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Commissioner	:	Dian Grueneich
Admin. Law Judge	:	Steven Weissman
DRA Witness	:	Zaininger

DIVISION OF RATEPAYER ADVOCATES
CALIFORNIA PUBLIC UTILITIES COMMISSION

A.06-08-010

REPORT ON THE SUNRISE POWERLINK

San Diego Gas & Electric Company (SDG&E)

Phase 1 Direct Testimony
Volume 2 of 5

San Francisco, California
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1 INTRODUCTION

My name is Mr. Henry Zaininger and I am President of Zaininger Engineering Company. My qualifications are provided in Appendix A to the Volume. In this chapter, I present the results of my independent review and assessment of several transmission expansion alternatives to the Sunrise Powerlink.

2 DESCRIPTION OF TRANSMISSION ALTERNATIVES

The following potential transmission expansion alternatives to the Sunrise Powerlink were analyzed by the San Diego Gas and Electric (SDG&E) in its Supplemental Testimony.[1]

2.1 Mexico-Lite

The "Mexico-Lite" transmission alternative suggested by Utility Consumers Action Network (UCAN) is described and analyzed by SDG&E beginning on Page 26. The intent of the proposed UCAN Mexico-Lite plan is to change several existing special protection schemes (SPS's) that now operate for the loss of the Imperial Valley – Miguel 500 kilovolt (kV) line and add new SPS's to provide additional import capability into San Diego under N-1 contingency conditions. Specifically, the Mexico-Lite option would consist of developing appropriate SPS's to first trip off certain generation and transmission facilities near Imperial Valley properly after the loss of the Imperial Valley – Miguel 500 kV line, then – assuming these initial existing SPS's work correctly – implement additional SPS's to require some of the tripped-off generation from the initial SPS's to be restarted and some initially out-of-phase transmission to be reconnected. If all aspects of the new set of SPS's worked correctly, the San Diego area would receive an additional 165 MW of import capacity during N-1 contingency conditions.

2.2 SONGS-Lite and SONGS-Heavy

The "SONGS-Lite" and "SONGS-Heavy" transmission alternatives suggested by UCAN are described and analyzed by SDG&E beginning on Page 32 of its Supplemental Testimony.[2]

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[1] Application (A.) 06-08-010, SDG&E, *Chapter VII Supplemental Testimony*, January 26, 2007

[2] "SONGS" is the acronym for the San Onofre Nuclear Generating Station. Power flows into San Diego through the SONGS Substation over the "South of SONGS" transmission path.

SONGS-Lite consists of looping the existing Southern California Edison (SCE) SONGS – Viejo 230 kV line into SDG&E's Talega substation to create a third SONGS – Talega 230 kV line and a new Talega – Viejo 230 kV line.

SONGS-Heavy consists of SONGS-Lite plus the addition of a second Talega – Escondido 230 kV line and a fourth SONGS – San Luis Rey 230 kV line using unstrung positions on existing double circuit transmission towers.

2.3 Second SWPL

The Second Southwest Powerlink (Second SWPL) transmission alternative is described and analyzed by SDG&E beginning on Page 34 of its Supplemental Testimony.

The Second SWPL consists of a second Imperial Valley – Miguel 500 kV line paralleling the existing 500 kV line, plus more than ten associated transmission facility upgrades in the vicinity to handle the resulting increased power flows associated with the resulting increase in SDG&E import capability.

2.4 Lake Elsinore Advanced Pumped Storage (LEAPS)

The Lake Elsinore Advanced Pumped Storage (LEAPS) project, including transmission facilities that would further interconnect the SCE and SDG&E power systems, is described and analyzed by SDG&E beginning on Page 23 of its Supplemental Testimony.

LEAPS consists of the following components to connect the pumped storage plant to SCE and SDG&E, plus more than 20 additional associated transmission facility upgrades in the SDG&E system to handle the resulting increased power flows associated with the resulting increase in SDG&E import capability.

