BEFORE THE PUBLIC UTILITIES COMMISSION OF THE STATE OF CALIFORNIA

Order Instituting Rulemaking to Oversee the Resource Adequacy Program, Consider Program Refinements, and Establish Annual Local Procurement Obligations.	Rulemaking 11-10-023 (Filed October 20, 2011)

COMMENTS OF CALPINE CORPORATION

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Pursuant to the March 11, 2013 *Administrative Law Judge's Ruling Resetting Schedule for Comments on Phase 2 Resource Adequacy Issues and Scheduling a Prehearing Conference* ("*March 11, 2013 ALJ Ruling*") and Administrative Law Judge ("ALJ") Gamson's oral request at the March 20, 2013 prehearing conference,[1] Calpine Corporation ("Calpine") submits these comments addressing flexible capacity procurement issues.

Calpine strongly supports the implementation of flexible capacity procurement requirements and related modifications to the resource adequacy ("RA") program to preserve the availability of resources that possess the operational flexibility needed to satisfy future reliability requirements and integrate intermittent renewable generation. Accordingly, Calpine may eventually support proposals similar to the *Energy Division Flexible Capacity Procurement Revised Proposal*[2] ("*Energy Division Proposal*") and the October 29, 2012 *Resource Adequacy and Flexible Capacity Procurement Joint Parties' Proposal* ("*Joint Parties Proposal*").[3] However, in their current form, both proposals lack adequate resource counting rules and uniform enhanced must-offer obligations for all resources.

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[1] Prehearing Conference Transcript ("PHC Transcript") at 8.

[2] The *Energy Division Proposal* is attached to the *March 11, 2013 ALJ Ruling*.

[3] The *Joint Parties Proposal* was jointly sponsored by the California Independent System Operator, Southern California Edison Company, and San Diego Gas & Electric Company. The *Joint Parties Proposal* is attached to the *Scoping Memo and Ruling of Assigned Commissioner and Administrative Law Judge* at Attachment A (December 6, 2012).

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To address these deficiencies, the proposals should be modified to:

1. Eliminate resource counting conventions that arbitrarily differentiate resources based on cold start times.

2. Adjust the methodology for calculating flexibility to account for the fact that combined cycle gas turbines ("CCGTs") rarely start cold.

3. Discount the flexible capacity value of resources that (i) are incapable of starting within the timeframe covered by the California Independent System Operator's ("CAISO") Short-Term Unit Commitments,[4] or (ii) are generally uneconomic to operate.

4. Include an enhanced must-offer obligation that applies uniformly to all use-limited resources. The California Public Utilities Commission ("Commission") should only adopt flexible capacity procurement requirements that treat resources equitably with respect to how these resources are counted and their performance obligations.

I. THE *ENERGY DIVISION PROPOSAL* AND THE *JOINT PARTIES PROPOSAL* SHOULD BE FURTHER REFINED

The *Energy Division Proposal* and *Joint Parties Proposal* are now nearly identical. Most significantly, they share the same flawed resource counting convention. In addition, while the *Energy Division Proposal* includes a refined must-offer obligation for hydroelectric resources,[5] neither proposal articulates clear must-offer obligations applicable to all use-limited resources including storage, demand response, and many combustion turbines ("CTs"). Resource counting rules and must-offer obligations for all use-limited resources should be refined before either proposal is implemented.

In particular, certain aspects of the counting rules in each proposal function to minimize the fraction of CCGT capacity that is deemed flexible and overstate the fraction of capacity of

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[4] *See* Section 7.7 of the CAISO's Business Practice Manual for Market Operations. A copy is available at: http://bpmcm.caiso.com/BPM%20Document%20Library/Market%20Operations/BPM_for_Market%20Operations_V32_clean.doc.

steam units that should be deemed flexible.[6] CCGTs are the backbone of California's conventional generation fleet and flexible capacity counting rules should be crafted to appropriately recognize the flexibility inherent in CCGTs, as well as the incremental flexibility that could be realized from these resources.[7] As the CAISO previously described, the accurate counting of flexible capacity is particularly critical given that:

> intermittent resource additions made to reach the 33 percent renewable portfolio standard, in conjunction with retirements of flexible generation resources due to revenue insufficiency or as a consequence of the once-through-cooling policy, will "crowd-out" and reduce the fleet of flexible generation capacity available to meet resource adequacy obligations, thereby leading to insufficient flexible operating capability to ensure future reliability.[8]

If an objective of flexible capacity procurement requirements is to retain flexible generation needed to meet prospective reliability requirements, the Commission should not skew resource counting rules towards low capacity-factor, slow-starting, and inefficient steam units to the disadvantage of newer, more flexible, and more efficient resources, such as CCGTs. Many steam units are close to the end of their useful lives and/or will be forced to retire to comply with Once-Through-Cooling ("OTC") regulations. Thus, they do not represent long-term solutions to impending reliability needs.

