



SDG&E Comments on 2017-2018 CAISO Preliminary Study Results Reported in 9/2017 Stakeholder Meeting

10/6/2017

Thank you for this opportunity to make comment on your preliminary study results and also for the discussions during the Stakeholder meeting on September 21 – 22, 2017. SDG&E respectfully share our following concerns regarding the preliminary results and comments to clarify some of discussion points that SDG&E did not have opportunity to do by phone during the stakeholder meeting.

Our objective continues to be finding most cost-effective solutions to maintain our system reliability and support State GHG and RPS goals.

Below are our comments

1 Baseline Case Comments:

- a Thermal overloads for P1 contingencies are a major concern. The mitigations described in the CAISO's results tables is vague.
- b For large numbers of contingencies, including P1, Suncrest voltage issues are a known issue. The status of the CAISO-approved mitigation in the CPUC approval process is not clear.
- c Previously, the CAISO requested that SDG&E mitigate for P6 contingency (N-1-1) violations. Now, there are a significantly larger number of P6 contingencies that trigger overloads. Mitigation for these overloads is unclear.
- d Assuming operational redispatch would mitigate all those issues would not necessarily be sufficient to meet TPL standard requirement.

2 Sensitivity cases Comments:

- a Most of the TPL-001-4 violations get amplified in the sensitivity cases; mainly for two reasons:
 - i Root cause one: High through-flow from the Imperial Valley and south-central Arizona through the SDG&E system to the rest of the CAISO system. SDG&E's existing system was designed to accommodate around 1200 MW of north-to-south flow from the SCE system. Historically, this level of imports helped to serve SDGE load during normal heavy summer peak conditions. Now there is often 1500 MW of south to north flow from the SDG&E system to the SCE system. Unsurprisingly, the significant change in flow pattern is creating contingency-based overload conditions that did not previously exist.

