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Evaluation of the Petition to Amend The Carlsbad Energy Center Project

The Carlsbad Energy Project 07-AFC-06C (CECP) was certified by the California Energy Commission in 2013. The attached evaluation examines the specific claims and justifications of the Petition to Amend (PTA) with facts, logic and expert research. It concludes that the PTA fails to justify the changes proposed.

Californians for Rational Regulation

Additional submitted attachment is included below.

Evaluation of the Petition to Amend
The Carlsbad Energy Center Project

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Necessity of Proposed Change

The PTA sets forth the following "Necessity of Proposed Change" (emphasis added):

> "The purpose of the proposed changes in this PTA is to make the CECP conform to current electrical energy needs for fast-response peaking generation and to better respond to the unanticipated and unprecedented retirement of the San Onofre Nuclear Generating Station. Further, and something that could not be anticipated, changing circumstances created an opportunity for cooperation with the City of Carlsbad. The result of that cooperation was an agreement between the City of Carlsbad and the Project Owner (see Appendix 2A) that allows for a much improved design that also includes full shut down of EPS Units 1 through 5."

Retirement of SONGS: San Onofre Nuclear Generating Station (SONGS) was a 2,200 MW that was fully and continuously operated plant with no stack emissions. SONGS also had a very low cost of generation compared to fossil resources. Therefore, "responding" to the loss of SONGS would entail providing:

- firm capacity as needed to maintain Resource Adequacy;
- the lowest cost of energy;
- the lowest cost of inertia and
- the lowest stack emission rates.

Firm Capacity: The comparably sized Amended CECP and certified CECP capacities are roughly equal in their contribution to firm capacity. Roughly equal is not a "necessity" for change.

Cost of Energy: In 2014, the CEC staff published the results of a study (*Estimated Cost of New Renewable and Fossil Generation in California, Draft Staff Report*, May 2014) which compared the levelized cost of energy (LCOE) from new central station generating plants in California for various technologies. For its medium scenario for a merchant plant such as CECP, the CEC estimated the LCOE from a LMS100 simple cycle gas turbine (SCGT) plant to be $460.39/MWh. The CEC estimated the LCOE of a 500 MW F-class combined cycle (CCGT) plant to be only $147.74/MWh. In other words, the energy generated by a California SCGT plant costs about three times as much as a CCGT plant, as evaluated by the CEC.

The Petitioner has undoubtedly evaluated the economics of the two alternatives but has not provided it in the PTA. If the Petitioner does not provide its third party EPC bids and economic dispatch simulations to the CEC, then the CEC can reasonably assume that the Amended CECP's LMS100 plant will be much more costly than the certified CECP's CCGT plant.

Costly energy is not a "necessity" nor a "better response" to the SONGS retirement. It would be unconscionable for the CEC to impose a radical increase in energy cost to the ratepayers without a comparable offsetting benefit (*e.g.* much lower CO_2 emission rates).

Cost of Inertia: Inertia is an attribute of the grid that allows large amounts of energy to be reliably imported into Southern California, including San Diego County. Inertia can be supplied by hydroelectric and thermal turbines but only if sufficient capacity is available and is actually generating. Wind turbines and PV solar panels cannot replace the lost inertia even when generating.

Both the Amended CECP and the certified CECP units can replace the inertia lost to retirements by generating whenever system inertia is required. But, as discussed above, the generating cost to keep the Amended CECP generating longer will be much greater than for the certified CECP.

Stack Emission Rates: The rates of CO_2 and PM emitted by a fossil fueled power plant (lb. /MWh) is directly proportional to the rate of fuel burned (Btu/MWh). For example, a 20% reduction in heat rate (btu/KWh) results in a 20% reduction in the CO_2 and PM emission rates.

The certified CECP technology is no exception. CECP's CCGT technology offers significantly lower heat rate than the proposed change to LMS 100 SCGT units. Thus the change to SCGT units would significantly increase the emissions rates. Unnecessarily increasing the CO_2 and PM emission rates is not an appropriate response to the retirement of a zero emission nuclear plant and it is contrary to California public policy. It is certainly not a "necessity" that would justify the Amendment.

Finally, the PTA compares annual emissions for the site instead of for the air basin (or the globe in the case of CO_2). But a more efficient plant will dispatch more and thus increase emissions at the stacks. But by dispatching more at the stacks, the better efficiency is reducing the generation and emissions elsewhere. The CEC needs to compare the effect on system-wide emissions and air quality, not just at the plant site.

A responsible PTA would propose to reduce the heat rate and emission rates of the currently licensed CECP facility, instead of increasing them.

Fast-Response Peaking: Peaking generation is used to ramp up the supply of system energy each day to accommodate the rise in peak energy demand during the day and into the early evening hours of the day. As the demand subsides in the evening, the peaking generation is ramped down and often terminated until the following day.