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[6] For example, based on the CAISO's April 1, 2013 Draft Effective Flexible Capacity Calculations (a copy is available at http://www.caiso.com/Documents/DraftEffectiveFlexibleCapacityCalculationsApr1_2013.xls), Moss Landing Unit 7 has an August Effective Flexible Capacity (EFC) of 703.7 MW relative to an August Net Qualifying Capacity (NQC) of 755.7 MW. In contrast, Delta Energy Center a CCGT with an August NQC of 813 MW has an August EFC of only 560 MW.

[7] *See CCGT Technology and Operational Flexibility* describing the constraints that currently exist on a typical CCGT facility and some possible modifications and upgrades to enhance flexibility. A copy of *CCGT Technology and Operational Flexibility* is attached to these comments.

[8] R.11-10-023, *California Independent System Operator Corporation Comments on Proposed Decision* at 2 (June 11, 2012).

A. Resource counting conventions that arbitrarily differentiate resources based on cold start times should be eliminated

The *Energy Division Proposal* and the *Joint Parties Proposal* each rely on the same flawed resource counting convention that arbitrarily differentiates resources based on cold start times - specifically, whether a resource can start cold and reach Pmin, the lowest output above which it is dispatchable, within 90 minutes.[9] Under the respective proposals, resources that can start cold within 90 minutes are allowed to count the capacity between 0 and Pmin as flexible.

As Calpine has previously discussed, no party has demonstrated that the 90 minute cold start limit contained in either proposal is justified or otherwise necessary to satisfy reliability needs.[10] As a result, such a limit creates potentially perverse incentives for generators to undertake costly investments to comply with the 90 minute limit without any demonstrable benefit to the system in terms of flexibility and reliability.

For example, a typical CCGT can be modified to cold start in 90 minutes by thermally decoupling its CTs from the rest of the plant.[11] Decoupling allows the CTs to start and ramp to their full capacity without the typical limits associated with thermal stresses on the steam cycle of a CCGT. The ability of the plant to ramp above the capacity of its CTs, however, would still be limited by constraints on the steam cycle. As a result, decoupling would not affect the plant's ramping capability over a three hour period. Thus, before a 90 minute cold start limit is adopted, the Commission should first determine whether the ability to access some portion of a resource's flexible capacity over a time period less than 90 minutes provides tangible reliability benefits.

In addition, the 90 minute cold start limit does not provide any incentive to pursue investments that, although they may reduce start times and hence increase flexibility, do not

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[9] *See Energy Division Proposal* at 5; *Joint Parties Proposal* at 20.

[10] *See* R.11-10-023, *Comments of Calpine Corporation on the Joint Parties' Proposal Regarding Resource Adequacy and Flexible Capacity Procurement* ("Calpine Comments") at 9-10 (December 26, 2012).

[11] *See CCGT Technology and Operational Flexibility* at A-4.

yield cold start times below 90 minutes. For example, steam turbine blankets and auxiliary boilers can keep elements of the steam cycle warmer for longer periods after a CCGT shuts down.[12] Subsequent starts are thus more likely to be from "warm" conditions and, as a result, shorter. While these types of investments will increase the flexibility of CCGTs in actual operations, primarily by enabling shorter starts, they may not enable CCGTs to start cold in 90 minutes. Thus, the use of a 90 minute limit may inappropriately discourage modifications that might otherwise increase flexibility.

