Rulemaking: R.12-03-014
Exhibit No.: NRG-1
Witness: Brian Theaker

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 12-03-014

TRACK 4 TESTIMONY OF BRIAN THEAKER

ON BEHALF OF NRG ENERGY, INC.

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Table of Contents

PREPARED DIRECT TESTIMONY OF BRIAN THEAKER

I. Witness Qualifications

My name is Brian Theaker. My business address is 3161 Ken Derek Lane, Placerville, California. I am employed by NRG Energy, Inc. as Director of Market Affairs for the West Region, a position I have held since March 2011.

I have a bachelor's degree in Electrical Engineering from the Ohio State University and a master's degree in Business Administration from Pepperdine University. My 31-year work experience includes: special laboratory and field test work at the Los Angeles Department of Water and Power (LADWP); system operations, including security analysis and operations application development at LADWP; operating engineering, contracts management, and regulatory affairs work for the CAISO; and federal and state regulatory affairs work for the Williams Companies, Dynegy and NRG Energy, Inc. I am a registered professional engineer in the State of California. I am currently a member of the Board of Directors for the Western Electricity Coordinating Council. I have not previously testified before the California Public Utilities Commission (CPUC). I testified before the Federal Energy Regulatory Commission in proceeding No. ER98-441 *et al* regarding Reliability Must-Run contracts.

II. Purpose

This testimony is being submitted in Track 4 of the Long-Term Procurement Planning (LTPP) proceeding. Track 4 considers the local reliability impacts caused by the retirement of San Onofre Nuclear Generating Station (SONGS) Units 2 and 3.

This testimony has three primary purposes, namely, to demonstrate:

1. That an NRG generation development project that has already received approval from the California Energy Commission (the Carlsbad Energy Center Project, or CECP) provides all

of the services that meet the different reliability needs created or exacerbated by the retirement of SONGS Units 2 and 3;

2. That CECP can be on-line to meet the 2018 needs for additional San Diego generation identified by the California Independent System Operator Corporation (CAISO) if expeditious steps are taken to move forward with that project; and
3. That existing NRG generating resources, Units 3 and 4 at the Etiwanda generating station (Etiwanda), could continue to operate to meet reliability needs identified by the CAISO if a mechanism is provided that would allow it to recover the costs of necessary turbine overhauls. Similarly, NRG's Coolwater Units 3 and 4 could remain in operation if those units can recover the costs of needed maintenance.

III. The Carlsbad Energy Center Project Is Uniquely Positioned To Meet Reliability Needs Created or Exacerbated by the Retirement of SONGS Units 2 and 3

The Preliminary Reliability Plan ("PRP") prepared by the staffs of the CPUC, the California Energy Commission (CEC) and CAISO observes that the permanent retirement of SONGS Units 2 and 3 creates or exacerbates the following needs:[1]

- The need for energy to serve load;
- The need for location-specific real power along a critical transmission path connecting Orange County and San Diego; and
- The need for voltage support, which is necessary to reliably move real power within the Southern California transmission system.

[1] *Preliminary Reliability Plan for LA Basin and San Diego, Prepared by Staff of the California Public Utilities Commission, California Energy Commission, and California Independent System Operator – Draft August 30, 2013* at 1. This draft report is available at http://www.energy.ca.gov/2013_energypolicy/documents/2013-09-09_workshop/2013-08-30_prelim_plan.pdf .

Similarly, the CAISO's August 5 testimony observes that the permanent retirement of SONGS Units 2 and 3 results in the loss of 2,246 MW of real power support and 1,100 MVAR of dynamic reactive power support in an "ideal" electrical location.[2] Real power support from SONGS both helped manage transmission line flows in the Los Angeles and San Diego areas and provided energy to serve load in this urban load center, while reactive power support from SONGS enabled the bulk power transmission system in the Los Angeles and San Diego areas to reliably transfer power to serve load.

a. The Loss of SONGS Units 2 and 3 Creates An Immediate and Significant Need for New Reliability Services

Based on CAISO analysis, the need to replace the reliability services lost by the permanent retirement of SONGS is both acute and immediate. The CAISO's 2014 Local Capacity Technical Analysis indicates that the San Diego sub-area is 458 MW deficient in the generating resources it requires to meet local reliability criteria without SONGS generation.[3] This deficiency emerged prior to 2014; CAISO analysis conducted in 2012 indicated a 467 MW generation deficiency in the San Diego sub-area without SONGS for 2013.[4] While the CAISO's August 5 testimony in this proceeding identifies a need for 520 MW of new generation in Northwest San Diego County *in 2018*,[5] the San Diego area already lacks the generation it needs to meet CAISO reliability criteria *in 2013*. Additionally, the need for additional generation in San Diego in 2014 (458 MW) exceeds the amount of new generation for which SDG&E currently is seeking approval in proceeding A.13-06-015 (305 MW).