In California, as the CEC well knows, the dominant source of peaking energy is CCGT technology. The PTA claims a "need for fast response peaking," but offers no evidence that CCGT technology is too slow for peaking or that a faster response is "necessary" or will even be useful for peaking for SDG&E. In fact, no California regulator actually requires faster peaking capability than is currently deployed.

Nevertheless, the CEC has already certified "Rapid-Response" CCGT peaking technology for CECP – as originally proposed by the Petitioner. CECP can technology by GE and Siemens who offer fast start CCGT peakers with the ability to start and ramp up CECP GT's to full output (over 400 MW) in about twelve minutes. After an overnight shut down, the STG output (about 120 MW) can achieve full output two or three times faster than the more conventional CCGT plants. This technology is not required by anticipated load swings, but it can make the certified CECP more competitive against other plants.

The Petitioner has actually been operating a "Rapid-Response" CCGT plant – Petitioner's El Segundo Energy Center – for about a year. As the CEC can readily confirm, El Segundo is being successfully dispatched to accommodate system peaks. Concurrently, the Petitioner has been seeking permits for another fast response CCGT unit to expand its El Segundo plant capacity. Finally, the CEC staff has just recommended certification of fast response CCGT peaking technology for the AES Huntington Beach Energy Project.

Clearly, fast peaking is not a valid reason to change to costly, high emission rate SCGT technology.

Agreement with Carlsbad: The PTA states that the agreement with the City of Carlsbad "allows for a much improved design that also includes full shut down of EPS Units 1 through 5." However, the Carlsbad agreement does not oblige the CEC to certify the PTA. The CEC is not a party to the agreement and the agreement does not negate the certified CECP.

Even though the Amended CECP would increase the stack emission rates, the PTA claims that the amendment will reduce emissions because the Petitioner has agreed to shut down all of the existing Encina plant which would eliminate the Encina emissions. However, in its comparison to the certified CECP, the Petitioner gives credit for the Encina shut down emissions reduction to the Amended CECP but gives no credit

for the Encina emissions reduction to the certified CECP. The PTA thus implies that the Petitioner would continue operating Encina if the PTA is denied.

Actually, the CEC can reasonably expect that Encina generation and emissions will cease even if the CEC denies the PTA. Encina will not be competitive, whether the replacement plant is the certified CECP or a competing plant. SDG&E knows this and has cited the imminent shut down of Encina to the CPUC to justify a rushed approval of an Amended CECP PPA without competitive bidding.

"Necessity" in Summary: Significantly elevated emission rates (lb/MWh) and a scandalously elevated generating cost rate ($/MWh) would be imposed by the Amended CECP and would be contrary to California's public policy. The CEC certified CECP as a fast response peaker that is more than adequate for SDG&E cycling and peaking requirements. Further, the closure of Encina will occur soon after its capacity has been replace by the certified CECP, even without an agreement with Carlsbad. Therefore, the CEC must reasonably conclude that the proposed change is not "necessary" as claimed in this PTA.

Renewable Integration

The Petitioner's Project Description favorably compares the proposed PTA to the certified CECP, claiming:

> "The six smaller peaking units will also be much better suited to allow the continued integration of cyclical and intermittent renewable generation, as all of the net output from the Amended CECP will be fast start and readily dispatchable."

Actually, the opposite is true – the certified CECP is "better suited" for renewable integration. Here's why.

What is renewable integration? Grid balancing authorities like the California Independent System Operator (CAISO) need to maintain a persistent and precise balance between the supply and demand for energy on the grid. Imbalance disrupts the delivery of energy from generators to loads and could even lead to the collapse of an entire electric grid.

Maximum use of renewable energy can significantly reduce CO_2 and other emissions from electric utility power grids. However, the intermittent and non-dispatchable aspects of renewable resources requires that the CAISO use firm (reliable and controllable) hydro or thermal generating units to compensate for rapid shifts in renewable resource output threaten to de-stabilize the grid with over-generation or under-generation (energy supply that does not match energy demand).

Transmission grid balancing authorities reserve firm generating resources to be available to supply grid balancing services that can be dispatched to counter system imbalances that are caused by fluctuating supply or demand. The requirements for system energy balancing can be quite significant during periods when there are large flows of rapidly fluctuating renewable energy. In the CAISO grid, balancing capabilities are defined and labeled as: load following, regulation and spinning reserve. Units that are committed to supplying these capabilities must be on line and operating to be functional. The load following and regulation capabilities can be either up (increasing output) or down (decreasing output). The CAISO also manages non-spinning reserves, but non-spinning units cannot simultaneously supply balancing energy or spinning reserves.