B. The methodology for calculating flexibility should be adjusted to account for the fact that CCGTs rarely start cold

The focus on cold start time limits in the proposed resource counting rules unfairly and unnecessarily discriminates against CCGTs, which rarely start cold. The following table summarizes starts over the last three years for several Calpine CCGTs:

		2010	2011	2012	Total
Sutter	Hot	34	59	42	135
	Warm	18	33	11	62
	Cold	22	22	7	51
	Capacity Factor (%)	38.3	20.1	26.8	
Delta	Hot	93	43	13	149
	Warm	18	26	13	57
	Cold	9	12	1	22
	Capacity Factor (%)	56.1	58.4	79.8	
Metcalf	Hot	147	134	160	441
	Warm	36	61	10	107
	Cold	8	21	14	43
	Capacity Factor (%)	52.7	30.8	53.8	

As the above table demonstrates, even CCGTs that operate at relatively low capacity factors, such as Calpine's Sutter plant, do not often start cold—primarily because CCGTs are

[12] *See CCGT Technology and Operational Flexibility* at A-5.

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often operated episodically. For example, although a CCGT like Sutter did not operate in certain months, in the months in which it did operate, the plant typically started daily. Thus, the majority of Sutter's starts were warm or hot starts. To more accurately account for how CCGTs actually operate, the methodology for calculating flexibility should be modified to reflect that CCGTs rarely start cold.

C. The "flexible capacity" value of resources that (i) are incapable of starting through CAISO Short-Term Unit Commitments, or (ii) do not operate economically should be discounted

Most steam units cannot be started within the window covered by the CAISO's Short-Term Unit Commitment (*i.e.*, within the operating day) and are not generally economic to operate above minimum load. For example, OTC compliance filing shows that the two Ormond Beach units ran at a combined capacity factor of 4 percent during 2006-2010.[13] Similarly, based on data from the California Energy Commission, the Moss Landing steam units ran at a 2 percent capacity factor in 2011.[14] The flexible capacity value for such resources should be discounted to reflect flexibility limits.

To respond to ramps that exceed ramps that are expected day-ahead, resources that cannot be started during the operating day will either be unavailable or will require commitment at minimum load. A resource committed at minimum load, however, potentially exacerbates over-generation conditions about which the CAISO has repeatedly expressed concern, artificially suppresses prices, and results in bid cost recovery payments that are ultimately borne by load. Because the provision of flexibility from resources that cannot be started intra-day either results

[13] A copy of the OTC compliance filing is available at: http://www.swrcb.ca.gov/water_issues/programs/ocean/cwa316/powerplants/ormond_beach/docs/ob_ip2011.pdf .

[14] A copy of the CEC Annual Generation – Plant Unit data is available at: http://energyalmanac.ca.gov/electricity/web_qfer/Annual_Generation-Plant_Unit.php.

in lower reliability or entails additional costs, the assumed flexible capacity provided by such resources should be discounted.

The appropriate discount for resources that cannot be started during the operating day should be the subject of further workshops. One potential approach is to use the multiplier from the Commission's demand response cost-effectiveness methodology that is applied to programs that must be called day-ahead as opposed to those that can be called the same day-ahead or day-of.[15]

D. An enhanced must-offer obligation that applies uniformly to all use-limited resources should be adopted

The *Energy Division Proposal* includes a distinct must-offer obligation for hydro resources. However, neither the *Energy Division Proposal* nor the *Joint Parties Proposal* addresses must-offer obligations for other use-limited resources, such as CTs, that may have limits on annual, monthly, or daily starts and/or annual, monthly, or daily emissions.

Similarly, neither proposal considers how storage and demand response—which may only be dispatched during certain hours, for limited durations, and with minimum durations between dispatches— could comply with an enhanced must-offer obligation. To the extent that storage or demand response might not be able to satisfy an enhanced must-offer obligation, neither proposal indicates how they will be counted towards flexible capacity procurement requirements.

The inclusion of separate requirements for hydro resources in the *Energy Division Proposal* highlights the need to address all use-limited resources uniformly. Accordingly, before any proposal is implemented, it should be modified to include an enhanced must-offer obligation that applies to all use-limited resources.

[15] *See* Calpine Comments at 25 (December 26, 2012).

II. FURTHER DEVELOPMENT OF THE RECORD IS BEST ACHIEVED THROUGH ADDITIONAL WORKSHOPS RATHER THAN THROUGH HEARINGS

At the March 20, 2013 prehearing conference, ALJ Gamson requested comments on the March 11, 2013 *Request for Evidentiary Hearings of Sierra Club and The Utility Reform Network* ("*Sierra Club/TURN Request*").[16] Calpine does not oppose further development of the record on flexible capacity procurement requirements, particularly to address both resource counting rules and enhanced must-offer obligations. However, workshops would provide a better process to constructively develop a more meaningful record than hearings. Accordingly, ALJ Gamson should reject the *Sierra Club/TURN Request* and, in the alternative: (i) defer implementation of flexible capacity procurement obligations until the 2015 RA delivery year; (ii) commit to consider refinements to resource counting rules, enhanced must-offer obligations, and other elements of flexible capacity procurement requirements throughout the remainder of this year and the first half of 2014; and (iii) if the Commission deems further development of the record necessary, implement a series of workshops to supplement the record in this proceeding.