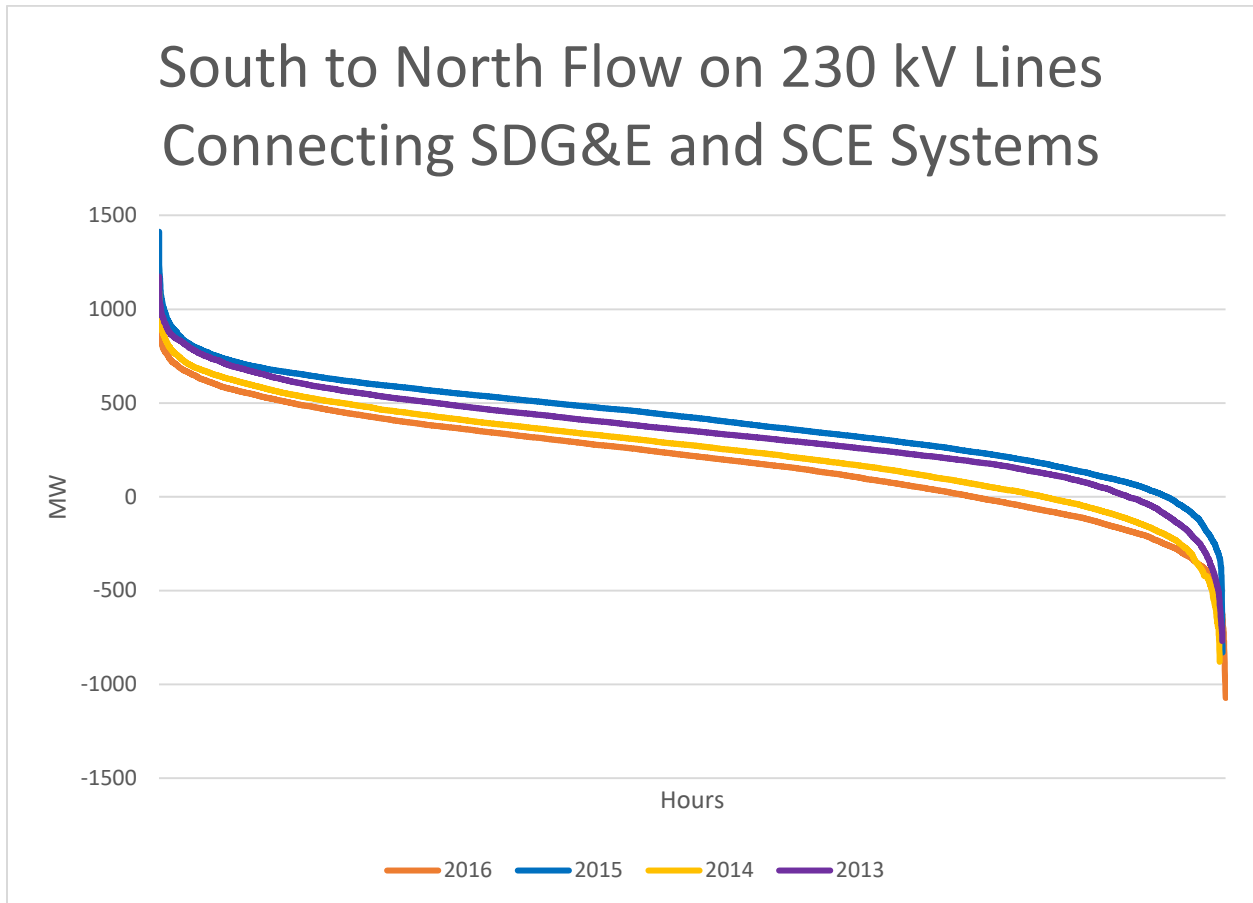


- ii Root cause two: A significant amount of San Diego in basin area gas-fired generation has been, and will be, removed from service, such as the South Bay and Encina boiler plants. Much of the new generation is renewable resources outside of the San Diego area in the Imperial Valley or in south-central Arizona.

- b The higher north-bound flow is becoming normal. In California, GHG reduction goals continue to push retirement of fossil-fueled generation. Obtaining regulatory approvals and permits to build new fossil-fueled generation is almost impossible. Higher RPS goals and the saturation of roof top Solar's growth will result in more utility-scale renewable projects installed east of Miguel and Suncrest leading to more power flowing westward into the San Diego area and north into the large California load centers. This will exacerbate overloads that are already listed in the CAISO results tables.

The change in flow patterns is also related to the San Onofre nuclear power plant shut down. Northbound flow from the SDG&E system into the SCE system is now normal, not just "occasional." The graph below shows for the years 2013, 2014, 2015, and 2016, the south-to-north flow on the 230 kV lines connecting the SDG&E and SCE transmission systems (retired Path 44).

- c In the higher northbound flow cases, overloads appear under many contingencies including P1. SDG&E is very concerned about the potential risk of reliability criterion violations for a significant number of hours in a year as shown in the duration curves.



- 3 Comments to a discussion between several stakeholders regarding SDG&E’s proposed Phase Shifting Transformer (PST) mitigation project in comparison to a “Smart Wires” solution.**
- a SDG&E transmission planning as a matter of standard practice always performs studies to verify system reliability and the effectiveness of possible mitigations. If reliability issues are identified, we use our best efforts to find the most cost-effective mitigation.
 - b The original reliability issues were:
 - i The final CPUC-approved 230 kV Sycamore-Penasquitos project design has a lower impedance than SDG&E’s original plan. The lower impedance is due to the CPUC-required shorter path and the use of underground cables. The lower impedance results in P1 contingency overloads when there is high south-to-north flow through the San Diego area.
 - ii Suncrest -> Sycamore -> Penasquitos path becomes more congested due to higher northbound flow. Such high northbound flows are observed very frequently in real-time operations.



