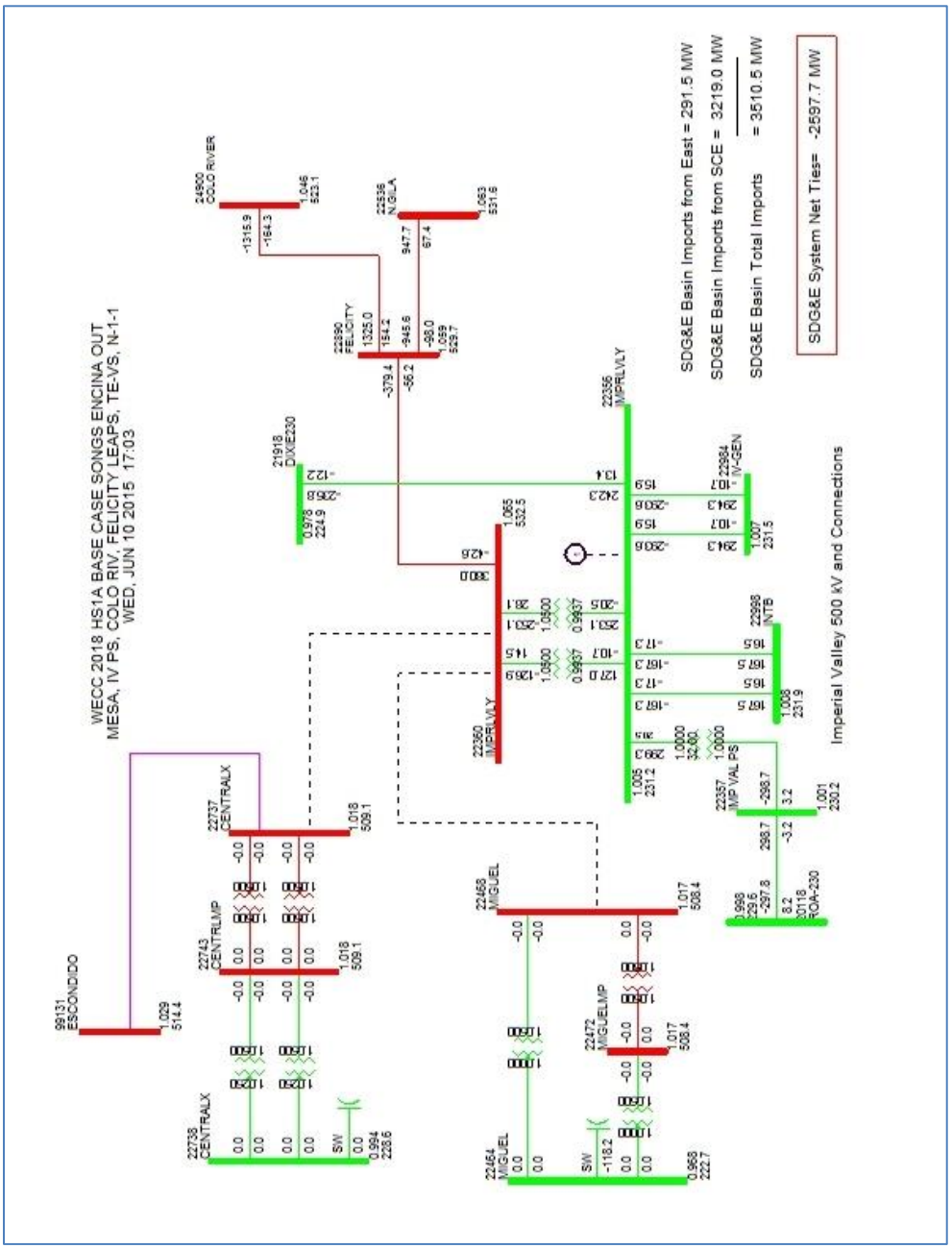

WECC 2018 HS1A BASE CASE SONGS ENCINA OUT
MESA, IV PS, COLO RIV, FELICITY LEAPS, TE-VS ADDED
WED, JUN 10 2015 15:28
South of Lugo Flows = 4105.0 MW
Bus - VOLTAGE (kV/PU)
Branch - MW/Mvar
Equipment - MW/Mvar
kV: <=30.000 <=230.000 <=345.000 <=500.000 >500.000
24042 ELDORDO
24097 MOHAVE
24801 DEVERS
24151 VALLEYSC
24845 ALBERHILL
24800 COLO RIVER
15021 PALOVRDE
22390 FELICITY
99104 LEAPS
24154 VILLA PK
25201 LEWIS
22344 TALEGA
24025 CHINO
24137 SERRANO
24138 SERRANO
24236 RANCHVST
24092 MIRALOMA
24086 LUGO
24156 VINCENT
26105 VICTORVL

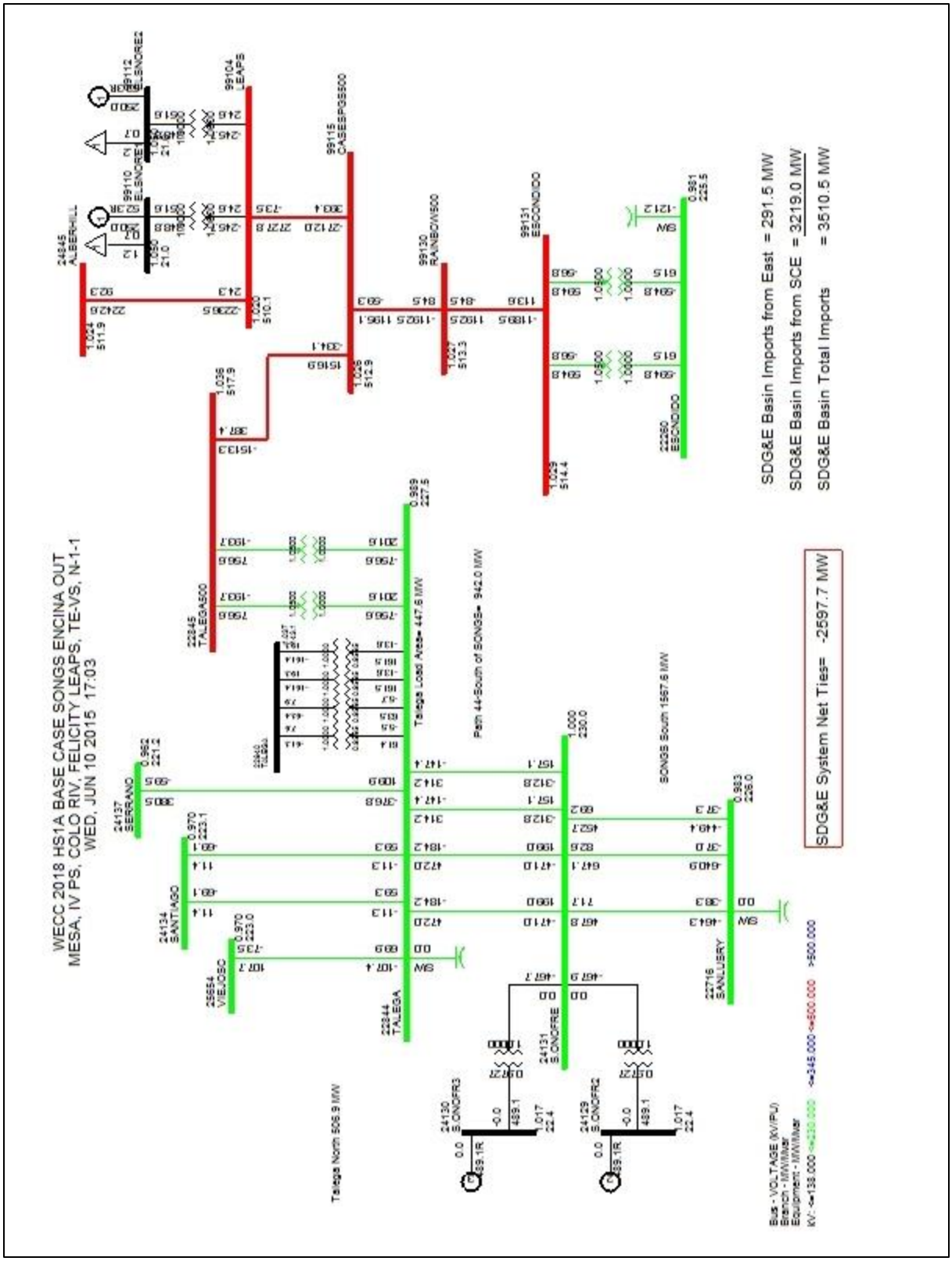
B. Power flow diagrams for 2018 system heavy load