It appears likely that by 2020, the California grid will need to accommodate the legislated RPS target of an annual average of 33% of the total energy supply. So the peak renewable energy flow could be a raging river of rapidly fluctuating energy supply -- perhaps double the 33% average – challenging the ability of the CAISO to maintain energy balance and requiring the CAISO to keep a minimum level of firm units in operation for to maintain viable unit commitments to provide both system energy balance and inertia.

So, renewable integration simply means providing the required firm resources that can be reserved to supply balancing energy and inertia -- accommodating the growing supply of rapidly fluctuating renewable energy.

Why the certified CECP is "better suited": System balancing and inertial response need to be instantaneous. Waiting for a gas turbine startup, even a fast startup, is inadequate for balancing or inertial response, especially when the grid is transmitting a high level of renewable energy. System response requires that the units that are committed (reserved) to provide inertia and balancing energy, be generating during any period of time for which a unit has been committed. Thus fast starting is irrelevant to renewable integration.

What is relevant is ramping between minimum load and full load. Ramping is the key requirement for integrating wind and solar resources. Happily, CCGT technology is now available for the certified CECP that can ramp just as fast and as far as SCGT units – from minimum load to full load in 5 minutes or less.

CCGT units are more economical than SCGT units to generate balancing energy. Therefore, it is the certified CECP – not the Amended CECP – that is "better suited to allow the continued integration of cyclical and intermittent renewable generation."

CAISO's Renewable Integration Study: The California Air Resources Board (CARB) asked the CAISO to evaluate the ability of planned replacement generators to support the grid while transmitting a massive volume of renewable energy during peak renewable production periods. The CAISO choice was appropriate because the CAISO is the Balancing Authority for the California investor-owned utility grids, as well as for a few municipal systems. As the Balancing Authority and System Operator, the CAISO has intimate knowledge of California's power markets, generation resources, transmission resources and constraints.

In response, the CAISO examined the CAISO operated transmission grids owned by Southern California Edison (SCE) and San Diego Gas & Electric (SDG&E. The result was reported in: *California ISO Renewable Integration Study in Support of the California Air Resources Board for Meeting Assembly Bill (AB) 1318,* May 7, 2013.

The CAISO studied and forecasted the inertia, bulk energy and balancing requirements for the year 2020. From those studies, the CAISO determined that about 1 GW of firm replacement resources would be required to maintain reliability in the SDG&E transmission grid – even when the renewable energy flow exceeds the energy flow from all other resources combined.

The CAISO simulated the economic dispatch of a specific set of firm resources that would be needed to satisfy the requirements in the year 2020. The CAISO simulated 520 MW of CCGT capacity, 400 MW of SCGT capacity and 25 MW of demand response in the SDG&E area. The capacity was simulated as SDG&E system replacements for retiring gas fired and nuclear thermal resources. Units expected to be retired (*e.g.* Encina) were not included in the simulated resources. Renewable resources simulated were adequate to supply 33% of the energy throughout the year 2020 without curtailment.

The simulated replacement resources were assigned the characteristics listed in Table 1. The listed characteristics are consistent with plants which have been deployed in California in the past decade. The SCGT heat rate and start-up costs closely match that of an LMS100 simple cycle plant. The CCGT characteristics are comparable to typical F-class combined cycle plant now in service. Note, however, that the "Fast-Response" CCGT technology that is available to the certified CECP units, could ramp at around 60 MW/minute (two units simultaneously) and 95% of startups could achieve full load in 30 minutes to 60 minutes.

SDG&E Replacement Resources	Table 1: Characteristics of CAISO Simulated Replacement Resources						
	Max/Min Capacity (MW)	Heat Rate (Btu/kWh HHV)	Ramp Rate (MW/min)	Forced Outage Rate (%)	Maintenance Rate (%)	Start-up Time (minutes)	Start-up Cost ($)
Simulated CCGT	500/200	7,000	7.5	4.96	10.0	120	44,520
Simulated SCGT	100/40	9,191	12.0	7.24	10.0	10	1,200

The CAISO Study Results: The CAISO simulation dispatched energy resources and balancing resources in the order of their economic merit (their variable cost to generate).

Simulated SDG&E Firm Replacement Resources	Firm Capacity (MW)	Simulated Energy Capacity Factor	Table 2: Simulated Balancing Energy for 2020 (GWh)					
			Load Follow Down	Load Follow Up	Non-Spin-ning Reserve	Regula-tion Down	Regula-tion Up	Spinning Reserve
Simulated CCGT	520	66.4 %	566.6	618.1	0.1	97.0	1.8	125.0
Simulated SCGT	400	11.2 %	2.7	220.8	0.4	4.3	60.7	92.9

As shown in Table 2, 79% of the balancing energy (load follow, regulation and spinning reserve) for SDG&E would be dispatched from CCGT capacity. Even though only a little over half of the replacement capacity was CCGT capacity, the capacity factor for CCGT is six times the capacity factor for SCGT. Also note that there was virtually no dispatch for non-spinning reserves.

