Docket No.: R.13-09-011

Exhibit No.: _____

Date: May 22, 2014

REPLY TESTIMONY
OF CALPINE CORPORATION

Q1. Please describe the purpose of your reply testimony.

A1. I previously submitted direct testimony addressing the reasons why Demand Response ("DR") resources should have the potential to set clearing prices for energy and ancillary services in California Independent System Operator ("CAISO") markets. Specifically, I testified that if DR does not have the potential to set clearing prices (*e.g.* if it is dispatched outside the CAISO energy markets) then it could lead to the inefficient dispatch of DR at prices higher than the prices at which additional energy is available from clearing price markets.

The purpose of my reply testimony is to respond to testimony submitted Pacific Gas and Electric Company ("PG&E") that Load Modifying Resource DR directly contributes to price formation in CAISO markets without participating in CAISO markets. Furthermore, my reply testimony addresses the operational benefits and increased efficiency of integrating DR into the CAISO's economic dispatch.

Q2. Please summarize PG&E's testimony regarding the ability of Load-Modifying Resource DR to directly contribute to price formation in CAISO energy markets.

A2. PG&E witness Alex Papalexopoulos asserts that Load-Modifying Resource DR directly contributes to the price formation in the CAISO energy markets and helps reduce the CAISO energy market price.[1] A Load-Modifying Resource, as defined by the California Public Utilities Commission ("Commission") in D.14-03-026, is a resource that reshapes

[1] PG&E 2013 Demand Response Rulemaking 13-09-011 Phases 2 and 3 Appendices (May 6, 2014), PG&E/Papalexopoulos, Ex. PG&E -1, Volume 2, at A-3.

or reduces the net load curve.[2] By contrast, Supply Resource DR is integrated into and dispatched through CAISO markets.[3] Mr. Papalexopoulos argues that a DR resource that is not integrated into CAISO markets nevertheless, "directly contributes to the price formation in these energy markets."[4]

According to Mr. Papalexopoulos, if effective, Load-Modifying Resource DR should "impact the type and the number of conventional generation resources that are needed to balance the CAISO's net load curve."[5] He further states that, "Load Modifying Resource DR, even though it is not bid into the CAISO market like generation, directly impacts the wholesale market because its action directly results in load changes. As a result, one can conclude that Load Modifying Resource DR directly contributes to the price formation in the CAISO energy market."[6]

Similarly, PG&E witness Jay Zarnikau asserts that "[i]f durable in the long-term, Load Modifying Resource DR reshapes the [Load Serving Entity's] LSE's load curve and reduces the need for conventional generation resources."[7] Mr. Zarnikau further explains that "[a] lower net load forecast leads to the dispatch of a smaller quantity of supply-side resources by the [CA]ISO, which in turn reduces market prices."[8] Mr. Zarnikau takes the position a step further by stating that "[t]he two types of DR resources [Supply Resource

[2] D.14-03-026, mimeo at 28 (Ordering Paragraph 2).
[3] D.14-03-026, mimeo at 28 (Ordering Paragraph 3).
[4] PG&E/Papalexopoulos, Ex. PG&E-1, Volume 2, at A-6.
[5] PG&E/Papalexopoulos, Ex. PG&E-1, Volume 2, at A-6.
[6] PG&E/Papalexopoulos, Ex. PG&E-1, Volume 2, at A-6.
[7] PG&E 2013 Demand Response Rulemaking 13-09-011 Phases 2 and 3 Appendices (May 6, 2014), PG&E/Zarnikau, Ex. PG&E -1, Volume 2, at C-8.
[8] PG&E/Zarnikau, Ex. PG&E-1, Volume 2, at C-10.

and Load-Modifying Resource] may affect the CAISO energy market price in a similar manner."[9]

Q3. Please explain why it is necessary for DR to participate directly in CAISO energy markets in order to *efficiently* contribute to price formation.