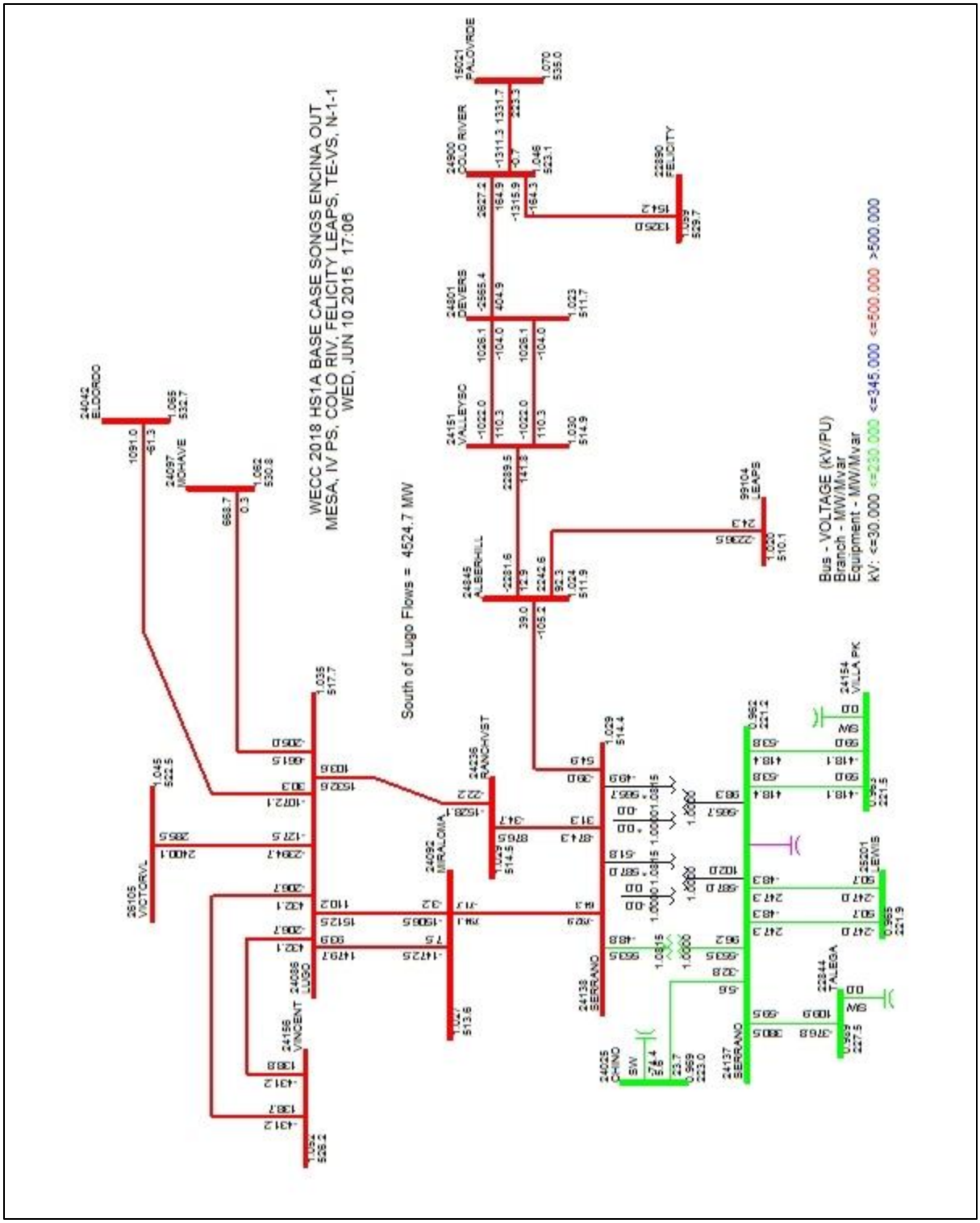
1. Under N-1-1 Contingency Conditions

a) Loss of Imperial Valley-Miguel 500 kV Line

b) Followed by Loss of Imperial Valley-Suncrest 500 kV Line)




WECC 2018 HS1A BASE CASE SONGS ENCINA OUT
MESA, IV PS, COLO RIV, FELICITY LEAPS, TE-VS, N-1-1
WED, JUN 10 2015 17:03
SDG&E Basin Imports from East = 291.6 MW
SDG&E Basin Imports from SCE = 3219.0 MW
SDG&E Basin Total Imports = 3510.5 MW
SDG&E System Net Ties= -2597.7 MW
Path 44-South of SONGS= 942.0 MW
Talega Loss Area= 447.6 MW
SONGS South 1567.6 MW
Talega Norm 506.9 MW
99112 ELSNORE2
99110 ELSNORE1
99104 LEAPS
99115 CASESPGS500
99130 RAINBOW500
99131 ESCNDIDO
24845 ALBERHILL
22360 ESCNDIDO
22845 TALEGA500
24137 SERRANO
24134 SANTIAGO
25654 VIEJOSC
22844 TALEGA
24131 S.ONOFRE
24130 S.ONOFR3
24129 S.ONOFR2
22716 SANLUISRY
Bus - VOLTAGE (kV/PU)
Branch - MW/Mvar
Equipment - MW/Mvar
kV: <=138.000 <=230.000 <=345.000 <=500.000 >500.000


WECC 2018 HS1A BASE CASE SONGS ENCINA OUT
MESA, IV PS, COLO RIV, FELICITY LEAPS, TE-VS, N-1-1
WED, JUN 10 2015 17:06
South of Lugo Flows = 4524.7 MW
Bus - VOLTAGE (kV/PU)
Branch - MW/Mvar
Equipment - MW/Mvar
kV: <=30.000 <=230.000 <=345.000 <=500.000 >500.000

C. Power flow diagrams for2018 system heavy load

1. Under System Normal Conditions, with the following projects added:

a) Mesa Cal 500/230 kV Substation

b) Colorado River Substation

c) Felicity Substation and Felicity-Colorado River 500 kV line

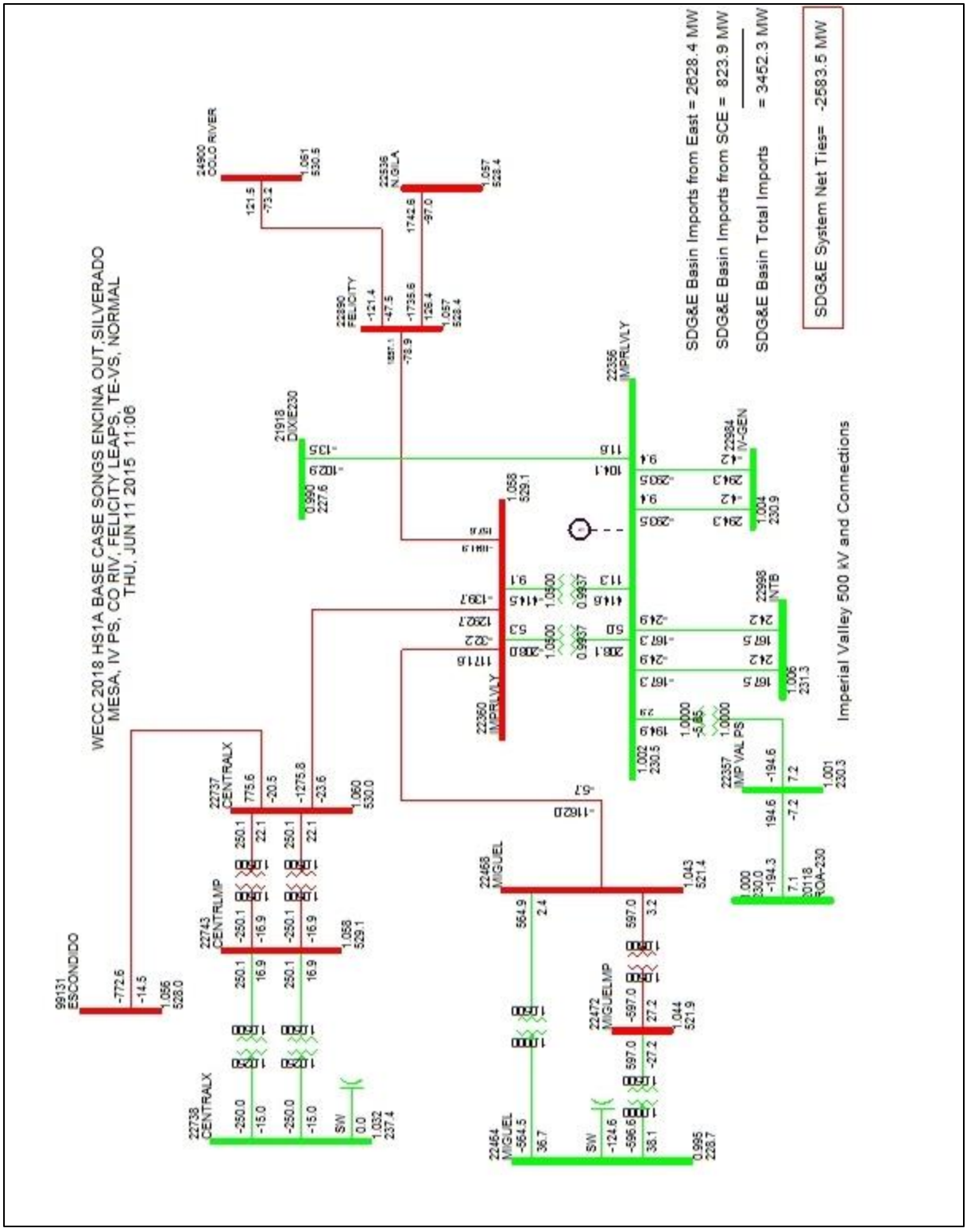
d) Imperial Valley-Rosarita 230 kV Line Phase Shifter