It should be expected that the loss of SONGS Units 2 and 3 creates a substantial need for new resources in the Los Angeles and San Diego areas. The Southern California bulk power system made up

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[2] *Track 4 Testimony of Robert Sparks on Behalf of the California Independent System Operator Corporation* ("CAISO August 5 Testimony") at 16:1-18.
[3] *2014 Local Capacity Technical Analysis Final Report and Study Results* ("2014 Local Capacity Technical Analysis"), dated April 30, 2014, at pages 2 and 101. This report is available at http://www.caiso.com/Documents/Final2014LocalCapacityTechnicalStudyReportApr30_2013.pdf.
[4] *2013 Local Capacity Technical Analysis Addendum to the Final Report and Study Results – Absence of San Onofre Nuclear Generating Station, dated August 20, 2012* at pages 2, 26 (available at http://www.caiso.com/Documents/Addendum-Final2013LocalCapacityTechnicalStudyReportAug20_2012.pdf).
[5] CAISO August 5 Testimony at 19:13.

of the high voltage system transmission lines and central station generation (most of it located along the coast to take advantage of the ocean as a source of cooling water) was designed and constructed and has been operated as an integrated bulk power delivery system, in which high voltage transmission provided a way to deliver large amounts of central station electrical power within the local area, and in which the generating resources provided real power support to manage flow on, and provide the reactive power support necessary to transfer power through, the high voltage network to which the generating resources are interconnected. This integrated bulk power system minimized total cost and enabled the reliable delivery of power to millions of customers in Southern California. As noted above, the loss of resources providing 2,246 MW of real power support and 1,100 MVAR of reactive power support interconnected between two highly populated, urban load centers unavoidably degrades the reliability of the local bulk power system and creates a need for new infrastructure to replace the reliability services they provided.

b. The Benefits Provided By Repowering Coastal Power Plants

Because of the interdependence between central station generating facilities and the high voltage transmission system, repowering generating units at existing central station plants has several advantages.

First, doing so helps preserve the ability of the existing high voltage transmission network to bring reliable power to millions of people. Coastal power plants, which utilize this existing transmission infrastructure, provide real power to manage flow and serve local area load and reactive power to ensure acceptable voltages. While the capacity factors of these older coastal power plants have gone down as more efficient generation sources have been developed at other locations in the grid, the need for these coastal power plants to maintain the reliability of the local transmission system remains. The CAISO's 2014 Local Capacity Technical Analysis indicates that over 24,000 MW of local generation is still needed within ten local areas to ensure the reliability of these local areas.

Second, repowering existing generating stations obviates the need for expensive new, greenfield gas or electric transmission facilities, which often face significant public opposition. Moreover, it may be very difficult to construct new greenfield gas or electric transmission facilities in urban load centers.

Third, repowering coastal generation sites to use newer, more efficient generation technology reduces or eliminates the use of ocean water for cooling in alignment with the once-through-cooling ("OTC") policy adopted by the State Water Resources Control Board.

In sum, repowering existing generation stations with modern, efficient technology levers the benefits of the existing transmission network, which was built at significant ratepayer expense, to maintain reliable electric service to millions of Californians, and supports state policy with regards to the reduced use of ocean water for cooling.

c. The Specific Benefits of the Carlsbad Energy Center Project

NRG's Carlsbad Energy Center Project (CECP) proposes to repower existing generation at the Encina Generating Station. The CECP is a proposed new 560 MW combined cycle facility consisting of two approximately 280 MW power "trains". Each train consists of a 200 MW combustion turbine and a heat recovery steam generator that uses the waste heat from the combustion turbine to power a roughly 80 MW steam turbine. Each 280 MW power train can deliver 150 MW of energy in ten minutes, allowing this facility to provide up to 300 MW of non-spinning reserve to meet the CAISO's needs. Further, each power train can be ramped up to full capacity in 10 minutes, which allows CECP to provide up to 260 MW of spinning reserve. The gas-fired CECP provides efficient electrical energy, with a base load heat rate of 7,564 Btu/kWh. This heat rate provides significant efficiency over the generating units currently operating at Encina. And because it uses dry cooling, CECP largely eliminates the need for ocean water for cooling, in accordance with the state's OTC policy.