- A new Lee Lake 500 kV switching station
- A loop-in of existing Valley – Serrano 500 kV line into Lee lake switching station

- A new Lee lake – Lake Elsinore 500 kV line
- A new Lake Elsinore substation including two pumped storage units and two step-up transformers
- A new Lake Elsinore – Camp Pendleton 500 kV line
- A 500/230 kV Camp Pendleton substation including two 500/230 kV transformers and two 230 kV phase shifters
- A loop-in of existing Talega – Escondido 230 kV line into Camp Pendleton substation, which would create a Talega – Camp Pendleton 230 kV line and a Camp Pendleton – Escondido 230 kV line
- A new second Talega – Camp Pendleton 230 kV circuit and a second new Camp Pendleton – Escondido 230 kV circuit

2.5 Green Path North

Green Path North, suggested as a transmission alternative to the Sunrise Powerlink by several intervenors, is described and analyzed by SDG&E beginning on Page 36 of its Supplemental Testimony.

Green Path North consists of the following transmission components to deliver power from generation located in Imperial Valley to Los Angeles Department of Water and Power (LADWP) and to connect to SCE at the Devers substation.

- A new Hesperia 500/287 kV substation
- A new Indian Hills 500/230 kV substation
- A new Devers II – Hesperia 500 kV line
- A new Devers II – Indian Hills 500 kV line
- A re-routing of the existing Victorville-Century 287 kV line to create the Hesperia – Victorville 287 kV and Hesperia – Century 287 kV lines
- An upgrade of the Hesperia – Victorville 287 kV line to 500 kV

3 ALTERNATIVES POSSIBLY MEETING LOCAL RELIABILITY NEED

My testimony concerning the Sunrise Powerlink and potential transmission alternatives is based the following system planning perspective:

- First, to meet local SDG&E reliability needs the transmission alternatives should ensure similar levels of reliable service[3] to customers in the SDG&E service area, considering the whole decade from 2010 to 2020.
- Second, the relative capital investments (CI) of the transmission alternatives are considered.
- Third, the flexibility of the transmission alternatives to be part of potential bulk power system expansion plans to meet potential local SDG&E reliability needs in the future after 2020 is also considered.

3.1 Sunrise Powerlink

The Sunrise Powerlink transmission project increases the local SDG&E service area import capability from 2,850 MW to 4,200 MW during normal (N-0) no contingency conditions, and from 2,500 MW to 3,500 MW during credible contingency (G-1, N-1) conditions[4]. The project CI is $1,265 Million.

Considering the future after 2020, the Sunrise Powerlink would be a portion of the "Full Loop"[5] transmission expansion alternative. Adding the Sunrise Powerlink project results in SDG&E being served by two 500 kV lines. The Sunrise Powerlink provides the flexibility to complete the Full Loop, which essentially will result in SDG&E being served by three 500 kV lines, which should further increase the SDG&E import capability if and when such capacity were needed or economical.

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[3] A.06-08-010, SDG&E, *Sunrise Powerlink Transmission Project Purpose and Need*, Volume 2, Chapter II Reliability, August 4, 2006, CAISO Grid Planning Standards, pp II-5 to II-6.

[4] A.06-08-010, SDG&E, *Chapter VII Supplemental Testimony*, January 26, 2007, Table 6, p23.

[5] A.06-08-010, SDG&E, *Sunrise Powerlink Transmission Project Purpose and Need*, Volume 2, Chapter VI Alternatives, August 4, 2006, pp VI-2 to VI-3.

Another location-specific benefit is that the Sunrise Powerlink project also provides for the reliable delivery of more than 1,900 MW of power from Imperial Valley to the SDG&E service area, allowing for an (N-1) outage of either the existing SWPL[6] or Sunrise[7] lines.

3.2 Second SWPL

The Second SWPL transmission project increases the local SDG&E service area import capability from 2,850 MW to 3,500 MW during normal (N-0) no contingency conditions, and assuming an N-2 credible contingency the import capability remains at 2,500 MW[8]. SDG&E presents their reasoning for adopting an N-2 credible contingency in their supplemental testimony on Pages 34 and 35 and in their response to UCAN data request 2-99. The reasoning behind the (more restrictive) N-2 credible outage criteria is that the two SWPL lines would be in close proximity for a long distance in an area subject to wild fires, and that the existing SWPL line has experienced more than two outages per year over the past 10 years. However, in their response to UCAN 2-99, they further state that adopting this more restrictive N-2 credible contingency criterion is *not* required by WECC for two parallel transmission lines not on common towers.