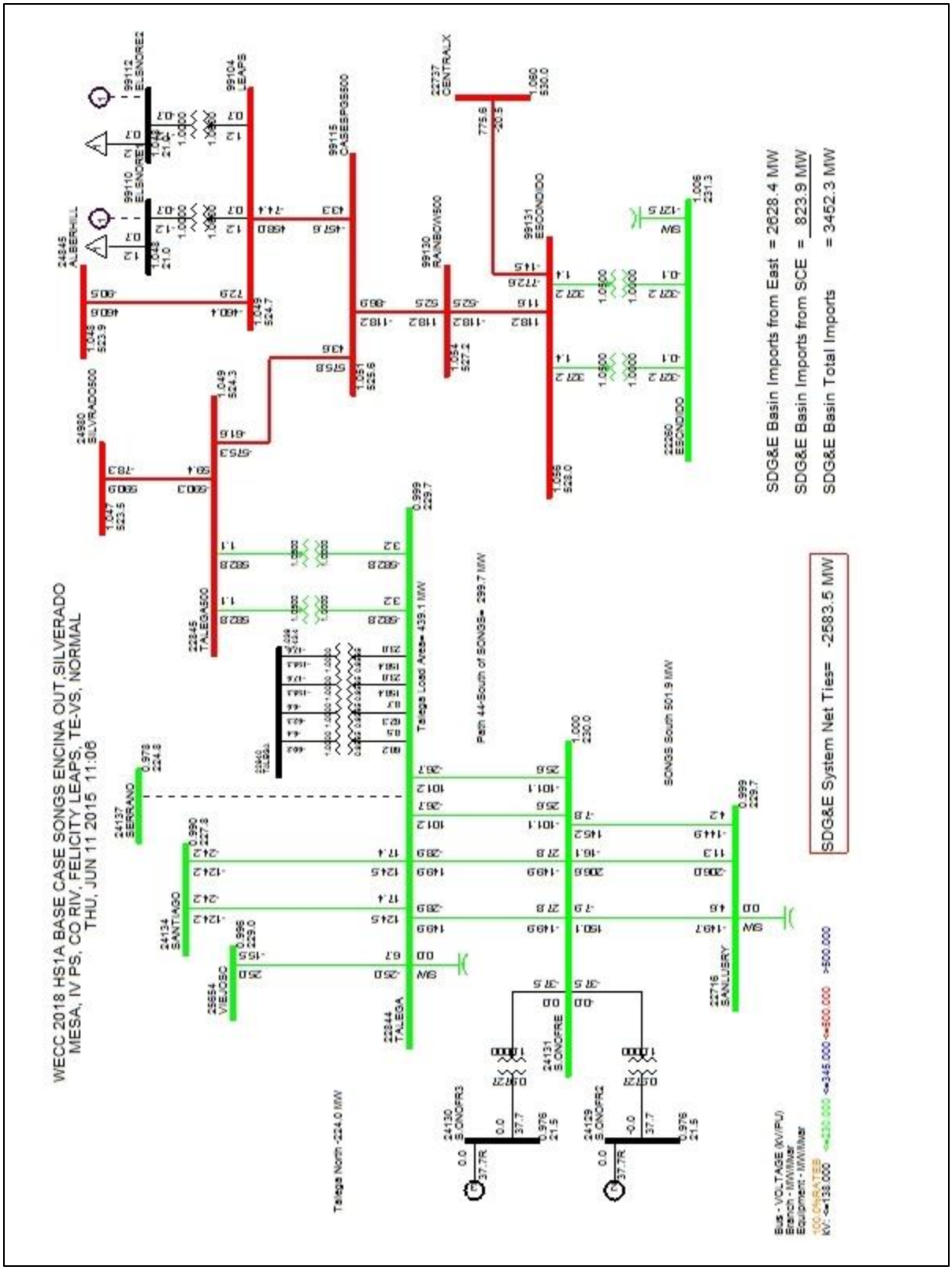
e) LEAPS

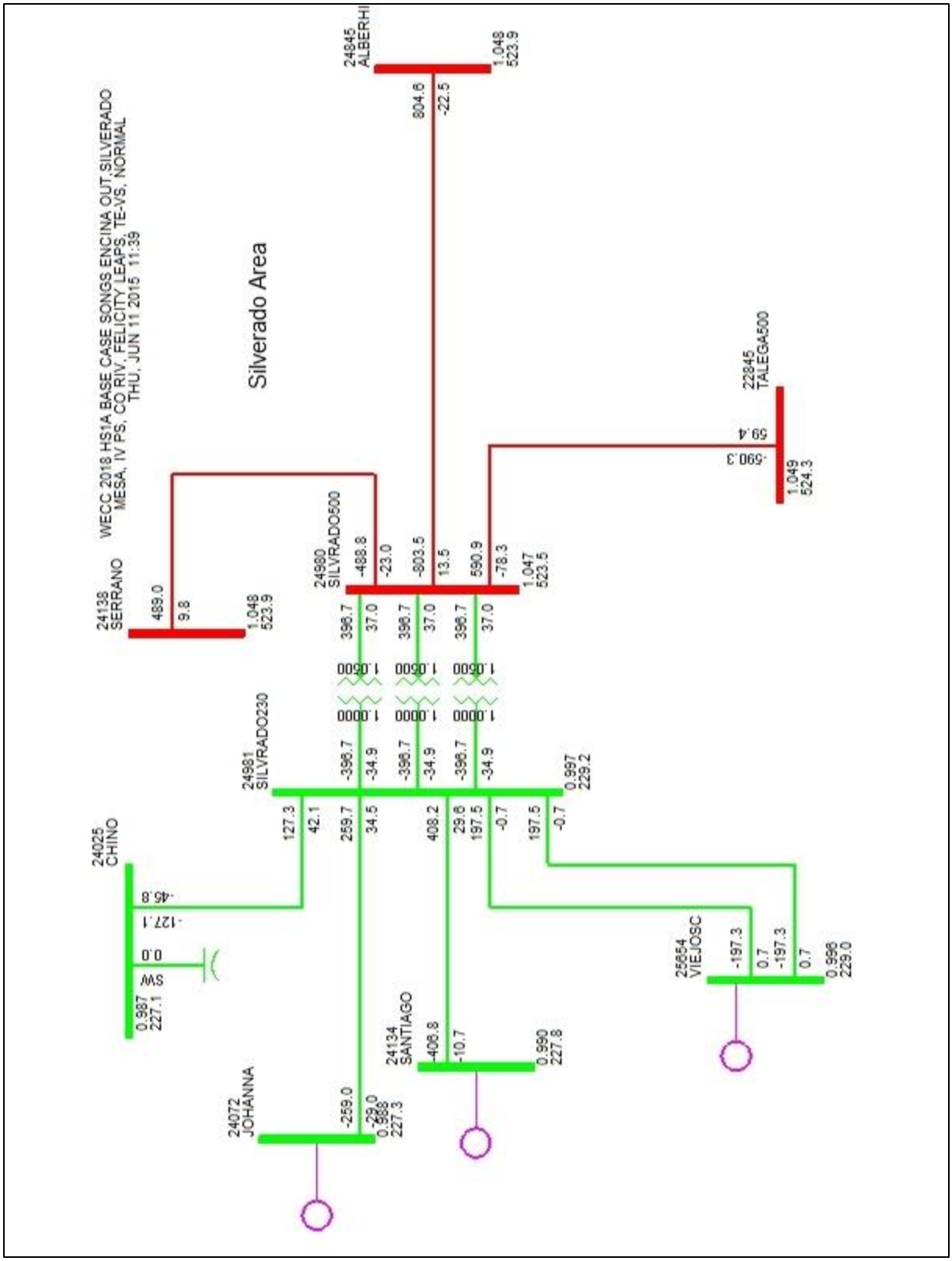
f) Enhanced TE-VS

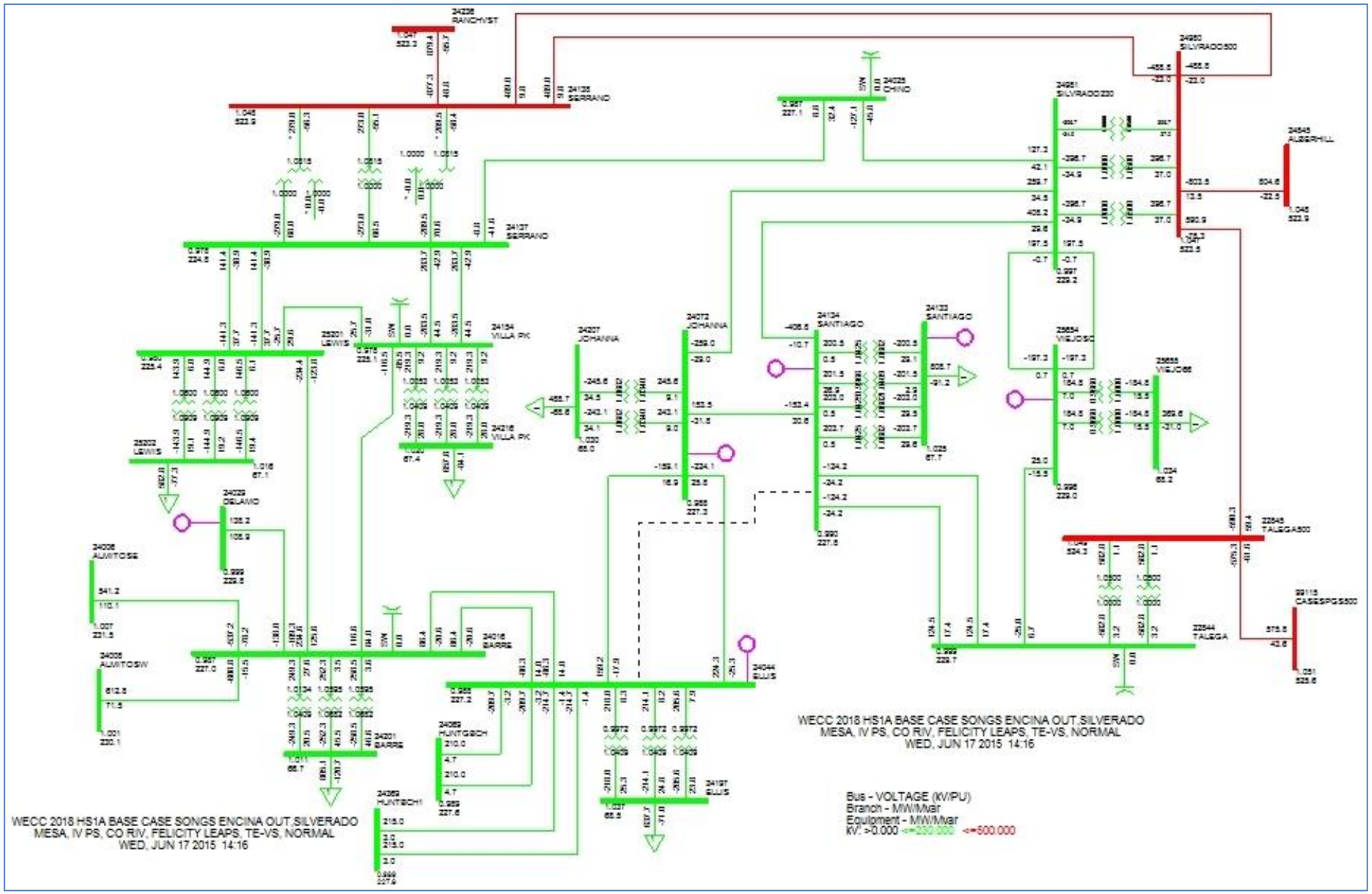
g) Suncrest-Escondido 500 kV Line

h) Silverado 500/230 kV Substation and 230 kV Upgrades


WECC 2018 HS1A BASE CASE SONGS ENCINA OUT,SILVERADO
MESA, IV PS, CO RIV, FELICITY LEAPS, TE-VS, NORMAL
THU, JUN 11 2015 11:06
SDG&E Basin Imports from East = 2628.4 MW
SDG&E Basin Imports from SCE = 823.9 MW
SDG&E Basin Total Imports = 3452.3 MW
SDG&E System Net Ties= -2583.5 MW
Imperial Valley 500 kV and Connections
24900 COLO RIVER
22536 N.GILA
22390 FELICITY
21918 DIXIE230
22356 IMPRLVLY
22984 IV-GEN
22998 INTB
22357 IMP VAL PS
30118 TOA-230
22360 IMPERLVLY
22737 CENTRALX
22743 CENTRLMP
22738 CENTRALX
99131 ESCONDIDO
22468 M/GUEL
22472 M/GUELMP
22464 M/GUEL
SW


WECC 2018 HS1A BASE CASE SONGS ENCINA OUT,SILVERADO
MESA, IV PS, CO RIV, FELICITY LEAPS, TE-VS, NORMAL
THU, JUN 11 2015 11:06
SDG&E Basin Imports from East = 2628.4 MW
SDG&E Basin Imports from SCE = 823.9 MW
SDG&E Basin Total Imports = 3452.3 MW
SDG&E System Net Ties= -2583.5 MW
Path 44-South of SONGS= 299.7 MW
Talega Load Area= 439.1 MW
SONGS South 501.9 MW
Talega North -224.0 MW
99112 ELSNORE2
99110 ELSNORE
99104 LEAPS
99115 CASESPGS500
22737 CENTRALX
99130 RAINBOW500
99131 ESCONDIDO
22360 ESCONDIDO
24845 ALBERHILL
24980 SILVRADO500
22845 TALEGA500
24137 SERRANO
24134 SANTIAGO
25654 VIEJOSC
22844 TALEGA
24131 SONGRE
24130 SONGRR3
24129 SONGRR2
22716 SANLUSRY
Bus - VOLTAGE (KV/PU)
Branch - MW/Mvar
Equipment - MW/Mvar
KV: <=138.000 <=230.000 <=345.000 <=500.000 >500.000


WECC 2018 HS1A BASE CASE SONGS ENCINA OUT,SILVERADO
MESA, IV PS, CO RIV, FELICITY LEAPS, TE-VS, NORMAL
THU, JUN 11 2015 11:39
Silverado Area
24845
ALBERHI
1.048
523.9
804.6
-22.5
22845
TALEGA500
59.4
-590.3
1.049
524.3
24138
SERRANO
469.0
9.8
1.048
523.9
24980
SILVRADO500
-488.8
-23.0
-803.5
13.5
590.9
-78.3
1.047
523.5
396.7
37.0
-396.7
-34.9
24981
SILVRADO230
0.997
229.2
127.3
42.1
259.7
34.5
408.2
29.6
197.5
-0.7
197.5
-0.7
24025
CHINO
-45.8
-127.1
0.0
SW
0.987
227.1
25854
VIEJOSC
-197.3
0.7
0.996
229.0
24134
SANTIAGO
-406.8
-10.7
0.990
227.8
24072
JOHANNA
-259.0
-29.0
227.3


WECC 2018 HS1A BASE CASE SONGS ENCINA OUT,SILVERADO
MESA, IV PS, CO R/V, FELICITY LEAPS, TE-VS, NORMAL
WED, JUN 17 2015 14:16
WECC 2018 HS1A BASE CASE SONGS ENCINA OUT,SILVERADO
MESA, IV PS, CO R/V, FELICITY LEAPS, TE-VS, NORMAL
WED, JUN 17 2015 14:16
Bus - VOLTAGE (kV/PU)
Branch - MW/Mvar
Equipment - MW/Mvar
kV: >0.000 <=230.000 <=500.000

Attachment 4

Notice of Ex Parte Communication by the California Independent System Operator Corporation, PUC Docket R–13–12–010, July 21, 2015

BEFORE THE PUBLIC UTILITIES COMMISSION
OF THE STATE OF CALIFORNIA