The CAISO study confirms that a relatively large, slow starting CCGT unit with a modest ramp rate would have adequate operating flexibility to competitively provide both the peaking and load balancing capability that will be required of the SDG&E system in the foreseeable future. The CCGT units that the certified CECP would deploy could be much more flexible than the CAISO CCGT simulation in every important way. The CECP CCGTs would be half the MW size of the simulated units and equipment suppliers can offer CECP combined cycle startup and ramp rates that are much faster. Without question, the CAISO study validates the certified CECP's technical qualifications to reliably integrate renewables for SDG&E.

Unit Size: The PTA asserts that smaller unit size will improve renewable integration. However, in the CAISO renewable integration study, the simulated CCGT was a lumbering giant compared to the smaller SCGT. But the larger CCGT units proved to be both technically viable and economically superior to SCGT.

The Role of SCGT: The CAISO study confirms the logical conclusion that SCGT capacity is not needed at all for peaking or renewable integration if there is an adequate supply of reasonably modern CCGT capacity. To further confirm that conclusion, the CAISO simulation for Southern California Edison (4616 MW replacement capacity) the CCGT supply was increased to 87%% of the total. The increase allowed the CCGT capacity to produce 96% of the balancing energy.

The PTA asserted that fast starting will improve renewable integration. Clearly that is not true. The main virtue of fast starting is to provide competitive non-spinning reserve capacity.

However, as the CAISO dispatch simulation revealed (Table 2), there apparently will be little demand for additional non-spinning reserve capacity in the SDG&E zone in the foreseeable future. To understand why, compare the capacity of existing fast starting resources in Southern California to the grid reliability requirement that 3% of CAISO's Southern California's system peak load be available for non-spinning reserve duty. The existing capacity far exceeds the 3% non-spinning resource requirement.

Startup Emissions: PTA emission claims need to be supported by simulations. A CAISO simulation predicted that LMS100 SCGT units would experience between 272 to 445 starts annually. By comparison, various CCGT units would experience between 23 and 63 starts annually. This means that the Amended CECP could experience as much as ten times the tonnage of startup emissions as the certified CECP.

Renewable Integration in Summary: The intended purpose of integrating renewables is to reduce CO_2 emissions from fossil fuel combustion. It would be ironic and embarrassing for the CEC and the San Diego APCD to certify an increase in system-wide CO_2 emissions based on unsupported claims by the PTA.

Thanks to the CEC for the rigorous economic comparison of CCGT and SCGT generation. Thanks to the CARB for asking the right questions and thanks to the CAISO for providing a well-researched reply.

Visual Appearance

The Amended CECP would have six exhaust stacks that would be shorter than the two stacks in the certified CECP. The photo on the left is PTA figure 5.13-9A. It shows the stacks and transmission lines as they would appear with the certified CECP. The photo on the right is PTA figure 5.13-9B. It shows the same view but with the taller CCGT stacks replaced by the shorter SCGT stacks in the Amended CECP.

SDG&E could significantly improve the visual impact on the City of Carlsbad by downsizing, rerouting and undergrounding the transmission lines.

The shorter PTA stacks improve the visual impact of CECP but the modest improvement does not justify the higher cost and emissions and is dwarfed by the impact of the transmission towers and lines which would be retained with the Amended CECP.

Appearance in Summary: Mitigating Carlsbad's transmission line eyesore could be expensive, but perhaps much less expensive than deploying the Amended CECP in place of the certified CEPC to obtain a comparatively minor improvement in Carlsbad's visual appeal.

Conclusion

The "Necessity for the Petition to Amend" has been thoroughly refuted by this evaluation. The certified CECP has a lower heat rate and emissions; it is more than adequate as a fast-response peaker; and it has superior performance for renewable integration. The minor visual improvements offered by the PTA are far outweighed by the negative impact on emission rates and cost. Responsible alternatives to CECP might include lower heat rate and emissions rates, demolition of Encina and/or undergrounding or re-routing of the transmission lines.

So this PTA offers the California Energy Commission and the San Diego APCD a unique opportunity to defend SDG&E ratepayers and California's greenhouse gas policies by recognizing that the research by the CEC and the CAISO have now firmly established a key principle for the evaluation of California generation:

> The most economical and environmentally friendly fossil fuel technology (combined cycle) has evolved into the preferred technology to supply system inertia, peaking and renewable integration.

Please address questions and requests to: californiansforrationalreg@gmail.com