- iii Quite often, Miguel -> Bay Blvd -> Silvergate – Old Town path is also congested. There are thermal overloads under various contingency conditions.
- iv Outages of the 230 kV SX-PQ and OT-PQ lines push the flow to the parallel underlying sub-transmission system and cause overloads.
- c SDG&E’s proposed PQ-OT PST has the following advantages compared to other alternatives evaluated by SDG&E:
 - i PST would direct its flow to counter congestion and/or eliminate overloads on elements of the Suncrest -> Sycamore -> Penasquitos path.
 - ii PST angle adjustments control MW flows to fit system conditions.
 - iii Most critically, when needed, the range of PST angle controls will allow grid operators to reverse PST flow. This will counter congestion and/or eliminates overloads on the Miguel -> Bay Blvd -> Silvergate -> Old Town 230 kV path.
 - iv With a proper breaker switching scheme, the PST can be switched from the 230 kV to the 138 kV system to counter the overloads on the 138 kV sub-transmission system. SDG&E presented a detailed proposal along these lines at the stakeholder meeting on September 22, 2017.
- d What Smart Wire equipment can do, and cannot do:
 - i Smart Wire 2nd generation equipment can adjust magnitude of MW flow (as phrased by a stakeholder in the meeting: “push and pull”) by varying the apparent impedance of a line. This is similar to the PST features mentioned in 3. c. i and 3.c.ii above. However, unlike a PST, the Smart Wire equipment does not control flow by varying the angle difference between the sending end and the receiving end of a line.
 - ii Because of the lack of phase angle control, contrary to the PST solution, the Smart Wire equipment would not be able to reverse its own flow under certain system conditions to mitigate the issues highlighted in 3.c.iii and 3.c.iv above, which is the other half of the reliability issues that needs to be resolved.
- e The stakeholder(s) in the meeting suggested that SDG&E is proposing a PST instead of Smart Wires because SDG&E planners prefer to stay within their “[technology] comfort zone.” SDG&E strongly disagrees with this misleading and baseless comment.
 - i SDG&E’s transmission planners performed extensive studies for the first generation (“clamp-on”) Smart Wires equipment. SDG&E later evaluated the second generation of Smart Wire equipment. SDG&E’s transmission planners are compelled to evaluate Smart Wires equipment, versus other technologies, in order to identify the most efficient solution for our ratepayers. SDG&E’s evaluations are not done simply for the sake of supporting newer technologies.
 - ii SDG&E is comfortable with using new technologies. This can be seen through (i) the installation of the first new generation of rotational synchronous condensers at various



- substations, (ii) the installation of the newest PSTs with largest angle range in California, (iii) the lead role SDG&E has in microgrid deployment and electric vehicle (EV) adoption efforts nationwide, and (iv) the proposed first HVAC to HVDC conversion project in the US to support higher state RPS requirements. SDG&E's planners never lack creativity and an adventurous desire to explore the most cost-effective solutions for our ratepayers.
- iii This is in no way a criticism of SmartWires technology; SDG&E continues to evaluate this technology as a possible mitigation for identified system issues where it is both effective and efficient.

Economic Study -Assumptions; and Special Study Section

1 General Comments on the Inter Regional Transmission Project (ITP) / Economic Planning - Production Cost Model / ATC package

- a CAISO has asserted that evaluation of an ITP requires a bulk deliverability component from a hypothetical out of state resource portfolio as well as barriers to the flows under study. Thus, to study the value of SDG&E's proposed AC-to-DC conversion project, the SunZia transmission project has been assumed and 2000 MW of New Mexico wind has been added. The 2000 MW of export limit for CAISO (based on historical records, not from a study) remains.

The CAISO's 50% RPS special study in the (2016-2017 TPP) is completed with this stakeholder report. According to the CAISO the measure of the AC-to-DC conversion project's benefits is its ability to mitigate overloading on circuits near the New Mexico wind turbines and congestion around Imperial Valley substation.

CAISO's Slide 40 indicates that one necessary ingredient of a proposal is that it provides firm Available Transmission Capacity (ATC) from resources to the CAISO balancing authority (presumably via dynamic scheduling for resources that do not have a direct physical connection to the CAISO system) without relying on transmission resources out of the control of the sponsor. It is true that a continuous path under full control by the contracting parties would increase scheduling success. So, "Sun-Zia plus REX HVDC" might be improved with some firm transmission rights from Pinal Central to Hassayampa.

Regardless of whether a firm transmission path between Pinal Central and Hassayampa is assumed to exist, the results of the production costing analysis will not change. In any event, SDG&E suggests that the CAISO assume that a firm transmission path between Pinal Central and Hassayampa will exist. Power flow analysis indicates that absent SunZia, typical power flow is



from Hassayampa towards Pinal Central. Adding SunZia and New Mexico wind will create counter-flow. Accordingly, it is reasonable to assume firm transmission service will be available.

