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Comments of Calpine Corp. on the November 18, 2014 Staff Workshop on Californiaâ€™s Natural Gas Infrastructure, Storage, and Supply

Additional submitted attachment is included below.

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Calpine welcomes the opportunity to provide these comments on the AB 1257 Staff Workshop on California's Natural Gas Infrastructure, Storage, and Supply conducted on November 18, 2014. Calpine did not participate in the workshop but understands that the workshop addressed several questions related to the use of gas-fired generation for renewable integration, including the following:

> 9. Flexible capacity gas generation facilities are typically less efficient than conventional combined cycle generation. Will more frequent use of flexible capacity actually contribute to increased use of natural gas as a generation fuel overall for California? What would increased use of flexible capacity mean for particulate emissions, NOx and GHG emissions? Will flexible capacity generation facilities need to modify their permits for increased start and stop operations? Are there market signals or factors that would mitigate using these less efficient facilities?[1]

Calpine questions the premise of the question, i.e., that flexibility requirements cannot be satisfied with combined cycle generation (CCGTs). While many existing CCGTs were not designed to cycle extensively, the ability of CCGTs to cycle and meet flexibility requirements can be improved significantly through modest modifications.

CCGT technology involves burning gas in combustion turbines and then using the exhaust heat from combustion turbines to make steam and generate additional electricity using a steam turbine. Constraints on the flexibility of CCGTs are related to making steam from combustion turbines and generating electricity using steam, i.e., the steam cycle. Generally, thermal stresses on components of the steam cycle, including heat recovery steam generators (HRSGs) and steam turbines must be modulated. Typically, thermal stresses are modulated by starting and ramping CCGTs slowly. Modifications to CCGTs can enable thermal stresses to be modulated by other means, including steam bypass, attemperation, and by keeping components of the steam cycle warm using thermal blankets and auxiliary boilers.[2] In addition, the "turn down" of CCGTs, i.e., the ability to operate CCGTs at lower

[1] http://docketpublic.energy.ca.gov/PublicDocuments/15-IEPR-04/TN203337_20141114T154651_AB_1257_Staff_Workshop_Panel_Questions.pdf

output levels and remain in compliance with emissions limits can be improved through modifications to plant controls.[3]

The following diagram illustrates the flexibility improvements that Calpine believes could be realized across its fleet of CCGTs through combinations of various flexibility (and capacity) upgrades.

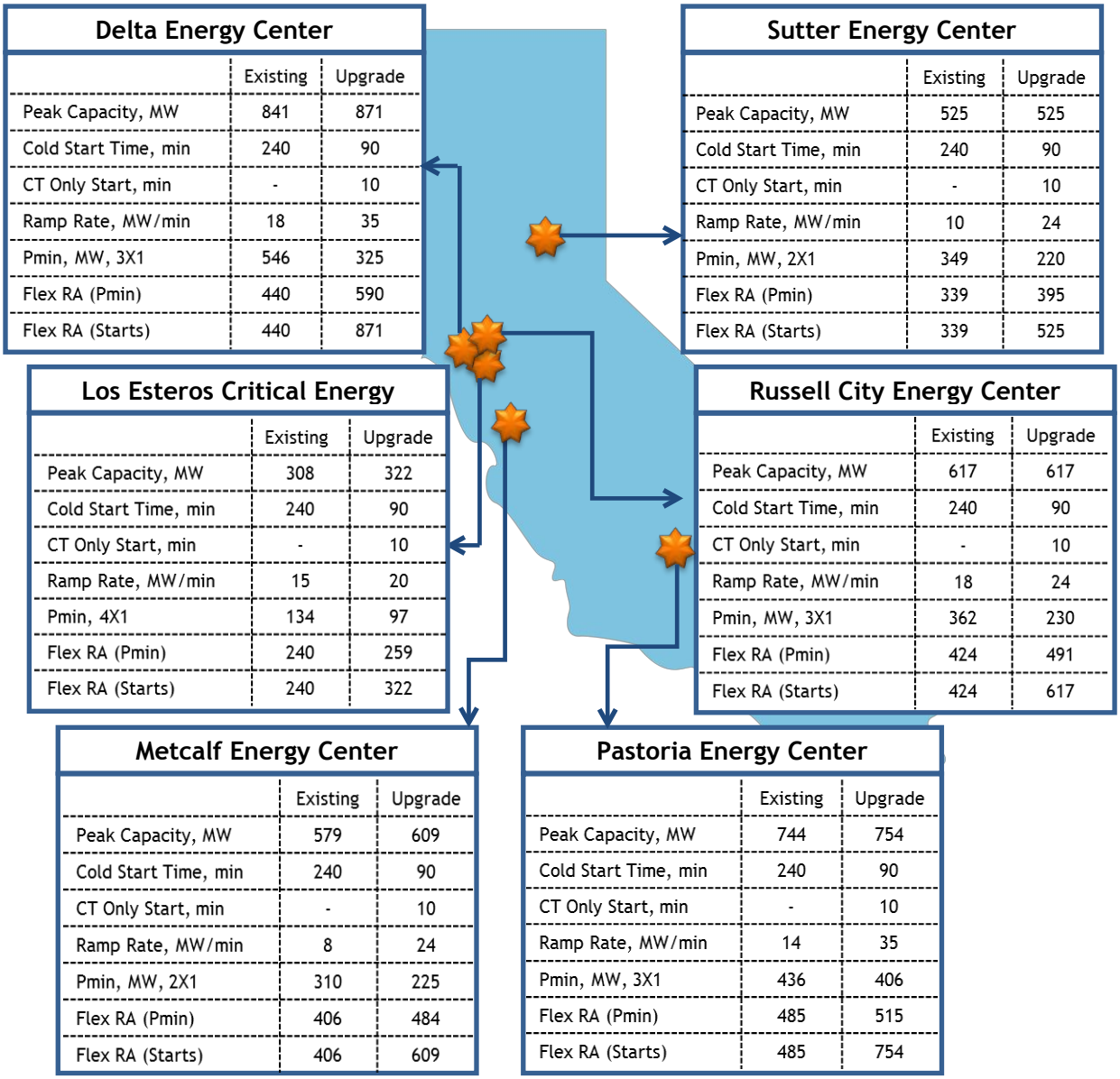
[2] Limits on the flexibility of existing CCGTs and potential strategies to address the limits are described extensively in Calpine's April 5, 2013 comments in R.11-10-023, especially the attachment entitled "CCGT Technology and Operational Flexibility." Calpine's April 5, 2013 comments in R.11-10-023 are attached to these comments as Attachment A.