The estimated Second SWPL project CI is $785 Million - $469 Million for the 500 kV line plus $317 Million for the more than ten associated transmission facility upgrades. The Second SWPL alternative cost estimate is significantly less (about $500 Million less CI) than Sunrise. Note the cost estimate for the associated transmission facility upgrades are conceptual in nature, and presumably less certain, than estimates of Sunrise's cost.

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[6] A.06-08-010, SDG&E response to UCAN Data Request 7-1 presents a 2,364 MVA continuous rating and emergency rating of 2,727 MVA for SWPL.

[7] A.06-08-010, SDG&E response to UCAN Data Request 7-139 presents a 2,252 MW continuous rating and emergency rating of 2,598 MW for Sunrise.

[8] A.06-08-010, SDG&E, *Chapter VII Supplemental Testimony*, January 26, 2007, Table 6, p. 23, pp34-35.

SDG&E has evaluated the increase in import capability with the Second SWPL added, and with and without assuming the N-2 common corridor outage criteria in a confidential report[9] obtained in SDG&E's response to DRA Data Request 3-1. This report explains the basis for the above SDG&E import limits assuming the N-2 credible contingency criteria. It also indicates that local SDG&E service area import capability can be increased from 2,850 MW to 4,200 MW during normal (N-0) no contingency conditions, and from 2,500 MW to 3,500 MW during credible contingency (G-1, N-1) conditions, the same as Sunrise Powerlink, without the N-2 credible contingency assumption.

In my opinion, the requirement to employ the N-2 credible contingency criteria should be reviewed further as this assumption is not actually required for the Second SWPL alternative. Employing the more restrictive N-2 credible contingency criteria is a judgment call, and may be overly conservative.

In particular, potential line outages caused by wild fires would be predictable in advance. If a wild fire occurs and approaches the SWPL lines, there is time to prepare the system by employing a "wild fire watch operating strategy." For example, in case a wild fire threatened either or both SWPL lines, there would be time to start up generation in the San Diego service area and reduce imports to levels such that no load would have to be tripped for an N-2 outage. Based on the past ten years experience with the existing SWPL, this wild fire operating strategy would only be required a couple times per year. The rest of the time the system import levels could be the same as for the Sunrise Powerlink option. In addition, fire risk analysis of transmission routes near the existing SWPL is being performed by the Commission and Bureau of Land Management[10]. These studies should indicate portions of the route where the fire risk is high, and the Second SWPL line could be moved away from the existing line in these locations to increase

[9] CONFIDENTIAL, SDG&E, *Second Southwest Powerlink Power Flow Screening Analysis*, Draft, January 12, 2007.

[10] SDG&E Sunrise Powerlink Project, *CPUC/BLM Notice Regarding Conclusions on EIR/EIS Alternatives to the Proposed Sunrise Powerlink Project, Results of the Second Scoping Process*, Final Notice – March 16, 2007, Page 19.

reliability if desired. Given the half-billion dollar difference between the costs of the Sunrise Powerlink and the Second SWPL, these possibilities are worth further consideration by the Commission.

Considering the future after 2020, the Second SWPL is not as flexible for future potential transmission expansion as the Sunrise Powerlink option. Like the Sunrise Powerlink, the Second SWPL results in SDG&E being served by two 500 kV lines. However, adding the Second SWPL will likely maximize the SDG&E import capability through Miguel. After 2020, adding additional import capability – if and when needed or economical – would likely have to come from some other corridor. Note, if the LEAPS pumped storage project were implemented, this would provide a third 500 kV line interconnection from the North.

Like the Sunrise Powerlink option, the Second SWPL alternative also provides for the reliable delivery of more than 1,900 MW of power from Imperial Valley to the SDG&E service area, allowing for an (N-1) outage of either SWPL line, assuming the normal and emergency ratings for the Second SWPL line are similar to the existing SWPL line ratings.

3.3 LEAPS

The LEAPS project transmission alternative increases the local SDG&E service area import capability from 2,850 MW to 4,100 MW during normal (N-0) no contingency conditions, and from 2,500 MW to 3,300 MW during credible contingency (G-1, N-1) conditions[11].