Although the CAISO has not suggested that its ITC analysis is exhaustive, SDG&E notes that that the “benefits” of transmission projects includes reductions in congestion-related costs, increased Maximum Import Capability (MIC) for system Resource Adequacy (RA), and decreases in Local Capacity Requirements (LCRs) (which reduces the cost that Load Serving Entities incur to meet the remaining LCRs). A comprehensive assessment of any proposed transmission, including an ITP such as SDG&E’s proposed AC-to-DC conversion project, requires that all potential benefits be assessed. For reasons not clear to SDG&E, SDG&E’s earlier comments on the CAISO’s ITP study plan -- which recommended that the CAISO augment its planned assessment with an evaluation of potential LCR-related benefits – were not incorporated or addressed. SDG&E hopes that this deficit will be rectified in the steps that CAISO next takes.

The study of Power Flow impacts was limited to measuring overloads near the new wind resources in New Mexico and on two 230 kV lines in the San Diego area (Silvergate-Bay Boulevard and San Luis Rey SC-Mission). It thus does not amount to a full reliability test of the effects of the AC-to-DC conversion project.

SDG&E suggests that in connection with future studies , the CAISO encourage its fellow Regional Transmission Groups (RTGs) to study the beneficial effects of transmission and related investment to the citizens and ratepayers within each RTG.

The analytical clarification in the CAISO’s Transmission Economic Assessment Methodology (TEAM) Documentation Review Initiative (August 10, 2017) is instructive here. In particular, SDG&E notes the documentation’s assertion that a “Full assessment will be made on a case-by-case basis.” (Slide 16) The CAISO’s ITP assessment should include such a “full assessment.”

Finally, it should be noted that production cost models using de-coupled (“DC”) solution techniques have limited capability to model the operational characteristics of DC systems. Production cost modeling is not capable of capturing the full range of benefits that modern DC technology provides. This applies not only to SDG&E’s proposed AC-to-DC conversion project, but also to the TransWest Express DC transmission line (another ITP).

b Additional comments:

On page 7, It is worth noting that of the four ITP’s, only one project (SDG&E’s AC-to-DC conversion project) allows access to both in-state and out-of-state renewables. Additionally, the AC-to-DC conversion project connects these renewables not simply to the CAISO BAA, but directly to major California load centers.



On page 10, the CAISO states that its study identifies constraints outside of California. However, constraints from the California border to the California load centers should be evaluated and not overlooked.

On page 12, do the costs for the SWIP North and Cross-Tie projects include the segments of the Gateway project discussed in the first footnote?

On page 12, what portion of the cost estimate indicated for the AC-to-DC conversion project reflects the costs of the SunZia project (if any)?

On Page 16, what are the cost assumptions for the SunZia project?

On page 20, in the third column, the CAISO notes that out-of-state renewables without deliverability to CAISO BAA are not viable in the long term. SDG&E would point out that an additional useful metric for deliverability is the ability to deliver renewable power to California load, not simply to the edge of the CAISO BAA.

On page 26, the powerflow results for the AC-to-DC conversion project are quite puzzling:

- i. Addition of the HVDC project should not result in additional thermal overloads. The flow on the HVDC system can and should be adjusted to avoid overloading the surrounding AC system. Simply setting the HVDC flow to a set amount fails to utilize the main feature of the technology – the ability to control and dispatch the flow at the HVDC terminals largely independent of generation dispatch. This is especially relevant for study periods with high renewables but relatively modest loads, such as studied here.
- ii. Overloading observed on the 230 kV Silvergate-Bay Boulevard line has been observed in numerous other cases and should not be attributed to the HVDC conversion project. In any case this overloading can be mitigated at modest cost, in addition with other observed system constraints, by the 230 kV projects submitted by SDG&E in the current planning cycle.
- iii. Overloading observed on the IV-El Centro (S-Line) can also be easily mitigated by adjusting flow on the IV HVDC terminal, and is indeed one of the main drivers of the project.
- iv. Please verify that the San Luis Rey SC – Mission line is modeled correctly and reflects the current plan of service for the 230 kV Sycamore Canyon-Penasquitos line.
- v. Specific data on the HVDC dispatch would be very helpful.
- vi. Also, a more specific explanation of how the 2000 MW of New Mexico wind was modeled, and how it was dispatched against other WECC resources, would be very



helpful. Dispatching the additional wind resources against resources in California is a much more useful test of deliverability than simply dispatching against other remote resources.