[3] Some of the modifications to plant controls to enable lower turn down are described at the following links:

http://assetevaluator.gepower.com/resource_files/GEA%2018782%20-%207FA%20-%20OpFlex%20Turndown.pdf

and:

http://www.energy.siemens.com/hq/pool/hq/power-generation/gas-turbines/SGT6-5000F/214_140601_WS_PAC_5000F_US_LowRes.pdf



Delta Energy Center

	Existing	Upgrade
Peak Capacity, MW	841	871
Cold Start Time, min	240	90
CT Only Start, min	-	10
Ramp Rate, MW/min	18	35
Pmin, MW, 3X1	546	325
Flex RA (Pmin)	440	590
Flex RA (Starts)	440	871

Sutter Energy Center

	Existing	Upgrade
Peak Capacity, MW	525	525
Cold Start Time, min	240	90
CT Only Start, min	-	10
Ramp Rate, MW/min	10	24
Pmin, MW, 2X1	349	220
Flex RA (Pmin)	339	395
Flex RA (Starts)	339	525

Los Esteros Critical Energy

	Existing	Upgrade
Peak Capacity, MW	308	322
Cold Start Time, min	240	90
CT Only Start, min	-	10
Ramp Rate, MW/min	15	20
Pmin, 4X1	134	97
Flex RA (Pmin)	240	259
Flex RA (Starts)	240	322

Russell City Energy Center

	Existing	Upgrade
Peak Capacity, MW	617	617
Cold Start Time, min	240	90
CT Only Start, min	-	10
Ramp Rate, MW/min	18	24
Pmin, MW, 3X1	362	230
Flex RA (Pmin)	424	491
Flex RA (Starts)	424	617

Metcalf Energy Center

	Existing	Upgrade
Peak Capacity, MW	579	609
Cold Start Time, min	240	90
CT Only Start, min	-	10
Ramp Rate, MW/min	8	24
Pmin, MW, 2X1	310	225
Flex RA (Pmin)	406	484
Flex RA (Starts)	406	609

Pastoria Energy Center

	Existing	Upgrade
Peak Capacity, MW	744	754
Cold Start Time, min	240	90
CT Only Start, min	-	10
Ramp Rate, MW/min	14	35
Pmin, MW, 3X1	436	406
Flex RA (Pmin)	485	515
Flex RA (Starts)	485	754

Cold start times could be reduced below 90 minutes by keeping components of the steam cycle warm. In addition, certain upgrades would allow the combustion turbines of a CCGT to start completely independently of the steam cycle and operate as standalone CTs (at heat rates comparable to standalone CTs). Ramp rates could be increased and minimum generation levels (Pmins) could be reduced through combinations of attemperation and new controls.

The CPUC recently implemented new rules for the load-serving entities that it regulates to purchase "flexible" capacity to satisfy Resource Adequacy (RA) requirements.[4] As shown in the figure, according to current flexible RA counting rules, such upgrades could expand the amount of flexible capacity

[4] See Appendix A of http://docs.cpuc.ca.gov/PublishedDocs/Published/G000/M097/K619/97619935.PDF.

available from the units, by expanding the dispatchable range between Pmin and the maximum output of a resource, as shown in the Flex RA (Pmin) values in the figure. The expansion of flexible RA capacity could be even larger if 90 minutes cold starts can be achieved, in which case the Pmin capacity also would be considered eligible flexible RA capacity, as reflected in the Flex RA (Starts) values in the figure.

Implementing these changes may require permit modifications, including modifications to California Energy Commission licenses and local air district permits.

Calpine looks forward to engaging with the CEC on these types of permit changes in the near future.