CECP unquestionably provides the three generic benefits of repowering projects mentioned above. CECP would meet the need for 520 MW of new generation identified by the CAISO's August 5

testimony. CECP would use the existing gas and electric transmission infrastructure in and around the Encina station. Finally, CECP would allow for the retirement of Encina Units 1-3 in accordance with the State's OTC policy, which calls for all OTC generation at Encina to be retired at the end of 2017.

In addition to the three generic benefits provided by repowering existing generating facilities, however, CECP provides a suite of services that directly meet the reliability needs created or exacerbated by the retirement of SONGS Units 2 and 3.

First, CECP's efficient real power output provides economic power to serve load within the urban San Diego load center. Moreover, because of CECP's location within an urban load center, delivering power to load from CECP reduces transmission losses compared to delivering that power from remote locations.

Second, because of its Northern San Diego County location within the San Diego Gas & Electric Company (SDG&E) high voltage transmission network, CECP's real power support along the 230 kV transmission system between Los Angeles and San Diego allows it to help manage flows into the San Diego area from both the north and the 500 kV system to the east.

Finally, each CECP power train can provide up to approximately 140 MVAR of reactive power support to maintain a reliable voltage profile in the Orange County and Northern San Diego areas, which supports the reliable and efficient transfer of electrical power in this area. Because each power train is made up of synchronous machines, the voltage support that CECP provides is dynamic. The voltage support, measured in MVAR, which static reactive power devices like capacitors provide is proportional to the voltage at their point of interconnection. This means that their MVAR output drops as the voltage at their location drops. As their MVAR output drops, the voltage at their location drops, which in turn causes their MVAR output to drop – a phenomenon that can contribute to local voltage collapse. In contrast, CECP's MVAR output does not depend solely on the interconnection voltage, and CECP can provide maximum MVAR output to support voltage under a much wider range of voltages.

Additionally, devices that provide only reactive power, including more sophisticated reactive power devices such as static VAR compensators and synchronous condensers, still provide *only* reactive power. CECP provides both real and reactive power.

CECP's location, electrically close to the SONGS switchyard, affords CECP a very high effectiveness factor. Effectiveness of a generating resource at a particular location can be measured as the ratio of the impact that power from that location has on changing the flow across a given transmission line relative to the impact that power from another generating resource has on changing the flow across the same transmission line. Testimony from SDG&E witness John Jontry indicated that generation at the SONGS Mesa site would have an effectiveness of 1.00 on mitigating voltage collapse in the San Diego area.[6] SDG&E Witness Jontry noted that generation at the Encina 230 kV bus – where one of the two CECP trains would be interconnected – was only slightly less effective relative to generation at SONGS Mesa, with an effectiveness of 0.96.[7] This indicates that the CECP's repowered generation located at the Encina site is only slightly less effective than new generation at SONGS Mesa in supporting San Diego area voltage. Yet no new transmission or gas infrastructure is required to site new, repowered generation at CECP's location.

In addition to the generic benefits afforded by a repowering project, and the services that meet specific needs created or exacerbated by the retirement of SONGS Units 2 and 3, CECP provides yet another service which is becomingly increasingly important as more and more variable renewable resources are interconnected – dispatchable flexibility to respond to fluctuations in output from these variable resources. Moreover, because of CECP's location in Northern San Diego County, CECP's

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[6] *Prepared Direct Testimony of San Diego Gas & Electric Company (U 902 E)* by Witness John M. Jontry at 15:1-18. However, as presented in Mr. Jontry's testimony, the limiting contingency in the case in which the effectiveness of generation at SONGS Mesa was evaluated was the G-1/N-1 contingency of the loss of the Otay Mesa generation station and the ECO-Miguel 500 kV line, while the limiting contingency for the other generation locations studied, including the interconnection point for one of the two trains of the CECP (the Encina 230 kV bus) was the non-simultaneous but overlapping N-1-1 contingency of the loss of the ECO-Miguel 500 kV line, and the Ocotillo Express-Suncrest 500 kV lines. Because the limiting contingencies are different, it is not clear whether the effectiveness factors are truly comparable.