Order Instituting Rulemaking to Integrate and Refine Procurement Policies and Consider Long-Term Procurement Plans.	Rulemaking 13-12-010 (Filed December 19, 2013)

NOTICE OF EX PARTE COMMUNICATION BY THE CALIFORNIA INDEPENDENT SYSTEM OPERATOR CORPORATION

Roger E. Collanton
General Counsel
Anthony Ivancovich
Deputy General Counsel
Anna A. McKenna
Assistant General Counsel
Jordan Pinjuv
Counsel
California Independent System Operator Corporation
250 Outcropping Way
Folsom, CA 95630
Tel. 916-351-4429
Fax. 916-608-7222
Email: jpinjuv@caiso.com

Attorneys for the California Independent System Operator Corporation

July 21, 2015

BEFORE THE PUBLIC UTILITIES COMMISSION
OF THE STATE OF CALIFORNIA

Order Instituting Rulemaking to Integrate and Refine Procurement Policies and Consider Long-Term Procurement Plans.	Rulemaking 13-12-010 (Filed December 19, 2013)

NOTICE OF EX PARTE COMMUNICATION BY THE CALIFORNIA INDEPENDENT SYSTEM OPERATOR CORPORATION

Pursuant to Article 8.3 and 8.4 of the California Public Utilities Commission (Commission) Rules of Practice and Procedure, the California Independent System Operator Corporation (CAISO) hereby files this notice of written ex parte communication in the above captioned proceeding.

On July 21, 2015, CAISO Chief Executive Officer and President sent the attached letter to all five Commissioners and their respective Chiefs of Staff and Energy Advisors.

To request a copy of this notice, please contact Anna Pascuzzo (916-351-2212).

Respectfully submitted,

By: /s/ *Jordan Pinjuv*

Roger E. Collanton
General Counsel
Anthony Ivancovich
Deputy General Counsel
Anna A. McKenna
Assistant General Counsel
Jordan Pinjuv
Counsel
California Independent System Operator Corporation

Folsom, CA 95630
Tel. 916-351-4429
Fax. 916-608-7222
Email: jpinjuv@caiso.com

Attorneys for the California Independent System Operator Corporation

Dated: July 21, 2015

ATTACHMENT

California ISO
Shaping a Renewed Future

California Independent System Operator Corporation

Steve Berberich
President & Chief Executive Officer

July 21, 2015

California Public Utilities Commission
505 Van Ness Avenue
San Francisco, CA 94102

Commissioners,

As you know, California is experiencing unprecedented changes in how electricity is generated, delivered and consumed. As increasing amounts of renewable resources come on line, we are encountering new challenges for operating those resources most efficiently. We are already seeing certain times of day when more renewable energy is being generated than there is demand to use it. The Commission and the California ISO have both recognized that increased reliance on renewable resources requires thoughtful changes in policy and innovations in technology.