A3. While it is true that Load-Modifying Resource DR can influence prices in CAISO markets by lowering overall demand, it is not clear that DR dispatched outside of CAISO markets will lead to the most economically efficient dispatch of resources. There are at least two ways that DR dispatched outside of CAISO markets can lead to operational and economic inefficiencies. First, due to forecast error, DR may be dispatched when it is not needed, or not be dispatched when it is needed. This problem is likely to be exacerbated when DR is dispatched outside of CAISO markets, and potentially based on forecasts different than the CAISO's. Second, DR dispatched outside of CAISO markets may depress clearing prices inappropriately, leading to long-term inefficiencies.

Q4. Explain how forecast error can lead to less cost-effective dispatch of DR resources when DR is dispatched outside the CAISO energy markets.

A4. Mr. Papalexopoulos describes how Load-Modifying Resource DR is dispatched manually and often significantly in advance of real-time.[10] The dispatch of DR outside of CAISO markets before system conditions are actually known can be influenced by forecast error and lead to the dispatch of DR when it is not actually needed.

[9] PG&E/Zarnikau, Ex. PG&E-1, Volume 2, at C-7.
[10] PG&E/Papalexopoulos, Ex. PG&E-1, Volume 2, at A-7.

Forecast error in the dispatch of DR is particularly problematic because, in contrast to other resources, it cannot be easily undone. For example, if a generator is scheduled day-ahead and the real-time system conditions no longer warrant its operation, it generally can reduce its output. The same is not generally true for Load-Modifying Resource DR. As Commission Staff has explained:

> Because most DR programs are dispatched a day-ahead or several hours ahead of events, it is difficult for the utilities to effectively use DR programs in response to real time price spikes. There were many days where price spikes occurred but DR programs were not called, and conversely there were days where DR programs were called but no price spikes occurred.[11]

Mr. Zarnikau acknowledges this inefficiency in dispatching Load-Modifying Resource DR outside of CAISO markets, though he argues that these inefficiencies are small.[12] Mr. Papalexopoulos also seeks to de-emphasize the potential inefficiency by arguing that DR is dispatched infrequently, and, as a result, the inefficiency will be insignificant.[13] However, this inefficiency will increase as DR is potentially dispatched more often, not only under peak demand conditions, but also for renewable integration and other purposes.

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[11] Chapter 7 of *Lessons Learned From Summer 2012 Southern California Investor Owned Utilities' Demand Response Programs* (May 1, 2013). A copy is available at: http://www.cpuc.ca.gov/NR/rdonlyres/523B9D94-ABC4-4AF6-AA09-DD9ED8C81AAD/0/StaffReport_2012DRLessonsLearned.pdf.

[12] PG&E/Zarnikau, Ex. PG&E-1, Volume 2, at C-28.

[13] For example, Papalexopoulos states: "[t]he current DR programs derive most of their benefits from the value of capacity, because they are only dispatched for a small number of hours." [13] PG&E/Papalexopoulos, Ex. PG&E-1, Volume 2, at A-21.

Q5. Please provide an example of how forecast error can lead to the inefficient dispatch of DR.

A5. A recent example of how forecast error can lead to the inefficient dispatch of DR occurred in the PJM.[14] In two instances in the summer of 2013, based on forecasts of afternoon load, the system operator dispatched DR that required between one and two hours notification, which proved to be unneeded less than three hours later.[15] Although these DR resources "were anticipated to be needed to maintain reliability at the time they were dispatched – two hours prior to when they were expected to be needed – the end result was that they were not required to maintain reliability due to the sharp [change in conditions]."[16] Because the DR that was dispatched also had a two-hour minimum duration requirement, the system operator was required to pay for the expensive curtailments even though they were not actually needed and energy prices were significantly below the cost of dispatching the DR. The PJM system operator was then required to recover almost $44 million in uplift (*i.e.* the difference between clearing prices and the cost of dispatching the DR) for these two incidents.[17]

[14] The PJM (Pennsylvania-New Jersey-Maryland Interconnection) is a Regional Transmission Organization ("RTO"). It is part of the Eastern Interconnection grid operating an electric transmission system serving all or parts of Delaware, Illinois, Indiana, Kentucky, Maryland, Michigan, New Jersey, North Carolina, Ohio, Pennsylvania, Tennessee, Virginia, West Virginia and the District of Columbia.