III. CONCLUSION

Calpine is encouraged by the progress made in this proceeding towards the development of flexible capacity procurement requirements. However, the Commission should only adopt

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[16] PHC Transcript at 32. The request was reiterated in the March 28 *Amended Request For Evidentiary Hearings Of Sierra Club And The Utility Reform Network.*

flexible capacity procurement requirements that treat resources equitably with respect to both how these resources are counted and their performance obligations.

Respectfully submitted,

/s/

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ATTACHMENT

CCGT Technology and Operational Flexibility

Rob Parker[17]

As California's investor-owned utilities strive to meet 33% renewables portfolio standard requirements, intermittent renewable resources will continue to increase in capacity and continue to put pressure on existing fossil-fueled generation resources to provide operational flexibility. A majority of the existing fossil-fueled generation fleet is made up of both conventional steam generation and combined cycle gas turbine ("CCGTs") facilities, each having its own flexible constraints and capabilities. The purpose of this paper is to describe the constraints that currently exist on a typical CCGT facility and some possible modifications and upgrades to enhance flexibility.

Limits on the operational flexibility of CCGTs are primarily related to managing the thermal stresses associated with changes in the temperature of certain components when a unit starts and meeting minimum condenser vacuum requirements. Thermal stresses can be addressed by limiting them directly and/or by maintaining the temperature of specific CCGT components when a CCGT is not operating. The ability to limit thermal stresses and/or keep components warm can be accomplished through relatively low cost upgrades such as terminal attemperators, thermal blankets, boiler drum upgrades, and auxiliary boilers. Similarly, the time to reach condenser vacuum requirements can also be reduced through the installation and use of vacuum pumps and auxiliary boilers.

[17] Mr. Parker is Vice President, West Operations for Calpine. He has over 22 years of experience in the power generation industry. As Vice President of West Operations for Calpine, Mr. Parker is responsible for the operations and maintenance of all gas fired assets in California, Oregon, and Arizona. He joined Calpine in July 2001 as a Senior Operations Engineer. Prior to joining Calpine, Mr. Parker spent 10 years with General Electric as a field turbine engineer and contract performance manager and 2 years as an Area Manager of Utilities in the pulp and paper industry. Mr. Parker has a Bachelor of Science degree in mechanical engineering and marine engineering technology from the California Maritime Academy.

CCGTs generate electricity through two distinct thermodynamic cycles. In the first cycle, the Brayton cycle, gas is burned in a combustion turbine. The expansion of the resulting hot gases drives a turbine which turns a generator and creates electricity. In the second cycle, the steam or Rankine cycle, the hot exhaust gases from the first cycle are used to generate steam in a heat-recovery steam generator ("HRSG" also known as a boiler or steam generator). The steam from the HRSG is then used to turn a steam turbine which spins a generator and creates electricity. Once steam exits the steam turbine it is condensed in a condenser and the resulting condensate is recirculated to the HRSG. In order to operate, the condenser must reach sufficient negative pressure (*i.e.*, vacuum). The utilization of the steam cycle to recover and produce electricity from the exhaust heat from the first cycle of CCGT operations contributes to the high efficiency of CCGT generation relative to power plants that rely on combustion turbines ("CTs") or steam alone.

CCGTs typically consist of multiple combustion turbines and a single steam turbine. CCGTs can be operated in different configurations depending on the number of CTs that are operated simultaneously. For example, a 2x1 CCGT (2 CTs and 1 steam turbine) can operate in either 1x1 (1 CT, 1 steam turbine) or 2x1 (2 CTs, 1 steam turbine) modes. Each CCGT combustion turbine typically has its own HRSG.

The CTs utilized in CCGTs are no different from the CTs utilized on a standalone basis in many peaking plants and have the same inherent flexibility (*e.g.*, the CTs utilized in Calpine's California CCGTs are generally capable of starting within 10 minutes and ramping to full load in 20 minutes). In contrast, the steam cycle is subject to many of the constraints inherent in generating electricity from steam.