To this end, the ISO, the Commission and stakeholders have worked together within a number of forums to facilitate the changes necessary to lead the way to a reliable, efficient, low-carbon grid. This collaboration has included joint efforts, such as the Energy Storage Roadmap, and increased alignment in the ISO, Commission and Energy Commission planning and procurement processes.

In the Commission's current LTPP, the ISO has identified over-generation and ramping concerns associated with increased renewable generation. In the spring of 2015, changes to the net load curve outpaced expectations and significant renewable generation additions scheduled for 2016 and 2017 will only expedite the need for fast-ramping and flexible resources to balance the grid that also mitigate over generation conditions.

To meet these growing needs, the ISO and the Commission must be prepared to implement solutions that will allow for the reliable operation of a highly dynamic grid. Energy storage, with its unique ability to both consume excess renewable energy and to quickly inject clean energy back onto the grid to meet ramping and peak demand needs, has the potential to be a cornerstone of the new electric network.

Pumped energy storage, in particular, can be constructed at large scale, with characteristics that are necessary to meet our grid's over-generation and ramping needs. The ISO has begun a preliminary analysis of the benefits of large-scale pumped storage in regards to ramping and curtailment risk based on our 2014 LTPP modeling, and the results are promising. The ISO intends to further incorporate this initial work into its 2015-2016 transmission planning process. The ISO would be pleased to present these results in the context of the Commission's current LTPP in order to move the discussion forward.

In addition, the ISO intends to conduct further study leveraging updated LTPP and TPP standard planning assumptions and scenarios to analyze the benefits of large-scale pumped storage. The intent is to provide a solid, empirical basis to review the benefits of large-scale pumped storage to meet over-generation, ramping and other system needs in the in the 2016 LTPP. The ISO looks forward to sharing this study with the Commission and to using the results to inform potential procurement in the 2016 LTPP.

Please feel free to call me if you would like to discuss this further.

Sincerely,

Steve Berberich
President and Chief Executive Officer

Attachment 5

Presentation - A CAISO Bulk Energy Storage Case Study – Workshop, CPUC/CEC Joint Workshop on Bulk Energy Storage, November 20, 2015 (CEC Docket 15-MISC-05)

DOCKETED

Docket Number:	15-MISC-05
Project Title:	2015 Bulk Storage Workshop
TN #:	206656
Document Title:	Presentation - A CAISO Bulk Energy Storage Case Study - Workshop
Description:	CPUC/CEC Joint Workshop on Bulk Energy Storage, November 20, 2015
Filer:	Collin Doughty
Organization:	California ISO
Submitter Role:	Public
Submission Date:	11/17/2015 12:09:25 PM
Docketed Date:	11/17/2015

A CAISO Bulk Energy Storage Case Study

CPUC/CEC Joint Workshop on Bulk Energy Storage

November 20, 2015

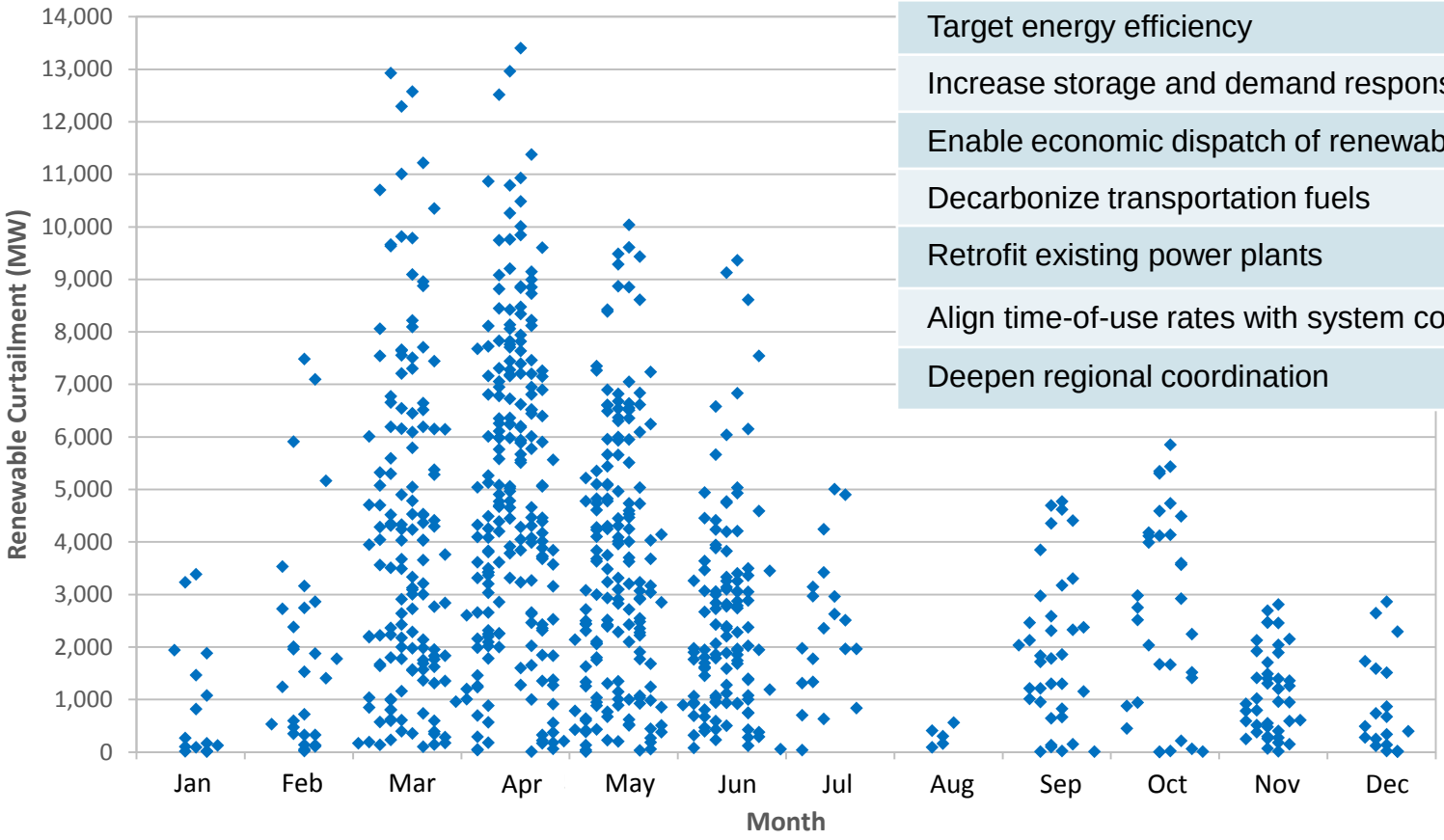
Shucheng Liu

Principal, Market Development

About the 2014 Long-Term Procurement Plan (LTPP) study conducted by the CAISO

- The study follows the CPUC 2014 LTPP Planning Assumptions and Scenarios
- In 2014, the CAISO studied four scenarios and one sensitivity
  - Trajectory scenario
  - High Load scenario
  - Expanded Preferred Resources scenario
  - 40% RPS in 2024 scenario
  - Trajectory without Diablo Canyon sensitivity case

The study identified large quantity of renewable curtailment in the 40% RPS in 2024 scenario.



Solutions
Target energy efficiency
Increase storage and demand response
Enable economic dispatch of renewables
Decarbonize transportation fuels
Retrofit existing power plants
Align time-of-use rates with system conditions
Deepen regional coordination