[7] *Id.*

flexibility is electrically close to a major source of variability, namely, the intermittent resources interconnecting to the east of Los Angeles and San Diego. Having dispatchable, flexible generation electrically close to the source of variability and within a load center minimizes the transmission flow impacts of responding to fluctuations in variable resource output, and helps ensure that the needed flexibility is not "stranded" by being located behind a constraint in the network.

For all of these reasons – because CECP provides (1) the generic benefits of a repowering project in reducing the need for new infrastructure and mitigates OTC impacts, (2) a suite of electrical services that both meet the need for service created or exacerbated by the retirement of SONGS Units 2 and 3 and (3) flexibility that is well-located relative to the need – CECP is an ideal resource, if not *the* ideal resource, to develop to meet post-SONGS needs.

IV. The Timing of the Need for New Generation in the San Diego Area Warrants Prompt Action

As noted above, CECP efficiently provides the services provided by SONGS Units 2 and 3 – efficient real power and dynamic reactive power support – in a location that is within the deficient San Diego sub-area and is only a few percent less effective than generation that would be located at San Onofre.

In accordance with the SWRCB's OTC policy, all five steam turbine units at the existing Encina Station (950 MW total) are to be retired by December 31, 2017. As the CAISO has identified, this creates a 2018 need for 520 MW of new generation in Northwest San Diego County, in addition to the 400 MW of new generation needed in Southwest and Southeast San Diego County.

The CEC approved CECP's Application for Certification by a 4-0 vote on May 31, 2012. [8] As evidence of the time the CEC licensing process can take, NRG submitted CECP's application to the CEC on September 14, 2007.

Because it already has its CEC license, CECP could be in full operation by 2018 under a reasonable set of assumptions regarding procurement and construction time frames. One key assumption necessary to allow CECP to achieve this schedule is the assumption that a power purchase agreement supporting CECP is approved by the CPUC by late 2014 or early 2015.

In contrast, it is highly unlikely that any new generation of sufficient size within the San Diego area could begin commercial operation by 2018. CECP's own experience is illustrative of the pitfalls that can befall any project. While every license application has its own unique circumstances that will affect its timing, CECP's application – which took nearly five years to complete - was for a repowering project on an existing brownfield site.

To summarize, CECP, which is well-positioned to help meet the reliability needs created by the retirement of SONGS Units 2 and 3, is also uniquely positioned by virtue of its prior approval by the CEC to be in service to meet these needs by 2018, in time to allow for the retirement of OTC units at Encina.

V. Existing Generation Can Meet Some of the Identified Local Area Needs If Provided With a Reliable Means to Recover the Costs of Required Maintenance

The CAISO's August 5 testimony identified the need to retain 640 MW of non-OTC existing generation at the Etiwanda Generating Station (Units 3 and 4) in the Eastern Los Angeles Basin to meet reliability needs in the 2018 time frame.[9] In accordance with the assumptions provided in Attachment A to the May 21, 2013 Revised Scoping Ruling and Memo of the Assigned Commissioner and

[8] Available at http://www.energy.ca.gov/2011publications/CEC-800-2011-004/CEC-800-2011-004-CMF.pdf
[9] CAISO Testimony at 19:13.

Administrative Law Judge, the CAISO assumed this generation would be retired by 2018.[10] Southern California Edison, however, explicitly assumed that Etiwanda units 3 and 4 – and Coolwater units 3 and 4 – would continue to operate, noting that "some facilities in California have operated beyond 40 years".[11]

In reality, without additional capacity revenues, it is more reasonable to assume that older gas-fired generating stations such as Etiwanda and Coolwater will be retired, especially if those resources face significant future major maintenance, such as a turbine overhaul, and capacity continues to be contracted one year at a time. Conversely, if reliable and sufficient multi-year forward capacity revenues are available to make such major maintenance economic (e.g., as potentially available under five-year forward Resource Adequacy (RA) solicitations) the life of these resources may well be extended.