[11] A.06-08-010, SDG&E, *Chapter VII Supplemental Testimony*, January 26, 2007, Table 6, p23, pp23-26. However, subsequent CAISO analyses have arrived at different estimates of the import capacity LEAPS transmission component would provide.

The estimated LEAPS project CI is $3,474 Million – $1,578 Million for the pumped storage facilities and transmission facilities to connect the pumped storage units to SCE and SDG&E described previously plus $1,896 Million for the more than twenty associated SDG&E system transmission facility upgrades. The LEAPS pumped storage alternative cost estimate is significantly higher than Sunrise. The SDG&E response to UCAN Data Request 6-52 indicates that they are not aware of any studies of the LEAPS transmission only alternatives addressing SDG&E reliability needs. However, CI cost estimate for the (more than 20) associated projects to distribute the LEAPS power into the SDG&E system alone are over $600 Million more than the total Sunrise Powerlink option without considering the cost of the LEAPS transmission facilities presented earlier. Note the cost estimate for the associated transmission facility upgrades are conceptual in nature, and presumably less certain, than the estimates of Sunrise's cost.

Considering the future after 2020, the LEAPS project would be a portion of the "Full Loop" transmission expansion alternative. Like the Sunrise Powerlink option, adding the LEAPS project results in SDG&E being served by two 500 kV lines. The LEAPS project provides the flexibility to complete the full loop from Imperial Valley with future transmission additions. This essentially will result in SDG&E being served by three 500 kV lines, which should further increase the SDG&E import capability if and when if is needed or economical.

The LEAPS project does not provide a direct connection between generation located near Imperial Valley and the SDG&E service area like the Sunrise Powerlink option. However, the LEAPS transmission alternative will provide an indirect path for the delivery of power from Imperial Valley to the SDG&E service area via IID to SCE transmission facilities.

In my opinion, the benefits of the LEAPS project will not just be based on its value as a transmission line, but also be heavily influenced by the merits of its pumped storage

component. If LEAPS can be justified on the combined merits of these two components, it could then provide additional import capability levels into SDG&E similar to those provided by the Sunrise Powerlink.

4 ALTERNATIVES NOT MEETING LOCAL RELIABILITY NEED

4.1 Mexico-Lite

Mexico-Lite results in no increase in SDG&E import capability during normal everyday conditions and a potential 165 MW additional import capability during G-1, N-1[12] credible outage design conditions.

I am doubtful about the value of Mexico-Lite. For it to provide import capacity, the existing SPS's would first need to work correctly, which means that certain generation and transmission facilities would need to trip off properly after a disturbance. Then after the initial existing SPS's work correctly, additional SPS's would need to work correctly, which would require that some of the generation the initial SPS's caused to trip off would need to be restarted and some initially out-of-phase transmission lines reconnected. If all these SPS's work right, the San Diego area might benefit from some additional import capacity during N-1 conditions. Further, no additional import capability is obtained most of the time under N-0 conditions.

In my opinion this scheme is really stretching the transmission reliability criteria to attain a small incremental increase in SDG&E's emergency import capability. Thus it should not be considered as a transmission alternative to the Sunrise Powerlink project, which increases SDG&E import capability 1,350 MW most of the time during normal operating conditions and 1,000 MW during relatively unlikely G-1, N-1 credible outage design conditions.

[12] A.06-08-010, SDG&E, *Chapter VII Supplemental Testimony*, January 26, 2007, Table 6 p23, pp 26-32.

4.2 SONGS-Lite and SONGS-Heavy

For both SONGS-Lite and SONGS-Heavy, SDG&E studies show no increase in South of SONGS import capability[13], based on preliminary SDG&E analysis. The SDG&E South of SONGS path import capability is based on the SCE Barre-Ellis 230 kV line overloading for another SCE line outage, and neither SONGS-Lite nor SONGS-Heavy relieves this limit.

In addition, the implementation of either SONGS-Lite or SONGS-Heavy disturbs the North of SONGS transmission path into SCE. Although not studied by SDG&E, implementing SONGS-Lite or SONGS-Heavy may also tend to reduce the North of SONGS path rating. SCE would obviously also need to be involved in studying any project that would change the North of SONGS path rating.