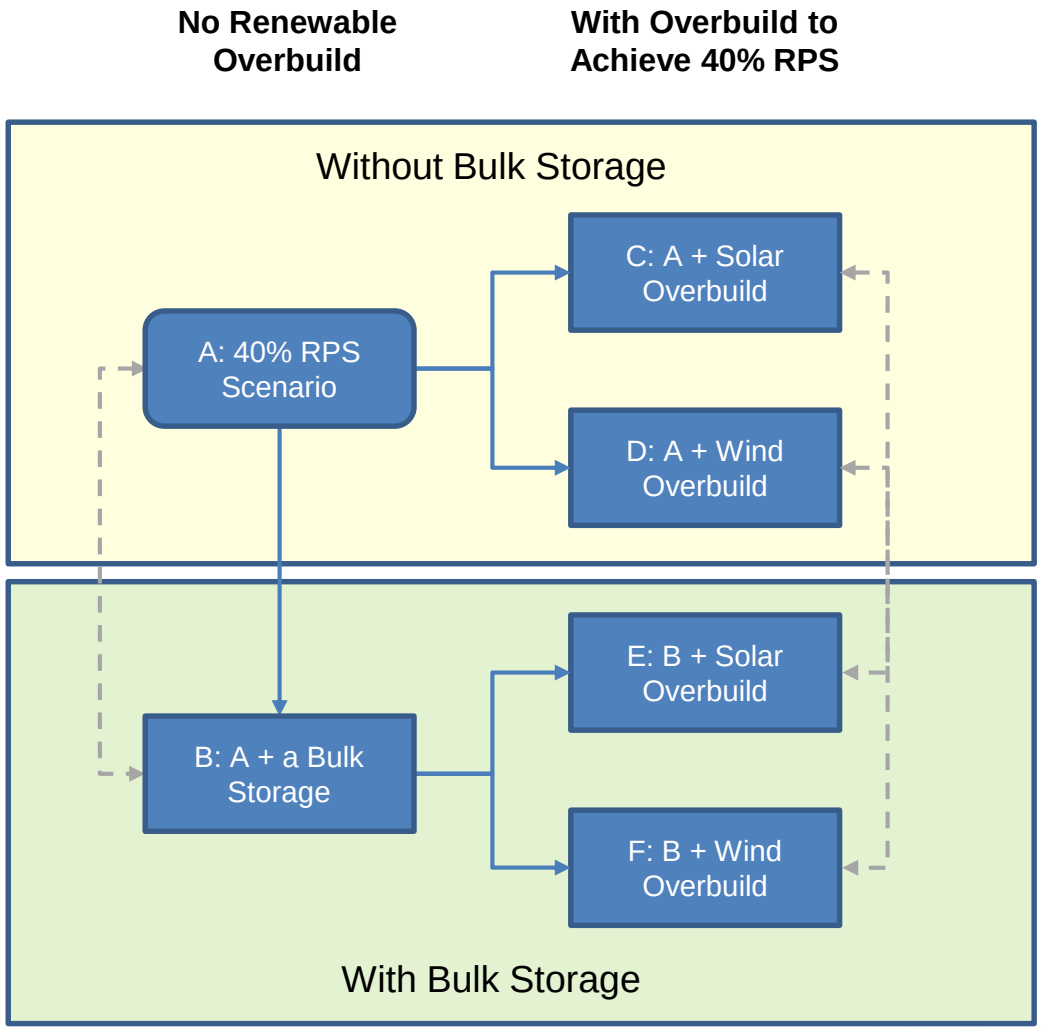
Purpose of the CAISO bulk energy storage case study

- To explore solutions to curtailment of large quantity of renewable generation
- To assess a bulk storage resource's ability to reduce
  - production cost
  - renewable curtailment
  - CO2 emission
  - renewable overbuild to achieve the 40% RPS target
- To analyze the economic feasibility of the bulk storage resource
  - More comprehensive analyses will be performed with 50% RPS

Study approach

- Based on the 2014 LTPP 40% RPS in 2024 Scenario with renewable curtailment remaining unlimited
- Analyses will compare two renewable build baselines, with and without the new bulk storage resource:
  - No overbuild of renewable resources
  - Overbuild renewables to achieve the 40% RPS target
- Overbuild of renewable with solar or wind
  - Demonstrate the benefits of more diversified RPS portfolios

Definition of the study cases and expected takeaways



This study quantifies

- reduction of production cost renewable curtailment and CO2 emission,
- quantity and cost of renewable overbuild
- cost and market revenue of the bulk storage

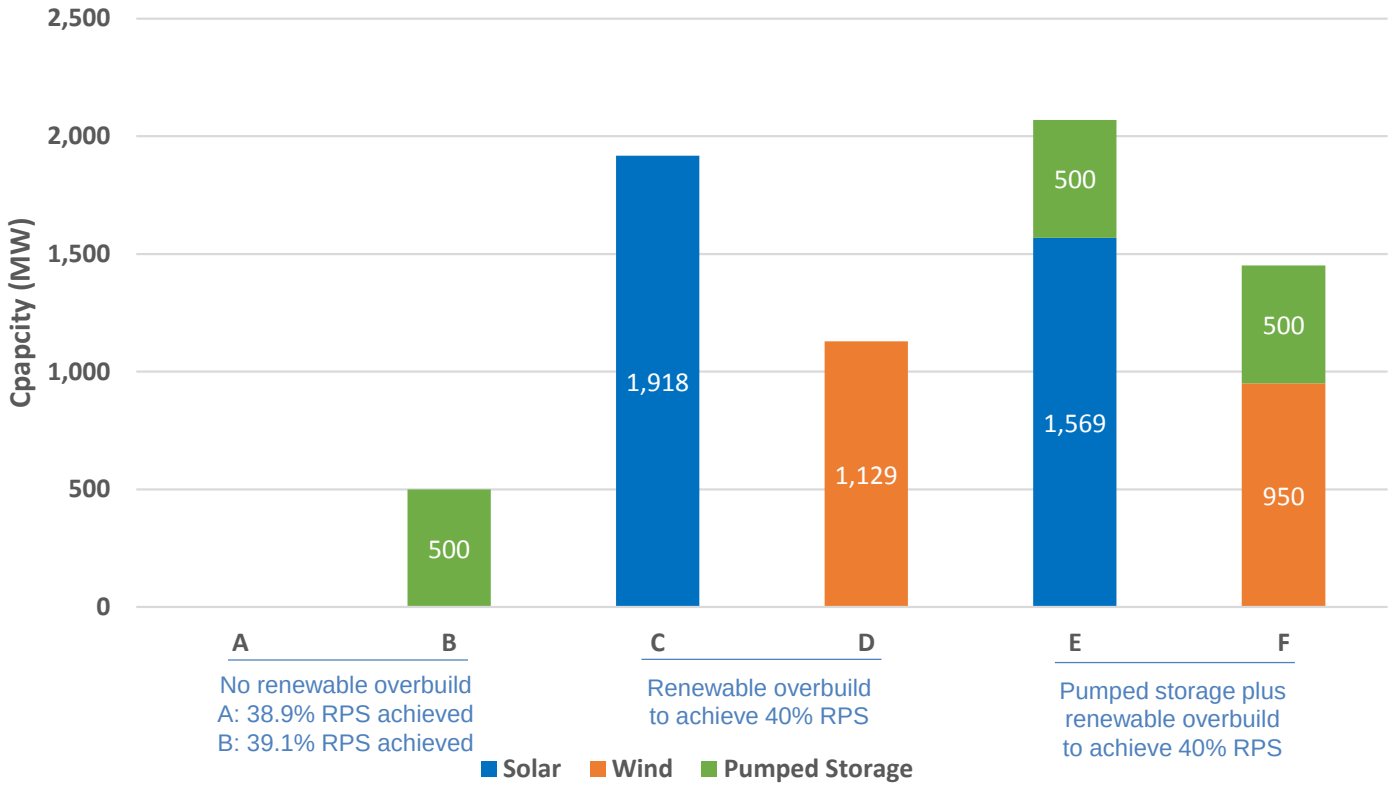
It does not quantify

- transmission impact

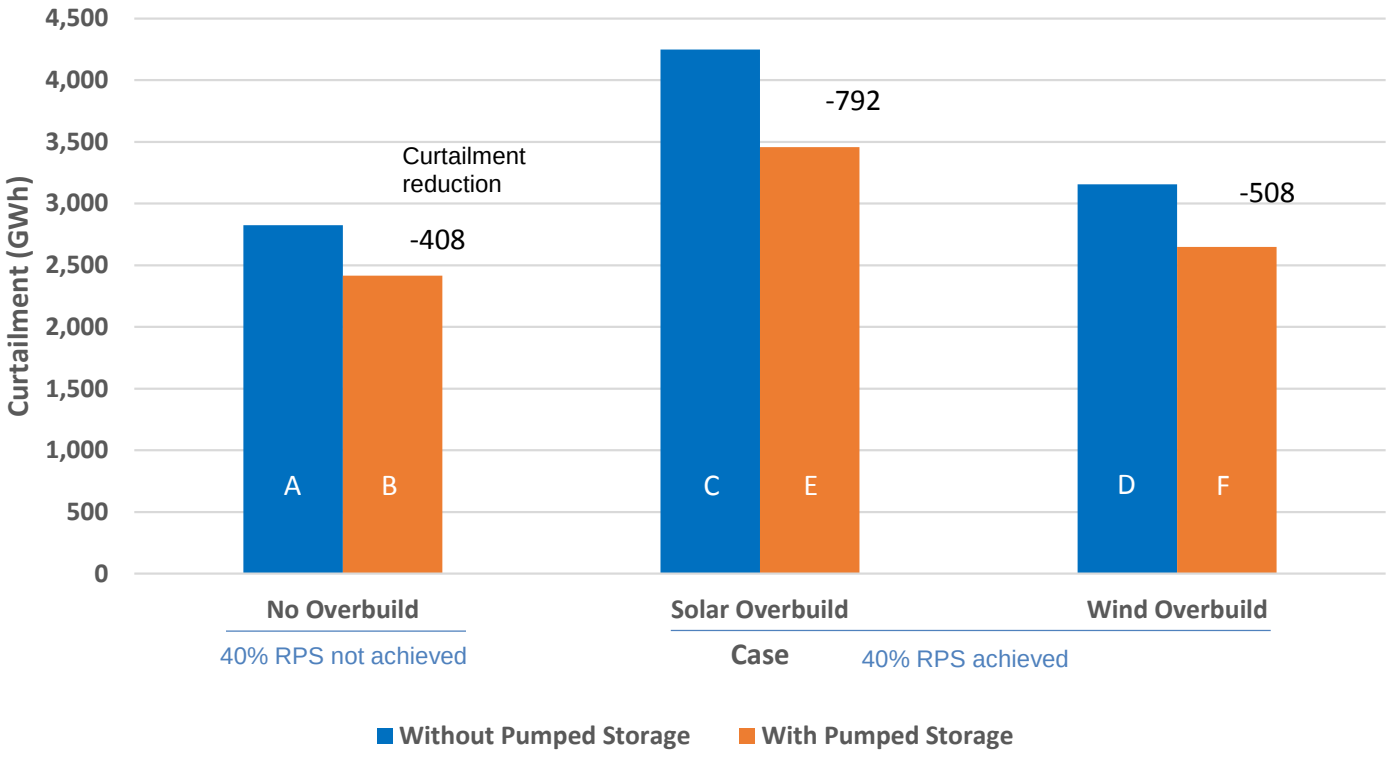
Assumptions of the new pumped storage resource