[15] *See* PJM Interconnection L.L.C., Docket No. ER14-822-000, filing seeking modifications to the PJM Open Access Transmission Tariff ("Tariff"), Amended and Restated Operating Agreement of PJM Interconnection, L.L.C. ("Operating Agreement") and the Reliability Assurance Agreement Among Load Serving Entities in the PJM Region ("RAA") (Dec. 24, 2013). A copy is available at: http://www.pjm.com/~/media/documents/ferc/2013-filings/20131224-er14-822-000.ashx, at 5-8.

[16] *Id.* at 6.

[17] *Id.* at 6, 8.

These incidents demonstrate the significant magnitude of potential costs (in these two incidents almost $44 million) that can result from a same-day forecast error, even when DR is integrated into clearing price markets. These costs are likely to be compounded when DR is dispatched outside of markets administered by the system operator and based on forecasts that may reflect less complete information than the system operator's.

Q6. How else is the PJM experience relevant to issues raised in this California Public Utilities Commission's Demand Response proceeding?

A6. In addition to demonstrating the potential operating and economic inefficiencies caused by forecast errors, the PJM experience demonstrates that the economic and reliability benefits of a resource with significant operational constraints, such as long notification lead times and minimum duration requirements, may be limited. As noted by PJM's Independent Market Monitor:

> DR with long lead times and long minimum run times is both an operational issue for PJM and a financial issue for other loads. If PJM must call DR when the need is uncertain and must pay DR for the full two hour minimum run period, substantial uplift costs are imposed on other loads.[18]

[18] PJM Interconnection L.L.C., Docket No. ER14-822-000, *Comments, Complaints and Motion to Consolidate of the Independent Market Monitor for PJM*, at 6 (January 14, 2014). A copy is available at: http://www.monitoringanalytics.com/reports/Reports/2014/IMM_Comments_ER14-822-000_20140114.pdf.

Q7. Are there other inefficiencies created by DR dispatched outside of CAISO markets?

A7. Yes. DR dispatched outside of CAISO markets may suppress energy and ancillary services prices below competitive levels. For example, in a situation where supply and demand fundamentals in the CAISO energy market warrant a clearing price of $100/MWh and a LSE needs to procure 1000 MW, it might be economic for the LSE to dispatch 10 MW of DR at $1000/MWh to the extent that each MW of DR reduces clearing prices by at least $1/MWh. That is, in the absence of dispatching the DR, the LSE has procurement costs of $100/MWh*1000 MW=$100,000. After dispatching the DR, the LSE's procurement costs are $1000/MWh*10 MW + new clearing price/MWh * 990 MW. Under these circumstances, dispatching Load-Modifying Resource DR will lower the LSE's procurement costs as long as the new clearing price is below $90.91/MWh.

Even though an LSE could lower its procurement costs in the short-term by dispatching higher-cost Load-Modifying Resource DR in order to lower clearing prices, this manipulation could lead to the premature economic retirement of lower-cost resources, such as conventional generation resources, that would not be sufficiently compensated by the depressed clearing prices. The decreased supply of lower-cost resources could then lead to higher procurement costs in the long-term, as well as a loss of resources the state continues to rely on to ensure reliability.

Q8. Please address the operational benefits of DR that is dispatched through CAISO markets rather than outside of CAISO markets.

A8. In addition to economic inefficiencies, DR resources that are not fully integrated into CAISO markets create operational challenges, particularly during stressed system conditions when rapid and efficient use of these DR resources is most important. As the CAISO explains, "continuing to coordinate and dispatch emergency demand response programs during stressful operating conditions through phone calls and email with third parties is not a productive, efficient, or convenient way to manage critical resources."[19] These challenges will only be exacerbated as the operating environment becomes increasingly complex as more variable resources come online.

For the reasons described above, Calpine agrees with the CAISO that "[i]t is the submission of bids, along with the modeled resource attributes, that allows the [CA]ISO to consider all other available resources and dispatch those supply-side resources that produce the overall least-cost solution while observing system and reliability constraints."[20]

Q9. Does this conclude your reply testimony?

A9. Yes.

[19] Testimony of John Goodin on Behalf of the California Independent System Operator Corporation (May 6, 2014), CAISO/Goodin, Ex. ISO-DR001, at 9.
[20] CAISO/Goodin, Ex. ISO-DR001, at 8.