At this time, both Etiwanda Unit 3 and Unit 4 are in need of major maintenance. Etiwanda Unit 4, with a nameplate rating of 320 MW, is currently experiencing a 15 MW de-rate due to high re-heat pressure in the turbine. This capacity lost to this de-rate cannot be restored until the unit's turbine is overhauled. This de-rate is just one example of a number of issues symptomatic of an aging fleet with deferred major maintenance. Etiwanda Unit 4's turbine was last overhauled in 2002, while Unit 3's turbine was last overhauled in 2004. Since turbine overhauls are due on both units, reduced availability or additional de-rates on either unit are possible.

It is worth noting that, as with most steam turbine units within the CAISO's footprint, operation of Etiwanda 3 and 4 has dramatically changed since these "base load" units were initially designed and constructed. As system heat rates fell, steam turbine units have been increasingly cycled, exacerbating wear and tear on such units. Although Etiwanda 3 and 4 were designed to be operated with only a limited number of starts and long run times, NRG has successfully transitioned the operation of these units into intermediate duty, typically cycling both units daily. In the first eight months of 2013, Etiwanda 3 and 4 have started a total of 142 times, demonstrating the significant contribution to grid

[10] Attachment A, at page 12, sets forth the assumption that 1,645 MW of non-OTC generation in the Los Angeles Basin would be retired due to age in 2018 and 2022.
[11] *Track 4 Testimony of the Southern California Edison Company* at 14:6-21.

reliability these resources continue to provide and the increased cycling that these resources now experience.

Coolwater 3 and 4 are combined cycle units, each with two combustion turbines and a steam turbine. These units were designed as intermediate duty units subject to more frequent starts and cycling. While not local area resources, the four combustion turbines and two steam turbines have started 257 times in the first eight months of 2013, demonstrating that Coolwater 3 and 4 also play a key role in meeting the grid's daily demand and flexibility requirements.

Based on the current state of the generating units, and the significant work needed to keep Etiwanda 3 and 4 in operation, NRG estimates that the cost to maintain these units in service through and beyond 2018 would require capacity revenues materially in excess of what NRG forecasts will be available through the "RA market". As NRG currently envisions, this work would take place over the period 2015-2018. Until the turbines are opened up, the full extent of the work required cannot be known, and it is possible that the inspection may reveal additional damage that will increase the cost of the work needed to restore these units to service.

Given the amount of turbine degradation already experienced (as evidenced by the 15 MW de-rate), it would be irresponsible, and inconsistent with good utility practice, to intentionally run these units to failure. In no case will NRG defer maintenance and continue to operate these units if doing so would raise safety issues. Additionally, adopting a run to failure strategy could also have significant impacts on the salvage value of this asset.

Coolwater 3 and 4 are in a similar circumstance, with major maintenance soon required on these units. Faced with the prospect of year-to-year capacity contracts at low prices for system RA capacity in the future, NRG is unable to justify investment in major repairs that cannot be amortized over a very short payback period (*i.e.,* one year – a common RA contracting period).

Whether these units will remain in service hinges on whether NRG can earn sufficient revenues to recover the costs of the major maintenance needed to keep these units in service. If NRG cannot recover the costs of this needed maintenance, NRG expects that the Etiwanda 3 and 4 turbines will degrade to the point that the units will be retired prior to 2018. Similarly, based on current forecast capacity values, NRG expects Coolwater 3 and 4 will be retired by 2016.

While maintaining these units in operation will require capacity revenues greater than those that NRG expects will be available through the RA market, keeping these units in operation will be a less expensive alternative to constructing new generation to meet the projected reliability needs over the 2018-2022 time frame. These existing units do not use ocean water for cooling (and therefore have no OTC policy-mandated retirement dates), require no new gas or electric transmission infrastructure, and face no significant permitting issues. While these units are started and stopped frequently, they are not operated at capacity factors that would suggest new generation would be an economic alternative to keeping these units in operation. A modest investment in the maintenance needed to keep these units in operation may well be the most cost-effective way to meet the projected reliability needs over the 2018-2022 time frame.

To summarize: Under current market conditions and based on current RA market pricing, it is unreasonable to simply assume that Etiwanda 3 and 4 and Coolwater 3 and 4 will remain in service. Continued operation will depend on whether these units receive contracts of sufficient value and duration to justify the essential maintenance required to keep these units safely and reliably in service.

This concludes my testimony.