Item	Value
Number of units	**2**
Max pumping capacity per unit (MW)	**300**
Minimum pumping capacity per unit (MW)	75
Maximum generation capacity per unit (MW)	**250**
Minimum generation capacity per unit (MW)	5
Pumping ramp rate (MW/min)	**50**
Generation ramp rate (MW/min)	**250**
Round-trip efficiency	**83%**
Maintenance rate	8.65%
Forced outage rate	6.10%
Upper reservoir maximum capacity (GWh)	8
Upper reservoir minimum capacity (GWh)	2
Interval to restore upper reservoir water level	Monthly
Pump technology	**Variable speed**
Reserves can provide in generation and pumping modes	**Regulation, spinning and load following**
Reserves can provide in off modes	**Non-spinning**
Location	Southern California

Capacity of renewable overbuild to achieve the 40% RPS target

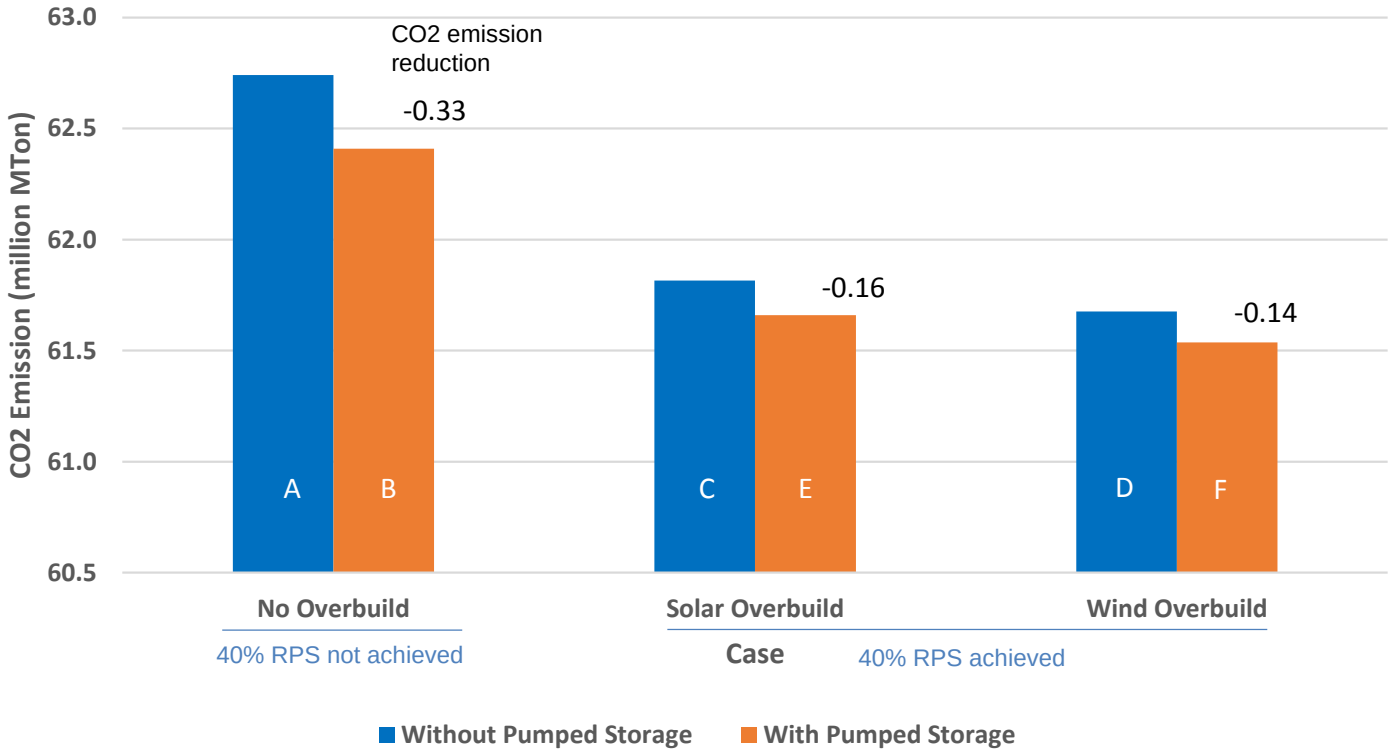


California renewable generation curtailment



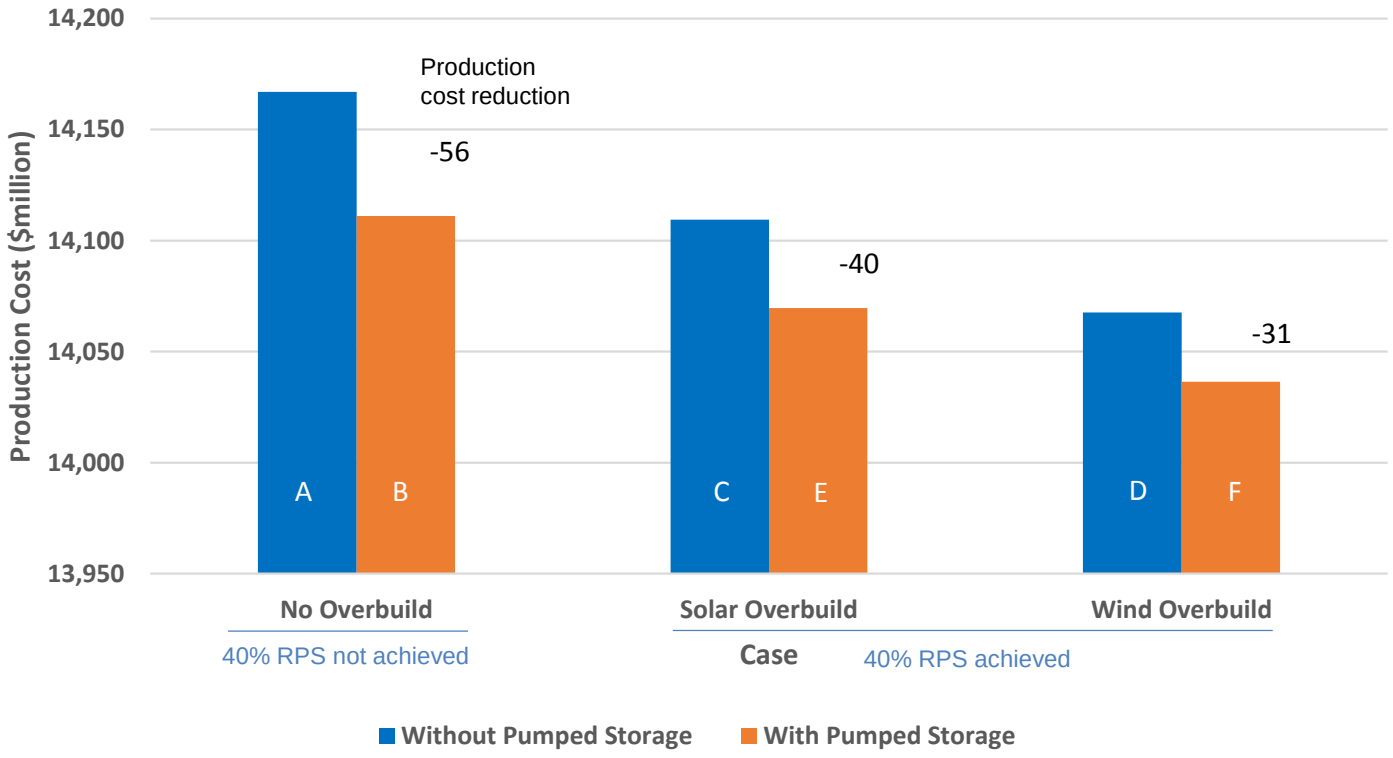
* Renewable generation is curtailed at -$300/MWh market clearing price (MCP).