On pages 29 and 30, it is not clear if the new out of state resources (NM and WY wind) are treated as within the CAISO balancing authority for analysis of the CAISO export limit scenarios.

On page 39, it does not appear that the analysis of the impact on ATC of the AC-to-DC conversion project includes the SunZia project. This would be a reasonable assumption to make with the assumption of 2000 MW of new wind resources in New Mexico.

On page 40, with regard to the second bullet and specifically in regard to the AC-to-DC conversion project, is the CAISO referring only to reliance on SunZia to provide additional ATC, or does this assertion also refer to other transmission capacity?

On page 42, with regards to the last bullet in the third column, the AC-to-DC conversion project is not intended or designed to mitigate upstream constraints in the NM-AZ path. It is intended to increase transfer capability from the CAISO border to load centers. However, if the main focus of the analysis is to evaluate the impact to upstream constraints in the NM/AZ region, the study of the REX-HVDC project should be done in conjunction with the SunZia project.

On page 44, regarding the last bullet, some of the other attributes worth exploring might include:

- i. RA/LCR benefits
- ii. Increase in San Diego area import capability
- iii. Increase in Southern California import capability (Path 46, Path 49, SCIT, etc.)
- iv. Impact on other critical flow paths into California (COI, Path 15, etc.)
- v. Other reliability benefits

2 General Comments on the Bulk Energy Storage Resource Case Study

- a SDG&E notes on slide 15 that Pumped Storage In-State G&T costs are listed at \$407.91 in 2016 \$/kW-year. But on slides in which Pumped Hydro Levelized Revenue Requirements are compared to benefits, it states the 1400 MW Pumped Storage Hydro (PSH) unit costs \$408 million per year levelized. Clearly $1,400,000 \text{ kW} \times 407.91 \text{ \$/kW-yr} = \$571.074 \text{ million per year}$. Further, SDG&E notes that the E3- RESOLVE inputs (September 2017) cite Pumped Storage Hydro all-in (with fixed O&M) and levelized at 146 \$/kW-yr (2016USD) page 41-42. This means



the Cost (numerator) is about \$205 million/yr. This means that for some cases evaluated by the CAISO, the Pumped Storage Hydro, benefits exceed or are close to the costs estimated by E3.

The point of analyzing a multi-purpose resource like a PSH unit is to solve system problems caused by RPS policy. Planning assumptions which reduce native demand, such as increasing Additional Achievable Energy Efficiency (AAEE) and assuming must-run Combined Heat and Power (CHP) and Qualifying Facilities (QF) will become fully dispatchable, pretty much removes the point of looking at storage at all. Such assumptions assume away problems that need to be addressed.

Further, the study was undertaken with a zonal production cost model. Restricting the discussion to over-production of energy, as if there is no grid as a constraint or relief valve, conceals any transmission congestion or inefficiency issue.

SDG&E looks forward to the study in which reasonably located PSH resources are modeled in a grid which can represent the system effects (generation- and transmission-related) of addressing the issues of curtailment and negative LMP in a transparent and useful way.

b Additional comments:

On page 2, with respect to the last bullet, SDG&E would suggest that the inverse of this approach (i.e. first identifying the location(s) in the transmission system that would most benefit from storage) would be a more useful approach, encouraging development of large storage projects.

On page 12, with respect to the last bullet, quantifying transmission impacts (positive and negative) is the logical next step, and one which the CAISO is uniquely qualified to carry out.

On pages 13 and 14, more detailed information on location of the modeled pumped storage would be useful. Southern California has many sub-areas that would be significantly impacted by 500 or 1400 MW of storage.

On page 27, with regards to the second bullet, will the CAISO consider treating the type of large pumped storage projects considered in this analysis as a “load shifting product” in terms of rate treatment?