4.3 Green Path North

Green Path North (GPN) consists of building and upgrading transmission facilities from SCE's Devers substation to various LADWP substations. These GPN transmission improvements will allow an increase in power import from generation located in the IID service area to LADWP via SCE's Devers substation. However, these GPN transmission upgrades do not increase SDG&E import capability[14]. Therefore, GPN does not apply in meeting local SDG&E reliability needs.

[13] A.06-08-010, SDG&E, *Chapter VII Supplemental Testimony*, January 26, 2007, Table 6 p23, pp 33-34.
[14] A.06-08-010, SDG&E, *Chapter VII Supplemental Testimony*, January 26, 2007, pp 36-37.

APPENDIX A

Henry Zaininger Qualifications

ZAININGER ENGINEERING COMPANY, INC.

1718 Nursery Way
Pleasanton, CA 94588
Tel: (925) 425-9654
Email: hzaininger@aol.com
Web: www.zeco-inc.com

Resume: Henry W. Zaininger, President

Mr. Zaininger founded Zaininger Engineering Company (ZECO) in 1978. Over the past 29 years he has successfully performed numerous electric utility generation, transmission and distribution system technical and economic assessment studies. He has performed T&D system impact studies with new generation or other T&D facilities installed, including load flow, stability, and post transient voltage and reactive margin assessments as appropriate. He has performed innovative electric power system assessments of a broad range of advanced energy technologies, including solar, wind and biogas renewable resources, energy storage, distributed generation and end use technologies. He has investigated distributed generation interconnection requirements, power quality impacts and potential benefits of distributed resources when integrated into distribution systems. He has investigated requirements to enhance intermittent renewable resource benefits for applications in competitive electric utility system markets. He has determined relative SO_2, NO_x, CO_2 and other emissions for both central stations, distributed generation and end use technology alternatives. He has investigated electromagnetic pulse interaction and coupling with electric power systems. He has provided expert witness services in the both the transmission and distribution system areas.

Mr. Zaininger was employed by Power Technologies, Inc. for a total of seven years. He was employed by PTI for five years prior to forming ZECO, and returned to PTI to serve as manager of the Sacramento office for two years from 1997 to 1999. At PTI, he undertook assignments in both transmission and distribution system planning and line design areas. He evaluated interconnection requirements, assessed transmission reliability and performed power transfer capability studies for interconnecting new generation additions. He served as an expert witness in cases involving large-scale generation connected to a transmission system and small-scale generation connected to a distribution system, developing testimony based on performing T&D system planning studies as appropriate. He developed the initial version of PTI's transmission line optimization program, LOP1, and performed several EHV line design optimization studies with this methodology. He developed synthetic generation and transmission systems and data for evaluating advanced technologies and new energy resources, and performed several technical and economic assessments of advanced energy technologies and distributed generation, including battery storage and wind generation.

Mr. Zaininger was employed by the Electric Power Research Institute for one year. At EPRI, he participated in technical and economic cost/benefit assessments of a wide range of new energy technologies, and played a significant role in developing the initial version of the EPRI *Technical Assessment Guide*.

Mr. Zaininger was employed by Illinois Power Company for five years. At IP, he served as a system planner, where he performed transmission and distribution system planning studies involving load flow, transient stability, and economic considerations. He was then assigned generation planning responsibilities for the company, where he performed generation planning studies leading to the announcement of two generating units currently on line. These generation planning studies involved reliability assessment, production costing, economic and financial evaluation, future plant siting, and environmental impact assessment of new generation alternatives. In addition he served as a transmission line design engineer, where he developed complete design specifications for several transmission lines, and developed a new computerized method of structural analysis for both wood and steel transmission structures.

Mr. Zaininger was employed by Bell Telephone Laboratories for one year as a member of the technical staff. At Bell Labs, he performed computer program development and determined system requirements for computerized telephone electronic switching stations, commonly employed today.

Mr. Zaininger received his degree in Electrical Engineering from the University of Illinois in 1968 where he was elected into Eta Kappa Nu. He is a senior member of the IEEE. Until recently he served as Chairman of the IEEE-PES Power System Analysis, Computing and Economics Committee. He has authored 49 technical publications and has been awarded a patent for the invention of a solar water heating teaching aid.