California CO2 emission



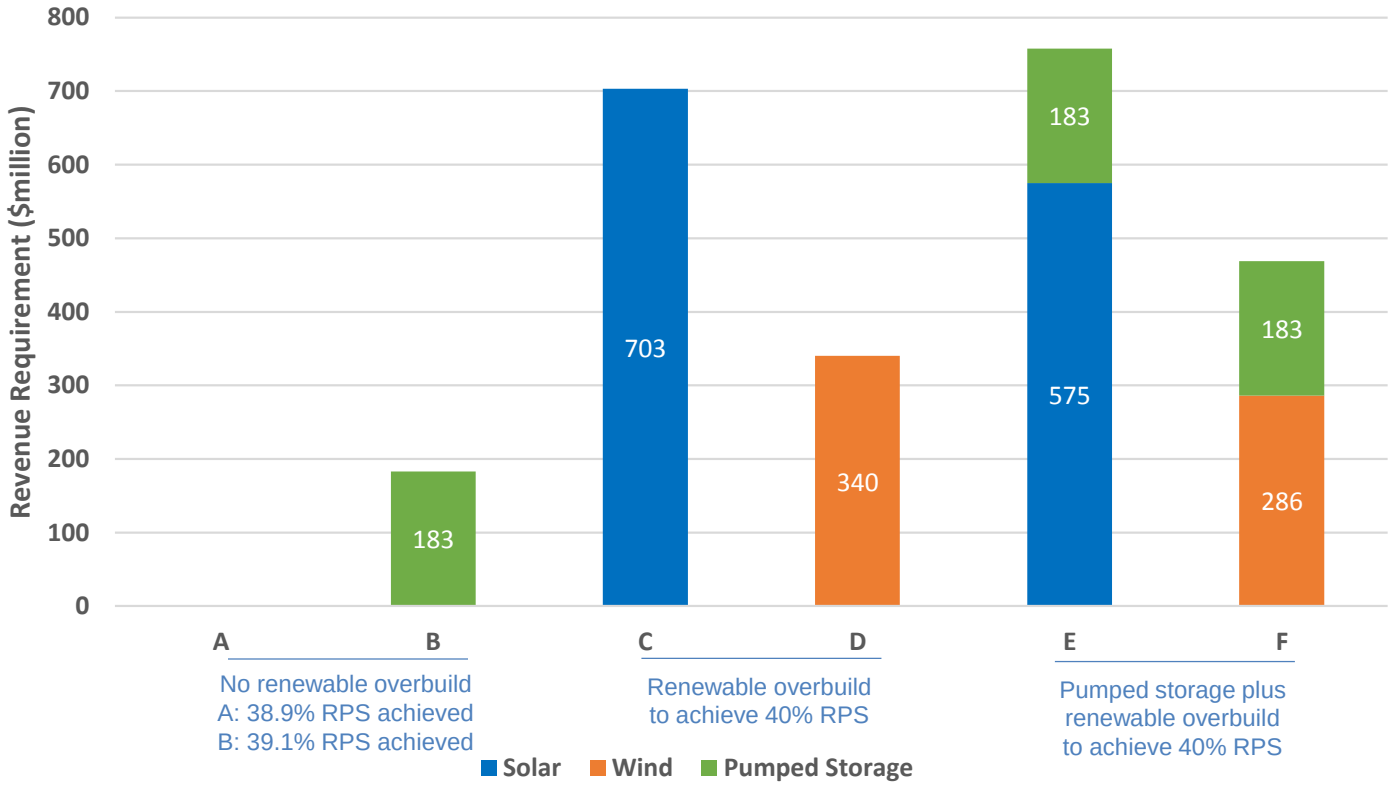
** California CO2 emission includes the emission from energy net import.

WECC annual production cost

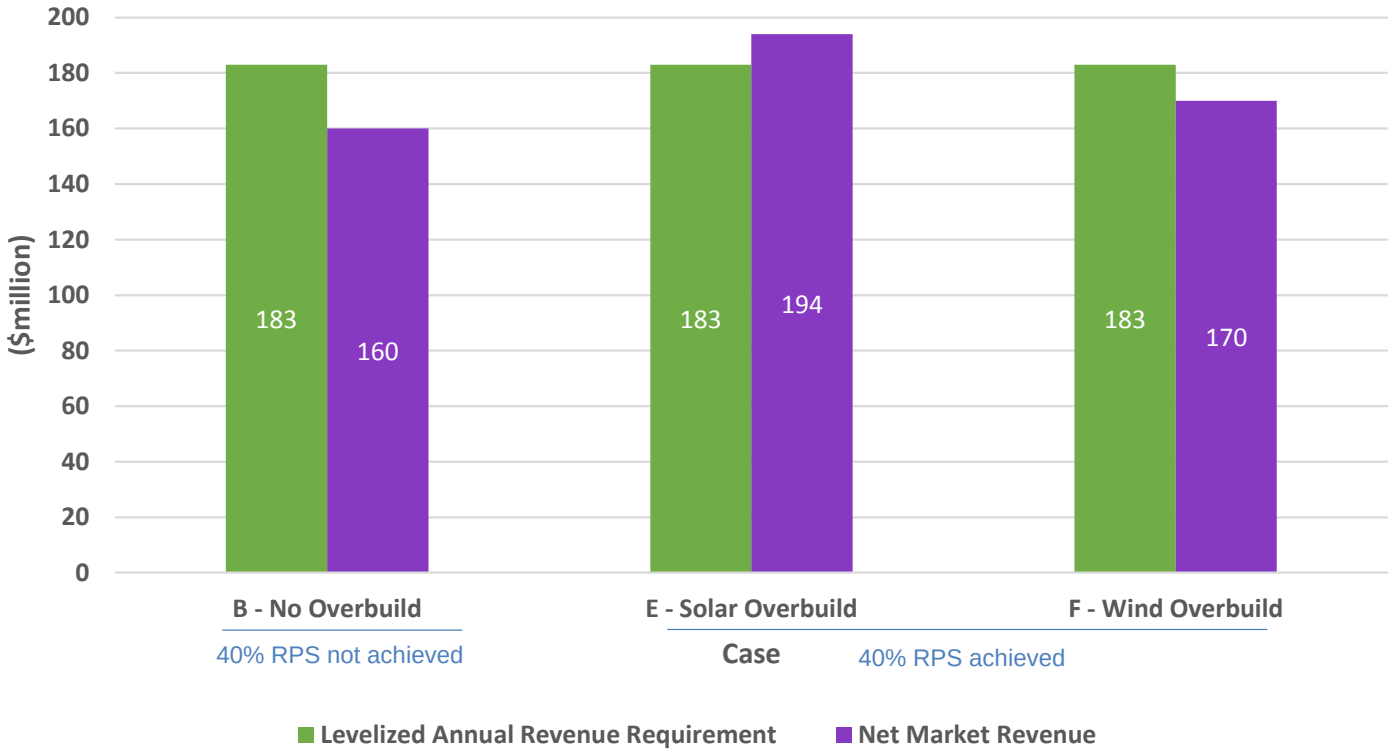


**** Production cost includes start-up, fuel and VOM cost, not CO2 cost.

Renewable overbuild and pumped storage levelized annual revenue requirements



Pumped storage levelized annual revenue requirement and net market revenue of 2024



***** Net revenue is revenue from generation, reserves and load following minus cost of operation and energy consumed.

Some observations

- Original 40% RPS portfolio is solar-dominant (53% in capacity)
- Wind overbuild increases diversity of the RPS portfolio and shows more benefits than solar overbuild
  - Requires less overbuild than solar due to less incremental curtailment from the overbuild
  - Has lower CO2 emission and production costs than solar due to less steep ramping

Some observations (cont.)

- Bulk storage brings benefits in all cases
  - Reduced curtailment, CO2 emission, production costs and overbuild of renewables to achieve the 40% RPS target
- Bulk storage is better utilized with solar-dominant RPS portfolio than wind
  - Capturing more renewable curtailment in midday
  - Moving more energy to the evening and morning
  - Reducing more production cost and CO2 emission

Some observations (cont.)

- Bulk storage benefit to cost ratios dependent on
  - Storage costs
  - Mix of renewable resources
  - Renewable curtailment price
  - Other assumptions

Next steps

- Perform additional analysis with following model updates:
  - A 50% RPS portfolio from the RPS Calculator v6.1
  - 2025 Load and DG PV forecast from the 2014 IEPR forecast
  - A frequency response requirement replacing the 25% minimum local generation requirements
  - Allowing renewable to provide a portion of load following-down
  - Increased net export capability
- Continue to collect information and refine economic analysis of the bulk storage

Preliminary results by case

	Without Pumped Storage			With Pumped Storage		
Case	A	C	D	B	E	F
Renewable Curtailment (GWh)*	2,825	4,249	3,157	2,417	3,457	2,649
CA CO2 Emission (Million Ton)**	62.74	61.82	61.68	62.41	61.66	61.54
CA CO2 Emission ($ mil)***	1,460	1,438	1,435	1,452	1,435	1,432
Production Cost ($ mil)****						
WECC	14,167	14,109	14,068	14,111	14,070	14,037
CA	3,866	3,826	3,795	3,803	3,779	3,751
Renewable Overbuild and Pumped Storage Capacity (MW)						
Solar		1,918			1,569	
Wind			1,129			950
Pumped Storage				500	500	500
Levelized Annual Revenue Requirement of Renewable Overbuild and Pumped Storage ($ mil)						
Solar		703			575	
Wind			340			286
Pumped Storage				183	183	183
Pumped Storage Net Market Revenue ($ mil) *****				160	194	170

* Renewable generation is curtailed at -$300/MWh market clearing price (MCP)
** Includes the CO2 emission from net import.
*** Calculated using $23.27/m-ton price.
**** Includes start-up, fuel and VOM cost, not CO2 cost.
***** Net revenue is revenue of energy, reserves and load following minus cost of energy and operation.