Generally, the hotter and higher pressure the steam, the greater the efficiency of the associated generation of electricity. Steam turbines in modern CCGTs utilize steam as hot as 1,050 degrees Fahrenheit and 2000 psig. To withstand the pressure and heat associated with high temperature and pressure steam, steam turbines have thick metal casings which expand and shrink as their temperature changes. The rotors and blades inside a steam turbine also expand and contract as their temperature changes. It is important that the expansion and contraction of the components within a steam turbine match the expansion and contraction of the steam turbine casing to avoid performance degradation and maintain operability.

In addition, HRSGs may be damaged by large and rapid changes in temperature. Traditional HRSG design involves steam drums which are susceptible to damage from large rapid temperature changes. The joints between the thin-walled boiler tubes which convey heat to the drums and thick-walled drums are also susceptible to damage if their temperatures diverge. Existing CCGTs can be retrofitted with two newer and smaller drums that are less susceptible to thermal stresses. For example, a typical drum on a 10 year-old CCGT may be able to withstand changes in temperature of 5 degrees/minute while a newer drum can withstand changes in temperature of 17 degrees/minute. Such retrofits may shorten start times. In addition, because the time to transition between different CCGT configurations (*e.g.*, 1x1 to 2x1) is often limited by thermal constraints on the HRSG associated with the incremental CT in the new configuration, boiler upgrades can increase operational flexibility after a unit has started.

Starts are frequently characterized as "hot," "warm," or "cold" depending on the time that has elapsed since a unit last operated. For example, depending on the turbine/HRSG manufacturer's recommendation, starting a unit after it has been down for more than 48 to 72 hours might be considered "cold." Similarly, a start after a unit has been down for more than eight hours but less than 48 to 72 hours might be considered "warm." A start within eight hours after a unit last operated might be considered "hot." The elapsed times by which starts are categorized as "hot," "warm," or "cold" are essentially proxies for the temperature of the steam turbine and/or HRSG, which cool gradually once they shut down. Start times are linked directly to the starting temperature of the steam turbine and pressure in the condenser. For example, a cold start might take six hours, while a warm start could take two hours and a hot start even less time.

There are at least three general approaches to shortening start times for CCGTs. First, CCGTs can be constructed with steam cycle components that are less susceptible to failure when exposed to large thermal stresses. In fact, the most recent innovations in CCGT technology, such as GE Rapid Response or Siemens Flex-10 and Flex-30 technologies have focused on the development of more robust steam cycle components, such as once-through boilers.[18] While relying on such technologies in new plants may be economic, retrofitting existing plants with new HRSGs or steam turbines is generally not economic under current market structures.

Second, thermal stresses can be managed and greater gas turbine flexibility can be achieved during CCGT starts. For example, the CT cycle may be decoupled from the steam turbine to a certain extent by using terminal attemperation. Attemperation involves injecting fine water mist into steam flow to reduce its temperature. While most existing CCGTs have some attemperation capability, the ability to substantially reduce the temperature of steam entering the steam turbine is limited and places a large constraint on the CT supporting the CCGT facility start-up. The use of terminal attemperation allows a CT associated with a CCGT to start nearly

[18] Once-through boilers dispense with the drums associated with older designs.

as fast as a standalone CT and, more importantly, allows access to potential dispatchable CT megawatts earlier in the CCGT facility start-up.

Third, thermal stresses can be avoided by keeping components of the steam cycle warm with thermal blankets, auxiliary boilers, and stack dampers. Keeping components of the steam cycle warm cannot permanently delay the cooling of the components of a steam cycle and it will not shorten starts when the components of the steam cycle are truly cold, but it can expand the window from the previous shut down of a plant during which a start might be considered "hot" or "warm" rather than "cold." In addition, auxiliary boilers can help a CCGT establish and maintain minimum condenser vacuum requirements.

Starts can also be shortened by 9-12 minutes using "purge credit." A start typically requires clearing potential natural gas build-up in the HRSG by ensuring a pre-prescribed volume of air has circulated through the HRSG prior to the ignition of the CT.[19] This step can be eliminated at start-up by completing the purge during a CT shut down. This is achieved by performing the pre-prescribed air volume exchange during shut-down and then, following shutdown, a series of valves, vents and a nitrogen blanket are used in conjunction to ensure no natural gas can leak into the HRSG prior to the next CT start.

[19] Gas might enter the HRSG due to incomplete combustion in the CTs.